Project Identification
No. SAG.CP29
Rev. 4

EBASCO SERVICES INCORPORATED

TEXAS UTILITIES GENERATING COMPANY

COMANCHE PEAK STEAM ELECTRIC STATION

UNIT NO. 1

GENERAL INSTRUCTIONS FOR DESIGN VERIFICATION OF ELECTRICAL CONDUIT AND BOX SUPPORTS

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GENERAL INSTRUCTIONS FOR DESIGN VERIFICATION OF ELECTRICAL CONDUIT AND BOX SUPPORTS

TABLE OF CONTENTS

TWO WORLD TRADE CENTER
NEW YORK
R1

TABLE OF CONTENTS (cont'd)

TABLE OF CONTENTS (cont'd)

TABLE OF CONTENTS (cont'd)

LIST OF ATTACHMENTS (Cont'd)

1.0 INTRODUCTION

These general instructions have been written to assist personnel design verifying Electrical Conduit & Box Supports. It is merely a means of interpretation of the Design Criteria for Seismic Category I Electrical Conduit System (SAG.CP10). It is by no means a substitute or replacement of the Design Criteria. These instructions also provide a uniform approach in calculations. The approaches identified in these instructions are those which the writers believe would have involved too much variability in interpretation, or would have been interpretated with unnecessary overconservatism. All engineers must therefore follow these instructions exactly as specified. The requirements herein are minimum requirements. Conservative approaches may be used provided that the support can pass the design verification process. If conservative approach is used a statement to this effect must be included in the calculation. For approaches which are not specifically outlined herein the engineers shall use documentation, books and other sources traditionally used and accepted in the design process.

1.1 SCOPE

This document is applicable to the design verification of Unit No. 1
generic (S-0910 package), modified and individually engineered (IN)
electrical conduit and junction box supports. IN supports attached
directly to the Spread Room Framing (SRF) are considered as part of SRF R2
framing and are in the SWEC scope of work.

The modified and IN supports shall be design verified based on "as-built"
conditions obtained from the walkdown package prepared by the walkdown
group. The calculations for IN supports shall include the evaluation of
all clamps in accordance with the procedure specified in Reference 9 R3
(SAG.CP25).

Calculation packages shall be prepared per Appendix Q of Ebasco Manual R2
of Procedures (Reference 3).

2.0 DESIGN VERIFICATION PROCEDURE |R2

2.1 GENERIC SUPPORTS

a. Set up structural model with proper boundary conditions (Hinged, Fixed, or Spring) & critical dimensions.

b. If spring rate at anchorage point needs to be considered give plate or base angle size; bolt size, and location to base plate group to get the spring rate. |R1

c. Fill input data for frequency analysis and static analysis with proper spring rate obtained from item (b).

d. Review the static output to verify that all members pass code check (see Attachment "F" for reduction in interaction equation coefficient due to 1/32 undercut). Add warping stresses, and other stresses due to eccentricity not considered in the model. The "Combs" computer program shall be used to calculate member and weld stresses for structures with composite channels, see Design Aid (Calc. Book No. Supt-0040) for detail. |R1

e. Check anchorage (surface angle, base plate, and bolts) using the procedure given in Attachment "G" (approximate method). If anchorage evaluation results in failure, or the configuration is not covered by Attachment "G", complete base plate evaluation form and request the base plate group to perform a more detailed analysis by STRUDL base plate program. Results of this analysis shall be part of the calculations.

f. Complete calculations for all welds, gusset plate and members not included in code check performed by STRUDL. |R2

g. Code violations, if any, (such as bolt edge distance, bolt spacing etc.) shall be identified in the calculations.

2.2 MODIFIED SUPPORTS

A modified support is a support which has deviation(s) from S-0190 package typical details.

a. Modified supports with minor deviations from a generic support may be design verified by comparison to the generic support by hand calculations provided that all corresponding members and attributes which impact the capacity of the support can be demonstrated to be more conservative than those used for the generic support to meet frequency requirements and acceptance criteria.

b. If only the anchorage of a modified support matches the anchorage of the generic support, the spring rate obtained for the generic support (see Attachment "I") may be used instead of performing new analysis to calculate the spring rate at anchorage point. However, steps c to g of Section 2.1 shall be repeated except when deviations from generic supports are such that the support frequency is not affected, in which case the minimum frequency requirement is satisfied and the frequency analysis need not be repeated. R2

c. When a modified support is significantly different from a generic support all aspects of the support shall be design verified in accordance with the procedure in Section 2.1.

2.3 "IN" SUPPORTS

An individually engineered (IN) support is a support which does not conform to S-0910 package typical details. The procedures described in Section 2.1 shall be used in the design verification of IN supports.

2.4 MODIFICATION OF SUPPORTS

Modified and IN supports which are found "not-adequate" based on the evaluation performed as described in Sections 2.2 and 2.3 respectively shall be modified as follows:

a. A DCA for the proposed modification shall be issued to site for feasibility review. Site walkdown group will respond to this as soon as possible. In case of a complicated support, the DV engineer will directly investigate the support and its surrounding situation to solve the problems. The proposed modification may consist of reinforcing the existing support or if absolutely necessary, providing additional supports to reduce the loads on the support under investigation. When the modification involves an additional support, a new ISO evaluation shall be performed to obtain the new loads and used to verify the support. R2

b. Perform custom ISO evaluation of all pertinent primary and secondary isometrics as described in Appendix 1 of SAG-CP25 to determine the actual "g" value and qualify the support.

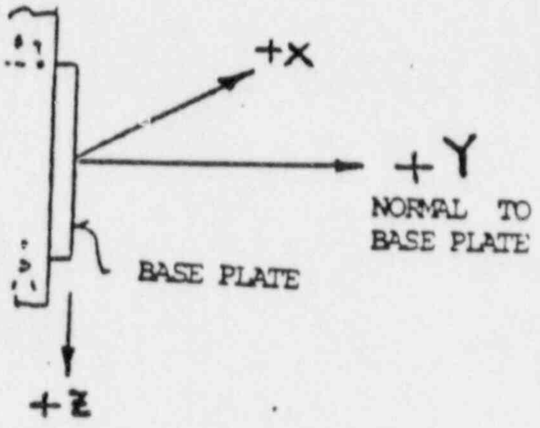
3.0 COMPUTER ANALYSIS

Supports shall be analyzed using a computer programs such as STRUDL or Ezhang. |R2

3.1 MODEL

A three dimensional Strudl or Ezhang model of the support shall be used with relative eccentricities between interconnected members determined in accordance with guidelines contained herein.

a. For generic supports the model shall be prepared using a global axes where the Y-axis is perpendicular to the base plate or embedded plate as shown below. |R2



b. For Modified and IN supports the model shall be prepared using a global axes where the Y axis is vertical, the X & Z axes oriented in the N-S and E-W directions according to Table 1. |R2

3.2 ECCENTRICITIES

Various eccentricities must be considered to realistically account for the application of loads and interconnections between structural members:

a. A rigid member shall be used to represent the eccentricity between the center of gravity of conduit (point of load application) and the center of gravity of supporting member (see Attachment "A"). Any torsional moment from shear center to center of conduit not accounted for by the use of rigid members shall be added to the model as additional torsion. |R1

b. A rigid member from the center of gravity of a member to the center of gravity of a connected member shall be used to represent the eccentricity between members where relative movement is negligible. (Attachments B1 & B2).

c. For simplicity, the eccentricity between the centerline of gusset plate and center of gravity of connected member (strut) may be excluded from the model and the procedure described in Attachment "J" used for verifying the members and welds involved.

3.3 NODAL POINTS

All nodal point connections shall be as follows:

a. For bracing:

- pin connection shall be assumed on connection with plate. (see Attachment "B3")
- pin connection shall be assumed for braces welded to back of posts. (see Attachments "B2")

Assume one nodal point if the dimension between the top of the horizontal tier and the bottom of the diagonal brace is within d/2 inches for $\alpha \geqslant 50°$ and d/3 inches for $\alpha < 50°$. where "d" is the width of the post to which bracing is welded. Refer also to ATTACHMENT "B4".

b. For post to tiers:

- all shall be fixed connections.

3.4 BOUNDARY CONDITIONS

Boundary assumptions should reflect the actual anchorage configuration.

Specific conditions for various anchorage configurations shall be as follows.

a. Surface angle or base plate connection to concrete with Hilti bolts or Richmond Inserts.

The anchorage flexibility shall be considered in the analysis by introducing the spring rate at the connection in order to provide a more realistic distribution of moments throughout the entire frame. For guidelines see Attachment "I".

The anchorage shall not be modeled in the static analysis model, however, it will be checked as described in Section 9.0. |R2

|R2

b. Welded Connection

If a structural member is welded all around to an embedded plate or containment liner the connection should be assumed to be fixed in all three (3) directions. |R1

3.5 ADDITIONAL NOTES

R1

a. For KL/r requirements and K values to be used in slenderness ratio calculations see Attachment "C".

b. For additional notes on models see Attachment "D".

c. Whenever open section members are used, hand calculations should be made to check warping stresses. Shear stresses due to torsion are to be checked if not already verified by the STRUDL program.

d. When using rotational stiffness coefficients with the frequency analysis, these spring constants should be included in the input under "joint releases" command (Reference: PD-STRUDL, Page 3-23).

R2

e. For clarification in using Beta Angles, refer to Attachment "D".

f. The input data required to perform the anchorage spring rate and finite element static analysis shall be filled on the standard input sheets prepared for this purpose. The standard input sheet contains the base plate geometry, anchor length, locations of load points and loads. The bolt springs shall be obtained from the Teledyne Report, which is provided in Attachment P. R3

g. In the design verification of L-shaped structural steel members subject to bending and compression such as bracing angle connected with a gusset plate, the required reduction in allowable bending stress about the strong axis of various angle sizes for spans from 24" to 144" are provided in a graph as well as tabular form in Attachment Q.

3.5 ADDITIONAL NOTES (Cont'd)

In calculating the interaction ratio, the allowable bending stress
about the weak axis shall be taken as 0.6 Fy (22 ksi for A36 steel) R2
and the allowable compressive stress (Fa) obtained with consideration
of torsional buckling. For this purpose a table was developed (See
Appendix Q) listing the maximum angle lengths of various angle sizes
for which torsional buckling needs to be considered.

The allowable load in a 3 x 3 x 3/8 angle bracing for lengths from
36 to 108 inches has been calculated and is provided in Attachment Q R3
(Sh Q-5). For sample calculations of angles subject to bending
see Calc. Book No. SUPT-0235. R2

4.0 FREQUENCY REQUIREMENTS

All conduit and junction box supports shall meet the minimum frequency requirements as contained in Appendix 7 of the design criteria (SAG.CP10) with consideration of base plate flexibility. (See Attachment "I" for anchorage spring rates).

a. For generic supports which do not meet the minimum frequency requirement allowable weight of attached conduit (capacity) shall be reduced until the frequency requirement of the support is met (For guidelines see Calc. Book No. SUPT-0231). R2

b. For modified and IN supports which do not meet the minimum frequency requirement one of the two following approaches shall be used:

   a) Modify the support to meet the minimum frequency requirement.

   b) Re-evaluate all primary and secondary ISO's attached to that support using the actual support frequency.

A computer input skeleton has been prepared to perform the frequency analysis using the STRUDL program (see Attachment "K4").

5.0 LOADS & LOAD COMBINATIONS

5.1 DEAD LOADS

a. Generic Supports |R2

Values specified in the capacity table shown on the S-0910 drawings
which includes the weight of clamp, shim plates, filler plates, |R3
connection bolts, etc. shall be used as the dead load of conduit
lumped at the C.G. of the conduit. The weight of structural
members shall be automatically generated by the STRUDL program.
The weight of cover plate shall be calculated and input as mass
at the tip of the tube. Conduit loads shall be applied at the |R2
conduit location which produces maximum stress. For supports where
application of load at one location does not produce maximum
stress on all structural components, the member where the load was
not applied at the most critical location shall be verified manually
or by making an additional computer run to print stresses only for
the member under investigation.

b. Modified and "IN" Supports

For modified and IN supports, tributary conduit load (L_L & L_T) |
shall be obtained from the DV packages of the isometric (see |
Figure 1 for definition of tributary conduit load). The weight of |
shim and filler plates shall be calculated based on as-built |R2
dimensions and added to the conduit loads. When as-built |
demensions are not marked on the redline drawings, it indicates that |
the standard shim and filler plate sizes were used and the |
2323-S-0910 CSD series drawings shall be used to calculate the |
weights of standard shim and filler plates. |

The following procedure shall be used to obtain tributary conduit |R2 R3
loads which are not available from the DV package of the isometric. |

5.1 DEAD LOADS (Cont'd)

b. Modified and "IN" and Supports (Cont'd)

The determination of tributary conduit Loads, L_L and L_T, for all supports shall be done as per "LS" series of the generic S-0910 package. If conduit configuration is not contained in S-0910 package but is covered by LS-series of S2-0910 package, the equations to compute L_L and L_T can be used. In these instances, the LS-series drawing of the S2-0910 package shall be referenced in the calculation package. |R2| R3

The term L_{ADJ} used in the L_T formula for a support represents the conduit load from the adjacent span to the support evaluated. |R2

Conduit load imposed on junction box is equal to half the span to the first support times the weight of conduit(s) entering the box.

5.2 SEISMIC LOADS

The seismic loads are calculated by multiplying the appropriate weights
by the applicable accelerations in three orthogonal directions R1
specified in the Unit #1 design criteria (SAG. CP10).

a. Generic Supports

The design "g" values (Table A.7.1 through A.7.6 in Appendix 7 of
Reference 1) in each direction shall be rotated to account for
the most critical loading conditions for the support. A computer R1
input skeleton (see Attachment "K1") was prepared to account for the R4
rotations in "g" value (as described below) and loading combinations
for structures mounted in various (vertical, horizontal) orientations.

For each computer run using the input skeleton in Attachment "K1" the R4
"g" value is kept the same in one direction while the other two are
rotated. Therefore, when the strong axis of the support is evident,
applying the lowest "g" value in the strongest direction and rotating
the other two is sufficient to account for all rotations.

When the strong axis of the support cannot be easily determined,
separate runs shall be made for each of the three "g" values. In each R3
run, one of the three (3) "g" values shall be applied in the same
direction of the structure while the other two are rotated. This
procedure will be repeated until all three (3) "g" values are applied
in that particular direction. In these cases, a total of six R4
permutations of "g" values are required to account for rotations of
both OBE and SSE cases. Therefore, for complicated structures,
three runs may be required to account for all rotations unless the
critical direction can be determined by other means.

5.2 SEISMIC LOADS (Cont'd)

Since "g" values differ for each elevation in each building, the number of analyses required may be reduced by using the most critical set (g_1, g_2, g_3) which will envelope all other sets. R2 A set of enveloped design "g" values thus obtained is provided in Table 2 for each building.

In accordance with Appendix 5 of the Design Criteria (Reference 1) the weight of the junction box including its contents shall be considered for 1.5 times peak "g" values while the weight of conduit and dead weight of the support is designed for the design "g" values. To simplify the STRUDL input, the weight of the junction box and contents may be multiplied by an equivalent coefficient (maximum ratio between 1.5 peak "g" and design "g" in three directions) to convert the weight of the box and contents. The design "g" value is then used to obtain seismic loads for the design verification of junction box supports. To reduce the number of analyses required, the equivalent coefficients for the six buildings are condensed into three groups based on controlling "g" value and frequency and are provided in Table 3A. The buildings and elevations in each group are provided in Table 3B. R2

b. "IN" and Modified Supports

Unless the RSM analysis is performed to detemine the actual "g" values and the support orientation is known, the support has to be design verified in accordance with Paragraph (Y) Section 7.0 and Appendix 7 of the design criteria (SAG.CP10).

The design "g" values used for IN supports shall be multiplied by a load factor as specified in Reference 9.

5.2 SEISMIC LOADS (Cont'd)

For supports mounted between two floor elevations, the larger of the "g" values of the two floors shall be used. R2

b. Modified and "IN" Supports (Cont'd)

When a portion of the ISO is attached to a support by other discipline
or to the Spread Room Framing (SRF) the seismic loads on the next
and second next supports to other discipline or SRF support shall be
calculated based on the enveloped 1.5 times peak "g" values from
floor elevation above and below. This may be accomplished by
multiplying conduit loads (L_L & L_T) by a coefficient equal to the
ratio of 1.5 peak "g" to design "g" and using the design "g" values R2
in the static analysis of the support.

For the cases when the conduit support is attached to steel platform bring the fact to Supervisor's attention in order to obtain steel platform response spectra.

5.3 LOAD COMBINATIONS

Load combinations to be considered shall be as specified in the Unit #1 Design Criteria (SAG. CP10) |R1

a. Generic Supports

The required load combinations based on the orientation the support is mounted (floor, ceiling or wall) are identified in the computer skeleton for generic supports (see Attachment "K1")

b. Modified and "IN" Supports

Specific load combinations for modified and "IN" supports are identified in the computer input skeletons prepared for "g" values which require to be rotated (see Attachment "K2") and those for which rotation is not required (see Attachment "K3"). |R2

6.0 ALLOWABLE STRESSES

Allowable stresses shall be as specified in the Unit #1 Design Criteria (SAG.CP10).

Structural members shall be designed to account for a possible undercut of 1/32" at welding locations. This will affect interaction ratios computed based on formulas in Section 1.6.1 of the AISC Spec. The reduction in the interaction ratios to be used for structural members due to 1/32" undercut is provided in Attachment "F".

6.1 PUNCHING SHEAR AT TUBULAR CONNECTIONS: (Main Members Only)

a. The allowable normal weld forces for OBE condition for stepped tubular section connections is listed in Attachment "L".

The allowables are determined based on the punching shear requirements stipulated in Section 10.5 of AWS D1.1, 1979 Edition R2

The following clarifications are provided in conjunction with the allowable normal weld force table:

1. Deleted

R3

6.1 PUNCHING SHEAR AT TUBULAR CONNECTIONS: (Main Members Only) (Cont'd)

R3

2. SSE allowables shall be 1.6 times OBE allowables provided they do not exceed the following limit:

Limit on SSE Allowables (lbs/in)	Main Member Thickness (inch)
4310	3/16
5750	1/4
7185	5/16
8625	3/8

R2

3. When the branch member is adjacent to the open end of the main member ($\leq$ 2D) only 50 percent of the allowable will be used. If the allowable is exceeded, provide cover plates at the open end of the main member, and weld all around, using a 3/16 min. fillet weld.

4. Where possible an all around weld between TS members should be used in design, unless it is not feasible to construct.

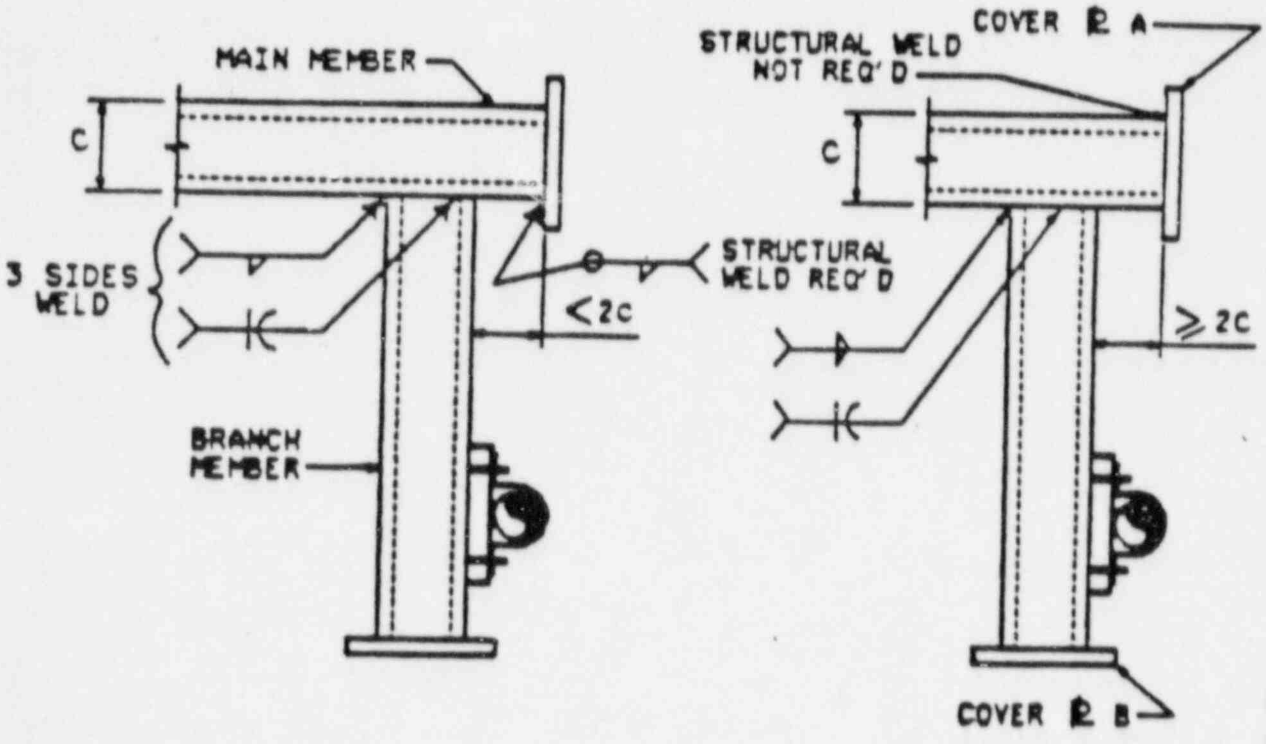
5. For formulas used in calculating the punching shear and nomenclature for stepped connection, See Attachment "L".

6.1 PUNCHING SHEAR AT TUBULAR CONNECTIONS: (Main Members Only) (Cont'd)

b. No punching shear requirement for matched box connections whether perpendicular or skew; however, minimum edge distance from the side of branch member to the end of main member shall not be less than 2X Depth(C)of main member. If minimum edge distance is not met, one of the following shall be satisfied. R3

1. Structural weld between branch member and main member shall be evaluated by using 3 sided weld

2. Cover plate shall be welded all around to main member by using a structural weld.



6.2 WARPING STRESSES

After the static analysis results are obtained, torsional moments are found in various members. These torsional moments generate warping stresses (both normal and shear) on members with open cross-sections (Attachment "M") which have to be added to the normal and shear stresses obtained from the frame analysis done by computer. A few typical cases where warping stresses should be considered are illustrated on Figure 2. For special cases contact your group leader for guidance. For this purpose Attachment "M" or any other approved procedure may be used.

6.3 EVALUATION METHODOLOGY OF OVERSIZED BOLT HOLE EFFECTS

For "IN", modified and generic conduit support redline drawings, the following procedure shall be used to evaluate bolt hole edge distance and bolt stresses to account for the oversized bolt hole effects.

a. Bolt Hole Edge Distance

For connections with more than two (2) bolts, the oversized bolt hole effect need not be considered if the "As-Built" dimensions from center of bolts to free edges (edge distance) meet the edge distance requirement specified in Table 1.16.5 of the AISC Specification (7th Edition).

For two (2) bolt connections, the worst edge distances to free edges of structural member or plate shall be computed as follows:

$$d_w = d - e$$

Following Sheet is 22a

6.3 EVALUATION METHODOLOGY OF OVERSIZED BOLT HOLE EFFECTS (Cont'd)

a. Bolt Hole Edge Distance (Cont'd)

where: d_w = Worst Edge Distance (From centerline of bolt to nearest free edge)

d = "As-Built" Edge Distance (From centerline of bolt to nearest free edge)

e = Permissible Bolt Hole Oversize Based on Statistical Evaluation are shown below. (Bolt Hole Dia - Bolt Dia)

The minimum d_w shall be considered in the design validation of support.

R4

BOLT DIAMETER (INCH)	BOLT HOLE OVERSIZE (e) (INCH)
3/8	3/16
1/2	3/16
5/8	1/8
3/4	3/16
1	3/8
1 1/4	3/8
1 1/2	3/8

If calculated d_w is equal to or greater than the minimum edge distance specified in Table 1.16.5 of the AISC Specification (7th Edition), the "As-Built" edge distance is acceptable.

For cases where above requirements (as applicable) are not met, the

Following Sheet is 22b

6.3 EVALUATION METHODOLOGY OF OVERSIZED BOLT HOLE EFFECTS (Cont'd)

a. Bolt Hole Edge Distance (Cont'd)

worst edge distance shall be checked to assure that the shear stress in the net section of the connecting part produced by bolt shear load (bolt capacity or actual bolt load described in paragraphs 6.3.b and 6.3.c) is less than 0.3 Fu. Fu is 58 Ksi for A36 steel.

b) Bolt Stresses for Bolts in Steel to Steel Connections

Allowable bolt stresses for bolts used in steel to steel connections shall be calculated considering the connection as a bearing connection with threads in the plane of shear.

Bolts subjected to combined shear and tension loads shall satisfy the interaction formula specified in AISC Specification, Section 1.6.3. R4

In calculating the shear in bolts for two bolt connections, the total shear force parallel to an axis common to both bolts (excluding shear due to torsion on the connection which is applied to both bolts) shall be considered as acting on one (1) bolt only.

c) Bolt Stresses for Bolts in Steel to Concrete Connections

Bolts subjected to combined shear and tension shall satisfy the interaction formula specified in Appendix 2 of SAG.CP10.

In calculating the shear for bolts in two bolt connections, the total shear force parallel to an axis common to both bolts (excluding shear due to torsion on the connection which is applied

Following Sheet is 22c

6.3 EVALUATION METHODOLOGY OF OVERSIZED BOLT HOLE EFFECTS (Cont'd)

c) Bolt Stresses for Bolts in Steel to Concrete Connections (Cont'd)

to both bolts) shall be considered as acting on one (1) bolt only. However, if the shear ratio (actual shear divided by allowable shear) is less than or equal to 0.25, the oversized bolt hole effect need not be considered. R4

6.4 EVALUATION OF INSTALLATION TOLERANCES

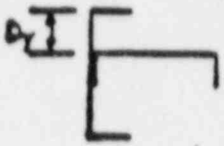
Installation tolerances specified on the generic 2323-S-0910 shall be considered in the design verification.

Following Sheet is 23

7.0 SHEAR CENTER LOCATION OF COMPOSITE CHANNELS

Attachment "E" is a summary of shear center locations for the following composite sections which consist of two channels:

1. C6 x 8.2 and C6 x 8.2
2. C8 x 11.5 and C6 x 8.2
3. C6 x 8.2 and C4 x 5.4



Due to variation of distance "Dy", the above composite sections represent twenty two different sections used in the Comache Peak project.

Notes:

1. Attachment "E" also includes the information on C.G. and the area moments of inertia with respect to principal axes as indicated by I1-1 and I2-2.

2. The above information was determined by a computer program which is written in Basic and can be run on IBM PCs and other compatible models.

3. If the shear center location is needed for composite section other than those supplied forward the geometrical configuration to your group leader and the information will be provided.

8.0 WELD DESIGN VERIFICATION

Allowable stresses for welds shall be as specified in the Unit #1 Design Criteria (SAG. CP10).

Provision shall be made for an undersize of 1/32 inch for fillet welds as per the Unit #1 Design Criteria (SAG. CP10).

In order to standardize welding stress calculations, forms provided for this purpose shall be used.

a. Minimum Weld Size

Welds not meeting the AWS code minimum weld size requirements, but found through detailed analysis to have stress within the allowable stress, are acceptable from a design verification standpoint. However, a minimum acceptable structural weld (as shown on the As-Built drawing) shall not be less than 1/8 inch.

b. Warping Stresses in Anchorage Welds

In cases where members are subjected to warping effects (members welded "all around" at embedded plates or anchored plates or other members), the anchorage weld verification shall include warping stresses in addition to other stresses. For such cases, warping will cause two additional stresses in the weld. One of these will be in the same direction as, and must be added to, the shear stresses caused by direct shear and pure torsion loads. The other warping stress is in the same direction as, and must be added to, normal stresses caused by member axial and bending loads. These two total weld stresses must then be combined by SRSS.

8.0 WELD DESIGN VERIFICATION (Cont'd)

c. The stress on welds between composite channels shall be calculated by the "Combs" program. Long hand calculations are not recommended.

d. For the effective throat thickness of prequalified partial penetration bevel groove welds, see Attachment "H". |R1

9.0 ANCHORAGE EVALUATION

Base plate analysis can be performed by hand calculations or by computer analysis. In either method, Hilti bolt interaction and base plate/angle stresses shall be checked.

a. Hand Calculations

The procedure given in Attachment "G" (approximate method) may be used to evaluate stresses in the base plate, surface angle and anchor bolts.

If the anchorage can not be qualified by hand calculations, or the configuration is not covered in Attachment "G", a computer analysis shall be performed.

R2

b. Base Plate Finite Element Analysis

The computer analysis for the base plate shall be performed using the PD STRUDL base plate program with anchorage loads obtained from the static run. The effect of prying action and anchorage flexibility will be accounted for. Input sheets for a standard computer run provided for this purpose shall be used.

c. Anchoring with Bolts in Combination with Welds

When welds are used together with Hilti bolts for anchoring the base plate, welds should be designed such that total shear force is resisted by weld alone. Tension force will be distributed between bolts and weld according to their relative axial stiffness. For the design of the Hilti's shear forces shall be considered to be resisted by the Hilti bolts and welds in proportion to their shear stiffnesses.

10.0 INTERFACE REQUIREMENTS

Conduits in our scope of work are sometimes connected/attached to the the supports of subsystems/systems which are in the scope of other disciplines such as Cable Tray Hangers (CTH) and pipe supports. In addition, conduits not in our scope of work may be supported by conduit supports within our scope of work.

R2

a. Interface requirements with Ebasco CTH group, SWEC and Impell shall be in accordance with Task Description TE-TD-EB-033 (Reference 8).

b. Any information missing on the redline drawings which are required for design verification of IN and Modified supports shall be requested form the walkdown group.

11.0 RESOLUTION OF INACCESSIBLE AREA (I.A.) ITEMS

For resolution of Inaccessible Attributes see Attachment K to SAG.CP25. R4

11.0 RESOLUTION OF INACCESSIBLE AREA (I.A.) ITEMS (Cont'd)

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12.0 FOOTPRINT LOAD (FPL) AND ENGINEERING EVALUATION OF SEPARATION VIOLATION (EESV) FORMS

a. Footprint Loads

For each support analyzed which has attachments to embedded plates or has attachments consisting of Hilti bolts/Richmond inserts that violate the minimum spacing requirements specified in App. 3 of Unit #1 Design Criteria SAG.CP-10 (Spec. No. 2323-SS-30) or Attachment "N2" a set of footprint loads (maximum absolute values) must be developed and the information must be incorporated in the footprint load transmittal form (referenced in procedure ECE 5.11-14) which is then transmitted to the Structural Embedment Group (SEG). Each engineer must be aware that the local coordinate "Y" is always assumed normal to the embedded plate to which the support is attached. Therefore, the XYZ axes used in the analysis in general do not coincide with the XYZ on the transmittal form. The engineer must relate properly the Fx, Fy, Fz, Mx, My, Mz from analysis with the Fx, Fy, Fz, and Mx, My, Mz on the transmittal form. The footprint loads shall be given in Kips and Ft-Kips. The forces must be developed always at the intersection point of the c.g. of the support member and the surface of the embedded plate and/or anchored baseplate (building surface element).

12.0 FOOTPRINT LOAD (FPL) AND ENGINEERING EVALUATION OF SEPARATION VIOLATION (EESV) FORMS (Cont'd)

a. Footprint Loads (Cont'd)

To Summarize:

1. Footprint load transmittal forms must be completed for each support with building atachments which affect the qualification of embedded plates. These are attachments that are welded directly to the embedded plates or are attachments via concrete expansion anchors (CEA)/Richmond inserts that are closer to an embedded plate than the minimum distance specified in Attachment N2 or App. 2 of the Unit #1 Design Criteria (SAG.CP-10).

2. Loads are required to be listed in the local coordinate system and are unsigned (maximum absolute value).

3. One footprint load transmittal form is required for each attachment point and each attachment point shall be identified by a number obtained from SEG.

4. To void a previously submitted FPL, a copy of the FPL shall be submitted to SEG stating on the form that the FPL is void and the reason it was voided.

5. Any revisions to be made to the footprint load transmittal forms shall be prepared with all items filled out on a new footprint load transmittal form (see Attachment "N3").

6. When footprint loads provided for a conduit support attachment are based on an envelope load case drived from a representative calculation, the loads shall be indicated as "conservative" Item No. 8 on the footprint load transmittal form.

12.0 FOOTPRINT LOAD (FPL) AND ENGINEERING EVALUATION OF SEPARATION VIOLATION (EESV) FORMS (Cont'd)

b. Engineering Evaluation of Separation Violation (EESV)

The following guidelines apply for filling out EESV forms.

1. EESV form shall be filled out whenever separation violations exist, per Appendix 3 of Reference 1 (Spec. No. 2323-SS-30) or as shown on Attachment "N5".

2. Attachment "N5" shows: 1) cases where an EESV form is required (also shown in a tabular form on Attachment "N4"; 2) methods to be used in evaluating the separation violation; and 3) dimensions to be shown on conduit support drawing. R2

3. Attachment "N5" shows a sample EESV form and depicts how the information should be filled out.

4. i. Transmittal letters for EESV form approval shall be prepared by an originator of calcualtions and sent out to concerned disipline by a checker. Standard transmittal letters should be used. If a support is released pending approval of the EESV form, the copies of the transmittal letter and the EESV form shall be made an attachment to the calculations.

12.0 FOOTPRINT LOAD (FPL) AND ENGINEERING EVALUATION OF SEPARATION VIOLATION (EESV) FORMS (Cont'd)

b. Engineering Evaluation of Separation Violation (EESV) (Cont'd)

4. (Cont'd)

ii. When the response from affected discipline/organization the receival date should be entered in the log book and EESV form made an attachment to the calculations.

iii. If the EESV form is received after releasing the support drawing, it will then be incorporated into calculation package during next revision or ISO evaluation phase. In the interim, a copy of the approved EESV form will be left in the calculation package and original will be filed in a folder (or binder) labeled "EESV Forms To Be Incorporated".

5. Whenever separation violation exists between two conduit/junction box supports, both drawings shall be identical in showing the violation. If both support drawings are not identical or one drawing does not show the violation at all, the inconsistency shall be rectified.

12.0 FOOTPRINT LOAD (FPL) AND ENGINEERING EVALUATION OF SEPARATION VIOLATION (EESV) FORMS (Cont'd)

b. Engineering Evaluation of Separation Violation (EESV) (Cont'd)

6. Revision of EESV Card

When an EESV card needs to be revised because of a revision to a modified/"IN" drawing, the original EESV card shall be revised to show the change. This shall be documented by putting another set of signatures by the preparer and the checker of the current calculation revision (see Attachment "N6"). The EESV card shall be clouded to highlight the change with a calculation revision number shown in a triangle.

7. A new transmittal letter with a new file number shall be used to transmit the revised EESV card to other discipline. A note stating "This Letter supersedes transmittal File No. ________ dated ________" shall be put at the bottom of the transmittal letter. The same shall be noted in the EESV card log book remark column. R2

13.0 REFERENCES

1. Design Criteria for Seismic Category I Electrical Conduit System, Unit No.1 (Project Identification No. SAG.CP10).
2. Drawing No. 2323-S-0910 Package.
3. Ebasco Manual of Procedure Appendix Q, instruction for Unit No. 1 conduit calculation package preparation.
4. Procedure ECE 5.11-I4, reporting attachment loads and locations to the structural embedment group.
5. Procedure ECE 5.01-13. Design Change Authorization.
6. CPE-FVM-CS-033, Design Control of Electrical Conduit Raceways for Unit No.1 Installation in Unit 1 and Common Areas.
7. CPE-FVM-CS-014, Design Control of Electrical Conduit Raceways for Unit 2 Installation in Unit 1 and common Areas.
8. Task Description TE-TD-EB-033, Interface Control Guideline.
9. Technical Guidelines for Seismic Category I Electrical Conduit Isometric Evaluation, Unit 1 and Common Areas (Project Identification No. SAG.CP25)

R2

TABLE 1

ORIENTATION OF BUILDING GLOBAL COORDINATES

BUILDING	VERTICAL	N-S	E-W
Reactor Building Internal Structures	Y	X	Z
Safeguards Building	Y	Z	X
Electrical Building	Y	Z	X
Auxiliary Building	Y	Z	X
Fuel Building	Y	Z	X
Containment Building	Y	X	Z
Diesel Generator Building	Y	Z	X

R2

TABLE 2

ENVELOPED DESIGN "G" VALUES

Building	2% Damping			3% Damping			
	OBE			SSE			
	g_x	g_y	g_z	g_x	g_y	g_z	f_{supt} (Min.)
Elect Control	1.19*	1.98*	2.12*	1.82*	3.10*	2.50*	16 Hz
Safeguards	1.95	3.53	2.73	2.88	4.87+	4.13	16 Hz
Auxiliary	1.79	4.08	1.88	2.30*	4.87*	2.64*	14 Hz
Internal Struct	2.14*	2.42*	2.14*	3.13*	3.36*	3.13*	12 Hz
Containment	1.41*	3.63*	1.56*	1.79*	4.25*	2.19*	12 Hz
Fuel (below El 860.00')	2.43*	2.01*	2.43*	3.47*	3.03*	3.57*	16 Hz

R2

* 'g' value may be enveloped by other building.

+ Original value 4.83 was increased to 4.87 to envelope other building.

The Diesel Generator Building is contained within the Safeguard Building.

TABLE 3A

BUILDING & ELEVATION GROUPS FOR JUNCTION BOX SUPPORTS

Group No.	I_A	I_B	II_A	II_B	III_A	III_B
Mm. Supt. Frequency Req'd (Hz)	12	16	12	16	12	16
Elec Control Bldg (Elev)	-	-	873.33" 854.33'	-	830.00'	807.00' 778.00'
Fuel Bldg (Elev)	-	-	-	860.00' 841.00' 825.00'	-	810.50'
Safeguards Bldg (Elev)	-	896.50' 873.50' 852.50'	-	831.50' 810.50' 790.50' 785.50'	-	773.50'
Auxiliary Bldg (Elev)	899.50' 886.50' 873.50' 852.50'	-	831.50' 810.50'	790.50'	-	-
Containment Bldg (Elev)	1000.50' 950.58' 905.75'	-	783.58'	860.00' 805.50'	-	-
Internal Structure (Elev)	905.75' 885.50'	-	860.00' 832.50' 808.00' 783.58'	-	-	-
Diesel Generator Bldg (Elev)	-	844.0'	-	810.50'	-	-

R2

TABLE 3B

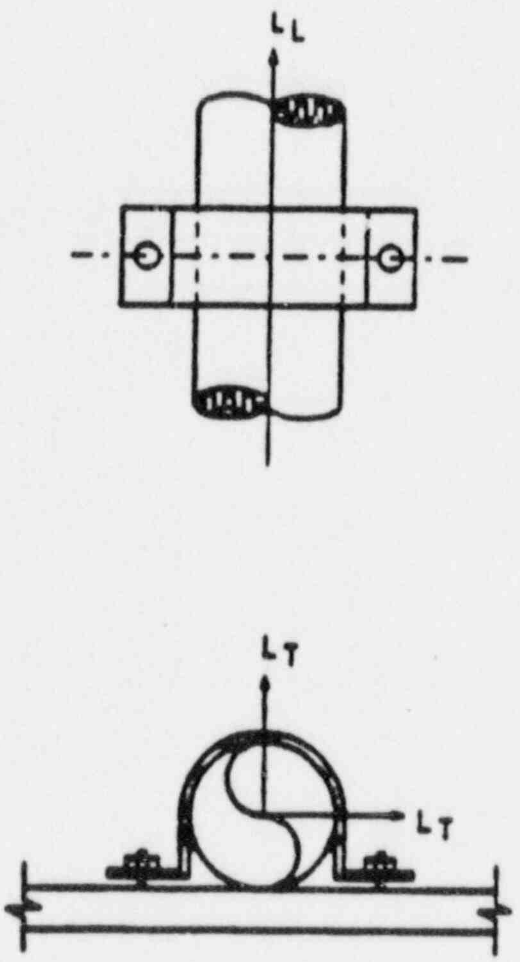
EQUIVALENT COEFFICIENT AND "G" VALUE GROUPING FOR JUNCTION BOX SUPPORTS

Group No.	Description	OBE (2% Damping)			SSE (3% Damping)		
		Max	Med	Min	Max	Med	Min
I_A & I_B	1.5 x Peak "G"	6.35	5.54	4.15	7.51	6.51	4.78
	Design "G"	4.08	3.55	2.66	4.87	4.23	3.11
	Equivalent Coef.	1.56	1.56	1.56	1.54	1.54	1.54
II_A & II_B	1.5 x Peak "G"	3.81	3.28	2.89	5.10	4.36	3.50
	Design "G"	2.43	2.43	2.01	3.57	3.47	3.03
	Equivalent Coef.	1.57	1.35	1.44	1.43	1.26	1.16
III_A & III_B	1.5 x Peak "G"	2.77	2.36	2.10	4.16	2.91	2.71
	Design "G"	2.12	1.85	1.60	3.10	2.31	2.02
	Equivalent Coef.	1.31	1.28	1.31	1.34	1.26	1.34

Note: Use coeffiecient underlined to multiply weight of junction box and its contents to obtain equivalent weight to be used in static analysis with design "g" values.

FIGURE 1

DEFINITION OF TRIBUTARY CONDUIT LOAD ON SUPPORT

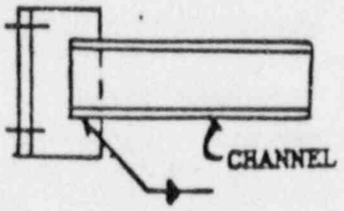


R2

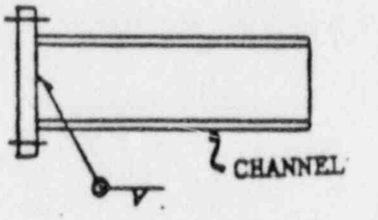
FIGURE 2

TYPICAL CASES FOR WARPING CONSIDERATION

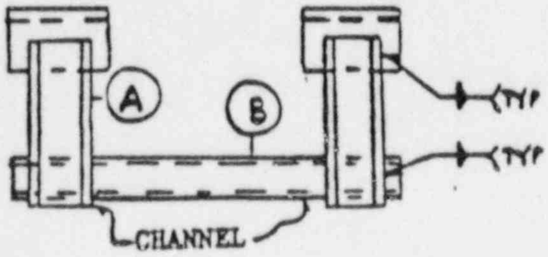
R2



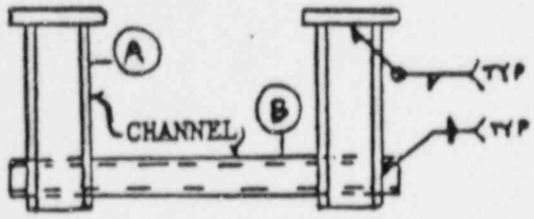
NO WARPING STRESS



WARPING STRESS
FIXED - FREE CONDITION



MEMBER "A" - NO WARPING
MEMBER "B" - WARPING STRESS
HINGE-HINGE CONDITION



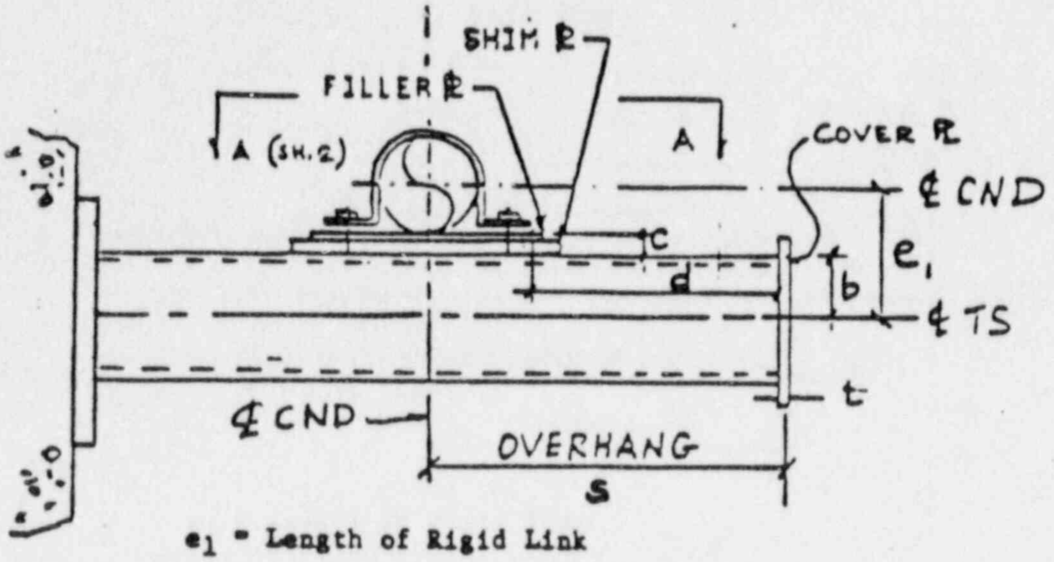
MEMBER "A" - WARPING STRESS
FIXED-FREE CONDITION
MEMBER "B" - WARPING STRESS
HINGE-HINGE CONDITION

ATTACHMENT A

LOAD ECCENTRICITIES ON MEMBERS

R1

ATTACHMENT A - LOAD ECCENTRICITIES ON MEMBERS



R2

e_1 = Length of Rigid Link

= 1/2 conduit O.D.* + b + c

S = Overhang

= 1/2 (Conduit Clamp Length* + t) + d

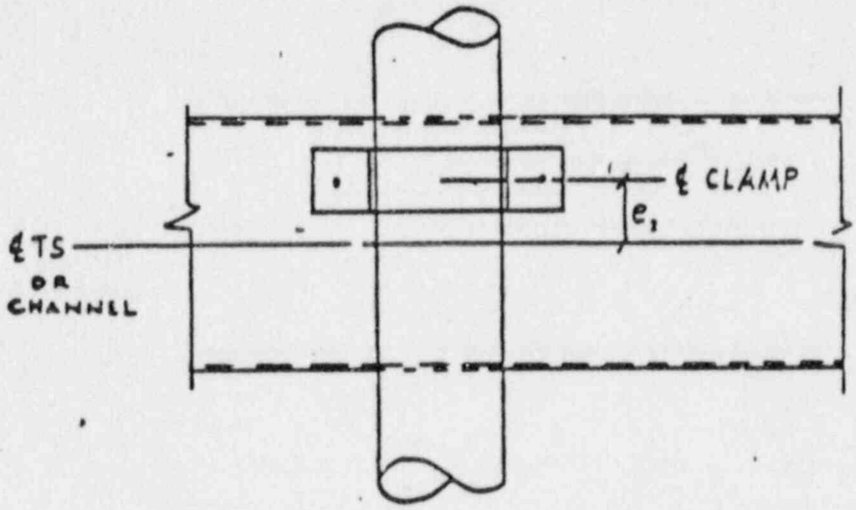
* Use 5" Ø max. conduit unless otherwise noted.

c = Maximum combined thickness of shim plates and filler plate as shown on the drawings. (use 1-1/4" max. if not specified). R1

d = Maximum distance between edge of clamp and the tip of tube as shown on the drawings. (use 2" if not specified).

t = cover plate thickness.

