

# Normalization of Deviance

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# Learning Objectives and Topics

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## Learning Objective:

Stretch your Professional Development beyond “pure engineering”

## Topics:

- Normalization of Deviance
- Professional Responsibility
- Doing the Right Thing

## Main References:

*The Challenger Launch Decision*  
by Diane Vaughan  
(Purchase on your own)

# Lessons from NASA (And a few others)

- **Great engineering organization**
- **Long and rich history**
- **A culture of excellence**



# Why you?





# February 1, 2003

What tragic event happened on this date?

Space Shuttle Columbia broke up over Texas during reentry



All seven crew members perished

# February 1, 2003

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**What happened?**

**Foam hitting the orbiter during launch was the physical reason for the failure happened during launch.**

**But WHY did this happen?**

**Normalization of Deviance**

# NASA

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Need to rewind NASA's history to understand

NASA was created in 1958.

Early spectacular rocket failures.



# May 5, 1961

## What happened this day?



**Alan Shepard took the first suborbital flight  
by an American**



# May 5, 1961

## What happened this day?



# July 21, 1961

## What happened this day?



**Astronaut Gus Grissom  
successfully flew a similar  
suborbital mission**



# July 21, 1961



# February 20, 1962






**John Glenn was the First  
American to Orbit the Earth**




# A string of 13 successful manned missions after Atlas 6

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1962






-  [Mercury Atlas 6](#) - 20 February 1962 - Earth Orbiter (Glenn)
-  [Mercury Atlas 7](#) - 24 May 1962 - Earth Orbiter (Carpenter)
-  [Mercury Atlas 8](#) - 3 October 1962 - Earth Orbiter (Schirra)

1963






-  [Mercury Atlas 9](#) - 15 May 1963 - Earth Orbiter (Cooper)

1964

1965

-  [Gemini 3](#) - 23 March 1965 - Earth Orbiter (Grissom, Young)
-  [Gemini 4](#) - 3 June 1965 - Earth Orbiter (McDivitt, White)
-  [Gemini 5](#) - 21 August 1965 - Earth Orbiter (Cooper, Conrad)
-  [Gemini 7](#) - 4 December 1965 - Earth Orbiter (Borman, Lovell)
-  [Gemini 6A](#) - 15 December 1965 - Earth Orbiter (Schirra, Stafford)

1966






-  [Gemini 8](#) - 16 March 1966 - Earth Orbiter (Armstrong, Scott)
-  [Gemini 9A](#) - 3 June 1966 - Earth Orbiter (Stafford, Cernan)
-  [Gemini 10](#) - 18 July 1966 - Earth Orbiter (Young, Collins)
-  [Gemini 11](#) - 12 September 1966 - Earth Orbiter (Conrad, Gordon)
-  [Gemini 12](#) - 11 November 1966 - Earth Orbiter (Lovell, Aldrin)

1967

1968

# A string of 13 successful manned missions after Atlas 6



- 1966
  -  [Gemini 8](#) - 16 March 1966 - Earth Orbiter (Armstrong, Scott)
  -  [Gemini 9A](#) - 3 June 1966 - Earth Orbiter (Stafford, Cernan)
  -  [Gemini 10](#) - 18 July 1966 - Earth Orbiter (Young, Collins)
  -  [Gemini 11](#) - 12 September 1966 - Earth Orbiter (Conrad, Gordon)
  -  [Gemini 12](#) - 11 November 1966 - Earth Orbiter (Lovell, Aldrin)
- 1967
- 1968

