DGES, Inc./EXELTECH

ODOT - Interstate 5 Bridges over Columbia River

Seismic Evaluation of Lift Span Unit

ODOT On-Call Design Contract 11814

Work Order No. 8

DGES Project No. 93-109.08

December 23, 1994

REGISTERED PROFESSIONAL
ENGINEER
13182
OREGON
MARCH 20, 1986
W. DAVID GOODYEAR

Introduction and Background

General Description

The Interstate 5 crossing of the Columbia River is a 16 span steel truss and concrete T-beam structure, with a main span unit that includes a 279 foot steel truss lift span and a 531 foot steel truss main span over the primary navigation channel. The bridge was constructed in stages: the first stage (ODOT Bridge 1377A) was constructed about 1915 and now functions as the Northbound lanes of the crossing; the second stage (ODOT Bridge 7333C) was constructed in 1958 and functions as the Southbound lanes of the crossing. The substructures of the two stages were connected together upon completion of the Southbound spans. On the NB bridge, the 531 foot steel truss main span over the navigation channel was added in 1961 replacing two shorter low-level truss spans of the original crossing. The 1961 work on the NB bridge also involved modification of the profile grade to accommodate the new main span and included extensive modifications of several existing piers.

Other significant modifications of the original structures include a traffic rail replacement completed in 1988 and a complete deck restoration completed in 1990.

The structures were designed and constructed at a time when the risk of damage from a seismic event was not well understood and when the design and analysis tools necessary to deal with the anticipated seismic demand were not very well developed. The structure continues to serve as a critical lifeline in the interstate transportation system, and as such, the decision was made to review the structure for survivability in a major seismic event.

The vintage of the I-5 structure and the nature of the lift span configuration are indicators that the bridge may not meet modern seismic design criteria. In contrast to a girder system, truss systems often require attention to superstructure members to evaluate their ability to withstand the expected seismic forces. This superstructure review is in addition to the assessment of bearings and foundations that is the focus of typical seismic evaluations. The truss towers, lift span and counterweights are the most unique features of this structure and require special analysis and evaluation.

Summary of evaluation

The scope of this review was established based on a "level of effort" to conform with the available budget in our stand-by services agreement. The focus of the review is the main lift span, towers and adjacent approach spans which form a critical structural link in the bridge, and represent a potentially vulnerable element in the structure. Analysis and evaluation is limited to these portions of the bridge.

The evaluation consists of estimating the seismic force demand on the various components of the structure and then comparing the demand to the estimated structural capacity of the component. The expected level of seismic demand in the various components of the bridge is based upon 3D elastic response spectrum analyses of the system. The available capacity of each component is estimated based upon the available plan data.

Due to resource limitations, the superstructure evaluation had to be limited to one direction, either NB or SB. Due to the limited quantity and quality of design detail for the Northbound truss spans, the decision was made to use the Southbound trusses (Bridge 7333C) for the detailed superstructure evaluation. The linkages between the substructure units make it necessary to model both the NB and the SB units for the response spectrum analysis.

A detailed model of the southbound truss is combined with an equivalent beam model of the northbound truss. Both structures are supported on a common substructure model. The earthquake response spectrum is applied at the base of the pier model. Geotechnical investigation is not included in the scope of the evaluation. Geotechnical analysis is limited to procedures necessary to develop the supporting elements of the seismic model. Assumptions regarding geotechnical data are made as required. Analyses for soil liquefaction have not been performed.

Seismic analysis is limited to the configuration in which the bridge is open to vehicular traffic. Specifics of the analysis models and of the component capacity evaluations are discussed in greater detail in subsequent sections of this report.

Critical components of the structure are identified based upon the results of the demand/capacity evaluation. Where applicable, assessments of progressive yielding or other behaviors that may be expected to modify the analytical results are identified and incorporated. Options for seismic retrofit of critical components are identified and discussed.

Based upon this review, the following components are identified as candidates for retrofit:

- All piers are founded on timber piles. The piles are significantly overloaded due to the design seismic event. Pile uplift is considered to be a serious condition. Pile compression and shear capacity is also exceeded.
- Pier columns are loaded beyond the elastic capacity in flexure. The elastic demand/capacity ratio is not excessive, but the lack of sufficient transverse reinforcement limits the available ductility.
- Truss bearings are overloaded. Anchor bolt shear and tension failures are likely and could lead to the truss sliding off of the bearings and/or piers.
- Various truss members are identified as exceeding the available elastic capacity. In our opinion, however, few members are seriously overloaded. Truss members which are subject to local buckling or which form a part of a critical load path or which provide essential stability to the structure should be strengthened. These include:

  - Tower members in the area of counterweight contact,
  - Bottom chords of the portal sway frames,
  - Several vertical posts in the primary trusses,
  - Primary truss bottom chord lateral bracing system.

- Other truss members have demand/capacity ratios marginally over 1.0, but we do not judge these to be critical.
- The loose counterweight masses need to be secured.

Relative displacements between the trusses and the piers at the expansion bearings are computed and identified. The computed displacements are within the normal capacity of the existing bearing mechanisms.

The report does not address the detailed design or drawing of retrofit options. Recommendations for subsequent design and/or analysis are provided in the report summary.

Supporting material listed in the body of the summary is contained in the appendix.

Input Data

General input data and dead loads

The superstructure geometry and member section properties in the 3D analysis models are developed using data taken directly from the original plans for the Southbound bridge 7333C. The plan data is supplemented by observations made during field inspections in August and September.

Data used to develop the substructure configuration and member properties are taken from both the original plans for SB bridge 7333C and the archived plans for the NB bridge 1377A.

Material properties (strength and elasticity):

> Structural steel is assumed to have a modulus of elasticity of 30000 ksi. "Low Alloy" steel (ASTM A242-46; designated as type "A" on the truss plans) is assumed to have a yield strength of 50 ksi. "Carbon" steel (ASTM A7-51T; designated as type "C" on the truss plans) is assumed to have a yield strength of 33 ksi.
>
> Lifting cables (1-5/8" dia. 6x19 wire rope specified; 6x19 SEALE assumed) are assumed to have a modulus of elasticity of 13500 ksi based upon industry standards.
>
> Substructure concrete is assumed to have a compressive strength of 3300 ksi with an elastic modulus of 3600 ksi. All rebar is assumed to be grade 40 (yield strength of 40 ksi).

Based upon a review of selected members, 20% is added to the nominal steel density of 490 pcf to account for additional material not included in the stiffness properties and material at connections, splices, etc.

As-built concrete unit weights for the superstructure are specified in the plans; 7 pcf is added to account for reinforcing steel.

While the original plans for the SB bridge 7333C did not indicate an overlay, the plans for the 1990 deck restoration indicate a 1-1/2" ACWS overlay was typically present on the SB bridge (ODOT dwg. 45669). The reported overlay on the NB bridge varies significantly. These existing overlays were replaced with a latex modified concrete overlay (LMC) under the deck restoration contract. For analysis, a uniform 1-1/2" layer of LMC is added to the plan specified 6" reinforced concrete deck thickness.

Field observation indicates that a significant amount of supplementary weights have been added to the counterweights. A tabulation of the total weight and distribution is not currently available. For analysis purposes, the counterweight dead load (and mass) was set to just balance the total computed weight of the lift span. Field observation also revealed racks of concrete blocks hung from the underside of the lift span, presumably to maintain side-to-side balance. These loads were tabulated and added to the models.

A machinery house is located at the middle of the lift span above the roadway deck. Machinery weights and locations are not available. For analysis, the total weight of the machinery house plus its contents is computed using the truss panel point dead loads provided on the original truss plans. The house itself is not analyzed.

Geotechnical data for the existing substructure units is not included in the plans and could not be located from other sources. Therefore, the soil profile assumed for analysis is based upon soil boring data from the Interstate 5 Oregon Slough Bridge (ODOT Bridge 16526; drawing no. 39602). This bridge is the continuation of the Columbia River Crossing to the south side of Hayden Island. A copy of the relevant plan sheets and a summary of the soil profile assumed for this project are included in the report.

An approximate groundline elevation at each of the substructure units is taken from the SB bridge 7333C plans. Current groundline elevations are not available. While we anticipate that the actual groundline varies significantly over time and over the plan extent of the foundation footprint, sufficient data to address this variation is currently unavailable.

Pile driving records for bridge 7333C were used to verify the pile configurations shown on the plans and to establish free pile lengths for analysis. In particular, the plans conflicted over the presence of piles on pier 1; the pile driving records indicate that piles were installed at this pier.

The plans for SB bridge 7333C specifies that all piles be driven to an allowable load of 40 tons. Pile driving records vary. The plans for NB bridge 1377A indicate a maximum pile load of 30 tons. Driving records are not available for bridge 1377A.

The plans indicate a high water elevation of 32.6' and a low water elevation 1.8'. Stream flow data is not available on the plans. ODOT Bridge supplied the following data from the Hydraulics unit:

> 100 yr. flood elevation = 28.1'; current velocity = 3.8 fps
> 10 yr. flood = 22.5'
> 50 yr. flood = 26.5'
> 500 yr. flood = 31.5'
> Maximum low water elevation is not available
> Current velocity is not available for the 10,50 and 500 yr. events.

Based upon this data, the following was used for substructure evaluation:

> Use low water = 1.8' from the plans
> Use 10 yr. flood with maximum seismic event (500 yr. return interval), but conservatively use 100 yr. flood current velocity = 3.8 fps.

Seismic loading

The seismic demand on the structure is computed using an area specific response spectrum developed for ODOT by Geomatrix Consultants of San Francisco, CA (copy included). The spectra supplied are for 500, 1000 and 5000 year recurrence intervals and are developed for rock site conditions and 5% structural damping at a specific location in the Portland area. The 500-year spectrum is used for the analysis of the Columbia River crossing.

The Geomatrix spectra have a peak response at a period of 0.20s and decrease for periods less than 0.20s. The rock site acceleration spectrum must be modified to account for local site effects. Rock level is not indicated on the available borings. Soil column analyses to obtain foundation level spectra have not been performed. In parallel with current AASHTO design procedures, the rock spectrum for all periods greater than or equal to 0.20s is multiplied by a constant factor for local site effects. Also in accordance with traditional design procedures, the modified peak at 0.20s is used for all periods less than 0.20s.

Review of the soil boring data provided for the Oregon Slough Bridge site indicates loose to medium-dense, primarily cohesionless material in the upper portion of the soil column with cemented sandy gravel/cobbles at lower depths. Based upon this profile, the soil is categorized as Type II per the AASHTO specification for which S=1.2. Therefore, the project spectrum is multiplied by 1.2 for site effects as discussed in the preceding paragraph.

Comparisons of the project spectra with the AASHTO spectra are on the included charts. For purposes of comparison, the AASHTO spectra are computed assuming a peak ground acceleration of 0.2g.

To recognize the directional variability of the seismic input, two separate combinations of seismic loading are considered. The combinations considered are those of the current AASHTO specifications with the addition of a component in the vertical direction. Seismic combinations are as follows:

EQX = Longitudinal = 1.0*X + 0.3*Y + 2/3*Z
EQY = Transverse = 0.3*X + 1.0*Y + 2/3*Z

Where X = longitudinal direction; Y = transverse direction; Z = vertical.

For typical short to medium span bridge configurations, the vertical component of acceleration is generally ignored on the basis that the vertical component of the seismic input is small and that it adds relatively little to the overall response. However, data recorded during the January, 1994 Northridge earthquake in Southern California indicated a higher than expected vertical response at several locations. Given the critical nature of this bridge and the unique configuration, it was decided to include a vertical component of seismic input. A comparison of the relative contribution of the vertical component to the total seismic force in selected members of the span 4 truss is included in the report. For the selected members, the vertical component (=2/3*Z) adds from 0.7% to 22.5% to the governing seismic demand. A rigorous evaluation of vertical seismic response will require a site specific spectra and time history analysis of the soil/structure system.

Demand Analysis

Overview of analysis

The dynamic analysis of the structure is performed using ALGOR, a general purpose finite-element/frame program with user specified response spectrum input capabilities. The analysis assumes linear, elastic material response. The models used for this project consist of 3-D beam element members interconnected in a 3-D framework and supported by boundary elements with user specified spring stiffnesses. Masses are lumped at the nodes utilizing the member cross-sectional areas with specified material densities and/or as externally applied lumped masses. The analysis is a traditional multi-mode response spectrum analysis. Individual modal results are combined using an SRSS procedure. The seismic loads are considered to be fully reversible. The two basic seismic combinations defined previously are added to the dead load forces to determine the total seismic demand. Slican too?

The results reported herein are based upon a series of analysis models. All models are derived from a basic analysis model. The basic model consists of a fully developed model of the substructure units with simplified models of the superstructure spans connecting the substructure units. Piers 1,2,3 and 4 are modeled in detail. Boundary conditions at the North abutment and at pier 5 are incorporated using boundary elements at the geometric location of the superstructure connection. Superstructure spans 1,2,3,4 and 5 are represented in the basic model.

Substructure assessments are determined from an envelope of two models. The first model, SUBFLEX, consists of the basic model with relatively flexible boundary elements applied at the base of piers 1,2,3 and 4 to model the pile supported footings. The second model, SUBFIX, is identical to the first except that the stiffnesses of the boundary elements supporting Piers 1,2,3 and 4 are increased to represent an upper bound to the foundation stiffness. Superstructure assessments are conducted using the basic model with a detailed model of the Southbound truss span under review substituted for the simplified representation.

Earlier stages of the investigation in which the detailed models of southbound spans 2, 3 and 4 were added simultaneously to the basic model indicated that there is not significant dynamic coupling between the truss spans. Therefore span-by-span modeling is utilized to reduce the computational intensity of the model and to lessen the output from the detailed model to a more manageable level. Each truss span was analyzed using both the flexible and the stiff pier support models. Review indicates that virtually all of the truss members are governed by the model with flexible pier supports. All truss results reported herein are based upon the flexible models: S2FLEX, S3FLEX and S4FLEX.

Static dead load analyses of each span are conducted using the dynamic models modified as required to approximate the static support conditions.

Significant details of the structural modeling are discussed in the following sections; sketches of the models are included in the report.

Substructure modeling

Sketches are included in the report showing the general arrangement and controlling dimensions of the pier models.

All primary member (columns, cap beams, spandrel beams, etc.) section properties are computed assuming uncracked sections and gross section dimensions. Web walls between columns and the extensive monolithic footings of the Northbound structure are modeled as truss frameworks with equivalent section properties for in-plane stiffness computed using a procedure modified from "Theory and Analysis of Plates" by Rudolph Szilard, Prentice-Hall, Inc., 1974. The substructure details associated with the gatekeeper's houses at piers 1 and 4 and the operator's house at pier 2 are not considered in these models on the assumption that their relative contribution to the dynamic response will be small compared to the overall mass and stiffness.

All piers are supported on timber piles. For the 3-D frame analysis, pile support is modeled as a set of linear springs located at the base of each individual footing. Six springs are applied at each support corresponding to each of the six global degrees-of-freedom. These springs represent the diagonal terms of the foundation stiffness matrix. Coupling between degrees-of-freedom is not considered in the 3-D frame analysis (i.e. the off-diagonal terms of the foundation stiffness matrix are ignored). This procedure is adopted primarily to simplify the process of identifying footing reactions from the response spectrum analysis. ALGOR will accept full 6x6 stiffness matrix elements at boundary nodes, but reactions are not output for these elements. Although the analysis results may be expected to change slightly using the full 6x6 stiffness matrices, it is our judgment that the magnitude of the change due to this factor is significantly less than the overall uncertainty in the general input data, soil information and loading assumptions.

Due to the uncertainty in the geotechnical data, the decision was made to envelope the expected stiffnesses of the foundation support. The flexible model, SUBFLEX, considers the stiffness contribution of the piles only and essentially ignores any passive soil resistance against the footings (however, the confining effect of the soil on the lateral stiffnesses of the piles is considered). SUBFLEX is intended to estimate a minimum (lower-bound) expected foundation stiffness. The stiffer model, SUBFIX, simply consists of the flexible model boundary element spring constants multiplied uniformly by a factor of 100 and is intended to approximate an upper-bound to the foundation stiffness.

The lateral and flexural stiffnesses of individual piles are computed using the lateral pile analysis program LPILE. Timber modulus is assumed to be 1600 ksi. Foundation material is assumed to be cohesionless sand of varying density. Input parameters for the LPILE analyses are included in the report. The individual pile stiffnesses are adjusted for closely spaced pile group action by a procedure recommended by FHWA. The axial and torsional stiffnesses of individual piles are computed assuming an effective pile length equal to 2/3 of the total pile length below the footing. All piles are assumed to be 10 inch diameter for stiffness computations except Pier 1 SB piles are assumed to be 9 inch diameter for computing the axial and torsional stiffnesses. Considering the scarcity of definitive geotechnical and seismological data for this bridge, investigation of non-linear behavior of the piles and soil-structure interaction (SSI) is judged to be unwarranted. For each footing, the individual pile stiffnesses are combined using the plan specified layout into a resultant stiffness matrix at the geometric center of the pile group. The diagonal terms of this matrix are assigned to the boundary elements of the ALGOR model. The results of the LPILE analyses and the pile group stiffnesses are included in the report.

Superstructure modeling

Equivalent beam models for global analysis and for substructure assessment

Simplified line element models of the superstructure spans are used to model the truss spans on the common foundation for substructure assessment. Members consist of 3-D beam elements with section properties computed to approximately match the composite global stiffnesses of the primary truss/tower frames. The densities of the simplified elements are set to match the total weights of the spans. Additional lumped masses are applied to the top of the tower to represent the counterweight and other top of tower material. The southbound truss span properties are used to represent both the southbound and the northbound spans.

The top of the tower is set at an elevation corresponding to the center of gravity of the additional masses. The members are located transversely at approximately the center of gravity of the truss spans considering the eccentricity of the deck self-weight. The line element models are connected to the substructure members at the plan specified bearing locations through a system of rigid links. Member end releases are applied to these links as appropriate to model the plan specified bearing support conditions.

3-D truss models for superstructure assessment

All members of the superstructure truss models are 3-D beam elements with full fixity at each end (except at bearing interfaces as noted previously). ALGOR automatically assigns node and member numbers to the model based upon the graphical input. A member identification labeling system organized by member type is shown on drawings included in the report. This system is used to identify and manage the output from the ALGOR analyses.

Truss geometry is defined by the major working lines on the plans. Local eccentricities at member connections are ignored. In general, the section properties for stiffness analysis are based upon the same gross section dimensions and components used to determine member capacities (i.e. properties consider the built-up nature of the member such as laced, battened or perforated plate construction). Torsional properties are not explicitly computed and are set at nominally small values to provide primarily for numerical stability. Local member torsional response should not be significant to the dynamic analysis.

To maintain reasonable model size and to reduce complexity, the concrete deck and the trussed floorbeams are not explicitly modeled. Idealized beam members are used to represent the floorbeams. All bottom lateral members including the floorbeam members are set in the plane of the primary truss bottom chords. Preliminary dynamic runs indicate that the results are sensitive to the stiffness assumptions of the bottom lateral system. Therefore, the dynamic analysis models are adjusted to incorporate the diaphragm stiffness of the concrete deck. The deck is modeled as an equivalent truss framework using the same procedure as discussed previously for the substructure web walls. In this case, the cross-sectional areas of the equivalent framework are added to the computed components of the bottom lateral framing system: diagonal bracing, floorbeams and primary truss bottom chords. Lumped masses corresponding to the mass of the deck and floorbeams are applied to the bottom chord truss nodes.

Due to the simplification of the dynamic model, the reported seismic forces in the bottom lateral system must be proportioned between the steel framing and the deck diaphragm. To estimate an appropriate adjustment, the span 3 truss model is modified to explicitly model the geometry and the stiffness of the deck+floorbeam+post+chord+diagonal bracing system. Uniformly distributed longitudinal and transverse loads are applied statically to the deck of the refined model. The same total load is also applied statically to the "deck" nodes of the simplified dynamic analysis model. The resulting forces in the steel framing for the two static models are compared and a scale factor is determined which is then used to adjust the reported response spectrum forces in the bottom lateral framing system.

Several other regions of the truss model are simplified for the analysis. The cable attachment panels of the lifting girders of the span 3 truss are idealized as "truss" members. Local framing details at the tops of the towers in spans 2 and 4 are also simplified. These areas are not significantly affected by the seismic loading.

For the static dead load analysis of the lift span (span 3), the counterweight and lifting cables are modeled in order to determine the required balancing weight for the counterweights. The total mass and distribution of the counterweight is set to result in a residual vertical reaction at the span 3 truss bearings of approximately 1 kip. The resultant total reaction of the counterweights plus cables plus lift span is then applied to the top of the tower for the static dead load analysis of spans 2 and 4. The cables are found to have a negligible effect upon the dynamic response of the lift span. Therefore, the cables and counterweight are not considered in the lift span dynamic analysis.

The mass of the counterweight and the cables is applied to the towers for the dynamic analysis of spans 2 and 4. Gap elements are not used for the dynamic analysis. Therefore, the counterweight mass is transmitted to the tower legs through a set of rigid links set near the geometric location of the four front corners of the counterweight in the fully raised position. The tributary mass (adjusted for transverse balance) of the counterweight is distributed equally to each of the two links on each side of the tower. The four connection nodes are not linked together and are permitted to move independently of each other.

In all three spans, the out-of-plane flexural stiffnesses of several series of members are increased to eliminate local modes of vibration that have little effect upon the global response of the span. For example, this situation occurs for several x-braced diagonal members with nodes at the intersection of the braces and for the laterally unbraced bottom chords of the transverse portal frame trussed struts.

The utility bridges which connect the SB and NB counterweight towers at the top and at mid-height are not modeled in the analysis. These bridges are connected to the tower legs by hanger links on one side and thus permit some relative lateral movement of the adjacent towers. Practically, however, movement towards each other will be limited to the existing gap while movement away from each other will be virtually unlimited (for small to medium deflections).

Dynamic analysis overview

The number of modes considered in the dynamic analysis are established by consideration of the period of vibration and the mass participation factors. Models of truss spans 2 and 3 are analyzed for period, mode shape and participation factors through 60 modes. These truss models are supported by essentially rigid boundary elements in the applicable directions at the four truss corners. Tabulation of the period and participation factors are included in the report. Based upon inspection of the modal and cumulative participation factor results, 30 modes is judged sufficient to capture the majority of the significant vibration modes of each truss. The 30th mode corresponds to a period of vibration of 0.11s for span 2 and 0.09s for span 3.

These periods of vibration are used as general targets for establishing the minimum number of modes in the global analyses. The global models encompass individual modes of vibration that effect various local portions of the structure and may have little effect upon the response elsewhere in the structure. Sufficient total modes must be chosen to mobilize all significant modes of response for each area of the structure under review. For the substructure assessment models, 60 modes are considered. The 60th mode corresponds to a period of vibration of 0.125s for the flexibly supported model and 0.048s for the stiffly supported model. For the truss assessment models, additional modes are required to ensure consideration of all relevant truss modes; 80 modes are considered. The 80th mode corresponds to a period of vibration of 0.113s for the flexibly supported model of span 2 and 0.101s for the flexibly supported model of span 3.

The relative modal contribution to individual total member force is illustrated for several members of the span 4 truss model on the included diagrams. Most of the seismic force in the bottom framing system is contributed by modes with periods of vibration in the 0.4s to 0.6s range. The dynamic response of these members is governed primarily by the relatively stiff behavior of the concrete deck acting as a diaphragm. Conversely, longer periods of vibration contribute a greater proportion of the total seismic force for members in the counterweight towers. These members are governed by the relatively flexible behavior of the tower + counterweight.

The fundamental periods of vibration of the tower + counterweight are computed to be about 2.0 seconds in the longitudinal direction and about 1.8 seconds in the transverse direction. These values are computed assuming the counterweight is attached to the tower as discussed previously. In reality, the counterweight has some limited freedom of movement before contacting the tower. This freedom is defined by the counterweight guide systems. Actual contact will involve some hammering as the counterweight moves back and forth within the confines of the guide system. The analysis does not consider the free-swinging (pendulum) behavior of the counterweight, nor does it consider the effects of hammering. We note that the period of vibration of the free-swinging counterweight (in the fully raised position) is about 6.2 seconds in the longitudinal direction, 4.4 seconds in the transverse direction and 2.1 seconds for twisting about a vertical axis. It is possible that the differences between the dynamic behavior of the tower and the free-swinging counterweight will modify the overall results of the analysis, but the magnitude of the changes are unknown. It is also possible that the guide system may not be strong enough to withstand the hammering of the counterweight. This will increase the available range of motion of the free-swinging counterweight and further complicate the analysis. Advanced modeling and time-history analysis techniques are required to capture these effects.

Interpretation of truss analysis results

Static self-weight analyses are conducted to estimate the existing dead load member forces in the structure. Computed dead load axial forces in the truss members are tabulated along with the elastic seismic forces in the appendix to this report.

For the superstructure models, review of the results of both the static and the dynamic analyses indicates that notwithstanding the end fixity of the truss members in the models, truss behavior does in fact dominate the response. Member end moments are small relative to the axial loads. The actual magnitudes of the end moments present in the structure will vary from the computed moments and will depend upon the original tightness of the riveted connections and upon the erection sequence and procedures employed at the time of construction. Thus, the reported demand/capacity ratio for the majority of the truss members considers only the computed axial loads. Exceptions to this occur in the portal frames and in some of the members of the counterweight tower where moment continuity is essential to the equilibrium and/or stability of the frame.

Considering the type of structure and the vintage of the design, we assume that most of the trusses were originally analyzed and designed on the basis of 2-D behavior. The primary trusses carry the tributary gravity loads in the (vertical) plane of the truss, while the top and bottom lateral bracing systems carry lateral loads to the bearings and would typically be ignored in the gravity design. We observed, however, that as a result of the strain compatibility of the 3-D frame analysis, several groups of bracing members do in fact carry significant computed dead load axial forces. For example, the top chord lateral bracing system has significant axial compression forces in the diagonal members as a result of the shortening of the top chords. Similarly, the bottom chord lateral bracing members carry significant tension due to the dead load extension of the bottom chords. The counterweight tower framing exhibits similar results.

While a portion of this computed dead load is likely present in the in-place structure, the actual magnitude and distribution of these secondary dead load forces is highly dependent upon the erection sequence employed and upon the relative fixities of the individual riveted member end connections. It is reasonable to conclude that the computed secondary forces represent an upper bound to the dead load demand on those members. In order to perform the capacity review of these groups of members, the computed secondary dead load is conservatively added to the seismic load when it increases the combined demand and is neglected when it would lessen the combined demand.

We also noted that several of the diagonal bracing member groups were clearly designed on the basis of tension-only behavior. The linear, elastic response spectrum analysis is not capable of making this distinction, therefore, adjustments to the reported forces are made outside of the analysis in those situations. These adjustments are described in greater detail in following sections.

Demand/Capacity Calculations

Substructure

Timber piles

Seismic demand

Substructure footing reactions due to seismic loading are computed using models SUBFLEX and SUBFIX. The elastic reactions from the response spectrum analyses are tabulated and included in the report. Maximum and minimum footing reactions considering buoyancy are determined. The effects of stream flow are investigated and are found to be negligible in comparison with the order of magnitude and the relative uncertainty of the seismic force levels.

Modern seismic design philosophy for highway bridges dictates that inelastic behavior in the substructure generally be restricted to those details which possess the necessary ductility capacity and which may be easily identified and repaired after a seismic event. In practice, inelastic behavior is usually limited to the flexural behavior of exposed columns of the piers (plastic hinging). Foundation components such as footings and piles are designed to remain elastic at all times; these components are typically designed to the maximum of the computed elastic demand or to the maximum force capable of being transmitted from the pier columns to the footing during plastic hinging. For this structure, the piers and footings were designed and constructed without the structural details necessary to provide sufficient ductility to the columns. Therefore, the footings and piles are reviewed for the elastic seismic loads.

Individual maximum pile axial reactions are computed assuming a rigid distribution of the combined dead + buoyancy + elastic seismic forces at the base of the footing ($P/N \pm M_L{*}x/(\Sigma x^2) \pm M_T{*}y/(\Sigma y^2)$). Shear forces are assumed to be distributed uniformly to each pile.

Two cases are considered and the tabulated results are included in the report. In the first case, passive resistance of the soil mass surrounding the footing is ignored. In the second case, the maximum available passive soil resistance using a uniform groundline elevation (same gl that is assumed for the LPILE stiffness analysis) is computed. The available passive pressure for seismic loading is computed using the Mononobe-Okabe equation as suggested in AASHTO Division IA, Section 6 Commentary and assuming an acceleration coefficient of 0.2g. The procedure also considers the relative stiffness of the foundation unit. The seismic shear force (reaction) is reduced by up to the amount of the available passive resistance. The passive resistance utilized also resists a portion of the overturning moment. Pile demands quoted in the following discussion reflect the passive pressure contribution unless otherwise stated.

In general, pile axial loads are governed by longitudinal seismic loading from the stiffly supported model. Pile shear loads are governed by transverse seismic loading, generally from the flexibly supported model. Due to differences in design configuration, the NB (original bridge 1377A) side of each pier is significantly stiffer than the SB side. Therefore, the NB side of each pier carries a higher proportion of the seismic demand.

For piers 2,3 and 4, the estimated pile dead load + min. buoyancy reaction is about 28-29 tons per pile. For pier 1 SB, pile dead load is about 15 tons; for pier 1 NB, pile dead load is about 26 tons.

The maximum per pile total seismic demands (DL+B+EQ; in tons) are as follows:

> Piers 2,3,4 SB, max. compression = 138; max. uplift = 83; max. shear = 6.9.
>
> Piers 2,3,4 NB, max. compression = 176; max. uplift = 114; max. shear = 18.
>
> Pier 1 SB, max. compression = 36; max. uplift = 8.8; max. shear = 6.2.
>
> Pier 1 NB, max. compression = 65; max. uplift = 15; max. shear = 11.
>
> For pier 1 NB ignoring passive resistance, max. compression = 80; max. uplift = 30; max. shear = 18.

The passive resistance has less proportional effect upon the axial loads in the piles of piers 2,3 and 4 but is effective in reducing the shear demand on the SB piles.

Pile capacity

As previously discussed, the plans for SB bridge 7333C specify that all piles be driven to an allowable load of 40 tons. Pile driving records vary. The plans for NB bridge 1377A indicate a maximum pile "load" of 30 tons. Driving records are not available for bridge 1377A.

As noted, pile driving records are available and have been reviewed for the SB footing units. Ideally, it should be possible to estimate the in-place capacity of the piles based upon these records. However, the task of interpreting the records is made somewhat difficult due to differences in the reporting tendencies used by different installers/ inspectors on the various units. For example, records for pier 1 SB indicate maximum bearing as "40+" (tons). This is recorded for 22 of the 80 piles installed. All other piles are recorded as bearing at some specific value less than 40 tons; the smallest recorded bearing is 19.7 tons. At the other end of the recording spectrum, records for pier 3SB upstream record specific bearing values on just two of the 92 piles. One other pile is recorded as "no reading" and another pile is recorded as "200 BPF". All other piles for this footing are recorded as "refusal". Records for the other units contain various combinations of these methods of indicating installed bearing capacity. It is noted that the recorded capacity of the piles of pier 2 and 4 are in general somewhat greater than the plan specified 40 tons.

These variations in the installation records make it difficult to accurately define an in-place capacity for the piles. Typically, the allowable capacity of a pile is about one-half of the ultimate capacity. Therefore, the ultimate capacity of the piles for review will be assumed to be equal to twice the design allowable specified for the SB piles. That is, all piles are assumed to have an ultimate bearing capacity of 80 tons for this assessment. According to the AASHTO seismic design provisions as defined in section IA, the seismic load combinations are considered to be ultimate loads and may utilize the full available strength of the structure.

It is not possible to accurately estimate the capacity of the piles in uplift given the lack of geotechnical data. Moreover, the uplift capacity is dependent upon the condition of the pile connection to the footing. The design connection detail is not well defined on the plans and the actual in-place condition of the connection is unknown. Using modern design criteria, uplift would not be allowed in the design of short timber piles such as these and, based upon the design details and loads, it is reasonable to assume that pile uplift was not considered in the original design.

In reality, there will be some resistance to uplift. An upper bound to the expected ultimate uplift resistance may be defined based upon typical practice. In the absence of geotechnical data, WSDOT defines procedures to estimate an ultimate pile uplift capacity which is not to exceed 40% of the bearing capacity. These procedures are to be used only for friction piles over 10 feet in length and assume that an adequate connection detail is provided. Realistically, given these considerations, it is likely that the uplift capacity of the existing piles is limited.

The computed pile reactions assume that sufficient uplift capacity exists. Failure of piles in uplift will cause a redistribution of force in the remaining piles. Progressive failure of the piles in uplift or compression may result in pier failure by overturning.

The ultimate structural shear capacity of the timber pile is determined using the provisions of the AASHTO LRFD Design Specification:

$V_r = \phi V_n$ EQN.(8.7-1)

Where ϕ = 1.0 for the extreme event limit state and $V_n = F_v$*A/(4/3);
F_v = Base shear resistance
= 0.300 ksi for Douglas Fir-Coast piles per table 8.4.1.3-1,
A = $\pi d^2/4$ = 78.5 sq.in. for assumed 10" diameter at top of pile,
and 4/3 is the shear stress form factor for a circular section.

Note that the base shear resistance from the table assumes wet-use conditions and the traditional duration of load factor is considered in the resistance factor, ϕ.

Therefore V_r = 17.7 kips = 8.8 tons per pile.

Pile flexural stresses and capacity are dependent upon the end restraint of the pile at the footing, the size, length and taper of the pile and the geotechnical properties of the surrounding soil. Due to the uncertainties in all of these factors and considering the fact that the piles are generally overloaded already in axial load and in shear, pile flexural stresses are not reviewed.

In summary:

a.) pile uplift is experienced at all piers with little or no uplift capacity available.

b.) pile compression capacity is exceeded for the river piers 2,3 and 4.

c.) pile compression capacity may be adequate at pier 1 but pile load redistribution due to inadequate uplift capacity is not considered.

d.) pile shear capacity is exceeded for the NB footing units with (and without) the passive soil resistance considered; shear capacity is exceeded for pier 3 SB footings when the passive resistance is ignored.

Piers

Elastic forces in the columns and walls of the piers are obtained from the same models used to establish the seismic demand in the piles. Forces at selected locations (identified in the included sketches of the pier models) are tabulated and included in the report. The seismic load cases are combined with the estimated dead load forces to establish the elastic seismic demand. The transverse shear demand on the northbound columns of piers 2,3 and 4 and all columns of pier 1 are modified to include the horizontal component of the maximum forces in the diagonal "wall" members.

Based upon the original design plans of the southbound bridge, axial/flexural interaction diagrams are plotted for the southbound columns. Columns are tapered and are circular in cross-section. Overlaid upon the interaction diagrams are the maximum computed elastic demands in the columns. Note that the tabulated demand is at the point just below the web wall spandrel beam connection which is in the precast shaft portion of the column. The interaction diagram is computed at the base of the cast-in-place upper column. The flexural demand/capacity ratio for the southbound columns varies from 1.3 for pier 1 to 3.0 for pier 4. We note that the vertical steel reinforcement ratio in the southbound columns ranges from a maximum of .0059 at the top of pier 4 (smallest section) to a minimum of .0032 at the base of piers 2 and 3 (largest section). These ratios are small by current design criteria.

The available plans for the northbound bridge do not clearly indicate the existing column reinforcement. Estimates of the NB column reinforcement are made by comparison with the SB columns and with the modifications to the NB pier 4 columns made at the time of the construction of the SB bridge. The maximum elastic demands on the NB columns are overlaid upon interaction diagrams plotted using the plan dimensions with the estimated quantities of steel. The flexural demand/capacity ratio for the northbound columns is 1.5 for pier 4 and is less than 1 for piers 1,2 and 3. We note that the overall dimensions of the northbound columns are greater than those of the corresponding southbound columns.

Transverse reinforcement in all cast-in-place columns of the southbound bridge consists of #5 hoops at 18" uniform spacing. Transverse reinforcement in the pre-cast shafts supporting the cast-in-place columns of the southbound bridge consists of #6 hoops at 12" spacing. Hoop steel lap splices are 12" for the #5 hoops and 15" for the #6 hoops. The available plans for the northbound bridge do not clearly indicate the existing column reinforcement. #6 hoops at 18" spacing are specified for the cast-in-place shell added to the existing shaft of each column of northbound pier 4. The original northbound plans do indicate 3/4" diameter (#6) bars in the walls and cap beams. Therefore, we assume #6 hoops at 18" in the columns of the northbound bridge for consideration of the shear strength of the columns. All steel is assumed to be grade 40 and the nominal compressive strength of the concrete is assumed to be 3300 psi.

By inspection, the transverse reinforcement of the columns is modest in comparison to modern design criteria and would not be considered adequate to provide the confinement necessary to permit inelastic deformation (plastic hinging) of the columns. Therefore, although the elastic demand/capacity ratios for the majority of the columns are not of exceptionally large magnitude, the inadequate confinement of the columns and the limited bar lap lengths significantly limits their ductility capacity and justifies the use of elastic capacity to rate the columns.

For the tapered CIP columns of both bridges, column shear is a significant consideration only in the longitudinal direction. Transverse shearing forces are resisted by the web walls between the columns. The circular pre-cast shafts of the southbound bridge must resist the resultant of both the longitudinal and the transverse components of shear force.

For new design, the shear strength of bridge columns typically depends upon the axial load present in the columns. If the minimum compression stress in the column is less than 10% of the nominal concrete strength, the AASHTO specification requires that the shearing strength of the concrete be ignored in determining the transverse reinforcing requirements of the column. However, for predicting the strength of an existing structure, we feel it is overly conservative to ignore the concrete contribution.

The maximum longitudinal shear force in the cast-in-place southbound columns is 1000 kips. For #5 hoops at 18" spacing the maximum nominal shear strength due to the steel is 154 kips at the base of the pier 2 and 3 columns (~140" diameter with the effective depth of the circular section assumed = 0.8*diameter). The nominal shear strength due to concrete at this section is 1801 kips (axial load not considered). The factored shear strength of the section considering both the concrete and the steel is 1662 kips. The strength contribution of the transverse steel is small. At this shear load, the minimum axial load in the column is 1622 kips which is 0.105 ksi and is significantly less than 10% of the concrete strength.

The maximum resultant shear force in the southbound pre-cast shaft is 1404 kips. The diameter of the shaft is 160". Ignoring effects of axial load, the shear strength due to concrete is 2353 kips. For #6 hoops at 12" spacing, the shear strength due to the steel is 375 kips. Combined factored shear strength in this section is 2319 kips.

The maximum longitudinal shear force on the northbound columns of piers 2, 3 and 4 is 1593 kips. The minimum base of column diameter is 155" at pier 4. Assuming #6 hoops at 18", the combined factored shear strength of this section will be similar to that of the SB pre-cast shaft and is greater than 1593 kips.

We conclude that the longitudinal shear strength of the columns considering only the transverse reinforcement is small compared with the seismic demand, but it is adequate if the concrete contribution is considered. However, column ductility is limited by the small amount of transverse reinforcement, and inelastic flexural response would degrade shear capacity significantly.

Transverse shear is resisted by the web walls between the columns. Seismic demand is estimated by summing the horizontal components of the axial forces in the diagonal members used to model the walls. This is conservative considering that the maximum demand in each individual member is unlikely to be reached simultaneously and that vertical load components on the pier will generate some axial force in the diagonal members as a result of frame action in the discretized model that is not equivalent to a shear force in the actual continuous wall system. The approximated shear forces are tabulated in the report.

Probable wall strength is computed using the provisions of the AASHTO specification, section IA. Wall reinforcement as specified in the plans consists of #5 bars at 18" spacing each way and each face in the 1.5' thick walls between the southbound columns and the 1.5' thick walls connecting the southbound substructure to the northbound substructure; the walls between the northbound columns contain 3/4" diameter (#6) bars at 18" vertical spacing with 3/4" diameter bars at 4'-0" horizontal spacing each face. Northbound walls are 3' thick at piers 2 and 3 and are 2.5' thick at piers 1 and 4. Wall reinforcement percentage is somewhat substandard by modern criteria, varying from .0019 each way in the SB walls to .0014 horizontally and .0005 vertically in the NB walls. The current AASHTO specification requires a minimum reinforcement percentage of .0025 each way with 18" minimum bar spacing.

Wall strengths are computed based upon the horizontal steel only. The total factored shear strength is computed to be about 5590 kips for piers 1 and 4 and about 5900 kips for piers 2 and 3. Seismic demand is greatest at pier 4 (note that pier 4 carries the load of the 531' main span truss in addition to the lifting unit tower span) and is estimated to be about 5480 kips total maximum shear force or about 98% of the computed capacity. We note that the estimated shear demand on individual panels varies considerably and is sensitive to the stiffness distribution of the supporting substructures. The local strength of individual panels could be exceeded in the maximum event, but the total strength of the pier appears to be adequate.

Bearings

Bearing forces and strength

As noted previously, the truss models are connected to the substructure through a system of rigid links. The links are placed to duplicate the geometry of the physical structure with joints located at the working line of the truss chord, at the truss pin and at the centerline of the pier cap beam. The flexibility of bearing components is not explicitly considered. Member end releases are applied to the links to match the plan specified conditions. All bearing links are released for bending about a transverse axis (longitudinal bending) and for bending about a vertical axis (torsion). Expansion bearings are released for longitudinal deflection. All other degrees of freedom are fixed for analysis.

Member end forces representing the maximum elastic bearing loads at the pin are tabulated in the report. Review of the bearing details for these loads indicates that the capacities of the bearings are significantly exceeded in several modes of behavior.

The large transverse reaction forces at the bearings generate transverse bending moments within the bearing assembly. The actual distribution of moments over the height of the assembly will depend upon the location within the assembly and upon the fixity of the pin + pin plate details relative to the fixity of the truss framing details.

Pin plates and anchor bolts are reviewed for the set of forces computed at the pin location. Pin reactions due to the transverse bending moment result in significant tension on the outstanding pin plates. As a result, the relatively thin sections of the outstanding pin plates are overloaded in shear under the combined vertical load + transverse bending moment. Several anchor bolts are overloaded in tension as a result of this loading condition. Finally, the anchor bolts are overloaded in shear at all of the bearings.

There are no net uplift forces on the tower-span bearings (spans 2 and 4) or on the lift-span cables of span 3.

Relative bearing displacements

Longitudinal displacements of the expansion bearings relative to the pier are tabulated in the report. Note that the tabulated displacements are the SRSS (absolute value) combination of the individual modal displacements. The maximum relative displacement computed by taking the difference between the truss and the pier displacements is 1.4" at the expansion ends of spans 2 and 4 and is 0.3" at the expansion end of span 3.

Assuming that the recorded pier displacement might be in the opposite direction to the truss displacement, the maximum relative displacement would be 4.8" at the expansion end of span 4 and would be 3.6" at the expansion end of span 3.

Bearing displacements do not appear to be excessively large. Note that the maximum displacements discussed here do not consider the effects of failures in the fixed bearings.

The expansion bearings of spans 2 and 4 are steel rocker bearings with a maximum range of displacement of 7" each side of the neutral position. Rocker radius to the centerline of the truss pin is 17". At pier 4, the span 4 face of the cap beam is about 3' from the centerline of the rocker bearing. At pier 1, the span 2 face of the cap beam is about 3'2" from the centerline of the rocker bearing. Thus, in the event of rocker collapse, the truss pin may be expected to land on the pier cap.

The expansion bearings of span 3 (lift span) are sliding bearings with a total range of displacement of about 11" each side of the neutral position before becoming unstable. The bearing is centered upon a 2'-8" wide pedestal which is about 16" above the surface of the pier cap. The edge of the pier cap is about 2'-0" from the center of the pedestal and bearing.

Superstructure

Sketches are included in the report which identify all members with adjusted demand/capacity ratios greater than 1.0 and identify whether the ratio is based upon axial load only or upon combined axial load + bending.

Also included are detailed spreadsheets which tabulate the truss span analysis results. The first set tabulates the adjusted loads and D/C ratios. A second set tabulates the results of investigating combined axial + bending loads using the adjusted results as applicable.

Truss span elastic analysis results

Initially, all members were checked for both tension and compression under seismic and dead load forces determined from the computer analyses.

For compression, the AASHTO Load Factor Design approach for design of compression members was used. Demand was calculated as $P = \gamma (\beta_d D + EQ)$, where $\beta_d = 1.00$ or 0.75 in accordance with the Specifications, and γ was set at 1.00 in accordance with the Seismic Design Specifications (AASHTO Div. I-A, Section 4.7). Equation (10-150)...... $P_u = 0.85 A_s F_{cr}$ ......of the 1992 AASHTO Standard Specifications for Design of Highway Bridges was used to calculate member compressive capacity. F_{cr} was based on the larger (KL_c/r) value for bending about the member Y or Z axis. K was in all cases set equal to 1.00, according to AASHTO Div. I-A, Section 7.3.

Since the AASHTO Standard Specifications have no explicit provisions governing tension members, we used the AASHTO LRFD Bridge Design Specifications (1st edition, 1994) for our tension capacity and demand calculations. Capacity was set equal to $P = \phi F_y A_g$, according to Eq. 6.8.2.1-1. Earthquake is an extreme event limit state, so $\phi = 1.00$ (Sec. 6.5.5). Load factors were obtained from Tables 3.4.1-1 and 3.4.1-2 : $\gamma = 1.25$ for dead load and 1.00 for earthquake forces. Where dead load forces were compressive, γ_{DL} was reduced to 0.75 for the tension-demand calculations.

The results at this stage, not surprisingly, showed compression failure due to elastic buckling for nearly all "X"-bracing members (top and bottom lateral diagonals, tower lateral diagonals, diagonal truss members L4-U5 and L4'-U5' in all spans, and members L5-U5' and U5-L5' in the tower spans), as well as in the tower diagonals running from panel point U1' or U1 to points F1 and R1. Some tension-only members, including nearly all top lateral diagonals, tower members U1-F1 and U1-R1, and west-truss diagonals L4-U5 and L4'-U5', showed up as failing in compression under dead load compatibility forces alone.

These members were originally designed as tension-only members. Their compressive "failure" merely results in the shifting of the load path to other members. Ideally, these members would be analyzed using their true member properties under net tensile force, and with very small areas when subjected to a net compressive force. Since the analysis does not include member properties that are different for tension and compression (cable members), member forces must be redistributed by as rational a hand method as can be devised.

The remaining problem areas, where acceptable alternate load paths do not exist, include the lateral crossframes at the tops of the truss portal members L0-U1 and L0'-U1' in Spans 2 and 4, several tower diagonal and horizontal truss members in the vicinity of the counterweights, and some of the east truss bottom chord members in the tower spans.

The portal crossframes at the ends of Span 3 are braced in the middle by the lifting girder struts, whereas the crossframe bottom chord members in Spans 2 and 4 are unsupported and prone to lateral buckling under compressive loads. The crossframe bottom chord members' D/C ratios are quite high - as large as 3.3 - because of their high slenderness ratios in the horizontal plane. This is a serious problem because members L0-U1 and L0'-U1' do not have lateral diagonal bracing as do the other truss top chord members, and lateral seismic forces must be carried by the portal frame made up of members L0-U1 and the lateral crossframing.

Tower truss diagonals F3-R4 and F4-R5, which are closest to the counterweight in its normal, raised position, have compressive demands as much as twice their buckling capacities. These are nonredundant truss diagonals, and their compressive failure could lead to collapse.

A number of east truss bottom chord members in Spans 2 and 4 have D/C ratios greater than one. The ratios are all less than 1.2, and are all based on tension forces.

Adjustment of truss analysis results

Truss Top Lateral System

The largest forces in these members are from the primarily transverse, or EQY, load combination. For this case, it is assumed that the full lateral shear in each "X"-braced bay is carried in tension by one leg of the "X". Thus, each top lateral diagonal member is checked for the maximum tension produced by adding the seismic force in the opposite diagonal member to the force in the member. The only exceptions are the diagonals in panel 5-5', which have compressive capacity greater than demand.

Dead load compatibility forces in the top lateral diagonals are all compressive and are therefore conservatively assumed to be zero (except in panel 5-5'). Although buckling of the diagonals would in reality cause dead load compatibility forces in the top lateral struts to decrease, we conservatively include strut dead load forces whenever they increase demand (tension) and assume them to be zero when they reduce demand (compression).

Since the forces in the diagonals are very small compared to those in the main truss top chord, and the top-chord members all have demands comfortably within their capacities, we do not consider it necessary to redistribute the forces in the lateral diagonals to the truss members.

No attempt is made to redistribute the seismic compressive forces in the lateral diagonals to the top lateral struts, either. The top lateral struts have ample excess capacity. As a conceptual check, the results of a static analysis of the top lateral system in which a unit lateral force was applied at each panel point is compared to the results from a modified lateral system, similarly loaded, in which all diagonal members experiencing compression are eliminated. The maximum force in a strut is slightly decreased in the modified version.

All top lateral members have adequate capacity for these adjusted loads.

Truss Bottom Lateral Diagonals

These member loads are redistributed as for the top laterals. The dead load forces are tensile, and are therefore included in the demands. The seismic forces in the bottom lateral diagonals are adjusted downward by an estimated factor of 75%. Since the bottom diagonal member stiffnesses were artificially increased for the analysis input as an economical way to include the deck stiffness in the model, the resulting member forces are in reality shared between the lateral members and the deck slab.

Many bottom lateral diagonals do not have sufficient capacity for these adjusted forces. The demand/capacity ratios range up to about 2.0.

Truss Diagonals in Panels 4-5, 5-5' and 4'-5'

It is assumed that the dead load and seismic compression force from failed members L4-U5 and L4'-U5' are taken up in tension by members U4-L5 and U4'-L5'. The maximum tension for members U4-L5 and U4'-L5' is thus augmented by an additional tension force of 1.25 times the dead load force plus the maximum seismic force in the opposite diagonal member.

Since members U4-L5 and U4'-L5' do not fail under the forces from analysis, members L4-U5 and L4'-U5' are only checked for maximum tension (with no additional loads from other members).

The diagonal members in panel 5-5' are checked for maximum tension similarly to the top lateral diagonals. Dead load tension is multiplied by 1.25 (no contribution from other members) and added to the sum of the seismic forces in the two opposing diagonals.

All truss diagonals in the three central "X"-braced truss panels have sufficient capacities for the adjusted tension forces.

Again, it is not considered necessary to redistribute any of these loads to the truss chords or vertical members. A dead-load analysis with members L4-U5 and L4'-U5' (and U1-F1 and U1-R1) removed from the system shows tension forces in the bottom chord members either unchanged or slightly reduced, and the only increase in compression forces in the top-chord members is by 2%. The verticals have enough capacity so that one could sum the maximum seismic force and dead load in the diagonal and the forces in the vertical, and the result would still be less than half the member capacity.

Tower Front and Rear Lateral Diagonals

All lateral "X" bracing members in the tower show up with demands on the order of two to as much as four times their compressive capacities. The controlling load combination is the primarily transverse (EQY + 0.3EQX + 0.67EQZ) combination. Based on a simple static analysis, the loads are redistributed as follows:

- Each "X" brace is checked, in tension, for the sum of its own maximum seismic force and that in the opposite diagonal, plus 1.25 times the member dead load force if dead load causes tension.
- Each lateral strut is checked for both tension and compression. For compression, the horizontal component of seismic force in a typical diagonal immediately above the strut and the horizontal component of force in a diagonal below the strut are added to the strut forces from analysis.
- The vertical component of seismic force (dead-load forces were negligible compared to vertical member forces) in a typical "X" brace is added to the maximum compression force in the tower main vertical members in the same bay as the "X" brace.

These adjusted loads exceed member capacities in a number of tower lateral members, but in no case by more than 12%.

Tower Truss Diagonals U1-F1 and U1-R1

Although these members are not configured in the traditional "X" shape associated with tension-only bracing, their geometry is such that their compressive failure does not cause the structure to be unstable. For a mechanism to form, one of these diagonals must fail in tension (or some other member must fail). These members are therefore treated the same way they were designed, i.e. as tension-only members. Members U1-F1 and U1-R1 are each checked, in tension, for the sum of their maximum seismic forces. Dead load compatibility forces are compressive and are therefore disregarded.

Both members, in both trusses and in both tower spans, are adequate for these adjusted tension forces.

Three static analyses were performed for Span 2 in order to determine the effects on other members of compressive failure in one or both of these members. The first is a dead load analysis in which both members are removed from the system. The other two analyses involve forces applied to the tower in the northward (towards the lift span) and southward (away from the lift span) directions. The first, or northward, load case is run for the structure as-is and then with member U1'-F1 taken out. The southward loading is applied to the span as-is and then with member U1'-R1 removed.

From these analyses, force redistribution factors were arrived at for the members whose loads are affected by compressive failure of members U1'-F1 and/or U1'-R1. The effect on forces in the other truss members are not found to be important.

Combined bending and axial load in truss members

Bending effects are examined in a separate set of calculations for members in which bending is considered or suspected to be important. Equations (10-155) and (10-156) from the AASHTO Standard Specifications, modified for biaxial bending, are evaluated for all truss verticals, members L0-U1 and L0'-U1', and all main-truss tower members except diagonals U1-F1 and U1-R1.

Bending effects due to the primarily transverse, or (EQY + 0.3EQX), load combination causes demand:capacity (D/C) ratios for the main truss verticals to double or triple as compared to the ratios when only axial forces were considered. Controlling ratios are based on compression plus bending (AASHTO Eq. 10-155), and range up to 1.4.

The D/C ratios in truss portal members L0-U1 and L0'-U1' increase by twenty to sixty percent, bringing the values to approximately 1.0. These numbers may be nonconservative, in that the actual effective length factor K for the transverse direction may be greater than 1.0 if the floorbeam and top portal crossframe do not sufficiently resist rotation of the truss member ends. As we noted earlier, the portal crossframes in both tower spans do not seem adequate in the unretrofitted condition.

Combined bending and compression cannot be evaluated using AASHTO Eq. 10-155 for tower truss diagonals F4-R5 and Span 4 west truss diagonal F3-R4, since the term $[1 - P/A_sF_e]$ changes sign when P is greater than A_sF_e (P is greater than the elastic buckling load). However, the addition of bending effects causes D/C ratios for many other nearby tower members, including the remaining three F3-R4 tower diagonals, tower horizontals F5-R5, F4-R4, and F3-R3, and tower verticals F3-F4 and F4-F5, to increase substantially. Nearly all tower members (except the rear verticals) between panel levels 5 and 3 have demands in excess of capacities due to combined bending and axial compression.

Tower verticals L0-U0 and L0'-U0' are also significantly affected by bending. D/C for combined bending and axial compression is in the range of 1.1 to 1.2, of which about half is attributable to moments and half to concentric loading.

Retrofit Considerations

Substructure

After review of the estimated seismic demands and the existing structural capacities, we anticipate that the costs required to retrofit the substructure will significantly exceed the costs required to retrofit the truss superstructure units. There are three components to be considered in the retrofit of the substructure units: the pile foundations, the pier details and the bearing assemblies supporting the superstructure trusses. Retrofit efforts can take the form of strengthening structural components to withstand the predicted seismic demands and/or taking measures to reduce the anticipated demands to an acceptable level. Demand reduction can sometimes be accomplished by physical means such as seismic isolation bearings or similar technology. In some cases, refined analytical techniques applied to the existing or partially retrofitted structure may reduce the computed demands and thereby lessen the overall cost of retrofitting.

Seismic isolation

& extra damping too.

In its usual form, a seismic isolation system reduces the seismic force demand in a structure by lengthening the period(s) of vibration of the structure to a point farther out on the specified response spectrum. The period shift is typically accomplished by adding relatively flexible elements into the structure. These elements are most commonly installed at the primary bearing locations. The trade-off for the force reduction is increased deflections within the system.

Inspection of the mode-by-mode responses of several superstructure truss members indicates some possibility for force reduction through the use of isolation bearings. The greatest potential exists for the bottom lateral system for which the majority of the seismic demand is contributed by vibration modes in the relatively short 0.4 to 0.6 second range. The overall potential may be limited, however, by the longer period response of the counterweights + towers. In fact, any system of isolation technology considered for this bridge must be designed with caution to avoid the possibility of magnifying the responses in the longer periods of vibration.

In the case of the substructure units, a significant portion of the seismic load on the pile foundations is generated by the massive pier units. This suggests that seismic isolation techniques as applied at the level of the truss bearings might be of limited benefit to the overall load on the pier components and would be of even less relative benefit to the total demand on the foundation piles.

Refined analysis techniques

Numerous simplifying assumptions have been made to develop the models used for the response spectrum analysis of this bridge. These range from the assumption of basic input data related to the geotechnical regime at the site to specific modeling simplifications employed to reduce complexity and to control the scope of the modeling effort.

The response spectrum method of analysis is widely used for the seismic assessment of highway bridges of typical span and configuration. For such structures, the simplicity and relatively low cost of the method justifies its use, and the method yields sufficiently accurate results. For large, multi-span bridges of unique configuration for which retrofit costs may be large, other more refined analysis techniques may be necessary. The Interstate 5 bridge over the Columbia River may represent the latter case.

With regard to the overall analysis results, we feel that refinements in the geotechnical data/analyses would likely have the greatest effect. For any given set of geotechnical data, several advanced analysis techniques are available which can improve the validity of the results.

The response spectrum used for the assessment of this bridge is defined at rock with a rudimentary adjustment applied to model the site response effects. For analysis, the adjusted spectrum is applied at the base of the piers which are supported by non-coupled linear spring elements representing the foundation piles. The computed pile stiffnesses are based on a single level of applied loading for the idealized soil profile assumed for the analysis. The non-linear response of the soil is ignored as is the coupling of pile stiffnesses.

One simple refinement is to apply the fully coupled spring elements representing the estimated pile group stiffness to the response spectrum model. With more accurate data available, it is possible to more precisely assess the (secant) stiffness of the pile group at the expected magnitude of lateral load.

Methods using the program SASSI (finite element analysis) and soil-structure interaction are available. These methods can develop time histories at the base of the piers by using super-elements for the structure-in-soil model. Then, time-history analysis of the superstructure can be used to obtain member results.

To more accurately assess the site response to the rock level spectrum, we can also use one-dimensional soil column models (SHAKE). With this method, as with SASSI, it is also possible to consider the spatial variation of site input along the bridge.

There are foundation models for pile groups (Martin) that present a non-linear spring for 'yielding' pile groups, giving a hysteresis loop type model for the pile group and a residual set for piles. It is possible that the non-linearity of the model might lower the overall response. Such an evaluation requires a non-linear time-history analysis. In the alternative, we could run a piecewise linear push analysis using the pile group stiffness to assess the capacity of the foundation against ductility demand (displacement assessment).

The use of non-linear time-history analysis also presents an opportunity to more accurately model the stiffness behavior of the superstructure including the pendulum behavior of the counterweight and the tension-only behavior of the truss bracing elements.

While all of the options mentioned will result in a model which more accurately reflects the actual conditions, there is unfortunately no way to predict the effect these changes would have on the present results. Overall computed response could be lowered or raised.

Substructure strengthening

In our opinion, foundation retrofit is likely to be the most expensive single aspect of the retrofit scheme. The lack of pile capacity (especially uplift capacity) to resist longitudinal overturning is the most critical aspect to be addressed. Typical retrofit for foundations is to surround the existing foundations with new shafts/piles, etc. This will be difficult under field conditions and with the necessity of maintaining both marine and vehicular traffic. Large cofferdams will likely be required which could effect the navigation channel. As an alternative in this case, it may be advantageous to have a geotechnical engineer look into soil grouting or ground modification in-situ to engage granular soils. Innovative procedures in this regard could result in large savings.

For the piers, the lack of ductility in the existing columns is the most significant issue. The columns of the southbound bridge appear to be more critical than those of the northbound as a result of their smaller diameters in the lower portion of the shaft. Typical retrofit for isolated columns is to provide some external confinement to the column concrete by jacketing or wrapping the column. Several schemes have been developed in recent years. In this case, a heavily reinforced cast-in-place shell could be installed surrounding the existing column. The construction of this shell would be similar in concept to the column/pier enlargements applied to the northbound piers during the modifications undertaken after construction of the southbound bridge. The need for additional reinforcement of the northbound columns could be reassessed by recomputing the demand in the piers after retrofitting the southbound columns. The northbound columns were nearly adequate for the elastic demand. The increased stiffness of the southbound columns may draw enough load from the northbound side to permit the existing northbound columns to remain in place without additional modification. If this is not possible, column reinforcement for the northbound columns of pier 4 (and piers 6-9) may be applied in a similar manner, but this could be complicated by the earlier modifications to the NB columns.

Bearings

The design seismic event subjects the bearings to large horizontal shear forces and transverse moments which obviously were not envisioned by the original designers.

Likely modes of failure are non-ductile shear failures in the pin plates and in the anchor bolts. Failure of the pin plates leads to a complete lack of transverse moment resistance at the pin and could lead to the truss jumping off of the bearing. Failure of the anchor bolts could result in the bearings sliding off of the base with unknown consequences. Other modes of failure could be identified upon in-depth review of the bearing details.

The large seismic forces dictate a detailed analysis and redesign of the bearing components to increase the bearing strength and/or to limit the potential for bearing collapse. The detailed analysis should consider the flexibilities and strengths of the bearing components both before and after retrofitting. Note that the actual flexibilities of the components may effect the results of the seismic analysis. The local distribution of forces within the bearing assembly and in neighboring members will likely change; the overall forces could change.

At a minimum, we recommend that these bridges be retrofitted at all bearing locations with some type of "restrainer" and catch-block system that will limit the horizontal movements of the trusses relative to the bearings and of the bearings relative to the piers.

Superstructure

The first priority for superstructure retrofitting should be tower-diagonal members F4-R5 and F3-R4, which experience large forces caused by the counterweight mass in its normal raised position. The axial forces from the three-dimensional multimodal seismic analysis are large enough to cause Euler buckling in these members, which could in turn cause progressive collapse of the tower. This situation is made more serious by the fact that the main tower verticals at the level of these diagonals are also overstressed.

Also a high priority is providing adequate bracing of the portal crossframe bottom chords at the ends of Spans 2 and 4. Loss of support provided by these members would significantly decrease the buckling resistance in portal frame members L0-U1 and L0'-U1', whose D/C ratios for buckling already hover around 1.0. The portal frame truss members carry the full top chord compressive forces due to dead and live loads. In addition, a major portion of the lateral seismic forces on the truss top chord are transferred to the bearings through these members in transverse bending and shear.

Third priority should be the truss verticals at panel points 2, 2', 3, and 3' (all spans), the main tower verticals L0-U0, and other tower truss members with D/C ratios greater than one. Although the demand:capacity ratios are not extremely high, the failure mode - buckling due to combined bending and axial compression - is undesirable. We do not believe the bending moments in these members can be safely dismissed, as there is no alternate load-carrying mechanism for transverse (east-west) seismic forces.

Finally, the bottom lateral diagonals in all three spans should be strengthened. Failure is in tension for the lateral diagonal members, so member areas should be augmented.

Several east truss bottom chord members in spans 2 and 4 have D/C ratios greater than 1.0. The tension forces considered in the review were not adjusted for the presence of the deck diaphragm (see discussion regarding the bottom lateral bracing). We expect the actual demand in these members to be well within the member capacity.

The retrofit considerations should be expanded to consider the truss connections. Connection details and stresses are not considered in this review.

Northbound Structure

General observations

The northbound substructure has been modeled and included in the analysis and review. Retrofit considerations relative to the substructure have been discussed previously.

The northbound superstructure has not been explicitly modeled in the analysis. It is represented in the full model by equivalent beam members with properties based upon the southbound truss properties.

The chord-to-chord width of the northbound truss spans is 41'-0", 4'-5" narrower than the southbound truss. Otherwise, the member layout of the northbound superstructure is generally similar to that of the southbound. There are some significant differences in details such as built-up member construction, bearing details, counterweight details, top of tower framing, etc. Notwithstanding these differences, it is reasonable to conclude that the seismic demand in the northbound truss is on the same order as the southbound. Subject to review of individual member capacities, we expect that northbound superstructure retrofit considerations would be similar to the southbound truss requirements.

Miscellaneous

Observed pier 1 conditions

All analysis and review has been conducted on the basis of the plan specified boundary conditions. However, during our visits to the bridge, we observed evidence of residual substructure displacement at pier 1.

Pier 1 supports the north ends of the span 2 tower spans and the south ends of the short end spans. The truss spans are supported by expansion bearings at pier 1 with fixed bearings at span 2. The northbound expansion bearing consists of a set of rollers. The southbound expansion bearing consists of a single steel rocker bearing. The north ends of the end spans are supported by the north abutment(s). The northbound end span consists of steel plate girders with (apparently) fixed bearings at both ends of the span. The southbound span consists of concrete t-beam construction with fixed bearings at the north abutment and steel rocker bearings at pier 1.

The groundline slopes from the north abutment to about 4' below the bottom of the cap beam on the north side (land side) of pier 1. A roadway runs adjacent to the south side (river side) of pier 1 and crosses under the truss span. The surface of the roadway shoulder adjacent to the river side of the pier is about 10' below the bottom of the cap beam.

The truss bearings are offset significantly from their neutral position toward the center of the pier (away from the river). This is evidenced by the tilt of the rocker bearings and by the large deformation of the anchor bolts in the northbound span. We note that the deformation of the anchor bolts shows evidence of having been there for an extended period of time. Conversely, the end span bearings are also offset toward the center of the pier as evidenced by the tilt of the southbound end span rocker bearings and by the significant cracks at the north side of the base of the northbound end span pedestals. Both the northbound and the southbound expansion joints are solidly closed and there is obvious contact between the truss spans and the end spans. As a result of the relative displacements, span 2 and the end span of both roadways are effectively fixed at both ends.

In our opinion, the visible evidence suggests that both the north abutment and pier 1 have experienced some permanent movement towards the river. Apparently, the north abutment has moved somewhat more than pier 1. The alternative explanation is that thermal expansion of both spans has been large enough to close the designed expansion joint gaps and to crack the pedestals under the northbound end span. The air temperature on the first day of inspection was about 75-80 degrees. At the time of our second visit the air temperature was about 65-70 degrees. Thus, excessive thermal deflection seems unlikely.

Under the observed conditions, it is possible that the superstructure is now functioning to restrain/limit further movement of the north abutment and pier 1 with relief only available through flexibility of pier 2. It is difficult to predict the stress that may be presently locked into the superstructure as a result of this condition.

In order to restore the plan specified freedom to the structure, we recommend that a plan be developed to verify the source of the displacements and to determine appropriate corrective action.

Counterweight conditions

The counterweight systems for both bridges include a number of supplementary weights utilized to balance the lift span dead load. The supplementary weights on the southbound counterweights consist primarily of large (roughly 1.5' square by 6' long) concrete blocks stacked on the top of the counterweight. The upper tier of blocks is estimated to be at least 5' above the lip of the 6" curbing around the top of counterweight. There is no containment system for the loose concrete blocks. In our opinion, it is likely that the loose blocks will begin to "walk" during shaking of even moderate magnitude. Banging of the counterweight against the tower legs will increase this tendency. Sustained shaking or shaking of large magnitude could cause blocks to fall off of the top of the counterweight down onto the roadway surface below. We recommend that a block containment system be developed and installed to avoid the potentially disastrous consequences of this situation.

Conversely, the supplementary weights on the northbound counterweight consist primarily of thick steel plates set in cavities recessed in the top of the counterweight. All weights are contained within the limits of the counterweight and should be stable in a seismic event. A possible concern with regard to the northbound counterweight is general deterioration due to its age. An example of this is the vegetation growing out of spalls in the south face of the south counterweight. Other spalls/cracks are visible. The timber blocks located under the counterweight also show visible evidence of deterioration. Although these conditions may not be serious at this stage, it is difficult to assess the competency of the counterweight shell when subjected to the hammering which is possible during a significant seismic event. We recommend that the northbound counterweight be inspected to better ascertain the structural condition of the counterweight supporting shell/skeleton.

Summary of review

Spans 2, 3 and 4 together with piers 1-4 of the Interstate 5 crossing over the Columbia River are reviewed for strength and ductility demands during a significant seismic event. This analysis and review is a "level of effort" task with the scope of evaluation defined to fit within the available budget in our existing stand-by agreement with ODOT.

The structure is analyzed by the multi-modal response spectrum technique utilizing an input elastic response spectrum provided by ODOT and modified to adjust for site response effects. Site specific geotechnical and seismological data are unavailable for this review. An idealized soil profile is assumed based upon information provided for a bridge located on the far side of the river.

Due to budget limitations, superstructure analysis and review is limited to the southbound truss spans. Several simplifications to the 3-D model are made to reduce complexity and to control the scope of the modeling effort.

Critical major components of the structure are identified based upon the results of the demand/capacity evaluation. Where applicable, assessments of progressive yielding or other behaviors that may be expected to modify the analytical results are identified and incorporated. Options for seismic retrofit of critical components are identified and discussed.

Based upon the results of this analysis, the following components are identified as requiring retrofit:

- All piers are founded on relatively short timber piles. The piles are significantly overloaded due to the design seismic event. Pile uplift is considered to be a serious condition. Pile compression and shear capacity is also exceeded.
- Pier columns are loaded beyond the elastic capacity in flexure. The elastic demand/capacity ratio is not excessive, but the lack of sufficient transverse reinforcement limits the available ductility.
- Truss bearings are overloaded. Anchor bolt shear and tension failures are likely and could lead to the truss sliding off of the bearings and/or piers. Other components of the bearings require strengthening also.
- Various truss members are identified as exceeding the available elastic capacity. Truss members which are subject to local buckling or which form a part of a critical load path or which provide essential stability to the structure should be strengthened. These include:
  - Tower members in the area of counterweight contact,
  - Bottom chords of the portal sway frames,
  - Several vertical posts in the primary trusses,
  - Primary truss bottom chord lateral bracing system.
- Other truss members have demand/capacity ratios marginally over 1.0, but we do not judge these to be critical.

The review of the trusses is limited to the evaluation of gross member strengths. Compression member strengths have been computed assuming an effective length factor for buckling of 1.0 for all members. Member connections and other details have not been reviewed. The review does not consider the operability of the mechanical lift span equipment after a seismic event.

Relative displacements between the trusses and the piers at the expansion bearings are computed and identified. The computed displacements are observed to be within the normal displacement capacity of the existing bearing mechanisms.

Recommendations

The anticipated next phase of work is to use the information developed here to formulate a detailed retrofit program for critical elements of the bridge. The following discussion outlines the work which we believe is necessary to devise a safe and cost-effective solution.

Additional data input

We expect the retrofit of the substructure to be the most costly item of the rehabilitation scheme. Therefore, it makes sense to concentrate resources in this area. Geotechnical and seismological data and assumptions are key to this task and can have significant effects upon the analysis. The current analysis indicates that the dynamic response of the structure is sensitive to the geotechnical assumptions. The relative stiffnesses of the dissimilar southbound and northbound foundations are important to both the overall response of the structure and to the local distribution of forces within the structure.

Considering the lack of available quantitative data and the importance of this structure, we recommend that an experienced geotechnical engineer be engaged to develop an exploration program which will define the existing physical conditions at the site including engineering characteristics of the existing soil and the existing groundline elevations around the piers. Groundline elevations are required to establish the stiffness behavior of the massive foundation units and to assess the passive resistance available to offset the predicted seismic demands. Accurate data will make it easier to establish realistic bounds on the foundation stiffnesses. The data gathered will establish the essential criteria necessary to perform the dynamic analysis with increased accuracy and confidence.

We also recommend that an analysis be made of the potential for soil liquefaction due to the design seismic event at the site. By agreement with ODOT staff, the current review did not consider this mode of behavior. An assessment using the conservative geotechnical properties which were assumed for this review indicates some potential for liquefaction. The options available/required for retrofit of the foundations would be strongly affected by this mode of failure.

Substructure retrofit must address both the southbound and the northbound units. We also anticipate that the department will wish to address the northbound truss spans concurrently with the southbound. It is desirable to obtain additional data regarding the northbound structure to augment the data gathered to date. Specifically, pier column reinforcement details are not clear on the original plan sheets that we have recieved and additional data relative to the northbound truss details and materials will be helpful if available.

Analysis

Before proceeding to the final design and drawing of retrofit details, we believe that further analysis is required.

At a minimum, the updated geotechnical information should be incorporated into the existing response spectrum analysis. Concurrently, refinements to the analysis model could be made to improve the assessment of critical areas identified in this report. These refinements would include the modeling of the deck-floorbeam-bottom lateral system and the counterweight detailing. Refinements in the modeling of the bearing details could also be useful. It is anticipated that full modeling and review of the northbound truss spans would be required before finalizing the retrofit design.

Truss connections have not been reviewed in this report. A necessary part of the next phase of the retrofit design will be to review and identify critical connection details for the expected seismic demands.

The details of this structure are such that an elastic response spectrum analysis can not consider. In addition to or in place of the necessary analyses identified above, there are several refined analytical techniques available which could be utilized to more precisely and confidently define the displacement and force demands on this unique structure. These techniques include advanced soil-structure interaction analyses, site response analyses to better define the seismic input at the level of the structure and the use of time-history analyses which permits the consideration of the non-linear behavior of several major components of this structure. Evidence gathered in other investigations suggests that the consideration of the generally more flexible non-linear behavior may reduce the overall dynamic forces on the structure. Although there is no assurance that the results will be lowered by such analyses, we believe that the use of these techniques can better describe the overall response of the bridge. Selected specific techniques are discussed in the retrofit section of the report.

In general, these advanced techniques of analysis are expensive and are often not justifiable for typical bridges. However, in our opinion the importance of this structure and the anticipated high cost of retrofit options warrants an in-depth consideration of such techniques.

At this point in the investigation, a decision should be made regarding the minimum acceptable level of analysis with regards to the relative positions of the lift span and the counterweight. Section 2.1.15 of the AASHTO Standard Specifications for Movable Highway Bridges requires consideration of the seismic load for both the open and closed positions. For movable spans which are in one position over 90% of the time, the specification permits the use of one-half of the seismic load in the lesser used position. The current analysis considers only the open to vehicular traffic configuration which is the normal position for this crossing.

Finally, we recommend that the analysis be extended to consider a greater portion (or the remainder) of the structure. While we expect that the results of the truss investigations of spans 2, 3 and 4 would be generally applicable to the other similar length spans, we believe that the 531 foot main spans warrant separate review. In addition, differences in substructure heights and dimensions can generate different response.

Retrofit design

Having established an analytical baseline, it is possible to begin the selection and design of component retrofit options. The designer must recognize that the retrofit details can and often do effect the subsequent response of the structure to dynamic loading. It is important to assess each option in terms of its effects upon the entire system. A recommended procedure is listed as follows:

- prioritize the elements needing retrofit.
- estimate retrofit requirements of the highest priority item(s) based upon the current analysis.
- identify retrofit options for the element.
- prepare conceptual retrofit designs for the elements in sufficient detail to estimate their relative costs and to assess their effects upon the remainder of the system before proceeding to the next level of priority. This would typically require the

incremental modification and review of the analytical models to correspond to the retrofitted details.

- Continue the procedure until all critical items have been addressed at the conceptual level. Depending upon the incremental analytical results, iteration may be required to reach a safe and cost-effective systemwide solution.

At this stage, detailed design and preparation of the plans, specifications and estimates for the retrofit may proceed.

For this bridge, the predicted seismic loads on the piles and the truss bearings exceed the available capacities. Failure of either component can lead to collapse of the bridge. While updated and/or refined analysis of the current models can be expected to change the computed demands, we judge it unlikely that changes would be sufficient to eliminate the need for strengthening of these components.

Details to increase the strength of the foundations will likely increase the stiffness of the foundations. The change in foundation stiffness may be significant enough to effect the overall response of the structure. Likewise, bearing retrofit options that change the stiffness or restraint conditions (such as isolation bearings) might also have an effect upon the overall response of the structure.

Therefore, we recommend that retrofit options for the foundations and the bearings be established and evaluated before proceeding to the detailed retrofit design of the piers and the trusses.

We recommend that foundation retrofit be considered as the highest priority as changes in the foundation are likely to have the largest effects upon the response of the remainder of the structure.

If an incremental approach to the design and construction of the component retrofit schemes is required due to program budgetary constraints, we recommend that bearing retrofit be considered as top priority since it will repair a very weak link in the bridge at relatively modest cost (as compared to the foundation retrofit). The bearing retrofit is less likely to have a significant effect upon the overall response of the bridge. In this scenario, the foundation retrofit should be developed sufficiently enough to assess the range of foundation stiffnesses and incorporated in the analytical model to lessen the likelihood of later having to revise the bearings once again.

For the final retrofit design of the trusses, a more refined analysis of the buckling strength of certain critical members is recommended. These members are the portal frame end posts which provide the transverse stability to the top (compression) chord system. These members are unbraced and subject to sidesway. The buckling strength (as expressed by the effective length) of these members depends upon the fixity provided by the portal truss at the top and by the floorbeam truss at the bottom. The effective length (KL_b) for transverse buckling of these members is greater than or equal to the unbraced length between the bottom chord of the portal truss and the top chord of the floorbeam truss. In other words, the effective length factor, K, is greater than or equal to 1.0. K is equal to 1.0 only if full flexural fixity is provided at the ends of the unbraced length. In reality, this is not possible and K will be somewhat greater than 1.0. For our review, we used K = 1.0 with a length equal to the distance from the bottom chord of the portal truss to the work point at the intersection of the bottom and top chords. This length is about 5' longer than the actual unbraced length. Note that this is the procedure used on all of the vertical posts of the primary trusses. The interior posts are not as critical to the stability of the overall system as the portal frame posts.

TRANSMITTAL LETTER

BRIDGE ENGINEERING SECTION
ROOM 329 TRANSPORTATION BLDG
SALEM, OREGON 97310-0780

TO:	DATE
Lynn Rust, Design Engineering Manager, CRC Project	May 11, 2006
700 Washington Street, Suite 300	CONTRACT NUMBER
Vancouver, WA 98660-3177	BRIDGE NUMBER 01377A & 07333

ATTENTION	PROJECT NAME
	Columbia River Crossing Project

WE ARE SENDING YOU ☒ ATTACHED ☐ UNDER SEPARATE COVER VIA:

THE FOLLOWING: ☐ PRINTS ☐ PLANS ☐ SAMPLES ☐ SPECIFICATIONS

☐ COPY OF LETTER ☒ OTHER: Seismic Evaluation of Interstate Bridges Lift Spans

COPIES	DATED	DESCRIPTION
1	12-23-94	Seismic evaluation report with appendix

THESE ITEMS ARE SENT FOR THE PURPOSE CHECKED BELOW:

☐ FOR APPROVAL ☐ FOR YOUR ACTION ☐ AS REQUESTED ☒ FOR YOUR INFORMATION

☐ FOR REVIEW AND COMMENT ☐ RETURN COMMENTS BY:

REMARKS Please pass on a copy of this report to Mark Hirota.

FROM: Craig Shike, Bridge *Craig Shike* TELEPHONE: (503) 986-3323

FORM PDT ADM01 (3/95)

GAP

Interstate 5 Bridges over the Columbia River

Seismic Evaluation of Lift Span Unit

PRESENTED TO
THE

Oregon Department of Transportation

HIGHWAY DIVISION

BRIDGE DESIGN SECTION

DGES

DGES, Inc./EXELTECH

ODOT - Interstate 5 Bridges over Columbia River

Seismic Evaluation of Lift Span Unit

ODOT On-Call Design Contract 11814

Work Order No. 8

DGES Project No. 93-109.08

December 23, 1994

REGISTERED PROFESSIONAL
ENGINEER
13182
OREGON
MARCH 20, 1986
W. DAVID GOODYEAR

Introduction and Background

General Description

The Interstate 5 crossing of the Columbia River is a 16 span steel truss and concrete T-beam structure, with a main span unit that includes a 279 foot steel truss lift span and a 531 foot steel truss main span over the primary navigation channel. The bridge was constructed in stages: the first stage (ODOT Bridge 1377A) was constructed about 1915 and now functions as the Northbound lanes of the crossing; the second stage (ODOT Bridge 7333C) was constructed in 1958 and functions as the Southbound lanes of the crossing. The substructures of the two stages were connected together upon completion of the Southbound spans. On the NB bridge, the 531 foot steel truss main span over the navigation channel was added in 1961 replacing two shorter low-level truss spans of the original crossing. The 1961 work on the NB bridge also involved modification of the profile grade to accommodate the new main span and included extensive modifications of several existing piers.

Other significant modifications of the original structures include a traffic rail replacement completed in 1988 and a complete deck restoration completed in 1990.

The structures were designed and constructed at a time when the risk of damage from a seismic event was not well understood and when the design and analysis tools necessary to deal with the anticipated seismic demand were not very well developed. The structure continues to serve as a critical lifeline in the interstate transportation system, and as such, the decision was made to review the structure for survivability in a major seismic event.

The vintage of the I-5 structure and the nature of the lift span configuration are indicators that the bridge may not meet modern seismic design criteria. In contrast to a girder system, truss systems often require attention to superstructure members to evaluate their ability to withstand the expected seismic forces. This superstructure review is in addition to the assessment of bearings and foundations that is the focus of typical seismic evaluations. The truss towers, lift span and counterweights are the most unique features of this structure and require special analysis and evaluation.

Summary of evaluation

The scope of this review was established based on a "level of effort" to conform with the available budget in our stand-by services agreement. The focus of the review is the main lift span, towers and adjacent approach spans which form a critical structural link in the bridge, and represent a potentially vulnerable element in the structure. Analysis and evaluation is limited to these portions of the bridge.

The evaluation consists of estimating the seismic force demand on the various components of the structure and then comparing the demand to the estimated structural capacity of the component. The expected level of seismic demand in the various components of the bridge is based upon 3D elastic response spectrum analyses of the system. The available capacity of each component is estimated based upon the available plan data.

Due to resource limitations, the superstructure evaluation had to be limited to one direction, either NB or SB. Due to the limited quantity and quality of design detail for the Northbound truss spans, the decision was made to use the Southbound trusses (Bridge 7333C) for the detailed superstructure evaluation. The linkages between the substructure units make it necessary to model both the NB and the SB units for the response spectrum analysis.

A detailed model of the southbound truss is combined with an equivalent beam model of the northbound truss. Both structures are supported on a common substructure model. The earthquake response spectrum is applied at the base of the pier model. Geotechnical investigation is not included in the scope of the evaluation. Geotechnical analysis is limited to procedures necessary to develop the supporting elements of the seismic model. Assumptions regarding geotechnical data are made as required. Analyses for soil liquefaction have not been performed.

Seismic analysis is limited to the configuration in which the bridge is open to vehicular traffic. Specifics of the analysis models and of the component capacity evaluations are discussed in greater detail in subsequent sections of this report.

Critical components of the structure are identified based upon the results of the demand/capacity evaluation. Where applicable, assessments of progressive yielding or other behaviors that may be expected to modify the analytical results are identified and incorporated. Options for seismic retrofit of critical components are identified and discussed.

Based upon this review, the following components are identified as candidates for retrofit:

- All piers are founded on timber piles. The piles are significantly overloaded due to the design seismic event. Pile uplift is considered to be a serious condition. Pile compression and shear capacity is also exceeded.
- Pier columns are loaded beyond the elastic capacity in flexure. The elastic demand/capacity ratio is not excessive, but the lack of sufficient transverse reinforcement limits the available ductility.
- Truss bearings are overloaded. Anchor bolt shear and tension failures are likely and could lead to the truss sliding off of the bearings and/or piers.
- Various truss members are identified as exceeding the available elastic capacity. In our opinion, however, few members are seriously overloaded. Truss members which are subject to local buckling or which form a part of a critical load path or which provide essential stability to the structure should be strengthened. These include:

  - Tower members in the area of counterweight contact,
  - Bottom chords of the portal sway frames,
  - Several vertical posts in the primary trusses,
  - Primary truss bottom chord lateral bracing system.

- Other truss members have demand/capacity ratios marginally over 1.0, but we do not judge these to be critical.
- The loose counterweight masses need to be secured.

Relative displacements between the trusses and the piers at the expansion bearings are computed and identified. The computed displacements are within the normal capacity of the existing bearing mechanisms.

The report does not address the detailed design or drawing of retrofit options. Recommendations for subsequent design and/or analysis are provided in the report summary.

Supporting material listed in the body of the summary is contained in the appendix.

Input Data

General input data and dead loads

The superstructure geometry and member section properties in the 3D analysis models are developed using data taken directly from the original plans for the Southbound bridge 7333C. The plan data is supplemented by observations made during field inspections in August and September.

Data used to develop the substructure configuration and member properties are taken from both the original plans for SB bridge 7333C and the archived plans for the NB bridge 1377A.

Material properties (strength and elasticity):

> Structural steel is assumed to have a modulus of elasticity of 30000 ksi. "Low Alloy" steel (ASTM A242-46; designated as type "A" on the truss plans) is assumed to have a yield strength of 50 ksi. "Carbon" steel (ASTM A7-51T; designated as type "C" on the truss plans) is assumed to have a yield strength of 33 ksi.
>
> Lifting cables (1-5/8" dia. 6x19 wire rope specified; 6x19 SEALE assumed) are assumed to have a modulus of elasticity of 13500 ksi based upon industry standards.
>
> Substructure concrete is assumed to have a compressive strength of 3300 ksi with an elastic modulus of 3600 ksi. All rebar is assumed to be grade 40 (yield strength of 40 ksi).

Based upon a review of selected members, 20% is added to the nominal steel density of 490 pcf to account for additional material not included in the stiffness properties and material at connections, splices, etc.

As-built concrete unit weights for the superstructure are specified in the plans; 7 pcf is added to account for reinforcing steel.

While the original plans for the SB bridge 7333C did not indicate an overlay, the plans for the 1990 deck restoration indicate a 1-1/2" ACWS overlay was typically present on the SB bridge (ODOT dwg. 45669). The reported overlay on the NB bridge varies significantly. These existing overlays were replaced with a latex modified concrete overlay (LMC) under the deck restoration contract. For analysis, a uniform 1-1/2" layer of LMC is added to the plan specified 6" reinforced concrete deck thickness.

Field observation indicates that a significant amount of supplementary weights have been added to the counterweights. A tabulation of the total weight and distribution is not currently available. For analysis purposes, the counterweight dead load (and mass) was set to just balance the total computed weight of the lift span. Field observation also revealed racks of concrete blocks hung from the underside of the lift span, presumably to maintain side-to-side balance. These loads were tabulated and added to the models.

A machinery house is located at the middle of the lift span above the roadway deck. Machinery weights and locations are not available. For analysis, the total weight of the machinery house plus its contents is computed using the truss panel point dead loads provided on the original truss plans. The house itself is not analyzed.

Geotechnical data for the existing substructure units is not included in the plans and could not be located from other sources. Therefore, the soil profile assumed for analysis is based upon soil boring data from the Interstate 5 Oregon Slough Bridge (ODOT Bridge 16526; drawing no. 39602). This bridge is the continuation of the Columbia River Crossing to the south side of Hayden Island. A copy of the relevant plan sheets and a summary of the soil profile assumed for this project are included in the report.

An approximate groundline elevation at each of the substructure units is taken from the SB bridge 7333C plans. Current groundline elevations are not available. While we anticipate that the actual groundline varies significantly over time and over the plan extent of the foundation footprint, sufficient data to address this variation is currently unavailable.

Pile driving records for bridge 7333C were used to verify the pile configurations shown on the plans and to establish free pile lengths for analysis. In particular, the plans conflicted over the presence of piles on pier 1; the pile driving records indicate that piles were installed at this pier.

The plans for SB bridge 7333C specifies that all piles be driven to an allowable load of 40 tons. Pile driving records vary. The plans for NB bridge 1377A indicate a maximum pile load of 30 tons. Driving records are not available for bridge 1377A.

The plans indicate a high water elevation of 32.6' and a low water elevation 1.8'. Stream flow data is not available on the plans. ODOT Bridge supplied the following data from the Hydraulics unit:

> 100 yr. flood elevation = 28.1'; current velocity = 3.8 fps
> 10 yr. flood = 22.5'
> 50 yr. flood = 26.5'
> 500 yr. flood = 31.5'
> Maximum low water elevation is not available
> Current velocity is not available for the 10,50 and 500 yr. events.

Based upon this data, the following was used for substructure evaluation:

> Use low water = 1.8' from the plans
> Use 10 yr. flood with maximum seismic event (500 yr. return interval), but conservatively use 100 yr. flood current velocity = 3.8 fps.

Seismic loading

The seismic demand on the structure is computed using an area specific response spectrum developed for ODOT by Geomatrix Consultants of San Francisco, CA (copy included). The spectra supplied are for 500, 1000 and 5000 year recurrence intervals and are developed for rock site conditions and 5% structural damping at a specific location in the Portland area. The 500-year spectrum is used for the analysis of the Columbia River crossing.

The Geomatrix spectra have a peak response at a period of 0.20s and decrease for periods less than 0.20s. The rock site acceleration spectrum must be modified to account for local site effects. Rock level is not indicated on the available borings. Soil column analyses to obtain foundation level spectra have not been performed. In parallel with current AASHTO design procedures, the rock spectrum for all periods greater than or equal to 0.20s is multiplied by a constant factor for local site effects. Also in accordance with traditional design procedures, the modified peak at 0.20s is used for all periods less than 0.20s.

Review of the soil boring data provided for the Oregon Slough Bridge site indicates loose to medium-dense, primarily cohesionless material in the upper portion of the soil column with cemented sandy gravel/cobbles at lower depths. Based upon this profile, the soil is categorized as Type II per the AASHTO specification for which S=1.2. Therefore, the project spectrum is multiplied by 1.2 for site effects as discussed in the preceding paragraph.

Comparisons of the project spectra with the AASHTO spectra are on the included charts. For purposes of comparison, the AASHTO spectra are computed assuming a peak ground acceleration of 0.2g.

To recognize the directional variability of the seismic input, two separate combinations of seismic loading are considered. The combinations considered are those of the current AASHTO specifications with the addition of a component in the vertical direction. Seismic combinations are as follows:

$$EQX = \text{Longitudinal} = 1.0*X + 0.3*Y + 2/3*Z$$
$$EQY = \text{Transverse} = 0.3*X + 1.0*Y + 2/3*Z$$

Where X = longitudinal direction; Y = transverse direction; Z = vertical.

For typical short to medium span bridge configurations, the vertical component of acceleration is generally ignored on the basis that the vertical component of the seismic input is small and that it adds relatively little to the overall response. However, data recorded during the January, 1994 Northridge earthquake in Southern California indicated a higher than expected vertical response at several locations. Given the critical nature of this bridge and the unique configuration, it was decided to include a vertical component of seismic input. A comparison of the relative contribution of the vertical component to the total seismic force in selected members of the span 4 truss is included in the report. For the selected members, the vertical component (=2/3*Z) adds from 0.7% to 22.5% to the governing seismic demand. A rigorous evaluation of vertical seismic response will require a site specific spectra and time history analysis of the soil/structure system.

Demand Analysis

Overview of analysis

The dynamic analysis of the structure is performed using ALGOR, a general purpose finite-element/frame program with user specified response spectrum input capabilities. The analysis assumes linear, elastic material response. The models used for this project consist of 3-D beam element members interconnected in a 3-D framework and supported by boundary elements with user specified spring stiffnesses. Masses are lumped at the nodes utilizing the member cross-sectional areas with specified material densities and/or as externally applied lumped masses. The analysis is a traditional multi-mode response spectrum analysis. Individual modal results are combined using an SRSS procedure. The seismic loads are considered to be fully reversible. The two basic seismic combinations defined previously are added to the dead load forces to determine the total seismic demand.

The results reported herein are based upon a series of analysis models. All models are derived from a basic analysis model. The basic model consists of a fully developed model of the substructure units with simplified models of the superstructure spans connecting the substructure units. Piers 1,2,3 and 4 are modeled in detail. Boundary conditions at the North abutment and at pier 5 are incorporated using boundary elements at the geometric location of the superstructure connection. Superstructure spans 1,2,3,4 and 5 are represented in the basic model.

Substructure assessments are determined from an envelope of two models. The first model, SUBFLEX, consists of the basic model with relatively flexible boundary elements applied at the base of piers 1,2,3 and 4 to model the pile supported footings. The second model, SUBFIX, is identical to the first except that the stiffnesses of the boundary elements supporting Piers 1,2,3 and 4 are increased to represent an upper bound to the foundation stiffness. Superstructure assessments are conducted using the basic model with a detailed model of the Southbound truss span under review substituted for the simplified representation.

Earlier stages of the investigation in which the detailed models of southbound spans 2, 3 and 4 were added simultaneously to the basic model indicated that there is not significant dynamic coupling between the truss spans. Therefore span-by-span modeling is utilized to reduce the computational intensity of the model and to lessen the output from the detailed model to a more manageable level. Each truss span was analyzed using both the flexible and the stiff pier support models. Review indicates that virtually all of the truss members are governed by the model with flexible pier supports. All truss results reported herein are based upon the flexible models: S2FLEX, S3FLEX and S4FLEX.

Static dead load analyses of each span are conducted using the dynamic models modified as required to approximate the static support conditions.

Significant details of the structural modeling are discussed in the following sections; sketches of the models are included in the report.

Substructure modeling

Sketches are included in the report showing the general arrangement and controlling dimensions of the pier models.

All primary member (columns, cap beams, spandrel beams, etc.) section properties are computed assuming uncracked sections and gross section dimensions. Web walls between columns and the extensive monolithic footings of the Northbound structure are modeled as truss frameworks with equivalent section properties for in-plane stiffness computed using a procedure modified from "Theory and Analysis of Plates" by Rudolph Szilard, Prentice-Hall, Inc., 1974. The substructure details associated with the gatekeeper's houses at piers 1 and 4 and the operator's house at pier 2 are not considered in these models on the assumption that their relative contribution to the dynamic response will be small compared to the overall mass and stiffness.

All piers are supported on timber piles. For the 3-D frame analysis, pile support is modeled as a set of linear springs located at the base of each individual footing. Six springs are applied at each support corresponding to each of the six global degrees-of-freedom. These springs represent the diagonal terms of the foundation stiffness matrix. Coupling between degrees-of-freedom is not considered in the 3-D frame analysis (i.e. the off-diagonal terms of the foundation stiffness matrix are ignored). This procedure is adopted primarily to simplify the process of identifying footing reactions from the response spectrum analysis. ALGOR will accept full 6x6 stiffness matrix elements at boundary nodes, but reactions are not output for these elements. Although the analysis results may be expected to change slightly using the full 6x6 stiffness matrices, it is our judgment that the magnitude of the change due to this factor is significantly less than the overall uncertainty in the general input data, soil information and loading assumptions.

Due to the uncertainty in the geotechnical data, the decision was made to envelope the expected stiffnesses of the foundation support. The flexible model, SUBFLEX, considers the stiffness contribution of the piles only and essentially ignores any passive soil resistance against the footings (however, the confining effect of the soil on the lateral stiffnesses of the piles is considered). SUBFLEX is intended to estimate a minimum (lower-bound) expected foundation stiffness. The stiffer model, SUBFIX, simply consists of the flexible model boundary element spring constants multiplied uniformly by a factor of 100 and is intended to approximate an upper-bound to the foundation stiffness.

The lateral and flexural stiffnesses of individual piles are computed using the lateral pile analysis program LPILE. Timber modulus is assumed to be 1600 ksi. Foundation material is assumed to be cohesionless sand of varying density. Input parameters for the LPILE analyses are included in the report. The individual pile stiffnesses are adjusted for closely spaced pile group action by a procedure recommended by FHWA. The axial and torsional stiffnesses of individual piles are computed assuming an effective pile length equal to 2/3 of the total pile length below the footing. All piles are assumed to be 10 inch diameter for stiffness computations except Pier 1 SB piles are assumed to be 9 inch diameter for computing the axial and torsional stiffnesses. Considering the scarcity of definitive geotechnical and seismological data for this bridge, investigation of non-linear behavior of the piles and soil-structure interaction (SSI) is judged to be unwarranted. For each footing, the individual pile stiffnesses are combined using the plan specified layout into a resultant stiffness matrix at the geometric center of the pile group. The diagonal terms of this matrix are assigned to the boundary elements of the ALGOR model. The results of the LPILE analyses and the pile group stiffnesses are included in the report.

Superstructure modeling

Equivalent beam models for global analysis and for substructure assessment

Simplified line element models of the superstructure spans are used to model the truss spans on the common foundation for substructure assessment. Members consist of 3-D beam elements with section properties computed to approximately match the composite global stiffnesses of the primary truss/tower frames. The densities of the simplified elements are set to match the total weights of the spans. Additional lumped masses are applied to the top of the tower to represent the counterweight and other top of tower material. The southbound truss span properties are used to represent both the southbound and the northbound spans.

The top of the tower is set at an elevation corresponding to the center of gravity of the additional masses. The members are located transversely at approximately the center of gravity of the truss spans considering the eccentricity of the deck self-weight. The line element models are connected to the substructure members at the plan specified bearing locations through a system of rigid links. Member end releases are applied to these links as appropriate to model the plan specified bearing support conditions.

3-D truss models for superstructure assessment

All members of the superstructure truss models are 3-D beam elements with full fixity at each end (except at bearing interfaces as noted previously). ALGOR automatically assigns node and member numbers to the model based upon the graphical input. A member identification labeling system organized by member type is shown on drawings included in the report. This system is used to identify and manage the output from the ALGOR analyses.

Truss geometry is defined by the major working lines on the plans. Local eccentricities at member connections are ignored. In general, the section properties for stiffness analysis are based upon the same gross section dimensions and components used to determine member capacities (i.e. properties consider the built-up nature of the member such as laced, battened or perforated plate construction). Torsional properties are not explicitly computed and are set at nominally small values to provide primarily for numerical stability. Local member torsional response should not be significant to the dynamic analysis.

To maintain reasonable model size and to reduce complexity, the concrete deck and the trussed floorbeams are not explicitly modeled. Idealized beam members are used to represent the floorbeams. All bottom lateral members including the floorbeam members are set in the plane of the primary truss bottom chords. Preliminary dynamic runs indicate that the results are sensitive to the stiffness assumptions of the bottom lateral system. Therefore, the dynamic analysis models are adjusted to incorporate the diaphragm stiffness of the concrete deck. The deck is modeled as an equivalent truss framework using the same procedure as discussed previously for the substructure web walls. In this case, the cross-sectional areas of the equivalent framework are added to the computed components of the bottom lateral framing system: diagonal bracing, floorbeams and primary truss bottom chords. Lumped masses corresponding to the mass of the deck and floorbeams are applied to the bottom chord truss nodes.

Due to the simplification of the dynamic model, the reported seismic forces in the bottom lateral system must be proportioned between the steel framing and the deck diaphragm. To estimate an appropriate adjustment, the span 3 truss model is modified to explicitly model the geometry and the stiffness of the deck+floorbeam+post+chord+diagonal bracing system. Uniformly distributed longitudinal and transverse loads are applied statically to the deck of the refined model. The same total load is also applied statically to the "deck" nodes of the simplified dynamic analysis model. The resulting forces in the steel framing for the two static models are compared and a scale factor is determined which is then used to adjust the reported response spectrum forces in the bottom lateral framing system.

Several other regions of the truss model are simplified for the analysis. The cable attachment panels of the lifting girders of the span 3 truss are idealized as "truss" members. Local framing details at the tops of the towers in spans 2 and 4 are also simplified. These areas are not significantly affected by the seismic loading.

For the static dead load analysis of the lift span (span 3), the counterweight and lifting cables are modeled in order to determine the required balancing weight for the counterweights. The total mass and distribution of the counterweight is set to result in a residual vertical reaction at the span 3 truss bearings of approximately 1 kip. The resultant total reaction of the counterweights plus cables plus lift span is then applied to the top of the tower for the static dead load analysis of spans 2 and 4. The cables are found to have a negligible effect upon the dynamic response of the lift span. Therefore, the cables and counterweight are not considered in the lift span dynamic analysis.

