

A black and white photograph of a construction worker wearing a hard hat and safety vest, using a level on a wall. The worker is positioned on the left side of the frame, looking towards the right. The background shows a concrete wall with a grid pattern. The overall tone is professional and industrial.

Engineering Ethics: Keeping Bridges from Falling Down

Graham Bettis, P.E.

Vice President



RAW DATA. REFINED RESULTS.

Let's Talk Core Function

- As transportation professionals we have a great many responsibilities when it comes to ensuring public safety.
- As bridge engineers we have specific duties when it comes to safety, especially when it comes to existing bridges. Evaluating existing structures can often be more complex (and risky) than designing new ones.
- But what would you say our most important responsibility is?

Let's Talk Core Function

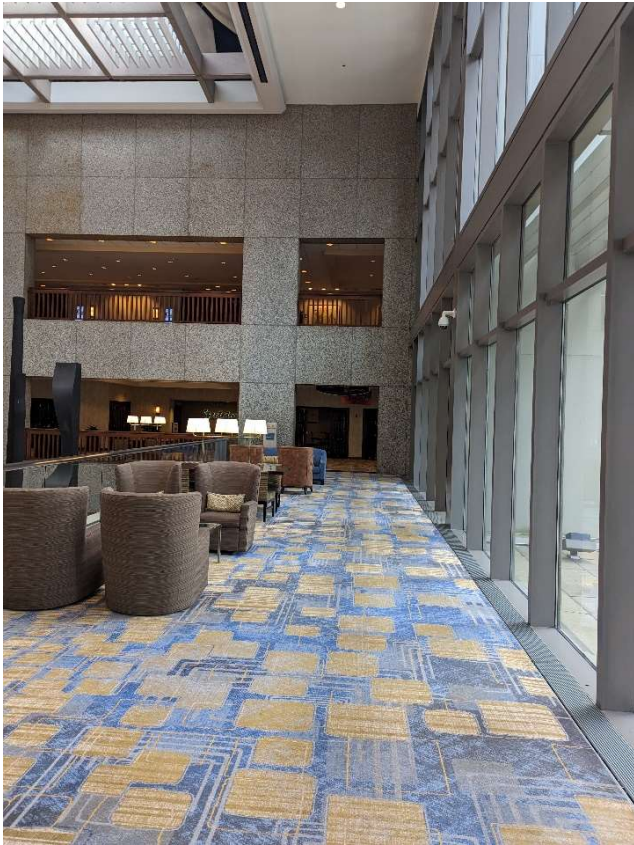
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KEEPING BRIDGES FROM FALLING DOWN!

Bridge Safety

- We have a very real responsibility to ensure safety of the traveling public, and those of us in this room are frequently the first, middle, and **especially** the last line of defense when it comes to preventing catastrophe.
- We must work to keep things from going wrong but also be prepared to act on those occasions when they do.
- It is extremely important that we be willing to discuss the mistakes, not just the successes. There are some sensitive topics covered here, and not everyone will agree with the conclusions. Crucial, though, that we be willing to have these discussions so we can learn from them.

Example No. 1



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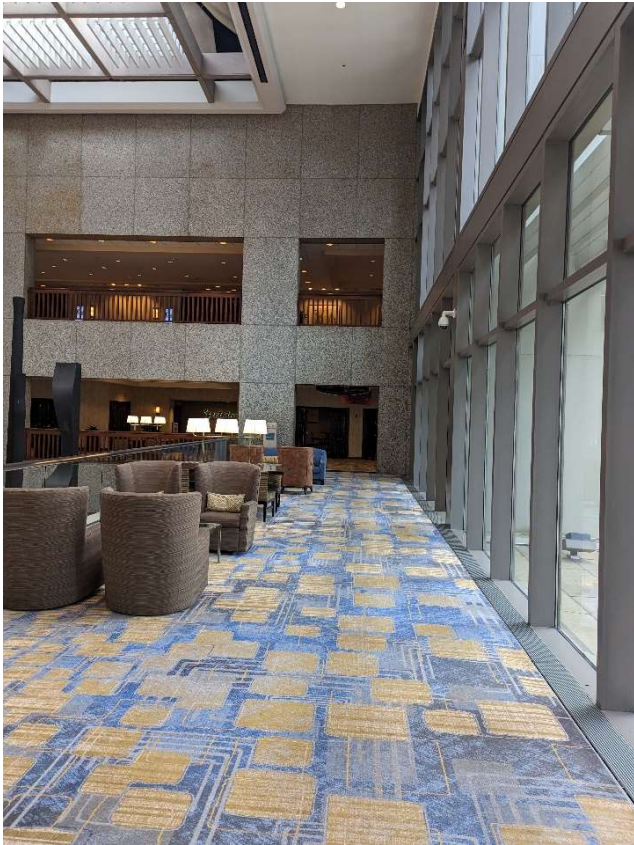


