UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 20, 2000

LICENSEE: Commonwealth Edison Company

FACILITIES: LaSalle County Station, Units 1 and 2

SUBJECT: SUMMARY OF JUNE 8, 2000, MEETING WITH COMMONWEALTH EDISON COMPANY TO DISCUSS THE DESIGN OF PIPE SUPPORTS AT LASALLE COUNTY STATION, UNITS 1 AND 2

On June 8, 2000, the U. S. Nuclear Regulatory Commission (NRC) met with the Commonwealth Edison Company (ComEd) to discuss the licensee's analytical approach to the design of pipe supports at LaSalle County Station, Units 1 and 2.

On April 12, 2000, the NRC held a conference call with ComEd to discuss the anchor bolt stiffness values used in pipe support calculations and to resolve the fundamental issue related to the appropriateness of modeling the structural attachments of base plates as pinned connections. The staff also requested a meeting with ComEd to discuss the issue. By letter dated April 18, 2000, the NRC submitted a letter to ComEd listing the specific concerns to be addressed at the meeting.

At the meeting on June 8, 2000, ComEd provided a description of the analysis it used to conclude that the pipe supports can transfer the loads from the pipes to the wall with a margin of four against ultimate structural failure. The licensee stated that its analysis bounds the population of pipe supports at LaSalle. At the conclusion of the meeting, the NRC staff requested that the licensee submit a letter describing its design approach and a discussion of how the sample of supports analyzed by ComEd are representative of all of the supports at the site. ComEd agreed to provide a letter within 30 days of the meeting. One of the issues addressed in the April 18, 2000, letter concerned the in-structure floor response values for operating basis earthquake and safe shutdown earthquake. Based on discussions with the licensee, the staff agreed to separate this issue from the June 8, 2000, meeting.

A list of those attending the meeting is provided as Enclosure 1. The slides used by ComEd during the meeting are provided in Enclosure 2.

Donna M. Skay

Donna M. Skay, Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos.: 50-373, 50-374

Enclosures: 1. Meeting Attendees
2. Slides

cc w/encls: See next page

June 20, 2000

LICENSEE: Commonwealth Edison Company

FACILITIES: LaSalle County Station, Units 1 and 2

SUBJECT: SUMMARY OF JUNE 8, 2000, MEETING WITH COMMONWEALTH EDISON COMPANY TO DISCUSS THE DESIGN OF PIPE SUPPORTS AT LASALLE COUNTY STATION, UNITS 1 AND 2

On June 8, 2000, the U. S. Nuclear Regulatory Commission (NRC) met with the Commonwealth Edison Company (ComEd) to discuss the licensee's analytical approach to the design of pipe supports at LaSalle County Station, Units 1 and 2.

On April 12, 2000, the NRC held a conference call with ComEd to discuss the anchor bolt stiffness values used in pipe support calculations and to resolve the fundamental issue related to the appropriateness of modeling the structural attachments of base plates as pinned connections. The staff also requested a meeting with ComEd to discuss the issue. By letter dated April 18, 2000, the NRC submitted a letter to ComEd listing the specific concerns to be addressed at the meeting.

At the meeting on June 8, 2000, ComEd provided a description of the analysis it used to conclude that the pipe supports can transfer the loads from the pipes to the wall with a margin of four against ultimate structural failure. The licensee stated that its analysis bounds the population of pipe supports at LaSalle. At the conclusion of the meeting, the NRC staff requested that the licensee submit a letter describing its design approach and a discussion of how the sample of supports analyzed by ComEd are representative of all of the supports at the site. ComEd agreed to provide a letter within 30 days of the meeting. One of the issues addressed in the April 18, 2000, letter concerned the in-structure floor response values for operating basis earthquake and safe shutdown earthquake. Based on discussions with the licensee, the staff agreed to separate this issue from the June 8, 2000, meeting.

A list of those attending the meeting is provided as Enclosure 1. The slides used by ComEd during the meeting are provided in Enclosure 2.

/RA/

Donna M. Skay, Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos.: 50-373, 50-374

Enclosures: 1. Meeting Attendees
2. Slides

cc w/encls: See next page

*See previous concurrence

OFFICE	PM:PDIII/2	LA:PDIII/2	BC:EMEB	SC:PDIII/2
NAME	D. Skay	C. Moore*	G.Imbro	A. Mendiola
DATE	06/ 19 /00	06/ 16 /00	06/ 19 /00	06/ 20 /00

DOCUMENT NAME: G:\PDIII-2\lasalle\MTG6-8-00SUM.WPD

MEETING SUMMARY DISTRIBUTION FORJUNE 8, 2000 MTG W/COMED

Distribution:
PUBLIC
J. Zwolinski (JAZ)
S. Black (SCB)
A. Mendiola
PD III-2 r/f
S. Bailey (SNB)
D. Skay (DMS6)
OGC
OPA (e-mail to OPA)
ACRS
T. Quay (TRQ)
R. McIntyre (RPM1)
E. Imbro (EXI)
J. Ma (JSM1)
K. Manoly (KAM)
J. Gavula (JAG1)
C. Moore (ACM)
G. Grant, RIII
B. P. Jain, (BPJ)
R. Pettis (RLP4)

cc:

Phillip P. Steptoe, Esquire
Sidley and Austin
One First National Plaza
Chicago, Illinois 60603

Assistant Attorney General
100 W. Randolph St. Suite 12
Chicago, Illinois 60601

U.S. NRC-LaSalle Resident Inspectors Office
2605 N. 21st Road
Marseilles, Illinois 61341-9756

Chairman
LaSalle County Board
707 Etna Road
Ottawa, Illinois 61350

Attorney General
500 S. Second Street
Springfield, Illinois 62701

Chairman
Illinois Commerce Commission
527 E. Capitol Avenue, Leland Building
Springfield, Illinois 62706