The mass of the counterweight and the cables is applied to the towers for the dynamic analysis of spans 2 and 4. Gap elements are not used for the dynamic analysis. Therefore, the counterweight mass is transmitted to the tower legs through a set of rigid links set near the geometric location of the four front corners of the counterweight in the fully raised position. The tributary mass (adjusted for transverse balance) of the counterweight is distributed equally to each of the two links on each side of the tower. The four connection nodes are not linked together and are permitted to move independently of each other.

In all three spans, the out-of-plane flexural stiffnesses of several series of members are increased to eliminate local modes of vibration that have little effect upon the global response of the span. For example, this situation occurs for several x-braced diagonal members with nodes at the intersection of the braces and for the laterally unbraced bottom chords of the transverse portal frame trussed struts.

The utility bridges which connect the SB and NB counterweight towers at the top and at mid-height are not modeled in the analysis. These bridges are connected to the tower legs by hanger links on one side and thus permit some relative lateral movement of the adjacent towers. Practically, however, movement towards each other will be limited to the existing gap while movement away from each other will be virtually unlimited (for small to medium deflections).

Dynamic analysis overview

The number of modes considered in the dynamic analysis are established by consideration of the period of vibration and the mass participation factors. Models of truss spans 2 and 3 are analyzed for period, mode shape and participation factors through 60 modes. These truss models are supported by essentially rigid boundary elements in the applicable directions at the four truss corners. Tabulation of the period and participation factors are included in the report. Based upon inspection of the modal and cumulative participation factor results, 30 modes is judged sufficient to capture the majority of the significant vibration modes of each truss. The 30th mode corresponds to a period of vibration of 0.11s for span 2 and 0.09s for span 3.

These periods of vibration are used as general targets for establishing the minimum number of modes in the global analyses. The global models encompass individual modes of vibration that effect various local portions of the structure and may have little effect upon the response elsewhere in the structure. Sufficient total modes must be chosen to mobilize all significant modes of response for each area of the structure under review. For the substructure assessment models, 60 modes are considered. The 60th mode corresponds to a period of vibration of 0.125s for the flexibly supported model and 0.048s for the stiffly supported model. For the truss assessment models, additional modes are required to ensure consideration of all relevant truss modes; 80 modes are considered. The 80th mode corresponds to a period of vibration of 0.113s for the flexibly supported model of span 2 and 0.101s for the flexibly supported model of span 3.

The relative modal contribution to individual total member force is illustrated for several members of the span 4 truss model on the included diagrams. Most of the seismic force in the bottom framing system is contributed by modes with periods of vibration in the 0.4s to 0.6s range. The dynamic response of these members is governed primarily by the relatively stiff behavior of the concrete deck acting as a diaphragm. Conversely, longer periods of vibration contribute a greater proportion of the total seismic force for members in the counterweight towers. These members are governed by the relatively flexible behavior of the tower + counterweight.

The fundamental periods of vibration of the tower + counterweight are computed to be about 2.0 seconds in the longitudinal direction and about 1.8 seconds in the transverse direction. These values are computed assuming the counterweight is attached to the tower as discussed previously. In reality, the counterweight has some limited freedom of movement before contacting the tower. This freedom is defined by the counterweight guide systems. Actual contact will involve some hammering as the counterweight moves back and forth within the confines of the guide system. The analysis does not consider the free-swinging (pendulum) behavior of the counterweight, nor does it consider the effects of hammering. We note that the period of vibration of the free-swinging counterweight (in the fully raised position) is about 6.2 seconds in the longitudinal direction, 4.4 seconds in the transverse direction and 2.1 seconds for twisting about a vertical axis. It is possible that the differences between the dynamic behavior of the tower and the free-swinging counterweight will modify the overall results of the analysis, but the magnitude of the changes are unknown. It is also possible that the guide system may not be strong enough to withstand the hammering of the counterweight. This will increase the available range of motion of the free-swinging counterweight and further complicate the analysis. Advanced modeling and time-history analysis techniques are required to capture these effects.

Interpretation of truss analysis results

Static self-weight analyses are conducted to estimate the existing dead load member forces in the structure. Computed dead load axial forces in the truss members are tabulated along with the elastic seismic forces in the appendix to this report.

For the superstructure models, review of the results of both the static and the dynamic analyses indicates that notwithstanding the end fixity of the truss members in the models, truss behavior does in fact dominate the response. Member end moments are small relative to the axial loads. The actual magnitudes of the end moments present in the structure will vary from the computed moments and will depend upon the original tightness of the riveted connections and upon the erection sequence and procedures employed at the time of construction. Thus, the reported demand/capacity ratio for the majority of the truss members considers only the computed axial loads. Exceptions to this occur in the portal frames and in some of the members of the counterweight tower where moment continuity is essential to the equilibrium and/or stability of the frame.

Considering the type of structure and the vintage of the design, we assume that most of the trusses were originally analyzed and designed on the basis of 2-D behavior. The primary trusses carry the tributary gravity loads in the (vertical) plane of the truss, while the top and bottom lateral bracing systems carry lateral loads to the bearings and would typically be ignored in the gravity design. We observed, however, that as a result of the strain compatibility of the 3-D frame analysis, several groups of bracing members do in fact carry significant computed dead load axial forces. For example, the top chord lateral bracing system has significant axial compression forces in the diagonal members as a result of the shortening of the top chords. Similarly, the bottom chord lateral bracing members carry significant tension due to the dead load extension of the bottom chords. The counterweight tower framing exhibits similar results.

While a portion of this computed dead load is likely present in the in-place structure, the actual magnitude and distribution of these secondary dead load forces is highly dependent upon the erection sequence employed and upon the relative fixities of the individual riveted member end connections. It is reasonable to conclude that the computed secondary forces represent an upper bound to the dead load demand on those members. In order to perform the capacity review of these groups of members, the computed secondary dead load is conservatively added to the seismic load when it increases the combined demand and is neglected when it would lessen the combined demand.

We also noted that several of the diagonal bracing member groups were clearly designed on the basis of tension-only behavior. The linear, elastic response spectrum analysis is not capable of making this distinction, therefore, adjustments to the reported forces are made outside of the analysis in those situations. These adjustments are described in greater detail in following sections.

Demand/Capacity Calculations

Substructure

Timber piles

Seismic demand

Substructure footing reactions due to seismic loading are computed using models SUBFLEX and SUBFIX. The elastic reactions from the response spectrum analyses are tabulated and included in the report. Maximum and minimum footing reactions considering buoyancy are determined. The effects of stream flow are investigated and are found to be negligible in comparison with the order of magnitude and the relative uncertainty of the seismic force levels.

Modern seismic design philosophy for highway bridges dictates that inelastic behavior in the substructure generally be restricted to those details which possess the necessary ductility capacity and which may be easily identified and repaired after a seismic event. In practice, inelastic behavior is usually limited to the flexural behavior of exposed columns of the piers (plastic hinging). Foundation components such as footings and piles are designed to remain elastic at all times; these components are typically designed to the maximum of the computed elastic demand or to the maximum force capable of being transmitted from the pier columns to the footing during plastic hinging. For this structure, the piers and footings were designed and constructed without the structural details necessary to provide sufficient ductility to the columns. Therefore, the footings and piles are reviewed for the elastic seismic loads.

Individual maximum pile axial reactions are computed assuming a rigid distribution of the combined dead + buoyancy + elastic seismic forces at the base of the footing ($P/N \pm M_L*x/(\Sigma x^2) \pm M_T*y/(\Sigma y^2)$). Shear forces are assumed to be distributed uniformly to each pile.

Two cases are considered and the tabulated results are included in the report. In the first case, passive resistance of the soil mass surrounding the footing is ignored. In the second case, the maximum available passive soil resistance using a uniform groundline elevation (same gl that is assumed for the LPILE stiffness analysis) is computed. The available passive pressure for seismic loading is computed using the Mononobe-Okabe equation as suggested in AASHTO Division IA, Section 6 Commentary and assuming an acceleration coefficient of 0.2g. The procedure also considers the relative stiffness of the foundation unit. The seismic shear force (reaction) is reduced by up to the amount of the available passive resistance. The passive resistance utilized also resists a portion of the overturning moment. Pile demands quoted in the following discussion reflect the passive pressure contribution unless otherwise stated.

In general, pile axial loads are governed by longitudinal seismic loading from the stiffly supported model. Pile shear loads are governed by transverse seismic loading, generally from the flexibly supported model. Due to differences in design configuration, the NB (original bridge 1377A) side of each pier is significantly stiffer than the SB side. Therefore, the NB side of each pier carries a higher proportion of the seismic demand.

For piers 2,3 and 4, the estimated pile dead load + min. buoyancy reaction is about 28-29 tons per pile. For pier 1 SB, pile dead load is about 15 tons; for pier 1 NB, pile dead load is about 26 tons.

The maximum per pile total seismic demands (DL+B+EQ; in tons) are as follows:

> Piers 2,3,4 SB, max. compression = 138; max. uplift = 83; max. shear = 6.9.
>
> Piers 2,3,4 NB, max. compression = 176; max. uplift = 114; max. shear = 18.
>
> Pier 1 SB, max. compression = 36; max. uplift = 8.8; max. shear = 6.2.
>
> Pier 1 NB, max. compression = 65; max. uplift = 15; max. shear = 11.
>
> For pier 1 NB ignoring passive resistance, max. compression = 80; max. uplift = 30; max. shear = 18.

The passive resistance has less proportional effect upon the axial loads in the piles of piers 2,3 and 4 but is effective in reducing the shear demand on the SB piles.

Pile capacity

As previously discussed, the plans for SB bridge 7333C specify that all piles be driven to an allowable load of 40 tons. Pile driving records vary. The plans for NB bridge 1377A indicate a maximum pile "load" of 30 tons. Driving records are not available for bridge 1377A.

As noted, pile driving records are available and have been reviewed for the SB footing units. Ideally, it should be possible to estimate the in-place capacity of the piles based upon these records. However, the task of interpreting the records is made somewhat difficult due to differences in the reporting tendencies used by different installers/ inspectors on the various units. For example, records for pier 1 SB indicate maximum bearing as "40+" (tons). This is recorded for 22 of the 80 piles installed. All other piles are recorded as bearing at some specific value less than 40 tons; the smallest recorded bearing is 19.7 tons. At the other end of the recording spectrum, records for pier 3SB upstream record specific bearing values on just two of the 92 piles. One other pile is recorded as "no reading" and another pile is recorded as "200 BPF". All other piles for this footing are recorded as "refusal". Records for the other units contain various combinations of these methods of indicating installed bearing capacity. It is noted that the recorded capacity of the piles of pier 2 and 4 are in general somewhat greater than the plan specified 40 tons.

These variations in the installation records make it difficult to accurately define an in-place capacity for the piles. Typically, the allowable capacity of a pile is about one-half of the ultimate capacity. Therefore, the ultimate capacity of the piles for review will be assumed to be equal to twice the design allowable specified for the SB piles. That is, all piles are assumed to have an ultimate bearing capacity of 80 tons for this assessment. According to the AASHTO seismic design provisions as defined in section IA, the seismic load combinations are considered to be ultimate loads and may utilize the full available strength of the structure.

It is not possible to accurately estimate the capacity of the piles in uplift given the lack of geotechnical data. Moreover, the uplift capacity is dependent upon the condition of the pile connection to the footing. The design connection detail is not well defined on the plans and the actual in-place condition of the connection is unknown. Using modern design criteria, uplift would not be allowed in the design of short timber piles such as these and, based upon the design details and loads, it is reasonable to assume that pile uplift was not considered in the original design.

In reality, there will be some resistance to uplift. An upper bound to the expected ultimate uplift resistance may be defined based upon typical practice. In the absence of geotechnical data, WSDOT defines procedures to estimate an ultimate pile uplift capacity which is not to exceed 40% of the bearing capacity. These procedures are to be used only for friction piles over 10 feet in length and assume that an adequate connection detail is provided. Realistically, given these considerations, it is likely that the uplift capacity of the existing piles is limited.

The computed pile reactions assume that sufficient uplift capacity exists. Failure of piles in uplift will cause a redistribution of force in the remaining piles. Progressive failure of the piles in uplift or compression may result in pier failure by overturning.

The ultimate structural shear capacity of the timber pile is determined using the provisions of the AASHTO LRFD Design Specification:

$V_r = \phi V_n$ EQN.(8.7-1)

Where ϕ = 1.0 for the extreme event limit state and $V_n = F_v{*}A/(4/3)$;
F_v = Base shear resistance
= 0.300 ksi for Douglas Fir-Coast piles per table 8.4.1.3-1,
$A = \pi d^2/4$ = 78.5 sq.in. for assumed 10" diameter at top of pile,
and 4/3 is the shear stress form factor for a circular section.

Note that the base shear resistance from the table assumes wet-use conditions and the traditional duration of load factor is considered in the resistance factor, ϕ.

Therefore V_r = 17.7 kips = 8.8 tons per pile.

Pile flexural stresses and capacity are dependent upon the end restraint of the pile at the footing, the size, length and taper of the pile and the geotechnical properties of the surrounding soil. Due to the uncertainties in all of these factors and considering the fact that the piles are generally overloaded already in axial load and in shear, pile flexural stresses are not reviewed.

In summary:

a.) pile uplift is experienced at all piers with little or no uplift capacity available.

b.) pile compression capacity is exceeded for the river piers 2,3 and 4.

c.) pile compression capacity may be adequate at pier 1 but pile load redistribution due to inadequate uplift capacity is not considered.

d.) pile shear capacity is exceeded for the NB footing units with (and without) the passive soil resistance considered; shear capacity is exceeded for pier 3 SB footings when the passive resistance is ignored.

Piers

Elastic forces in the columns and walls of the piers are obtained from the same models used to establish the seismic demand in the piles. Forces at selected locations (identified in the included sketches of the pier models) are tabulated and included in the report. The seismic load cases are combined with the estimated dead load forces to establish the elastic seismic demand. The transverse shear demand on the northbound columns of piers 2,3 and 4 and all columns of pier 1 are modified to include the horizontal component of the maximum forces in the diagonal "wall" members.

Based upon the original design plans of the southbound bridge, axial/flexural interaction diagrams are plotted for the southbound columns. Columns are tapered and are circular in cross-section. Overlaid upon the interaction diagrams are the maximum computed elastic demands in the columns. Note that the tabulated demand is at the point just below the web wall spandrel beam connection which is in the precast shaft portion of the column. The interaction diagram is computed at the base of the cast-in-place upper column. The flexural demand/capacity ratio for the southbound columns varies from 1.3 for pier 1 to 3.0 for pier 4. We note that the vertical steel reinforcement ratio in the southbound columns ranges from a maximum of .0059 at the top of pier 4 (smallest section) to a minimum of .0032 at the base of piers 2 and 3 (largest section). These ratios are small by current design criteria.

The available plans for the northbound bridge do not clearly indicate the existing column reinforcement. Estimates of the NB column reinforcement are made by comparison with the SB columns and with the modifications to the NB pier 4 columns made at the time of the construction of the SB bridge. The maximum elastic demands on the NB columns are overlaid upon interaction diagrams plotted using the plan dimensions with the estimated quantities of steel. The flexural demand/capacity ratio for the northbound columns is 1.5 for pier 4 and is less than 1 for piers 1,2 and 3. We note that the overall dimensions of the northbound columns are greater than those of the corresponding southbound columns.

Transverse reinforcement in all cast-in-place columns of the southbound bridge consists of #5 hoops at 18" uniform spacing. Transverse reinforcement in the pre-cast shafts supporting the cast-in-place columns of the southbound bridge consists of #6 hoops at 12" spacing. Hoop steel lap splices are 12" for the #5 hoops and 15" for the #6 hoops. The available plans for the northbound bridge do not clearly indicate the existing column reinforcement. #6 hoops at 18" spacing are specified for the cast-in-place shell added to the existing shaft of each column of northbound pier 4. The original northbound plans do indicate 3/4" diameter (#6) bars in the walls and cap beams. Therefore, we assume #6 hoops at 18" in the columns of the northbound bridge for consideration of the shear strength of the columns. All steel is assumed to be grade 40 and the nominal compressive strength of the concrete is assumed to be 3300 psi.

By inspection, the transverse reinforcement of the columns is modest in comparison to modern design criteria and would not be considered adequate to provide the confinement necessary to permit inelastic deformation (plastic hinging) of the columns. Therefore, although the elastic demand/capacity ratios for the majority of the columns are not of exceptionally large magnitude, the inadequate confinement of the columns and the limited bar lap lengths significantly limits their ductility capacity and justifies the use of elastic capacity to rate the columns.

For the tapered CIP columns of both bridges, column shear is a significant consideration only in the longitudinal direction. Transverse shearing forces are resisted by the web walls between the columns. The circular pre-cast shafts of the southbound bridge must resist the resultant of both the longitudinal and the transverse components of shear force.

For new design, the shear strength of bridge columns typically depends upon the axial load present in the columns. If the minimum compression stress in the column is less than 10% of the nominal concrete strength, the AASHTO specification requires that the shearing strength of the concrete be ignored in determining the transverse reinforcing requirements of the column. However, for predicting the strength of an existing structure, we feel it is overly conservative to ignore the concrete contribution.

The maximum longitudinal shear force in the cast-in-place southbound columns is 1000 kips. For #5 hoops at 18" spacing the maximum nominal shear strength due to the steel is 154 kips at the base of the pier 2 and 3 columns (~140" diameter with the effective depth of the circular section assumed = 0.8*diameter). The nominal shear strength due to concrete at this section is 1801 kips (axial load not considered). The factored shear strength of the section considering both the concrete and the steel is 1662 kips. The strength contribution of the transverse steel is small. At this shear load, the minimum axial load in the column is 1622 kips which is 0.105 ksi and is significantly less than 10% of the concrete strength.

The maximum resultant shear force in the southbound pre-cast shaft is 1404 kips. The diameter of the shaft is 160". Ignoring effects of axial load, the shear strength due to concrete is 2353 kips. For #6 hoops at 12" spacing, the shear strength due to the steel is 375 kips. Combined factored shear strength in this section is 2319 kips.

The maximum longitudinal shear force on the northbound columns of piers 2, 3 and 4 is 1593 kips. The minimum base of column diameter is 155" at pier 4. Assuming #6 hoops at 18", the combined factored shear strength of this section will be similar to that of the SB pre-cast shaft and is greater than 1593 kips.

We conclude that the longitudinal shear strength of the columns considering only the transverse reinforcement is small compared with the seismic demand, but it is adequate if the concrete contribution is considered. However, column ductility is limited by the small amount of transverse reinforcement, and inelastic flexural response would degrade shear capacity significantly.

Transverse shear is resisted by the web walls between the columns. Seismic demand is estimated by summing the horizontal components of the axial forces in the diagonal members used to model the walls. This is conservative considering that the maximum demand in each individual member is unlikely to be reached simultaneously and that vertical load components on the pier will generate some axial force in the diagonal members as a result of frame action in the discretized model that is not equivalent to a shear force in the actual continuous wall system. The approximated shear forces are tabulated in the report.

Probable wall strength is computed using the provisions of the AASHTO specification, section IA. Wall reinforcement as specified in the plans consists of #5 bars at 18" spacing each way and each face in the 1.5' thick walls between the southbound columns and the 1.5' thick walls connecting the southbound substructure to the northbound substructure; the walls between the northbound columns contain 3/4" diameter (#6) bars at 18" vertical spacing with 3/4" diameter bars at 4'-0" horizontal spacing each face. Northbound walls are 3' thick at piers 2 and 3 and are 2.5' thick at piers 1 and 4. Wall reinforcement percentage is somewhat substandard by modern criteria, varying from .0019 each way in the SB walls to .0014 horizontally and .0005 vertically in the NB walls. The current AASHTO specification requires a minimum reinforcement percentage of .0025 each way with 18" minimum bar spacing.

Wall strengths are computed based upon the horizontal steel only. The total factored shear strength is computed to be about 5590 kips for piers 1 and 4 and about 5900 kips for piers 2 and 3. Seismic demand is greatest at pier 4 (note that pier 4 carries the load of the 531' main span truss in addition to the lifting unit tower span) and is estimated to be about 5480 kips total maximum shear force or about 98% of the computed capacity. We note that the estimated shear demand on individual panels varies considerably and is sensitive to the stiffness distribution of the supporting substructures. The local strength of individual panels could be exceeded in the maximum event, but the total strength of the pier appears to be adequate.

Bearings

Bearing forces and strength

As noted previously, the truss models are connected to the substructure through a system of rigid links. The links are placed to duplicate the geometry of the physical structure with joints located at the working line of the truss chord, at the truss pin and at the centerline of the pier cap beam. The flexibility of bearing components is not explicitly considered. Member end releases are applied to the links to match the plan specified conditions. All bearing links are released for bending about a transverse axis (longitudinal bending) and for bending about a vertical axis (torsion). Expansion bearings are released for longitudinal deflection. All other degrees of freedom are fixed for analysis.

Member end forces representing the maximum elastic bearing loads at the pin are tabulated in the report. Review of the bearing details for these loads indicates that the capacities of the bearings are significantly exceeded in several modes of behavior.

The large transverse reaction forces at the bearings generate transverse bending moments within the bearing assembly. The actual distribution of moments over the height of the assembly will depend upon the location within the assembly and upon the fixity of the pin + pin plate details relative to the fixity of the truss framing details.

Pin plates and anchor bolts are reviewed for the set of forces computed at the pin location. Pin reactions due to the transverse bending moment result in significant tension on the outstanding pin plates. As a result, the relatively thin sections of the outstanding pin plates are overloaded in shear under the combined vertical load + transverse bending moment. Several anchor bolts are overloaded in tension as a result of this loading condition. Finally, the anchor bolts are overloaded in shear at all of the bearings.

There are no net uplift forces on the tower-span bearings (spans 2 and 4) or on the lift-span cables of span 3.

Relative bearing displacements

Longitudinal displacements of the expansion bearings relative to the pier are tabulated in the report. Note that the tabulated displacements are the SRSS (absolute value) combination of the individual modal displacements. The maximum relative displacement computed by taking the difference between the truss and the pier displacements is 1.4" at the expansion ends of spans 2 and 4 and is 0.3" at the expansion end of span 3.

Assuming that the recorded pier displacement might be in the opposite direction to the truss displacement, the maximum relative displacement would be 4.8" at the expansion end of span 4 and would be 3.6" at the expansion end of span 3.

Bearing displacements do not appear to be excessively large. Note that the maximum displacements discussed here do not consider the effects of failures in the fixed bearings.

The expansion bearings of spans 2 and 4 are steel rocker bearings with a maximum range of displacement of 7" each side of the neutral position. Rocker radius to the centerline of the truss pin is 17". At pier 4, the span 4 face of the cap beam is about 3' from the centerline of the rocker bearing. At pier 1, the span 2 face of the cap beam is about 3'2" from the centerline of the rocker bearing. Thus, in the event of rocker collapse, the truss pin may be expected to land on the pier cap.

The expansion bearings of span 3 (lift span) are sliding bearings with a total range of displacement of about 11" each side of the neutral position before becoming unstable. The bearing is centered upon a 2'-8" wide pedestal which is about 16" above the surface of the pier cap. The edge of the pier cap is about 2'-0" from the center of the pedestal and bearing.

Superstructure

Sketches are included in the report which identify all members with adjusted demand/capacity ratios greater than 1.0 and identify whether the ratio is based upon axial load only or upon combined axial load + bending.

Also included are detailed spreadsheets which tabulate the truss span analysis results. The first set tabulates the adjusted loads and D/C ratios. A second set tabulates the results of investigating combined axial + bending loads using the adjusted results as applicable.

Truss span elastic analysis results

Initially, all members were checked for both tension and compression under seismic and dead load forces determined from the computer analyses.

For compression, the AASHTO Load Factor Design approach for design of compression members was used. Demand was calculated as $P = \gamma\ (\ \beta_d\ D + EQ\ )$, where β_d = 1.00 or 0.75 in accordance with the Specifications, and γ was set at 1.00 in accordance with the Seismic Design Specifications (AASHTO Div. I-A, Section 4.7). Equation (10-150)...... $P_u = 0.85\ A_s\ F_{cr}$ ......of the 1992 AASHTO Standard Specifications for Design of Highway Bridges was used to calculate member compressive capacity. F_{cr} was based on the larger (KL_c/r) value for bending about the member Y or Z axis. K was in all cases set equal to 1.00, according to AASHTO Div. I-A, Section 7.3.

Since the AASHTO Standard Specifications have no explicit provisions governing tension members, we used the AASHTO LRFD Bridge Design Specifications (1st edition, 1994) for our tension capacity and demand calculations. Capacity was set equal to $P = \phi\ F_y\ A_g$, according to Eq. 6.8.2.1-1. Earthquake is an extreme event limit state, so ϕ =1.00 (Sec. 6.5.5). Load factors were obtained from Tables 3.4.1-1 and 3.4.1-2 : γ = 1.25 for dead load and 1.00 for earthquake forces. Where dead load forces were compressive, γ_{DL} was reduced to 0.75 for the tension-demand calculations.

The results at this stage, not surprisingly, showed compression failure due to elastic buckling for nearly all "X"-bracing members (top and bottom lateral diagonals, tower lateral diagonals, diagonal truss members L4-U5 and L4'-U5' in all spans, and members L5-U5' and U5-L5' in the tower spans), as well as in the tower diagonals running from panel point U1' or U1 to points F1 and R1. Some tension-only members, including nearly all top lateral diagonals, tower members U1-F1 and U1-R1, and west-truss diagonals L4-U5 and L4'-U5', showed up as failing in compression under dead load compatibility forces alone.

These members were originally designed as tension-only members. Their compressive "failure" merely results in the shifting of the load path to other members. Ideally, these members would be analyzed using their true member properties under net tensile force, and with very small areas when subjected to a net compressive force. Since the analysis does not include member properties that are different for tension and compression (cable members), member forces must be redistributed by as rational a hand method as can be devised.

The remaining problem areas, where acceptable alternate load paths do not exist, include the lateral crossframes at the tops of the truss portal members L0-U1 and L0'-U1' in Spans 2 and 4, several tower diagonal and horizontal truss members in the vicinity of the counterweights, and some of the east truss bottom chord members in the tower spans.

The portal crossframes at the ends of Span 3 are braced in the middle by the lifting girder struts, whereas the crossframe bottom chord members in Spans 2 and 4 are unsupported and prone to lateral buckling under compressive loads. The crossframe bottom chord members' D/C ratios are quite high - as large as 3.3 - because of their high slenderness ratios in the horizontal plane. This is a serious problem because members L0-U1 and L0'-U1' do not have lateral diagonal bracing as do the other truss top chord members, and lateral seismic forces must be carried by the portal frame made up of members L0-U1 and the lateral crossframing.

Tower truss diagonals F3-R4 and F4-R5, which are closest to the counterweight in its normal, raised position, have compressive demands as much as twice their buckling capacities. These are nonredundant truss diagonals, and their compressive failure could lead to collapse.

A number of east truss bottom chord members in Spans 2 and 4 have D/C ratios greater than one. The ratios are all less than 1.2, and are all based on tension forces.

Adjustment of truss analysis results

Truss Top Lateral System

The largest forces in these members are from the primarily transverse, or EQY, load combination. For this case, it is assumed that the full lateral shear in each "X"-braced bay is carried in tension by one leg of the "X". Thus, each top lateral diagonal member is checked for the maximum tension produced by adding the seismic force in the opposite diagonal member to the force in the member. The only exceptions are the diagonals in panel 5-5', which have compressive capacity greater than demand.

Dead load compatibility forces in the top lateral diagonals are all compressive and are therefore conservatively assumed to be zero (except in panel 5-5'). Although buckling of the diagonals would in reality cause dead load compatibility forces in the top lateral struts to decrease, we conservatively include strut dead load forces whenever they increase demand (tension) and assume them to be zero when they reduce demand (compression).

Since the forces in the diagonals are very small compared to those in the main truss top chord, and the top-chord members all have demands comfortably within their capacities, we do not consider it necessary to redistribute the forces in the lateral diagonals to the truss members.

No attempt is made to redistribute the seismic compressive forces in the lateral diagonals to the top lateral struts, either. The top lateral struts have ample excess capacity. As a conceptual check, the results of a static analysis of the top lateral system in which a unit lateral force was applied at each panel point is compared to the results from a modified lateral system, similarly loaded, in which all diagonal members experiencing compression are eliminated. The maximum force in a strut is slightly decreased in the modified version.

All top lateral members have adequate capacity for these adjusted loads.

Truss Bottom Lateral Diagonals

These member loads are redistributed as for the top laterals. The dead load forces are tensile, and are therefore included in the demands. The seismic forces in the bottom lateral diagonals are adjusted downward by an estimated factor of 75%. Since the bottom diagonal member stiffnesses were artificially increased for the analysis input as an economical way to include the deck stiffness in the model, the resulting member forces are in reality shared between the lateral members and the deck slab.

Many bottom lateral diagonals do not have sufficient capacity for these adjusted forces. The demand/capacity ratios range up to about 2.0.

Truss Diagonals in Panels 4-5, 5-5' and 4'-5'

It is assumed that the dead load and seismic compression force from failed members L4-U5 and L4'-U5' are taken up in tension by members U4-L5 and U4'-L5'. The maximum tension for members U4-L5 and U4'-L5' is thus augmented by an additional tension force of 1.25 times the dead load force plus the maximum seismic force in the opposite diagonal member.

Since members U4-L5 and U4'-L5' do not fail under the forces from analysis, members L4-U5 and L4'-U5' are only checked for maximum tension (with no additional loads from other members).

The diagonal members in panel 5-5' are checked for maximum tension similarly to the top lateral diagonals. Dead load tension is multiplied by 1.25 (no contribution from other members) and added to the sum of the seismic forces in the two opposing diagonals.

All truss diagonals in the three central "X"-braced truss panels have sufficient capacities for the adjusted tension forces.

Again, it is not considered necessary to redistribute any of these loads to the truss chords or vertical members. A dead-load analysis with members L4-U5 and L4'-U5' (and U1-F1 and U1-R1) removed from the system shows tension forces in the bottom chord members either unchanged or slightly reduced, and the only increase in compression forces in the top-chord members is by 2%. The verticals have enough capacity so that one could sum the maximum seismic force and dead load in the diagonal and the forces in the vertical, and the result would still be less than half the member capacity.

Tower Front and Rear Lateral Diagonals

All lateral "X" bracing members in the tower show up with demands on the order of two to as much as four times their compressive capacities. The controlling load combination is the primarily transverse (EQY + 0.3EQX + 0.67EQZ) combination. Based on a simple static analysis, the loads are redistributed as follows:

- Each "X" brace is checked, in tension, for the sum of its own maximum seismic force and that in the opposite diagonal, plus 1.25 times the member dead load force if dead load causes tension.
- Each lateral strut is checked for both tension and compression. For compression, the horizontal component of seismic force in a typical diagonal immediately above the strut and the horizontal component of force in a diagonal below the strut are added to the strut forces from analysis.
- The vertical component of seismic force (dead-load forces were negligible compared to vertical member forces) in a typical "X" brace is added to the maximum compression force in the tower main vertical members in the same bay as the "X" brace.

These adjusted loads exceed member capacities in a number of tower lateral members, but in no case by more than 12%.

Tower Truss Diagonals U1-F1 and U1-R1

Although these members are not configured in the traditional "X" shape associated with tension-only bracing, their geometry is such that their compressive failure does not cause the structure to be unstable. For a mechanism to form, one of these diagonals must fail in tension (or some other member must fail). These members are therefore treated the same way they were designed, i.e. as tension-only members. Members U1-F1 and U1-R1 are each checked, in tension, for the sum of their maximum seismic forces. Dead load compatibility forces are compressive and are therefore disregarded.

Both members, in both trusses and in both tower spans, are adequate for these adjusted tension forces.

Three static analyses were performed for Span 2 in order to determine the effects on other members of compressive failure in one or both of these members. The first is a dead load analysis in which both members are removed from the system. The other two analyses involve forces applied to the tower in the northward (towards the lift span) and southward (away from the lift span) directions. The first, or northward, load case is run for the structure as-is and then with member U1'-F1 taken out. The southward loading is applied to the span as-is and then with member U1'-R1 removed.

From these analyses, force redistribution factors were arrived at for the members whose loads are affected by compressive failure of members U1'-F1 and/or U1'-R1. The effect on forces in the other truss members are not found to be important.

Combined bending and axial load in truss members

Bending effects are examined in a separate set of calculations for members in which bending is considered or suspected to be important. Equations (10-155) and (10-156) from the AASHTO Standard Specifications, modified for biaxial bending, are evaluated for all truss verticals, members L0-U1 and L0'-U1', and all main-truss tower members except diagonals U1-F1 and U1-R1.

Bending effects due to the primarily transverse, or (EQY + 0.3EQX), load combination causes demand:capacity (D/C) ratios for the main truss verticals to double or triple as compared to the ratios when only axial forces were considered. Controlling ratios are based on compression plus bending (AASHTO Eq. 10-155), and range up to 1.4.

The D/C ratios in truss portal members L0-U1 and L0'-U1' increase by twenty to sixty percent, bringing the values to approximately 1.0. These numbers may be nonconservative, in that the actual effective length factor K for the transverse direction may be greater than 1.0 if the floorbeam and top portal crossframe do not sufficiently resist rotation of the truss member ends. As we noted earlier, the portal crossframes in both tower spans do not seem adequate in the unretrofitted condition.

Combined bending and compression cannot be evaluated using AASHTO Eq. 10-155 for tower truss diagonals F4-R5 and Span 4 west truss diagonal F3-R4, since the term $[1 - P/A_sF_e]$ changes sign when P is greater than A_sF_e (P is greater than the elastic buckling load). However, the addition of bending effects causes D/C ratios for many other nearby tower members, including the remaining three F3-R4 tower diagonals, tower horizontals F5-R5, F4-R4, and F3-R3, and tower verticals F3-F4 and F4-F5, to increase substantially. Nearly all tower members (except the rear verticals) between panel levels 5 and 3 have demands in excess of capacities due to combined bending and axial compression.

Tower verticals L0-U0 and L0'-U0' are also significantly affected by bending. D/C for combined bending and axial compression is in the range of 1.1 to 1.2, of which about half is attributable to moments and half to concentric loading.

Retrofit Considerations

Substructure

After review of the estimated seismic demands and the existing structural capacities, we anticipate that the costs required to retrofit the substructure will significantly exceed the costs required to retrofit the truss superstructure units. There are three components to be considered in the retrofit of the substructure units: the pile foundations, the pier details and the bearing assemblies supporting the superstructure trusses. Retrofit efforts can take the form of strengthening structural components to withstand the predicted seismic demands and/or taking measures to reduce the anticipated demands to an acceptable level. Demand reduction can sometimes be accomplished by physical means such as seismic isolation bearings or similar technology. In some cases, refined analytical techniques applied to the existing or partially retrofitted structure may reduce the computed demands and thereby lessen the overall cost of retrofitting.

Seismic isolation

In its usual form, a seismic isolation system reduces the seismic force demand in a structure by lengthening the period(s) of vibration of the structure to a point farther out on the specified response spectrum. The period shift is typically accomplished by adding relatively flexible elements into the structure. These elements are most commonly installed at the primary bearing locations. The trade-off for the force reduction is increased deflections within the system.

Inspection of the mode-by-mode responses of several superstructure truss members indicates some possibility for force reduction through the use of isolation bearings. The greatest potential exists for the bottom lateral system for which the majority of the seismic demand is contributed by vibration modes in the relatively short 0.4 to 0.6 second range. The overall potential may be limited, however, by the longer period response of the counterweights + towers. In fact, any system of isolation technology considered for this bridge must be designed with caution to avoid the possibility of magnifying the responses in the longer periods of vibration.

In the case of the substructure units, a significant portion of the seismic load on the pile foundations is generated by the massive pier units. This suggests that seismic isolation techniques as applied at the level of the truss bearings might be of limited benefit to the overall load on the pier components and would be of even less relative benefit to the total demand on the foundation piles.

Refined analysis techniques

Numerous simplifying assumptions have been made to develop the models used for the response spectrum analysis of this bridge. These range from the assumption of basic input data related to the geotechnical regime at the site to specific modeling simplifications employed to reduce complexity and to control the scope of the modeling effort.

The response spectrum method of analysis is widely used for the seismic assessment of highway bridges of typical span and configuration. For such structures, the simplicity and relatively low cost of the method justifies its use, and the method yields sufficiently accurate results. For large, multi-span bridges of unique configuration for which retrofit costs may be large, other more refined analysis techniques may be necessary. The Interstate 5 bridge over the Columbia River may represent the latter case.

With regard to the overall analysis results, we feel that refinements in the geotechnical data/analyses would likely have the greatest effect. For any given set of geotechnical data, several advanced analysis techniques are available which can improve the validity of the results.

The response spectrum used for the assessment of this bridge is defined at rock with a rudimentary adjustment applied to model the site response effects. For analysis, the adjusted spectrum is applied at the base of the piers which are supported by non-coupled linear spring elements representing the foundation piles. The computed pile stiffnesses are based on a single level of applied loading for the idealized soil profile assumed for the analysis. The non-linear response of the soil is ignored as is the coupling of pile stiffnesses.

One simple refinement is to apply the fully coupled spring elements representing the estimated pile group stiffness to the response spectrum model. With more accurate data available, it is possible to more precisely assess the (secant) stiffness of the pile group at the expected magnitude of lateral load.

Methods using the program SASSI (finite element analysis) and soil-structure interaction are available. These methods can develop time histories at the base of the piers by using super-elements for the structure-in-soil model. Then, time-history analysis of the superstructure can be used to obtain member results.

To more accurately assess the site response to the rock level spectrum, we can also use one-dimensional soil column models (SHAKE). With this method, as with SASSI, it is also possible to consider the spatial variation of site input along the bridge.

There are foundation models for pile groups (Martin) that present a non-linear spring for 'yielding' pile groups, giving a hysteresis loop type model for the pile group and a residual set for piles. It is possible that the non-linearity of the model might lower the overall response. Such an evaluation requires a non-linear time-history analysis. In the alternative, we could run a piecewise linear push analysis using the pile group stiffness to assess the capacity of the foundation against ductility demand (displacement assessment).

The use of non-linear time-history analysis also presents an opportunity to more accurately model the stiffness behavior of the superstructure including the pendulum behavior of the counterweight and the tension-only behavior of the truss bracing elements.

While all of the options mentioned will result in a model which more accurately reflects the actual conditions, there is unfortunately no way to predict the effect these changes would have on the present results. Overall computed response could be lowered or raised.

Substructure strengthening

In our opinion, foundation retrofit is likely to be the most expensive single aspect of the retrofit scheme. The lack of pile capacity (especially uplift capacity) to resist longitudinal overturning is the most critical aspect to be addressed. Typical retrofit for foundations is to surround the existing foundations with new shafts/piles, etc. This will be difficult under field conditions and with the necessity of maintaining both marine and vehicular traffic. Large cofferdams will likely be required which could effect the navigation channel. As an alternative in this case, it may be advantageous to have a geotechnical engineer look into soil grouting or ground modification in-situ to engage granular soils. Innovative procedures in this regard could result in large savings.

For the piers, the lack of ductility in the existing columns is the most significant issue. The columns of the southbound bridge appear to be more critical than those of the northbound as a result of their smaller diameters in the lower portion of the shaft. Typical retrofit for isolated columns is to provide some external confinement to the column concrete by jacketing or wrapping the column. Several schemes have been developed in recent years. In this case, a heavily reinforced cast-in-place shell could be installed surrounding the existing column. The construction of this shell would be similar in concept to the column/pier enlargements applied to the northbound piers during the modifications undertaken after construction of the southbound bridge. The need for additional reinforcement of the northbound columns could be reassessed by recomputing the demand in the piers after retrofitting the southbound columns. The northbound columns were nearly adequate for the elastic demand. The increased stiffness of the southbound columns may draw enough load from the northbound side to permit the existing northbound columns to remain in place without additional modification. If this is not possible, column reinforcement for the northbound columns of pier 4 (and piers 6-9) may be applied in a similar manner, but this could be complicated by the earlier modifications to the NB columns.

Bearings

The design seismic event subjects the bearings to large horizontal shear forces and transverse moments which obviously were not envisioned by the original designers.

Likely modes of failure are non-ductile shear failures in the pin plates and in the anchor bolts. Failure of the pin plates leads to a complete lack of transverse moment resistance at the pin and could lead to the truss jumping off of the bearing. Failure of the anchor bolts could result in the bearings sliding off of the base with unknown consequences. Other modes of failure could be identified upon in-depth review of the bearing details.

The large seismic forces dictate a detailed analysis and redesign of the bearing components to increase the bearing strength and/or to limit the potential for bearing collapse. The detailed analysis should consider the flexibilities and strengths of the bearing components both before and after retrofitting. Note that the actual flexibilities of the components may effect the results of the seismic analysis. The local distribution of forces within the bearing assembly and in neighboring members will likely change; the overall forces could change.

At a minimum, we recommend that these bridges be retrofitted at all bearing locations with some type of "restrainer" and catch-block system that will limit the horizontal movements of the trusses relative to the bearings and of the bearings relative to the piers.

Superstructure

The first priority for superstructure retrofitting should be tower-diagonal members F4-R5 and F3-R4, which experience large forces caused by the counterweight mass in its normal raised position. The axial forces from the three-dimensional multimodal seismic analysis are large enough to cause Euler buckling in these members, which could in turn cause progressive collapse of the tower. This situation is made more serious by the fact that the main tower verticals at the level of these diagonals are also overstressed.

Also a high priority is providing adequate bracing of the portal crossframe bottom chords at the ends of Spans 2 and 4. Loss of support provided by these members would significantly decrease the buckling resistance in portal frame members L0-U1 and L0'-U1', whose D/C ratios for buckling already hover around 1.0. The portal frame truss members carry the full top chord compressive forces due to dead and live loads. In addition, a major portion of the lateral seismic forces on the truss top chord are transferred to the bearings through these members in transverse bending and shear.

Third priority should be the truss verticals at panel points 2, 2', 3, and 3' (all spans), the main tower verticals L0-U0, and other tower truss members with D/C ratios greater than one. Although the demand:capacity ratios are not extremely high, the failure mode - buckling due to combined bending and axial compression - is undesirable. We do not believe the bending moments in these members can be safely dismissed, as there is no alternate load-carrying mechanism for transverse (east-west) seismic forces.

Finally, the bottom lateral diagonals in all three spans should be strengthened. Failure is in tension for the lateral diagonal members, so member areas should be augmented.

Several east truss bottom chord members in spans 2 and 4 have D/C ratios greater than 1.0. The tension forces considered in the review were not adjusted for the presence of the deck diaphragm (see discussion regarding the bottom lateral bracing). We expect the actual demand in these members to be well within the member capacity.

The retrofit considerations should be expanded to consider the truss connections. Connection details and stresses are not considered in this review.

Northbound Structure

General observations

The northbound substructure has been modeled and included in the analysis and review. Retrofit considerations relative to the substructure have been discussed previously.

The northbound superstructure has not been explicitly modeled in the analysis. It is represented in the full model by equivalent beam members with properties based upon the southbound truss properties.

The chord-to-chord width of the northbound truss spans is 41'-0", 4'-5" narrower than the southbound truss. Otherwise, the member layout of the northbound superstructure is generally similar to that of the southbound. There are some significant differences in details such as built-up member construction, bearing details, counterweight details, top of tower framing, etc. Notwithstanding these differences, it is reasonable to conclude that the seismic demand in the northbound truss is on the same order as the southbound. Subject to review of individual member capacities, we expect that northbound superstructure retrofit considerations would be similar to the southbound truss requirements.

Miscellaneous

Observed pier 1 conditions

All analysis and review has been conducted on the basis of the plan specified boundary conditions. However, during our visits to the bridge, we observed evidence of residual substructure displacement at pier 1.

Pier 1 supports the north ends of the span 2 tower spans and the south ends of the short end spans. The truss spans are supported by expansion bearings at pier 1 with fixed bearings at span 2. The northbound expansion bearing consists of a set of rollers. The southbound expansion bearing consists of a single steel rocker bearing. The north ends of the end spans are supported by the north abutment(s). The northbound end span consists of steel plate girders with (apparently) fixed bearings at both ends of the span. The southbound span consists of concrete t-beam construction with fixed bearings at the north abutment and steel rocker bearings at pier 1.

The groundline slopes from the north abutment to about 4' below the bottom of the cap beam on the north side (land side) of pier 1. A roadway runs adjacent to the south side (river side) of pier 1 and crosses under the truss span. The surface of the roadway shoulder adjacent to the river side of the pier is about 10' below the bottom of the cap beam.

The truss bearings are offset significantly from their neutral position toward the center of the pier (away from the river). This is evidenced by the tilt of the rocker bearings and by the large deformation of the anchor bolts in the northbound span. We note that the deformation of the anchor bolts shows evidence of having been there for an extended period of time. Conversely, the end span bearings are also offset toward the center of the pier as evidenced by the tilt of the southbound end span rocker bearings and by the significant cracks at the north side of the base of the northbound end span pedestals. Both the northbound and the southbound expansion joints are solidly closed and there is obvious contact between the truss spans and the end spans. As a result of the relative displacements, span 2 and the end span of both roadways are effectively fixed at both ends.

In our opinion, the visible evidence suggests that both the north abutment and pier 1 have experienced some permanent movement towards the river. Apparently, the north abutment has moved somewhat more than pier 1. The alternative explanation is that thermal expansion of both spans has been large enough to close the designed expansion joint gaps and to crack the pedestals under the northbound end span. The air temperature on the first day of inspection was about 75-80 degrees. At the time of our second visit the air temperature was about 65-70 degrees. Thus, excessive thermal deflection seems unlikely.

Under the observed conditions, it is possible that the superstructure is now functioning to restrain/limit further movement of the north abutment and pier 1 with relief only available through flexibility of pier 2. It is difficult to predict the stress that may be presently locked into the superstructure as a result of this condition.

In order to restore the plan specified freedom to the structure, we recommend that a plan be developed to verify the source of the displacements and to determine appropriate corrective action.

Counterweight conditions

The counterweight systems for both bridges include a number of supplementary weights utilized to balance the lift span dead load. The supplementary weights on the southbound counterweights consist primarily of large (roughly 1.5' square by 6' long) concrete blocks stacked on the top of the counterweight. The upper tier of blocks is estimated to be at least 5' above the lip of the 6" curbing around the top of counterweight. There is no containment system for the loose concrete blocks. In our opinion, it is likely that the loose blocks will begin to "walk" during shaking of even moderate magnitude. Banging of the counterweight against the tower legs will increase this tendency. Sustained shaking or shaking of large magnitude could cause blocks to fall off of the top of the counterweight down onto the roadway surface below. We recommend that a block containment system be developed and installed to avoid the potentially disastrous consequences of this situation.

Conversely, the supplementary weights on the northbound counterweight consist primarily of thick steel plates set in cavities recessed in the top of the counterweight. All weights are contained within the limits of the counterweight and should be stable in a seismic event. A possible concern with regard to the northbound counterweight is general deterioration due to its age. An example of this is the vegetation growing out of spalls in the south face of the south counterweight. Other spalls/cracks are visible. The timber blocks located under the counterweight also show visible evidence of deterioration. Although these conditions may not be serious at this stage, it is difficult to assess the competency of the counterweight shell when subjected to the hammering which is possible during a significant seismic event. We recommend that the northbound counterweight be inspected to better ascertain the structural condition of the counterweight supporting shell/skeleton.

Summary of review

Spans 2, 3 and 4 together with piers 1-4 of the Interstate 5 crossing over the Columbia River are reviewed for strength and ductility demands during a significant seismic event. This analysis and review is a "level of effort" task with the scope of evaluation defined to fit within the available budget in our existing stand-by agreement with ODOT.

The structure is analyzed by the multi-modal response spectrum technique utilizing an input elastic response spectrum provided by ODOT and modified to adjust for site response effects. Site specific geotechnical and seismological data are unavailable for this review. An idealized soil profile is assumed based upon information provided for a bridge located on the far side of the river.

Due to budget limitations, superstructure analysis and review is limited to the southbound truss spans. Several simplifications to the 3-D model are made to reduce complexity and to control the scope of the modeling effort.

Critical major components of the structure are identified based upon the results of the demand/capacity evaluation. Where applicable, assessments of progressive yielding or other behaviors that may be expected to modify the analytical results are identified and incorporated. Options for seismic retrofit of critical components are identified and discussed.

Based upon the results of this analysis, the following components are identified as requiring retrofit:

- All piers are founded on relatively short timber piles. The piles are significantly overloaded due to the design seismic event. Pile uplift is considered to be a serious condition. Pile compression and shear capacity is also exceeded.
- Pier columns are loaded beyond the elastic capacity in flexure. The elastic demand/capacity ratio is not excessive, but the lack of sufficient transverse reinforcement limits the available ductility.
- Truss bearings are overloaded. Anchor bolt shear and tension failures are likely and could lead to the truss sliding off of the bearings and/or piers. Other components of the bearings require strengthening also.
- Various truss members are identified as exceeding the available elastic capacity. Truss members which are subject to local buckling or which form a part of a critical load path or which provide essential stability to the structure should be strengthened. These include:
  - Tower members in the area of counterweight contact,
  - Bottom chords of the portal sway frames,
  - Several vertical posts in the primary trusses,
  - Primary truss bottom chord lateral bracing system.
- Other truss members have demand/capacity ratios marginally over 1.0, but we do not judge these to be critical.

The review of the trusses is limited to the evaluation of gross member strengths. Compression member strengths have been computed assuming an effective length factor for buckling of 1.0 for all members. Member connections and other details have not been reviewed. The review does not consider the operability of the mechanical lift span equipment after a seismic event.

Relative displacements between the trusses and the piers at the expansion bearings are computed and identified. The computed displacements are observed to be within the normal displacement capacity of the existing bearing mechanisms.

Recommendations

The anticipated next phase of work is to use the information developed here to formulate a detailed retrofit program for critical elements of the bridge. The following discussion outlines the work which we believe is necessary to devise a safe and cost-effective solution.

Additional data input

We expect the retrofit of the substructure to be the most costly item of the rehabilitation scheme. Therefore, it makes sense to concentrate resources in this area. Geotechnical and seismological data and assumptions are key to this task and can have significant effects upon the analysis. The current analysis indicates that the dynamic response of the structure is sensitive to the geotechnical assumptions. The relative stiffnesses of the dissimilar southbound and northbound foundations are important to both the overall response of the structure and to the local distribution of forces within the structure.

Considering the lack of available quantitative data and the importance of this structure, we recommend that an experienced geotechnical engineer be engaged to develop an exploration program which will define the existing physical conditions at the site including engineering characteristics of the existing soil and the existing groundline elevations around the piers. Groundline elevations are required to establish the stiffness behavior of the massive foundation units and to assess the passive resistance available to offset the predicted seismic demands. Accurate data will make it easier to establish realistic bounds on the foundation stiffnesses. The data gathered will establish the essential criteria necessary to perform the dynamic analysis with increased accuracy and confidence.

We also recommend that an analysis be made of the potential for soil liquefaction due to the design seismic event at the site. By agreement with ODOT staff, the current review did not consider this mode of behavior. An assessment using the conservative geotechnical properties which were assumed for this review indicates some potential for liquefaction. The options available/required for retrofit of the foundations would be strongly affected by this mode of failure.

Substructure retrofit must address both the southbound and the northbound units. We also anticipate that the department will wish to address the northbound truss spans concurrently with the southbound. It is desirable to obtain additional data regarding the northbound structure to augment the data gathered to date. Specifically, pier column reinforcement details are not clear on the original plan sheets that we have recieved and additional data relative to the northbound truss details and materials will be helpful if available.

Analysis

Before proceeding to the final design and drawing of retrofit details, we believe that further analysis is required.

At a minimum, the updated geotechnical information should be incorporated into the existing response spectrum analysis. Concurrently, refinements to the analysis model could be made to improve the assessment of critical areas identified in this report. These refinements would include the modeling of the deck-floorbeam-bottom lateral system and the counterweight detailing. Refinements in the modeling of the bearing details could also be useful. It is anticipated that full modeling and review of the northbound truss spans would be required before finalizing the retrofit design.

Truss connections have not been reviewed in this report. A necessary part of the next phase of the retrofit design will be to review and identify critical connection details for the expected seismic demands.

The details of this structure are such that an elastic response spectrum analysis can not consider. In addition to or in place of the necessary analyses identified above, there are several refined analytical techniques available which could be utilized to more precisely and confidently define the displacement and force demands on this unique structure. These techniques include advanced soil-structure interaction analyses, site response analyses to better define the seismic input at the level of the structure and the use of time-history analyses which permits the consideration of the non-linear behavior of several major components of this structure. Evidence gathered in other investigations suggests that the consideration of the generally more flexible non-linear behavior may reduce the overall dynamic forces on the structure. Although there is no assurance that the results will be lowered by such analyses, we believe that the use of these techniques can better describe the overall response of the bridge. Selected specific techniques are discussed in the retrofit section of the report.

In general, these advanced techniques of analysis are expensive and are often not justifiable for typical bridges. However, in our opinion the importance of this structure and the anticipated high cost of retrofit options warrants an in-depth consideration of such techniques.

At this point in the investigation, a decision should be made regarding the minimum acceptable level of analysis with regards to the relative positions of the lift span and the counterweight. Section 2.1.15 of the AASHTO Standard Specifications for Movable Highway Bridges requires consideration of the seismic load for both the open and closed positions. For movable spans which are in one position over 90% of the time, the specification permits the use of one-half of the seismic load in the lesser used position. The current analysis considers only the open to vehicular traffic configuration which is the normal position for this crossing.

Finally, we recommend that the analysis be extended to consider a greater portion (or the remainder) of the structure. While we expect that the results of the truss investigations of spans 2, 3 and 4 would be generally applicable to the other similar length spans, we believe that the 531 foot main spans warrant separate review. In addition, differences in substructure heights and dimensions can generate different response.

Retrofit design

Having established an analytical baseline, it is possible to begin the selection and design of component retrofit options. The designer must recognize that the retrofit details can and often do effect the subsequent response of the structure to dynamic loading. It is important to assess each option in terms of its effects upon the entire system. A recommended procedure is listed as follows:

- prioritize the elements needing retrofit.
- estimate retrofit requirements of the highest priority item(s) based upon the current analysis.
- identify retrofit options for the element.
- prepare conceptual retrofit designs for the elements in sufficient detail to estimate their relative costs and to assess their effects upon the remainder of the system before proceeding to the next level of priority. This would typically require the

incremental modification and review of the analytical models to correspond to the retrofitted details.

- Continue the procedure until all critical items have been addressed at the conceptual level. Depending upon the incremental analytical results, iteration may be required to reach a safe and cost-effective systemwide solution.

At this stage, detailed design and preparation of the plans, specifications and estimates for the retrofit may proceed.

For this bridge, the predicted seismic loads on the piles and the truss bearings exceed the available capacities. Failure of either component can lead to collapse of the bridge. While updated and/or refined analysis of the current models can be expected to change the computed demands, we judge it unlikely that changes would be sufficient to eliminate the need for strengthening of these components.

Details to increase the strength of the foundations will likely increase the stiffness of the foundations. The change in foundation stiffness may be significant enough to effect the overall response of the structure. Likewise, bearing retrofit options that change the stiffness or restraint conditions (such as isolation bearings) might also have an effect upon the overall response of the structure.

Therefore, we recommend that retrofit options for the foundations and the bearings be established and evaluated before proceeding to the detailed retrofit design of the piers and the trusses.

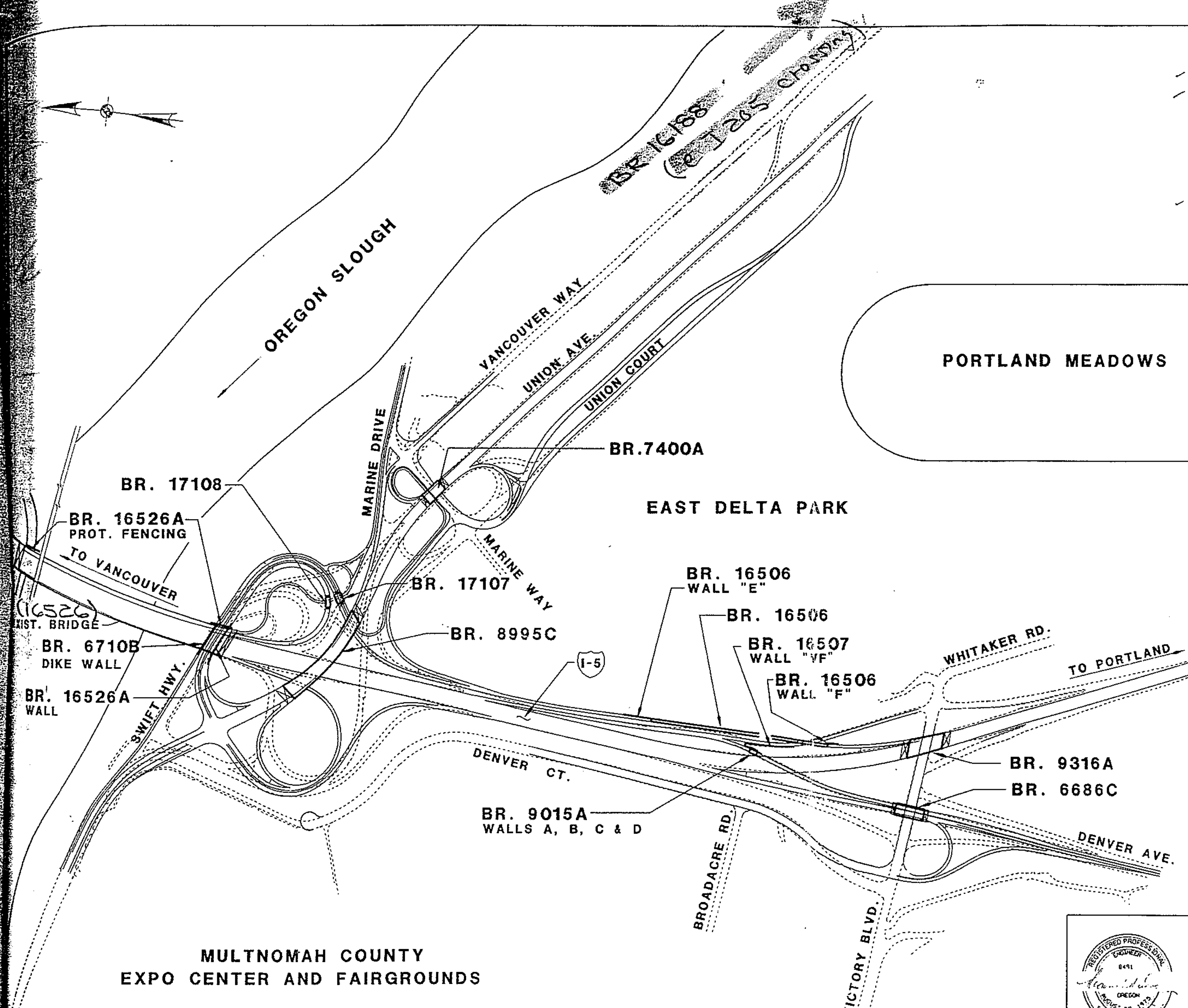
We recommend that foundation retrofit be considered as the highest priority as changes in the foundation are likely to have the largest effects upon the response of the remainder of the structure.

If an incremental approach to the design and construction of the component retrofit schemes is required due to program budgetary constraints, we recommend that bearing retrofit be considered as top priority since it will repair a very weak link in the bridge at relatively modest cost (as compared to the foundation retrofit). The bearing retrofit is less likely to have a significant effect upon the overall response of the bridge. In this scenario, the foundation retrofit should be developed sufficiently enough to assess the range of foundation stiffnesses and incorporated in the analytical model to lessen the likelihood of later having to revise the bearings once again.

For the final retrofit design of the trusses, a more refined analysis of the buckling strength of certain critical members is recommended. These members are the portal frame end posts which provide the transverse stability to the top (compression) chord system. These members are unbraced and subject to sidesway. The buckling strength (as expressed by the effective length) of these members depends upon the fixity provided by the portal truss at the top and by the floorbeam truss at the bottom. The effective length (KL_b) for transverse buckling of these members is greater than or equal to the unbraced length between the bottom chord of the portal truss and the top chord of the floorbeam truss. In other words, the effective length factor, K, is greater than or equal to 1.0. K is equal to 1.0 only if full flexural fixity is provided at the ends of the unbraced length. In reality, this is not possible and K will be somewhat greater than 1.0. For our review, we used K = 1.0 with a length equal to the distance from the bottom chord of the portal truss to the work point at the intersection of the bottom and top chords. This length is about 5' longer than the actual unbraced length. Note that this is the procedure used on all of the vertical posts of the primary trusses. The interior posts are not as critical to the stability of the overall system as the portal frame posts.

Appendix

All supporting sketches, tabulations and calculations are included in the appendix in approximately the order addressed within the body of the summary.



GENERAL PLAN

NO SCALE

NOTE:

LOCATION OF SIGN STRUCTURES AND ATTENUATORS NOT SHOWN ON THIS SHEET.

Structure Name	Bridge No.	Drawing Numbers
Union Ave. U'Xing	8995C	45721-45739
"FE" Off-Ramp Viaduct & Ret. Wall E & F	16506	45740-45765
Denver Ave. N.B. On-Ramp O'Xing Rigid Frame Extension Including Ret. Wall A, B, C & D	9015A	45767-45775
O'Xing of Victory Blvd. Br. Widening	9316A	45777-45787
Denver Ave. O'Xing Victory Blvd. Br. Modification	6686C	45789-45793
Union Ave. O'Xing Marine Way	7400A	45795-45801
"FE" Off-Ramp O'Xing Bikeway	17107	45803-45806
"SV" On-Ramp O'Xing Bikeway	17108	45807-45810
"VF" Ret. Wall	16507	45811
"SV" Retaining Wall	16526A	45812-45817
Oregon Slough Br. Bikeway Protective Fencing	16526A	45818-45819
Dike Retaining Wall Extension	6710B	45820
Attenuators	17109	45821-45822
Sign Structures	16508	45823-45827 45828-45831 46319-46323
Bridge Standard Drawings		29728, 30937, 30938, 30939 30940, 31275, 31600, 31724 34896, 34903, 34948, 34949 34959, 36857, 40050, 40396 40398, 40565, 40570, 43422 43495, 43496, 43533, 44636 43855
For Information Only		45673
Bridge Related Roadway Standard Drawings		2127, 2131

NOTE

THE SCALE OF THIS PRINT IS ½ THAT OF THE ORIGINAL DRWG. FOR EXAMPLE INDICATED SCALE 1"=10'-0" SHOULD BE READ 1"=20'-0"

DATE	REVISION	BY

REGISTERED PROFESSIONAL ENGINEER 8491 OREGON THOMAS D. LULAY

BRIDGE ENGINEER

APPROVED: ______ PE
BRIDGE ENGINEER

DESIGNED

JEFFREY LANNIGAN
DRAWN

CHECKED
K. A. ______
REVIEWED

REVIEWED

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

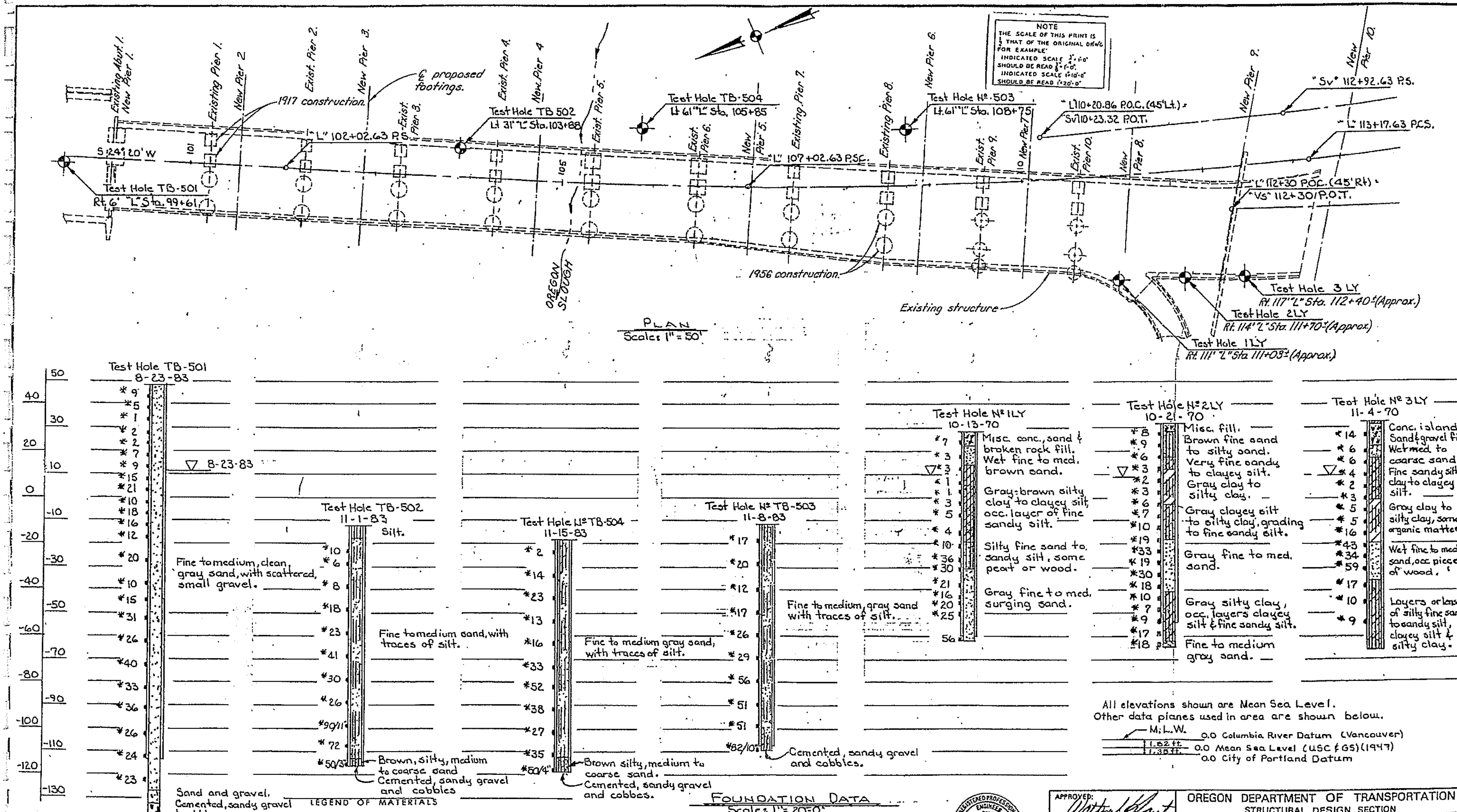
SWIFT INTCHGE.-DELTA PARK INTCHGE. SEC.
PACIFIC HIGHWAY (I-5)
MULTNOMAH COUNTY

GENERAL PLAN & INDEX

ACCOMPANIED BY DWGS. SEE ABOVE

DATE APRIL 1989 CALC. BOOK — SHEET 1 OF 137

BRIDGE NO. SEE ABOVE DRAWING NO. 45720



LEGEND OF MATERIALS

Gravels, cobbles and boulders.	Silts.	Silty gravels, gravel-silt mixture.	Clayey gravel, gravel-clay mixture.
Silty clay.	Shale.	Basalt rock, broken, solid, weathered, lava.	
Sand.	Clays	Silty sand, sand-silt mixture.	Clayey sand, sand-clay mixture.
Sand-silt-clay mixture, near equal proportions.	Sandstone.		

∇ Elevation ground water encountered.
* Standard Penetration test.
** Oregon Miniature Pile test.
RQD = Rock Quality Designation
U = Undisturbed Sample
C = Core Sample

Foundation data shown on this drawing, in some instances, is a consolidation of and a revision in terminology from the original field drilling logs. The original field drilling logs are available for review through the office of the Structural Design Engineer in Salem.

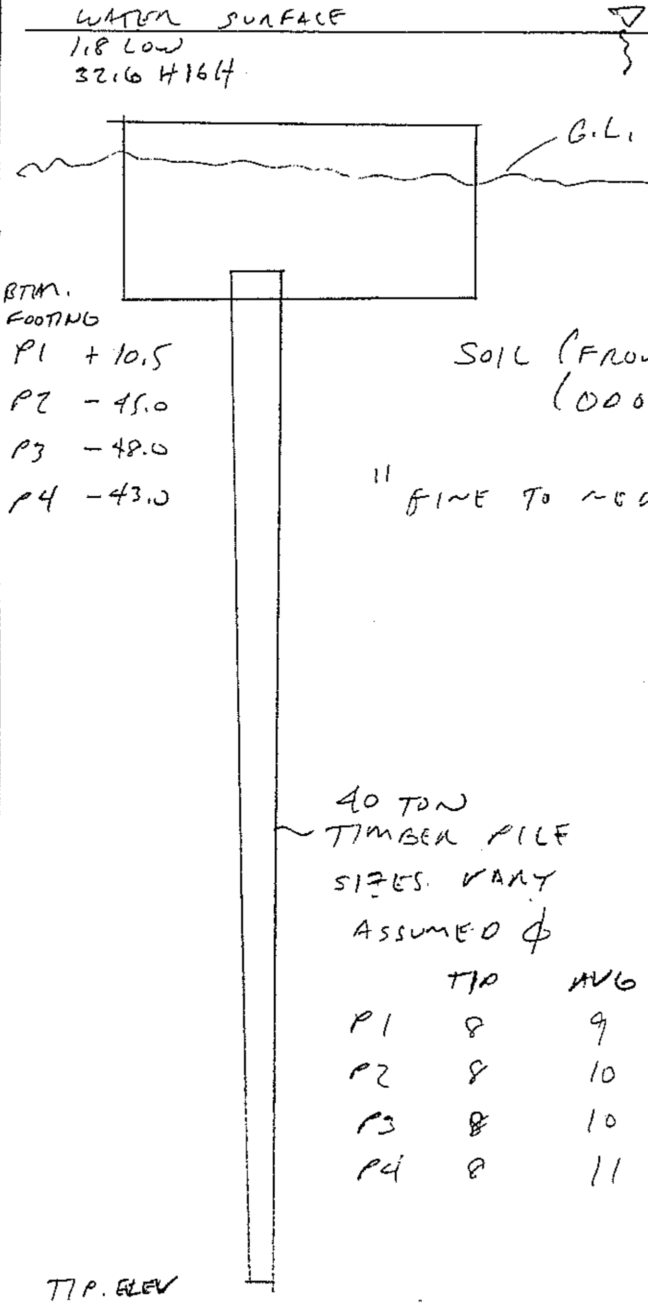
REGISTERED PROFESSIONAL ENGINEER — OREGON — JULY 14, 1978 — JOHN R. MARKS

John R. Marks

APPROVED: Walter Hart	OREGON DEPARTMENT OF TRANSPORTATION STRUCTURAL DESIGN SECTION
STRUCTURAL DESIGN ENGINEER	OREGON SLOUGH BRIDGE
DESIGNED J.J.D.	
DRAWN G.C.	
CHECKED	
REVIEWED	
REVIEWED	
CALC. BOOK	
DATE / REVISION	FOUNDATION DATA
DATE 12-12-83	SHEET 2 OF 136
BRIDGE NO. 16526	DRAWING NO. 39602

DGES CONSULTING ENGINEERS OLYMPIA, WASHINGTON 206-754-0544	Project: ODOT - I5 Date: 9/15/94	Proj # 4504.08
	Subject: SUBSTRUCTURE Engr: GS	Page Rev. Ref.

WATER SURFACE
1.8 LOW
32.6 HIGH



G.L.

ESTIMATED
@ ℄ PIER
P1 = +22'
P2 = -28'
P3 = -30'
P4 = -30'

FROM 12347

BTM. FOOTING
P1 +10.5
P2 -45.0
P3 -48.0
P4 -43.0

SOIL (FROM OREGON SLOUGH BRIDGE)
(ODOT DRAWING 33602)

"FINE TO MEDIUM GRAY SAND WITH TRACES OF SILT"

D	N MIN.	N AVG
7	2	10
17	6	13
27	8	11
37	13	16
47	16	22
57	29	34
67	30	46
77	26	38
87	27	59

40 TON
TIMBER PILE
SIZES VARY
ASSUMED ϕ

	TIP	AVG	TOP (@FTG)
P1	8	9	10
P2	8	10	12
P3	8	10	12
P4	8	11	14

TIP. ELEV
P1 = +1.3
P2 = -67.2
P3 = -65.6
P4 = -91.5

* PIER 1 HAS BEEN FILLED BEHIND TO APPROX 6' BELOW TOP OF CAP (OR ≈ +27'); THERE IS A DEPRESSED ROADWAY IN FRONT OF PIER; ELEV. ≈ +21'

FAX MESSAGE

To: Steve Starky
Oregon DOT
Salem, Oregon

From: Bob Youngs
Geomatrix Consultants
San Francisco, Calif. USA

Fax No: 1-503-378-3740

Date: August 4, 1994

Subject: **Portland Spectra**

==

Dear Steve:

The following are the computed equal-hazard spectra for the Portland site, latitude 45° 30'30.3" N, longitude 122° 40' 14.0" W. These spectra are for the reference rock site condition.

	5%-damped Spectral Acceleration (g)		
Period	500-yr	1,000-yr	5,000-yr
0.03	0.197	0.274	0.501
0.10	0.390	0.545	1.031
0.20	0.444	0.626	1.212
0.30	0.388	0.542	1.062
0.50	0.294	0.402	0.765
1.00	0.151	0.197	0.369
2.00	0.059	0.083	0.174
3.00	0.033	0.047	0.092

The first attached plot shows the spectra. The second and third attached plots show the contributions of the three source types (interface, intraslab, and crustal) and the relative contributions of various magnitudes to the hazard at PGA, 0.3 and 2,0 seconds. Please call if there are any questions.

Sincerely,

Bob Youngs

Bob Youngs

3 Figures attached

RECEIVED
AUG - 4 1994
BRIDGE DIVISION

RESPONSE SPECTRUM
PORTLAND AREA
PROPOSED FOR USE ON I5-COLUMBIA RIVER SEISMIC SURVEY

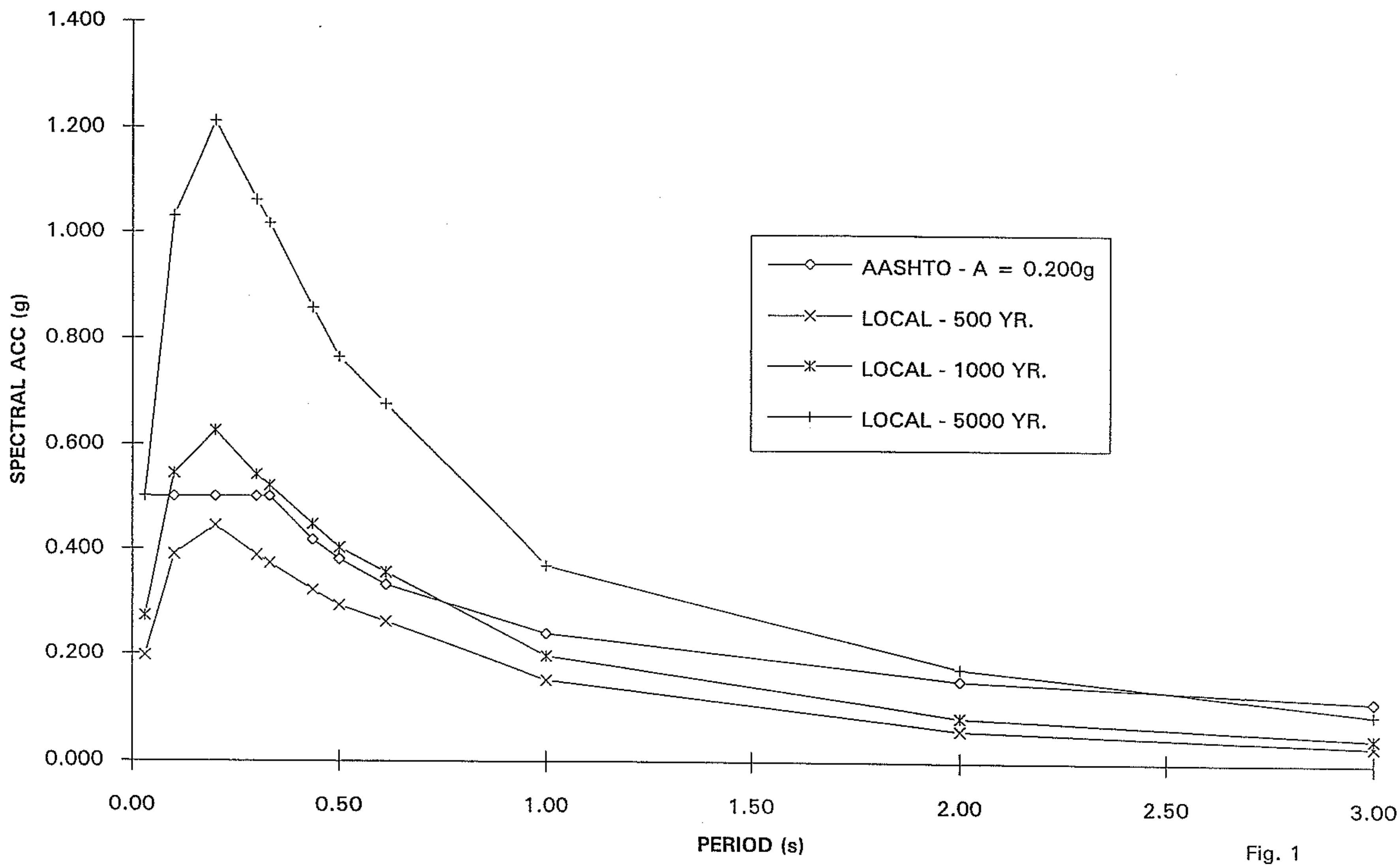


Fig. 1

RESPONSE SPECTRUM
PORTLAND AREA
PROPOSED FOR USE ON I5-COLUMBIA RIVER SEISMIC SURVEY

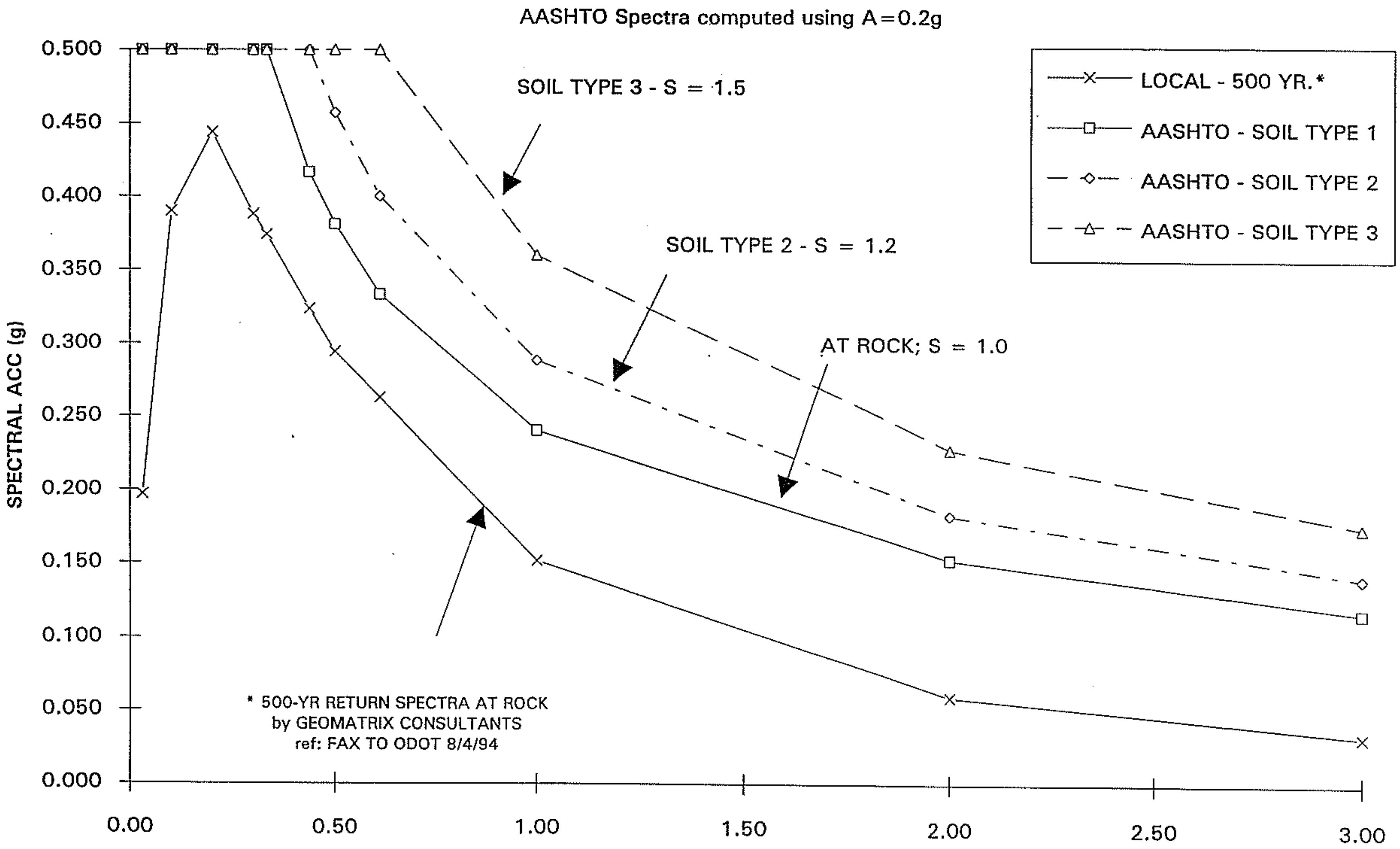


Fig. 2

RESPONSE SPECTRUM
PORTLAND AREA
PROPOSED FOR USE ON I5-COLUMBIA RIVER SEISMIC SURVEY

AASHTO Spectra computed using A=0.2g

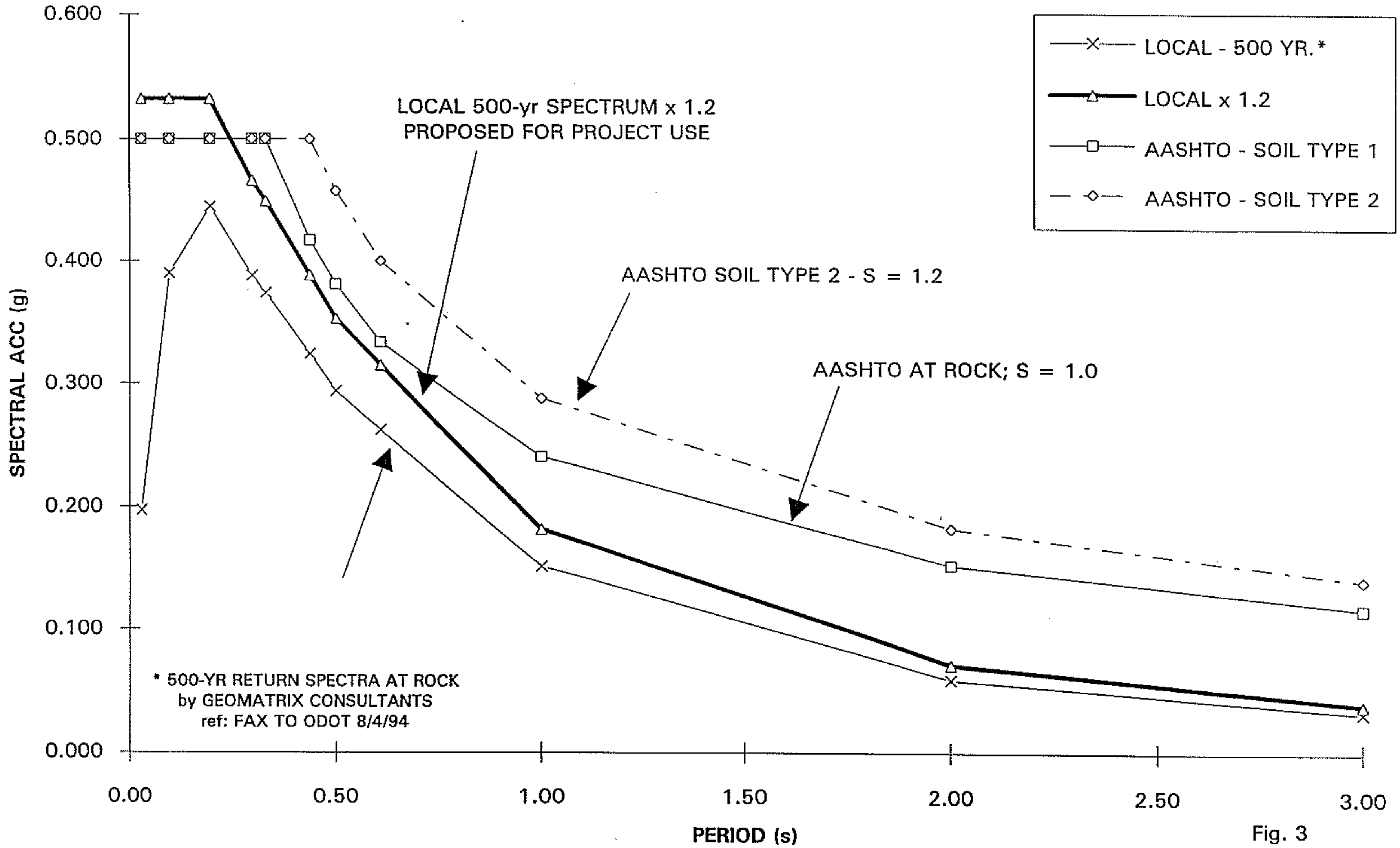
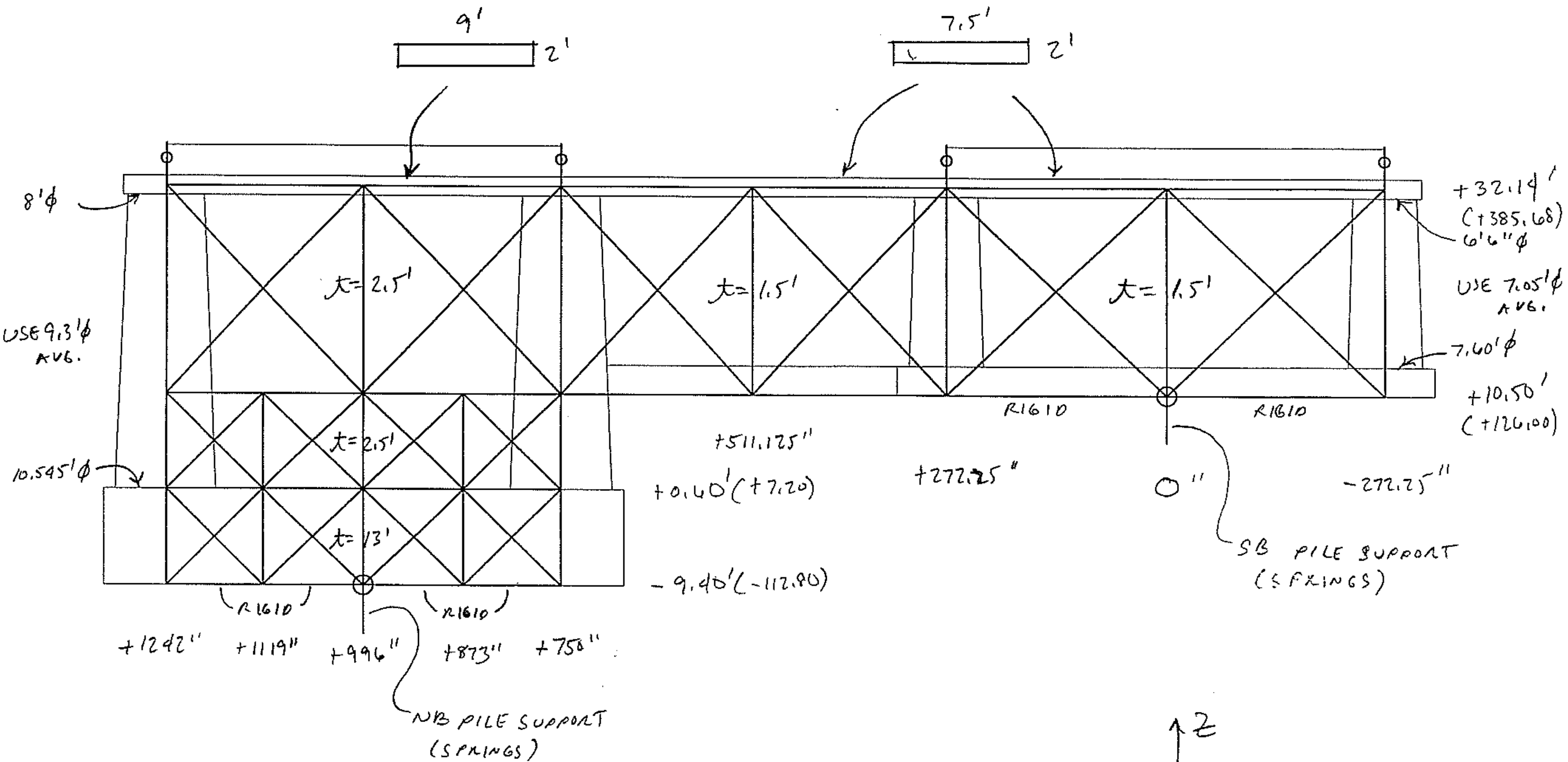


Fig. 3

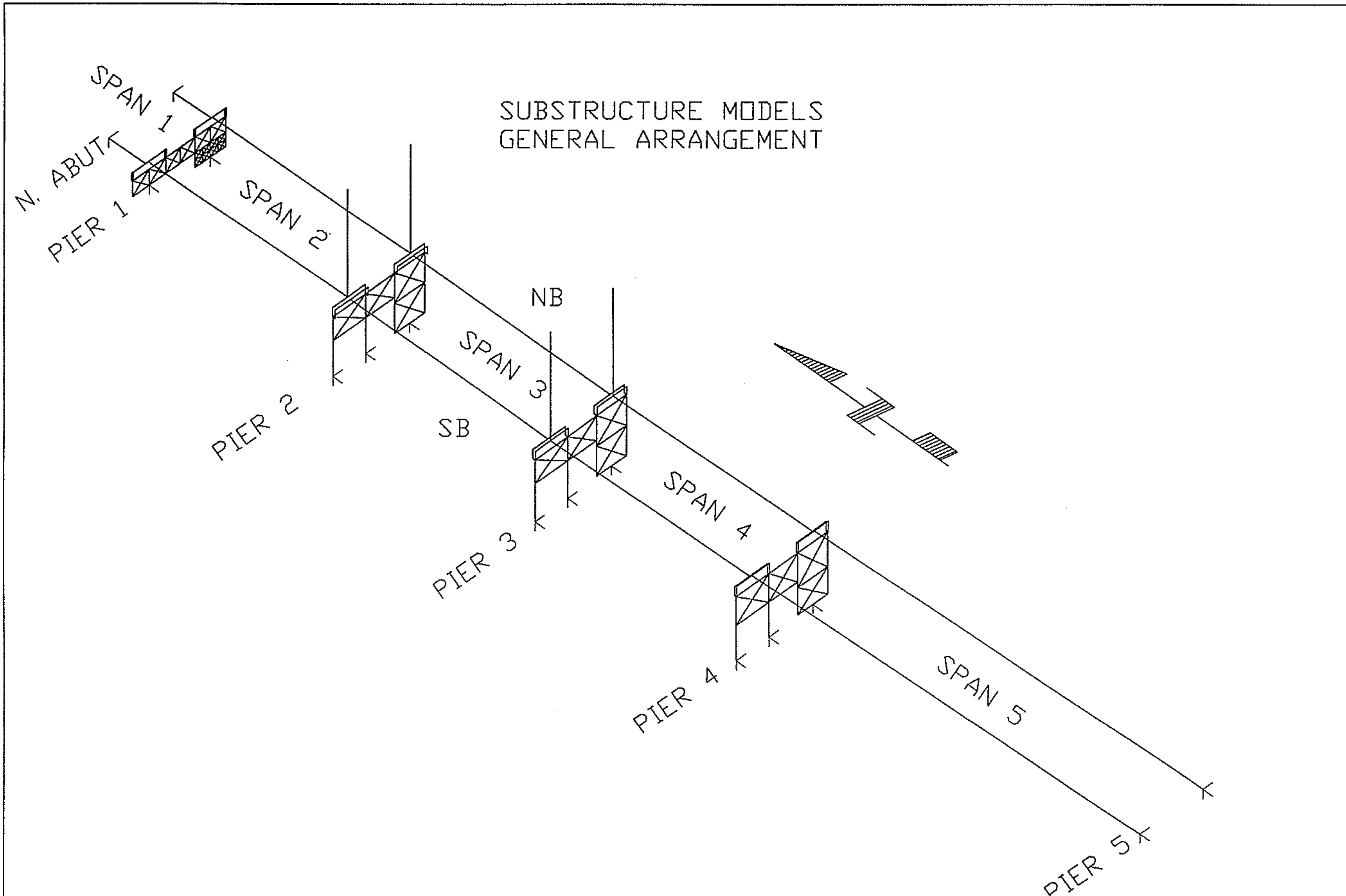
ODOT - SR5 COLUMBIA RIVER
SEISMIC ASSESSMENT

RESPONSE SPECTRUM ANALYSIS
EFFECT OF INCLUDING Z (VERTICAL) COMPONENT
DATA FROM MODEL S4FLEX (SPAN 4 TRUSS ON FLEXIBLE SUBSTRUCTURE)
UNITS = LB

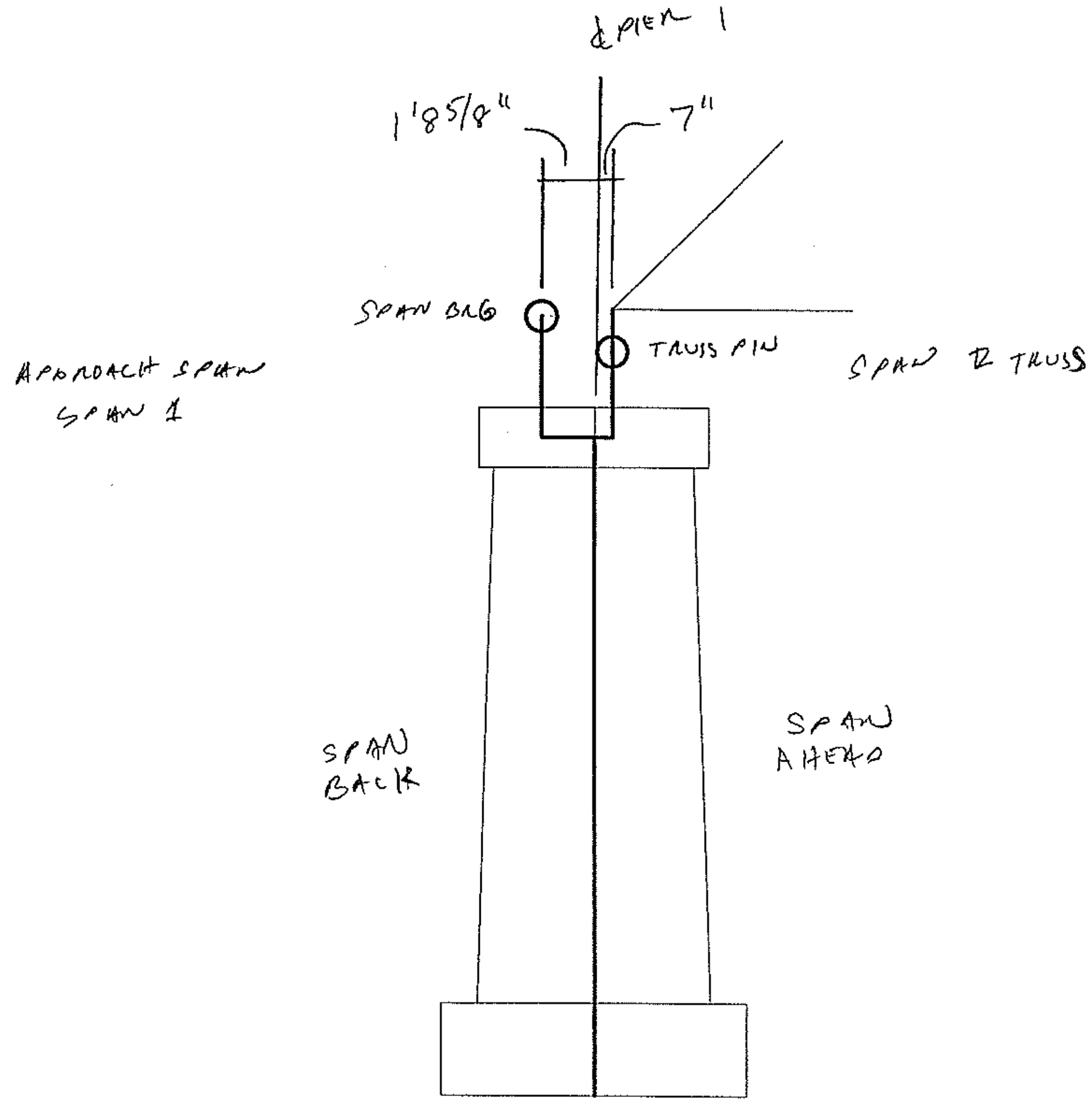
DESCR	TOWER VERTICAL	TOWER FRONT DIAGONAL	TOWER REAR DIAGONAL	TOWER SIDE DIAGONAL	BOTTOM DIAGONAL	BOTTOM CHORD
MEM	SW4084 41	SF4505 86	SR4401 416	SW4061 107	SB4206 210	SE4024 196
EQX (Z = 2/3)	439680	23936	36044	55516	258813	453398
EQX (Z = 0)	365462	22994	29303	45323	222604	374371
Z ADDS:	74218	942	6741	10193	36209	79027
% INCREASE	20.3%	4.1%	23.0%	22.5%	16.3%	21.1%
EQY (Z = 2/3)	487333	58125	66699	44190	479509	629898
EQY (Z = 0)	430907	57694	62115	33890	456367	551120
Z ADDS:	56426	431	4584	10300	23142	78778
% INCREASE	13.1%	0.7%	7.4%	30.4%	5.1%	14.3%


9'
2'
7.5'
2'
8'ϕ
USE 9.3'ϕ AVG.
10.545'ϕ
t=2.5'
t=1.5'
t=1.5'
t=2.5'
t=13'
+32.14'
(+385.68)
6'6"ϕ
USE 7.05'ϕ AVG.
7.60'ϕ
+10.50'
(+126.00)
RIGID
RIGID
RIGID
RIGID
+511.125"
+0.60'(+7.20)
-9.40'(-112.80)
+272.25"
0"
-272.25"
SB PILE SUPPORT (SPRINGS)
+1242"
+1119"
+996"
+873"
+750"
NB PILE SUPPORT (SPRINGS)
Z
Y
X