**Gemini 8 redefined “Cool”**

# January 27, 1967

## What happened this day?

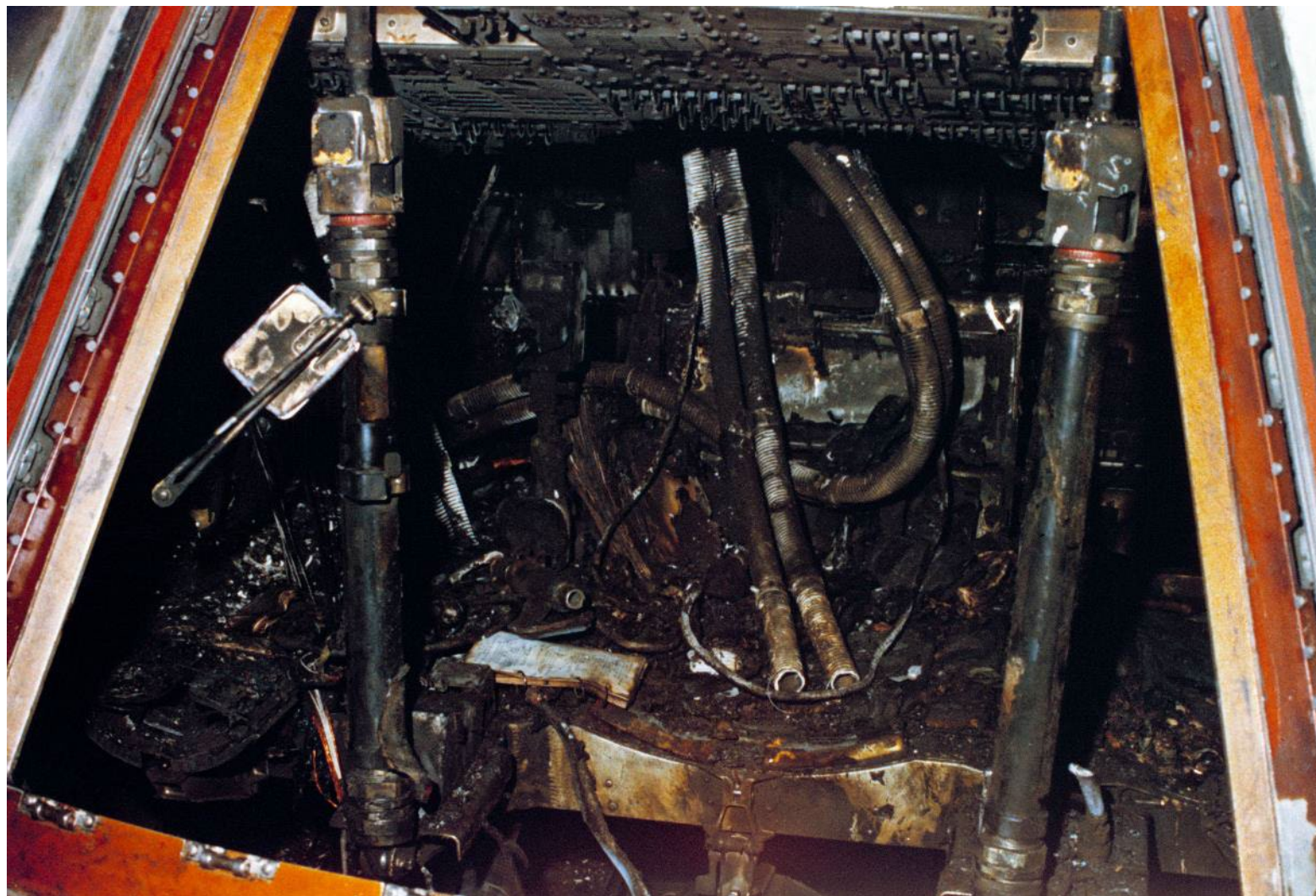


**Gus Grissom, Ed White and Roger Chaffee**



# January 27, 1967

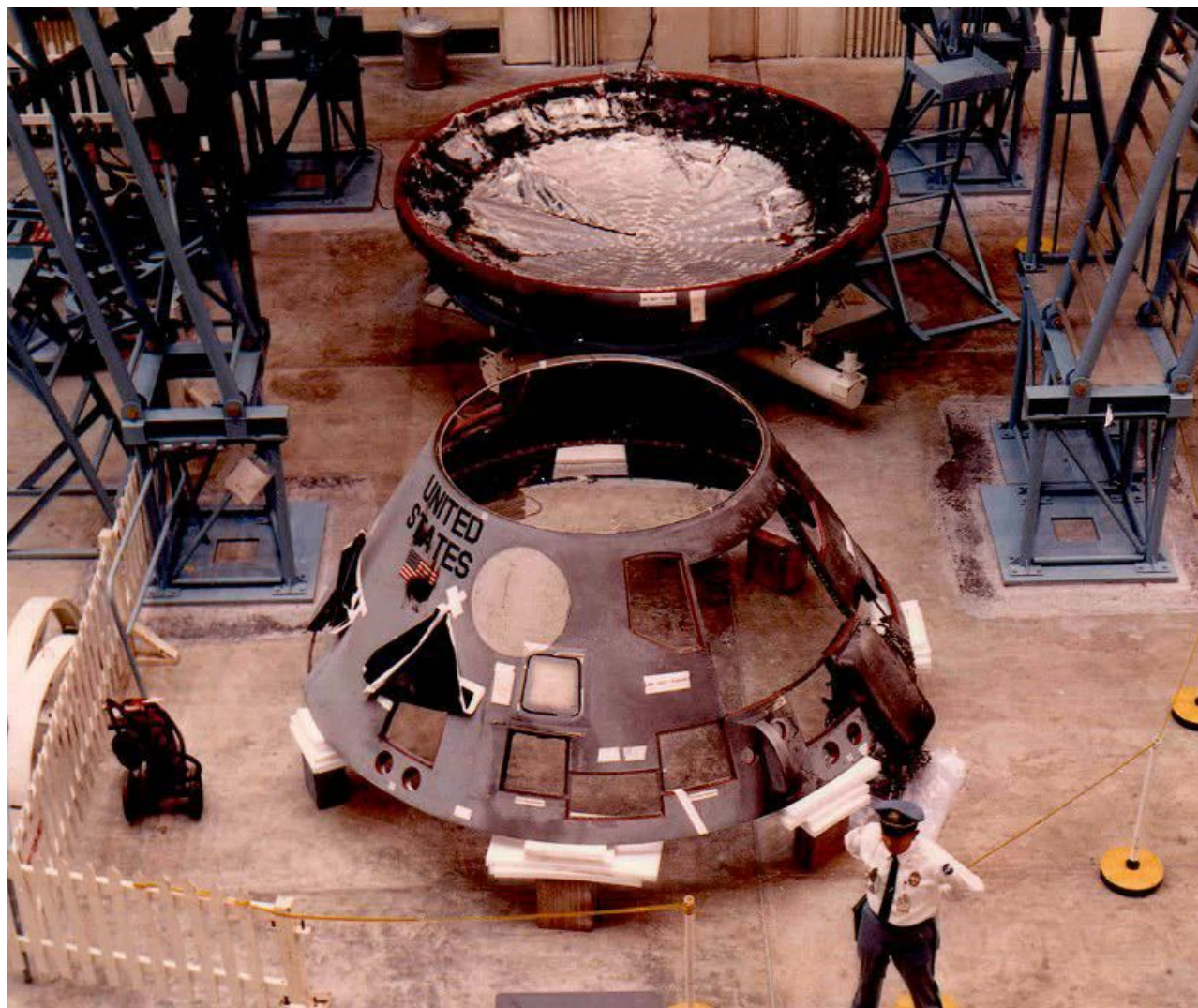
## Fire!





# January 27, 1967

## Apollo 1 capsule is still in storage in Langley, Virginia



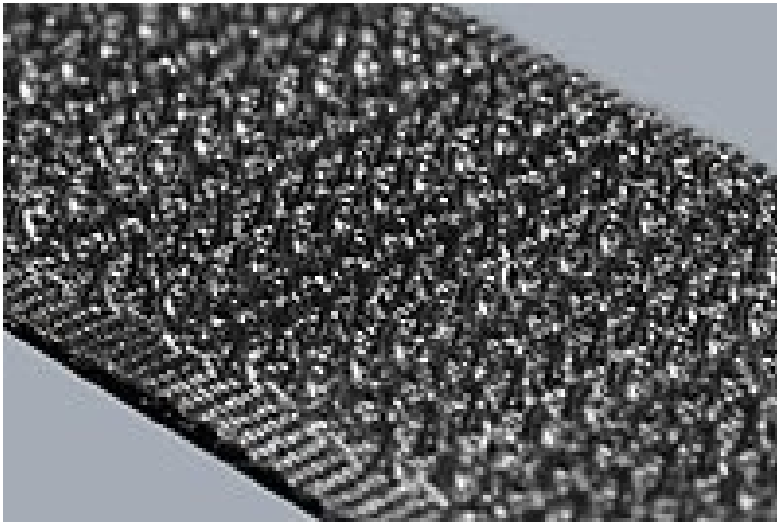
# What happened?

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Prior missions: If it burns it doesn't fly

Rules were relaxed as more and more successful missions were flown.

**“Wall to wall Velcro”**



# Why was this allowed?

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Nothing bad had ever happened.

It became the norm. An informal relaxing of the rules.

“We’ve always done this and it’s ok.”

**This is called: Normalization of Deviance**

# New safety measures were implemented

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- **No further fatal accidents.**
- **Apollo 11 safely landed and returned in July of 1969**
- **Even Apollo 13 made it home**
- **Apollo was followed by the Shuttle Program**





# January 28, 1986



**January 28, 1986**



**January 28, 1986**



# January 28, 1986

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**Was this the first time this had ever happened, that O-rings had failed during launch?**

**In 14 of 24 missions prior to Challenger there was evidence that the O-rings had been burned.**

**O-ring failure was identified after just the second shuttle launch.**

**Failures occurred regardless of low temperatures at launch.**





# January 28, 1986

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**With these known failures why didn't they do something?**

