Bridge Owners' Forum

CROSS UPDATE

Alastair Soane

Director: Structural-Safety

January 2021

Structural-Safety Group

SCOSS

Standing Committee on Structural Safety

- Founded 1976
- Collects data from public sources
- Does unacceptable risk exist?
- Publishes Alerts and Topic Papers

CROSS

Confidential Reporting on Structural Safety

- Started 2005
- Collects confidential data
- 1,000 reports by December 2020
- Provides comments on lessons to be learned
- Re-launch March 2021

Voluntary Committee and Panel Members

Top causes of structural failure from CROSS

1. Quality culture and priority not set by top management
2. Inadequate scope, resources, and time
3. Cutting corners, by-passing known quality steps
4. The fast-paced, often chaotic environment we work in today
   a. Things fall through the cracks
   b. Can’t keep up with changes
5. Failure to take decisive ownership early when problems arise
6. Inadequate communication
7. Inadequate definition/understanding of responsibilities
8. Lack of adequate continuity of design engineer of record during construction administration
9. Review/approval of submittals
10. Addressing contractor problems
11. Checking that what is built conforms with contract design documents
12. Inadequate checking of structural design (internal or peer reviews)
13. Inadequate engineering input into construction means and methods
14. Overloading and/or inadequate support/bracing during construction
15. Delegated design
16. Erroneous computer modeling/lack of independent verification of results
17. Connection/fastener failures
18. Non-redundant structures/lack of robustness
19. Brittle materials/brittle fracture
20. Buckling/instability
21. Inadequate standards and guidelines for temporary structures
22. Deterioration (inadequate inspection and maintenance)
23. Scaling up
24. Inadequate research/vetting into new materials and systems

Glenn Bell CROSS-US Director

Top ten

1. Quality culture and priority not set by top management
2. Cutting corners, by-passing known quality steps
3. Inadequate communication
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Lifecycle Stage for the Underlying Cause of the Safety Issue

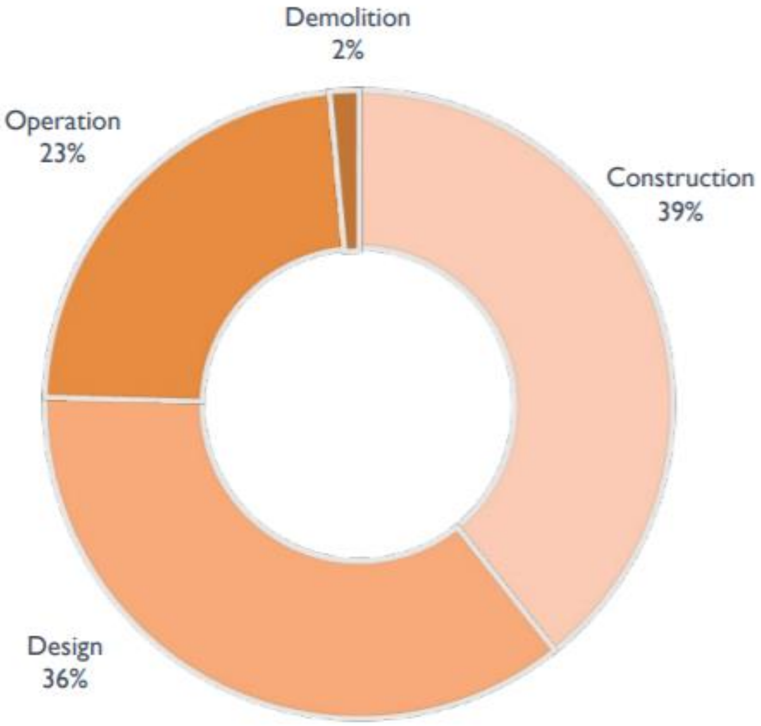

Figure 12: Lifecycle stage for the underlying cause of the safety issue

Definitions

Design
The pre-construction process carried out by the Principal Designer and other designers.

Construction
The construction process carried out by the Principal Contractor and other contractors.

Operation
The period from completion of construction, over the life of the asset, to the end of use of the asset.

Demolition
The de-construction of the asset.

CROSS Reports Related to Infrastructure

Current	Next stage	Future
Bridges	Fire	Complex systems (RAEng)
Retaining structures	Climate change effects	High speed railways
Masts & towers	Environmental	Dams and reservoirs
Rail structures	Utilities	Maritime
Excavations	Roads	Nuclear