PIER 1
MODEL

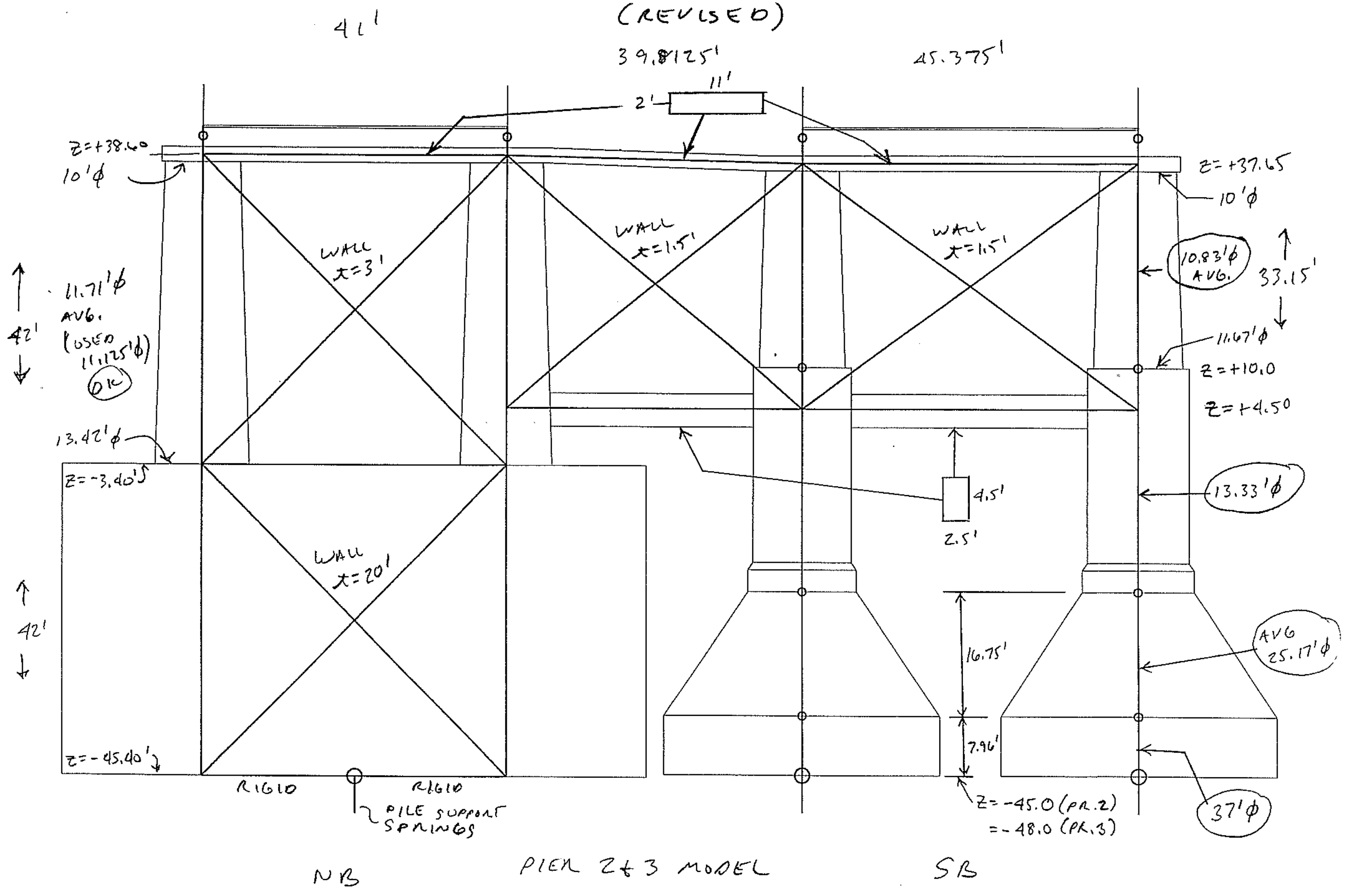


SVIEW 4.12 File:subflex 94/11/07 16:12 LC 1/ 60 Vu= 7 Lo= 45 La= 45 R= 0

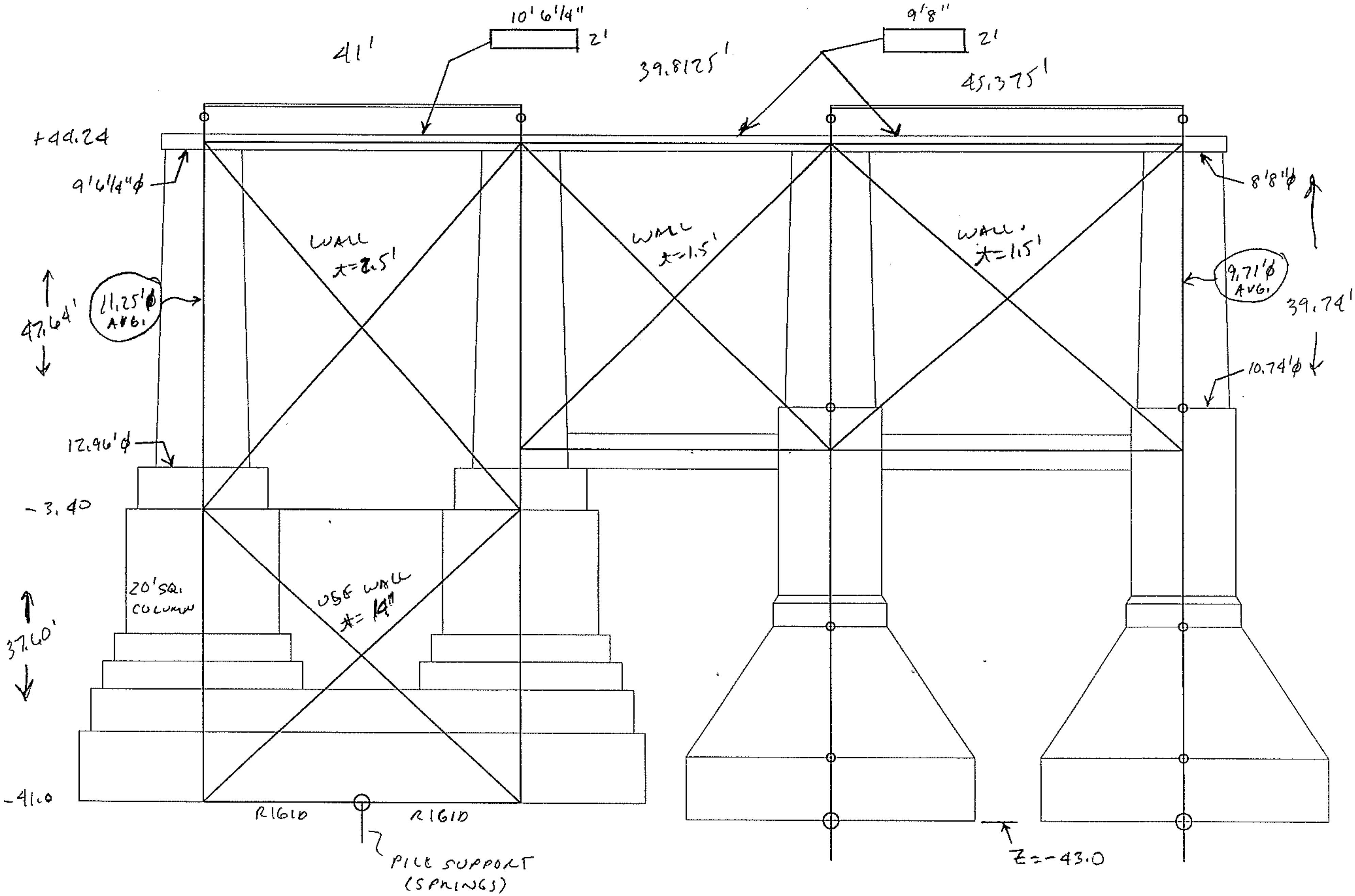


PIER 1 SIDE ELEVATION

PIER 2 + 3 MODEL (REVISED)

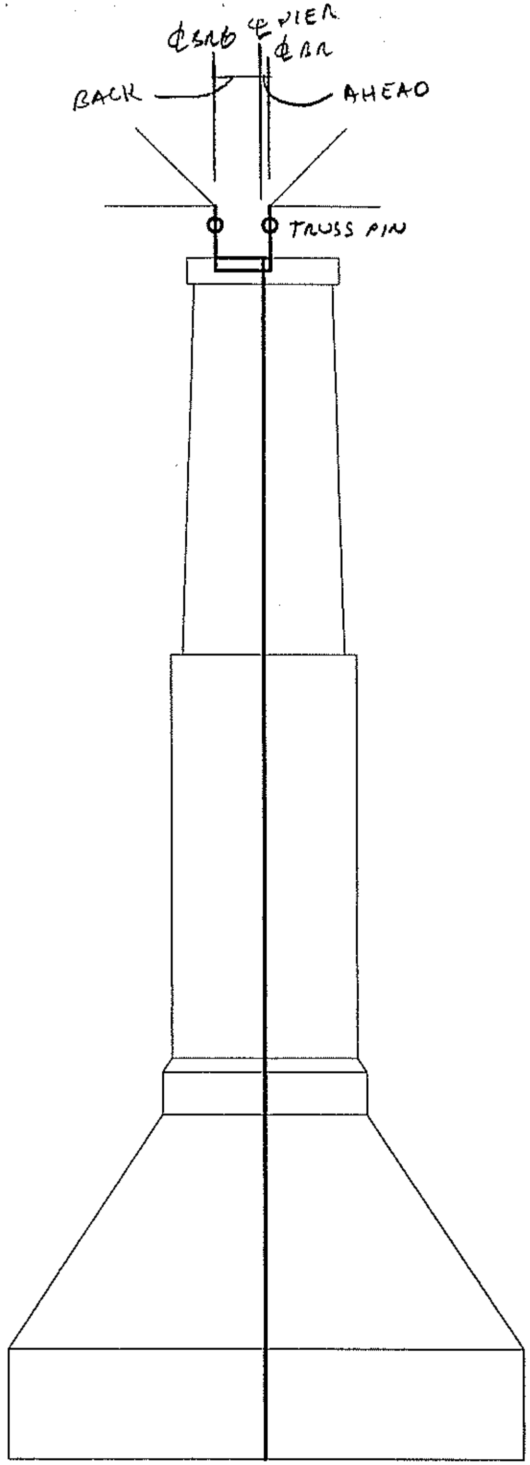


PIER 2 + 3 MODEL



PIER 4 MODEL

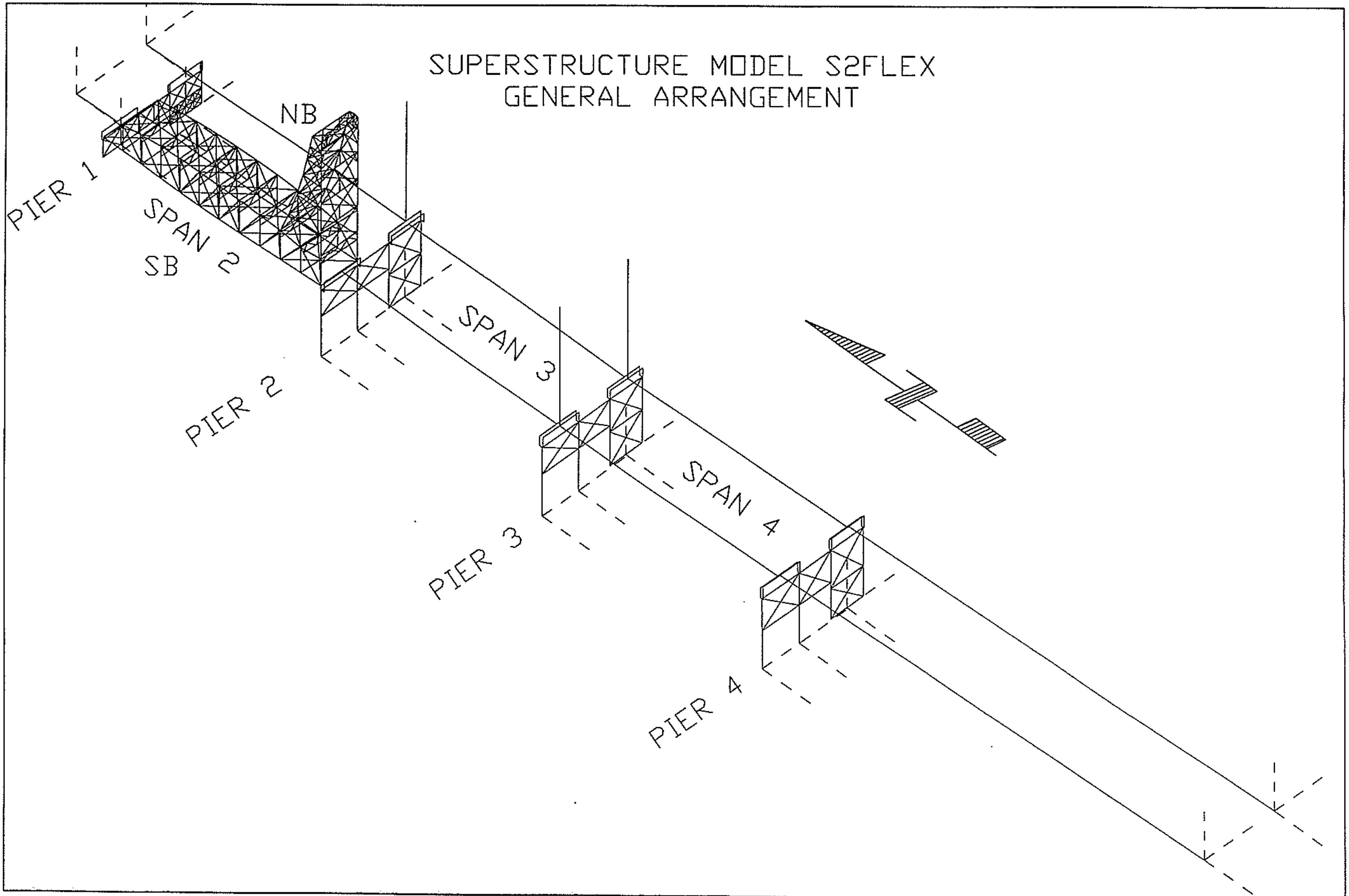
(SEE PIER 2,3 FOR DATA NOT SHOWN)



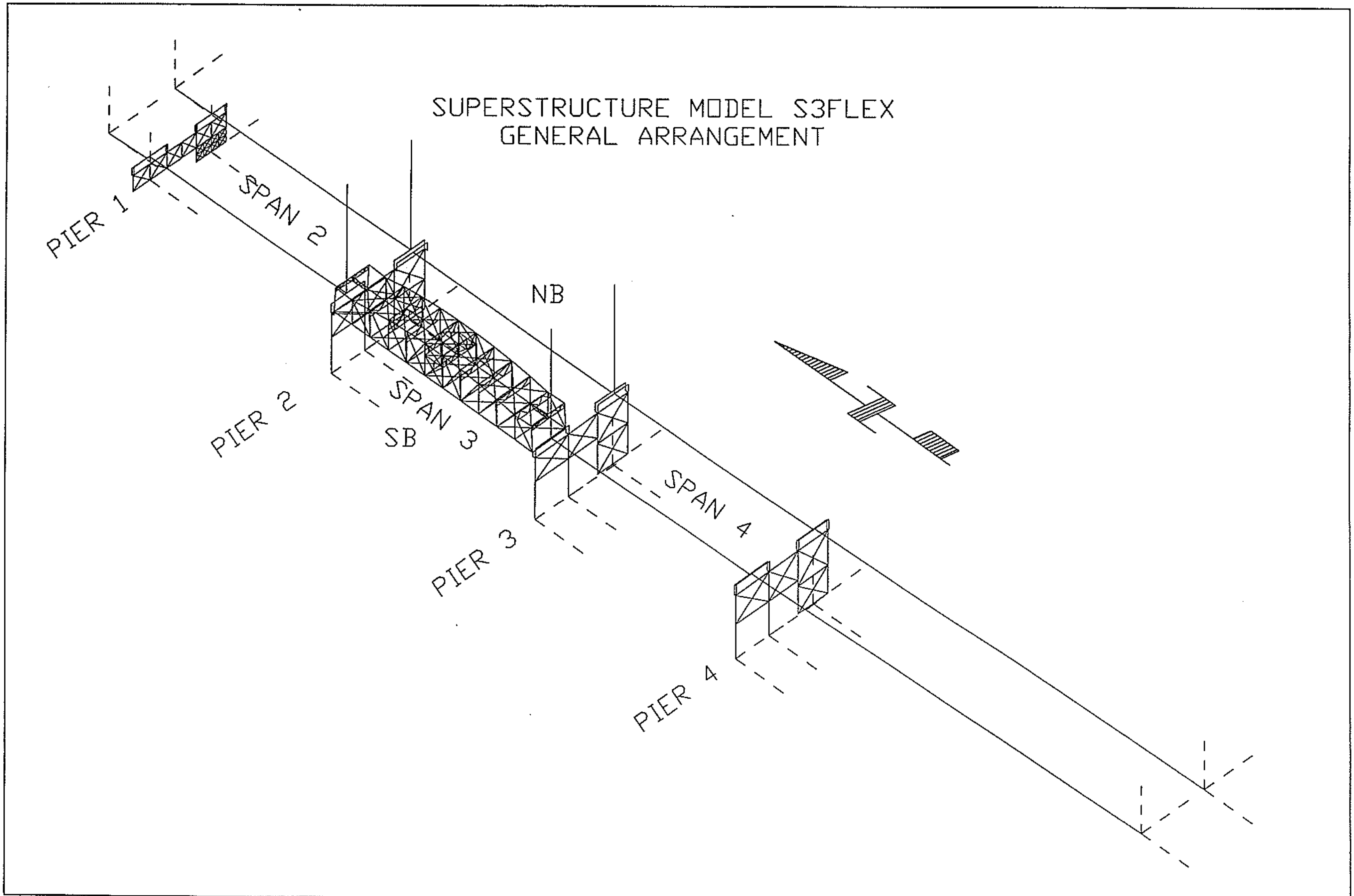
PIER MODEL (2,3,4)
SIDE ELEVATION (NB NOT SHOWN)

	BRG. OFFSET	
PIER	BACK	AHEAD
2	6"	3'5½"
3	3'5½"	6"
4	1'10"	1'0"

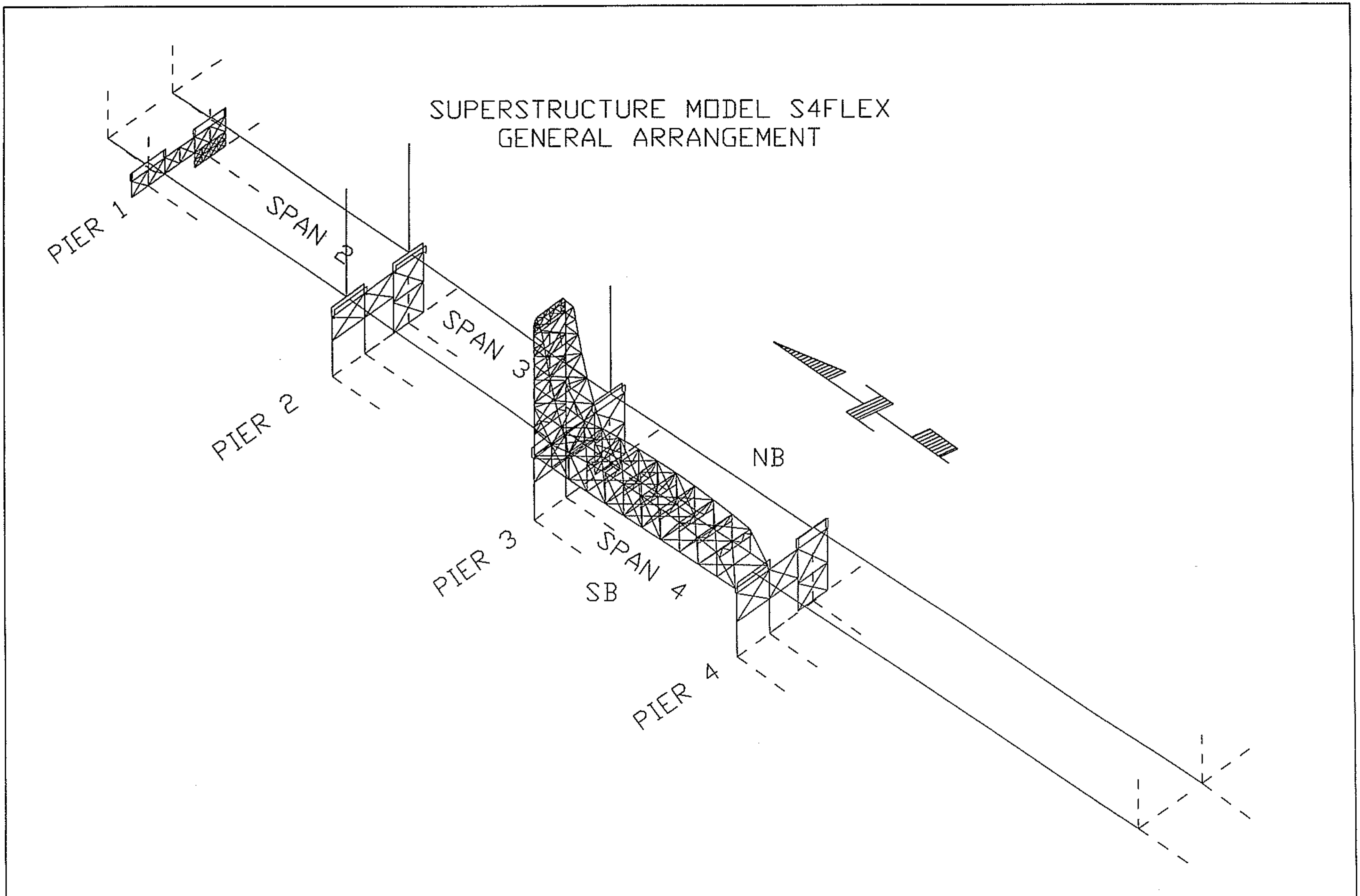
REF. PLAN SHEET 12356



SVIEW 4.12 File:S2FLEX 94/11/08 13:33 LC 1/ 80 Vu= 7 Lo= 45 La= 45 R= 0



SVIEW 4.12 File:S3FLEX 94/11/14 17:19 LC 1/ 80 Vu= 7 Lo= 45 La= 45 R= 0



SVIEW 4.12 File:S4FLEX 94/11/15 11:50 LC 1/ 80 Vu= 7 Lo= 45 La= 45 R= 0

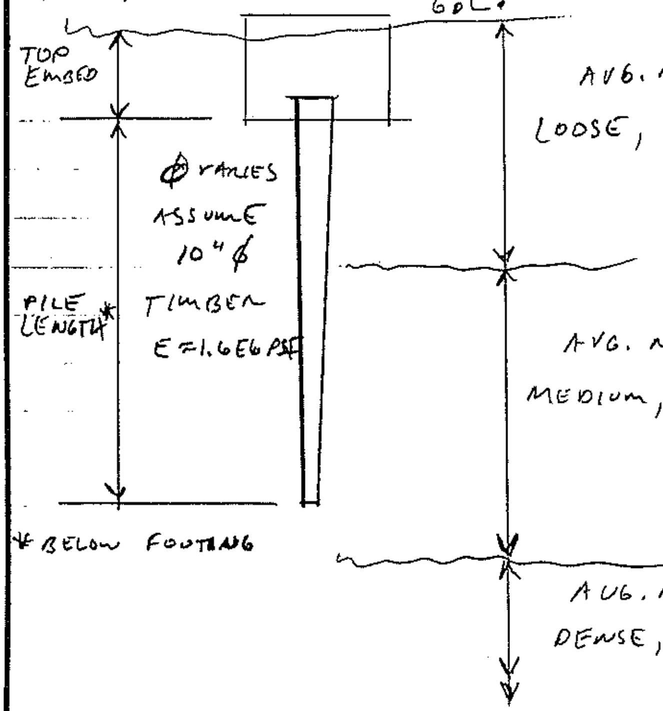
DGES CONSULTING ENGINEERS OLYMPIA, WASHINGTON 206-754-0544	Project: ODOT ~ I5	Date: 10/30/94	Proj # 93109.08
	Subject: SUBSTRUCTURE	Engr: GS	Page / Rev. / Ref.

LATERAL PILE STIFFNESS
L-PILE ANALYSIS PARAMETERS

+32.6' HIGH
+1.8' LOW

ASSUMED SOIL PROFILE (USING OREGON SLOUGH DATA)

PILE PROFILE



$\gamma_{SAT} = 120$ PCF TYPICAL
$\gamma_{EFF} = 120 - 62.4 = 57.6$ PCF

NOTE:
USE 0.25 K FOR GROUP ACTION; REF. FHWA

APPROXIMATED SOIL PROPERTIES FROM PH+T, PG. 310 + LPILE MANUAL, PG. 62

PIER	G.L.	LOOSE SOIL THICKNESS	MEDIUM SOIL THICKNESS	PILE TOP EMBED	PILE LENGTH
1SB	+22	15'	5'	11.5'	9.7'
1NB	+22	15'	5'	31.4'	20'
2+3SB	-28/-30	17'	20'	17'	17.5'
2NB	-28	17'	20'	17'	15'
3NB	-30	15.4'	20'	15.4'	25'
4SB+NB	-30	17'	20'	13'	48.5' (17.5' USED FOR LPILE)

DGES - FILE: SPRING.XLS						
LAST UPDATE:	9/19/94					
INTERSTATE 5 BRIDGE FOR ODOT						
COMPUTE SPRING CONSTANTS AT TOP OF PILES					UNITS IN,LB UON	
NOTES:	CASE A = ISOLATED PILE RESULT					
	CASE B = REDUCED FOR GROUP EFFECTS					
	PIER 1' = LOW WATER (ALL PILES ABOVE WATER TABLE)					
	PIER 1'' = HIGH WATER					
		PILE	PILE	OMPUTED STIFFNESSES		
		LENGTH	DIA	UNITS LB,IN		
		(FT)				
1'	A	9.7	9.	KF1F1	1.01E+05	
				KF2F2	1.31E+06	AXIAL
				KF3F3	1.01E+05	
				KM1M1	5.36E+07	
				KM2M2	5.15E+06	TORSIONAL
				KM3M3	5.36E+07	
				KF1M3	1.70E+06	
				KF3M1	-1.70E+06	
1'	B	9.7	9.	KF1F1	4.03E+04	
				KF2F2	1.31E+06	AXIAL
				KF3F3	4.03E+04	
				KM1M1	4.08E+07	
				KM2M2	5.15E+06	TORSIONAL
				KM3M3	4.08E+07	
				KF1M3	9.66E+05	
				KF3M1	-9.66E+05	
1''	A	9.7	9.	KF1F1	1.01E+05	
				KF2F2	1.31E+06	AXIAL
				KF3F3	1.01E+05	
				KM1M1	5.36E+07	
				KM2M2	5.15E+06	TORSIONAL
				KM3M3	5.36E+07	
				KF1M3	1.70E+06	
				KF3M1	-1.70E+06	
1''	B	9.7	9.	KF1F1	4.03E+04	
				KF2F2	1.31E+06	AXIAL
				KF3F3	4.03E+04	
				KM1M1	4.08E+07	
				KM2M2	5.15E+06	TORSIONAL
				KM3M3	4.08E+07	
				KF1M3	9.66E+05	
				KF3M1	-9.66E+05	

NO EFFECT

DGES - FILE: SPRING.XLS						
LAST UPDATE:		9/19/94				
INTERSTATE 5 BRIDGE FOR ODOT						
COMPUTE SPRING CONSTANTS AT TOP OF PILES					UNITS IN,LB UON	
NOTES:	CASE A = ISOLATED PILE RESULT					
	CASE B = REDUCED FOR GROUP EFFECTS					
	PIER 1' = LOW WATER (ALL PILES ABOVE WATER TABLE)					
	PIER 1'' = HIGH WATER					
2-3	A	17.5	10.	KF1F1	2.80E+05	
				KF2F2	8.98E+05	AXIAL
				KF3F3	2.80E+05	
				KM1M1	7.16E+07	
				KM2M2	4.35E+06	TORSIONAL
				KM3M3	7.16E+07	
				KF1M3	3.25E+06	
				KF3M1	-3.25E+06	
2-3	B	17.5	10.	KF1F1	1.00E+05	
				KF2F2	8.98E+05	AXIAL
				KF3F3	1.00E+05	
				KM1M1	5.07E+07	
				KM2M2	4.35E+06	TORSIONAL
				KM3M3	5.07E+07	
				KF1M3	1.63E+06	
				KF3M1	-1.63E+06	
4	A	48.5	10.	KF1F1	1.07E+05	
				KF2F2	3.24E+05	AXIAL
				KF3F3	1.07E+05	
				KM1M1	5.37E+07	
				KM2M2	1.57E+06	TORSIONAL
				KM3M3	5.37E+07	
				KF1M3	1.73E+06	
				KF3M1	-1.73E+06	
4	B	48.5	10.	KF1F1	4.20E+04	
				KF2F2	3.24E+05	AXIAL
				KF3F3	4.20E+04	
				KM1M1	4.11E+07	
				KM2M2	1.57E+06	TORSIONAL
				KM3M3	4.11E+07	
				KF1M3	9.80E+05	
				KF3M1	-9.80E+05	

DGES - FILE: NBSPRING.XLS							
LAST UPDATE:		11/1/94					
INTERSTATE 5 BRIDGE FOR ODOT							
COMPUTE SPRING CONSTANTS AT TOP OF NORTHBOUND						UNITS IN,LB UON	
NOTES:	CASE A = ISOLATED PILE RESULT						
	CASE B = REDUCED FOR GROUP EFFECTS						
		PILE	PILE	OMPUTED STIFFNESSES			
		LENGTH	DIA	UNITS LB,IN			
		(FT)					
1	A	20	10.	KF1F1	6.77E+05		
				KF2F2	7.85E+05	AXIAL	
				KF3F3	6.77E+05		
				KM1M1	9.82E+07		
				KM2M2	3.80E+06	TORSIONAL	
				KM3M3	9.82E+07		
				KF1M3	6.05E+06		
				KF3M1	-6.05E+06		
1	B	20	10.	KF1F1	2.43E+05		
				KF2F2	7.85E+05	AXIAL	
				KF3F3	2.43E+05		
				KM1M1	6.88E+07		
				KM2M2	3.80E+06	TORSIONAL	
				KM3M3	6.88E+07		
				KF1M3	3.00E+06		
				KF3M1	-3.00E+06		
2	A	15	10.	KF1F1	4.38E+05		
				KF2F2	1.05E+06	AXIAL	
				KF3F3	4.38E+05		
				KM1M1	8.64E+07		
				KM2M2	5.07E+06	TORSIONAL	
				KM3M3	8.64E+07		
				KF1M3	4.70E+06		
				KF3M1	-4.70E+06		
2	B	15	10.	KF1F1	1.60E+05		
				KF2F2	1.05E+06	AXIAL	
				KF3F3	1.60E+05		
				KM1M1	6.03E+07		
				KM2M2	5.07E+06	TORSIONAL	
				KM3M3	6.03E+07		
				KF1M3	2.28E+06		
				KF3M1	-2.28E+06		

DGES - FILE: NBSPRING.XLS							
LAST UPDATE:		11/1/94					
INTERSTATE 5 BRIDGE FOR ODOT							
COMPUTE SPRING CONSTANTS AT TOP OF NORTHBOUND						UNITS IN,LB UON	
NOTES:	CASE A = ISOLATED PILE RESULT						
	CASE B = REDUCED FOR GROUP EFFECTS						
3	A	25	10.	KF1F1	2.62E+05		
				KF2F2	6.28E+05	AXIAL	
				KF3F3	2.62E+05		
				KM1M1	7.00E+07		
				KM2M2	3.04E+06	TORSIONAL	
				KM3M3	7.00E+07		
				KF1M3	3.11E+06		
				KF3M1	-3.11E+06		
3	B	25	10.	KF1F1	9.38E+04		
				KF2F2	6.28E+05	AXIAL	
				KF3F3	9.38E+04		
				KM1M1	4.98E+07		
				KM2M2	3.04E+06	TORSIONAL	
				KM3M3	4.98E+07		
				KF1M3	1.57E+06		
				KF3M1	-1.57E+06		

DGES 9/22/94 TIME 16:36:45 PAGE 3

*** GROUP PILE ANALYSIS *** REV 4/12/88

PIER 1 SOUTHBOUND

GENERAL INPUT DATA

THE PILE SPRING MATRICES ARE:

PILE TYPE 1

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.131E+07	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.403E+05	0.0	0.0	0.0	.966E+06
Šw	0.0	0.0	.403E+05	0.0	-.966E+06	0.0
Õu	0.0	0.0	0.0	.515E+07	0.0	0.0
Õv	0.0	0.0	-.966E+06	0.0	.408E+08	0.0
Õw	0.0	.966E+06	0.0	0.0	0.0	.408E+08

PILE TYPE 2

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.898E+06	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.100E+06	0.0	0.0	0.0	.163E+07
Šw	0.0	0.0	.100E+06	0.0	-.163E+07	0.0
Õu	0.0	0.0	0.0	.435E+07	0.0	0.0
Õv	0.0	0.0	-.163E+07	0.0	.507E+08	0.0
Õw	0.0	.163E+07	0.0	0.0	0.0	.507E+08

PILE TYPE 3

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.324E+06	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.420E+05	0.0	0.0	0.0	.980E+06
Šw	0.0	0.0	.420E+05	0.0	-.980E+06	0.0
Õu	0.0	0.0	0.0	.157E+07	0.0	0.0
Õv	0.0	0.0	-.980E+06	0.0	.411E+08	0.0
Õw	0.0	.980E+06	0.0	0.0	0.0	.411E+08

PIER 1 SOUTHBOUND

GLOBAL GROUP STIFFNESS MATRIX:

	FX	FY	FZ	MX	MY	MZ
ŠX	.322E+07	.000E+00	.000E+00	.000E+00	.000E+00	.773E+08
ŠY	.000E+00	.105E+09	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.322E+07	-.773E+08	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.773E+08	.385E+13	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.122E+12	.000E+00
ÕZ	.773E+08	.000E+00	.000E+00	.000E+00	.000E+00	.121E+12

DGES 11/01/94 TIME 14:26:26 PAGE 3

*** GROUP PILE ANALYSIS *** REV 4/12/88

PIER 1 NORTHBOUND

THE PILE SPRING MATRICES ARE:

PILE TYPE 1

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.785E+06	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.243E+06	0.0	0.0	0.0	.300E+07
Šw	0.0	0.0	.243E+06	0.0	-.300E+07	0.0
Õu	0.0	0.0	0.0	.380E+07	0.0	0.0
Õv	0.0	0.0	-.300E+07	0.0	.688E+08	0.0
Õw	0.0	.300E+07	0.0	0.0	0.0	.688E+08

PIER 1 NORTHBOUND

GLOBAL GROUP STIFFNESS MATRIX:

	FX	FY	FZ	MX	MY	MZ
ŠX	.146E+08	.000E+00	.000E+00	.000E+00	.000E+00	.180E+09
ŠY	.000E+00	.471E+08	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.146E+08	-.180E+09	.000E+00	.000E+00
[illegible]	.000E+00	.000E+00	-.180E+09	.156E+13	.000E+00	.000E+00
[illegible]	.000E+00	.000E+00	.000E+00	.000E+00	.512E+12	.000E+00
ÕZ	.180E+09	.000E+00	.000E+00	.000E+00	.000E+00	.108E+12

DGES 9/22/94 TIME 16:06:42 PAGE 3

*** GROUP PILE ANALYSIS *** REV 4/12/88

PIERS 2&3 SOUTHBOUND BELL

GENERAL INPUT DATA

THE PILE SPRING MATRICES ARE:

PILE TYPE 1

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.131E+07	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.403E+05	0.0	0.0	0.0	.966E+06
Šw	0.0	0.0	.403E+05	0.0	-.966E+06	0.0
Õu	0.0	0.0	0.0	.515E+07	0.0	0.0
Õv	0.0	0.0	-.966E+06	0.0	.408E+08	0.0
Õw	0.0	.966E+06	0.0	0.0	0.0	.408E+08

PILE TYPE 2

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.898E+06	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.100E+06	0.0	0.0	0.0	.163E+07
Šw	0.0	0.0	.100E+06	0.0	-.163E+07	0.0
Õu	0.0	0.0	0.0	.435E+07	0.0	0.0
Õv	0.0	0.0	-.163E+07	0.0	.507E+08	0.0
Õw	0.0	.163E+07	0.0	0.0	0.0	.507E+08

PILE TYPE 3

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.324E+06	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.420E+05	0.0	0.0	0.0	.980E+06
Šw	0.0	0.0	.420E+05	0.0	-.980E+06	0.0
Õu	0.0	0.0	0.0	.157E+07	0.0	0.0
Õv	0.0	0.0	-.980E+06	0.0	.411E+08	0.0
Õw	0.0	.980E+06	0.0	0.0	0.0	.411E+08

DGES 9/22/94 TIME 16:06:42 PAGE 23

*** GROUP PILE ANALYSIS *** REV 4/12/88

PIERS 2&3 SOUTHBOUND BELL

GLOBAL GROUP STIFFNESS MATRIX:

	FX	FY	FZ	MX	MY	MZ
ŠX	.920E+07	.000E+00	.000E+00	.000E+00	.000E+00	.150E+09
ŠY	.000E+00	.826E+08	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.920E+07	-.150E+09	.000E+00	.000E+00
X	.000E+00	.000E+00	-.150E+09	.795E+12	.000E+00	.000E+00
ÓY	.000E+00	.000E+00	.000E+00	.000E+00	.193E+12	.000E+00
ÕZ	.150E+09	.000E+00	.000E+00	.000E+00	.000E+00	.944E+12

PIER 2 NORTHBOUND

THE PILE SPRING MATRICES ARE:

PILE TYPE 1

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.105E+07	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.160E+06	0.0	0.0	0.0	.228E+07
Šw	0.0	0.0	.160E+06	0.0	-.228E+07	0.0
Õu	0.0	0.0	0.0	.507E+07	0.0	0.0
Õv	0.0	0.0	-.228E+07	0.0	.603E+08	0.0
Õw	0.0	.228E+07	0.0	0.0	0.0	.603E+08

GLOBAL GROUP STIFFNESS MATRIX (PILE GROUP 1):

	FX	FY	FZ	MX	MY	MZ
ŠX	.157E+08	.000E+00	.000E+00	.000E+00	.000E+00	.223E+09
ŠY	.000E+00	.103E+09	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.157E+08	-.223E+09	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.223E+09	.125E+14	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.198E+13	.000E+00
ÕZ	.223E+09	.000E+00	.000E+00	.000E+00	.000E+00	.539E+12

GLOBAL GROUP STIFFNESS MATRIX (PILE GROUP 2):

	FX	FY	FZ	MX	MY	MZ
ŠX	.134E+08	.000E+00	.000E+00	.000E+00	.000E+00	.192E+09
ŠY	.000E+00	.882E+08	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.134E+08	-.192E+09	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.192E+09	.137E+13	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.278E+12	.000E+00
ÕZ	.192E+09	.000E+00	.000E+00	.000E+00	.000E+00	.462E+12

GLOBAL GROUP STIFFNESS MATRIX (COMBINED):

	FX	FY	FZ	MX	MY	MZ
ŠX	.291E+08	.000E+00	.000E+00	.000E+00	.000E+00	.415E+09
ŠY	.000E+00	.191E+09	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.291E+08	-.415E+09	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.415E+09	.139E+14	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.226E+13	.000E+00
ÕZ	.415E+09	.000E+00	.000E+00	.000E+00	.000E+00	.100E+13

PIER 3 NORTHBOUND

THE PILE SPRING MATRICES ARE:

PILE TYPE 1

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.628E+06	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.938E+05	0.0	0.0	0.0	.157E+07
Šw	0.0	0.0	.938E+05	0.0	-.157E+07	0.0
Õu	0.0	0.0	0.0	.304E+07	0.0	0.0
Õv	0.0	0.0	-.157E+07	0.0	.498E+08	0.0
Õw	0.0	.157E+07	0.0	0.0	0.0	.498E+08

GLOBAL GROUP STIFFNESS MATRIX (PILE GROUP 1):

	FX	FY	FZ	MX	MY	MZ
ŠX	.919E+07	.000E+00	.000E+00	.000E+00	.000E+00	.154E+09
ŠY	.000E+00	.615E+08	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.919E+07	-.154E+09	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.154E+09	.745E+13	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.116E+13	.000E+00
ÕZ	.154E+09	.000E+00	.000E+00	.000E+00	.000E+00	.324E+12

GLOBAL GROUP STIFFNESS MATRIX (PILE GROUP 2):

	FX	FY	FZ	MX	MY	MZ
ŠX	.788E+07	.000E+00	.000E+00	.000E+00	.000E+00	.132E+09
ŠY	.000E+00	.528E+08	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.788E+07	-.132E+09	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.132E+09	.819E+12	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.163E+12	.000E+00
ÕZ	.132E+09	.000E+00	.000E+00	.000E+00	.000E+00	.278E+12

GLOBAL GROUP STIFFNESS MATRIX (COMBINED):

	FX	FY	FZ	MX	MY	MZ
ŠX	.170E+08	.000E+00	.000E+00	.000E+00	.000E+00	.286E+09
ŠY	.000E+00	.114E+09	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.170E+08	-.286E+09	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.286E+09	.827E+13	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.132E+13	.000E+00
ÕZ	.286E+09	.000E+00	.000E+00	.000E+00	.000E+00	.602E+12

1 PAGE: 1

DGES 9/22/94 TIME 16:06:50 PAGE 3

*** GROUP PILE ANALYSIS *** REV 4/12/88

PIER 4 SOUTHBOUND BELL

GENERAL INPUT DATA

THE PILE SPRING MATRICES ARE:

PILE TYPE 1

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.131E+07	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.403E+05	0.0	0.0	0.0	.966E+06
Šw	0.0	0.0	.403E+05	0.0	-.966E+06	0.0
Õu	0.0	0.0	0.0	.515E+07	0.0	0.0
Õv	0.0	0.0	-.966E+06	0.0	.408E+08	0.0
Õw	0.0	.966E+06	0.0	0.0	0.0	.408E+08

PILE TYPE 2

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.898E+06	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.100E+06	0.0	0.0	0.0	.163E+07
Šw	0.0	0.0	.100E+06	0.0	-.163E+07	0.0
Õu	0.0	0.0	0.0	.435E+07	0.0	0.0
Õv	0.0	0.0	-.163E+07	0.0	.507E+08	0.0
Õw	0.0	.163E+07	0.0	0.0	0.0	.507E+08

PILE TYPE 3

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.324E+06	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.420E+05	0.0	0.0	0.0	.980E+06
Šw	0.0	0.0	.420E+05	0.0	-.980E+06	0.0
Õu	0.0	0.0	0.0	.157E+07	0.0	0.0
Õv	0.0	0.0	-.980E+06	0.0	.411E+08	0.0
Õw	0.0	.980E+06	0.0	0.0	0.0	.411E+08

DGES 9/22/94 TIME 16:06:50 PAGE 22

*** GROUP PILE ANALYSIS *** REV 4/12/88

PIER 4 SOUTHBOUND BELL

GLOBAL GROUP STIFFNESS MATRIX:

	FX	FY	FZ	MX	MY	MZ
ŠX	.361E+07	.000E+00	.000E+00	.000E+00	.000E+00	.843E+08
ŠY	.000E+00	.279E+08	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.361E+07	-.843E+08	.000E+00	.000E+00
X	.000E+00	.000E+00	-.843E+08	.259E+12	.000E+00	.000E+00
ÓY	.000E+00	.000E+00	.000E+00	.000E+00	.772E+11	.000E+00
ÕZ	.843E+08	.000E+00	.000E+00	.000E+00	.000E+00	.342E+12

PIER 4 NORTHBOUND

THE PILE SPRING MATRICES ARE:

PILE TYPE 1

	Fu	Fv	Fw	Mu	Mv	Mw
Šu	.324E+06	0.0	0.0	0.0	0.0	0.0
Šv	0.0	.420E+05	0.0	0.0	0.0	.980E+06
Šw	0.0	0.0	.420E+05	0.0	-.980E+06	0.0
Õu	0.0	0.0	0.0	.157E+07	0.0	0.0
Õv	0.0	0.0	-.980E+06	0.0	.411E+08	0.0
Õw	0.0	.980E+06	0.0	0.0	0.0	.411E+08

GLOBAL GROUP STIFFNESS MATRIX (PILE GROUP 1):

	FX	FY	FZ	MX	MY	MZ
ŠX	.277E+07	.000E+00	.000E+00	.000E+00	.000E+00	.647E+08
ŠY	.000E+00	.214E+08	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.277E+07	-.647E+08	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.647E+08	.124E+13	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.163E+12	.000E+00
ÕZ	.647E+08	.000E+00	.000E+00	.000E+00	.000E+00	.212E+11

GLOBAL GROUP STIFFNESS MATRIX (PILE GROUP 2):

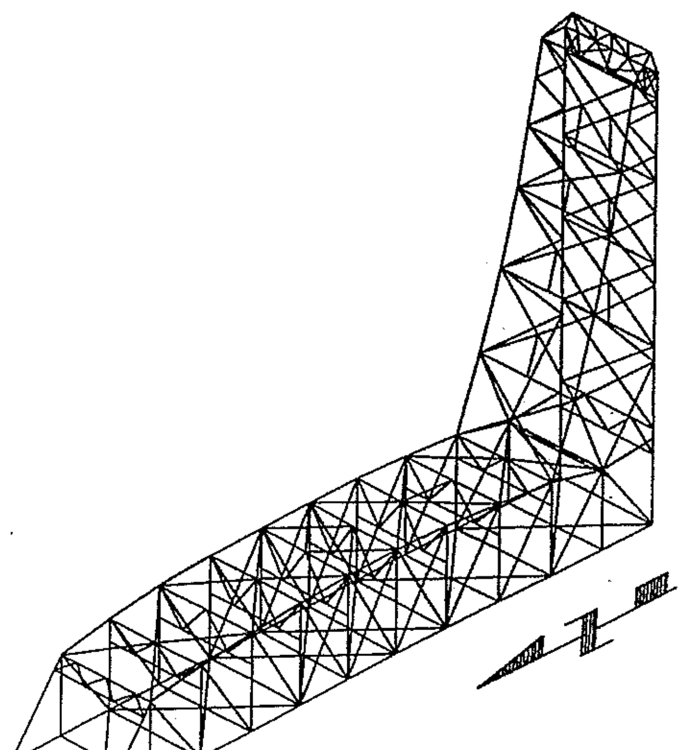
	FX	FY	FZ	MX	MY	MZ
ŠX	.370E+07	.000E+00	.000E+00	.000E+00	.000E+00	.862E+08
ŠY	.000E+00	.285E+08	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.370E+07	-.862E+08	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.862E+08	.165E+13	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.251E+12	.000E+00
ÕZ	.862E+08	.000E+00	.000E+00	.000E+00	.000E+00	.297E+12

GLOBAL GROUP STIFFNESS MATRIX (PILE GROUP 3):

	FX	FY	FZ	MX	MY	MZ
ŠX	.185E+07	.000E+00	.000E+00	.000E+00	.000E+00	.431E+08
ŠY	.000E+00	.143E+08	.000E+00	.000E+00	.000E+00	.000E+00
ŠZ	.000E+00	.000E+00	.185E+07	-.431E+08	.000E+00	.000E+00
ÕX	.000E+00	.000E+00	-.431E+08	.825E+12	.000E+00	.000E+00
ÕY	.000E+00	.000E+00	.000E+00	.000E+00	.155E+12	.000E+00
ÕZ	.431E+08	.000E+00	.000E+00	.000E+00	.000E+00	.376E+12

GLOBAL GROUP STIFFNESS MATRIX (COMBINED):

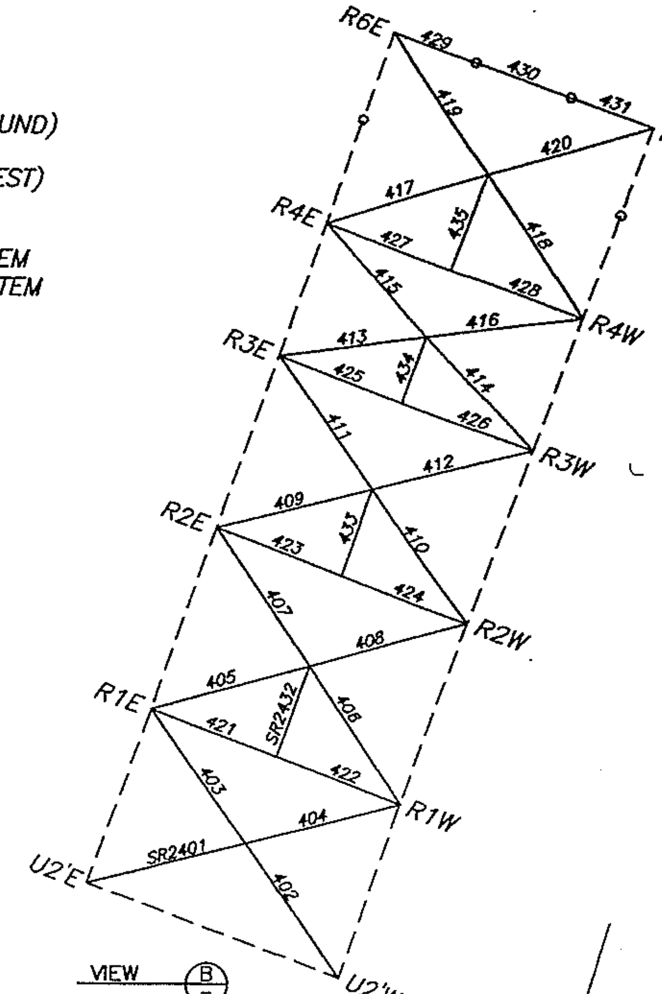
	FX	FY	FZ	MX	MY	MZ
ŠX	8.32E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.94E+08
ŠY	0.00E+00	6.42E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ŠZ	0.00E+00	0.00E+00	8.32E+06	-1.94E+08	0.00E+00	0.00E+00
ÕX	0.00E+00	0.00E+00	-1.94E+08	3.72E+12	0.00E+00	0.00E+00
ÕY	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.69E+11	0.00E+00
ÕZ	1.94E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.94E+11



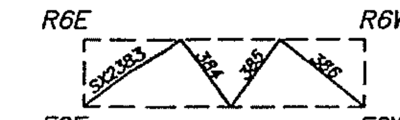
SPAN 2 ISOMETRIC

MEMBER NUMBERING KEY -
XY# _ _ _

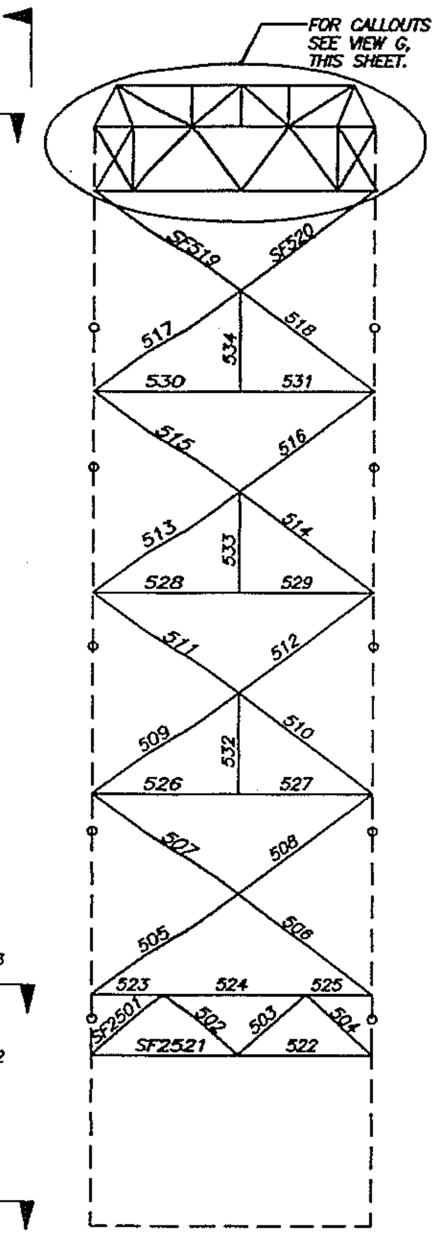
X = S or N (SOUTHBOUND/NORTHBOUND)
Y = MEMBER TYPE/LOCATION:
E,W = PRIMARY TRUSS (EAST/WEST)
T = TOP LATERAL SYSTEM
B = BOTTOM LATERAL SYSTEM
R = REAR TOWER LATERAL SYSTEM
F = FRONT TOWER LATERAL SYSTEM
X = CROSS FRAMES
A = ARTIFICIAL MEMBERS
(TO SIMPLIFY MODEL)
= SPAN ID NUMBER



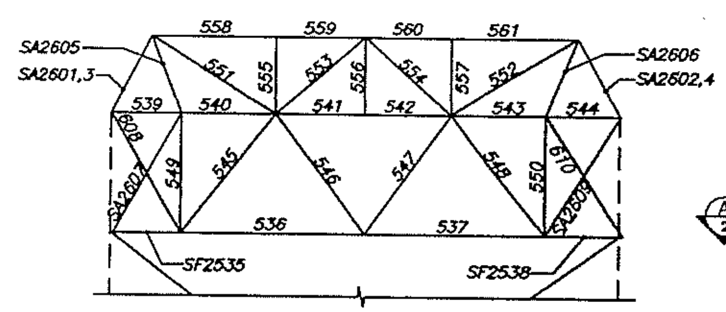
VIEW B



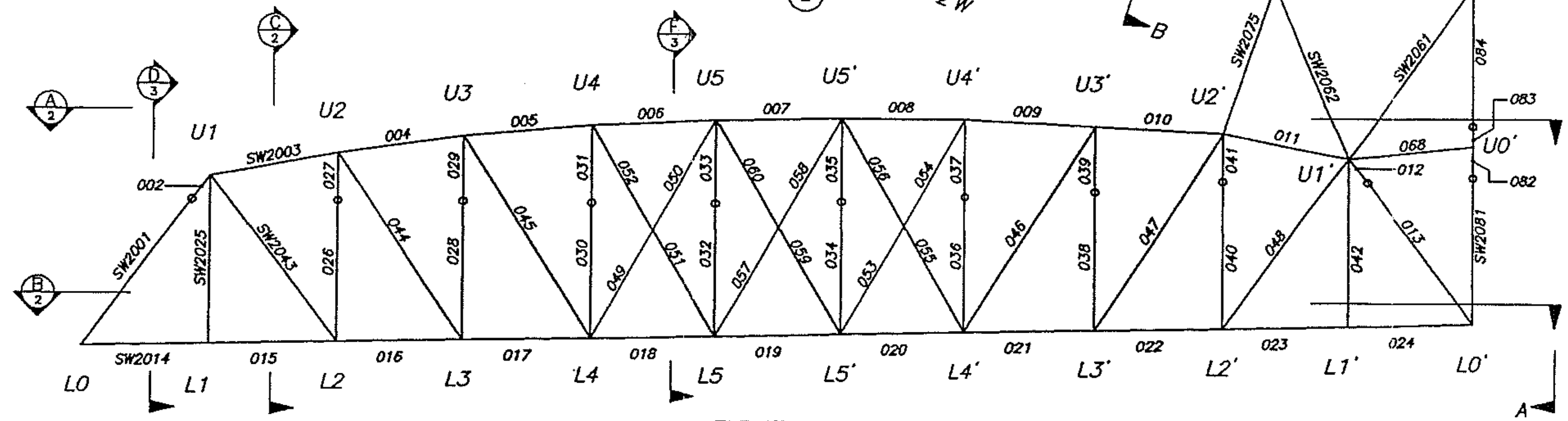
SECTION E



VIEW A



VIEW G

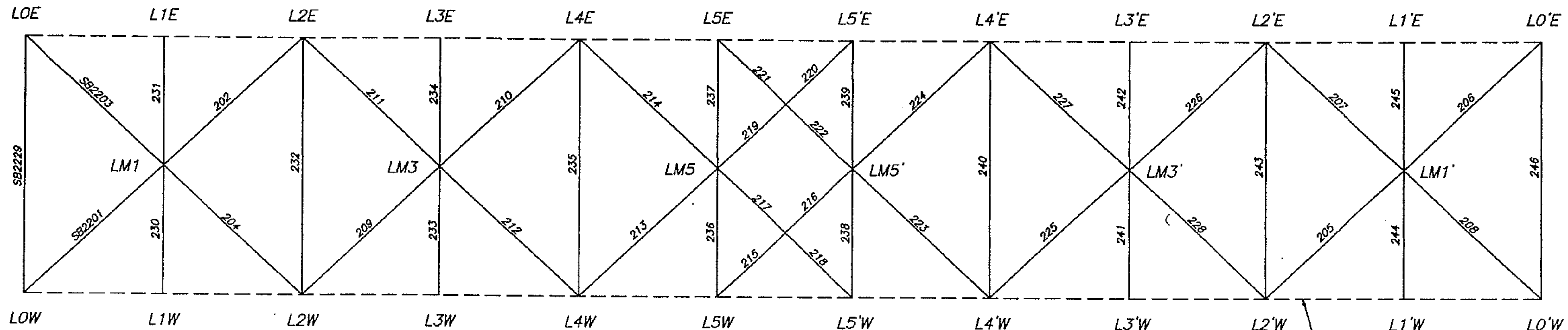


ELEVATION

PANEL POINTS AS SHOWN ON ODOT PLAN SHT 12302
WEST TRUSS NUMBERING SHOWN; EAST SIMILAR, SEE KEY
(SOUTHBOUND MEMBERS ARE USED TO MODEL NORTHBOUND TRUSS)
SPAN 4 SIMILAR BUT OPP HAND

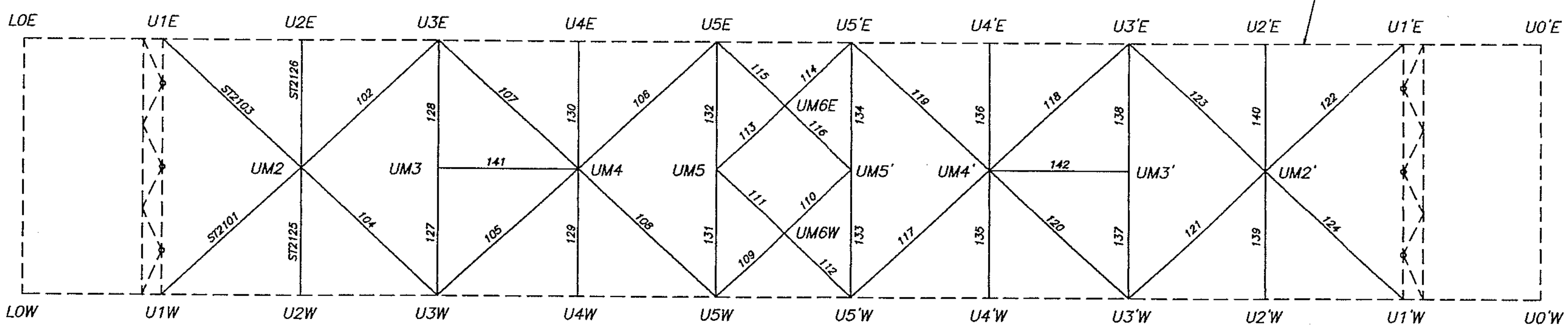
10/4/94

DATE	REVISION	BY	DRAFTED: DESIGNED: CHECKED: REVIEWED:	REVIEWED	BRIDGE ENGINEER	OREGON DEPARTMENT OF TRANSPORTATION BRIDGE DESIGN SECTION	BRIDGE NO. / DATE / CALC. BOOK	i5 - COLUMBIA RIVER 3D MODEL MEMBER GEN'L ARR SPAN 2	SHEET 1 OF 3
				EXPIRES:	EXPIRES:	DGES CONSULTING ENGINEERS OLYMPIA, WASHINGTON — EXELTECH		FEDERAL HIGHWAY ADMINISTRATION REGION 10 OREGON DIVISION — PROJECT NUMBER	DRAWING NO. 3D-S2-1



SECTION (B/1) BOTTOM LATERALS AND FLOORBEAMS

PRIMARY TRUSS CHORD
SEE SHEET 1



SECTION (A/1) TOP LATERAL BRACING

9/28/94

DATE	REVISION	BY

DRAFTED:
DESIGNED:
CHECKED:
REVIEWED:

REVIEWED
EXPIRES:

BRIDGE ENGINEER
EXPIRES:

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

EXELTECH

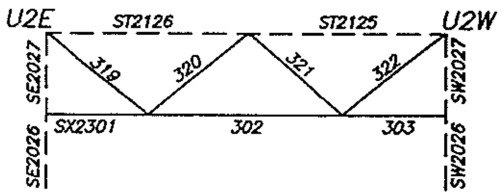
BRIDGE NO.
DATE
CALC. BOOK

I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 2

FEDERAL HIGHWAY ADMINISTRATION
REGION 10 | OREGON DIVISION
PROJECT NUMBER

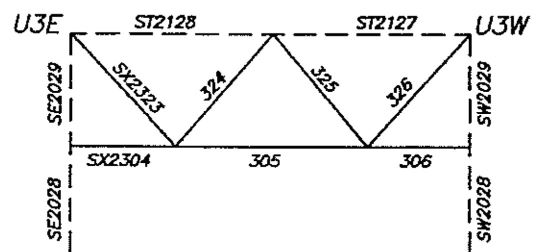
SHEET
2
OF
3

DRAWING NO.
3D-S2-2



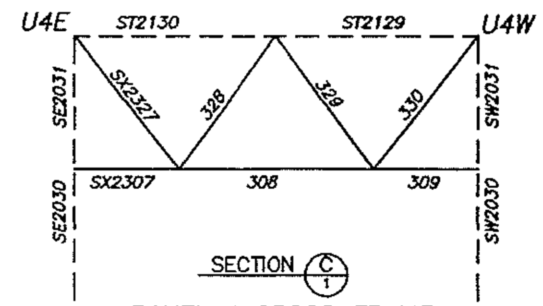
SECTION C/1

PANEL 2 CROSS FRAME



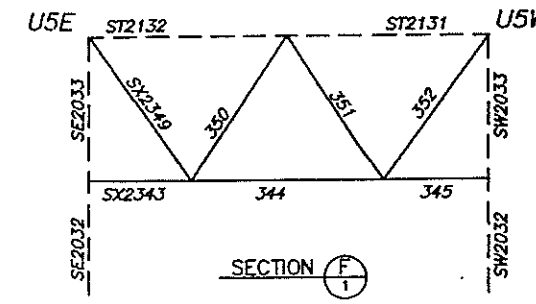
SECTION C/1

PANEL 3 CROSS FRAME



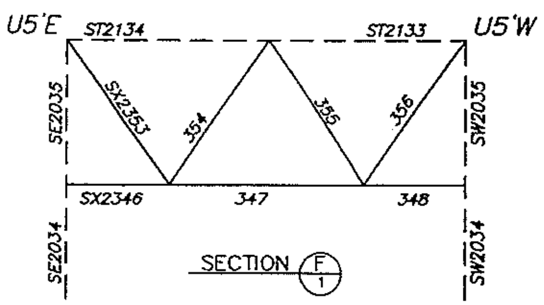
SECTION C/1

PANEL 4 CROSS FRAME



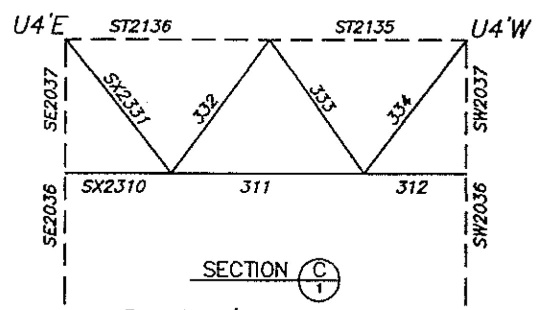
SECTION F/1

PANEL 5 CROSS FRAME



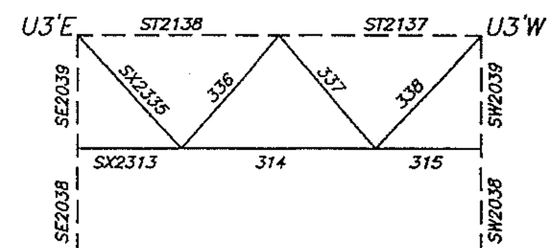
SECTION F/1

PANEL 5' CROSS FRAME



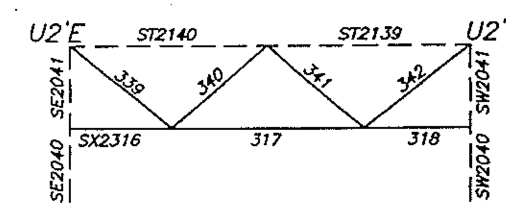
SECTION C/1

PANEL 4' CROSS FRAME



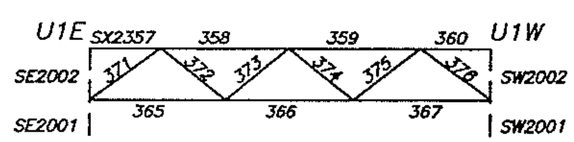
SECTION C/1

PANEL 3' CROSS FRAME



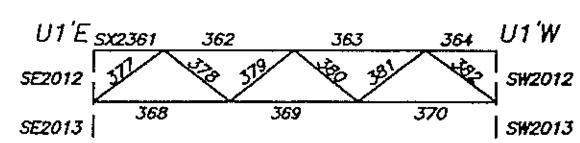
SECTION C/1

PANEL 2' CROSS FRAME



SECTION D/1

PORTAL FRAME AT PANEL 1

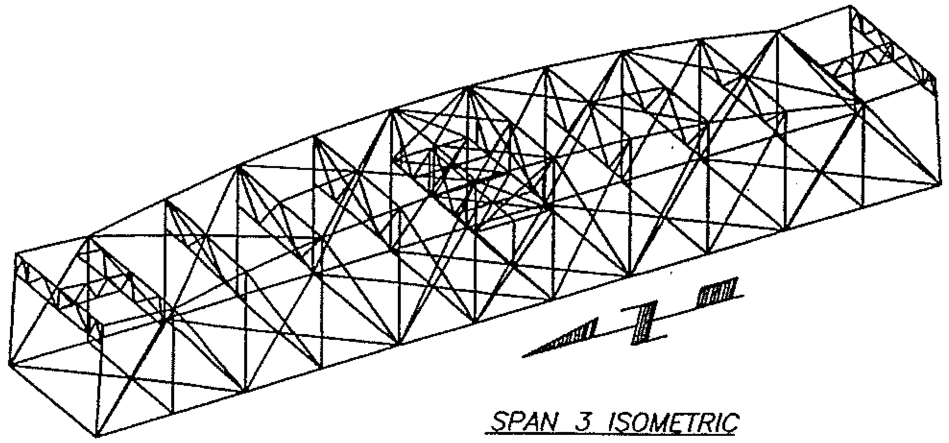


SECTION D/1

PORTAL FRAME AT PANEL 1'

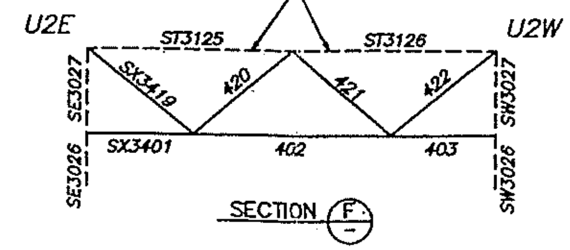
9/28/94

DATE	REVISION	BY	DRAFTED: / DESIGNED: / CHECKED: / REVIEWED:	REVIEWED	BRIDGE ENGINEER	OREGON DEPARTMENT OF TRANSPORTATION BRIDGE DESIGN SECTION	BRIDGE NO.	I5 - COLUMBIA RIVER 3D MODEL MEMBER GEN'L ARR SPAN 2	SHEET 3 OF 3
				EXPIRES	EXPIRES	DGES CONSULTING ENGINEERS OLYMPIA, WASHINGTON / EXELTECH	DATE / CALC. BOOK	FEDERAL HIGHWAY ADMINISTRATION REGION 10 OREGON DIVISION / PROJECT NUMBER	DRAWING NO. 3D-S2-3

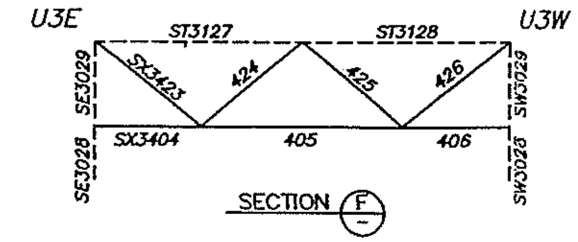


SPAN 3 ISOMETRIC

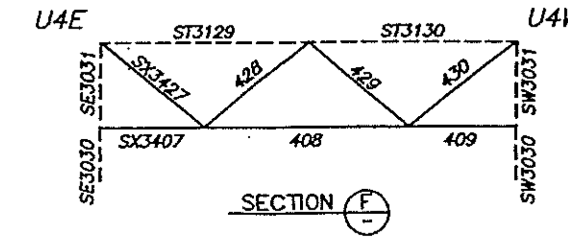
TOP LATERALS - SEE SHT 2



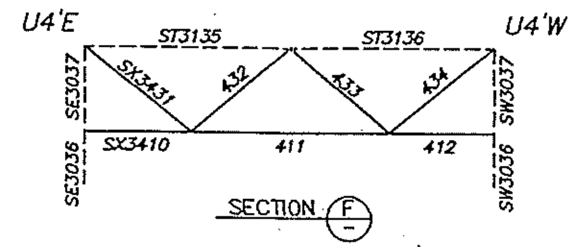
PANEL 2 CROSS FRAME



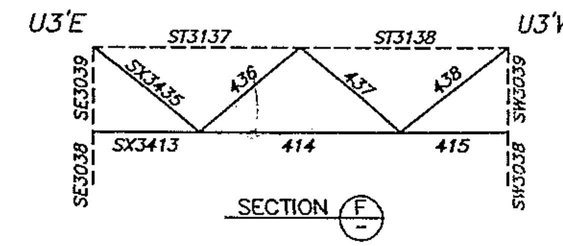
PANEL 3 CROSS FRAME



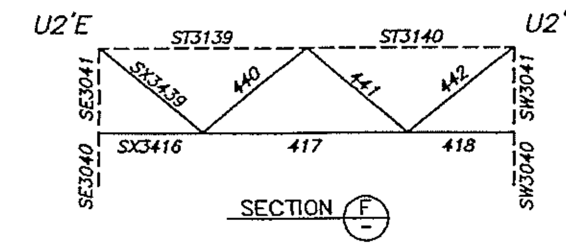
PANEL 4 CROSS FRAME



PANEL 4' CROSS FRAME



PANEL 3' CROSS FRAME

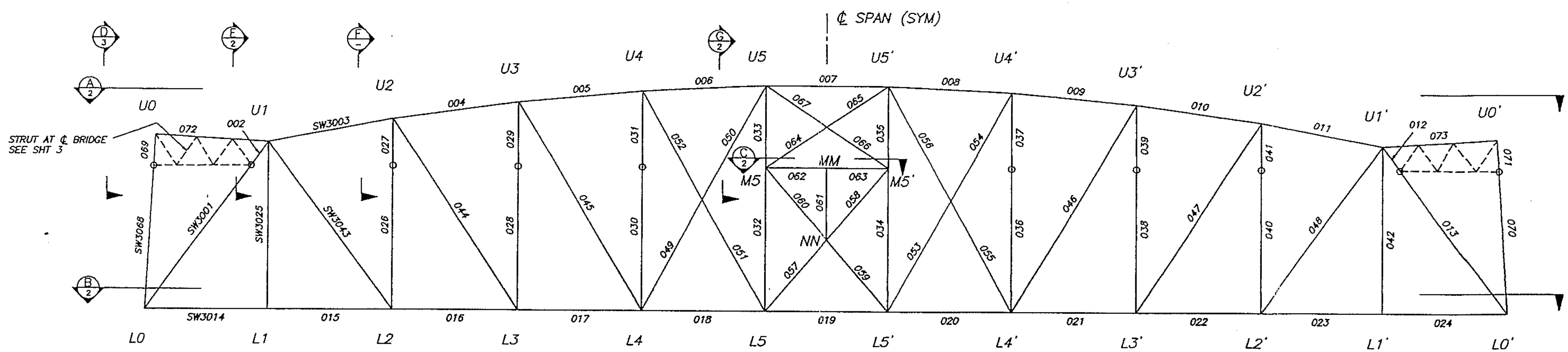


PANEL 2' CROSS FRAME

MEMBER NUMBERING KEY -

XY# _ _ _

- X = S or N (SOUTHBOUND/NORTHBOUND)
- Y = MEMBER TYPE/LOCATION:
  - E,W = PRIMARY TRUSS (EAST/WEST)
  - T = TOP LATERAL SYSTEM
  - B = BOTTOM LATERALS & FLOORBEAMS
  - L = LIFTING FRAME
  - X = CROSS FRAMES
  - M = MACHINERY HOUSE
- # = SPAN ID NUMBER

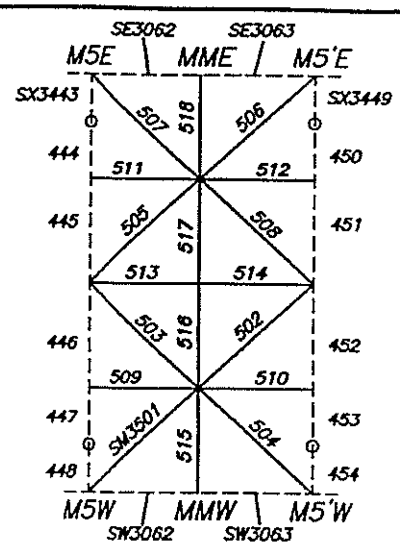


ELEVATION

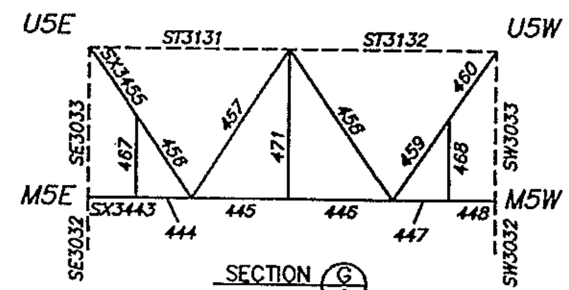
PANEL POINTS AS SHOWN ON ODOT PLAN SHT 12308
WEST TRUSS NUMBERING SHOWN; EAST SIMILAR, SEE KEY
(SOUTHBOUND MEMBERS ARE USED TO MODEL NORTHBOUND TRUSS)

8/30/94

DATE	REVISION	BY	DRAFTED: / DESIGNED: / CHECKED: / REVIEWED:	REVIEWED	BRIDGE ENGINEER	OREGON DEPARTMENT OF TRANSPORTATION BRIDGE DESIGN SECTION	BRIDGE NO.	I5 - COLUMBIA RIVER 3D MODEL MEMBER GEN'L ARR SPAN 3	SHEET 1 OF 3
				EXPIRES:	EXPIRES:	DGES. CONSULTING ENGINEERS OLYMPIA, WASHINGTON	DATE		DRAWING NO.
							CALC. BOOK	FEDERAL HIGHWAY ADMINISTRATION REGION 10 OREGON DIVISION / PROJECT NUMBER	3D-S3-1

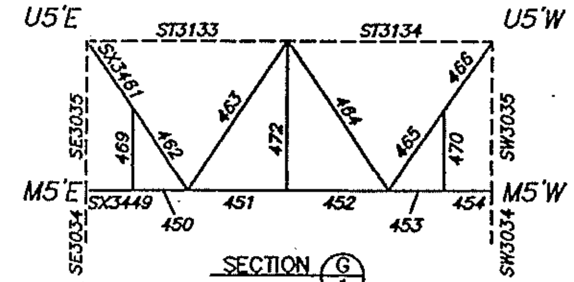


SECTION (C/1) PLAN AT MACHINERY HOUSE



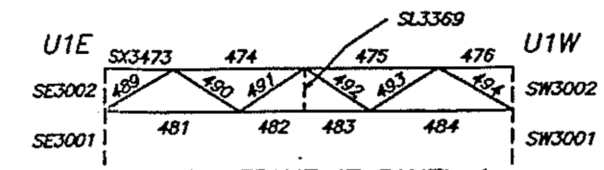
SECTION (G/1)

PANEL 5 AT MACHINERY HOUSE

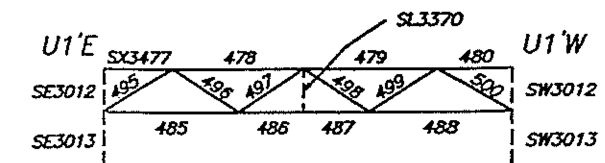


SECTION (G/1)

PANEL 5' AT MACHINERY HOUSE

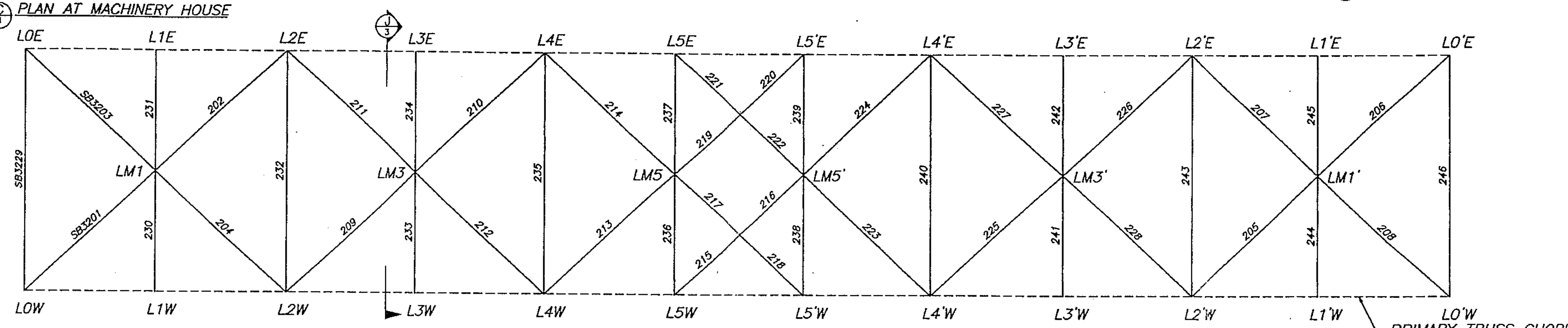


PORTAL FRAME AT PANEL 1

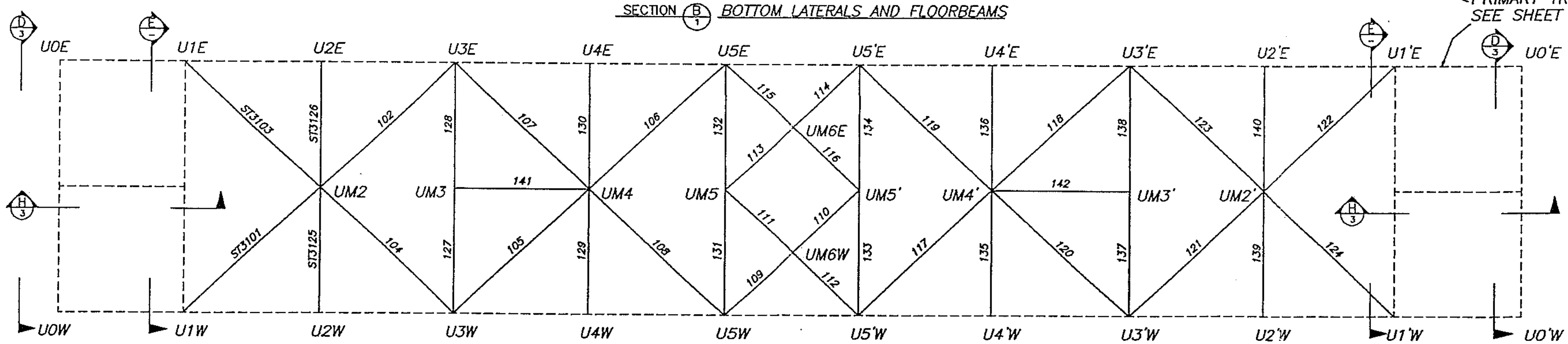


PORTAL FRAME AT PANEL 1'

SECTION (E/1)



SECTION (B/1) BOTTOM LATERALS AND FLOORBEAMS



SECTION (A/1) TOP LATERAL BRACING

8/30/94

DATE	REVISION	BY	DRAFTED: / DESIGNED: / CHECKED: / REVIEWED:	REVIEWED	BRIDGE ENGINEER
				EXPIRES:	EXPIRES:

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

BRIDGE NO.

DATE

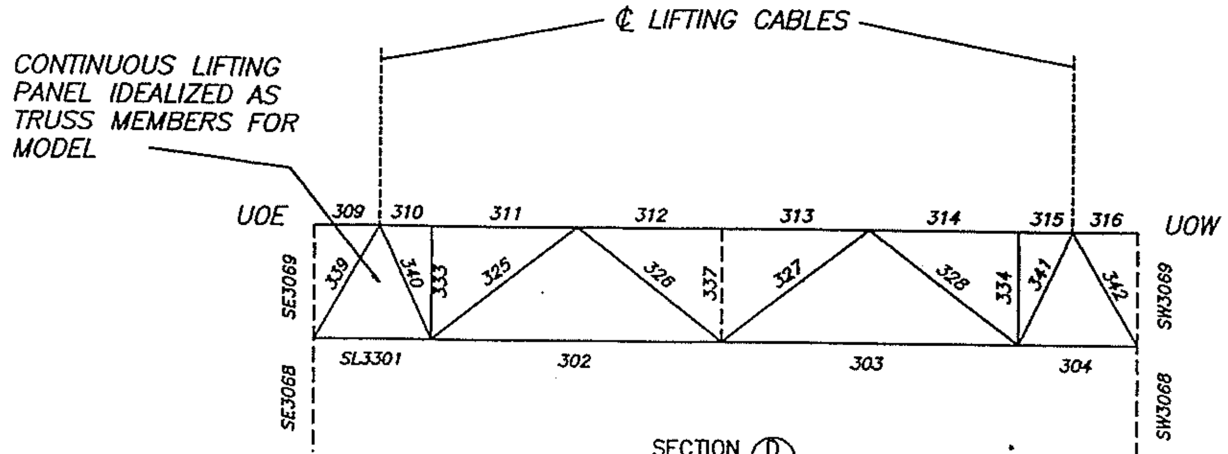
CALC. BOOK

I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 3

FEDERAL HIGHWAY ADMINISTRATION | PROJECT NUMBER
REGION 10 | OREGON DIVISION

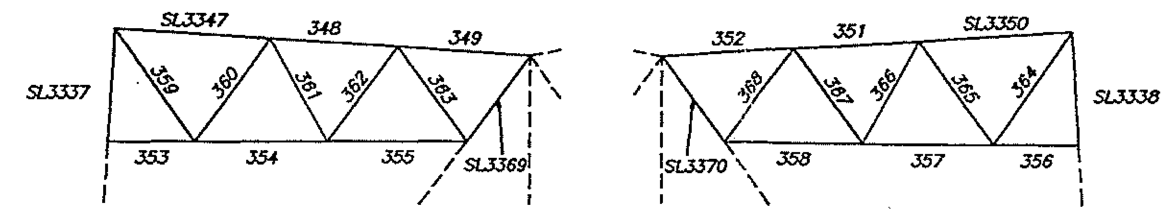
SHEET 2 OF 3

DRAWING NO.
3D-S3-2

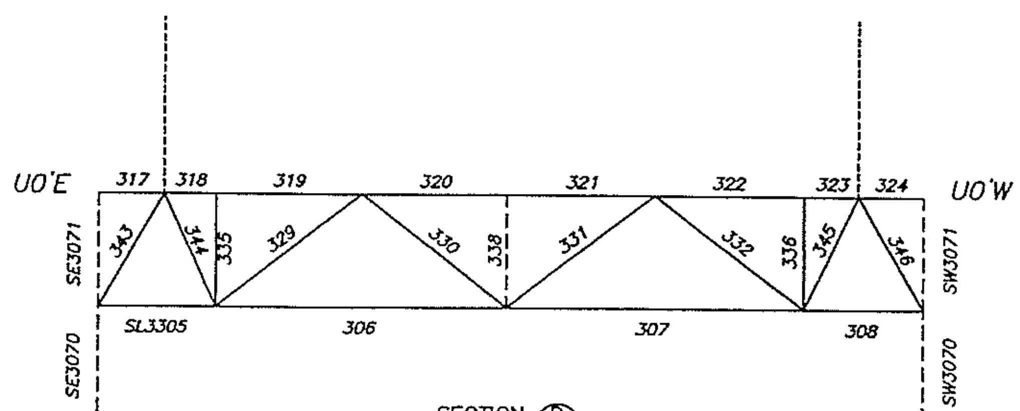


SECTION D/1

PANEL 0 LIFTING GIRDER

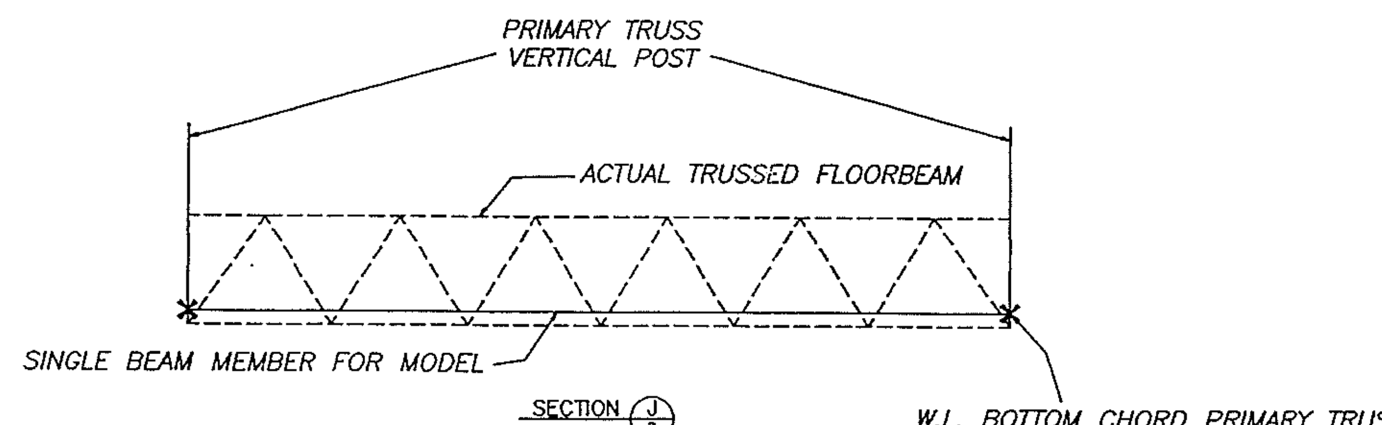


SECTION H/2 LIFTING GIRDER STRUT AT ℄ BRIDGE



SECTION D/–

PANEL 0' LIFTING GIRDER



SECTION J/2

TYPICAL FLOORBEAM

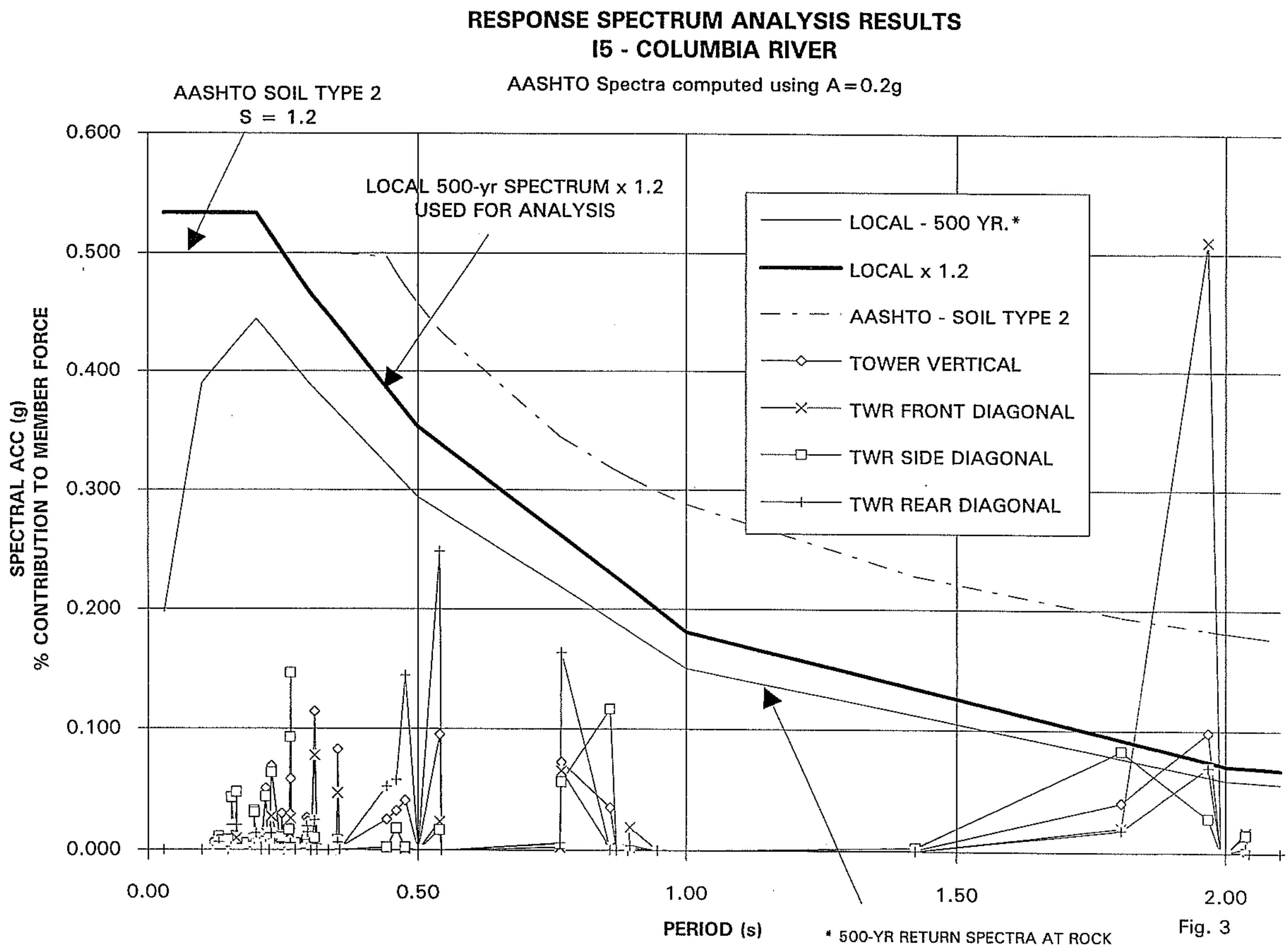
8/30/94

DATE	REVISION	BY	DRAFTED: / DESIGNED: / CHECKED: / REVIEWED:	REVIEWED	BRIDGE ENGINEER	OREGON DEPARTMENT OF TRANSPORTATION BRIDGE DESIGN SECTION	BRIDGE NO.	I5 - COLUMBIA RIVER 3D MODEL MEMBER GEN'L ARR SPAN 3	SHEET 3 OF 3
				EXPIRES:	EXPIRES:	DGES CONSULTING ENGINEERS OLYMPIA, WASHINGTON	DATE / CALC. BOOK	FEDERAL HIGHWAY ADMINISTRATION REGION 10 OREGON DIVISION / PROJECT NUMBER	DRAWING NO. 3D-S3-3

SPAN 2 ON RIGID SUPPORTS										
		PARTICIPATION FACTORS			CUMULATIVE PARTICIPATION			% MAX CUM PARTICIPATION		
MODE	PERIOD	X	Y	Z	X	Y	Z	X	Y	Z
1	1.96510	1.840	62.059	0.475	1.840	62.059	0.475	0.63%	23.67%	0.15%
2	1.76000	-61.160	2.125	-8.400	63.000	64.184	8.875	21.67%	24.48%	2.73%
3	0.75968	0.755	18.044	1.939	63.755	82.228	10.813	21.93%	31.36%	3.32%
4	0.47839	-5.553	3.972	63.130	69.308	86.200	73.943	23.84%	32.87%	22.72%
5	0.44544	1.661	15.834	-20.893	70.969	102.034	94.836	24.41%	38.91%	29.14%
6	0.35324	0.174	0.444	1.572	71.143	102.478	96.408	24.47%	39.08%	29.63%
7	0.30604	-0.394	15.089	-3.212	71.537	117.567	99.620	24.61%	44.83%	30.61%
8	0.28027	0.141	30.384	2.405	71.679	147.951	102.025	24.65%	56.42%	31.35%
9	0.26145	12.093	-0.201	25.593	83.772	148.152	127.618	28.81%	56.50%	39.22%
10	0.24713	-1.510	-7.803	-8.383	85.282	155.954	136.001	29.33%	59.47%	41.79%
11	0.22538	-5.270	0.481	36.094	90.551	156.435	172.095	31.15%	59.65%	52.89%
12	0.22200	2.291	-2.996	10.627	92.842	159.431	182.722	31.93%	60.80%	56.15%
13	0.21515	-1.854	-1.563	-38.584	94.696	160.994	221.306	32.57%	61.39%	68.01%
14	0.21016	-0.108	47.552	-2.601	94.804	208.546	223.906	32.61%	79.53%	68.81%
15	0.19876	1.645	-5.202	-0.081	96.450	213.748	223.987	33.17%	81.51%	68.83%
16	0.18957	-0.062	-10.522	-3.581	96.511	224.270	227.569	33.20%	85.52%	69.93%
17	0.16604	-1.556	0.255	2.982	98.068	224.525	230.550	33.73%	85.62%	70.85%
18	0.16141	-11.097	1.332	-15.694	109.165	225.857	246.244	37.55%	86.13%	75.67%
19	0.15343	-0.701	-0.650	3.012	109.866	226.507	249.257	37.79%	86.38%	76.60%
20	0.14750	16.093	0.821	5.202	125.959	227.328	254.458	43.32%	86.69%	78.20%
21	0.14110	42.595	0.665	-6.555	168.554	227.993	261.014	57.98%	86.94%	80.21%
22	0.12884	42.269	-1.229	-2.365	210.823	229.223	263.378	72.51%	87.41%	80.94%
23	0.12639	-0.301	-6.103	-1.537	211.124	235.326	264.916	72.62%	89.74%	81.41%
24	0.12139	15.249	0.748	0.195	226.373	236.074	265.111	77.86%	90.02%	81.47%
25	0.11769	-0.505	-0.009	0.075	226.878	236.083	265.186	78.04%	90.03%	81.49%
26	0.11360	3.623	-0.476	3.724	230.501	236.559	268.911	79.28%	90.21%	82.64%
27	0.11270	8.343	0.642	-5.243	238.844	237.201	274.154	82.15%	90.45%	84.25%
28	0.10959	0.179	-0.093	-0.142	239.024	237.294	274.296	82.21%	90.49%	84.29%
29	0.10868	12.814	0.066	-0.927	251.838	237.361	275.224	86.62%	90.51%	84.58%
30	0.10752	-6.275	-0.625	12.078	258.113	237.986	287.302	88.78%	90.75%	88.29%
31	0.10215	4.494	-0.629	-10.958	262.607	238.615	298.260	90.33%	90.99%	91.66%
32	0.10146	4.469	-1.148	-3.744	267.076	239.763	302.004	91.86%	91.43%	92.81%
33	0.09883	-0.312	0.781	0.506	267.388	240.544	302.510	91.97%	91.73%	92.96%
34	0.09864	-0.119	1.491	-1.742	267.507	242.035	304.252	92.01%	92.30%	93.50%
35	0.09830	7.387	0.251	-2.273	274.894	242.287	306.525	94.55%	92.39%	94.20%
36	0.09538	-1.087	0.076	2.618	275.981	242.363	309.143	94.93%	92.42%	95.00%
37	0.09240	-2.612	-0.357	0.794	278.593	242.720	309.936	95.83%	92.56%	95.24%
38	0.08984	-0.384	-0.156	4.150	278.977	242.876	314.086	95.96%	92.62%	96.52%
39	0.08832	-0.130	0.191	-0.045	279.107	243.066	314.132	96.00%	92.69%	96.53%
40	0.08579	0.366	-2.961	0.035	279.473	246.027	314.166	96.13%	93.82%	96.54%
41	0.08566	0.297	4.744	0.854	279.769	250.771	315.021	96.23%	95.63%	96.81%
42	0.08552	0.041	0.770	-0.046	279.810	251.542	315.067	96.24%	95.92%	96.82%
43	0.08333	-1.427	-0.485	0.592	281.237	252.026	315.658	96.73%	96.11%	97.00%
44	0.08295	1.640	0.128	-1.483	282.877	252.154	317.141	97.30%	96.16%	97.46%
45	0.08254	-1.501	1.401	1.710	284.378	253.556	318.851	97.82%	96.69%	97.98%
46	0.08238	1.846	-1.736	-1.361	286.224	255.291	320.212	98.45%	97.35%	98.40%
47	0.08210	0.789	-0.921	0.298	287.013	256.212	320.510	98.72%	97.70%	98.49%
48	0.08170	1.121	-1.323	2.128	288.135	257.535	322.638	99.11%	98.21%	99.15%
49	0.07989	-0.064	-0.021	0.054	288.199	257.556	322.692	99.13%	98.22%	99.16%
50	0.07944	-0.006	-0.764	0.078	288.206	258.319	322.771	99.13%	98.51%	99.19%
51	0.07915	-0.053	-0.563	0.051	288.259	258.883	322.821	99.15%	98.72%	99.20%
52	0.07905	-0.004	-0.059	-0.016	288.263	258.941	322.837	99.15%	98.74%	99.21%
53	0.07876	-0.029	-0.237	-0.087	288.292	259.179	322.925	99.16%	98.83%	99.24%
54	0.07872	-0.008	-0.289	-0.019	288.301	259.467	322.944	99.16%	98.94%	99.24%
55	0.07851	0.044	1.045	-0.007	288.345	260.513	322.950	99.18%	99.34%	99.24%
56	0.07726	-0.690	-0.453	-1.000	289.035	260.966	323.950	99.42%	99.52%	99.55%
57	0.07695	0.763	0.446	0.125	289.799	261.412	324.076	99.68%	99.69%	99.59%
58	0.07642	0.558	0.196	-0.650	290.357	261.608	324.726	99.87%	99.76%	99.79%
59	0.07590	-0.156	0.101	0.390	290.513	261.709	325.116	99.93%	99.80%	99.91%
60	0.07528	0.217	0.526	0.295	290.730	262.234	325.411	100.00%	100.00%	100.00%