Note = Weight of cover plate shall be lumped at the tip of the tube.



e_2 = Length of Rigid Link

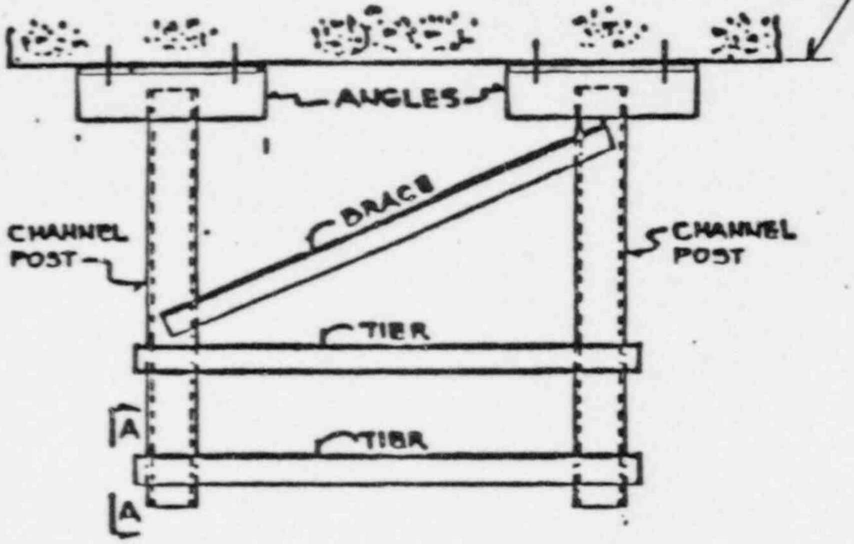
Section A - A

ATTACHMENT B

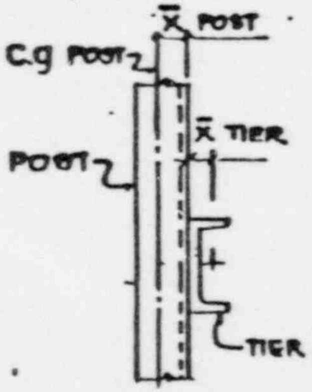
MEMBER ECCENTRICITIES AND WORKING POINTS

R1

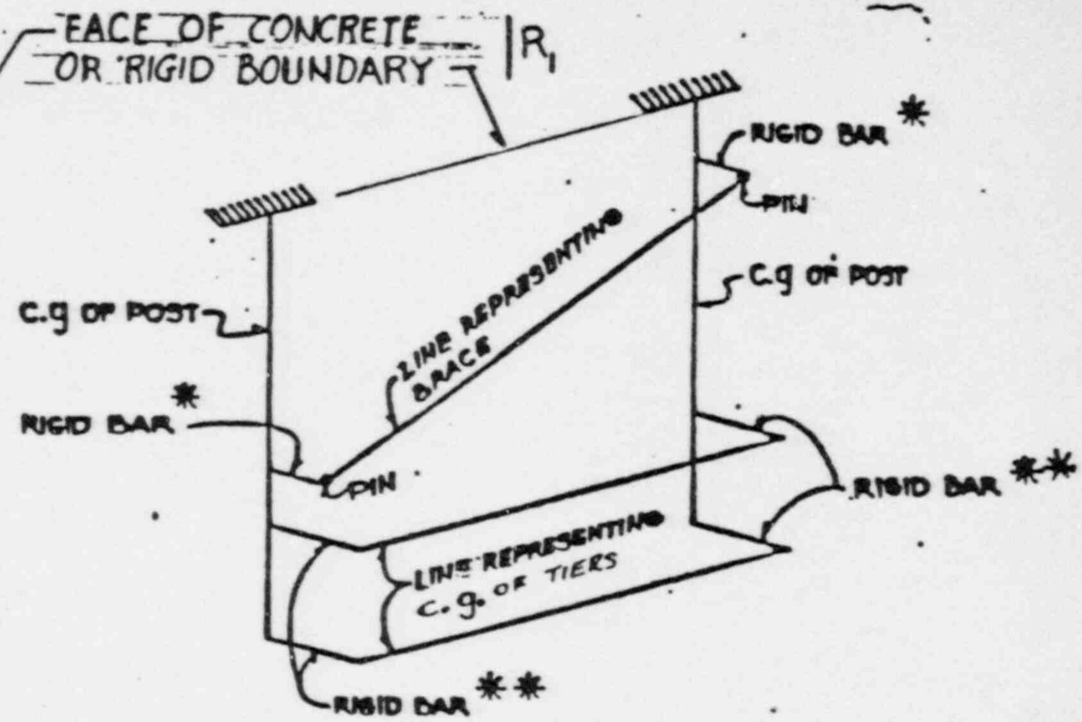
ATTACHMENT B1_MEMBER ECCENTRICITIES



ACTUAL SUPPORT CONFIGURATION



SECTION A-A



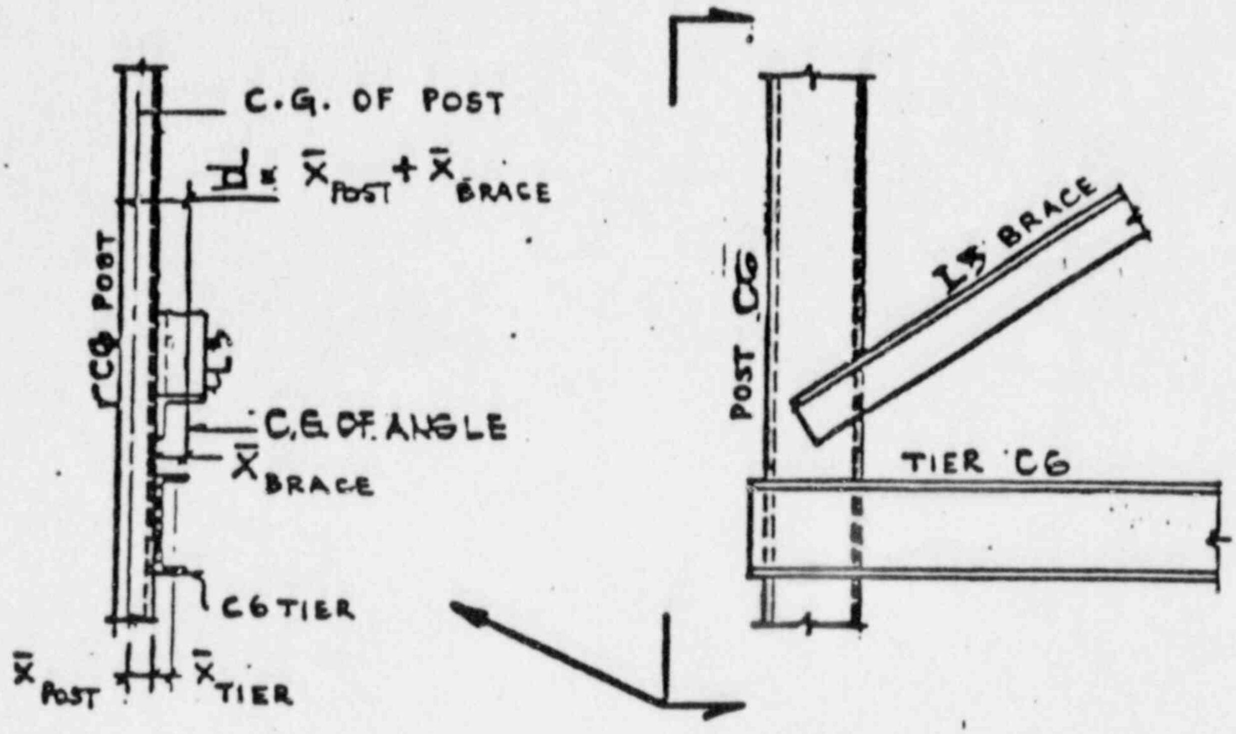
MODEL

* SEE ATTACHMENT B2 FOR LENGTH OF RIGID BAR TO BE INPUT. AFTER RUNNING MODEL, GO BACK AND CHECK BRACE WITH AN ECCENTRICITY EQUAL TO $C.g._{POST} + C.g._{BRACE}$

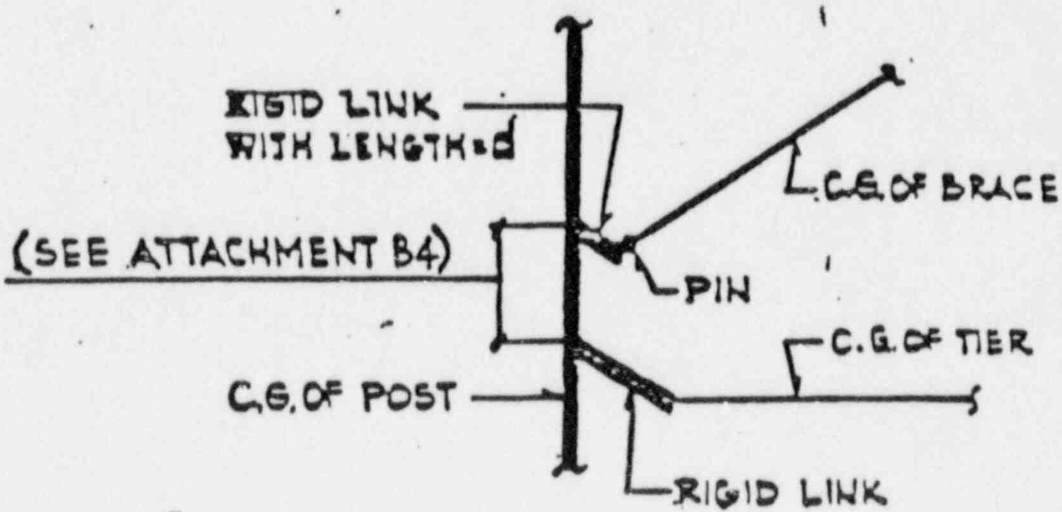
** L = LENGTH OF RIGID BAR REPRESENTING THE POST-BEAM EFFECTIVE ECCENTRICITY

$L = \bar{x}_{POST} + \bar{x}_{TIER}$

ATTACHMENT B2- ECCENTRICITIES FOR BRACES WELDED TO THE BACK OF VERTICAL POST



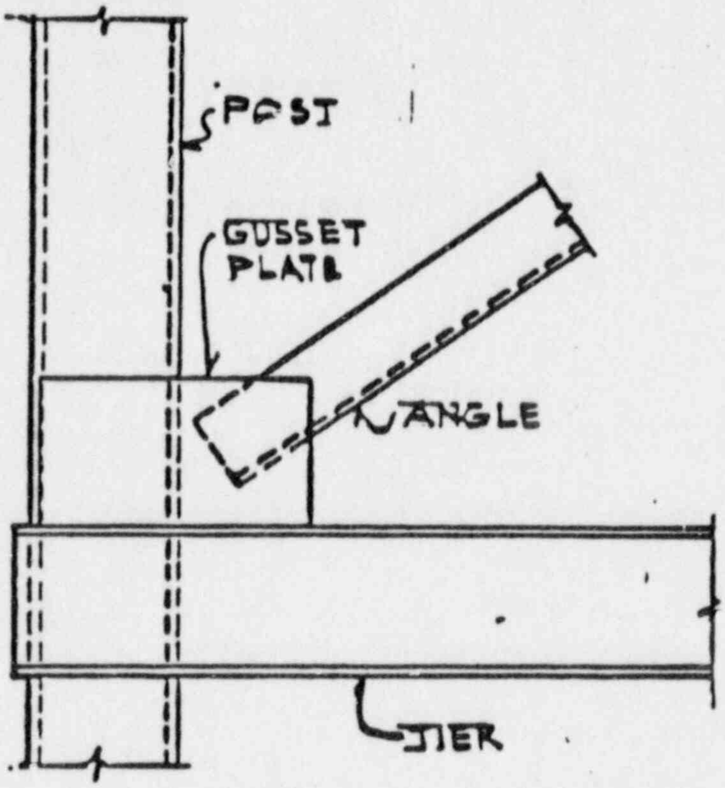
ACTUAL SUPPORT DET.



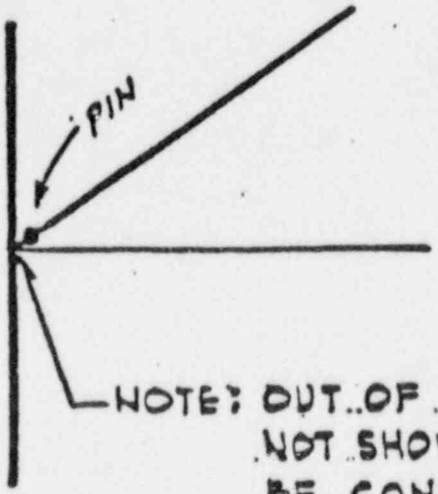
MODEL

ATTACHMENT B3- WORKING POINT ECCENTRICITY FOR BRACE WITH GUSSET PLATES

ACTUAL
SUPPORT
DETAIL

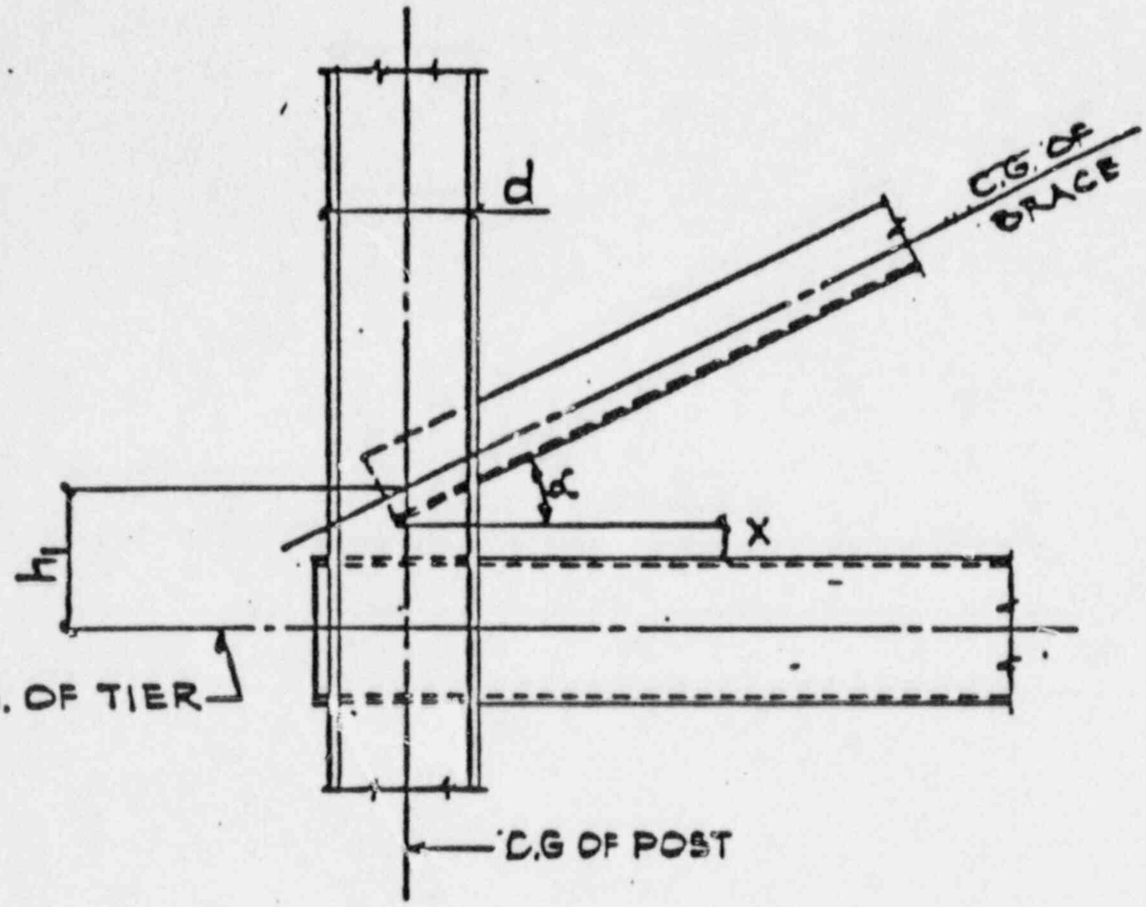


COMPUTER
MODEL
INPUT



NOTE: OUT OF PAPER ECCENTRICITY NOT SHOWN HERE BUT SHOULD BE CONSIDERED IF IT EXISTS.

ATTACHMENT B4- WORKING POINT ECCENTRICITY FOR BRACE WITHOU GUSSET PLATES



ACTUAL SUPPORT DETAIL

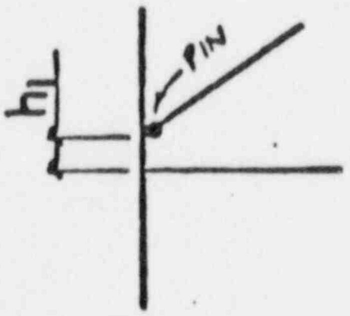
R1

CONDITIONS:

$X < \frac{d}{2}$ FOR $\alpha \geq 50°$

$X < \frac{d}{3}$ FOR $\alpha < 50°$

MODEL WHEN CONDITIONS ARE MET
(SEE ATTACHMENT B2)



MODEL WHEN CONDITIONS ARE NOT MET
(SEE ATTACHMENT B2)

ATTACHMENT C

KL/r REQUIREMENTS AND K FACTORS

|R1

ATTACHMENT C - KL/r REQUIREMENTS

1. <u>Compression Member KL/r Requirements</u>

Slenderness ratios (KL/r) for "compression members" shall be limited to 200 in accordance with AISC Specification Section 1.8.4.
All support members shall conservatively be considered as "compression members" except for vertical posts as noted below.

2. <u>Classification of support Vertical Post Members of Trapeze, LW and L Shape Configurations and Their KL/r Requirements</u>

Classification of a vertical post member as a "compression" or "tension" member shall be based upon the axial load component. If there is any static compressive force (due to dead load) the member shall be classified as a "compression member" and the requirement in (1) above shall be applied.

If a <u>vertical post member</u> is subject to static tension and the combined static plus dynamic load does not lead to a compressive force greater than 50% of the design compressive strength (where KL/r is used to calculate the design compression strength Fa), the member is classified as a "tension member. R1
A maximum slenderness ratio (L/r) limit of 300 is applied to these members. All other vertical post members shall be classified as "compression members" and the requirements of (1) above shall be applied.

3. <u>"K" Value Determination for Slenderness Ratio Check</u>

K values shall be determined as specified on Sheet C-2 for KL/r check.

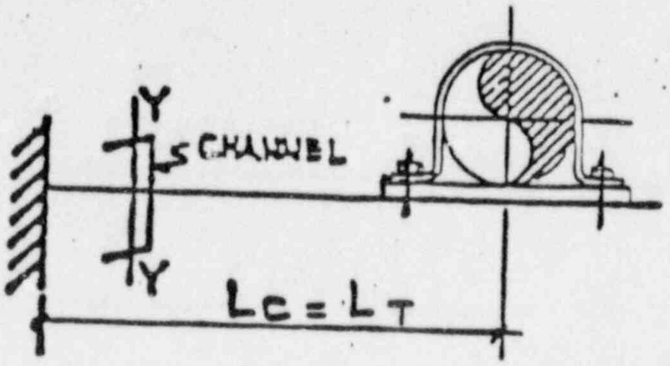
4. <u>Compressive Stress Check Requirement</u>

Regardless of the member classification, a full compressive stress check shall be performed in accordance with the AISC Specification for any member subject to a compressive load, regardless of the amplitude of the load and whether the load is static or dynamic.

For compression members, the appropriate "K" value shall be used. For "tension members", (K=1) shall be used.

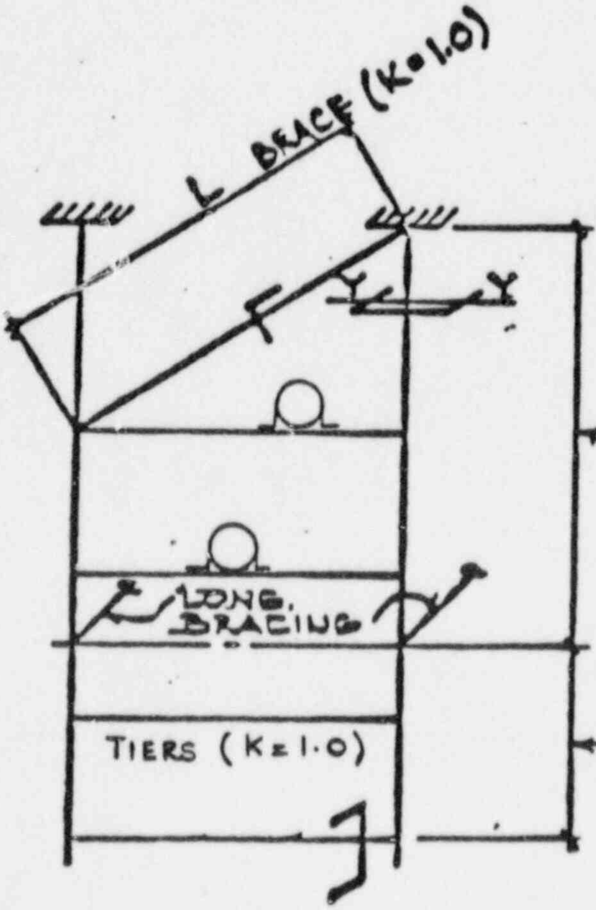
ATTACHMENT C - K FACTOR

a) Cantilever Support



$K = 2.0$ For compression members R1

b) Trapeze Support with Out-of-Plane Bracing



For this segment of post: K=1.0 (for compression & tension members*) R1

For this segment of post: K=1.0 if tension member*; K=2.1 if compression member*

*See sheet C-1 for definition

ATTACHMENT D

ADDITIONAL NOTES ON MODELS AND DESIGN VERIFICATION

R1

ATTACHMENT D - ADDITIONAL NOTES ON MODELS AND DESIGN VERIFICATION

1. The model should be drawn in the calculations.

2. The global Axes should be shown.

3. Node points should be circled. The starting point may be assigned as point no. 1 and the remaining points numbered in sequence. R2

4. Members should have the member number indicated by placing a box around the member number.

5. Arrow Heads should indicate the + X Local Axis for the member. (This is determined by the way the member incidences are input.)

6. Two copies of output should be printed. These copies should be separated and carbon paper discarded.

7. Each copy should be stamped twice with the following stamp.

TEXAS UTILITIES GENERATING CO.
COMANCHE PEAK UNIT 1
SUBJECT .... SUPPORT VERIFICATION ....
COMPUTER PROGRAM ....
PREPARED BY: .... DATE ....
CHECKED BY: .... DATE ....
CALCULATION BOOK NO. ....

First stamp is for input where card input is copied. Second stamp is placed in front of run to reflect that the entire run results are correct and reasonable. (on page where "Strudl version" is shown).

8. Deleted R1

9. For all calculations:

E_s (Modulus of elasticity for steel) = 29×10^3 ksi

E_c (Modulus of elasticity for concrete) = 3460 ksi

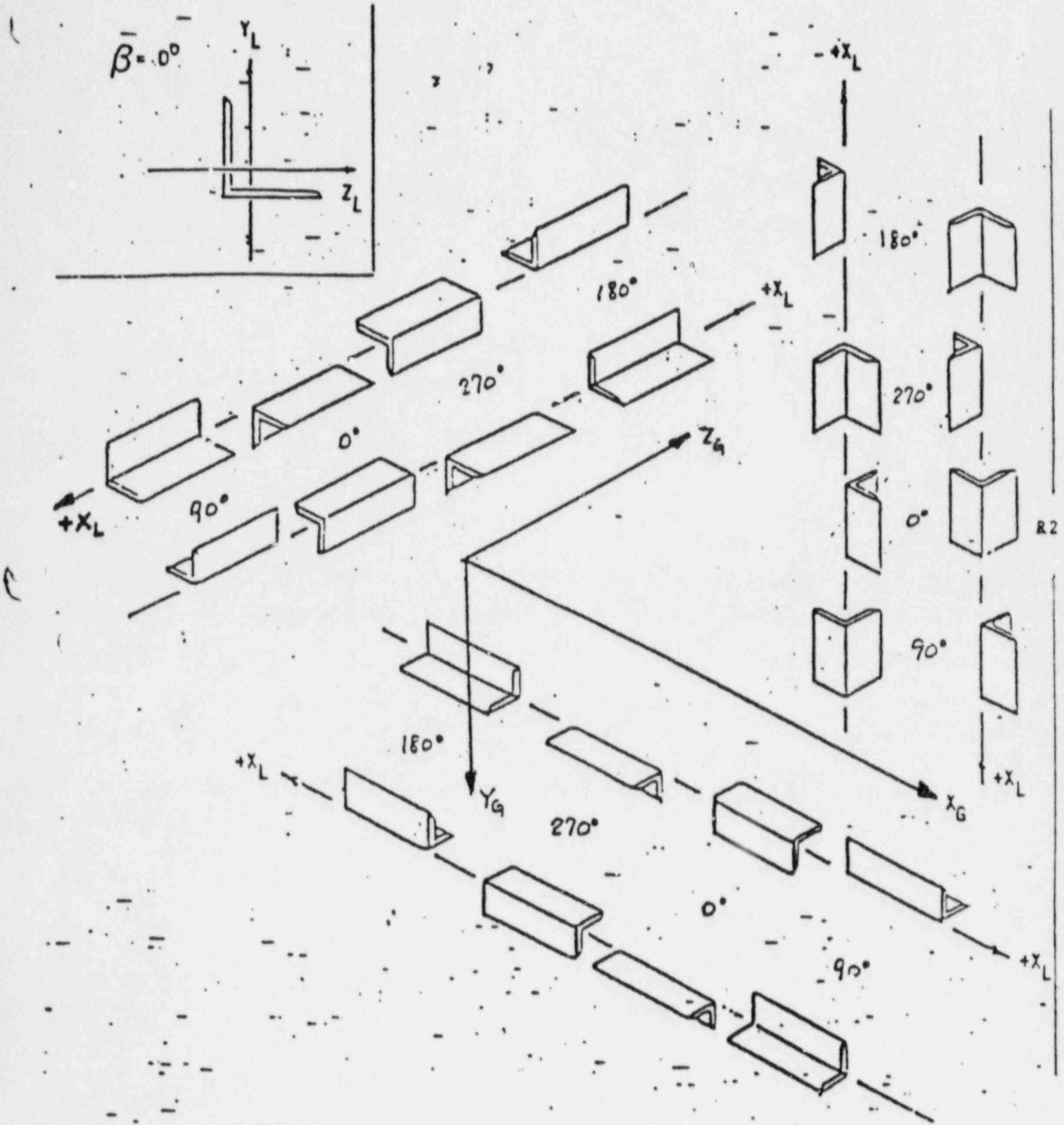
G (Shearing Modulus of elasticity for steel) = 11.2×10^3 ksi

10. If any section with a used or unused bolt hole has an interaction equation coefficient larger than 0.75, the section shall be manually verified by reducing the area and moment of inertia to account for the bolt hole.

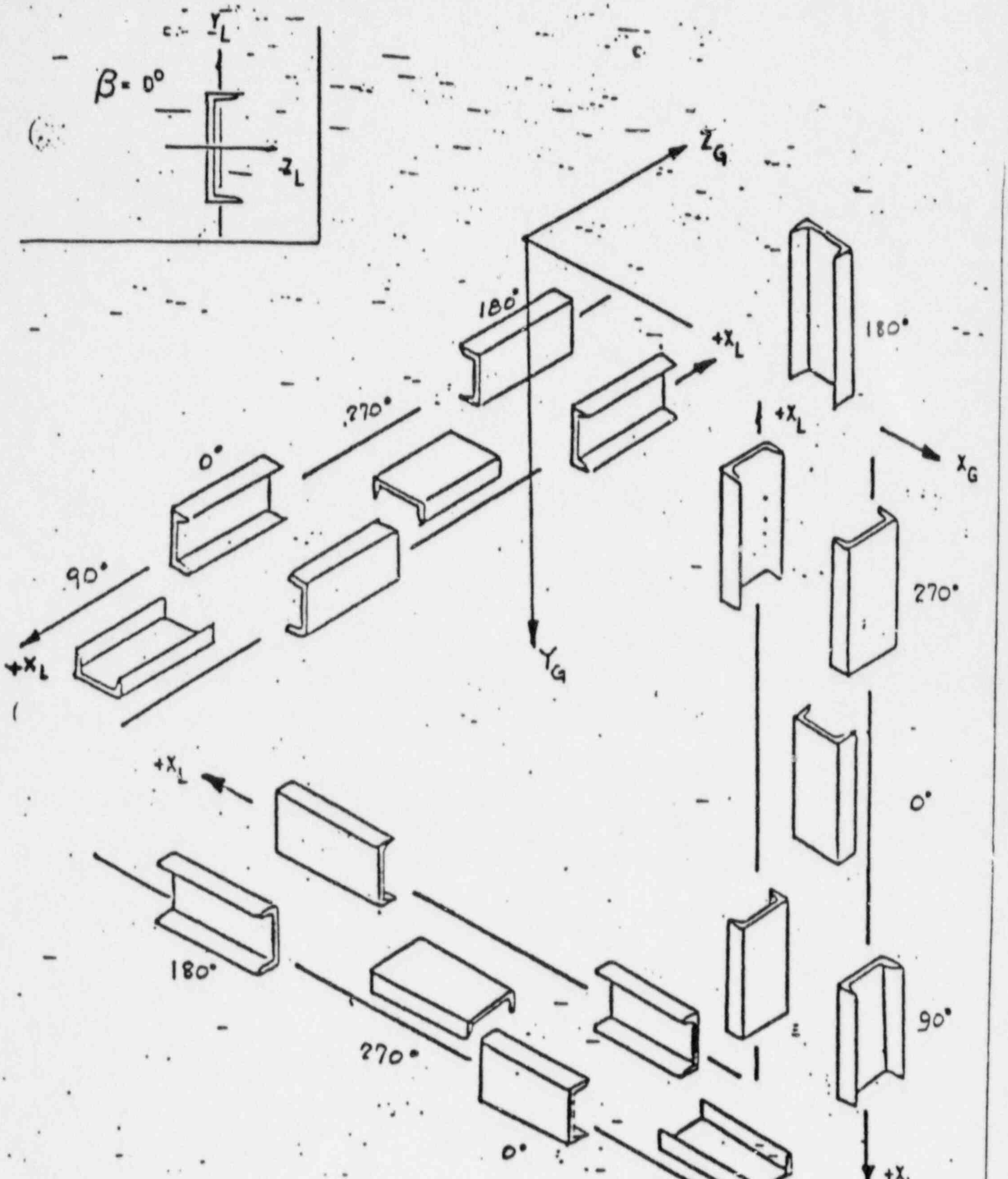
11. Whenever an as-built drawing shows that a conduit orientation is not perpendicular to a support (skewed), the forces should be appropriately decomposed into components.

12. Principal axes properties shall be used in the design verification of all angle sections under general loading conditions except when the member is restrained at the loading point or at the ends. R1

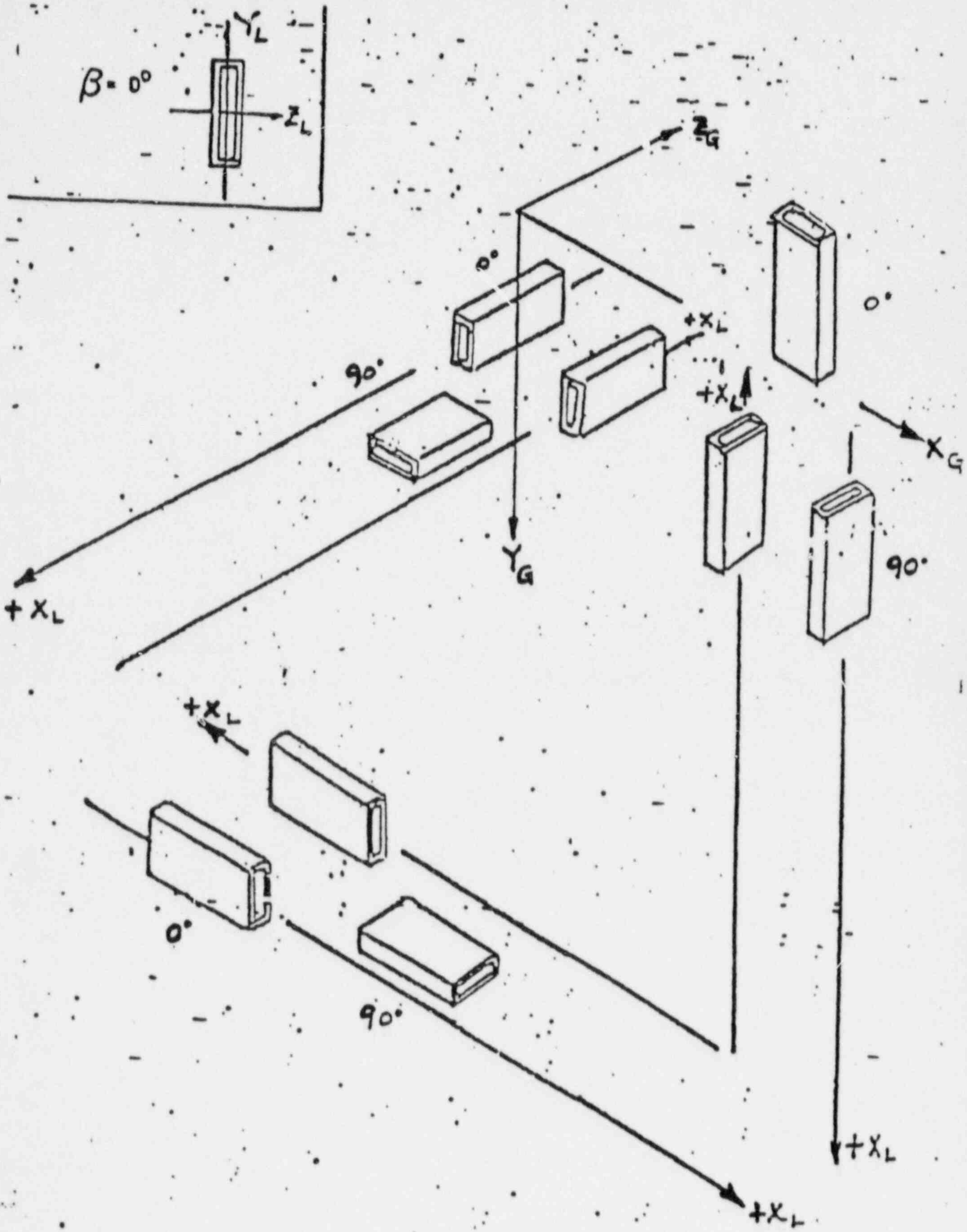
ATTACHMENT D - BETA ANGLES FOR ANGLE SECTION



ATTACHMENT D - BETA ANGLES FOR CHANNEL SECTION



ATTACHMENT D - BETA ANGLES FOR TUBE SECTION



ATTACHMENT E

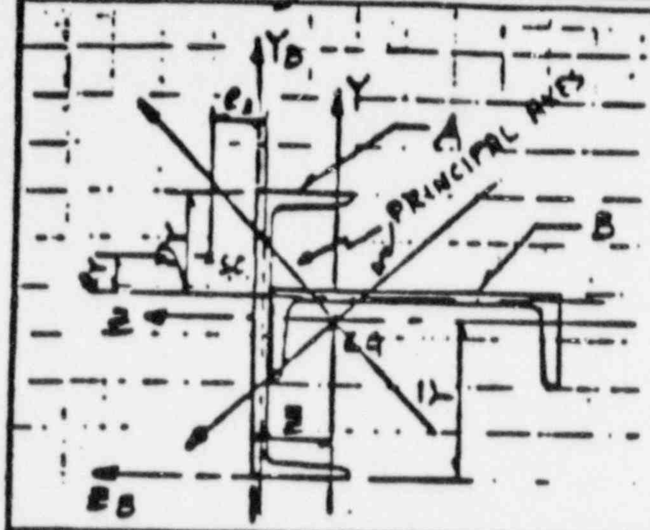
SHEAR CENTER LOCATION OF COMPOSITE CHANNELS

R1

ATTACHMENT E - Shear center location of composite channel

EBASCO SERVICES INCORPORATED

BY C.G.J. DATE 5/10/85
CHKD. BY [illegible] 6/7/85
SHEET 1 OF 2
CLIENT TEXAS UTILITIES GENERATING CO.
OFS NO. 3317-002 DEPT. NO. 549
PROJECT COMANCHE PEAK UNIT 2 AND UNIT 1
CABLE TRAY HANGERS
SUBJECT Summary of Shear Center Location of Composite Channels



Note: Iy-y is moment of inertia about the y-y axis.

Iz-z is moment of inertia about the z - z axis.

Sections		Dy in	Composite C.G.					Composite S.C.	
A	B		$\bar{Y}$ in	$\bar{Z}$ in	I_{zz} in⁴	I_{yy} in⁴	I_{yz} in⁴	e_y in	e_z in
C6x8.2	C6x8.2	3.637	2.344	-1.888	15.946	22.088	4.111	0.698	0.494
C6x8.2	C6x8.2	3.00	2.762	-1.888	14.164	22.088	1.426	0.664	0.480
C6x8.2	C6x8.2	2.00	3.262	-1.888	14.221	22.088	-1.636	0.626	0.476
C6x8.2	C6x8.2	1.00	3.762	-1.888	16.659	22.088	-4.759	0.585	0.487
C6x8.2	C6x8.2	0.443	4.041	-1.888	19.048	22.088	-6.498	0.560	0.498
C6x8.2	C6x8.2	2.524	3.000	-1.888	13.895	22.088	0.00	0.645	0.476
C6x8.2	C6x8.2	2.324	3.100	-1.888	13.942	22.088	-0.625	0.638	0.475
C6x8.2	C6x8.2	2.424	3.050	-1.888	13.906	22.088	-0.312	0.642	0.475
C6x8.2	C6x8.2	2.624	2.950	-1.888	13.906	22.088	0.312	0.649	0.476
C8x11.5	C6x8.2	5.790	3.059	-1.715	40.435	23.894	8.115	0.832	0.716
C8x11.5	C6x8.2	4.000	3.802	-1.715	33.603	23.894	1.705	0.662	0.708
C8x11.5	C6x8.2	5.000	3.387	-1.715	36.319	23.894	5.286	0.756	0.710
C8x11.5	C6x8.2	3.000	4.218	-1.715	33.670	23.894	-1.877	0.569	0.712
C8x11.5	C6x8.2	2.000	4.633	-1.715	36.520	23.894	-5.458	0.473	0.721
C8x11.5	C6x8.2	1.000	5.048	-1.715	42.153	23.894	-9.039	0.374	0.733
C8x11.5	C6x8.2	0.49	5.260	-1.715	46.098	23.894	-10.866	0.321	0.739
C6x8.2	C4x5.4	4.165	2.371	-1.220	15.804	7.163	2.429	0.741	0.616
C6x8.2	C4x5.4	4.000	2.437	-1.220	15.336	7.163	2.176	0.716	0.615
C6x8.2	C4x5.4	3.000	2.834	-1.220	13.600	7.163	0.643	0.570	0.616
C6x8.2	C4x5.4	2.000	3.230	-1.220	13.752	7.163	-0.890	0.422	0.631
C6x8.2	C4x5.4	1.000	3.627	-1.220	15.792	7.163	-2.423	0.263	0.657
C6x8.2	C4x5.4	0.435	3.851	-1.220	17.779	7.163	-3.290	0.168	0.672

ATTACHMENT E - Shear center location of composite channel

EBASCO SERVICES INCORPORATED

BY C. Wu DATE 5/6/85 SHEET 2 OF 2

CHKD. BY [illegible] Haring 6/7/85 OFS NO. 3317-002 DEPT. NO. 549

CLIENT TEXAS UTILITIES GENERATING CO.

COMANCHE PEAK UNIT 2 AND UNIT 1

PROJECT CABLE TRAY HANGERS

SUBJECT Summary of Shear Center Location of Composite Channels

Sections		Dy	Total Area	Composite C.G - Principal Axis		
A	B	in	in²	I_{1-1} in⁴	I_{2-2} in⁴	ϕ_1 (deg.)
C6x8.2	C6x8.2	3.837	4.760	24.140	13.895	-26.581°
↑	↑	3.000	↑	22.358	13.895	-10.281
		2.000		22.415	13.895	11.294
		1.000		24.852	13.895	30.148
		0.443		27.242	13.895	-38.417
		2.524		22.088	13.895	0.000
		2.324		22.136	13.895	4.359
↓	↓	2.424	↓	22.100	13.895	2.182
C6x8.2	C6x8.2	2.624	4.760	22.100	13.895	-2.182
C8x11.5	C6x8.2	5.790	5.731	43.749	20.577	22.230
↑	↑	4.000	↑	33.893	23.603	9.674
		5.000		38.263	21.949	20.196
		3.000		34.018	23.546	-10.502
		2.000		38.552	21.861	-20.423
↓	↓	1.000	↓	45.871	20.176	-22.357
C8x11.5	C6x8.2	0.490	5.731	50.530	19.461	-22.192
C6x8.2	C4x5.4	4.165	3.945	16.440	6.527	14.675
↑	↑	4.000	↑	15.879	6.620	14.020
		3.000		13.663	7.100	5.651
		2.000		13.870	7.045	-7.560
↓	↓	1.000	↓	16.426	6.529	-14.661
C6x8.2	C4x5.4	0.435	3.945	18.716	6.227	-15.894

Notes:

1. I_{1-1} and I_{2-2} are the maximum and minimum moments of inertia, respectively, about the principal axes 1-1 and 2-2.

2. The angle ϕ is measured from the axis with the maximum moment of inertia (either y-y or z-z) to the 1-1 principal axis. ϕ should always be between +45° and -45°. ϕ sign convention: ↻+ ↺-

3. $\bar{y}$ and $\bar{z}$ are measured in Y_B and Z_B coordinate system.

4. e_y and e_z refer to centerline of channel webs.