Florida University International

Making of the first SCOSS International Safety Alert

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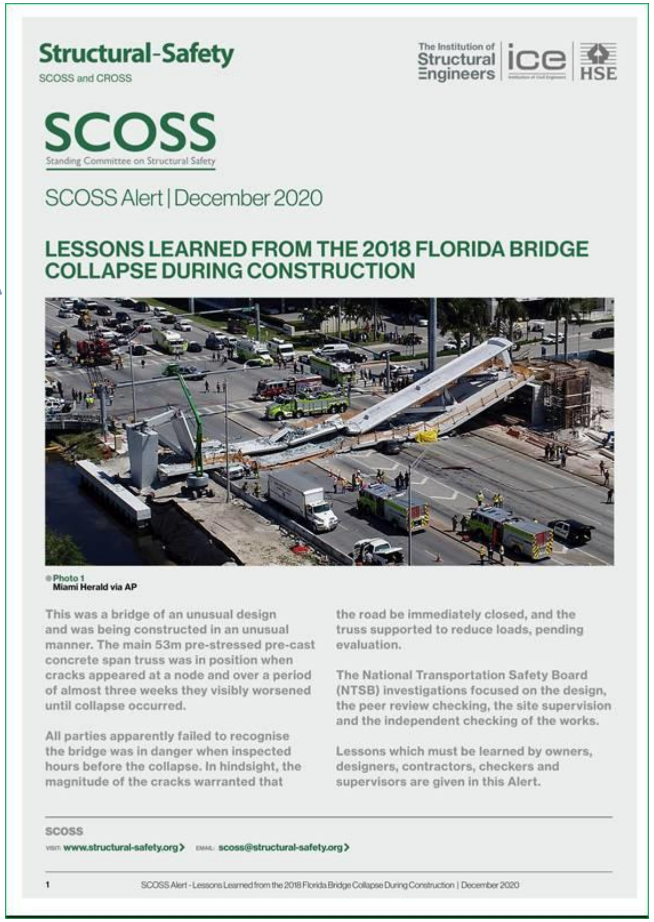

Structural-Safety
SCOSS and CROSS

The Institution of Structural Engineers | ice | HSE

SCOSS
Standing Committee on Structural Safety

SCOSS Alert | December 2020

LESSONS LEARNED FROM THE 2018 FLORIDA BRIDGE COLLAPSE DURING CONSTRUCTION

Photo 1
Miami Herald via AP

This was a bridge of an unusual design and was being constructed in an unusual manner. The main 53m pre-stressed pre-cast concrete span truss was in position when cracks appeared at a node and over a period of almost three weeks they visibly worsened until collapse occurred.

All parties apparently failed to recognise the bridge was in danger when inspected hours before the collapse. In hindsight, the magnitude of the cracks warranted that the road be immediately closed, and the truss supported to reduce loads, pending evaluation.

The National Transportation Safety Board (NTSB) investigations focused on the design, the peer review checking, the site supervision and the independent checking of the works.

Lessons which must be learned by owners, designers, contractors, checkers and supervisors are given in this Alert.

SCOSS
VISIT: www.structural-safety.org › EMAIL: scoss@structural-safety.org ›

1 SCOSS Alert - Lessons Learned from the 2018 Florida Bridge Collapse During Construction | December 2020

Florida Bridge Collapse – What Happened

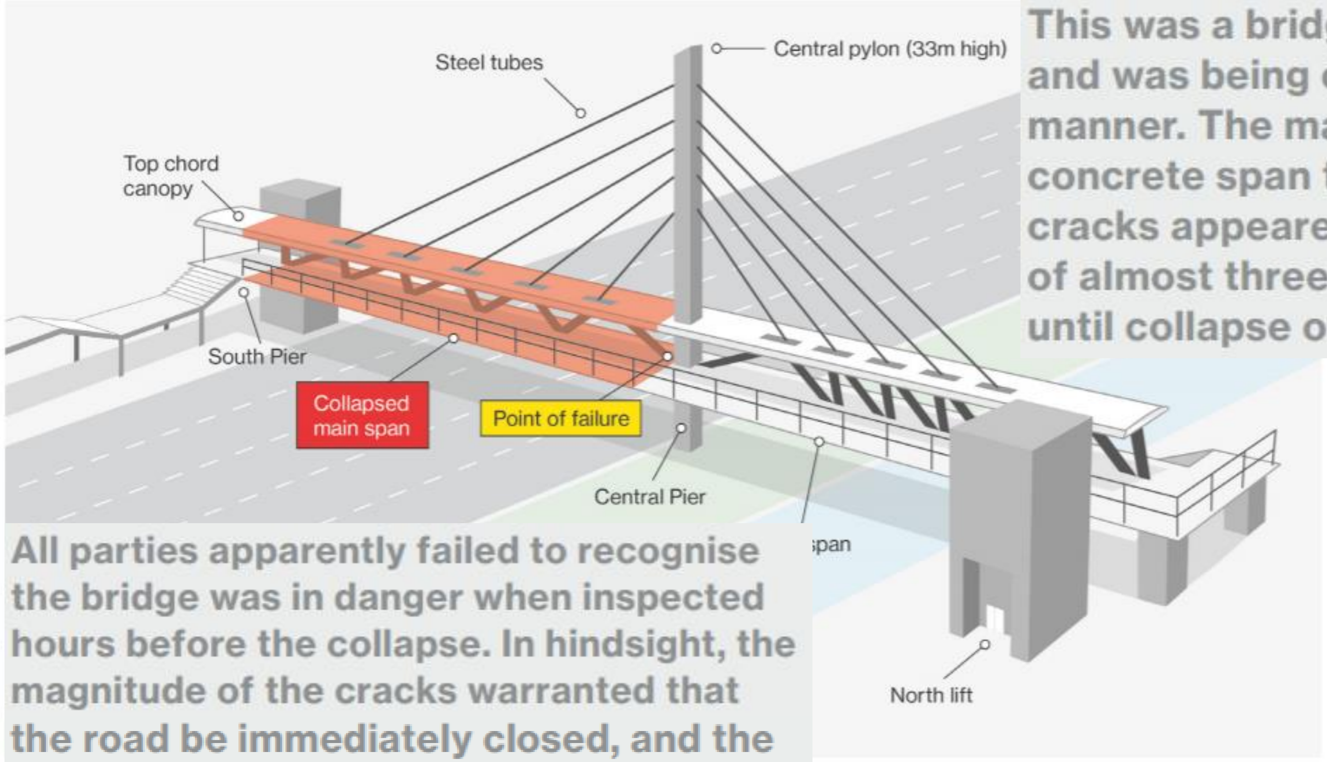

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Photo 3
Cracking to diagonal member 11 (taken from NTSB Ref 1)