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Example No. 1



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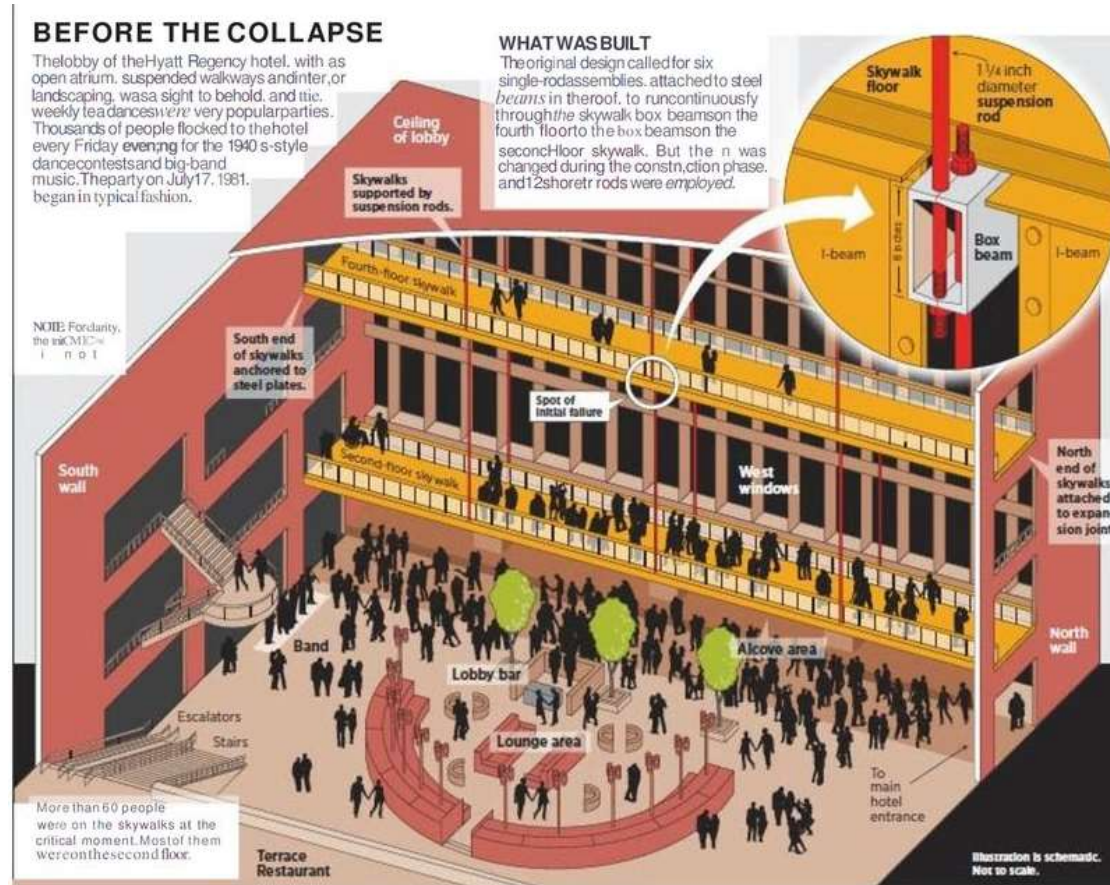
Engineering Ethics – Keeping Bridges from Falling Down