SPAN 3 ON RIGID SUPPORTS

		PARTICIPATION FACTORS			CUMULATIVE PARTICIPATION			% MAX CUM PARTICIPATION		
MODE	PERIOD	X	Y	Z	X	Y	Z	X	Y	Z
1	0.54954	0.039	-36.948	-1.034	0.039	36.948	1.034	0.02%	21.07%	0.62%
2	0.51111	-4.569	-0.240	65.334	4.607	37.188	66.368	1.91%	21.21%	39.82%
3	0.35720	-0.073	-20.711	0.502	4.681	57.899	66.870	1.94%	33.02%	40.13%
4	0.28770	-0.259	-1.614	0.010	4.939	59.513	66.880	2.05%	33.94%	40.13%
5	0.24225	-0.266	0.030	0.084	5.206	59.543	66.964	2.16%	33.96%	40.18%
6	0.22556	-15.423	-4.257	-0.203	20.629	63.800	67.168	8.57%	36.39%	40.30%
7	0.20934	-4.342	34.359	0.003	24.971	98.159	67.171	10.37%	55.99%	40.31%
8	0.19584	2.677	39.041	-0.149	27.648	137.200	67.319	11.48%	78.26%	40.40%
9	0.17573	0.691	4.689	-0.443	28.339	141.888	67.762	11.77%	80.93%	40.66%
10	0.17430	26.685	0.407	-20.646	55.024	142.296	88.408	22.85%	81.16%	53.05%
11	0.16106	42.314	-0.930	11.460	97.338	143.225	99.868	40.43%	81.69%	59.93%
12	0.15672	5.596	2.173	4.511	102.934	145.398	104.380	42.75%	82.93%	62.63%
13	0.14903	-0.230	-3.400	-0.588	103.164	148.797	104.967	42.85%	84.87%	62.99%
14	0.12861	11.744	-0.644	0.896	114.908	149.442	105.863	47.73%	85.24%	63.52%
15	0.11998	-38.268	-0.874	-1.088	153.176	150.315	106.951	63.62%	85.74%	64.18%
16	0.11674	-10.448	2.177	0.026	163.624	152.492	106.977	67.96%	86.98%	64.19%
17	0.11273	-1.261	0.067	-3.262	164.885	152.560	110.238	68.48%	87.02%	66.15%
18	0.11167	12.841	0.072	-1.836	177.726	152.631	112.074	73.82%	87.06%	67.25%
19	0.10942	-11.371	0.137	-12.887	189.097	152.768	124.961	78.54%	87.14%	74.98%
20	0.10143	-0.056	-0.493	-1.863	189.153	153.262	126.825	78.56%	87.42%	76.10%
21	0.10119	-4.131	0.003	-0.014	193.284	153.265	126.839	80.28%	87.42%	76.11%
22	0.10000	0.685	0.035	2.063	193.970	153.299	128.902	80.56%	87.44%	77.35%
23	0.09934	8.016	0.053	1.470	201.985	153.352	130.372	83.89%	87.47%	78.23%
24	0.09266	-5.533	0.006	-3.448	207.519	153.358	133.819	86.19%	87.47%	80.30%
25	0.09137	2.472	0.326	0.426	209.991	153.684	134.245	87.22%	87.66%	80.55%
26	0.09107	-7.899	0.029	-0.934	217.890	153.713	135.179	90.50%	87.67%	81.11%
27	0.08918	-0.178	1.439	0.232	218.067	155.152	135.411	90.57%	88.50%	81.25%
28	0.08846	-6.005	-0.474	-8.633	224.072	155.626	144.044	93.07%	88.77%	86.43%
29	0.08784	-1.142	1.093	-1.625	225.215	156.719	145.668	93.54%	89.39%	87.41%
30	0.08735	-1.151	0.115	-2.417	226.365	156.833	148.086	94.02%	89.45%	88.86%
31	0.08728	0.126	0.092	0.072	226.491	156.926	148.158	94.07%	89.51%	88.90%
32	0.08615	-0.215	0.482	-0.096	226.706	157.408	148.254	94.16%	89.78%	88.96%
33	0.08437	0.130	-1.514	0.092	226.837	158.922	148.346	94.22%	90.65%	89.02%
34	0.08379	0.151	0.657	0.422	226.987	159.579	148.768	94.28%	91.02%	89.27%
35	0.08344	-0.110	0.548	-0.270	227.097	160.128	149.038	94.32%	91.33%	89.43%
36	0.08333	-0.639	-0.268	-1.189	227.736	160.396	150.227	94.59%	91.49%	90.14%
37	0.08297	1.096	-0.236	2.147	228.832	160.632	152.374	95.05%	91.62%	91.43%
38	0.08271	3.188	-0.414	2.040	232.020	161.046	154.414	96.37%	91.86%	92.66%
39	0.08246	2.080	1.815	0.862	234.101	162.860	155.276	97.23%	92.89%	93.17%
40	0.08227	-1.788	1.228	-0.321	235.889	164.088	155.597	97.98%	93.59%	93.37%
41	0.08051	-0.039	-5.747	-0.391	235.928	169.835	155.988	97.99%	96.87%	93.60%
42	0.07907	0.240	-0.656	3.348	236.168	170.490	159.335	98.09%	97.24%	95.61%
43	0.07743	0.117	-0.129	-0.074	236.285	170.619	159.409	98.14%	97.32%	95.65%
44	0.07698	-0.367	0.337	-1.944	236.652	170.957	161.353	98.29%	97.51%	96.82%
45	0.07306	0.103	-0.436	0.043	236.755	171.393	161.397	98.34%	97.76%	96.85%
46	0.07074	-0.420	0.587	1.366	237.175	171.980	162.763	98.51%	98.09%	97.67%
47	0.07014	-0.029	-0.211	-0.024	237.205	172.191	162.787	98.52%	98.21%	97.68%
48	0.07006	0.001	0.067	0.007	237.205	172.258	162.793	98.52%	98.25%	97.68%
49	0.06990	0.061	0.666	-0.538	237.267	172.924	163.331	98.55%	98.63%	98.01%
50	0.06848	0.138	0.014	0.041	237.405	172.939	163.372	98.61%	98.64%	98.03%
51	0.06833	-0.009	0.468	-1.436	237.414	173.406	164.809	98.61%	98.91%	98.89%
52	0.06505	-0.088	-0.006	-0.033	237.502	173.413	164.842	98.65%	98.91%	98.91%
53	0.06211	0.000	0.036	0.007	237.502	173.448	164.849	98.65%	98.93%	98.92%
54	0.06171	-0.016	-0.158	-0.035	237.518	173.606	164.883	98.65%	99.02%	98.94%
55	0.06169	0.000	0.028	0.002	237.518	173.634	164.886	98.65%	99.04%	98.94%
56	0.05922	-0.612	0.069	-0.107	238.130	173.703	164.993	98.91%	99.08%	99.00%
57	0.05851	0.727	-0.015	0.391	238.858	173.718	165.384	99.21%	99.08%	99.24%
58	0.05687	-1.185	0.038	-0.344	240.043	173.755	165.728	99.70%	99.11%	99.45%
59	0.05494	-0.693	0.087	-0.767	240.736	173.842	166.494	99.99%	99.16%	99.91%
60	0.05473	-0.026	1.480	0.158	240.762	175.322	166.652	100.00%	100.00%	100.00%


RESPONSE SPECTRUM ANALYSIS RESULTS
I5 - COLUMBIA RIVER
AASHTO Spectra computed using A=0.2g
AASHTO SOIL TYPE 2
S = 1.2
LOCAL 500-yr SPECTRUM x 1.2
USED FOR ANALYSIS
LOCAL - 500 YR.*
LOCAL x 1.2
AASHTO - SOIL TYPE 2
TOWER VERTICAL
TWR FRONT DIAGONAL
TWR SIDE DIAGONAL
TWR REAR DIAGONAL
SPECTRAL ACC (g)
% CONTRIBUTION TO MEMBER FORCE
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.00
0.50
1.00
1.50
2.00
PERIOD (s)
* 500-YR RETURN SPECTRA AT ROCK
Fig. 3

RESPONSE SPECTRUM ANALYSIS RESULTS
I5 - COLUMBIA RIVER

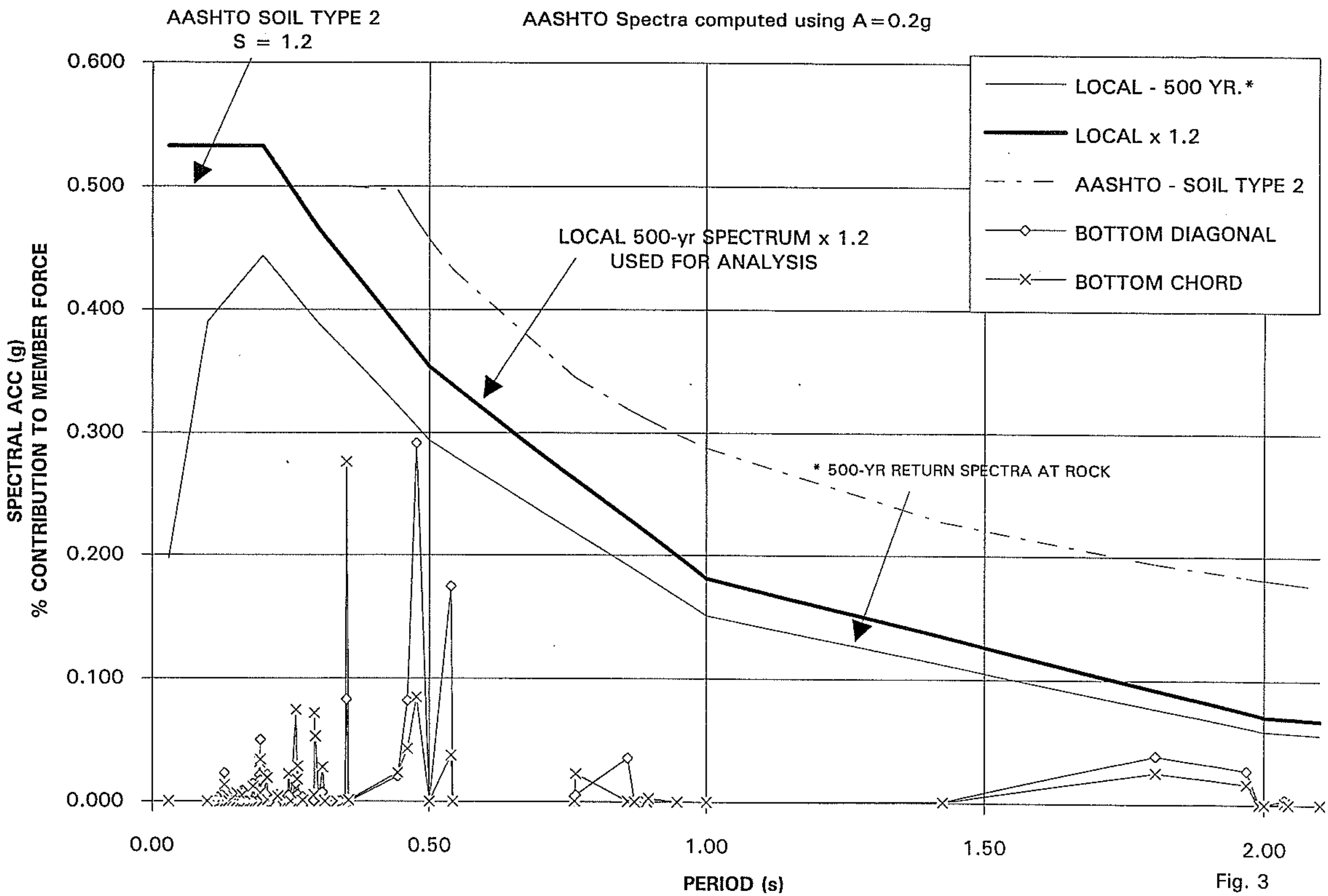


Fig. 3

DGES FILENAME: SUBEQRCT.XLS

LAST UPDATE: 11/8/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = LB, IN			FLEXIBLE		RIGID			
			SUPPORT SPRINGS		SUPPORT SPRINGS		% CHANGE FOR	
			60 MODES		60 MODES		RIGID SUPPORTS	
FNDN		ALGOR	EQX	EQY	EQX	EQY	EQX	EQY
UNIT	DOF	ELEM #	F/M	F/M	F/M	F/M	F/M	F/M
P1 SB	DX	10	400720	339490	259800	98475	-35.2%	-71.0%
P1 NB	DX	11	533510	249850	469410	154500	-12.0%	-38.2%
P2 SB OUT	DX	4	1094100	361320	1032300	370880	-5.6%	2.6%
P2 SB CTR	DX	5	1216700	396340	909440	344380	-25.3%	-13.1%
P2 NB	DX	6	2290500	722830	3478400	1098300	51.9%	51.9%
P3 SB OUT	DX	1	938670	566710	822140	289140	-12.4%	-49.0%
P3 SB CTR	DX	2	1545300	586840	688440	253110	-55.4%	-56.9%
P3 NB	DX	3	2270600	893670	3069500	989970	35.2%	10.8%
P4 SB OUT	DX	7	922400	299760	1112700	350890	20.6%	17.1%
P4 SB CTR	DX	8	1125200	368530	1007700	320670	-10.4%	-13.0%
P4 NB	DX	9	2469100	771860	3423700	1044800	38.7%	35.4%
N ABUT	DX	67	278590	85048	704.15	1459.8	-99.7%	-98.3%
N ABUT	DX	68	317980	99932	750.17	1164.8	-99.8%	-98.8%
SUM FX			15403370	5742180	16274984	5317740	5.7%	-7.4%
P1 SB	DY	21	275610	732060	345720	1017200	25.4%	39.0%
P1 NB	DY	22	660050	1757800	194140	570860	-70.6%	-67.5%
P2 SB OUT	DY	15	481980	1532700	275550	895660	-42.8%	-41.6%
P2 SB CTR	DY	16	477160	1571100	361900	1195700	-24.2%	-23.9%
P2 NB	DY	17	2030100	6693000	1305700	4279900	-35.7%	-36.1%
P3 SB OUT	DY	12	660540	1714800	274620	884550	-58.4%	-48.4%
P3 SB CTR	DY	13	638500	1801300	362030	1146400	-43.3%	-36.4%
P3 NB	DY	14	1942800	6042900	1830000	5037900	-5.8%	-16.6%
P4 SB OUT	DY	18	480140	1464300	405950	1201100	-15.5%	-18.0%
P4 SB CTR	DY	19	510880	1581200	551060	1536300	7.9%	-2.8%
P4 NB	DY	20	1734500	5410600	2122900	5718600	22.4%	5.7%
N ABUT	DY	69	128020	143870	73292	191570	-42.7%	33.2%
N ABUT	DY	70	84375	180550	105090	307520	24.6%	70.3%
PIER 5	DY	77	328680	1092400	13839	4491	-95.8%	-99.6%
PIER 5	DY	78	558020	1855700	8466.2	3120.3	-98.5%	-99.8%
SUM FY			10991355	33574280	8230257	23990871	-25.1%	-28.5%

DGES FILENAME: SUBEQRCT.XLS

LAST UPDATE: 11/8/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = LB, IN

			FLEXIBLE SUPPORT SPRINGS 60 MODES		RIGID SUPPORT SPRINGS 60 MODES		% CHANGE FOR RIGID SUPPORTS	
FNDN UNIT	DOF	ALGOR ELEM #	EQX F/M	EQY F/M	EQX F/M	EQY F/M	EQX F/M	EQY F/M
P1 SB	DZ	32	331270	845470	222250	604380	-32.9%	-28.5%
P1 NB	DZ	33	367410	943920	184560	509260	-49.8%	-46.0%
P2 SB OUT	DZ	26	715250	1812300	698010	1748100	-2.4%	-3.5%
P2 SB CTR	DZ	27	512570	1214900	321160	509840	-37.3%	-58.0%
P2 NB	DZ	28	1054200	2867700	764030	1901700	-27.5%	-33.7%
P3 SB OUT	DZ	23	849860	2051000	670940	1818100	-21.1%	-11.4%
P3 SB CTR	DZ	24	455350	1056300	293650	544570	-35.5%	-48.4%
P3 NB	DZ	25	2056900	3862800	2347500	3893200	14.1%	0.8%
P4 SB OUT	DZ	29	2445100	3740200	1659500	3243500	-32.1%	-13.3%
P4 SB CTR	DZ	30	2272600	2589000	1306900	1649800	-42.5%	-36.3%
P4 NB	DZ	31	5525900	6912800	3368000	5256800	-39.1%	-24.0%
N ABUT	DZ	71	5109.3	1560	24.764	51.159	-99.5%	-96.7%
N ABUT	DZ	72	5831.8	1832.9	25.205	39.024	-99.6%	-97.9%
PIER 5	DZ	79	62966	21483	80612	24324	28.0%	13.2%
PIER 5	DZ	80	73998	24257	68103	20550	-8.0%	-15.3%
SUM FZ			16734315	27945523	11985265	21724214	-28.4%	-22.3%
P1 SB	RX	43	7.219E+06	1.901E+07	3.994E+07	1.043E+08	453.3%	448.5%
P1 NB	RX	44	1.065E+08	2.837E+08	8.137E+07	2.394E+08	-23.6%	-15.6%
P2 SB OUT	RX	37	1.095E+08	3.596E+08	1.337E+08	4.357E+08	22.1%	21.1%
P2 SB CTR	RX	38	1.096E+08	3.614E+08	1.660E+08	5.490E+08	51.5%	51.9%
P2 NB	RX	39	8.069E+08	2.661E+09	9.262E+08	2.998E+09	14.8%	12.7%
P3 SB OUT	RX	34	1.488E+08	4.588E+08	1.367E+08	4.436E+08	-8.1%	-3.3%
P3 SB CTR	RX	35	1.518E+08	4.718E+08	1.691E+08	5.438E+08	11.3%	15.3%
P3 NB	RX	36	6.872E+08	1.971E+09	1.050E+09	3.316E+09	52.8%	68.2%
P4 SB OUT	RX	40	8.695E+07	2.697E+08	1.802E+08	5.657E+08	107.2%	109.8%
P4 SB CTR	RX	41	8.409E+07	2.619E+08	2.228E+08	6.786E+08	164.9%	159.1%
P4 NB	RX	42	5.077E+08	1.566E+09	1.254E+09	3.971E+09	147.0%	153.6%

DGES FILENAME: SUBEQRCT.XLS

LAST UPDATE: 11/8/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = LB, IN			FLEXIBLE		RIGID			
			SUPPORT SPRINGS		SUPPORT SPRINGS		% CHANGE FOR	
			60 MODES		60 MODES		RIGID SUPPORTS	
FNDN		ALGOR	EQX	EQY	EQX	EQY	EQX	EQY
UNIT	DOF	ELEM #	F/M	F/M	F/M	F/M	F/M	F/M
P1 SB	RY	54	9.468E+07	6.746E+07	6.270E+07	2.390E+07	-33.8%	-64.6%
P1 NB	RY	55	1.523E+08	6.176E+07	1.924E+08	6.285E+07	26.4%	1.8%
P2 SB OUT	RY	48	6.940E+08	2.162E+08	9.553E+08	3.043E+08	37.6%	40.8%
P2 SB CTR	RY	49	7.327E+08	2.270E+08	8.658E+08	2.790E+08	18.2%	22.9%
P2 NB	RY	50	1.384E+09	4.279E+08	2.343E+09	7.274E+08	69.3%	70.0%
P3 SB OUT	RY	45	5.953E+08	3.503E+08	7.239E+08	2.319E+08	21.6%	-33.8%
P3 SB CTR	RY	46	7.037E+08	2.623E+08	6.174E+08	2.004E+08	-12.3%	-23.6%
P3 NB	RY	47	1.062E+09	3.762E+08	1.833E+09	5.801E+08	72.6%	54.2%
P4 SB OUT	RY	51	6.107E+08	1.849E+08	9.843E+08	2.990E+08	61.2%	61.7%
P4 SB CTR	RY	52	6.047E+08	1.823E+08	8.921E+08	2.713E+08	47.5%	48.9%
P4 NB	RY	53	1.342E+09	4.052E+08	2.218E+09	6.712E+08	65.3%	65.6%
P1 SB	RZ	65	3.567E+07	2.886E+07	3.567E+07	1.989E+07	0.0%	-31.1%
P1 NB	RZ	66	3.971E+07	8.532E+07	2.672E+07	5.114E+07	-32.7%	-40.1%
P2 SB OUT	RZ	59	1.093E+07	4.925E+06	1.761E+07	6.309E+06	61.2%	28.1%
P2 SB CTR	RZ	60	1.584E+07	6.397E+06	1.911E+07	6.946E+06	20.6%	8.6%
P2 NB	RZ	61	2.062E+08	8.094E+07	1.146E+08	1.072E+08	-44.4%	32.4%
P3 SB OUT	RZ	56	3.064E+07	3.582E+07	1.820E+07	6.353E+06	-40.6%	-82.3%
P3 SB CTR	RZ	57	3.681E+07	3.946E+07	1.998E+07	6.989E+06	-45.7%	-82.3%
P3 NB	RZ	58	3.199E+08	2.509E+08	1.339E+08	5.944E+07	-58.2%	-76.3%
P4 SB OUT	RZ	62	7.715E+06	4.848E+06	1.805E+07	5.547E+06	133.9%	14.4%
P4 SB CTR	RZ	63	9.492E+06	5.785E+06	1.938E+07	5.890E+06	104.1%	1.8%
P4 NB	RZ	64	1.449E+08	5.660E+07	1.163E+08	3.984E+07	-19.7%	-29.6%

EQX = 1.0X + 0.3Y + 0.667Z

EQY = 0.3X + 1.0Y + 0.667Z

X = LONGITUDINAL

Y = TRANSVERSE

Z = VERTICAL

DGES FILENAME: PILERCT.XLS

LAST UPDATE: 11/10/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = KIP, IN

			FLEXIBLE SUPPORT SPRINGS 60 MODES		RIGID SUPPORT SPRINGS 60 MODES		PIER	DL + BUOYANCY			PILE REACTIONS FLEXIBLE SPRINGS		PILE REACTIONS RIGID SPRINGS	
FNDN UNIT	GLOBAL DOF (GPILE)	ALGOR DOF	EQL F/M	EQT F/M	EQL F/M	EQT F/M	DEAD LOAD	MIN LOAD	MAX LOAD		EQL F/M	EQT F/M	EQL F/M	EQT F/M
P1 SB	FV (FY)	DZ	331.3	845.5	222.3	604.4	-2272.5	-2272.5	-2075.9	MIN Rv	-80.7	-74.7	-66.8	-59.1
P1 SB	MT (MX)	RX	7219.0	19008.0	39940.0	104250.0				MAX Rv	26.3	20.4	12.5	4.7
P1 SB	ML (MZ)	RY	94681.0	67464.0	62699.0	23897.0								
P1 SB	FT (FZ)	DY	275.6	732.1	345.7	1017.2				MAX Vt	4.0	9.6	4.9	13.0
P1 SB	FL (FX)	DX	400.7	339.5	259.8	98.5				MAX Vl	8.7	7.2	7.0	3.3
P1 SB	MV (MY)	RZ	35673.0	28855.0	35673.0	19892.0				MAX V	9.6	12.0	8.5	13.4
P1 NB	FV (FY)	DZ	367.4	943.9	184.6	509.3	-3693.4	-3188.0	-2867.8	MIN Rv	-147.6	-140.5	-159.9	-127.2
P1 NB	MT (MX)	RX	106460.0	283650.0	81369.0	239350.0				MAX Rv	46.7	39.6	59.0	26.2
P1 NB	ML (MZ)	RY	152250.0	61764.0	192370.0	62853.0								
P1 NB	FT (FZ)	DY	660.1	1757.8	194.1	570.9				MAX Vt	12.2	31.8	4.0	11.0
P1 NB	FL (FX)	DX	533.5	249.9	469.4	154.5				MAX Vl	14.4	16.1	11.5	9.7
P1 NB	MV (MY)	RZ	39706.0	85321.0	26717.0	51144.0				MAX V	18.9	35.7	12.2	14.7

MAJORITY OF SEISMIC LOADING
TAKEN AT NB SIDE OF PIER
DUE TO INCREASED STIFFNESS

PASSIVE RESISTANCE IGNORED

DGES FILENAME: PILERCT.XLS

LAST UPDATE: 11/10/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = KIP, IN

			ADJUSTED FOR PASSIVE RESISTANCE								PILE REACTIONS			
			FLEXIBLE SUPPORT SPRINGS 60 MODES		RIGID SUPPORT SPRINGS 60 MODES			DL + BUOYANCY			FLEXIBLE SPRINGS		RIGID SPRINGS	
FNDN UNIT	GLOBAL DOF (GPILE)	MAXIMUM PASSIVE RESISTANCE	EQL F/M	EQT F/M	EQL F/M	EQT F/M	PIER DEAD LOAD	MIN LOAD	MAX LOAD		EQL F/M	EQT F/M	EQL F/M	EQT F/M
P1 SB	FV (FY)		331.3	845.5	222.3	604.4	-2272.5	-2272.5	-2075.9	MIN Rv	-72.0	-67.3	-61.1	-56.7
P1 SB	MT (MX)	2748	4471.0	16260.0	37192.0	101502.0				MAX Rv	17.6	13.0	6.7	2.4
P1 SB	ML (MZ)	19908	77850.8	53205.4	51787.4	19761.1								
P1 SB	FT (FZ)	72	203.6	660.1	273.7	945.2				MAX Vt	3.1	8.7	4.0	12.1
P1 SB	FL (FX)	474	0.0	0.0	0.0	0.0				MAX Vl	3.7	3.0	3.7	2.1
P1 SB	MV (MY)		35673.0	28855.0	35673.0	19892.0				MAX V	4.8	9.2	5.4	12.3
P1 NB	FV (FY)		367.4	943.9	184.6	509.3	-3693.4	-3188.0	-2867.8	MIN Rv	-106.9	-112.1	-130.1	-109.5
P1 NB	MT (MX)	95009	37471.3	188641.0	61077.4	179683.5				MAX Rv	6.0	11.2	29.2	8.5
P1 NB	ML (MZ)	479040	88356.8	31842.0	136153.5	44350.1								
P1 NB	FT (FZ)	909	0.0	848.8	0.0	0.0				MAX Vt	1.2	16.7	0.8	1.5
P1 NB	FL (FX)	4000	0.0	0.0	0.0	0.0				MAX Vl	5.5	11.9	3.7	7.1
P1 NB	MV (MY)		39706.0	85321.0	26717.0	51144.0				MAX V	5.7	20.5	3.8	7.3

NOTE: SIMPLIFIED ADJUSTMENT ALGORITHM IGNORES INTERACTION; PERMITS SIMULTANEOUS APPLICATION OF MAX F_{TP} + MAX F_{LP}. RESULTS ARE SLIGHTLY UNCONSERVATIVE, BUT FOR THESE FOUNDATIONS THE MAXIMUM PILE CAPACITY IS STILL EXCEEDED BY A SUBSTANTIAL MARGIN. GREATER REFINEMENT NOT NECESSARY.

DGES FILENAME: PILERCT.XLS

LAST UPDATE: 11/10/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = KIP, IN

			FLEXIBLE SUPPORT SPRINGS 60 MODES		RIGID SUPPORT SPRINGS 60 MODES		PIER	DL + BUOYANCY		PILE REACTIONS				
											FLEXIBLE SPRINGS		RIGID SPRINGS	
FNDN UNIT	GLOBAL DOF (GPILE)	ALGOR DOF	EQL F/M	EQT F/M	EQL F/M	EQT F/M	DEAD LOAD	MIN LOAD	MAX LOAD		EQL F/M	EQT F/M	EQL F/M	EQT F/M
P2 SB OUT	FV (FY)	DZ	715.3	1812.3	698.0	1748.1	-5883.6	-4568.8	-4382.8	MIN Rv	-196.6	-179.3	-245.3	-209.0
P2 SB OUT	MT (MX)	RX	109510.0	359630.0	133700.0	435670.0				MAX Rv	99.3	82.0	148.0	111.7
P2 SB OUT	ML (MZ)	RY	694000.0	216160.0	955260.0	304330.0								
P2 SB OUT	FT (FZ)	DY	482.0	1532.7	275.6	895.7				MAX Vt	6.2	17.1	4.6	10.3
P2 SB OUT	FL (FX)	DX	1094.1	361.3	1032.3	370.9				MAX Vl	12.9	4.4	12.9	4.6
P2 SB OUT	MV (MY)	RZ	10925.0	4925.4	17606.0	6309.1				MAX V	14.3	17.7	13.7	11.3
P2 SB CTR	FV (FY)	DZ	512.6	1214.9	321.2	509.8	-6089.9	-4775.1	-4558.8	MIN Rv	-203.2	-177.2	-235.0	-216.7
P2 SB CTR	MT (MX)	RX	109570.0	361410.0	166040.0	548990.0				MAX Rv	101.7	75.8	133.6	115.2
P2 SB CTR	ML (MZ)	RY	732680.0	227010.0	865770.0	278950.0								
P2 SB CTR	FT (FZ)	DY	477.2	1571.1	361.9	1195.7				MAX Vt	6.6	17.7	5.7	13.6
P2 SB CTR	FL (FX)	DX	1216.7	396.3	909.4	344.4				MAX Vl	14.7	4.9	11.7	4.4
P2 SB CTR	MV (MY)	RZ	15844.0	6397.1	19111.0	6946.2				MAX V	16.1	18.3	13.0	14.3
P2 NB	FV (FY)	DZ	1054.2	2867.7	764.0	1901.7	-15797.0	-11530.3	-10973.4	MIN Rv	-254.9	-218.3	-367.2	-258.7
P2 NB	MT (MX)	RX	806870.0	2661200.0	926150.0	2997900.0				MAX Rv	131.3	94.7	243.5	135.1
P2 NB	ML (MZ)	RY	1383700.0	427900.0	2343200.0	727400.0								
P2 NB	FT (FZ)	DY	2030.1	6693.0	1305.7	4279.9				MAX Vt	12.7	37.4	8.1	24.3
P2 NB	FL (FX)	DX	2290.5	722.8	3478.4	1098.3				MAX Vl	19.1	6.5	22.7	9.4
P2 NB	MV (MY)	RZ	206240.0	80944.0	114580.0	107180.0				MAX V	23.0	38.0	24.1	26.1

PASSIVE RESISTANCE IGNORED

DGES FILENAME: PILERCT.XLS

LAST UPDATE: 11/10/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = KIP, IN

			ADJUSTED FOR PASSIVE RESISTANCE								PILE REACTIONS			
			FLEXIBLE SUPPORT SPRINGS 60 MODES		RIGID SUPPORT SPRINGS 60 MODES			DL + BUOYANCY			FLEXIBLE SPRINGS		RIGID SPRINGS	
FNDN UNIT	GLOBAL DOF (GPILE)	MAXIMUM PASSIVE RESISTANCE	EQL F/M	EQT F/M	EQL F/M	EQT F/M	PIER DEAD LOAD	MIN LOAD	MAX LOAD		EQL F/M	EQT F/M	EQL F/M	EQT F/M
P2 SB OUT	FV (FY)		715.3	1812.3	698.0	1748.1	-5883.6	-4568.8	-4382.8	MIN Rv	-181.1	-164.3	-232.6	-193.9
P2 SB OUT	MT (MX)	53880	78221.9	305750.0	115812.5	381790.0				MAX Rv	83.8	67.0	135.3	96.6
P2 SB OUT	ML (MZ)	53880	640120.0	192704.7	901380.0	280254.1								
P2 SB OUT	FT (FZ)	830	0.0	702.7	0.0	65.7				MAX Vt	1.0	8.1	1.6	1.3
P2 SB OUT	FL (FX)	830	264.1	0.0	202.3	0.0				MAX Vl	3.9	0.5	3.8	0.6
P2 SB OUT	MV (MY)		10925.0	4925.4	17606.0	6309.1				MAX V	4.0	8.1	4.2	1.4
P2 SB CTR	FV (FY)		512.6	1214.9	321.2	509.8	-6089.9	-4775.1	-4558.8	MIN Rv	-187.8	-161.9	-221.2	-201.9
P2 SB CTR	MT (MX)	53880	78594.8	307530.0	142547.0	495110.0				MAX Rv	86.3	60.4	119.7	100.4
P2 SB CTR	ML (MZ)	53880	678800.0	201281.3	811890.0	256594.3								
P2 SB CTR	FT (FZ)	830	0.0	741.1	0.0	365.7				MAX Vt	1.4	8.6	1.7	4.6
P2 SB CTR	FL (FX)	830	386.7	0.0	79.4	0.0				MAX Vl	5.7	0.6	2.6	0.6
P2 SB CTR	MV (MY)		15844.0	6397.1	19111.0	6946.2				MAX V	5.9	8.7	3.2	4.7
P2 NB	FV (FY)		1054.2	2867.7	764.0	1901.7	-15797.0	-11530.3	-10973.4	MIN Rv	-239.2	-211.4	-351.5	-248.8
P2 NB	MT (MX)	35090	771780.0	2626110.0	891060.0	2962810.0				MAX Rv	115.6	87.7	227.8	125.1
P2 NB	ML (MZ)	126700	1257000.0	377579.9	2216500.0	650941.4								
P2 NB	FT (FZ)	504	1526.1	6189.0	801.7	3775.9				MAX Vt	10.0	34.6	5.3	21.6
P2 NB	FL (FX)	1820	470.5	0.0	1658.4	0.0				MAX Vl	9.1	2.6	12.7	3.4
P2 NB	MV (MY)		206240.0	80944.0	114580.0	107180.0				MAX V	13.5	34.7	13.8	21.8

SEE NOTE PIER 1

DGES FILENAME: PILERCT.XLS

LAST UPDATE: 11/10/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = KIP, IN

			FLEXIBLE SUPPORT SPRINGS 60 MODES		RIGID SUPPORT SPRINGS 60 MODES		PIER	DL + BUOYANCY			PILE REACTIONS FLEXIBLE SPRINGS		PILE REACTIONS RIGID SPRINGS	
FNDN UNIT	GLOBAL DOF (GPILE)	ALGOR DOF	EQL F/M	EQT F/M	EQL F/M	EQT F/M	DEAD LOAD	MIN LOAD	MAX LOAD		EQL F/M	EQT F/M	EQL F/M	EQT F/M
P3 SB OUT	FV (FY)	DZ	849.9	2051.0	670.9	1818.1	-5799.3	-4458.3	-4272.3	MIN Rv	-188.3	-223.5	-205.5	-198.0
P3 SB OUT	MT (MX)	RX	148790.0	458760.0	136680.0	443590.0				MAX Rv	93.4	128.6	110.6	103.1
P3 SB OUT	ML (MZ)	RY	595310.0	350260.0	723850.0	231900.0								
P3 SB OUT	FT (FZ)	DY	660.5	1714.8	274.6	884.6				MAX Vt	10.0	21.9	4.6	10.2
P3 SB OUT	FL (FX)	DX	938.7	566.7	822.1	289.1				MAX Vl	13.1	9.5	10.6	3.7
P3 SB OUT	MV (MY)	RZ	30635.0	35821.0	18198.0	6352.7				MAX V	16.4	23.9	11.6	10.9
P3 SB CTR	FV (FY)	DZ	455.4	1056.3	293.7	544.6	-6673.2	-5332.2	-5115.9	MIN Rv	-212.4	-210.1	-199.6	-208.8
P3 SB CTR	MT (MX)	RX	151830.0	471780.0	169050.0	543790.0				MAX Rv	98.8	96.5	86.0	95.3
P3 SB CTR	ML (MZ)	RY	703660.0	262260.0	617370.0	200430.0								
P3 SB CTR	FT (FZ)	DY	638.5	1801.3	362.0	1146.4				MAX Vt	10.3	23.2	5.8	13.1
P3 SB CTR	FL (FX)	DX	1545.3	586.8	688.4	253.1				MAX Vl	20.2	10.1	9.3	3.4
P3 SB CTR	MV (MY)	RZ	36808.0	39459.0	19976.0	6988.6				MAX V	22.7	25.3	11.0	13.5
P3 NB	FV (FY)	DZ	2056.9	3862.8	2347.5	3893.2	-15429.0	-11162.3	-10605.4	MIN Rv	-217.5	-192.5	-319.6	-261.6
P3 NB	MT (MX)	RX	687190.0	1971300.0	1049700.0	3315900.0				MAX Rv	97.9	72.9	200.0	142.0
P3 NB	ML (MZ)	RY	1061800.0	376230.0	1832500.0	580120.0								
P3 NB	FT (FZ)	DY	1942.8	6042.9	1830.0	5037.9				MAX Vt	13.1	35.1	11.1	28.1
P3 NB	FL (FX)	DX	2270.6	893.7	3069.5	990.0				MAX Vl	22.6	12.8	21.1	7.3
P3 NB	MV (MY)	RZ	319880.0	250860.0	133850.0	59444.0				MAX V	26.1	37.4	23.8	29.1

PASSIVE RESISTANCE IGNORED

DGES FILENAME: PILERCT.XLS

LAST UPDATE: 11/10/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = KIP, IN

			ADJUSTED FOR PASSIVE RESISTANCE								PILE REACTIONS			
			FLEXIBLE SUPPORT SPRINGS 60 MODES		RIGID SUPPORT SPRINGS 60 MODES		PIER	DL + BUOYANCY			FLEXIBLE SPRINGS		RIGID SPRINGS	
FNDN UNIT	GLOBAL DOF (GPILE)	MAXIMUM PASSIVE RESISTANCE	EQL F/M	EQT F/M	EQL F/M	EQT F/M	DEAD LOAD	MIN LOAD	MAX LOAD		EQL F/M	EQT F/M	EQL F/M	EQT F/M
P3 SB OUT	FV (FY)		849.9	2051.0	670.9	1818.1	-5799.3	-4458.3	-4272.3	MIN Rv	-168.5	-204.2	-192.2	-182.3
P3 SB OUT	MT (MX)	62710	103765.6	396050.0	117961.1	383296.4				MAX Rv	73.6	109.3	97.3	87.4
P3 SB OUT	ML (MZ)	62710	532600.0	311631.3	667810.4	212191.3								
P3 SB OUT	FT (FZ)	920	0.0	794.8	0.0	0.0				MAX Vt	2.8	11.9	1.7	0.6
P3 SB OUT	FL (FX)	920	18.7	0.0	0.0	0.0				MAX Vl	3.1	3.3	1.7	0.6
P3 SB OUT	MV (MY)		30635.0	35821.0	18198.0	6352.7				MAX V	4.2	12.4	2.4	0.8
P3 SB CTR	FV (FY)		455.4	1056.3	293.7	544.6	-6673.2	-5332.2	-5115.9	MIN Rv	-192.9	-190.5	-186.7	-193.1
P3 SB CTR	MT (MX)	62710	108307.9	409070.0	144372.9	481080.0				MAX Rv	79.3	76.9	73.1	79.5
P3 SB CTR	ML (MZ)	62710	640950.0	222259.2	570443.8	183177.3								
P3 SB CTR	FT (FZ)	920	0.0	881.3	0.0	226.4				MAX Vt	3.4	13.2	1.8	3.1
P3 SB CTR	FL (FX)	920	625.3	0.0	0.0	0.0				MAX Vl	10.2	3.7	1.9	0.7
P3 SB CTR	MV (MY)		36808.0	39459.0	19976.0	6988.6				MAX V	10.8	13.7	2.6	3.2
P3 NB	FV (FY)		2056.9	3862.8	2347.5	3893.2	-15429.0	-11162.3	-10605.4	MIN Rv	-206.6	-185.3	-308.7	-253.8
P3 NB	MT (MX)	24320	662870.0	1946980.0	1025380.0	3291580.0				MAX Rv	87.0	65.7	189.1	134.2
P3 NB	ML (MZ)	87840	973960.0	321180.9	1744660.0	519139.0								
P3 NB	FT (FZ)	395	1547.8	5647.9	1435.0	4642.9				MAX Vt	11.0	33.0	8.9	26.0
P3 NB	FL (FX)	1426	844.6	0.0	1643.5	0.0				MAX Vl	14.8	7.9	13.3	1.9
P3 NB	MV (MY)		319880.0	250860.0	133850.0	59444.0				MAX V	18.4	33.9	16.0	26.0

SEE NOTE PLER 1

DGES FILENAME: PILERCT.XLS

LAST UPDATE: 11/10/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = KIP, IN

			FLEXIBLE SUPPORT SPRINGS 60 MODES		RIGID SUPPORT SPRINGS 60 MODES		PIER	DL + BUOYANCY			PILE REACTIONS FLEXIBLE SPRINGS		PILE REACTIONS RIGID SPRINGS	
FNDN UNIT	GLOBAL DOF (GPILE)	ALGOR DOF	EQL F/M	EQT F/M	EQL F/M	EQT F/M	DEAD LOAD	MIN LOAD	MAX LOAD		EQL F/M	EQT F/M	EQL F/M	EQT F/M
P4 SB OUT	FV (FY)	DZ	2445.1	3740.2	1659.5	3243.5	-6084.2	-4786.8	-4600.8	MIN Rv	-206.7	-191.8	-281.7	-272.7
P4 SB OUT	MT (MX)	RX	86949.0	269700.0	180200.0	565740.0				MAX Rv	97.5	82.6	172.5	163.5
P4 SB OUT	ML (MZ)	RY	610720.0	184890.0	984320.0	298970.0								
P4 SB OUT	FT (FZ)	DY	480.1	1464.3	406.0	1201.1				MAX Vt	6.3	17.5	6.5	14.5
P4 SB OUT	FL (FX)	DX	922.4	299.8	1112.7	350.9				MAX Vl	11.5	4.0	14.7	4.6
P4 SB OUT	MV (MY)	RZ	7714.7	4847.7	18047.0	5546.7				MAX V	13.1	17.9	16.1	15.2
P4 SB CTR	FV (FY)	DZ	2272.6	2589.0	1306.9	1649.8	-6224.5	-4927.1	-4711.2	MIN Rv	-204.6	-177.8	-273.4	-276.9
P4 SB CTR	MT (MX)	RX	84093.0	261870.0	222790.0	678590.0				MAX Rv	92.6	65.7	161.3	164.8
P4 SB CTR	ML (MZ)	RY	604680.0	182250.0	892050.0	271340.0								
P4 SB CTR	FT (FZ)	DY	510.9	1581.2	551.1	1536.3				MAX Vt	6.9	18.9	8.3	18.4
P4 SB CTR	FL (FX)	DX	1125.2	368.5	1007.7	320.7				MAX Vl	14.0	4.9	13.6	4.3
P4 SB CTR	MV (MY)	RZ	9491.7	5784.7	19376.0	5889.6				MAX V	15.6	19.6	15.9	18.9
P4 NB	FV (FY)	DZ	5525.9	6912.8	3368.0	5256.8	-15223.0	-11431.3	-10798.9	MIN Rv	-206.5	-179.6	-289.3	-277.4
P4 NB	MT (MX)	RX	507720.0	1565900.0	1254000.0	3970800.0				MAX Rv	94.2	67.3	177.0	165.1
P4 NB	ML (MZ)	RY	1341700.0	405180.0	2217700.0	671180.0								
P4 NB	FT (FZ)	DY	1734.5	5410.6	2122.9	5718.6				MAX Vt	10.5	28.0	12.1	29.4
P4 NB	FL (FX)	DX	2469.1	771.9	3423.7	1044.8				MAX Vl	16.8	5.6	20.8	6.5
P4 NB	MV (MY)	RZ	144850.0	56598.0	116340.0	39841.0				MAX V	19.8	28.6	24.1	30.1

ALGOR EQX = EQL = 1.0L + 0.3T + 0.667V

ALGOR EQY = EQT = 0.3L + 1.0T + 0.667V

ALGOR X = LONGITUDINAL

ALGOR Y = TRANSVERSE

ALGOR Z = VERTICAL

PASSIVE RESISTANCE IGNORED

DGES FILENAME: PILERCT.XLS

LAST UPDATE: 11/10/94

SUBSTRUCTURE ELASTIC REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = KIP, IN

			ADJUSTED FOR PASSIVE RESISTANCE								PILE REACTIONS			
			FLEXIBLE SUPPORT SPRINGS 60 MODES		RIGID SUPPORT SPRINGS 60 MODES			DL + BUOYANCY			FLEXIBLE SPRINGS		RIGID SPRINGS	
FNDN UNIT	GLOBAL DOF (GPILE)	MAXIMUM PASSIVE RESISTANCE	EQL F/M	EQT F/M	EQL F/M	EQT F/M	PIER DEAD LOAD	MIN LOAD	MAX LOAD		EQL F/M	EQT F/M	EQL F/M	EQT F/M
P4 SB OUT	FV (FY)		2445.1	3740.2	1659.5	3243.5	-6084.2	-4786.8	-4600.8	MIN Rv	-199.6	-185.8	-275.2	-266.4
P4 SB OUT	MT (MX)	18250	69493.7	251450.0	165441.9	547490.0				MAX Rv	90.5	76.6	166.1	157.2
P4 SB OUT	ML (MZ)	18250	592470.0	173992.4	966070.0	286213.5								
P4 SB OUT	FT (FZ)	502	0.0	962.3	0.0	699.1				MAX Vt	0.7	11.7	1.7	8.7
P4 SB OUT	FL (FX)	502	420.4	0.0	610.7	0.0				MAX Vl	5.6	0.5	8.9	0.5
P4 SB OUT	MV (MY)		7714.7	4847.7	18047.0	5546.7				MAX V	5.7	11.7	9.0	8.7
P4 SB CTR	FV (FY)		2272.6	2589.0	1306.9	1649.8	-6224.5	-4927.1	-4711.2	MIN Rv	-197.4	-171.4	-266.2	-270.8
P4 SB CTR	MT (MX)	18250	65843.0	243620.0	204540.0	660340.0				MAX Rv	85.3	59.3	154.1	158.7
P4 SB CTR	ML (MZ)	18250	586430.0	168852.2	873800.0	259682.2								
P4 SB CTR	FT (FZ)	502	8.9	1079.2	49.1	1034.3				MAX Vt	1.0	13.1	2.4	12.6
P4 SB CTR	FL (FX)	502	623.2	0.0	505.7	0.0				MAX Vl	8.2	0.6	7.8	0.6
P4 SB CTR	MV (MY)		9491.7	5784.7	19376.0	5889.6				MAX V	8.2	13.1	8.2	12.6
P4 NB	FV (FY)		5525.9	6912.8	3368.0	5256.8	-15223.0	-11431.3	-10798.9	MIN Rv	-203.4	-176.5	-286.2	-274.3
P4 NB	MT (MX)	13800	493920.0	1552100.0	1240200.0	3957000.0				MAX Rv	91.1	64.2	173.9	162.0
P4 NB	ML (MZ)	34100	1307600.0	371080.0	2183600.0	637080.0								
P4 NB	FT (FZ)	301	1433.5	5109.6	1821.9	5417.6				MAX Vt	9.0	26.5	10.6	27.8
P4 NB	FL (FX)	740	1729.1	31.9	2683.7	304.8				MAX Vl	13.1	1.9	17.1	2.7
P4 NB	MV (MY)		144850.0	56598.0	116340.0	39841.0				MAX V	15.9	26.5	20.1	28.0

ALGOR EQX = EQL = 1.0L + 0.3T + 0.667V

ALGOR EQY = EQT = 0.3L + 1.0T + 0.667V

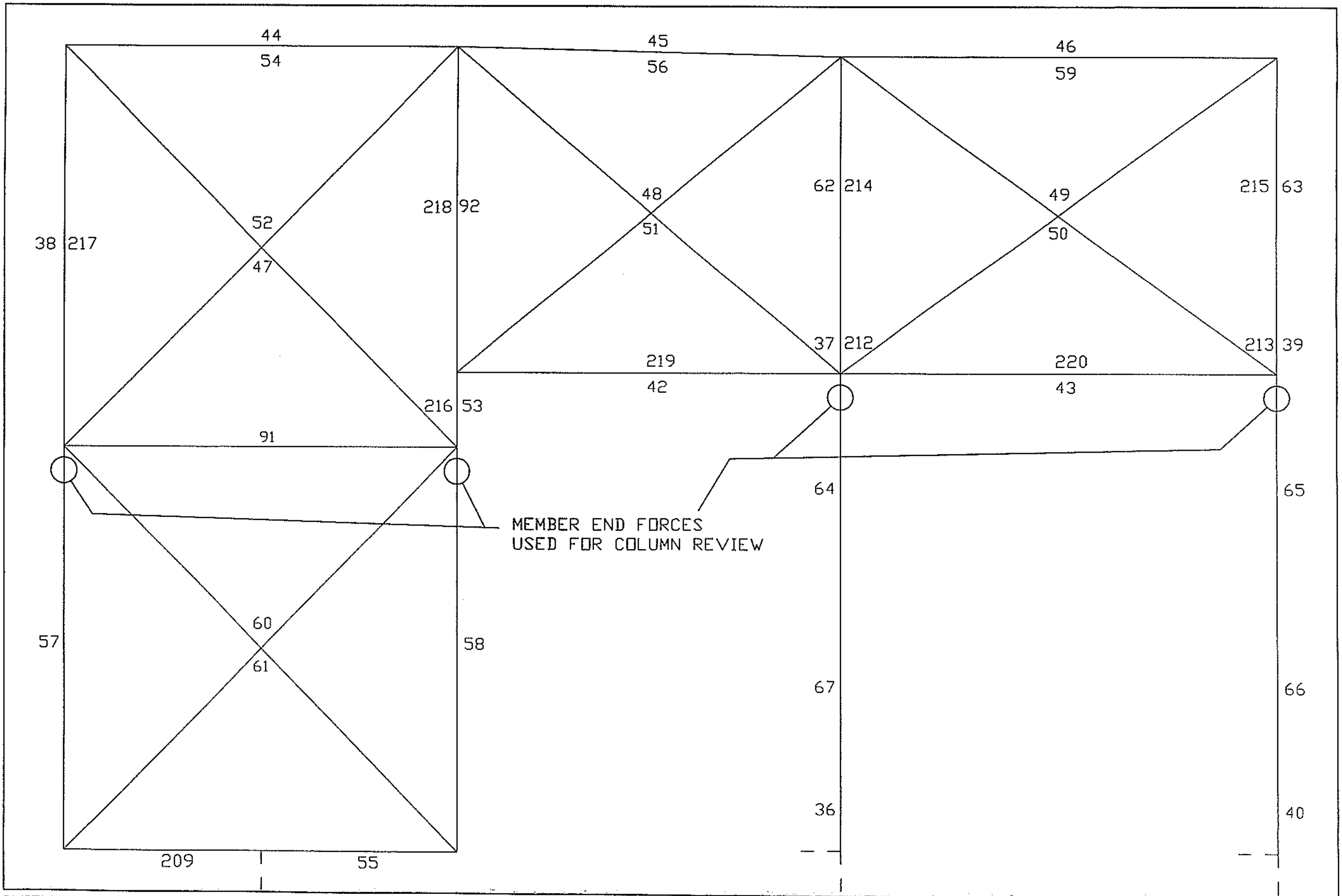
ALGOR X = LONGITUDINAL

ALGOR Y = TRANSVERSE

ALGOR Z = VERTICAL

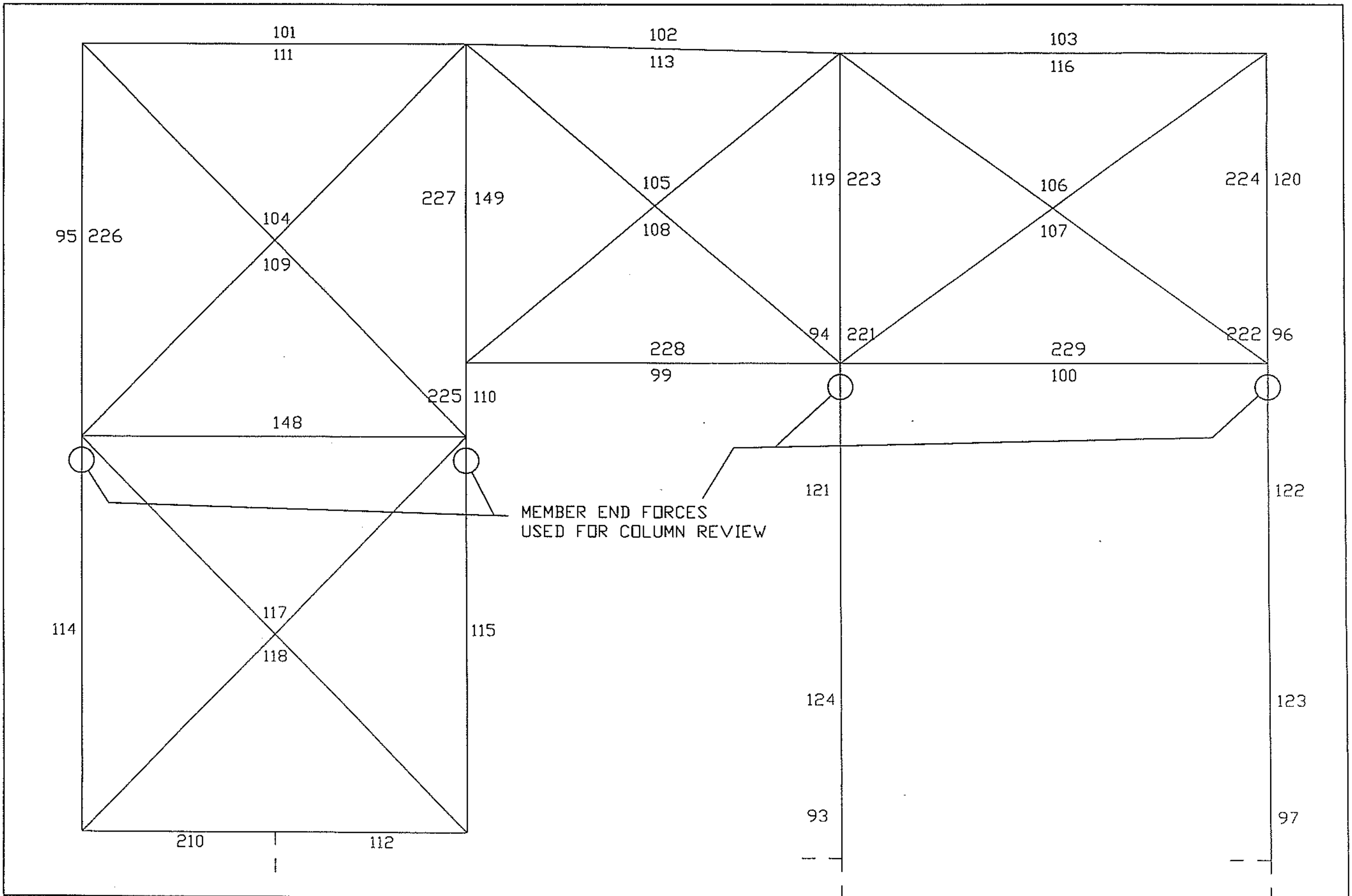
SEE NOTE PIER 4

PIER 2 MODEL



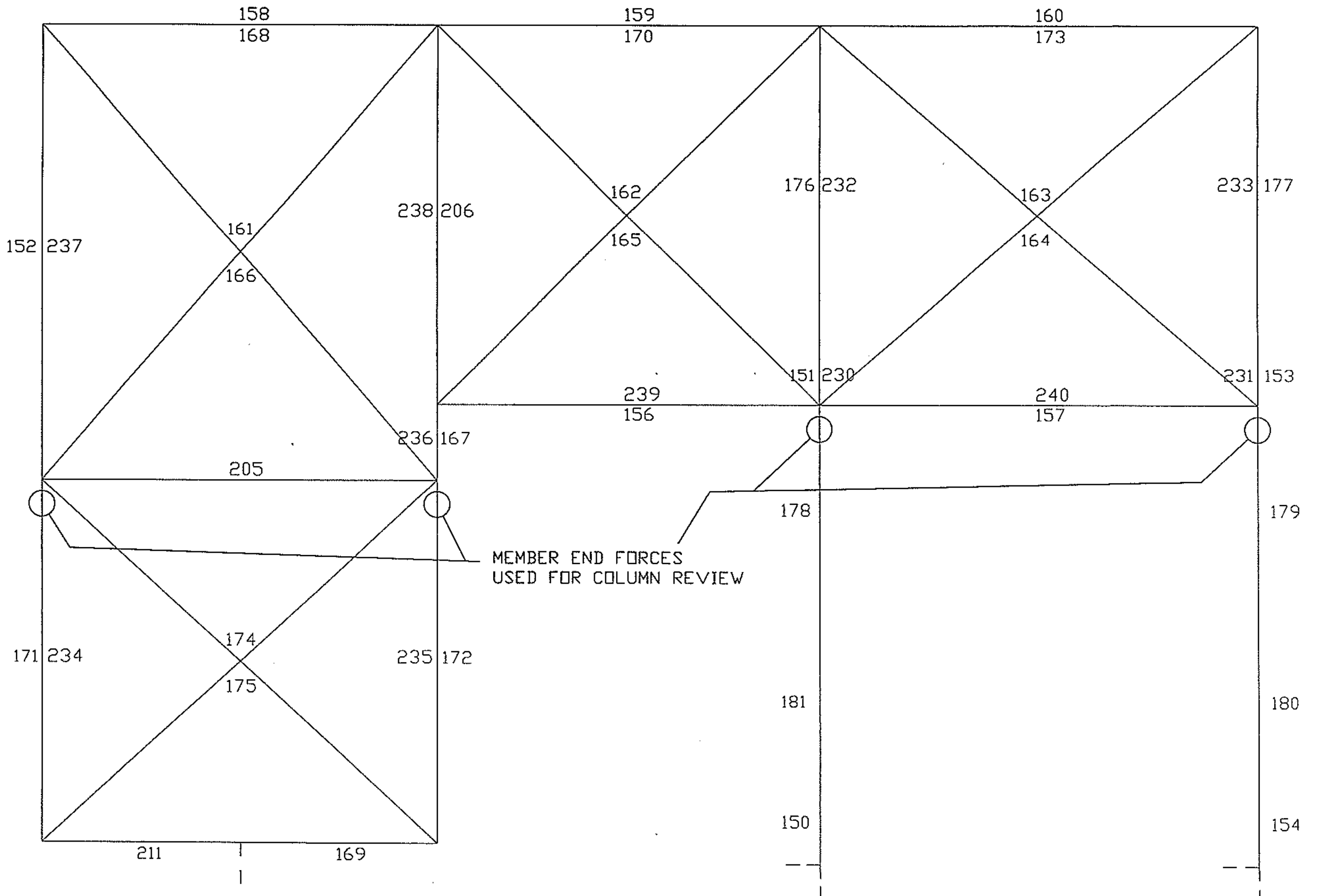
SVIEW 4.12 File:subflex 94/11/07 16:12 LC 1/ 60 Vu= 6 Lo= -90 La= 0 R= 0

PIER 3 MODEL



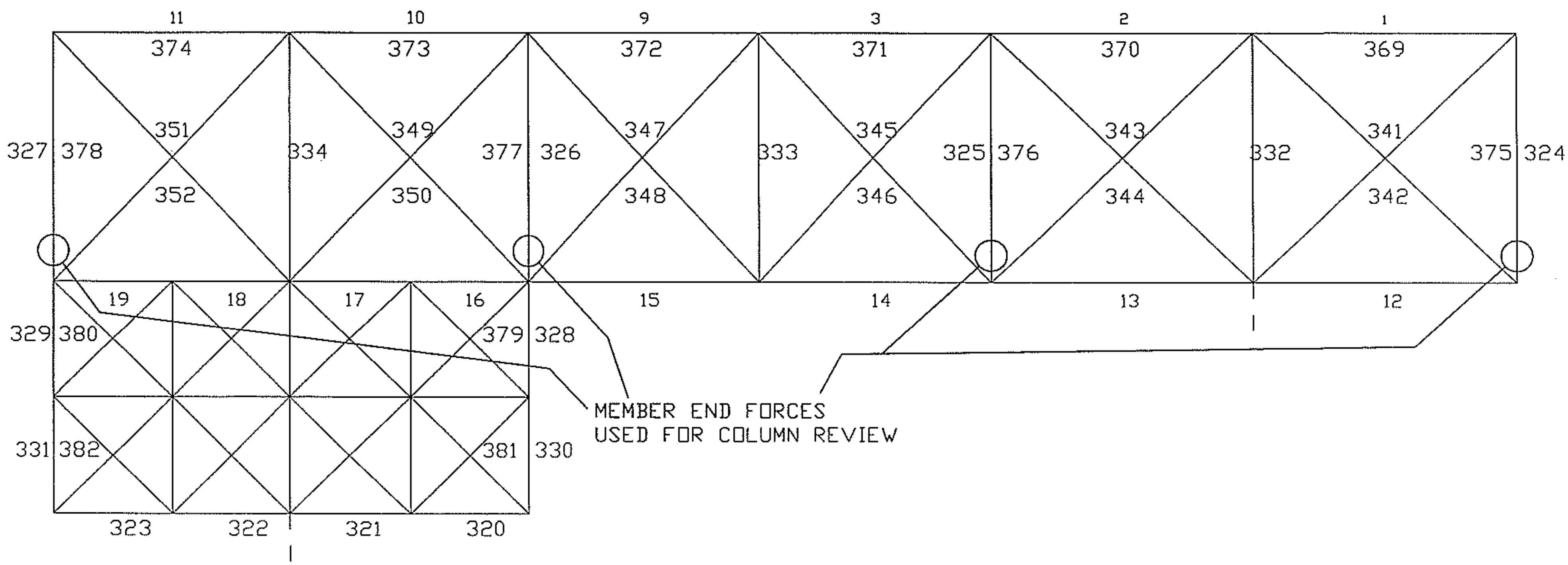
SVIEW 4.12 File:subflex 94/11/07 16:12 LC 1/ 60 Vu= 6 Lo= -90 La= 0 R= 0

PIER 4 MODEL



SVIEW 4.12 File:subflex 94/11/07 16:12 LC 1/ 60 Vu= 6 Lo= -90 La= 0 R= 0

PIER 1 MODEL



SVIEW 4.12 File:subflex 94/11/07 16:12 LC 1/ 60 Vu= 6 Lo= -90 La= 0 R= 0

PIERCHEK.XLS

ODOT - COLUMBIA RIVER/SR5

SEISMIC DEMAND FOR PIER COLUMN MEMBERS

UNITS KIP, FT

X = LONGITUDINAL

Y = TRANSVERSE

Z = VERTICAL

		DEAD LOAD			RESPONSE SPECTRUM ANALYSIS OUTPUT EQX = 1.0X + 0.3Y + 2/3Z RUN SXFIX					EQX = 1.0X + 0.3Y + 2/3Z RUN SXFLEX				
DESCRIPTION	MEM	P	MLj	MTj *	P	VT	VL	MLj	MTj	P	VT	VL	MLj	MTj
PIER 2														
NB OUTER COLUMN	57	-3941	688	0	1275	60	1129	20542	553	934	81	745	13283	1228
NB INNER COLUMN	58	-3743	705	0	949	60	1275	20442	468	499	83	670	15625	1106
SB INNER COLUMN	64	-3175	1368	0	317	339	874	29833	3402	482	237	748	23567	5795
SB OUTER COLUMN	65	-2969	1363	0	688	255	997	30975	1880	678	244	685	23300	4833
PIER 3														
NB OUTER COLUMN	114	-4129	-649	0	1494	95	965	15350	1539	1108	71	770	11192	1241
NB INNER COLUMN	115	-3329	-684	0	1283	82	1153	15625	1088	386	77	517	11708	1181
SB INNER COLUMN	121	-3726	-1428	0	292	331	639	19900	3866	428	404	725	20575	8942
SB OUTER COLUMN	122	-2852	-1416	0	663	253	776	21092	2311	780	394	563	19442	7155
PIER 4														
SUM NB OUTER		-5021	354	0	2159	370	1521	36445	3601	1919	262	896	27195	3247
SUM NB INNER		-4940	350	0	1882	350	1593	37583	3118	1817	302	865	26747	2544
SB INNER COLUMN	178	-3332	381	0	1215	440	886	34242	3958	1341	325	580	23717	10450
SB OUTER COLUMN	179	-3192	376	0	1570	340	1000	35942	2110	1571	304	582	23108	8583
		P	MLi	MTi *	P	VT	VL	MLi	MTi	P	VT	VL	MLi	MTi
PIER 1														
SUM NB OUTER		-767	-30	0	103	5	144	3066	28	88	8	131	1982	41
SUM NB INNER		-637	-65	0	33	11	165	3149	120	46	36	59	1506	425
SUM SB INNER		-661	-96	0	32	60	164	2861	695	46	85	230	4159	1062
SUM SB OUTER		-547	-111	0	98	7	72	1837	74	72	5	115	2865	79

* MT FROM DL ANALYSIS IS PRIMARILY DUE TO NB/SB SUBSTRUCTURE CONNECTIVITY.
UNITS WERE NOT CONNECTED UNTIL AFTER DEAD LOAD PLACED.
THEREFORE, DEAD LOAD MT IS IGNORED.

ODOT - COLUMBIA RIVER/SR5											
SEISMIC DEMAND FOR PIER COLUMN											
UNITS KIP, FT											
X = LONGITUDINAL		RESPONSE SPECTRUM ANALYSIS OUTPUT									
Y = TRANSVERSE											
Z = VERTICAL											
		EQY = 0.3X + 1.0Y + 2/3Z					EQY = 0.3X + 1.0Y + 2/3Z				
		RUN SYFIX					RUN SYFLEX				
DESCRIPTION	MEM	P	VT	VL	MLj	MTj	P	VT	VL	MLj	MTj
PIER 2											
NB OUTER COLUMN	57	4043	195	379	6702	1806	3009	266	235	4188	4038
NB INNER COLUMN	58	3009	194	419	6646	1439	1518	273	215	5004	3633
SB INNER COLUMN	64	508	1119	308	9225	11125	1158	780	232	7340	19092
SB OUTER COLUMN	65	1736	834	338	9550	6183	1748	763	214	7258	15692
PIER 3											
NB OUTER COLUMN	114	4482	239	314	4879	2939	2496	226	405	5343	3868
NB INNER COLUMN	115	3504	226	375	5009	2150	763	243	213	4472	3764
SB INNER COLUMN	121	542	1068	224	6249	12267	1016	1106	255	8525	26375
SB OUTER COLUMN	122	1804	823	262	6603	7442	1957	1022	379	8294	20833
PIER 4											
SUM NB OUTER		5934	942	465	10980	6158	2907	773	278	8336	9826
SUM NB INNER		4185	956	487	11324	4271	2059	919	267	8201	7591
SB INNER COLUMN	178	1533	1377	274	10325	11408	1766	999	176	7249	32517
SB OUTER COLUMN	179	3157	1085	308	10833	6321	3053	914	177	7028	26517
		P	VT	VL	MLi	MTi	P	VT	VL	MLi	MTi
PIER 1											
SUM NB OUTER		293	11	67	1025	53	208	16	93	865	24
SUM NB INNER		52	34	69	1039	347	77	96	80	805	1129
SUM SB INNER		52	173	61	1037	2020	98	222	120	2418	2778
SUM SB OUTER		252	15	48	868	68	167	5	150	2745	89

ODOT - COLUMBIA RIVER/SR5

SEISMIC DEMAND FOR PIER COLUMN

UNITS KIP, FT

X = LONGITUDINAL

Y = TRANSVERSE

Z = VERTICAL

COMBINED FORCES

VT' = COLUMN VT + HORIZ COMPONENT OF DIAGONAL MEM AXIAL FORCE

		DL + SXFIX						DL + SXFLEX					
DESCRIPTION	MEM	P+	P-	VT'	VL	MLj	MTj	P+	P-	VT'	VL	MLj	MTj
PIER 2													
NB OUTER COLUMN	57	-2666	-5216	644	1129	21230	553	-3007	-4875	831	745	13971	1228
NB INNER COLUMN	58	-2794	-4692	644	1275	21147	468	-3244	-4242	833	670	16330	1106
SB INNER COLUMN	64	-2858	-3492	339	874	31201	3402	-2693	-3657	237	748	24935	5795
SB OUTER COLUMN	65	-2281	-3657	255	997	32338	1880	-2291	-3647	244	685	24663	4833
PIER 3													
NB OUTER COLUMN	114	-2635	-5623	922	965	15999	1539	-3021	-5237	770	770	11841	1241
NB INNER COLUMN	115	-2046	-4612	909	1153	16309	1088	-2943	-3715	776	517	12392	1181
SB INNER COLUMN	121	-3434	-4018	331	639	21328	3866	-3298	-4154	404	725	22003	8942
SB OUTER COLUMN	122	-2189	-3515	253	776	22508	2311	-2072	-3632	394	563	20858	7155
PIER 4													
SUM NB OUTER		-2862	-7180	1004	1521	36799	3601	-3102	-6940	734	896	27549	3247
SUM NB INNER		-3058	-6822	984	1593	37933	3118	-3123	-6757	774	865	27097	2544
SB INNER COLUMN	178	-2117	-4547	440	886	34623	3958	-1991	-4673	325	580	24098	10450
SB OUTER COLUMN	179	-1622	-4762	340	1000	36318	2110	-1621	-4763	304	582	23484	8583
		P+	P-	VT	VL	MLi	MTi	P+	P-	VT	VL	MLi	MTi
PIER 1													
SUM NB OUTER		-664	-870	93	144	3096	28	-679	-855	166	131	2012	41
SUM NB INNER		-604	-670	99	165	3214	120	-591	-683	194	59	1571	425
SUM SB INNER		-629	-693	148	164	2957	695	-615	-707	243	230	4255	1062
SUM SB OUTER		-449	-645	95	72	1948	74	-475	-619	163	115	2976	79

ODOT - COLUMBIA RIVER/SR5

SEISMIC DEMAND FOR PIER COLUMN

UNITS KIP, FT

X = LONGITUDINAL

Y = TRANSVERSE

Z = VERTICAL

COMBINED FORCES

VT' = COLUMN VT + HORIZ COMPONENT OF DIAGONAL MEM AXIAL FORCE

DESCRIPTION	MEM	DL + SYFIX P+	P-	VT'	VL	MLj	MTj	DL + SYFLEX P+	P-	VT'	VL	MLj	MTj
PIER 2													
NB OUTER COLUMN	57	102	-7984	2098	379	7390	1806	-932	-6950	2724	235	4876	4038
NB INNER COLUMN	58	-734	-6752	2097	419	7351	1439	-2225	-5261	2731	215	5709	3633
SB INNER COLUMN	64	-2667	-3683	1119	308	10593	11125	-2017	-4333	780	232	8708	19092
SB OUTER COLUMN	65	-1233	-4705	834	338	10913	6183	-1221	-4717	763	214	8621	15692
PIER 3													
NB OUTER COLUMN	114	353	-8611	2495	314	5528	2939	-1633	-6625	2331	405	5992	3868
NB INNER COLUMN	115	175	-6833	2482	375	5693	2150	-2566	-4092	2348	213	5156	3764
SB INNER COLUMN	121	-3184	-4268	1068	224	7677	12267	-2710	-4742	1106	255	9953	26375
SB OUTER COLUMN	122	-1048	-4656	823	262	8019	7442	-895	-4809	1022	379	9710	20833
PIER 4													
SUM NB OUTER		913	-10955	2769	465	11334	6158	-2114	-7928	2157	278	8690	9826
SUM NB INNER		-755	-9125	2783	487	11674	4271	-2881	-6999	2303	267	8551	7591
SB INNER COLUMN	178	-1799	-4865	1377	274	10706	11408	-1566	-5098	999	176	7630	32517
SB OUTER COLUMN	179	-35	-6349	1085	308	11209	6321	-139	-6245	914	177	7404	26517
		P+	P-	VT	VL	MLi	MTi	P+	P-	VT	VL	MLi	MTi
PIER 1													
SUM NB OUTER		-474	-1060	258	67	1055	53	-559	-975	420	93	895	24
SUM NB INNER		-585	-689	281	69	1104	347	-560	-714	500	80	870	1129
SUM SB INNER		-609	-713	420	61	1133	2020	-563	-759	626	120	2514	2778
SUM SB OUTER		-295	-799	262	48	979	68	-380	-714	409	150	2856	89

PIERCHEK.XLS

ODOT - COLUMBIA RIVER/SR5

SEISMIC DEMAND FOR PIER COLUMN

UNITS KIP, FT

X = LONGITUDINAL

Y = TRANSVERSE

Z = VERTICAL

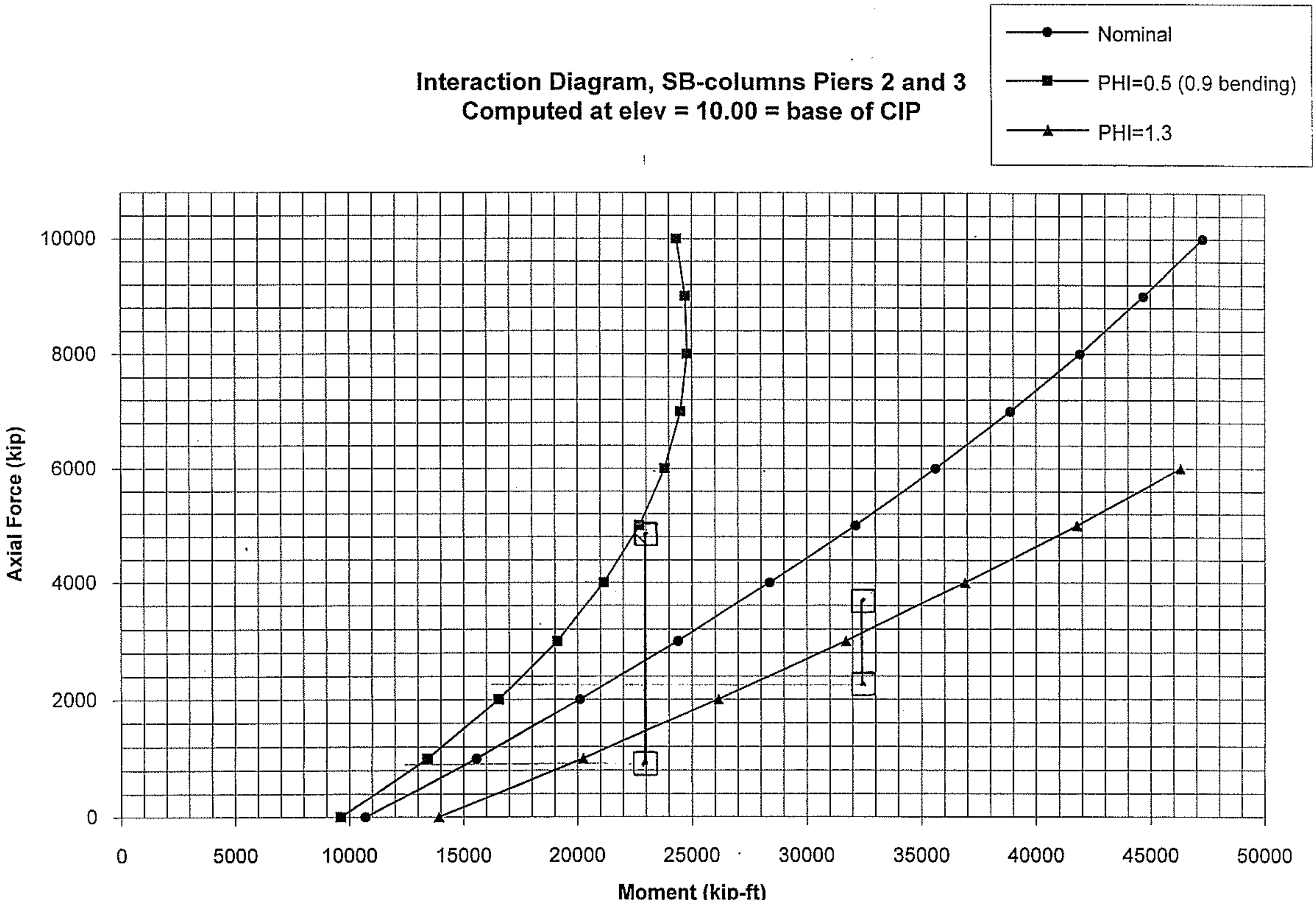
COMBINED FORCES

VT' = COLUMN VT + HORIZ COMPONENT OF DIAGONAL MEM AXIAL FORCE

ENVELOPE OF ELASTIC SEISMIC DEMAND

DESCRIPTION	MEM	P+	P-	VT'	VL	MLj	MTj
PIER 2							
NB OUTER COLUMN	57	102	-7984	2724	1129	21230	4038
NB INNER COLUMN	58	-734	-6752	2731	1275	21147	3633
SB INNER COLUMN	64	-2017	-4333	1119	874	31201	19092
SB OUTER COLUMN	65	-1221	-4717	834	997	32338	15692
PIER 3							
NB OUTER COLUMN	114	353	-8611	2495	965	15999	3868
NB INNER COLUMN	115	175	-6833	2482	1153	16309	3764
SB INNER COLUMN	121	-2710	-4742	1106	725	22003	26375
SB OUTER COLUMN	122	-895	-4809	1022	776	22508	20833
PIER 4							
SUM NB OUTER		913	-10955	2769	1521	36799	9826
SUM NB INNER		-755	-9125	2783	1593	37933	7591
SB INNER COLUMN	178	-1566	-5098	1377	886	34623	32517
SB OUTER COLUMN	179	-35	-6349	1085	1000	36318	26517
		P+	P-	VT	VL	MLi	MTi
PIER 1							
SUM NB OUTER		-474	-1060	420	144	3096	53
SUM NB INNER		-560	-714	500	165	3214	1129
SUM SB INNER		-563	-759	626	230	4255	2778
SUM SB OUTER		-295	-799	409	150	2976	89

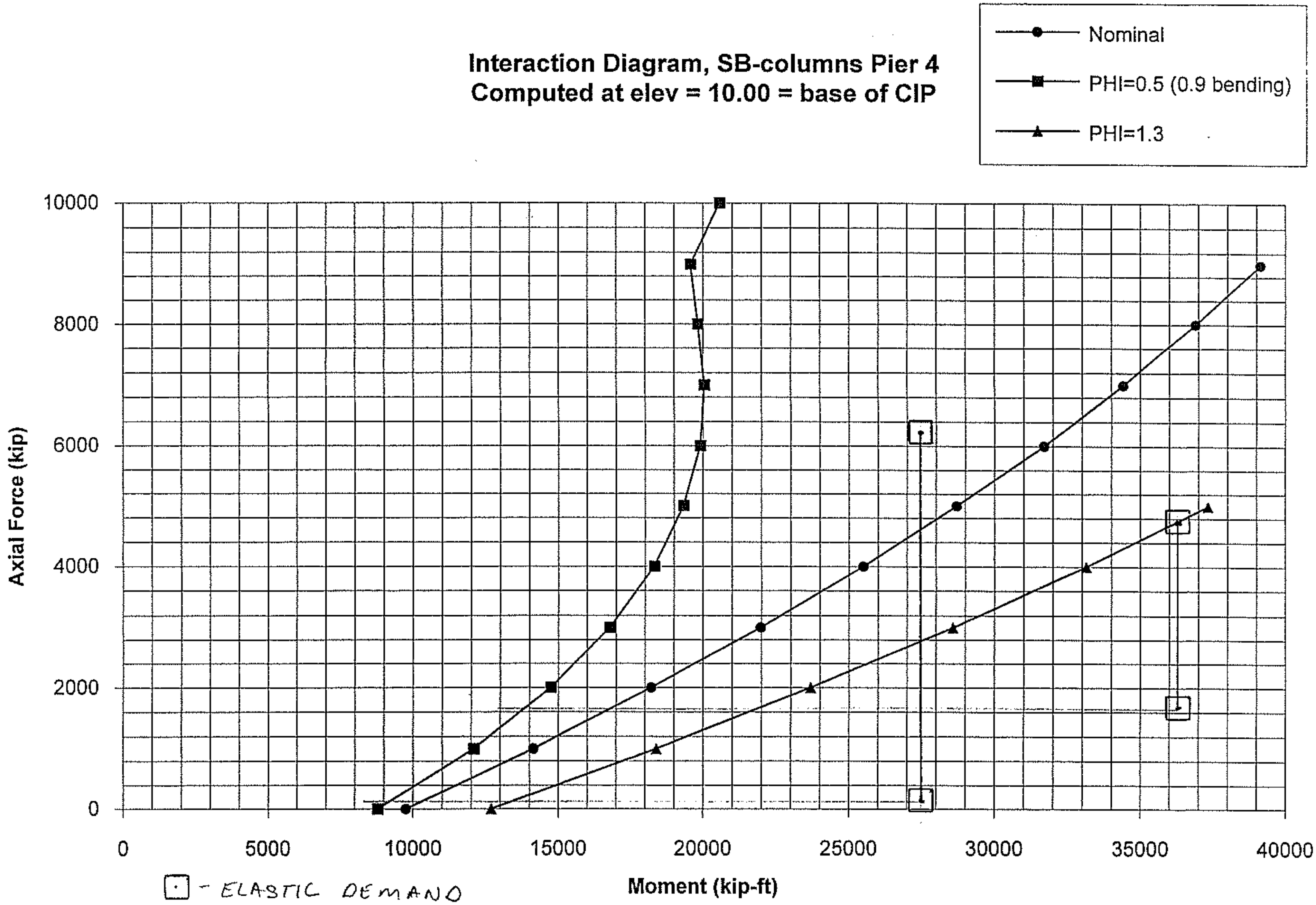
Interaction Diagram, SB-columns Piers 2 and 3
Computed at elev = 10.00 = base of CIP



$\boxed{\cdot}$ – ELASTIC DEMAND

$D/C = 23/13 = 1.8$

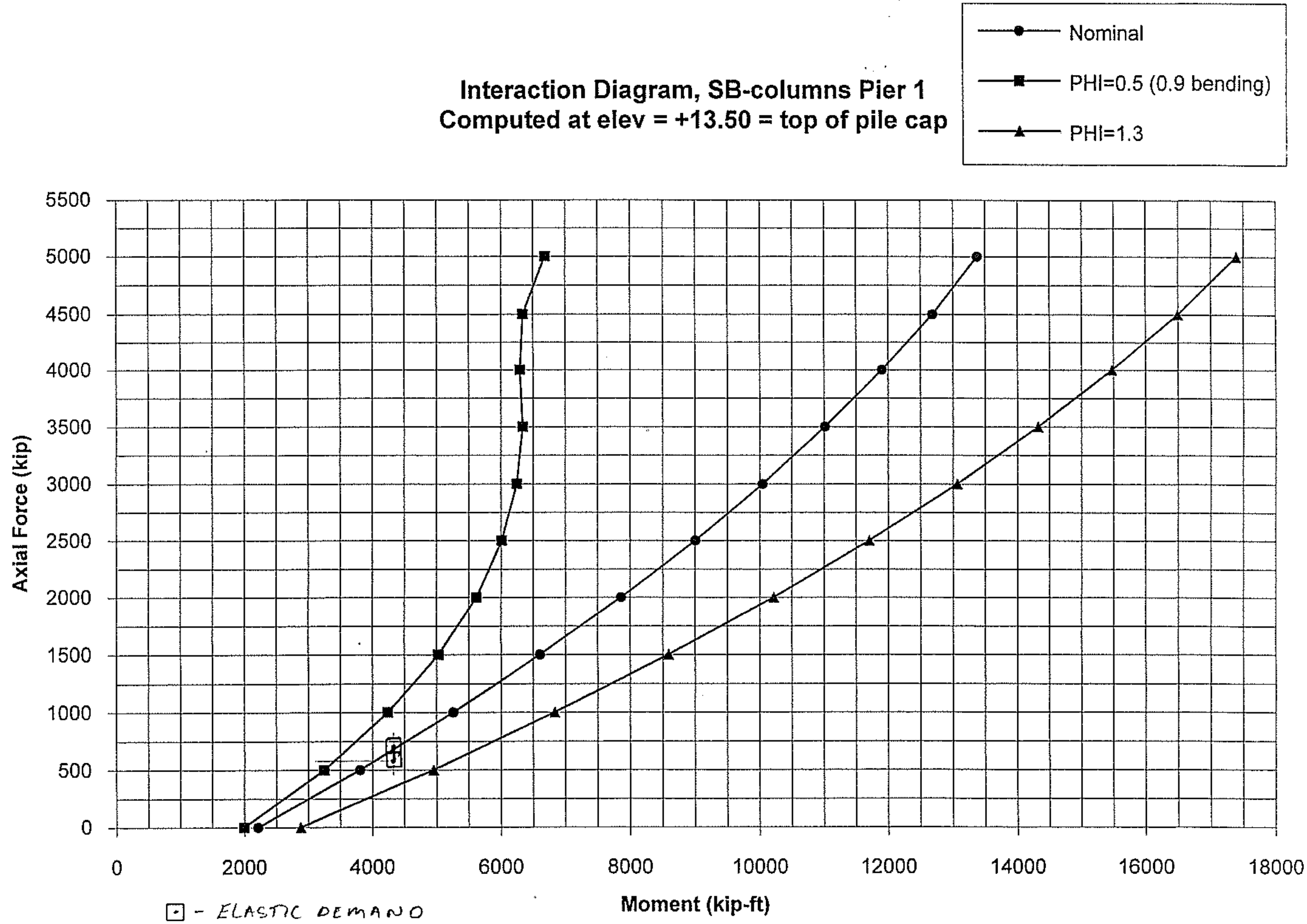
$= 32.4/17.2 = \boxed{1.9}$



□ - ELASTIC DEMAND

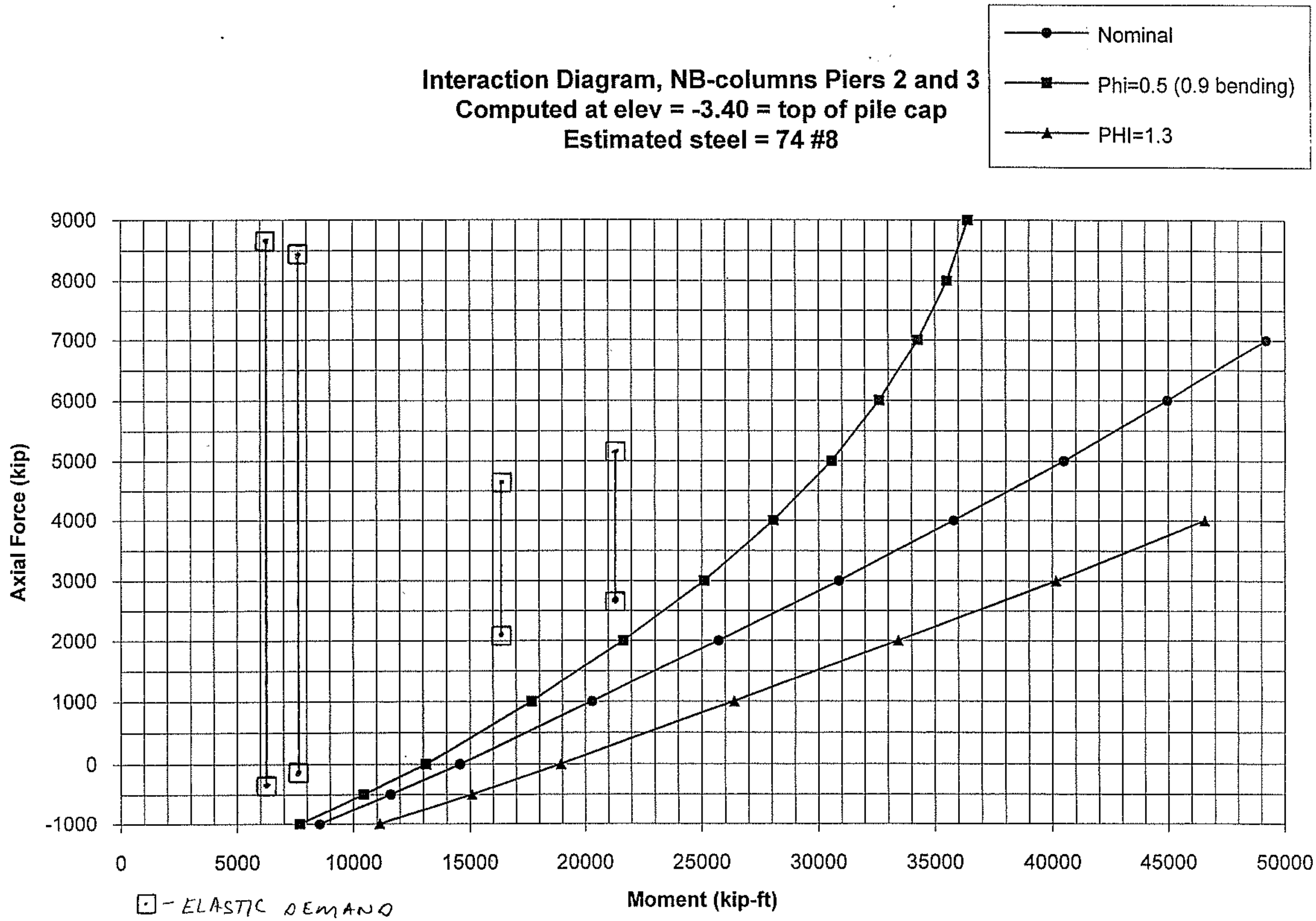
$D/C = 27.5/9.1 = \boxed{3.0}$

$= 36.4/13.7 = 2.7$



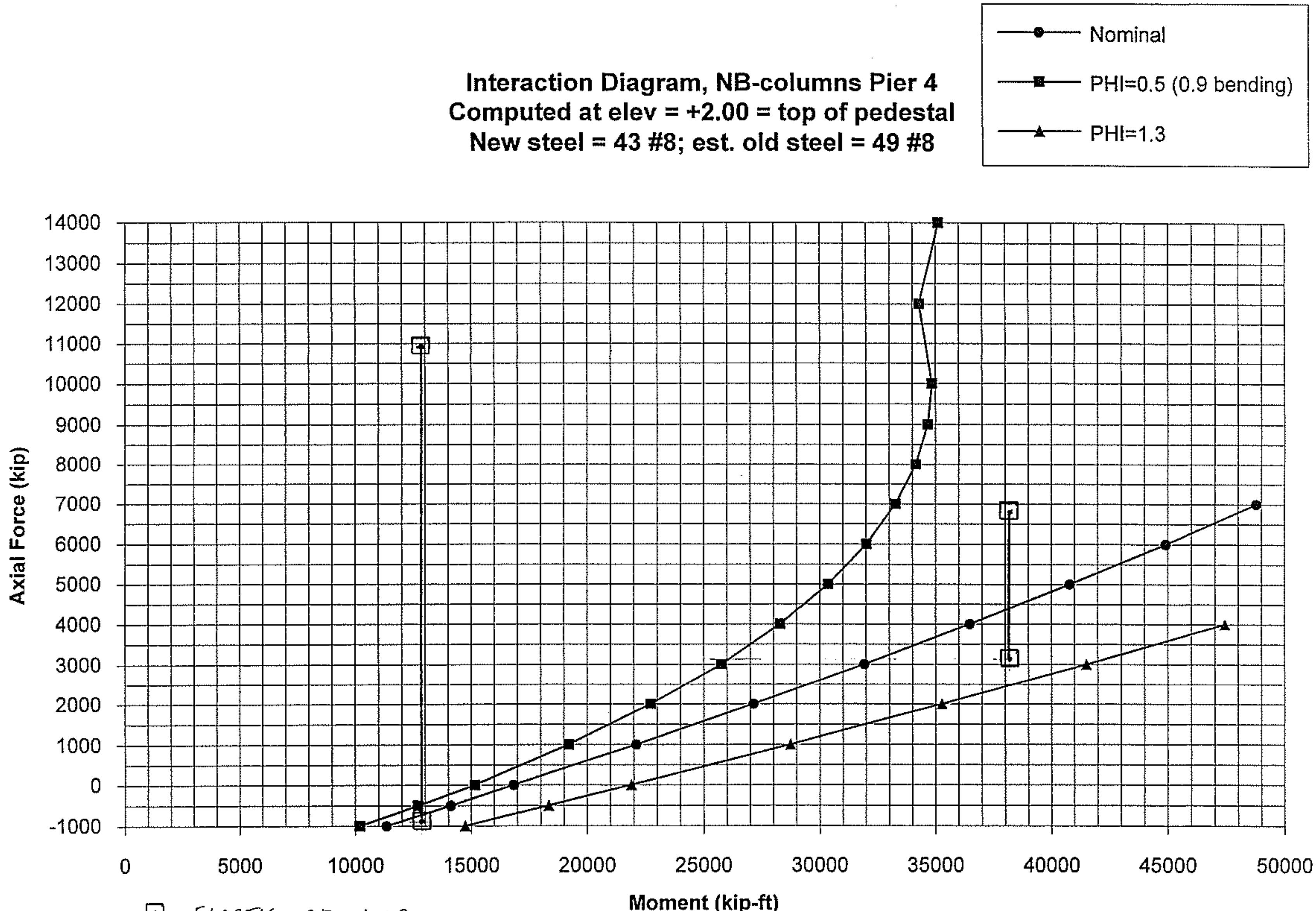
⊡ - ELASTIC DEMAND

$O/C = 4.4/3.4 = \boxed{1.3}$



$\boxed{\cdot}$ - ELASTIC DEMAND

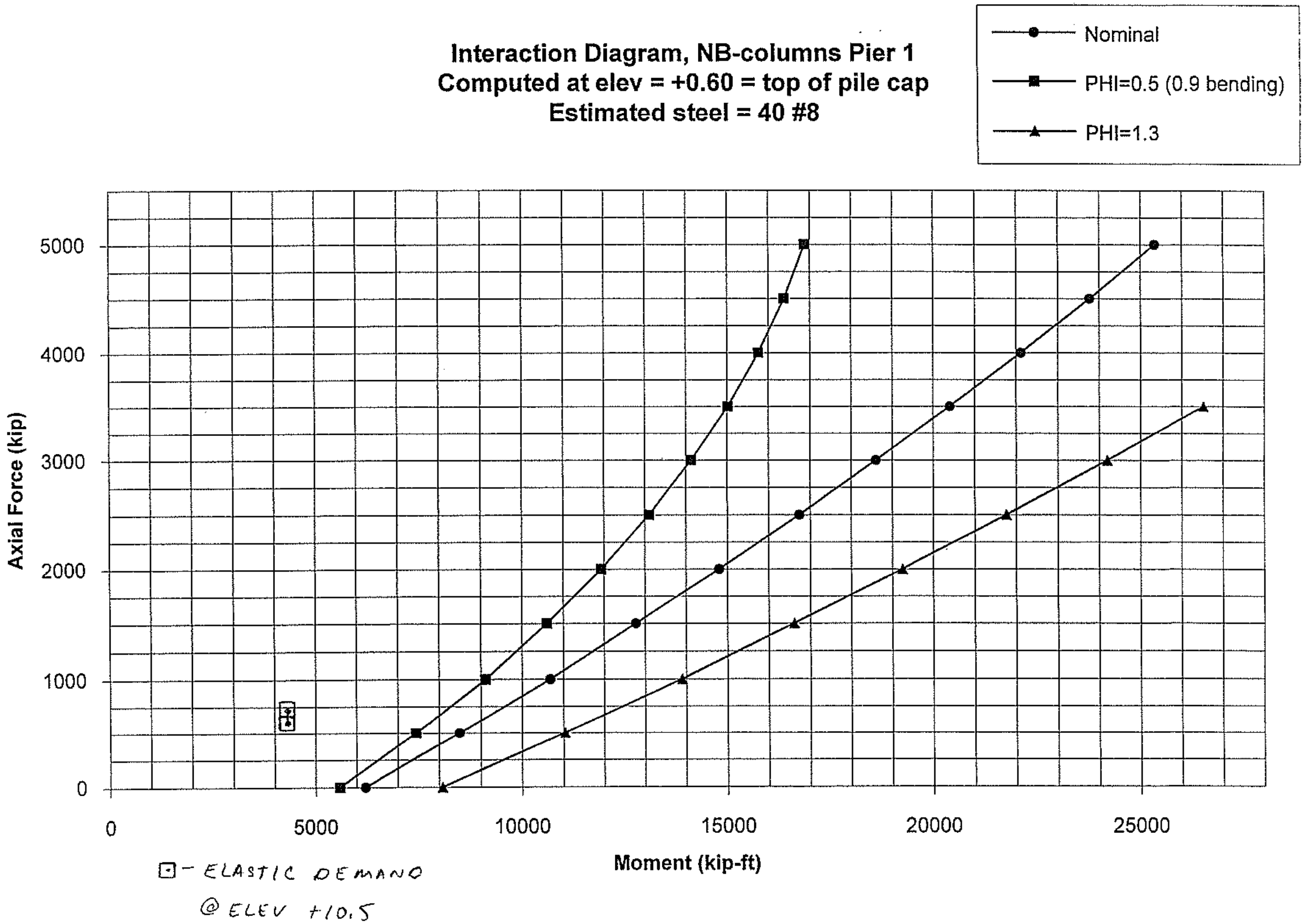
D/C < 1 OK!