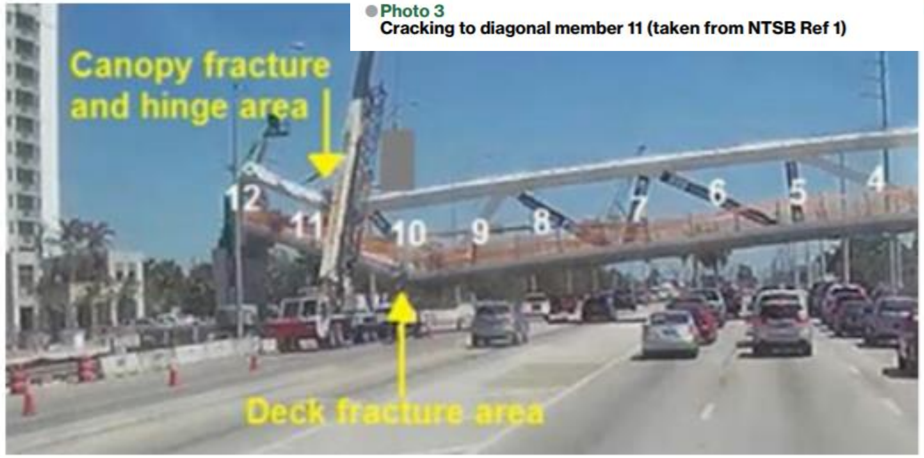
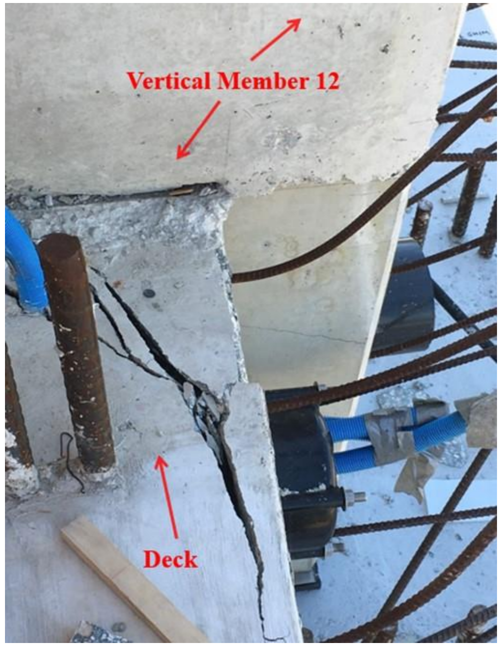


Photo 4
Catastrophic failure of bridge during re-tensioning activities. (taken from NTSB Ref 2)

The National Transportation Safety Board (NTSB) investigations focused on the design, the peer review checking, the site supervision and the independent checking of the works.