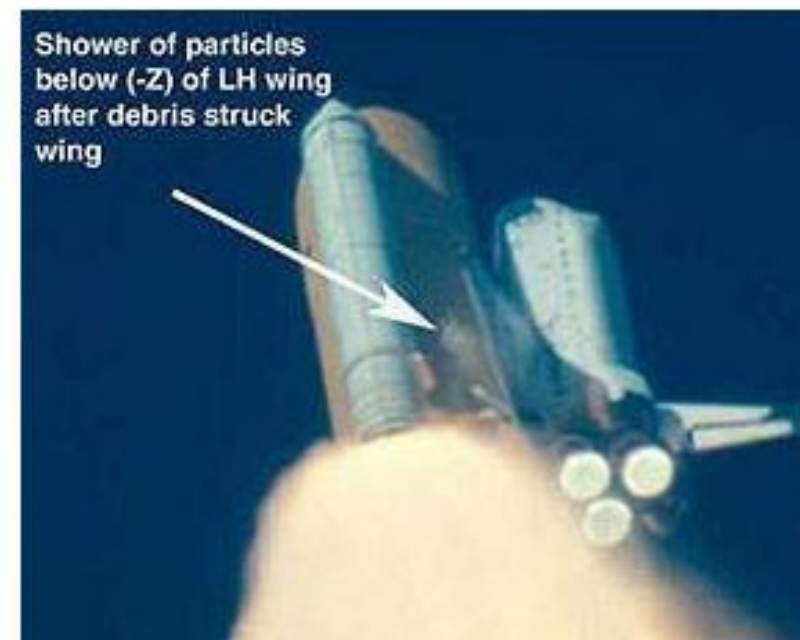
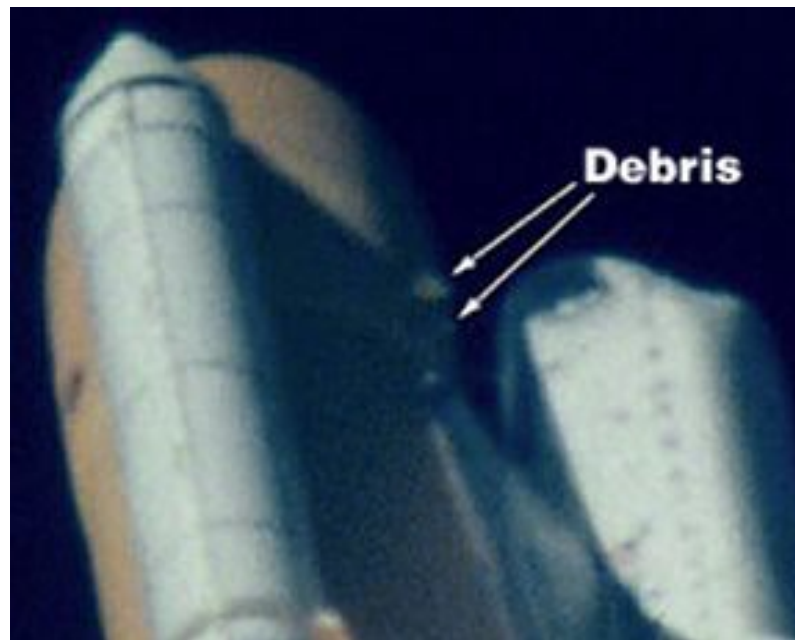
**Because nothing bad had ever happened.**

**Normalization of Deviance dictated that this became more of an annoyance than a problem.**



# February 1, 2003

Back to where we started  
Space Shuttle Columbia broke  
up over Texas during reentry



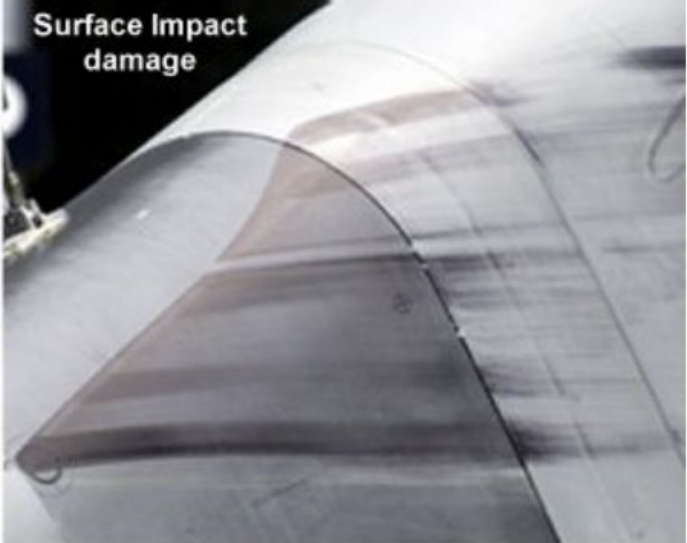
# Original Shuttle Design Requirements

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*3.2.1.2.14 Debris Prevention: The Space Shuttle System, including the ground systems, shall be designed to preclude the shedding of ice and/or other debris from the Shuttle elements during prelaunch and flight operations that would jeopardize the flight crew, vehicle, mission success, or would adversely impact turnaround operations.*

*3.2.1.1.17 External Tank Debris Limits: No debris shall emanate from the critical zone of the External Tank on the launch pad or during ascent except for such material which may result from normal thermal protection system recession due to ascent heating.*

# Foam Testing



Damage done to wing RCC panels during foam impact tests



## Email to Columbia crew

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**We have seen this same phenomenon on several other flights and there is absolutely no concern for entry**

*- Email from Mission Control to the Columbia crew on January 23, 2003.*

# Loss of the vehicle

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**Normalization of  
Deviance Strikes again!**

# Normalization of Deviance

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*“The gradual process through which unacceptable practices and standards become acceptable. As the deviant practice is repeated without catastrophic consequences it becomes the social norm of the organization”*

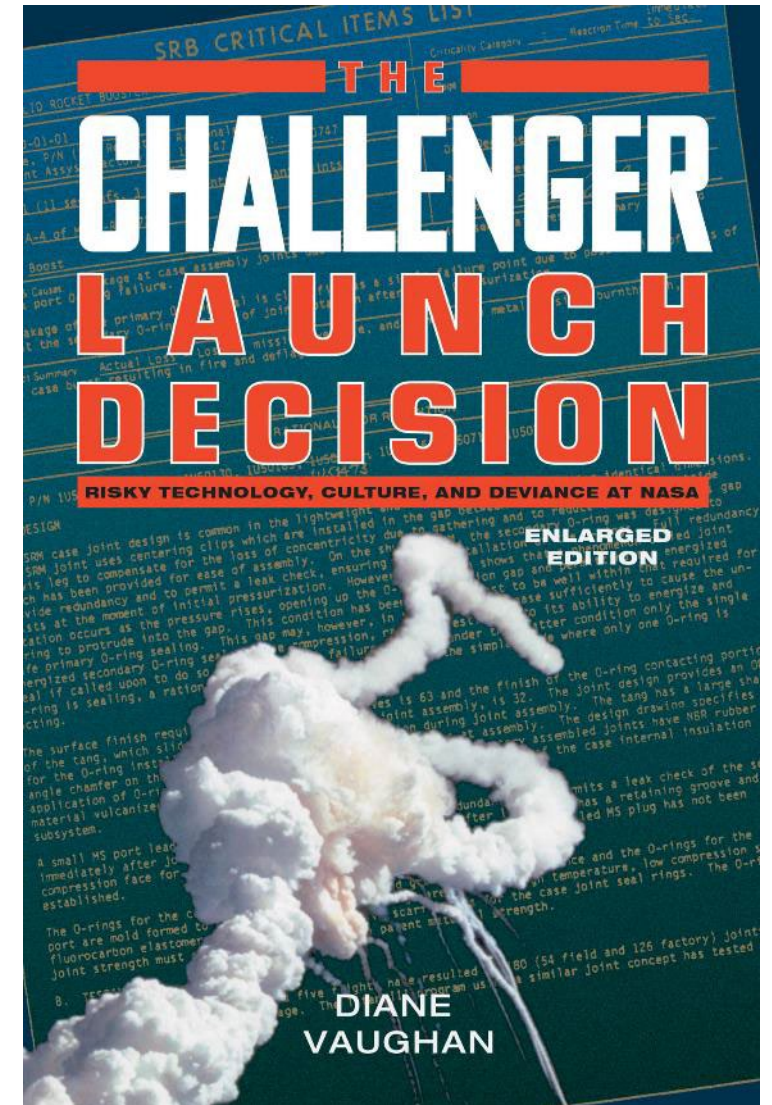
*– coined by American sociologist Diane Vaughan*