Hyatt Regency Walkway Collapse

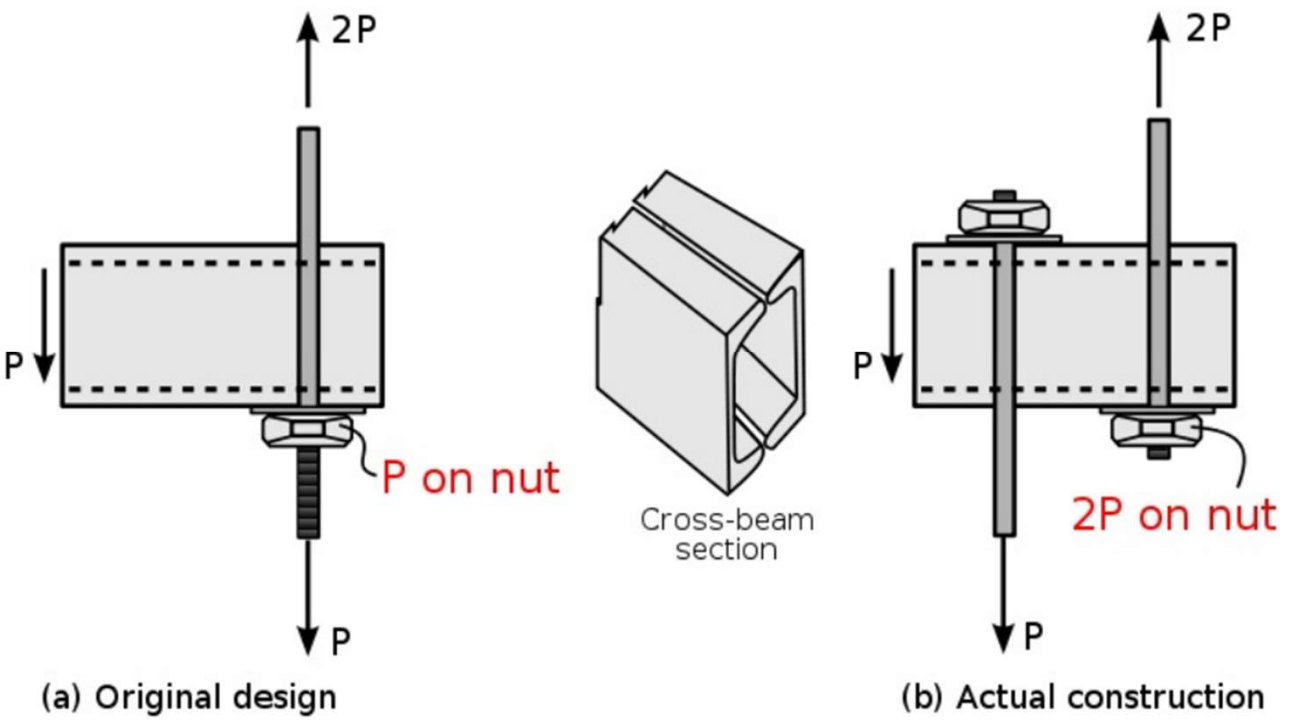
- On July 17, 1981 two overhead walkways collapsed at the Kansas City Hyatt Regency during a party, killing 114 and injuring another 216.
- Deadliest structural failure in United States history. What happened?



Hyatt Regency Walkway Collapse

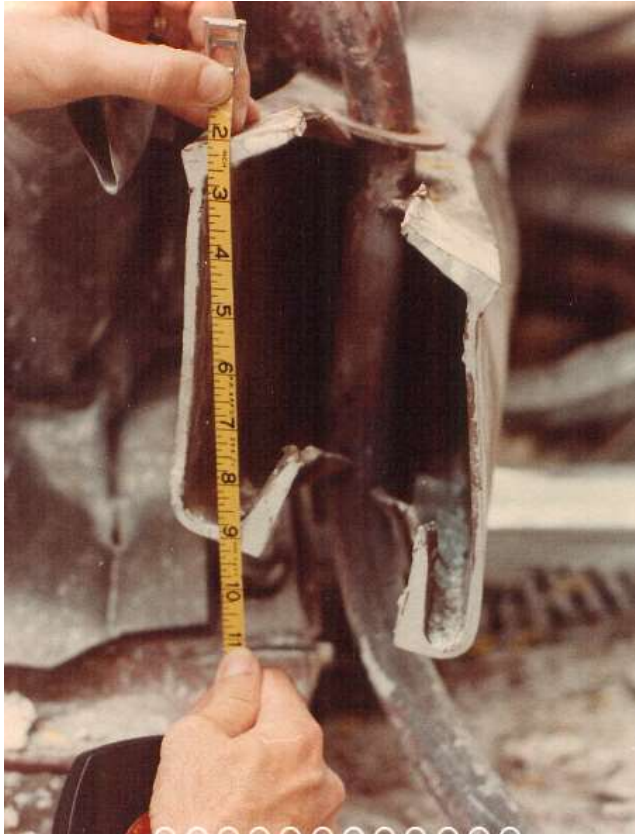


Hyatt Regency Walkway Collapse



- Load was doubled on an already under-designed connection detail.
- Change proposed by fabricator and contractor.
- Acceptance given by designer as part of review of large submittal package.