ATTACHMENT F

MEMBER STRENGTH LOSS DUE TO 1/32" UNDERCUT R1

ATTACHMENT "F" — MEMBER STRENGTH LOSS DUE TO 1/32" UNDERCUT

A) TUBULAR SECTION

MEMBER SIZE	PERCENTAGE LOSS		ADJ. INTER. RATIO
	AREA	SECT. MOD.	
TS 2 X 2 X 0.25	14.06	14.79	0.852
TS 3 X 3 X 0.25	13.49	13.80	0.862
TS 4 X 4 X 0.25	13.23	13.40	0.866
TS 5 X 5 X 0.25	13.07	13.18	0.868
TS 6 X 6 X 0.25	12.97	13.05	0.870
TS 6 X 6 X 0.375	12.97	8.96	0.870
TS 4 X 2 X 0.25	13.49	13.97	0.860
TS 8 X 4 X 0.375	8.90	9.00	0.910
TS 8 X 6 X 0.375	8.80	8.80	0.911

Reference: Calculation Book No. 5, Comanche Peak SES Unit NO. 2
Electrical Conduit and Box Supports

ATTACHMENT "F" — MEMBER STRENGTH LOSS DUE TO 1/32" UNDERCUT

B) CHANNEL SECTION

MEMBER SIZE	PERCENTAGE LOSS			ADJ. INTER. RATIO
	"A" AREA	"SX" SECT. MOD.	"SY" SECT. MOD.	
C4 X 5.4	27.64	24.07	26.40	0.724
C5 X 9	19.95	27.40	21.08	0.726
C6 X 8.2	25.15	21.45	23.01	0.748
C8 X 11.5	22.81	19.47	20.29	0.772
C10 X 15.3	20.89	17.73	18.18	0.791
MC3 X 7.1	19.58	18.08	21.27	0.787
MC6 X 16.3	15.23	13.77	15.72	0.843

R1

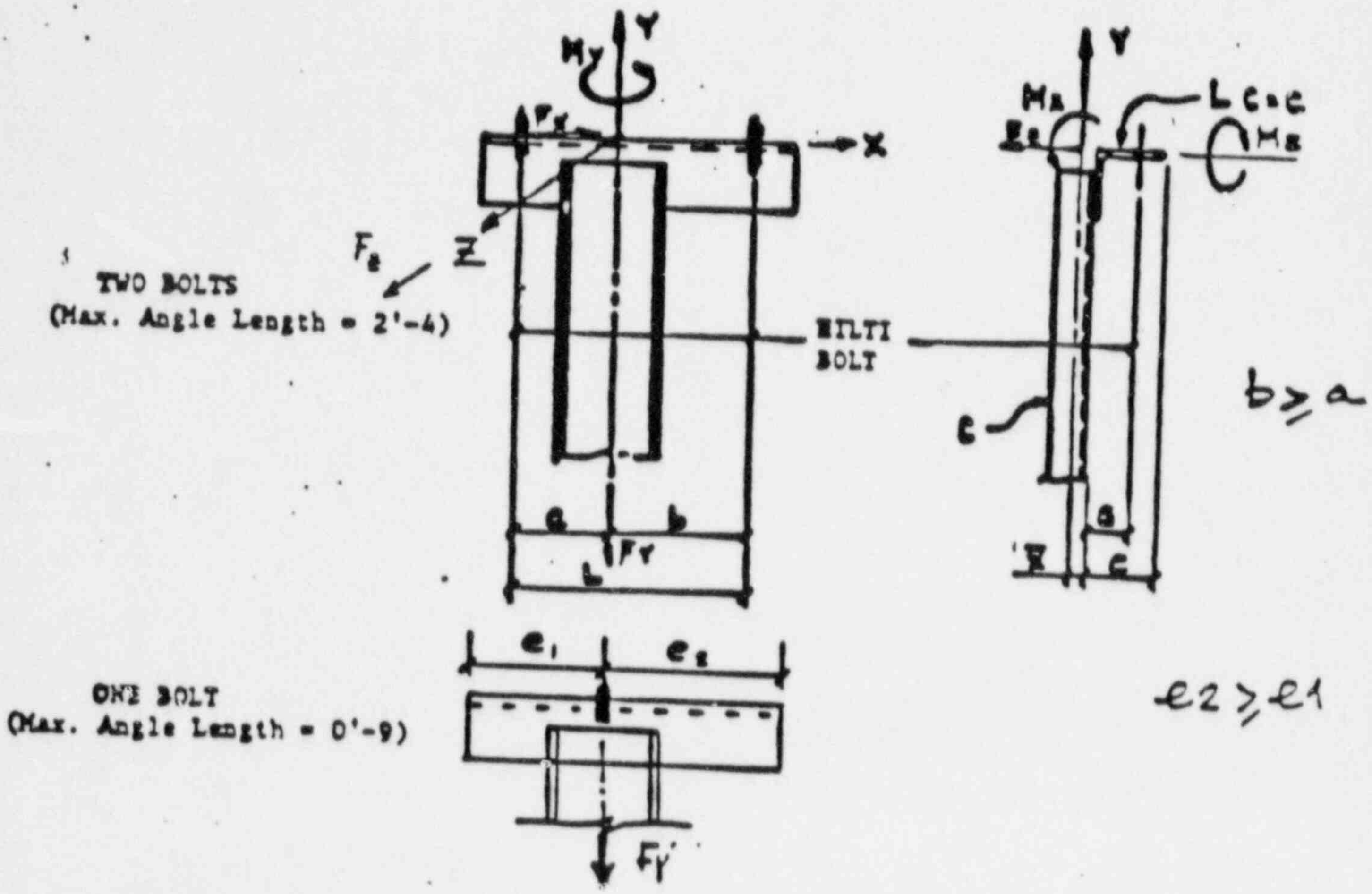
Reference calculation Book No. Supt-0231, Comanche Peak SES Unit No. 1 Electrical Conduit and Box Supports.

ATTACHMENT G

VERIFICATION OF HILTI ANCHOR AND RICHMOND ANCHOR BOLTS R1

ATTACHMENT G1 - VERIFICATION OF HILTI ANCHOR BOLT FOR SURFACE ANGLE CONNECTIONS
ANGLE IS MIN. 3/4 INCH THICK
(APPLIES TO BOTH HILTI KWIK AND HILTI SUPERKWIK)

The tension formulas below are conservative. If anchorage fails, go to ATTACHMENT-G3.



FORCES FROM COMPUTER OUTPUT

F_x F_y F_z M_x M_y M_z Calculate $M'_z = M_z + F_Y\left(b - \frac{L}{2}\right)$

MAX BOLT TENSION

$$T = 2.15\,\frac{M'_z}{L} + \frac{1}{(C-G)}\left[1.15\,\frac{F_Y\,b\,(c + E)}{L} + 1.1\,\frac{M_x\,b}{L}\right]$$ FOR TWO BOLTS
C = 8 INCHES

$$T = 1.81\,\frac{M'_z}{L} + \frac{1}{(C-G)}\left[1.15\,\frac{F_Y\,b\,(c + E)}{L} + 1.1\,\frac{M_x\,b}{L}\right]$$ FOR TWO BOLTS
C = 6 INCHES

$$T = 1.15\,\frac{M_z}{e_1} + \frac{1.1}{(C-G)}\left[F_y(C + E) + M_x\right]$$ FOR ONE BOLT

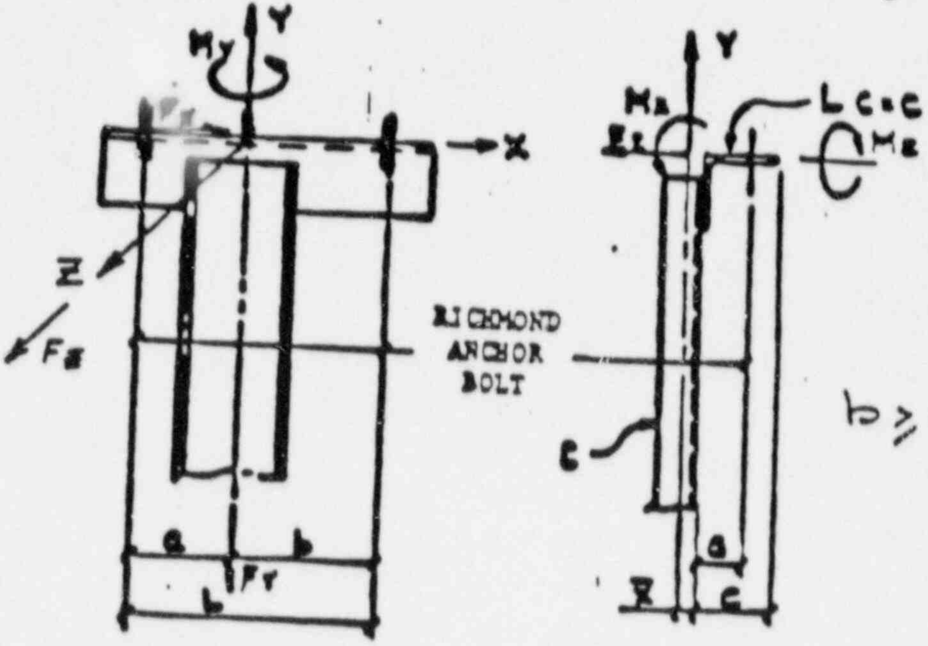
MAX BOLT SHEAR

$$S = \left[\left(\frac{M_y + F_z.b + F_x\,(G + E)}{L}\right)^2 + \left(\frac{F_z}{2}\right)^2\right]^{1/2}$$

ATTACHMENT G2 - VERIFICATION OF RICHMOND ANCHOR BOLTS FOR SURFACE ANGLE CONNECTIONS
ANGLE IS MIN. 3/4 INCH THICK
(APPLIES TO ALL DIAMETERS OF RICHMOND ANCHORS)

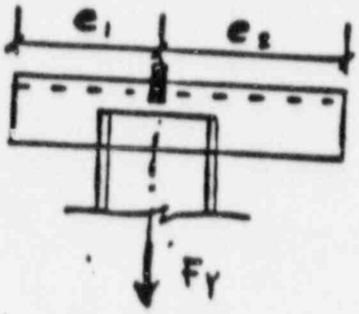
The tension formulas below are conservative. If anchorage fails, go to ATTACHMENT-G3

TWO BOLTS
(Max. Angle Length = 2'-4)



b ≥ a

ONE BOLT
(Max. Angle Length = 0'-9)



e2 ≥ e1

FORCES FROM COMPUTER OUTPUT

F_x F_y F_z M_x M_y M_z . Calculate $M'_z = M_z + Fy\left(b - \frac{L}{2}\right)$

MAX BOLT TENSION

$T = 3.20\,\frac{M'z}{L} + \frac{1}{(C-G)}\left[1.20\,\frac{Fy\,b\,(c+\bar{x})}{L} + 1.25\,\frac{Mx\,b}{L}\right]$ FOR TWO BOLTS
C = 8 INCHES

$T = 2.70\,\frac{M'z}{L} + \frac{1}{(C-G)}\left[1.20\,\frac{Fy\,b\,(c+\bar{x})}{L} + 1.25\,\frac{Mx\,b}{L}\right]$ FOR TWO BOLTS
C = 6 INCHES

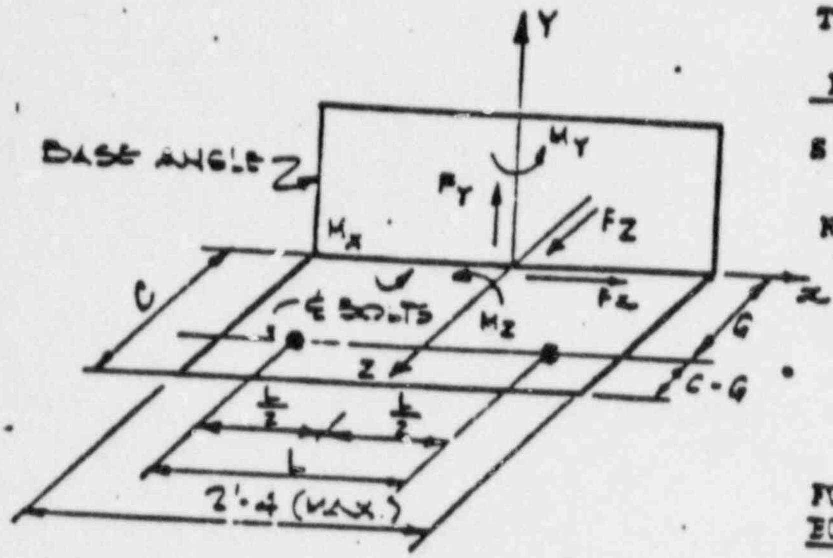
$T = 1.70\,\frac{M\,z}{e_1} + \frac{1.20}{(C-G)}\left[Fy\,(C+\bar{x}) + Mx\right]$ FOR ONE BOLT

MAX BOLT SHEAR

$$S = \left[\left(\frac{M_y + F_z.b + F_x\,(C+\bar{x})}{L}\right)^2 + \left(\frac{Fx}{2}\right)^2\right]^{1/2}$$

ATTACHMENT G3 - VERIFICATION OF ANCHOR BOLTS SECURING SURFACE ANGLES

BASE ANGLE WITH 2 ANCHOR BOLTS



FOR TWO BOLTS

BOLT TENSION

$$T = a_1\left(\frac{Mx}{2(C-G)}\right) + a_2\left(\frac{Mz}{L}\right) + a_3\left(\frac{C\cdot Fy}{2(C-G)}\right)$$

BOLT SHEAR

$$S = \left[\left(\frac{Fx}{2}\right)^2 + \left(\frac{Fz}{2} + \frac{My'}{L}\right)^2\right]^{1/2}$$

NOTE: 1) For a_1, a_2 & a_3 ; See Table 1 (SH. G-4)

2) L, C & G in inches.

3) Mx, My & Mz in Kips-in. and Fx, Fy & Fz in Kips.

4) $My' = My + Fx\cdot G$

FOR ONE BOLT

BOLT TENSION

$$T = a_1\left(\frac{Mx}{C-G}\right) + a_2\left(\frac{Mz}{e'}\right) + a_3\left(\frac{C\cdot Fy}{C-G}\right)$$

BOLT SHEAR

$$S = (Fx^2 + Fz^2)^{1/2}$$

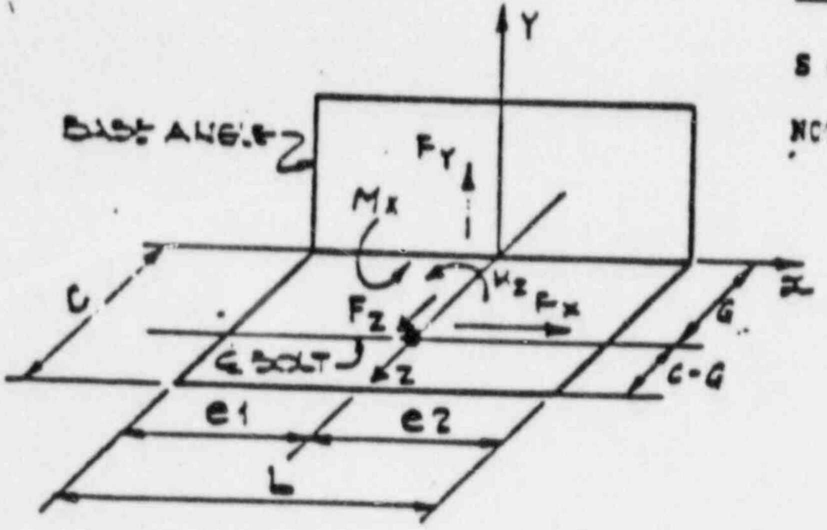
NOTE: 1) For a_1, a_2 & a_3; See Table 2 (SH. G-5)

2) e' = The smaller dimension of e1 & e2 ,

3) e1, e2, C & G in inches.

4) Mx & Mz in Kips-in. and Fx, Fy & Fz in Kips.

BASE ANGLE WITH 1 ANCHOR BOLT



NOTE: Please note a different point of application for loads in this attachment when compared to attachments G_1 and G_2 .

See Attachment G6

ATTACHMENT G5 - VERIFICATION OF ANCHOR BOLTS

TABLE 1 - PRYING ACTION FACTORS FOR BASE ANGLES W/2 BOLTS

TYPE & SIZE OF BOLTS	BASE ANGLE	L	C (INCHES)	Prying action factors			REMARKS*
				a_1	a_2	a_3	
ALL SIZES OF HILTI KWIK & SUPER KWIK 1_4", 3_8", 1_2" 5_8", 3_4", 1" 1¼",	L8 x 6 x 3_4	1'-9 MAX	8.	1.12	2.00	1.09	
	L6 x 6 x 3_4	"	6.	1.09	1.69	1.06	
	L5 x 5 x 3_4	"	5.	1.09	1.69	1.06	
1 ¼" DIA. RICHMOND INSERT	L8 x 6 x 3_4	"	8.	1.27	3.07	1.23	
	L6 x 6 x 3_4	"	6.	1.26	2.56	1.21	
	L5 x 5 x 3_4	"	5.	1.26	2.56	1.21	
1" DIA. RICHMOND INSERT	L8 x 6 x 3_4	"	8.	1.23	2.88	1.19	
	L6 x 6 x 3_4	"	6.	1.22	2.38	1.16	
	L5 x 5 x 3_4	"	5.	1.22	2.38	1.16	

* See Attachment G6

ATTACHMENT G3 - VERIFICATION OF ANCHOR BOLTS

TABLE 2 - PRYING ACTION FACTORS FOR BASE ANGLES W/1 BOLT

TYPE & SIZE OF BOLTS	BASE ANGLE	L	C (IN)	PRYING ACTION FACTORS			REMARKS*
				a_1	a_2	a_3	
ALL SIZES OF HILTI KWIK & SUPER KWIK ¼", ⅜", ½", ⅝", ¾", 1" 1¼"	L8 x 6 x ¾	0'-9 MAX	8.	1.11	1.15	1.08	
	L6 x 6 x ¾	"	6.	1.10	1.11	1.04	
	L5 x 5 x ¾	"	5.	1.10	1.11	1.04	
1¼" DIA. RICHMOND INSERT	L8 x 6 x ¾	"	8.	1.20	1.67	1.15	
	L6 x 6 x ¾	"	6.	1.19	1.56	1.12	
	L5 x 5 x ¾	"	5.	1.19	1.56	1.12	
1" DIA. RICHMOND INSERT	L8 x 6 x ¾	"	8.	1.17	1.55	1.12	
	L6 x 6 x ¾	"	6.	1.16	1.47	1.11	
	L5 x 5 x ¾	"	5.	1.16	1.47	1.11	

*See Attachment G6

ATTACHMENT G4 - PRYING ACTION FACTOR FOR ANCHOR BOLTS

EBASCO SERVICES INCORPORATED

BY J T Liu DATE 4/20/85

CHKD. BY JES DATE 4/22/85

SHEET ___ OF ___

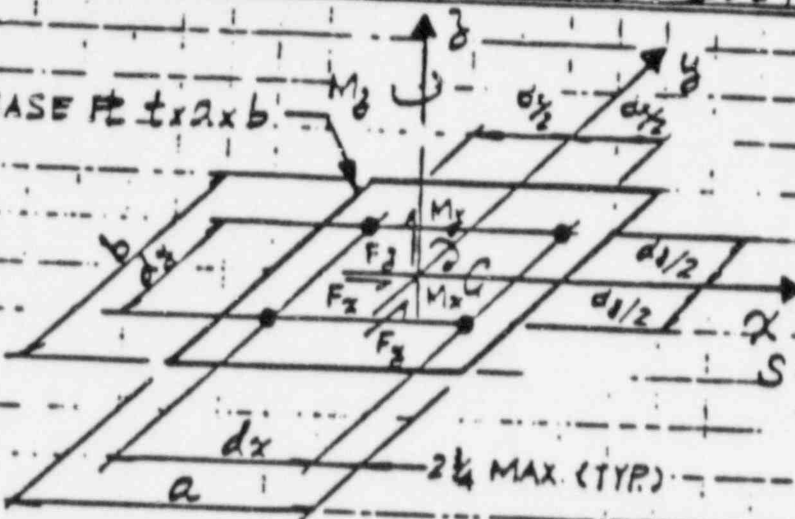
CLIENT TEXAS UTILITIES GENERATING CO. OFS NO. 3317.002 DEPT. NO. 549

PROJECT ~~COMANCHE PEAK UNIT 2 AND UNIT 1~~ CABLE TRAY HANGERS

SUBJECT PRYING ACTION FACTORS FOR ANCHOR BOLTS

TABLE - 3

BASE PLATE WITH 4 ANCHOR BOLTS



BOLT TENSION:

$$T = a_1 \frac{M_x}{2d_y} + a_2 \frac{M_y}{2d_x} + a_3 \frac{F_z}{4}$$

BOLT SHEAR:

$$S = \left\{ \left[\frac{F_x}{4} + \frac{M_z d_y}{2(d_x^2 + d_y^2)} \right]^2 + \left[\frac{F_y}{4} + \frac{M_z d_x}{2(d_x^2 + d_y^2)} \right]^2 \right\}^{1/2}$$

TYPE & SIZE OF BOLTS	BASE PLATE DIM'S (IN)			PRYING ACTION FACTORS			REMARKS*
	t	d_x	d_y	a_1	a_2	a_3	
ALL SIZES OF HILTI KWIK & SUPER KWIK	1.0 MIN.	18½ MAX.	18½ MAX.	1.22	1.22	1.30	----
1½" φ RICHMOND INSERT	"	"	"	2.16	2.16	2.09	----
1" φ RICHMOND INSERT	"	"	"	1.95	1.95	1.90	----

* SEE ATTACHMENT G6

ATTACHMENT G5 - INTERACTION REQUIREMENTS FOR ANCHOR BOLTS

1. For Hilti & Super Hilti Bolts*

$$\frac{T}{T'(S.R.)} + \frac{S}{S'(S.R.)} \leq 1.0$$

2. For Richmond Inserts & Bolts*

A) Check Insert; $$\left(\frac{T}{T'(S.R.)}\right)^{4/3} + \left(\frac{S}{S'(S.R.)}\right)^{4/3} \leq 1.0$$

B) Check bolt; $$\left(\frac{T}{T'}\right)^{2} + \left(\frac{S}{S'}\right)^{2} \leq 1.0$$

---

*Where:

T = Tension Value Calculated
S = Shear Value Calculated
S.R. = Separation ratio **
T' and S' = allowable bolt loads or insert capacity **

**See Appendix 2 and 3 of the seismic design criteria
(SAG.CP10)

ATTACHMENT G6-COMMENTS FOR 'G' ATTACHMENTS

1. For the design verification of anchorages utilizing Hilti Kwik or Super Hilti Kwik for which arrangements and bolt sizes are not addressed in Attachments G1-G5, or if the anchorage fails, use the finite element baseplate program with bolt stiffnesses given in Teledyne Engineering Services "Anchor Bolt Shear and Tension Stiffness" Test Report dated May 25, 1979 for Hilti Kwik and Hilti Super Kwik or conservatively use values given below. For Richmond Anchors use the values shown below.

2. Bolt stiffnesses:

Bolt Type	Bolt Diameter (in)	Bolt Tension Stiffness (K/in)	Bolt Shear Stiffness (K/in)
Hilti	1/4 to 1.25	461	111
Super Hilti	1/4 to 1.25	461	111
Richmond	1.5	3460	652
Richmond	1	2175	485

Note: the above stiffnesses were used to develop Attachments G1-G5.

ATTACHMENT H

EFFECTIVE THROAT THICKNESS OF PREQUALIFIED PARTIAL PENETRATION BEVEL GROOVE WELDS

R1

ATTACHMENT H - EFFECTIVE THROAT THICKNESS OF PREQUALIFIED PARTIAL PENETRATION BEVEL GROOVE WELDS

I. Flare Bevel Groove Weld

The following effective throat shall be used for prequalified partial penetration flare bevel groove welds between cold formed rectangular/square tubes and -

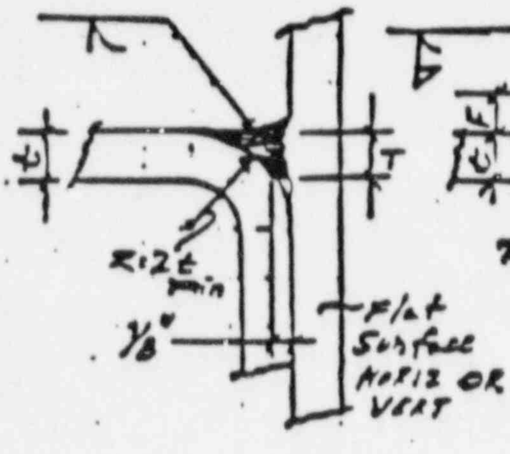
A. flat plate surfaces (such as embedded plate, anchorage angle, etc.) with or without reinforcing fillet weld.

B. tube to tube matched box connections.

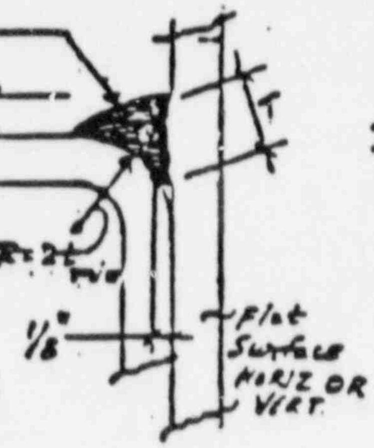
t = thickness of the thinner tube
T = effective throat thickness
R = minimum corner radius of the tube = 2t

Effective Throat Thickness T(in)

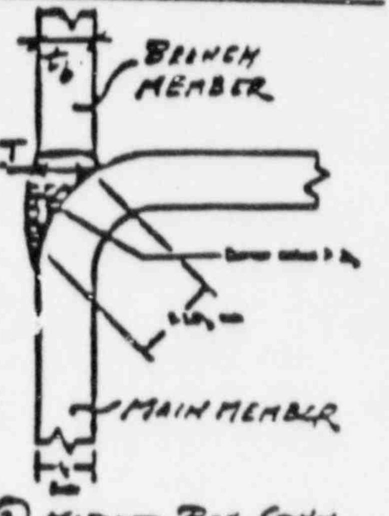
Tube thickness t (in)	min. radius R (in)	(A) Flat Surface			(B) Matched Box(3) T (in)
		w/o reinf fillet(1) T(in)	w/reinforcing fillet(2)		
			Size of fillet F (in)	T (in)	
1/4	1/2	0.16	3/16	0.29	0.25
5/16	5/8	0.31	1/8	0.35	0.31
3/8	3/4	0.37	1/8	0.40	0.37
1/2	1	0.5	1/8	0.62	0.5
5/8	1 1/4	0.62	-	-	0.62



① w/o REINF. FILLET



② w/-REINF. FILLET.



③ MATCHED BOX CONN.

R

Notes:

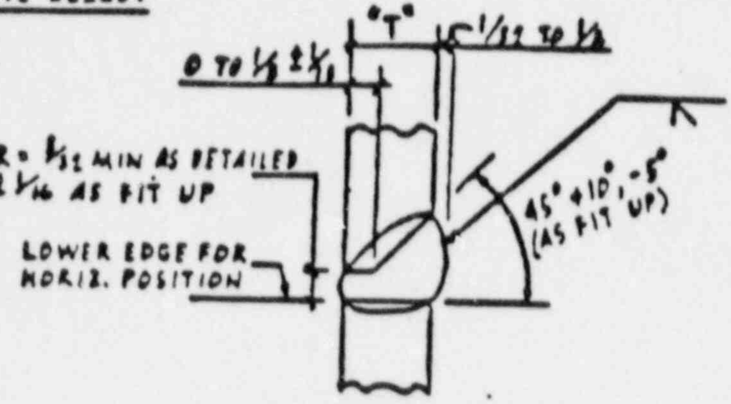
1. As per AWS-D.1.1., Table 2.3.1.4 for t≤1/4", T = 5/16" R. As per AWS-D.1.1, Figure 10.13.3B and test results, for t≥5/16", T = t.

2. As per geometric proportions with weld penetration to the 1/8" groove width level.

3. As per AWS-D.1.1., Figure 10.13.3B.

ATTACHMENT H - EFFECTIVE THROAT THICKNESS OF PREQUALIFIED PARTIAL PENETRATION BEVEL GROOVE WELDS

[illegible] Single-Bevel-Groove Welds:



BTC - P4a
JOINT DETAIL
(ALL WELDING POSITIONS)

Single-bevel-groove welds for butt joints, T-joints and corner joints welded from one side only having base metal thickness ("T") of 1/4 inch up to 1/2 inch shall have effective throats equal to "T"-1/8 inch, where ("T"-1/8 inch) $\leq$ T/2. The above shall not be used for the qualification of welded standard tray clamp plates. R1

ATTACHMENT I

ANCHORAGE SPRING RATES IN STRUDL FRAME ANALYSIS

R2

ATTACHMENT I - ANCHORAGE SPRING RATES IN STRUDL FRAME ANALYSIS (SH. 1)

Deleted |R1

The spring rates to be used shall be obtained as follows:

a. Spring rate values may be obtained from the attached table if the anchorage configuration falls within the range covered by the table. The values in the table were developed using standard AISC "G" gage distances for location of the anchor bolts, i.e. 3.0 in. for L5X5X.75, 3.5 in. for L6X6X.75 and 4.5 in. for L8X8X.75. A +1/2 in. variation from these gages is acceptable. The distance of the bolt from the end of the angle can vary from 2.5 inches minimum to 4.5 inches maximum. If the spacing L of the anchorage does not match exactly the spacing in the table linear interpolation between the immediately higher and lower spacing can be used. The values shown in the table are acceptable when the centerline of the post is within 6 inches of the centerline of the two bolts, so long as the edge of the channel attachment is not beyond the bolt centerline. It must be noted that the spring rates are given in the local coordinate system of the base angle. They have to be converted to the global coordinate system of each individual STRUDL analysis.

b. Deleted |R2 R3

c. If the anchorage configuration is not covered by either "a" or "b" above, then a baseplate analysis run to obtain spring rates for each such plate must be requested from the baseplate group. It must be noted that the spring rates as obtained are given in the local coordinate system of base angle. They have to be converted to the global coordinate system of each individual STRUDL analysis. |R2

ATTACHMENT "I" - ANCHORAGE SPRING RATE IN STRUDL FRAME ANALYSIS (SH. 2)

d. For steel members welded directly to embedded plates, the joint shall be assumed rigid with all anchorage translations and rotations fixed.

Translational stiffnesses for base angle configurations in the attached table need not be considered in design verification. Their impact on system frequency is insignificant for frequencies smaller than 33 Hertz for the normal load range. In addition, disregarding translational spring rates in the static analysis yields slightly higher reactions, which is conservative. For marginal cases, where reduction in conservativism is required, translational spring rates can be incorporated in the design, and will be calculated on a case by case basis. |R1

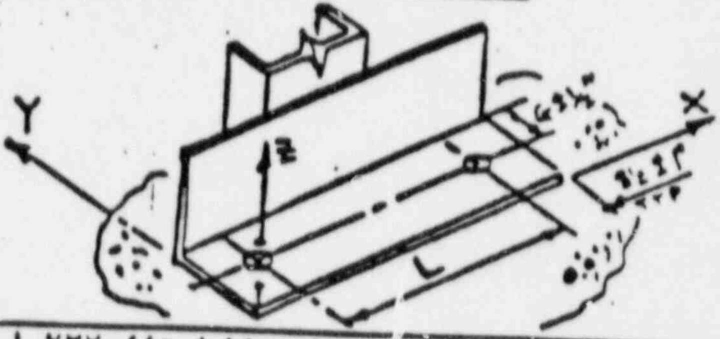
For "softer" anchor bolts, (specifically 1" Hilti Kwik bolts and smaller, with an anchorage reaction due to dead load greater than 1 Kip), the impact of the translational stiffness on the frequency may not be negligible. For these cases translational stiffness in all three directions should routinely be incorporated in the design. These stiffnesses should be obtained from the baseplate group as described above.

e. Spring rates for the base plates of modified or IN supports with anchorage configurations which are similar to generic supports may be obtained from the calculation books of the applicable generic support. |R3

ATTACHMENT "I" (Cont'd)
FOR TYPICAL BASEPLATE CONFIGURATIONS

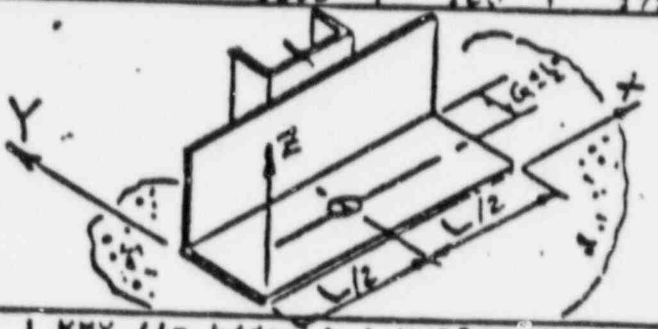
SPRING RATES FOR TYPICAL BASEPLATE CONFIGURATIONS

CASE 1: 2 BOLT PATTERN



ANGLE SIZE	L (in.)	KMX (in.k/deg.)		KMY (in.k/deg.)		KMZ (in.k/deg.)	
		1.25 dia SU.HILTI	1.5 dia. INSERT	1.25 dia SU.HILTI	1.5 dia. INSERT	1.25 dia SU.HILTI	1.5 dia. INSERT
L5X5X.75	12	20	41	277	651	113	171
	18	21	46	417	904	152	193
	24	22	49	544	1084	178	206
	30	22	49	653	1187	180	206
	36	22	48	740	1229	184	202
L6X6X.75	12	27	39	295	606	107	156
	18	30	46	457	878	144	182
	24	32	50	612	1091	163	192
	30	33	52	749	1237	172	195
	36	33	52	863	1323	176	194
L8X8X.75	12	28	33	266	497	94	129
	18	33	40	431	771	126	153
	24	36	46	601	1021	145	166
	30	39	50	764	1229	155	173
	36	40	52	914	1296	160	175

CASE 2: 1 BOLT PATTERN



ANGLE SIZE	L (in.)	KMX (in.k/deg.)		KMY (in.k/deg.)		KMZ* (in.k/deg.)	
		1.25 dia SU.HILTI	1.5 dia. INSERT	1.25 dia SU.HILTI	1.5 dia. INSERT	1.25 dia SU.HILTI	1.5 dia. INSERT
L5X5X.75	12	14	27	86	180	—	—
	9	13	22	55	113	—	—
L6X6X.75	12	16	26	80	165	—	—
	9	14	21	53	103	—	—
L8X8X.75	12	18	22	72	134	---	---
	9	14	17	47	85	---	---

*Rotational degree of freedom about Z axis must be fully released for these configurations.

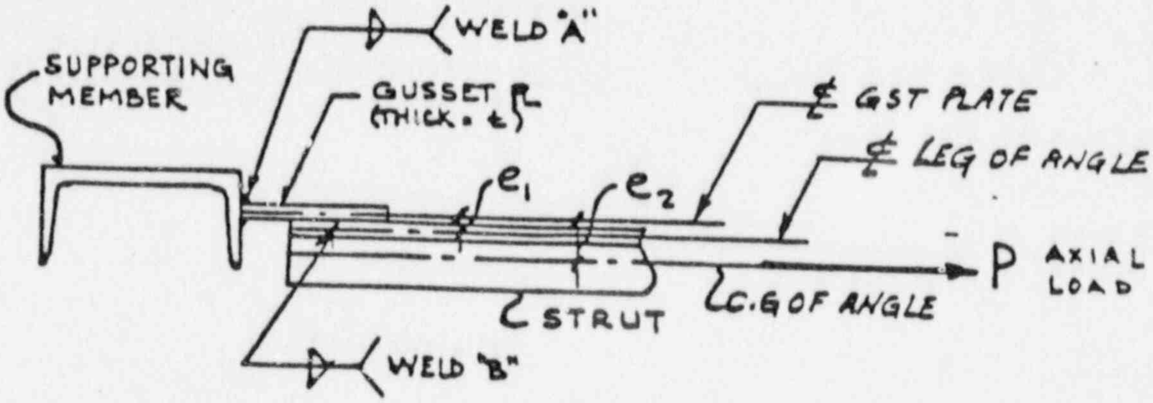
ATTACHMENT J

PROCEDURE FOR VERIFYING MEMBERS SUBJECT TO BENDING DUE TO GUSSET PLATE CONNECTION

R1

ATTACHMENT "J" - Procedure for verifying members subject to bending due to gusset plate connection.

The following procedure shall be used to include the effects of excluding eccentricty between centerline of gusset plate and center of gravity of attached member (strut) as shown below:



1) The moment due to the eccentricity ($P \times e_2$) shall be taken by the strut member. The stresses due to this moment shall be manually added to stresses from computer output due to axial load (P.)

2) The gusset plate and weld "A" and weld "B" shall be designed for the axial load (P) plus the moment due to ($P \times e_1$).

ATTACHMENT K

INPUT SKELETONS FOR STATIC RUN AND LOAD COMBINATIONS R1

ATTACHMENT K1 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - GENERIC SUPPORTS

PROG. CODED BY: ____________________

BANNER TITLE : ____________________

DATA ENTERED BY: ____________________

SAMPLE

NOTE,
CROSS-OUT THE
LOAD CASES IF NOT
APPLICABLE.

```
LOADING 1 'UNIT "G" +X DIRECTION'
DEAD LOAD COMP GLD X 1.0 BY JOINTS
JOINT LOADS
____________________ F X ________ M Y ________ M Z ________
____________________ F X ________ M Y ________ M Z ________
____________________ F X ________ M Y ________ M Z ________
LOADING 2 'UNIT "G" +Y DIRECTION'
DEAD LOAD COMP GLD Y 1.0 BY JOINTS
JOINT LOADS
____________________ F Y ________ M X ________
____________________ F Y ________ M X ________
____________________ F Y ________ M X ________
```

CEILING FLOOR OR WALL

```
LOADING '2A' 'UNIT "G" -Y DIRECTION'
DEAD LOAD COMP GLD Y -1.0 BY JOINTS
JOINT LOADS
____________________ F Y ________ M X ________
____________________ F Y ________ M X ________
____________________ F Y ________ M X ________
```

FLOOR (USE - FOR F_Y)

```
LOADING 3 'UNIT "G" +Z DIRECTION'
DEAD LOAD COMP GLD Z 1.0 BY JOINTS
JOINT LOADS
____________________ F Z ________ M X ________
____________________ F Z ________ M X ________
____________________ F Z ________ M X ________
```

CEILING FLOOR OR WALL

```
LOAD COMB 4  'OBE LOADING +X DIR ' COMPONENTS -
1 ________
LOAD COMB 5  'OBE LOADING +X DIR ' COMPONENTS -
1 ________
```

CEILING FLOOR OR WALL

```
LOAD COMB 6  'OBE LOADING +X DIR ' COMPONENTS -
1 ________
LOAD COMB 7  'OBE LOADING +Y DIR ' COMPONENTS -
2 ________
LOAD COMB 8  'OBE LOADING +Y DIR ' COMPONENTS -
2 ________
```

WALL

```
LOAD COMB 9  'OBE LOADING +Y DIR ' COMPONENTS -
2 ________
```

CEILING OR FLOOR

```
LOAD COMB 10 'OBE LOADING +Z DIR ' COMPONENTS -
3 ________
LOAD COMB 11 'OBE LOADING +Z DIR ' COMPONENTS -
3 ________
```

CEILING FLOOR OR WALL

```
LOAD COMB 12 'OBE LOADING +Z DIR ' COMPONENTS -
3 ________
```

WALL

```
LOAD COMB 13 'SSE LOADING +X DIR ' COMPONENTS -
  ________
LOAD COMB 14 'SSE LOADING +X DIR ' COMPONENTS -
1 ________
```

CEILING FLOOR OR WALL

```
LOAD COMB 15 'SSE LOADING +X DIR ' COMPONENTS -
1 ________
LOAD COMB 16 'SSE LOADING +Y DIR ' COMPONENTS -
2 ________
```

WALL

R1

ATTACHMENT K1 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - GENERIC SUPPORTS

SAMPLE

```
LOAD COMB 17 'SSE LOADING +Y DIR ' COMPONENTS -
2 _______
LOAD COMB 18 'SSE LOADING +Y DIR ' COMPONENTS -
2 _______
LOAD COMB 19 'SSE LOADING +Z DIR ' COMPONENTS -
3 _______
LOAD COMB 20 'SSE LOADING +Z DIR ' COMPONENTS -
3 _______
LOAD COMB 21 'SSE LOADING +Z DIR ' COMPONENTS -
3 _______
PRINT STRUCTURAL DATA
PRINT LOADING DATA
PLOT DEVICE PRINTER WID 10 LEN 10
PLOT PROJECTION XY
PLOT PROJECTION YZ
PLOT PROJECTION TH1 45. TH2 30.
STIFFNESS ANALYSIS REDUCE BAND
LOAD COMB 22 'DBE SRSS 4 9 11' RMS -
4 9 11
LOAD COMB 23 'DBE SRSS 5 9 10' RMS -
5 9 10
LOAD COMB 24 'DBE SRSS 4 8 12' RMS -
4 8 12
LOAD COMB 25 'DBE SRSS 6 8 10' RMS -
6 8 10
LOAD COMB 26 'DBE SRSS 5 7 12' RMS -
5 7 12
LOAD COMB 27 'DBE SRSS 6 7 11' RMS -
6 7 11
LOAD COMB 28 'SSE SRSS 13 18 20' RMS -
13 18 20
LOAD COMB 29 'SSE SRSS 14 18 19' RMS -
14 18 19
LOAD COMB 30 'SSE SRSS 13 17 21' RMS -
13 17 21
LOAD COMB 31 'SSE SRSS 15 17 19' RMS -
15 17 19
LOAD COMB 32 'SSE SRSS 14 16 21' RMS -
14 16 21
LOAD COMB 33 'SSE SRSS 15 16 20' RMS -
15 16 20
STRESS RESULTS ARE TO BE COMBINED AT STRESS LEVEL
$ FOLLOWING LOAD CASES 1000 SERIES ARE DBE & 2000 SERIES ARE SSE
$ CEILING MOUNTED : CASE 1
LOAD COMB 1001 'DL+SRSS 4 9 11 (DBE)' COMPONENTS -
2   1.0  22   1.0
LOAD COMB 1002 'DL-SRSS 4 9 11 (DBE)' COMPONENTS -
2   1.0  22  -1.0
$ CEILING MOUNTED : CASE 2
LOAD COMB 1003 'DL+SRSS 5 9 10 (DBE)' COMPONENTS -
2   1.0  23   1.0
```

WALL

CEILING OR FLOOR

CEILING FLOOR OR WALL

WALL

CEILING OR FLOOR

WALL

CEILING OR FLOOR

WALL

CEILING

R1

ATTACHMENT K1 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - GENERIC SUPPORTS

SAMPLE

```
LOAD COMB 1004 'DL-SRSS 5 9 10 (OBE)' COMPONENTS -        CEILING
2  1.0  23  -1.0
$ FLOOR MOUNTED :  CASE 1
LOAD COMB 1005 'DL+SRSS 4 9 11 (OBE)' COMPONENTS -
'2A' 1.0  22   1.0
LOAD COMB 1006 'DL-SRSS 4 9 11 (OBE)' COMPONENTS -
'2A' 1.0  22  -1.0
$ FLOOR MOUNTED :  CASE 2                                  FLOOR
LOAD COMB 1007 'DL+SRSS 5 9 10 (OBE)' COMPONENTS -
'2A' 1.0  23   1.0
LOAD COMB 1008 'DL-SRSS 5 9 10 (OBE)' COMPONENTS -
'2A' 1.0  23  -1.0
$ MOUNTED  WALL : CASE 1
LOAD COMB 1009 'DL+SRSS 4 8 12 (OBE)' COMPONENTS -
3   1.0  24   1.0
LOAD COMB 1010 'DL-SRSS 4 8 12 (OBE)' COMPONENTS -
3   1.0  24  -1.0
$ MOUNTED  WALL : CASE 1
LOAD COMB 1011 'DL+SRSS 6 8 10 (OBE)' COMPONENTS -
1  -1.0  25   1.0
LOAD COMB 1012 'DL-SRSS 6 8 10 (OBE)' COMPONENTS -        WALL
1  -1.0  25  -1.0
$ MOUNTED  WALL : CASE 2
LOAD COMB 1013 'DL+SRSS 5 7 12 (OBE)' COMPONENTS -
3   1.0  26   1.0
LOAD COMB 1014 'DL-SRSS 5 7 12 (OBE)' COMPONENTS -
3   1.0  26  -1.0
$ MOUNTED  WALL : CASE 2                                         R1
LOAD COMB 1015 'DL+SRSS 6 7 11 (OBE)' COMPONENTS -
1  -1.0  27   1.0
LOAD COMB 1016 'DL-SRSS 6 7 11 (OBE)' COMPONENTS -
1  -1.0  27  -1.0
$ CEILING MOUNTED : CASE 1
LOAD COMB 2001 'DL+SRSS 13 18 20 (SSE)' COMPONENTS -
2   1.0  28   1.0
LOAD COMB 2002 'DL-SRSS 13 18 20 (SSE)' COMPONENTS -
2   1.0  28  -1.0
$ CEILING MOUNTED : CASE 2                                 CEILING
LOAD COMB 2003 'DL+SRSS 14 18 19 (SSE)' COMPONENTS -
2   1.0  29   1.0
LOAD COMB 2004 'DL-SRSS 14 18 19 (SSE)' COMPONENTS -
2   1.0  29  -1.0
$ FLOOR MOUNTED :   CASE 1
LOAD COMB 2005 'DL+SRSS 13 18 20 (SSE)' COMPONENTS -
'2A' 1.0  28   1.0
LOAD COMB 2006 'DL-SRSS 13 18 20 (SSE)' COMPONENTS -
'2A' 1.0  28  -1.0
$ FLOOR MOUNTED :   CASE 2                                 FLOOR
LOAD COMB 2007 'DL+SRSS 14 18 19 (SSE)' COMPONENTS -
'2A' 1.0  29   1.0
LOAD COMB 2008 'DL-SRSS 14 18 19 (SSE)' COMPONENTS -
'2A' 1.0  29  -1.0
$ MOUNTED  WALL : CASE 1                                   WALL
```

ATTACHMENT K1 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - GENERIC SUPPORTS

SAMPLE

```
LOAD COMB 2009 'DL+SRSS 13 17 21 (SSE)' COMPONENTS -
3   1.0  30   1.0
LOAD COMB 2010 'DL-SRSS 13 17 21 (SSE)' COMPONENTS -
3   1.0  30  -1.0
$ MOUNTED  WALL : CASE 1
LOAD COMB 2011 'DL+SRSS 15 17 19 (SSE)' COMPONENTS -
1  -1.0  31   1.0
LOAD COMB 2012 'DL-SRSS 15 17 19 (SSE)' COMPONENTS -
1  -1.0  31  -1.0
$ MOUNTED  WALL : CASE 2
LOAD COMB 2013 'DL+SRSS 14 16 21 (SSE)' COMPONENTS -
3   1.0  32   1.0
LOAD COMB 2014 'DL-SRSS 14 16 21 (SSE)' COMPONENTS -
3   1.0  32  -1.0
$ MOUNTED  WALL : CASE 2
LOAD COMB 2015 'DL+SRSS 15 16 20 (SSE)' COMPONENTS -
1  -1.0  33   1.0
LOAD COMB 2016 'DL-SRSS 15 16 20 (SSE)' COMPONENTS -
1  -1.0  33  -1.0
```