# Normalization of Deviance

Further Reading:

*The Challenger Launch Decision*

by Diane Vaughan





# NASA gets it right?

## Boeing Starliner

June 5, 2024, astronauts Suni Williams and Butch Wilmore launched from Cape Canaveral in Florida aboard the Boeing Starliner.

Launch was successful however, five thrusters failed during docking due to what was later identified through ground tests as heat build up. However, they could not replicate the problem in space.

Because NASA could not fully understand why the thrusters malfunctioned, they determined returning the craft with astronauts aboard was too risky.

Starliner, returned uncrewed on September 7<sup>th</sup> without incident.



## Other Examples - Northwest flight 255


On August 16, 1987, a McDonnell Douglas MD-82, operating as Northwest Airlines Flight 255, crashed shortly after takeoff from Detroit Metropolitan Airport, about 8:46 pm EDT (00:46 UTC August 17), resulting in the deaths of all six crew members and 148 of the 149 passengers, along with two people on the ground. The sole survivor was a 4-year-old girl who sustained serious injuries.



# Other Examples - Northwest flight 255

The National Transportation Safety Board determines that the probable cause of the accident was the flight crew's failure to use the taxi checklist to ensure that the flaps and slats were extended for takeoff. **Contributing to the accident was the absence of electrical power to the airplane takeoff warning system**, which thus did not warn the flightcrew that the airplane was not configured properly for takeoff. The reason for the absence of electrical power could not be determined.

PB88-910406



**NATIONAL  
TRANSPORTATION  
SAFETY  
BOARD**

WASHINGTON, D.C. 20594

**AIRCRAFT ACCIDENT REPORT**

NORTHWEST AIRLINES, INC.  
McDONNELL DOUGLAS DC-9-82, N312RC  
DETROIT METROPOLITAN WAYNE COUNTY AIRPORT  
ROMULUS, MICHIGAN  
AUGUST 16, 1987

NTSB/AAR-88-91

The cover features a vertical column of four icons on the left: an airplane, a train, a ship, and a truck. The text is arranged in a structured layout with the title and report details on the right side.



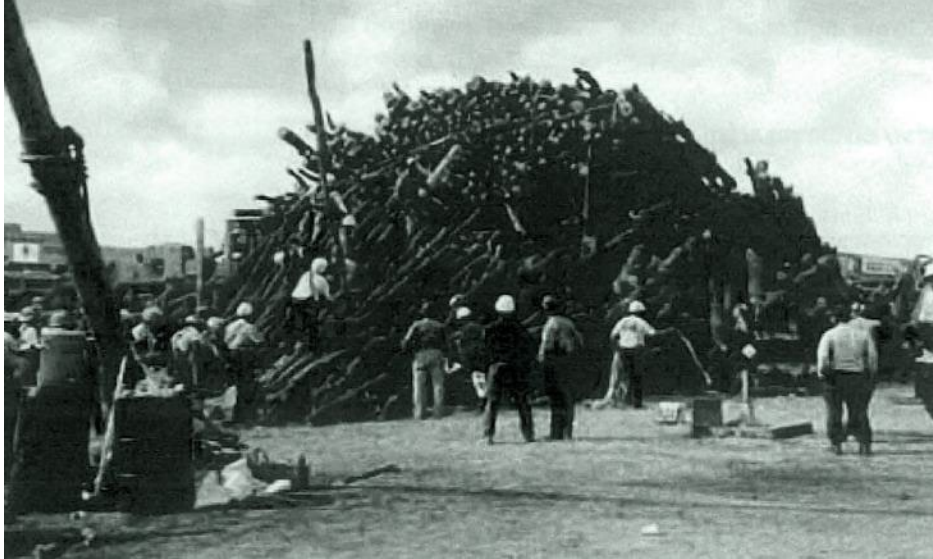
## Other Examples - Northwest Flight 255

The investigators spoke with other MD-80 pilots and learned that many of them found it a nuisance to hear a take-off configuration warning ("Slats ... Slats... Slats...") while they were simply taxiing. It was so common for pilots to pull the P-40 circuit breaker that the area around the circuit breaker was smudged from routinely being manipulated. **This circuit breaker also controls some of the stall warning sounds.**



# Other Examples – Texas A&M Bonfire Collapse

At approximately 2:42 a.m. on November 18, 1999, the annual Aggie Bonfire at Texas A&M University collapsed during its construction, killing 12 people and injuring 27.



Video clip on next page compliments of @fascinatinghorror.  
Don't worry, it's not graphic.

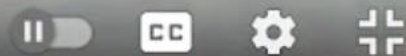


to investigate what went wrong.