Cracks

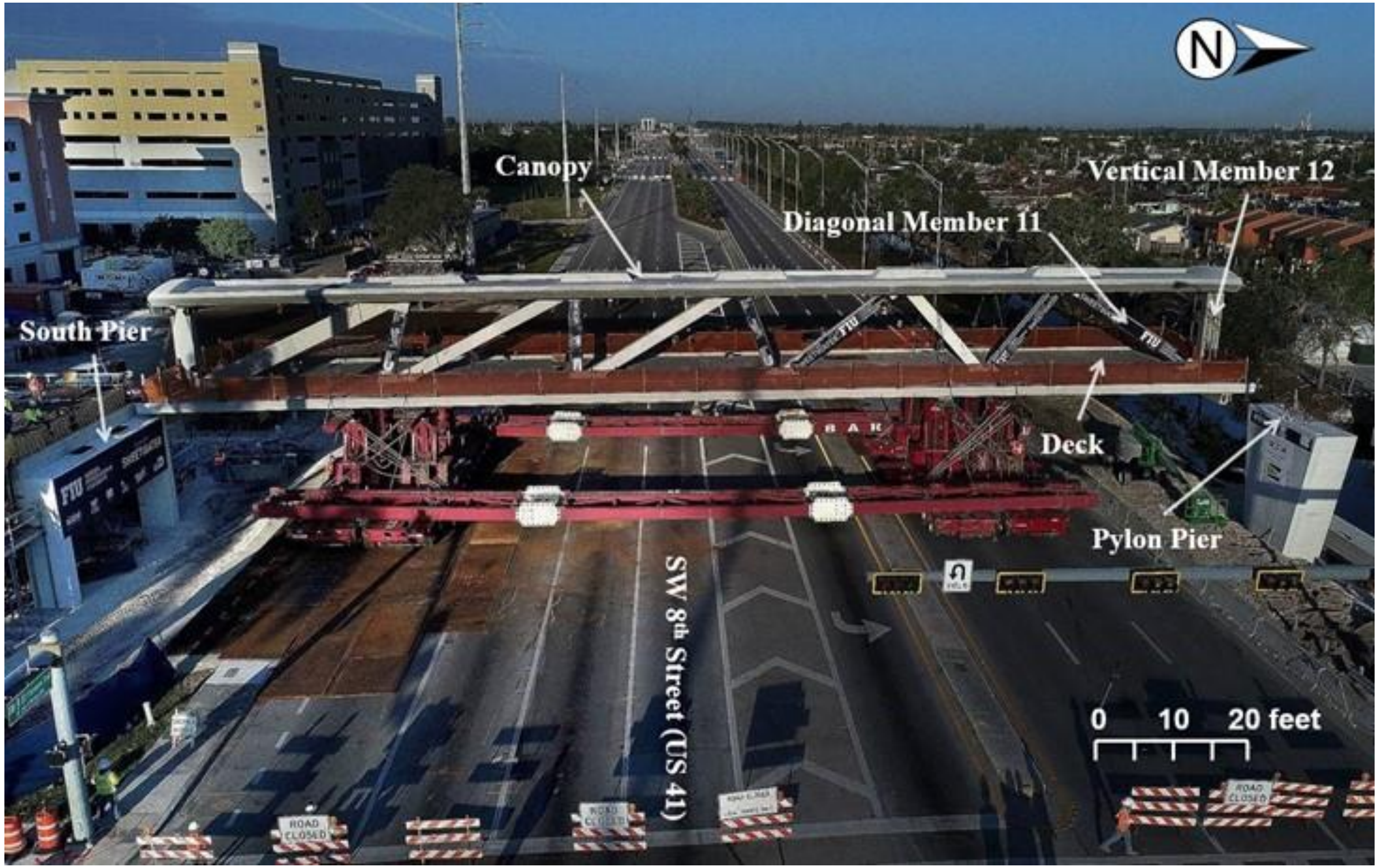


Diagrammatic representations

Figure 6. Cross-section rendering of pedestrian bridge, north view. (Source: FIU, modified by NTSB)

Figure 7. Nomenclature of bridge components and numbering of diagonal and vertical truss members on main span of pedestrian bridge, east view.

Transportation underway



Sequence

Figure 9. Still image (time stamp 13:46:43:881) from in-vehicle mounted video camera on pickup truck traveling east on SW 8th Street, showing concrete dust and debris blowout at north end (pylon pier), March 15, about 1:46 p.m.

Figure 10. Still image (time stamp 13:46:44:046) from in-vehicle mounted video camera on pickup truck traveling east on SW 8th Street, showing full-width canopy fracture and deck fracture areas at north end (pylon pier), March 15, about 1:46 p.m.

Figure 11. Still image (time stamp 13:46:44:310) from in-vehicle mounted video camera on pickup truck traveling east on SW 8th Street, showing main span completely collapsed, March 15, about 1:46 p.m.