WALL

```
LOADS LIST -
__ TO __ __ TO __
```

CEILING OR FLOOR	22 TO 25 28 TO 29
WALL	SEE ATTACHMENT
CEILING, FLOOR OR WALL	22 TO 30

```
STRESS RESULTS ARE TO BE COMBINED AT STRESS LEVEL
GENERATE RESULTS
LOAD LIST -
____ TO ____  ____ TO ____
```

CEILING	1001 TO 1006 2001 TO 2006
CEILING OR FLOOR	1001 TO 1008 2001 TO 2008
WALL	SEE ATTACHMENT
CEILING, FLOOR OR WALL	1001 TO 1016 2001 TO 2016

R1

```
COMBINED ALL
LOAD LIST ALL
OUTPUT DECIMAL 3
OUTPUT BY JOINTS ; OUTPUT BY MEMBERS
LIST DISPLACEMENTS, REACTIONS, FORCES
SECTION FR NS 2  0.0 1.0
GROUP '&LM' DEFINITION
MEMBERS ALL BUT ______________________
END OF GROUP DEFINITION
LIST SECTION STRESS MEMBERS '&LM'
$ DL COMB OBE (FOR CHECK WELD)
LOAD LIST -
____ TO ____
```

RIGID BARS

CEILING	1001 TO 1006
CEILING OR FLOOR	1001 TO 1008
WALL	SEE ATTACHMENT
CEILING, FLOOR OR WALL	1001 TO 1016

```
LIST FORCES ENVELOPE MEMBERS ____________
$ DL COMB SSE (FOR CHECK WELD)
LOAD LIST -
____ TO ____
```

MEMBER WITH WELD CONNECTION

CEILING	2001 TO 2006
CEILING OR FLOOR	2001 TO 2008
WALL	SEE ATTACHMENT
CEILING, FLOOR OR WALL	2001 TO 2016

```
LIST FORCES ENVELOPE MEMBERS ____________
PARAMETERS
'CODE' 'AISC' ALL ; 'VERSION' '69U1' ALL
'TORSION' 'YES' ALL ; 'CB' 1.0 ALL
'ASF' 1.6 LOADINGS ____ TO ____
'FSHMAX'  0.55 ALL
'CBIRUCS' 'YES' LOADINGS -
_____ TO _____  _____ TO _____
```

MEMBER WITH WELD CONNECTION

CEILING	2001 TO 2006
CEILING OR FLOOR	2001 TO 2008
WALL	SEE ATTACHMENT
CEILING, FLOOR OR WALL	2001 TO 2016

CEILING	1001 TO 1006 2001 TO 2006
CEILING OR FLOOR	1001 TO 1008 2001 TO 2008
WALL	SEE ATTACHMENT
CEILING, FLOOR OR WALL	1001 TO 1016 2001 TO 2016

ATTACHMENT K1 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - GENERIC SUPPORTS

SAMPLE

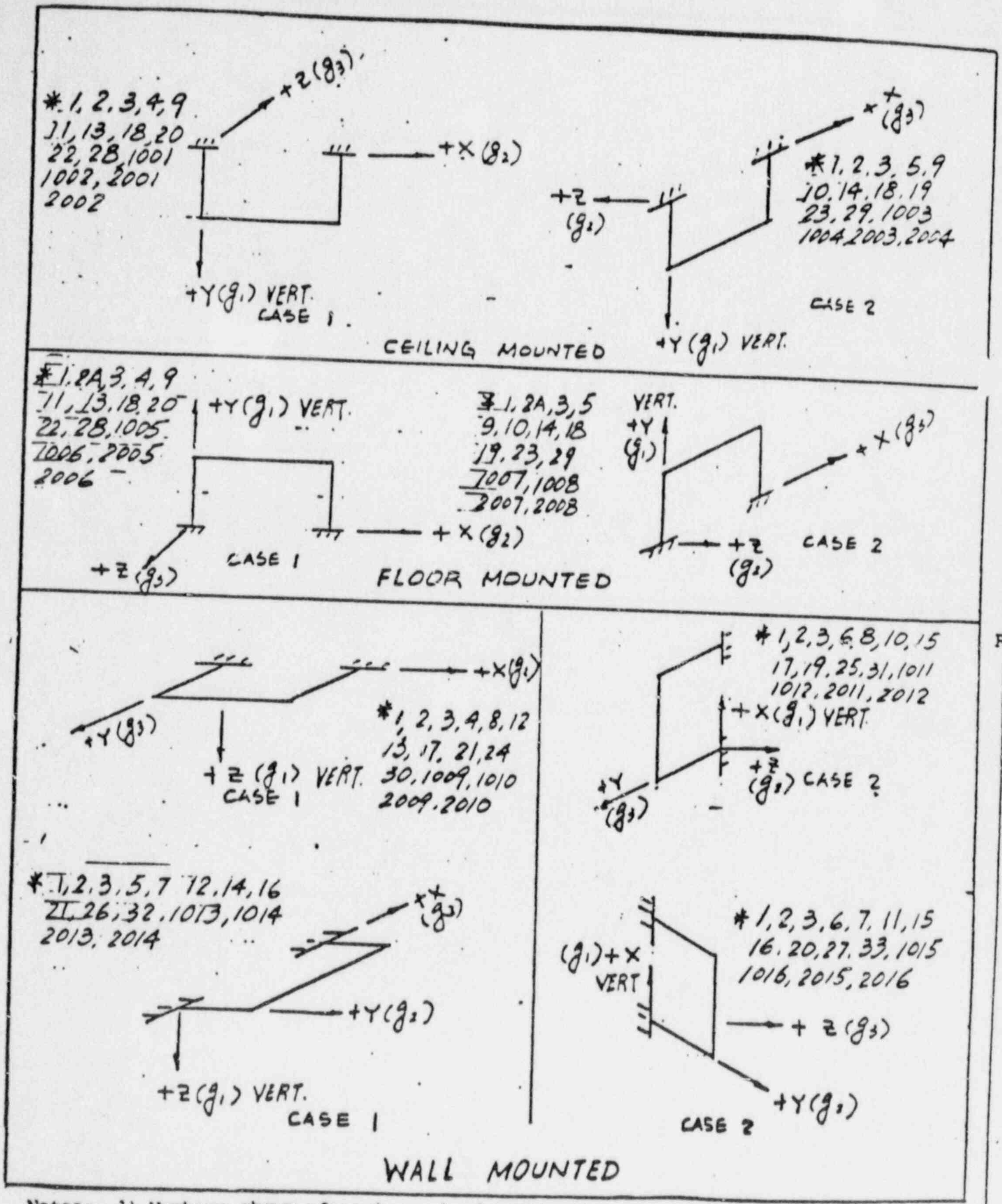
PARAMETERS
'LY' ________ MEM ____________
'LY' ________ MEM ____________
'LY' ________ MEM ____________
'LZ' ________ MEM ____________
'LZ' ________ MEM ____________
'LZ' ________ MEM ____________
'CMY' ______ MEM ____________
'CMY' ______ MEM ____________
'CMZ' ______ MEM ____________
'CMZ' ______ MEM ____________
'KY' ________ MEM ____________
'KY' ________ MEM ____________
'KY' ________ MEM ____________
'KZ' ________ MEM ____________
'KZ' ________ MEM ____________
'KZ' ________ MEM ____________
'UNLCF' ________ MEM ____________
'UNLCF' ________ MEM ____________
'UNLCF' ________ MEM ____________
LOAD LIST -
___ TO ____ ____ TO ____

CEILING	1001 TO 1004 2001 TO 2004
CEILING OR FLOOR	1001 TO 1008 2001 TO 2008
WALL	SEE ATTACHMENT
CEILING, FLOOR OR WALL	1001 TO 1016 2001 TO 2016

ECK CODE ALL BUT ________________________ ← RIGID BARS & MEMBERS NOT REQUIRE CODE CHECK
NERATE TRACE 6 RESULTS FOR FAILING MEMBERS
FINISH NOMESSAGES

R1

ATTACHMENT K1 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - GENERIC SUPPORTS



R1

Notes:
1) Numbers shown after * are load combination Nos. to be filled in the blanks under the load list on the input skeleton.

2) g_1, g_2, g_3 can be any one of the design "g" in 3 orthogonal directions shown on Table A.7 of the design criteria. (SAG.CP-10)

ATTACHMENT K2 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - MODIFIED / IN SUPPORTS ("G" VALUES ROTATED)

COND-RG

```
$ PLEASE USE  'COND-RG.SKL' SKELETON TO CREATE THE NEW FILE
$ INPUT FILE NO. ________.___  DISK ID: ______      DATE:___________
$ USER :_______       BANNER NAME :______
STRUDL 'CFSS #1' '_________'
$ CFSS1 ELECTRIC CONDUIT & JUNCTION BOX SUPPORTS
TYPE SPACE FRAME
ALPHANUMERIC IDENTIFIER TREATMENT BY CHARACTER COMPARISON
UNITS INCHES, KIPS, DEGREES, FAHRENHEIT, LBM, SECONDS
$SHIFT COOR SYST 101 TRA  X_______ Y_______ Z_______ -
$                    ROT  R1______ R2______ R3______
$JOINT COOR SHIFT BY 101
JOINT COORDINATES
1                 .                 .                 .
2                 .                 .                 .
3                 .                 .                 .
4                 .                 .                 .
5                 .                 .                 .
6                 .                 .                 .
7                 .                 .                 .
8                 .                 .                 .
9                 .                 .                 .
10                .                 .                 .
11                .                 .                 .
12                .                 .                 .
13                .                 .                 .
14                .                 .                 .
15                .                 .                 .
16                .                 .                 .
17                .                 .                 .
18                .                 .                 .
19                .                 .                 .
20                .                 .                 .
21                .                 .                 .
22                .                 .                 .
23                .                 .                 .
24                .                 .                 .
25                .                 .                 .
26                .                 .                 .
27                .                 .                 .
28                .                 .                 .
29                .                 .                 .
30                .                 .                 .
31                .                 .                 .
SUPPORT JOINTS -
--------------
JOINT RELEASES
__________ F _ _ _  M _ _ _
__________ F _ _ _  M _ _ _
__________ KFX _______ KFY _______ KFZ _______
           KMX _______ KMY _______ KMZ _______
__________ KFX _______ KFY _______ KFZ _______
           KMX _______ KMY _______ KMZ _______
__________ KMX _______ KMY _______ KMZ _______
__________ KMX _______ KMY _______ KMZ _______
__________ KMX _______ KMY _______ KMZ _______
MEMBER INCIDENCES
1
2
3
4
```

SUPT I D

USE THESE COMMANDS WHEN SUPPORT COORD NOT AGRE WITH BLDG GLOB COORD. CROSS OUT $'s & JOINT COORDINATE COMMAND WHEN USE.

SAMPLE

BY: J TSHEN 8/11/87

CHKD BY: JTLau 8/11/87

SUPPORT JOINT ONLY

R3

ATTACHMENT K2 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - MODIFIED / IN SUPPORTS ("G" VALUES ROTATED)

2

SAMPLE

BY: J T SHEN 8/7/87
CHKD BY: JTLau 8/11/87

```
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
TYFE SFACE TRUSS
MEMBER INCIDENCES
_______
_______
MEMBER RELEASES
__________ STA F _ _ M _ _ _ END F _ _ M _ _
__________ STA F _ _ M _ _ _ END F _ _ M _ _
CONSTANTS
E 29.E3 ALL ; FOISSON 0.3 ALL ; DENS 0.284 ALL
G 11.2E3 ALL ; CTE 0.0000065 ALL
FYLD 36.0 ALL BUT 46.0 ________________________
CONSTANTS
DENS 1E-3
CONSTANTS
BETA
BETA
BETA
MEMBER PROPERTIES
________________ TABLE 'STEELW' 'W__X___'
________________ TABLE 'TUBESQR' 'T__X__X__'
________________ TAPLE 'TUBERECT' 'T__X__X__'
________________ TAPLE 'STEELC' 'C X   ' TYFE 'CHANNEL'
________________ TABLE 'STEELMC' 'MC X   ' TYPE 'CHANNEL'
________________ TABLE 'STEELL' 'L______'
________________ TABLE 'STEELL' 'L______'
________________ AX 100. AY 100. AZ 100. IX 1000. IY 1000. IZ 1000.
________________ AX      AY      AZ      IX      IY      IZ
                 SY      SZ
INERTIA OF JOINTS LUMPED
INERTIA OF JOINTS FACTOR  1  ADD
* INPUT WEIGHT OF CONDUITS / BOXES IN POUNDS ( LBS )
_____ _______ LINEAR X _____ Y _____ Z _____
```

INPUT FOR DIAG BRACING (AXIAL LO

DO NOT RELEASE M_x AT START & END SIMULTANE

FOR FITITIOUS MEMBERS ONLY

R3

ATTACHMENT K2 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION
MODIFIED / IN SUPPORTS ("G" VALUES ROTATED)

```
-------------- LINEAR X ----- Y ----- Z -----
-------------- LINEAR X ----- Y ----- Z -----
-------------- LINEAR X ----- Y ----- Z -----
-------------- LINEAR X ----- Y ----- Z -----
PRINT STRUCTURAL DATA
PLOT DEVICE PRINTER WID 10 LEN 10
PLOT PROJECTION XY
PLOT PROJECTION XZ
PLOT PROJECTION YZ
GROUP '&RET' DEFINITION
JOI ALL ACTIVE
DYNAMIC DEGREE STATIC
JOI DEGREE OF FREEDOM
'&RET'  XT,YT,ZT
END
UNITS CYCLES
ASSEMBLE FOR DYNAMICS
MODAL ANALYSIS MAX FREQ 40.0
LIST DYNAMIC EIGENVALUES
LIST DYNAMIC EIGENVECTORS
LIST DYNAMIC NORM PART FACTORS
$CHANGE
$INERTIA OF JOINTS LUMPED
$INERTIA OF JOINTS FACTOR  1  ADD
$            --- LINEAR X 0.0   Y 0.0   Z 0.0
$ADDITION
UNITS DEGREES
$ DEAD LOAD OF CONDUIT SUPPORT IS IN  -Y  DIRECTION
LOADING 1 'UNIT "G" +X DIRECTION'
DEAD LOAD COMP GLO X 1.0 BY JOINTS
$JOINT LOADS
$               --- MOM X           Y           Z
$MEMBER LOADS
$              FORCE    X CON FRA P                L  1.0
$              FORCE    Y CON FRA P                L  1.0
$              FORCE    Z CON FRA P                L  1.0
$              MOM      X CON FRA P                L  1.0
$              MOM      Y CON FRA P                L  1.0
$              MOM      Z CON FRA P                L  1.0
LOADING 2 'UNIT "G" -Y DIRECTION'
DEAD LOAD COMP GLO Y -1.0 BY JOINTS
$JOINT LOADS
$                   MOM X           Y           Z
$MEMBER LOADS
$              FORCE    X CON FRA P                L  1.0
$              FORCE    Y CON FRA P                L  1.0
$              FORCE    Z CON FRA P                L  1.0
$              MOM      X CON FRA P                L  1.0
$              MOM      Y CON FRA P                L  1.0
$              MOM      Z CON FRA P                L  1.0
LOADING 3 'UNIT "G" +Z DIRECTION'
DEAD LOAD COMP GLO Z 1.0 BY JOINTS
$JOINT LOADS
$                   MOM X           Y           Z
$MEMBER LOADS
$              FORCE    X CON FRA P                L  1.0
$              FORCE    Y CON FRA P                L  1.0
$              FORCE    Z CON FRA P                L  1.0
$              MOM      X CON FRA P                L  1.0
$              MOM      Y CON FRA P                L  1.0
```

CROSS OUT THE PROJECTION NOT

S A M P L E

BY: J T SHEN 8/11/87

CHK'D BY: JTLin 8/11/87

REMOVE '$' SIGN
INPUT JOINT NO WHERE WEIGHT IS INPUT BY USING MEMBER LOADS COMMANDS IN FOLLOWING LOADING CASE 1, 2 OR 3

REMOVE '$' SIGN, INPUT JOINT NO & MOM WHERE JOINT MOMENTS ARE APPLIED WITH RESPECT TO GLOBAL COORD.

REMOVE '$' SIGN
INPUT MEMBER NO, FORCES & MOMENTS WHERE MEMBER FORCE & MOMENTS ARE APPLIED WITH RESPECT TO MEMBER COORD.
(USE L 0.0 WHEN LOAD @ START JT)

R3

SEE NOTE ABOVE (LOADING 1)

SEE NOTE ABOVE (LOADING 1)

SEE NOTE ABOVE (LOADING 1)

SEE NOTE ABOVE (LOADING 1)

ATTACHMENT K2 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION -

MODIFIED / IN SUPPORTS ("G" VALUES ROTATED)

```
$                 MOM       Z CON FRA P                  L  1.0
LOAD COMB 4   'OBE LOADING +X DIR   (MAX SEIS)' COMPONENTS -
1 ______
LOAD COMB 5   'OBE LOADING +X DIR   (MED SEIS)' COMPONENTS -
1 ______
LOAD COMB 6   'OBE LOADING +X DIR   (MIN SEIS)' COMPONENTS -
1 ______
LOAD COMB 7   'OBE LOADING +Y DIR   (MAX SEIS)' COMPONENTS -
2 ______
LOAD COMB 8   'OBE LOADING +Y DIR   (MED SEIS)' COMPONENTS -
2 ______
LOAD COMB 9   'OBE LOADING +Y DIR   (MIN SEIS)' COMPONENTS -
2 ______
LOAD COMB 10 'OBE LOADING +Z DIR   (MAX SEIS)' COMPONENTS -
3 ______
LOAD COMB 11 'OBE LOADING +Z DIR   (MED SEIS)' COMPONENTS -
3 ______
LOAD COMB 12 'OBE LOADING +Z DIR   (MIN SEIS)' COMPONENTS -
3 ______
LOAD COMB 13 'SSE LOADING +X DIR   (MAX SEIS)' COMPONENTS -
1 ______
LOAD COMB 14 'SSE LOADING +X DIR   (MED SEIS)' COMPONENTS -
1 ______
LOAD COMB 15 'SSE LOADING +X DIR   (MIN SEIS)' COMPONENTS -
1 ______
LOAD COMB 16 'SSE LOADING +Y DIR   (MAX SEIS)' COMPONENTS -
2 ______
LOAD COMB 17 'SSE LOADING +Y DIR   (MED SEIS)' COMPONENTS -
2 ______
LOAD COMB 18 'SSE LOADING +Y DIR   (MIN SEIS)' COMPONENTS -
2 ______
LOAD COMB 19 'SSE LOADING +Z DIR   (MAX SEIS)' COMPONENTS -
3 ______
LOAD COMB 20 'SSE LOADING +Z DIR   (MED SEIS)' COMPONENTS -
3 ______
LOAD COMB 21 'SSE LOADING +Z DIR   (MIN SEIS)' COMPONENTS -
3 ______
PRINT STRUCTURAL DATA
PRINT LOADING DATA
STIFFNESS ANALYSIS REDUCE BAND
LOAD COMB 22 'OBE SRSS 4 9 11' RMS -
4 9 11
LOAD COMB 23 'OBE SRSS 5 9 10' RMS -
5 9 10
LOAD COMB 24 'OBE SRSS 4 8 12' RMS -
4 8 12
LOAD COMB 25 'OBE SRSS 6 8 10' RMS -
6 8 10
LOAD COMB 26 'OBE SRSS 5 7 12' RMS -
5 7 12
LOAD COMB 27 'OBE SRSS 6 7 11' RMS -
6 7 11
LOAD COMB 28 'SSE SRSS 13 18 20' RMS -
13 18 20
LOAD COMB 29 'SSE SRSS 14 18 19' RMS -
14 18 19
LOAD COMB 30 'SSE SRSS 13 17 21' RMS -
13 17 21
LOAD COMB 31 'SSE SRSS 15 17 19' RMS -
15 17 19
```

SEE NOTE ON P3 (LOADING 1)

"g" VALUES

R3

BY. J T SHEN 8/11/87

CHKD BY. JTL 8/11/87

SAMPLE

ATTACHMENT K2 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION -

MODIFIED / IN SUPPORTS ("G" VALUES ROTATED)

5

```
LOAD COMB 32 'SSE SRSS 14 16 21' RMS -
14 16 21
LOAD COMB 33 'SSE SRSS 15 16 20' RMS -
15 16 20
STRESS RESULTS ARE TO BE COMBINED AT STRESS LEVEL
$ FOLLOWING LOAD CASES 1000 SERIES ARE DBE & 2000 SERIES ARE SSE
LOAD COMB 1001 'DL+SRSS 4 9 11 (DBE)' COMPONENTS -
2   1.0  22   1.0
LOAD COMB 1002 'DL-SRSS 4 9 11 (DBE)' COMPONENTS -
2   1.0  22  -1.0
LOAD COMB 1003 'DL+SRSS 5 9 10 (DBE)' COMPONENTS -
2   1.0  23   1.0
LOAD COMB 1004 'DL-SRSS 5 9 10 (DBE)' COMPONENTS -
2   1.0  23  -1.0
LOAD COMB 1005 'DL+SRSS 4 8 12 (DBE)' COMPONENTS -
2     1.0  24   1.0
LOAD COMB 1006 'DL-SRSS 4 8 12 (DBE)' COMPONENTS -
2     1.0  24  -1.0
LOAD COMB 1007 'DL+SRSS 6 8 10 (DBE)' COMPONENTS
2      1.0  25   1.0
LOAD COMB 1008 'DL-SRSS 6 8 10 (DBE)' COMPONENT
2      1.0  25  -1.0
LOAD COMB 1009 'DL+SRSS 5 7 12 (DBE)' COMPONENTS
2      1.0  26   1.0
LOAD COMB 1010 'DL-SRSS 5 7 12 (DBE)' COMPONENTS -
2      1.0  26  -1.0
LOAD COMB 1011 'DL+SRSS 6 7 11 (DBE)' COMPONENTS -
2      1.0  27   1.0
LOAD COMB 1012 'DL-SRSS 6 7 11 (DBE)' COMPONENTS -
2      1.0  27  -1.0
LOAD COMB 2001 'DL+SRSS 13 18 20 (SSE)' COMPONENTS -
2      1.0  28   1.0
LOAD COMB 2002 'DL-SRSS 13 18 20 (SSE)' COMPONENTS -
2      1.0  28  -1.0
LOAD COMB 2003 'DL+SRSS 14 18 19 (SSE)' COMPONENTS -
2      1.0  29   1.0
LOAD COMB 2004 'DL-SRSS 14 18 19 (SSE)' COMPONENTS -
2      1.0  29  -1.0
LOAD COMB 2005 'DL+SRSS 13 17 21 (SSE)' COMPONENTS -
2      1.0  30   1.0
LOAD COMB 2006 'DL-SRSS 13 17 21 (SSE)' COMPONENTS -
2      1.0  30  -1.0
LOAD COMB 2007 'DL+SRSS 15 17 19 (SSE)' COMPONENTS -
2       1.0  31   1.0
LOAD COMB 2008 'DL-SRSS 15 17 19 (SSE)' COMPONENTS -
2       1.0  31  -1.0
LOAD COMB 2009 'DL+SRSS 14 16 21 (SSE)' COMPONENTS -
2      1.0  32   1.0
LOAD COMB 2010 'DL-SRSS 14 16 21 (SSE)' COMPONENTS -
2      1.0  32  -1.0
LOAD COMB 2011 'DL+SRSS 15 16 20 (SSE)' COMPONENTS -
2       1.0  33   1.0
LOAD COMB 2012 'DL-SRSS 15 16 20 (SSE)' COMPONENTS -
2       1.0  33  -1.0
PRINT LOADING DATA
LOADS LIST -
22 TO 33
STRESS RESULTS ARE TO BE COMBINED AT STRESS LEVEL
GENERATE RESULTS
LOAD LIST -
```

SAMPLE

R3

BY: J T SHEN 8/11/87
CHKD BY: JTLiu 8/11/87

ATTACHMENT K2 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - MODIFIED / IN SUPPORTS ("G" VALUES ROTATED)

```
   1001 TO 1012   2001 TO 2012
   COMBINED ALL
   LOAD LIST ALL
   OUTPUT DECIMAL 3
   OUTPUT BY JOINTS ; OUTPUT BY MEMBERS
   LIST REACTIONS
   LOAD LIST 1001 1002
   LIST REACTION
   LOAD LIST 1003 1004
   LIST REACTION
   LOAD LIST 1005 1006
   LIST REACTION
   LOAD LIST 1007 1008
   LIST REACTION
   LOAD LIST 1009 1010
   LIST REACTION
   LOAD LIST 1011 1012
   LIST REACTION
   LOAD LIST 1001 TO 1012
   LIST REACTION
   LOAD LIST 2001 2002
   LIST REACTION
   LOAD LIST 2003 2004
   LIST REACTION
   LOAD LIST 2005 2006
   LIST REACTION
   LOAD LIST 2007 2008
   LIST REACTION
   LOAD LIST 2009 2010
   LIST REACTION
   LOAD LIST 2011 2012
   LIST REACTION
   LOAD LIST 2001 TO 2012
   LIST REACTION
   LOAD LIST 1001 TO 1012 2001 TO 2012
   SECTION FR NS 2  0.0 1.0
   GROUP '&LM' DEFINITION
   MEMBERS ALL BUT ____________________
   END OF GROUP DEFINITION
   LIST SECTION STRESS MEMBERS '&LM'
   $ DL COMB OBE (FOR CHECK WELD)
   LOAD LIST -
   1001 TO 1012
   LIST FORCES ENVELOPE MEMBERS _______________
   $ DL COMB SSE (FOR CHECK WELD)
   LOAD LIST -
   2001 TO 2012
   LIST FORCES ENVELOPE MEMBERS _______________
   PARAMETERS
   'CODE' 'AISC' ALL ; 'VERSION' '69U1' ALL
   'TORSION' 'YES' ALL ; 'CB' 1.0 ALL
   'ASF' 1.6 LOADINGS 2001 TO 2012
   'FSHMAX'  0.5 ALL
   'FACMAX'  0.9 ALL
   'FATMAX'  0.9 ALL
   'FBMAX'   0.9 ALL
   PARAMETERS
   'LY' ______  MEM __________
   'LY' ______  MEM __________
   'LY' ______  MEM __________
   'LZ' ______  MEM __________
```

L

BY, J T SHEN 8/11/87

CHK'D BY: JTLiu 8/11/87

SAMPLE

R3

← RIGID MEMBERS

← MEMBER WITH WELD CONNECTION

K-12

ATTACHMENT K 3 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION MODIFIED / IN SUPPORTS ("G" VALUES ROTATED)

```
'LZ'' ------  MEM ----------
'LZ' ------  MEM ----------
'CMY' -----  MEM ----------
'CMY' -----  MEM ----------
'CMZ' -----  MEM ----------
'CMZ' -----  MEM ----------
'KY' ------  MEM ----------
'KY' ------  MEM ----------
'KY' ------  MEM ----------
'KZ' ------  MEM ----------
'KZ' ------  MEM ----------
'KZ' ______  MEM __________
'UNLCF' --------- MEM ----------
'UNLCF' --------- MEM ----------
'UNLCF' _________ MEM __________
LOAD LIST -
1001 TO 1012  2001 TO 2012
CHECK CODE ALL BUT ____________________   -
GENERATE TRACE & RESULTS FOR FAILING MEMBERS
FINISH NOMESSAGES
```

SAMPLE

RIGID MEMBERS &
MEMBER NOT
REQIRE CODE CHECK

BY: J T SHEN 8/11/87

CHK'D BY: 8/11/87

R3

ATTACHMENT K 3 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - MODIFIED / IN SUPPORTS ("G" VALUES NOT ROTATED)

COND-UK/REV 1

DATE: ____________

____ SUPT I.D

```
$ PLEASE USE 'COND-UR.SKL' AS THE SKELETON
$ INPUT FILE NO. ________.___  DISK ID: _______
                               BANNER NAME : ______
$ USER :____________
STRUDL 'CFSS #1' '____________'
$ CFSS1 ELECTRIC CONDUIT & JUNCTION BOX SUPPORTS
TYPE SPACE FRAME
ALPHANUMERIC IDENTIFIER TREATMENT BY CHARACTER COMPARISON
UNITS INCHES, KIPS, DEGREES, FAHRENHEIT, LBM, SECONDS
$SHIFT COOR SYST 101 TRA  X_______  Y_______  Z_______ -
$                    ROT  R1______  R2______  R3______
$JOINT COOR SHIFT BY 101
JOINT COORDINATES
1        .            .            .
2        .            .            .
3        .            .            .
4        .            .            .
5        .            .            .
6        .            .            .
7        .            .            .
8        .            .            .
9        .            .            .
10       .            .            .
11       .            .            .
12       .            .            .
13       .            .            .
14       .            .            .
15       .            .            .
16       .            .            .
17       .            .            .
18       .            .            .
19       .            .            .
20       .            .            .
21       .            .            .
22       .            .            .
23       .            .            .
24       .            .            .
25       .            .            .
26       .            .            .
27       .            .            .
28       .            .            .
29       .            .            .
30       .            .            .
31       .            .            .
SUPPORT JOINTS -
--------------
JOINT RELEASES
__________ F - -  M - - -
__________ F - -  M - - -
__________ KFX ________ KFY ________ KFZ _______
           KMX ________ KMY ________ KMZ _______
__________ KFX ________ KFY ________ KFZ _______
           KMX ________ KMY ________ KMZ _______
__________ KMX ________ KMY ________ KMZ _______
__________ KMX ________ KMY ________ KMZ _______
__________ KMX ________ KMY ________ KMZ _______
MEMBER INCIDENCES
1
2
3
4
```

USE THESE COMMAND WHEN SUPPORT COORD. NOT AGREE WITH BLDG GLOBAL COORD. CROSS OUT $'s & JOINT COORDINATE COMMAND WHEN USE

SUPPORT JOINT ONLY

BY: J T SHEN 8/11/83

CHK'D BY: JT Lau 8/11/83

R3

ATTACHMENT K.3 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - MODIFIED / IN SUPPORTS ("G" VALUES NOT ROTATED)

S A M P L E

BY: J T SHEN 8/11/87

CHKD BY: JTLIU 8/11/87

```
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
TYPE SPACE TRUSS
MEMBER INCIDENCES
------
------
MEMBER RELEASES
---------- STA F _ _ M _ _ _ END F _ _ M _ _
---------- STA F _ _ M _ _ _ END F _ _ M _ _
CONSTANTS
E 29.E3 ALL ; POISSON 0.3 ALL ; DENS 0.284 ALL
G 11.2E3 ALL ; CTE 0.0000065 ALL
FYLD 36.0 ALL BUT 46.0 _______________________
CONSTANTS
DENS 1E-3
CONSTANTS
BETA
BETA
BETA
MEMBER PROPERTIES
_______________ TABLE 'STEELW'    'W__X___'
_______________ TABLE 'TUBESQR'   'T__X__X__'
_______________ TABLE 'TUBERECT'  'T__X__X__'
_______________ TABLE 'STEELC'    'C X  ' TYPE 'CHANNEL'
_______________ TABLE 'STEELMC'   'MC X  ' TYPE 'CHANNEL'
_______________ TABLE 'STEELL' 'L______'
_______________ TABLE 'STEELL' 'L______'
_______________ AX 100. AY 100. AZ 100. IX 1000. IY 1000. IZ 1000.
_______________ AX      AY      AZ      IX       IY       IZ
_______________ SY      SZ
INERTIA OF JOINTS LUMPED
INERTIA OF JOINTS FACTOR  1  ADD
$ INPUT WEIGHT OF CONDUITS / BOXES IN POUNDS ( LBS )
_____________ LINEAR X ____ Y ____ Z ____
```

INPUT FOR DIAG BRACING (AXIAL LOAD)

DO NOT RELEASE M_x AT START & END SIMULTANEOUSLY

FOR FICTITIOUS MEMBER ONLY

R3

ATTACHMENT K 3 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - MODIFIED / IN SUPPORTS ("G" VALUES NOT ROTATED)

3

BY, J T SHEN 8/11/87

CHK'D BY: JTLiu 8/11/87

SAMPLE

```
______________ LINEAR X _____ Y _____ Z _____
______________ LINEAR X _____ Y _____ Z _____
______________ LINEAR X _____ Y _____ Z _____
______________ LINEAR X _____ Y _____ Z _____
PRINT STRUCTURAL DATA
PLOT DEVICE PRINTER WID 10 LEN 10
PLOT PROJECTION XY
PLOT PROJECTION XZ
PLOT PROJECTION YZ
GROUP '&RET' DEFINITION
JOI ALL ACTIVE
DYNAMIC DEGREE STATIC
JOI DEGREE OF FREEDOM
'&RET'   XT,YT,ZT
END
UNITS CYCLES
ASSEMBLE FOR DYNAMICS
MODAL ANALYSIS MAX FREQ 40.0
LIST DYNAMIC EIGENVALUES
LIST DYNAMIC EIGENVECTORS
LIST DYNAMIC NORM PART FACTORS
$CHANGE
$INERTIA OF JOINTS LUMPED
$INERTIA OF JOINTS FACTOR  1  ADD
$
$ADDITION      --- LINEAR X 0.0   Y 0.0   Z 0.0
UNITS DEGREES
$ DEAD LOAD OF CONDUIT SUPPORT IS IN  -Y  DIRECTION
LOADING 1 'UNIT "G" +X DIRECTION'
DEAD LOAD COMP GLD X 1.0 BY JOINTS
$JOINT LOADS
$               --- MOM X             Y             Z
$MEMBER LOADS
$                   FORCE    X CON FRA P                    L  1.0
$                   FORCE    Y CON FRA P                    L  1.0
$                   FORCE    Z CON FRA P                    L  1.0
$                   MOM      X CON FRA P                    L  1.0
$                   MOM      Y CON FRA P                    L  1.0
$                   MOM      Z CON FRA P                    L  1.0
LOADING 2 'UNIT "G" -Y DIRECTION'
DEAD LOAD COMP GLD Y -1.0 BY JOINTS
$JOINT LOADS
$                    MOM X             Y             Z
$MEMBER LOADS
$                   FORCE    X CON FRA P                    L  1.0
$                   FORCE    Y CON FRA P                    L  1.0
$                   FORCE    Z CON FRA P                    L  1.0
$                   MOM      X CON FRA P                    L  1.0
$                   MOM      Y CON FRA P                    L  1.0
$                   MOM      Z CON FRA P                    L  1.0
LOADING 3 'UNIT "G" +Z DIRECTION'
DEAD LOAD COMP GLD Z 1.0 BY JOINTS
$JOINT LOADS
$                    MOM X             Y             Z
$MEMBER LOADS
$                  FORCE    X CON FRA P                    L  1.0
$                  FORCE    Y CON FRA P                    L  1.0
$                  FORCE    Z CON FRA P                    L  1.0
$                  MOM      X CON FRA P                    L  1.0
$                  MOM      Y CON FRA P                    L  1.0
```

CROSS OUT THE PROJECTION NOT REQD

NOTE :-

TORSIONAL MOMENT SHALL BE INPUT ONLY IN ONE OF FOLLOWING LOADING 1, 2 OR 3. FOR CONSERVATISM, THE SELECTION SHALL BE BASED ON THE DIRECTION OF THE LARGER "g" VALUE WHICH CAUSES THE L_T LOAD.

REMOVE '$' SIGN
INPUT JOINT NO WHERE WEIGHT IS INPUT BY USING MEMBER LOADS COMMANDS IN FOLLOWING LOADING CASE 1, 2 OR 3

REMOVE '$' SIGN, INPUT JOINT NO & MOM. WHERE JOINT MOMENTS ARE APPLIED WITH RESPECT TO GLOBAL COORD.

R3

REMOVE '$' SIGN
INPUT MEMBER NO, FORCES & MOMENTS WHERE MEMBER FORCES & MOMENTS ARE APPLIED WITH RESPECT TO MEMBER COORD.
(USE L 0.0 WHEN LOADS @ START JT.)

SEE NOTE ABOVE (LOADING 1)

SEE NOTE ABOVE (LOADING 1)

SEE NOTE ABOVE (LOADING 1)

SEE NOTE ABOVE (LOADING 1)

ATTACHMENT K 3 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - MODIFIED / IN SUPPORTS ("G" VALUES NOT ROTATED)

```
$              MOM      Z CON FRA P                    L  1.0
LOAD COMB 4  'DBE LOADING +X DIR' COMPONENTS -
1 ______
LOAD COMB 5  'DBE LOADING +Y DIR' COMPONENTS -
2 ______
LOAD COMB 6  'DBE LOADING +Z DIR' COMPONENTS -
3 ______
LOAD COMB 7  'SSE LOADING +X DIR' COMPONENTS -
1 ______
LOAD COMB 8  'SSE LOADING +Y DIR' COMPONENTS -
2 ______
LOAD COMB 9  'SSE LOADING +Z DIR' COMPONENTS -
3 ______
PRINT LOADING DATA
STIFFNESS ANALYSIS REDUCE BAND
LOAD COMB 10 'DBE SRSS 4 5 6' RMS -
4 5 6
LOAD COMB 11 'SSE SRSS 7 8 9' RMS -
7 8 9
STRESS RESULTS ARE TO BE COMBINED AT STRESS LEVEL
$ FOLLOWING LOAD CASES 1000 SERIES ARE DBE & 2000 SERIES ARE SSE
LOAD COMB 1001 'DL+SRSS 4 5 6 (DBE)' COMPONENTS -
2  1.0  10   1.0
LOAD COMB 1002 'DL-SRSS 4 5 6 (DBE)' COMPONENTS -
2   1.0  10  -1.0
LOAD COMB 2001 'DL+SRSS 7 8 9 (SSE)' COMPONENTS -
2   1.0  11    1.0
LOAD COMB 2002 'DL-SRSS 7 8 9 (SSE)' COMPONENTS -
2   1.0  11  -1.0
LOADS LIST -
10 TO 11
PRINT LOADING DATA
GENERATE RESULTS
LOAD LIST -
1001 TO 1002  2001 TO 2002 ..
COMBINED ALL
LOAD LIST ALL
OUTPUT DECIMAL 3
OUTPUT BY JOINTS ; OUTPUT BY MEMBERS
LIST DISPLACEMENTS, REACTIONS, FORCES
SECTION FR NS 2  0.0 1.0
GROUP '&LM' DEFINITION
MEMBERS ALL BUT ___________________
END OF GROUP DEFINITION
LIST SECTION STRESS MEMBERS '&LM'
$ DL COMB DBE (FOR CHECK WELD)
LOAD LIST -
1001 TO 1002
LIST FORCES ENVELOPE MEMBERS _______________
$ DL COMB SSE (FOR CHECK WELD)
LOAD LIST -
2001 TO 2002
LIST FORCES ENVELOPE MEMBERS ______________
PARAMETERS
'CODE' 'AISC' ALL ; 'VERSION' '69U1' ALL
'TORSION' 'YES' ALL ; 'CB' 1.0 ALL
'ASF' 1.6 LOADINGS 2001 TO 2002
'FSHMAX'  0.5 ALL
'FACMAX'  0.9 ALL
```

4

← SEE NOTE ON P3 (LOADING 1)

"g" VALUES

SAMPLE

← RIGID MEMBERS

MEMBER WITH WELD CONNECTION

BY. J T SHEN 2/11/87
CHK'D BY. JTL 8/11/87

R3

ATTACHMENT K 3 - INPUT SKELETON FOR STATIC RUN AND LOAD COMBINATION - MODIFIED / IN SUPPORTS ("G" VALUES NOT ROTATED)

5

S A M P L E

```
'FATMAX'  0.9 ALL
'FBMAX'   0.9 ALL
PARAMETERS
'LY' ------  MEM ----------
'LY' ------  MEM ----------
'LY' ------  MEM ----------
'LZ' ------  MEM ----------
'LZ' ------  MEM ----------
'LZ' ------  MEM ----------
'CMY' -----  MEM ----------
'CMY' -----  MEM ----------
'CMZ' -----  MEM ----------
'CMZ' -----  MEM ----------
'KY' ------  MEM ----------
'KY' ------  MEM ----------
'KY' ------  MEM ----------
'KZ' ------  MEM ----------
'KZ' ------  MEM ----------
'KZ' ------  MEM ----------
'UNLCF' --------  MEM ----------
'UNLCF' --------  MEM ----------
'UNLCF' --------  MEM ----------
LOAD LIST -
1001 TO 1002  2001 TO 2002
CHECK CODE ALL BUT ------------------  -
GENERATE TRACE 6 RESULTS FOR FAILING MEMBERS
FINISH NOMESSAGES
```

← RIGID MEMBERS & MEMBER NOT REQUIRE CODE CHECK

BY: J T CHEN 8/11/87

CHKD BY: JTL 8/11/87

R3

ATTACHMENT K4 - INPUT SKELETON FOR FREQUENCY RUN

S A M P L E

```
$ PLEASE USE 'IN-MF.SKL' AS THE SKELETON
$ INPUT FILE NO. _______.___   DISK ID: _______      DATE:___________
$ USER :________       BANNER NAME :______
STRUDL 'CPSES #1' '_________________________________'      ←— SUPT I D
$ CPSS1 ELECTRIC CONDUIT & JUNCTION BOX SUPPORTS
$ input file no. _______.__
TYPE SPACE FRAME
ALPHANUMERIC IDENTIFIER TREATMENT BY CHARACTER COMPARISON
UNITS INCHES, KIPS, DEGREES, FAHRENHEIT, LBM, SECONDS
$SHIFT COOR SYST 101 TRA  X_______ Y_______ Z_______ -
$                    ROT  R1______ R2______ R3______
$JOINT COOR SHIFT BY 101
JOINT COORDINATES
1                 .                    .                    .
2                 .                    .                    .
3                 .                    .                    .
4                 .                    .                    .
5                 .                    .                    .
6                 .                    .                    .
7                 .                    .                    .
8                 .                    .                    .
9                 .                    .                    .
10                .                    .                    .
11                .                    .                    .
12                .                    .                    .
13                .                    .                    .
14                .                    .                    .
15                .                    .                    .
16                .                    .                    .
17                .                    .                    .
18                .                    .                    .
19                .                    .                    .
20                .                    .                    .
21                .                    .                    .
22                .                    .                    .
23                .                    .                    .
24                .                    .                    .
25                .                    .                    .
26                .                    .                    .
27                .                    .                    .
28                .                    .                    .
29                .                    .                    .
30                .                    .                    .
31                .                    .                    .
SUPPORT JOINTS -
---------------
JOINT RELEASES
__________ F _ _  M _ _ _ .
__________ F _ _  M _ _ _
---------- KFX ________ KFY ________ KFZ ________     -
           KMX ________ KMY ________ KMZ ________
__________ KFX ________ KFY ________ KFZ ________     -
           KMX ________ KMY ________ KMZ ________
__________ KMX ________ KMY ________ KMZ ________
__________ KMX ________ KMY ________ KMZ ________
__________ KMX ________ KMY ________ KMZ ________
MEMBER INCIDENCES
1
2
```

USE THESE TWO COMMANDS WHEN SUPPORT COOD NOT AGREE WITH BLDG GLOBAL COORD. CROSS OUT $'s & JOINT COORDIN COMMAND WHEN USE.

BY JTSHEN 7/17/87

CHK'D BY J.T.Lai 7/17/8

SUPPORT JOINT ONLY

R2

R3

ATTACHMENT K4 - INPUT SKELETON FOR FREQUENCY RUN

SAMPLE

```
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
TYPE SPACE TRUSS
MEMBER INCIDENCES
------
------
MEMBER RELEASES
---------- STA F _ _ M _ _ _ END F _ _ M _ .
---------- STA F _ _ M _ _ _ END F _ _ M _ .
CONSTANTS
E 29.E3 ALL ; POISSON 0.3 ALL ; DENS 0.284 ALL
G 11.2E3 ALL ; CTE 0.0000065 ALL
FYLD 36.0 ALL BUT 46.0 ______
CONSTANTS
DENS 1E-3 ___
CONSTANTS
BETA ___
BETA ___
BETA ___
MEMBER PROPERTIES
-------------- TABLE 'STEELW' 'W__X___'
-------------- TABLE 'TUBESQR' 'T__X__X__'
-------------- TABLE 'TUBERECT' 'T__X__X__'
-------------- TABLE 'STEELC' 'C X  ' TYPE 'CHANNEL'
-------------- TABLE 'STEELMC' 'MC X   ' TYPE 'CHANNEL'
-------------- TABLE 'STEELL' 'L______'
-------------- TABLE 'STEELL' 'L______'
-------------- AX 100. AY 100. AZ 100. IX 1000. IY 1000. IZ 1000.
-------------- AX      AY      AZ       IX       IY       IZ       -
               SY      SZ
INERTIA OF JOINTS LUMPED
INERTIA OF JOINTS FACTOR  1  ADD
$ INPUT WEIGHT OF CONDUITS / BOXES IN POUNDS ( LBS )
```

INPUT FOR DIAG BRACING (AXIAL LOAD)

DO NOT RELEASE M_x AT START & END SIMULTANEOUSLY

FOR FICTIOUS MEMBER ONLY

R2

R.