Illinois Department of Nuclear Safety
Office of Nuclear Facility Safety
1035 Outer Park Drive
Springfield, Illinois 62704

Regional Administrator
U.S. NRC, Region III
801 Warrenville Road
Lisle, Illinois 60532-4351

Commonwealth Edison Company
LaSalle Station Manager
2601 N. 21st Road
Marseilles, Illinois 61341-9757

Robert Cushing, Chief, Public Utilities Division
Illinois Attorney General's Office
100 W. Randolph Street
Chicago, Illinois 60601

Document Control Desk-Licensing
Commonwealth Edison Company
1400 Opus Place, Suite 400
Downers Grove, Illinois 60515

Commonwealth Edison Company
Site Vice President - LaSalle
2601 N. 21st Road
Marseilles, Illinois 61341-9757

Mr. David Helwig
Senior Vice President
Commonwealth Edison Company
Executive Towers West III
1400 Opus Place, Suite 900
Downers Grove, Illinois 60515

Mr. Gene H. Stanley
Vice President - Nuclear Operations
Commonwealth Edison Company
Executive Towers West III
1400 Opus Place, Suite 900
Downers Grove, Illinois 60515

Mr. Christopher Crane
Senior VP - Nuclear Operations
Commonwealth Edison Company
Executive Towers West III
1400 Opus Place, Suite 900
Downers Grove, Illinois 60515

Mr. R. M. Krich
Vice President - Regulatory Services
Commonwealth Edison Company
Executive Towers West III
1400 Opus Place, Suite 500
Downers Grove, Illinois 60515

Commonwealth Edison Company
Reg. Assurance Supervisor - LaSalle
2601 N. 21st Road
Marseilles, Illinois 61341-9757

Ms. Pamela B. Stroebel
Senior Vice President and General Counsel
Commonwealth Edison Company
P.O. Box 767
Chicago, Illinois 60690-0767

MEETING TO DISCUSS PIPE SUPPORT DESIGN
JUNE 8, 2000

NAME	AFFILIATION
Donna Skay	NRC/NRR/DLPM
Anthony Mendiola	NRC/NRR/DLPM
Gene Imbro	NRC/NRR/DE/EMEB
Kamal Manoly	NRC/NRR/DE/EMEB
John Ma	NRC/NRR/DE/EMEB
B.P. Jain	NRC/NRR/DE/EMEB
Jim Gavula	NRC/Region III
T. R. Quay	NRC/NRR/DIPM
Rich McIntyre	NRC/NRR/DIPM
Robert Pettis	NRC/NRR/DIPM
R. M. Krich	ComEd/Regulatory Services
W. M. Bohlke	ComEd/Engineering
D. Bost	ComEd/Engineering
J. T. Conner	ComEd/Engineering
P. C. Riccardella	Structural Integrity Associates
Javad Moslemian	Sargent & Lundy
Ron Janowiak	ComEd/Engineering
H. Roger Gavankar	ComEd/Engineering
Robert Brady	ComEd/Regulatory Services
R. Kennedy (by phone)	

ENCLOSURE 1

ENCLOSURE 2

LaSalle County Station, Units 1 & 2
Presentation to the NRC

Resolution of
Pipe Support Analysis Issues

June 8, 2000

ComEd

LaSalle County Station
Analysis of Pipe Supports

❑ Introduction and Purpose	W. H. Bohlke
❑ Review of Analytical Issues	J. T. Conner
❑ Description of Additional Analyses	
❑ Results and Comparisons	
❑ APLAN/ADINA Comparison	
❑ Summary	D. Bost

ComEd

Origin of Issue

- ComEd review of S&L calculations, questioned the use of pinned end conditions for pipe support baseplates (Spring 1999)
- In response, a problem identification form(PIF) was generated and sampling study performed to verify design methodology and design margins (Spring 1999)
- NRC review of the sampling study questioned the adequacy of the documentation regarding the anchor bolt stiffness values (Fall 1999)

ComEd

Origin of Issue

- ComEd provided additional information in a letter dated Dec. 21, 1999
  - The analysis inputs used were developed and documented in accordance with Reg. Guide 1.64 and ANSI N45.2.11(i.e., used "state of the art")
  - The method for establishing stiffness values was taken directly from the IEB 79-02 ComEd response. (July 5, 1979 Letter from Cordell Reed to J.G. Keppler)
  - ComEd considers the method for determining the stiffness values consistent with the plant licensing basis

Origin of Issue

- NRC issued RAI's in February and April 2000
- ComEd provided an additional response in March of 2000
- This meeting provides the results of additional analyses to facilitate issue resolution

ComEd

ComEd Review Efforts in 1999

- LaSalle Pipe Support Licensing Design Basis
  - Uses various boundary conditions which have been selected by the designer based on the support details (Fixed-ends or Pinned-ends)
  - Uses secant modulus at design ultimate for anchor bolt stiffness as required by the methodology established in IEB 79-02 commitments

ComEd

ComEd Review Efforts in 1999

- Independent reviews of the design basis and sampling study results were performed by Dr. du Bouchet, Dr. Kennedy, Stone & Webster Engg. Corp, Raytheon Engineers, and Harstead & Assoc.
- The ComEd conclusions were:
  - Modeling techniques are appropriate and conservative
    - Sample Study
    - Boundary Conditions
  - The overall support designs have adequate margins.
    - Steel and anchor design

ComEd

Problem Statement

- Demonstrate that the use of the secant modulus at design ultimate for anchor bolt stiffness is appropriate for LaSalle pipe support design