Collapse mode

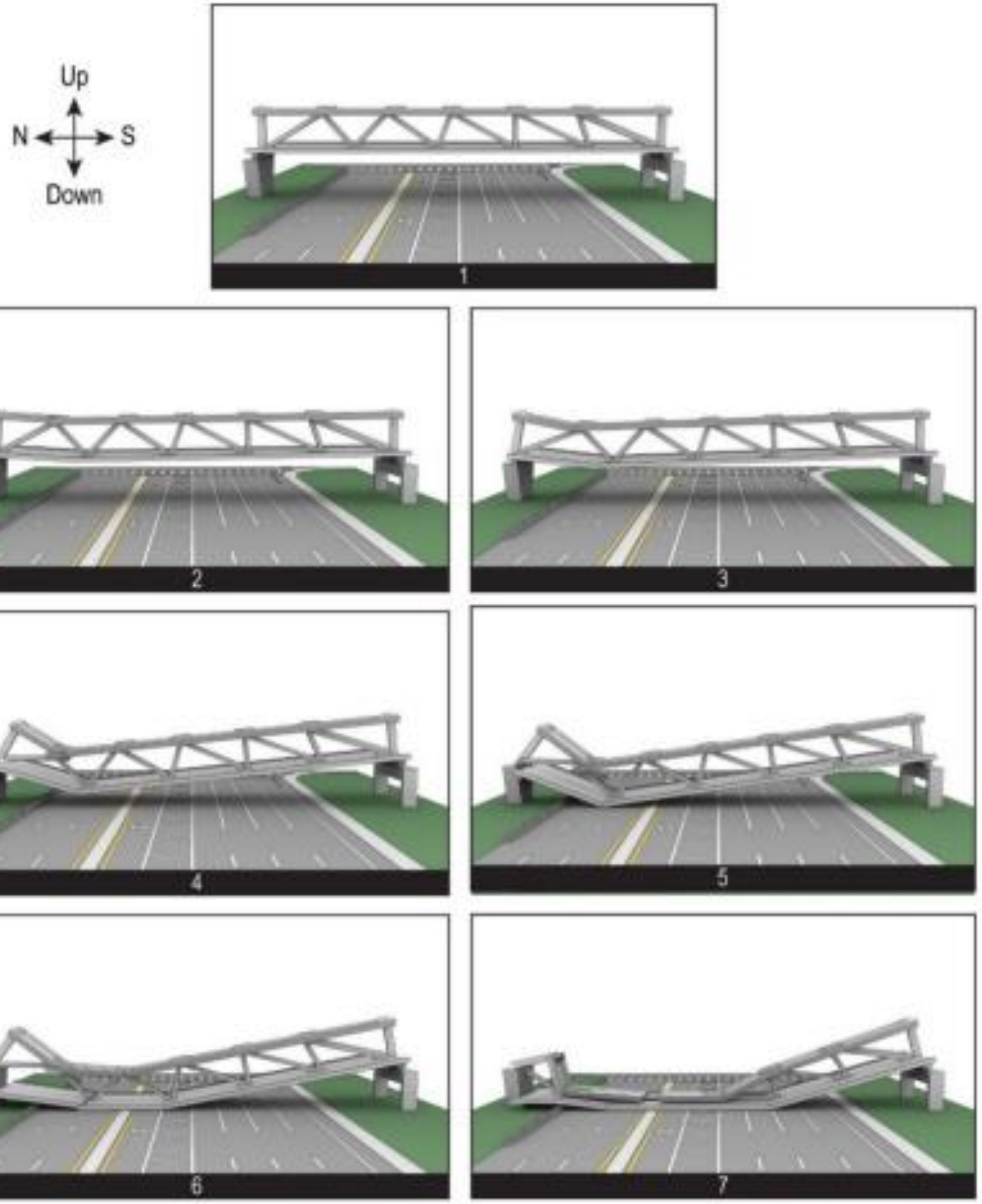


Figure 12. Collapse sequence diagram, facing east, depicting bridge's precollapse condition in phase 1 through postcollapse position (onto SW 8th Street) in phase 7.

North end details

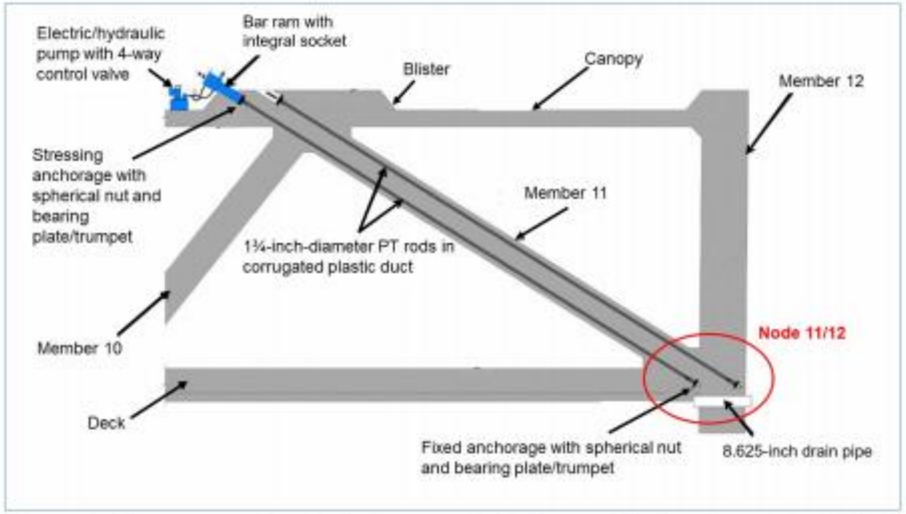


Figure 19. Main span, north end, showing post-tensioning specialized equipment in relation to location of PT rods in member 11. (Source: Structural Technologies, annotated by NTSB)

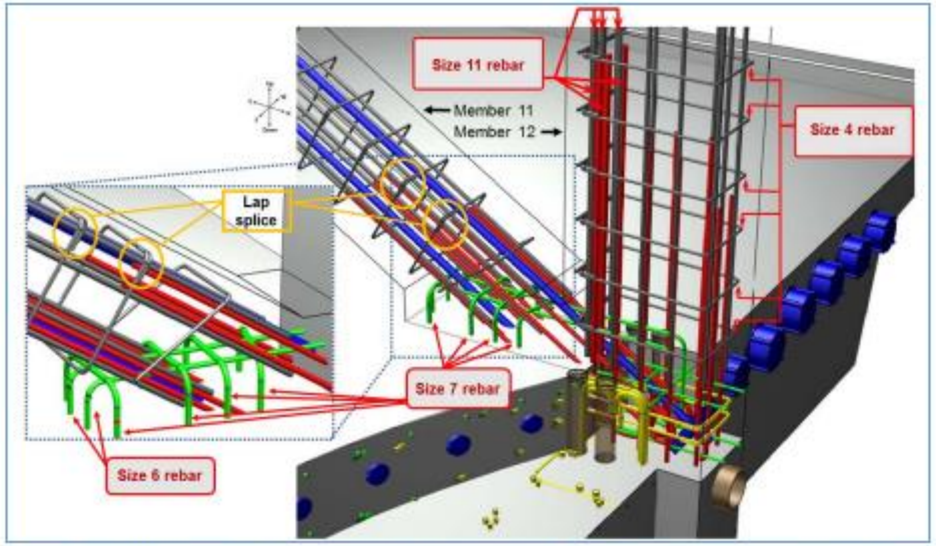


Figure 17. Main span, north end, showing rebar detailing in member 11, member 12, and node 11/12. Inset shows another view of rebar in node 11/12 and detail of lap splice from member 11. (Source: FHWA 2019)