ATTACHMENT K4 - INPUT SKELETON FOR FREQUENCY RUN

SAMPLE

```
_____________ LINEAR X _____ Y _____ Z _____
_____________ LINEAR X _____ Y _____ Z _____
_____________ LINEAR X _____ Y _____ Z _____
_____________ LINEAR X _____ Y _____ Z _____
_____________ LINEAR X _____ Y _____ Z _____
PRINT STRUCTURAL DATA
STEEL TAKE OFF ITEMIZE
PLOT DEVICE PRINTER WID 10 LEN 10
PLOT PROJECTION XY
PLOT PROJECTION XZ
PLOT PROJECTION YZ
GROUP '&RET' DEFINITION
JOI ALL ACTIVE
DYNAMIC DEGREE STATIC
JOI DEGREE OF FREEDOM
'&RET'  XT,YT,ZT
END
UNITS CYCLES
ASSEMBLE FOR DYNAMICS
MODAL ANALYSIS MAX FREQ 40.0
LIST DYNAMIC EIGENVALUES
LIST DYNAMIC EIGENVECTORS
LIST DYNAMIC NORM PART FACTORS
UNITS DEGREES
FINISH NOMESSAGES
```

CROSS OUT PROJECTION NOT REQ'D

R2

R3

ATTACHMENT L

ALLOWABLE NORMAL FORCE FOR STEPPED TUBULAR SECTION CONNECTIONS AND FORMULAS FOR FINDING PUNCHING SHEAR

R2

ATTACHMENT L - ALLOWABLE NORMAL FORCE FOR STEPPED TUBULAR SECTION CONNECTION

R2

Main Member t_cXD	B = $\frac{b}{D}$	Allowable Normal Weld Force lbs/"	Main Member t_cXD	B = $\frac{b}{D}$	Allowable Normal Weld Force lbs/"	Main Member t_cXD	B = $\frac{b}{D}$	Allowable Normal Weld Force lbs/"
3/16 x 4	.5	792	1/2 x 5	.4	4507	5/16 x 7	.43	1257
	.625	845		.5	4507		.57	1282
	.75	1055		.6	4695		.71	1527
	.875	1811		.7	5366		.86	2611
1/4 x 4	.5	1408		.8	7042	3/8 x 7	.43	1811
	.625	1502	3/16 x 6	.33	528		.57	1847
	.75	1878		.5	528		.71	2199
	.875	3219		.67	597		.86	3760
5/16 x 4	.5	2200		.83	835	3/16 x 8	.375	396
	.625	2347	1/4 x 6	.33	939		.5	396
	.75	2935		.5	939		.625	422
	.875	5030		.67	1061		.875	905
3/16 x 5	.4	634		.83	1664	1/4 x 8	.375	704
	.5	634	5/16 x 6	.33	1467		.5	704
	.6	660		.5	1467		.625	751
	.7	754		.67	1659		.875	1609
	.8	990		.83	2600	5/16 x 8	.375	1100
1/4 x 5	.4	1127	3/8 x 6	.33	2112		.5	1100
	.5	1127		.5	2112		.625	1173
	.6	1173		.67	2389		.875	2515
	.7	1341		.83	3743	3/8 x 8	.375	1584
	.8	1760	3/16 x 7	.43	452		.5	1584
5/16 x 5	.4	1760		.57	462		.625	1690
	.5	1760		.71	549		.875	3622
	.5	1833		.86	940	1/2 x 8	.375	2817
	.7	2095	1/4 x 7	.43	804		.5	2817
	.8	2751		.57	820		.625	3004
3/8 x 5	.4	2535		.71	977		.875	6438
	.5	2535		.86	1671			
	.6	2641						
	.7	3018						
	.8	3961						

R2

ATTACHMENT L - FORMULAS FOR FINDING PUNCHING SHEAR

R2

Nomenclature for stepped tabular connection;

branch number is perpendicular to main number. The configuration is shown below.

b - Minor width of structural tube branch member (in.)

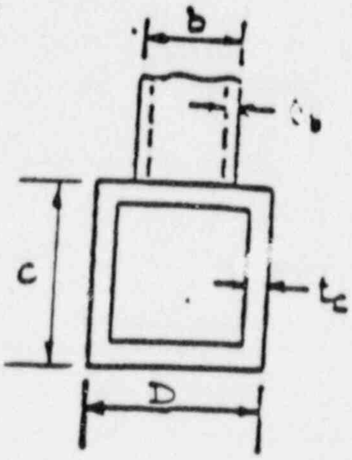
t_b - Thickness of branch member (in.)

D - Width of structural tube main member (in.)

t_c - Thickness of main member (in.)

β - Beta ratio, (b/D) box sections

C - Depth of structural tube main member (in.)



R2

EBASCO SERVICES INCORPORATED

BY C. H. CHEN DATE 11-14-86

ATTACHMENT L

CHKD. BY JIN DATE 11-14-86

TEXAS UTILITIES GENERATING CO.

COMANCHE PEAK UNIT 1

B-0010 CONDUIT DESIGN VERIFICATION

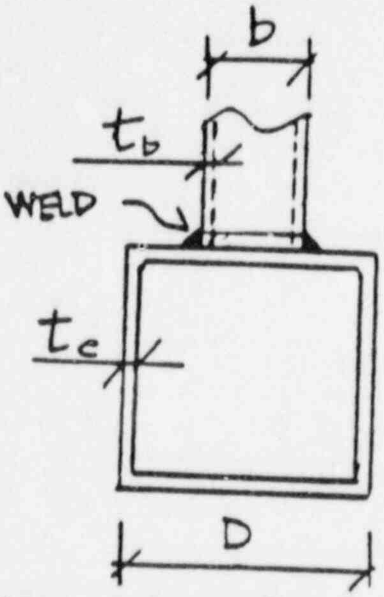
SHEET 49 OF 75

CO. 3306.071 DEPT. NO. 520

CLIENT

PROJECT

SUBJECT TUBULAR STL SECT CONNECTION DESIGN



REF: A.W.S. D1.1-79 SECT 10.5

ALLOWABLE PUNCHING SHEAR

$$V_p = Q_q \cdot Q_f \cdot (\text{basic } V_p)$$

WHERE

$$\text{basic } V_p = \frac{F_y}{0.6\gamma} = \frac{F_y}{.6(D/2t_c)} = \frac{3.33 t_c F_y}{D}$$

$$\gamma = \frac{D}{2t_c}, \quad \beta = \frac{b}{D}$$

$$Q_q = 1.0 \text{ FOR } \beta \leq .5$$

$$= \frac{.25}{\beta(1-\beta)} \text{ FOR } \beta > .5$$

$$Q_f = 1.0 \text{ FOR } U \leq .44$$

$$= 1.\overset{\circledast}{2} - .5U \text{ FOR } U > .44$$

FOR CONSERVATIVE DESIGN, USE

$\overset{\circledast}{Q_f} = 0.7$ FOR ALL U VALUES

STL A500 GR. B

$F_y = 46^{KSI}$ OR

2/3 OF MIN. TENSILE STRENGTH

$= 2/3\,(58^{KSI}) = 38.67^{KSI}$

⊛ 1.22 FOR '79 CODE.

USE 1.2 & U=1.0

TO ENVELOPE THE ALLOWABLES IN THE TABLE CONSERVATIVELY.

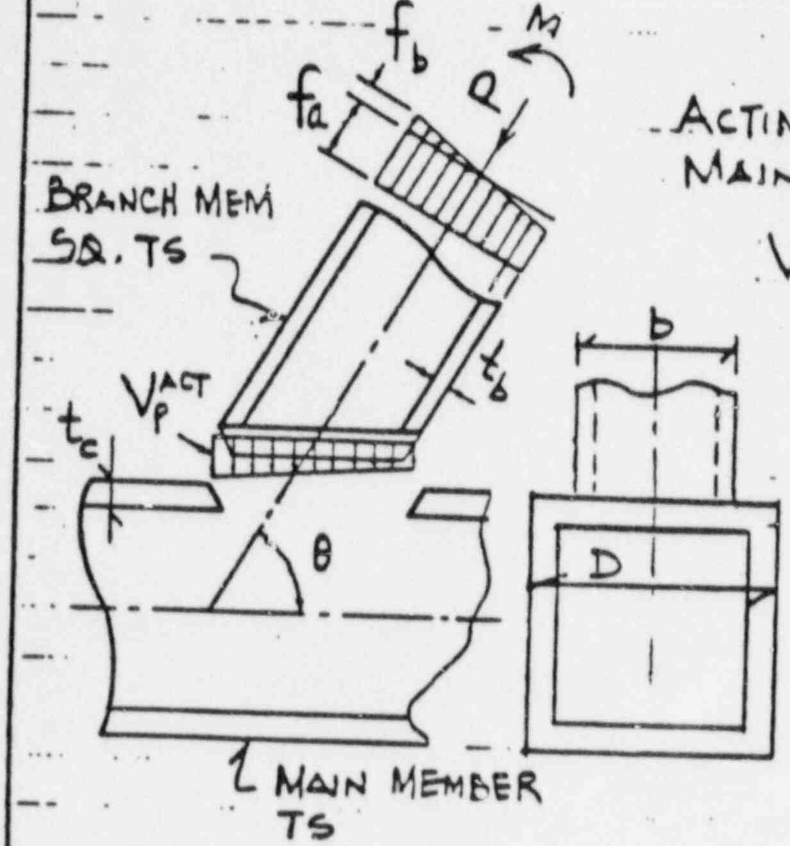
R2

$$V_p = (1)(.7)\left(\frac{3.333 t_c \times 38.67}{D}\right) = 90.22 \frac{t_c}{D} \quad \text{FOR } \beta \leq .5$$

$$V_p = \frac{.25}{\beta(1-\beta)} \times (0.7) \times \frac{128.9\, t_c}{D} = \frac{22.55}{\beta(1-\beta)} \cdot \frac{t_c}{D} \quad \text{FOR } \beta > .5$$

ALLOW. NORM. WELD FORCE FOR CONN $= t_c V_p$ (lbs/in)

SUBJECT STEPPED TUBULAR SECT CONN



ACTING PUNCHING SHEAR STRESS IN MAIN MEMBER

$$V_p^{ACT} = \frac{t_b}{t_c}\left[\frac{f_a \sin\theta}{K_a} + \frac{f_b}{K_b}\right]$$

WHERE $f_a = \frac{P}{A_b}$ AXIAL STRESS

$f_b = \left(f_{bY}^2 + f_{bZ}^2\right)^{\frac{1}{2}}$ BENDING STRESS

(IF APPLICABLE FOR OUT OF PLANE BENDING)

$K_a = \frac{1+\sin\theta}{2\sin\theta}$

$K_b = \frac{1+3\sin\theta}{4\sin^2\theta}$

(K_b: USE ENVELOPE)

AFTER SUBSTITUTION, THEN

$$V_p^{ACT} = \frac{t_b}{t_c}\sin^2\theta\left(\frac{2f_a}{1+\sin\theta} + \frac{4f_b}{1+3\sin\theta}\right)$$

CALCULATED ACTING PUNCHING SHEAR FORCE IN MAIN MEMBER $(V_p^{ACT})t_c \le t_c V_p$ (ALLOW. NORMAL WELD FORCE - SEE TABLE SH. L-2

REF: 1. AWS CODE D1.1-79 SECT 10.5

2. NEW AWS CODE SPECIFIES THE DESIGN OF TUBULAR STRUCT BY O. BLODGETT.

ATTACHMENT M

WARPING STRESS TABLE

R1

ATTACHMENT M. SUMMARY OF WARPING STRESS TABLES

A. Channel Sections

Warping stress table for channel sizes listed below have been developed for different points (0, 1, 2, 3 see Figure 1) on the channel section for various cases (3, 6 & 9) depending on the end condition. These tables are compiled in the Unit #1 Design Aids and may be obtained from your group leader.

CHANNEL SIZE	CASE
C6 x 8.2	9
C4 x 7.25	9
C6 x 8.2	6
C4 x 7.25	6
MC3 x 7.1	6
MC6 x 12	6
MC6 x 18	6
MC3 x 7.1	9
MC6 x 12	9
MC6 x 18	9
C6 x 8.2	3
C4 x 7.25	3

END CONDITIONS

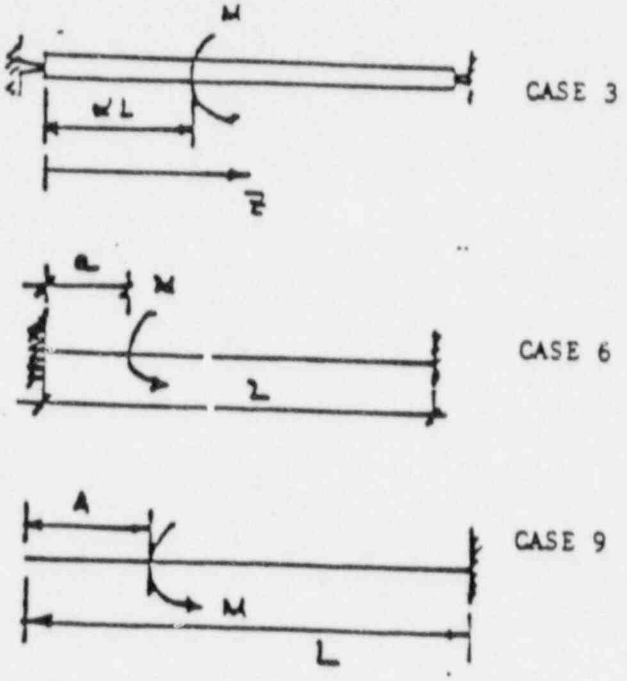
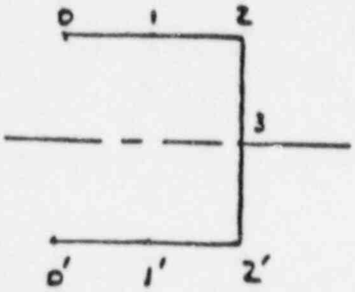


Figure 1: Stresses of the following points are calculated:



WARPING NORMAL STRESSES

σ_{w0}(SIGW0) at point 0
σ_{w2}(SIGW2) at point 2

WARPING SHEAR STRESSES

τ_{w1} (TAUW1) at point 1
τ_{w2} (TAUW2) at point 2
τ_{w3} (TAUW3) at point 3

B. Composite Channel Sections

Warping stress tables for composite channel sections are compiled in the Unit #1 Design Aids (Calculation Book No. SUPT-0040) and may be obtained from your group leader. R1

ATTACHMENT N

FOOTPRINT LOAD (FPL) AND ENGINEERING EVALUATION

OF

SEPARATION VIOLATION (EESV) GUIDELINES

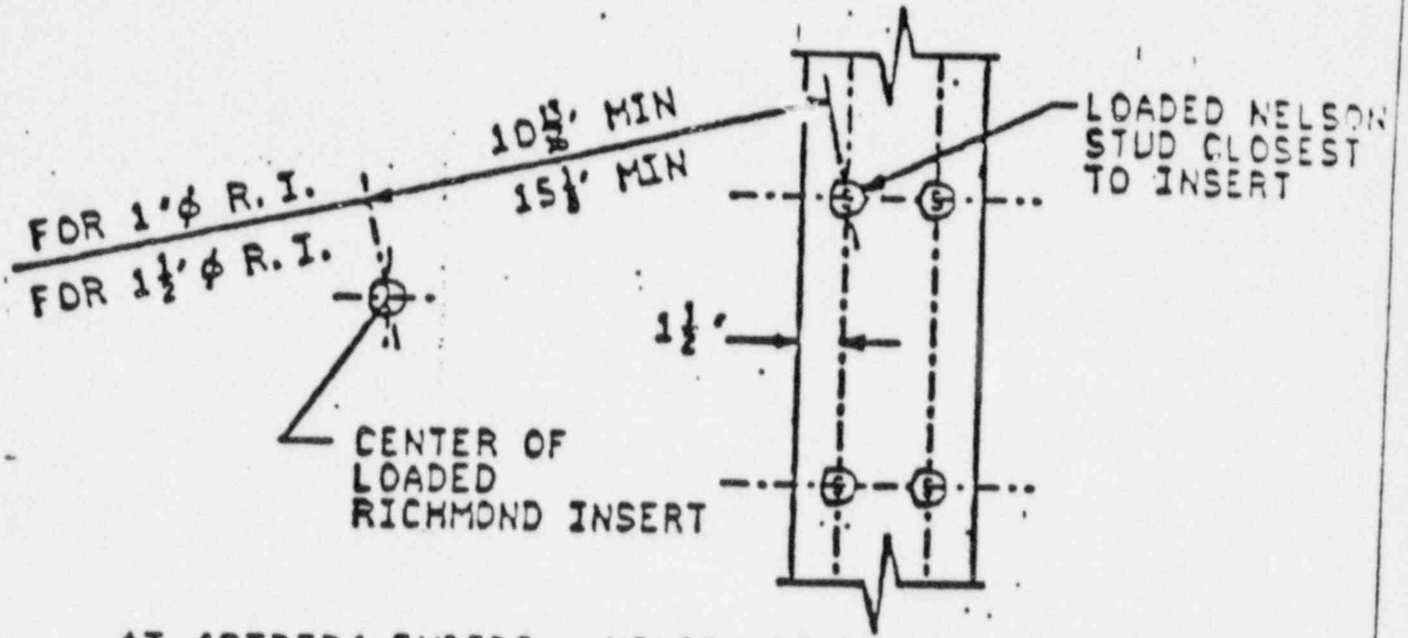
R2

ATTACHMENT N1 - MINIMUM SPACING REQUIREMENT

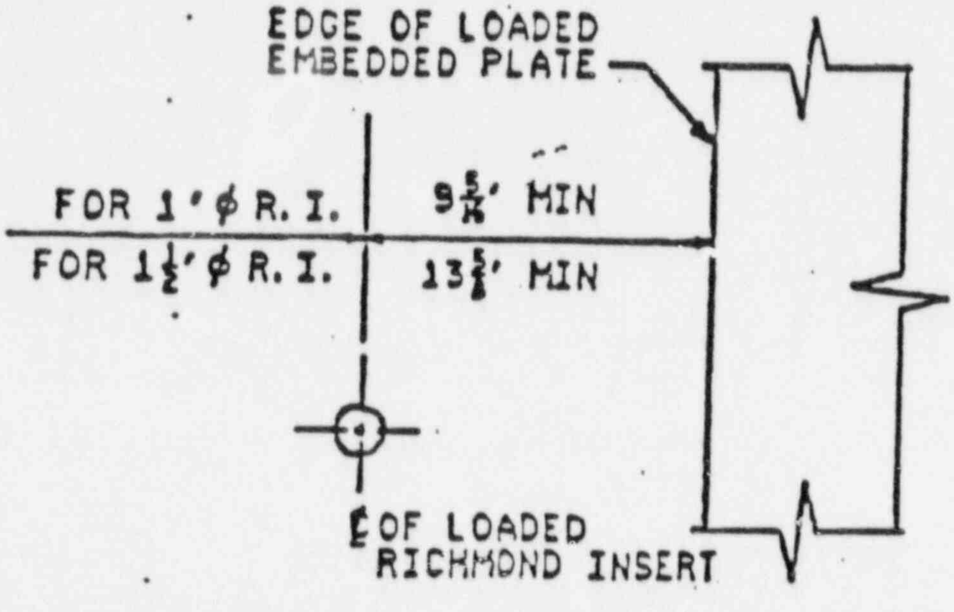
Deleted

(Refer to Appendix 2 of the Unit 1 Design Criteria SAG-CP-10)

ATTACHMENT N2 - MINIMUM SPACING REQUIREMENT
(LOADED RICHMOND INSERT TO LOADED EMBEDDED PLATE)



AT 'STRIP' EMBEDS - NELSON STUD LOCATIONS KNOWN



AT 'STRIP' EMBEDS - NELSON STUD LOCATIONS UNKNOWN AND AT 'SPREAD' EMBEDS (4x8 & LARGER)

ATTACHMENT N3 - FOOTPRINT LOAD TRANSMITTAL FORM

R2

FOR FOOTPRINT LOAD TRANSMITTAL FORM SEE
FIGURE 7.1 IN PROCEDURE ECE 5.11-14

R2

ATTACHMENT N4 - GUIDELINES FOR EESV AND FPL FORMS

R2

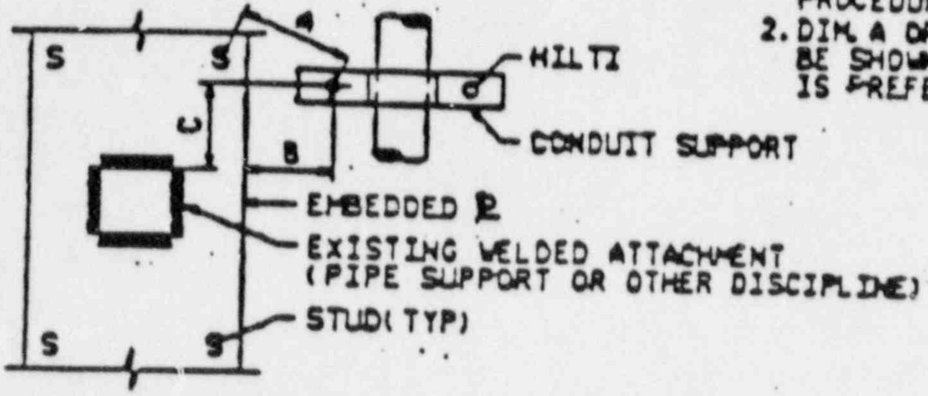
CASE NO.	CONDUIT SUPPORT USING-	STRUCTURE BY OTHER DISCIPLINE USING	EESV FORM	FPL FORM	MINIMUM REQUIREMENTS TO BE MET TO RELEASE DWGS. TO DCC PENDING APPROVALS OF EESV/FPL FORM
1.	HILTI	HILTI OR RICHMOND INSERT	REQUIRED	NOT REQUIRED	1. COND. SUPPT HILTI SHOULD BE OK 2. MEET GUIDELINES OF SECT. 11 3. PUNCHLIST THE SUPPT.
2.	HILTI	EMBED PLATE	REQUIRED	NOT REQUIRED	1. HILTI SHOULD BE OK. 2. SEND DWG. COPY TO STRUCTURAL EMBEDMENT GROUP (SEC) (LATER)
3.	EMBED PLATE	HILTI	REQUIRED	REQUIRED SEE SECTION 8.2	1. MEET GUIDELINES OF SECT. 11 2. PUNCHLIST THE SUPPT.
4.	EMBED PLATE	EMBED PLATE	NOT* REQUIRED	REQUIRED SEE SECTION 8.2	*HOWEVER, IF OTHER DISCIPLINE SENDS THE EESV FOR CSDV APPROVAL, IT SHALL BE PROCESSED FOR ESTABLISHED GUIDELINES.

R2

CASE NO.	CONDUIT SUPPORT USING-	CONDUIT SUPPORT USING-	EESV FORM	FPL FORM	MINIMUM REQUIREMENTS TO BE MET TO RELEASE DWGS. TO DCC PENDING APPROVALS OF EESV/FPL FORM
5.	EMBED PLATE	EMBED PLATE	NOT REQUIRED	REQUIRED SEE SECTION 8.2	
6.	EMBED PLATE	HILTI	NOT REQUIRED	REQUIRED SEE SECTION 8.2	HILTI BOLT SHOULD BE ACCEPTABLE
7.	HILTI	HILTI	NOT REQUIRED	NOT REQUIRED	HILTI BOLTS FOR BOTH SUPPTS. SHOULD BE ACCEPTABLE.
8.	EMBED PLATE	THERE IS NO SEPARATION VIOLATION	NOT* REQUIRED	REQUIRED SEE SECTION 8.2	

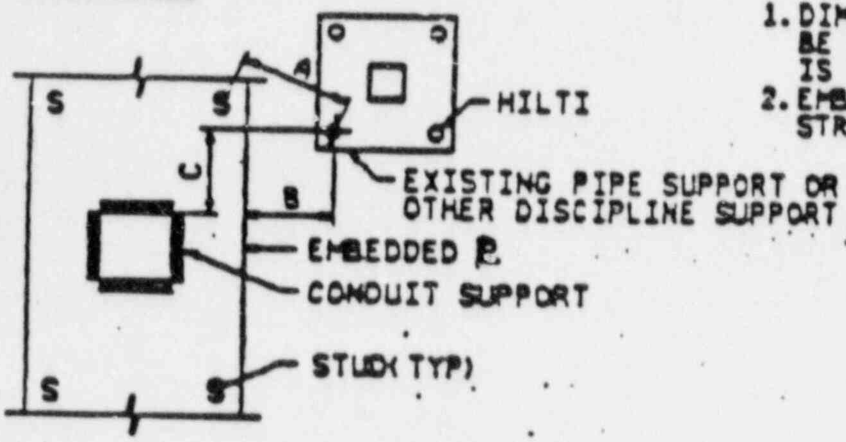
ATTACHMENT N5 - SEPARATION VIOLATIONS TO BE DOCUMENTED ON EESV CARDS FOR THE FOLLOWING CONDITIONS

CASE I



1. USE METHOD 6 OF THE PROCEDURE DBD-CS-15.
2. DIM. A OR B & C SHOULD BE SHOWN ON DWG.. DIM. A IS PREFERABLE.

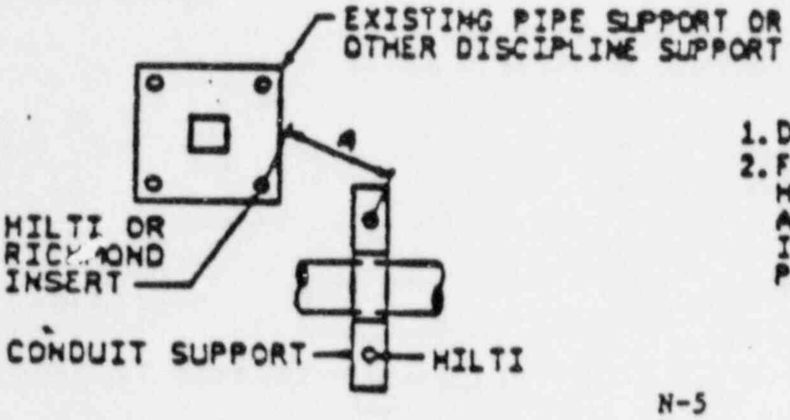
CASE II



1. DIM. A OR B & C SHOULD BE SHOWN ON DWG.. DIM. A IS PREFERABLE.
2. EMB. ℄ TO BE EVALUATED BY STRUTURAL EMBEDMENT GROUP.

R2

CASE III



1. DIM. A SHOULD BE SHOWN ON DWG..
2. FOR VIOLATION BETWEEN TWO HILTI BOLTS USE METHOD 1 AND BETWEEN HILTI & RICHMOND INSERT USE METHOD 2 OF THE PROCEDURE DBD-CS-15.

RB#2 F.S.E.G. EESV 752

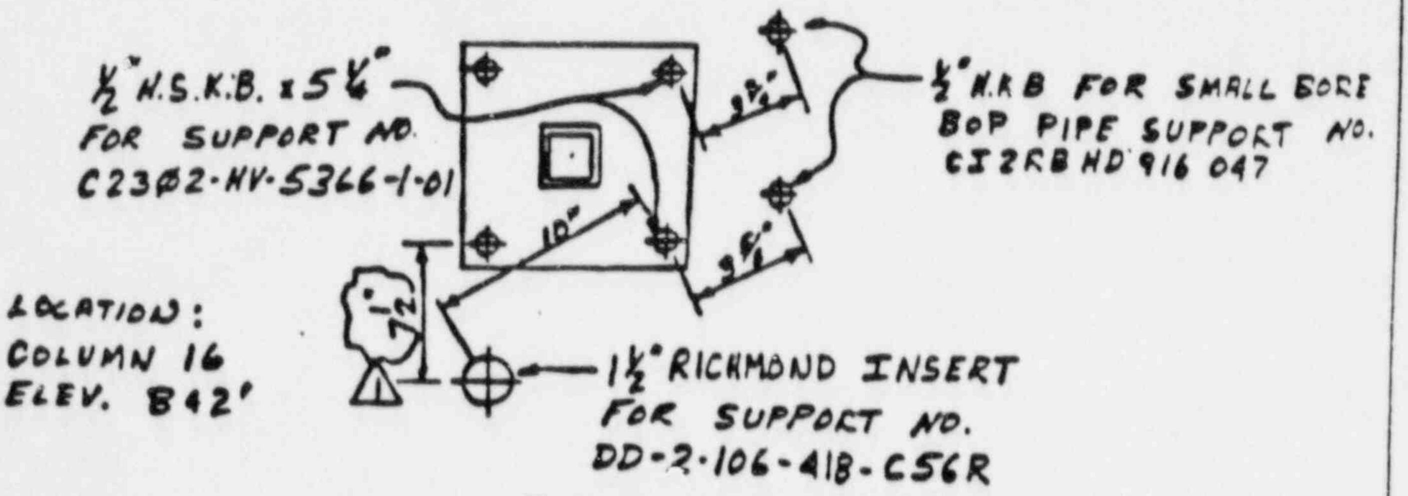
ENGINEERING EVALUATION OF SEPARATION VIOLATION (EESV)

		HANGER 1	HANGER 2
A.	SUPPORT NO.	C23Ø2-HV-5366-1-01	CI2RBHD916047
B.	HANGER TYPE (IF APPLICABLE I.E., CONDUIT SUPPORT CST-18)	CSM-116-I	
C.	SEPARATION PROVIDED	3¾", 3⅝"	.3¾". 3⅝"
D.	ACTUAL LOADING ON BOLT IN QUESTION	OBE SSE T: .307K .396K S: .132 .169	FOOT PRINT LOADS ATTACHED
E.	METHOD OF EVALUATION	METHOD NO. 1	BT SEG GROUP
F.	RESULTS OF INTERACTION CALCULATION	OBE SSE .294 .302	BT SEG GROUP
G.	APPROVAL SIGNATURE	1/9/86 (DATE) Guell 1/9/86	

REV. NO. 01 | BY C. cur D/ 2.5.86
CHKD D/ 3.25.86

R2

REFERENCE: CP-EP-4.3 - ATTACHMENT 6



ELEVATION VIEW

ATTACHMENT P

TENSION SPRING CONSTANT FOR ANCHOR BOLTS

R2

ATTACHMENT P - TENSION SPRING CONSTANT FOR ANCHOR BOLTS

Anchor Bolt Shear and Tension Stiffness

May 25, 1979

R3

HILTI KWIK BOLTS
&
HILTI SUPER KWIK BOLTS

Bolt stiffnesses for tension and shear are summarized in the following tables. The data was collected from manufacturers tests, FFTF report, and Detroit Edison testing.

The stiffnesses were calculated by determining Pu, the ultimate tensile or shear load, and dividing it by an appropriate factor of safety (four or five). The deflection at $\frac{Pu}{4 \text{ or } 5}$ is read off the loading-deflection curve. The 'linear' stiffness using $\frac{Pu}{4 \text{ or } 5}$ is then calculated. If the load-deflection behavior of the bolt is better approximated by a bilinear curve in this load range then two slopes were calculated. The load and deflection at which this change in slope occur is tabulated in the last column of the tables.

R3

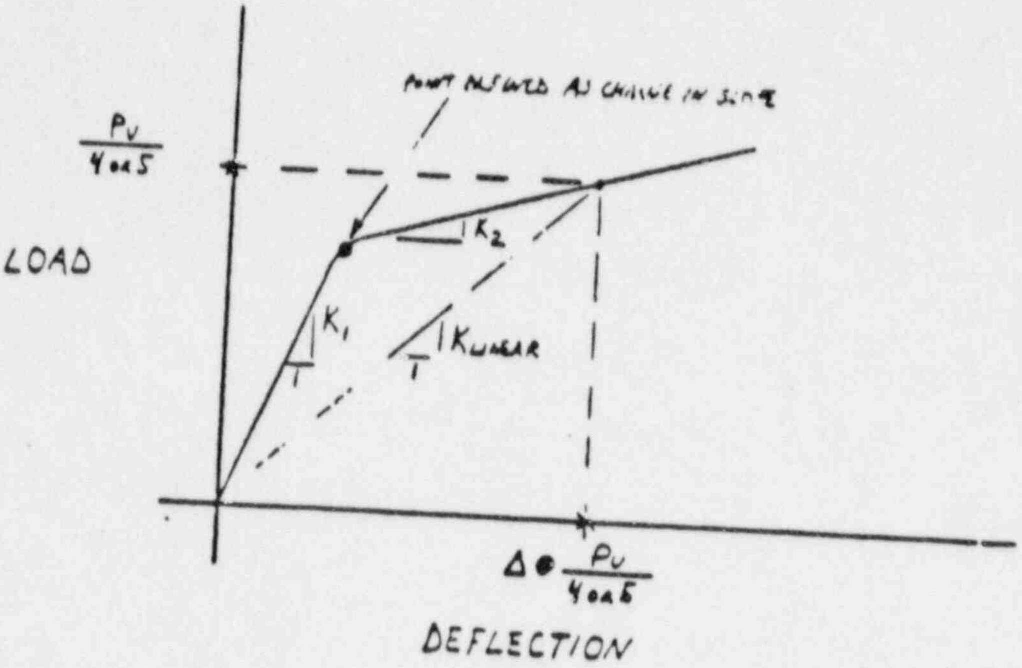
Some of the data indicated that the bolts are rigid up to the allowable design load. Actually, the measuring devices used to obtain this data may have not been sensitive enough to measure small displacements. For these cases the stiffness is based on the lowest load to have a measured displacement.

The raw data used in these tables are on file at TES and copies will be provided to individual utilities upon request. Note that a substantial amount of 'scatter' is evident in most of this data; this fact should be considered in using these values for analysis.

TELEDYNE ENGINEERING SERVICES

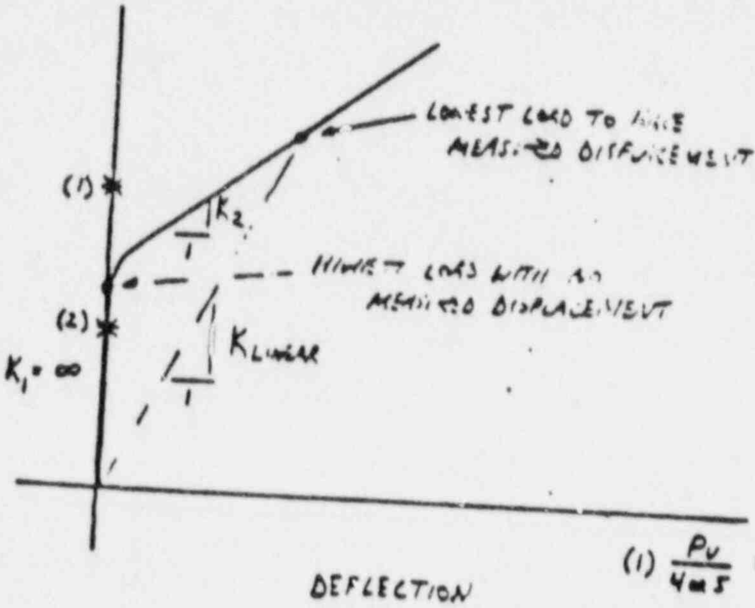
BY ______ DATE ______
CHKD. BY LJD DATE 5-25-79

SHEET NO. 1 OF 1
PROJ. NO. 3501



TYPICAL LOAD-DEFLECTION CURVE

R3



(1) $\frac{P_V}{4 \text{ or } 5}$ (BOLT DEFLECTION UNKNOWN)

(2) $\frac{P_V}{4 \text{ or } 5}$ (BOLT RIGID)

LOAD-DEFLECTION CURVE SHOWING RIGID BEHAVIOR

ATTACHMENT P - TENSION SPRING CONSTANT FOR ANCHOR BOLTS

HILTI KWIK BOLTS TENSION

Bolt Size (in)	Embed. Depth (in)	Concrete Strength (psi)	Pu (lbs)	$\frac{Pu}{4}$ (lbs)	Δ @ $\frac{Pu}{4}$ (in)	Linear K (lbs/in)	Bilinear K (lbs/in)		Load (Defl.) at Charge in Slope for Bilinear K (lbs)
							K_1	K_2	
1/4	1 1/8	2000	940	235	0.019	12,370	21,000	9,290	105 (.005)
		4000	1475	370	0.0039	94,900	180,000	65,500	180 (.001)
		6000	1760	440	0.008	55,000	45,700	120,000	320 (.007)
	2 5/8	2000	2925	730	0.03	24,300	12,000	86,000	300 (.025)
		4000	3350	840	0.004	210,000			
		6000	3225	806	0.007	115,000	167,000	76,500	500 (.003)
3/8	1 5/8	2000	2160	540	0.018	30,000	13,300	63,300	160 (0.012)
		4000	2300	575	0.005	115,000	210,000	51,700	420 (0.002)
		6000	2840	710	0.006	118,000			
	4 5/8	2000	3350	840	0.046	18,300	10,530	55,000	400 (0.038)
		4000	4950	1240	0.010	124,000			
		6000	4700	1175	0.012	97,920			
1/2	2 1/4	2000	4720	1180	0.041	28,780	14,300	60,000	400 (0.028)
		4000	5650	1412	0.015	94,200	73,080	231,250	950 (0.013)
		6000	6850	1712	0.008	214,062			
	6 1/4	2000	9600	2400	0.067	35,820	16,000	47,600	400 (0.025)
		4000	12600	3150	0.005	630,000			
		6000	15500	3875	0.040	96,880	285,710	56,820	2000 (0.007)

ATTACHMENT P - TENSION SPRING CONSTANT FOR ANCHOR BOLTS

f 2.

HILTI KWIK-BOLTS TENSION

Bolt Size (in)	Embed. Depth (in)	Concrete Strength (psi)	P_u (lbs)	$\frac{P_u}{4}$ (lbs)	δ @ $\frac{P_u}{4}$ (in)	Linear K (lbs/in)	Bilinear K (lbs/in)		Load (Defl.) at Change in Slope for Bilinear K (lbs)
							K_1	K_2	
5/3	2 3/4	2,000	6,000	1,500	0.015	100,000			
		4,000	6,900	1,725	0.016	107,800			
		6,000	8,200	2,050	0.006	341,700			
	7 3/4	2,000	10,000	2,500	0.025	100,000			
		4,000	17,000	4,250	0.030	141,700			
		6,000	21,000	5,250	0.105	50,000	138,200	18,710	3,800 (.0275)
3/4	3 1/4	2,000	8,200	2,050	0.007	292,900			
		4,000	10,500	2,625	0.023	114,100			
		6,000	10,700	2,675	0.018	148,600	30,000	296,900	300 (.01)
	9 1/4	2,000	15,700	3,925	0.10	38,250			
		4,000	24,500	6,125	0.070	87,500	700,000	3,421	3,500 (0.005)
		6,000	22,375	5,594	0.03	186,500	262,500	17,500	5,250 (0.02)
1.0	4 1/2	2,000	14,300	3,575	0.019	188,200			
		4,000	16,200	4,050	0.01	405,000			
		6,000	21,600	5,400	0.025	216,000			
	10 1/2	2,000	16,500	4,125	0.02	206,250			
		4,000	27,000	6,750	0.045	150,000	400,000	53,846	5,000 (0.012)
		6,000	35,750	8,937	0.23	38,900	650,000	11,100	6,500 (0.01)
1 1/4	5 1/2	2,000	18,400	4,600	0.099	51,111	75,000	32,000	3,000 (0.04)
		4,000	23,800	5,950	0.165	36,060			
		6,000	33,500	8,375	0.180	46,527	160,000	28,226	4,000 (0.025)
	10 1/2	2,000	26,000	6,500	0.160	40,625	88,808	21,739	4,000 (0.045)
		4,000	40,500	10,125	0.26	38,942	225,000	23,437	4,500 (0.02)
		6,000	45,000	11,250	0.095	118,421	340,000	39,285	8,500 (0.025)

R3

ATTACHMENT P - TENSION SPRING CONSTANT FOR ANCHOR BOLTS

HILTI KWIK BOLTS SHEAR

Bolt Size (in)	Embed. Depth (in)	Concrete Strength (psi)	P_u (lbs)	$\frac{P_u}{4}$ (lbs)	Δ @ $\frac{P_u}{4}$ (in)	Linear K (lbs/in)	Bilinear K (lbs/in)		Load (Defl.) at Change in Slope for Bilinear K (lbs)
							K_1	K_2	
1/4	1 1/8	2000	2230	577	0.090	6,194	80,000	4,511	160 (.002)
		4000	3400	870	0.066	13,182	20,000	12,241	160 (.008)
		6000	4050	1012	0.042	24,107			
	2 5/8	2000	1750	437	0.070	6,250	29,167	4,094	175 (0.006)
		4000	2700	675	0.018	37,500	130,000	25,937	260 (.002)
		6000	2300	575	0.014	41,071	80,000	34,583	160 (.002)
3/8	1 5/8	2000	3904	976	0.080	12,200	30,357	8,348	425 (.014)
		4000	5100	1275	0.044	28,977	220,000	19,881	440 (.002)
		6000	6200	1550	0.048	32,292	75,000	28,410	300 (.004)
	4 5/8	2000	3400	850	0.019	44,737	266,700	25,700	400 (.0015)
		4000	5500	1375	0.040	34,375	181,250	18,056	725 (.004)
		6000	6600	1650	0.026	63,461	125,000	52,300	500 (.004)
1/2	2 1/4	2000	7400	1850	0.069	26,810	15,500	86,400	900 (.058)
		4000	8300	2075	0.024	86,460	366,700	46,430	1100 (.003)
		6000	9100	2275	0.056	40,630	19,440	78,750	700 (.036)
	6 1/4	2000	8900	2225	0.089	25,000	14,470	86,540	1000 (.076)
		4000	10400	2600	0.020	130,000	600,000	77,780	1200 (.002)
		6000	11500	2875	0.022	130,700	255,000	76,790	1800 (.008)
5/8	2 3/4	2000	12200	3050	0.072	42,360			
		4000	11800	2950	0.011	268,200	1,000,000	195,000	1000 (.001)
		6000	12900	3225	0.025	129,000	81,820	166,100	900 (.011)

R3

ATTACHMENT P - TENSION SPRING CONSTANT FOR ANCHOR BOLTS

HILTI KWIK BOLT SHEAR

Bolt Size (in)	Embed. Depth (in)	Concrete Strength (psi)	P_u (lbs)	$\frac{P_u}{4}$ (lbs)	Δ @ $\frac{P_u}{4}$ (in)	Linear K (lbs/in)	Bilinear K (lbs/in)		Load (Defl.) at Change in Slope for Bilinear K (lbs)
							K_1	K_2	
5/8	7 3/4	2,000	12,900	3,225	.096	33,590	18,000	50,540	900 (.050)
		4,000	15,400	3,850	.026	140,100	850,000	89,580	1,700 (.002)
		6,000	15,000	3,750	.018	208,300	850,000	128,100	1,700 (.002)
3/4	3 1/4	2,000	13,200	3,300	.037	89,200			
		4,000	17,600	4,400	.020	220,000	550,000	137,500	2,200 (.004)
		6,000	18,000	4,500	.068	66,200	23,530	108,800	800 (.034)
	9 1/4	2,000	15,400	3,850	.042	91,670	120,000	65,910	2,400 (.020)
		4,000	18,800	4,700	.070	67,140	250,000	56,100	1,000 (.004)
		6,000	21,200	5,300	.028	189,300			
1	4 1/2	2,000	30,000	7,500	.066	113,640	1,000,000	185,900	2,000 (.002)
		4,000	27,000	6,750	.038	177,600	700,000	148,600	1,400 (.002)
		6,000	30,500	7,625	.021	363,100	1,500,000	243,400	3,000 (.002)
	10 1/2	2,000	27,750	6,937	.120	57,810			
		4,000	35,000	8,750	.105	83,300	600,000	57,500	3,000 (.005)
		6,000	37,000.	9,250	.045	205,600	650,000	150,000	3,250 (.005)
1 1/4	5 1/2	2,000	37,000	9,250	.072	128,500	333,300	109,800	2,000 (.006)
		4,000	41,000	10,250	.088	116,500	312,500	96,880	2,500 (.008)
		6,000	45,500	11,375	.044	258,500	1,750,000	187,500	3,500 (.002)
	10 1/2	2,000	40,500	10,125	.130	77,880	33,330	116,100	2,000 (.060)
		4,000	31,500	7,875	.085	92,650			
		6,000	49,500	12,375	.080	154,700	400,000	138,300	2,000 (.005)

R3

ATTACHMENT P - TENSION SPRING CONSTANT FOR ANCHOR BOLTS

HILTI SUPER KWIK BOLTS TENSION

Bolt Size (in)	Embed. Depth (in)	Concrete Strength (psi)	P_u (lbs)	$\frac{P_u}{4}$ (lbs)	Δ @ $\frac{P_u}{4}$ (in)	Linear K (lbs/in)	Bilinear K (lbs/in)		Load (Defl.) at Change in Slope for Bilinear K (lbs)
							K_1	K_2	
1/2	3 1/4	1,500	6,350	1,587	.014	113,400			
		4,000	9,200	2,300	.015	153,300			
		6,000	13,600	3,400	.023	147,800	75,000	227,300	900 (.012)
	6 1/4	1,500	9,600	2,400	.050	48,000			
		4,000	15,000	3,750	.015	250,000			
		6,000	15,000	3,750	.010	375,000			
1	6 1/2	2,000	21,400	5,350	.019	281,600	800,000	203,000	2,000 (.0025)
		4,000	35,000	8,750	.019	460,500			
		6,000	37,500	9,375	.020	468,800			
	10 1/2	2,000	35,000	8,750	.140	62,500	240,000	23,910	6,000 (.025)
		4,000	48,500	12,125	.045	269,400			
		6,000	57,500	14,375	.030	479,200			
1 1/4	8 1/8	2,000	28,541	7,135	.165	43,240	440,000	17,650	4,400 (.010)
		4,000	43,000	10,750	.045	238,800			
		6,000	47,000	11,750	.090	130,600	300,000	65,380	7,500 (.025)
	13 1/8	2,000	41,500	10,375	.275	37,730	240,000	17,500	5,700 (.025)
		4,000	65,500	16,375	.045	363,900			
		6,000	73,000	18,250	.060	304,200	387,500	137,500	15,500 (.040)