- ELASTIC DEMAND

$D/C = 38.1/26.0 = \boxed{1.5}$

$D/C = 12.9/10.5 = 1.2$


Interaction Diagram, NB-columns Pier 1
Computed at elev = +0.60 = top of pile cap
Estimated steel = 40 #8
Nominal
PHI=0.5 (0.9 bending)
PHI=1.3
Axial Force (kip)
5000
4000
3000
2000
1000
0
5000
10000
15000
20000
25000
Moment (kip-ft)
ELASTIC DEMAND
@ ELEV +10.5

ODOT - COLUMBIA RIVER/SR5
SHEAR IN WEB WALL PANELS
UNITS KIP

		ALGOR AXIAL FORCE SYFLEX	PANEL SHEAR	ALGOR AXIAL FORCE SYFIX	PANEL SHEAR
PIER 2	NB	267.6		680.3	
		477.7	527.0	878.6	1102.3
	CTR	1721.0		1154.0	
		1304.0	2139.0	964.1	1497.7
	SB	782.5		642.0	
		626.7	996.5	513.5	817.1
	TOTAL		3662.5		3417.1
PIER 3	NB	256.9		747.8	
		345.5	426.0	1019.0	1249.3
	CTR	1679.0		1275.0	
		1499.0	2247.2	993.5	1604.1
	SB	1030.0		649.1	
		761.6	1266.9	528.2	832.5
	TOTAL		3940.0		3685.9
PIER 4	NB	204.3		1261.0	
		433.5	451.0	1657.0	2063.3
	CTR	2358.0		1694.0	
		2026.0	3100.0	1339.0	2144.7
	SB	1324.0		993.5	
		1028.0	1663.1	800.3	1268.4
	TOTAL		5214.1		5476.4

DGES FILENAME: S2BRG.XLS

LAST UPDATE:

11/16/94

BEARING DISPLACEMENTS/REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = LB, IN

SPAN 2; FLEXIBLE SUPPORT SPRINGS

	ALGOR			EQX				DEAD LOAD		EQX					
BRG	MEM	END		DX				F1		F1	F2	F3	M1	M2	M3
				PIER	TRUSS	REL		VERT		VERT	FL	FT	TOR	MT	ML
1W	4	I		0.40	1.79	1.38		601300		166400	0	120500	0	2854000	0
1E	25	I		0.60	1.77	1.17		499100		134500	0	128100	0	2975000	0
2W	68	I		1.70	1.75	0.04		2014500		340000	390900	217000	0	6812000	0
2E	77	I		1.77	1.78	0.02		1753300		334100	381400	309800	0	8506000	0
	ALGOR			EQY						EQY					
	MEM	END		DX						F1	F2	F3	M1	M2	M3
				PIER	TRUSS	REL				VERT	FL	FT	TOR	MT	ML
1W	4	I		0.46	0.62	0.17				214800	0	322700	0	6875000	0
1E	25	I		0.40	0.60	0.20				218500	0	342400	0	7090000	0
2W	68	I		0.56	0.58	0.02				679800	367800	265600	0	14690000	0
2E	77	I		0.57	0.59	0.02				671100	416800	635000	0	20670000	0

DGES FILENAME: S4BRG.XLS

LAST UPDATE:

11/16/94

BEARING DISPLACEMENTS/REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = LB, IN

SPAN 4; FLEXIBLE SUPPORT SPRINGS

	ALGOR			EQX				DEAD LOAD		EQX					
BRG	MEM	END		DX				F1		F1	F2	F3	M1	M2	M3
				PIER	TRUSS	REL		VERT		VERT	FL	FT	TOR	MT	ML
3W	125	I		1.60	1.65	0.05		2015400		436000	554300	368100	0	7498000	0
3E	134	I		1.74	1.74	0.00		1753100		408300	514200	413500	0	8353000	0
4W	155	I		3.10	1.74	-1.36		600900		228200	0	160300	0	3698000	0
4E	192	I		3.07	1.70	-1.37		501000		145400	0	195400	0	4323000	0
	ALGOR			EQY						EQY					
	MEM	END		DX						F1	F2	F3	M1	M2	M3
				PIER	TRUSS	REL				VERT	FL	FT	TOR	MT	ML
3W	125	I		1.16	1.18	0.02				608700	306700	516500	0	14490000	0
3E	134	I		0.82	0.88	0.05				638500	741000	613100	0	15540000	0
4W	155	I		0.94	1.00	0.06				294700	0	241400	0	6115000	0
4E	192	I		0.93	1.14	0.21				183800	0	442600	0	9806000	0

DGES FILENAME: S3BRG.XLS

LAST UPDATE:

11/16/94

BEARING DISPLACEMENTS/REACTIONS FROM RESPONSE SPECTRUM ANALYSIS

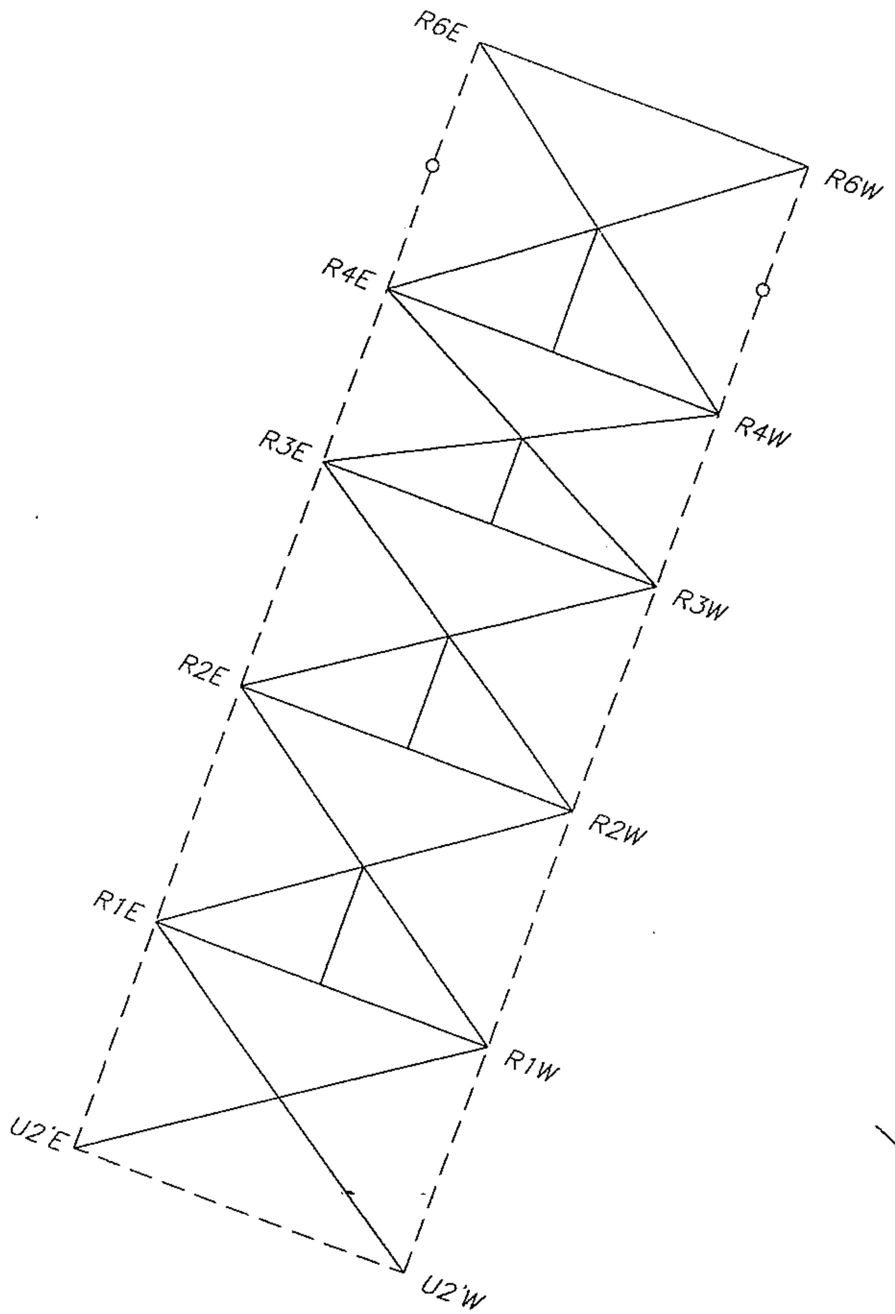
USING ODOT SITE SPECIFIC RESPONSE SPECTRUM MODIFIED FOR SITE EFFECTS

UNITS = LB, IN

SPAN 3; FLEXIBLE SUPPORT SPRINGS

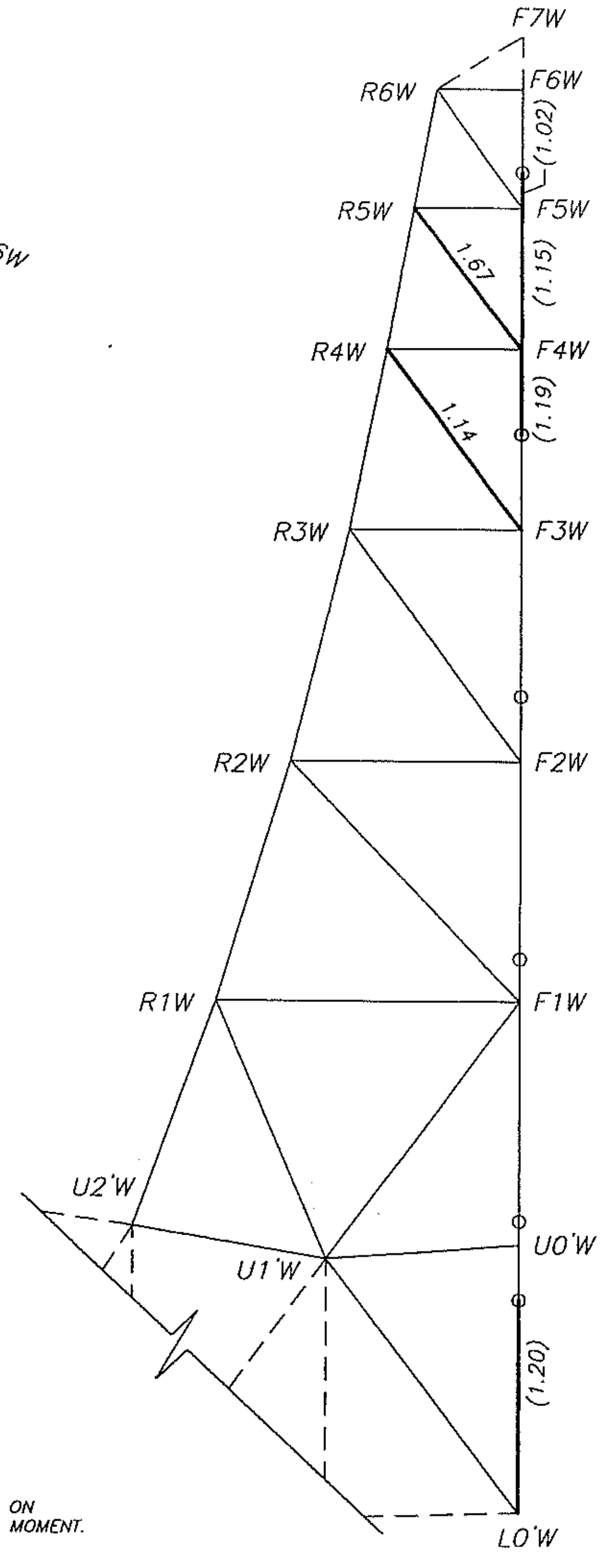
	ALGOR		EQX			DEAD LOAD		EQX					
BRG	MEM	END	DX			VERT	VERT	F1	F2	F3	M1	M2	M3
			PIER	TRUSS	REL	BRG	HANGER	VERT	FL	FT	TOR	MT	ML
2W	41	I	1.74	1.80	0.07	1100	630700	188000	395800	312500	0	5713000	0
2E	78	I	1.79	1.83	0.04	1100	534700	164400	337300	387300	0	7348000	0
3W	98	I	1.59	1.88	0.29	1100	630700	187300	0	528800	0	8919000	0
3E	135	I	1.76	1.87	0.11	1100	534700	170400	0	536400	0	10230000	0
	ALGOR		EQY					EQY					
	MEM	END	DX					F1	F2	F3	M1	M2	M3
			PIER	TRUSS	REL			VERT	FL	FT	TOR	MT	ML
2W	41	I	0.66	0.68	0.03			269800	312500	437400	0	9645000	0
2E	78	I	0.62	0.67	0.04			250200	461000	736800	0	13530000	0
3W	98	I	0.96	0.71	-0.25			272700	0	557700	0	10030000	0
3E	135	I	0.75	0.71	-0.03			256200	0	616700	0	11750000	0

SPAN 2

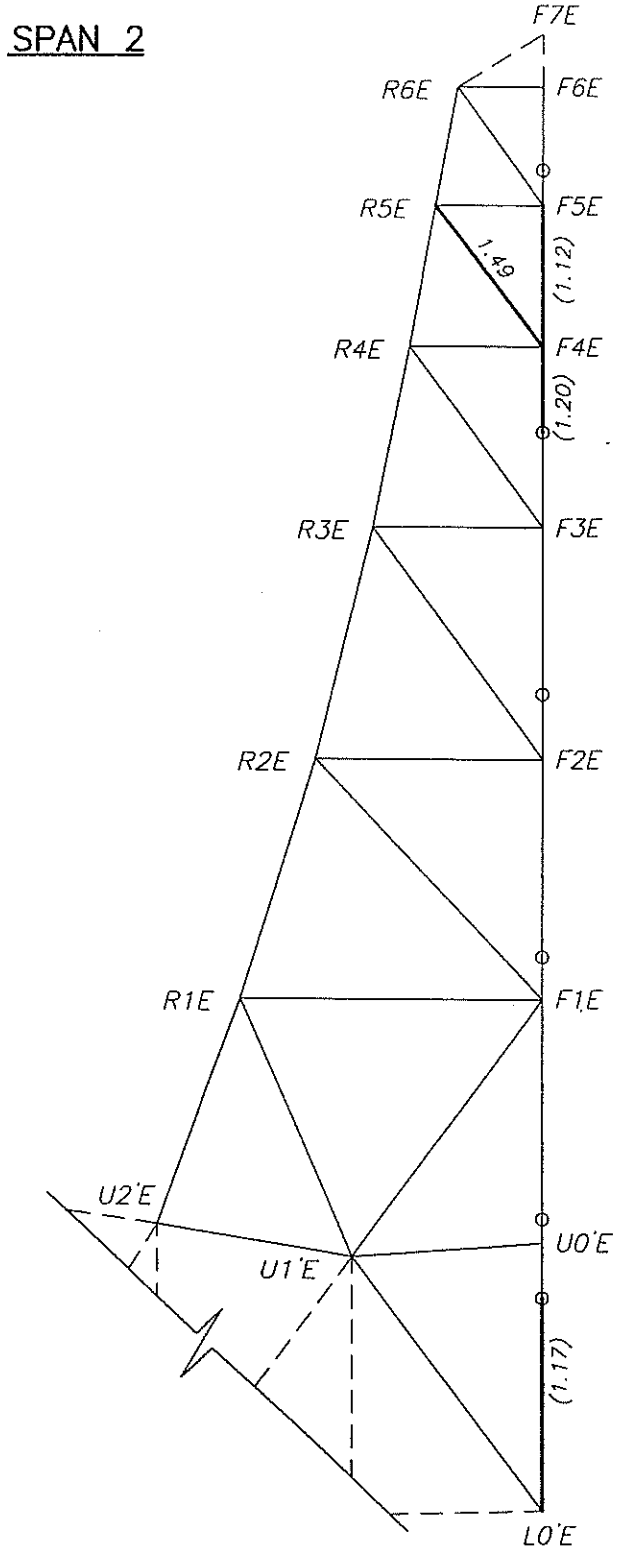


REAR TOWER
LATERAL BRACING

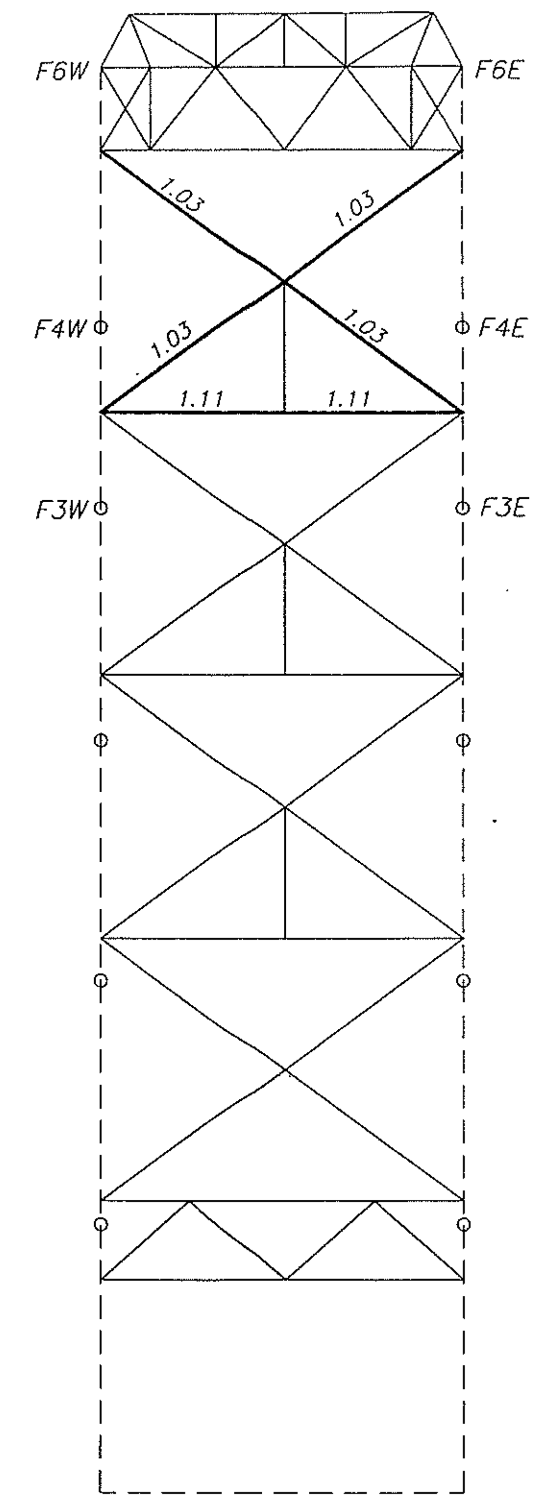
NOTE
NUMBERS IN PARENTHESES ARE BASED ON COMBINED AXIAL FORCES AND BENDING MOMENT.



WEST TRUSS TOWER
(Viewed from West)



EAST TRUSS TOWER
(Viewed from West)



FRONT TOWER
LATERAL BRACING

12/23/94

DATE	REVISION	BY

DRAFTED:
DESIGNED:
CHECKED:
REVIEWED:

REVIEWED
EXPIRES:

BRIDGE ENGINEER
EXPIRES:

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

EXELTECH

BRIDGE NO.
DATE
CALC. BOOK

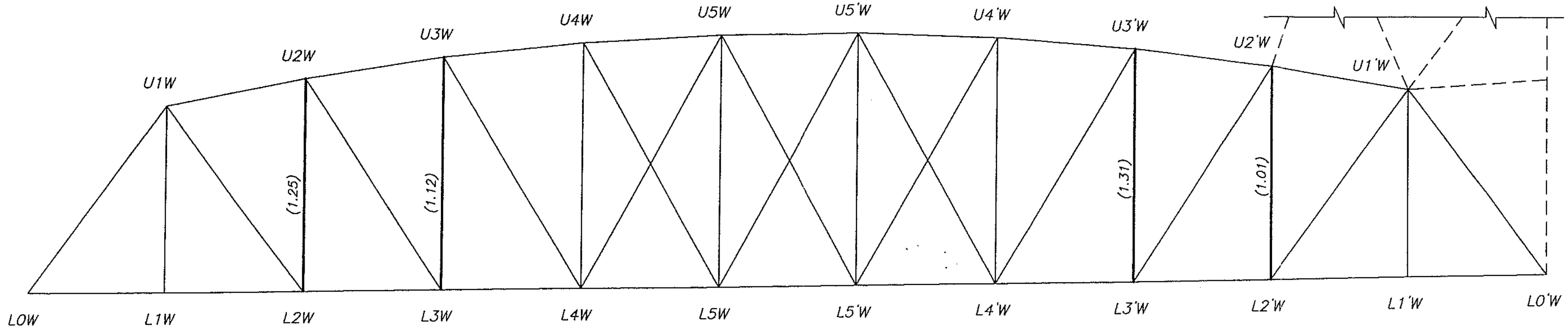
I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 2

FEDERAL HIGHWAY ADMINISTRATION
REGION 10 | OREGON DIVISION
PROJECT NUMBER

SHEET 1 OF 3

DRAWING NO.
3D-S2-1

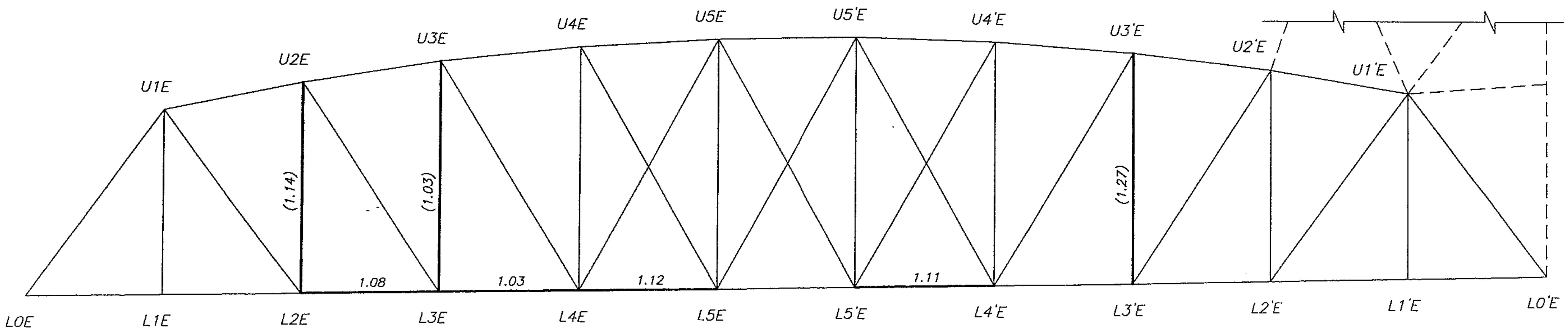
SPAN 2



WEST TRUSS
(Viewed from West)

NOTE

NUMBERS IN PARENTHESES ARE BASED ON COMBINED AXIAL FORCES AND BENDING MOMENT.



EAST TRUSS
(Viewed from West)

12/9/94

DATE	REVISION	BY		REVIEWED	BRIDGE ENGINEER
			DRAFTED:		
			DESIGNED:		
			CHECKED:		
			REVIEWED:	EXPIRES:	EXPIRES:

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

EXELTECH

BRIDGE NO.

DATE

CALC. BOOK

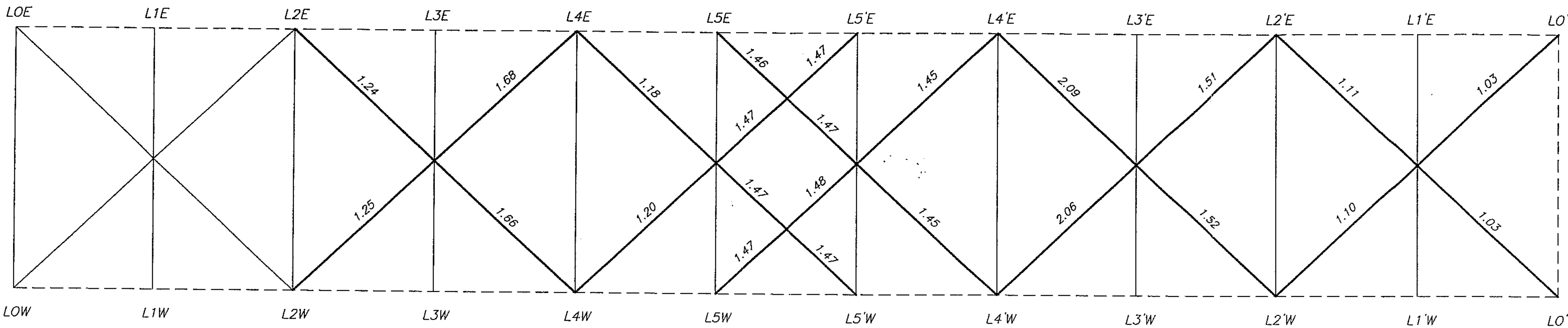
I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 2

SHEET 1 OF 3

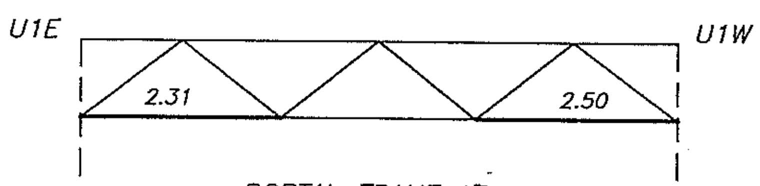
DRAWING NO.
3D-S2-1

FEDERAL HIGHWAY ADMINISTRATION | PROJECT NUMBER
REGION 10 | OREGON DIVISION

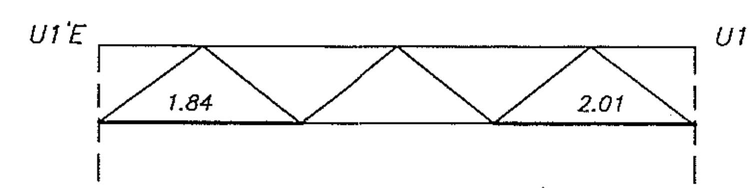
SPAN 2



BOTTOM LATERALS AND FLOORBEAMS



PORTAL FRAME AT 1



PORTAL FRAME AT 1'

12/22/94

DATE	REVISION	BY	DRAFTED: DESIGNED: CHECKED: REVIEWED:	REVIEWED	BRIDGE ENGINEER
				EXPIRES:	EXPIRES:

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

EXELTECH

BRIDGE NO.
DATE
CALC. BOOK

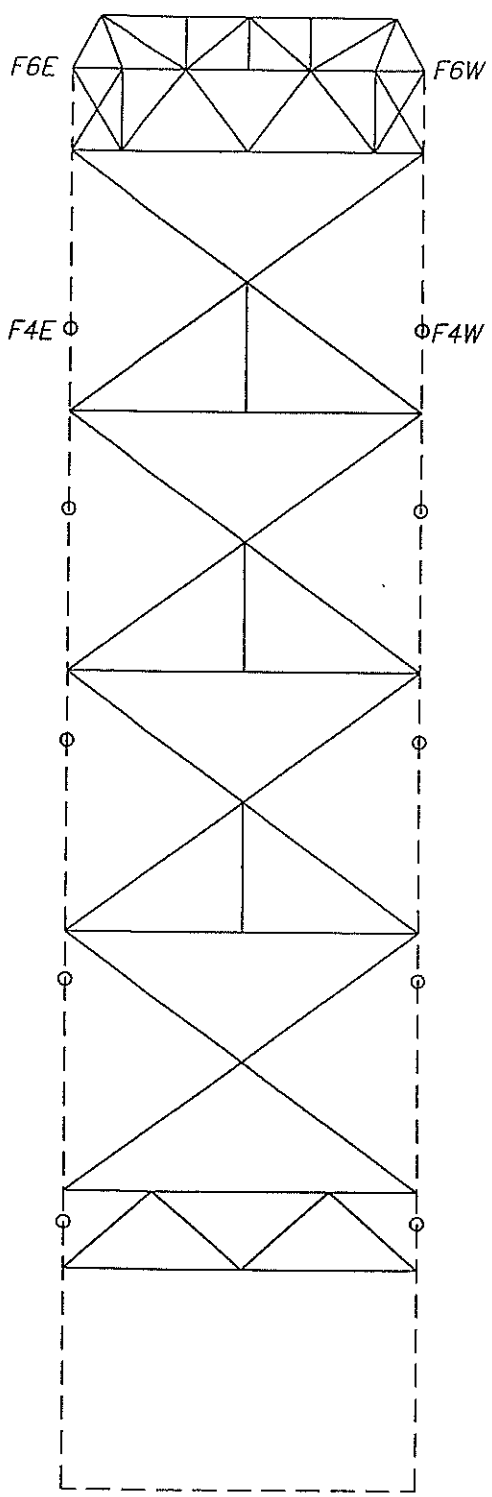
I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 2

FEDERAL HIGHWAY ADMINISTRATION — REGION 10 | OREGON DIVISION
PROJECT NUMBER

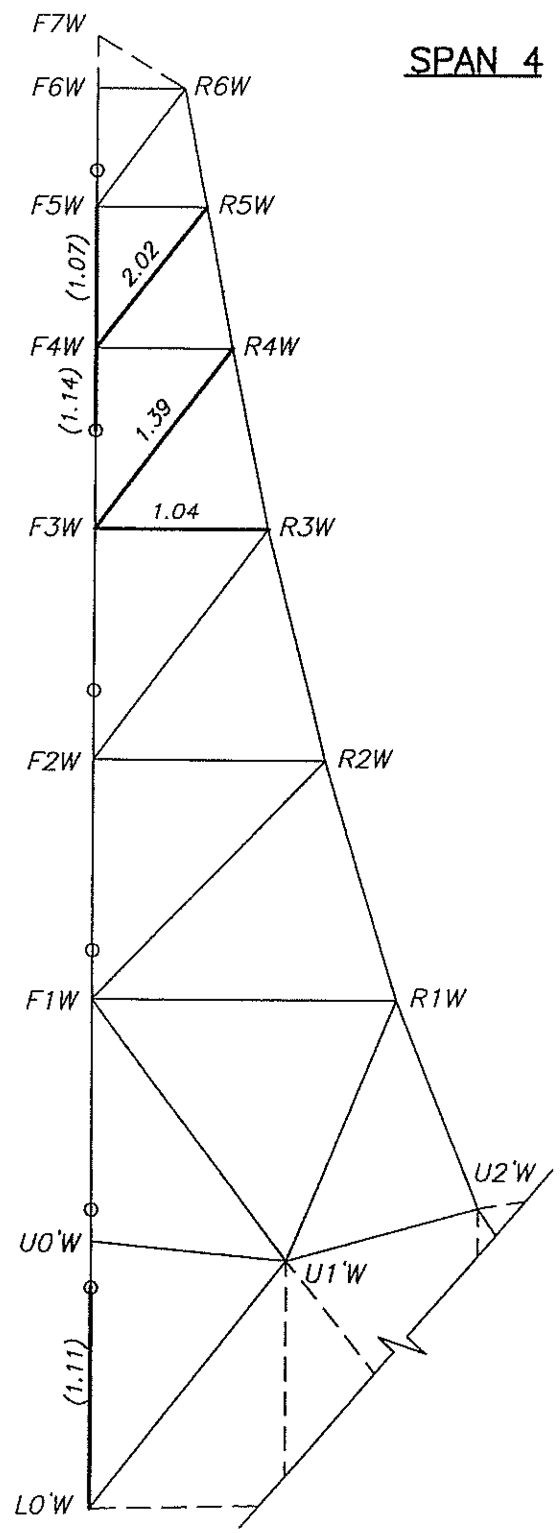
SHEET 2 OF 3

DRAWING NO. 3D-S2-2

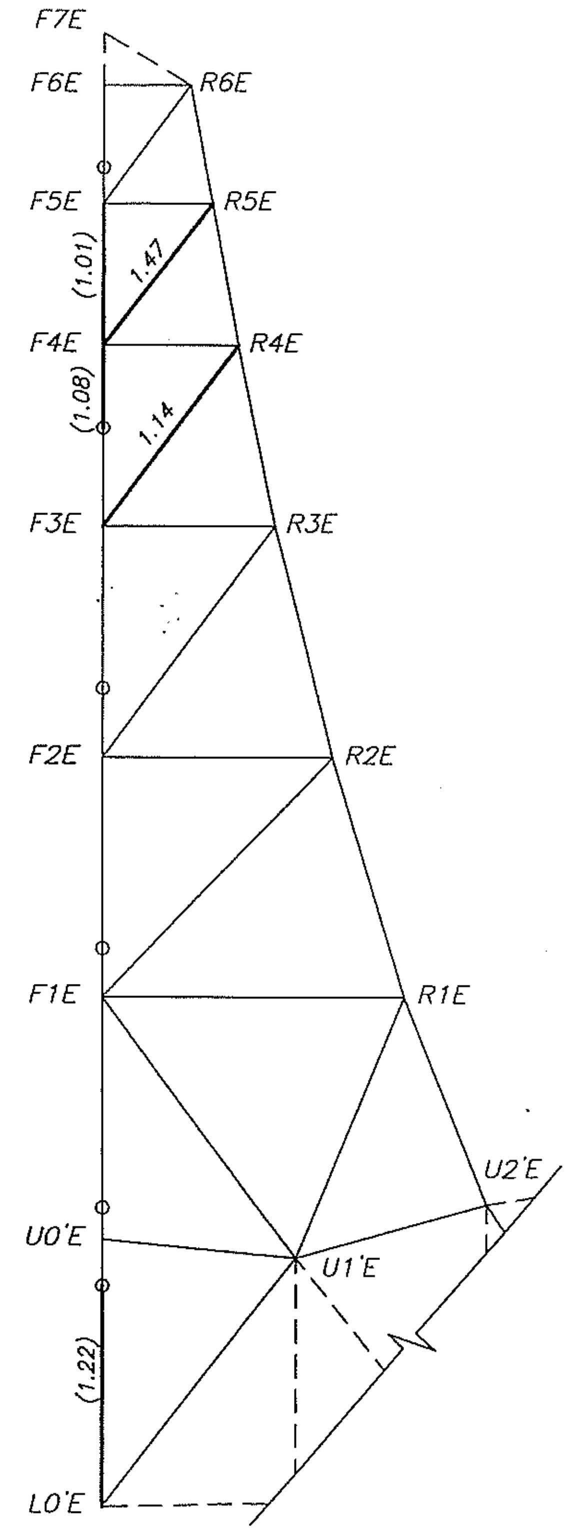
SPAN 4



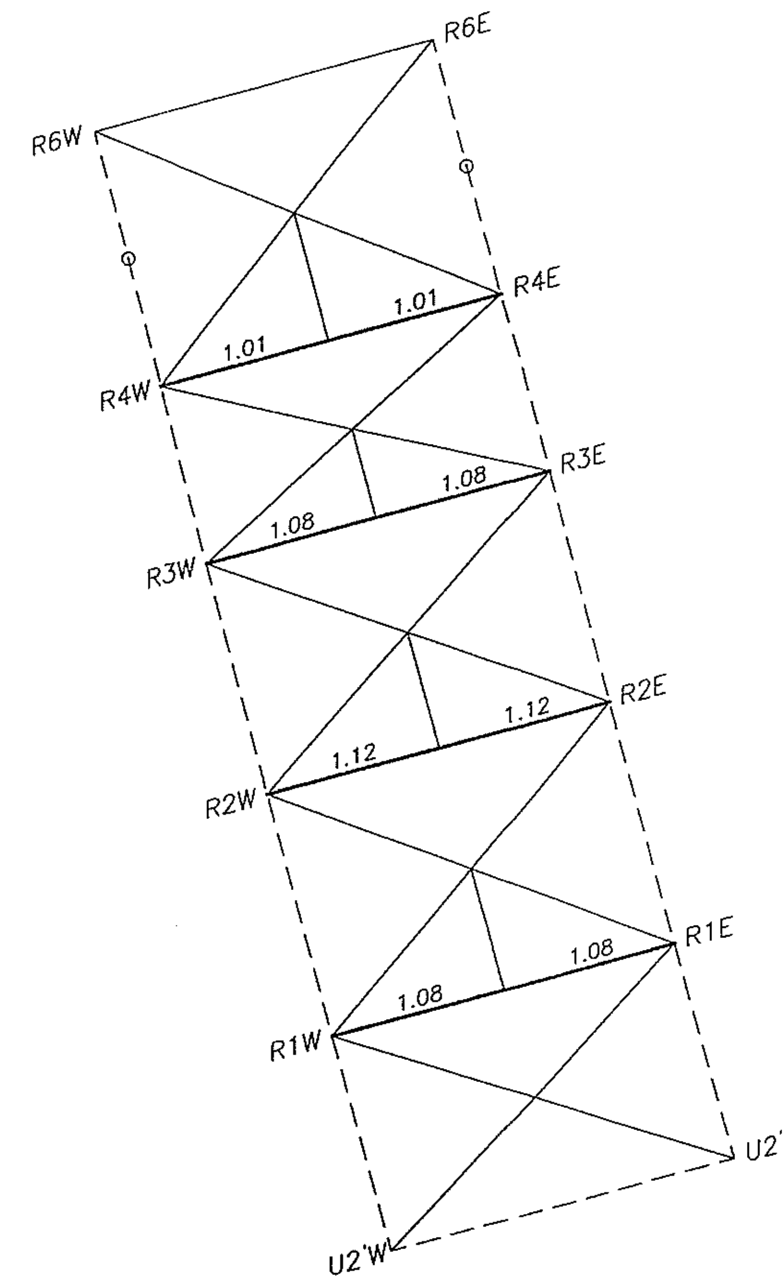
FRONT TOWER
LATERAL BRACING



WEST TRUSS TOWER
(Viewed from West)



EAST TRUSS TOWER
(Viewed from West)



REAR TOWER
LATERAL BRACING

NOTE
NUMBERS IN PARENTHESES ARE BASED ON COMBINED AXIAL FORCES AND BENDING MOMENT.

12/23/94

DATE	REVISION	BY

DRAFTED:
DESIGNED:
CHECKED:
REVIEWED:

REVIEWED '

BRIDGE ENGINEER

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

EXELTECH

BRIDGE NO.

DATE

CALC. BOOK

I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 4

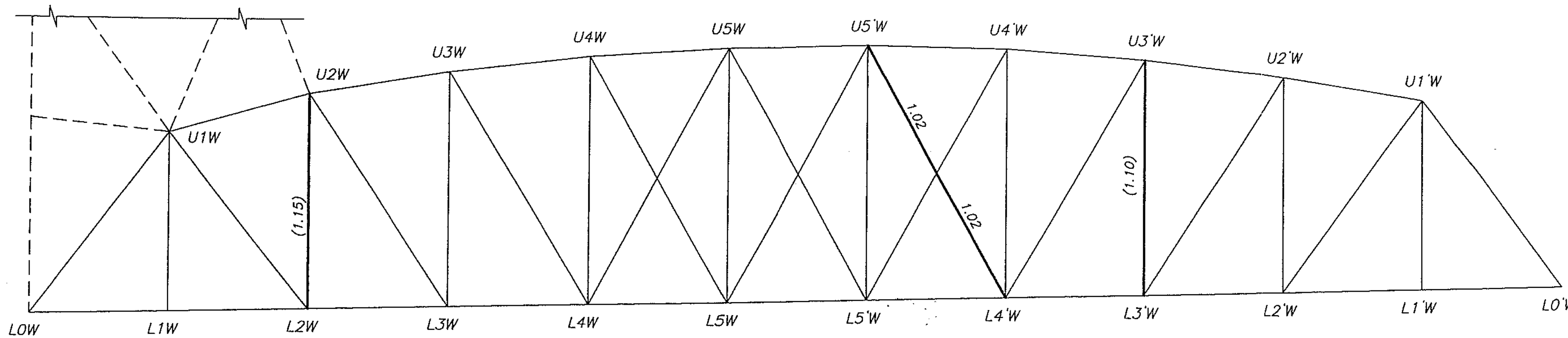
FEDERAL HIGHWAY ADMINISTRATION

PROJECT NUMBER

SHEET
1
OF
3

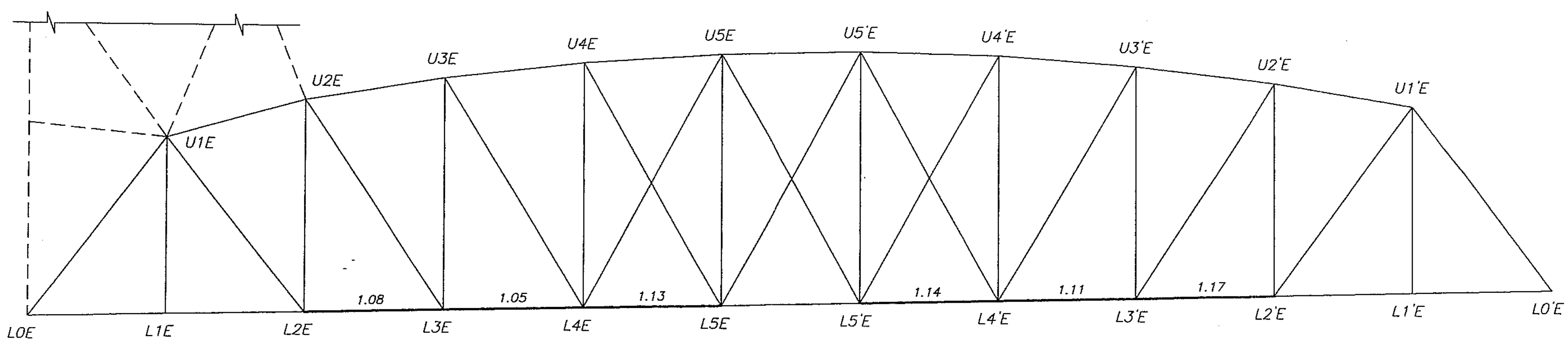
DRAWING NO.
3DSPAN4A

SPAN 4



WEST TRUSS
(Viewed from West)

NOTE
NUMBERS IN PARENTHESES ARE BASED ON COMBINED AXIAL FORCES AND BENDING MOMENT.



EAST TRUSS
(Viewed from West)

12/22/94

DATE	REVISION	BY			
			DRAFTED:	REVIEWED	BRIDGE ENGINEER
			DESIGNED:		
			CHECKED:		
			REVIEWED:	EXPIRES:	EXPIRES:

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

EXELTECH

BRIDGE NO.
DATE
CALC. BOOK

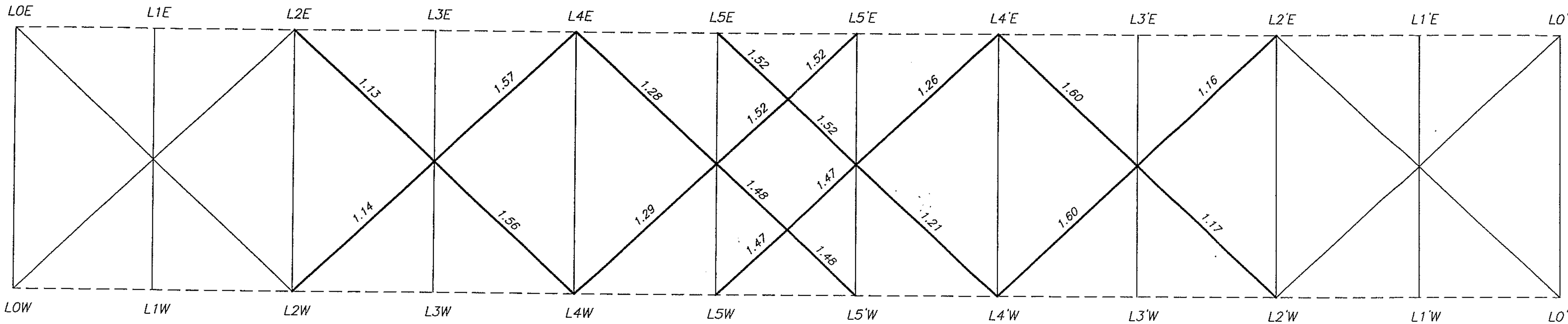
I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 4

FEDERAL HIGHWAY ADMINISTRATION
PROJECT NUMBER

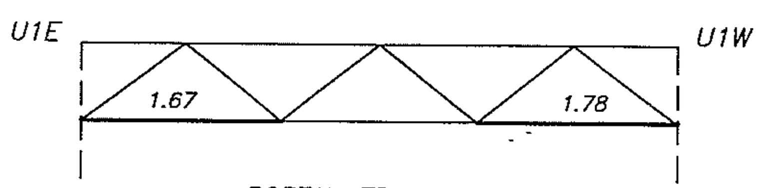
SHEET
1
OF
3

DRAWING NO.
3DSPAN4B

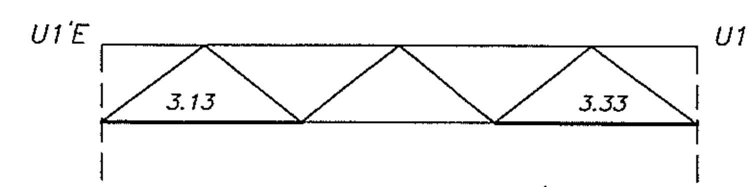
SPAN 4



BOTTOM LATERALS AND FLOORBEAMS



PORTAL FRAME AT 1



PORTAL FRAME AT 1'

12/22/94

DATE	REVISION	BY	
			DRAFTED:
			DESIGNED:
			CHECKED:
			REVIEWED:

REVIEWED
EXPIRES:

BRIDGE ENGINEER
EXPIRES:

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

EXELTECH

BRIDGE NO.
DATE
CALC. BOOK

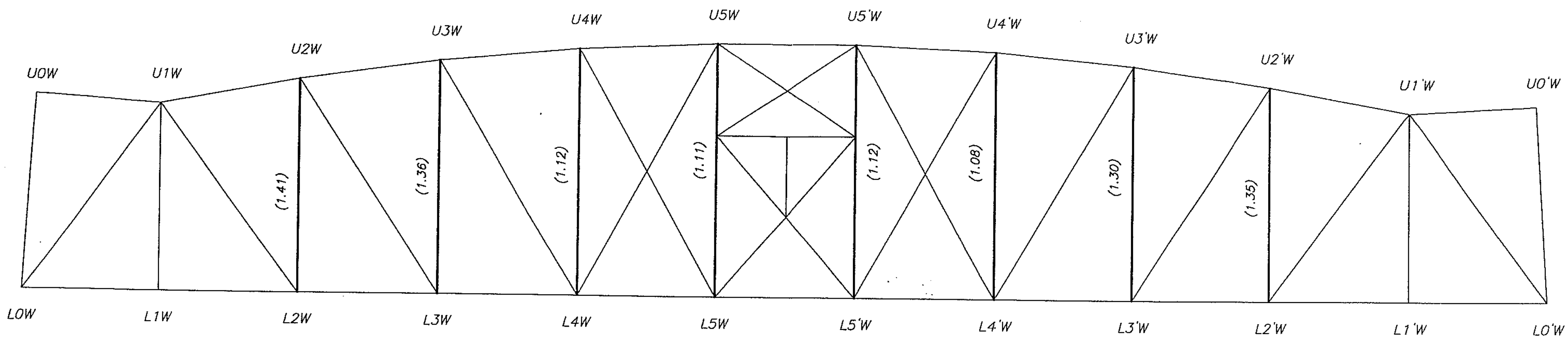
I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 4

FEDERAL HIGHWAY ADMINISTRATION | PROJECT NUMBER
REGION 10 | OREGON DIVISION

SHEET 2 OF 3

DRAWING NO.
3DSPAN4C

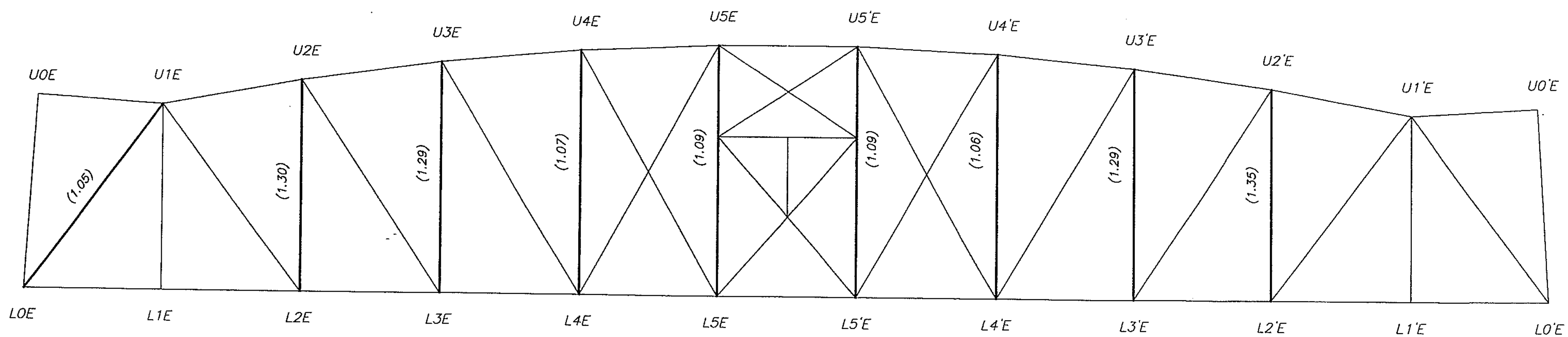
SPAN 3



WEST TRUSS
(Viewed from West)

NOTE

NUMBERS IN PARENTHESES ARE BASED ON COMBINED AXIAL FORCES AND BENDING MOMENT.



EAST TRUSS
(Viewed from West)

12/22/94

DATE	REVISION	BY

DRAFTED:
DESIGNED:
CHECKED:
REVIEWED:

REVIEWED
EXPIRES:

BRIDGE ENGINEER
EXPIRES:

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

EXELTECH

BRIDGE NO.
DATE
CALC. BOOK

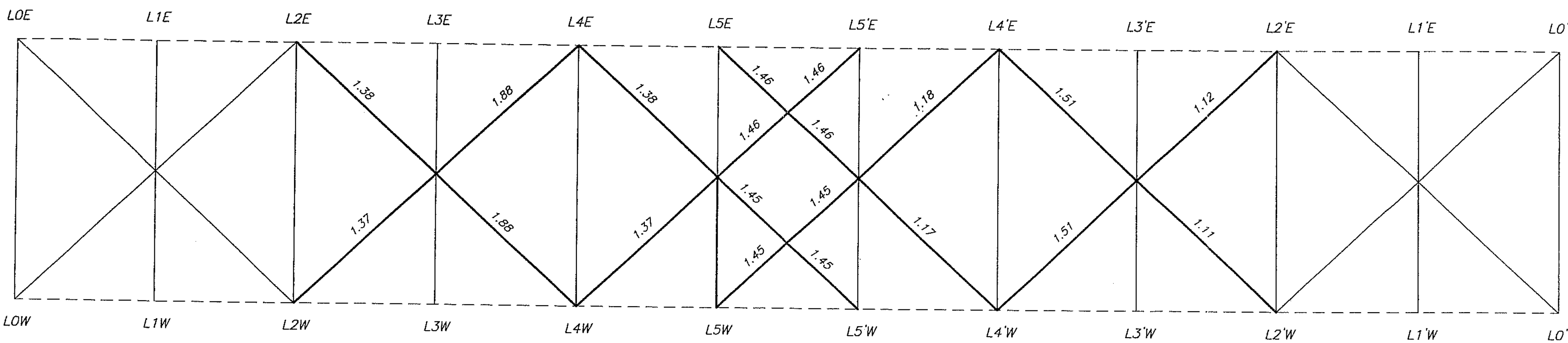
I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 3

FEDERAL HIGHWAY ADMINISTRATION
REGION 10 | OREGON DIVISION
PROJECT NUMBER

SHEET
1
OF

DRAWING NO.
3D-S3-A

SPAN 3



BOTTOM LATERALS AND FLOORBEAMS

12/22/94

DATE	REVISION	BY

DRAFTED:
DESIGNED:
CHECKED:
REVIEWED:

REVIEWED
EXPIRES:

BRIDGE ENGINEER
EXPIRES:

OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE DESIGN SECTION

DGES
CONSULTING ENGINEERS
OLYMPIA, WASHINGTON

EXELTECH

BRIDGE NO.
DATE
CALC. BOOK

I5 - COLUMBIA RIVER
3D MODEL MEMBER GEN'L ARR
SPAN 3

FEDERAL HIGHWAY ADMINISTRATION
REGION 10 OREGON DIVISION
PROJECT NUMBER

SHEET
1
OF
1

DRAWING NO.
3DSPAN3C

FILENAME: 2DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

UNITS INCH,LB. (Fy in ksi)

SPAN 2

* - Adjusted for true behavior of tension-only members

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
50	23	SW2001	52.50	1.00	424.75	7.066	60.109	1.00	494.75	6.673	74.138	-37997.6	-1695661.8	-961800.0	0.57	0.16		West truss top chord, L0-U1	0.00E+00	-9.62E+05	-689900	210600	271900
50	341	SW2002	52.50	1.00	70.00	7.066	9.906	1.00	494.75	6.673	74.138	-37997.6	-1695661.8	-948200.0	0.56	0.16		West truss top chord, L0-U1	0.00E+00	-9.48E+05	-680300	206200	267900
50	24	SW2003	35.57	1.00	301.65	6.946	43.427	1.00	301.65	7.286	41.404	-45881.9	-1387313.5	-899500.0	0.65	0.19		West truss top chord, U1-U2	0.00E+00	-9.00E+05	-633300	200300	266200
50	25	SW2004	47.10	1.00	299.48	7.056	42.445	1.00	299.48	6.822	43.896	-45792.4	-1833321.3	-1127300.0	0.61	0.19		West truss top chord, U2-U3	0.00E+00	-1.13E+06	-787700	253900	339600
50	26	SW2005	47.10	1.00	297.87	7.056	42.217	1.00	297.87	6.822	43.661	-45837.3	-1835119.8	-1248400.0	0.68	0.20		West truss top chord, U3-U4	0.00E+00	-1.25E+06	-878700	283100	369700
50	27	SW2006	49.35	1.00	296.92	7.026	42.262	1.00	296.92	6.731	44.109	-45751.5	-1919186.6	-1333713.3	0.69	0.21	*	West truss top chord, U4-U5	0.00E+00	-1.33E+06	-908700	293400	376700
50	28	SW2007	49.35	1.00	296.59	7.026	42.216	1.00	296.59	6.731	44.060	-45760.8	-1919576.7	-1353700.0	0.71	0.20		West truss top chord, U5-U5'	0.00E+00	-1.35E+06	-975000	324700	378700
50	30	SW2008	49.35	1.00	296.92	7.026	42.262	1.00	296.92	6.731	44.109	-45751.5	-1919186.6	-1331615.5	0.69	0.21	*	West truss top chord, U4'-U5'	0.00E+00	-1.33E+06	-910700	331000	367300
50	29	SW2009	47.10	1.00	297.87	7.056	42.217	1.00	297.87	6.822	43.661	-45837.3	-1835119.8	-1231000.0	0.67	0.19		West truss top chord, U3'-U4'	0.00E+00	-1.23E+06	-882400	337800	348600
50	40	SW2010	47.10	1.00	299.48	7.056	42.445	1.00	299.48	6.822	43.896	-45792.4	-1833321.3	-1150500.0	0.63	0.20		West truss top chord, U2'-U3'	0.00E+00	-1.15E+06	-792000	358500	311400
50	41	SW2011	35.57	1.00	301.65	6.946	43.427	1.00	301.65	7.286	41.404	-45881.9	-1387313.5	-944000.0	0.68	0.22		West truss top chord, U1'-U2'	0.00E+00	-9.44E+05	-639500	304500	241300
50	231	SW2012	52.50	1.00	70.00	7.066	70.016	1.00	494.75	6.673	74.138	-37997.6	-1695661.8	-1051900.0	0.62	0.19		West truss top chord, L0'-U1'	0.00E+00	-1.05E+06	-730800	321100	259500
50	355	SW2013	52.50	1.00	424.75	7.066	70.016	1.00	494.75	6.673	74.138	-37997.6	-1695661.8	-1063600.0	0.63	0.19		West truss top chord, L0'-U1'	0.00E+00	-1.06E+06	-740500	323100	258900
50	22	SW2014	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	764825.0	0.61	0.23		West truss bottom chord, L0-L1	7.65E+05	-3.83E+03	380500	146800	289200
50	21	SW2015	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	787075.0	0.63	0.25		West truss bottom chord, L1-L2	7.87E+05	-2.09E+04	383100	160700	308200
50	20	SW2016	33.96	1.00	296.59	7.461	39.750	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1623025.0	0.96	0.49		West truss bottom chord, L2-L3	1.62E+06	-3.44E+05	639300	350000	823900
50	19	SW2017	42.96	1.00	296.59	7.413	40.007	1.00	296.59	6.073	48.838	-44791.7	2148000.0	1790350.0	0.83	0.37		West truss bottom chord, L3-L4	1.79E+06	-1.98E+05	796200	372300	795100
50	18	SW2018	44.76	1.00	296.59	7.401	40.074	1.00	296.59	6.040	49.103	-44735.0	2238000.0	2140400.0	0.96	0.45		West truss bottom chord, L4-L5	2.14E+06	-3.15E+05	912800	442600	999400
50	17	SW2019	48.36	1.00	296.59	7.372	40.231	1.00	296.59	5.981	49.585	-44631.1	2418000.0	1947175.0	0.81	0.33		West truss bottom chord, L5-L5'	1.95E+06	-1.12E+05	917500	349300	800300
50	16	SW2020	44.76	1.00	296.59	7.401	40.074	1.00	296.59	6.040	49.103	-44735.0	2238000.0	2132775.0	0.95	0.44		West truss bottom chord, L4'-L5'	2.13E+06	-2.96E+05	918300	450300	984900
50	15	SW2021	42.96	1.00	296.59	7.413	40.007	1.00	296.59	6.073	48.838	-44791.7	2148000.0	1684475.0	0.78	0.31		West truss bottom chord, L3'-L4'	1.68E+06	-7.03E+04	807100	356900	675600
50	14	SW2022	33.96	1.00	296.59	7.461	39.750	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1525425.0	0.90	0.43		West truss bottom chord, L2'-L3'	1.53E+06	-2.49E+05	638100	385300	727800
50	12	SW2023	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	776225.0	0.62	0.20		West truss bottom chord, L1'-L2'	7.76E+05	0.00E+00	420500	250600	164200
50	13	SW2024	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	790275.0	0.63	0.21		West truss bottom chord, L0'-L1'	7.90E+05	0.00E+00	417900	267900	169600
50	11	SW2025	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	984000.0	153842.5	0.16	0.04		West truss vertical, U1-L1	1.54E+05	0.00E+00	91050	37040	40030
33	161	SW2026	24.80	1.00	340.66	7.238	47.066	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-339700.0	0.58	0.19		West truss vertical, U2-L2	0.00E+00	-3.40E+05	-227700	89070	112000
33	10	SW2027	24.80	1.00	110.37	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-336900.0	0.58	0.19		West truss vertical, U2-L2	0.00E+00	-3.37E+05	-225400	88830	111500
33	168	SW2028	24.80	1.00	340.62	7.238	47.062	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-224260.0	0.40	0.16		West truss vertical, U3-L3	0.00E+00	-2.24E+05	-135700	79530	88560
33	9	SW2029	24.80	1.00	151.88	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-221780.0	0.39	0.16		West truss vertical, U3-L3	0.00E+00	-2.22E+05	-133300	79580	88480
33	175	SW2030	24.80	1.00	340.61	7.238	47.059	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-158234.3	0.29	0.18	*	West truss vertical, U4-L4	3.17E+04	-1.58E+05	-22680	44080	48670
33	8	SW2031	24.80	1.00	179.50	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-156295.2	0.28	0.18	*	West truss vertical, U4-L4	3.47E+04	-1.56E+05	-20280	44880	49900
33	182	SW2032	24.80	1.00	340.62	7.238	47.062	1.00	534.00	6.085	87.756	-25674.7	818400.0	104257.5	0.13	0.07		West truss vertical, U5-L5	1.04E+05	-2.74E+04	38430	34160	56220
33	7	SW2033	24.80	1.00	193.38	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	109040.0	0.13	0.07		West truss vertical, U5-L5	1.09E+05	-2.74E+04	40800	35670	58040
33	193	SW2034	24.80	1.00	340.62	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	101937.5	0.12	0.06		West truss vertical, U5'-L5'	1.02E+05	-2.04E+04	40790	28140	50950
33	6	SW2035	24.80	1.00	193.38	7.238	47.059	1.00	534.00	6.085	87.756	-25674.7	818400.0	106247.5	0.13	0.06		West truss vertical, U5'-L5'	1.06E+05	-1.99E+04	43150	29240	52310
33	208	SW2036	24.80	1.00	340.61	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-164199.7	0.30	0.20	*	West truss vertical, U4'-L4'	4.57E+04	-1.64E+05	-17140	58560	50640
33	5	SW2037	24.80	1.00	179.50	7.238	47.062	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-160893.2	0.29	0.20	*	West truss vertical, U4'-L4'	4.75E+04	-1.61E+05	-14740	58570	50660
33	209	SW2038	24.80	1.00	340.62	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-313200.0	0.56	0.27		West truss vertical, U3'-L3'	3.01E+04	-3.13E+05	-161800	131000	151400
33	4	SW2039	24.80	1.00	151.88	7.238	47.066	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-310500.0	0.55	0.27		West truss vertical, U3'-L3'	3.14E+04	-3.11E+05	-159500	130800	151000
33	212	SW2040	24.80	1.00	340.66	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-313500.0	0.54	0.24		West truss vertical, U2'-L2'	1.41E+04	-3.14E+05	-171100	142400	100600
33	3	SW2041	24.80	1.00	110.37	7.238	54.712	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-311100.0	0.53	0.24		West truss vertical, U2'-L2'	1.55E+04	-3.11E+05	-168900	142200	100300
50	2	SW2042	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	-185357.5	-59255.0	0.32	0.68		West truss vertical, U1'-L1'	2.38E+05	-5.93E+04	89260	99580	126200
50	219	SW2043	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	686875.0	0.69	0.18		West truss diagonal, U1-L2	6.87E+05	0.00E+00	405100	137700	180500
50	220	SW2044	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	482875.0	0.66	0.19		West truss diagonal, U2-L3	4.83E+05	0.00E+00	274300	106300	140000
50	221	SW2045	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	341500.0	0.57	0.19		West truss diagonal, U3-L4	3.42E+05	0.00E+00	179600	97120	117000
50	228	SW2046	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	397925.0	0.66	0.30		West truss diagonal, U3'-L4'	3.98E+05	-4.89E+04	174500	152300	179800
50	229	SW2047	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	611525.0	0.84	0.31		West truss diagonal, U2'-L3'	6.12E+05	0.00E+00	308500	179600	225900
50	230	SW2048	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	615300.0	0.62	0.19		West truss diagonal, U1'-L2'	6.15E+05	0.00E+00	344000	185300	134500
33	395	SW2049	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	24755.0	0.13	0.30	*	West truss diagonal, U5-L4	2.48E+04	-9.94E+04	-42660	53060	56750
33	223	SW2050	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	25170.0	0.13	0.30	*	West truss diagonal, U5-L4	2.52E+04	-9.85E+04	-41920	53170	56610
50	394	SW2051	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	140842.5	0.41	0.35	*	West truss diagonal, U4-L5	1.41E+05	-1.62E+04	60630	56500	61630
50	222	SW2052	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	142735.0	0.42	0.35	*	West truss diagonal, U4-L5	1.43E+05	-1.58E+04	61340	56620	61850
50	391	SW2053	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	157652.5	0.46	0.41	*	West truss diagonal, U4'-L5'	1.58E+05	-2.74E+04	54920	62870	68570
50	227	SW2054	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	159422.5	0.47	0.41	*	West truss diagonal, U4'-L5'	1.59E+05	-2.72E+04	55640	63020	68880
33	390	SW2055	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	40407.5	0.21	0.37	*	West truss diagonal, U5'-L4'	4.04E+04	-1.10E+05	-39950	60940	70370
33	226	SW2056	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	40607.5	0.22	0.37	*	West truss diagonal, U5'-L4'	4.06E+04	-1.09E+05	-39230	60890	70030
33	392	SW2057	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	119451.3	0.63	0.61	*	West truss diagonal, L5-U5'	6.19E+04	-5.39E+04	3953	56250	56910
33	225	SW2058	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	120330.0	0.64	0.61	*	West truss diagonal, L5-U5'	6.29E+04	-5.36E+04	4616	56440	57090
33	393	SW2059	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	124622.5	0.66	0.61	*	West truss diagonal, L5'-U5	6.77E+04	-5.15E+04	8090	54760	57600
33	224	SW2060	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	125491.3	0.66	0.61	*	West truss diagonal, L5'-U5	6.84E+04	-5.09E+04	8745	54770	57470
33	338	SW2061	5.74	1.00	492.96	5.336	92.392	1.00	492.96	1.949	252.953	-4473.2	189420.0	108020.0	0.57	0.57	*	West truss tower diag., U1-F1	1.73E+04	-9.52E+04	-44530	50660	50010
33	51	SW2062	5.74	1.00	429.19	5.336	80.441	1.00	429.19	1.949	220.233	-5901.1	189420.0	108020.0	0.57	0.57	*	West truss tower diag., U1-R1	2.24E+04	-1.05E+05	-47430	41640	58010
33	337	SW2063	20.47	1.00	509.54	5.701	89.381	1.00	509.54	4.363	116.790	-20025.8	-348438.5	-82308.0	0.24	0.21		West truss tower diag., F1-R2	6.87E+04	-8.23E+04	-7798	68110	74510
33	335	SW2064	18.06	1.00	442.31	6.026	73.405	1.00	442.31	2.552	173.320	-9528.0	-146224.2	-112335.0	0.77	0.73		West truss tower diag., F2-R3	1.03E+05	-1.12E+05	-5435	106900	97220
33	333	SW2065	13.98	1.00	345.96	5.940	58.245	1.00	345.96	2.030	170.452	-9851.3	-117020.7	-133504.0	1.14	1.11		West truss tower diag., F3-R4	1.27E+05	-1.34E+05	-3504	130000	101500
33	330	SW2066	12.74	1.00	274.09	5.813	47.148	1.00	274.09	1.544	177.493	-9085.2	-98345.5	-164426.0	1.67	1.62		West truss tower diag., F4-R5	1.56E+05	-1.64E+05	-4726	139900	159700
33	329	SW2067	12.74	1.00	226.74	5.813	39.004	1.00	226.74	1.544	146.833	-13275.5	-143703.5	-59180.0	0.41	0.21		West truss tower diag., F5-R6	8.92E+03	-5.92E+04	-28720	26950	30460
33	31	SW2068	13.98	1.00	297.39	5.940	50.068	1.00	297.39	2.030	146.522	-13331.9	-158366.3	-26522.0	0.17	0.16		West truss, U1'-U0'	2.40E+04	-2.65E+04	-1432	25090	24150
33	39	SW2069	20.47	1.00	467.37	5.701	81.983	1.00	467.37	4.363	107.124	-22084.5	675510.0	78805.0	0.12	0.06		West truss tower horiz., R1-F1	7.88E+04	-1.68E+04	30980	26720	40080
33	43	SW2070	13.98	1.00	354.50	5.940	59.683	1.00	354.50	2.030	174.662	-9382.1	-111447.3	-64520.5	0.58	0.61		West truss tower horiz., R2-F2	7.27E+04	-6.45E+04	4106	67600	64080
33	45	SW2071	12.74	1.00	265.18	5.813	45.616	1.00	265.18	1.544	171.725	-9705.8	-105062.5	-86832.5	0.83	0.84		West truss tower horiz., R3-F3	9.12E+04	-8.68E+04	2170	88460	74030
33	47	SW2072	12.74	1.00	208.59	5.813	35.882	1.00	208.59	1.544	135.079	-15686.3	-169800.5	-99361.5	0.59	0.59		West truss tower horiz., R4-F4	1.02E+05	-9.94E+04	1518	100500	79210
33	49	SW2073	12.10	1.00	168.73	5.737	29.412	1.00	168.73	1.306	129.223	-17116.2	-175967.9	-119265.8	0.68	0.69		West truss tower horiz., R5-F5	1.25E+05	-1.19E+05	2979	106300	121500
33	430	SW2074	9.72	1.00	134.30	5.452	24.636	1.00	77.00	1.152	66.850	-28749.2	320595.0	3277.1	0.01	0.00		West truss tower horiz., R6-F6	3.28E+03	0.00E+00	1899	666.3	903.3
50	42	SW2075	18.41	1.00	367.56	6.457	56.928	1.00	367.56	3.908	94.064	-30679.0	-480079.8	-336359.5	0.70	0.66	*	West truss tower, U2'-R1	3.08E+05	-3.36E+05	21320	263400	157400
50	44	SW2076	15.47	1.00	383.01	6.425	59.613	1.00	383.01	4.074	94.024	-30695.6	-403631.2	-305475.2	0.76	0.72	*	West truss tower, R1-R2	2.79E+05	-3.05E+05	-15350	271100	156900
33	46	SW2077	15.47	1.00	365.10	6.425	56.826	1.00	365.10	4.074	89.627	-25359.1	-333459.3	-272115.4	0.82	0.78	*	West truss tower, R2-R3	2.49E+05	-2.72E+05	-13460	242600	154000
33	48	SW2078	15.47	1.00	281.74	6.425	43.852	1.00	281.74	4.074	69.164	-28449.7	-374099.9	-217259.3	0.58	0.55	*	West truss tower, R3-R4	1.97E+05	-2.17E+05	-11430	194900	157000
33	50	SW2079	15.47	1.00	219.65	6.425	34.187	1.00	405.42	4.074	99.527	-23577.9	-310037.4	-196906.7	0.64	0.61	*	West truss tower, R4-R5	1.84E+05	-1.97E+05	-7650	144400	160400
33	125	SW2080	15.47	1.00	185.77	6.425	28.915	1.00	405.42	4.074	99.527	-23577.9	-310037.4	-92438.7	0.30	0.27	*	West truss tower, R5-R6	7.62E+04	-9.24E+04	-9272	40170	54310
50	38	SW2081	85.86	1.00	339.12	7.097	47.783	1.00	411.12	8.339	49.299	-44692.9	-3261734.7	-1887400.0	0.58	0.16		West truss tower, L0'-U0'	0.00E+00	-1.89E+06	-1354000	394900	533400
50	1	SW2082	85.86	1.00	119.75	7.097	16.873	1.00	411.12	8.339	49.299	-44692.9	-3261734.7	-1877700.0	0.58	0.16		West truss tower, L0'-U0'	0.00E+00	-1.88E+06	-1345000	394700	532700

FILENAME: 2DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 2

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
50	32	SW2083	71.99	1.00	119.75	7.077	16.920	1.00	372.00	8.775	42.395	-46075.3	-2819218.9	-1876100.0	0.67	0.19		West truss tower, U0'-F1	0.00E+00	-1.88E+06	-1343000	394500	533100
50	106	SW2084	71.99	1.00	398.00	7.077	56.235	1.00	372.00	8.775	42.395	-43094.5	-2636835.4	-1843500.0	0.70	0.20		West truss tower, U0'-F1	0.00E+00	-1.84E+06	-1319000	389000	524500
50	33	SW2085	71.99	1.00	398.00	7.077	56.235	1.00	366.00	8.775	41.711	-43094.5	-2636835.4	-1854000.0	0.70	0.19		West truss tower, F1-F2	0.00E+00	-1.85E+06	-1340000	339900	514000
50	111	SW2086	71.99	1.00	398.00	7.077	56.235	1.00	366.00	8.775	41.711	-43094.5	-2636835.4	-1827400.0	0.69	0.19		West truss tower, F1-F2	0.00E+00	-1.83E+06	-1336000	336500	491400
50	34	SW2087	71.99	1.00	398.00	7.077	56.235	1.00	354.00	8.775	40.344	-43094.5	-2636835.4	-1795100.0	0.68	0.18		West truss tower, F2-F3	0.00E+00	-1.80E+06	-1324000	289900	471100
50	116	SW2088	71.99	1.00	398.00	7.077	56.235	1.00	354.00	8.775	40.344	-43094.5	-2636835.4	-1762600.0	0.67	0.17		West truss tower, F2-F3	0.00E+00	-1.76E+06	-1316000	284900	446600
50	35	SW2089	71.99	1.00	398.00	7.077	56.235	1.00	276.00	8.775	31.454	-43094.5	-2636835.4	-1748100.0	0.66	0.17		West truss tower, F3-F4	0.00E+00	-1.75E+06	-1307000	250200	441100
50	118	SW2090	71.99	1.00	398.00	7.077	56.235	1.00	276.00	8.775	31.454	-43094.5	-2636835.4	-1699100.0	0.64	0.14		West truss tower, F3-F4	0.00E+00	-1.70E+06	-1317000	241700	382100
50	36	SW2091	71.99	1.00	398.00	7.077	56.235	1.00	216.00	8.775	24.616	-43094.5	-2636835.4	-1537300.0	0.58	0.09		West truss tower, F4-F5	0.00E+00	-1.54E+06	-1308000	126300	229300
50	37	SW2092	71.99	1.00	398.00	7.077	56.235	1.00	182.69	8.775	20.820	-43094.5	-2636835.4	-1386400.0	0.53	0.04		West truss tower, F5-F6	0.00E+00	-1.39E+06	-1281000	41650	105400
50	120	SW2093	71.99	1.00	126.94	7.077	17.935	1.00	182.69	8.775	20.820	-49053.4	-3001445.6	-297310.0	0.10	0.00		West truss tower, F5-F6	0.00E+00	-2.97E+05	-282500	9193	14810
50	57	SE2001	48.90	1.00	424.75	7.049	60.259	1.00	494.75	6.766	73.127	-38322.8	-1592907.1	-849400.0	0.53	0.17		East truss top chord, L0-U1	0.00E+00	-8.49E+05	-572800	170400	276600
50	340	SE2002	48.90	1.00	70.00	7.049	9.931	1.00	494.75	6.766	73.127	-38322.8	-1592907.1	-838000.0	0.53	0.17		East truss top chord, L0-U1	0.00E+00	-8.38E+05	-564400	168000	273600
50	62	SE2003	33.77	1.00	301.65	6.910	43.654	1.00	301.65	7.741	38.968	-45838.6	-1315872.1	-786000.0	0.60	0.20		East truss top chord, U1-U2	0.00E+00	-7.86E+05	-519400	160500	266600
50	55	SE2004	35.57	1.00	299.48	6.927	43.233	1.00	299.48	7.286	41.103	-45918.6	-1388423.5	-989000.0	0.71	0.25		East truss top chord, U2-U3	0.00E+00	-9.89E+05	-647800	207300	341200
50	71	SE2005	39.17	1.00	297.87	6.989	42.620	1.00	297.87	7.120	41.839	-46033.5	-1532761.4	-1096500.0	0.72	0.24		East truss top chord, U3-U4	0.00E+00	-1.10E+06	-726000	235000	370500
50	70	SE2006	42.77	1.00	296.92	7.019	42.301	1.00	296.92	6.978	42.550	-46046.6	-1674097.4	-1128600.0	0.67	0.22		East truss top chord, U4-U5	0.00E+00	-1.13E+06	-752100	247400	376500
50	72	SE2007	42.77	1.00	296.59	7.019	42.255	1.00	296.59	6.978	42.503	-46055.2	-1674412.0	-1191300.0	0.71	0.22		East truss top chord, U5-U5'	0.00E+00	-1.19E+06	-815300	278300	376000
50	53	SE2008	42.77	1.00	296.92	7.019	42.301	1.00	296.92	6.978	42.550	-46046.6	-1674097.4	-1111500.0	0.66	0.21		East truss top chord, U4'-U5'	0.00E+00	-1.11E+06	-753900	283600	357600
50	86	SE2009	39.17	1.00	297.87	6.989	42.620	1.00	297.87	7.120	41.839	-46033.5	-1532761.4	-1065100.0	0.69	0.22		East truss top chord, U3'-U4'	0.00E+00	-1.07E+06	-729100	294200	336000
50	85	SE2010	35.57	1.00	299.48	6.927	43.233	1.00	299.48	7.286	41.103	-45918.6	-1388423.5	-965300.0	0.70	0.23		East truss top chord, U2'-U3'	0.00E+00	-9.65E+05	-651200	314100	296200
50	77	SE2011	33.77	1.00	301.65	6.910	43.654	1.00	301.65	7.741	38.968	-45838.6	-1315872.1	-795700.0	0.60	0.21		East truss top chord, U1'-U2'	0.00E+00	-7.96E+05	-524700	271000	227300
50	244	SE2012	48.90	1.00	70.00	7.049	9.931	1.00	494.75	6.766	73.127	-38322.8	-1592907.1	-896600.0	0.56	0.18		East truss top chord, L0'-U1'	0.00E+00	-8.97E+05	-606600	290000	237400
50	356	SE2013	48.90	1.00	424.75	7.049	60.259	1.00	494.75	6.766	73.127	-38322.8	-1592907.1	-908000.0	0.57	0.18		East truss top chord, L0'-U1'	0.00E+00	-9.08E+05	-615100	292900	236900
50	58	SE2014	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	664375.0	0.53	0.22		East truss bottom chord, L0-L1	6.64E+05	-4.30E+04	310700	126000	276000
50	61	SE2015	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	679725.0	0.54	0.23		East truss bottom chord, L1-L2	6.80E+05	-5.31E+04	313300	129900	288100
50	56	SE2016	26.76	1.00	296.59	7.440	39.865	1.00	296.59	6.547	45.302	-45518.5	1338000.0	1444750.0	1.08	0.59		East truss bottom chord, L2-L3	1.44E+06	-3.89E+05	527800	313400	785000
50	68	SE2017	30.36	1.00	296.59	7.456	39.779	1.00	296.59	6.402	46.330	-45312.8	1518000.0	1569725.0	1.03	0.49		East truss bottom chord, L3-L4	1.57E+06	-2.54E+05	658100	320200	747100
50	67	SE2018	33.96	1.00	296.59	7.444	39.845	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1895375.0	1.12	0.56		East truss bottom chord, L4-L5	1.90E+06	-3.82E+05	756700	396100	949500
50	69	SE2019	38.46	1.00	296.59	7.428	39.930	1.00	296.59	6.167	48.090	-44950.0	1923000.0	1698575.0	0.88	0.39		East truss bottom chord, L5-L5'	1.70E+06	-1.84E+05	757100	313100	752200
50	54	SE2020	33.96	1.00	296.59	7.444	39.845	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1886200.0	1.11	0.55		East truss bottom chord, L4'-L5'	1.89E+06	-3.64E+05	761200	414800	934700
50	84	SE2021	30.36	1.00	296.59	7.456	39.779	1.00	296.59	6.402	46.330	-45312.8	1518000.0	1461825.0	0.96	0.41		East truss bottom chord, L3'-L4'	1.46E+06	-1.28E+05	666900	350900	628200
50	83	SE2022	26.76	1.00	296.59	7.440	39.865	1.00	296.59	6.547	45.302	-45518.5	1338000.0	1344375.0	1.00	0.51		East truss bottom chord, L2'-L3'	1.34E+06	-2.93E+05	525900	385500	687000
50	79	SE2023	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	707175.0	0.57	0.22		East truss bottom chord, L1'-L2'	7.07E+05	-1.94E+04	343900	277300	168000
50	92	SE2024	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	710800.0	0.57	0.23		East truss bottom chord, L0'-L1'	7.11E+05	-2.84E+04	341200	284300	173000
50	59	SE2025	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	984000.0	144490.0	0.15	0.05		East truss vertical, U1-L1	1.44E+05	0.00E+00	74400	39040	51490
33	160	SE2026	24.80	1.00	340.66	7.238	47.066	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-303000.0	0.52	0.19		East truss vertical, U2-L2	0.00E+00	-3.03E+05	-190200	77220	112800
33	60	SE2027	24.80	1.00	110.37	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-300100.0	0.51	0.19		East truss vertical, U2-L2	0.00E+00	-3.00E+05	-188000	76990	112100
33	167	SE2028	24.80	1.00	340.62	7.238	47.062	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-193470.0	0.34	0.14		East truss vertical, U3-L3	0.00E+00	-1.93E+05	-115200	68690	78270
33	63	SE2029	24.80	1.00	151.88	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-190710.0	0.34	0.14		East truss vertical, U3-L3	0.00E+00	-1.91E+05	-112800	68780	77910
33	174	SE2030	24.80	1.00	340.61	7.238	47.059	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-62360.0	0.11	0.07		East truss vertical, U4-L4	2.27E+04	-6.24E+04	-22650	35020	39710
33	64	SE2031	24.80	1.00	179.50	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-61040.0	0.11	0.07		East truss vertical, U4-L4	2.56E+04	-6.10E+04	-20230	35390	40810
33	181	SE2032	24.80	1.00	340.62	7.238	47.062	1.00	534.00	6.085	87.756	-25674.7	818400.0	86577.5	0.11	0.06		East truss vertical, U5-L5	8.66E+04	-3.01E+04	28230	23130	51290
33	65	SE2033	24.80	1.00	193.38	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	91490.0	0.11	0.06		East truss vertical, U5-L5	9.15E+04	-3.02E+04	30640	24220	53190
33	192	SE2034	24.80	1.00	340.62	7.238	47.062	1.00	534.00	6.085	87.756	-25674.7	818400.0	87192.5	0.11	0.06		East truss vertical, U5'-L5'	8.72E+04	-2.69E+04	30170	22290	49480
33	66	SE2035	24.80	1.00	193.38	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	91985.0	0.11	0.06		East truss vertical, U5'-L5'	9.20E+04	-2.68E+04	32580	23270	51260
33	207	SE2036	24.80	1.00	340.61	7.238	47.059	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-69530.0	0.13	0.09		East truss vertical, U4'-L4'	3.75E+04	-6.95E+04	-18320	51210	47060
33	81	SE2037	24.80	1.00	179.50	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-67150.0	0.12	0.09		East truss vertical, U4'-L4'	3.93E+04	-6.72E+04	-15900	51250	46670
33	210	SE2038	24.80	1.00	340.62	7.238	47.062	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-287200.0	0.51	0.26		East truss vertical, U3'-L3'	4.62E+04	-2.87E+05	-137700	104100	149500
33	82	SE2039	24.80	1.00	151.88	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-283900.0	0.50	0.26		East truss vertical, U3'-L3'	4.70E+04	-2.84E+05	-135400	103800	148500
33	211	SE2040	24.80	1.00	340.66	7.238	47.066	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-264200.0	0.45	0.21		East truss vertical, U2'-L2'	1.55E+04	-2.64E+05	-142100	122100	76460
33	80	SE2041	24.80	1.00	110.37	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-261800.0	0.45	0.21		East truss vertical, U2'-L2'	1.72E+04	-2.62E+05	-139800	122000	76260
50	91	SE2042	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	984000.0	118490.0	0.12	0.03		East truss vertical, U1'-L1'	1.18E+05	0.00E+00	72840	25540	27440
50	232	SE2043	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	600350.0	0.61	0.18		East truss diagonal, U1-L2	6.00E+05	0.00E+00	335800	111100	180600
50	233	SE2044	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	425275.0	0.58	0.19		East truss diagonal, U2-L3	4.25E+05	0.00E+00	228300	92120	139900
50	234	SE2045	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	294075.0	0.49	0.18		East truss diagonal, U3-L4	2.94E+05	0.00E+00	150700	85110	105700
50	241	SE2046	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	360800.0	0.60	0.29		East truss diagonal, U3'-L4'	3.61E+05	-6.64E+04	147200	121000	176800
50	242	SE2047	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	546375.0	0.75	0.31		East truss diagonal, U2'-L3'	5.46E+05	-3.06E+04	257900	140700	224000
50	243	SE2048	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	515275.0	0.52	0.16		East truss diagonal, U1'-L2'	5.15E+05	0.00E+00	283500	160900	114600
33	396	SE2049	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	67447.5	0.36	0.49	*	East truss diagonal, U5-L4	2.03E+04	-8.01E+04	-34150	45040	45910
33	236	SE2050	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	67747.5	0.36	0.49	*	East truss diagonal, U5-L4	2.06E+04	-7.91E+04	-33430	45050	45670
50	397	SE2051	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	158705.0	0.46	0.27	*	East truss diagonal, U4-L5	1.13E+05	0.00E+00	52660	46100	46970
50	235	SE2052	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	159772.5	0.47	0.27	*	East truss diagonal, U4-L5	1.14E+05	0.00E+00	53370	46170	47150
50	401	SE2053	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	197415.0	0.58	0.40	*	East truss diagonal, U4'-L5'	1.27E+05	-1.88E+04	48180	52460	67020
50	240	SE2054	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	198842.5	0.58	0.40	*	East truss diagonal, U4'-L5'	1.29E+05	-1.87E+04	48890	52580	67560
33	400	SE2055	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	113610.0	0.60	0.73	*	East truss diagonal, U5'-L4'	4.61E+04	-1.02E+05	-32160	50790	70170
33	239	SE2056	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	113612.5	0.60	0.73	*	East truss diagonal, U5'-L4'	4.61E+04	-1.01E+05	-31450	50730	69640
33	398	SE2057	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	103885.0	0.55	0.53	*	East truss diagonal, L5-U5'	5.37E+04	-4.55E+04	3652	47540	49130
33	238	SE2058	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	104972.5	0.56	0.53	*	East truss diagonal, L5-U5'	5.48E+04	-4.51E+04	4314	47620	49390
33	399	SE2059	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	108200.0	0.57	0.53	*	East truss diagonal, U5-L5'	5.88E+04	-4.33E+04	6896	46120	50190
33	237	SE2060	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	108716.3	0.58	0.53	*	East truss diagonal, U5-L5'	5.93E+04	-4.23E+04	7549	46120	49890
33	339	SE2061	5.74	1.00	492.96	5.336	92.392	1.00	492.96	1.949	252.953	-4473.2	189420.0	96370.0	0.51	0.51	*	East truss tower diag., U1-F1	1.22E+04	-7.86E+04	-37920	39230	40670
33	75	SE2062	5.74	1.00	429.19	5.336	80.441	1.00	429.19	1.949	220.233	-5901.1	189420.0	96370.0	0.51	0.51	*	East truss tower diag., U1-R1	2.56E+04	-9.59E+04	-40150	41680	55700
33	336	SE2063	20.47	1.00	509.54	5.701	89.381	1.00	509.54	4.363	116.790	-20025.8	-348438.5	-75705.0	0.22	0.20		East truss tower diag., F1-R2	6.43E+04	-7.57E+04	-6505	57550	69200
33	334	SE2064	18.06	1.00	442.31	6.026	73.405	1.00	442.31	2.552	173.320	-9528.0	-146224.2	-95782.0	0.66	0.62		East truss tower diag., F2-R3	8.77E+04	-9.58E+04	-4612	91170	90220
33	332	SE2065	13.98	1.00	345.96	5.940	58.245	1.00	345.96	2.030	170.452	-9851.3	-117020.7	-116888.0	1.00	0.97		East truss tower diag., F3-R4	1.11E+05	-1.17E+05	-3388	113500	98140
33	331	SE2066	12.74	1.00	274.09	5.813	47.148	1.00	274.09	1.544	177.493	-9085.2	-98345.5	-146605.0	1.49	1.44		East truss tower diag., F4-R5	1.38E+05	-1.47E+05	-4805	113300	141800
33	328	SE2067	12.74	1.00	226.74	5.813	39.004	1.00	226.74	1.544	146.833	-13275.5	-143703.5	-54180.0	0.38	0.20		East truss tower diag., F5-R6	9.10E+03	-5.42E+04	-25760	24810	28420
33	89	SE2068	13.98	1.00	297.39	5.940	50.068	1.00	297.39	2.030	146.522	-13331.9	-158366.3	-29258.0	0.18	0.18		East truss, U1'-U0'	2.70E+04	-2.93E+04	-1288	26330	27970
33	78	SE2069	20.47	1.00	467.37	5.701	81.983	1.00	467.37	4.363	107.124	-22084.5	675510.0	70190.0	0.10	0.06		East truss tower horiz., R1-F1	7.02E+04	-1.80E+04	26080	24520	37590
33	76	SE2070	13.98	1.00	354.50	5.940	59.683	1.00	354.50	2.030	174.662	-9382.1	-111447.3	-57006.5	0.51	0.53		East truss tower horiz., R2-F2	6.38E+04	-5.70E+04	3378	57200	59540
33	99	SE2071	12.74	1.00	265.18	5.813	45.616	1.00	265.18	1.544	171.725	-9705.8	-105062.5	-74774.3	0.71	0.73		East truss tower horiz., R3-F3	7.87E+04	-7.48E+04	1941	76230	69500

FILENAME: 2DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 2

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
33	100	SE2072	12.74	1.00	208.59	5.813	35.882	1.00	208.59	1.544	135.079	-15686.3	-169800.5	-86286.3	0.51	0.52		East truss tower horiz., R4-F4	8.96E+04	-8.63E+04	1645	87520	76060
33	101	SE2073	12.10	1.00	168.73	5.737	29.412	1.00	168.73	1.306	129.223	-17116.2	-175967.9	-105506.5	0.60	0.61		East truss tower horiz., R5-F5	1.12E+05	-1.06E+05	3058	85890	107800
33	429	SE2074	9.72	1.00	134.30	5.452	24.636	1.00	77.00	1.152	66.850	-28749.2	320595.0	2808.2	0.01	0.00		East truss tower horiz., R6-F6	2.81E+03	0.00E+00	1626	483	775.7
50	87	SE2075	18.41	1.00	367.56	6.457	56.928	1.00	367.56	3.908	94.064	-30679.0	-480079.8	-234412.0	0.49	0.53	*	East truss tower, U2'-R1	2.79E+05	-2.34E+05	19950	236900	156800
50	88	SE2076	15.47	1.00	383.01	6.425	59.613	1.00	383.01	4.074	94.024	-30695.6	-403631.2	-274355.9	0.68	0.65	*	East truss tower, R1-R2	2.56E+05	-2.74E+05	-10240	245200	157500
33	73	SE2077	15.47	1.00	365.10	6.425	56.826	1.00	365.10	4.074	89.627	-25359.1	-333459.3	-245320.3	0.74	0.71	*	East truss tower, R2-R3	2.31E+05	-2.45E+05	-8237	221000	155100
33	97	SE2078	15.47	1.00	281.74	6.425	43.852	1.00	281.74	4.074	69.164	-28449.7	-374099.9	-195690.7	0.52	0.51	*	East truss tower, R3-R4	1.84E+05	-1.96E+05	-6596	178000	152600
33	95	SE2079	15.47	1.00	219.65	6.425	34.187	1.00	405.42	4.074	99.527	-23577.9	-310037.4	-177713.9	0.57	0.56	*	East truss tower, R4-R5	1.70E+05	-1.78E+05	-4299	124600	144600
33	126	SE2080	15.47	1.00	185.77	6.425	28.915	1.00	405.42	4.074	99.527	-23577.9	-310037.4	-84482.9	0.27	0.25	*	East truss tower, R5-R6	7.40E+04	-8.45E+04	-5998	39580	49670
50	52	SE2081	85.86	1.00	339.12	7.097	47.783	1.00	411.12	8.339	49.299	-44692.9	-3261734.7	-1736500.0	0.53	0.16		East truss tower, L0'-U0'	0.00E+00	-1.74E+06	-1204000	368100	532500
50	90	SE2082	85.86	1.00	119.75	7.097	16.873	1.00	411.12	8.339	49.299	-44692.9	-3261734.7	-1725700.0	0.53	0.16		East truss tower, L0'-U0'	0.00E+00	-1.73E+06	-1195000	368500	530700
50	93	SE2083	71.99	1.00	119.75	7.077	16.920	1.00	372.00	8.775	42.395	-46075.3	-2819218.9	-1724300.0	0.61	0.19		East truss tower, U0'-F1	0.00E+00	-1.72E+06	-1193000	368200	531300
50	107	SE2084	71.99	1.00	398.00	7.077	56.235	1.00	372.00	8.775	42.395	-43094.5	-2636835.4	-1689000.0	0.64	0.20		East truss tower, U0'-F1	0.00E+00	-1.69E+06	-1168000	361900	521000
50	94	SE2085	71.99	1.00	398.00	7.077	56.235	1.00	366.00	8.775	41.711	-43094.5	-2636835.4	-1690200.0	0.64	0.19		East truss tower, F1-F2	0.00E+00	-1.69E+06	-1185000	323300	505200
50	112	SE2086	71.99	1.00	398.00	7.077	56.235	1.00	366.00	8.775	41.711	-43094.5	-2636835.4	-1659600.0	0.63	0.18		East truss tower, F1-F2	0.00E+00	-1.66E+06	-1180000	317800	479600
50	74	SE2087	71.99	1.00	398.00	7.077	56.235	1.00	354.00	8.775	40.344	-43094.5	-2636835.4	-1620900.0	0.61	0.17		East truss tower, F2-F3	0.00E+00	-1.62E+06	-1170000	274800	450900
50	117	SE2088	71.99	1.00	398.00	7.077	56.235	1.00	354.00	8.775	40.344	-43094.5	-2636835.4	-1578300.0	0.60	0.16		East truss tower, F2-F3	0.00E+00	-1.58E+06	-1160000	265400	418300
50	98	SE2089	71.99	1.00	398.00	7.077	56.235	1.00	276.00	8.775	31.454	-43094.5	-2636835.4	-1550200.0	0.59	0.15		East truss tower, F3-F4	0.00E+00	-1.55E+06	-1151000	227900	399200
50	119	SE2090	71.99	1.00	398.00	7.077	56.235	1.00	276.00	8.775	31.454	-43094.5	-2636835.4	-1484600.0	0.56	0.12		East truss tower, F3-F4	0.00E+00	-1.48E+06	-1160000	209800	324600
50	96	SE2091	71.99	1.00	398.00	7.077	56.235	1.00	216.00	8.775	24.616	-43094.5	-2636835.4	-1350500.0	0.51	0.08		East truss tower, F4-F5	0.00E+00	-1.35E+06	-1151000	113400	199500
50	102	SE2092	71.99	1.00	398.00	7.077	56.235	1.00	182.69	8.775	20.820	-43094.5	-2636835.4	-1225480.0	0.46	0.04		East truss tower, F5-F6	0.00E+00	-1.23E+06	-1126000	42110	99480
50	121	SE2093	71.99	1.00	126.94	7.077	17.935	1.00	182.69	8.775	20.820	-49053.4	-3001445.6	-269540.0	0.09	0.01		East truss tower, F5-F6	0.00E+00	-2.70E+05	-248800	10880	20740
33	382	ST2101	7.06	1.00	406.41	8.737	46.514	1.00	406.41	1.606	253.121	-4467.3	232980.0	62430.0	0.27	0.27	*	Top lat. diagonal, U1W-UM2	0.00E+00	-7.97E+04	-56190	19230	23510
33	381	ST2102	7.06	1.00	404.79	8.737	46.329	1.00	404.79	1.606	252.116	-4502.9	232980.0	62430.0	0.27	0.27	*	Top lat. diagonal, UM2-U3E	0.00E+00	-8.63E+04	-56030	22150	30250
33	379	ST2103	7.06	1.00	406.41	8.737	46.514	1.00	406.41	1.606	253.121	-4467.3	232980.0	62430.0	0.27	0.27	*	Top lat. diagonal, U1E-UM2	0.00E+00	-8.07E+04	-55160	17970	25580
33	380	ST2104	7.06	1.00	404.79	8.737	46.329	1.00	404.79	1.606	252.116	-4502.9	232980.0	62430.0	0.27	0.27	*	Top lat. diagonal, UM2-U3W	0.00E+00	-8.72E+04	-54980	21670	32180
33	389	ST2105	7.06	1.00	403.61	8.737	46.193	1.00	403.61	1.606	251.379	-4529.4	232980.0	72110.0	0.31	0.31	*	Top lat. diagonal, U3W-UM4	0.00E+00	-9.37E+04	-58590	24310	35140
33	378	ST2106	7.06	1.00	402.90	8.737	46.113	1.00	402.90	1.606	250.939	-4545.3	232980.0	72110.0	0.31	0.31	*	Top lat. diagonal, UM4-U5E	0.00E+00	-9.45E+04	-59030	24020	35440
33	376	ST2107	7.06	1.00	403.61	8.737	46.193	1.00	403.61	1.606	251.379	-4529.4	232980.0	72110.0	0.31	0.31	*	Top lat. diagonal, U3E-UM4	0.00E+00	-9.32E+04	-56530	25190	36670
33	377	ST2108	7.06	1.00	402.90	8.737	46.113	1.00	402.90	1.606	250.939	-4545.3	232980.0	72110.0	0.31	0.31	*	Top lat. diagonal, UM4-U5W	0.00E+00	-9.41E+04	-58060	26590	35990
33	386	ST2109	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-21886.0	0.20	0.19		Top lat. diagonal, U5W-UM6W	1.90E+04	-2.19E+04	-1636	10450	20250
33	427	ST2110	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-22377.0	0.21	0.19		Top lat. diagonal, UM6W-UM5'	1.99E+04	-2.24E+04	-1397	10630	20980
33	424	ST2111	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-26250.0	0.24	0.23		Top lat. diagonal, UM5-UM6W	2.39E+04	-2.63E+04	-1340	12920	24910
33	388	ST2112	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-26149.0	0.24	0.23		Top lat. diagonal, UM6W-U5'W	2.34E+04	-2.61E+04	-1549	12990	24600
33	425	ST2113	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-25072.6	0.23	0.23		Top lat. diagonal, UM5-UM6E	2.48E+04	-2.51E+04	-162.6	12750	24910
33	387	ST2114	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-24967.7	0.23	0.23		Top lat. diagonal, UM6E-U5'E	2.43E+04	-2.50E+04	-367.7	12780	24600
33	385	ST2115	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-20607.4	0.19	0.19		Top lat. diagonal, U5E-UM6E	2.01E+04	-2.06E+04	-267.4	10350	20340
33	426	ST2116	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-21092.4	0.19	0.19		Top lat. diagonal, UM6E-UM5'	2.10E+04	-2.11E+04	-32.44	10550	21060
33	374	ST2117	7.06	1.00	402.90	8.737	46.113	1.00	402.90	1.606	250.939	-4545.3	232980.0	96770.0	0.42	0.42	*	Top lat. diagonal, U5'W-UM4'	0.00E+00	-1.00E+05	-58280	28830	41940
33	375	ST2118	7.06	1.00	403.61	8.737	46.193	1.00	403.61	1.606	251.379	-4529.4	232980.0	96770.0	0.42	0.42	*	Top lat. diagonal, UM4'-U3'E	6.54E+03	-1.06E+05	-56610	32230	49000
33	372	ST2119	7.06	1.00	402.90	8.737	46.113	1.00	402.90	1.606	250.939	-4545.3	232980.0	96770.0	0.42	0.42	*	Top lat. diagonal, U5'E-UM4'	0.00E+00	-9.99E+04	-58940	33540	40930
33	373	ST2120	7.06	1.00	403.61	8.737	46.193	1.00	403.61	1.606	251.379	-4529.4	232980.0	96770.0	0.42	0.42	*	Top lat. diagonal, UM4'-U3'W	3.87E+03	-1.06E+05	-58540	37390	47770
33	369	ST2121	7.06	1.00	404.79	8.737	46.329	1.00	404.79	1.606	252.116	-4502.9	232980.0	92800.0	0.40	0.40	*	Top lat. diagonal, U3'W-UM2'	6.11E+03	-1.02E+05	-54520	35040	47000
33	383	ST2122	7.06	1.00	406.41	8.737	46.514	1.00	406.41	1.606	253.121	-4467.3	232980.0	92800.0	0.40	0.40	*	Top lat. diagonal, UM2'-U1'W	0.00E+00	-8.74E+04	-54570	32790	29620
33	370	ST2123	7.06	1.00	404.79	8.737	46.329	1.00	404.79	1.606	252.116	-4502.9	232980.0	92800.0	0.40	0.40	*	Top lat. diagonal, U3'E-UM2'	4.10E+03	-1.01E+05	-55600	38870	45800
33	384	ST2124	7.06	1.00	406.41	8.737	46.514	1.00	406.41	1.606	253.121	-4467.3	232980.0	92800.0	0.40	0.40	*	Top lat. diagonal, UM2'-U1'W	0.00E+00	-8.65E+04	-56250	30200	27620
33	213	ST2125	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-16780.0	0.06	0.06		Top lateral strut, U2W-UM2	1.85E+04	-1.68E+04	1401	8206	16780
33	151	ST2126	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-15590.0	0.06	0.06		Top lateral strut, UM2-U2E	1.69E+04	-1.56E+04	1067	7198	15590
33	420	ST2127	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	112732.5	0.24	0.05		Top lateral strut, U3W-UM3	1.13E+05	-2.41E+04	70890	20370	24120
33	152	ST2128	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	108505.0	0.23	0.04		Top lateral strut, UM3-U3E	1.09E+05	-2.02E+04	70660	20180	19860
33	214	ST2129	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-11500.0	0.04	0.04		Top lateral strut, U4W-UM4	1.31E+04	-1.15E+04	1281	5434	11500
33	153	ST2130	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-10310.0	0.04	0.04		Top lateral strut, UM4-U4E	1.14E+04	-1.03E+04	884.1	4579	10310
33	215	ST2131	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	65270.0	0.14	0.04		Top lateral strut, U5W-UM5	6.53E+04	-1.87E+04	37280	14370	18670
33	154	ST2132	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	63687.5	0.13	0.04		Top lateral strut, UM5-U5E	6.37E+04	-1.74E+04	37030	12750	17400
33	216	ST2133	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	62472.5	0.13	0.03		Top lateral strut, U5'W-UM5'	6.25E+04	-1.57E+04	37410	14150	15710
33	155	ST2134	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	62325.0	0.13	0.03		Top lateral strut, UM5'-U5'E	6.23E+04	-1.60E+04	37060	16000	14540
33	217	ST2135	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-10770.0	0.04	0.04		Top lateral strut, U4'W-UM4'	1.24E+04	-1.08E+04	1302	4898	10770
33	156	ST2136	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-9774.0	0.04	0.04		Top lateral strut, UM4'-U4'E	1.09E+04	-9.77E+03	882.1	4391	9774
33	419	ST2137	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	118815.0	0.25	0.06		Top lateral strut, U3'W-UM3'	1.19E+05	-3.01E+04	70940	30140	21110
33	157	ST2138	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	118762.5	0.25	0.06		Top lateral strut, UM3'-U3'E	1.19E+05	-3.02E+04	70850	30200	18710
33	127	ST2139	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-33610.0	0.12	0.12		Top lateral strut, U2'W-UM2'	3.80E+04	-3.36E+04	3520	24550	33610
33	218	ST2140	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-33720.0	0.12	0.12		Top lateral strut, UM2'-U2'E	3.71E+04	-3.37E+04	2735	26480	33720
33	466	ST2141	7.06	1.00	297.96	8.737	34.102	1.00	297.96	1.606	185.578	-8310.8	-49873.3	-2652.0	0.05	0.02		Top lat. brace, UM3-UM4	1.16E+02	-2.65E+03	-1449	1203	760.7
33	371	ST2142	7.06	1.00	297.96	8.737	34.102	1.00	297.96	1.606	185.578	-8310.8	-49873.3	-2280.1	0.05	0.02		Top lat. brace, UM3'-UM4'	0.00E+00	-2.28E+03	-1374	906.1	704.3
50	245	SB2201	6.84	1.00	201.33	0.982	204.960	1.00	402.66	2.817	142.959	-6813.3	342000.0	294537.5	0.86	0.69	*	Btm. lat. diagonal, L0W-LM1	5.25E+05	-4.33E+05	46010	173600	467900
50	248	SB2202	6.10	1.00	201.33	1.024	196.557	1.00	402.66	2.269	177.444	-7408.3	305000.0	279725.0	0.92	0.74	*	Btm. lat. diagonal, LM1-L2E	4.79E+05	-3.94E+05	42620	157300	425600
50	246	SB2203	6.84	1.00	201.33	0.982	204.960	1.00	402.66	2.817	142.959	-6813.3	342000.0	293250.0	0.86	0.69	*	Btm. lat. diagonal, L0E-LM1	5.36E+05	-4.46E+05	44980	179200	480200
50	247	SB2204	6.10	1.00	201.33	1.024	196.557	1.00	402.66	2.269	177.444	-7408.3	305000.0	279175.0	0.92	0.74	*	Btm. lat. diagonal, LM1-L2W	4.90E+05	-4.06E+05	42260	162100	437500
50	260	SB2205	6.10	1.00	201.33	1.024	196.557	1.00	402.66	2.269	177.444	-7408.3	305000.0	336575.0	1.10	0.91	*	Btm. lat. diagonal, L2'W-LM1'	6.19E+05	-5.26E+05	46560	263700	560600
50	277	SB2206	6.84	1.00	201.33	0.982	204.960	1.00	402.66	2.817	142.959	-6813.3	342000.0	352562.5	1.03	0.85	*	Btm. lat. diagonal, LM1'-L0'E	6.72E+05	-5.73E+05	49510	278700	609800
50	259	SB2207	6.10	1.00	201.33	1.024	196.557	1.00	402.66	2.269	177.444	-7408.3	305000.0	337687.5	1.11	0.92	*	Btm. lat. diagonal, L2'E-LM1'	5.65E+05	-4.72E+05	46850	224700	506700
50	275	SB2208	6.84	1.00	201.33	0.982	204.960	1.00	402.66	2.817	142.959	-6813.3	342000.0	353887.5	1.03	0.85	*	Btm. lat. diagonal, LM1'-L0'W	6.16E+05	-5.15E+05	50570	238800	552900
50	261	SB2209	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	176500.0	220225.0	1.25	1.32	*	Btm. lat. diagonal, L2W-LM3	3.96E+05	-3.27E+05	34620	143700	352900
33	250	SB2210	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	195825.0	1.68	1.71	*	Btm. lat. diagonal, LM3-L4E	2.93E+05	-2.21E+05	36140	113700	247700
50	249	SB2211	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	176500.0	218900.0	1.24	1.32	*	Btm. lat. diagonal, L2E-LM3	3.97E+05	-3.30E+05	33560	143000	354900
33	251	SB2212	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	193450.0	1.66	1.71	*	Btm. lat. diagonal, LM3-L4W	2.92E+05	-2.23E+05	34360	111400	249100
33	254	SB2213	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	139512.5	1.20	0.38	*	Btm. lat. diagonal, L4W-LM5	1.82E+05	-1.07E+05	37850	108100	134900
33	253	SB2214	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	137962.5	1.18	0.38	*	Btm. lat. diagonal, L4E-LM5	1.82E+05	-1.07E+05	37170	100500	135100
33	256	SB2215	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	171712.5	1.47	1.18	*	Btm. lat. diagonal, L5W-LM6W	3.19E+05	-2.48E+05	35670	149000	274600
33	268	SB2216	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	171825.0	1.48	1.18	*	Btm. lat. diagonal, LM6W-LM5'	3.20E+05	-2.48E+05	35680	149100	275000
33	262	SB2217	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	171675.0	1.47	1.18	*	Btm. lat. diagonal, LM5-LM6W	2.78E+05	-2.07E+05	35560	128600	233900
33	267	SB2218	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	171612.5	1.47	1.18	*	Btm. lat. diagonal, LM6W-L5'W	2.78E+05	-2.07E+05	35570	128600	233600

