



The Kansas City Hyatt Regency Walkways Collapse

Outline

- NSPE Code of Ethics
- What Happened
- Comments from the Engineer
- National Bureau of Standards Report
- Some Lessons Learned

NSPE Code of Ethics

Fundamental Canons

Engineers, in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

What Happened

- 1981, newly opened Hyatt Regency Hotel
- Social function (tea dance)
- Two suspended walkways collapsed
- 114 dead, 186 injured
- In terms of loss of life and injuries, this was the most devastating structural collapse ever to take place in the United States.
- Two structural engineers lost their PE licenses

What the Licensing Board Said

- Following the accident investigations, on February 3, 1984, the Missouri Board of Architects, Professional Engineers and Land Surveyors filed a complaint against Daniel M. Duncan, Jack D. Gillum, and G.C.E. International, Inc., charging **gross negligence, incompetence, misconduct and unprofessional conduct in the practice of engineering** in connection with their performance of engineering services in the design and construction of the Hyatt Regency Hotel.



NBS BUILDING SCIENCE SERIES 143

Investigation of the Kansas City Hyatt Regency Walkways Collapse

U.S. DEPARTMENT OF COMMERCE • NATIONAL BUREAU OF STANDARDS



Details from the NBS Report

- G.C.E., in preparation of their structural detail drawings, "depicting the box beam hanger rod connection for the Hyatt atrium walkways, **failed to conform to acceptable engineering practice.** [This is based] upon evidence of a number of **mistakes, errors, omissions and inadequacies** contained on this section detail itself and of [G.C.E.'s] alleged **failure to conform to the accepted custom and practice of engineering for proper communication of the engineer's design intent.**"
- Evidence showed that **neither due care during the design phase, nor appropriate investigations following the atrium roof collapse were undertaken by G.C.E.** In addition, G.C.E. was found responsible for the change from a one-rod to a two-rod system.
- Further, it was found that **even if Havens [the structural steel contractor] failed to review the shop drawings or to specifically note the box beam hanger rod connections, the engineers were still responsible for the final check.**
- Evidence showed that G.C.E. engineers **did not "spot check" the connection** and that they **placed too much reliance on Havens.**

A Picture is Worth . . .