Figure 24. Cracks of 3–4 inch depth at northern end of precast main span, along west side of diaphragm 2 (north view), March 13, 11:17 a.m. (Source: MCM)

Lessons Learnt & Recommendations (1 of 2)

- Projects should undertake 'what if' contingency planning. What can go wrong, and how do we prevent it or mitigate it? In the case of the Florida bridge, there were weeks to consider the consequential effects of the developing cracks.
- All increases in crack width, particularly those that occur over a short period of time, must be taken seriously and assessed by an expert.
- Due to the increasingly fragmented nature of the industry, it is often observed that engineering decisions are made by non-engineers, without consulting competent engineers. This results in significant safety risks due to non-engineers not understanding the implications of their decisions. This is a serious and widespread issue, which the industry needs to recognise, and find a way to prevent from happening.
- Design and Build contract procurement methodology needs to ensure that there is an appropriate level of Designer input and supervision on site, to assure quality and safety.

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Lessons Learnt & Recommendations (2 of 2)

- Projects should check the alignment of the procurement strategy and contracts with the competence of those involved, and the complexity of the work.
- Train engineers to recognise, through learning and experience, the early warnings of failure.
- The industry must do more to ensure competency of individuals and companies is demonstrated.
- There is often undue pressure on duty holders, which can lead to compromising quality and safety. SCOSS believe that this is unacceptable behaviour, which needs to be rooted out. There is a strong case for improved teaching on behaviours and the impact culture has on safety and quality. The Institution of Structural Engineers and Institution of Civil Engineers resources on engineering ethics are a good starting point for education on behaviours.

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NCE's reaction to the Florida Bridge Collapse SCOSS Alert:

FIU bridge collapse highlights risk of 'non-engineers' making engineering decisions

11 DEC, 2020 | BY ROB HORGAN

The collapse of the Florida International University (FIU) bridge highlights the unnecessary "risk" of allowing engineering decisions to be made by "non-engineers", the Standing Committee on Structural Safety (SCOSS) concludes in its latest report.

UK engineering safety body SCOSS has now outlined a number of recommendations to prevent a similar disaster from occurring again.

> Among its recommendations, SCOSS calls for qualified engineers to be solely responsible for making engineering decisions.

SCOSS argues that due to the "increasingly fragmented nature of the industry" engineering decisions are often made by "non-engineers [who do] not understand the implications of their decisions".

> It adds that this is a "widespread issue" which needs to be corrected.

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IABSE Task Group 1.5 Bridge Collapse: cases and causes

- Bridge failure database 1966 - 2020
- Partial data for 800 bridge collapses
- More information requested from international participants
- Data will be analysed
- Report will be published end 2021
- More UK participation wanted

Some reports from 2020

CROSS-UK

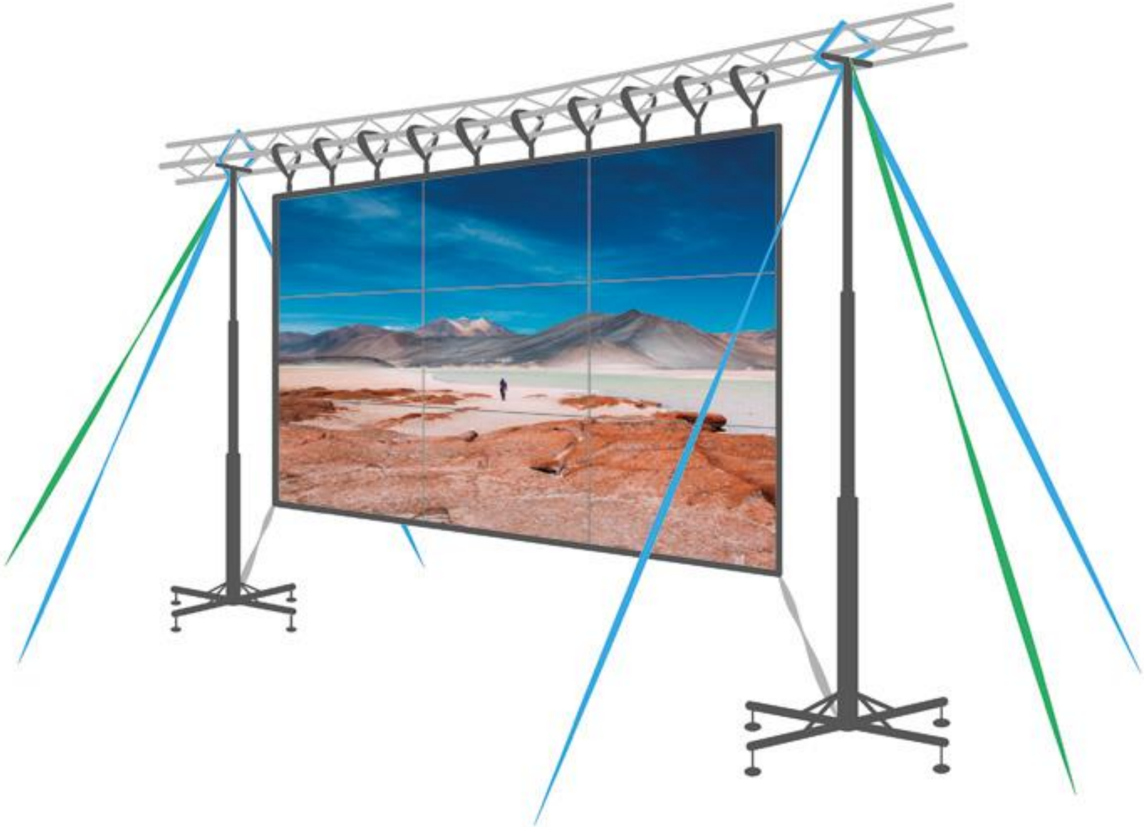
- Fire in multi-storey car parks
- Inadequate punching shear reinforcement
- Emergency motorway lane closure during concrete repairs
- Fire protection of mixed hot/cold rolled steel structure
- Consequences of low professional fees
- Disproportionate collapse assessment of Large Panel System (LPS) buildings
- Principal Designers' obligations for temporary works