FILENAME: 2DEMCAP.XLS
12/23/94
I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT
FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS
UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 2

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.	DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
33	263	SB2219	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	170800.0	1.47	1.16	* Btm. lat. diagonal, LM5-LM6E	2.76E+05	-2.04E+05	36300	124100	230900
33	266	SB2220	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	170737.5	1.47	1.16	* Btm. lat. diagonal, LM6E-L5'E	2.76E+05	-2.03E+05	36310	124100	230600
33	255	SB2221	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	170650.0	1.46	1.16	* Btm. lat. diagonal, L5E-LM6E	3.16E+05	-2.43E+05	36240	136000	270500
33	264	SB2222	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	170737.5	1.47	1.16	* Btm. lat. diagonal, LM6E-LM5'	3.16E+05	-2.44E+05	36250	136100	270800
33	265	SB2223	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	168987.5	1.45	0.50	* Btm. lat. diagonal, LM5'-L4'W	2.59E+05	-1.83E+05	37930	121800	211300
33	269	SB2224	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	168475.0	1.45	0.50	* Btm. lat. diagonal, LM5'-L4'E	2.62E+05	-1.87E+05	37500	136800	215600
33	258	SB2225	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	240450.0	2.06	2.23	* Btm. lat. diagonal, L4'W-LM3'	3.85E+05	-3.15E+05	34740	194200	341100
50	274	SB2226	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	176500.0	266325.0	1.51	1.68	* Btm. lat. diagonal, LM3'-L2'E	4.93E+05	-4.26E+05	33440	222500	451100
33	257	SB2227	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	242887.5	2.09	2.24	* Btm. lat. diagonal, L4'E-LM3'	3.84E+05	-3.11E+05	36410	175200	338400
50	272	SB2228	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	176500.0	267725.0	1.52	1.68	* Btm. lat. diagonal, LM3'-L2'W	4.90E+05	-4.21E+05	34560	201900	447000
33	159	SX2301	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-35375.8	0.14	0.14	X-frame btm. strut, panel 2	3.53E+04	-3.54E+04	-45.84	15530	35330
33	278	SX2302	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-1699.5	0.01	0.01	X-frame btm. strut, panel 2	2.19E+03	-1.70E+03	247.4	1727	1885
33	279	SX2303	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-35967.1	0.14	0.14	X-frame btm. strut, panel 2	3.47E+04	-3.60E+04	-717.1	15500	35250
33	166	SX2304	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-30385.8	0.12	0.12	X-frame btm. strut, panel 3	3.35E+04	-3.04E+04	1539	12000	31540
33	280	SX2305	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	8161.5	0.02	0.00	X-frame btm. strut, panel 3	8.16E+03	0.00E+00	4990	1663	1924
33	281	SX2306	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-30602.0	0.12	0.12	X-frame btm. strut, panel 3	3.28E+04	-3.06E+04	1104	11970	31430
33	173	SX2307	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-34630.4	0.14	0.13	X-frame btm. strut, panel 4	3.35E+04	-3.46E+04	-650.4	12240	33980
33	282	SX2308	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-2285.5	0.02	0.02	X-frame btm. strut, panel 4	2.39E+03	-2.29E+03	51.33	1598	2324
33	283	SX2309	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-33969.6	0.13	0.13	X-frame btm. strut, panel 4	3.40E+04	-3.40E+04	27.18	12230	33990
33	198	SX2310	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-34340.5	0.14	0.13	X-frame btm. strut, panel 4'	3.30E+04	-3.43E+04	-750.5	11980	33590
33	288	SX2311	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-1438.1	0.01	0.01	X-frame btm. strut, panel 4'	1.67E+03	-1.44E+03	115.9	1517	1525
33	289	SX2312	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-33535.1	0.13	0.13	X-frame btm. strut, panel 4'	3.38E+04	-3.35E+04	113.2	11990	33620
33	199	SX2313	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-29488.5	0.12	0.12	X-frame btm. strut, panel 3'	3.20E+04	-2.95E+04	1242	11210	30420
33	291	SX2314	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	-7532.0	0.02	0.00	X-frame btm. strut, panel 3'	7.53E+03	0.00E+00	4668	1631	1697
33	292	SX2315	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-29557.8	0.12	0.12	X-frame btm. strut, panel 3'	3.17E+04	-2.96E+04	1083	11210	30370
33	205	SX2316	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-29586.9	0.12	0.12	X-frame btm. strut, panel 2'	2.99E+04	-2.96E+04	164.2	12180	29710
33	295	SX2317	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-13562.0	0.10	0.05	X-frame btm. strut, panel 2'	1.87E+03	-1.36E+04	-6681	6881	2609
33	294	SX2318	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-30257.0	0.12	0.12	X-frame btm. strut, panel 2'	2.92E+04	-3.03E+04	-597	12100	29660
33	162	SX2319	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-19981.5	0.16	0.16	X-frame diagonal, panel 2	2.21E+04	-2.00E+04	1078	9329	20790
33	163	SX2320	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-20890.7	0.16	0.16	X-frame diagonal, panel 2	2.24E+04	-2.09E+04	745.7	9493	21450
33	164	SX2321	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-21398.4	0.16	0.16	X-frame diagonal, panel 2	2.20E+04	-2.14E+04	295.5	9468	21620
33	165	SX2322	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-20144.0	0.16	0.17	X-frame diagonal, panel 2	2.31E+04	-2.01E+04	1488	9361	21260
33	169	SX2323	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-18217.5	0.18	0.20	X-frame diagonal, panel 3	2.52E+04	-1.82E+04	3470	8072	20820
33	170	SX2324	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-23797.0	0.22	0.21	X-frame diagonal, panel 3	2.09E+04	-2.38E+04	-1667	8442	22130
33	171	SX2325	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-24446.0	0.23	0.21	X-frame diagonal, panel 3	2.09E+04	-2.44E+04	-2006	8497	22440
33	172	SX2326	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-18686.5	0.18	0.21	X-frame diagonal, panel 3	2.62E+04	-1.87E+04	3778	8149	21520
33	176	SX2327	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-23501.5	0.28	0.29	X-frame diagonal, panel 4	2.63E+04	-2.35E+04	1398	9061	24550
33	177	SX2328	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-26336.0	0.30	0.30	X-frame diagonal, panel 4	2.69E+04	-2.63E+04	272	9658	26540
33	178	SX2329	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-26219.9	0.30	0.30	X-frame diagonal, panel 4	2.79E+04	-2.62E+04	840.1	9654	26850
33	179	SX2330	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-24633.9	0.29	0.30	X-frame diagonal, panel 4	2.63E+04	-2.46E+04	848.1	9065	25270
33	194	SX2331	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-23458.0	0.28	0.29	X-frame diagonal, panel 4'	2.65E+04	-2.35E+04	1536	8984	24610
33	195	SX2332	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-26337.6	0.30	0.30	X-frame diagonal, panel 4'	2.66E+04	-2.63E+04	136.6	9537	26440
33	196	SX2333	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-25884.1	0.29	0.30	X-frame diagonal, panel 4'	2.76E+04	-2.59E+04	861.2	9506	26530
33	197	SX2334	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-24283.4	0.29	0.29	X-frame diagonal, panel 4'	2.60E+04	-2.43E+04	835.5	8943	24910
33	200	SX2335	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-17970.0	0.17	0.20	X-frame diagonal, panel 3'	2.49E+04	-1.80E+04	3440	7688	20550
33	201	SX2336	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-23258.0	0.22	0.20	X-frame diagonal, panel 3'	2.04E+04	-2.33E+04	-1658	7981	21600
33	202	SX2337	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-23470.0	0.22	0.20	X-frame diagonal, panel 3'	2.03E+04	-2.35E+04	-1790	7953	21680
33	290	SX2338	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-18044.3	0.17	0.20	X-frame diagonal, panel 3'	2.51E+04	-1.80E+04	3541	7643	20700
33	203	SX2339	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-21380.0	0.17	0.14	X-frame diagonal, panel 2'	1.52E+04	-2.14E+04	-3550	8182	17830
33	204	SX2340	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-14322.0	0.11	0.14	X-frame diagonal, panel 2'	2.49E+04	-1.43E+04	5304	8328	18300
33	206	SX2341	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-14690.8	0.11	0.14	X-frame diagonal, panel 2'	2.43E+04	-1.47E+04	4799	8761	18290
33	293	SX2342	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-20898.0	0.16	0.14	X-frame diagonal, panel 2'	1.55E+04	-2.09E+04	-3078	8651	17820
33	180	SX2343	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-36982.7	0.15	0.14	X-frame btm. strut, panel 5	3.64E+04	-3.70E+04	-352.7	13080	36630
33	284	SX2344	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	6239.8	0.02	0.01	X-frame btm. strut, panel 5	6.24E+03	0.00E+00	3271	1478	2151
33	285	SX2345	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-36040.1	0.14	0.14	X-frame btm. strut, panel 5	3.75E+04	-3.60E+04	733.2	13090	36590
33	188	SX2346	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-36790.9	0.15	0.14	X-frame btm. strut, panel 5'	3.61E+04	-3.68E+04	-370.9	12950	36420
33	286	SX2347	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	5466.8	0.01	0.00	X-frame btm. strut, panel 5'	5.47E+03	0.00E+00	3215	1243	1448
33	287	SX2348	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-35773.1	0.14	0.14	X-frame btm. strut, panel 5'	3.73E+04	-3.58E+04	782.6	12940	36360
33	183	SX2349	7.06	1.00	238.45	3.418	69.753	1.00	238.45	1.606	148.510	-12977.4	-77877.4	-24935.8	0.32	0.36	X-frame diagonal, panel 5	3.30E+04	-2.49E+04	4019	10290	27950
33	184	SX2350	7.06	1.00	234.56	3.418	68.617	1.00	234.56	1.606	146.090	-13410.9	-80478.6	-32466.0	0.40	0.38	X-frame diagonal, panel 5	2.85E+04	-3.25E+04	-2256	10980	30210
33	185	SX2351	7.06	1.00	234.56	3.418	68.617	1.00	234.56	1.606	146.090	-13410.9	-80478.6	-31804.0	0.40	0.38	X-frame diagonal, panel 5	2.95E+04	-3.18E+04	-1294	10930	30510
33	186	SX2352	7.06	1.00	238.45	3.418	69.753	1.00	238.45	1.606	148.510	-12977.4	-77877.4	-26304.3	0.34	0.37	X-frame diagonal, panel 5	3.25E+04	-2.63E+04	3101	10230	28630
33	189	SX2353	7.06	1.00	238.45	3.418	69.753	1.00	238.45	1.606	148.510	-12977.4	-77877.4	-24859.8	0.32	0.36	X-frame diagonal, panel 5'	3.28E+04	-2.49E+04	3987	10180	27850
33	187	SX2354	7.06	1.00	234.56	3.418	68.617	1.00	234.56	1.606	146.090	-13410.9	-80478.6	-32253.0	0.40	0.37	X-frame diagonal, panel 5'	2.84E+04	-3.23E+04	-2223	10840	30030
33	190	SX2355	7.06	1.00	234.56	3.418	68.617	1.00	234.56	1.606	146.090	-13410.9	-80478.6	-31532.0	0.39	0.38	X-frame diagonal, panel 5'	2.94E+04	-3.15E+04	-1202	10810	30330
33	191	SX2356	7.06	1.00	238.45	3.418	69.753	1.00	238.45	1.606	148.510	-12977.4	-77877.4	-26181.0	0.34	0.37	X-frame diagonal, panel 5'	3.22E+04	-2.62E+04	3012	10140	28440
33	350	SX2357	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	92930.0	0.14	0.07	Portal frame top chord, U1	9.29E+04	-2.48E+04	34080	28470	50330
33	351	SX2358	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	57042.5	0.08	0.03	Portal frame top chord, U1	5.70E+04	0.00E+00	29330	12910	20380
33	352	SX2359	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	60530.0	0.09	0.03	Portal frame top chord, U1	6.05E+04	-6.10E+02	29960	15310	23080
33	342	SX2360	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	98422.5	0.14	0.08	Portal frame top chord, U1	9.84E+04	-2.65E+04	35970	31650	53460
33	158	SX2361	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	85102.5	0.12	0.06	Portal frame top chord, U1'	8.51E+04	-1.64E+04	34330	25440	42190
33	366	SX2362	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	54082.5	0.08	0.03	Portal frame top chord, U1'	5.41E+04	0.00E+00	29530	16340	17170
33	365	SX2363	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	56602.5	0.08	0.03	Portal frame top chord, U1'	5.66E+04	0.00E+00	30250	15400	18790
33	364	SX2364	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	89277.5	0.13	0.06	Portal frame top chord, U1'	8.93E+04	-1.63E+04	36470	23440	43690
33	353	SX2365	7.06	1.00	544.50	1.606	339.129	1.00	183.25	8.737	20.973	-2488.7	-14934.6	-34523.5	2.31	2.61	Portal frame btm. chord, U1	4.66E+04	-3.45E+04	6022	21520	39040
33	354	SX2366	7.06	1.00	544.50	1.606	339.129	1.00	178.00	8.737	20.372	-2488.7	232980.0	9132.3	0.04	0.01	Portal frame btm. chord, U1	9.13E+03	0.00E+00	6041	1387	1581
33	343	SX2367	7.06	1.00	544.50	1.606	339.129	1.00	183.25	8.737	20.973	-2488.7	-14934.6	-37292.5	2.50	2.75	Portal frame btm. chord, U1	4.73E+04	-3.73E+04	5010	22460	41050
33	357	SX2368	7.06	1.00	544.50	1.606	339.129	1.00	183.25	8.737	20.973	-2488.7	-14934.6	-27466.0	1.84	2.14	Portal frame btm. chord, U1'	3.95E+04	-2.75E+04	6032	14310	31990
33	367	SX2369	7.06	1.00	544.50	1.606	339.129	1.00	178.00	8.737	20.372	-2488.7	232980.0	9503.3	0.04	0.01	Portal frame btm. chord, U1'	9.50E+03	0.00E+00	5829	2217	1579
33	368	SX2370	7.06	1.00	544.50	1.606	339.129	1.00	183.25	8.737	20.973	-2488.7	-14934.6	-30035.0	2.01	2.26	Portal frame btm. chord, U1'	3.98E+04	-3.00E+04	4860	15540	33680
33	344	SX2371	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-25889.0	0.25	0.19	Portal frame diagonal, U1	1.53E+04	-2.59E+04	-6049	11230	19840
33	345	SX2372	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-21765.2	0.21	0.21	Portal frame diagonal, U1	2.31E+04	-2.18E+04	659.8	12250	22260

FILENAME: 2DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

* - Adjusted for true behavior of tension-only members

UNITS INCH,LB. (Fy in ksi)

SPAN 2

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
33	346	SX2373	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-25747.1	0.25	0.25		Portal frame diagonal, U1	2.68E+04	-2.57E+04	537.2	14460	26150
33	347	SX2374	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-26422.1	0.25	0.25		Portal frame diagonal, U1	2.60E+04	-2.64E+04	-222.1	14440	26200
33	348	SX2375	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-21314.0	0.20	0.21		Portal frame diagonal, U1	2.37E+04	-2.13E+04	1168	12170	22190
33	349	SX2376	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-27654.0	0.27	0.20		Portal frame diagonal, U1	1.49E+04	-2.77E+04	-7284	11770	20370
33	363	SX2377	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-22336.0	0.22	0.16		Portal frame diagonal, U1'	1.12E+04	-2.23E+04	-6356	7793	15980
33	362	SX2378	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-18120.6	0.17	0.18		Portal frame diagonal, U1'	1.91E+04	-1.81E+04	492.6	8308	18490
33	361	SX2379	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-20982.5	0.20	0.20		Portal frame diagonal, U1'	2.23E+04	-2.10E+04	636.7	9581	21460
33	360	SX2380	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-21687.0	0.21	0.20		Portal frame diagonal, U1'	2.13E+04	-2.17E+04	-227	9636	21460
33	359	SX2381	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-17536.5	0.17	0.18		Portal frame diagonal, U1'	1.97E+04	-1.75E+04	1098	8227	18360
33	358	SX2382	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-23763.0	0.23	0.16		Portal frame diagonal, U1'	1.03E+04	-2.38E+04	-7693	7370	16070
33	462	SX2383	3.98	1.00	221.21	1.692	130.703	1.00	221.21	1.444	153.179	-12198.3	-41266.9	-17489.6	0.42	0.43		Tower bracing, panel F6-R6	1.82E+04	-1.75E+04	333.9	9265	17740
33	461	SX2384	3.98	1.00	164.99	1.692	97.484	1.00	164.99	1.444	114.248	-20584.5	-69637.4	-16296.1	0.23	0.23		Tower bracing, panel F6-R6	1.55E+04	-1.63E+04	-466.1	8195	15830
33	460	SX2385	3.98	1.00	164.99	1.692	97.484	1.00	164.99	1.444	114.248	-20584.5	-69637.4	-15483.1	0.22	0.23		Tower bracing, panel F6-R6	1.61E+04	-1.55E+04	302.5	8295	15710
33	459	SX2386	3.98	1.00	221.21	1.692	130.703	1.00	221.21	1.444	153.179	-12198.3	-41266.9	-17983.2	0.44	0.42		Tower bracing, panel F6-R6	1.71E+04	-1.80E+04	-513.2	9456	17470
33	327	SR2401	6.19	1.00	656.95	4.144	158.529	1.00	328.47	1.252	262.398	-4157.0	204270.0	90291.3	0.44	0.43	*	Tower rear lat. diag., U2'E-R1W	4.60E+04	-4.18E+04	2113	31230	43350
33	132	SR2402	6.19	1.00	656.95	4.144	158.529	1.00	328.47	1.252	262.398	-4157.0	204270.0	89781.3	0.44	0.43	*	Tower rear lat. diag., U2'W-R1E	4.62E+04	-4.28E+04	1705	30840	44080
33	326	SR2403	6.19	1.00	656.95	4.144	158.529	1.00	328.47	1.252	262.398	-4157.0	204270.0	91238.8	0.45	0.43	*	Tower rear lat. diag., U2'W-R1E	4.78E+04	-4.21E+04	2871	30890	44210
33	133	SR2404	6.19	1.00	656.95	4.144	158.529	1.00	328.47	1.252	262.398	-4157.0	204270.0	91747.5	0.45	0.43	*	Tower rear lat. diag., U2'E-R1W	4.75E+04	-4.10E+04	3278	31210	43440
33	324	SR2405	6.19	1.00	665.71	4.144	160.644	1.00	332.86	1.252	265.899	-4048.2	204270.0	88310.0	0.43	0.43	*	Tower rear lat. diag., R1E-R2W	4.20E+04	-4.60E+04	-2280	33070	43720
33	134	SR2406	6.19	1.00	665.71	4.144	160.644	1.00	332.86	1.252	265.899	-4048.2	204270.0	88310.0	0.43	0.43	*	Tower rear lat. diag., R1W-R2E	4.25E+04	-4.74E+04	-2783	31840	44590
33	325	SR2407	6.19	1.00	665.71	4.144	160.644	1.00	332.86	1.252	265.899	-4048.2	204270.0	88310.0	0.43	0.43	*	Tower rear lat. diag., R1W-R2E	4.42E+04	-4.51E+04	-533.2	31730	44560
33	135	SR2408	6.19	1.00	665.71	4.144	160.644	1.00	332.86	1.252	265.899	-4048.2	204270.0	88310.0	0.43	0.43	*	Tower rear lat. diag., R1E-R2W	4.36E+04	-4.36E+04	-29.89	32880	43620
33	322	SR2409	6.19	1.00	655.57	4.144	158.197	1.00	327.79	1.252	261.848	-4174.4	204270.0	84010.0	0.41	0.41	*	Tower rear lat. diag., R2E-R3W	4.01E+04	-4.30E+04	-1630	28830	41350
33	136	SR2410	6.19	1.00	655.57	4.144	158.197	1.00	327.79	1.252	261.848	-4174.4	204270.0	84010.0	0.41	0.41	*	Tower rear lat. diag., R2W-R3E	4.06E+04	-4.48E+04	-2412	27230	42360
33	323	SR2411	6.19	1.00	655.57	4.144	158.197	1.00	327.79	1.252	261.848	-4174.4	204270.0	84010.0	0.41	0.41	*	Tower rear lat. diag., R2W-R3E	4.25E+04	-4.27E+04	-99.75	27420	42560
33	137	SR2412	6.19	1.00	655.57	4.144	158.197	1.00	327.79	1.252	261.848	-4174.4	204270.0	84862.8	0.42	0.41	*	Tower rear lat. diag., R2E-R3W	4.23E+04	-4.09E+04	682.2	28880	41450
33	321	SR2413	6.19	1.00	613.07	4.144	147.942	1.00	306.54	1.252	244.874	-4773.3	204270.0	80450.0	0.39	0.39	*	Tower rear lat. diag., R3E-R4W	3.91E+04	-4.06E+04	-870.1	23780	39730
33	138	SR2414	6.19	1.00	613.07	4.144	147.942	1.00	306.54	1.252	244.874	-4773.3	204270.0	80450.0	0.39	0.39	*	Tower rear lat. diag., R3W-R4E	3.85E+04	-4.21E+04	-2039	22740	40070
33	320	SR2415	6.19	1.00	613.07	4.144	147.942	1.00	306.54	1.252	244.874	-4773.3	204270.0	81229.4	0.40	0.39	*	Tower rear lat. diag., R3W-R4E	4.11E+04	-3.99E+04	623.5	23140	40360
33	139	SR2416	6.19	1.00	613.07	4.144	147.942	1.00	306.54	1.252	244.874	-4773.3	204270.0	82692.5	0.40	0.39	*	Tower rear lat. diag., R3E-R4W	4.23E+04	-3.87E+04	1794	24140	40090
33	297	SR2417	6.19	1.00	678.86	4.144	163.816	1.00	339.43	1.252	271.149	-3893.0	204270.0	96410.0	0.47	0.47	*	Tower rear lat. diag., R4E-R5W	4.74E+04	-4.96E+04	-1288	27710	48320
33	298	SR2418	6.19	1.00	678.86	4.144	163.816	1.00	339.43	1.252	271.149	-3893.0	204270.0	96410.0	0.47	0.47	*	Tower rear lat. diag., R4W-R5E	4.59E+04	-5.10E+04	-2927	26150	48090
33	296	SR2419	6.19	1.00	678.86	4.144	163.816	1.00	339.43	1.252	271.149	-3893.0	204270.0	96410.0	0.47	0.47	*	Tower rear lat. diag., R4W-R5E	4.74E+04	-4.87E+04	-702.1	26340	47960
33	299	SR2420	6.19	1.00	678.86	4.144	163.816	1.00	339.43	1.252	271.149	-3893.0	204270.0	97582.3	0.48	0.47	*	Tower rear lat. diag., R4E-R5W	4.94E+04	-4.75E+04	937.8	27850	48250
33	409	SR2421	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-87993.6	0.73	0.73	*	Tower rear lat. strut, R1	2.98E+04	-8.80E+04	-562.2	30210	14320
33	128	SR2422	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-88013.4	0.73	0.73	*	Tower rear lat. strut, R1	2.98E+04	-8.80E+04	-562	30220	14340
33	407	SR2423	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-84882.8	0.71	0.72	*	Tower rear lat. strut, R2	3.31E+04	-8.49E+04	1877	30780	15130
33	129	SR2424	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-84922.8	0.71	0.72	*	Tower rear lat. strut, R2	3.31E+04	-8.49E+04	1877	30800	15170
33	405	SR2425	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-82236.1	0.69	0.69	*	Tower rear lat. strut, R3	2.06E+04	-8.22E+04	290.4	20210	11590
33	130	SR2426	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-82287.5	0.69	0.69	*	Tower rear lat. strut, R3	2.06E+04	-8.23E+04	289	20250	11640
33	403	SR2427	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-82679.2	0.69	0.71	*	Tower rear lat. strut, R4	1.54E+04	-8.27E+04	2242	12630	10320
33	131	SR2428	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-82600.2	0.69	0.71	*	Tower rear lat. strut, R4	1.54E+04	-8.26E+04	2241	12630	10240
33	463	SR2429	12.76	1.00	544.50	3.911	139.214	1.00	272.25	29.419	9.254	-14768.3	-160177.3	-67571.3	0.42	0.41	*	Tower rear lat. strut, R6	2.48E+04	-6.76E+04	-2330	14650	26540
33	464	SR2430	12.76	1.00	544.50	3.911	139.214	1.00	272.25	29.419	9.254	-14768.3	-160177.3	-52952.3	0.33	0.31	*	Tower rear lat. strut, R6	9.16E+03	-5.30E+04	-2911	10510	11340
33	465	SR2431	12.76	1.00	544.50	3.911	139.214	1.00	272.25	29.419	9.254	-14768.3	-160177.3	-66976.3	0.42	0.40	*	Tower rear lat. strut, R6	2.22E+04	-6.70E+04	-3475	15550	24800
33	408	SR2432	6.19	1.00	191.50	4.144	46.211	1.00	191.50	1.252	152.978	-12230.4	204270.0	1582.2	0.01	0.00		Tower rear C.L. brace, R1	1.58E+03	0.00E+00	1049	248.5	270.9
33	406	SR2433	6.19	1.00	182.55	4.144	44.051	1.00	182.55	1.252	145.827	-13459.4	204270.0	1541.6	0.01	0.00		Tower rear C.L. brace, R2	1.54E+03	0.00E+00	1042	234.8	239.1
33	404	SR2434	6.19	1.00	140.87	4.144	33.994	1.00	140.87	1.252	112.533	-20954.3	204270.0	1562.7	0.01	0.00		Tower rear C.L. brace, R3	1.56E+03	0.00E+00	1044	227.4	257.7
33	402	SR2435	6.19	1.00	202.71	4.144	48.917	1.00	202.71	1.252	161.934	-10915.0	204270.0	1646.4	0.01	0.00		Tower rear C.L. brace, R4	1.65E+03	0.00E+00	1013	336.7	380.1
33	316	SF2501	7.97	1.00	183.28	5.060	36.218	1.00	183.28	1.443	126.996	-17659.1	-119631.4	-78148.0	0.65	0.62		Tower front lat. diag. @ U0'	7.22E+04	-7.81E+04	-3408	27170	74740
33	108	SF2502	7.97	1.00	179.34	5.060	35.439	1.00	179.34	1.443	124.265	-18311.8	-124053.5	-74137.0	0.60	0.60		Tower front lat. diag. @ U0'	7.64E+04	-7.41E+04	1124	27260	74980
33	109	SF2503	7.97	1.00	179.34	5.060	35.439	1.00	179.34	1.443	124.265	-18311.8	-124053.5	-74080.8	0.60	0.60		Tower front lat. diag. @ U0'	7.65E+04	-7.41E+04	1199	27260	74980
33	317	SF2504	7.97	1.00	183.28	5.060	36.218	1.00	183.28	1.443	126.996	-17659.1	-119631.4	-78161.0	0.65	0.62		Tower front lat. diag. @ U0'	7.22E+04	-7.82E+04	-3431	27160	74730
33	315	SF2505	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	115760.0	0.44	0.44	*	Tower front lat. diag. @ F1	3.38E+04	-8.93E+04	-31690	21970	57600
33	314	SF2506	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	115760.0	0.44	0.44	*	Tower front lat. diag. @ F1	3.41E+04	-9.03E+04	-32100	22450	58160
33	312	SF2507	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	115760.0	0.44	0.44	*	Tower front lat. diag. @ F1	3.50E+04	-8.85E+04	-30600	22390	57920
33	313	SF2508	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	115760.0	0.44	0.44	*	Tower front lat. diag. @ F1	3.47E+04	-8.75E+04	-30190	21920	57350
33	309	SF2509	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	123190.0	0.47	0.47	*	Tower front lat. diag. @ F2	4.01E+04	-8.92E+04	-28090	24040	61120
33	310	SF2510	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	123190.0	0.47	0.47	*	Tower front lat. diag. @ F2	3.98E+04	-9.01E+04	-28730	24620	61370
33	308	SF2511	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	123190.0	0.47	0.47	*	Tower front lat. diag. @ F2	4.21E+04	-8.77E+04	-26020	24760	61660
33	311	SF2512	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	123190.0	0.47	0.47	*	Tower front lat. diag. @ F2	4.25E+04	-8.69E+04	-25380	24280	61530
33	305	SF2513	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	136640.0	0.52	0.52	*	Tower front lat. diag. @ F3	4.46E+04	-9.77E+04	-30340	29500	67370
33	307	SF2514	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	136640.0	0.52	0.52	*	Tower front lat. diag. @ F3	4.54E+04	-1.00E+05	-31210	30390	68830
33	304	SF2515	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	136640.0	0.52	0.52	*	Tower front lat. diag. @ F3	4.76E+04	-9.75E+04	-28490	30480	69000
33	306	SF2516	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	136640.0	0.52	0.52	*	Tower front lat. diag. @ F3	4.69E+04	-9.53E+04	-27620	29710	67640
33	303	SF2517	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	270600.0	1.03	1.03	*	Tower front lat. diag. @ F4	1.27E+05	-1.31E+05	-2519	45340	128500
33	302	SF2518	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	270600.0	1.03	1.03	*	Tower front lat. diag. @ F4	1.38E+05	-1.47E+05	-4777	50650	142000
33	300	SF2519	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	270600.0	1.03	1.03	*	Tower front lat. diag. @ F4	1.40E+05	-1.44E+05	-1998	50420	141700
33	301	SF2520	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	270938.1	1.03	1.03	*	Tower front lat. diag. @ F4	1.29E+05	-1.28E+05	270.5	45430	128600
33	104	SF2521	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-54042.3	0.37	0.39		Tower front lat. strut (below U0')	6.16E+04	-5.40E+04	3797	20750	56890
33	416	SF2522	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-54185.8	0.37	0.39		Tower front lat. strut (below U0')	6.17E+04	-5.42E+04	3739	20810	56990
33	105	SF2523	11.77	1.00	544.50	5.133	27.032	1.00	138.75	1.936	71.681	-28112.6	388410.0	141962.5	0.37	0.29		Tower front lat. strut (above U0')	1.42E+05	-9.32E+04	24370	41000	111500
33	318	SF2524	11.77	1.00	544.50	5.133	52.017	1.00	267.00	1.936	137.937	-15043.1	388410.0	32394.5	0.08	0.02		Tower front lat. strut (above U0')	3.24E+04	0.00E+00	21010	6132	4535
33	319	SF2525	11.77	1.00	544.50	5.133	27.032	1.00	138.75	1.936	71.681	-28112.6	388410.0	142062.5	0.37	0.29		Tower front lat. strut (above U0')	1.42E+05	-9.32E+04	24450	40750	111500
33	110	SF2526	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-69414.3	0.48	0.81	*	Tower front lat. strut (above F1)	1.66E+05	-6.94E+04	48290	11510	9329
33	415	SF2527	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-69314.3	0.48	0.81	*	Tower front lat. strut (above F1)	1.66E+05	-6.93E+04	48290	11530	9229
33	113	SF2528	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-82006.1	0.57	0.87	*	Tower front lat. strut (above F2)	1.69E+05	-8.20E+04	43430	9106	9234
33	413	SF2529	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-82423.1	0.57	0.87	*	Tower front lat. strut (above F2)	1.69E+05	-8.24E+04	43430	9170	9651
33	114	SF2530	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-160850.3	1.11	1.34	*	Tower front lat. strut (above F3)	2.28E+05	-1.61E+05	33560	9065	15680
33	411	SF2531	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-160467.8	1.11	1.34	*	Tower front lat. strut (above F3)	2.28E+05	-1.60E+05	33550	9008	15290
33	414	SF2532	7.97	1.00	199.00	5.060	39.324	1.00	199.00	1.443	137.889	-15053.6	263010.0	1693.4	0.01	0.00		Tower front C.L. brace (above F1)	1.69E+03	0.00E+00	1162	209.1	240.9
33	412	SF2533	7.97	1.00	199.00	5.060	39.324	1.00	199.00	1.443	137.889	-15053.6	263010.0	1836.9	0.01	0.00		Tower front C.L. brace (above F2)	1.84E+03	0.00E+00	1207	283.2	328.1

FILENAME: 2DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 2

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
33	410	SF2534	7.97	1.00	199.00	5.060	39.324	1.00	199.00	1.443	137.889	-15053.6	263010.0	1928.7	0.01	0.00		Tower front C.L. brace (above F3)	1.93E+03	0.00E+00	1169	377.5	467.4
33	115	SF2535	18.38	1.00	544.50	2.878	26.567	1.00	76.45	15.070	5.073	-32328.6	606540.0	387814.4	0.64	0.31	*	Tower front lat. strut (~ F5)	3.88E+05	0.00E+00	198600	15910	25170
33	421	SF2536	18.38	1.00	544.50	2.878	68.042	1.00	195.80	15.070	12.993	-28596.2	606540.0	441065.7	0.73	0.35	*	Tower front lat. strut (~ F5)	4.41E+05	0.00E+00	305100	22150	40640
33	437	SF2537	18.38	1.00	544.50	2.878	189.218	1.00	195.80	15.070	12.993	-7994.1	606540.0	525959.4	0.87	0.39	*	Tower front lat. strut (~ F5)	5.26E+05	0.00E+00	289900	24380	49190
33	440	SF2538	18.38	1.00	544.50	2.878	189.218	1.00	76.45	15.070	5.073	-7994.1	606540.0	371789.4	0.61	0.32	*	Tower front lat. strut (~ F5)	3.72E+05	-2.00E+04	175900	18760	37520
33	122	SF2539	18.38	1.00	272.25	2.878	94.609	1.00	79.75	15.070	5.292	-24485.9	-382543.8	-37390.0	0.10	0.01		Tower front lat. strut @ F6	0.00E+00	-3.74E+04	-33030	2758	4360
33	423	SF2540	18.38	1.00	272.25	2.878	94.609	1.00	96.25	15.070	6.387	-24485.9	-382543.8	-154004.0	0.40	0.01		Tower front lat. strut @ F6	0.00E+00	-1.54E+05	-148700	3633	5304
33	458	SF2541	18.38	1.00	272.25	2.878	94.609	1.00	96.25	15.070	6.387	-24485.9	-382543.8	-172825.0	0.45	0.03		Tower front lat. strut @ F6	0.00E+00	-1.73E+05	-162900	6163	9925
33	457	SF2542	18.38	1.00	272.25	2.878	94.609	1.00	96.25	15.070	6.387	-24485.9	-382543.8	-175230.0	0.46	0.03		Tower front lat. strut @ F6	0.00E+00	-1.75E+05	-163400	6323	11830
33	435	SF2543	18.38	1.00	272.25	2.878	94.609	1.00	96.25	15.070	6.387	-24485.9	-382543.8	-150273.0	0.39	0.02		Tower front lat. strut @ F6	0.00E+00	-1.50E+05	-143000	3721	7273
33	441	SF2544	18.38	1.00	272.25	2.878	94.609	1.00	79.75	15.070	5.292	-24485.9	-382543.8	-36229.0	0.09	0.02		Tower front lat. strut @ F6	0.00E+00	-3.62E+04	-29910	3166	6319
33	418	SF2545	6.84	1.00	161.34	14.119	11.427	1.00	161.34	1.942	83.071	-26436.0	-153698.9	-15454.2	0.10	0.10		Tower front lat. diag., panel F5-F6	1.49E+04	-1.55E+04	-324.2	9307	15130
33	124	SF2546	6.84	1.00	159.35	14.119	11.286	1.00	159.35	1.942	82.049	-26596.4	-154631.7	-34510.0	0.22	0.14		Tower front lat. diag., panel F5-F6	1.07E+04	-3.45E+04	-13610	12840	20900
33	444	SF2547	6.84	1.00	159.35	14.119	11.286	1.00	159.35	1.942	82.049	-26596.4	225720.0	35065.0	0.16	0.09		Tower front lat. diag., panel F5-F6	3.51E+04	-1.23E+04	11380	12810	20840
33	436	SF2548	6.84	1.00	161.34	14.119	11.427	1.00	161.34	1.942	83.071	-26436.0	-153698.9	-33450.0	0.22	0.10		Tower front lat. diag., panel F5-F6	1.41E+03	-3.35E+04	-18310	9267	15140
33	422	SF2549	45.53	1.00	127.00	11.847	10.720	1.00	127.00	2.539	50.012	-30620.9	-1185042.8	-32671.0	0.03	0.01		Tower, panel F5-F6 vert.	0.00E+00	-3.27E+04	-24790	5065	7881
33	442	SF2550	45.53	1.00	127.00	11.847	10.720	1.00	127.00	2.539	50.012	-30620.9	-1185042.8	-32430.0	0.03	0.01		Tower, panel F5-F6 vert.	0.00E+00	-3.24E+04	-20840	5942	11590
33	417	SF2551	5.34	1.00	115.58	13.955	8.282	1.00	115.58	1.254	92.156	-24921.8	-113120.2	-52928.0	0.47	0.08		Tower front lat. diag., panel F6-F7	0.00E+00	-5.29E+04	-44210	5549	8718
33	434	SF2552	5.34	1.00	115.58	13.955	8.282	1.00	115.58	1.254	92.156	-24921.8	-113120.2	-41920.0	0.37	0.09		Tower front lat. diag., panel F6-F7	0.00E+00	-4.19E+04	-32050	5744	9870
33	448	SF2553	5.34	1.00	112.80	13.955	8.083	1.00	112.80	1.254	89.934	-25306.5	-114866.3	-30840.0	0.27	0.09		Tower front lat. diag., panel F6-F7	0.00E+00	-3.08E+04	-20110	6319	10730
33	447	SF2554	5.34	1.00	112.80	13.955	8.282	1.00	112.80	1.254	89.934	-25306.5	-114866.3	-42313.0	0.37	0.08		Tower front lat. diag., panel F6-F7	0.00E+00	-4.23E+04	-32710	6068	9603
33	445	SF2555	3.86	1.00	58.81	14.094	4.173	1.00	58.81	1.092	53.875	-30239.1	-99214.6	-224.9	0.00	0.00		Tower, panel F6-F7 vert.	0.00E+00	-2.25E+02	-129.5	78.01	95.42
33	431	SF2556	3.86	1.00	58.81	14.094	4.173	1.00	58.81	1.092	53.875	-30239.1	127380.0	43812.5	0.34	0.02		Tower, panel F6-F7 vert.	4.38E+04	0.00E+00	33330	1211	2150
33	446	SF2557	3.86	1.00	58.81	14.094	4.173	1.00	58.81	1.092	53.875	-30239.1	-99214.6	-240.9	0.00	0.00		Tower, panel F6-F7 vert.	0.00E+00	-2.41E+02	-145.9	77.81	95.04
33	453	SF2558	5.34	1.00	192.5	13.955	13.794	1.00	96.25	1.254	76.742	-27398.1	-124360.1	-131741.0	1.06	0.08		Tower front lat. strut @ F7	0.00E+00	-1.32E+05	-122000	6220	9741
33	454	SF2559	5.34	1.00	192.5	13.955	13.794	1.00	96.25	1.254	76.742	-27398.1	-124360.1	-131637.0	1.06	0.08		Tower front lat. strut @ F7	0.00E+00	-1.32E+05	-122000	6211	9637
33	455	SF2560	5.34	1.00	192.5	13.955	13.794	1.00	96.25	1.254	76.742	-27398.1	-124360.1	-125830.0	1.01	0.11		Tower front lat. strut @ F7	0.00E+00	-1.26E+05	-112300	7081	13530
33	456	SF2561	5.34	1.00	192.5	13.955	13.794	1.00	96.25	1.254	76.742	-27398.1	-124360.1	-125660.0	1.01	0.11		Tower front lat. strut @ F7	0.00E+00	-1.26E+05	-112300	7041	13360

FILENAME: 4DEMCAP.XLS
12/23/94
I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS
UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 4

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.	DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z	EQ(Y+0.3X+0.67Z
50	343	SW4001	52.50	1.00	424.75	7.066	60.109	1.00	494.75	6.673	74.138	-37997.6	-1695661.8	-1035800.0	0.61	0.22	West truss top chord, L0-U1	0.00E+00	-1.04E+06	-670200	284700	365600
50	119	SW4002	52.50	1.00	70.00	7.066	9.906	1.00	494.75	6.673	74.138	-37997.6	-1695661.8	-1010200.0	0.60	0.21	West truss top chord, L0-U1	0.00E+00	-1.01E+06	-660800	277300	349400
50	120	SW4003	35.57	1.00	301.65	6.946	43.427	1.00	301.65	7.286	41.404	-45881.9	-1387313.5	-940000.0	0.68	0.24	West truss top chord, U1-U2	0.00E+00	-9.40E+05	-610700	255000	329300
50	121	SW4004	42.77	1.00	299.48	7.019	42.666	1.00	299.48	6.978	42.919	-45977.7	-1671593.4	-1137100.0	0.68	0.23	West truss top chord, U2-U3	0.00E+00	-1.14E+06	-751500	286600	385600
50	122	SW4005	47.10	1.00	297.87	7.056	42.217	1.00	297.87	6.822	43.661	-45837.3	-1835119.8	-1225500.0	0.67	0.21	West truss top chord, U3-U4	0.00E+00	-1.23E+06	-832000	291400	393500
50	123	SW4006	49.35	1.00	296.92	7.026	42.262	1.00	296.92	6.731	44.109	-45751.5	-1919186.6	-1358597.9	0.71	0.21	* West truss top chord, U4-U5	0.00E+00	-1.36E+06	-915300	313200	394800
50	124	SW4007	49.35	1.00	296.59	7.026	42.216	1.00	296.59	6.731	44.060	-45760.8	-1919576.7	-1245300.0	0.65	0.20	West truss top chord, U5-U5'	0.00E+00	-1.25E+06	-854900	291300	390400
50	125	SW4008	49.35	1.00	296.92	7.026	42.262	1.00	296.92	6.731	44.109	-45751.5	-1919186.6	-1314925.2	0.69	0.20	* West truss top chord, U4'-U5'	0.00E+00	-1.31E+06	-861500	322400	390600
50	126	SW4009	47.10	1.00	297.87	7.056	42.217	1.00	297.87	6.822	43.661	-45837.3	-1835119.8	-1209500.0	0.66	0.20	West truss top chord, U3'-U4'	0.00E+00	-1.21E+06	-841400	334900	368100
50	127	SW4010	42.77	1.00	299.48	7.019	42.666	1.00	299.48	6.978	42.919	-45977.7	-1671593.4	-1136400.0	0.68	0.22	West truss top chord, U2'-U3'	0.00E+00	-1.14E+06	-765600	369600	370800
50	139	SW4011	35.57	1.00	301.65	6.946	43.427	1.00	301.65	7.286	41.404	-45881.9	-1387313.5	-976900.0	0.70	0.24	West truss top chord, U1'-U2'	0.00E+00	-9.77E+05	-645700	331200	297400
50	153	SW4012	52.50	1.00	70.00	7.066	70.016	1.00	494.75	6.673	74.138	-37997.6	-1695661.8	-1083200.0	0.64	0.20	West truss top chord, L0'-U1'	0.00E+00	-1.08E+06	-742300	340900	305500
50	329	SW4013	52.50	1.00	424.75	7.066	70.016	1.00	494.75	6.673	74.138	-37997.6	-1695661.8	-1095800.0	0.65	0.20	West truss top chord, L0'-U1'	0.00E+00	-1.10E+06	-752100	343700	312500
50	138	SW4014	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	835975.0	0.67	0.30	West truss bottom chord, L0-L1	8.36E+05	-8.82E+04	373900	189300	368600
50	137	SW4015	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	829800.0	0.66	0.29	West truss bottom chord, L1-L2	8.30E+05	-7.70E+04	376400	199600	359300
50	136	SW4016	33.96	1.00	296.59	7.461	39.750	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1632125.0	0.96	0.51	West truss bottom chord, L2-L3	1.63E+06	-3.93E+05	619700	404700	857500
50	135	SW4017	40.71	1.00	296.59	7.415	39.997	1.00	296.59	6.118	48.480	-44867.7	2035500.0	1805300.0	0.89	0.42	West truss bottom chord, L3-L4	1.81E+06	-2.81E+05	762400	425000	852300
50	134	SW4018	46.11	1.00	296.59	7.383	40.172	1.00	296.59	6.017	49.291	-44694.6	2305500.0	2136375.0	0.93	0.46	West truss bottom chord, L4-L5	2.14E+06	-4.13E+05	861900	516900	1059000
50	133	SW4019	46.11	1.00	296.59	7.383	40.172	1.00	296.59	6.017	49.291	-44694.6	2305500.0	1921725.0	0.83	0.37	West truss bottom chord, L5-L5'	1.92E+06	-2.06E+05	858100	422000	849100
50	132	SW4020	46.11	1.00	296.59	7.383	40.172	1.00	296.59	6.017	49.291	-44694.6	2305500.0	2085000.0	0.90	0.44	West truss bottom chord, L4'-L5'	2.09E+06	-3.55E+05	864800	530400	1004000
50	131	SW4021	40.71	1.00	296.59	7.415	39.997	1.00	296.59	6.118	48.480	-44867.7	2035500.0	1751250.0	0.86	0.39	West truss bottom chord, L3'-L4'	1.75E+06	-2.07E+05	772200	477800	786000
50	130	SW4022	33.96	1.00	296.59	7.461	39.750	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1535125.0	0.90	0.44	West truss bottom chord, L2'-L3'	1.54E+06	-2.65E+05	634900	466900	741500
50	129	SW4023	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	963075.0	0.77	0.34	West truss bottom chord, L1'-L2'	9.63E+05	-1.10E+05	426300	430200	345100
50	118	SW4024	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	973775.0	0.78	0.36	West truss bottom chord, L0'-L1'	9.74E+05	-1.27E+05	423500	444400	323100
50	117	SW4025	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	984000.0	184927.5	0.19	0.07	West truss vertical, U1-L1	1.85E+05	-2.39E+03	91270	69640	70840
33	257	SW4026	24.80	1.00	340.66	7.238	47.066	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-344900.0	0.59	0.22	West truss vertical, U2-L2	0.00E+00	-3.45E+05	-215900	106400	129000
33	116	SW4027	24.80	1.00	110.37	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-342500.0	0.58	0.22	West truss vertical, U2-L2	0.00E+00	-3.43E+05	-213600	107100	128900
33	266	SW4028	24.80	1.00	340.62	7.238	47.062	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-268200.0	0.48	0.26	West truss vertical, U3-L3	5.45E+04	-2.68E+05	-122100	146100	144300
33	115	SW4029	24.80	1.00	151.88	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-267000.0	0.47	0.26	West truss vertical, U3-L3	5.75E+04	-2.67E+05	-119700	147300	145300
33	277	SW4030	24.80	1.00	340.61	7.238	47.059	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-174367.6	0.32	0.24	* West truss vertical, U4-L4	5.71E+04	-1.74E+05	-14020	67590	66380
33	114	SW4031	24.80	1.00	179.50	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-171212.2	0.31	0.24	* West truss vertical, U4-L4	5.90E+04	-1.71E+05	-11520	67660	66690
33	287	SW4032	24.80	1.00	340.62	7.238	47.062	1.00	534.00	6.085	87.756	-25674.7	818400.0	117865.0	0.14	0.07	West truss vertical, U5-L5	1.18E+05	-2.25E+04	47700	46180	58240
33	113	SW4033	24.80	1.00	193.38	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	123972.5	0.15	0.07	West truss vertical, U5-L5	1.24E+05	-2.36E+04	50210	48930	61210
33	146	SW4034	24.80	1.00	340.62	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	103645.0	0.13	0.06	West truss vertical, U5'-L5'	1.04E+05	-1.10E+04	46340	34420	45720
33	382	SW4035	24.80	1.00	193.38	7.238	47.059	1.00	534.00	6.085	87.756	-25674.7	818400.0	109080.0	0.13	0.06	West truss vertical, U5'-L5'	1.09E+05	-1.14E+04	48840	36300	48030
33	379	SW4036	24.80	1.00	340.61	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-218752.0	0.40	0.33	* West truss vertical, U4'-L4'	8.84E+04	-2.19E+05	-12460	97790	93310
33	112	SW4037	24.80	1.00	179.50	7.238	47.062	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-215015.7	0.39	0.33	* West truss vertical, U4'-L4'	9.08E+04	-2.15E+05	-9955	98300	93180
33	378	SW4038	24.80	1.00	340.62	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-315000.0	0.56	0.36	West truss vertical, U3'-L3'	1.16E+05	-3.15E+05	-114000	172600	201000
33	111	SW4039	24.80	1.00	151.88	7.238	47.066	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-312600.0	0.55	0.36	West truss vertical, U3'-L3'	1.17E+05	-3.13E+05	-111600	173400	201000
33	377	SW4040	24.80	1.00	340.66	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-292800.0	0.50	0.24	West truss vertical, U2'-L2'	2.70E+04	-2.93E+05	-151900	140900	124500
33	110	SW4041	24.80	1.00	110.37	7.238	54.712	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-291200.0	0.50	0.24	West truss vertical, U2'-L2'	2.94E+04	-2.91E+05	-149600	141600	125000
50	109	SW4042	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	984000.0	179312.5	0.18	0.07	West truss vertical, U1'-L1'	1.79E+05	-1.53E+03	88890	68200	65770
50	140	SW4043	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	706800.0	0.71	0.21	West truss diagonal, U1-L2	7.07E+05	0.00E+00	396800	158300	210800
50	141	SW4044	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	475325.0	0.65	0.20	West truss diagonal, U2-L3	4.75E+05	0.00E+00	260900	123400	149200
50	142	SW4045	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	369850.0	0.61	0.28	West truss diagonal, U3-L4	3.70E+05	-4.47E+04	162600	166600	165600
50	150	SW4046	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	420450.0	0.70	0.38	West truss diagonal, U3'-L4'	4.20E+05	-1.17E+05	151800	187000	230700
50	151	SW4047	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	571750.0	0.78	0.36	West truss diagonal, U2'-L3'	5.72E+05	-8.02E+04	245800	199900	264500
50	152	SW4048	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	566650.0	0.57	0.17	West truss diagonal, U1'-L2'	5.67E+05	0.00E+00	315400	172400	163600
33	385	SW4049	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	48222.5	0.26	0.39	* West truss diagonal, U5-L4	4.82E+04	-1.06E+05	-33090	73040	66700
33	144	SW4050	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	48705.0	0.26	0.39	* West truss diagonal, U5-L4	4.87E+04	-1.05E+05	-32340	72960	66470
50	386	SW4051	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	-70037.8	-40702.5	0.58	1.10	* West truss diagonal, U4-L5	1.69E+05	-4.07E+04	48330	76950	69720
50	143	SW4052	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	-70037.8	-40387.5	0.58	1.10	* West truss diagonal, U4-L5	1.71E+05	-4.04E+04	49070	77190	69860
50	380	SW4053	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	269850.0	0.79	0.62	* West truss diagonal, U4'-L5'	1.69E+05	-7.80E+04	45320	104500	112000
50	149	SW4054	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	270450.0	0.79	0.62	* West truss diagonal, U4'-L5'	1.70E+05	-7.77E+04	46040	104700	112200
33	381	SW4055	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	192147.5	1.02	1.13	* West truss diagonal, U5'-L4'	8.01E+04	-1.29E+05	-28070	94350	101200
33	148	SW4056	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	192417.5	1.02	1.13	* West truss diagonal, U5'-L4'	8.02E+04	-1.28E+05	-27310	94340	100700
33	383	SW4057	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	162792.5	0.86	0.82	* West truss diagonal, L5-U5'	8.82E+04	-7.58E+04	6202	80440	77230
33	147	SW4058	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	163806.3	0.87	0.82	* West truss diagonal, L5-U5'	8.93E+04	-7.56E+04	6877	80750	77500
33	384	SW4059	- 5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	167445.0	0.89	0.82	* West truss diagonal, L5'-U5	8.70E+04	-6.72E+04	9924	74600	69600
33	145	SW4060	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	168472.5	0.89	0.82	* West truss diagonal, L5'-U5	8.77E+04	-6.65E+04	10610	74460	69030
33	107	SW4061	5.74	1.00	492.96	5.336	92.392	1.00	492.96	1.949	252.953	-4473.2	189420.0	115060.0	0.61	0.61	* West truss tower diag., U1-F1	3.15E+04	-8.76E+04	-32090	55520	44200
33	19	SW4062	5.74	1.00	429.19	5.336	80.441	1.00	429.19	1.949	220.233	-5901.1	189420.0	115060.0	0.61	0.61	* West truss tower diag., U1-R1	3.54E+04	-9.85E+04	-36070	59540	62470
33	106	SW4063	20.47	1.00	509.54	5.701	89.381	1.00	509.54	4.363	116.790	-20025.8	-348438.5	-101793.0	0.29	0.27	West truss tower diag., F1-R2	8.79E+04	-1.02E+05	-7963	93830	88220
33	104	SW4064	18.06	1.00	442.31	6.026	73.405	1.00	442.31	2.552	173.320	-9528.0	-146224.2	-143621.0	0.98	0.95	West truss tower diag., F2-R3	1.34E+05	-1.44E+05	-5421	138200	130800
33	102	SW4065	13.98	1.00	345.96	5.940	58.245	1.00	345.96	2.030	170.452	-9851.3	-117020.7	-163021.0	1.39	1.36	West truss tower diag., F3-R4	1.57E+05	-1.63E+05	-3621	159400	151500
33	99	SW4066	12.74	1.00	274.09	5.813	47.148	1.00	274.09	1.544	177.493	-9085.2	-98345.5	-198340.0	2.02	1.97	West truss tower diag., F4-R5	1.90E+05	-1.98E+05	-4840	193500	152000
33	98	SW4067	12.74	1.00	226.74	5.813	39.004	1.00	226.74	1.544	146.833	-13275.5	-143703.5	-65920.0	0.46	0.26	West truss tower diag., F5-R6	1.55E+04	-6.59E+04	-28790	37130	28730
33	2	SW4068	13.98	1.00	297.39	5.940	50.068	1.00	297.39	2.030	146.522	-13331.9	-158366.3	-28090.1	0.18	0.17	West truss, U1'-U0'	2.68E+04	-2.81E+04	-750.1	27340	19610
33	10	SW4069	20.47	1.00	467.37	5.701	81.983	1.00	467.37	4.363	107.124	-22084.5	675510.0	72395.0	0.11	0.06	West truss tower horiz., R1-F1	7.24E+04	-2.63E+04	23060	39330	43570
33	11	SW4070	13.98	1.00	354.50	5.940	59.683	1.00	354.50	2.030	174.662	-9382.1	-111447.3	-84157.0	0.76	0.78	West truss tower horiz., R2-F2	9.28E+04	-8.42E+04	4324	87400	80530
33	13	SW4071	12.74	1.00	265.18	5.813	45.616	1.00	265.18	1.544	171.725	-9705.8	-105062.5	-108958.3	1.04	1.05	West truss tower horiz., R3-F3	1.13E+05	-1.09E+05	2189	110600	103700
33	15	SW4072	12.74	1.00	208.59	5.813	35.882	1.00	208.59	1.544	135.079	-15686.3	-169800.5	-122192.5	0.72	0.73	West truss tower horiz., R4-F4	1.25E+05	-1.22E+05	1610	123400	119500
33	17	SW4073	12.10	1.00	168.73	5.737	29.412	1.00	168.73	1.306	129.223	-17116.2	-175967.9	-144502.0	0.82	0.83	West truss tower horiz., R5-F5	1.51E+05	-1.45E+05	3064	146800	115600
33	323	SW4074	9.72	1.00	134.30	5.452	24.636	1.00	77.00	1.152	66.850	-28749.2	320595.0	3333.2	0.01	0.00	West truss tower horiz., R6-F6	3.33E+03	0.00E+00	1900	769.6	958.2
50	128	SW4075	18.41	1.00	367.56	6.457	56.928	1.00	367.56	3.908	94.064	-30679.0	-480079.8	-354683.9	0.74	0.77	* West truss tower, U2'-R1	3.13E+05	-3.55E+05	12790	275700	183000
50	12	SW4076	15.47	1.00	383.01	6.425	59.613	1.00	383.01	4.074	94.024	-30695.6	-403631.2	-326963.5	0.81	0.78	* West truss tower, R1-R2	3.03E+05	-3.27E+05	-13930	288100	186200
33	14	SW4077	15.47	1.00	365.10	6.425	56.826	1.00	365.10	4.074	89.627	-25359.1	-333459.3	-299678.4	0.90	0.86	* West truss tower, R2-R3	2.78E+05	-3.00E+05	-12460	263500	171200
33	16	SW4078	15.47	1.00	281.74	6.425	43.852	1.00	281.74	4.074	69.164	-28449.7	-374099.9	-254187.2	0.68	0.65	* West truss tower, R3-R4	2.35E+05	-2.54E+05	-10720	226200	148900
33	18	SW4079	15.47	1.00	219.65	6.425	34.187	1.00	405.42	4.074	99.527	-23577.9	-310037.4	-232635.7	0.75	0.73	* West truss tower, R4-R5	2.20E+05	-2.33E+05	-7312	201800	147600
33	56	SW4080	15.47	1.00	185.77	6.425	28.915	1.00	405.42	4.074	99.527	-23577.9	-310037.4	-103600.5	0.33	0.31	* West truss tower, R5-R6	8.78E+04	-1.04E+05	-9026	55020	54580
50	9	SW4081	85.86	1.00	339.12	7.097	47.783	1.00	411.12	8.339	49.299	-44692.9	-3261734.7	-1876100.0	0.58	0.16	West truss tower, L0-U0'	0.00E+00	-1.88E+06	-1366000	446300	510100
50	1	SW4082	85.86	1.00	119.75	7.097	16.873	1.00	411.12	8.339	49.299	-44692.9	-3261734.7	-1856900.0	0.57	0.15	West truss tower, L0'-U0'	0.00E+00	-1.86E+06	-1357000	445300	499900

FILENAME: 4DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

* - Adjusted for true behavior of tension-only members

UNITS INCH,LB. (Fy in ksi)

SPAN 4

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.	DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
50	3	SW4083	71.99	1.00	119.75	7.077	16.920	1.00	372.00	8.775	42.395	-46075.3	-2819218.9	-1855000.0	0.66	0.18	West truss tower, U0'-F1	0.00E+00	-1.86E+06	-1355000	445800	500000
50	41	SW4084	71.99	1.00	398.00	7.077	56.235	1.00	372.00	8.775	42.395	-43094.5	-2636835.4	-1817400.0	0.69	0.18	West truss tower, U0'-F1	0.00E+00	-1.82E+06	-1330000	439700	487400
50	4	SW4085	71.99	1.00	398.00	7.077	56.235	1.00	366.00	8.775	41.711	-43094.5	-2636835.4	-1813200.0	0.69	0.18	West truss tower, F1-F2	0.00E+00	-1.81E+06	-1342000	435800	471200
50	46	SW4086	71.99	1.00	398.00	7.077	56.235	1.00	366.00	8.775	41.711	-43094.5	-2636835.4	-1782400.0	0.68	0.17	West truss tower, F1-F2	0.00E+00	-1.78E+06	-1337000	433000	445400
50	5	SW4087	71.99	1.00	398.00	7.077	56.235	1.00	354.00	8.775	40.344	-43094.5	-2636835.4	-1754900.0	0.67	0.16	West truss tower, F2-F3	0.00E+00	-1.75E+06	-1325000	429900	424800
50	50	SW4088	71.99	1.00	398.00	7.077	56.235	1.00	354.00	8.775	40.344	-43094.5	-2636835.4	-1741900.0	0.66	0.16	West truss tower, F2-F3	0.00E+00	-1.74E+06	-1317000	424900	400500
50	6	SW4089	71.99	1.00	398.00	7.077	56.235	1.00	276.00	8.775	31.454	-43094.5	-2636835.4	-1741100.0	0.66	0.16	West truss tower, F3-F4	0.00E+00	-1.74E+06	-1307000	434100	406300
50	52	SW4090	71.99	1.00	398.00	7.077	56.235	1.00	276.00	8.775	31.454	-43094.5	-2636835.4	-1758000.0	0.67	0.17	West truss tower, F3-F4	0.00E+00	-1.76E+06	-1318000	440000	373400
50	7	SW4091	71.99	1.00	398.00	7.077	56.235	1.00	216.00	8.775	24.616	-43094.5	-2636835.4	-1512400.0	0.57	0.08	West truss tower, F4-F5	0.00E+00	-1.51E+06	-1309000	195700	203400
50	8	SW4092	71.99	1.00	398.00	7.077	56.235	1.00	182.69	8.775	20.820	-43094.5	-2636835.4	-1366510.0	0.52	0.03	West truss tower, F5-F6	0.00E+00	-1.37E+06	-1281000	42150	85510
50	54	SW4093	71.99	1.00	126.94	7.077	17.935	1.00	182.69	8.775	20.820	-49053.4	-3001445.6	-305420.0	0.10	0.01	West truss tower, F5-F6	0.00E+00	-3.05E+05	-282400	11740	23020
50	342	SE4001	48.90	1.00	424.75	7.049	60.259	1.00	494.75	6.766	73.127	-38322.8	-1592907.1	-783600.0	0.49	0.14	East truss top chord, L0-U1	0.00E+00	-7.84E+05	-559300	176200	224300
50	189	SE4002	48.90	1.00	70.00	7.049	9.931	1.00	494.75	6.766	73.127	-38322.8	-1592907.1	-768600.0	0.48	0.14	East truss top chord, L0-U1	0.00E+00	-7.69E+05	-551200	172900	217400
50	156	SE4003	33.77	1.00	301.65	6.910	43.654	1.00	301.65	7.741	38.968	-45838.6	-1315872.1	-715900.0	0.54	0.16	East truss top chord, U1-U2	0.00E+00	-7.16E+05	-504100	160200	211800
50	187	SE4004	35.57	1.00	299.48	6.927	43.233	1.00	299.48	7.286	41.103	-45918.6	-1388423.5	-886000.0	0.64	0.19	East truss top chord, U2-U3	0.00E+00	-8.86E+05	-622100	196700	263900
50	184	SE4005	39.17	1.00	297.87	6.989	42.620	1.00	297.87	7.120	41.839	-46033.5	-1532761.4	-986100.0	0.64	0.19	East truss top chord, U3-U4	0.00E+00	-9.86E+05	-691300	213200	294800
50	185	SE4006	42.77	1.00	296.92	7.019	42.301	1.00	296.92	6.978	42.550	-46046.6	-1674097.4	-1011900.0	0.60	0.18	East truss top chord, U4-U5	0.00E+00	-1.01E+06	-711700	219700	300200
50	186	SE4007	42.77	1.00	296.59	7.019	42.255	1.00	296.59	6.978	42.503	-46055.2	-1674412.0	-1080600.0	0.65	0.19	East truss top chord, U5-U5'	0.00E+00	-1.08E+06	-768800	243500	311800
50	160	SE4008	42.77	1.00	296.92	7.019	42.301	1.00	296.92	6.978	42.550	-46046.6	-1674097.4	-1015600.0	0.61	0.18	East truss top chord, U4'-U5'	0.00E+00	-1.02E+06	-716900	248300	298700
50	168	SE4009	39.17	1.00	297.87	6.989	42.620	1.00	297.87	7.120	41.839	-46033.5	-1532761.4	-991700.0	0.65	0.19	East truss top chord, U3'-U4'	0.00E+00	-9.92E+05	-699200	263400	292500
50	167	SE4010	35.57	1.00	299.48	6.927	43.233	1.00	299.48	7.286	41.103	-45918.6	-1388423.5	-919500.0	0.66	0.21	East truss top chord, U2'-U3'	0.00E+00	-9.20E+05	-633500	286000	262800
50	191	SE4011	33.77	1.00	301.65	6.910	43.654	1.00	301.65	7.741	38.968	-45838.6	-1315872.1	-793000.0	0.60	0.20	East truss top chord, U1'-U2'	0.00E+00	-7.93E+05	-533600	259400	217000
50	195	SE4012	48.90	1.00	70.00	7.049	9.931	1.00	494.75	6.766	73.127	-38322.8	-1592907.1	-897800.0	0.56	0.17	East truss top chord, L0'-U1'	0.00E+00	-8.98E+05	-620200	277600	246700
50	328	SE4013	48.90	1.00	424.75	7.049	60.259	1.00	494.75	6.766	73.127	-38322.8	-1592907.1	-910100.0	0.57	0.18	East truss top chord, L0'-U1'	0.00E+00	-9.10E+05	-628800	281300	248500
50	190	SE4014	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	704750.0	0.56	0.26	East truss bottom chord, L0-L1	7.05E+05	-9.08E+04	307000	170400	321000
50	155	SE4015	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	734175.0	0.59	0.28	East truss bottom chord, L1-L2	7.34E+05	-1.15E+05	309500	180200	347300
50	183	SE4016	26.76	1.00	296.59	7.440	39.865	1.00	296.59	6.547	45.302	-45518.5	1338000.0	1450200.0	1.08	0.60	East truss bottom chord, L2-L3	1.45E+06	-4.21E+05	514800	395200	806700
50	180	SE4017	30.36	1.00	296.59	7.456	39.779	1.00	296.59	6.402	46.330	-45312.8	1518000.0	1590775.0	1.05	0.53	East truss bottom chord, L3-L4	1.59E+06	-3.22E+05	634300	411400	797900
50	181	SE4018	33.96	1.00	296.59	7.444	39.845	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1911625.0	1.13	0.60	East truss bottom chord, L4-L5	1.91E+06	-4.75E+05	718100	513400	1014000
50	182	SE4019	38.46	1.00	296.59	7.428	39.930	1.00	296.59	6.167	48.090	-44950.0	1923000.0	1717425.0	0.89	0.43	East truss bottom chord, L5-L5'	1.72E+06	-2.92E+05	712500	409600	826800
50	159	SE4020	33.96	1.00	296.59	7.444	39.845	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1937000.0	1.14	0.61	East truss bottom chord, L4'-L5'	1.94E+06	-4.95E+05	720800	522900	1036000
50	166	SE4021	30.36	1.00	296.59	7.456	39.779	1.00	296.59	6.402	46.330	-45312.8	1518000.0	1677475.0	1.11	0.58	East truss bottom chord, L3'-L4'	1.68E+06	-3.92E+05	642700	496700	874100
50	165	SE4022	26.76	1.00	296.59	7.440	39.865	1.00	296.59	6.547	45.302	-45518.5	1338000.0	1559150.0	1.17	0.67	East truss bottom chord, L2'-L3'	1.56E+06	-5.02E+05	528600	512200	898400
50	197	SE4023	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	1052225.0	0.84	0.49	East truss bottom chord, L1'-L2'	1.05E+06	-3.49E+05	351700	450200	612600
50	196	SE4024	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	1066025.0	0.85	0.50	East truss bottom chord, L0'-L1'	1.07E+06	-3.68E+05	348900	453400	629900
50	188	SE4025	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	984000.0	138907.5	0.14	0.05	East truss vertical, U1-L1	1.39E+05	0.00E+00	74590	43590	45670
33	258	SE4026	24.80	1.00	340.66	7.238	47.066	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-278060.0	0.47	0.16	East truss vertical, U2-L2	0.00E+00	-2.78E+05	-182200	78300	95860
33	177	SE4027	24.80	1.00	110.37	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-275590.0	0.47	0.16	East truss vertical, U2-L2	0.00E+00	-2.76E+05	-179900	78410	95690
33	267	SE4028	24.80	1.00	340.62	7.238	47.062	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-192210.0	0.34	0.16	East truss vertical, U3-L3	8.99E+03	-1.92E+05	-104700	82420	87510
33	176	SE4029	24.80	1.00	151.88	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-190010.0	0.34	0.16	East truss vertical, U3-L3	1.10E+04	-1.90E+05	-102300	82920	87710
33	278	SE4030	24.80	1.00	340.61	7.238	47.059	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-59340.0	0.11	0.08	East truss vertical, U4-L4	3.19E+04	-5.93E+04	-15670	43670	43100
33	175	SE4031	24.80	1.00	179.50	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-57420.0	0.10	0.08	East truss vertical, U4-L4	3.44E+04	-5.74E+04	-13130	44290	43860
33	288	SE4032	24.80	1.00	340.62	7.238	47.062	1.00	534.00	6.085	87.756	-25674.7	818400.0	84162.5	0.10	0.05	East truss vertical, U5-L5	8.42E+04	-1.12E+04	36490	24250	38550
33	178	SE4033	24.80	1.00	193.38	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	89180.0	0.11	0.05	East truss vertical, U5-L5	8.92E+04	-1.11E+04	39040	25760	40380
33	393	SE4034	24.80	1.00	340.62	7.238	47.062	1.00	534.00	6.085	87.756	-25674.7	818400.0	79560.0	0.10	0.04	East truss vertical, U5'-L5'	7.96E+04	-8.84E+03	35360	22050	35360
33	179	SE4035	24.80	1.00	193.38	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	84355.0	0.10	0.05	East truss vertical, U5'-L5'	8.44E+04	-8.56E+03	37900	23220	36980
33	394	SE4036	24.80	1.00	340.61	7.238	47.059	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-77920.0	0.14	0.12	East truss vertical, U4'-L4'	5.39E+04	-7.79E+04	-13720	64200	57350
33	163	SE4037	24.80	1.00	179.50	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-75770.0	0.14	0.12	East truss vertical, U4'-L4'	5.62E+04	-7.58E+04	-11190	64580	57350
33	395	SE4038	24.80	1.00	340.62	7.238	47.062	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-226650.0	0.40	0.23	East truss vertical, U3'-L3'	5.77E+04	-2.27E+05	-96550	120200	130100
33	164	SE4039	24.80	1.00	151.88	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-223750.0	0.40	0.23	East truss vertical, U3'-L3'	5.90E+04	-2.24E+05	-94150	120400	129600
33	396	SE4040	24.80	1.00	340.66	7.238	47.066	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-235000.0	0.40	0.18	East truss vertical, U2'-L2'	1.10E+04	-2.35E+05	-128000	107000	83430
33	193	SE4041	24.80	1.00	110.37	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-232800.0	0.40	0.18	East truss vertical, U2'-L2'	1.28E+04	-2.33E+05	-125700	107100	83440
50	194	SE4042	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	984000.0	120020.0	0.12	0.03	East truss vertical, U1'-L1'	1.20E+05	0.00E+00	72520	29370	27570
50	154	SE4043	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	557100.0	0.56	0.14	East truss diagonal, U1-L2	5.57E+05	0.00E+00	331200	110900	143100
50	174	SE4044	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	389300.0	0.53	0.16	East truss diagonal, U2-L3	3.89E+05	0.00E+00	218800	92240	115800
50	173	SE4045	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	277675.0	0.46	0.18	East truss diagonal, U3-L4	2.78E+05	-3.48E+03	137100	96800	106300
50	162	SE4046	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	305950.0	0.51	0.24	East truss diagonal, U3'-L4'	3.06E+05	-5.28E+04	126600	128300	147700
50	161	SE4047	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	433500.0	0.59	0.24	East truss diagonal, U2'-L3'	4.34E+05	-2.47E+04	204400	144800	178000
50	325	SE4048	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	466775.0	0.47	0.14	East truss diagonal, U1'-L2'	4.67E+05	0.00E+00	262300	138900	115100
33	388	SE4049	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	82330.0	0.44	0.54	* East truss diagonal, U5-L4	3.35E+04	-7.97E+04	-26400	53310	52660
33	171	SE4050	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	83102.5	0.44	0.54	* East truss diagonal, U5-L4	3.43E+04	-7.92E+04	-25650	53510	52870
50	387	SE4051	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	155662.5	0.46	0.30	* East truss diagonal, U4-L5	1.06E+05	-9.54E+03	42770	52310	49330
50	172	SE4052	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	156727.5	0.46	0.30	* East truss diagonal, U4-L5	1.07E+05	-8.78E+03	43510	52290	49470
50	392	SE4053	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	180622.5	0.53	0.38	* East truss diagonal, U4'-L5'	1.18E+05	-2.88E+04	39570	68080	68390
50	157	SE4054	6.84	1.00	598.73	7.524	79.572	1.00	299.37	1.942	154.142	-12046.4	342000.0	181945.0	0.53	0.38	* East truss diagonal, U4'-L5'	1.19E+05	-2.85E+04	40300	68170	68800
33	391	SE4055	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	115422.5	0.61	0.70	* East truss diagonal, U5'-L4'	4.66E+04	-8.43E+04	-21530	60940	62770
33	158	SE4056	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	115875.0	0.61	0.70	* East truss diagonal, U5'-L4'	4.71E+04	-8.34E+04	-20780	61010	62660
33	390	SE4057	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	117246.3	0.62	0.59	* East truss diagonal, L5-U5'	6.77E+04	-5.73E+04	4597	61910	58180
33	169	SE4058	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	118450.0	0.63	0.59	* East truss diagonal, L5-U5'	6.87E+04	-5.68E+04	5272	62100	58540
33	389	SE4059	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	122237.5	0.65	0.59	* East truss diagonal, U5-L5'	6.78E+04	-4.91E+04	8302	57380	53320
33	170	SE4060	5.72	1.00	610.84	7.596	80.414	1.00	305.42	1.609	189.873	-7939.1	188760.0	123053.8	0.65	0.59	* East truss diagonal, U5-L5'	6.86E+04	-4.84E+04	8987	57360	53280
33	108	SE4061	5.74	1.00	492.96	5.336	92.392	1.00	492.96	1.949	252.953	-4473.2	189420.0	109840.0	0.58	0.58	* East truss tower diag., U1-F1	2.32E+04	-7.12E+04	-27430	43770	38110
33	23	SE4062	5.74	1.00	429.19	5.336	80.441	1.00	429.19	1.949	220.233	-5901.1	189420.0	109840.0	0.58	0.58	* East truss tower diag., U1-R1	4.86E+04	-1.03E+05	-30850	54900	71730
33	105	SE4063	20.47	1.00	509.54	5.701	89.381	1.00	509.54	4.363	116.790	-20025.8	-348438.5	-92785.0	0.27	0.25	East truss tower diag., F1-R2	8.11E+04	-9.28E+04	-6685	77650	86100
33	103	SE4064	18.06	1.00	442.31	6.026	73.405	1.00	442.31	2.552	173.320	-9528.0	-146224.2	-119716.0	0.82	0.79	East truss tower diag., F2-R3	1.12E+05	-1.20E+05	-4516	106600	115200
33	101	SE4065	13.98	1.00	345.96	5.940	58.245	1.00	345.96	2.030	170.452	-9851.3	-117020.7	-133008.0	1.14	1.11	East truss tower diag., F3-R4	1.27E+05	-1.33E+05	-3308	121500	129700
33	100	SE4066	12.74	1.00	274.09	5.813	47.148	1.00	274.09	1.544	177.493	-9085.2	-98345.5	-144480.0	1.47	1.42	East truss tower diag., F4-R5	1.36E+05	-1.44E+05	-4680	139800	117900
33	97	SE4067	12.74	1.00	226.74	5.813	39.004	1.00	226.74	1.544	146.833	-13275.5	-143703.5	-58260.0	0.41	0.23	East truss tower diag., F5-R6	1.33E+04	-5.83E+04	-25690	32570	26170
33	27	SE4068	13.98	1.00	297.39	5.940	50.068	1.00	297.39	2.030	146.522	-13331.9	-158366.3	-41182.5	0.26	0.26	East truss, U1'-U0'	3.99E+04	-4.12E+04	-752.5	28400	40430
33	25	SE4069	20.47	1.00	467.37	5.701	81.983	1.00	467.37	4.363	107.124	-22084.5	675510.0	72497.5	0.11	0.07	East truss tower horiz., R1-F1	7.25E+04	-3.36E+04	19430	35400	48210
33	24	SE4070	13.98	1.00	354.50	5.940	59.683	1.00	354.50	2.030	174.662	-9382.1	-111447.3	-72478.8	0.65	0.67	East truss tower horiz., R2-F2	7.95E+04	-7.25E+04	3495	69680	75100
33	35	SE4071	12.74	1.00	265.18	5.813	45.616	1.00	265.18	1.544	171.725	-9705.8	-105062.5	-88383.8	0.84	0.85	East truss tower horiz., R3-F3	9.21E+04	-8.84E+04	1835	84610	89760

FILENAME: 4DEMCAP.XLS
12/23/94
I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS
UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 4

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.	DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z	EQ(Y+0.3X+0.67Z
33	36	SE4072	12.74	1.00	208.59	5.813	35.882	1.00	208.59	1.544	135.079	-15686.3	-169800.5	-100114.3	0.59	0.60	East truss tower horiz., R4-F4	1.03E+05	-1.00E+05	1581	93350	101300
33	37	SE4073	12.10	1.00	168.73	5.737	29.412	1.00	168.73	1.306	129.223	-17116.2	-175967.9	-103577.0	0.59	0.60	East truss tower horiz., R5-F5	1.10E+05	-1.04E+05	2964	105800	89600
33	324	SE4074	9.72	1.00	134.30	5.452	24.636	1.00	77.00	1.152	66.850	-28749.2	320595.0	2852.5	0.01	0.00	East truss tower horiz., R6-F6	2.85E+03	0.00E+00	1626	623.8	820
50	192	SE4075	18.41	1.00	367.56	6.457	56.928	1.00	367.56	3.908	94.064	-30679.0	-480079.8	-234318.9	0.49	0.51	* East truss tower, U2'-R1	2.57E+05	-2.34E+05	9891	223100	161400
50	26	SE4076	15.47	1.00	383.01	6.425	59.613	1.00	383.01	4.074	94.024	-30695.6	-403631.2	-265219.9	0.66	0.63	* East truss tower, R1-R2	2.45E+05	-2.65E+05	-11590	228800	163300
33	21	SE4077	15.47	1.00	365.10	6.425	56.826	1.00	365.10	4.074	89.627	-25359.1	-333459.3	-245281.9	0.74	0.71	* East truss tower, R2-R3	2.29E+05	-2.45E+05	-9286	212400	151600
33	33	SE4078	15.47	1.00	281.74	6.425	43.852	1.00	281.74	4.074	69.164	-28449.7	-374099.9	-211188.8	0.56	0.55	* East truss tower, R3-R4	1.98E+05	-2.11E+05	-7286	186700	136200
33	31	SE4079	15.47	1.00	219.65	6.425	34.187	1.00	405.42	4.074	99.527	-23577.9	-310037.4	-184357.3	0.59	0.58	* East truss tower, R4-R5	1.76E+05	-1.84E+05	-4644	156100	120500
33	57	SE4080	15.47	1.00	185.77	6.425	28.915	1.00	405.42	4.074	99.527	-23577.9	-310037.4	-103067.7	0.33	0.31	* East truss tower, R5-R6	9.21E+04	-1.03E+05	-6242	53970	56670
50	20	SE4081	85.86	1.00	339.12	7.097	47.783	1.00	411.12	8.339	49.299	-44692.9	-3261734.7	-1707200.0	0.52	0.15	East truss tower, L0'-U0'	0.00E+00	-1.71E+06	-1211000	393000	496200
50	28	SE4082	85.86	1.00	119.75	7.097	16.873	1.00	411.12	8.339	49.299	-44692.9	-3261734.7	-1685700.0	0.52	0.15	East truss tower, L0'-U0'	0.00E+00	-1.69E+06	-1202000	390100	483700
50	29	SE4083	71.99	1.00	119.75	7.077	16.920	1.00	372.00	8.775	42.395	-46075.3	-2819218.9	-1682100.0	0.60	0.17	East truss tower, U0'-F1	0.00E+00	-1.68E+06	-1199000	389800	483100
50	42	SE4084	71.99	1.00	398.00	7.077	56.235	1.00	372.00	8.775	42.395	-43094.5	-2636835.4	-1643200.0	0.62	0.18	East truss tower, U0'-F1	0.00E+00	-1.64E+06	-1175000	382300	468200
50	30	SE4085	71.99	1.00	398.00	7.077	56.235	1.00	366.00	8.775	41.711	-43094.5	-2636835.4	-1631900.0	0.62	0.17	East truss tower, F1-F2	0.00E+00	-1.63E+06	-1184000	385900	447900
50	47	SE4086	71.99	1.00	398.00	7.077	56.235	1.00	366.00	8.775	41.711	-43094.5	-2636835.4	-1595700.0	0.61	0.16	East truss tower, F1-F2	0.00E+00	-1.60E+06	-1179000	380000	416700
50	22	SE4087	71.99	1.00	398.00	7.077	56.235	1.00	354.00	8.775	40.344	-43094.5	-2636835.4	-1553600.0	0.59	0.15	East truss tower, F2-F3	0.00E+00	-1.55E+06	-1168000	373300	385600
50	51	SE4088	71.99	1.00	398.00	7.077	56.235	1.00	354.00	8.775	40.344	-43094.5	-2636835.4	-1525100.0	0.58	0.14	East truss tower, F2-F3	0.00E+00	-1.53E+06	-1159000	366100	348800
50	34	SE4089	71.99	1.00	398.00	7.077	56.235	1.00	276.00	8.775	31.454	-43094.5	-2636835.4	-1511600.0	0.57	0.14	East truss tower, F3-F4	0.00E+00	-1.51E+06	-1150000	361600	334800
50	53	SE4090	71.99	1.00	398.00	7.077	56.235	1.00	276.00	8.775	31.454	-43094.5	-2636835.4	-1503900.0	0.57	0.13	East truss tower, F3-F4	0.00E+00	-1.50E+06	-1159000	344900	282500
50	32	SE4091	71.99	1.00	398.00	7.077	56.235	1.00	216.00	8.775	24.616	-43094.5	-2636835.4	-1329400.0	0.50	0.07	East truss tower, F4-F5	0.00E+00	-1.33E+06	-1150000	179400	169900
50	38	SE4092	71.99	1.00	398.00	7.077	56.235	1.00	182.69	8.775	20.820	-43094.5	-2636835.4	-1208340.0	0.46	0.03	East truss tower, F5-F6	0.00E+00	-1.21E+06	-1126000	61810	82340
50	55	SE4093	71.99	1.00	126.94	7.077	17.935	1.00	182.69	8.775	20.820	-49053.4	-3001445.6	-272360.0	0.09	0.01	East truss tower, F5-F6	0.00E+00	-2.72E+05	-248800	11890	23560
33	375	ST4101	7.06	1.00	406.41	8.737	46.514	1.00	406.41	1.606	253.121	-4467.3	232980.0	58620.0	0.25	0.25	* Top lat. diagonal, U1W-UM2	0.00E+00	-8.76E+04	-55380	22640	32210
33	376	ST4102	7.06	1.00	404.79	8.737	46.329	1.00	404.79	1.606	252.116	-4502.9	232980.0	58620.0	0.25	0.25	* Top lat. diagonal, UM2-U3E	0.00E+00	-8.89E+04	-55060	24680	33830
33	374	ST4103	7.06	1.00	406.41	8.737	46.514	1.00	406.41	1.606	253.121	-4467.3	232980.0	58620.0	0.25	0.25	* Top lat. diagonal, U1E-UM2	0.00E+00	-7.57E+04	-54120	21620	20920
33	373	ST4104	7.06	1.00	404.79	8.737	46.329	1.00	404.79	1.606	252.116	-4502.9	232980.0	58620.0	0.25	0.25	* Top lat. diagonal, UM2-U3W	0.00E+00	-8.05E+04	-54210	26270	24790
33	371	ST4105	7.06	1.00	403.61	8.737	46.193	1.00	403.61	1.606	251.379	-4529.4	232980.0	65780.0	0.28	0.28	* Top lat. diagonal, U3W-UM4	0.00E+00	-8.42E+04	-54910	23600	29260
33	370	ST4106	7.06	1.00	402.90	8.737	46.113	1.00	402.90	1.606	250.939	-4545.3	232980.0	65780.0	0.28	0.28	* Top lat. diagonal, UM4-U5E	0.00E+00	-8.46E+04	-55290	21950	29350
33	369	ST4107	7.06	1.00	403.61	8.737	46.193	1.00	403.61	1.606	251.379	-4529.4	232980.0	65780.0	0.28	0.28	* Top lat. diagonal, U3E-UM4	0.00E+00	-7.96E+04	-53580	25480	26010
33	368	ST4108	7.06	1.00	402.90	8.737	46.113	1.00	402.90	1.606	250.939	-4545.3	232980.0	65780.0	0.28	0.28	* Top lat. diagonal, UM4-U5W	0.00E+00	-9.15E+04	-55100	27500	36430
33	364	ST4109	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-21318.0	0.20	0.18	Top lat. diagonal, U5W-UM6W	1.90E+04	-2.13E+04	-1308	10780	20010
33	419	ST4110	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-21554.0	0.20	0.19	Top lat. diagonal, UM6W-UM5'	1.96E+04	-2.16E+04	-1114	10970	20440
33	422	ST4111	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-30389.0	0.28	0.27	Top lat. diagonal, UM5-UM6W	2.81E+04	-3.04E+04	-1319	14470	29070
33	367	ST4112	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-31094.0	0.29	0.27	Top lat. diagonal, UM6W-U5'W	2.84E+04	-3.11E+04	-1544	14750	29550
33	421	ST4113	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-28299.8	0.26	0.26	Top lat. diagonal, UM5-UM6E	2.82E+04	-2.83E+04	-39.75	14190	28260
33	366	ST4114	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-28682.5	0.26	0.26	Top lat. diagonal, UM6E-U5'E	2.82E+04	-2.87E+04	-262.5	14370	28420
33	365	ST4115	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-19859.6	0.18	0.18	Top lat. diagonal, U5E-UM6E	1.90E+04	-1.99E+04	-489.6	10690	19370
33	420	ST4116	7.06	1.00	402.66	8.737	46.085	1.00	201.33	1.606	125.395	-18043.5	-108278.9	-20288.3	0.19	0.18	Top lat. diagonal, UM6E-UM5'	1.98E+04	-2.03E+04	-298.3	10920	19990
33	363	ST4117	7.06	1.00	402.90	8.737	46.113	1.00	402.90	1.606	250.939	-4545.3	232980.0	151790.0	0.65	0.65	* Top lat. diagonal, U5'W-UM4'	1.24E+04	-1.09E+05	-55260	32920	53830
33	362	ST4118	7.06	1.00	403.61	8.737	46.193	1.00	403.61	1.606	251.379	-4529.4	232980.0	151790.0	0.65	0.65	* Top lat. diagonal, UM4'-U3'E	2.67E+04	-1.21E+05	-53850	38750	67130
33	361	ST4119	7.06	1.00	402.90	8.737	46.113	1.00	402.90	1.606	250.939	-4545.3	232980.0	151790.0	0.65	0.65	* Top lat. diagonal, U5'E-UM4'	2.61E+04	-1.25E+05	-56290	39870	68320
33	360	ST4120	7.06	1.00	403.61	8.737	46.193	1.00	403.61	1.606	251.379	-4529.4	232980.0	151790.0	0.65	0.65	* Top lat. diagonal, UM4'-U3'W	4.27E+04	-1.41E+05	-55960	47110	84660
33	358	ST4121	7.06	1.00	404.79	8.737	46.329	1.00	404.79	1.606	252.116	-4502.9	232980.0	157110.0	0.67	0.67	* Top lat. diagonal, U3'W-UM2'	2.91E+04	-1.28E+05	-56410	43690	71390
33	357	ST4122	7.06	1.00	406.41	8.737	46.514	1.00	406.41	1.606	253.121	-4467.3	232980.0	157110.0	0.67	0.67	* Top lat. diagonal, UM2'-U1'W	0.00E+00	-8.96E+04	-56930	32690	25000
33	356	ST4123	7.06	1.00	404.79	8.737	46.329	1.00	404.79	1.606	252.116	-4502.9	232980.0	157110.0	0.67	0.67	* Top lat. diagonal, U3'E-UM2'	4.23E+04	-1.44E+05	-57850	50260	85720
33	355	ST4124	7.06	1.00	406.41	8.737	46.514	1.00	406.41	1.606	253.121	-4467.3	232980.0	157110.0	0.67	0.67	* Top lat. diagonal, UM2'-U1'W	0.00E+00	-8.76E+04	-58720	27440	28870
33	250	ST4125	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-12840.0	0.05	0.05	Top lateral strut, U2W-UM2	1.45E+04	-1.28E+04	1306	7905	12840
33	276	ST4126	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-11600.0	0.04	0.04	Top lateral strut, UM2-U2E	1.28E+04	-1.16E+04	936.9	7526	11600
33	249	ST4127	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	107385.0	0.23	0.05	Top lateral strut, U3W-UM3	1.07E+05	-2.22E+04	68180	20860	22160
33	275	ST4128	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	106330.0	0.22	0.04	Top lateral strut, UM3-U3E	1.06E+05	-2.10E+04	68280	20530	20980
33	254	ST4129	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-9676.0	0.04	0.04	Top lateral strut, U4W-UM4	1.10E+04	-9.68E+03	1077	5434	9676
33	255	ST4130	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-8945.0	0.03	0.03	Top lateral strut, UM4-U4E	9.86E+03	-8.95E+03	728.1	5497	8945
33	248	ST4131	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	64112.5	0.13	0.04	Top lateral strut, U5W-UM5	6.41E+04	-2.02E+04	35130	15090	20200
33	286	ST4132	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	57202.5	0.12	0.03	Top lateral strut, UM5-U5E	5.72E+04	-1.38E+04	34730	11340	13790
33	247	ST4133	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	60135.0	0.13	0.03	Top lateral strut, U5'W-UM5'	6.01E+04	-1.60E+04	35300	13980	16010
33	417	ST4134	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	67707.5	0.14	0.05	Top lateral strut, UM5'-U5'E	6.77E+04	-2.37E+04	35190	16910	23720
33	246	ST4135	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-9335.0	0.03	0.03	Top lateral strut, U4'W-UM4'	1.07E+04	-9.34E+03	1084	5371	9335
33	252	ST4136	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-8436.0	0.03	0.03	Top lateral strut, UM4'-U4'E	9.34E+03	-8.44E+03	722.8	4921	8436
33	418	ST4137	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	115917.5	0.24	0.06	Top lateral strut, U3'W-UM3'	1.16E+05	-2.82E+04	70150	28230	20750
33	245	ST4138	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	118072.5	0.25	0.06	Top lateral strut, UM3'-U3'E	1.18E+05	-3.04E+04	70170	30360	21690
33	244	ST4139	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-51350.0	0.19	0.19	Top lateral strut, U2'W-UM2'	5.54E+04	-5.14E+04	3267	29640	51350
33	253	ST4140	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-52910.0	0.20	0.20	Top lateral strut, UM2'-U2'E	5.66E+04	-5.29E+04	2939	32990	52910
33	372	ST4141	7.06	1.00	297.96	8.737	34.102	1.00	297.96	1.606	185.578	-8310.8	-49873.3	-2719.0	0.05	0.03	Top lat. brace, UM3-UM4	3.67E+02	-2.72E+03	-1344	1268	1375
33	359	ST4142	7.06	1.00	297.96	8.737	34.102	1.00	297.96	1.606	185.578	-8310.8	-49873.3	-2392.0	0.05	0.02	Top lat. brace, UM3'-UM4'	0.00E+00	-2.39E+03	-1385	1007	896.2
50	242	SB4201	6.84	1.00	201.33	0.982	204.960	1.00	402.66	2.817	142.959	-6813.3	342000.0	272687.5	0.80	0.63	* Btm. lat. diagonal, L0W-LM1	4.72E+05	-3.82E+05	45430	189200	415700
50	239	SB4202	6.10	1.00	201.33	1.024	196.557	1.00	402.66	2.269	177.444	-7408.3	305000.0	257100.0	0.84	0.67	* Btm. lat. diagonal, LM1-L2E	4.23E+05	-3.39E+05	42040	172500	370300
50	241	SB4203	6.84	1.00	201.33	0.982	204.960	1.00	402.66	2.817	142.959	-6813.3	342000.0	271225.0	0.79	0.63	* Btm. lat. diagonal, L0E-LM1	5.03E+05	-4.15E+05	44260	181100	447900
50	240	SB4204	6.10	1.00	201.33	1.024	196.557	1.00	402.66	2.269	177.444	-7408.3	305000.0	255475.0	0.84	0.67	* Btm. lat. diagonal, LM1-L2W	4.51E+05	-3.68E+05	41500	162500	398700
50	213	SB4205	6.10	1.00	201.33	1.024	196.557	1.00	402.66	2.269	177.444	-7408.3	305000.0	287725.0	0.94	0.75	* Btm. lat. diagonal, L2'W-LM1'	4.83E+05	-3.89E+05	47080	245600	424100
50	210	SB4206	6.84	1.00	201.33	0.982	204.960	1.00	402.66	2.817	142.959	-6813.3	342000.0	305200.0	0.89	0.71	* Btm. lat. diagonal, LM1'-L0'E	5.42E+05	-4.42E+05	49980	258800	479500
50	212	SB4207	6.10	1.00	201.33	1.024	196.557	1.00	402.66	2.269	177.444	-7408.3	305000.0	288525.0	0.95	0.75	* Btm. lat. diagonal, L2'E-LM1'	4.94E+05	-3.98E+05	48100	218700	434100
50	211	SB4208	6.84	1.00	201.33	0.982	204.960	1.00	402.66	2.817	142.959	-6813.3	342000.0	307450.0	0.90	0.71	* Btm. lat. diagonal, LM1'-L0'W	5.56E+05	-4.53E+05	51780	233500	491400
50	237	SB4209	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	176500.0	201412.5	1.14	1.19	* Btm. lat. diagonal, L2W-LM3	3.62E+05	-2.94E+05	33710	168800	319500
33	234	SB4210	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	183125.0	1.57	1.58	* Btm. lat. diagonal, LM3-L4E	2.83E+05	-2.13E+05	35200	142600	238900
50	236	SB4211	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	176500.0	200237.5	1.13	1.19	* Btm. lat. diagonal, L2E-LM3	3.59E+05	-2.93E+05	32770	143200	317600
33	235	SB4212	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	181637.5	1.56	1.58	* Btm. lat. diagonal, LM3-L4W	2.79E+05	-2.11E+05	34090	118400	236600
33	232	SB4213	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	150087.5	1.29	0.44	* Btm. lat. diagonal, L4W-LM5	1.99E+05	-1.29E+05	35090	123500	155200
33	231	SB4214	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	149275.0	1.28	0.43	* Btm. lat. diagonal, L4E-LM5	1.88E+05	-1.17E+05	35180	103300	143700
33	230	SB4215	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	171700.0	1.47	1.20	* Btm. lat. diagonal, L5W-LM6W	2.89E+05	-2.20E+05	34240	150400	245900
33	225	SB4216	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	171750.0	1.47	1.20	* Btm. lat. diagonal, LM6W-LM5'	2.89E+05	-2.20E+05	34240	150500	246100
33	229	SB4217	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	171962.5	1.48	1.20	* Btm. lat. diagonal, LM5-LM6W	3.13E+05	-2.44E+05	34410	151200	269700
33	223	SB4218	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	171875.0	1.48	1.19	* Btm. lat. diagonal, LM6W-L5'W	3.12E+05	-2.44E+05	34400	151200	269400

FILENAME: 4DEMCAP.XLS
12/23/94
I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS
UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 4