R3

ATTACHMENT P - TENSION SPRING CONSTANT FOR ANCHOR BOLTS

HILTI SUPER KWIK-BOLTS SHEAR

Bolt Size (in)	Embed. Depth (in)	Concrete Strength (psi)	Pu (lbs)	$\frac{Pu}{4}$ (lbs)	Δ @ $\frac{Pu}{4}$ (in)	Linear K (lbs/in)	Bilinear K (lbs/in)		Load (Defl.) at Change in Slope for Bilinear K (lbs)
							K$_1$	K$_2$	
1/2	3-1/4	1500	10,000	2,500	.015	166,700			
		4000	11,800	2,950	.025	118,000			
		6000	14,000	3,500	.012	291,700			
	6-1/4	2000	11,800	2,950	.025	118,000	400,000	47,500	2000 (0.005)
		4000	15,400	3,850	.050	77,000			
		6000	10,700	2,675	.005	535,000			
1	6-1/2	2000	19,200	4,800	.056	85,710	800,000	59,260	1600 (0.002)
		4000	26,250	6,562	.059	111,200	312,500	79,660	2500 (0.008)
		6000	34,000	8,500	.062	137,100	1,000,000	77,590	4000 (0.004)
	10-1/2	2000	27,000	6,750	.075	90,000			
		4000	32,750	8,187	.058	141,200	500,000	107,700	2500 (0.005)
		6000	34,000	8,500	.055	154,500			
1-1/4	8-1/8	2000	52,420	13,105	.200	65,530			
		4000	42,000	10,500	.030	350,000	916,700	208,300	5500 (0.006)
		6000	39,000	9,750	.035	278,600			
	13-1/8	2000	38,000	9,500	.055	172,700			
		4000	47,000	11,750	.058	202,600			
		6000	47,000	11,750	.065	180,800			

R3

ATTACHMENT Q

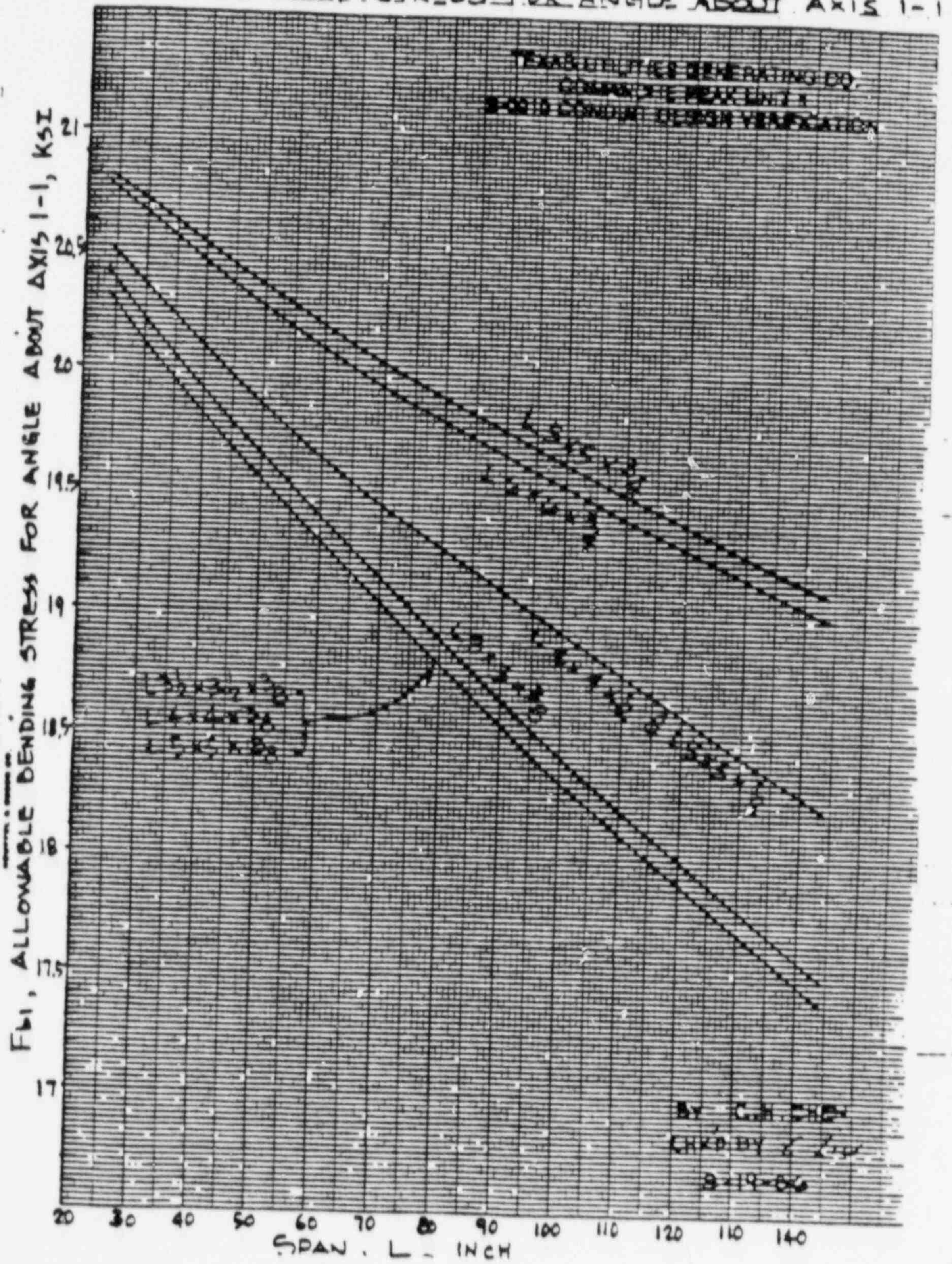
ALLOWABLE BENDING AND COMPRESSIVE STRESSES IN ANGLES

R2

EBASCO SERVICES INCORPORATED

BY C.H. CHEN DATE 7-25-86
CHKD. BY C Liu DATE 8-19-86
ATTACHMENT Q -
SHEET 42 OF 7?
OFS NO. 3306.071 DEPT NO. 550
CLIENT TEXAS UTILITIES GENERATING CO.
PROJECT COMANCHE PEAK UNIT 1
SUBJECT S-0910 CONDUIT DESIGN VERIFICATION

ALLOWABLE BENDING STRESS FOR ANGLE ABOUT AXIS 1-1



R2

BY C.H. CHEN DATE 7-25-86 ATTACHMENT Q - SHEET 40 OF [illegible]

CHKD. BY JIN DATE 8-14-86 TEXAS UTILITIES GENERATING CO. OFS NO. 3306.071 DEPT NO. 550

CLIENT COMANCHE PEAK UNIT 1

PROJECT S-0910 CONDUIT DESIGN VERIFICATION

SUBJECT ALLOWABLE BENDING STRESS FOR ANGLE ABOUT AXIS 1-1

REF: BASIC STEEL DESIGN BY BRUCE G JOHNSTON
P324 ~ 326

MEMBER SIZE & PROPERTIES	$f_{cr} = \frac{18000\pi C_c}{l\, I_1}\sqrt{J I_2}$	SPAN L INCH	f_{cr} KSI	F'_e (equiv) $\frac{12}{23} f_{cr}$	THE EQUIV $\frac{Kl}{r}$	F_b ABOUT AXIS 1-1 KSI
L3 × 3 × 3/8	$\frac{11893}{l}$	24	495.5	258.5	24	20.4
$I_1 = 2.793''^4$		48	247.8	129.3	34	19.7
$I_2 = .727''^4$		72	165.2	86.2	41.6	19.1
$J = .1055''^4$		96	123.9	64.6	48.1	18.5
$C_c = 2.121''$		120	99.1	51.7	53.8	18
		144	82.6	43.1	58.9	17.5
L3½ × 3½ × 3/8	$\frac{11619}{l}$	24	484.1	252.6	24.4	20.3
$I_1 = 4.57$		48	242.1	126.3	34.4	19.6
$I_2 = 1.17$		72	161.4	84.2	42.1	19
$J = .123$		96	121	63.1	48.7	18.5
$C_c = 2.475$		120	96.8	50.5	54.4	18
		144	80.7	42.1	59.6	17.5
L4 × 4 × 3/8	$\frac{11508}{l}$	24	479.5	250.2	24.5	20.3
$I_1 = 6.944$		48	239.8	125.1	34.6	19.6
$I_2 = 1.776$		72	159.8	83.4	42.3	19
$J = .1406$		96	119.9	62.6	48.9	18.4
$C_c = 2.828$		120	95.9	50	54.7	17.9
		144	79.9	41.7	59.9	17.4
L4 × 4 × ½	$\frac{15838}{l}$	24	659.9	344.3	20.8	20.5
$I_1 = 8.827$		48	330	172.2	29.5	20
$I_2 = 2.293$		72	220	114.8	36.1	19.5
$J = .3333$		96	165	86.1	41.7	19.1
$C_c = 2.828$		120	132	68.9	46.6	18.6
		144	110	57.4	51	18.3
L5 × 5 × 3/8	$\frac{11309}{l}$	24	471.2	245.8	24.7	20.3
$I_1 = 13.94$		48	235.6	122.9	34.9	19.6
$I_2 = 3.538$		72	157.1	82	42.5	19
$J = .1758$		96	117.8	61.5	49.3	18.4
$C_c = 3.535$		120	94.2	49.1	55.1	17.9
		144	78.5	41	60.3	17.4

R2

BY C.H.CHEN DATE 7-25-86 ATTACHMENT Q - SHEET 41 OF [illegible]

CHKD. BY JIN DATE 8-14-86 TEXAS UTILITIES GENERATING CO. JOB NO. 3306.071 DEPT NO. 550

CLIENT COMANCHE PEAK UNIT 1

PROJECT S-0910 CONDUIT DESIGN VERIFICATION

SUBJECT ALLOWABLE BENDING STRESS FOR ANGLE ABOUT AXIS 1-1

MEMBER SIZE & PROPERTIES	$f_{cr} = \frac{18000\pi C_c}{\ell I_1}\sqrt{J I_2}$	SPAN L INCH	f_{cr} KSI	F'_e (equiv) $\frac{12}{23} f_{cr}$	THE EQUIV $\frac{K\ell}{r}$	F_b ABOUT AXIS 1-1 KSI	
L5×5×1/2	$\frac{-15350}{\ell}$	24	639.6	333.7	21.2	20.5	
I_1=18.01 in^4		48	319.8	166.9	29.9	19.9	
I_2= 4.59 in^4		72	213.2	111.2	36.6	19.4	
J = .4167 in^4		96	159.9	83.4	42.3	19	
C_c= 3.535"		120	127.9	66.7	47.3	18.6	
		144	106.6	55.6	51.8	18.2	
L5×5×3/4	$\frac{24548}{\ell}$	24	1022.8	533.6	16.7	20.8	
I_1= 24.8		48	511.4	266.8	23.7	20.4	
I_2= 6.597		72	340.9	177.9	29	20	
J = 1.406		96	255.7	133.4	33.5	19.7	
C_c= 3.535		120	204.6	106.7	37.4	19.4	
		144	170.5	89	41	19.1	
L6×6×3/4	$\frac{23618}{\ell}$	24	984.1	513.4	17.1	20.8	
I_1= 44.847		48	492	256.7	24.1	20.3	
I_2= 11.554		72	328	171.1	29.6	20	(19.9)
J = 1.6875		96	246	128.3	34.1	19.6	
C_c = 4.242		120	196.8	102.7	38.1	19.3	
		144	164	85.6	41.8	19	
L × ×	$\frac{\quad}{\ell}$	24					
I_1=		48					
I_2=		72					
J =		96					
C_c=		120					
		144					
L × ×	$\frac{\quad}{\ell}$	24					
I_1 =		48					
I_2=		72					
J =		96					
C_c=		120					
		144					

R2

ATTACHMENT Q - TORSIONAL BUCKLING OF ANGLE MEMBERS

The following lists the maximum angle lengths for which torsional buckling needs to be considered. If the actual angle length is less than or equal to the length listed, the L/r shown shall be used to calculate the allowable compressive stress F(a). For lengths greater than those shown, torsional buckling is not critical.

ANGLE SIZE	LENGTH (L)	L/r
L 2 X 2 X 0.250	16"	41
L 2 X 2 X 0.375	12"	31
L 2.5 X 2.5 X 0.375	16"	33
L 3 X 3 X 0.250	37"	61
L 3 X 3 X 0.375	25"	42
L 3 X 3 X 0.500	19"	31
L 3.5 X 3.5 X 0.375	33"	47
L 4 X 4 X 0.250	65"	81
L 4 X 4 X 0.375	42"	53
L 4 X 4 X 0.500	31"	39
L 5 X 5 X 0.375	67"	67
L 5 X 5 X 0.500	49"	49
L 5 X 5 X 0.625	39"	39
L 5 X 5 X 0.750	33"	33
L 6 X 6 X 0.375	97"	81
L 6 X 6 X 0.500	72"	61
L 6 X 6 X 0.625	56"	47
L 6 X 6 X 0.750	46"	39
L 8 X 8 X 0.500	131"	82
L 8 X 8 X 0.625	103"	65
L 8 X 8 X 0.750	84"	53
L 8 X 8 X 1.000	63"	40

R2

If the angle fails using the above values, consult the group leader.

The equations and tabular values presented above apply to equal leg angles only. Unequal leg angles shall be addressed on a case-by-case basis.

EBASCO SERVICES INCORPORATED

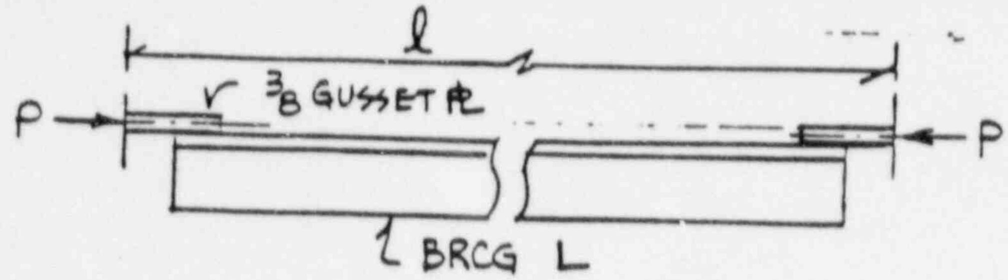
BY C.H.CHEN DATE 8-19-86 ATTACHMENT Q - SHEET 46 OF -5

CHKD. BY DATE 8-20-86 OFS NO. 3306.071 DEPT NO. 550

CLIENT

PROJECT

SUBJECT ALLOWABLE LOAD IN ANGLE BRCG WITH GUSSET PL CONNECTION



ANGLE SIZE	SPAN l (INCH)	ALLOWABLE LOAD P (KIPS)
$L3\times3\times\frac{3}{8}$	36	16
	48	14
	60	13
	72	11
	84	9
	96	7
	108	6

NOTES:

1.) ALLOWABLE LOAD SHOWN ON THE TABLE IS FOR OBE LOAD COMBINATION.

2.) 1.6 TIMES ALLOWABLE LOAD SHALL BE USED FOR SSE LOAD COMBINATION.

3.) FOR CALCULATION OF ALLOWABLE LOAD, SEE BOOK NO. SUPT 0235.

4.) LINEAR INTERPOLATION IS ACCEPTABLE.

R3

881/8-81

EBASCO Interoffice Correspondence

DATE March 14, 1988
FILE REF. 2-CP/C-2313
CND-70-20-04

TO DISTRIBUTION
OFFICE LOCATION CPSES

FROM C. Y. CHIOU/M. BAGHAEI
S. DUTT
CYC MB SD
OFFICE LOCATION CPSES

SUBJECT TU ELECTRIC
COMANCHE PEAK STEAM ELECTRIC STATION
ADDENDUM NO. S2 TO SAG. CP25, REVISION 1
NODAL SPACING FOR CONDUITS WITH FIREWRAP
OR THERMOLAG

When modeling the ISO for conduit system covered with firewrap or thermolag, maximum nodal spacing shall be as specified in Addendum No. S2 to SAG.CP25, Revision 1. Attached for your use is the marked-up page 6 of Appendix 1 to be incorporated into Revision 2 of SAG.CP25 at a later date. This addendum is to be used immediately in design verification.

Please acknowledge receipt of subject document by signing below and returning this memo to C. Y. Chiou no later than March 25, 1988.

CYC:rm

Receipt Acknowledged ______________________________

cc: E. Odar
F. Hettinger
R. Muldoon
C. Anderson
J. Dwyer
J. Young, IMPELL
A. Jones, Site File

Distribution

[redacted]
I. Wolff
M. McGrath
A. Wong

PREPARED BY: S. Dutt 3-14-88
REVIEWED BY: M. Baghai 3-14-88
APPROVED BY: C.Y. Chiou 3/14/88
DATE:

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
ELECTRICAL CONDUIT ISOMETRIC VALIDATION
APPENDIX I

PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. S2

5.2 LOCATION OF CONDUIT NODAL POINTS

a. For overhang segment, two nodal points shall be specified, one at the tip of the overhang and the other at the midspan.

b. Any segment shall have preferably three equally spaced nodal points between the end points. A segment is defined as straight portion of the conduit run without turns. A single bend has two segments and a double-bend has three segments.

The nodal spacing shall not exceed the S_{max} when modeling the ISO:

CND SIZE	S_{max} (INCH) *
3/4	26.2
1	30.2
1.5	34.8
2	39.7
2.5	43.6
3	45.8
4	51.9
5	59.6

* The maximum nodal spacing, S_{max}, is calculated by the following formula:

$$S_{MAX} = \frac{1}{2} \times \sqrt{\frac{\pi}{2F}} \times \sqrt[4]{\frac{EI386.4}{W}}$$

Where F = cut-off frequency = 33.0 Hz
W = unit weight of conduit #/inch
E = modulus of elasticity #/inch^2
I = moment of inertia of conduit (in^4)

For Smax of conduits covered with firewrap see attached page.

c. If Additional weights, such as BC or LBD are imposed, additional nodal points should be added.

d. Conduit with a bend less than or equal to 15 degrees is considered a straight run.

EBASCO SERVICES INCORPORATED

BY S. Dutt DATE 1-27-88 APPROVED BY CY Chiou DATE 3/14/88 SHEET 3 OF 3

CHKD. BY NB DATE 3-12-88 OFS NO. DEPT. NO.

CLIENT TU ELECTRIC

PROJECT CPSES - UNIT #1

SUBJECT MAX. NODAL SPACING OF CONDUITS W/FIREWRAP.

PROJECT IDENTIFICATION
NO. SAG, CP25
REV. 1 ADDENDUM NO. 32

THE NODAL SPACING Smax. FOR CONDUITS WITH B&B BLANKET FIREWRAP -

CONDUIT SIZE	Smax. (inch.)		
	CONDUIT WITH DRY BLANKET	CONDUIT WITH WET BLANKET	CONDUIT WITH THERMOLAG
3/4"	23.04	16.82	19.1
1"	27.04	20.28	22.65
1½"	32.64	26.0	28.2
2"	37.52	30.42	32.6
2½"	41.85	35.28	37.22
3"	44.47	38.94	40.52
4"	50.66	45.26	46.6
5"	58.2	52.23	53.57

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
ELECTRICAL CONDUIT ISOMETRIC VALIDATION
APPENDIX II

PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. S1

APPENDIX II

PROCEDURE FOR DESIGN VALIDATION OF SEISMICALLY RESTRAINTED 'C' TRAIN LARGER THAN TWO (2") INCH DIAMETER CONDUIT ISOMETRIC

REVISION	PREPARED BY	REVIEWED BY	APPROVED BY	DATE	PAGE AFFECTED
–	Hui S. Ju	T. Kuo,		10/30/87	

PROCEDURE FOR DESIGN VALIDATION OF SEISMICALLY RESTRAINTED 'C ' TRAIN LARGER THAN TWO INCH CONDUIT ISOMETRIC

TABLE OF CONTENTS

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
ELECTRICAL CONDUIT ISOMETRIC VALIDATION
APPENDIX II

PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. S1

1.0 PURPOSE

The purpose of this design procedure is to provide guidelines for design validating the seismically restrained (CSR) Train "C" larger than two inch diameter conduit isometrics in the Unit No. 1 and common area where the failure of conduit system will affect the capability of safe shutdown of the Unit No. 1 operation in accordance R.G. 1.29 (Reference 2) or inflict injury to the Control Room personnel during and after safe shutdown earthquake (SSE).

2.0 REFERENCES

1. Design criteria SAG.CP-10.
2. R. G. 1.29 - Regulatory Guide 1.92
"Combining Modal Responses and Spatial Components in Seismic Response Analysis Rev. 1. Feb. 1976."

3.0 BACKGROUND

Train "C" conduits larger than 2 inch in diameter fall under three (3) categories: 1) seismically designed, 2) seismically restrained by aircraft cables and 3) non-seismically designed. (NONIS)

For seismically designed train "C" conduits, design validation shall be in accordance with "Design Criteria for Seismic Category I Electrical Conduit System " SAG.CP10 for Unit No. 1 and SAG.CP2 for Unit No. 2. Non-safety related, non-seismically designed Train "C" conduits (NONIS) shall be addressed as part of System Interaction Interaction Program to evaluate the adequacy of conduit systems.

This document, Appendix II of SAG.CP25, shall be used for the design validation of seismically restrained conduits. Seismic restraints were installed in accordance with the CSR and LSR series drawings of the original 2323-S-0910 package. The CSR drawing series contains all restraint details, such as Aircraft Cable sizes, clamps types, anchorage details, etc. The LSR series drawings contains the maximum conduit allowable span length. For this design validation effort, the LSR series drawings need not be considered since the "As-Built" span lengths vary greatly from those shown on the LSR series drawings and the conduit span length can be checked based on the requirement specified in Section 4.0. The CSR series drawings shall be design validated based on this procedure on an as required basis in order to validate the conduit isometrics.

4.0 DESIGN VALIDATION REQUIREMENTS AND CONSIDERATIONS

The design validation requirements shall be in accordance with Design Criteria SAG.CP10 latest revision, except the following:

1) Only dead load plus Safe Shutdown Earthquake (SSE) need to be considered.

2) Dead load hangers marked as NONIS on isometrics exist, however, for conservative reasons, the capability of dead load hangers to resist any dead load as well as seismic load shall not be considered. Also the weight of the dead load hangers need not be considered.

3) The following design "g" values for various zones and building elevations shall be utilized. These design "g" values are the highest peak accelerations from Amplified Response Spectra of 7% damping among all building elevations in the specified zone plus dead load. The 7% damping is selected due to the fact that all CSR supports are constructed of aircraft cables, unistrut members, bolts, split clamps, etc. All these items are highly energy absorbers.

Zone	Buildings and Elevations	Design "g's" + 1
1.	Safeguard Building: 790'-6", 785'-6", 773'-6" Internal Structures: 783'-7" Fuel Building: 860'-0", 841'-0", 825'-0", 810'-0"	2.46
2.	Safeguard Building: 831'-6", 810'-6" Internal Structures: 860'-6", 832'-6", 808'-0" Elec./Control Building: 830'-0", 807'-0", 778'-0"	2.81
3.	Safeguard Building: 852'-6" Auxiliary Building: 810'-6", 790'-6" Elec./Control Building: 873'-4", 854'-4"	3.04
4.	Safeguard Building: 896'-6", 873'-6" Auxiliary Building: 899'-6",886'-6",873'-6",852'-6" 831'-6" Internal Structures: 905'-9", 885'-6". Fuel Building: 918'-0", 899'-6"	3.22

4) A factor of safety of 3 shall be used for Hilti bolts.

5) The allowable stress for conduit shall not exceed the yield stress Fy. (Reference 1)

6) The allowable stress for miscellaneous structural steels shall be limited to the yield stress Fy. (Reference 1).

7) The conduit tributary weights on conduit restraints shall be calculated as follows:

- For conduit support adjacent to an overhang, the conduit tributary weight shall be computed by static equilibrium method.

- For conduit support in all other cases, the conduit tributary weight on support may be computed based on sum of one half span length on each side of the support, if there is not electrical fittings. Should there be an electrical fitting on a span, the additional electrical fitting weight shall be added to the conduit tributary weight on supports on each end of the span.

8) Stainless steel type 304 aircraft cable shall be as manufactured by Indusco Inc. "Power-Strand" wire rope or equal. The breaking strength in pound shall be as shown and a factor of safety of 2.5 has been applied to obtain the allowable design tensile load.

Cable Size	Breaking Strength	Allowable Design Tensile Load (lb)
1/8	1700	680
3/16	3700	1480
1/4	6100	2440
5/16	9000	3600
3/8	12000	4800
7/16	16300	6520
1/2	21000	8400

9) Eye nuts shall be galvanized carbon steel and manufactured by Billings and Spencer Company or equal (Chicago Hardware and Fixture Co. is an equal).

Size	Allowable Design Tensile Load (lb)
3/8	1150
1/2	2250
5/8	3675
3/4	6625
7/8	9000
1"	11775

In order to account for the possible shear load due to inclination of aircraft cable, these allowable design loads were obtained by dividing the manufacturer's recommendation safe load by a factor 2.

10) The conduit clamp types C-725 and C-725-H shall manufactured by Superstrut Company and the allowable load shall be obtained by multiplying the manufacturer's recommended loads by 1.6.

11) Unistrut members shall be manufactured by Unistrut Company and the allowable loads shall be obtained by multiplying the manufacturer's recommended load by 1.6.

12) Since the CSR restraints can not resist compression, the conduit system stability shall be reviewed and if required, additional restraints shall be provided.

13) Any seismic supports which are in "C" Train conduits with CSR restraints shall be treated as NONIS (dead load hangers).

14) For all junction box supports which are identified as NONIS with CSR restrained conduit runs attached, CSR restraints shall be added.

15) In evaluating the conduit isometrics attached to junction box. the conduit may be considered as free end. However, in evaluating the junction box restraint adequacy, the conduit tributary weight on the junction box shall be considered.

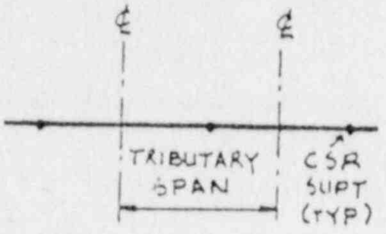
   a) If junction box is seismic supported and conduit runs are seismically retrainted, CSR restraint shall be added to the junction box. Otherwise, locknuts between conduit and junction box may be removed to release the restraint from the junction box or flexible conduit may be installed with the Electrical Department's approval.

   b) If junction box is seismically restrained and conduit runs are seismically supported, locknuts between junction box and the conduit runs may be removed or flexible conduit may be installed with Electrical Department's approval. Otherwise, seismic restraints shall be added to the conduit runs and seismic supports shall be treated as NONIS.

17) Pendulum effects (horizontal motion) of CSR restraints shall be considered. Maximum horizontal motion of the conduit and restraint is considered as "Commodity Clearance" and they will be input to the PCHVP. In calculating the pendulum effects, the restraint shall be assumed as a simple pendulum. Based on the pendulum frequency, the horizontal motion can be obtained from the floor response spectra of various buildings for pendulum frequency equal to or greater than 0.9 Hz. or based on the ground motion displacement (Figure 3.7B-4, CPSES FSAR) multiplied by an amplification factor which is the response spectra acceleration value divided by the ground motion acceleration values at 0.9 Hz. for pendulum frequency less than 0.9 Hz.

18). Conduit run with NONIS or CSR restraint shall not be attached to the seismic category I (Train A and Train B) support.

TABLE I
MAXIMUM ALLOWABLE RESTRAINT TRIBUTARY SPAN LENGTH WITH ONE CONDUIT ON THE SUPPORT



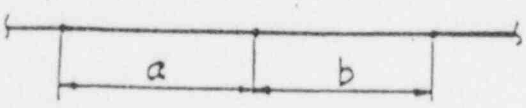
- o If ISO tributary span is less than table value, ISO is adequate, nothing else need to be checked.
- o For determining tributary span for cantilever bends etc. SEE NOTE 3 on next sheet.

CND SIZE Ø	ZONE 1	ZONE 2	ZONE 3	ZONE 4
5	13'-0	11'-3	10'-5	9'-9
4	15'-9	13'-8	12'-8	11'-9
3	15'-9	13'-8	12'8	11'-9
2½	15'-9	13'-8	12'8	11'-9

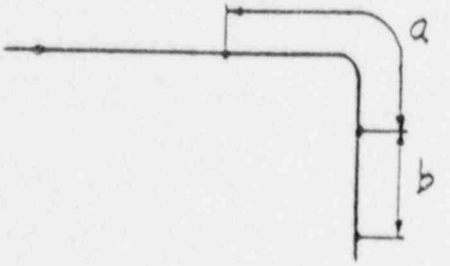
NOTES:

1. In case there is a B.C. or UNION on adjacent span, minus 6" from table value for 5"Ø and 4"Ø conduits. No deduction for 3"Ø and 2½"Ø conduits.
2. In case there is a LBD on one adjacent span, minus 3'-0 for 5"Ø and 2'-0 for 3"Ø and 2½"Ø conduits.
3. Conduit tributary span length:

(a) Continuous conduit span interior support



Tributary Span = $\frac{a + b}{2}$



Tributary Span = $\frac{a + b}{2}$

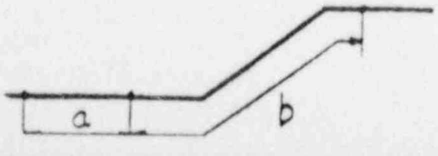
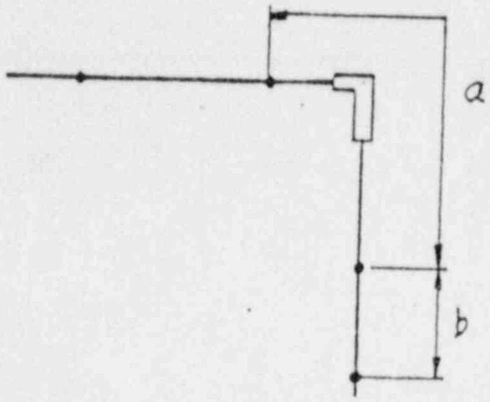


TABLE I (CONT'D)



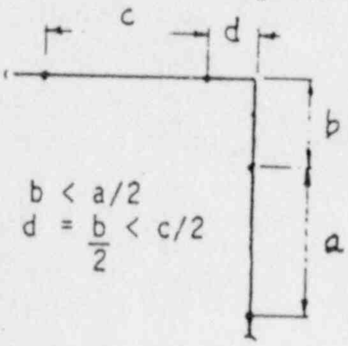
Tributary Span = $\frac{a + b}{2}$

(b) Overhang

Use static solution to compute reaction at support and converted to equivlent span length.

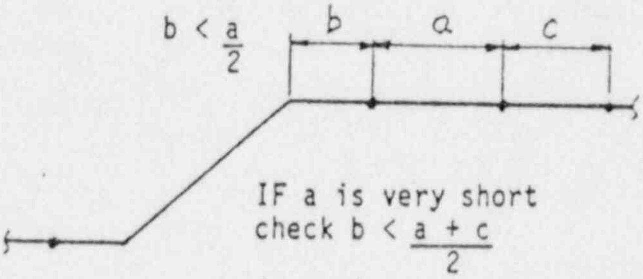
4. ADDITIONAL SPAN LIMITATIONS

The outstanding leg of a single or double bend shall not exceed one half of the adjacent span.



$b < a/2$

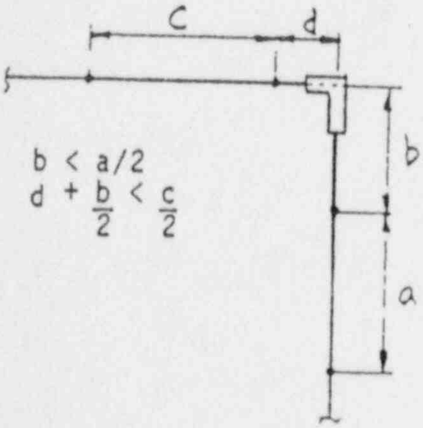
OR IF $d = \frac{b}{2} < c/2$



$b < \frac{a}{2}$

IF a is very short
check $b < \frac{a + c}{2}$

$(a + c) <$ Allowable Span Length
(Table I)

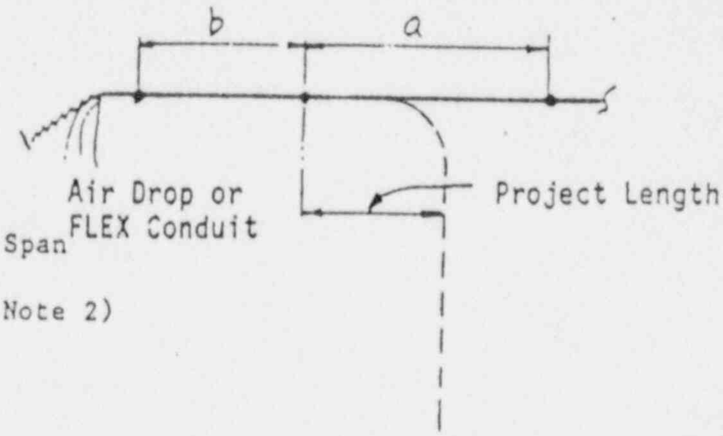


$b < a/2$

OR IF $d + \frac{b}{2} < \frac{c}{2}$

$b < a/2$

$a + b$
$<$ Allowable Span Length
(Table I & Note 2)



Reaction limited by Note 3b

TABLE II
ALLOWABLE DEAD LOAD ON CSR CONCRETE
CONNECTIONS (LBS)

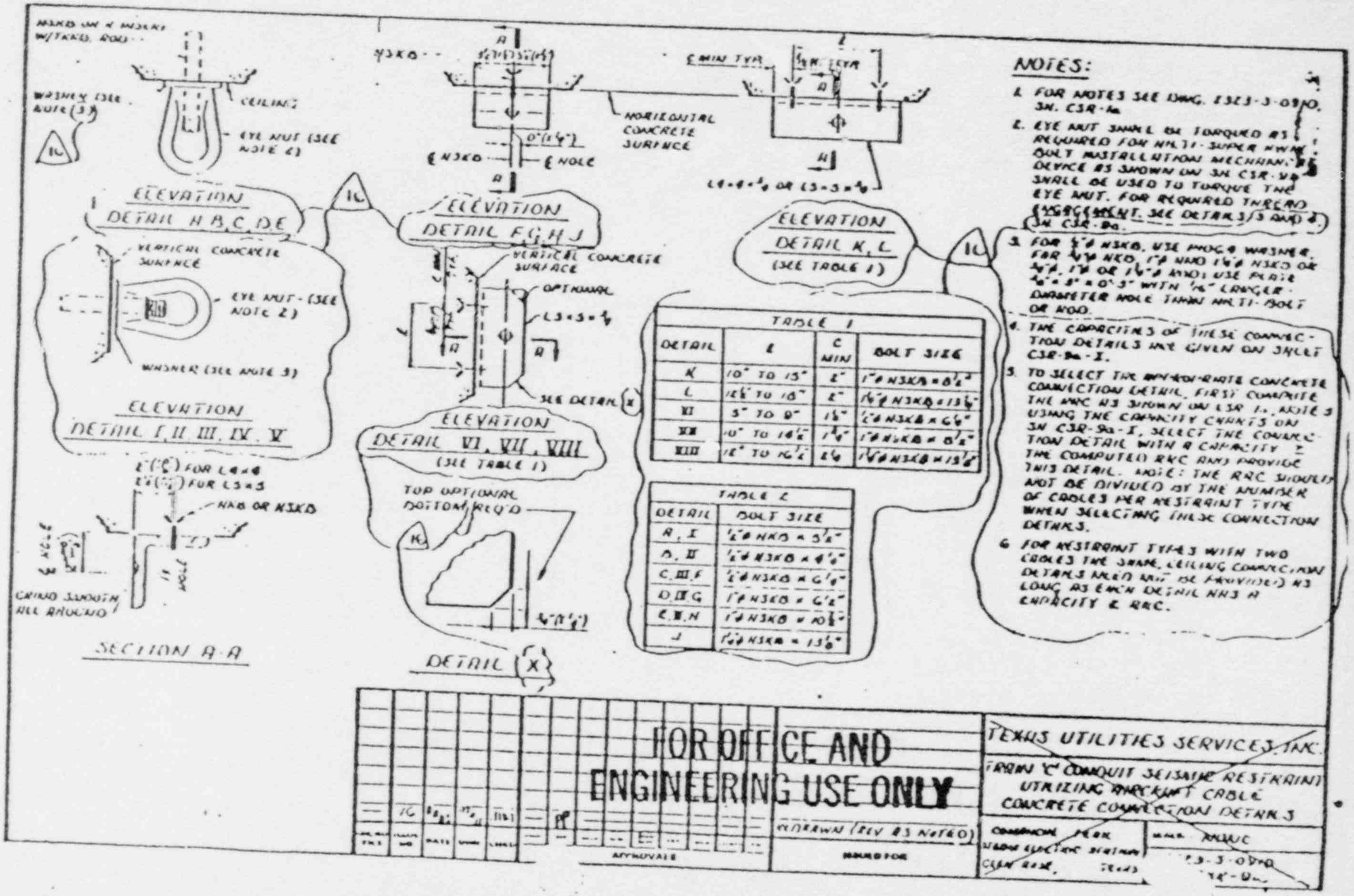


TABLE 1

DETAIL	ℓ	C MIN	BOLT SIZE
K	10" TO 15"	2"	1"Ø HSKB × 8½"
L	12½" TO 18"	2"	1¼"Ø HSKB × 13¼"
VI	5" TO 8"	1½"	½"Ø HSKB × 6¼"
VII	10" TO 14½"	1¾"	1"Ø HSKB × 8½"
VIII	12" TO 16½"	2¼"	1¼"Ø HSKB × 13½"

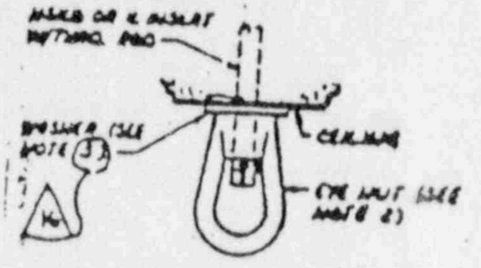
TABLE 2

DETAIL	BOLT SIZE
A, I	½"Ø HKB × 5½"
B, II	½"Ø HSKB × 4½"
C, III, F	½"Ø HSKB × 6⅛"
D, IV, G	1"Ø HSKB × 6½"
E, V, H	1"Ø HSKB × 10½"
J	1¼"Ø HSKB × 13½"

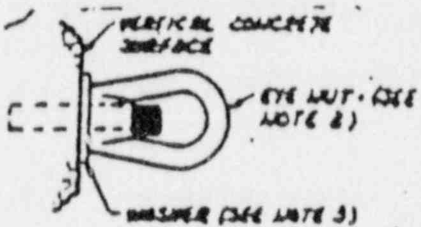
NOTES:

1. FOR NOTES SEE DWG. 2323-S-0910, SH. CSR-1a.
2. EYE NUT SHALL BE TORQUED AS REQUIRED FOR HILTI-SUPER HWK BOLT INSTALLATION. MECHANICAL DEVICE AS SHOWN ON SH CSR-9b SHALL BE USED TO TORQUE THE EYE NUT. FOR REQUIRED THREAD ENGAGEMENT, SEE DETAILS 3/3 AND 4, SH CSR-9a.
3. FOR ¾"Ø HSKB, USE MOGA WASHER. FOR ¾"Ø HKB, 1"Ø AND 1¼"Ø HSKB OR ¾"Ø, 1"Ø OR 1¼"Ø ROD, USE PLATE 4"×3"×0'-3" WITH 1/16" LARGER DIAMETER HOLE THAN HILTI-BOLT OR ROD.
4. THE CAPACITIES OF THESE CONNECTION DETAILS ARE GIVEN ON SHEET CSR-9a-I.
5. TO SELECT THE APPROPRIATE CONCRETE CONNECTION DETAIL, FIRST COMPUTE THE RRC AS SHOWN ON CSR 1a, NOTE 5 USING THE CAPACITY CHARTS ON SH CSR-9a-I, SELECT THE CONNECTION DETAIL WITH A CAPACITY ≥ THE COMPUTED RRC AND PROVIDE THIS DETAIL. NOTE: THE RRC SHOULD NOT BE DIVIDED BY THE NUMBER OF CABLES PER RESTRAINT TYPE WHEN SELECTING THESE CONNECTION DETAILS.
6. FOR RESTRAINT TYPES WITH TWO CABLES THE SAME CEILING CONNECTION DETAILS NEED NOT BE PROVIDED AS LONG AS EACH DETAIL HAS A CAPACITY ≥ RRC.

TABLE II
ALLOWABLE DEAD LOAD ON CSR CONCRETE CONNECTIONS (LBS)



ELEVATION
DETAIL A.B.C.D.E

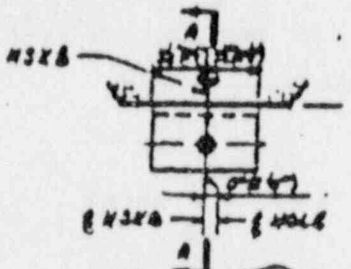


ELEVATION
DETAIL I, II, III, IV, V

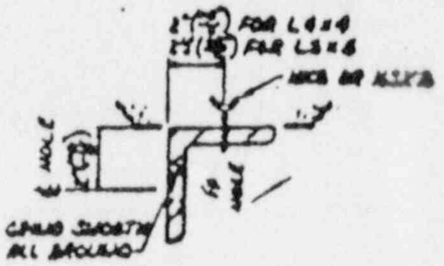
ALLOWABLE DEAD LOAD ON CSR (LBS)

DETAIL NO	BOLT SIZE	ZONE 1	ZONE 2	ZONE 3	ZONE 4
		1+g = 2.46	1+g = 2.81	1+g = 3.04	1+g = 3.22
A, I	½"φ HKB x 5½	310	271	251	237
B, II	½"φ HSKB x 4¼	354	310	286	271
C, III	½"φ HSKB x 6¼	354	310	286	271
D. IV	1"φ HSKB x 6½	1315	1151	1064	1005
E. V	1"φ HSKB x 10½	1547	1354	1251	1181

TABLE II
ALLOWABLE DEAD LOAD ON CSR CONCRETE CONNECTIONS (LBS)



ELEVATION
DETAIL F,G,H,J

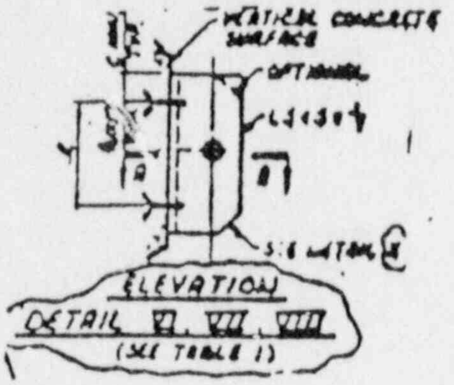


SECT. A-A

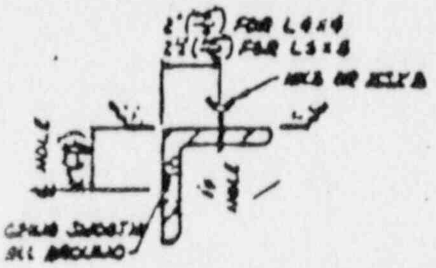
ALLOWABLE DEAD LOAD ON CSR (LBS)

DETAIL NO	BOLT SIZE	ZONE 1	ZONE 2	ZONE 3	ZONE 4
		1+g = 2.46	1+g = 2.81	1+g = 3.04	1+g = 3.22
F	1/2"φ HSKB x 6 1/4	605	530	490	462
G	1"φ HSKB x 6 1/2	1407	1232	1139	1075
H	1"φ HSKB x 10 1/2	1865	1633	1509	1425
J	1 1/4"φ HSKB x 13 1/8	2517	2204	2037	1923
—					

TABLE II
ALLOWABLE DEAD LOAD ON CSR CONCRETE CONNECTIONS (LBS)



ELEVATION
DETAIL VI, VII, VIII
(SEE TABLE I)

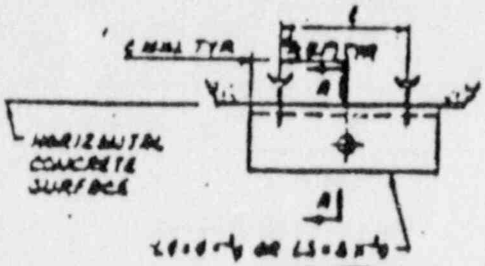


SECT A-A
(ROTATE 90° TO VIEW)

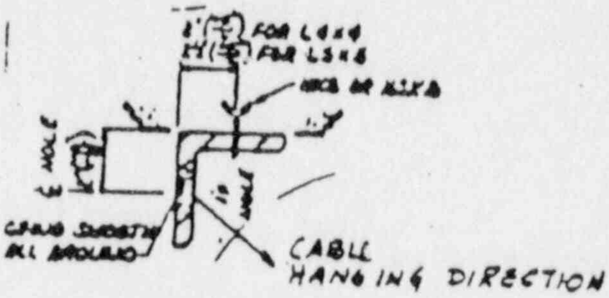
ALLOWABLE DEAD LOAD ON CSR

DETAIL NO	BOLT SIZE	ZONE 1	ZONE 2	ZONE 3	ZONE 4
		1+g = 2.46	1+g = 2.81	1+g = 3.04	1+g = 3.22
VI	½"ϕ HSKB×6¼	745	652	603	569
VII	1"ϕ HSKB×8½	2367	2073	1916	1808
VIII	1¼"ϕ HSKB×13⅛	3146	2754	2546	2404
—					

TABLE II
ALLOWABLE DEAD LOAD ON CSR CONCRETE CONNECTIONS (LBS)



ELEVATION
DETAIL K, L



SECT A-A

ALLOWABLE DEAD LOAD ON CSR

DETAIL NO	BOLT SIZE	ZONE 1	ZONE 2	ZONE 3	ZONE 4
		1+g = 2.46	1+g = 2.81	1+g = 3.04	1+g = 3.22
K	1"HSKB×8½	3121	2732	2525	2384
L	1¼"HSKB×13⅛	3121	2732	2525	2384
—					
—					
—					

TABLE III
ISO VALIDATION WORK SHEET

EBASCO SERVICES INCORPORATED

SHEET ____ OF ____

CLIENT TU ELECTRIC
PROJECT COMANCHE PEAK SES UNIT 1 & 2X
SUBJECT DESIGN VALIDATION OF "C" TRAIN WITH CSR SUPPORT · ISO. NO ____________

OFS NO. ____________ DEPT. NO. ____
BY ____________ DATE ____________
CHECKED BY ____________ DATE ____________

ISO. NO. ____________, BUILDING & ELEVATION: ____________
CND SIZE ________ "G" SPAN ________ ZONE ________

SPAN NO & SPAN LENGTH	SPAN CHECK			SOLUTION RESPONSE TO SPAN CHECK "NO"	SUPPT NO.	SUPPT. ADEQUACY					REMARK SECONDARY ISO NO OR REACTION FOR PRIMARY ISO	NOTES
	YES		NO			YES	NO					
	G	S				G	DESIGN No.	CAPACITY KG.	MIXED OF SEISMIC SUPPT	UNSTABLE		
												①. "G" Means that span or support meet the Minimum requirements As in guideline. ② Support unstable means that support is not in the equilibrium position once the the dead load hangers Failed. ③ overall static unstable of conduit Run Means that conduit May Tip over or Flap over. supports NEED to be Added. ④ Supports Not checked. see Primary ISO. ⑤ "S" Means that span exceed Minimum requirement; Evaluation is req'd.