CROSS-AUS and CROSS-US

- Inspection and maintenance of Super-T bridge girders
- GFRP reinforcement in concrete structures
- Collapse of a large reinforcing cage
- Collapse of tower cranes during dismantling
- Dislodged finger plate on highway bridge
- Design and erection of prefabricated (precast) concrete

All accessed from www. structural-safety.org

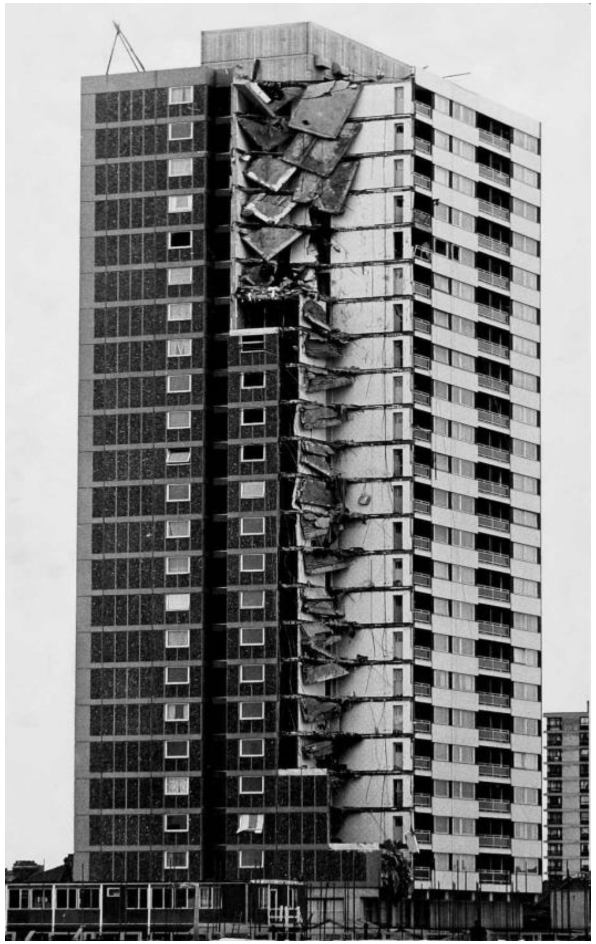
A pre-cursor and a current problem



Covid problems

- Working from home
  - Lack of interaction with peers
  - Difficulties in checking
  - Not seeing the broader picture
  - Apathy
- Sites
  - Complexities of social distancing
  - Shortages of personnel
  - Difficulties with close supervision
  - Taking short cuts
- Operation and maintenance
  - Complexities of social distancing
  - Shortages of personnel
  - Difficulties with close supervision
  - Taking short cuts
  - Antagonism from occupants?
  - Means of access blocked due to safety concerns
  - Exhaustion