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.	DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
33	228	SB4219	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	177325.0	1.52	1.25	* Btm. lat. diagonal, LM5-LM6E	3.20E+05	-2.52E+05	34140	163200	277500
33	222	SB4220	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	177262.5	1.52	1.25	* Btm. lat. diagonal, LM6E-L5'E	3.20E+05	-2.52E+05	34130	163100	277300
33	227	SB4221	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	177550.0	1.52	1.25	* Btm. lat. diagonal, L5E-LM6E	3.04E+05	-2.35E+05	34380	145300	260800
33	224	SB4222	3.53	1.00	201.33	1.000	201.332	1.00	201.33	1.606	125.395	-7061.1	116490.0	177612.5	1.52	1.25	* Btm. lat. diagonal, LM6E-LM5'	3.04E+05	-2.35E+05	34370	145400	261100
33	221	SB4223	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	140887.5	1.21	0.40	* Btm. lat. diagonal, LM5'-L4'W	1.84E+05	-1.13E+05	35510	114700	139900
33	220	SB4224	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	146612.5	1.26	0.42	* Btm. lat. diagonal, LM5'-L4'E	1.94E+05	-1.25E+05	34910	134800	150800
33	218	SB4225	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	186462.5	1.60	1.63	* Btm. lat. diagonal, L4'W-LM3'	2.83E+05	-2.15E+05	34310	187700	240600
50	215	SB4226	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	176500.0	205300.0	1.16	1.23	* Btm. lat. diagonal, LM3'-L2'E	3.63E+05	-2.97E+05	33120	207500	321900
33	217	SB4227	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	116490.0	186525.0	1.60	1.60	* Btm. lat. diagonal, L4'E-LM3'	2.89E+05	-2.17E+05	36040	159000	244000
50	216	SB4228	3.53	1.00	201.33	1.000	201.332	1.00	402.66	1.606	250.790	-4550.7	176500.0	207137.5	1.17	1.23	* Btm. lat. diagonal, LM3'-L2'W	3.77E+05	-3.08E+05	34590	181500	333700
33	322	SX4301	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-23312.0	0.09	0.09	X-frame btm. strut, panel 2	2.31E+04	-2.33E+04	-122	15290	23190
33	318	SX4302	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-11206.0	0.08	0.04	X-frame btm. strut, panel 2	1.84E+03	-1.12E+04	-5354	5852	2958
33	316	SX4303	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-23455.0	0.09	0.09	X-frame btm. strut, panel 2	2.29E+04	-2.35E+04	-345	14940	23110
33	313	SX4304	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-16563.8	0.07	0.07	X-frame btm. strut, panel 3	1.89E+04	-1.66E+04	1155	10770	17430
33	314	SX4305	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	8541.3	0.02	0.01	X-frame btm. strut, panel 3	8.54E+03	0.00E+00	4817	2520	2312
33	309	SX4306	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-16477.3	0.06	0.07	X-frame btm. strut, panel 3	1.89E+04	-1.65E+04	1217	10940	17390
33	308	SX4307	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-18277.9	0.07	0.07	X-frame btm. strut, panel 4	1.72E+04	-1.83E+04	-617.9	9175	17660
33	305	SX4308	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-1660.6	0.01	0.01	X-frame btm. strut, panel 4	2.22E+03	-1.66E+03	280.6	1871	1751
33	302	SX4309	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-17616.1	0.07	0.07	X-frame btm. strut, panel 4	1.78E+04	-1.76E+04	98.57	9162	17690
33	284	SX4310	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-18451.8	0.07	0.07	X-frame btm. strut, panel 4'	1.73E+04	-1.85E+04	-671.8	8721	17780
33	283	SX4311	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-1877.0	0.01	0.02	X-frame btm. strut, panel 4'	2.39E+03	-1.88E+03	256	2069	1824
33	274	SX4312	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-17686.9	0.07	0.07	X-frame btm. strut, panel 4'	1.80E+04	-1.77E+04	164.1	8740	17810
33	273	SX4313	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-16508.3	0.07	0.07	X-frame btm. strut, panel 3'	1.87E+04	-1.65E+04	1109	9822	17340
33	272	SX4314	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	8356.8	0.02	0.01	X-frame btm. strut, panel 3'	8.36E+03	0.00E+00	4831	2318	2313
33	265	SX4315	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-16187.0	0.06	0.07	X-frame btm. strut, panel 3'	1.88E+04	-1.62E+04	1324	9762	17180
33	264	SX4316	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-27378.4	0.11	0.11	X-frame btm. strut, panel 2'	2.69E+04	-2.74E+04	-258.4	16200	27120
33	263	SX4317	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-2946.5	0.02	0.02	X-frame btm. strut, panel 2'	3.67E+03	-2.95E+03	359.3	3216	3058
33	256	SX4318	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-27491.5	0.11	0.11	X-frame btm. strut, panel 2'	2.68E+04	-2.75E+04	-411.5	16210	27080
33	321	SX4319	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-17096.0	0.13	0.11	X-frame diagonal, panel 2	1.27E+04	-1.71E+04	-2496	9989	14600
33	320	SX4320	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-11570.8	0.09	0.11	X-frame diagonal, panel 2	2.01E+04	-1.16E+04	4279	9783	14780
33	319	SX4321	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-11206.3	0.09	0.11	X-frame diagonal, panel 2	1.95E+04	-1.12E+04	4125	10490	14300
33	317	SX4322	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-16426.0	0.13	0.11	X-frame diagonal, panel 2	1.23E+04	-1.64E+04	-2366	10130	14060
33	312	SX4323	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-9484.5	0.09	0.12	X-frame diagonal, panel 3	1.68E+04	-9.48E+03	3634	8517	12210
33	311	SX4324	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-14432.0	0.13	0.12	X-frame diagonal, panel 3	1.12E+04	-1.44E+04	-1822	8297	12610
33	310	SX4325	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-14234.0	0.13	0.12	X-frame diagonal, panel 3	1.11E+04	-1.42E+04	-1784	7577	12450
33	315	SX4326	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-9177.3	0.09	0.11	X-frame diagonal, panel 3	1.63E+04	-9.18E+03	3577	6898	11860
33	307	SX4327	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-12084.8	0.14	0.16	X-frame diagonal, panel 4	1.52E+04	-1.21E+04	1567	7575	13260
33	306	SX4328	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-14015.0	0.16	0.16	X-frame diagonal, panel 4	1.42E+04	-1.40E+04	113.3	7629	14100
33	304	SX4329	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-13643.8	0.15	0.16	X-frame diagonal, panel 4	1.51E+04	-1.36E+04	715	7232	14180
33	303	SX4330	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-12499.8	0.15	0.16	X-frame diagonal, panel 4	1.45E+04	-1.25E+04	986.9	6637	13240
33	282	SX4331	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-12218.3	0.14	0.16	X-frame diagonal, panel 4'	1.54E+04	-1.22E+04	1589	6618	13410
33	281	SX4332	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-14314.4	0.16	0.16	X-frame diagonal, panel 4'	1.45E+04	-1.43E+04	87.44	6980	14380
33	280	SX4333	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-13757.8	0.16	0.16	X-frame diagonal, panel 4'	1.53E+04	-1.38E+04	789.6	7261	14350
33	279	SX4334	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-12625.8	0.15	0.16	X-frame diagonal, panel 4'	1.45E+04	-1.26E+04	912.3	7098	13310
33	271	SX4335	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-8906.0	0.09	0.11	X-frame diagonal, panel 3'	1.63E+04	-8.91E+03	3672	6548	11660
33	270	SX4336	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-14101.0	0.13	0.11	X-frame diagonal, panel 3'	1.08E+04	-1.41E+04	-1871	6820	12230
33	269	SX4337	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-14068.0	0.13	0.12	X-frame diagonal, panel 3'	1.11E+04	-1.41E+04	-1718	7074	12350
33	268	SX4338	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-9253.5	0.09	0.12	X-frame diagonal, panel 3'	1.63E+04	-9.25E+03	3502	7182	11880
33	262	SX4339	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-15682.5	0.12	0.13	X-frame diagonal, panel 2'	1.83E+04	-1.57E+04	1290	10160	16650
33	261	SX4340	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-16435.6	0.12	0.13	X-frame diagonal, panel 2'	1.75E+04	-1.64E+04	539.2	10190	16840
33	260	SX4341	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-16150.9	0.12	0.13	X-frame diagonal, panel 2'	1.70E+04	-1.62E+04	425.5	9931	16470
33	259	SX4342	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-15332.5	0.12	0.13	X-frame diagonal, panel 2'	1.81E+04	-1.53E+04	1370	10000	16360
33	301	SX4343	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-18677.9	0.07	0.07	X-frame btm. strut, panel 5	1.83E+04	-1.87E+04	-227.9	9086	18450
33	298	SX4344	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	6035.0	0.02	0.01	X-frame btm. strut, panel 5	6.04E+03	0.00E+00	3268	1806	1950
33	295	SX4345	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-17974.5	0.07	0.07	X-frame btm. strut, panel 5	1.93E+04	-1.80E+04	647.3	9099	18460
33	294	SX4346	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-19445.8	0.08	0.08	X-frame btm. strut, panel 5'	1.90E+04	-1.94E+04	-235.8	9407	19210
33	293	SX4347	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	6194.8	0.02	0.01	X-frame btm. strut, panel 5'	6.19E+03	0.00E+00	3231	2070	2156
33	285	SX4348	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-18710.5	0.07	0.08	X-frame btm. strut, panel 5'	2.01E+04	-1.87E+04	692.7	9421	19230
33	300	SX4349	7.06	1.00	238.45	3.418	69.753	1.00	238.45	1.606	148.510	-12977.4	-77877.4	-11903.0	0.15	0.19	X-frame diagonal, panel 5	1.97E+04	-1.19E+04	3916	7926	14840
33	299	SX4350	7.06	1.00	234.56	3.418	68.617	1.00	234.56	1.606	146.090	-13410.9	-80478.6	-17937.0	0.22	0.20	X-frame diagonal, panel 5	1.42E+04	-1.79E+04	-2147	8037	15790
33	297	SX4351	7.06	1.00	234.56	3.418	68.617	1.00	234.56	1.606	146.090	-13410.9	-80478.6	-16968.0	0.21	0.19	X-frame diagonal, panel 5	1.46E+04	-1.70E+04	-1368	7660	15600
33	296	SX4352	7.06	1.00	238.45	3.418	69.753	1.00	238.45	1.606	148.510	-12977.4	-77877.4	-12046.5	0.15	0.19	X-frame diagonal, panel 5	1.84E+04	-1.20E+04	3178	7130	14430
33	292	SX4353	7.06	1.00	238.45	3.418	69.753	1.00	238.45	1.606	148.510	-12977.4	-77877.4	-12761.8	0.16	0.20	X-frame diagonal, panel 5'	2.05E+04	-1.28E+04	3891	8244	15680
33	291	SX4354	7.06	1.00	234.56	3.418	68.617	1.00	234.56	1.606	146.090	-13410.9	-80478.6	-18782.0	0.23	0.21	X-frame diagonal, panel 5'	1.51E+04	-1.88E+04	-2122	8440	16660
33	290	SX4355	7.06	1.00	234.56	3.418	68.617	1.00	234.56	1.606	146.090	-13410.9	-80478.6	-17586.0	0.22	0.20	X-frame diagonal, panel 5'	1.53E+04	-1.76E+04	-1296	7963	16290
33	289	SX4356	7.06	1.00	238.45	3.418	69.753	1.00	238.45	1.606	148.510	-12977.4	-77877.4	-12649.8	0.16	0.19	X-frame diagonal, panel 5'	1.89E+04	-1.26E+04	3107	7454	14980
33	340	SX4357	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	82095.0	0.12	0.05	Portal frame top chord, U1	8.21E+04	-1.11E+04	35500	29850	37720
33	339	SX4358	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	55950.0	0.08	0.03	Portal frame top chord, U1	5.60E+04	0.00E+00	30640	17650	15310
33	338	SX4359	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	59582.5	0.09	0.03	Portal frame top chord, U1	5.96E+04	0.00E+00	31330	16020	20420
33	326	SX4360	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	91350.0	0.13	0.06	Portal frame top chord, U1	9.14E+04	-1.62E+04	37560	27060	44400
33	352	SX4361	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	106170.0	0.15	0.09	Portal frame top chord, U1'	1.06E+05	-3.94E+04	33400	35730	64420
33	351	SX4362	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	58767.5	0.09	0.03	Portal frame top chord, U1'	5.88E+04	-1.11E+03	28830	14990	22730
33	350	SX4363	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	71465.0	0.10	0.05	Portal frame top chord, U1'	7.15E+04	-1.23E+04	29580	20130	34490
33	251	SX4364	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	121007.5	0.18	0.11	Portal frame top chord, U1'	1.21E+05	-4.98E+04	35590	42150	76520
33	336	SX4365	7.06	1.00	544.50	1.606	339.129	1.00	183.25	8.737	20.973	-2488.7	-14934.6	-24894.5	1.67	1.97	Portal frame btm. chord, U1	3.71E+04	-2.49E+04	6114	17480	29480
33	337	SX4366	7.06	1.00	544.50	1.606	339.129	1.00	178.00	8.737	20.372	-2488.7	232980.0	10019.8	0.04	0.01	Portal frame btm. chord, U1	1.00E+04	0.00E+00	5911	2631	1788
33	327	SX4367	7.06	1.00	544.50	1.606	339.129	1.00	183.25	8.737	20.973	-2488.7	-14934.6	-26637.8	1.78	2.03	Portal frame btm. chord, U1	3.66E+04	-2.66E+04	5003	19250	30390
33	353	SX4368	7.06	1.00	544.50	1.606	339.129	1.00	183.25	8.737	20.973	-2488.7	-14934.6	-46812.5	3.13	3.44	Portal frame btm. chord, U1'	5.89E+04	-4.68E+04	6050	27820	51350
33	354	SX4369	7.06	1.00	544.50	1.606	339.129	1.00	178.00	8.737	20.372	-2488.7	232980.0	9738.3	0.04	0.01	Portal frame btm. chord, U1'	9.74E+03	0.00E+00	5981	1889	2262
33	341	SX4370	7.06	1.00	544.50	1.606	339.129	1.00	183.25	8.737	20.973	-2488.7	-14934.6	-49783.3	3.33	3.57	Portal frame btm. chord, U1'	5.94E+04	-4.98E+04	4809	28750	53390
33	330	SX4371	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-21207.0	0.21	0.14	Portal frame diagonal, U1	9.94E+03	-2.12E+04	-6437	9415	14770
33	331	SX4372	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-16440.1	0.16	0.16	Portal frame diagonal, U1	1.75E+04	-1.64E+04	506.5	10370	16820

FILENAME: 4DEMCAP.XLS
12/23/94
I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT
FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS
UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 4

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.	DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z	EQ(Y+0.3X+0.67Z
33	332	SX4373	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-19206.8	0.18	0.19	Portal frame diagonal, U1	2.05E+04	-1.92E+04	644.3	11830	19690
33	333	SX4374	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-19903.5	0.19	0.19	Portal frame diagonal, U1	1.96E+04	-1.99E+04	-183.5	11920	19720
33	334	SX4375	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-16109.8	0.15	0.16	Portal frame diagonal, U1	1.82E+04	-1.61E+04	1067	10300	16910
33	335	SX4376	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-23983.0	0.23	0.16	Portal frame diagonal, U1	1.04E+04	-2.40E+04	-7763	9084	16220
33	349	SX4377	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-33424.0	0.32	0.27	Portal frame diagonal, U1'	2.32E+04	-3.34E+04	-5864	14640	27560
33	348	SX4378	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-29152.6	0.28	0.28	Portal frame diagonal, U1'	3.04E+04	-2.92E+04	609.9	15840	29610
33	347	SX4379	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-34491.7	0.33	0.33	Portal frame diagonal, U1'	3.57E+04	-3.45E+04	597.7	18760	34940
33	346	SX4380	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-34773.4	0.33	0.33	Portal frame diagonal, U1'	3.42E+04	-3.48E+04	-313.4	18640	34460
33	345	SX4381	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-27805.5	0.27	0.27	Portal frame diagonal, U1'	3.03E+04	-2.78E+04	1246	15670	28740
33	344	SX4382	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-35740.0	0.35	0.28	Portal frame diagonal, U1'	2.32E+04	-3.57E+04	-7190	15610	28550
33	453	SX4383	3.98	1.00	221.21	1.692	130.703	1.00	221.21	1.444	153.179	-12198.3	-41266.9	-23843.7	0.58	0.57	Tower bracing, panel F6-R6	2.32E+04	-2.38E+04	-373.7	14600	23470
33	424	SX4384	3.98	1.00	164.99	1.692	97.484	1.00	164.99	1.444	114.248	-20584.5	-69637.4	-20686.0	0.30	0.30	Tower bracing, panel F6-R6	2.10E+04	-2.07E+04	178.7	12680	20820
33	445	SX4385	3.98	1.00	164.99	1.692	97.484	1.00	164.99	1.444	114.248	-20584.5	-69637.4	-20942.3	0.30	0.30	Tower bracing, panel F6-R6	2.03E+04	-2.09E+04	-342.3	12180	20600
33	431	SX4386	3.98	1.00	221.21	1.692	130.703	1.00	221.21	1.444	153.179	-12198.3	-41266.9	-22824.2	0.55	0.56	Tower bracing, panel F6-R6	2.32E+04	-2.28E+04	194.4	13520	22970
33	416	SR4401	6.19	1.00	656.95	4.144	158.529	1.00	328.47	1.252	262.398	-4157.0	204270.0	135081.3	0.66	0.65	* Tower rear lat. diag., U2'E-R1W	6.81E+04	-6.59E+04	1081	36050	66710
33	415	SR4402	6.19	1.00	656.95	4.144	158.529	1.00	328.47	1.252	262.398	-4157.0	204270.0	134795.1	0.66	0.65	* Tower rear lat. diag., U2'W-R1E	6.76E+04	-6.59E+04	852.1	37730	66560
33	413	SR4403	6.19	1.00	656.95	4.144	158.529	1.00	328.47	1.252	262.398	-4157.0	204270.0	136280.0	0.67	0.65	* Tower rear lat. diag., U2'W-R1E	6.93E+04	-6.52E+04	2040	37750	66760
33	414	SR4404	6.19	1.00	656.95	4.144	158.529	1.00	328.47	1.252	262.398	-4157.0	204270.0	136566.3	0.67	0.65	* Tower rear lat. diag., U2'E-R1W	6.98E+04	-6.53E+04	2269	36320	66970
33	62	SR4405	6.19	1.00	665.71	4.144	160.644	1.00	332.86	1.252	265.899	-4048.2	204270.0	143630.0	0.70	0.70	* Tower rear lat. diag., R1E-R2W	6.88E+04	-7.29E+04	-2346	40870	70580
33	95	SR4406	6.19	1.00	665.71	4.144	160.644	1.00	332.86	1.252	265.899	-4048.2	204270.0	143630.0	0.70	0.70	* Tower rear lat. diag., R1W-R2E	7.04E+04	-7.47E+04	-2473	43160	72240
33	63	SR4407	6.19	1.00	665.71	4.144	160.644	1.00	332.86	1.252	265.899	-4048.2	204270.0	143630.0	0.70	0.70	* Tower rear lat. diag., R1W-R2E	7.24E+04	-7.28E+04	-226.3	43340	72530
33	96	SR4408	6.19	1.00	665.71	4.144	160.644	1.00	332.86	1.252	265.899	-4048.2	204270.0	143630.0	0.70	0.70	* Tower rear lat. diag., R1E-R2W	7.10E+04	-7.12E+04	-98.78	41540	71100
33	64	SR4409	6.19	1.00	655.57	4.144	158.197	1.00	327.79	1.252	261.848	-4174.4	204270.0	141930.0	0.69	0.69	* Tower rear lat. diag., R2E-R3W	6.83E+04	-7.21E+04	-2132	40680	69920
33	93	SR4410	6.19	1.00	655.57	4.144	158.197	1.00	327.79	1.252	261.848	-4174.4	204270.0	141930.0	0.69	0.69	* Tower rear lat. diag., R2W-R3E	6.99E+04	-7.33E+04	-1947	42370	71390
33	65	SR4411	6.19	1.00	655.57	4.144	158.197	1.00	327.79	1.252	261.848	-4174.4	204270.0	142386.5	0.70	0.69	* Tower rear lat. diag., R2W-R3E	7.20E+04	-7.13E+04	365.2	42590	71590
33	94	SR4412	6.19	1.00	655.57	4.144	158.197	1.00	327.79	1.252	261.848	-4174.4	204270.0	142154.9	0.70	0.69	* Tower rear lat. diag., R2E-R3W	7.06E+04	-7.02E+04	179.9	41230	70340
33	66	SR4413	6.19	1.00	613.07	4.144	147.942	1.00	306.54	1.252	244.874	-4773.3	204270.0	129910.0	0.64	0.64	* Tower rear lat. diag., R3E-R4W	6.28E+04	-6.59E+04	-1775	36030	64130
33	92	SR4414	6.19	1.00	613.07	4.144	147.942	1.00	306.54	1.252	244.874	-4773.3	204270.0	129910.0	0.64	0.64	* Tower rear lat. diag., R3W-R4E	6.46E+04	-6.66E+04	-1127	37430	65430
33	67	SR4415	6.19	1.00	613.07	4.144	147.942	1.00	306.54	1.252	244.874	-4773.3	204270.0	131831.3	0.65	0.64	* Tower rear lat. diag., R3W-R4E	6.75E+04	-6.44E+04	1537	37570	65530
33	91	SR4416	6.19	1.00	613.07	4.144	147.942	1.00	306.54	1.252	244.874	-4773.3	204270.0	131019.0	0.64	0.64	* Tower rear lat. diag., R3E-R4W	6.55E+04	-6.37E+04	887.2	36300	64380
33	70	SR4417	6.19	1.00	678.86	4.144	163.816	1.00	339.43	1.252	271.149	-3893.0	204270.0	132090.0	0.65	0.65	* Tower rear lat. diag., R4E-R5W	6.29E+04	-6.75E+04	-2664	37940	64850
33	69	SR4418	6.19	1.00	678.86	4.144	163.816	1.00	339.43	1.252	271.149	-3893.0	204270.0	132090.0	0.65	0.65	* Tower rear lat. diag., R4W-R5E	6.61E+04	-6.88E+04	-1552	39540	67240
33	71	SR4419	6.19	1.00	678.86	4.144	163.816	1.00	339.43	1.252	271.149	-3893.0	204270.0	132931.6	0.65	0.65	* Tower rear lat. diag., R4W-R5E	6.78E+04	-6.65E+04	673.3	39390	66970
33	68	SR4420	6.19	1.00	678.86	4.144	163.816	1.00	339.43	1.252	271.149	-3893.0	204270.0	132090.0	0.65	0.65	* Tower rear lat. diag., R4E-R5W	6.44E+04	-6.52E+04	-438.4	37930	64770
33	58	SR4421	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-129023.4	1.08	1.08	* Tower rear lat. strut, R1	1.29E+05	-1.29E+05	61.85	27830	14480
33	412	SR4422	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-128873.7	1.08	1.08	* Tower rear lat. strut, R1	1.29E+05	-1.29E+05	61.45	27720	14330
33	59	SR4423	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-134122.6	1.12	1.13	* Tower rear lat. strut, R2	1.38E+05	-1.34E+05	1795	30600	16850
33	410	SR4424	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-133922.6	1.12	1.13	* Tower rear lat. strut, R2	1.38E+05	-1.34E+05	1795	30470	16650
33	60	SR4425	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-129715.2	1.08	1.09	* Tower rear lat. strut, R3	1.30E+05	-1.30E+05	301.1	21060	12370
33	408	SR4426	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-129584.5	1.08	1.08	* Tower rear lat. strut, R3	1.30E+05	-1.30E+05	302.1	20970	12240
33	61	SR4427	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-121311.1	1.01	1.03	* Tower rear lat. strut, R4	1.26E+05	-1.21E+05	2239	15290	10860
33	406	SR4428	9.71	1.00	544.50	4.195	129.789	1.00	272.25	1.939	140.421	-14515.6	-119804.8	-121300.4	1.01	1.03	* Tower rear lat. strut, R4	1.26E+05	-1.21E+05	2240	15260	10850
33	430	SR4429	12.76	1.00	544.50	3.911	139.214	1.00	272.25	29.419	9.254	-14768.3	-160177.3	-90964.6	0.57	0.55	* Tower rear lat. strut, R6	8.52E+04	-9.10E+04	-3288	25810	33960
33	423	SR4430	12.76	1.00	544.50	3.911	139.214	1.00	272.25	29.419	9.254	-14768.3	-160177.3	-68386.6	0.43	0.41	* Tower rear lat. strut, R6	6.33E+04	-6.84E+04	-2910	17150	11760
33	452	SR4431	12.76	1.00	544.50	3.911	139.214	1.00	272.25	29.419	9.254	-14768.3	-160177.3	-87902.6	0.55	0.53	* Tower rear lat. strut, R6	8.35E+04	-8.79E+04	-2516	20980	31670
33	411	SR4432	6.19	1.00	191.50	4.144	46.211	1.00	191.50	1.252	152.978	-12230.4	204270.0	1938.3	0.01	0.00	Tower rear C.L. brace, R1	1.94E+03	0.00E+00	1047	629.5	510.7
33	409	SR4433	6.19	1.00	182.55	4.144	44.051	1.00	182.55	1.252	145.827	-13459.4	204270.0	1716.0	0.01	0.00	Tower rear C.L. brace, R2	1.72E+03	0.00E+00	1042	413.5	295.5
33	407	SR4434	6.19	1.00	140.87	4.144	33.994	1.00	140.87	1.252	112.533	-20954.3	204270.0	1620.3	0.01	0.00	Tower rear C.L. brace, R3	1.62E+03	0.00E+00	1044	315.3	246.8
33	405	SR4435	6.19	1.00	202.71	4.144	48.917	1.00	202.71	1.252	161.934	-10915.0	204270.0	1621.6	0.01	0.00	Tower rear C.L. brace, R4	1.62E+03	0.00E+00	1013	344.6	355.3
33	87	SF4501	7.97	1.00	183.28	5.060	36.218	1.00	183.28	1.443	126.996	-17659.1	-119631.4	-74219.0	0.62	0.59	Tower front lat. diag. @ U0'	6.76E+04	-7.42E+04	-3809	27360	70410
33	43	SF4502	7.97	1.00	179.34	5.060	35.439	1.00	179.34	1.443	124.265	-18311.8	-124053.5	-69457.8	0.56	0.57	Tower front lat. diag. @ U0'	7.25E+04	-6.95E+04	1523	27450	70600
33	44	SF4503	7.97	1.00	179.34	5.060	35.439	1.00	179.34	1.443	124.265	-18311.8	-124053.5	-70009.9	0.56	0.57	Tower front lat. diag. @ U0'	7.16E+04	-7.00E+04	800.2	27450	70610
33	88	SF4504	7.97	1.00	183.28	5.060	36.218	1.00	183.28	1.443	126.996	-17659.1	-119631.4	-73464.0	0.61	0.59	Tower front lat. diag. @ U0'	6.82E+04	-7.35E+04	-3034	27390	70430
33	86	SF4505	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	116930.0	0.44	0.44	* Tower front lat. diag. @ F1	3.40E+04	-9.03E+04	-32210	23940	58130
33	85	SF4506	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	116930.0	0.44	0.44	* Tower front lat. diag. @ F1	3.48E+04	-9.08E+04	-31990	24900	58800
33	83	SF4507	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	116930.0	0.44	0.44	* Tower front lat. diag. @ F1	3.58E+04	-8.92E+04	-30500	24840	58710
33	84	SF4508	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	116930.0	0.44	0.44	* Tower front lat. diag. @ F1	3.50E+04	-8.88E+04	-30710	23920	58040
33	80	SF4509	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	124580.0	0.47	0.47	* Tower front lat. diag. @ F2	4.07E+04	-9.04E+04	-28380	26520	62020
33	81	SF4510	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	124580.0	0.47	0.47	* Tower front lat. diag. @ F2	4.09E+04	-9.05E+04	-28380	27320	62140
33	79	SF4511	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	124580.0	0.47	0.47	* Tower front lat. diag. @ F2	4.30E+04	-8.80E+04	-25680	27340	62300
33	82	SF4512	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	124580.0	0.47	0.47	* Tower front lat. diag. @ F2	4.30E+04	-8.80E+04	-25670	26630	62280
33	77	SF4513	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	139190.0	0.53	0.53	* Tower front lat. diag. @ F3	4.51E+04	-9.87E+04	-30650	32650	68090
33	400	SF4514	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	139190.0	0.53	0.53	* Tower front lat. diag. @ F3	4.77E+04	-1.02E+05	-30920	32800	70840
33	76	SF4515	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	139190.0	0.53	0.53	* Tower front lat. diag. @ F3	4.98E+04	-9.91E+04	-28190	32750	70930
33	78	SF4516	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	139190.0	0.53	0.53	* Tower front lat. diag. @ F3	4.73E+04	-9.62E+04	-27920	32620	68260
33	75	SF4517	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	204340.0	0.78	0.78	* Tower front lat. diag. @ F4	9.40E+04	-9.89E+04	-2782	37970	96100
33	74	SF4518	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	204340.0	0.78	0.78	* Tower front lat. diag. @ F4	1.05E+05	-1.13E+05	-4514	47960	108200
33	72	SF4519	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	204340.0	0.78	0.78	* Tower front lat. diag. @ F4	1.06E+05	-1.10E+05	-1735	47180	107800
33	73	SF4520	7.97	1.00	674.45	5.060	133.278	1.00	337.23	1.443	233.666	-5242.1	263010.0	204350.2	0.78	0.78	* Tower front lat. diag. @ F4	9.62E+04	-9.61E+04	8.168	38340	96140
33	39	SF4521	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-50789.8	0.35	0.37	Tower front lat. strut (below U0')	5.78E+04	-5.08E+04	3507	20860	53420
33	397	SF4522	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-50314.0	0.35	0.37	Tower front lat. strut (below U0')	5.84E+04	-5.03E+04	4048	20790	53350
33	40	SF4523	11.77	1.00	544.50	5.133	27.032	1.00	138.75	1.936	71.681	-28112.6	388410.0	136712.5	0.35	0.27	Tower front lat. strut (above U0')	1.37E+05	-8.65E+04	25130	41110	105300
33	89	SF4524	11.77	1.00	544.50	5.133	52.017	1.00	267.00	1.936	137.937	-15043.1	388410.0	33420.5	0.09	0.02	Tower front lat. strut (above U0')	3.34E+04	0.00E+00	21170	6958	4585
33	90	SF4525	11.77	1.00	544.50	5.133	27.032	1.00	138.75	1.936	71.681	-28112.6	388410.0	135612.5	0.35	0.27	Tower front lat. strut (above U0')	1.36E+05	-8.76E+04	24010	41860	105600
33	45	SF4526	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-70915.2	0.49	0.82	* Tower front lat. strut (above F1)	1.68E+05	-7.09E+04	48440	14110	9683
33	404	SF4527	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-70785.2	0.49	0.82	* Tower front lat. strut (above F1)	1.68E+05	-7.08E+04	48440	14060	9553
33	48	SF4528	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-88016.4	0.61	0.91	* Tower front lat. strut (above F2)	1.75E+05	-8.80E+04	43410	15000	13090
33	402	SF4529	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-88296.4	0.61	0.91	* Tower front lat. strut (above F2)	1.75E+05	-8.83E+04	43410	14980	13370
33	49	SF4530	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-151621.6	1.05	1.28	* Tower front lat. strut (above F3)	2.19E+05	-1.52E+05	33560	15010	32180
33	399	SF4531	11.77	1.00	544.50	5.133	106.080	1.00	272.25	1.936	140.649	-14468.5	-144750.4	-151461.6	1.05	1.28	* Tower front lat. strut (above F3)	2.19E+05	-1.51E+05	33560	14990	32020
33	403	SF4532	7.97	1.00	199.00	5.060	39.324	1.00	199.00	1.443	137.889	-15053.6	263010.0	1728.8	0.01	0.00	Tower front C.L. brace (above F1)	1.73E+03	0.00E+00	1162	276.3	238.6
33	401	SF4533	7.97	1.00	199.00	5.060	39.324	1.00	199.00	1.443	137.889	-15053.6	263010.0	1902.1	0.01	0.00	Tower front C.L. brace (above F2)	1.90E+03	0.00E+00	1207	393.3	339.4

FILENAME: 4DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 4

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z	EQ(Y+0.3X+0.67Z
33	398	SF4534	7.97	1.00	199.00	5.060	39.324	1.00	199.00	1.443	137.889	-15053.6	263010.0	2086.0	0.01	0.00		Tower front C.L. brace (above F3)	2.09E+03	0.00E+00	1169	619.2	624.7
33	457	SF4535	18.38	1.00	544.50	2.878	26.567	1.00	76.45	15.070	5.073	-32328.6	606540.0	348476.9	0.57	0.28	*	Tower front lat. strut (~ F5)	3.48E+05	0.00E+00	176000	21380	41450
33	429	SF4536	18.38	1.00	544.50	2.878	68.042	1.00	195.80	15.070	12.993	-28596.2	606540.0	416441.9	0.69	0.33	*	Tower front lat. strut (~ F5)	4.16E+05	0.00E+00	290000	29370	57540
33	434	SF4537	18.38	1.00	544.50	2.878	189.218	1.00	195.80	15.070	12.993	-7994.1	606540.0	523926.9	0.86	0.36	*	Tower front lat. strut (~ F5)	5.24E+05	0.00E+00	305000	26480	55650
33	442	SF4538	18.38	1.00	544.50	2.878	189.218	1.00	76.45	15.070	5.073	-7994.1	606540.0	373641.9	0.62	0.29	*	Tower front lat. strut (~ F5)	3.74E+05	0.00E+00	198500	18370	38490
33	456	SF4539	18.38	1.00	272.25	2.878	94.609	1.00	79.75	15.070	5.292	-24485.9	-382543.8	-36928.0	0.10	0.02		Tower front lat. strut @ F6	0.00E+00	-3.69E+04	-29920	3741	7008
33	462	SF4540	18.38	1.00	272.25	2.878	94.609	1.00	96.25	15.070	6.387	-24485.9	-382543.8	-150855.0	0.39	0.02		Tower front lat. strut @ F6	0.00E+00	-1.51E+05	-142900	4534	7955
33	425	SF4541	18.38	1.00	272.25	2.878	94.609	1.00	96.25	15.070	6.387	-24485.9	-382543.8	-178640.0	0.47	0.04		Tower front lat. strut @ F6	0.00E+00	-1.79E+05	-163300	8793	15340
33	446	SF4542	18.38	1.00	272.25	2.878	94.609	1.00	96.25	15.070	6.387	-24485.9	-382543.8	-176800.0	0.46	0.04		Tower front lat. strut @ F6	0.00E+00	-1.77E+05	-163000	8817	13800
33	433	SF4543	18.38	1.00	272.25	2.878	94.609	1.00	96.25	15.070	6.387	-24485.9	-382543.8	-155316.0	0.41	0.02		Tower front lat. strut @ F6	0.00E+00	-1.55E+05	-148700	4394	6616
33	441	SF4544	18.38	1.00	272.25	2.878	94.609	1.00	79.75	15.070	5.292	-24485.9	-382543.8	-39454.0	0.10	0.02		Tower front lat. strut @ F6	0.00E+00	-3.95E+04	-33020	3185	6434
33	461	SF4545	6.84	1.00	161.34	14.119	11.427	1.00	161.34	1.942	83.071	-26436.0	-153698.9	-37230.0	0.24	0.12		Tower front lat. diag., panel F5-F6	5.29E+03	-3.72E+04	-18250	10710	18980
33	428	SF4546	6.84	1.00	159.35	14.119	11.286	1.00	159.35	1.942	82.049	-26596.4	225720.0	40157.5	0.18	0.12		Tower front lat. diag., panel F5-F6	4.02E+04	-1.75E+04	11310	14540	26020
33	449	SF4547	6.84	1.00	159.35	14.119	11.286	1.00	159.35	1.942	82.049	-26596.4	-154631.7	-39580.0	0.26	0.17		Tower front lat. diag., panel F5-F6	1.59E+04	-3.96E+04	-13540	14480	26040
33	435	SF4548	6.84	1.00	161.34	14.119	11.427	1.00	161.34	1.942	83.071	-26436.0	-153698.9	-19318.0	0.13	0.12		Tower front lat. diag., panel F5-F6	1.87E+04	-1.93E+04	-378	10510	18940
33	464	SF4549	45.53	1.00	127.00	11.847	10.720	1.00	127.00	2.539	50.012	-30620.9	-1185042.8	-33540.0	0.03	0.01		Tower, panel F5-F6 vert.	0.00E+00	-3.35E+04	-20870	7538	12670
33	444	SF4550	45.53	1.00	127.00	11.847	10.720	1.00	127.00	2.539	50.012	-30620.9	-1185042.8	-36360.0	0.03	0.01		Tower, panel F5-F6 vert.	0.00E+00	-3.64E+04	-24770	6008	11590
33	460	SF4551	5.34	1.00	115.58	13.955	8.282	1.00	115.58	1.254	92.156	-24921.8	-113120.2	-43330.0	0.38	0.10		Tower front lat. diag., panel F6-F7	0.00E+00	-4.33E+04	-32070	6323	11260
33	436	SF4552	5.34	1.00	115.58	13.955	8.282	1.00	115.58	1.254	92.156	-24921.8	-113120.2	-55230.0	0.49	0.10		Tower front lat. diag., panel F6-F7	0.00E+00	-5.52E+04	-44190	5834	11040
33	427	SF4553	5.34	1.00	112.80	13.955	8.083	1.00	112.80	1.254	89.934	-25306.5	-114866.3	-44800.0	0.39	0.11		Tower front lat. diag., panel F6-F7	0.00E+00	-4.48E+04	-32680	6586	12120
33	448	SF4554	5.34	1.00	112.80	13.955	8.282	1.00	112.80	1.254	89.934	-25306.5	-114866.3	-32500.0	0.28	0.11		Tower front lat. diag., panel F6-F7	0.00E+00	-3.25E+04	-20140	6823	12360
33	463	SF4555	3.86	1.00	58.81	14.094	4.173	1.00	58.81	1.092	53.875	-30239.1	-99214.6	-263.6	0.00	0.00		Tower, panel F6-F7 vert.	8.27E+00	-2.64E+02	-145.9	117.7	97.12
33	451	SF4556	3.86	1.00	58.81	14.094	4.173	1.00	58.81	1.092	53.875	-30239.1	127380.0	44497.5	0.35	0.02		Tower, panel F6-F7 vert.	4.45E+04	0.00E+00	33330	1383	2835
33	450	SF4557	3.86	1.00	58.81	14.094	4.173	1.00	58.81	1.092	53.875	-30239.1	-99214.6	-251.2	0.00	0.00		Tower, panel F6-F7 vert.	2.46E+01	-2.51E+02	-129.5	121.7	101.6
33	454	SF4558	5.34	1.00	192.5	13.955	13.794	1.00	96.25	1.254	76.742	-27398.1	-124360.1	-127560.0	1.03	0.12		Tower front lat. strut @ F7	0.00E+00	-1.28E+05	-112300	8267	15260
33	426	SF4559	5.34	1.00	192.5	13.955	13.794	1.00	96.25	1.254	76.742	-27398.1	-124360.1	-127720.0	1.03	0.12		Tower front lat. strut @ F7	0.00E+00	-1.28E+05	-112400	8270	15320
33	447	SF4560	5.34	1.00	192.5	13.955	13.794	1.00	96.25	1.254	76.742	-27398.1	-124360.1	-136580.0	1.10	0.12		Tower front lat. strut @ F7	0.00E+00	-1.37E+05	-122000	7056	14580
33	432	SF4561	5.34	1.00	192.5	13.955	13.794	1.00	96.25	1.254	76.742	-27398.1	-124360.1	-136660.0	1.10	0.12		Tower front lat. strut @ F7	0.00E+00	-1.37E+05	-122000	7085	14660

FILENAME: 3DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 3

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
50	72	SW3001	52.67	1.00	424.75	7.063	60.142	1.00	494.75	6.936	71.330	-38889.7	-1741155.6	-1002800.0	0.58	0.19		West truss top chord, L0-U1	0.00E+00	-1.00E+06	-672700	232200	330100
50	123	SW3002	52.67	1.00	70.00	7.063	9.911	1.00	494.75	6.936	71.330	-38889.7	-1741155.6	-988400.0	0.57	0.19		West truss top chord, L0-U1	0.00E+00	-9.88E+05	-663100	229800	325300
50	112	SW3003	39.17	1.00	301.65	6.693	45.070	1.00	301.65	7.442	40.533	-45564.4	-1517141.9	-903000.0	0.60	0.20		West truss top chord, U1-U2	0.00E+00	-9.03E+05	-592300	206300	310700
50	99	SW3004	47.27	1.00	299.48	7.059	42.424	1.00	299.48	7.108	42.133	-46069.9	-1851161.9	-1148400.0	0.62	0.22		West truss top chord, U2-U3	0.00E+00	-1.15E+06	-746700	250200	401700
50	163	SW3005	53.57	1.00	297.87	7.070	42.135	1.00	297.87	6.911	43.104	-45942.8	-2092082.3	-1325700.0	0.63	0.23		West truss top chord, U3-U4	0.00E+00	-1.33E+06	-844100	277500	481600
50	166	SW3006	57.17	1.00	296.92	7.065	42.024	1.00	296.92	6.815	43.566	-45855.5	-2228420.3	-1384100.0	0.62	0.23		West truss top chord, U4-U5	0.00E+00	-1.38E+06	-876700	285500	507400
50	4	SW3007	57.17	1.00	296.59	7.065	41.978	1.00	296.59	6.815	43.518	-45864.5	-2228861.2	-1455500.0	0.65	0.24		West truss top chord, U5-U5'	0.00E+00	-1.46E+06	-912800	297700	542700
50	322	SW3008	57.17	1.00	296.92	7.065	42.024	1.00	296.92	6.815	43.566	-45855.5	-2228420.3	-1380300.0	0.62	0.23		West truss top chord, U4'-U5'	0.00E+00	-1.38E+06	-876700	281200	503600
50	320	SW3009	53.57	1.00	297.87	7.070	42.135	1.00	297.87	6.911	43.104	-45942.8	-2092082.3	-1328100.0	0.63	0.23		West truss top chord, U3'-U4'	0.00E+00	-1.33E+06	-844100	274200	484000
50	302	SW3010	47.27	1.00	299.48	7.059	42.424	1.00	299.48	7.108	42.133	-46069.9	-1851161.9	-1147900.0	0.62	0.22		West truss top chord, U2'-U3'	0.00E+00	-1.15E+06	-746700	249600	401200
50	340	SW3011	39.17	1.00	301.65	6.693	45.070	1.00	301.65	7.442	40.533	-45564.4	-1517141.9	-908700.0	0.60	0.21		West truss top chord, U1'-U2'	0.00E+00	-9.09E+05	-592300	208200	316400
50	344	SW3012	52.67	1.00	70.00	7.063	9.911	1.00	494.75	6.936	71.330	-38889.7	-1741155.6	-985800.0	0.57	0.19		West truss top chord, L0'-U1'	0.00E+00	-9.86E+05	-663100	227600	322700
50	276	SW3013	52.67	1.00	424.75	7.063	60.142	1.00	494.75	6.936	71.330	-38889.7	-1741155.6	-1002200.0	0.58	0.19		West truss top chord, L0'-U1'	0.00E+00	-1.00E+06	-672700	230100	329500
50	86	SW3014	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	742225.0	0.59	0.25		West truss bottom chord, L0-L1	7.42E+05	-6.20E+04	340100	317100	229300
50	87	SW3015	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	729975.0	0.58	0.24		West truss bottom chord, L1-L2	7.30E+05	-4.54E+04	342300	302100	233900
50	81	SW3016	33.96	1.00	296.59	7.461	39.750	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1516600.0	0.89	0.45		West truss bottom chord, L2-L3	1.52E+06	-3.19E+05	598800	398200	768100
50	96	SW3017	47.01	1.00	296.59	7.383	40.170	1.00	296.59	6.002	49.412	-44668.6	2350500.0	1703000.0	0.72	0.32		West truss bottom chord, L3-L4	1.70E+06	-1.91E+05	756000	394400	758000
50	97	SW3018	50.61	1.00	296.59	7.353	40.337	1.00	296.59	5.949	49.858	-44571.9	2530500.0	2144875.0	0.85	0.41		West truss bottom chord, L4-L5	2.14E+06	-3.83E+05	880700	487500	1044000
50	5	SW3019	54.21	1.00	296.59	7.320	40.516	1.00	296.59	5.902	50.255	-44485.1	2710500.0	1944600.0	0.72	0.31		West truss bottom chord, L5-L5'	1.94E+06	-1.81E+05	882000	380500	842100
50	296	SW3020	50.61	1.00	296.59	7.353	40.337	1.00	296.59	5.949	49.858	-44571.9	2530500.0	2117875.0	0.84	0.40		West truss bottom chord, L4'-L5'	2.12E+06	-3.56E+05	880700	470200	1017000
50	295	SW3021	47.01	1.00	296.59	7.383	40.170	1.00	296.59	6.002	49.412	-44668.6	2350500.0	1741600.0	0.74	0.34		West truss bottom chord, L3'-L4'	1.74E+06	-2.30E+05	756000	385300	796600
50	287	SW3022	33.96	1.00	296.59	7.461	39.750	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1522400.0	0.90	0.46		West truss bottom chord, L2'-L3'	1.52E+06	-3.25E+05	598800	353600	773900
50	301	SW3023	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	735775.0	0.59	0.25		West truss bottom chord, L1'-L2'	7.36E+05	-5.12E+04	342300	168500	307900
50	300	SW3024	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	713025.0	0.57	0.23		West truss bottom chord, L0'-L1'	7.13E+05	-3.28E+04	340100	154100	287900
50	80	SW3025	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	-185357.5	-48367.5	0.26	0.59		West truss vertical, U1-L1	2.09E+05	-4.84E+04	80310	98180	108600
33	70	SW3026	24.80	1.00	340.66	7.238	47.066	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-405600.0	0.69	0.28		West truss vertical, U2-L2	0.00E+00	-4.06E+05	-241400	110200	164200
33	111	SW3027	24.80	1.00	110.37	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-403000.0	0.69	0.28		West truss vertical, U2-L2	0.00E+00	-4.03E+05	-239100	110200	163900
33	69	SW3028	24.80	1.00	340.62	7.238	47.062	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-279700.0	0.50	0.23		West truss vertical, U3-L3	1.44E+04	-2.80E+05	-151600	97660	128100
33	159	SW3029	24.80	1.00	151.88	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-276800.0	0.49	0.23		West truss vertical, U3-L3	1.59E+04	-2.77E+05	-149100	98180	127700
33	67	SW3030	24.80	1.00	340.61	7.238	47.059	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-90060.0	0.16	0.10		West truss vertical, U4-L4	2.95E+04	-9.01E+04	-34610	53640	55450
33	157	SW3031	24.80	1.00	179.50	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-87830.0	0.16	0.10		West truss vertical, U4-L4	3.17E+04	-8.78E+04	-32060	54190	55770
33	68	SW3032	24.80	1.00	340.62	7.238	47.062	1.00	534.00	6.085	87.756	-25674.7	818400.0	48835.0	0.06	0.04		West truss vertical, U5-L5	4.88E+04	-2.39E+04	12460	31170	33260
33	158	SW3033	24.80	1.00	193.38	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	128255.0	0.16	0.07		West truss vertical, U5-L5	1.28E+05	-1.56E+04	56340	34840	57830
33	279	SW3034	24.80	1.00	340.62	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	52955.0	0.06	0.05		West truss vertical, U5'-L5'	5.30E+04	-2.80E+04	12460	29250	37380
33	317	SW3035	24.80	1.00	193.38	7.238	47.059	1.00	534.00	6.085	87.756	-25674.7	818400.0	120375.0	0.15	0.06		West truss vertical, U5'-L5'	1.20E+05	-7.70E+03	56340	36100	49950
33	280	SW3036	24.80	1.00	340.61	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-88750.0	0.16	0.10		West truss vertical, U4'-L4'	2.82E+04	-8.88E+04	-34610	54140	48970
33	318	SW3037	24.80	1.00	179.50	7.238	47.062	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-86920.0	0.16	0.10		West truss vertical, U4'-L4'	3.08E+04	-8.69E+04	-32060	54860	49900
33	278	SW3038	24.80	1.00	340.62	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-260900.0	0.46	0.19		West truss vertical, U3'-L3'	0.00E+00	-2.61E+05	-151600	97200	109300
33	316	SW3039	24.80	1.00	151.88	7.238	47.066	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-257900.0	0.46	0.19		West truss vertical, U3'-L3'	0.00E+00	-2.58E+05	-149100	97730	108800
33	277	SW3040	24.80	1.00	340.66	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-389400.0	0.67	0.25		West truss vertical, U2'-L2'	0.00E+00	-3.89E+05	-241400	98480	148000
33	339	SW3041	24.80	1.00	110.37	7.238	54.712	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-386600.0	0.66	0.25		West truss vertical, U2'-L2'	0.00E+00	-3.87E+05	-239100	98510	147500
50	286	SW3042	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	984000.0	176077.5	0.18	0.08		West truss vertical, U1'-L1'	1.76E+05	-1.55E+04	80310	68980	75690
50	79	SW3043	23.40	1.00	494.75	7.526	65.739	1.00	494.75	5.440	90.940	-31940.9	1170000.0	736550.0	0.63	0.19		West truss diagonal, U1-L2	7.37E+05	0.00E+00	413000	144900	220300
50	78	SW3044	17.58	1.00	539.81	7.615	70.888	1.00	539.81	4.282	126.053	-18013.3	879000.0	547325.0	0.62	0.22		West truss diagonal, U2-L3	5.47E+05	0.00E+00	282900	125900	193700
50	77	SW3045	14.64	1.00	574.91	7.616	75.483	1.00	574.91	4.428	129.847	-16976.1	732000.0	401950.0	0.55	0.22		West truss diagonal, U3-L4	4.02E+05	-1.76E+04	192200	115500	161700
50	283	SW3046	14.64	1.00	574.91	7.616	75.483	1.00	574.91	4.428	129.847	-16976.1	732000.0	382850.0	0.52	0.19		West truss diagonal, U3'-L4'	3.83E+05	0.00E+00	192200	114500	142600
50	284	SW3047	17.58	1.00	539.81	7.615	70.888	1.00	539.81	4.282	126.053	-18013.3	879000.0	529925.0	0.60	0.20		West truss diagonal, U2'-L3'	5.30E+05	0.00E+00	282900	114800	176300
50	285	SW3048	23.40	1.00	494.75	7.526	65.739	1.00	494.75	5.440	90.940	-31940.9	1170000.0	731350.0	0.63	0.18		West truss diagonal, U1'-L2'	7.31E+05	0.00E+00	413000	139400	215100
33	95	SW3049	6.10	1.00	610.84	7.460	81.885	1.00	305.42	1.599	190.984	-7847.0	201300.0	114757.5	0.57	0.75	*	West truss diagonal, U4-L5	3.61E+04	-1.23E+05	-49510	57630	73230
33	73	SW3050	6.10	1.00	610.84	7.460	81.885	1.00	305.42	1.599	190.984	-7847.0	201300.0	114932.5	0.57	0.75	*	West truss diagonal, U4-L5	3.63E+04	-1.21E+05	-48650	57550	72760
50	93	SW3051	7.96	1.00	598.73	7.466	80.191	1.00	299.37	2.275	131.586	-16530.2	398000.0	237467.5	0.60	0.38	*	West truss diagonal, U5-L4	1.64E+05	-2.66E+04	68830	63670	78200
50	76	SW3052	7.96	1.00	598.73	7.466	80.191	1.00	299.37	2.275	131.586	-16530.2	398000.0	238940.0	0.60	0.38	*	West truss diagonal, U5-L4	1.66E+05	-2.64E+04	69640	63830	78660
50	294	SW3053	7.96	1.00	598.73	7.466	80.191	1.00	299.37	2.275	131.586	-16530.2	398000.0	223437.5	0.56	0.35	*	West truss diagonal, U4'-L5'	1.59E+05	-2.18E+04	68830	64980	73400
50	282	SW3054	7.96	1.00	598.73	7.466	80.191	1.00	299.37	2.275	131.586	-16530.2	398000.0	224840.0	0.56	0.35	*	West truss diagonal, U4'-L5'	1.61E+05	-2.16E+04	69640	65160	73790
33	293	SW3055	6.10	1.00	610.84	7.460	81.885	1.00	305.42	1.599	190.984	-7847.0	201300.0	100657.5	0.50	0.68	*	West truss diagonal, U5'-L4'	2.69E+04	-1.14E+05	-49510	58510	64000
33	281	SW3056	6.10	1.00	610.84	7.460	81.885	1.00	305.42	1.599	190.984	-7847.0	201300.0	100972.5	0.50	0.68	*	West truss diagonal, U5'-L4'	2.72E+04	-1.12E+05	-48650	58610	63670
33	94	SW3057	6.10	1.00	354.40	7.460	47.509	1.00	177.20	1.599	110.808	-21320.8	201300.0	71182.5	0.35	0.24		West truss diagonal, L5-M5'	7.12E+04	-3.57E+04	17730	41030	49020
33	7	SW3058	6.10	1.00	354.40	7.460	47.509	1.00	177.20	1.599	110.808	-21320.8	201300.0	84487.5	0.42	0.24		West truss diagonal, L5-M5'	8.45E+04	-2.71E+04	28710	41830	48600
33	6	SW3059	6.10	1.00	354.40	7.460	47.509	1.00	177.20	1.599	110.808	-21320.8	201300.0	67372.5	0.33	0.22		West truss diagonal, L5'-M5	6.74E+04	-3.19E+04	17730	40810	45210
33	74	SW3060	6.10	1.00	354.40	7.460	47.509	1.00	177.20	1.599	110.808	-21320.8	201300.0	82387.5	0.41	0.23		West truss diagonal, L5'-M5	8.24E+04	-2.50E+04	28710	40420	46500
33	75	SW3061	11.10	1.00	170.00	6.340	26.816	1.00	170.00	1.476	115.202	-20376.3	-192250.2	-29100.0	0.15	0.07		West truss, NN-MM	2.34E+03	-2.91E+04	-15290	11130	13810
33	162	SW3062	23.14	1.00	148.30	6.802	21.802	1.00	148.30	5.140	28.852	-32208.2	763620.0	9167.5	0.01	0.01		West truss, M5-MM	9.17E+03	-3.64E+03	2766	5710	5094
33	1	SW3063	23.14	1.00	148.30	6.802	21.802	1.00	148.30	5.140	28.852	-32208.2	763620.0	10229.5	0.01	0.01		West truss, MM-M5'	1.02E+04	-4.70E+03	2766	6077	6772
33	160	SW3064	6.10	1.00	451.18	7.460	60.483	1.00	225.59	1.599	141.067	-14382.9	-74575.6	-66770.0	0.90	0.49		West truss diagonal, M5-U5'	1.45E+04	-6.68E+04	-29870	36900	33520
33	2	SW3065	6.10	1.00	451.18	7.460	60.483	1.00	225.59	1.599	141.067	-14382.9	-74575.6	-66230.0	0.89	0.50		West truss diagonal, M5-U5'	1.50E+04	-6.62E+04	-29290	36940	33170
33	3	SW3066	6.10	1.00	451.18	7.460	60.483	1.00	225.59	1.599	141.067	-14382.9	-74575.6	-67090.0	0.90	0.50		West truss diagonal, M5'-U5	1.48E+04	-6.71E+04	-29870	37220	31200
33	165	SW3067	6.10	1.00	451.18	7.460	60.483	1.00	225.59	1.599	141.067	-14382.9	-74575.6	-66470.0	0.89	0.50		West truss diagonal, M5'-U5	1.52E+04	-6.65E+04	-29290	37180	30830
50	71	SW3068	36.55	1.00	338.73	7.140	47.440	1.00	412.73	7.045	58.584	-42505.6	1827375.0	765385.0	0.42	0.01		West truss, L0-U0	7.65E+05	0.00E+00	601500	7919	13510
50	117	SW3069	36.55	1.00	74.00	7.140	10.364	1.00	412.73	7.045	58.584	-42505.6	-1320452.4	-5649.0	0.00	0.00		West truss, L0-U0	1.20E+03	-5.65E+03	-2541	3108	2215
50	275	SW3070	36.55	1.00	74.00	7.140	10.364	1.00	412.73	7.045	58.584	-42505.6	1827375.0	769295.0	0.42	0.01		West truss, L0'-U0'	7.69E+05	0.00E+00	601500	8664	17420
50	348	SW3071	36.55	1.00	338.73	7.140	47.440	1.00	412.73	7.045	58.584	-42505.6	-1320452.4	-3565.0	0.00	0.00		West truss, L0'-U0'	0.00E+00	-3.57E+03	-2540	762.1	1025
33	113	SW3072	20.56	1.00	272.56	6.678	40.813	1.00	272.56	5.314	51.294	-30497.3	678480.0	49012.5	0.07	0.01		West truss, U0-U1	4.90E+04	0.00E+00	31530	9600	7773
33	341	SW3073	20.56	1.00	272.56	6.678	40.813	1.00	272.56	5.314	51.294	-30497.3	678480.0	47037.5	0.07	0.01		West truss, U0'-U1'	4.70E+04	0.00E+00	31530	6446	7625
50	182	SE3001	49.07	1.00	424.75	7.065	60.120	1.00	494.75	7.047	70.209	-39236.2	-1636605.5	-883900.0	0.54	0.19		East truss top chord, L0-U1	0.00E+00	-8.84E+05	-577600	201700	306300
50	220	SE3002	49.07	1.00	70.00	7.065	9.908	1.00	494.75	7.047	70.209	-39236.2	-1636605.5	-869100.0	0.53	0.18		East truss top chord, L0-U1	0.00E+00	-8.69E+05	-568200	198100	300900
50	209	SE3003	33.77	1.00	301.65	6.910	43.654	1.00	301.65	7.741	38.968	-45838.6	-1315872.1	-796800.0	0.61	0.22		East truss top chord, U1-U2	0.00E+00	-7.97E+05	-502000	186400	294800
50	201	SE3004	39.17	1.00	299.48	6.693	44.744	1.00	299.48	7.442	40.241	-45628.2	-1519266.0	-1020400.0	0.67	0.25		East truss top chord, U2-U3	0.00E+00	-1.02E+06	-635100	233300	385300
50	238	SE3005	47.27	1.00	297.87	7.059	42.197	1.00	297.87	7.108	41.908	-46111.8	-1852847.8	-1179000.0	0.64	0.25		East truss top chord, U3-U4	0.00E+00	-1.18E+06	-718400	259200	460600
50	241	SE3006	47.27	1.00	296.92	7.059	42.061	1.00	296.92	7.108	41.773	-46136.8	-1853850.2	-1232900.0	0.67	0.26		East truss top chord, U4-U5	0.00E+00	-1.23E+06	-747800	268100	485100
50	11	SE3007	47.27	1.00	296.59	7.059	42.015	1.00	296.59	7.108	41.727	-46145.2	-1854190.0	-1298200.0	0.70	0.28		East truss top chord, U5-U5'	0.00E+00	-1.30E+06	-779600	278200	518600
50	403	SE3008	47.27	1.00	296.92	7.059	42.061	1.00	296.92	7.108	41.773	-46136.8	-1853850.2	-1226100.0	0.66	0.26		East truss top chord, U4'-U5'	0.00E+00	-1.23E+06	-747800	264400	478300
50	401	SE3009	47.27	1.00	297.87	7.059	42.197	1.00	297.87	7.108	41.908	-46111.8	-1852847.8	-1175200.0	0.63	0.25		East truss top chord, U3'-U4'	0.00E+00	-1.18E+06	-718400	255200	456800

FILENAME: 3DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

* - Adjusted for true behavior of tension-only members

UNITS INCH,LB. (Fy in ksi)

SPAN 3

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
50	389	SE3010	39.17	1.00	299.48	6.693	44.744	1.00	299.48	7.442	40.241	-45628.2	-1519266.0	-1010200.0	0.66	0.25		East truss top chord, U2'-U3'	0.00E+00	-1.01E+06	-635100	229900	375100
50	411	SE3011	33.77	1.00	301.65	6.910	43.654	1.00	301.65	7.741	38.968	-45838.6	-1315872.1	-793500.0	0.60	0.22		East truss top chord, U1'-U2'	0.00E+00	-7.94E+05	-502000	184800	291500
50	415	SE3012	49.07	1.00	70.00	7.065	9.908	1.00	494.75	7.047	70.209	-39236.2	-1636605.5	-868900.0	0.53	0.18		East truss top chord, L0'-U1'	0.00E+00	-8.69E+05	-568200	202700	300700
50	371	SE3013	49.07	1.00	424.75	7.065	60.120	1.00	494.75	7.047	70.209	-39236.2	-1636605.5	-885700.0	0.54	0.19		East truss top chord, L0'-U1'	0.00E+00	-8.86E+05	-577600	206500	308100
50	193	SE3014	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	627125.0	0.50	0.21		East truss bottom chord, L0-L1	6.27E+05	-5.17E+04	287700	226900	267500
50	194	SE3015	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	625450.0	0.50	0.21		East truss bottom chord, L1-L2	6.25E+05	-4.59E+04	289800	216200	263200
50	192	SE3016	30.36	1.00	296.59	7.468	39.716	1.00	296.59	6.402	46.330	-45312.8	1518000.0	1349000.0	0.89	0.47		East truss bottom chord, L2-L3	1.35E+06	-3.31E+05	509200	329700	712500
50	199	SE3017	33.96	1.00	296.59	7.461	39.750	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1512125.0	0.89	0.42		East truss bottom chord, L3-L4	1.51E+06	-2.24E+05	644100	328700	707000
50	200	SE3018	42.51	1.00	296.59	7.417	39.986	1.00	296.59	6.082	48.769	-44806.4	2125500.0	1938200.0	0.91	0.47		East truss bottom chord, L4-L5	1.94E+06	-4.32E+05	753200	437900	996700
50	12	SE3019	44.76	1.00	296.59	7.401	40.074	1.00	296.59	6.040	49.103	-44735.0	2238000.0	1749625.0	0.78	0.36		East truss bottom chord, L5-L5'	1.75E+06	-2.48E+05	750900	346600	811000
50	386	SE3020	42.51	1.00	296.59	7.417	39.986	1.00	296.59	6.082	48.769	-44806.4	2125500.0	1942500.0	0.91	0.47		East truss bottom chord, L4'-L5'	1.94E+06	-4.36E+05	753200	438200	1001000
50	385	SE3021	33.96	1.00	296.59	7.461	39.750	1.00	296.59	6.285	47.191	-45137.0	1698000.0	1593225.0	0.94	0.46		East truss bottom chord, L3'-L4'	1.59E+06	-3.05E+05	644100	360500	788100
50	382	SE3022	30.36	1.00	296.59	7.468	39.716	1.00	296.59	6.402	46.330	-45312.8	1518000.0	1406800.0	0.93	0.51		East truss bottom chord, L2'-L3'	1.41E+06	-3.88E+05	509200	335600	770300
50	388	SE3023	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	676950.0	0.54	0.25		East truss bottom chord, L1'-L2'	6.77E+05	-9.74E+04	289800	155300	314700
50	387	SE3024	24.96	1.00	296.59	7.454	39.789	1.00	296.59	6.634	44.709	-45635.0	1248000.0	660325.0	0.53	0.24		East truss bottom chord, L0'-L1'	6.60E+05	-8.49E+04	287700	146900	300700
33	191	SE3025	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	649440.0	128612.5	0.20	0.07		East truss vertical, U1-L1	1.29E+05	0.00E+00	67610	43080	44100
33	181	SE3026	24.80	1.00	340.66	7.238	47.066	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-353400.0	0.60	0.25		East truss vertical, U2-L2	0.00E+00	-3.53E+05	-208800	92110	144600
33	208	SE3027	24.80	1.00	110.37	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-350400.0	0.60	0.25		East truss vertical, U2-L2	0.00E+00	-3.50E+05	-206400	91970	144000
33	180	SE3028	24.80	1.00	340.62	7.238	47.062	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-244700.0	0.43	0.20		East truss vertical, U3-L3	1.14E+04	-2.45E+05	-133300	83930	111400
33	234	SE3029	24.80	1.00	151.88	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-241400.0	0.43	0.20		East truss vertical, U3-L3	1.23E+04	-2.41E+05	-130900	84090	110500
33	179	SE3030	24.80	1.00	340.61	7.238	47.059	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-74740.0	0.14	0.08		East truss vertical, U4-L4	1.82E+04	-7.47E+04	-32300	42440	38880
33	233	SE3031	24.80	1.00	179.50	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-72620.0	0.13	0.08		East truss vertical, U4-L4	2.05E+04	-7.26E+04	-29770	42850	38910
33	178	SE3032	24.80	1.00	340.62	7.238	47.062	1.00	534.00	6.085	87.756	-25674.7	-541223.1	-26487.0	0.05	0.05		East truss vertical, U5-L5	3.52E+04	-2.65E+04	4364	25150	29760
33	232	SE3033	24.80	1.00	193.38	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	117215.0	0.14	0.07		East truss vertical, U5-L5	1.17E+05	-1.98E+04	48700	39950	56340
33	375	SE3034	24.80	1.00	340.62	7.238	47.062	1.00	534.00	6.085	87.756	-25674.7	-541223.1	-28637.0	0.05	0.06		East truss vertical, U5'-L5'	3.74E+04	-2.86E+04	4364	25430	31910
33	399	SE3035	24.80	1.00	193.38	7.238	26.717	1.00	534.00	6.085	87.756	-25674.7	818400.0	106705.0	0.13	0.06		East truss vertical, U5'-L5'	1.07E+05	-9.31E+03	48700	32190	45830
33	374	SE3036	24.80	1.00	340.61	7.238	47.059	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-75200.0	0.14	0.08		East truss vertical, U4'-L4'	1.87E+04	-7.52E+04	-32300	42900	40980
33	398	SE3037	24.80	1.00	179.50	7.238	24.800	1.00	520.11	6.085	85.473	-26050.9	-549152.5	-73190.0	0.13	0.08		East truss vertical, U4'-L4'	2.11E+04	-7.32E+04	-29770	43420	41380
33	373	SE3038	24.80	1.00	340.62	7.238	47.062	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-233400.0	0.41	0.18		East truss vertical, U3'-L3'	1.25E+02	-2.33E+05	-133300	78180	100100
33	397	SE3039	24.80	1.00	151.88	7.238	20.983	1.00	492.50	6.085	80.936	-26769.0	-564291.4	-230360.0	0.41	0.18		East truss vertical, U3'-L3'	1.29E+03	-2.30E+05	-130900	78490	99460
33	372	SE3040	24.80	1.00	340.66	7.238	47.066	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-351800.0	0.60	0.24		East truss vertical, U2'-L2'	0.00E+00	-3.52E+05	-208800	96970	143000
33	410	SE3041	24.80	1.00	110.37	7.238	15.250	1.00	451.03	6.085	74.121	-27774.2	-585479.8	-348700.0	0.60	0.24		East truss vertical, U2'-L2'	0.00E+00	-3.49E+05	-206400	96740	142300
33	381	SE3042	19.68	1.00	396.00	6.774	58.457	1.00	396.00	2.464	160.719	-11080.7	649440.0	159392.5	0.25	0.12		East truss vertical, U1'-L1'	1.59E+05	-2.42E+04	67610	67810	74880
50	190	SE3043	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	650075.0	0.66	0.21		East truss diagonal, U1-L2	6.50E+05	0.00E+00	353900	131200	207700
50	189	SE3044	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	477625.0	0.65	0.24		East truss diagonal, U2-L3	4.78E+05	0.00E+00	243300	106600	173500
50	188	SE3045	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	352975.0	0.59	0.24		East truss diagonal, U3-L4	3.53E+05	-1.80E+04	167500	99340	143600
50	378	SE3046	12.06	1.00	574.91	7.595	75.699	1.00	574.91	4.609	124.734	-18396.2	603000.0	342375.0	0.57	0.22		East truss diagonal, U3'-L4'	3.42E+05	-7.38E+03	167500	94610	133000
50	379	SE3047	14.64	1.00	539.81	7.616	70.874	1.00	539.81	4.428	121.919	-19255.6	732000.0	473125.0	0.65	0.23		East truss diagonal, U2'-L3'	4.73E+05	0.00E+00	243300	110600	169000
50	380	SE3048	19.80	1.00	494.75	7.518	65.807	1.00	494.75	5.619	88.047	-33071.9	990000.0	647175.0	0.65	0.21		East truss diagonal, U1'-L2'	6.47E+05	0.00E+00	353900	132500	204800
33	198	SE3049	6.10	1.00	610.84	7.460	81.885	1.00	305.42	1.599	190.984	-7847.0	201300.0	93540.0	0.46	0.63	*	East truss diagonal, U4-L5	2.80E+04	-1.08E+05	-45560	48370	62160
33	184	SE3050	6.10	1.00	610.84	7.460	81.885	1.00	305.42	1.599	190.984	-7847.0	201300.0	93527.5	0.46	0.63	*	East truss diagonal, U4-L5	2.80E+04	-1.06E+05	-44710	48230	61510
50	196	SE3051	7.96	1.00	598.73	7.466	80.191	1.00	299.37	2.275	131.586	-16530.2	398000.0	204265.0	0.51	0.32	*	East truss diagonal, U5-L4	1.42E+05	-1.86E+04	61740	52950	64930
50	187	SE3052	7.96	1.00	598.73	7.466	80.191	1.00	299.37	2.275	131.586	-16530.2	398000.0	205897.5	0.52	0.32	*	East truss diagonal, U5-L4	1.44E+05	-1.86E+04	62550	53040	65550
50	384	SE3053	7.96	1.00	598.73	7.466	80.191	1.00	299.37	2.275	131.586	-16530.2	398000.0	200805.0	0.50	0.31	*	East truss diagonal, U4'-L5'	1.42E+05	-1.80E+04	61740	52700	64340
50	377	SE3054	7.96	1.00	598.73	7.466	80.191	1.00	299.37	2.275	131.586	-16530.2	398000.0	202457.5	0.51	0.31	*	East truss diagonal, U4'-L5'	1.43E+05	-1.81E+04	62550	52880	64980
33	383	SE3055	6.10	1.00	610.84	7.460	81.885	1.00	305.42	1.599	190.984	-7847.0	201300.0	90100.0	0.45	0.62	*	East truss diagonal, U5'-L4'	2.51E+04	-1.05E+05	-45560	48610	59290
33	376	SE3056	6.10	1.00	610.84	7.460	81.885	1.00	305.42	1.599	190.984	-7847.0	201300.0	90137.5	0.45	0.61	*	East truss diagonal, U5'-L4'	2.52E+04	-1.03E+05	-44710	48530	58690
33	197	SE3057	6.10	1.00	354.40	7.460	47.509	1.00	177.20	1.599	110.808	-21320.8	201300.0	58010.0	0.29	0.18		East truss diagonal, L5-M5'	5.80E+04	-2.35E+04	17280	36390	36410
33	14	SE3058	6.10	1.00	354.40	7.460	47.509	1.00	177.20	1.599	110.808	-21320.8	201300.0	70607.5	0.35	0.17		East truss diagonal, L5-M5'	7.06E+04	-1.38E+04	28390	35120	34860
33	13	SE3059	6.10	1.00	354.40	7.460	47.509	1.00	177.20	1.599	110.808	-21320.8	201300.0	56800.0	0.28	0.17		East truss diagonal, L5'-M5	5.68E+04	-2.22E+04	17280	35200	32950
33	185	SE3060	6.10	1.00	354.40	7.460	47.509	1.00	177.20	1.599	110.808	-21320.8	201300.0	72467.5	0.36	0.18		East truss diagonal, L5'-M5	7.25E+04	-1.57E+04	28390	36980	36280
33	186	SE3061	11.10	1.00	170.00	6.340	26.816	1.00	170.00	1.476	115.202	-20376.3	-192250.2	-30530.0	0.16	0.08		East truss, NN-MM	3.42E+03	-3.05E+04	-15490	10880	15040
33	237	SE3062	23.14	1.00	148.30	6.802	21.802	1.00	148.30	5.140	28.852	-32208.2	763620.0	11580.0	0.02	0.01		East truss, M5-MM	1.16E+04	-3.39E+03	4096	5742	6460
33	8	SE3063	23.14	1.00	148.30	6.802	21.802	1.00	148.30	5.140	28.852	-32208.2	763620.0	12214.0	0.02	0.01		East truss, MM-M5'	1.22E+04	-4.02E+03	4096	5987	7094
33	235	SE3064	6.10	1.00	451.18	7.460	60.483	1.00	225.59	1.599	141.067	-14382.9	-74575.6	-62140.0	0.83	0.41		East truss diagonal, M5-U5'	7.21E+03	-6.21E+04	-31390	30750	30490
33	9	SE3065	6.10	1.00	451.18	7.460	60.483	1.00	225.59	1.599	141.067	-14382.9	-74575.6	-61490.0	0.82	0.41		East truss diagonal, M5-U5'	7.56E+03	-6.15E+04	-30820	30670	29940
33	10	SE3066	6.10	1.00	451.18	7.460	60.483	1.00	225.59	1.599	141.067	-14382.9	-74575.6	-62600.0	0.84	0.42		East truss diagonal, M5'-U5	7.67E+03	-6.26E+04	-31390	31210	28870
33	240	SE3067	6.10	1.00	451.18	7.460	60.483	1.00	225.59	1.599	141.067	-14382.9	-74575.6	-62020.0	0.83	0.42		East truss diagonal, M5'-U5	8.09E+03	-6.20E+04	-30820	31200	28440
50	183	SE3068	36.55	1.00	338.73	7.140	47.440	1.00	412.73	7.045	58.584	-42505.6	1827375.0	665605.0	0.36	0.01		East truss, L0-U0	6.66E+05	0.00E+00	521300	6623	13980
50	217	SE3069	36.55	1.00	74.00	7.140	10.364	1.00	412.73	7.045	58.584	-42505.6	-1320452.4	-5727.0	0.00	0.00		East truss, L0-U0	1.68E+03	-5.73E+03	-2310	2766	3417
50	370	SE3070	36.55	1.00	74.00	7.140	10.364	1.00	412.73	7.045	58.584	-42505.6	1827375.0	669065.0	0.37	0.01		East truss, L0'-U0'	6.69E+05	0.00E+00	521300	8950	17440
50	422	SE3071	36.55	1.00	338.73	7.140	47.440	1.00	412.73	7.045	58.584	-42505.6	-1320452.4	-3369.0	0.00	0.00		East truss, L0'-U0'	0.00E+00	-3.37E+03	-2309	821.2	1060
33	210	SE3072	20.56	1.00	272.56	6.678	40.813	1.00	272.56	5.314	51.294	-30497.3	678480.0	43046.5	0.06	0.01		East truss, U0-U1	4.30E+04	0.00E+00	26630	8682	9759
33	412	SE3073	20.56	1.00	272.56	6.678	40.813	1.00	272.56	5.314	51.294	-30497.3	678480.0	41583.5	0.06	0.01		East truss, U0'-U1'	4.16E+04	0.00E+00	26630	7099	8296
33	110	ST3101	7.06	1.00	402.60	8.737	46.078	1.00	402.60	1.606	250.749	-4552.2	232980.0	105340.0	0.45	0.45	*	Top lat. diagonal, U1W-UM2	3.57E+03	-9.17E+04	-50340	22140	41320
33	58	ST3102	7.06	1.00	402.84	8.737	46.078	1.00	402.84	1.606	250.898	-4546.8	232980.0	105340.0	0.45	0.45	*	Top lat. diagonal, UM2-U3E	1.44E+04	-1.02E+05	-49940	25230	51870
33	61	ST3103	7.06	1.00	402.60	8.737	46.105	1.00	402.60	1.606	250.749	-4552.2	232980.0	105340.0	0.45	0.45	*	Top lat. diagonal, U1E-UM2	5.07E+03	-9.49E+04	-51330	24170	43570
33	100	ST3104	7.06	1.00	402.84	8.737	46.105	1.00	402.84	1.606	250.898	-4546.8	232980.0	105340.0	0.45	0.45	*	Top lat. diagonal, UM2-U3W	1.49E+04	-1.05E+05	-51490	26930	53470
33	155	ST3105	7.06	1.00	403.54	8.737	46.186	1.00	403.54	1.606	251.338	-4530.9	232980.0	172490.0	0.74	0.74	*	Top lat. diagonal, U3W-UM4	3.09E+04	-1.19E+05	-50440	29800	68770
33	60	ST3106	7.06	1.00	404.73	8.737	46.321	1.00	404.73	1.606	252.076	-4504.4	232980.0	172490.0	0.74	0.74	*	Top lat. diagonal, UM4-U5E	4.84E+04	-1.39E+05	-51520	34190	87050
33	59	ST3107	7.06	1.00	403.54	8.737	46.186	1.00	403.54	1.606	251.338	-4530.9	232980.0	172490.0	0.74	0.74	*	Top lat. diagonal, U3E-UM4	2.94E+04	-1.19E+05	-51300	31010	67900
33	154	ST3108	7.06	1.00	404.73	8.737	46.321	1.00	404.73	1.606	252.076	-4504.4	232980.0	172490.0	0.74	0.74	*	Top lat. diagonal, UM4-U5W	4.64E+04	-1.38E+05	-52080	35040	85440
33	153	ST3109	7.06	1.00	406.34	8.737	46.506	1.00	203.17	1.606	126.540	-17769.0	-106631.7	-23121.5	0.22	0.21		Top lat. diagonal, U5W-UM6W	2.19E+04	-2.31E+04	-691.5	9179	22430
33	27	ST3110	7.06	1.00	406.34	8.737	46.506	1.00	203.17	1.606	126.540	-17769.0	-106631.7	-23064.0	0.22	0.21		Top lat. diagonal, UM6W-UM5'	2.22E+04	-2.31E+04	-494	9159	22570
33	177	ST3111	7.06	1.00	406.34	8.737	46.506	1.00	203.17	1.606	126.540	-17769.0	-106631.7	-18924.0	0.18	0.17		Top lat. diagonal, UM5-UM6W	1.81E+04	-1.89E+04	-494	8016	18430
33	29	ST3112	7.06	1.00	406.34	8.737	46.506	1.00	203.17	1.606	126.540	-17769.0	-106631.7	-18741.5	0.18	0.17		Top lat. diagonal, UM6W-U5'W	1.75E+04	-1.87E+04	-691.5	8013	18050
33	57	ST3113	7.06	1.00	406.34	8.737	46.506	1.00	203.17	1.606	126.540	-17769.0	-106631.7	-19947.0	0.19	0.17		Top lat. diagonal, UM5-UM6E	1.75E+04	-1.99E+04	-1397	8034	18550
33	28	ST3114	7.06	1.00	406.34	8.737	46.506	1.00	203.17	1.606	126.540	-17769.0	-106631.7	-19786.0	0.19	0.17		Top lat. diagonal, UM6E-U5'E	1.70E+04	-1.98E+04	-1596	8032	18190
33	229	ST3115	7.06	1.00	406.34	8.737	46.506	1.00	203.17	1.606	126.540	-17769.0	-106631.7	-24046.0	0.23	0.21		Top lat. diagonal, U5E-UM6E	2.13E+04	-2.40E+04	-1596	9114	22450
33	26	ST3116	7.06	1.00	406.34	8.737	46.506	1.00	203.17	1.606	126.540	-17769.0	-106631.7	-23997.0	0.23	0.21		Top lat. diagonal, UM6E-UM5'	2.16E+04	-2.40E+04	-1397	9105	22600
33	313	ST3117	7.06	1.00	404.73	8.737	46.321	1.00	404.73	1.606	252.076	-4504.4	232980.0	166790.0	0.72	0.72	*	Top lat. diagonal, U5'W-UM4'	4.34E+04	-1.35E+05	-52080	36860	82430
33	267	ST3118	7.06	1.00	403.54	8.737	46.186	1.00	403.54	1.606	251.338	-4530.9	232980.0	166790.0	0.72	0.72	*	Top lat. diagonal, UM4'-U3'E	2.70E+04	-1.17E+05	-51300	34090	65470

FILENAME: 3DEMCAP.XLS

12/23/94

I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

* - Adjusted for true behavior of tension-only members

UNITS INCH,LB. (Fy in ksi)

SPAN 3

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
33	268	ST3119	7.06	1.00	404.73	8.737	46.321	1.00	404.73	1.606	252.076	-4504.4	232980.0	166790.0	0.72	0.72	*	Top lat. diagonal, U5'E-UM4'	4.57E+04	-1.36E+05	-51520	35440	84360
33	314	ST3120	7.06	1.00	403.54	8.737	46.186	1.00	403.54	1.606	251.338	-4530.9	232980.0	166790.0	0.72	0.72	*	Top lat. diagonal, UM4'-U3'W	2.82E+04	-1.16E+05	-50440	31960	66040
33	303	ST3121	7.06	1.00	402.84	8.737	46.105	1.00	402.84	1.606	250.898	-4546.8	232980.0	103750.0	0.45	0.45	*	Top lat. diagonal, U3'W-UM2'	1.38E+04	-1.04E+05	-51490	30050	52410
33	269	ST3122	7.06	1.00	402.60	8.737	46.078	1.00	402.60	1.606	250.749	-4552.2	232980.0	103750.0	0.45	0.45	*	Top lat. diagonal, UM2'-U1'W	5.22E+03	-9.51E+04	-51330	27580	43720
33	266	ST3123	7.06	1.00	402.84	8.737	46.105	1.00	402.84	1.606	250.898	-4546.8	232980.0	103750.0	0.45	0.45	*	Top lat. diagonal, U3'E-UM2'	1.39E+04	-1.01E+05	-49940	28100	51340
33	338	ST3124	7.06	1.00	402.60	8.737	46.078	1.00	402.60	1.606	250.749	-4552.2	232980.0	103750.0	0.45	0.45	*	Top lat. diagonal, UM2'-U1'W	3.67E+03	-9.18E+04	-50340	25310	41420
33	109	ST3125	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-11325.0	0.04	0.04		Top lateral strut, U2W-UM2	1.21E+04	-1.13E+04	380	5830	11610
33	53	ST3126	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-9894.5	0.04	0.04		Top lateral strut, UM2-U2E	1.05E+04	-9.89E+03	327.4	5175	10140
33	150	ST3127	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	110032.5	0.23	0.06		Top lateral strut, U3W-UM3	1.10E+05	0.00E+00	63610	19910	30520
33	54	ST3128	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	107905.0	0.23	0.06		Top lateral strut, UM3-U3E	1.08E+05	0.00E+00	63420	20440	28630
33	151	ST3129	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-6351.5	0.02	0.02		Top lateral strut, U4W-UM4	7.35E+03	-6.35E+03	499.4	3305	6726
33	55	ST3130	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-6014.3	0.02	0.02		Top lateral strut, UM4-U4E	6.66E+03	-6.01E+03	320.9	3360	6255
33	152	ST3131	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	36716.3	0.08	0.05		Top lateral strut, U5W-UM5	3.67E+04	-1.72E+04	9749	20730	24530
33	56	ST3132	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	35002.5	0.07	0.05		Top lateral strut, UM5-U5E	3.50E+04	-1.48E+04	10090	18750	22390
33	310	ST3133	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	38247.5	0.08	0.05		Top lateral strut, U5'W-UM5'	3.82E+04	-1.87E+04	9750	20890	26060
33	262	ST3134	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	39482.5	0.08	0.06		Top lateral strut, UM5'-U5'E	3.95E+04	-1.93E+04	10090	22320	26870
33	311	ST3135	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-7453.5	0.03	0.03		Top lateral strut, U4'W-UM4'	8.45E+03	-7.45E+03	499.4	3608	7828
33	263	ST3136	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-6766.3	0.03	0.03		Top lateral strut, UM4'-U4'E	7.41E+03	-6.77E+03	320.9	3090	7007
33	312	ST3137	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	110532.5	0.23	0.07		Top lateral strut, U3'W-UM3'	1.11E+05	0.00E+00	63610	20020	31020
33	264	ST3138	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	475200.0	107885.0	0.23	0.06		Top lateral strut, UM3'-U3'E	1.08E+05	0.00E+00	63420	20430	28610
33	337	ST3139	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-15164.9	0.06	0.06		Top lateral strut, U2'W-UM2'	1.59E+04	-1.52E+04	380.1	7755	15450
33	265	ST3140	14.40	1.00	272.25	8.649	31.476	1.00	272.25	2.541	107.129	-22083.4	-270301.4	-13044.4	0.05	0.05		Top lateral strut, UM2'-U2'E	1.37E+04	-1.30E+04	327.5	6305	13290
33	176	ST3141	7.06	1.00	297.87	8.737	34.092	1.00	297.87	1.606	185.523	-8315.8	-49902.9	-2320.0	0.05	0.02		Top lat. brace, UM3-UM4	5.20E+01	-2.32E+03	-1296	1024	969.8
33	328	ST3142	7.06	1.00	297.87	8.737	34.092	1.00	297.87	1.606	185.523	-8315.8	-49902.9	-2610.0	0.05	0.03		Top lat. brace, UM3'-UM4'	3.42E+02	-2.61E+03	-1296	1314	1308
50	84	SB3201	6.84	1.00	201.30	0.982	204.927	1.00	402.60	2.817	142.935	-6815.5	342000.0	319962.5	0.94	0.79	*	Btm. lat. diagonal, L0W-LM1	5.48E+05	-4.67E+05	40650	224400	497300
50	62	SB3202	6.10	1.00	201.30	1.024	196.525	1.00	402.60	2.269	177.415	-7410.8	305000.0	304175.0	1.00	0.84	*	Btm. lat. diagonal, LM1-L2E	4.96E+05	-4.20E+05	37740	211600	448700
50	66	SB3203	6.84	1.00	201.30	0.982	204.927	1.00	402.60	2.817	142.935	-6815.5	342000.0	320025.0	0.94	0.79	*	Btm. lat. diagonal, L0E-LM1	6.30E+05	-5.49E+05	40700	250300	579300
50	85	SB3204	6.10	1.00	201.30	1.024	196.525	1.00	402.60	2.269	177.415	-7410.8	305000.0	305050.0	1.00	0.84	*	Btm. lat. diagonal, LM1-L2W	5.77E+05	-5.00E+05	38800	236000	528900
50	298	SB3205	6.10	1.00	201.30	1.024	196.525	1.00	402.60	2.269	177.415	-7410.8	305000.0	246250.0	0.81	0.65	*	Btm. lat. diagonal, L2'W-LM1'	4.28E+05	-3.50E+05	38800	160800	379400
50	272	SB3206	6.84	1.00	201.30	0.982	204.927	1.00	402.60	2.817	142.935	-6815.5	342000.0	258525.0	0.76	0.61	*	Btm. lat. diagonal, LM1'-L0'E	4.70E+05	-3.88E+05	40700	175600	419000
50	273	SB3207	6.10	1.00	201.30	1.024	196.525	1.00	402.60	2.269	177.415	-7410.8	305000.0	245450.0	0.80	0.65	*	Btm. lat. diagonal, L2'E-LM1'	4.21E+05	-3.46E+05	37740	157900	374100
50	299	SB3208	6.84	1.00	201.30	0.982	204.927	1.00	402.60	2.817	142.935	-6815.5	342000.0	258462.5	0.76	0.61	*	Btm. lat. diagonal, LM1'-L0'W	4.62E+05	-3.81E+05	40650	172200	411600
50	82	SB3209	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	176500.0	242550.0	1.37	1.54	*	Btm. lat. diagonal, L2W-LM3	4.37E+05	-3.78E+05	29820	194600	399900
33	65	SB3210	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	116490.0	218887.5	1.88	2.05	*	Btm. lat. diagonal, LM3-L4E	3.39E+05	-2.78E+05	30630	165300	301200
50	63	SB3211	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	176500.0	243737.5	1.38	1.54	*	Btm. lat. diagonal, L2E-LM3	4.60E+05	-3.98E+05	30770	196600	421200
33	91	SB3212	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	116490.0	219562.5	1.88	2.05	*	Btm. lat. diagonal, LM3-L4W	3.62E+05	-2.99E+05	31130	165900	322700
33	92	SB3213	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	116490.0	159950.0	1.37	0.50	*	Btm. lat. diagonal, L4W-LM5	2.41E+05	-1.80E+05	30860	129300	202900
33	64	SB3214	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	116490.0	161037.5	1.38	0.50	*	Btm. lat. diagonal, L4E-LM5	2.47E+05	-1.84E+05	31210	122700	207500
33	90	SB3215	3.53	1.00	201.30	1.000	201.299	1.00	201.30	1.606	125.374	-7063.4	116490.0	168687.5	1.45	1.21	*	Btm. lat. diagonal, L5W-LM6W.	2.79E+05	-2.18E+05	30230	135800	241000
33	23	SB3216	3.53	1.00	201.30	1.000	201.299	1.00	201.30	1.606	125.374	-7063.4	116490.0	168787.5	1.45	1.21	*	Btm. lat. diagonal, LM6W-LM5'	2.79E+05	-2.19E+05	30230	135900	241400
33	98	SB3217	3.53	1.00	201.30	1.000	201.299	1.00	201.30	1.606	125.374	-7063.4	116490.0	168787.5	1.45	1.21	*	Btm. lat. diagonal, LM5-LM6W	3.20E+05	-2.60E+05	30230	149000	282600
33	24	SB3218	3.53	1.00	201.30	1.000	201.299	1.00	201.30	1.606	125.374	-7063.4	116490.0	168687.5	1.45	1.21	*	Btm. lat. diagonal, LM6W-L5'W	3.20E+05	-2.60E+05	30230	148900	282200
33	52	SB3219	3.53	1.00	201.30	1.000	201.299	1.00	201.30	1.606	125.374	-7063.4	116490.0	170125.0	1.46	1.22	*	Btm. lat. diagonal, LM5-LM6E	3.19E+05	-2.58E+05	30680	143500	280600
33	25	SB3220	3.53	1.00	201.30	1.000	201.299	1.00	201.30	1.606	125.374	-7063.4	116490.0	170025.0	1.46	1.22	*	Btm. lat. diagonal, LM6E-L5'E	3.19E+05	-2.57E+05	30680	143400	280200
33	195	SB3221	3.53	1.00	201.30	1.000	201.299	1.00	201.30	1.606	125.374	-7063.4	116490.0	170025.0	1.46	1.22	*	Btm. lat. diagonal, L5E-LM6E	2.84E+05	-2.23E+05	30680	125300	246100
33	22	SB3222	3.53	1.00	201.30	1.000	201.299	1.00	201.30	1.606	125.374	-7063.4	116490.0	170125.0	1.46	1.22	*	Btm. lat. diagonal, LM6E-LM5'	2.85E+05	-2.23E+05	30680	125400	246500
33	292	SB3223	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	116490.0	136150.0	1.17	0.40	*	Btm. lat. diagonal, LM5'-L4'W	1.87E+05	-1.26E+05	30860	100800	148900
33	270	SB3224	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	116490.0	136887.5	1.18	0.40	*	Btm. lat. diagonal, LM5'-L4'E	1.84E+05	-1.22E+05	31210	109000	145000
33	291	SB3225	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	116490.0	176312.5	1.51	1.56	*	Btm. lat. diagonal, L4'W-LM3'	2.64E+05	-2.01E+05	31130	118700	224700
50	274	SB3226	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	176500.0	197712.5	1.12	1.19	*	Btm. lat. diagonal, LM3'-L2'E	3.51E+05	-2.89E+05	30770	145100	312100
33	271	SB3227	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	116490.0	175587.5	1.51	1.56	*	Btm. lat. diagonal, L4'E-LM3'	2.75E+05	-2.14E+05	30630	117400	237100
50	288	SB3228	3.53	1.00	201.30	1.000	201.300	1.00	402.60	1.606	250.749	-4552.2	176500.0	196525.0	1.11	1.19	*	Btm. lat. diagonal, LM3'-L2'W	3.62E+05	-3.03E+05	29820	146300	324900
50	212	SL3301	20.00	1.00	272.25	6.017	45.246	1.00	79.00	2.462	32.092	-45529.6	-774002.6	-19275.0	0.02	0.01		Lift girder btm. chord, panel 0	0.00E+00	-1.93E+04	-15380	1871	3895
50	50	SL3302	20.00	1.00	272.25	6.017	45.246	1.00	193.25	2.462	78.502	-36543.0	-621230.8	-296730.0	0.48	0.03		Lift girder btm. chord, panel 0	0.00E+00	-2.97E+05	-278700	9233	18030
50	107	SL3303	20.00	1.00	272.25	6.017	45.246	1.00	193.25	2.462	78.502	-36543.0	-621230.8	-316780.0	0.51	0.03		Lift girder btm. chord, panel 0	0.00E+00	-3.17E+05	-298600	8516	18180
50	115	SL3304	20.00	1.00	272.25	6.017	45.246	1.00	79.00	2.462	32.092	-45529.6	-774002.6	-21951.0	0.03	0.01		Lift girder btm. chord, panel 0	0.00E+00	-2.20E+04	-18050	1863	3901
50	418	SL3305	20.00	1.00	272.25	6.017	45.246	1.00	79.00	2.462	32.092	-45529.6	-774002.6	-20591.0	0.03	0.01		Lift girder btm. chord, panel 0'	0.00E+00	-2.06E+04	-15380	2699	5211
50	261	SL3306	20.00	1.00	272.25	6.017	45.246	1.00	193.25	2.462	78.502	-36543.0	-621230.8	-302840.0	0.49	0.04		Lift girder btm. chord, panel 0'	0.00E+00	-3.03E+05	-278700	12530	24140
50	336	SL3307	20.00	1.00	272.25	6.017	45.246	1.00	193.25	2.462	78.502	-36543.0	-621230.8	-322840.0	0.52	0.04		Lift girder btm. chord, panel 0'	0.00E+00	-3.23E+05	-298600	12720	24240
50	347	SL3308	20.00	1.00	272.25	6.017	45.246	1.00	79.00	2.462	32.092	-45529.6	-774002.6	-23267.0	0.03	0.01		Lift girder btm. chord, panel 0'	0.00E+00	-2.33E+04	-18050	2699	5217
50	211	SL3309	20.00	1.00	272.25	6.017	45.246	1.00	42.00	2.462	17.061	-45529.6	1000000.0	13561.3	0.01	0.01		Lift girder top chord, panel 0	1.36E+04	-1.01E+04	1729	5254	11400
50	216	SL3310	20.00	1.00	272.25	6.017	45.246	1.00	37.00	2.462	15.030	-45529.6	1000000.0	387105.0	0.39	0.03		Lift girder top chord, panel 0	3.87E+05	0.00E+00	284300	15110	31730
50	202	SL3311	20.00	1.00	272.25	6.017	45.246	1.00	96.63	2.462	39.251	-45529.6	1000000.0	389410.0	0.39	0.03		Lift girder top chord, panel 0	3.89E+05	0.00E+00	285800	15390	32160
50	30	SL3312	20.00	1.00	272.25	6.017	45.246	1.00	96.63	2.462	39.251	-45529.6	1000000.0	376776.0	0.38	0.00		Lift girder top chord, panel 0	3.77E+05	0.00E+00	297500	4901	4379
50	128	SL3313	20.00	1.00	272.25	6.017	45.246	1.00	96.63	2.462	39.251	-45529.6	1000000.0	377076.0	0.38	0.01		Lift girder top chord, panel 0	3.77E+05	0.00E+00	297600	5076	4374
50	101	SL3314	20.00	1.00	272.25	6.017	45.246	1.00	96.63	2.462	39.251	-45529.6	1000000.0	438870.0	0.44	0.03		Lift girder top chord, panel 0	4.39E+05	0.00E+00	325000	15170	32620
50	120	SL3315	20.00	1.00	272.25	6.017	45.246	1.00	37.00	2.462	15.030	-45529.6	1000000.0	436575.0	0.44	0.03		Lift girder top chord, panel 0	4.37E+05	0.00E+00	323500	14910	32200
50	114	SL3316	20.00	1.00	272.25	6.017	45.246	1.00	42.00	2.462	17.061	-45529.6	1000000.0	14106.3	0.01	0.01		Lift girder top chord, panel 0	1.41E+04	-1.05E+04	1789	5474	11870
50	416	SL3317	20.00	1.00	272.25	6.017	45.246	1.00	42.00	2.462	17.061	-45529.6	1000000.0	14747.5	0.01	0.01		Lift girder top chord, panel 0'	1.47E+04	-1.13E+04	1726	6318	12590
50	421	SL3318	20.00	1.00	272.25	6.017	45.246	1.00	37.00	2.462	15.030	-45529.6	1000000.0	395945.0	0.40	0.04		Lift girder top chord, panel 0'	3.96E+05	0.00E+00	284300	19860	40570
50	404	SL3319	20.00	1.00	272.25	6.017	45.246	1.00	96.63	2.462	39.251	-45529.6	1000000.0	398710.0	0.40	0.04		Lift girder top chord, panel 0'	3.99E+05	0.00E+00	285800	20510	41460
50	242	SL3320	20.00	1.00	272.25	6.017	45.246	1.00	96.63	2.462	39.251	-45529.6	1000000.0	379638.0	0.38	0.01		Lift girder top chord, panel 0'	3.80E+05	0.00E+00	297500	6816	7763
50	365	SL3321	20.00	1.00	272.25	6.017	45.246	1.00	96.63	2.462	39.251	-45529.6	1000000.0	379908.0	0.38	0.01		Lift girder top chord, panel 0'	3.80E+05	0.00E+00	297600	6974	7908
50	329	SL3322	20.00	1.00	272.25	6.017	45.246	1.00	96.63	2.462	39.251	-45529.6	1000000.0	448030.0	0.45	0.04		Lift girder top chord, panel 0'	4.48E+05	0.00E+00	325000	20800	41780
50	351	SL3323	20.00	1.00	272.25	6.017	45.246	1.00	37.00	2.462	15.030	-45529.6	1000000.0	445265.0	0.45	0.04		Lift girder top chord, panel 0'	4.45E+05	0.00E+00	323500	20150	40890
50	345	SL3324	20.00	1.00	272.25	6.017	45.246	1.00	42.00	2.462	17.061	-45529.6	1000000.0	15161.3	0.02	0.01		Lift girder top chord, panel 0'	1.52E+04	-1.16E+04	1785	6619	12930
33	207	SL3325	10.00	1.00	121.71	5.824	20.897	1.00	121.71	1.459	83.392	-26385.2	330000.0	29012.5	0.09	0.06		Lift girder diag., panel 0	2.90E+04	-1.61E+04	6434	9756	20970
33	51	SL3326	10.00	1.00	121.71	5.824	20.897	1.00	121.71	1.459	83.392	-26385.2	-224274.3	-29636.0	0.13	0.10		Lift girder diag., panel 0	1.53E+04	-2.96E+04	-8206	9968	21430
33	129	SL3327	10.00	1.00	121.71	5.824	20.897	1.00	121.71	1.459	83.392	-26385.2	330000.0	42127.5	0.13	0.06		Lift girder diag., panel 0	4.21E+04	-8.87E+03	16630	10440	21340
33	108	SL3328	10.00	1.00	121.71	5.824	20.897	1.00	121.71	1.459	83.392	-26385.2	-224274.3	-38820.0	0.17	0.09		Lift girder diag., panel 0	7.43E+03	-3.88E+04	-17940	10270	20880
33	409	SL3329	10.00	1.00	121.71	5.824	20.897	1.00	121.71	1.459	83.392	-26385.2	330000.0	35403.8	0.11	0.08		Lift girder diag., panel 0'	3.54E+04	-2.25E+04	6435	13850	27360
33	260	SL3330	10.00	1.00	121.71	5.824	20.897	1.00	121.71	1.459	83.392	-26385.2	-224274.3	-36127.0	0.16	0.12		Lift girder diag., panel 0'	2.18E+04	-3.61E+04	-8207	14080	27920

FILENAME: 3DEMCAP.XLS
12/23/94
I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT

FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS

UNITS INCH,LB. (Fy in ksi)