ComEd Conclusions

- **Use of the secant modulus at design ultimate for anchor bolt stiffness values ensures a safety factor of 4**
- The "2-Step Bounding" method is more conservative than the 1-Step approach
- The analytical tools used to design baseplates provide conservative results (i.e., APLAN)

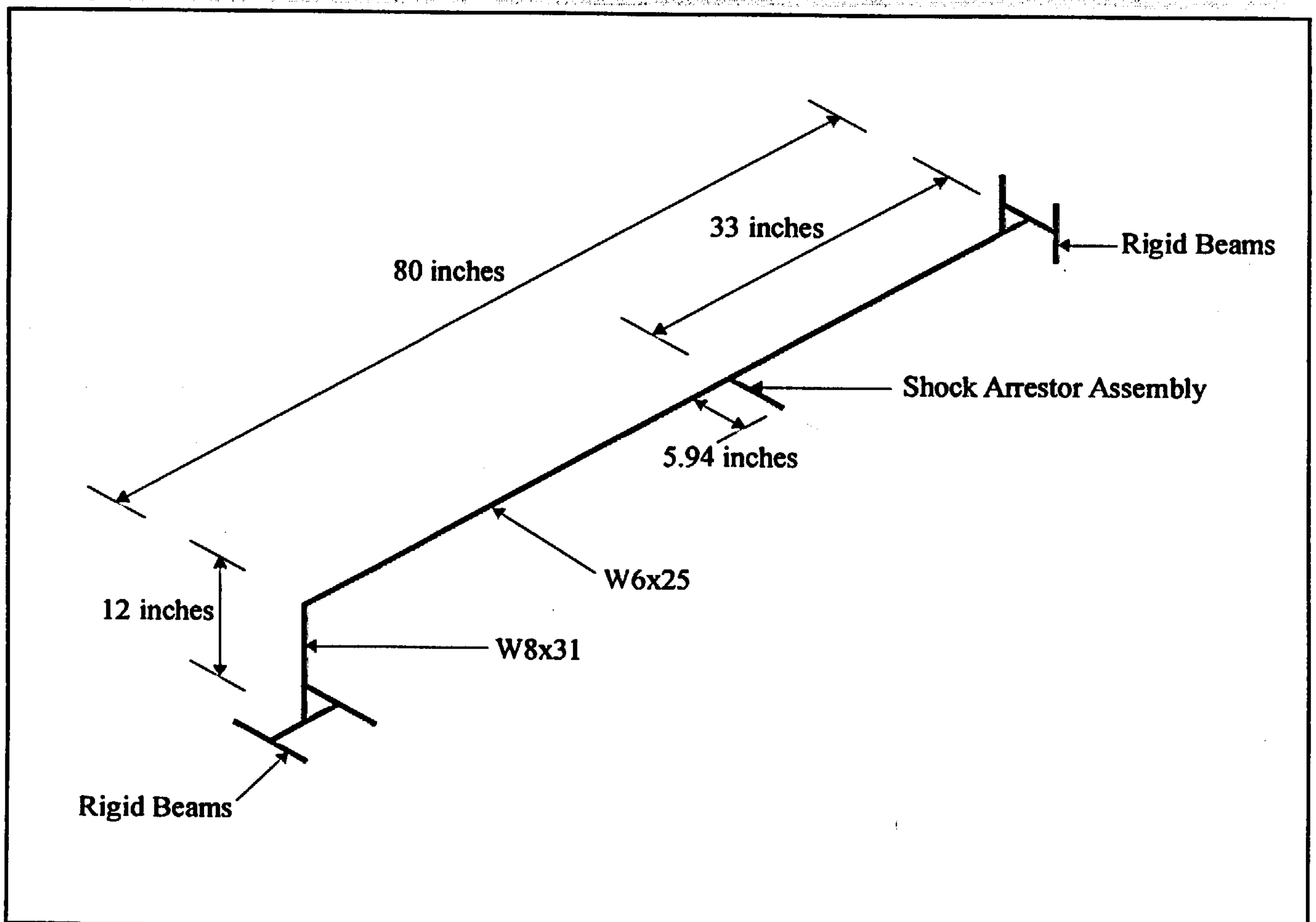
ComEd

Basis for Conclusions

- Given a support with Concrete Expansion Anchors (CEA's) at maximum design load, the support loads can be increased by a factor of 4 before the CEA ultimate capacity is reached.
- This was demonstrated in the 1979 ComEd submittal for IEB 79-02.
- New analyses have revalidated this finding for two highly stressed supports selected by the NRC.