SOLUTION RESPONSE TO SPAN CHECK "NO":

ⓐ ADD RESTRAINT AT BEND.
ⓑ ADD RESTRAINT CLOSE TO LBD/LB.
ⓒ ADD HORIZONTAL RESTRAINT.
ⓓ SPAN TOO LONG. PROVIDE RESTRAINT IN BETWEEN.
ⓒ PROVIDE AN ADDITIONAL RESTRAINT AT SPAN FREE END.
ⓕ SEISMIC SUPPORT(S) TO BE REPLACED BY ' R' RESTRAINT(S).
) CONCRETE WALL WILL PROVIDE RESTRAINT , ICTION.

EBASCO Interoffice Correspondence

DATE November 10, 1987 FILE REF SAG.TUG1.9811

TO Distribution OFFICE LOCATION Various

CYC HSYu JKuo

FROM C Y Chiou / H S Yu / J Kuo OFFICE LOCATION 81/2WTC

SUBJECT TU ELECTRIC
COMANCHE PEAK SES UNIT #1
ADDENDUM #2 TO SAG.CP25, REVISION 1
FORMULA FOR CALCULATING SUPPORT REAL STIFFNESS

REF: (1) SPEED LETTER # SAG.TUG1.9623, DATED 11/23/87
(2) MEMO # SAG.TUG1.9696, DATED 11/23/87
(3) MEMO # SAG.TUG1.9746, DATED 11/25/87

The referenced speed letter specified the proposed resolutions to the potential problems identified by NYO during ISO design validation process. References 2 and 3 provided our comments to all items except No. 17. This memo contains our resolution to problem No. 17.

Following material are attached for your use to calculate the support real stiffness.

a) Added Attachment X total 9 Shts. (Formula for calculating support real stiffness plus tables for clamp stiffness in conduit run direction).

b) Revised sheets IV, V & 21 (To provide reference to Attachment X).

c) Revised Attachment D total 19 sheets (Added tension spring constant for base plate).

This addendum is to be used immediately in design verification and will be incorporated into Revision 2 of SAG.CP25 at a later date.

Please acknowledge receipt of subject document by signing below and returning this memo to C.Y. Chiou at 81/2WTC no later than Dec. 17, 1987.

CYC/HSY/JK:mw

Receipt Acknowledge: ____

PRINT NAME (Last Name First) SIGNATURE DATE

Distribution:

K T Wu
I Wolff (CPSES Site)
H Patel (Dallas)

cc: R C Iotti
E Odar
J Padalino
R Shetty
M McGrath
F Hettinger

NYO Conduit Personnel (K T Wu)
CPSES Site Conduit Personnel (I Wolff)
Dallas Conduit Personnel (H Patel)

PREPARED BY: J Kao
REVIEWED BY:
APPROVED BY: CY Chiou
DATE: 12/10/87

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
ELECTRICAL CONDUIT ISOMETRIC VALIDATION

PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. 2

ATTACHMENT X SH. 1 OF 9

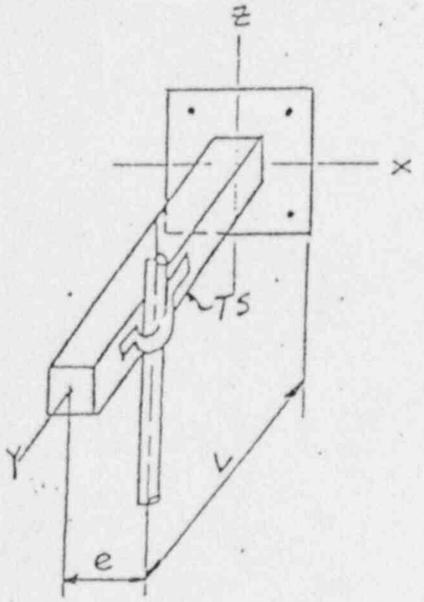
FORMULA FOR CALCULATING SUPPORT REAL STIFFNESS

NOMENCLATURE

K_s	is the shear spring of each bolt, see Attachment P of SAG.CP29.
K_L	is stiffness of support at center of conduit in the direction of conduit run (kip/in.).
K_c	is stiffness of conduit clamp in the direction of conduit run (kip/in.) (See Table X1 through X4).
K_{MX}, K_{MY}, K_{MZ}	are rotational spring of base plate about X, Y, Z axis respectively ("k/Rad). For K_{MX}, K_{MZ} value see Attachment D of SAG.CP25 transformation of axis may be required. $K_{MY} = 2C^2K_S$ for 4 bolt base plate, where C is distance between the bolts. (See Sh. 4 of 9)
K_Y	is the tension spring of base plate (kip/in.) (for K_Y value see Attachment D of SAG.CP25, Y is the axis perpendicular to base plate).
K_X, K_Z	is the shear spring of base plate (kip/in.). $K_X = K_Z = nK_S$ 'n' is no. of bolts in base plate
I	is moment of inertia of tubular section (in.^{4}).
e	is eccentricity from center of conduit to center of TS (in.).
A	is cross-sectional area of member (in.^{2}).
E	is modulus of elasticity of steel (29,000 k/in.^{2}).
E_s	is modulus of elasticity of steel in shear (11,200 k/in.^{2}).
α	is form factor (see Design of Welded Structure by Blodgett Section 2.6-2).
L	is distance from center of conduit to face of base plate (in.).

CASE A For single cantilevel tubular section with end base plate

A1. When conduit run is perpendicular to T_s section

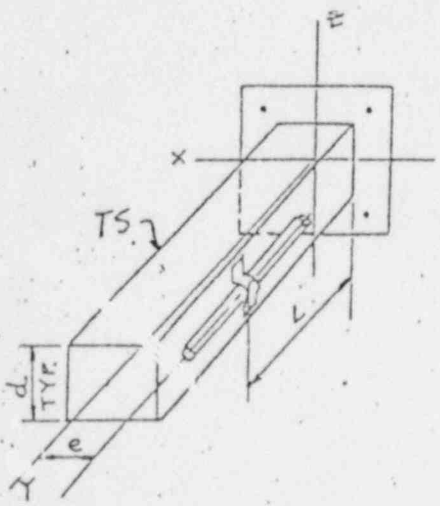


$$K_L = \left\{ [1 + 5.18 \ (\frac{e}{L})^2] \ \frac{L^3}{3EI} + \frac{1}{K_c} + \frac{L^2}{K_{MX}} + \frac{1}{K_Z} \right\}^{-1}$$

K_Z term can be neglected for tubular size and length as shown below:

T_s 2 x 2 & 3 x 3	L = 1'-6 and longer
T_s 4 x 4	L = 2'-0 and longer
T_s 5 x 5 & 6 x 6	L = 3'-0 and longer

A2. When conduit run is parallel to T_s section

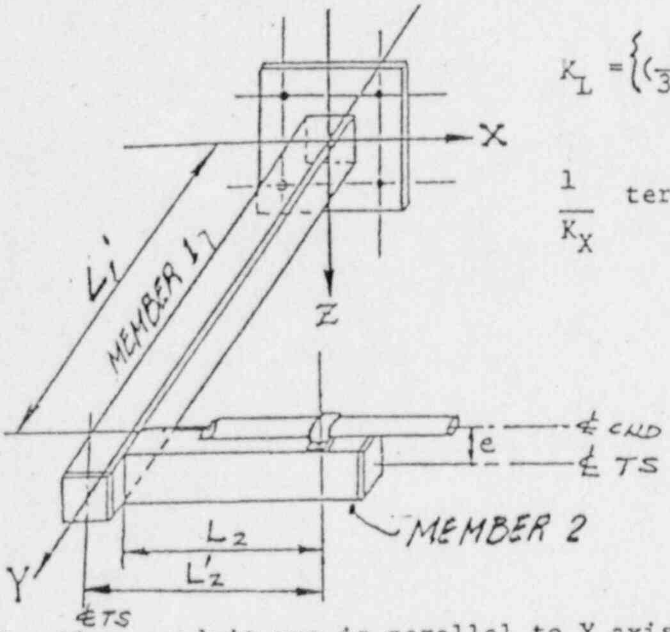


$$K_L = \left\{ \frac{L}{EA} \ [1 + 6 \ (\frac{e}{d})^2] + \frac{1}{K_c} + \frac{e^2}{K_{MZ}} + \frac{1}{K_Y} \right\}^{-1}$$

d is depth of square tubular section

CASE B For L shape support with tubular cross sections conforming to generic support type CSM18-f.

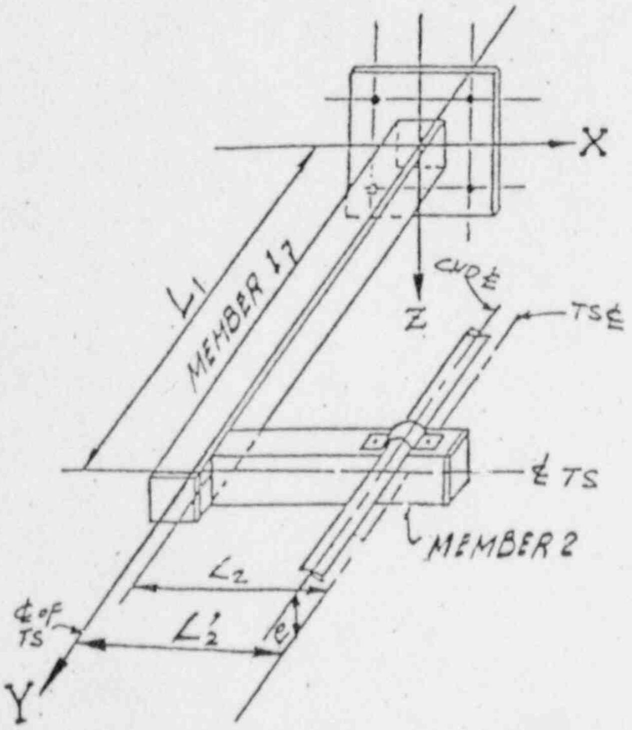
B1. When conduit run is parallel to X axis



$$K_L = \left\{\left(\frac{L_1}{3EI_1} + \frac{1}{K_{MZ}}\right) L_1^2 + \frac{L_2' e^2}{EI_2} + \frac{1}{K_c} + \frac{1}{K_x}\right\}^{-1}$$

$\frac{1}{K_X}$ term can be neglected when $L_1 \geq 2'-0$.

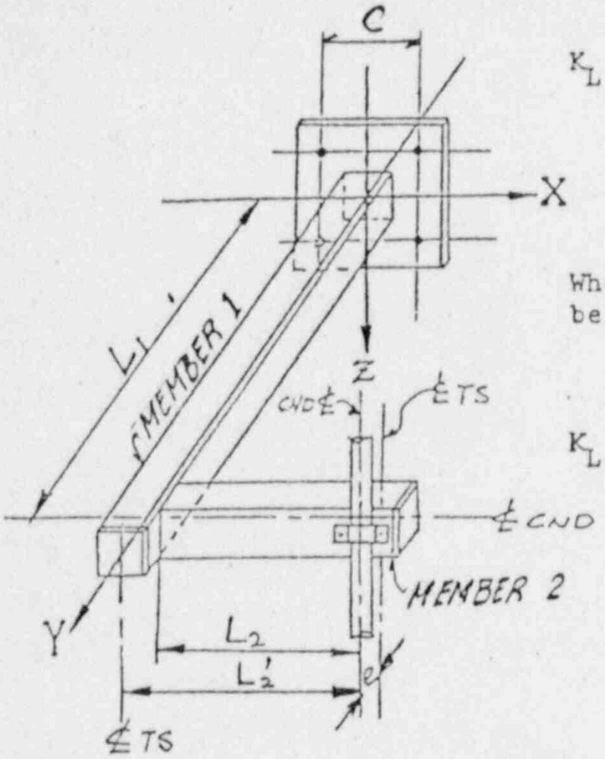
B2. When conduit run is parallel to Y axis



$$K_L = \left\{\frac{L_2'^3}{3EI_2}\left[(1+5.18\left(\frac{e}{L_2'}\right)^2\right] + L_2'^2\left(\frac{L_1}{EI_1} + \frac{1}{K_{MZ}}\right) + \frac{1}{K_T} + \frac{1}{K_C}\right\}^{-1}$$

$\frac{1}{K_T}$ term can be neglected for tube length $L_1 \geq 2'-0$.

E3. When conduit run is parallel to Z axis



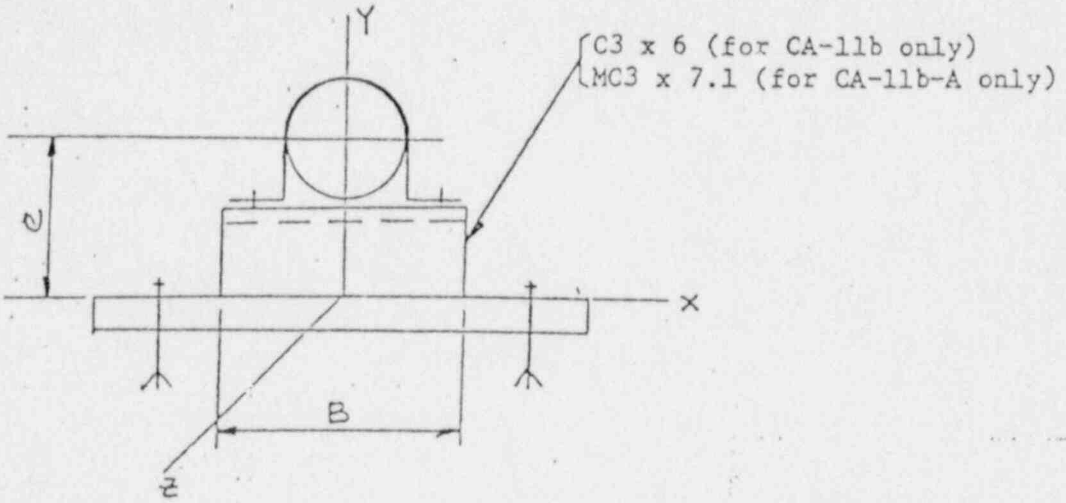
$$K_L = \left\{ \frac{L_1^3}{3EI_1} + \frac{L_2'^3}{3EI_2} + \frac{L_2'^2}{K_{MY}} + \frac{L_1^2}{K_{MX}} + \frac{L_1 L_2'^2}{E_S J_1} + \frac{L_2' e^2}{E_S J_2} + \frac{1}{K_C} \right\}^{-1}$$

When 2 tube size are same, above equation can be rewritten as

$$K_L = \left\{ \frac{L_1^3}{3EI} \left[1 + \left(\frac{L_2'}{L_1}\right)^3 + 5.18 \left(\frac{L_2' e^2}{L_1^3}\right) + 5.18 \left(\frac{L_2'}{L_1}\right)^2 \right] + \frac{L_2'^2}{K_{MY}} + \frac{L_1^2}{K_{MX}} + \frac{1}{K_C} \right\}^{-1}$$

ATTACHMENT X SH. 5 OF 9

CASE C For CA Type Support (CA-5a, CA-5a-A, CA-11b, CA-11b-A)



$K_L = K_C$ For Generic Supt CA-5a

$K_L = [\frac{1}{K_C} + \frac{e^2}{K_{MX}} + \frac{1}{K_Z}]^{-1}$ For Generic Supt CA-5a-A

$K_L = [\frac{1}{K_C} + \frac{e^2}{K_{MX}} + \frac{1}{K_Z} + 51B]^{-1}$ For Generic Supt CA-11b

$K_L = [\frac{1}{K_C} + \frac{e^2}{K_{MX}} + \frac{1}{K_Z} + 40.6B]^{-1}$ For Generic Supt CA-11b-A

Table X.I Axial Allowable Clamp Loads and Stiffnesses (K) Using Nelson Studs and a Maximum Filler Plate of 1"

Clamp Size (in.)	Clamp Type											
	P2558 or C708U		P2558 (Oversized Bolt) & C708N-U		C708N-U (Oversized Bolt)		P2558 Abrasive		P2558A (Oversized Bolt) & C708S (Std. Bolt)		C708S (Oversized Bolt)	
	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)
3/4	260	3.0E4	560	1.0E5	920	2.0E5	X	X	X	X	X	X
1	240	3.0E4	400	1.0E5	960	2.0E5	X	X	X	X	X	X
1-1/4	275	3.0E4	420	1.0E5	920	2.0E5	X	X	X	X	X	X
1-1/2	310	3.0E4	440	1.0E5	880	2.0E5	X	X	X	X	X	X
2	1000	1.0E5	1100	2.0E5	760	2.0E5	740	1.0E5	960	2.0E5	1100	2.0E5
2-1/2	750	1.0E5	1375	2.0E5	765	2.0E5	770	1.0E5	850	2.0E5	1000	2.0E5
3	460	1.0E5	1634	2.0E5	770	2.0E5	800	1.0E5	750	2.0E5	925	2.0E5
4	650	1.0E5	1640	2.0E5	785	2.0E5	790	1.0E5	700	2.0E5	950	2.0E5
5	675	1.0E5	1624	2.0E5	800	2.0E5	780	1.0E5	650	2.0E5	1000	2.0E5

ATTACHMENT X SH. 7 OF 9

Table X.2 Axial Allowable Clamp Loads and Stiffnesses (K) Using UNISTRUT

Clamp Size (in.)	Clamp Type											
	P2558 or C708U		P2558 (Oversized Bolt) & C708N-U		C708N-U (Oversized Bolt)		P2558 Abrasive		P2558A (Oversized Bolt) & C708S (Std. Bolt)		C708S (Oversized Bolt)	
	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)
3/4	90	3.0E4	520	3.0E4	280	3.0E4	X	X	X	X	X	X
1	180	3.0E4	160	3.0E4	480	3.0E4	X	X	X	X	X	X
1-1/4	180	3.0E4	250	3.0E4	420	3.0E4	X	X	X	X	X	X
1-1/2	200	3.0E4	340	3.0E4	360	3.0E4	X	X	X	X	X	X
2	560	3.0E4	750	3.0E4	500	3.0E4	580	3.0E4	520	3.0E4	640	3.0E4
2-1/2	500	3.0E4	700	3.0E4	750	3.0E4	440	3.0E4	500	3.0E4	620	3.0E4
3	400	3.0E4	650	3.0E4	1000	3.0E4	300	3.0E4	400	3.0E4	600	3.0E4
4	400	3.0E4	625	3.0E4	1000	3.0E4	360	3.0E4	530	3.0E4	600	3.0E4
5	400	3.0E4	600	3.0E4	1000	3.0E4	420	3.0E4	500	3.0E4	600	3.0E4

Table X.3 Axial Allowable Clamp Loads and Stiffnesses (K) Using HILTI

Clamp Size (in.)	Clamp Type									
	P2558 or C708U		P2558 (Oversized Bolt) & C708N-U		C708N-U (Oversized Bolt)		P2558 Abrasive		P2558A (Oversized Bolt) & C708S (Std. Bolt)	
	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)
3/4	70	3.0E4	360	7.0E4	650	1.0E5	X	X	X	X
1	125	3.0E4	230	7.0E4	800	1.0E5	X	X	X	X
1-1/4	125	3.0E4	175	7.0E4	790	1.0E5	X	X	X	X
1-1/2	130	3.0E4	120	7.0E4	780	1.0E5	X	X	X	X
2	250	7.0E4	525	1.0E5	X	X	300	7.0E4	700	1.0E5
2-1/2	265	7.0E4	660	1.0E5	X	X	240	7.0E4	660	1.0E5
3	280	7.0E4	800	1.0E5	X	X	180	7.0E4	625	1.0E5
4	230	7.0E4	800	1.0E5	X	X	205	7.0E4	875	1.0E5
5	180	7.0E4	800	1.0E5	X	X	230	7.0E4	1150	1.0E5

Table X.4 Axial Allowable Clamp Load and Stiffness (K)
Using Nelson Studs and a Filler Plate 1"-2" Thick

Clamp Size (in.)	Clamp Type					
	P2558 or C708U		P2558 (Oversized Bolt) & C708N-U		C708N-U (Oversized Bolt)	
	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)	Load (lbs)	K (lbs/in)
2	1150	1.0E4	1200	2.0E4	1200	4.0E4
2-1/2	1050	1.0E4	1175	2.0E4	1200	4.0E4
3	950	1.0E4	1150	2.0E4	1200	4.0E4
4	800	1.0E4	1000	2.0E4	1075	4.0E4
5	680	1.0E4	840	2.0E4	950	4.0E4

TABLE OF CONTENTS (CONT'D)

ATTACHMENTS

TABLE OF CONTENTS (CONT'D)

ATTACHMENTS

APPENDIX

9.7 VERIFICATION OF LONGITUDINAL LOAD DISTRIBUTION (Continued)

K_i = conduit support stiffness at support i. (See Attachment X for formula)

$\overline{W}$ = total conduit load (lbs), including electrical fittings for conduit run in the tributary length.

$$f = \frac{1}{2\pi} \times \sqrt{\frac{\Sigma K_j \times 386.4}{\overline{W}}}$$

g_R = maximum floor response spectra acceleration at frequency f between N-S and E-W responses.

g_{3F} = minimum design "g" values.

b. Vertical or Skewed Conduit Run on Vertical Plane

$$L'_L = \frac{K_i}{\Sigma K_j} \times \overline{W} \times \frac{(1 + g_R)}{(1 + g_{3F})}$$

g_R = floor response spectra acceleration at frequency f in vertical direction.

For definition of other symbols, see paragraph (a) above.

If L'_L is less than the support capacity, the isometric is adequate.

10.0 EVALUATION OF JUNCTION BOX CAPACITY AND JUNCTION BOX SUPPORTS

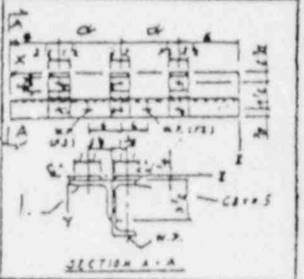
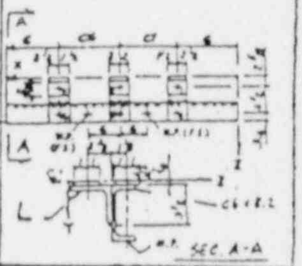
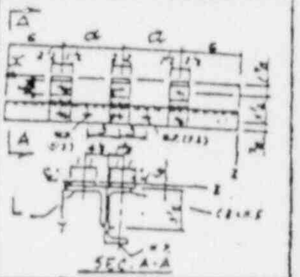
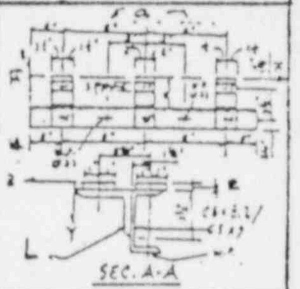
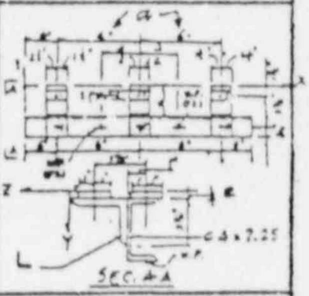
a. All redline drawings shall be reviewed for deviations from generic drawings. Junction Box shall be considered adequate if the conduit load on the Junction Box does not exceed capacity as shown in JA-14 and JA-15 Series drawings. Junction Box support shall be considered adequate if the total load on the support (conduit load, and Junction Box weight including contents) does not exceed support capacity of JA and JS Series drawings. In other situations conduit capacity for smaller Junction Box for support validation may be obtained as per 10.0b. Further analysis shall be performed when load capacities are exceeded or the redline drawings do not meet the generic drawing requirements.

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
ELECTRICAL CONDUIT ISOMETRIC VALIDATION

PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. 2

ATTACHMENT D SH. 1 OF 19

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

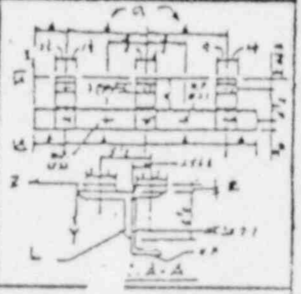
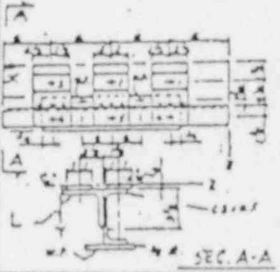
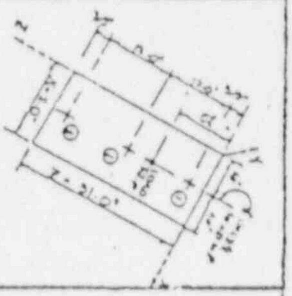
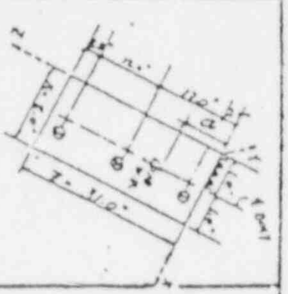
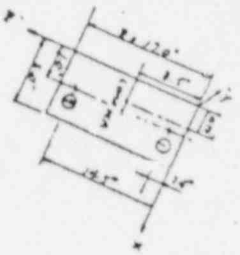
Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CA-3a (Case 1)	1/2"φ HKB w/5 1/2" EMB.	L 6 × 3 1/2 × 3/8 C8 × 11.5 (a = 12")	KMX = 95.72×10^3 KMY = 1627.89×10^3 KMZ = 491.81×10^3	KFY = 50.99×10^3	
CA-3a (Case 2)	1/2"φ HKB w/5 1/2" EMB.	L 6 × 3 1/2 × 3/8 C8 × 11.5 (a = 6")	KMX = 79.67×10^3 KMY = 690.13×10^3 KMZ = 537.66×10^3	KFY = 44.66×10^3	
CA-3a (Case 3)	1/2"φ HKB w/5 1/2" EMB.	L 6 × 3 1/2 × 3/8 C6 × 8.2 (a = 12")	KMX = 88.27×10^3 KMY = 2570.23×10^3 KMZ = 312.97×10^3	KFY = 68.92×10^3	
CA-3a (Case 4)	1/2"φ HKB w/5 1/2" EMB.	L 6 × 3 1/2 × 3/8 C6 × 8.2 (a = 6")	KMX = 77.38×10^3 KMY = 1012.27×10^3 KMZ = 380.03×10^3	KFY = 65.15×10^3	
CA-3a (Case 5)	1/2"φ HKB w/5 1/2" EMB.	L 6 × 3 1/2 × 3/8 C8 × 11.5 (a = 12")	KMX = 95.15×10^3 KMY = 1596.94×10^3 KMZ = 491.23×10^3	KFY = 50.86×10^3	
CA-3a (Case 6)	1/2"φ HKB w/5 1/2" EMB.	L 6 × 3 1/2 × 3/8 C8 × 11.5 (a = 6")	KMX = 79.10×10^3 KMY = 683.25×10^3 KMZ = 537.09×10^3	KFY = 44.54×10^3	
CA-3a (Case 7)	1/2"φ HKB w/5 1/2" EMB.	L 6 × 3 1/2" × 3/8 C6 × 8.2 (a = 6")	KMX = 76.81×10^3 KMY = 996.79×10^3 KMZ = 379.46×10^3	KFY = 64.98×10^3	
CA-3a (Case 8)	1/2"φ HKB w/5 1/2" EMB.	L 6 × 3 1/2 × 3/8 C5 × 9 (a = 6")	KMX = 1[illegible].71 × 10^3 KMY = 2097.91×10^3 KMZ = 355.38×10^3	KFY = 140.25×10^3	
CA-3a (Case 9)	1/2"φ HKB w/5 1/2" EMB.	L 6 × 3 1/2 × 3/8 C4 × 7.25 (a = 6")	KMX = 132.41×10^3 KMY = 2767.98×10^3 KMZ = 296.92×10^3	KFY = 172.12×10^3	

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
ELECTRICAL CONDUIT ISOMETRIC VALIDATION

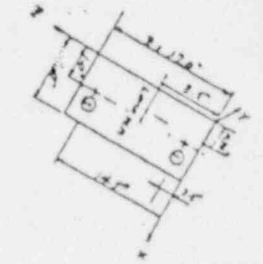
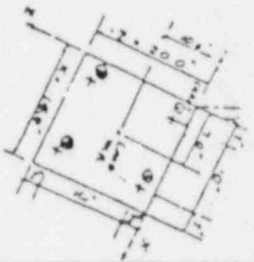
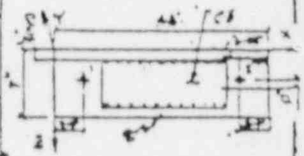
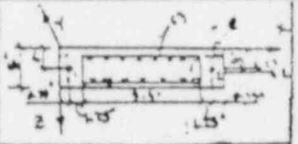
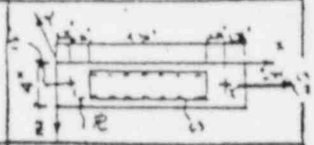
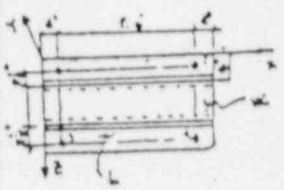
PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. 2

ATTACHMENT D SH. 2 OF 19

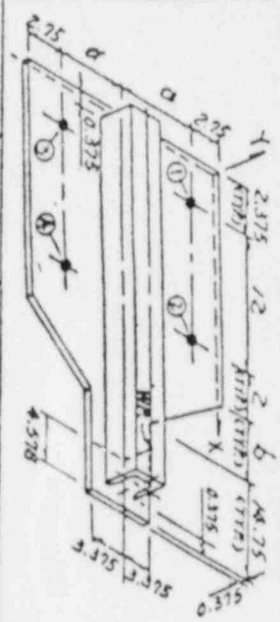
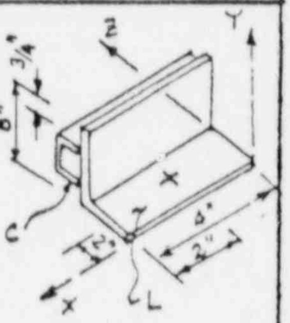
Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants Rotation (in-lb/Rad)	Spring Constants Tension (lb/in)	Remark
CA - 3a (Case 10)	½"φ HKB w/5½"EMB.	L6 × 2½ × 3/8 MC 3 × 7.1 (a = 6")	KMX = 162.73×10^{3} KMY = 4685.34×10^{3} KMZ = 363.64×10^{3}	KFY = 102.94×10^{3}	
CA - 3a (Case 11)	½"φ HKB w/5½"EMB.	L6 × 2½ × 3/8 MC 3 × 7.1 (a = 12")	KMX = 197.18×10^{3} KMY = 12644.22×10^{3} KMZ = 317.55×10^{3}	KFY = 99.1×10^{3}	
CA - 3a (Case 12)	½"φ HKB w/5½"EMB.	i.6 × 3½ × 3/8 C8 × 11.5	KMX = 89.42×10^{3} KMY = 783.56×10^{3} KMZ = 1129.20×10^{3}	KFY = 292.77×10^{3}	 SEC. A-A
CA - 5a (DET. 1)	3/8" HKB w/2"EMB.	⅊ ¼" × 2" × 31" ATTACHMENT: N.A. (a = 10.08")	KMX = 92.86×10^{3} KMY = N.A. KMZ = 47.00×10^{3}	KFY = 7.45×10^{3}	
CA - 5a (DET. 1)	3/8"φ HKB w/2"EMB	⅊ ¼" × 2" × 31" ATTACHMENT: N.A. (a = 9.5")	KMX = 92.29×10^{3} KMY = N.A. KMZ = 47.00×10^{3}	KFY = 6.91×10^{3}	
CA - 5a (DET. 1)	3/8"φ HKB w/2"EMB.	⅊ 1" × 2" × 31" ATTACHMENT: N.A. (a = 10.08")	KMX = 3927.57×10^{3} KMY = N.A. KMZ = 290.61×10^{3}	KFY = 104.38×10^{3}	
CA - 5a (ALT. DET. 1)	3/8"φ HKB. w/2"EMB.	⅊ ¼" × 2" × 17" ATTACHMENT: N.A	KMX = 91.77×10^{3} KMY = N.A. KMZ = 46.49×10^{3}	KFY = 7.191×10^{3}	
CA - 5a (ALT. DET. 1)	7/8"φ HKB. w/2" EMB.	⅊ 1¼" × 2" × 17" ATTACHMENT: N.A	KMX = 5978.48×10^{3} KMY = N.A. KMZ = 213.23×10^{3}	KFY = 106.37×10^{3}	
CA - 5a (ALT. DET. 1)	½"φ HKB w/5½"EMB.	⅊ 1 3/16" × 2" × 17" ATTACHMENT: N.A	KMX = 7427.53×10^{3} KMY = N.A. KMZ = 760.64×10^{3}	KFY = 228.2×10^{3}	

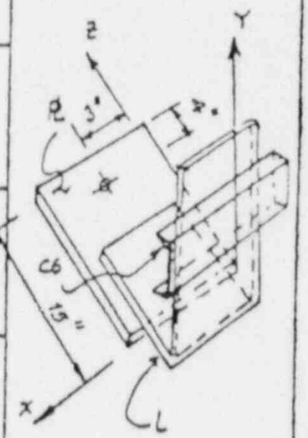
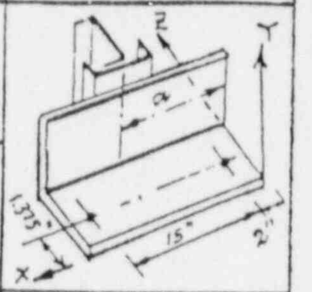
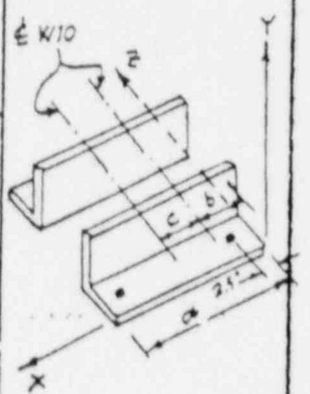
Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants Rotation (in-lb/Rad)	 Tension (lb/in)	Remark
CA-5a (ALT. DET. 1)	1/2"φ HKB. w/5 1/2" EMB.	PL 1 3/4" × 2" × 17" ATTACHMENT: N.A.	KMX = 18846.24 $\times 10^3$ KMY = N.A. KMZ = 827.13 $\times 10^3$	KFY = 402.56 $\times 10^3$	
CA-5b (SEC. A-A)	1/2"φ HKB w/5 1/2" EMB.	PL 3/4" × 14" × 20" ATTACHMENT: N.A	KMX = 5192.05 $\times 10^3$ KMY = N.A. KMZ = 4758.13 $\times 10^3$	KFY = 189.38 $\times 10^3$	
CA-11a (MODEL #1)	1"φ HKB w/7" EMB.	PL 3/8" × 7" × 48" C6 × 8.2	KMX = 934.89 $\times 10^3$ KMY = 99791.25 $\times 10^3$ KMZ = 1398.03 $\times 10^3$	KFY = 35.02 $\times 10^3$	
CA-11a (MODEL #2)	3/4" HKB w/5" EMB.	PL 3/8" × 7" × 48" C6 × 8.2	KMX = 734.84 $\times 10^3$ KMY = 119225.60 $\times 10^3$ KMZ = 1388.29 $\times 10^3$	KFY = 28.69 $\times 10^3$	
CA-11a (MODEL #3)	1"φ HKB w/7" EMB.	PL 1" × 7" × 48" C6 × 8.2	KMX = 1771.76 $\times 10^3$ KMY = 110528.44 $\times 10^3$ KMZ = 1438.16 $\times 10^3$	KFY = 48.24 $\times 10^3$	
CA-11b (MODEL #1)	1/2"φ HKB w/5 1/2" EMB.	PL 3/8" × 5" × 13 1/2" C3 × 6	KMX = 721.09 $\times 10^3$ KMY = 7143.79 $\times 10^3$ KMZ = 407.55 $\times 10^3$	KFY = 215.74 $\times 10^3$	
CA-11b (MODEL #2)	1/2"φ HKB w/5 1/2" EMB.	PL 3/8" × 4" × 6.5" C3 × 6	KMX = 487.22 $\times 10^3$ KMY = 1268.49 $\times 10^3$ KMZ = 547.98 $\times 10^3$	KFY = 283.58 $\times 10^3$	
CA-12 (MODEL #1)	3/4"φ HKB. w/6" EMB.	2L 6 × 4 × 3/4 MC 6 × 16.3	KMX = 1715.01 $\times 10^3$ KMY = 44949.77 $\times 10^3$ KMZ = 650.01 $\times 10^3$	KFY = 176.2 $\times 10^3$	

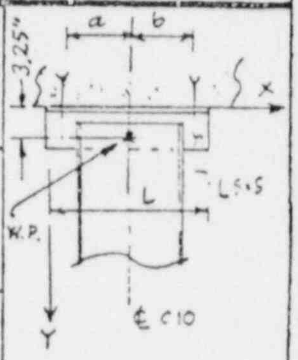
Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CA-12 (MODEL #2)	3/4"φ HKB. w/6" EMB.	2L 6×4×3/4 MC 6×16.3	KMX = 1257.03×10^3 KMY = 22733.69×10^3 KMZ = 767.51×10^3		
CA-13 (Case-1)	3/4"φ HKB w/5" EMB.	⅊ 3/8"×14"×34 3/4" C6×10.5 (a=4.25"; b=3.625")	KMX = 926.29×10^3 KMY = 32475.79×10^3 KMZ = 402.39×10^3		
CA-13 (Case-2)	3/4" HKB w/5" EMB	⅊ 3/8"×13"×34 3/4" C 6×10.5 (a=3.75"; b=3.125")	KMX = 868.97×10^3 KMY = 31000.38×10^3 KMZ = 361.12×10^3		
CA-13 (Case-3)	3/4"φ HKB w/5" EMB.	⅊ 3/8"×18×34 3/4" C10×15.3 (a=6.25"; b=3.625")	KMX = 358.82×10^3 KMY = 44492.93×10^3 KMZ = 205.72×10^3		
CA-13 (Case-4)	3/4"φ HKB w/5" EMB.	⅊ 3/8"×14×34 3/4" MC6×12 (a=4.25"; b=3.625")	KMX = 923.43×10^3 KMY = 32087.16×10^3 KMZ = 389.20×10^3		
CA-13 (Case-5)	3/4"φ HKB w/5" EMB.	⅊ 3/8"×14"×34 3/4" MC6×15.3 (a=4.25"; b=3.625")	KMX = 1167.04×10^3 KMY = 30831.85×10^3 KMZ = 511.87×10^3		
CA-13 (Case-6)	3/4"φ HKB w/5" EMB.	⅊ 3/8"×16"×34 3/4" C8×11.5 (a=5.25"; b=3.625")	KMX = 323.28×10^3 KMY = 37732.61×10^3 KMZ = 155.34×10^3		
CA-13 (Case-7)	3/4"φ HKB w/5" EMB.	⅊ 1"×18"×34 3/4" C10×15.3 (a=6.25"; b=3.625")	KMX = 380.60×10^3 KMY = 46723.25×10^3 KMZ = 206.35×10^3		
CA-14a (Case I)	1"φ HSKB w/8 1/2" EMB.	L 8×8×1 C6×13	KMX = 577.21×10^3 KMY = N.A. KMZ = 920.56×10^3		
CA 14a (Case II)	1"φ HSKB w/8 1/2" EMB.	L 8×8×3/4 C6×13	KMX = 338.76×10^3 KMY = N.A. KMZ = 652.87×10^3		
CA 14a (Case III)	3/4"φ HKB w/6 1/2" EMB	L 8×6×3/4 C6×13	KMX = 301.50×10^3 KMY = N.A. KMZ = 362.84×10^3		

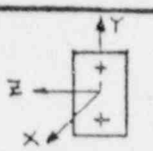
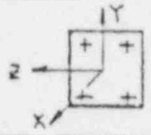
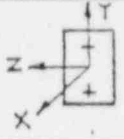
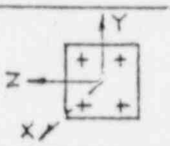
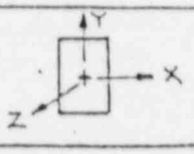
Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CA-14C (Case I)	1"φ HSKB w/8½" EMB.	⅊ 1"×6"×15" w/ L 8×8×1 C6×13	KMX = 1268.83×10^3 KMY = N.A. KMZ = 1185.29×10^3		
CA-14C (Case II)	1"φ HSKB w/8½" EMB.	⅊ 1"×6"×15" w/ L 8×8×¾ C6×13	KMX = 633.32×10^3 KMY = N.A. KMZ = 1010.69×10^3		
CA-14C (Case III)	¾"φ HKB w/6½" EMB	⅊ 1"×6"×15" w/ L 8×6×¾ C6×13	KMX = 849.33×10^3 KMY = N.A. KMZ = 610.23×10^3		
CA-14C (Case IV)	¾"φ HKB w/6½" EMB.	⅊ 1"×6"×15" w/ L 8×8×¾ C6×13	KMX = 609.60×10^3 KMY = N.A. KMZ = 548.04×10^3		
CA-14C (Case V)	1"φ RI	⅊ 1"×6"×15" w/ L 8×8×¾ C6 13	KMX = 467.33×10^3 KMY = N.A. KMZ = 1461.89×10^3		
CHM-1a (Case 2)	1¼"φ HSKB w/10⅝" EMB.	L 5×5×¾ C6×10.5 & C8×11.5 (a = 13")	KMX = $+2528.39\times10^3$ -713.06×10^3 KMY = 9165.47×10^3 KMZ = 15939.55×10^3		
CHM-1a (Case-4)	1¼"φ HSKB w/10⅝" EMB.	L 5×5×¾ C6×10.5 & C8×11.5 (a = 9.25")	KMX = $+2600.61\times10^3$ -723.95×10^3 KMY = 9376.98×10^3 KMZ = 16182.01×10^3		
CHM-2a (Case-2)	1¼"φ HSKB w/8½" EMB.	2 L 5×5×¾ 2 W10×25 (a = 53", b = 8.5", c = 36")	KMX = 40238.64×10^3 KMY = 32194.92×10^3 KMZ = 183131.09×10^3		
CHM-2a (Case-4)	1¼"φ HSKB w/8½" EMB.	2 L5×5×¾ 2 W10×25 (a = 35", b = 10.25", c = 14.5")	KMX = 51784.03×10^3 KMY = 29933.65×10^3 KMZ = 110549.64×10^3		
CHM-2a (Case-6)	1¼"φ HSKB w/8½" EMB.	2 L5×5×¾ 2 W10×25 (a = 39", b = 7", c = 25")	KMX = 44402.94×10^3 KMY = 30739.57×10^3 KMZ = 133302.25×10^3		