* - Adjusted for true behavior of tension-only members

SPAN 3

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.	DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
33	366	SL3331	10.00	1.00	121.71	5.824	20.897	1.00	121.71	1.459	83.392	-26385.2	330000.0	48697.5	0.15	0.08	Lift girder diag., panel 0'	4.87E+04	-1.54E+04	16630	13970	27910
33	335	SL3332	10.00	1.00	121.71	5.824	20.897	1.00	121.71	1.459	83.392	-26385.2	-224274.3	-45280.0	0.20	0.12	Lift girder diag., panel 0'	1.39E+04	-4.53E+04	-17940	13720	27340
50	215	SL3333	14.44	1.00	74.00	1.498	49.412	1.00	74.00	3.723	19.875	-44668.5	-548260.9	-4650.5	0.01	0.00	Lift girder vertical, panel 0	0.00E+00	-4.65E+03	-3716	431.9	934.5
50	119	SL3334	14.44	1.00	74.00	1.498	49.412	1.00	74.00	3.723	19.875	-44668.5	-548260.9	-5780.4	0.01	0.00	Lift girder vertical, panel 0	0.00E+00	-5.78E+03	-4837	443.1	943.4
50	419	SL3335	14.44	1.00	74.00	1.498	49.412	1.00	74.00	3.723	19.875	-44668.5	-548260.9	-4907.0	0.01	0.00	Lift girder vertical, panel 0'	0.00E+00	-4.91E+03	-3716	585.7	1191
50	349	SL3336	14.44	1.00	74.00	1.498	49.412	1.00	74.00	3.723	19.875	-44668.5	-548260.9	-6031.0	0.01	0.00	Lift girder vertical, panel 0'	0.00E+00	-6.03E+03	-4837	580.2	1194
33	131	SL3337	6.65	1.00	74.00	1.682	43.986	1.00	74.00	1.050	70.450	-28279.0	-159907.3	-4724.0	0.03	0.01	C.L. strut vert. @ lift girder (0)	0.00E+00	-4.72E+03	-3218	1506	978.8
33	367	SL3338	6.65	1.00	74.00	1.682	43.986	1.00	74.00	1.050	70.450	-28279.0	-159907.3	-4383.0	0.03	0.01	C.L. strut vert. @ lift girder (0')	0.00E+00	-4.38E+03	-3217	1038	1166
50	213	SL3339	100.00	1.00	85.09	2.236	38.053	1.00	85.09	3.162	26.907	-46838.1	5000000.0	598995.0	0.12	0.00	False member in lifting girder (0)	5.99E+05	0.00E+00	466100	7548	16370
50	214	SL3340	100.00	1.00	82.73	2.236	37.000	1.00	82.73	3.162	26.163	-47010.6	-3995900.0	-110728.0	0.03	0.00	False member in lifting girder (0)	0.00E+00	-1.11E+05	-108900	1728	1828
50	118	SL3341	100.00	1.00	82.73	2.236	37.000	1.00	82.73	3.162	26.163	-47010.6	-3995900.0	-111841.0	0.03	0.00	False member in lifting girder (0)	0.00E+00	-1.12E+05	-110100	1380	1741
50	116	SL3342	100.00	1.00	85.09	2.236	38.053	1.00	85.09	3.162	26.907	-46838.1	5000000.0	687090.0	0.14	0.00	False member in lifting girder (0)	6.87E+05	0.00E+00	536600	7877	16340
50	417	SL3343	100.00	1.00	85.09	2.236	38.053	1.00	85.09	3.162	26.907	-46838.1	5000000.0	603645.0	0.12	0.00	False member in lifting girder (0')	6.04E+05	0.00E+00	466100	10410	21020
50	420	SL3344	100.00	1.00	82.73	2.236	37.000	1.00	82.73	3.162	26.163	-47010.6	-3995900.0	-111683.0	0.03	0.00	False member in lifting girder (0')	0.00E+00	-1.12E+05	-108900	2033	2783
50	350	SL3345	100.00	1.00	82.73	2.236	37.000	1.00	82.73	3.162	26.163	-47010.6	-3995900.0	-112887.0	0.03	0.00	False member in lifting girder (0')	0.00E+00	-1.13E+05	-110100	2142	2787
50	346	SL3346	100.00	1.00	85.09	2.236	38.053	1.00	85.09	3.162	26.907	-46838.1	5000000.0	691770.0	0.14	0.00	False member in lifting girder (0')	6.92E+05	0.00E+00	536600	10310	21020
33	125	SL3347	6.65	1.00	272.84	1.682	162.176	1.00	100.25	1.050	95.441	-10882.4	219532.5	13788.3	0.06	0.01	Lift girder C.L. strut, U0-U1	1.38E+04	0.00E+00	8853	2722	1719
33	141	SL3348	6.65	1.00	272.84	1.682	162.176	1.00	84.25	1.050	80.208	-10882.4	219532.5	9354.5	0.04	0.01	Lift girder C.L. strut, U0-U1	9.35E+03	0.00E+00	6306	1399	1472
33	140	SL3349	6.65	1.00	272.84	1.682	162.176	1.00	88.34	1.050	84.102	-10882.4	219532.5	8211.8	0.04	0.01	Lift girder C.L. strut, U0-U1	8.21E+03	0.00E+00	4319	2813	2264
33	353	SL3350	6.65	1.00	272.84	1.682	162.176	1.00	100.25	1.050	95.441	-10882.4	219532.5	11878.9	0.05	0.00	Lift girder C.L. strut, U0'-U1'	1.19E+04	0.00E+00	8846	762.9	821.4
33	364	SL3351	6.65	1.00	272.84	1.682	162.176	1.00	84.25	1.050	80.208	-10882.4	219532.5	10736.0	0.05	0.01	Lift girder C.L. strut, U0'-U1'	1.07E+04	0.00E+00	6300	2540	2861
33	363	SL3352	6.65	1.00	272.84	1.682	162.176	1.00	88.34	1.050	84.102	-10882.4	219532.5	9503.5	0.04	0.02	Lift girder C.L. strut, U0'-U1'	9.50E+03	-8.76E+02	4314	3661	4111
33	132	SL3353	6.65	1.00	224.44	1.682	133.407	1.00	55.75	1.050	53.075	-16082.0	-90937.9	-11346.0	0.12	0.06	Lift girder C.L. strut, U0-U1	1.48E+03	-1.13E+04	-5637	5709	3579
33	126	SL3354	6.65	1.00	224.44	1.682	133.407	1.00	87.50	1.050	83.302	-16082.0	-90937.9	-6157.0	0.07	0.04	Lift girder C.L. strut, U0-U1	1.69E+03	-6.16E+03	-2550	3607	2302
33	139	SL3355	6.65	1.00	224.44	1.682	133.407	1.00	81.19	1.050	77.295	-16082.0	-90937.9	-2035.6	0.02	0.02	Lift girder C.L. strut, U0-U1	1.38E+03	-2.04E+03	-374.6	1661	1243
33	369	SL3356	6.65	1.00	224.44	1.682	133.407	1.00	55.75	1.050	53.075	-16082.0	-90937.9	-8819.0	0.10	0.04	Lift girder C.L. strut, U0'-U1'	0.00E+00	-8.82E+03	-5633	2857	3186
33	355	SL3357	6.65	1.00	224.44	1.682	133.407	1.00	87.50	1.050	83.302	-16082.0	-90937.9	-4747.0	0.05	0.02	Lift girder C.L. strut, U0'-U1'	2.90E+02	-4.75E+03	-2547	1994	2200
33	362	SL3358	6.65	1.00	224.44	1.682	133.407	1.00	81.19	1.050	77.295	-16082.0	-90937.9	-2350.0	0.03	0.02	Lift girder C.L. strut, U0'-U1'	1.70E+03	-2.35E+03	-373	1801	1977
33	130	SL3359	5.91	1.00	89.61	1.203	74.464	1.00	89.61	1.068	83.930	-26299.5	195112.5	5514.8	0.03	0.01	Lift girder C.L. strut, U0-U1	5.51E+03	0.00E+00	2847	1956	1265
33	127	SL3360	5.91	1.00	83.42	1.203	69.320	1.00	83.42	1.068	78.132	-27193.3	-136663.2	-4493.0	0.03	0.01	Lift girder C.L. strut, U0-U1	1.15E+02	-4.49E+03	-2502	1991	1278
33	137	SL3361	5.91	1.00	77.15	1.203	64.110	1.00	77.15	1.068	72.260	-28033.4	195112.5	4618.0	0.02	0.01	Lift girder C.L. strut, U0-U1	4.62E+03	-3.70E+02	2124	1963	1218
33	136	SL3362	5.91	1.00	76.87	1.203	63.877	1.00	76.87	1.068	71.998	-28069.3	-141066.0	-3915.0	0.03	0.01	Lift girder C.L. strut, U0-U1	6.72E+02	-3.92E+03	-1853	2062	1245
33	135	SL3363	5.91	1.00	76.36	1.203	63.453	1.00	76.36	1.068	71.520	-28134.5	195112.5	4018.3	0.02	0.01	Lift girder C.L. strut, U0-U1	4.02E+03	-1.10E+03	1457	2197	1333
33	368	SL3364	5.91	1.00	89.61	1.203	74.464	1.00	-89.61	1.068	83.930	-26299.5	195112.5	4982.8	0.03	0.01	Lift girder C.L. strut, U0'-U1'	4.98E+03	0.00E+00	2847	1267	1424
33	354	SL3365	5.91	1.00	83.42	1.203	69.320	1.00	83.42	1.068	78.132	-27193.3	-136663.2	-3881.0	0.03	0.01	Lift girder C.L. strut, U0'-U1'	0.00E+00	-3.88E+03	-2501	1228	1380
33	358	SL3366	5.91	1.00	77.15	1.203	64.110	1.00	77.15	1.068	72.260	-28033.4	195112.5	3710.8	0.02	0.01	Lift girder C.L. strut, U0'-U1'	3.71E+03	0.00E+00	2123	943.2	1057
33	359	SL3367	5.91	1.00	76.87	1.203	63.877	1.00	76.87	1.068	71.998	-28069.3	-141066.0	-2520.9	0.02	0.00	Lift girder C.L. strut, U0'-U1'	0.00E+00	-2.52E+03	-1852	604.2	668.9
33	360	SL3368	5.91	1.00	76.36	1.203	63.453	1.00	76.36	1.068	71.520	-28134.5	195112.5	2094.6	0.01	0.00	Lift girder C.L. strut, U0'-U1'	2.09E+03	0.00E+00	1456	274.6	272.4
33	138	SL3369	5.91	1.00	70.00	1.203	58.168	1.00	70.00	1.068	65.563	-28911.3	-145297.2	-1957.4	0.01	0.01	C.L. strut @ portal frame (U1)	0.00E+00	-1.96E+03	-1124	833.4	620
33	361	SL3370	5.91	1.00	70.00	1.203	58.168	1.00	70.00	1.068	65.563	-28911.3	-145297.2	-1703.6	0.01	0.00	C.L. strut @ portal frame (U1')	0.00E+00	-1.70E+03	-1123	533.9	580.6
33	203	SX3401	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-41042.7	0.16	0.16	X-frame btm. strut, panel 2	3.96E+04	-4.10E+04	-822.7	15390	40220
33	33	SX3402	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-2284.6	0.02	0.02	X-frame btm. strut, panel 2	3.31E+03	-2.28E+03	512.5	2669	2291
33	104	SX3403	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-41308.9	0.16	0.16	X-frame btm. strut, panel 2	4.11E+04	-4.13E+04	-138.9	15740	41170
33	221	SX3404	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-39783.0	0.16	0.16	X-frame btm. strut, panel 3	4.25E+04	-3.98E+04	1356	14090	40800
33	34	SX3405	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	8327.3	0.02	0.01	X-frame btm. strut, panel 3	8.33E+03	0.00E+00	4777	2244	2356
33	142	SX3406	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-40756.5	0.16	0.16	X-frame btm. strut, panel 3	4.27E+04	-4.08E+04	991.4	14380	41500
33	223	SX3407	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-44728.1	0.18	0.18	X-frame btm. strut, panel 4	4.52E+04	-4.47E+04	215.9	14520	44890
33	37	SX3408	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-1546.8	0.01	0.02	X-frame btm. strut, panel 4	3.10E+03	-1.55E+03	779	2035	2131
33	144	SX3409	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-45400.4	0.18	0.18	X-frame btm. strut, panel 4	4.44E+04	-4.54E+04	-550.4	14510	44850
33	393	SX3410	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-45188.1	0.18	0.18	X-frame btm. strut, panel 4'	4.56E+04	-4.52E+04	215.9	14940	45350
33	248	SX3411	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-1455.8	0.01	0.01	X-frame btm. strut, panel 4'	3.01E+03	-1.46E+03	779	1910	2040
33	307	SX3412	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-45870.4	0.18	0.18	X-frame btm. strut, panel 4'	4.49E+04	-4.59E+04	-550.4	14930	45320
33	391	SX3413	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-41103.0	0.16	0.17	X-frame btm. strut, panel 3'	4.38E+04	-4.11E+04	1356	14920	42120
33	246	SX3414	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	385563.8	8611.3	0.02	0.01	X-frame btm. strut, panel 3'	8.61E+03	0.00E+00	4777	2498	2640
33	304	SX3415	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-42086.5	0.17	0.17	X-frame btm. strut, panel 3'	4.41E+04	-4.21E+04	991.4	15220	42830
33	406	SX3416	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-44532.6	0.18	0.17	X-frame btm. strut, panel 2'	4.31E+04	-4.45E+04	-822.6	17160	43710
33	244	SX3417	11.68	1.00	544.50	6.145	88.609	1.00	265.50	1.838	144.438	-13719.4	-136249.5	-2403.0	0.02	0.02	X-frame btm. strut, panel 2'	3.43E+03	-2.40E+03	512	2787	2316
33	332	SX3418	11.68	1.00	544.50	6.145	88.609	1.00	139.50	1.838	75.891	-25531.6	-253558.7	-44868.9	0.18	0.18	X-frame btm. strut, panel 2'	4.46E+04	-4.49E+04	-138.9	17530	44730
33	204	SX3419	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-24325.0	0.19	0.20	X-frame diagonal, panel 2	2.78E+04	-2.43E+04	1740	9991	25630
33	32	SX3420	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-26118.1	0.20	0.20	X-frame diagonal, panel 2	2.63E+04	-2.61E+04	69.2	10030	26170
33	124	SX3421	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-25347.3	0.19	0.20	X-frame diagonal, panel 2	2.63E+04	-2.53E+04	497	9836	25720
33	103	SX3422	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-24165.5	0.19	0.20	X-frame diagonal, panel 2	2.67E+04	-2.42E+04	1286	9661	25130
33	222	SX3423	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-26936.8	0.26	0.29	X-frame diagonal, panel 3	3.38E+04	-2.69E+04	3431	10410	29510
33	35	SX3424	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-32366.0	0.30	0.29	X-frame diagonal, panel 3	2.95E+04	-3.24E+04	-1656	10680	30710
33	167	SX3425	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-32311.0	0.30	0.28	X-frame diagonal, panel 3	2.89E+04	-3.23E+04	-1941	10410	30370
33	143	SX3426	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-26454.0	0.26	0.28	X-frame diagonal, panel 3	3.38E+04	-2.65E+04	3688	10040	29220
33	224	SX3427	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-33721.0	0.40	0.41	X-frame diagonal, panel 4	3.63E+04	-3.37E+04	1292	11440	34690
33	36	SX3428	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-36413.6	0.41	0.42	X-frame diagonal, panel 4	3.72E+04	-3.64E+04	395.2	11930	36710
33	168	SX3429	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-36928.3	0.42	0.42	X-frame diagonal, panel 4	3.65E+04	-3.69E+04	-248.3	11850	36680
33	145	SX3430	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-33385.3	0.39	0.41	X-frame diagonal, panel 4	3.72E+04	-3.34E+04	1913	11330	34820
33	392	SX3431	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-33941.0	0.40	0.41	X-frame diagonal, panel 4'	3.65E+04	-3.39E+04	1292	11640	34910
33	249	SX3432	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-36683.6	0.42	0.42	X-frame diagonal, panel 4'	3.75E+04	-3.67E+04	395.2	12220	36980
33	324	SX3433	7.06	1.00	224.06	3.418	65.545	1.00	224.06	1.606	139.550	-14697.3	-88198.3	-37258.3	0.42	0.42	X-frame diagonal, panel 4'	3.68E+04	-3.73E+04	-248.3	12160	37010
33	306	SX3434	7.06	1.00	228.12	3.418	66.734	1.00	228.12	1.606	142.081	-14178.3	-85083.8	-33745.3	0.40	0.41	X-frame diagonal, panel 4'	3.76E+04	-3.37E+04	1913	11610	35180
33	390	SX3435	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-27656.8	0.27	0.29	X-frame diagonal, panel 3'	3.45E+04	-2.77E+04	3431	10900	30230
33	247	SX3436	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-33116.0	0.31	0.29	X-frame diagonal, panel 3'	3.02E+04	-3.31E+04	-1656	11160	31460
33	323	SX3437	7.06	1.00	202.47	3.418	59.230	1.00	202.47	1.606	126.105	-17873.7	-107260.0	-33211.0	0.31	0.29	X-frame diagonal, panel 3'	2.98E+04	-3.32E+04	-1941	11020	31270
33	305	SX3438	7.06	1.00	206.96	3.418	60.543	1.00	206.96	1.606	128.900	-17195.6	-103190.9	-27454.0	0.27	0.29	X-frame diagonal, panel 3'	3.48E+04	-2.75E+04	3688	10690	30220
33	405	SX3439	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-26215.0	0.21	0.22	X-frame diagonal, panel 2'	2.97E+04	-2.62E+04	1740	11050	27520
33	245	SX3440	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-28067.9	0.21	0.21	X-frame diagonal, panel 2'	2.82E+04	-2.81E+04	69.5	11060	28120
33	352	SX3441	7.06	1.00	173.29	3.418	50.692	1.00	173.29	1.606	107.927	-21920.2	-131543.3	-27377.0	0.21	0.21	X-frame diagonal, panel 2'	2.84E+04	-2.74E+04	497.3	10760	27750
33	331	SX3442	7.06	1.00	178.51	3.418	52.220	1.00	178.51	1.606	111.181	-21242.2	-127474.2	-26275.5	0.21	0.21	X-frame diagonal, panel 2'	2.88E+04	-2.63E+04	1286	10560	27240

FILENAME: 3DEMCAP.XLS
12/23/94
I5 - COLUMBIA RIVER BRIDGE SEISMIC SURVEY for ODOT
FORCE DEMAND/SECTION CAPACITY RATIOS (AXIAL LOADS ONLY) - FORCES FROM 3-D ANALYSIS
* - Adjusted for true behavior of tension-only members
UNITS INCH,LB. (Fy in ksi)
SPAN 3

Fy	ALGOR Memb. #	MEM(S)	A	K2	Lc2	r2	(KL/r)2	K3	Lc3	r3	(KL/r)3	Fcr	Capacity	Demand	D/C	(D/C) no D.L.		DESCRIPTION	Max. Tension	Max. Compr.	AXIAL FORCE (D.L. Compression Negative) D.L.	EQ(X+0.3Y+0.67Z)	EQ(Y+0.3X+0.67Z)
33	236	SX3443	11.68	1.00	136.12	6.145	22.152	1.00	62.25	1.838	33.865	-31909.1	-316895.3	-46473.0	0.15	0.14		X-frame btm. strut, panel 5	4.09E+04	-4.65E+04	-3203	24020	43270
33	226	SX3444	11.68	1.00	136.12	6.145	22.152	1.00	73.87	1.838	40.187	-31463.8	-312473.1	-45952.0	0.15	0.14		X-frame btm. strut, panel 5	4.04E+04	-4.60E+04	-3182	23930	42770
33	39	SX3445	11.68	1.00	136.13	6.145	22.153	1.00	136.13	1.838	74.058	-27783.1	385563.8	74107.5	0.19	0.10		X-frame btm. strut, panel 5	7.41E+04	-1.50E+04	29550	35700	37170
33	171	SX3446	11.68	1.00	136.13	6.145	22.153	1.00	136.13	1.838	74.058	-27783.1	385563.8	71277.5	0.18	0.09		X-frame btm. strut, panel 5	7.13E+04	-1.20E+04	29630	34240	33450
33	147	SX3447	11.68	1.00	136.12	6.145	22.152	1.00	73.87	1.838	40.187	-31463.8	-312473.1	-45804.0	0.15	0.13		X-frame btm. strut, panel 5	3.95E+04	-4.58E+04	-3624	24380	42180
33	161	SX3448	11.68	1.00	136.12	6.145	22.152	1.00	62.25	1.838	33.865	-31909.1	-316895.3	-46324.0	0.15	0.13		X-frame btm. strut, panel 5	3.99E+04	-4.63E+04	-3644	24460	42680
33	400	SX3449	11.68	1.00	136.12	6.145	22.152	1.00	62.25	1.838	33.865	-31909.1	-316895.3	-45853.0	0.14	0.13		X-frame btm. strut, panel 5'	4.02E+04	-4.59E+04	-3203	24140	42650
33	395	SX3450	11.68	1.00	136.12	6.145	22.152	1.00	73.87	1.838	40.187	-31463.8	-312473.1	-45332.0	0.15	0.13		X-frame btm. strut, panel 5'	3.98E+04	-4.53E+04	-3182	24060	42150
33	251	SX3451	11.68	1.00	136.13	6.145	22.153	1.00	136.13	1.838	74.058	-27783.1	385563.8	76817.5	0.20	0.10		X-frame btm. strut, panel 5'	7.68E+04	-1.77E+04	29550	35990	39880
33	327	SX3452	11.68	1.00	136.13	6.145	22.153	1.00	136.13	1.838	74.058	-27783.1	385563.8	75097.5	0.19	0.10		X-frame btm. strut, panel 5'	7.51E+04	-1.58E+04	29630	35470	38060
33	309	SX3453	11.68	1.00	136.12	6.145	22.152	1.00	73.87	1.838	40.187	-31463.8	-312473.1	-47684.0	0.15	0.14		X-frame btm. strut, panel 5'	4.12E+04	-4.76E+04	-3624	25190	43960
33	319	SX3454	11.68	1.00	136.12	6.145	22.152	1.00	62.25	1.838	33.865	-31909.1	-316895.3	-48114.0	0.15	0.14		X-frame btm. strut, panel 5'	4.17E+04	-4.81E+04	-3644	25280	44470
33	239	SX3455	9.12	1.00	237.30	3.468	68.422	1.00	108.52	2.014	53.877	-28546.9	300960.0	102140.0	0.34	0.16		X-frame diagonal, panel 5	1.02E+05	-1.58E+04	43160	37860	48190
33	225	SX3456	9.12	1.00	237.30	3.468	68.422	1.00	128.78	2.014	63.937	-28546.9	300960.0	99167.5	0.33	0.15		X-frame diagonal, panel 5	9.92E+04	-1.36E+04	42790	37530	45680
33	38	SX3457	9.12	1.00	237.31	3.468	68.424	1.00	237.31	2.014	117.817	-19796.6	-153462.9	-37700.0	0.25	0.15		X-frame diagonal, panel 5	1.29E+04	-3.77E+04	-14200	19190	23500
33	169	SX3458	9.12	1.00	237.31	3.468	68.424	1.00	237.31	2.014	117.817	-19796.6	-153462.9	-33240.0	0.22	0.12		X-frame diagonal, panel 5	7.57E+03	-3.32E+04	-14670	13930	18570
33	146	SX3459	9.12	1.00	237.30	3.468	68.422	1.00	128.78	2.014	63.937	-28546.9	300960.0	98575.0	0.33	0.15		X-frame diagonal, panel 5	9.86E+04	-1.21E+04	43220	39060	44550
33	164	SX3460	9.12	1.00	237.30	3.468	68.422	1.00	108.52	2.014	53.877	-28546.9	300960.0	101147.5	0.34	0.16		X-frame diagonal, panel 5	1.01E+05	-1.40E+04	43590	39480	46660
33	402	SX3461	9.12	1.00	237.30	3.468	68.422	1.00	108.52	2.014	53.877	-28546.9	300960.0	105160.0	0.35	0.17		X-frame diagonal, panel 5'	1.05E+05	-1.88E+04	43160	40110	51210
33	394	SX3462	9.12	1.00	237.30	3.468	68.422	1.00	128.78	2.014	63.937	-28546.9	300960.0	102347.5	0.34	0.16		X-frame diagonal, panel 5'	1.02E+05	-1.68E+04	42790	39770	48860
33	250	SX3463	9.12	1.00	237.31	3.468	68.424	1.00	237.31	2.014	117.817	-19796.6	-153462.9	-35630.0	0.23	0.14		X-frame diagonal, panel 5'	1.08E+04	-3.56E+04	-14200	17760	21430
33	325	SX3464	9.12	1.00	237.31	3.468	68.424	1.00	237.31	2.014	117.817	-19796.6	-153462.9	-36540.0	0.24	0.14		X-frame diagonal, panel 5'	1.09E+04	-3.65E+04	-14670	18550	21870
33	308	SX3465	9.12	1.00	237.30	3.468	68.422	1.00	128.78	2.014	63.937	-28546.9	300960.0	100405.0	0.33	0.15		X-frame diagonal, panel 5'	1.00E+05	-1.40E+04	43220	40570	46380
33	321	SX3466	9.12	1.00	237.30	3.468	68.422	1.00	108.52	2.014	53.877	-28546.9	300960.0	102787.5	0.34	0.16		X-frame diagonal, panel 5'	1.03E+05	-1.56E+04	43590	40930	48300
33	231	SX3467	5.49	1.00	105.49	2.821	37.390	1.00	105.49	0.604	174.776	-9369.9	-43724.5	-4630.2	0.11	0.11		X-frame brace, panel 5	4.58E+03	-4.63E+03	-30.22	1484	4600
33	156	SX3468	5.49	1.00	105.49	2.821	37.390	1.00	105.49	0.604	174.776	-9369.9	-43724.5	-4660.8	0.11	0.11		X-frame brace, panel 5	4.60E+03	-4.66E+03	-33.78	1490	4627
33	396	SX3469	5.49	1.00	105.49	2.821	37.390	1.00	105.49	0.604	174.776	-9369.9	-43724.5	-4651.2	0.11	0.11		X-frame brace, panel 5'	4.60E+03	-4.65E+03	-30.22	1502	4621
33	315	SX3470	5.49	1.00	105.49	2.821	37.390	1.00	105.49	0.604	174.776	-9369.9	-43724.5	-4699.8	0.11	0.11		X-frame brace, panel 5'	4.64E+03	-4.70E+03	-33.78	1506	4666
33	170	SX3471	9.12	1.00	194.38	3.468	56.046	1.00	194.38	2.014	96.505	-24141.4	300960.0	52902.5	0.18	0.08		X-frame C.L. vert., panel 5	5.29E+04	-8.80E+03	22050	24000	25340
33	326	SX3472	9.12	1.00	194.38	3.468	56.046	1.00	194.38	2.014	96.505	-24141.4	300960.0	54122.5	0.18	0.09		X-frame C.L. vert., panel 5'	5.41E+04	-1.00E+04	22050	24340	26560
33	218	SX3473	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	98272.5	0.14	0.08		Portal frame top chord, U1	9.83E+04	-3.18E+04	33250	27300	56710
33	31	SX3474	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	55520.0	0.08	0.03		Portal frame top chord, U1	5.55E+04	-4.72E+03	25400	13850	23770
33	102	SX3475	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	55010.0	0.08	0.04		Portal frame top chord, U1	5.50E+04	-5.57E+03	24720	12470	24110
33	121	SX3476	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	96835.0	0.14	0.08		Portal frame top chord, U1	9.68E+04	-3.34E+04	31700	24820	57210
33	413	SX3477	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	103682.5	0.15	0.09		Portal frame top chord, U1'	1.04E+05	-3.72E+04	33250	28590	62120
33	243	SX3478	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	57190.0	0.08	0.04		Portal frame top chord, U1'	5.72E+04	-6.39E+03	25400	14480	25440
33	330	SX3479	20.80	1.00	272.25	8.146	33.420	1.00	178.00	6.393	27.841	-31937.6	686235.0	58040.0	0.08	0.04		Portal frame top chord, U1'	5.80E+04	-8.60E+03	24720	13130	27140
33	342	SX3480	20.80	1.00	272.25	8.146	33.420	1.00	94.25	6.393	14.742	-31937.6	686235.0	103165.0	0.15	0.09		Portal frame top chord, U1'	1.03E+05	-3.98E+04	31700	26750	63540
33	206	SX3481	7.06	1.00	272.25	1.606	169.564	1.00	183.25	8.737	20.973	-9954.7	-59738.3	-38815.3	0.65	0.68		Portal frame btm. chord, U1	4.39E+04	-3.88E+04	2553	17570	40730
33	40	SX3482	7.06	1.00	272.25	1.606	169.564	1.00	89.00	8.737	10.186	-9954.7	232980.0	11136.5	0.05	0.02		Portal frame btm. chord, U1	1.11E+04	0.00E+00	5786	3904	2791
33	134	SX3483	7.06	1.00	272.25	1.606	169.564	1.00	89.00	8.737	10.186	-9954.7	232980.0	11304.5	0.05	0.02		Portal frame btm. chord, U1	1.13E+04	0.00E+00	5774	4087	3006
33	105	SX3484	7.06	1.00	272.25	1.606	169.564	1.00	183.25	8.737	20.973	-9954.7	-59738.3	-40642.3	0.68	0.73		Portal frame btm. chord, U1	4.86E+04	-4.06E+04	3957	19360	43610
33	407	SX3485	7.06	1.00	272.25	1.606	169.564	1.00	183.25	8.737	20.973	-9954.7	-59738.3	-44183.8	0.74	0.77		Portal frame btm. chord, U1'	4.93E+04	-4.42E+04	2555	19410	46100
33	253	SX3486	7.06	1.00	272.25	1.606	169.564	1.00	89.00	8.737	10.186	-9954.7	232980.0	9613.5	0.04	0.01		Portal frame btm. chord, U1'	9.61E+03	0.00E+00	5786	2376	2381
33	356	SX3487	7.06	1.00	272.25	1.606	169.564	1.00	89.00	8.737	10.186	-9954.7	232980.0	10203.5	0.04	0.01		Portal frame btm. chord, U1'	1.02E+04	0.00E+00	5774	2648	2986
33	334	SX3488	7.06	1.00	272.25	1.606	169.564	1.00	183.25	8.737	20.973	-9954.7	-59738.3	-46240.8	0.77	0.82		Portal frame btm. chord, U1'	5.42E+04	-4.62E+04	3959	21080	49210
33	219	SX3489	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-27662.0	0.27	0.19		Portal frame diagonal, U1	1.41E+04	-2.77E+04	-7762	9336	19900
33	205	SX3490	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-22497.5	0.21	0.23		Portal frame diagonal, U1	2.81E+04	-2.25E+04	2790	11080	24590
33	41	SX3491	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-28406.0	0.27	0.26		Portal frame diagonal, U1	2.62E+04	-2.84E+04	-1286	11990	27120
33	133	SX3492	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-27831.9	0.27	0.26		Portal frame diagonal, U1	2.71E+04	-2.78E+04	-441.9	11940	27390
33	106	SX3493	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-23200.8	0.22	0.23		Portal frame diagonal, U1	2.70E+04	-2.32E+04	1879	10740	24610
33	122	SX3494	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-27788.0	0.27	0.20		Portal frame diagonal, U1	1.44E+04	-2.78E+04	-7678	8749	20110
33	414	SX3495	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-30471.0	0.30	0.22		Portal frame diagonal, U1'	1.69E+04	-3.05E+04	-7761	9898	22710
33	408	SX3496	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-25468.3	0.24	0.26		Portal frame diagonal, U1'	3.10E+04	-2.55E+04	2789	11620	27560
33	252	SX3497	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-32014.0	0.31	0.29		Portal frame diagonal, U1'	2.98E+04	-3.20E+04	-1284	12970	30730
33	357	SX3498	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-31150.6	0.30	0.29		Portal frame diagonal, U1'	3.04E+04	-3.12E+04	-440.6	13140	30710
33	333	SX3499	4.56	1.00	113.23	1.430	79.202	1.00	113.23	8.852	12.791	-27033.2	-104780.7	-25710.8	0.25	0.26		Portal frame diagonal, U1'	2.95E+04	-2.57E+04	1879	11630	27120
33	343	SX3500	4.56	1.00	117.40	1.430	82.120	1.00	117.40	8.852	13.263	-26585.5	-103045.3	-30428.0	0.30	0.22		Portal frame diagonal, U1'	1.70E+04	-3.04E+04	-7678	9766	22750
33	148	SM3501	3.53	1.00	201.30	1.000	201.303	1.00	201.30	1.606	125.377	-7063.1	116490.0	57991.3	0.50	0.46	*	Mach. house floor diagonal	3.09E+04	-2.45E+04	3193	26920	20610
33	17	SM3502	3.53	1.00	201.30	1.000	201.303	1.00	201.30	1.606	125.377	-7063.1	-21192.9	-14618.3	0.69	0.71		Mach. house floor diagonal	1.58E+04	-1.46E+04	589	15060	10210
33	172	SM3503	3.53	1.00	201.30	1.000	201.303	1.00	201.30	1.606	125.377	-7063.1	-21192.9	-14408.3	0.68	0.70		Mach. house floor diagonal	1.56E+04	-1.44E+04	589	14850	9987
33	16	SM3504	3.53	1.00	201.30	1.000	201.303	1.00	201.30	1.606	125.377	-7063.1	116490.0	57991.3	0.50	0.46	*	Mach. house floor diagonal	3.11E+04	-2.47E+04	3193	27080	19510
33	48	SM3505	3.53	1.00	201.30	1.000	201.303	1.00	201.30	1.606	125.377	-7063.1	-21192.9	-13336.1	0.63	0.65		Mach. house floor diagonal	1.47E+04	-1.33E+04	698.6	13860	10150
33	15	SM3506	3.53	1.00	201.30	1.000	201.303	1.00	201.30	1.606	125.377	-7063.1	116490.0	55725.0	0.48	0.44	*	Mach. house floor diagonal	2.99E+04	-2.34E+04	3244	25860	19510
33	227	SM3507	3.53	1.00	201.30	1.000	201.303	1.00	201.30	1.606	125.377	-7063.1	116490.0	55725.0	0.48	0.44	*	Mach. house floor diagonal	2.99E+04	-2.34E+04	3244	25810	19650
33	18	SM3508	3.53	1.00	201.30	1.000	201.303	1.00	201.30	1.606	125.377	-7063.1	-21192.9	-13536.1	0.64	0.66		Mach. house floor diagonal	1.49E+04	-1.35E+04	698.6	14060	10370
33	174	SM3509	22.37	1.00	148.30	9.681	15.319	1.00	15.00	1.849	8.111	-32776.8	738210.0	9748.6	0.01	0.01		Mach. house floor stringer, M5-M5'	9.75E+03	-7.83E+03	958.9	8550	6153
33	19	SM3510	22.37	1.00	148.30	9.681	15.319	1.00	15.00	1.849	8.111	-32776.8	738210.0	9728.6	0.01	0.01		Mach. house floor stringer, M5-M5'	3.73E+03	-7.81E+03	958.9	8530	6327
33	230	SM3511	22.37	1.00	148.30	9.681	15.319	1.00	15.00	1.849	8.111	-32776.8	738210.0	9611.3	0.01	0.01		Mach. house floor stringer, M5-M5'	9.61E+03	-7.69E+03	960.2	8411	5531
33	21	SM3512	22.37	1.00	148.30	9.681	15.319	1.00	15.00	1.849	8.111	-32776.8	738210.0	9600.3	0.01	0.01		Mach. house floor stringer, M5-M5'	3.60E+03	-7.68E+03	960.2	8400	5522
33	175	SM3513	30.00	1.00	148.30	8.944	16.580	1.00	15.00	1.265	11.859	-32738.5	-834831.9	-1705.8	0.00	0.00		Mach. house floor stringer, M5-M5'	5.14E+02	-1.71E+03	-680.8	1025	848.2
33	20	SM3514	30.00	1.00	148.30	8.944	16.580	1.00	15.00	1.265	11.859	-32738.5	-834831.9	-1720.8	0.00	0.00		Mach. house floor stringer, M5-M5'	5.29E+02	-1.72E+03	-680.8	1040	973.6
33	149	SM3515	15.59	1.00	136.13	5.897	23.085	1.00	15.00	1.920	7.811	-32493.1	514470.0	11929.5	0.02	0.02		Mach. house flr. stringer, MMW-E	1.19E+04	-6.09E+03	2918	3599	8282
33	173	SM3516	15.59	1.00	136.13	5.897	23.085	1.00	15.00	1.920	7.811	-32493.1	514470.0	13760.8	0.03	0.01		Mach. house flr. stringer, MMW-E	1.38E+04	-5.15E+02	6623	4971	5482
33	49	SM3517	15.59	1.00	136.13	5.897	23.085	1.00	15.00	1.920	7.811	-32493.1	514470.0	14040.3	0.03	0.01		Mach. house flr. stringer, MMW-E	1.40E+04	-7.90E+02	6625	4936	5759
33	228	SM3518	15.59	1.00	136.13	5.897	23.085	1.00	15.00	1.920	7.811	-32493.1	514470.0	11763.0	0.02	0.02		Mach. house flr. stringer, MMW-E	1.18E+04	-5.76E+02	3004	3761	8008

FILENAME: 28MCOL.XLS

12/23/94

I5 - COLUMBIA RIVER SEISMIC SURVEY for ODOT

DEMAND/CAPACITY DATA INCLUDING BENDING EFFECTS

UNITS INCH,LB. (Fy in ksi)

SPAN 2

Fy	ALGOR Memb. #	MEM(S)	A	(KL/r)2	Z2	C2	(KL/r)3	Z3	C3	Fcr	D/C	DESCRIPTION
50	23	SW2001	52.50	60.109	360.3	1.0	74.138	311.0	1.0	-37997.6	0.85	West truss top chord, L0-U1
50	341	SW2002	52.50	9.906	360.3	1.0	74.138	311.0	1.0	-37997.6	0.72	West truss top chord, L0-U1
50	231	SW2012	52.50	70.016	360.3	1.0	74.138	311.0	1.0	-37997.6	0.78	West truss top chord, L0'-U1'
50	355	SW2013	52.50	70.016	360.3	1.0	74.138	311.0	1.0	-37997.6	0.98	West truss top chord, L0'-U1'
50	11	SW2025	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.43	West truss vertical, U1-L1
33	161	SW2026	24.80	47.066	180.1	1.0	74.121	144.0	1.0	-27774.2	1.25	West truss vertical, U2-L2
33	10	SW2027	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	1.04	West truss vertical, U2-L2
33	168	SW2028	24.80	47.062	180.1	1.0	80.936	144.0	1.0	-26769.0	1.12	West truss vertical, U3-L3
33	9	SW2029	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	0.87	West truss vertical, U3-L3
33	175	SW2030	24.80	47.059	180.1	1.0	85.473	144.0	1.0	-26050.9	0.87	West truss vertical, U4-L4
33	8	SW2031	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.62	West truss vertical, U4-L4
33	182	SW2032	24.80	47.062	180.1	1.0	87.756	144.0	1.0	-25674.7	0.90	West truss vertical, U5-L5
33	7	SW2033	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.69	West truss vertical, U5-L5
33	193	SW2034	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.91	West truss vertical, U5'-L5'
33	6	SW2035	24.80	47.059	180.1	1.0	87.756	144.0	1.0	-25674.7	0.70	West truss vertical, U5'-L5'
33	208	SW2036	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.87	West truss vertical, U4'-L4'
33	5	SW2037	24.80	47.062	180.1	1.0	85.473	144.0	1.0	-26050.9	0.61	West truss vertical, U4'-L4'
33	209	SW2038	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	1.31	West truss vertical, U3'-L3'
33	4	SW2039	24.80	47.066	180.1	1.0	80.936	144.0	1.0	-26769.0	1.08	West truss vertical, U3'-L3'
33	212	SW2040	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	1.01	West truss vertical, U2'-L2'
33	3	SW2041	24.80	54.712	180.1	1.0	74.121	144.0	1.0	-27774.2	0.90	West truss vertical, U2'-L2'
50	2	SW2042	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.59	West truss vertical, U1'-L1'
50	42	SW2075	18.41	56.93	118.8	1.0	94.06	65.3	1.0	-30679.0	0.59	West truss tower, U2'-R1
50	44	SW2076	15.47	59.61	99.4	1.0	94.02	58.0	1.0	-30695.6	0.74	West truss tower, R1-R2
33	46	SW2077	15.47	56.83	99.4	1.0	89.63	58.0	1.0	-25359.1	0.82	West truss tower, R2-R3
33	48	SW2078	15.47	43.85	99.4	1.0	69.16	58.0	1.0	-28449.7	0.66	West truss tower, R3-R4
33	50	SW2079	15.47	34.19	99.4	1.0	99.53	58.0	1.0	-23577.9	0.72	West truss tower, R4-R5
33	125	SW2080	15.47	28.92	99.4	1.0	99.53	58.0	1.0	-23577.9	0.41	West truss tower, R5-R6
50	38	SW2081	85.86	47.78	596.1	1.0	49.30	581.9	1.0	-44692.9	1.20	West truss tower, L0'-U0'
50	1	SW2082	85.86	16.87	596.1	1.0	49.30	581.9	1.0	-44692.9	0.84	West truss tower, L0'-U0'
50	32	SW2083	71.99	16.92	492.9	1.0	42.39	514.2	1.0	-46075.3	0.84	West truss tower, U0'-F1
50	106	SW2084	71.99	56.23	492.9	1.0	42.39	514.2	1.0	-43094.5	0.76	West truss tower, U0'-F1
50	33	SW2085	71.99	56.23	492.9	1.0	41.71	514.2	1.0	-43094.5	0.75	West truss tower, F1-F2
50	111	SW2086	71.99	56.23	492.9	1.0	41.71	514.2	1.0	-43094.5	0.77	West truss tower, F1-F2
50	34	SW2087	71.99	56.23	492.9	1.0	40.34	514.2	1.0	-43094.5	0.77	West truss tower, F2-F3
50	116	SW2088	71.99	56.23	492.9	1.0	40.34	514.2	1.0	-43094.5	0.80	West truss tower, F2-F3
50	35	SW2089	71.99	56.23	492.9	1.0	31.45	514.2	1.0	-43094.5	0.91	West truss tower, F3-F4
50	118	SW2090	71.99	56.23	492.9	1.0	31.45	514.2	1.0	-43094.5	1.19	West truss tower, F3-F4
50	36	SW2091	71.99	56.23	492.9	1.0	24.62	514.2	1.0	-43094.5	1.15	West truss tower, F4-F5
50	37	SW2092	71.99	56.23	492.9	1.0	20.82	514.2	1.0	-43094.5	1.02	West truss tower, F5-F6
50	120	SW2093	71.99	17.94	492.9	1.0	20.82	514.2	1.0	-49053.4	0.17	West truss tower, F5-F6

ALGOR Memb. #	DL+EQ(X+0.3Y+0.67Z) Eq. (10-156)	Eq. (10-155)	DL+EQ(Y+0.3X+0.67Z) Eq. (10-156)	Eq. (10-155)	Pa (D.L. Compr. Neg.) D.L.	EQX	EQY	D.L. M2i	M3i	M2j	M3j
23	0.534	0.701	0.647	0.853	-689900	210600	271900	-80580	234100	-41510	92570
341	0.486	0.618	0.574	0.717	-680300	206200	267900	-66630	-94330	45210	365800
231	0.544	0.736	0.573	0.777	-730800	321100	259500	-66340	-67370	73840	-128400
355	0.661	0.922	0.703	0.976	-740500	323100	258900	-85060	50300	-44600	69620
11	0.325	0.000	0.430	0.000	91050	37040	40030	-26770	64420	-18050	57030
161	0.776	0.923	1.055	1.246	-227700	89070	112000	-51520	416200	-39000	256200
10	0.684	0.795	0.915	1.039	-225400	88830	111500	28740	-254700	19880	460200
168	0.641	0.762	0.966	1.118	-135700	79530	88560	7930	442200	71850	146500
9	0.522	0.609	0.771	0.867	-133300	79580	88480	-76940	-147900	-52930	380500
175	0.419	0.457	0.824	0.874	-22680	44080	48670	4947	274500	2148	70330
8	0.297	0.326	0.586	0.619	-20280	44880	49900	-3475	-69980	2651	237100
182	0.432	0.339	0.904	0.827	38430	34160	56220	45150	101800	58080	20600
7	0.351	0.250	0.694	0.606	40800	35670	58040	-53620	-22180	-23240	79460
193	0.434	0.000	0.914	0.824	40790	28140	50950	49240	-82110	61130	-20680
6	0.350	0.000	0.702	0.606	43150	29240	52310	-56390	22220	-25520	-69320
208	0.441	0.482	0.829	0.868	-17140	58560	50640	13640	-262600	8476	-65780
5	0.302	0.337	0.571	0.608	-14740	58570	50660	-9196	65470	1520	-224000
209	0.776	0.943	1.117	1.311	-161800	131000	151400	15820	-497600	77080	-179100
4	0.640	0.805	0.900	1.076	-159500	130800	151000	-82960	180000	-37490	-453100
212	0.735	0.863	0.895	1.010	-171100	142400	100600	-45450	-408600	-28000	-268300
3	0.655	0.784	0.766	0.899	-168900	142200	100300	21790	266700	20320	-464800
2	0.389	0.355	0.496	0.588	89260	99580	126200	-20330	-59830	-9632	-49720
42	0.408	0.586	0.271	0.348	21320	263400	157400	7754	18310	-1391	31900
44	0.451	0.742	0.285	0.457	-15350	271100	156900	-7215	-10870	2734	3434
46	0.624	0.821	0.440	0.571	-13460	242600	154000	-4032	-14250	-19770	15270
48	0.570	0.664	0.504	0.583	-11430	194900	157000	24350	-17630	102000	22770
50	0.464	0.629	0.530	0.718	-7650	144400	160400	-83900	-15560	-137600	38970
125	0.241	0.292	0.346	0.413	-9272	40170	54310	154500	-37360	-140400	9580
38	0.786	0.905	1.025	1.197	-1354000	394900	533400	-11760	-472300	84500	6142
1	0.587	0.649	0.774	0.843	-1345000	394700	532700	-88320	-5527	12640	-91690
32	0.665	0.725	0.771	0.836	-1343000	394500	533100	-13860	85000	-33360	-81300
106	0.605	0.704	0.650	0.760	-1319000	389000	524500	47250	82360	19870	-46410
33	0.574	0.668	0.642	0.748	-1340000	339900	514000	-12030	59750	42590	15560
111	0.590	0.688	0.653	0.766	-1336000	336500	491400	-56730	-13680	-94180	332800
34	0.580	0.675	0.654	0.766	-1324000	289900	471100	105700	-316700	-137600	342200
116	0.601	0.703	0.678	0.800	-1316000	284900	446600	130000	-339100	305100	426300
35	0.642	0.750	0.771	0.914	-1307000	250200	441100	-278700	-415600	627300	458800
118	0.740	0.871	0.982	1.191	-1317000	241700	382100	-649500	-461800	-134800	503000
36	0.732	0.858	0.961	1.151	-1308000	126300	229300	81700	-491300	-1516000	860700
37	0.707	0.818	0.865	1.019	-1281000	41650	105400	1442000	-852500	-1904000	1730000
120	0.160	0.162	0.170	0.172	-282500	9193	14810	266900	183400	631900	492100

ALGOR Memb. #	EQX = EQ(X+0.3Y+0.67Z) M2i	M3i	M2j	M3j	EQY = EQ(Y+0.3X+0.67Z) M2i	M3i	M2j	M3j
23	1916000	64770	1625000	114000	3455000	72560	2953000	126100
341	1285000	118000	543000	185900	2351000	136900	1030000	243600
231	863500	241700	408700	588400	1890000	255200	847100	540000
355	1246000	1673000	1074000	273300	2761000	1455000	2376000	311700
11	701900	20990	597800	20510	1328000	25030	1129000	24470
161	1117000	170800	927100	105400	2513000	224500	2102000	133500
10	901400	104700	310500	219200	2045000	133000	719900	287200
168	1121000	231500	885600	133700	2911000	283000	2305000	160400
9	854800	131600	278200	239800	2226000	157400	732700	281700
175	1314000	206100	984500	143000	3653000	228700	2739000	137400
8	942400	141100	256800	261500	2622000	135900	695200	262700
182	1415000	289600	1036000	288800	3997000	315700	2928000	322300
7	989200	287500	313100	349900	2795000	321400	867000	360700
193	1403000	348400	1028000	317100	3973000	418200	2910000	396200
6	980800	315200	303000	337800	2778000	394400	853000	378400
208	1284000	280100	963700	123800	3604000	322900	2705000	122100
5	922800	122300	237500	269700	2590000	121100	660500	287400
209	1040000	345600	823700	165700	2789000	429000	2217000	198700
4	794900	163700	253300	371500	2141000	196000	684600	446500
212	877000	206000	738400	127700	2093000	276400	1761000	147600
3	718700	126500	268000	200800	1715000	146800	660000	276800
2	492100	64410	433000	62270	1099000	32980	938000	32890
42	53070	93330	37850	47920	79790	73990	74170	53780
44	22760	16890	15100	30900	51110	21050	23090	23180
46	28630	26460	33250	19270	47380	37070	71740	33870
48	37540	46990	51170	67740	56920	65780	81940	90890
50	60810	58520	97620	42020	123300	92250	168300	54720
125	153400	26270	127500	38160	368700	39420	232800	43960
38	3703000	4826000	2753000	889300	1.00E+07	4499000	7432000	1043000
1	2721000	470800	962500	1391000	7345000	290000	2571000	1204000
32	984900	1372000	158400	1335000	2642000	1192000	391100	976400
106	156700	911200	225300	379300	386000	693700	444500	460800
33	226300	341600	109900	453000	385900	387300	284200	557200
111	108000	346400	249300	428900	282300	459800	707300	268700
34	207300	443100	339400	498100	559400	273800	666700	545400
116	344900	403700	660800	557400	683100	480400	1342000	461400
35	721700	582500	992300	1277000	1469000	478500	2325000	1596000
118	1027000	435700	3129000	2013000	2400000	649200	7494000	2515000
36	3081000	1947000	2527000	1685000	7728000	2641000	6738000	2327000
37	2208000	1921000	1715000	1561000	5551000	2449000	2961000	1816000
120	26500	551600	52470	443700	41430	747100	81930	628300

FILENAME: 2BMCOL.XLS
12/23/94
I5 - COLUMBIA RIVER SEISMIC SURVEY for ODOT

DEMAND/CAPACITY DATA INCLUDING BENDING EFFECTS
UNITS INCH,LB. (Fy in ksi)
SPAN 2

Fy	ALGOR Memb. #	MEM(S)	A	(KL/r)2	Z2	C2	(KL/r)3	Z3	C3	Fcr	D/C	DESCRIPTION
50	57	SE2001	48.90	60.259	334.6	1.0	73.127	294.8	1.0	-38322.8	0.81	East truss top chord, L0-U1
50	340	SE2002	48.90	9.931	334.6	1.0	73.127	294.8	1.0	-38322.8	0.69	East truss top chord, L0-U1
50	244	SE2012	48.90	9.931	334.6	1.0	73.127	294.8	1.0	-38322.8	0.67	East truss top chord, L0'-U1'
50	356	SE2013	48.90	60.259	334.6	1.0	73.127	294.8	1.0	-38322.8	0.90	East truss top chord, L0'-U1'
50	59	SE2025	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.42	East truss vertical, U1-L1
33	160	SE2026	24.80	47.066	180.1	1.0	74.121	144.0	1.0	-27774.2	1.14	East truss vertical, U2-L2
33	60	SE2027	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	0.96	East truss vertical, U2-L2
33	167	SE2028	24.80	47.062	180.1	1.0	80.936	144.0	1.0	-26769.0	1.03	East truss vertical, U3-L3
33	63	SE2029	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	0.81	East truss vertical, U3-L3
33	174	SE2030	24.80	47.059	180.1	1.0	85.473	144.0	1.0	-26050.9	0.85	East truss vertical, U4-L4
33	64	SE2031	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.60	East truss vertical, U4-L4
33	181	SE2032	24.80	47.062	180.1	1.0	87.756	144.0	1.0	-25674.7	0.88	East truss vertical, U5-L5
33	65	SE2033	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.67	East truss vertical, U5-L5
33	192	SE2034	24.80	47.062	180.1	1.0	87.756	144.0	1.0	-25674.7	0.88	East truss vertical, U5'-L5'
33	66	SE2035	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.67	East truss vertical, U5'-L5'
33	207	SE2036	24.80	47.059	180.1	1.0	85.473	144.0	1.0	-26050.9	0.87	East truss vertical, U4'-L4'
33	81	SE2037	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.60	East truss vertical, U4'-L4'
33	210	SE2038	24.80	47.062	180.1	1.0	80.936	144.0	1.0	-26769.0	1.27	East truss vertical, U3'-L3'
33	82	SE2039	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	0.99	East truss vertical, U3'-L3'
33	211	SE2040	24.80	47.066	180.1	1.0	74.121	144.0	1.0	-27774.2	0.90	East truss vertical, U2'-L2'
33	80	SE2041	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	0.75	East truss vertical, U2'-L2'
50	91	SE2042	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.35	East truss vertical, U1'-L1'
50	87	SE2075	18.41	56.93	118.8	1.0	94.06	65.3	1.0	-30679.0	0.52	East truss tower, U2'-R1
50	88	SE2076	15.47	59.61	99.4	1.0	94.02	58.0	1.0	-30695.6	0.66	East truss tower, R1-R2
33	73	SE2077	15.47	56.83	99.4	1.0	89.63	58.0	1.0	-25359.1	0.74	East truss tower, R2-R3
33	97	SE2078	15.47	43.85	99.4	1.0	69.16	58.0	1.0	-28449.7	0.60	East truss tower, R3-R4
33	95	SE2079	15.47	34.19	99.4	1.0	99.53	58.0	1.0	-23577.9	0.68	East truss tower, R4-R5
33	126	SE2080	15.47	28.92	99.4	1.0	99.53	58.0	1.0	-23577.9	0.35	East truss tower, R5-R6
50	52	SE2081	85.86	47.78	596.1	1.0	49.30	581.9	1.0	-44692.9	1.17	East truss tower, L0'-U0'
50	90	SE2082	85.86	16.87	596.1	1.0	49.30	581.9	1.0	-44692.9	0.80	East truss tower, L0'-U0'
50	93	SE2083	71.99	16.92	492.9	1.0	42.39	514.2	1.0	-46075.3	0.79	East truss tower, U0'-F1
50	107	SE2084	71.99	56.23	492.9	1.0	42.39	514.2	1.0	-43094.5	0.70	East truss tower, U0'-F1
50	94	SE2085	71.99	56.23	492.9	1.0	41.71	514.2	1.0	-43094.5	0.69	East truss tower, F1-F2
50	112	SE2086	71.99	56.23	492.9	1.0	41.71	514.2	1.0	-43094.5	0.71	East truss tower, F1-F2
50	74	SE2087	71.99	56.23	492.9	1.0	40.34	514.2	1.0	-43094.5	0.71	East truss tower, F2-F3
50	117	SE2088	71.99	56.23	492.9	1.0	40.34	514.2	1.0	-43094.5	0.76	East truss tower, F2-F3
50	98	SE2089	71.99	56.23	492.9	1.0	31.45	514.2	1.0	-43094.5	0.89	East truss tower, F3-F4
50	119	SE2090	71.99	56.23	492.9	1.0	31.45	514.2	1.0	-43094.5	1.20	East truss tower, F3-F4
50	96	SE2091	71.99	56.23	492.9	1.0	24.62	514.2	1.0	-43094.5	1.12	East truss tower, F4-F5
50	102	SE2092	71.99	56.23	492.9	1.0	20.82	514.2	1.0	-43094.5	0.93	East truss tower, F5-F6
50	121	SE2093	71.99	17.94	492.9	1.0	20.82	514.2	1.0	-49053.4	0.15	East truss tower, F5-F6

MEM(S)	DL+EQ(X+0.3Y+0.67Z) Eq. (10-156)	Eq. (10-155)	DL+EQ(Y+0.3X+0.67Z) Eq. (10-156)	Eq. (10-155)	Pa (D.L. Compr. Neg.) D.L.	EQX	EQY	D.L. M2i	M3i	M2j	M3j
SE2001	0.485	0.628	0.624	0.813	-572800	170400	276600	-40060	202200	-40360	73860
SE2002	0.445	0.557	0.558	0.688	-564400	168000	273600	123900	-75620	-3452	325600
SE2012	0.508	0.666	0.538	0.671	-606600	290000	237400	124600	-62830	-17630	-121800
SE2013	0.619	0.833	0.680	0.904	-615100	292900	236900	-39010	45680	-38340	65010
SE2025	0.297	0.000	0.417	0.000	74400	39040	51490	12110	55830	4896	49040
SE2026	0.675	0.791	0.977	1.140	-190200	77220	112800	-681.7	335300	10280	212400
SE2027	0.598	0.688	0.850	0.957	-188000	76990	112100	-2298	-211300	473.2	375500
SE2028	0.578	0.675	0.905	1.030	-115200	68690	78270	-53130	357600	-98740	117600
SE2029	0.475	0.548	0.725	0.805	-112800	68780	77910	101700	-119300	60100	300500
SE2030	0.400	0.432	0.803	0.845	-22650	35020	39710	57890	220900	45780	58050
SE2031	0.283	0.308	0.570	0.598	-20230	35390	40810	-42380	-57900	-15130	189200
SE2032	0.398	0.328	0.879	0.830	28230	23130	51290	61600	86840	17440	17920
SE2033	0.318	0.242	0.674	0.614	30640	24220	53190	-17800	-19560	-688.9	66430
SE2034	0.396	0.000	0.880	0.823	30170	22290	49480	64060	-70660	19100	-18580
SE2035	0.313	0.000	0.669	0.602	32580	23270	51260	-19500	20180	78.23	-59310
SE2036	0.418	0.457	0.820	0.865	-18320	51210	47060	67010	-210900	52480	-54940
SE2037	0.297	0.326	0.571	0.600	-15900	51250	46670	-49040	54830	-17380	-179500
SE2038	0.670	0.806	1.061	1.266	-137700	104100	149500	-41060	-404800	-86480	-146600
SE2039	0.554	0.656	0.857	0.985	-135400	103800	148500	90600	148000	37580	-364100
SE2040	0.628	0.738	0.787	0.896	-142100	122100	76460	-12840	-324600	-9139	-219100
SE2041	0.566	0.655	0.674	0.749	-139800	122000	76260	13160	217900	-2148	-373200
SE2042	0.267	0.000	0.354	0.000	72840	25540	27440	9024	-52130	-3849	-42750
SE2075	0.367	0.520	0.268	0.347	19950	236900	156800	-6126	17510	-3064	28300
SE2076	0.405	0.663	0.277	0.444	-10240	245200	157500	2068	-9451	-5569	3391
SE2077	0.565	0.742	0.436	0.564	-8237	221000	155100	3758	-12780	19630	13900
SE2078	0.517	0.600	0.493	0.569	-6596	178000	152600	-20850	-15450	-94820	20590
SE2079	0.413	0.549	0.519	0.684	-4299	124600	144600	83840	-13790	135500	34440
SE2080	0.214	0.260	0.289	0.347	-5998	39580	49670	-147400	-33190	139300	8197
SE2081	0.736	0.841	1.005	1.166	-1204000	368100	532500	-1144	-416300	-59480	14790
SE2082	0.537	0.593	0.732	0.796	-1195000	368500	530700	63510	-16690	9252	-71050
SE2083	0.610	0.663	0.726	0.786	-1193000	368200	531300	-11310	64810	70350	-61670
SE2084	0.547	0.636	0.600	0.701	-1168000	361900	521000	-82330	59140	11200	-46230
SE2085	0.519	0.602	0.591	0.689	-1185000	323300	505200	-4935	57920	-13670	17650
SE2086	0.536	0.624	0.609	0.714	-1180000	317800	479600	27890	-16410	118800	294700
SE2087	0.531	0.618	0.610	0.715	-1170000	274800	450900	-108700	-280400	165800	315800
SE2088	0.546	0.637	0.640	0.756	-1160000	265400	418300	-157500	-312400	-265000	375100
SE2089	0.590	0.688	0.748	0.888	-1151000	227900	399200	254400	-365800	-541700	418100
SE2090	0.687	0.808	0.992	1.198	-1160000	209800	324600	563100	-419000	130700	444400
SE2091	0.654	0.762	0.943	1.124	-1151000	113400	199500	-78620	-434400	1408000	760100
SE2092	0.651	0.749	0.799	0.932	-1126000	42110	99480	-1341000	-753000	1769000	1517000
SE2093	0.140	0.142	0.151	0.153	-248800	10880	20740	-243900	153300	-565600	427600

MEM(S)	EQX = EQ(X+0.3Y+0.67Z) M2i	M3i	M2j	M3j	EQY = EQ(Y+0.3X+0.67Z) M2i	M3i	M2j	M3j
SE2001	1804000	56800	1544000	109500	3251000	74320	2802000	136500
SE2002	1214000	106900	540700	169200	2212000	143600	1025000	257000
SE2012	803000	230800	410900	630700	1784000	201800	849400	616000
SE2013	1172000	1578000	1014000	268000	2610000	1608000	2264000	269900
SE2025	702100	17420	600000	17170	1329000	25620	1132000	25160
SE2026	1118000	148700	928500	96330	2513000	227900	2103000	139600
SE2027	903100	95480	312000	193200	2047000	139100	726300	288200
SE2028	1122000	193400	887900	132000	2914000	248500	2313000	156000
SE2029	857200	129800	279200	229200	2234000	153100	735500	289700
SE2030	1316000	187100	986300	120600	3654000	200700	2739000	104400
SE2031	944300	119000	260600	205000	2623000	103200	695800	194300
SE2032	1415000	274400	1037000	314500	3998000	302500	2931000	361600
SE2033	989700	312800	311500	372600	2798000	360100	867400	406500
SE2034	1403000	277700	1028000	285600	3973000	337000	2913000	348600
SE2035	981400	284300	304700	320400	2781000	347800	859000	367300
SE2036	1284000	221500	963800	121400	3604000	301300	2705000	123600
SE2037	922800	120000	235000	238900	2590000	122500	656100	304800
SE2038	1040000	262300	824200	142400	2791000	410200	2221000	201200
SE2039	795700	140400	253500	313000	2146000	198600	685000	463100
SE2040	874500	145900	734400	101100	2093000	235800	1761000	128300
SE2041	714300	100200	274900	170300	1715000	127900	665200	274900
SE2042	488000	55580	423500	53180	1098000	36630	936300	35260
SE2075	51160	78800	40620	39070	79520	71470	72590	52100
SE2076	23780	18370	17350	31610	53050	21430	24430	23630
SE2077	28150	20280	38630	23230	49570	37240	94280	33440
SE2078	37250	37430	67520	59910	48180	66300	138400	84980
SE2079	46610	42990	130800	32720	80780	83400	291300	52080
SE2080	116300	21310	108300	34520	258100	37590	161200	39780
SE2081	3709000	4833000	2759000	987600	1.00E+07	5177000	7446000	1038000
SE2082	2727000	428500	967100	1470000	7359000	283200	2586000	1349000
SE2083	989300	1448000	160000	1396000	2656000	1331000	385300	1060000
SE2084	158700	897300	217900	322800	380000	702700	402000	424200
SE2085	221600	295100	134800	490400	352800	363000	364800	587400
SE2086	133900	381900	328300	422000	366600	500900	940500	310100
SE2087	285900	434300	424400	580000	800400	316400	954600	565700
SE2088	434900	355900	860800	497900	986500	503000	1998000	442600
SE2089	915200	519500	1413000	1129000	2114000	458200	3620000	1442000
SE2090	1460000	365900	3890000	1514000	3735000	671500	9957000	2066000
SE2091	3858000	1438000	2608000	1234000	9968000	1981000	6822000	1854000
SE2092	2179000	1452000	2085000	1372000	5727000	2107000	4126000	1658000
SE2093	29420	440600	61130	335000	58890	615500	122400	466400

FILENAME: 3BMCOL XLS
12/21/94
I5 - COLUMBIA RIVER SEISMIC SURVEY for ODOT

DEMAND/CAPACITY DATA INCLUDING BENDING EFFECTS
UNITS INCH,LB (Fy in ksi)

\# - Member axial compression exceeds the Euler buckling load
(Eq 10-155 cannot be correctly evaluated, and D/C is incorrect!)

SPAN 3

Fy	ALGOR Memb #	MEM(S)	A	(KL/r)2	Z2	C2	(KL/r)3	Z3	C3	Fcr	D/C	DESCRIPTION	DL+EQ(X+0 3Y+0 67Z) Eq (10-156)	DL+EQ(X+0 3Y+0 67Z) Eq (10-155)	DL+EQ(Y+0 3X+0 67Z) Eq (10-156)	DL+EQ(Y+0 3X+0 67Z) Eq (10-155)
50	72	SW3001	52.67	60.142	361.7	1.0	71.330	312.6	1.0	-38889.7	0.99	West truss top chord, L0-U1	0.655	0.868	0.741	0.987
50	123	SW3002	52.67	9.911	361.7	1.0	71.330	312.6	1.0	-38889.7	0.78	West truss top chord, L0-U1	0.538	0.692	0.615	0.781
50	344	SW3012	52.67	9.911	361.7	1.0	71.330	312.6	1.0	-38889.7	0.74	West truss top chord, L0'-U1'	0.487	0.619	0.596	0.742
50	276	SW3013	52.67	60.142	361.7	1.0	71.330	312.6	1.0	-38889.7	0.85	West truss top chord, L0'-U1'	0.501	0.645	0.651	0.845
50	80	SW3025	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.56	West truss vertical, U1-L1	0.387	0.398	0.497	0.559
33	70	SW3026	24.80	47.066	180.1	1.0	74.121	144.0	1.0	-27774.2	1.41	West truss vertical, U2-L2	0.799	0.960	1.171	1.408
33	111	SW3027	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	1.19	West truss vertical, U2-L2	0.722	0.846	1.037	1.190
33	69	SW3028	24.80	47.062	180.1	1.0	80.936	144.0	1.0	-26769.0	1.36	West truss vertical, U3-L3	0.709	0.852	1.156	1.361
33	159	SW3029	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	1.07	West truss vertical, U3-L3	0.598	0.703	0.944	1.070
33	67	SW3030	24.80	47.059	180.1	1.0	85.473	144.0	1.0	-26050.9	1.12	West truss vertical, U4-L4	0.509	0.562	1.053	1.124
33	157	SW3031	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.86	West truss vertical, U4-L4	0.395	0.438	0.809	0.858
33	68	SW3032	24.80	47.062	180.1	1.0	87.756	144.0	1.0	-25674.7	1.11	West truss vertical, U5-L5	0.445	0.427	1.112	1.100
33	158	SW3033	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.90	West truss vertical, U5-L5	0.400	0.000	0.905	0.771
33	279	SW3034	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	1.12	West truss vertical, U5'-L5'	0.445	0.424	1.116	1.101
[illegible]	317	SW3035	24.80	47.059	180.1	1.0	87.756	144.0	1.0	-25674.7	0.89	West truss vertical, U5'-L5'	0.402	0.000	0.892	0.756
[illegible]	[illegible]	SW3036	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	1.08	West truss vertical, U4'-L4'	0.510	0.557	1.032	1.081
[illegible]	[illegible]	SW3037	24.80	47.062	180.1	1.0	85.473	144.0	1.0	-26050.9	0.82	West truss vertical, U4'-L4'	0.386	0.431	0.769	0.822
33	278	SW3038	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	1.30	West truss vertical, U3'-L3'	0.731	0.862	1.156	1.305
33	316	SW3039	24.80	47.066	180.1	1.0	80.936	144.0	1.0	-26769.0	1.11	West truss vertical, U3'-L3'	0.627	0.751	0.956	1.114
33	277	SW3040	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	1.35	West truss vertical, U2'-L2'	0.802	0.936	1.188	1.355
33	339	SW3041	24.80	54.712	180.1	1.0	74.121	144.0	1.0	-27774.2	1.27	West truss vertical, U2'-L2'	0.725	0.871	1.049	1.269
50	286	SW3042	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.48	West truss vertical, U1'-L1'	0.342	0.213	0.484	0.388
50	182	SE3001	49.07	60.120	335.9	1.0	70.209	296.4	1.0	-39236.2	1.05	East truss top chord, L0-U1	0.610	0.791	0.791	1.046
50	220	SE3002	49.07	9.908	335.9	1.0	70.209	296.4	1.0	-39236.2	0.78	East truss top chord, L0-U1	0.505	0.638	0.623	0.785
50	415	SE3012	49.07	9.908	335.9	1.0	70.209	296.4	1.0	-39236.2	0.71	East truss top chord, L0'-U1'	0.467	0.585	0.577	0.714
50	371	SE3013	49.07	60.120	335.9	1.0	70.209	296.4	1.0	-39236.2	0.81	East truss top chord, L0'-U1'	0.480	0.612	0.634	0.813
33	191	SE3025	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.63	East truss vertical, U1-L1	0.455	0.000	0.628	0.000
33	181	SE3026	24.80	47.066	180.1	1.0	74.121	144.0	1.0	-27774.2	1.30	East truss vertical, U2-L2	0.728	0.862	1.101	1.304
33	208	SE3027	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	1.09	East truss vertical, U2-L2	0.651	0.755	0.964	1.094
33	180	SE3028	24.80	47.062	180.1	1.0	80.936	144.0	1.0	-26769.0	1.29	East truss vertical, U3-L3	0.668	0.791	1.112	1.289
33	234	SE3029	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	1.01	East truss vertical, U3-L3	0.555	0.646	0.896	1.005
33	179	SE3030	24.80	47.059	180.1	1.0	85.473	144.0	1.0	-26050.9	1.07	East truss vertical, U4-L4	0.478	0.523	1.014	1.069
33	233	SE3031	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.82	East truss vertical, U4-L4	0.378	0.414	0.781	0.820
33	178	SE3032	24.80	47.062	180.1	1.0	87.756	144.0	1.0	-25674.7	1.09	East truss vertical, U5-L5	0.414	0.416	1.078	1.088
33	232	SE3033	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.89	East truss vertical, U5-L5	0.391	0.270	0.890	0.777
33	375	SE3034	24.80	47.062	180.1	1.0	87.756	144.0	1.0	-25674.7	1.09	East truss vertical, U5'-L5'	0.412	0.413	1.077	1.088
33	399	SE3035	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.88	East truss vertical, U5'-L5'	0.379	0.000	0.875	0.758
33	374	SE3036	24.80	47.059	180.1	1.0	85.473	144.0	1.0	-26050.9	1.06	East truss vertical, U4'-L4'	0.473	0.517	1.003	1.058
33	398	SE3037	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.79	East truss vertical, U4'-L4'	0.368	0.403	0.756	0.792
33	373	SE3038	24.80	47.062	180.1	1.0	80.936	144.0	1.0	-26769.0	1.29	East truss vertical, U3'-L3'	0.675	0.796	1.118	1.288
33	397	SE3039	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	1.03	East truss vertical, U3'-L3'	0.578	0.671	0.920	1.030
33	372	SE3040	24.80	47.066	180.1	1.0	74.121	144.0	1.0	-27774.2	1.35	East truss vertical, U2'-L2'	0.761	0.901	1.144	1.350
33	410	SE3041	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	1.13	East truss vertical, U2'-L2'	0.678	0.784	0.997	1.127
33	381	SE3042	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.71	East truss vertical, U1'-L1'	0.487	0.343	0.706	0.595

MEM(S)	Pa (D L Compr Neg) D L	EQX	EQY	D L M2i	M3i	M2j	M3j	EQX = EQ(X+0 3Y+0 67Z) M2i	M3i	M2j	M3j	EQY = EQ(Y+0 3X+0 67Z) M2i	M3i	M2j	M3j
SW3001	-672700	232200	330100	-142000	67320	-40640	185900	1268000	2637000	1069000	481800	2841000	1939000	2385000	439900
SW3002	-663100	229800	325300	-56720	-184800	127300	421600	867600	479400	688100	1045000	1925000	438400	1589000	800800
SW3012	-663100	227600	322700	-56730	183800	127200	-422500	1032000	168800	735500	229900	2299000	219100	1745000	322800
SW3013	-672700	230100	329500	-142000	-66540	-40650	-185000	1507000	43210	1277000	169400	3396000	59050	2852000	219500
SW3025	80310	98180	108600	45440	67070	80830	64860	529700	58510	468500	50910	1201000	44770	1067000	41710
SW3026	-241400	110200	164200	-10540	352300	-5291	230100	1051000	195400	879900	129600	2680000	288700	2257000	185400
SW3027	-239100	110200	163900	-4523	-228800	14720	397200	856300	128300	350200	195200	2196000	184200	918800	306800
SW3028	-151600	97660	128100	6286	410200	61700	147000	1253000	248500	1001000	178500	3544000	331400	2841000	202000
SW3029	-149100	98180	127700	-68110	-148000	-52140	352400	965700	175600	358400	240100	2744000	198700	1026000	343000
SW3030	-34610	53640	55450	-56060	265700	-44150	77760	1499000	305200	1148000	307200	4597000	400500	3525000	443200
SW3031	-32060	54190	55770	39720	-77470	6261	227100	1099000	302000	305000	416500	3376000	434900	930700	612800
SW3032	12460	31170	33260	-51950	138400	-37090	95170	1816000	184900	1406000	148700	5699000	234100	4410000	172300
SW3033	56340	34840	57830	19620	7785	-64050	74190	1348000	177400	431800	256700	4221000	119500	1330000	196200
SW3034	12460	29250	37380	-51950	-138400	-37090	-95170	1824000	191300	1411000	146700	5710000	216200	4417000	151200
SW3035	56340	36100	49950	19620	-7784	-64050	-74180	1349000	174300	429800	263300	4221000	115800	1324000	197200
SW3036	-34610	54140	48970	-56060	-265700	-44150	-77760	1547000	269700	1186000	225800	4656000	298600	3572000	253800
SW3037	-32060	54860	49900	39720	77470	6262	-227100	1135000	223200	317000	328300	3421000	250700	942900	365400
SW3038	-151600	97200	109300	6284	-410200	61700	-147000	1341000	288200	1074000	270300	3687000	349100	2958000	299000
SW3039	-149100	97730	108800	-68110	148000	-52150	-352400	1036000	264500	379300	332700	2857000	292600	1060000	403500
SW3040	-241400	98480	148000	-10540	-352400	-5292	-230100	1192000	176300	998600	133300	2964000	253300	2490000	175500
SW3041	-239100	98510	147500	-4522	228800	14720	-397300	971900	131200	396800	196800	2423000	173900	997700	308300
SW3042	80310	68980	75690	45430	-67060	80810	-64830	620100	20420	541700	20320	1433000	28230	1263000	29200
SE3001	-577600	201700	306300	178000	62010	91630	191800	1200000	2222000	1022000	373300	2676000	2861000	2269000	548200
SE3002	-568200	198100	300900	9467	-190500	-173300	414600	810800	370800	657100	887400	1811000	545500	1518000	1157000
SE3012	-568200	202700	300700	9491	189600	-173200	-415400	963100	193900	709300	242400	2168000	244100	1686000	321400
SE3013	-577600	206500	308100	178000	-61340	91630	-191000	1420000	39130	1213000	194500	3202000	53760	2718000	244500
SE3025	67610	43080	44100	20890	65340	-24180	62770	539100	54740	483800	48150	1217000	63060	1099000	56990
SE3026	-208800	92110	144600	43340	355600	46620	228600	1053000	170400	878900	115900	2685000	281600	2253000	176600
SE3027	-206400	91970	144000	-36940	-227400	-24710	396500	853900	114700	313600	198900	2191000	175900	819100	333200
SE3028	-133300	83930	111400	-45680	399400	-85240	145600	1252000	254700	994200	184600	3546000	341000	2833000	206200
SE3029	-130900	84090	110500	89730	-146900	57860	346600	958700	181700	324600	242900	2734000	203200	934200	358900
SE3030	-32300	42440	38880	-16750	246500	-11600	76280	1502000	300600	1149000	338800	4605000	389300	3528000	463700
SE3031	-29770	42850	38910	13540	-76100	10260	215500	1100000	333200	304100	426600	3378000	455300	929100	606200
SE3032	4364	25150	29760	8739	127800	926.5	92410	1818000	177600	1408000	149700	5694000	199700	4403000	155600
SE3033	48700	39950	56340	17030	-1362	73690	53820	1349000	158600	427800	210500	4220000	120800	1334000	161400
SE3034	4364	25430	31910	8739	-127800	925.9	-92410	1825000	158600	1412000	137500	5707000	170200	4414000	133300
SE3035	48700	32190	45830	17030	1363	73690	-53810	1351000	153600	427500	203200	4226000	119100	1333000	154400
SE3036	-32300	42900	40980	-16750	-246500	-11610	-76280	1550000	234400	1187000	255600	4664000	273700	3575000	283600
SE3037	-29770	43420	41380	13540	76100	10260	-215500	1137000	252500	314000	389300	3423000	280000	940400	450900
SE3038	-133300	78180	100100	-45680	-399400	-85240	-145600	1340000	256400	1067000	278100	3689000	334000	2950000	309600
SE3039	-130900	78490	99460	89730	146900	57860	-346600	1030000	272300	343700	399300	2847000	303400	965500	483200
SE3040	-208800	96970	143000	43330	-355600	46620	-228600	1196000	182300	999200	120200	2969000	266700	2485000	169100
SE3041	-206400	96740	142300	-36940	227400	-24710	-396500	971300	119100	355800	231900	2416000	168500	891800	339900
SE3042	67610	67810	74880	20900	-65330	-24170	-62740	624700	21370	551300	21910	1445000	30350	1290000	31580

FILENAME: 4BMCOL.XLS
12/23/94
I5 - COLUMBIA RIVER SEISMIC SURVEY for ODOT

- Member axial compression exceeds the Euler buckling load
(Eq. 10-155 cannot be correctly evaluated, and D/C is incorrect!)

DEMAND/CAPACITY DATA INCLUDING BENDING EFFECTS
UNITS INCH,LB. (Fy in ksi)
SPAN 4

	ALGOR												DL + EQ(X + 0.3Y + 0.67Z)		DL + EQ(Y + 0.3X + 0.67Z)		Pa (D.L. Compr. Neg.)			D.L.				EQX = EQ(X + 0.3Y + 0.67Z)				EQY = EQ(Y + 0.3X + 0.67Z)			
Fy	Memb. #	MEM(S)	A	(KL/r)2	Z2	C2	(KL/r)3	Z3	C3	Fcr	D/C	DESCRIPTION	Eq. (10-156)	Eq. (10-155)	Eq. (10-156)	Eq. (10-155)	D.L.	EQX	EQY	M2i	M3i	M2j	M3j	M2i	M3i	M2j	M3j	M2i	M3i	M2j	M3j
50	343	SW4001	52.50	60.109	360.3	1.0	74.138	311.0	1.0	-37997.6	0.99	West truss top chord, L0-U1	0.590	0.778	0.744	0.989	-670200	284700	365600	-92620	-225300	-52030	-115800	2475000	80840	2085000	129700	4600000	79260	3872000	135900
50	119	SW4002	52.50	9.906	360.3	1.0	74.138	311.0	1.0	-37997.6	0.80	West truss top chord, L0-U1	0.531	0.673	0.643	0.799	-660800	277300	349400	-56240	117300	40290	-390400	1637000	141500	649500	281000	3038000	175700	1166000	379400
50	153	SW4012	52.50	70.016	360.3	1.0	74.138	311.0	1.0	-37997.6	0.79	West truss top chord, L0'-U1'	0.564	0.763	0.585	0.795	-742300	340900	305500	-67090	126600	66260	51350	961500	211400	574400	587900	1659000	169900	814500	380500
50	329	SW4013	52.50	70.016	360.3	1.0	74.138	311.0	1.0	-37997.6	0.98	West truss top chord, L0'-U1'	0.699	0.984	0.693	0.967	-752100	343700	312500	-87180	-64120	-46780	-131000	1411000	1881000	1198000	243100	2491000	1073000	2110000	181500
50	117	SW4025	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.50	West truss vertical, U1-L1	0.387	0.202	0.501	0.321	91270	69640	70840	-27670	-61980	-20670	-55770	843900	24230	719500	22650	1527000	29780	1306000	28910
33	257	SW4026	24.80	47.066	180.1	1.0	74.121	144.0	1.0	-27774.2	1.15	West truss vertical, U2-L2	0.794	0.946	0.968	1.151	-215900	106400	129000	-33190	-410000	-24250	-261500	1181000	190900	976300	126300	1971000	230900	1635000	140700
33	116	SW4027	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	0.97	West truss vertical, U2-L2	0.704	0.819	0.846	0.972	-213600	107100	128900	14820	260000	11980	-456000	947800	125500	324500	235900	1586000	140400	530800	324400
33	286	SW4028	24.80	47.062	180.1	1.0	80.936	144.0	1.0	-26769.0	0.99	West truss vertical, U3-L3	0.711	0.868	0.826	0.993	-122100	146100	144300	33330	-414900	87090	-148800	949700	345300	751200	196000	1640000	351200	1307000	193300
33	115	SW4029	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	0.80	West truss vertical, U3-L3	0.593	0.709	0.680	0.796	-119700	147300	145300	-90890	149800	-56540	-357700	724000	193900	231400	279400	1261000	191000	410100	308200
33	277	SW4030	24.80	47.059	180.1	1.0	85.473	144.0	1.0	-26050.9	0.62	West truss vertical, U4-L4	0.404	0.451	0.566	0.616	-14020	67590	66380	18020	-225900	12340	-67840	948900	361500	727200	171500	1934000	352500	1479000	174700
33	114	SW4031	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.44	West truss vertical, U4-L4	0.283	0.319	0.403	0.439	-11520	67660	66690	-12770	67520	-675.2	-195200	697300	169300	188600	277500	1416000	172200	381100	253000
33	287	SW4032	24.80	47.062	180.1	1.0	87.756	144.0	1.0	-25674.7	0.59	West truss vertical, U5-L5	0.390	0.275	0.591	0.484	47700	46180	58240	42670	-74400	54050	-18590	1022000	284300	770100	142600	2118000	280500	1595000	155700
33	113	SW4033	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.46	West truss vertical, U5-L5	0.308	0.187	0.461	0.346	50210	48930	61210	-49900	20080	-28900	-56160	735200	140600	245900	265600	1522000	153100	495300	197500
33	146	SW4034	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.58	West truss vertical, U5'-L5'	0.377	0.000	0.577	0.467	46340	34420	45720	39700	64080	52270	11890	986600	348300	751700	150400	2059000	372400	1549000	171200
33	382	SW4035	24.80	47.059	180.1	1.0	87.756	144.0	1.0	-25674.7	0.43	West truss vertical, U5'-L5'	0.285	0.000	0.435	0.318	48840	36300	48030	-47670	-13490	-25370	40430	717600	148500	231600	321100	1479000	169000	470600	264300
33	379	SW4036	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.68	West truss vertical, U4'-L4'	0.456	0.517	0.621	0.682	-12460	97790	93310	11790	206000	7666	56560	995300	404800	760800	174100	1923000	475300	1480000	210600
33	112	SW4037	24.80	47.062	180.1	1.0	85.473	144.0	1.0	-26050.9	0.50	West truss vertical, U4'-L4'	0.327	0.379	0.444	0.498	-9955	98300	93180	-8203	-56320	761.5	171000	727300	172000	200300	332900	1418000	208000	384200	324100
33	378	SW4038	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	1.10	West truss vertical, U3'-L3'	0.745	0.900	0.917	1.104	-114000	172600	201000	27980	374800	83500	134700	1014000	372900	804300	197900	1618000	513100	1298000	261900
33	111	SW4039	24.80	47.066	180.1	1.0	80.936	144.0	1.0	-26769.0	0.92	West truss vertical, U3'-L3'	0.624	0.761	0.758	0.921	-111600	173400	201000	-86840	-136100	-48310	322000	772800	195700	259100	375300	1253000	259400	416600	419600
33	377	SW4040	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	0.90	West truss vertical, U2'-L2'	0.703	0.813	0.794	0.904	-151900	140900	124500	-28190	306100	-15490	197100	1049000	170900	870600	111300	1607000	271300	1339000	178200
33	110	SW4041	24.80	54.712	180.1	1.0	74.121	144.0	1.0	-27774.2	0.82	West truss vertical, U2'-L2'	0.627	0.745	0.694	0.818	-149600	141600	125000	10100	-195900	13830	343600	846200	110400	302300	201900	1302000	176900	493500	253700
50	109	SW4042	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.41	West truss vertical, U1'-L1'	0.372	0.193	0.414	0.000	88890	68200	65770	-19630	59360	-8461	48030	602700	70470	529300	67550	987000	46250	837900	44070
50	128	SW4075	18.41	56.93	118.8	1.0	94.06	65.3	1.0	-30679.0	0.66	West truss tower, U2'-R1	0.431	0.650	0.314	0.445	12790	275700	183000	6776	-47160	-2152	-42570	62760	118600	66430	77190	119300	92910	94120	80020
50	12	SW4076	15.47	59.61	99.4	1.0	94.02	58.0	1.0	-30695.6	0.79	West truss tower, R1-R2	0.478	0.787	0.329	0.533	-13930	288100	186200	-7419	14920	2510	-2355	22860	20290	16860	29400	45620	26910	25490	26880
33	14	SW4077	15.47	56.83	99.4	1.0	89.63	58.0	1.0	-25359.1	0.90	West truss tower, R2-R3	0.679	0.903	0.484	0.632	-12460	263500	171200	-3842	14370	-19870	-15320	43520	40070	39200	30910	63870	53270	77660	44930
33	16	SW4078	15.47	43.85	99.4	1.0	69.16	58.0	1.0	-28449.7	0.79	West truss tower, R3-R4	0.669	0.787	0.514	0.594	-10720	226200	148900	24800	17650	102000	-22810	41650	72400	66250	114700	63920	92330	139900	115900
33	18	SW4079	15.47	34.19	99.4	1.0	99.53	58.0	1.0	-23577.9	0.85	West truss tower, R4-R5	0.608	0.846	0.530	0.706	-7312	201800	147600	-83400	15610	-137200	-38990	82620	84230	119900	51660	119000	85580	260900	60690
33	56	SW4080	15.47	28.92	99.4	1.0	99.53	58.0	1.0	-23577.9	0.39	West truss tower, R5-R6	0.284	0.350	0.323	0.390	-9026	55020	54580	154300	37410	-139800	-9480	170500	33460	120500	55410	279100	46490	202600	43870
50	9	SW4081	85.86	47.78	596.1	1.0	49.30	581.9	1.0	-44692.9	1.11	West truss tower, L0'-U0'	0.828	0.957	0.951	1.106	-1366000	446300	510100	-60970	494200	46590	-102100	3639000	5528000	2687000	822000	9263000	3113000	6826000	824600
50	1	SW4082	85.86	16.87	596.1	1.0	49.30	581.9	1.0	-44692.9	0.82	West truss tower, L0'-U0'	0.604	0.669	0.755	0.824	-1357000	445300	499900	-50890	99670	-800.4	-19220	2656000	459100	917300	1324000	6746000	420600	2332000	882800
50	3	SW4083	71.99	16.92	492.9	1.0	42.39	514.2	1.0	-46075.3	0.80	West truss tower, U0'-F1	0.679	0.739	0.739	0.800	-1355000	445800	500000	-351.3	30100	-31280	-12670	941800	1302000	162200	1154000	2396000	872800	376800	704100
50	41	SW4084	71.99	56.23	492.9	1.0	42.39	514.2	1.0	-43094.5	0.74	West truss tower, U0'-F1	0.618	0.720	0.634	0.740	-1330000	439700	487400	45330	10790	19960	98580	160600	794900	211800	508700	371500	571700	393000	478900
50	4	SW4085	71.99	56.23	492.9	1.0	41.71	514.2	1.0	-43094.5	0.73	West truss tower, F1-F2	0.613	0.713	0.629	0.734	-1342000	435800	471200	-11720	-108600	42520	20590	212700	446400	91950	661000	382300	413500	205200	618700
50	46	SW4086	71.99	56.23	492.9	1.0	41.71	514.2	1.0	-43094.5	0.74	West truss tower, F1-F2	0.618	0.720	0.630	0.737	-1337000	433000	445400	-56720	-22650	-93930	-347400	90270	553000	184800	386200	204300	584600	520000	234800
50	5	SW4087	71.99	56.23	492.9	1.0	40.34	514.2	1.0	-43094.5	0.75	West truss tower, F2-F3	0.632	0.737	0.644	0.755	-1325000	429900	424800	106200	331000	-136800	-350900	188900	398400	321700	672600	447200	239000	692100	647100
50	50	SW4088	71.99	56.23	492.9	1.0	40.34	514.2	1.0	-43094.5	0.79	West truss tower, F2-F3	0.648	0.760	0.668	0.790	-1317000	424900	400500	129200	347900	304800	-424600	326700	621600	660300	585600	708400	665200	1472000	473300
50	6	SW4089	71.99	56.23	492.9	1.0	31.45	514.2	1.0	-43094.5	0.91	West truss tower, F3-F4	0.730	0.855	0.772	0.915	-1307000	434100	406300	-278000	414000	628500	-458500	697400	615400	1068000	1904000	1557000	499000	2509000	1721000
50	52	SW4090	71.99	56.23	492.9	1.0	31.45	514.2	1.0	-43094.5	1.14	West truss tower, F3-F4	0.835	0.989	0.946	1.144	-1318000	440000	373400	-650700	461500	-135600	-504600	1107000	690700	3197000	2721000	2599000	920900	6816000	2362000
50	7	SW4091	71.99	56.23	492.9	1.0	24.62	514.2	1.0	-43094.5	1.07	West truss tower, F4-F5	0.785	0.913	0.906	1.075	-1309000	195700	203400	82360	493000	-2E+06	-861100	2781000	3885000	1968000	3044000	6701000	3013000	4932000	2401000
50	8	SW4092	71.99	56.23	492.9	1.0	20.82	514.2	1.0	-43094.5	0.99	West truss tower, F5-F6	0.731	0.845	0.844	0.990	-1281000	42150	85510	1443000	852900	-2E+06	-2E+06	2174000	2128000	2000000	1873000	4198000	2065000	4678000	1614000
50	54	SW4093	71.99	17.94	492.9	1.0	20.82	514.2	1.0	-49053.4	0.18	West truss tower, F5-F6	0.165	0.167	0.178	0.180	-282400	11740	23020	266700	-182500	631600	-490500	30420	595800	60310	547700	57300	927600	123500	733000
50	342	SE4001	48.90	60.259	334.6	1.0	73.127	294.8	1.0	-38322.8	0.85	East truss top chord, L0-U1	0.514	0.662	0.659	0.849	-559300	176200	224300	-50190	-196200	-50010	-94940	2334000	63340	1988000	111400	4349000	78740	3707000	125400
50	189	SE4002	48.90	9.931	334.6	1.0	73.127	294.8	1.0	-38322.8	0.69	East truss top chord, L0-U1	0.463	0.575	0.567	0.688	-551200	172900	217400	129700	96660	-1857	-348600	1558000	110100	648400	183600	2896000	144300	1169000	238400
50	195	SE4012	48.90	9.931	334.6	1.0	73.127	294.8	1.0	-38322.8	0.68	East truss top chord, L0'-U1'	0.516	0.666	0.543	0.683	-620200	277600	246700	131300	94200	-23840	37050	889400	240700	566200	614900	1573000	258800	801100	812700
50	328	SE4013	48.90	60.259	334.6	1.0	73.127	294.8	1.0	-38322.8	0.99	East truss top chord, L0'-U1'	0.636	0.857	0.732	0.987	-628800	281300	248500	-42550	-47470	-44540	-95480	1320000	1678000	1127000	283000	2338000	2427000	2001000	299300
50	188	SE4025	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.44	East truss vertical, U1-L1	0.324	0.000	0.437	0.000	74590	43590	45670	9828	-54190	4292	-48410	843900	17870	722500	17220	1523000	21330	1304000	20920
33	258	SE4026	24.80	47.066	180.1	1.0	74.121	144.0	1.0	-27774.2	0.98	East truss vertical, U2-L2	0.677	0.790	0.843	0.980	-182200	78300	95860	13510	-332200	21340	-217900	1180000	148900	976700	96150	1972000	188700	1637000	113700
33	177	SE4027	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	0.83	East truss vertical, U2-L2	0.599	0.687	0.736	0.832	-179900	78410	95690	-13330	216800	-3900	-374100	949300	95330	322200	194200	1592000	113200	530200	259600
33	267	SE4028	24.80	47.062	180.1	1.0	80.936	144.0	1.0	-26769.0	0.79	East truss vertical, U3-L3	0.549	0.646	0.678	0.786	-104700	82420	87510	-23140	-336700	-71430	-121600	951300	215500	756000	130700	1645000	237600	1319000	122200
33	176	SE4029	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	0.63	East truss vertical, U3-L3	0.455	0.529	0.551	0.629	-102300	82920	87710	74810	123100	51480	-286200	729000	129100	234500	221500	1274000	120700	418700	272600
33	278	SE4030	24.80	47.059	180.1	1.0	85.473	144.0	1.0	-26050.9	0.54	East truss vertical, U4-L4	0.340	0.372	0.504	0.538	-15670	43670	43100	62320	-184000	49430	-56250	947900	219500	726500	124800	1934000	211800	1479000	111400
33	175	SE4031	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.39	East truss vertical, U4-L4	0.245	0.270	0.363	0.388	-13130	44290	43860	-46240	56120	-15460	-158000	695100	123100	188000	212900	1416000	109900	377800	237500
33	288	SE4032	24.80	47.062	180.1	1.0	87.756	144.0	1.0	-25674.7	0.53	East truss vertical, U5-L5	0.329	0.000	0.528	0.443	36490	24250	38550	52670	-63310	13800	-17230	1023000	227300	770700	130700	2118000	197900	1595000	114100
33	178	SE4033	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.40	East truss vertical, U5-L5	0.251	0.000	0.401	0.308	39040	25760	40380	-14700	18770	6856	-48330	736200	128900	242800	232200	1523000	112500	494900	234900
33	393	SE4034	24.80	47.062	180.1	1.0	87.756	144.0	1.0	-25674.7	0.51	East truss vertical, U5'-L5'	0.322	0.000	0.514	0.430	35360	22050	35360	50500	53420	12260	10630	995900	247000	749700	133700	2059000	217100	1549000	114000
33	179	SE4035	24.80	26.717	180.1	1.0	87.756	144.0	1.0	-25674.7	0.39	East truss vertical, U5'-L5'	0.241	0.000	0.385	0.294	37900	23220	36980	-13220	-12260	4813	32970	716500	132100	233000	252000	1479000	112800	471400	255200
33	394	SE4036	24.80	47.059	180.1	1.0	85.473	144.0	1.0	-26050.9	0.56	East truss vertical, U4'-L4'	0.377	0.419	0.523	0.565	-13720	64200	57350	56900	166100	45270	45430	996500	251800	761600	123000	1922000	250600	1479000	110600
33	163	SE4037	24.80	24.800	180.1	1.0	85.473	144.0	1.0	-26050.9	0.41	East truss vertical, U4'-L4'	0.274	0.307	0.377	0.407	-11190	64580	57350	-42380	-45380	-14680	134500	730300	121400	198800	244800	1417000	109200	381300	276800
33	395	SE4038	24.80	47.062	180.1	1.0	80.936	144.0	1.0	-26769.0	0.86	East truss vertical, U3'-L3'	0.604	0.718	0.730	0.860	-96550	120200	130100	-30410	302400	-77950	108700	1009000	255300	791600	146300	1620000	296400	1301000	142600
33	164	SE4039	24.80	20.983	180.1	1.0	80.936	144.0	1.0	-26769.0	0.69	East truss vertical, U3'-L3'	0.504	0.591	0.600	0.691	-94150	120400	129600	80500	-110400	46620	254300	764200	144400	252100	293900	1257000	141100	420700	342000
33	396	SE4040	24.80	47.066	180.1	1.0	74.121	144.0	1.0	-27774.2	0.75	East truss vertical, U2'-L2'	0.590	0.685	0.662	0.755	-128000	107000	83430	6833	241000	7215	159700	1048000	115000	868000	79650	1610000	165500	1343000	94840
33	193	SE4041	24.80	15.250	180.1	1.0	74.121	144.0	1.0	-27774.2	0.64	East truss vertical, U2'-L2'	0.527	0.602	0.574	0.643	-125700	107100	83440	-2993	-158800	-5923	273700	844300	78900	341300	148900	1307000	94190	497000	212600
50	194	SE4042	19.68	58.457	126.1	1.0	160.719	30.5	1.0	-11080.7	0.36	East truss vertical, U1'-L1'	0.290	0.000	0.363	0.000	72520	29370	27570	14470	53340	-295.5	42660	603400	54020	528100	51410	991900	73790	851000	69060
50	192	SE4075	18.41	56.93	118.8	1.0	94.06	65.3	1.0	-30679.0	0.53	East truss tower, U2'-R1	0.351	0.527	0.279	0.396	9891	223100	161400	-6272	-43470	-4357	-37910	61870	91840	70450	57550	117600	83410	93620	71370
50	26	SE4076	15.47	59.61	99.4	1.0	94.02	58.0	1.0	-30695.6	0.63	East truss tower, R1-R2	0.384	0.627	0.290	0.467	-11590	228800	163300	3045	13050	-5731	-2226	23640	24180	21260	31770	45640	28860	27830	30570
33	21	SE4077	15.47	56.83	99.4	1.0	89.63	58.0	1.0	-25359.1	0.73	East truss tower, R2-R3	0.556	0.732	0.437	0.566	-9286	212400	151600	4079	12660	19840	-13890	42280	31780	40390	37670	65000	51440	90420	48360
33	33	SE4078	15.47	43.85	99.4	1.0	69.16	58.0	1.0	-28449.7	0.66	East truss tower, R3-R4	0.562	0.656	0.472	0.542	-7286	186700	136200	-20470	15330	-94840	-20570	41680	57500	74100	101600	55790	88400	149100	107900
33	31	SE4079	15.47	34.19	99.4	1.0	99.53	58.0	1.0	-23577.9	0.67	East truss tower, R4-R5	0.493	0.667	0.469	0.607	-4644	156100	120500	84370	13770	136000	-34410	57500	51370	137600	40510	97760	70590	298700	57400
33	57	SE4080	15.47	28.92	99.4	1.0	99.53	58.0	1.0	-23577.9	0.36	East truss tower, R5-R6	0.248	0.309	0.292	0.358	-6242	53970	56670	-147500	33130	140000	-8304	100500	31070	91890	47090	198500	46340	151000	39020
50	20	SE4081	85.86	47.78	596.1	1.0	49.30	581.9	1.0	-44692.9	1.22	East truss tower, L0'-U0'	0.760	0.871	1.054	1.224	-1211000	393000	496200	-50260	435700	-98120	-90390	3638000	5282000	2684000	1125000	9263000	7535000	6825000	976400
50	28	SE4082	85.86	16.87	596.1	1.0	49.30	581.9	1.0	-44692.9	0.77	East truss tower, L0'-U0'	0.544	0.601	0.707	0.770	-1202000	390100	483700	101700	91440	-3959	-16160	2652000	360300	915700	1521000	6744000	357100	2336000	2014000
50	29	SE4083	71.99	16.92	492.9	1.0	42.39	514.2	1.0	-46075.3	0.79	East truss tower, U0'-F1	0.617	0.671	0.725	0.788	-1199000	389800	483100	2002	25840	73450	-11920	940900	1498000	163600	1350000	2401000	1979000	373500	1619000
50	42	SE4084	71.99	56.23	492.9	1.0	42.39	514.2	1.0	-43094.5	0.71	East truss tower, U0'-F1	0.554	0.645	0.605	0.705	-1175000	382300	468200	-85480	14230	11890	92410	161700	893100	212200	470400	367900	1247000	333300	680700
50	30	SE4085	71.99	56.23	492.9	1.0	41.71	514.2	1.0	-43094.5	0.67	East truss tower, F1-F2	0.544	0.632	0.575	0.669	-1184000	385900	447900	-4799	-101600	-13930	14880	211000	413400	115800	647000	339000	602300	284000	674900
50	47	SE4086	71.99	56.23	492.9	1.0	41.71	514.2	1.0	-43094.5	0.68	East truss tower, F1-F2	0.551	0.641	0.577	0.675	-1179000	380000	416700	28050	-16220	118800	-303600	113500	473000	265900	347000	284600	494300	727000	240300
50	22	SE4087	71.99	56.23	492.9	1.0	40.34	514.2	1.0	-43094.5	0.69	East truss tower, F2-F3	0.570	0.664	0.589	0.689	-1168000	373300	385600	-107800	288900	166200	-321000	268900	359200	399600	788100	636400	246800	839600	713500
50	51	SE4088	71.99	56.23	492.9	1.0	40.34	514.2	1.0	-43094.5	0.71	East truss tower, F2-F3	0.577	0.675	0.607	0.715	-1159000	366100	348800	-158100	317700	-265200	-370700	411200	477800	845300	476100	866800	585000	1778000	421800
50	34	SE4089	71.99	56.23	492.9	1.0	31.45	514.2	1.0	-43094.5	0.84	East truss tower, F3-F4	0.657	0.767	0.713	0.841	-1150000	361600	334800	255100	361500	-540400	-418600	872400	499000	1449000	1703000	1872000	442400	3169000	1565000
50	53	SE4090	71.99	56.23	492.9	1.0	31.45	514.2	1.0	-43094.5	1.08	East truss tower, F3-F4	0.734	0.866	0.898	1.077	-1159000	344900	282500	561700	417400	130100	-444200	1497000	555700	3667000	1820000	3274000	850800	8308000	1718000
50	32	SE4091	71.99	56.23	492.9	1.0	24.62	514.2	1.0	-43094.5	1.01	East truss tower, F4-F5	0.708	0.824	0.852	1.010	-1150000	179400	169900	-78000	434100	1407000	-759500	3935000	2415000	2525000	1828000	8162000	1789000	5158000	1562000
50	38	SE4092	71.99	56.23	492.9	1.0	20.82	514.2	1.0	-43094.5	0.89	East truss tower, F5-F6	0.672	0.774	0.768	0.893	-1126000	61810	82340	-1E+06	752400	1767000	-2E+06	1919000	1573000	2287000	1549000	4432000	1685000	4584000	1455000
50	55	SE4093	71.99	17.94	492.9	1.0	20.82	514.2	1.0	-49053.4	0.16	East truss tower, F5-F6	0.145	0.147	0.161	0.163	-248800	11890	23560	-244100	-154200	-565900	-429400	35960	540000	70160	450000	64500	847000	134800	694400