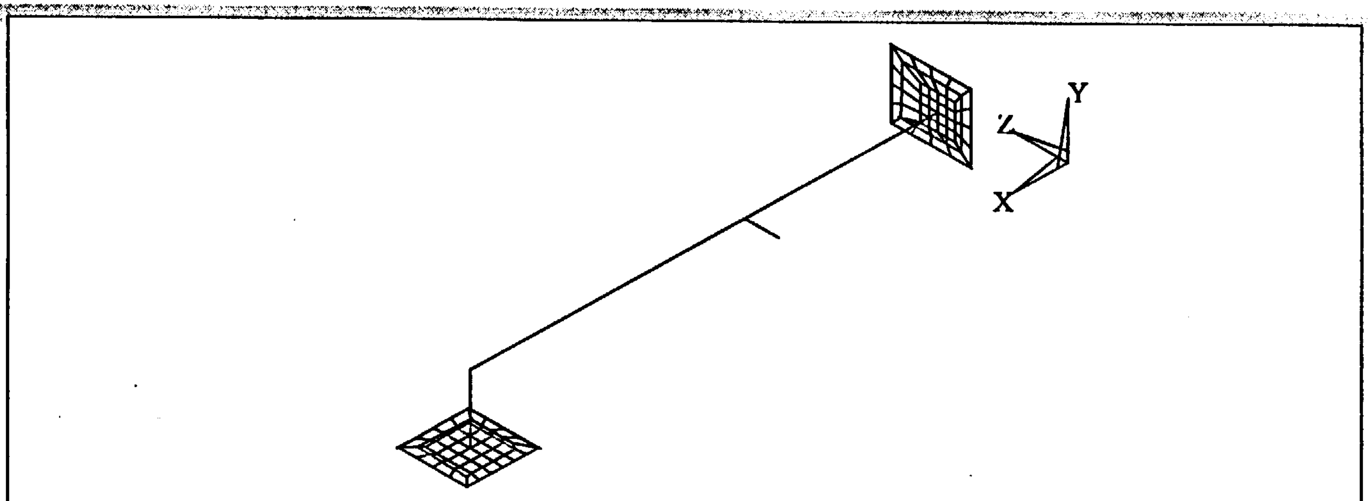
ComEd

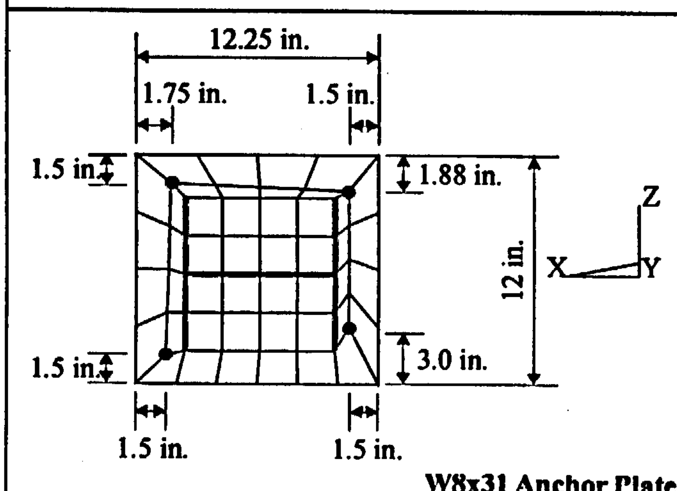
FEM Beam Elements -
First Support (MO9 RH04-2883S)

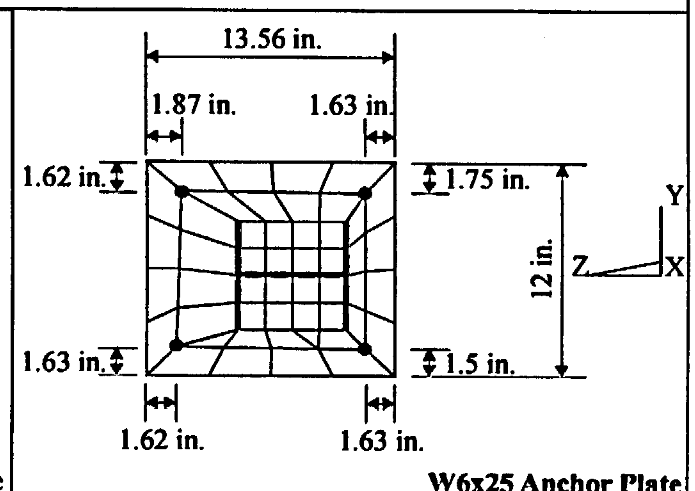


ComEd

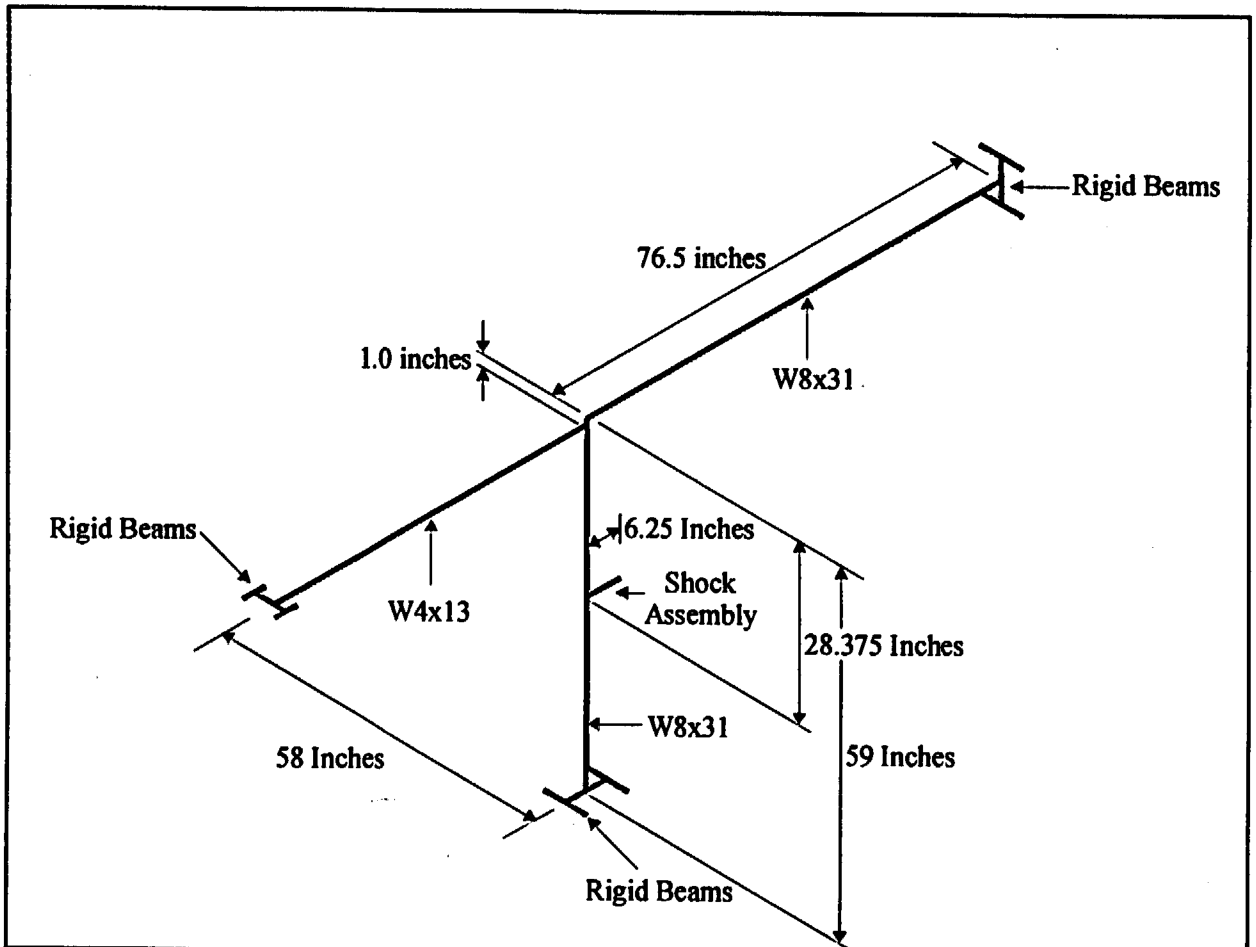
Anchor Plate Modeling Details - First Support