Hyatt Regency Walkway Collapse

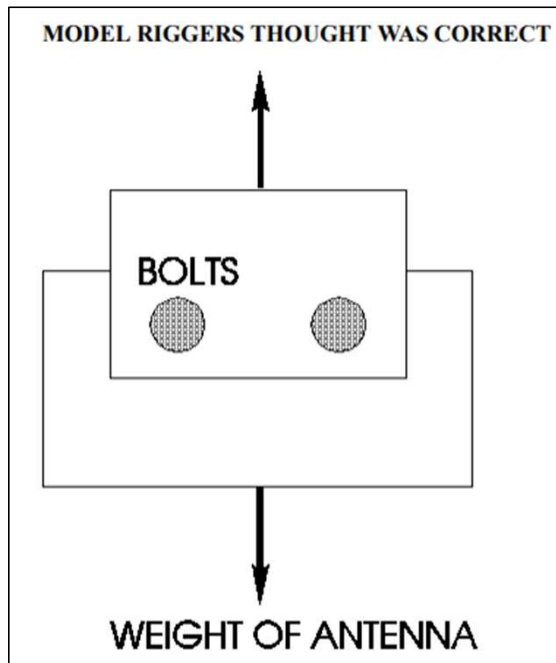


Example No. 2: Liability vs. Ethical Responsibility

- In November 1982, an 1,800 ft TV antennae tower collapsed during construction in Missouri City, Texas, killing five workers.
- Contractor asked Engineer to assist with design of hoist lug and bolts for the antennae but was denied, citing Means and Methods.
- Contractor did not have an engineer on staff but developed a design anyway to stay on schedule. Requested that Design Engineer review but was again denied, this time citing legal liability.

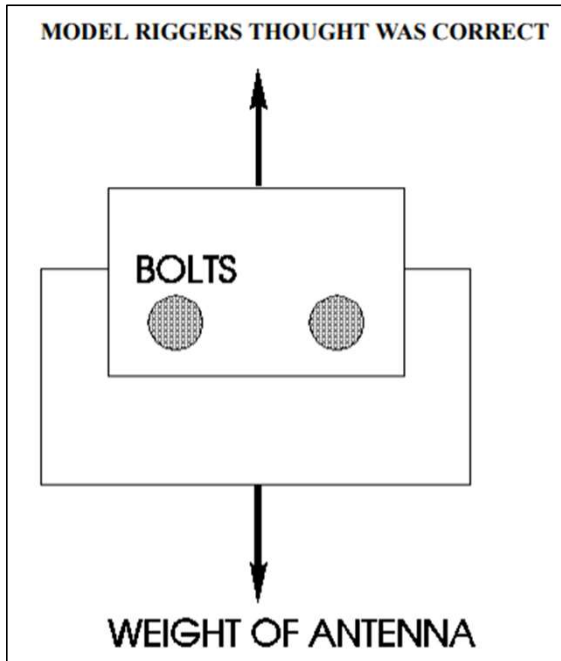
Legal Liability vs. Ethical Responsibility

- Contractor designed a connection based on the lug used to lift the antennae from the truck, which involved vertical forces only.