From National Geographic

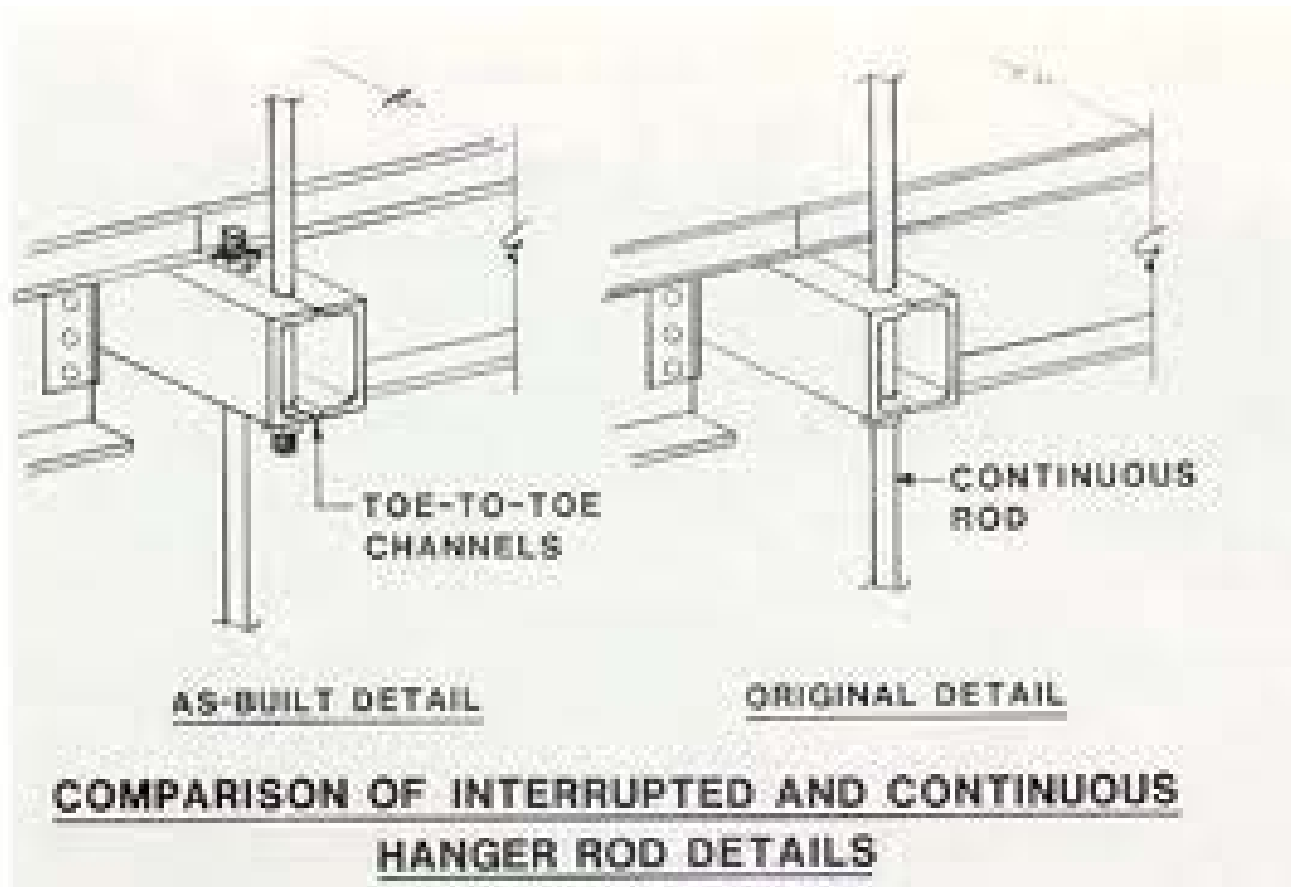
- Seconds From Disaster - S03E01 - Hotel Skywalk Collapse
9/1/2012 Season & Episode : S03E01 Title: Hotel Skywalk Collapse
Brief synopsis: 1,500 people gather for a dance in the Hyatt Regency Hotel in Kansas City....
<http://www.youtube.com/watch?v=oqp4K32sfDE>
- 21:33 – 22:47