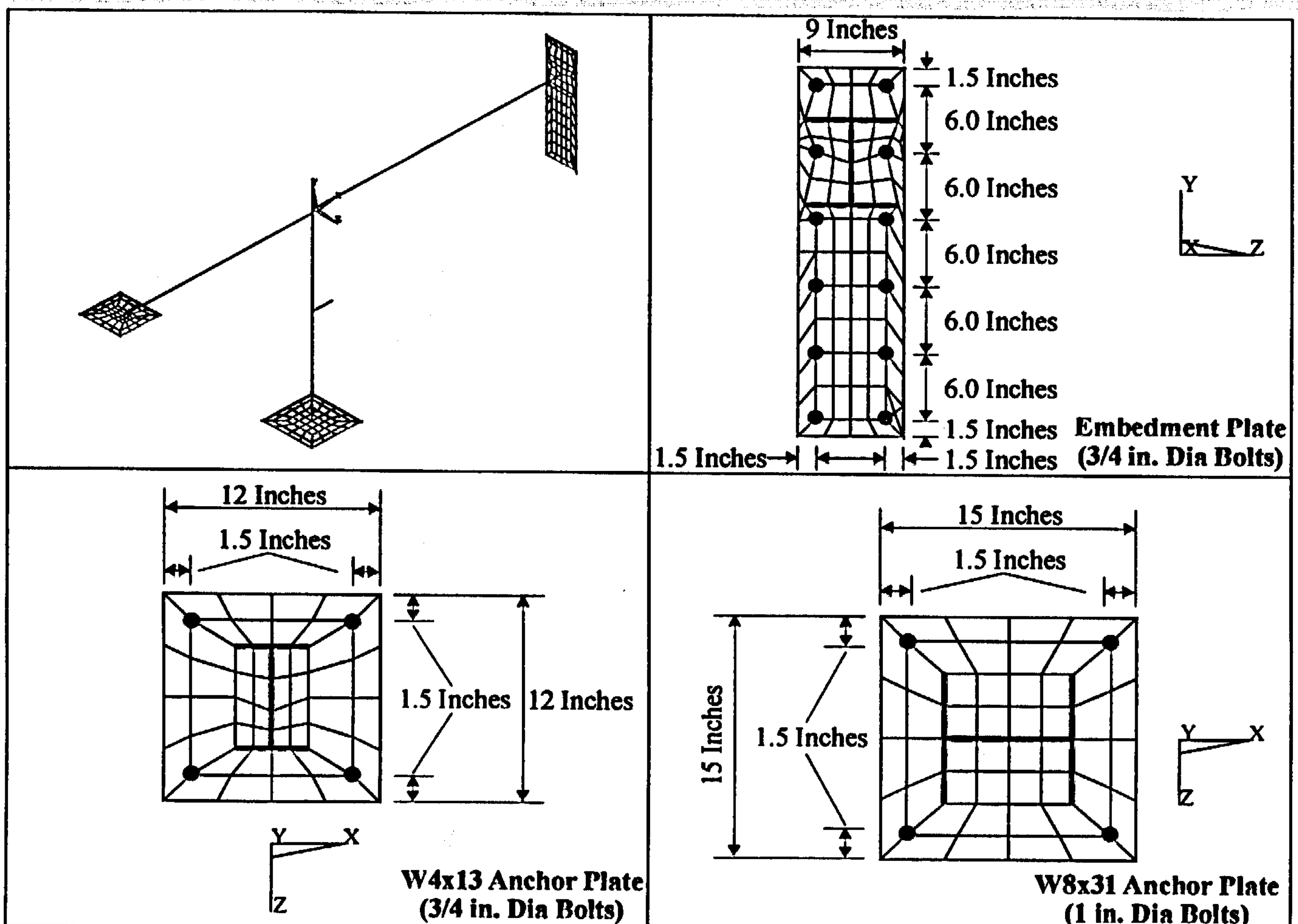


FEM Beam Elements - Second Support (MO9 LP28-2804X)