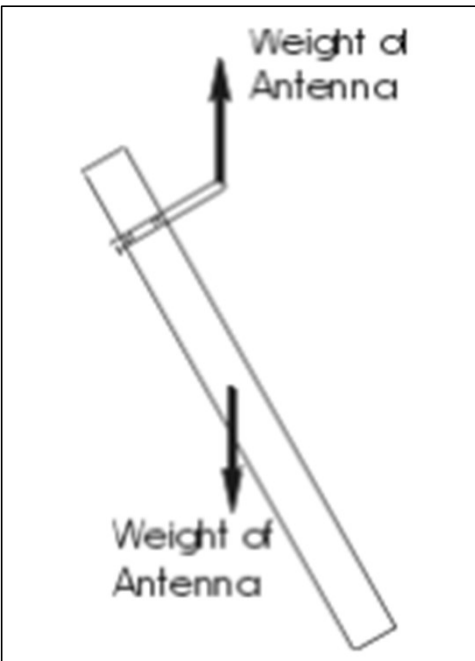


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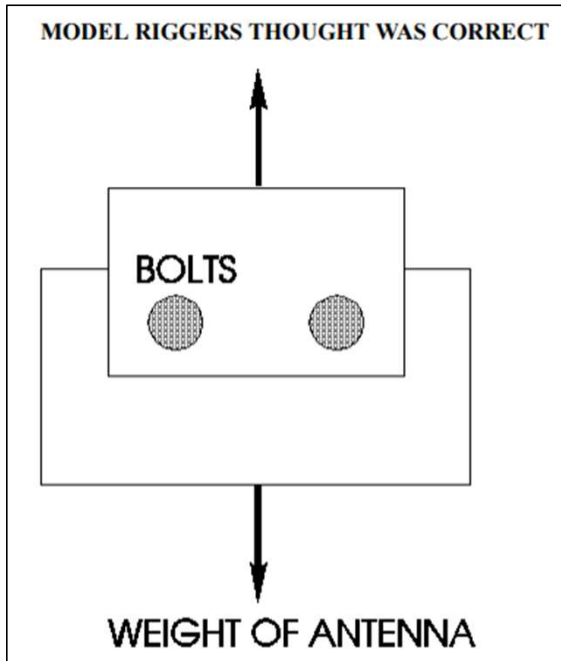


While the unloading from the truck was vertical, the lift to the top of the tower was far from it. Induced moment resulted in stresses 7x what they assumed.



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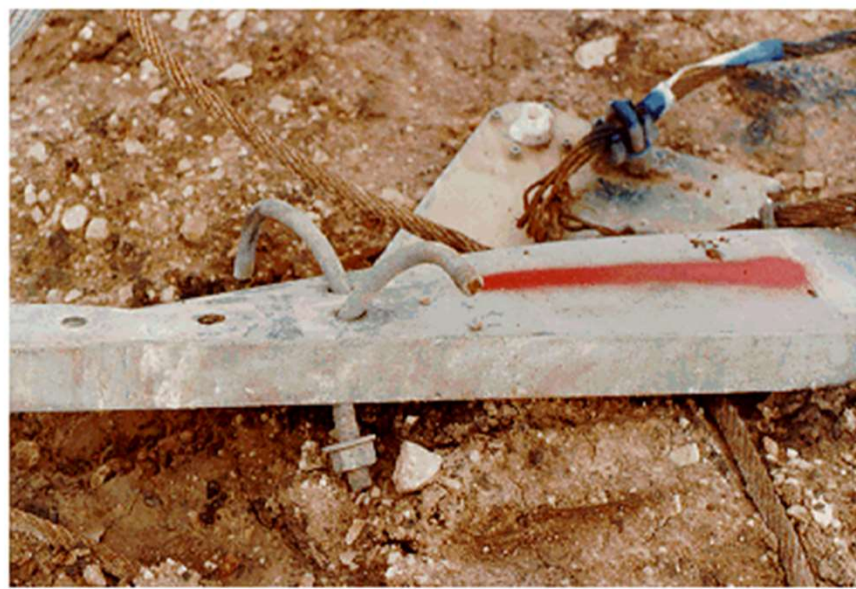
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Legal Liability vs. Ethical Responsibility

- There was a local TV news station present, and they captured photo and video of the collapse as it occurred.

Close-up of Failed U-bolts:

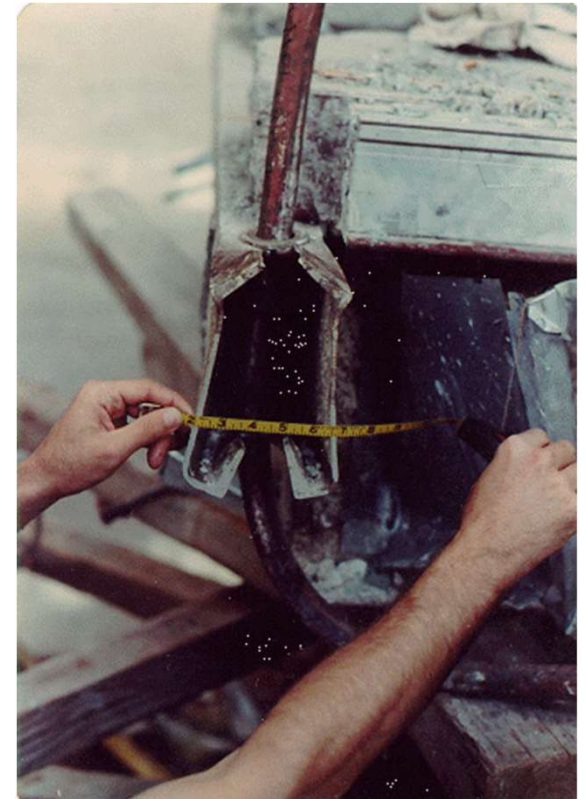


General View:



Common Feature

- Worth noting that both collapses occurred due to failures in very small connections.
- Small details matter, especially at connections.
- We must always think not only in terms of safety factors, but also in redundancy.



Engineering Ethics Case Studies

- Previous examples outlined in far more detail on Texas A&M Civil Engineering Ethics Site.
- Best source I have found for real-world examples of engineering ethical dilemmas.

CIVIL ENGINEERING ETHICS SITE

Home 1992 NSF Case Report 1995 NSF Workshop Collected Case Studies Collected Essays Collected Links References Guest Contributions Conferences

COLLECTED CASE STUDIES

- TV Antenna Collapse
- Failure of a Stacking Hoist
- Aberdeen
- Anhydrous Ammonia Hose Failure
- ASME vs. Hydrolevel
- Challenger Shuttle
- Gift Giving
- Gilbane Gold
- Goodrich
- Hyatt Regency Walkway Collapse (Photos)
- Mexican Plow
- Trench Failure

Menu

- Home
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- NSF Workshop
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- Hyatt Regency Photos

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The screenshot displays the Texas A&M Civil Engineering Ethics Site. The header includes the Texas A&M logo and the site title "CIVIL ENGINEERING ETHICS SITE". A navigation menu contains links for Home, 1992 NSF Case Report, 1995 NSF Workshop, Collected Case Studies, Collected Essays, Collected Links, References, Guest Contributions, and Conferences. The main content area is titled "COLLECTED CASE STUDIES" and lists various case studies. Two items are highlighted with red boxes: "TV Antenna Collapse" and "Hyatt Regency Walkway Collapse (Photos)". A "Menu" section on the right lists links to Home, NSF Report, NSF Workshop, Case Studies, Essays, Links, References, Guest Contributions, Conferences, and Hyatt Regency Photos.

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Something Missing?



Redundancy



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Minneapolis IH 35 Mississippi River Bridge



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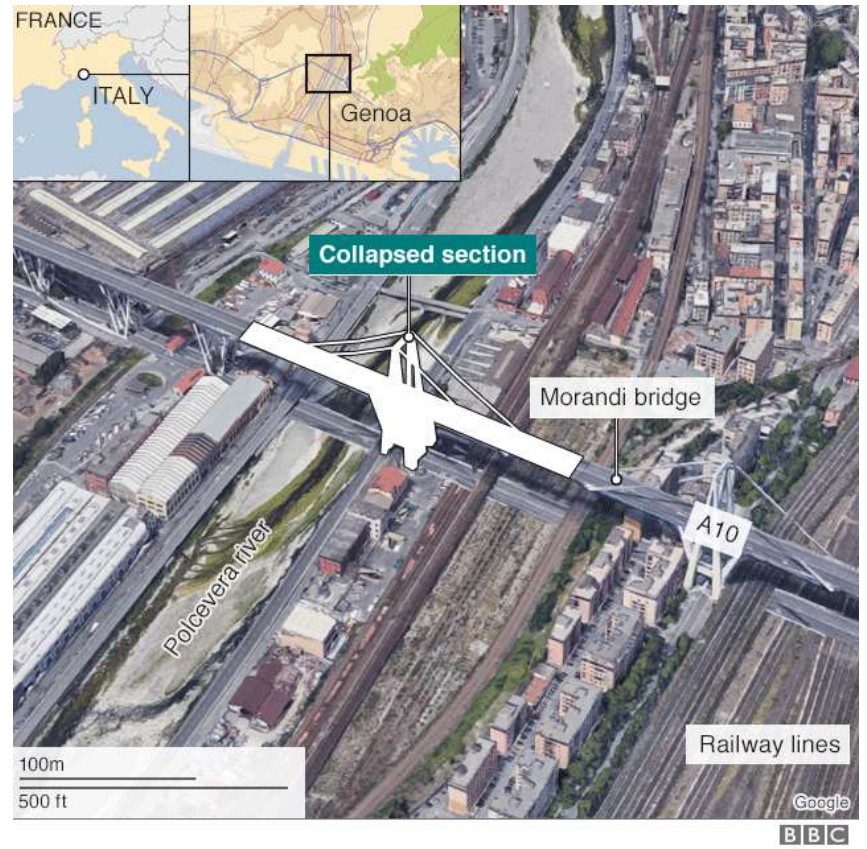


Collapse occurred due to gusset plate design issue combined with storage of heavy construction material as part of 2007 rehab.