Tower Block Tragedies



Ronan Point 1968

Catalyst for SCOSS

Grenfell Tower 2017

Catalyst for new CROSS

Pyramid of Risk

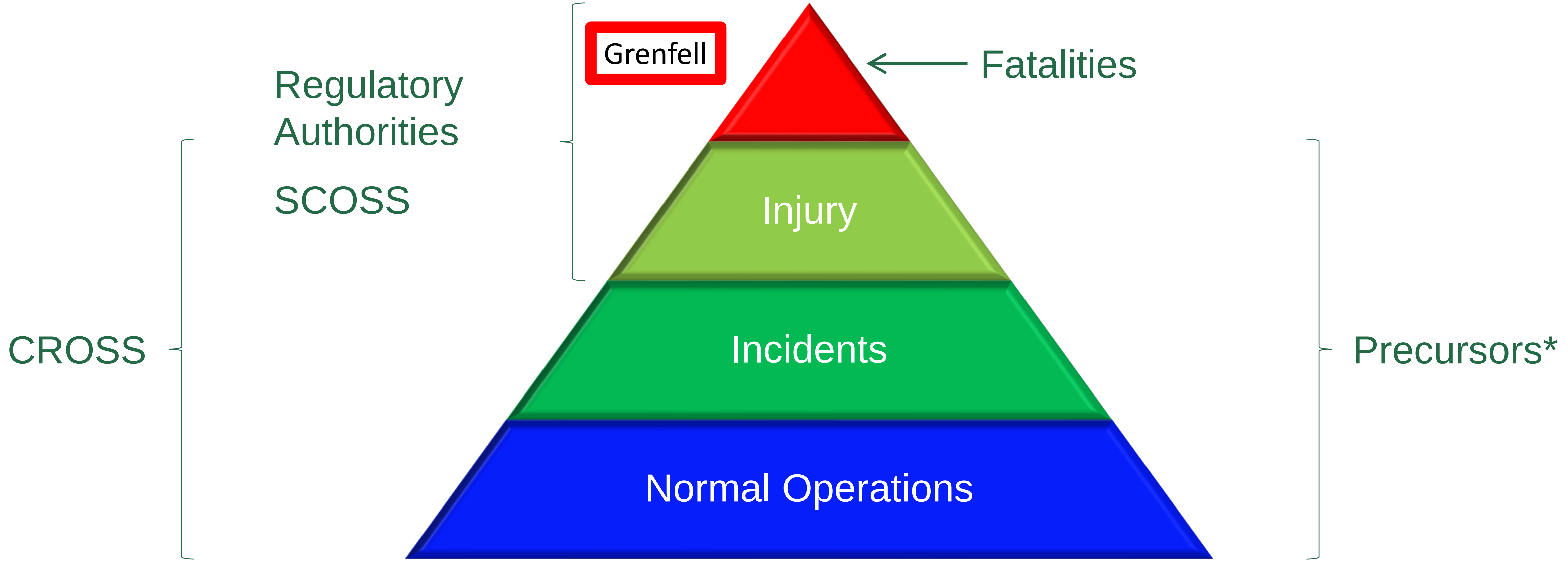


Diagram courtesy of ASRS

* Precursors should be reported internally and can be reported to CROSS

Hackitt review

recommends CROSS reporting for all buildings

recommends extension into fire safety

MHCLG grant in January 2020

Government Building Safety Bill

Accepts Hackitt recommendations

New Building Safety Regulator

Part of HSE and will start operations in 2022

Mandated to implement safety reporting

Voluntary reporting from CROSS

CROSS – Fire Safety

- In conjunction with the fire community and Government Departments
- Considerations:
  - Scope
  - Who should report
  - Type of event
  - Type of concern
  - Dissemination

Timeline

January 2020 – May 2020

Development of CROSS

- Strengthen CROSS for structural safety
- Extend CROSS into fire safety
- User research
- Branding review
- Develop a communications plan

June 2020 – March 2021

Develop new CROSS website

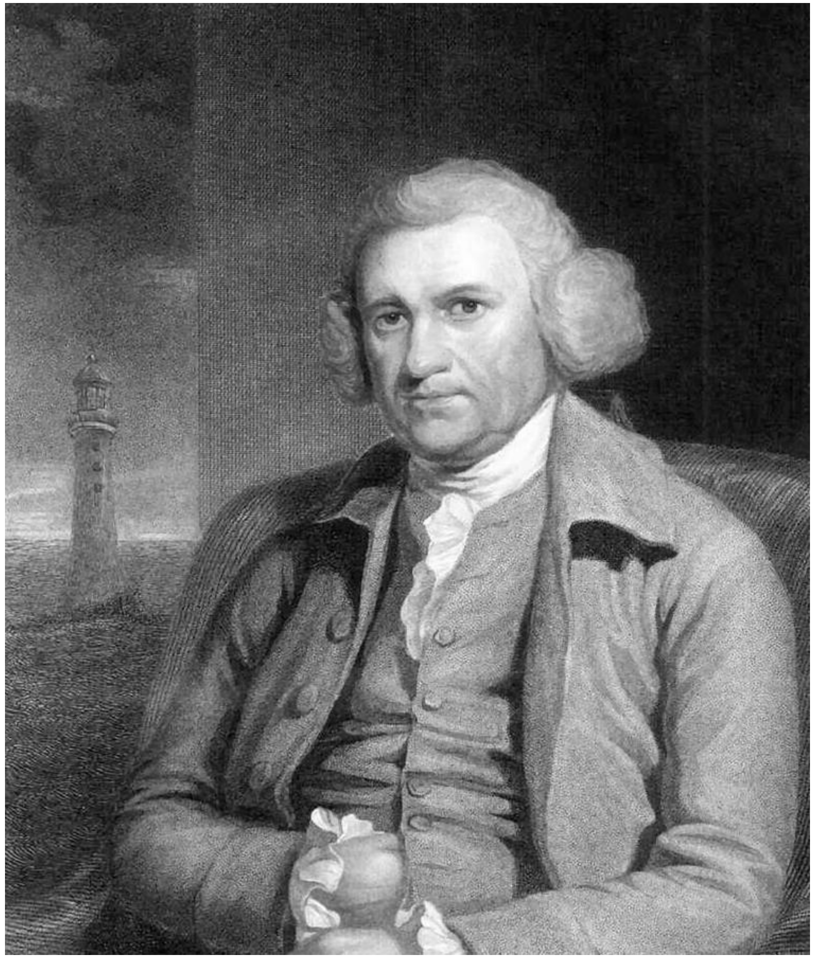
- Design website (testing on users)
- Build website
- Build report management system
- Implement supporting functions

March 2021

Launch redeveloped CROSS

- New brand
- Hugely improved website
- Much better database
- Extended to fire safety
- More scope for infrastructure and environmental reporting
- More benefits for practitioners and the public

John Smeaton, Civil Engineer (1724 – 92)



‘Stone, wood and iron are wrought and put together by mechanical methods, but the greatest work is to keep right the animal part of the machinery. ‘