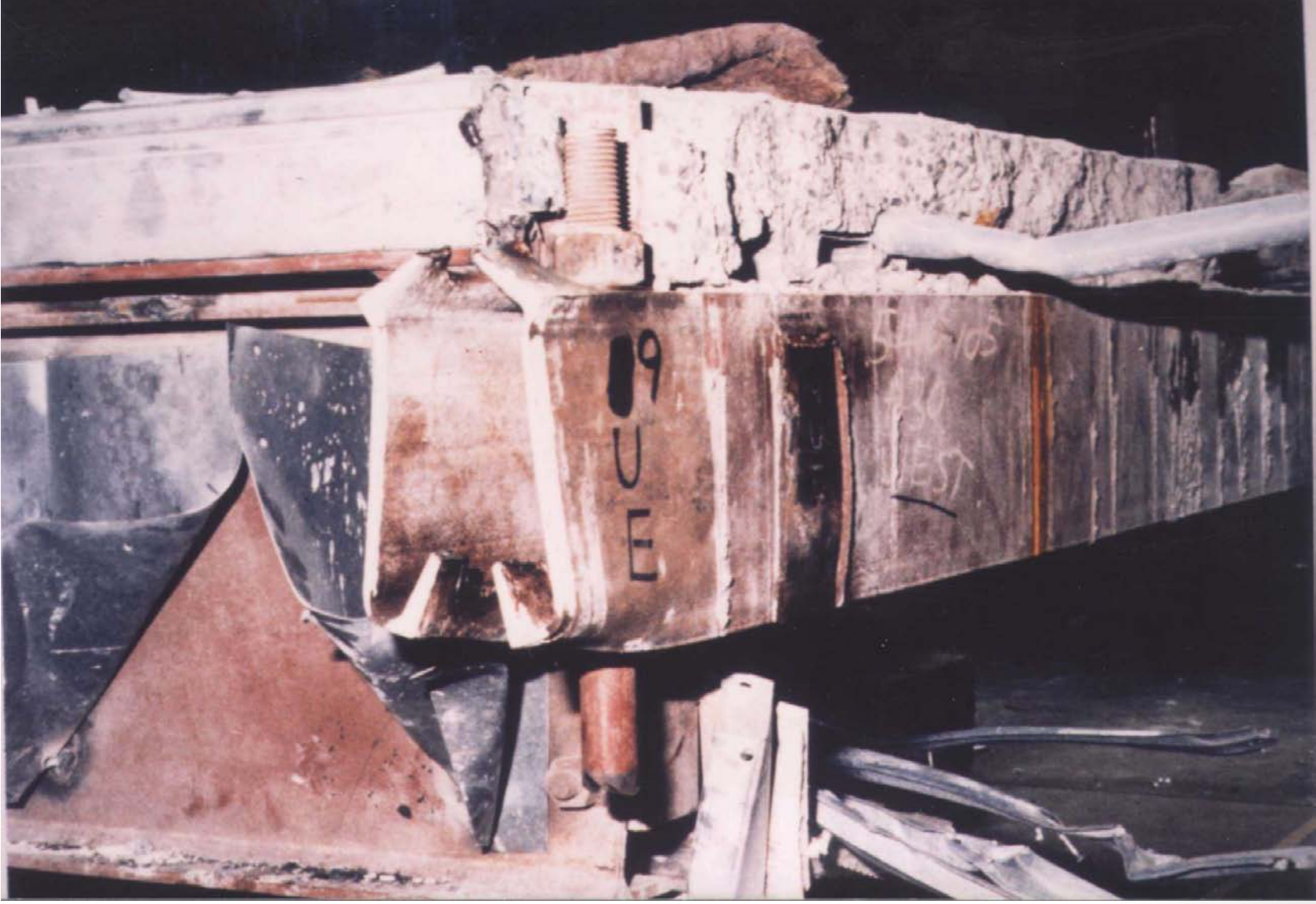
What Happened?

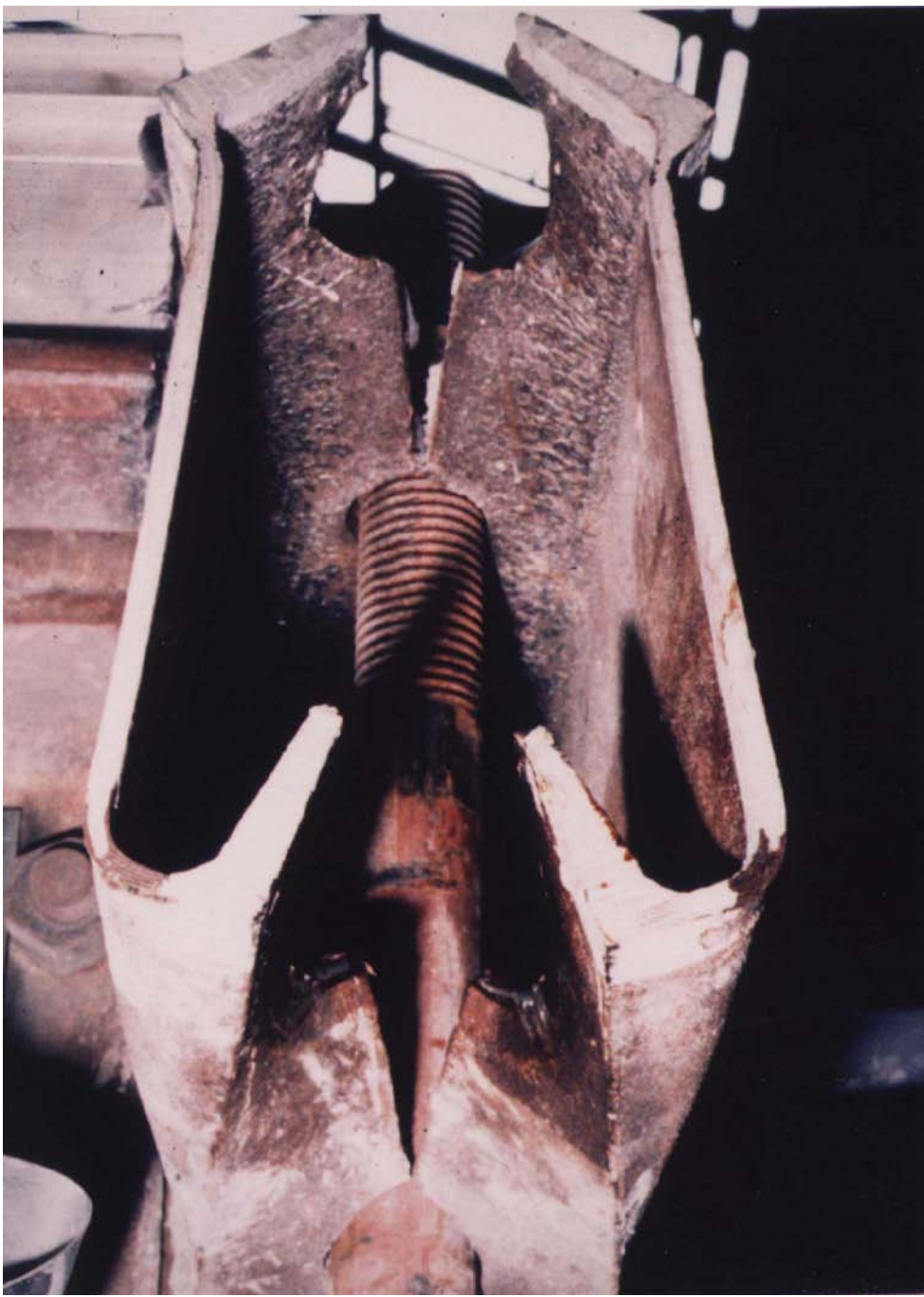
- Three suspended walkways
 - 2nd floor suspended from the fourth
 - 3rd floor off-set
- Probable Cause
 - Load capacity on box beam hanger connections
 - Per accident investigation, the original design was 60% below the Kansas City Building Code
 - Construction change doubled load on connection