Purdue Steel Bridge Research, Inspection, Training, and Engineering Center (S-BRITE)

Genoa Bridge Collapse in Italy

- Constructed between 1963 and 1967.
- Severe corrosion and section loss identified in 1990's.
- Collapsed during rain storm in August 2018, killing 43 people.
- What caused it? Good question.
We have to be willing to have tough conversations!



Genoa Bridge Collapse in Italy



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Genoa Bridge Collapse in Italy



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What did those last two examples have in common?

- Each of those failures had specific reasons for collapse, but there was one common element...
- Most structures tend to perform pretty well until we start screwing with them.

West Texas Pan Girder Bridge Collapse



Sudden collapse occurred during demolition activities.

Fern Hollow Bridge in Pittsburgh



Fern Hollow Bridge in Pittsburgh



Fern Hollow Bridge in Pittsburgh




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Engineering Ethics – Keeping Bridges from Falling Down

Fern Hollow – Lessons Learned

- Again, we must be willing to learn from these incidents.
- Great response from PennDOT and the City of Pittsburgh to NTSB findings.
- Rather than dodging the issue, they are making quick and substantive changes that could serve as a model all over the country.



TRB
104th ANNUAL MEETING
January 5–9, 2025 • Washington, DC



AGENDA
Bridge Preservation Committee Meeting (AKT60)
Tuesday – January 7, 2025
8:00am to 12:00pm EST
Marquis Salon 1 (M2), Marriott Marquis

Time	#	Topic	Total Presentation Time	Presented By
8:00 am	1	Welcome, Introductions and Announcements	5	Michael Brown, Chair
8:05 am	2	TRB Committee Liaison Report *Floating Item - Timing depends upon when TRB Liaison and Section Chair arrive.	10	Ilna Kastenhofer and Judith Corley-Lay
8:15 am	3	FHWA BPETG Update	10	Richard Dunne
8:25 am	4	FHWA Long-Term Infrastructure Program Update	10	Rob Zobel
8:35 am	5	FHWA NDE/SM Update	10	Hoda Azari
8:45 am	6	AASHTO BPTC Update	10	Jim Nelson
8:55 am	7	Bridge Preservation TSP Update	10	Nancy Huether
9:05 am	8	NDE Workshop Debrief	5	M. Brown/ Committee
9:10 am	9	City of Pittsburgh Bridge Management	20	Lou Ruzzi and Eric Setzler
9:30 am	10	General Wall-Climbing Robot for Bridge Inspection Using Multiple Sensors	20	Jizhong Xiao

Accident Aftermath

- If not already reviewing NTSB reports as they are published, consider making that a habit.



Hernando de Soto Bridge



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Hernando de Soto Bridge – May 11, 2021



- Fracture discovered and reported by consultant inspector.
- Inspecting truss and cable elements, NOT the tie beam.
- Why that matters...

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Back to West Texas



NOTE: Severe accumulation of gravel and dirt on top of caps at Bents 2 and 3 has caused moderate to severe flaking rust on steel I-beams at bearing areas.

2017 Routine Safety Inspection

2019 Routine Safety Inspection



NOTE: Moderate to severe flaking rust on steel I-beams, near bearing areas. (Estimate section loss at 20%)

Back to West Texas



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2017 Routine Safety Inspection

Estimated how???



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2019 Routine Safety Inspection

Before and After Cleaning in 2021



Back to West Texas

Emergency bridge closure on May 11, 2021



Back to West Texas

Emergency bridge closure on May 11, 2021



Back to West Texas

Emergency bridge closure on **May 11, 2021**

- Over a decade of inspection reports outlining this issue.
- TxDOT used this as an example for in-house and consultant inspectors.
- Bridges typically tell us when they aren't feeling well. We have to listen!



Closing Thoughts

- Remember that the buck stops with us. We are the transportation and bridge experts, and we are the ones responsible for preventing catastrophe from happening!