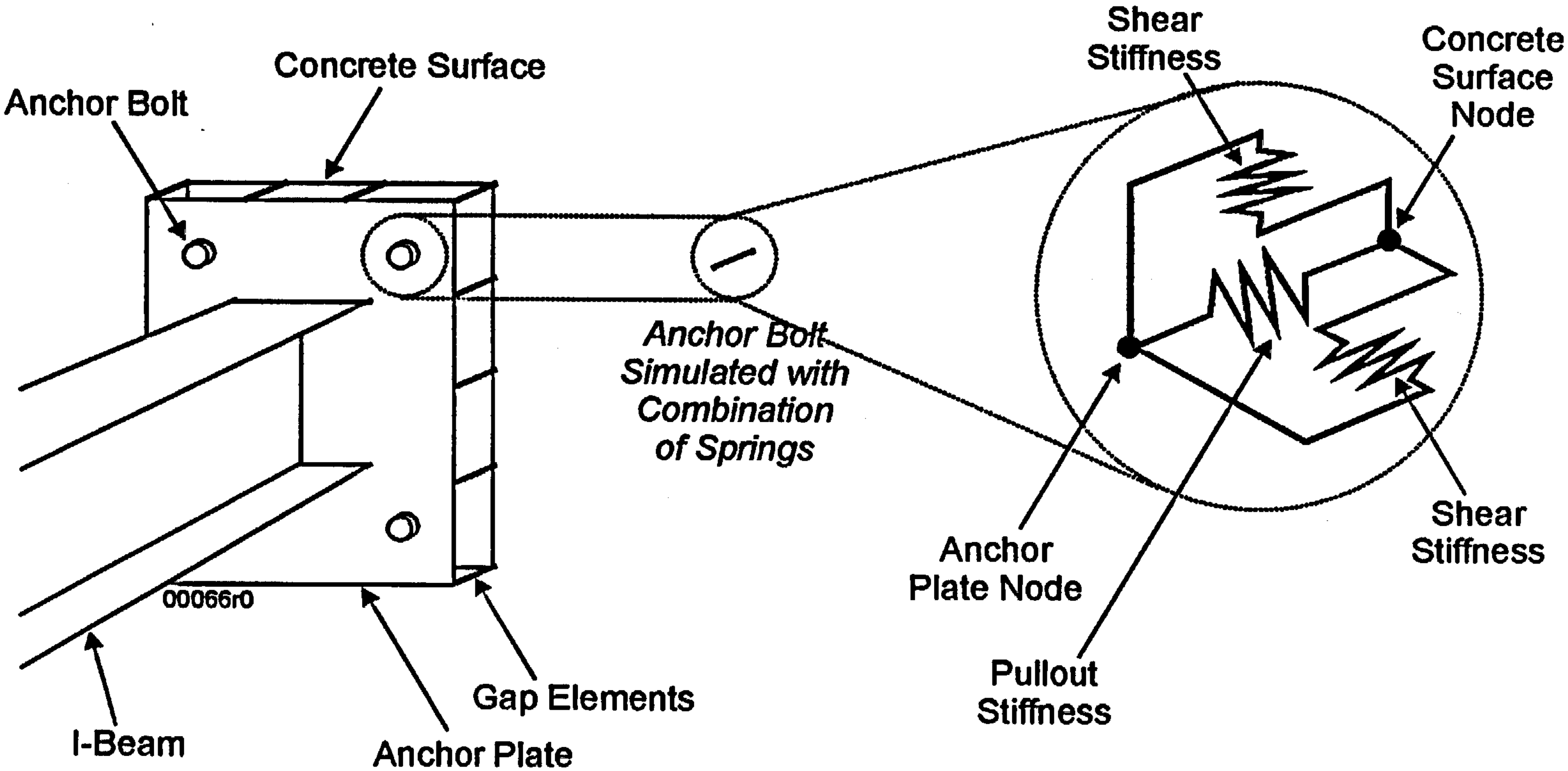


ComEd

Anchor Plate Modeling Details - Second Support



Finite Element Modeling Approach for Anchor Plates



ComEd

Basis for Conclusions

Results Using Non-Linear Stiffness

	First Support	Second Support
Design Basis Interaction Ratio	0.96	0.8
Safety Factor at Ultimate Capacity	4	5.5

ComEd

Basis for Conclusions

Comparison of Secant Modulus vs. Non-Linear Results

	Support 1	Support 2
Secant Modulus Anchor Bolt Load	12,239 lbs	20,831 lbs
Non-Linear Anchor Bolt Load	12,000 lbs	19,355 lbs
Ratio of Secant Modulus/Non-Linear	1.02	1.08

The applied support load corresponds to the load at the intersection of the design ultimate secant modulus (linear) and the non-linear curve. The fact that the ratio is about 1.0 demonstrates that the margin calculations are path independent and applies to all pipe supports. (i.e., results are bounding)