Connection Detail

- Box beam / hanger rod connection







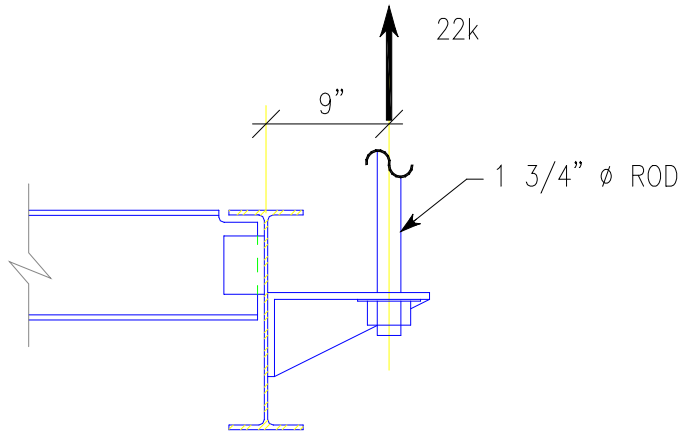
Hyatt Regency Walkway Collapse “A Personal Perspective & Insight”

Presented By:
Jack D. Gillum, P.E.

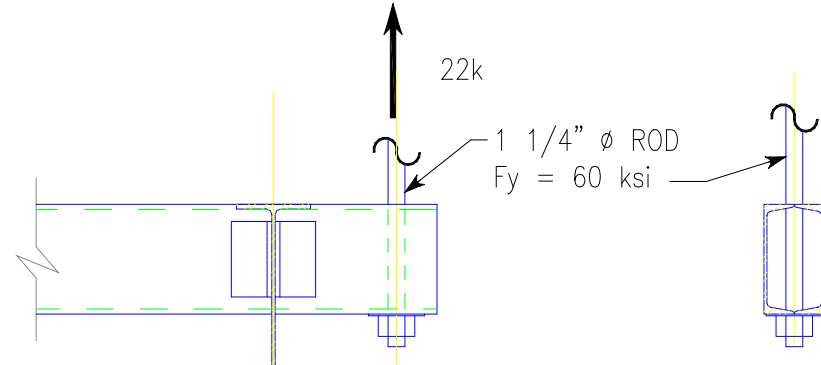
The Team Owner/Design & Construction Team