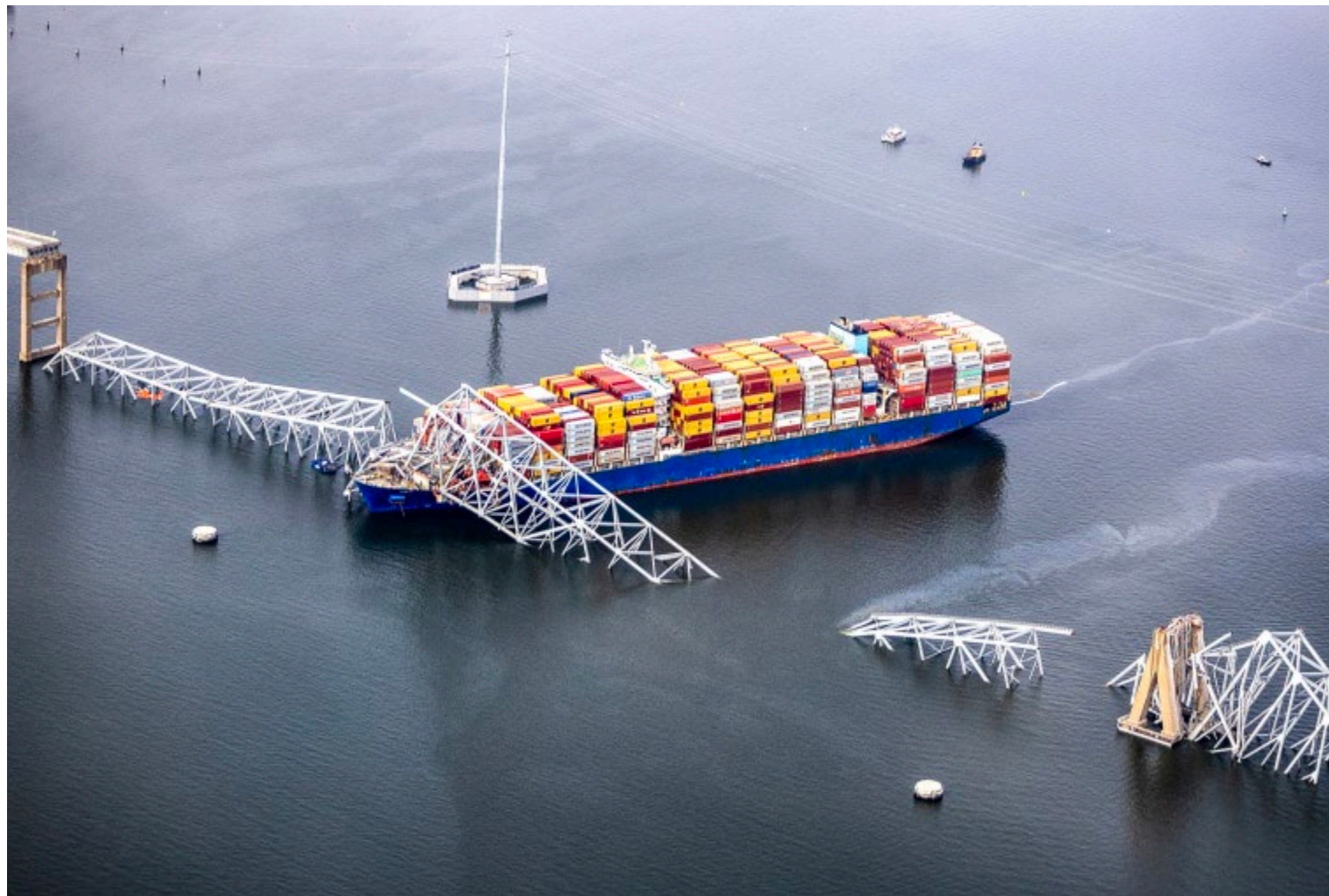
10:55 / 13:01 • The Aftermath >

Scroll for details

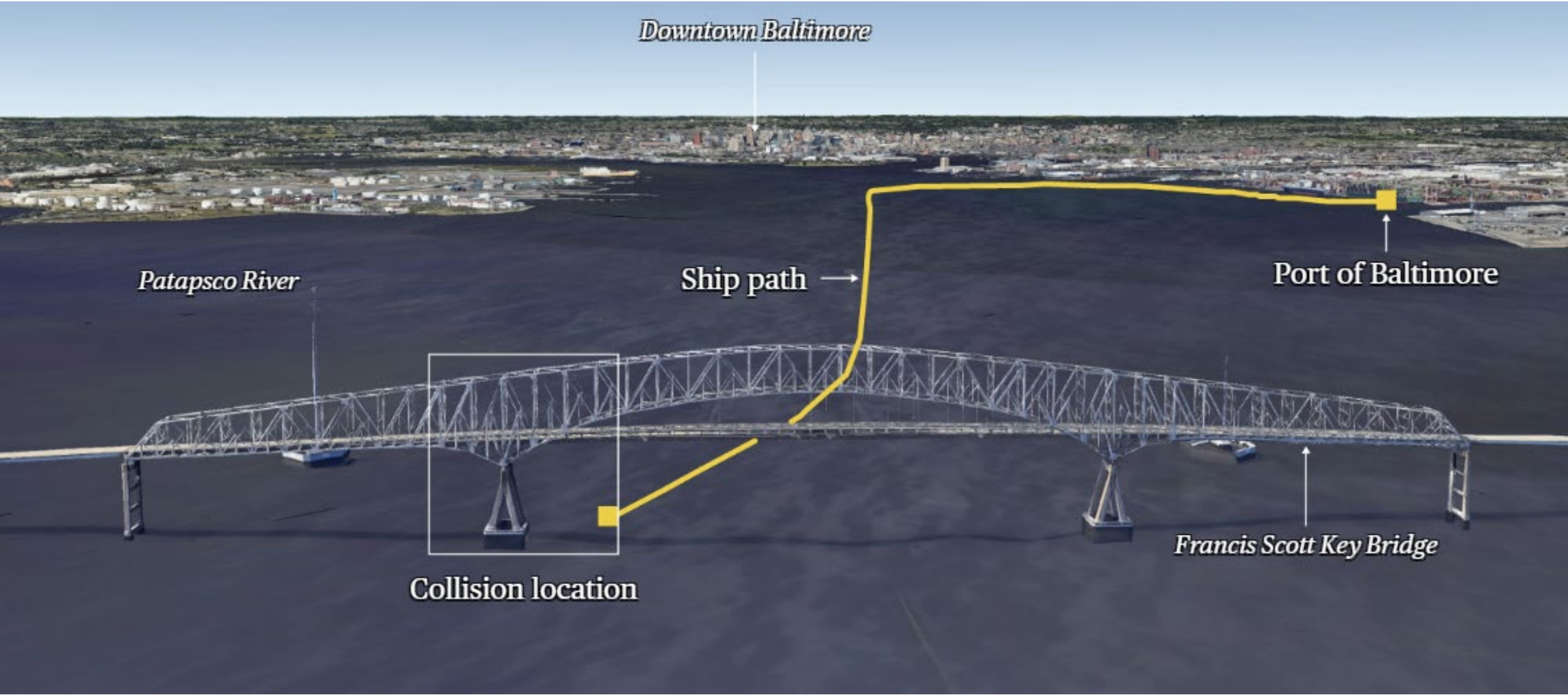




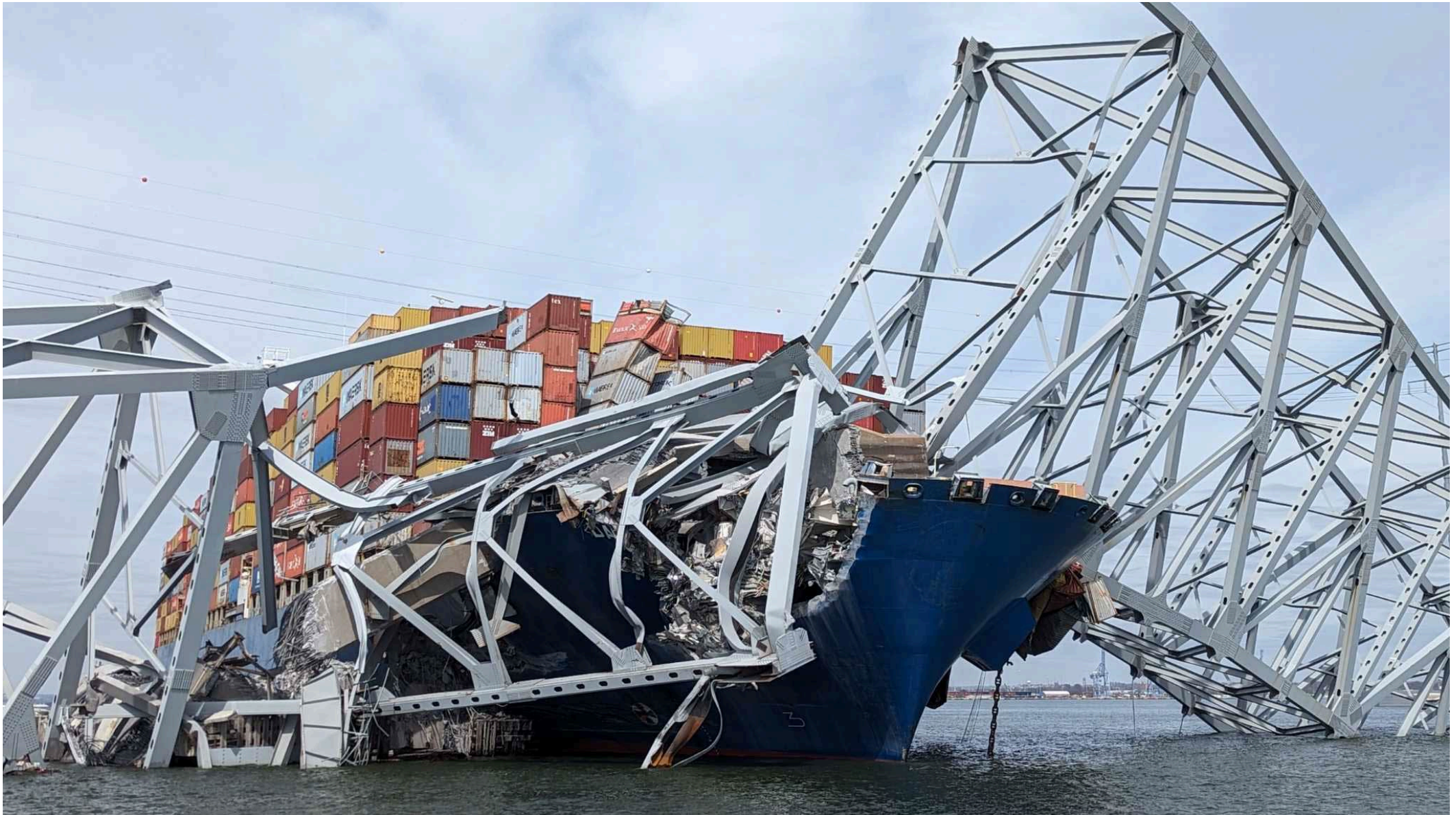
# Francis Scott Key Bridge Collapse



March 26, 2024.







# Does this happen often? Ships with no power?

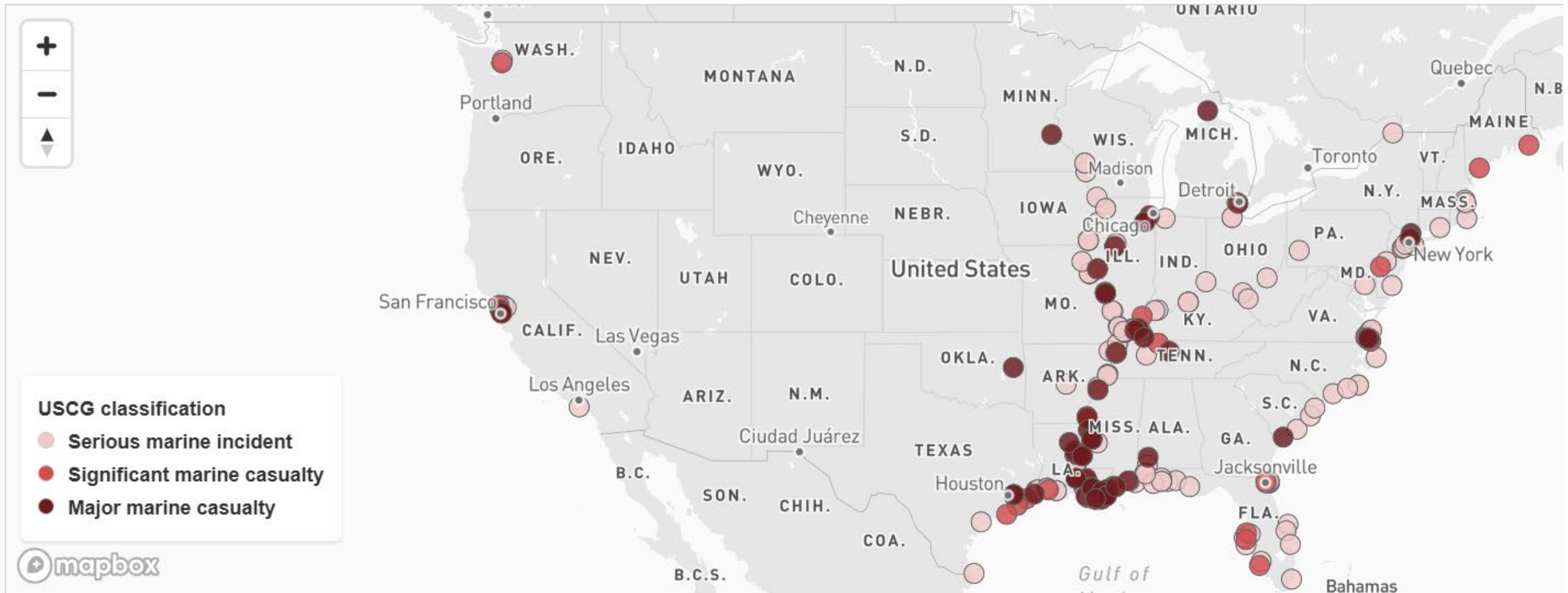
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**At least 6,000 times in the past 22 years – an average of more than five times a week – crews on board massive cargo ships, oil tankers, container barges and even cruise vessels have reported what befell the Dali: a loss of power, loss of propulsion, loss of steering, or some combination of the three – *USA Today***

***At least 900 of them occurred near bridges identified by the U.S. Department of Transportation as spanning navigable waters. The vast majority were classified as routine but a dozen were labeled major or significant. – USA Today***



# The Frequency of incidents is alarming



Source: USA TODAY analysis of U.S. Coast Guard incident investigation reports

# But nothing bad ever happens

## That's Normalization of Deviance!

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# And as I was preparing this presentation...