ComEd

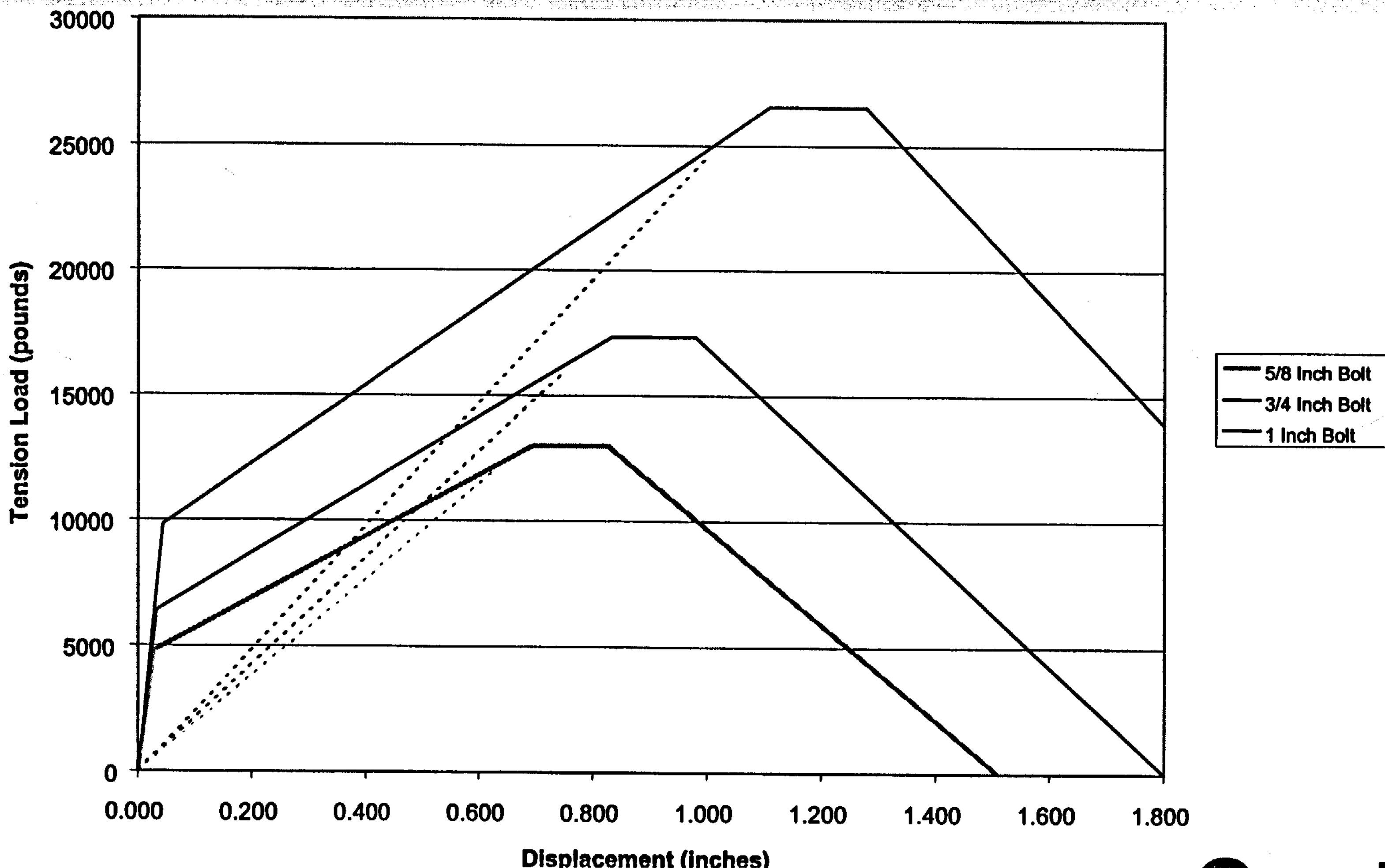
Basis for Conclusions

- 79-02 Margin Guidance- Licensee Action #2
  - "Verify that the concrete expansion anchor bolts have the following minimum factor of safety…a. Four - For wedge and sleeve type anchor bolts…The Bulletin factors of safety were intended for the maximum support load including the SSE…"

ComEd's Demonstrated Margin

  - Given a support with the anchor at maximum design load, the support loads can be increased by more than a factor of 4 before the anchor ultimate capacity is reached.

Anchor Bolt Load-Displacement Curves (Showing Secant Moduli)



ComEd Conclusions

- ✓ Use of the secant modulus at design ultimate for anchor bolt stiffness values ensures a safety factor of 4
- ☐ **The "2-Step Bounding" method is more conservative than the 1-Step approach**
- ☐ The analytical tools used to design baseplates provide conservative results (i.e., API AN)

ComEd

Basis for Conclusions

2-Step vs. 1-Step Method

- 1-Step Analysis of the same two pipe supports was performed using inputs that are consistent with the previous "2-Step bounding" analysis
- The anchor bolt loads at Node 6 (first support) and Node 1 (second support) were compared
- Results show that the "2-Step bounding" loads are greater than the 1-Step method
- Through iteration, the 2-Step method approaches the 1-Step method

ComEd

2-Step Bounding vs. 1-Step Comparison of Results

- Comparison of maximum bolt tensions:

	First Support M09-RH04-2883S	Second Support M09-LP28-2804X
"2-step bounding" approach	1.825 kips	3.47 kips
1-step approach	1.159 kips	0.89 kips
Ratio of 2-Step/1-Step	1.5	3.8

ComEd

ComEd Conclusions

- ✓ *Use of the secant modulus at design ultimate for anchor bolt stiffness values ensures a safety factor of 4*
- ✓ *The "2-Step Bounding" method is more conservative than the 1-Step approach*
- ❑ **The analytical tools used to design baseplates provide conservative results (i.e., APLAN)**