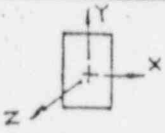
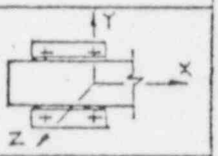
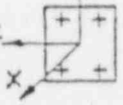
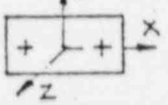
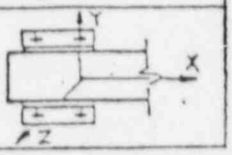
Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CHM-3a ¢4	1¼"φ HSKB w/13⅛" EMB.	L 5 × 5 × 3/4 (L = 17.5") C10 × 15.3 (a = 3.[illegible], b = 8.75")	KMX = 1383.70×10^3 KMY = 10318.17×10^3 KMZ = 28266.78×10^3		
CHM-3a ¢4	1¼"φ HSKB w/13⅛" EMB.	L5 × 5 × 3/4 (L = 17.5") C 10 × 15.3 (a = 6.25", b = 6.25")	KMX = 1439.88×10^3 KMY = 10383.52×10^3 KMZ = 29877.48×10^3		
CHM-3a ¢4	1"φ R1.	L 5 × 5 × 3/4 (L = 15") C10 × 15.3 (a = 3", b = 7")	KMX = 2350.69×10^3 KMY = 13636.43×10^3 KMZ = 44725.08×10^3		
CHM-3a	1¼"φ HSKB w/13⅛" EMB.	L 5 × 5 × 3/4 (L = 29") C10 × 15.3 (a = 12", b = 12")	KMX = 1716.16×10^3 KMY = 19916.41×10^3 KMZ = 67562.51×10^3		
CHM-3a	1¼"φ HSKB w/13⅛" EMB.	L 5 × 5 × 3/4 (L = 29") C10 × 15.3 (a = 7.2", b = 16.8")	KMX = 1662.28×10^3 KMY = 19417.72×10^3 KMZ = 65143.61×10^3		
CHM-3a ¢4	1"φ R1	L 5 × 5 × 3/4 (L = 17.5") C10 × 15.3 (a = 6.25", b = 6.25")	KMX = 2649.33×10^3 KMY = 17367.39×10^3 KMZ = 64848.98×10^3		
CHM-3a ¢4	1"φ HKB w/7" EMB.	L 5 × 5 × 3/4 (L = 17.5") C10 × 15.3 (a = 6.25", b = 6.25")	KMX = 1356.76×10^3 KMY = 7945.70×10^3 KMZ = 27253.94×10^3		

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CSM-18i	17l 3/8"ϕ HKB W/3 1/2" Min	TS 2×2×1/4" PL 3/8"×5"×8 1/2"	KMY = 6.292×10^5 KMZ = 1.36×10^6	KFX = 1.216×10^5	
CSM-18C CSM-18C-I CSM-18C-II	17d-1 1/2"ϕ HKB W/ 5 1/2" Min	TS 4×4×1/4" PL 1/2"×11 1/2"×11 1/2"	KMY = 1.617×10^7 KMZ = 1.617×10^7	KFX = 6.123×10^5	
CSM-18C CSM-18C-V CSM-18C-VI	17d-2 1/2"ϕ HKB W/ 5 1/2" Min	TS 4×4×1/4 PL 1/2"×11 1/2"×11 1/2"	KMY = 1.537×10^7 KMZ = 1.537×10^7	KFX = 5.427×10^5	//
CSM-18C CSM-18C-IX CSM-18C-X	17e-1 1/2"ϕ HKB W/ 5 1/2" Min	TS 3×3×1/4 PL 1/2"×9 1/2"×9 1/2"	KMY = 1.111×10^7 KMZ = 1.111×10^7	KFX = 6.99×10^5	//
CSM-18C CSM-18C-XIII CSM-18C-XIV	17e-2 1/2"ϕ HKB W/ 5 1/2" Min	TS 3×3×1/4 PL 1/2"×9 1/2"×9 1/2"	KMY = 1.089×10^7 KMZ = 1.089×10^7	KFX = 6.02×10^5	//
CSM-18d CSM-18d-I CSM-18d-II	17f 3/4"ϕ HKB W./5" Min	TS 4×4×1/4 PL 3/4"×12"×12"	KMY = 1.072×10^7 KMZ = 1.072×10^7	KFX = 2.912×10^5	//
CSM-18J	17m 1/2"ϕ HKB W/ 3 1/2" Min	TS 2×2×1/4 PL 1/2"×5"×8 1/2"	KMY = 1.399×10^6 KMZ = 3.079×10^6	KFX = 2.733×10^5	
CSM-18h	17K 3/8"ϕ HKB W/ 2" Min.	TS 2×2×1/4 PL 3/8"×5"×8 1/2"	KMY = 6.137×10^5 KMZ = 1.333×10^6	KFX = 1.193×10^5	//
CSM-18b CSM-18b-I CSM-18b-II	17B 1"ϕ HKB W/ 7" Min	TS 4×4×3/8 PL 1"×16"×16"	KMY = 2.889×10^7 KMZ = 2.884×10^7	KFX = 7.83×10^5	
CSM-18a CSM-18a-I CSM-18a-II	17A/17C 1"ϕ HSKB W/ 8 1/2" Min	TS 6×6×5/16 PL 1 1/4"×29"×29"	KMY = 7.641×10^7 KMZ = 7.6[illegible] $\times 10^7$	KFX = 5.956×10^5	//
CSM-37b (CASE I, II)	35b 1/2"ϕ HKB W/ 5 1/2" Min	d = 5" ~ 8"	KMX = 5.29×10^6 KMY = 1.19×10^6		

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

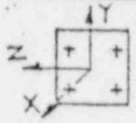
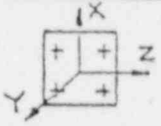
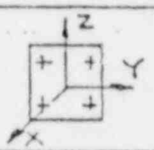
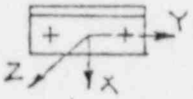
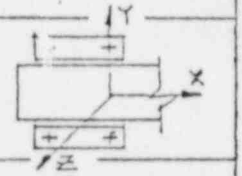
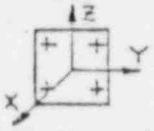
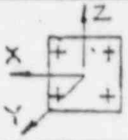
Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants Rotation (in-lb/Rad)	Spring Constants Tension (lb/in)	Remark
CSM-37b (CASE III, IV)	35b 1/2"ϕ HSKB W/ 4 1/4 Min	d = 5" ~ 8" TS 2×2×1/4	KMX = 1.855×10^5 KMY = 4.17×10^5		
CSM-37b (CASE V, VI, VII)	35b 3/4"ϕ HKB W/ 5" Min	d = 7 1/2" ~ 10" TS 3×3×1/4	KMX = 1.063×10^5 KMY = 4.25×10^5		//
CSM-42a CSM-42a-I.II CSM-42b	40 1/2"ϕ HSKB W/ 5 1/2" Min	2∠3×1 3/4"×3/8 TS 2×2×1/4	KMX = 5.292×10^6 KMY = 9.241×10^6		
CSM-42a CSM-42a-III.IV CSM-42b	40 1/2"ϕ HSKB W/ 5 1/2" Min	2∠3×2×3/8 TS 3×3×1/4	KMX = 7.618×10^6 KMY = 1.532×10^7		//
CSM-42a CSM-42a-V.VI CSM-42b	40 1"ϕ HSKB W/ 8 1/2" Min	2∠3×3×3/8 TS 4×4×1/4	KMX = 1.69×10^7 KMY = 4.431×10^7		//
CSM-14a CSM-14a-I	13A 1"ϕ HKB W/ 8" Min	2∠6×3 1/2×3/8 TS 6×6×3/16	KMX = 2.172×10^7 KMY = 2.172×10^7		//
CSM-14b CSM-14b-I	13B 1"ϕ HSKB W/ 8 1/2" Min	2∠5×3 1/2×3/4 TS 6×6×3/16	KMX = 6.507×10^7 KMY = 8.852×10^7		//
CSM-18g	17J 3/8"ϕ HKB W/ 3 1/2" Min	TS 2×2×1/4 PL 1/2"×10"×10"	KMY = 3.303×10^6 KMZ = 3.303×10^6	KFX = 3.506×10^5	
CSM-38	36 1"ϕ HKB W/ 7" Min	MC6- t=3/8"~1" PL 3/4×10 1/2×10 1/2	KMY = 1.71×10^7 KMZ = 1.297×10^7	KFX = 8.329×10^5	//
CSM-37A	35a 1"ϕ HSKB W/ 6 1/2" Min	TS 4×4×3/8 d = 10" ~ 16"	KMX = 3.662×10^6 KMY = 4.093×10^7	KFZ = 4.736×10^5	
CSM-25a CSM-25a-I	24a		KMX = 2.536×10^7 KMY = 3.527×10^7	-	

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
ELECTRICAL CONDUIT ISOMETRIC VALIDATION

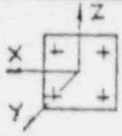
PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. 2

ATTACHMENT D SH. 9 OF 19

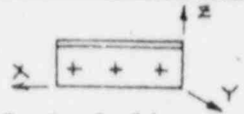
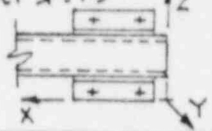
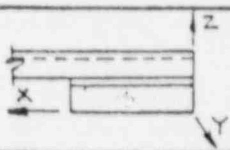
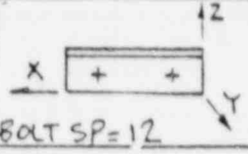
Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CSM-18d CSM-18d-V CSM-18d-VI CSM-18d-IX CSM-18d-X	17g 3/4"ϕ HKB W/ 5" Min	TS 3x3x1/4 ⅊ 3/4"x12"x12"	$KMY = 9.776 \times 10^6$ $KMZ = 9.776 \times 10^6$	$KFX = 2.912 \times 10^5$	
CSM-29b CSM-29b-I	28B 1"ϕ HSKB W/ 8 1/2" Min	TS 6x6x3/8. ⅊ 1"x16"x16"	$KMX = 4.834 \times 10^7$ $KMZ = 4.834 \times 10^7$	$KFY = 6.434 \times 10^5$	
CSM-30	29 1"ϕ HKB W/ 7" Min	TS 4x4x3/8 ⅊ 1"x14x14	$KMX = 3.352 \times 10^7$ $KMZ = 3.352 \times 10^7$	$KFY = 6.465 \times 10^5$	//
CSM-39a CSM.39b	37A,B 1 1/4"ϕ HSKB W/ 8 1/8" Min	TS 6x6x3/8 ⅊ 1 1/4"x24 1/2x24 1/2	$KMY = 6.77 \times 10^7$ $KMZ = 8.001 \times 10^7$	$KFX = 4.394 \times 10^5$	
CSM-33	32 3/4ϕ HKB W/ 5" EMB	∠ 6x6x3/4 d = 8"~12"	$KMX = 1.068 \times 10^7$ $KMY = 1.676 \times 10^6$		
CSM-25b CSM-25b-I	24-D	2L 3 1/2 x 2 x 1/2 TS 6x3x5/16	$KMX = 3.58 \times 10^7$ $KMY = 3.311 \times 10^7$		
CSM-39a CSM-39b	37A, B 1 1/4"ϕ HSKB W/ 8 1/8" Min	TS 6x6x3/8 ⅊ 1 1/4 x24 1/2 x 24 1/2	$KMY = 6.77 \times 10^7$ $KMZ = 1.019 \times 10^8$	$KFX = 4.394 \times 10^5$	
CSM-18e	17f				TS WELD TO CONT. LINER
CSM-18f	17d 1/2"ϕ HKB W/ 5 1/2 Min	TS 4x4x1/4 ⅊ 1/2"x11 1/2x11 1/2	$KMX = 1.617 \times 10^7$ $KMZ = 1.617 \times 10^7$	$KFY = 6.123 \times 10^5$	
CSM-18f	17e 1/2"ϕ HKB W/ 5 1/2 Min	TS 3x3x1/4 ⅊ 1/2"x9 1/2x9 1/2	$KMX = 1.111 \times 10^7$ $KMZ = 1.111 \times 10^7$	$KFY = 6.99 \times 10^5$	//
CSM-18f	17f 3/4"ϕ HKB W/ 5" Min	TS 4x4x1/4 ⅊ 3/4"x12x12	$KMX = 1.072 \times 10^7$ $KMZ = 1.072 \times 10^7$	$KFY = 2.912 \times 10^5$	//

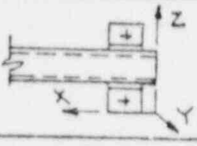
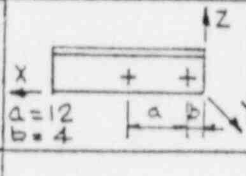
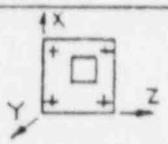
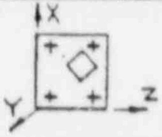
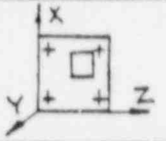
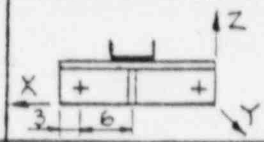
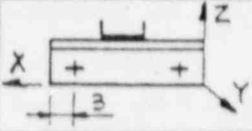
Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CSM-18f	17g 3/4"ϕ HKB W/. 5" Min	TS 3x3x1/4 PL 3/4"x12"x12"	KMX = 1.072×10^7 KMZ = 1.072×10^7	KFY = 2.912×10^5	

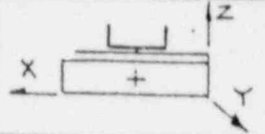
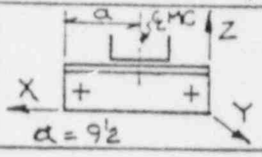
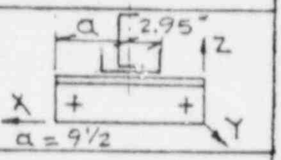
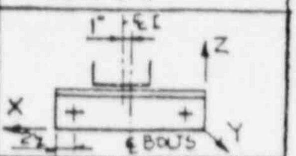
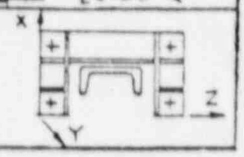
Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CSM-15a (CASE-1)	HSKB 1¼"ϕ	L6x6x¾x4'-9	$KMX = 2.17 \times 10^6$ $KMY = 102.5 \times 10^6$ $KMZ = 79.58 \times 10^6$		 BOLT SP= 24
CSM-15a (CASE-2)	RI 1"ϕ	L6x6x¾x4'-9	$KMX = 6.903 \times 10^6$ $KMY = 216.9 \times 10^6$ $KMZ = 263.3 \times 10^6$		〃
CSM-15a (CASE-3)	HSKB 1¼"ϕ	L6x6x¾x3'-1	$KMX = 2.231 \times 10^6$ $KMY = 77.03 \times 10^6$ $KMZ = 50.99 \times 10^6$		〃 BOLT SP= 14
CSM-15a (CASE-4)	RI 1"ϕ	L6x6x¾x3'-1	$KMX = 6.022 \times 10^6$ $KMY = 114.3 \times 10^6$ $KMZ = 102.5 \times 10^6$		〃
CSM-16b	HSKB 1"ϕ	TS4x4x⅜ L6x4x¾x1'-6	$KMX = 26.95 \times 10^6$ $KMY = 39.85 \times 10^6$ $KMZ = 79.9 \times 10^6$		BOLT SP=15 
CSM-16B	RI 1"ϕ	TS4x4x⅜ L6x4x¾x1'-6	$KMX = 39.81 \times 10^6$ $KMY = 141.9 \times 10^6$ $KMZ = 151.4 \times 10^6$		〃
CSM-16B	HSKB 1"ϕ	TS4x4x⅜ L6x4x¾x2'-5	$KMX = 36.07 \times 10^6$ $KMY = 85.30 \times 10^6$ $KMZ = 203.6 \times 10^6$		〃 BOLT SP= 24
CSM-16B	RI 1"ϕ	TS4x4x⅜ L6x4x¾x2'-5	$KMX = 56.72 \times 10^6$ $KMY = 313.8 \times 10^6$ $KMZ = 394.3 \times 10^6$		〃
CSM-17a	HSKB 1"ϕ	C6x13 L8x8x1"x0'-4	$KMX = 621.7 \times 10^3$ $KMZ = 937.4 \times 10^3$		
CSM-17C	HSKB ½ϕ	L6x4x½x1'-3	$KMX = 1.247 \times 10^6$ $KMY = 5.575 \times 10^6$ $KMZ = 6.070 \times 10^6$		 BOLT SP=12
CSM-17C	HSKB ½ϕ	L6x4x½x0'-9	$KMX = 840.0 \times 10^3$ $KMY = 1.385 \times 10^6$ $KMZ = 2.328 \times 10^6$		〃 BOLT SP=6

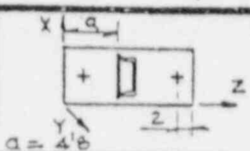
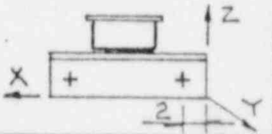
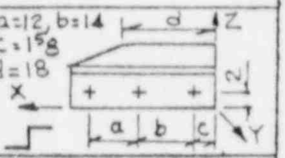
Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CSM-24 (CASE 1)	HKB 1"ϕ	TS 4x4x3/16 L6x3½x¼x0'-4	$KMX = 597.6 \times 10^3$ $KMY = 8.035 \times 10^6$ $KMZ = 219.4 \times 10^3$		
CSM-24 (CASE-2)	HKB 1"ϕ	TS 4x4x3/16 L6x3½x¼x0'-4	$KMX = 819.9 \times 10^3$ $KMY = 5.989 \times 10^6$ $KMZ = 328.3 \times 10^3$		″
CSM-27 (FIRST RUN)	HKB 1"ϕ	TS 6x6x3/16 L5x3½x½x0'-6	$KMX = 5.260 \times 10^6$ $KMY = 10.27 \times 10^6$ $KMZ = 1.902 \times 10^6$		″
CSM-27. (SECOND RUN)	HKB 1"ϕ	TS 6x6x3/16 L5x3½x½x0'-6	$KMX = 6.141 \times 10^6$ $KMY = 8.779 \times 10^6$ $KMZ = 2.263 \times 10^6$		″
CSM-28a	HKB 1"ϕ	L5x5x¾x2'-0	$KMX = 1.83 \times 10^6$ $KMY = 12.93 \times 10^6$ $KMZ = 20.25 \times 10^6$		
CSM.28a	HKB 1"ϕ	L5x5x¾x1'-6	$KMX = 1.340 \times 10^6$ $KMY = 6.967 \times 10^6$ $KMZ = 11.74 \times 10^6$		″ a = 10 b = 2
CSM-29a (CASE.1)	HSKB 1"ϕ	TS 6x6x3/8 PL 1"x13½x13½	$KMX = 45.23 \times 10^6$ $KMY = 27.30 \times 10^6$ $KMZ = 45.23 \times 10^6$		
CSM-29a (CASE-2)	HSKB 1"ϕ	TS 6x6x3/8 PL 1"x13½x13½	$KMX = 30.92 \times 10^6$ $KMY = 25.56 \times 10^6$ $KMZ = 30.92 \times 10^6$		
CSM-29a (CASE-3)	HSKB 1"ϕ	TS 6x6x3/8 PL 1"x13½x13½	$KMX = 49.28 \times 10^6$ $KMY = 24.0 \times 10^6$ $KMZ = 49.28 \times 10^6$		
CSM 31a CSM 31c (CASE I)	HSKB 1¼ϕ	C8x11.5 L6x6x¾x1'-6	$KMX = 2.728 \times 10^6$ $KMY = 7.647 \times 10^6$ $KMZ = 20.02 \times 10^6$		
CSM-31a CSM-31c (CASE 5)	HSKB 1¼ϕ	C8x11.5 L6x6x¾x1'-6	$KMX = 1.538 \times 10^6$ $KMY = 7.415 \times 10^6$ $KMZ = 18.48 \times 10^6$		

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CSM-32 a	HKB 1" φ	C4 × 7.25 L5×5×¾×0'-6	$KMX = 348.9 \times 10^3$ KMY = N/A $KMZ = 1.247 \times 10^6$		
CSM-34 a	HSKB 1¼ φ	MC 6×16.3 L6×6×¾×1'-4½	$KMX = 1.235 \times 10^6$ $KMY = 9.037 \times 10^6$ $KMZ = 13.81 \times 10^6$		 a = 9½
CSM-34 a	HSKB 1¼ φ	MC 6 × 16.3 L5×5×¾×1'-4½	$KMX = 1.082 \times 10^6$ $KMY = 11.62 \times 10^6$ $KMZ = 15.29 \times 10^6$		" a = 9½
CSM-34 a	HSKB 1¼ φ	MC6×16.3 L6×6×¾×1'-4½	$KMX = 1.244 \times 10^6$ $KMY = 9.046 \times 10^6$ $KMZ = 13.83 \times 10^6$		" a = 8¼
CSM-34 a	HSKB 1¼ φ	MC6 × 16.3 L5×5×¾×1'-4½	$KMX = 1.089 \times 10^6$ $KMY = 11.62 \times 10^6$ $KMZ = 15.32 \times 10^6$		" a = 8¼
CSM-34b	HSKB 1¼ φ	C6 × 8.2 (COMP.) L6×6×¾×1'-4½	$KMX = 1.218 \times 10^6$ $KMY = 6.646 \times 10^6$ $KMZ = 14.29 \times 10^6$		 a = 9½
CSM-34b	HSKB 1¼ φ	C6 × 8.2 (COMP.) L5×5×¾×1'-4½	$KMX = 1.067 \times 10^6$ $KMY = 8.279 \times 10^6$ $KMZ = 15.79 \times 10^6$		" a = 9½
CSM-34b	HSKB 1¼ φ	C6×8.2 (COMP.) L6×6×¾×1'-4½	$KMX = 1.223 \times 10^6$ $KMY = 6.65 \times 10^6$ $KMZ = 13.85 \times 10^6$		" a = 8¼
CSM-34b	HSKB 1¼ φ	C6×8.2 (COMP.) L5×5×¾×1'-4½	$KMX = 1.071 \times 10^6$ $KMY = 8.314 \times 10^6$ $KMZ = 15.81 \times 10^6$		a = 8¼
CSM-35 JOINT. 6	HSKB 1" φ	C10 × 15.3 L5×5×¾×1'-3	$KMX = 927.6 \times 10^3$ $KMY = 5.405 \times 10^6$ $KMZ = 12.46 \times 10^6$		
CSM-35 JOINT 8	HSKB 1" φ	C10 × 15.3 L5×5×¾×1'-3	$KMX = 124.6 \times 10^6$ $KMY = 27.28 \times 10^6$ $KMZ = 17.36 \times 10^6$		

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
CSM-40 CASE-I	HSKB 1¼φ	PL 1"x10x1'-2 MC6x16.3 PL 3/8x7	KMX = 19.83×10^6 KMY = 9.372×10^6 KMZ = 10.72×10^6		 a = 4'8
CSM-40 CASE-II	HSKB 1¼φ	PL 1"x10x1'-2 MC6x16.3 PL 3/8x7	KMX = 21.95×10^6 KMY = 9.736×10^6 KMZ = 10.73×10^6		// a = 5'8
CSM-41 CASE-I	HSKB 1"φ	C6x8.2 L5x5x3/4x1'-2	KMX = 867.5×10^3 KMY = 4.699×10^6 KMZ = 10.77×10^6		
CSM-41 CASE-II	HSKB 1"φ	C6x8.2 L5x5x3/4x1'-2	KMX = 861.7×10^3 KMY = 4.695×10^6 KMZ = 10.73×10^6		//
CSM-41 CASE-III	HSKB 1¼φ	C6x8.2 L5x5x3/4x1'-5	KMX = 817.0×10^3 KMY = 10.36×10^6 KMZ = 13.89×10^6		//
CSM-41 CASE-IV	HSKB 1¼φ	C6x8.2 L5x5x3/4x1'-5	KMX = 813.6×10^3 KMY = 10.37×10^6 KMZ = 13.89×10^6		//
JA-6 TYPE 7	HSKB 1¼φ	PL 4x½ L6x6x3/4x2'-10	KMX = 724.8×10^3 KMY = 18.80×10^6 KMZ = 1.278×10^6		a=12, b=14 c=1 5/8 d=18 
JA-6 TYPE 7A	HSKB 1¼φ	PL 4x½ L6x6x3/4x2'-10	KMX = 819.2×10^3 KMY = 19.54×10^6 KMZ = 1.050×10^6		// d = 24
JA6 TYPE 8	HSKB 1"φ	PL 4x½ L6x6x3/4x2'-4	KMX = 726.5×10^3 KMY = 11.20×10^6 KMZ = 1.263×10^6		// a = 10, b = 12 c = 1'4, d = 18
JA6 TYPE 9	HSKB 1"φ	PL 4x½ L6x6x3/4x1'-4	KMX = 538×10^3 KMY = 3.345×10^6 KMZ = 1.241×10^6		// a = 10, b = 0 c = 1'4, d = 12 (TWO BOLTS ONLY)

TECHNICAL GUIDELINES
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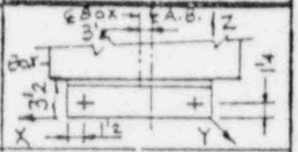
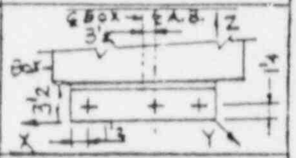
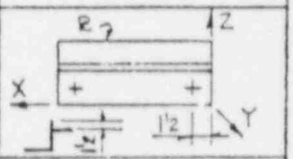
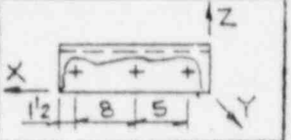
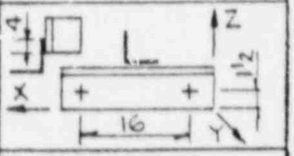
PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. 2

ATTACHMENT D SH. 15 OF 19

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
JA-8 TYPE 13	HKB ½ φ	BOX 36"x36"x24" L 5x3½x⅜x2'-3	$KMX = 222.9 \times 10^3$ $KMY = 467.5 \times 10^3$ $KMZ = 23.53 \times 10^6$		
JA-8 TYPE-13	HKB ½ φ	BOX 15"x10"x24" L 5x3½x⅜x1'-1	$KMX = 158.1 \times 10^3$ $KMY = 361.0 \times 10^3$ $KMZ = 6.099 \times 10^6$		//
JA-8 TYPE-12	HKB ½ φ	Box 60"x36"x24" L 5x3½x⅜x3'-3	$KMX = 219.4 \times 10^3$ $KMY = 503.1 \times 10^3$ $KMZ = 19.95 \times 10^6$		
JA-8 TYPE-12	HKB ½ φ	Box 36"x15"x24" L5x3½x⅜x1'-11	$KMX = 244.1 \times 10^3$ $KMY = 502.5 \times 10^3$ $KMZ = 45.17 \times 10^6$		//
JA-9 CASE I	HKB ¾ φ	PL ½ x 4 x 18 L 6x6x¾x1'-6	$KMX = 360.4 \times 10^3$ $KMY = 8.986 \times 10^6$ $KMZ = 1.181 \times 10^6$		
JA-9 CASE II	HKB ¾ φ	PL ½x4x18 L6x6x¾x2'-0	$KMX = 390.8 \times 10^3$ $KMY = 13.54 \times 10^6$ $KMZ = 1.201 \times 10^6$		//
JA-9 CASE II	HKB ¾ φ	PL ½x4x36 L6x6x¾x3'-0	$KMX = 438.9 \times 10^3$ $KMY = 32.08 \times 10^6$ $KMZ = 1.0 \times 10^6$		//
JA-12 CASE I	HKB ½ φ	CMC3x7.1x1'-4	$KMX = 171.3 \times 10^3$ $KMY = 2.09 \times 10^6$ $KMZ = 281.3 \times 10^3$		
JS-11	HKB 1" φ	L5x5x¾ L5x5x¾x1'-9½	$KMX = 862.3 \times 10^3$ $KMY = 6.794 \times 10^6$ $KMZ = 19.34 \times 10^6$		
JS.12 CASE.3	HKB 1" φ	L5x5x¾ L5x5x¾x2'-0	$KMX = 869.7 \times 10^3$ $KMY = 7.49 \times 10^6$ $KMZ = 20.92 \times 10^6$		//
JS-12 CASE-5	HKB 1" φ	L5x5x¾ L5x5x¾x2'-0	$KMX = 886.4 \times 10^3$ $KMY = 7.49 \times 10^6$ $KMZ = 20.92 \times 10^6$		//

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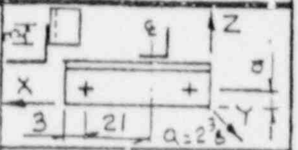
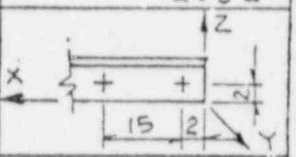
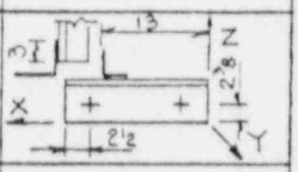
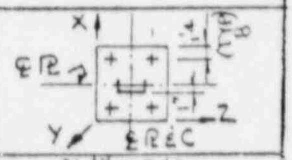
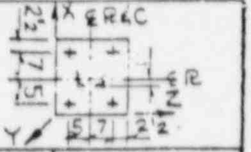
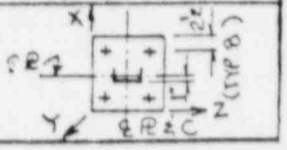
REV. 1 ADDENDUM NO. 2

ATTACHMENT D SH. 16 OF 19

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

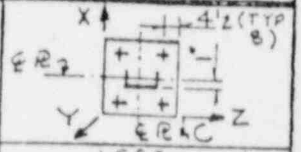
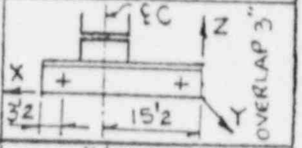
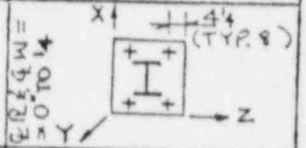
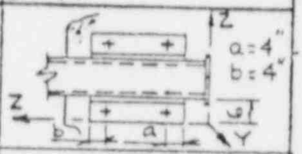
Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
JS-13	HSKB 1¼ϕ	L4x4x⅜ L6x6x¾x3'-0	KMX = 1.309 $\times 10^6$ KMY = 4.546 $\times 10^6$ KMZ = 44.14 $\times 10^6$		
JS-13 & JS-14	HSKB 1¼ϕ	L4x4x⅜ L6x6x¾x3'-0	KMX = 1.344 $\times 10^6$ KMY = 4.503 $\times 10^6$ KMZ = 64.89 $\times 10^6$		// a = 3½
JS-13 TYPE-I	HSKB 1¼ϕ	L4x4x⅜	KMX = 1.381 $\times 10^6$ KMY = 35.27 $\times 10^6$ KMZ = 14.16 $\times 10^6$		
JS-13 TYPE-V	HSKB 1¼ϕ	L4x4x⅜	KMX = 1.381 $\times 10^6$		//
JS-13 TYPE-III	HSKB 1¼ϕ	L4x4x⅜ L6x6x¾x1'-8	KMX = 1.101 $\times 10^6$ KMY = 3.548 $\times 10^6$ KMZ = 18.46 $\times 10^6$		
JS-13 TYPE-VIII	HSKB 1¼ϕ	L4x4x⅜ L6x6x¾x1'-8	KMX = 1.101 $\times 10^6$ KMZ = 18.54 $\times 10^6$		//
JS-14 TYPE-I	HSKB 1¼ϕ	L4x4x⅜ L6x6x¾x1'-5¼	KMX = 1.425 $\times 10^6$ KMY = 3.526 $\times 10^6$ KMZ = 27.59 $\times 10^6$		//
JS-14 TYPE-III	HSKB 1¼ϕ	L4x4x⅜ L6x6x¾x1'-8¼	KMX = 1.427 $\times 10^6$ KMZ = 27.79 $\times 10^6$		//
JS-15	HKB 1"ϕ	C6x8.2 PL¾x12½x12½	KMX = 15.35 $\times 10^6$ KMY = 27.75 $\times 10^6$ KMZ = 15.79 $\times 10^6$		
JS-15	HKB 1"ϕ	C6x8.2 PL¾x19x19	KMX = 15.55 $\times 10^6$ KMY = 40.08 $\times 10^6$ KMZ = 14.74 $\times 10^6$		
JS-15	HKB 1"ϕ	C6x8.2 PL¾x19x19	KMX = 13.79 $\times 10^6$ KMY = 47.58 $\times 10^6$ KMZ = 14.0 $\times 10^6$		

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
ELECTRICAL CONDUIT ISOMETRIC VALIDATION

PROJECT IDENTIFICATION
NO. SAG.CP23
REV. 1 ADDENDUM NO. 2

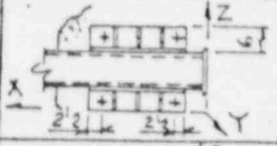
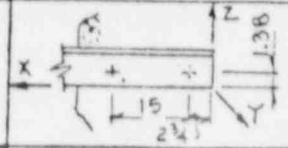
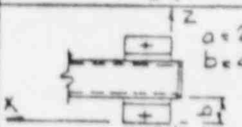
ATTACHMENT D SH. 17 OF 19

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants		Remark
			Rotation (in-lb/Rad)	Tension (lb/in)	
JS_15	HKB 1"ϕ	C6×8.2 ℞ $\frac{3}{4}$×19×19	KMX = 20.33×10^6 KMY = 24.08×10^6 KMZ = 11.07×10^6		
2323.S.0910 SH. JS_18 CASE_1	HKB 1"ϕ	2C 4×7.25 L 6×6×$\frac{3}{4}$×2'-1	KMX = 1.781×10^6 KMY = 6.187×10^6 KMZ = 41.70×10^6		
JS_21 TYPE-19	HSKB 1¼ϕ	W6×25 ℞ $\frac{7}{8}$×18½×18½	KMX = 32.75×10^6 KMY = 116.5×10^6 KMZ = 33.15×10^6		
JS_22a CASE-1	HKB $\frac{3}{4}\phi$	T.S. 4×4×$\frac{3}{16}$ 2L 6×3½×$\frac{3}{8}$×1'-8	KMX = 5.64×10^6 KMY = 36.39×10^6 KMZ = 24.41×10^6		 a=4" b=4"

JS_22b
CASE-1
	HKB
	$\frac{3}{4}\phi$
		TS 6×6×$\frac{5}{16}$
		2L 6×4×½×1'-5½
			KMX = 11.77×10^6
			KMY = 43.25×10^6
			KMZ = 30.20×10^6
					// a=2¼
					b=3¼

JS_22b.
CASE_2
	HSKB
	1"ϕ
		TS 6×6×$\frac{5}{16}$
		2L 6×4×½×1'-5½
			KMX = 17.43×10^6
			KMY = 31.78×10^6
			KMZ = 54.68×10^6
					// a=2¼
					b=3¼

JS.23 CASE.2	HSKB 1"ϕ	TS 4×4×¼ 2L 6×3½×$\frac{3}{8}$×1'-8 6 STIFF ℞ $\frac{3}{8}$ THK	KMX = 63.23×10^6 KMY = 40.43×10^6 KMZ = 58.76×10^6		
JS_27	HSKB. 1¼ϕ	L4×4×$\frac{3}{8}$	KMX = 700.7×10^3 KMY = 35.64×10^6 KMZ = 8.5×10^6		
JS_29	HKB ½ϕ	TS4×4×$\frac{3}{16}$ 2L4×3×$\frac{3}{8}$×0'-4	KMX = 2.543×10^6 KMY = 3.949×10^6 KMZ = 1.050×10^6		 a=2" b=4
JS-30 TYPE-I	HKB $\frac{3}{4}\phi$	TS6×4×$\frac{3}{16}$ 2L5×3×$\frac{3}{8}$×0'-6	KMX = 2.450×10^6 KMY = 10.010×10^6 KMZ = 688.7×10^3		/ a=3½ b=5

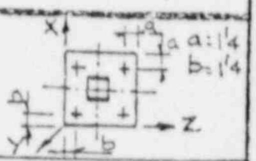
JS.30
TYPE-II
	HKB
	½ϕ
		TS6×4×$\frac{3}{16}$
		2L5×3×$\frac{3}{8}$×0'-6
			KMX = 3.502×10^6
			KMY = 7.443×10^6
			KMZ = 1.224×10^6
					// a=3½
					b=5

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
ELECTRICAL CONDUIT ISOMETRIC VALIDATION

PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. 2

ATTACHMENT D SH. 18 OF 19

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants Rotation (in-lb/Rad)	Tension (lb/in)	Remark
JS.28 TYPE-I	HKB 1"ϕ	TS4x4x3/16 PL 1"x9½x9½	KMX = 21.38x10⁶ KMY = 12.03x10⁶ KMZ = 21.38x10⁶		 a:1¼ b:1¼
JS.28 TYPE II JS.31a TYPE 29	HKB 1"ϕ	TS4x4x3/16 PL 1"x13x13	KMX = 23.99x10⁶ KMY = 12.05x10⁶ KMZ = 23.99x10⁶		〃 a=3 b=3
JS.31a TYPE 29a	HKB 1"ϕ	TS4x4x3/16 PL 1"x13x13"	KMX = 23.22x10⁶ KMY = 15.21x10⁶ KMZ = 23.22x10⁶		〃 a=2 b=3
JS.31b JS-31c CASE.I	HSKB 1"ϕ	TS6x6x¼ PL 1"x19x19	KMX = 46.60x10⁶ KMY = 23.79x10⁶ KMZ = 46.60x10⁶		〃 a=4½ b=4½
JS.31b JS-31c CASE II	HSKB 1"ϕ	TS6x6x¼ PL 1"x19x19	KMX = 41.81x10⁶ KMY = 33.36x10⁶ KMZ = 41.81x10⁶		〃 a=2½ b=4½
JS-39a JS-39b CASE I	HSKB 1"ϕ	TS6x6x5/16 PL 1¼x22½x22½	KMX = 61.15x10⁶ KMY = 56.32x10⁶ KMZ = 61.15x10⁶		〃 a=3¼ b=3¼
JS.39a JS.39b CASE II	HSKB 1"ϕ	TS6x6x5/16 PL 1¼x22½x22½	KMX = 56.10x10⁶ KMY = 68.87x10⁶ KMZ = 56.10x10⁶		〃 a=1¼ b=3¼
JS-39c JS-39d CASE.I	HKB ¾ϕ	TS4x4x¼ PL ¾x9x9	KMX = 8.291x10⁶ KMY = 10.14x10⁶ KMZ = 8.291x10⁶		〃 a=1½ b=1½
JS-39c JS-39d CASE.II	HKB ¾ϕ	TS4x4x¼ PL ¾x9x9	KMX = 7.96x10⁶ KMY = 11.77x10⁶ KMZ = 7.96x10⁶		〃 a=1" b=1½
JS-39e CASE.I	HKB 1"ϕ	TS4x4x¼ PL ¾x13½x13½	KMX = 16.29x10⁶ KMY = 23.67x10⁶ KMZ = 16.29x10⁶		〃 a=1¾ b=1¾
JS.39e CASE.II	HKB 1"ϕ	TS4x4x¼ PL ¾x13½x13½	KMX = 15.58x10⁶ KMY = 25.70x10⁶ KMZ = 15.58x10⁶		〃 a=1¼ b=1¾

TECHNICAL GUIDELINES
FOR SEISMIC CATEGORY I
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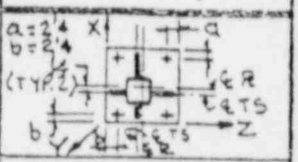
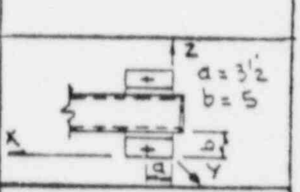
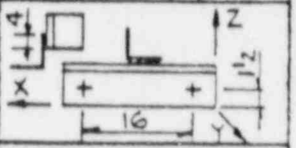
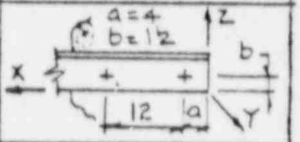
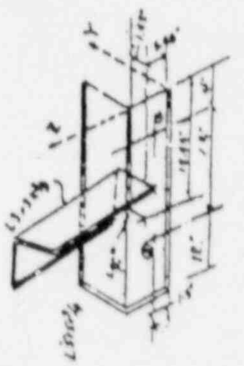
PROJECT IDENTIFICATION
NO. SAG.CP25
REV. 1 ADDENDUM NO. 2

ATTACHMENT D SH. 19 OF 19

Tensile and Rotational Spring Constants for Generic Base Plates of Generic Conduit Supports.

Support Type	Anchor Bolt Size	Base Plate Size & Attachment	Spring Constants Rotation (in-lb/Rad)	Tension (lb/in)	Remark
JS-31d TYPE 29c JS-31e TYPE 29d CASE.1	HSKB 1/2 ϕ	TS 3x3x1/4 PL 1/2 x10x10 STIFF. PL 3/8	KMX = 9.073×10^6 KMY = 5.860×10^6 KMZ = 9.670×10^6		
JS-31d TYPE 29c JS-31e TYPE.29d CASE.2	HSKB 1/2 ϕ	TS 3x3x1/4 PL 1/2 x10x10 STIFF PL 3/8	KMX = 8.508×10^6 KMY = 7.399×10^6 KMZ = 9.942×10^6		a=1 1/2 b=2 1/4 //
JS-32	HKB 3/4 ϕ	TS 4x4x3/16 2L 5x3x3/8 x0'-6	KMX = 2.234×10^6 KMY = 5.922×10^6 KMZ = 851.4×10^3		
2323-S-0910 SH. JS-33 CASE-3	HSKB 1 1/4 ϕ	L5x5x3/4 L5x5x3/4 x2'-0	KMX = 1.005×10^6 KMY = 9.697×10^6 KMZ = 23.39×10^6		
JS.33 CASE.4	HKB 1" ϕ	L5x5x3/4 L5x5x3/4 x2'-0	KMX = 869.7×10^3 KMY = 7.49×10^6 KMZ = 20.92×10^6		//
JS-34	HKB 3/4 ϕ	L5x3 1/2 x3/8	KMX = 257.3×10^3 KMY = 9.787×10^6 KMZ = 6.015×10^6		
JS.36	HKB 1" ϕ	L5x5x3/8	KMX = 758.6×10^3 KMY = 10.19×10^6 KMZ = 6.057×10^6		a = 3 b = 1 3/4 //
JS.37	HKB 1" ϕ	L4x4x1/2	KMX = 668.6×10^3 KMY = 10.24×10^6 KMZ = 8.476×10^6		a = 3 b = 1 1/4 //
JS.38	HKB 1" ϕ	L3x3x3/8 L5x5x3/4 x2'-4	KMX = 856×10^3 KMY = 3.326×10^6 KMZ = 6.90×10^6		

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COMANCHE PEAK SES UNIT #1
ADDENDUM #1 TO SAG.CP25, REVISION 1
DELETION OF SLENDERNESS RATIO REQUIREMENT FOR CONDUIT

Minor correction was made on the memo SAG.TUG1.9688 and its attachment distributed previously. Please discard the memo and its attachment and replace them with the attachment to this memo.

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FROM C Y Chiou / H S Yu / O S Yue OFFICE LOCATION 81/2WTC

SUBJECT TU ELECTRIC
COMANCHE PEAK SES UNIT #1
ADDENDUM #1 TO SAG.CP25, REVISION 1
DELETION OF SLENDERNESS RATIO REQUIREMENT FOR CONDUIT

Since conduit is not considered as a compression member, the slenderness ratio (KL/r) requirement as specified in Paragraph 7.3.h of Appendix I of SAG.CP25 is being deleted. Attached for your use is the marked-up page 19 of Appendix I to be incorporated into Revision 2 of SAG.CP25 at a later date. This addendum is to be used immediately in design verification.

Please acknowledge receipt of subject document by signing below and returning this memo to C.Y. Chiou at 81/2WTC no later than November 24, 1987.

CYC:mw

Receipt Acknowledged: Wu, K.T. 11/24/87
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cc: R C Iotti
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7.3 EVALUATION OF CONDUIT FORCES AND MOMENTS FROM RSM FROM SPANS (Continued)

h. Effective Length Factor in Slenderness Ratios

For overhang, single and double bends, the unbraced length and its respective K value is given in Table I.3.

The slenderness ratio of the conduit in the STRUDL printout need not be checked except for overhang. For Overhang, maximum slenderness ratio (KL/r) for conduits may be taken as 240 when fa/Fa < 0.15 (not applicable for conduit support members).

Where fa = computed axial stress
Fa = allowable axial stress

When fa/Fa > 0.15, maximum slenderness ratio (KL/r) shall not exceed 200.

The SSE allowable shall be used for SSE loads and OBE allowables shall be utilized for OBE loads and if necessary each conduit span shall be evaluated for corresponding member forces.

7.4 COMMON SUPPORT

a. Conduit Stresses

Each individual conduit has to satisfy the design requirements stated in the procedure described in Section 7.3.

b. Support Capacity

For Vertical Direction

$$\sum\left[R_i + W_x\,(1 + G_{Actual})\right] \leq (1 + G_{Design})\,(\overline{L}_L \text{ or } \overline{L}_T)$$