DC plane crash: NTSB calls for i

yahoo.com/news/dc-plane-crash-ntsb-updates-140853723.html

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## DC plane crash: NTSB calls for immediate changes at Reagan airport

EMILY SHAPIRO, SAM SWEENEY and AYESHA ALI

Tue, March 11, 2025 at 1:35 PM CDT · 3 min read

32

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2:33 PM 3/11/2025

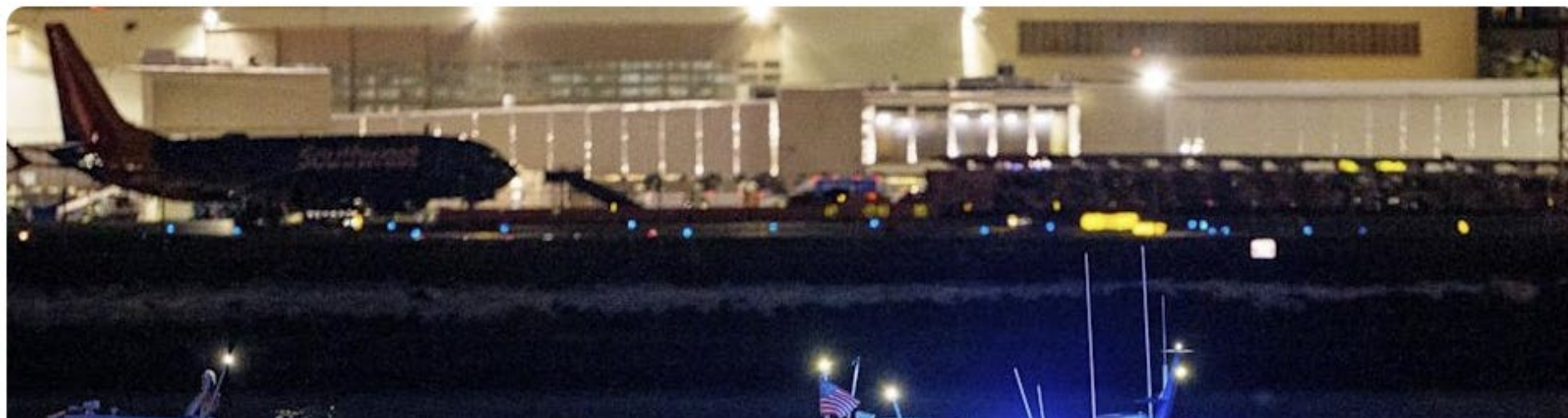


# NTSB Investigation

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Between October 2021 and December 2024, there were 944,179 commercial operations at Reagan, Homendy said. During that time, there were 15,214 close proximity events between commercial airplanes and helicopters, she said.

Encounters between helicopters and commercial aircraft near Reagan show that, from 2011 through 2024, a vast majority of reported events occurred on approach to landing, she said.

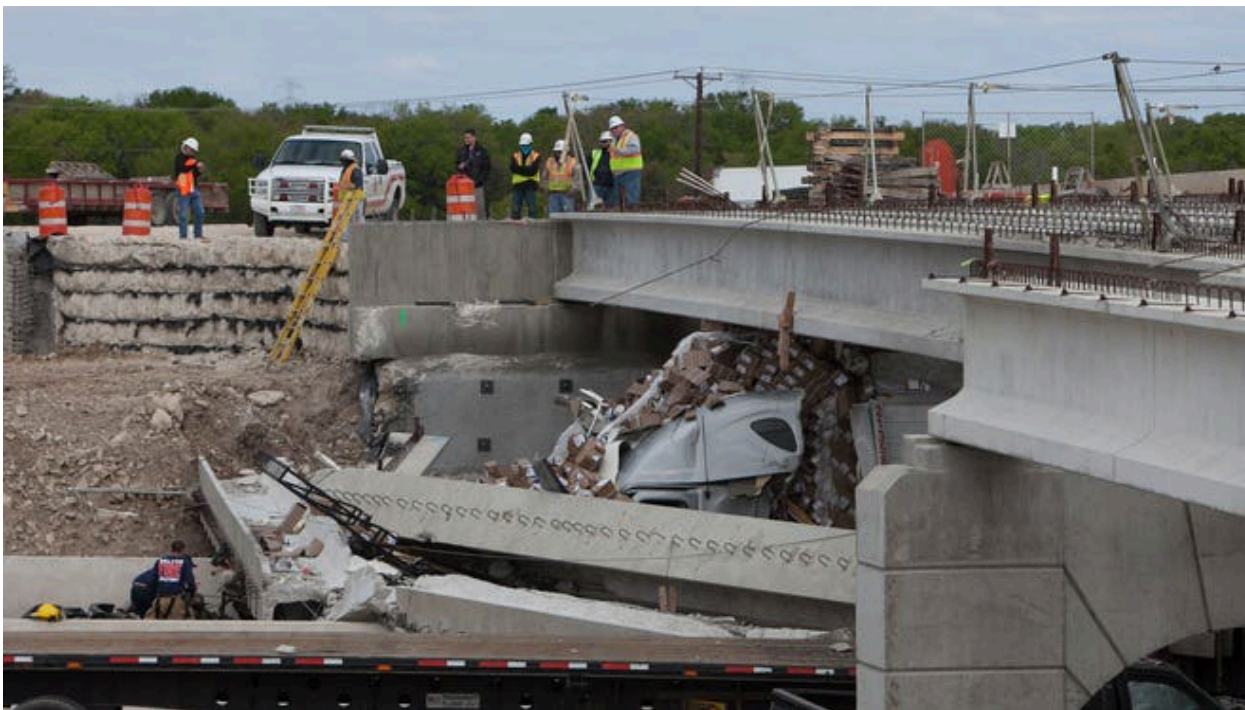


Source:  
CBS News



# What are some practices you have perhaps relaxed or just accepted?

- Design review and checking?
- QC/QA during construction?
- Safety procedures?



# **If we have time**

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**Opportunities from the American Segmental Bridge Institute.**

**Information from the National Concrete Bridge Council.**





American Segmental Bridge Institute

# ASBI Opportunities



# Monthly Webinars

- Last Wednesday of Each Month
- Recordings of All Past Webinars are Available Under the 'Learn'->'Monthly Webinars on the ASBI Website
- We will resume in February of 2025
- To pre-register for ALL ASBI webinars in 2025, use this QR code:



You will receive an email notice one month prior to each webinar. The email will include an option to create a calendar appointment.

<https://www.surveymonkey.com/r/5QMBDT5>

**Join Us**  
Wednesday, Sept. 25<sup>th</sup>  
12:00 p.m. CT

**ASBI**  
American Segmental Bridge Institute

Segmental Bridges Demystified: An Introductory Overview

Wade Bonzon  
GM2 Associates, Inc.

**Join Us**  
Wednesday, June 25<sup>th</sup>  
12:00 p.m. CT

**ASBI**  
American Segmental Bridge Institute

Lessons from the Queensferry Crossing Vessel Collision Studies

Matt Carter  
Arup

**ASBI**  
American Segmental Bridge Institute

2024 Monthly Webinar Series

Cast in Place Segmental Success at LAX with Form Travelers

Nabil Bouabid, Head of Strategic Projects  
PERI Formwork Systems, Inc.

Pawel Okolowicz, Project Manager  
PERI Formwork Systems, Inc.

**ASBI**  
American Segmental Bridge Institute

The Blue Ridge Parkway Bridges

Justin Campbell  
Structural Technologies

Jan Zitny  
COWI



# 2025 Grouting Certification Training

ASBI will host Grouting Training in  
Austin, TX on April 7, 2025

Please see the website for registration.