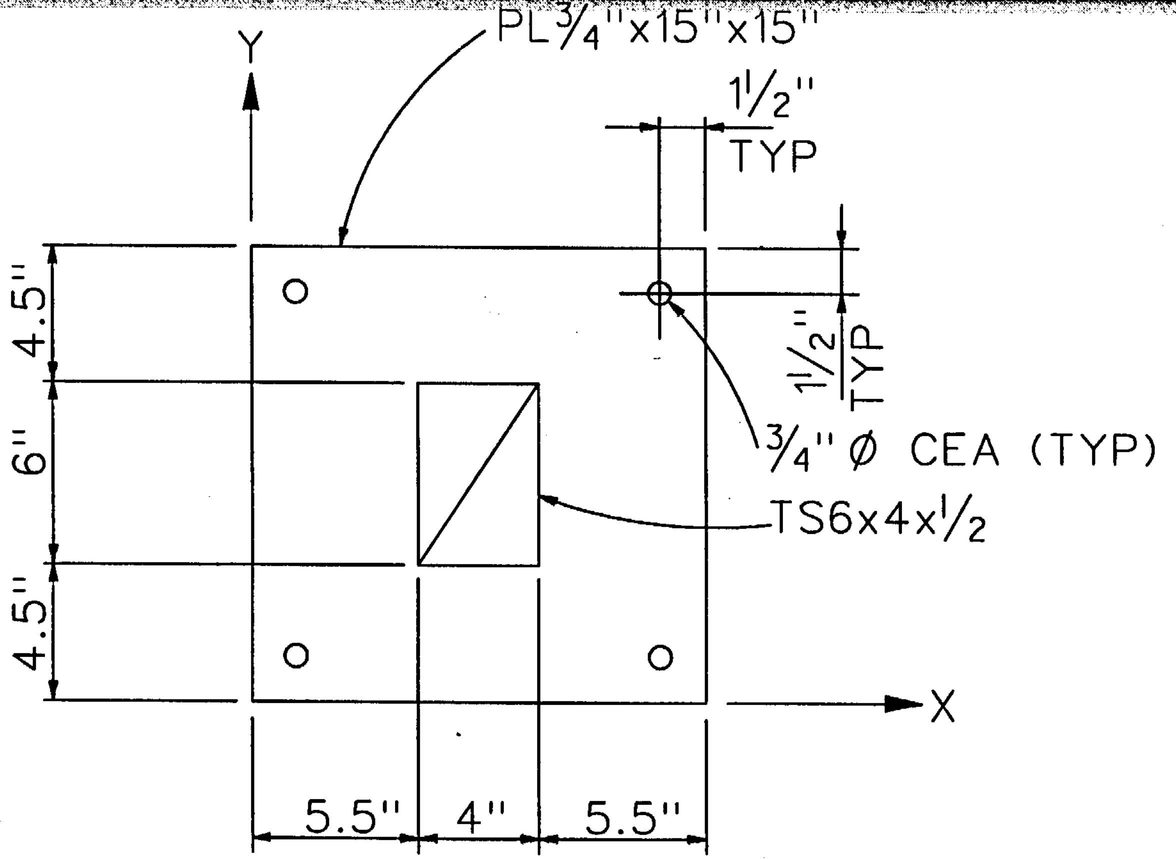
ComEd

Comparison of APLAN vs. ADINA Results for Base Plate of Pipe Support VG01-0024X

- Purpose - To demonstrate that the rotational stiffness corresponding to the two bending moments (102.89 kip-in and 17.72 kip-in)in calculation No. L-002379, using the APLAN code are similar to the values computed using the ADINA code

ComEd

Comparison of APLAN vs. ADINA Results for Base Plate of Pipe Support VG01-0024X



Dimensions and Coordinate System for the 15"x15"x3/4" CEA Plate

ComEd

Comparison of APLAN vs. ADINA Results for Base Plate of Pipe Support VG01-0024X

Results

Load Case 1: Mx=102.89 kip-inch, My=-0.94 kip-inch, Fz=5.46 kips

	Rotational Stiffness about x axis
ADINA	80.89 kip-in/deg
APLAN	86.3 kip-in/deg
ADINA/APLAN Ratio	0.94

Comparison of APLAN vs. ADINA Results for Base Plate of Pipe Support VG01-0024X

Results

Load Case 2: Mx=17.72 kip-inch, My=0.08 kip-inch, Fz=5.64 kips

	Rotational Stiffness about x axis
ADINA	47.03 kip-in/deg
APLAN	48.8 kip-in/deg
ADINA/APLAN Ratio	0.96

ComEd

Comparison of APLAN vs. ADINA Results for Base Plate of Pipe Support VG01-0024X

Observations/Conclusions

- The ADINA/APLAN ratios indicate that APLAN yields similar results
- Results are correlated and demonstrate that baseplate behavior is correctly captured using APLAN
  - Large tension causes the plate to lift off the concrete, the additional small applied moment is not of sufficient magnitude to cause the plate to bear on the concrete thus resulting in lower rotational stiffness
  - The case with the direct tension plus a large applied moment causes the plate to bear on the concrete resulting in a larger rotational stiffness

ComEd

ComEd Conclusions

- ✓ Use of the secant modulus at design ultimate for anchor bolt stiffness values ensures a safety factor of 4
- ✓ The "2-Step Bounding" method is more conservative than the 1-Step approach
- ✓ The analytical tools used to design baseplates provide conservative results (i.e., APLAN)

ComEd

Additional Requests by the NRC

- Determine the bending moment and bolt loads using a “more realistic bolt stiffness” that corresponds to operational loading
- Verify ComEd “2-Step bounding”approach is more conservative than 1-Step approach for anchor bolt loads
- Verification of APLAN results for rotational stiffness values

ComEd

Summary

- Use of the secant modulus at design ultimate has been adequately justified, and shown to ensure a support safety factor in excess of 4
  - *This restates the ComEd position established in IEB 79-02*
  - *This is demonstrated analytically by the new analysis*

ComEd

Summary

- The "2-Step bounding" method bounds the results of the 1-Step method
  - Anchor loads are greater using the "2-Step Bounding" method
  - The 2-Step method upon iteration approaches the 1-Step results

ComEd

Summary

- The use of APLAN for baseplate analysis is appropriate
  - Comparision has shown that anchor bolt rotational stiffness results are consistent and conservative with the results from other public domain software (i.e., ADINA)

ComEd

Summary

- The analytical methodologies employed at LaSalle County Station for the design and analysis of pipe supports and their base plates are conservative

ComEd