- OWNER:
Crown Center Redevelopment Corp.
- DESIGN TEAM:
 - ARCHITECTS
 - Patty Berkebile & Nelson
 - Herbert Duncan
 - Monroe - Lefbvre
 - Marshal & Brown
 - STRUCTURAL ENGINEERS:
 - Gillum Colaco
- OTHER TEAM MEMBERS:
 - Concordia Project Management
 - Havens Structural Steel
 - Eldridge & Son Construction
 - General Testing Laboratories

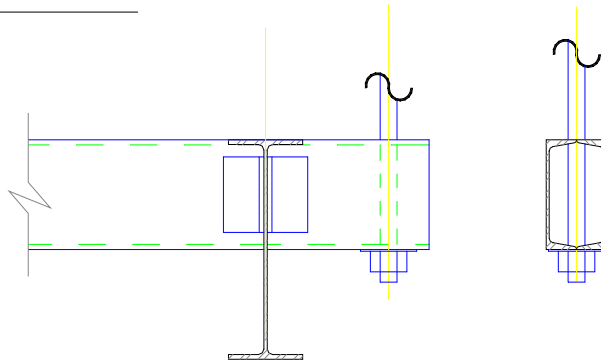
Design Phase – Bridge Connection Evolution



ORIGINAL DETAIL



REVISED DETAIL
(ENGINEER'S SKETCH)



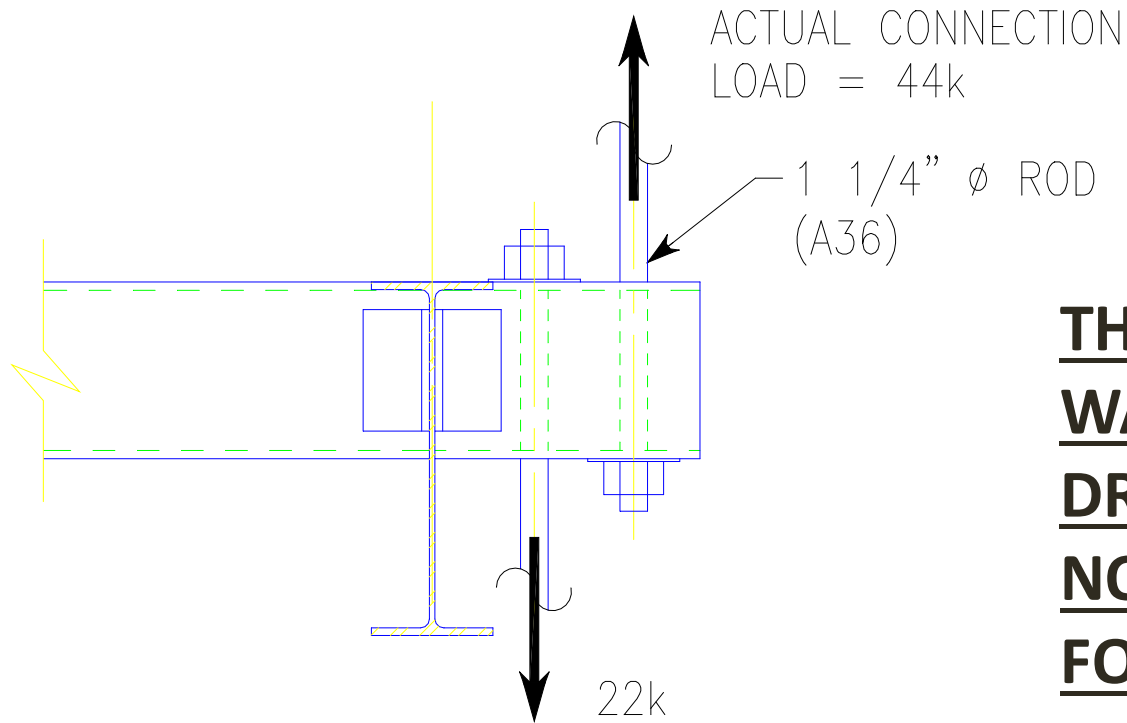
REVISED DETAIL
(AS TRANSCRIBED BY DRAFTSMAN)