[www.asbi-assoc.org](http://www.asbi-assoc.org)



# National Concrete Bridge Council



# National Concrete Bridge Council

... a council of allied industry organizations dedicated to:

- Promote quality in concrete bridge construction
- Gather and disseminate information on design, construction, and condition of concrete bridges
- Establish communication with federal and state departments of transportation, city and county public works departments, and consulting engineers
- Provide information on behalf of the concrete industries to codes and standards groups

NCBC website: [www.nationalconcretebridge.org](http://www.nationalconcretebridge.org)



# Current NCBC Members

## Principal Members

- American Segmental Bridge Institute (ASBI)
- Concrete Reinforcing Steel Institute (CRSI)
- Epoxy Interest Group of CRSI (EIG)
- National Ready Mixed Concrete Association (NRMCA)
- Precast/Prestressed Concrete Institute (PCI)
- Post-Tensioning Institute (PTI)
- Silica Fume Association (SFA)

## Associate Members

- American Concrete Institute (ACI)
- Expanded Shale, Clay, and Slate Institute (ESCSI)
- International Concrete Repair Institute (ICRI)
- Wire Reinforcement Institute (WRI)





# RESOURCES FOR CONCRETE BRIDGE DESIGN AND CONSTRUCTION

Catalog of Resources from AASHTO, FHWA, Members of the National Concrete Bridge Council, and Selected Other Sources



June 2024



**AASHTO | NCBC COLLABORATION**

American Association of State Highway and Transportation Officials  
National Concrete Bridge Council

NCBCRCB-1

- Developed from the AASHTO/NCBC Collaboration Agreement, this document compiles essential resources from AASHTO, FHWA, and NCBC members.
- This vital catalog will aid concrete bridge practitioners in their design and construction endeavors.



# Webinars

## Save the Dates!

Whether you are involved in bridge design, maintenance, construction, or asset management we will continue to bring valuable insights regarding the concrete bridge industry to you in 2025. Certificates of attendance are available for these free webinars. **Each webinar starts at 1 p.m. ET.**

## Dates:

February 19

March 19

April 23

May 22

June 18

July 23

August 20

September 10

October 22

November 19



# Prestressed Concrete Bridge Seminar

## Concepts for Extending Spans

Workshop presented by the National Concrete Bridge Council (NCBC) in cooperation with the Idaho Transportation Department, Oregon Department of Transportation, Washington State Department of Transportation, and Federal Highway Administration

November 14–15, 2024

Embassy Suites by Hilton Portland Downtown  
319 SW Pine Street, Portland, OR 97204

November 18–19, 2024

The Davenport Grand, Autograph Collection  
333 West Spokane Falls Boulevard, Spokane, WA 99201

### Instructors



Richard Miller, PhD, PE, FPCI, is Professor Emeritus and former head of the Department of Civil and Architectural Engineering and Construction Management at the University of Cincinnati, where he has taught for 36 years. Dr. Miller's research focuses on concrete materials and prestressed concrete bridges. He has been principal or co-principal investigator on seven projects for the prestigious National Cooperative Highway Research Program. Work done by Dr. Miller and his colleagues has resulted in numerous changes to the AASHTO LRFD Bridge Design Specifications, including incorporation of high-strength reinforcing bar and provisions on debonding and continuous for live-load bridges. Dr. Miller has also completed numerous projects for the Ohio Department of Transportation and the Federal Highway Administration related to concrete bridges. He has served on and chaired several PCI councils and committees and currently serves on the PCI Board of Directors as the chair of the Technical Activities Council. He is a Fellow of PCI, and in 2024 he was named a PCI Titan of the Industry.



Clay Naito, PhD, PE, FPCI, is a professor of structural engineering at Lehigh University in Bethlehem, Pa., where he has taught for 22 years. Dr. Naito's research focuses on experimental and analytical evaluation of reinforced and prestressed concrete structures subjected to extreme events, including earthquakes, tsunamis, and intentional blast demands. He has also conducted research studies for the Pennsylvania Department of Transportation, the Federal Highway Administration, and the Precast/Prestressed Concrete Institute on the performance of concrete bridge structures. Research topics include the performance of adjacent box beam bridges, integration of electrically isolated tendons, use of self-consolidating concrete and ultra-high-performance concrete in bridges, and strand bond. He has published over 100 peer-reviewed journal papers and participated in more than \$15 million in sponsored research. He received the Distinguished Educator Award from PCI in 2015 and was elected Fellow of PCI in 2019.

### Resources

PTI/ASBI Specification for Multistrand and Grouted Post-Tensioning

PTI Specification for Grouting of Post-Tensioned Structures, 4th Edition

FHWA Replaceable Grouted External Post-Tensioned Tendons

ASBI Construction Practices Handbook, 3rd Edition

PCI Bridge Design Manual, 4th Edition

PCI Guide Document for the Design of Curved, Spliced Precast Concrete U-Beam Bridges

### Optional tour for Spokane location only:

On November 20, 2024, there is an optional plant and site tour of Knife River's new facility and their North Spokane Corridor Over the River job site. Additional registration fee of \$50 is required for private consultant and contractor employees. Space is limited. Additional details are available on the registration website.

To register, sign in or create a new record. Government employee registration is at no cost. Registration cost is \$400 for private consultant and contractor employees. Space is limited, and seats are first come, first served, with additional requests added to a waiting list.

Each day is scheduled from 8:00 a.m.—5:00 p.m. Total PDH credit for both days is 14.5 hours. PCI has met the standards and requirements of the Registered Continuing

Education Program (RCEP). Credit earned on completion of this program will be reported to RCEP.

### Featured speakers



Gregg Freeby, PE  
ASBI and Chair of NCBC



Reggie Holt, PE  
FHWA



Tim Christie, PE  
PTI



William Nickas, PE  
PCI

April 15 -16, 2025

Columbus, Ohio

Attendance will be limited to the first 100 registrants.

- Intensive two-day seminar
- From basic to advanced concepts.

NCBC members ASBI, PCI, and PTI are providing resources and instruction at this event. To register, sign in or create a new record at: [www.pci.org/Portland2024BridgeSeminar](http://www.pci.org/Portland2024BridgeSeminar) for the Portland location, or [www.pci.org/Spokane2024BridgeSeminar](http://www.pci.org/Spokane2024BridgeSeminar) for the Spokane location





# ASPIRE Magazine

- *ASPIRE*, the concrete bridge magazine
    - About all types of concrete bridges
    - First issue was Winter 2007
    - All issues are available online
      - [www.aspirebridge.org](http://www.aspirebridge.org)
      - Can search an issue or across all issues
    - Free subscription
    - Supported by several members of NCBC
  - Need ideas for:
    - Project articles
    - State features
- Look for my article in the next issue, due for publication at the end of March, on Normalization of Deviance!





# Thank You!

Gregg Freeby

Executive Director

[gfreeby@asbi-assoc.org](mailto:gfreeby@asbi-assoc.org)

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