- No rod size
- No reaction
- No rod strength

Jack Gillum's Perspective

- 1st Walkway connection detail shows eccentric hanger to angle on the side of W16 stringers
- Mid 1978: Architect request rods supporting bridges be changed from 1 3/4" to 1 1/4". Plans are revised to 2-MC 8 channels in lieu of W8x10.
- Engineers Revised sketch of detail shows single rod w/ $F_y=60$ centered on 2 channels placed toe to toe with axial load of 22k
- August 1978 Draftsman transfer sketch to final drawings leaving off the yield strength of the rod and axial load.

Connection As Built



AS BUILT

THIS CONNECTION
WAS NEVER
DRAWN
NOR SUBMITTED
FOR APPROVAL

Jack Gillum's Perspective

- These changes are typical to the shortcomings of a Fast Track project. When one considers that the construction and final design and details for the tower, under construction, as well as the revolving restaurant were also being finalized. One must appreciate the project intensity and project environment which was fundamental to understanding the human aspects that led to the failure.
- In August of 1978, the drawings and specifications were issued for Construction. Already a significant amount of the construction was in place.

Warning Signs!!!

Never Transmitted to Engineer

- Walkway deflection of 3/4" observed by workman who notified architect's site representative seven weeks B4 July 80 opening.
No Follow Up
- General Contractor's attorney reported : *"....from date of full dead load loading of 4th and 2nd floor bridges (July 1, 1980), box beams began to distort and distortions were visible to naked eye."*

Warning Signs!!!

Never Transmitted to Engineer

- Handrail Deflection noted on punch list of 130 items (Aug, 1980)
- Feb 1981 Box Beam Deformations noticed by dry wall installer. (*No one notified*)

Jack Gillum's Perspective

- **Design shown on Engr's Dwg?** Yes, but normally not done.
- **Fabricator Design Connection?** Absolutely - but He said that it was designed. During the Administrative Hearing, We maintained steadfastly that connection shown on the drawings was concept only. Experts such as Lev Zetlin, Walter Moore, Kenneth Balk of St. Louis and John Tanner of Dallas concurred.
In my opinion, to consider the double rod connection that failed as well as the concept shown on the contract drawings a "designed connection" is ludicrous.
- **Disclaimer on Engr's Dwg?** Yes ! Particularly in Missouri.
- **We requested of the owner that we provide full time inspection on three separate occasions but were turned down. This surprised me because when I designed the Westin Crown Center for Crown Center, I was retained to provide full time inspection for the complete project**

From the NBS Report

- As indicated by their stamps, these shop drawings were reviewed by the contractor, structural engineer and architect.



What Should Have Occurred?

- Single Rod Concept detail on engineer's drawing noted as conceptual only
- Fabricator design connection
- Picked up during shop drawing check as not designed
- After atrium collapse picked up during design re-check which should have been a thorough design document check

Jack Gillum's Lessons Learned

- Procedures must be implemented that assure that all connections are designed by a competent professional
- Peer reviews and design checks should include a review of shop drawings

Jack Gillum's Lessons Learned

- When questions come up look at surrounding issues for related problems
- EOR should be retained to provide full inspection during construction of structure
- Owner needs on-site qualified representation



Jack Gillum's Lessons Learned

- ALL MEMBERS OF THE DESIGN TEAM ARE RESPONSIBLE FOR WHAT THEY DO!
 - Take the time to check your own work!
 - DON'T ASSUME SOMEONE ELSE WILL!
- Continuing Maintenance and inspections by OWNER !
- Final Responsibility? **The Engineer of Record!!**

ASCE: “Quality in the Constructed Project”, 2000 (*After 20 years*)

PP 17.3.2: Shop Drawings for Structural Components

Connections designed by Fabricator to tailor to fabrication methods

EOR has authority & responsibility for overall Design of Project

Fabricator responsible for connections & details



Consulting Engineer, Norman Scott recently wrote:

“Responsibility issues in construction, as in most endeavors, can be effectively resolved by adhering to the principle that responsibility and authority must be exactly linked.”

The corollary principle is that everyone must be responsible for his or her own work and decisions