IBP 2018 - News reporter of the year award entry – Katherine Smale New Civil Engineer

On the title I work primarily on the news desk which is an area I have really come to love. The quick turn around of stories and need for networking and building contacts and trust I feel really suits my personality.

I love to get under the skin of projects, meet new people and use my contacts to break exclusive stories. I get a real buzz from being able to a story. The opportunities I have had have been eye opening which is something I really want to share with the built environment audience the New Civil Engineer has.

I now feel I am becoming a valued and trusted voice within the engineering community.

My background is purely engineering having spent nine years as a structural engineer before joining New Civil Engineer three and a half years ago. Through that time I really feel I have grown into a journalist with a passion for the industry I work in.

Morandi bridge collapse

On August 15th this year, the Morandi motorway bridge, one of Italy's key infrastructure arteries, catastrophically collapsed killing 43 people. It sent shockwaves around the world not only for those affected by the deaths, but for those who design, build, own and maintain the millions of similar assets around the world.

Within 24 hours of the collapse I had written two stories for New Civil Engineer on the possible causes for the collapse, history and structure of the bridge, given four radio interviews including for Radio 4, Radio 5 live and the World Service, flown to the site of the collapse and given three television interviews, one for BBC news 24 and the other two for ITV live from Genoa, including Good Morning Britain.

Reporting from Genoa was a new experience for me, having never reported from a "disaster zone" before. Having been a structural engineer for nine years prior to changing careers, I really felt a personal connection to the impact a collapse has on the engineering community but also on the world affected by it. This is when the importance of the engineering media becomes even more clear.

Being able to talk to the engineers working on the rescue and relief effort on a technical level was key to gaining their trust that we would publish correct, clear, fair and balanced stories to try to establish what caused the horrific tragedy.

While there, despite the language barrier, by sheer hard work and determination in identifying and working hard to talk to the key people involved in the investigation on the ground, I was the first reporter to ascertain that corrosion had been found in the main cables – a key component for what might have caused the bridge to fail - and information about unreleased CCTV footage, and discount theories about what might have caused the collapse. All of which was picked up by the UK national papers. I also wrote a first person piece from scene.

Throughout the time I was at the scene I was in touch with the latest updates, taking photographs of the scene, feeding back information to my team in the UK and making valuable contacts for the investigation going forward.

The information which we published was picked up by the nationals including The Times, Telegraph, Independent and the Guardian.

I am continuing to follow the story throughout the investigation and the rebuilding of the bridge, the implications of which I believe will have ramifications for engineers, contractors, owners and maintainers of infrastructure assets the world over.

New Civil Engineer

Exclusive | Collapsed Italy bridge investigators find corrosion on main stay cables

17 August, 2018 **By Katherine Smale in Genoa, Rob Horgan**

Investigators examining the scene of the collapsed Polcevera Viaduct, more familiarly known as Morandi bridge, have found damage to the main stay cables on the collapsed section of the bridge, *New Civil Engineer* can reveal.

Sources close to the investigation told *New Civil Engineer* that when examining the main stay cables evidence of corrosion and damage had been found.

They suggested a failure of the cables – which were encased in concrete to protect them from the elements – may be behind the collapse.

“I have heard that video footage from the CCTV cameras on the bridge just before the collapse showed concrete being exploded off the main stay because of the violence of some of the cables snapping underneath,” one source said.

Thirty-eight people were killed last week when a 250m section of the bridge, including one of three 90m high towers collapsed during a heavy thunder storm.

Engineers have also suggested a potential cause for its collapse could be that the heavy rain washed ground from underneath the tower, undermining its foundations. The bridge’s foundations were undergoing strengthening works at the time of collapse, according to Italian highways operator Autostrade.

However, while the source close to the investigation said that nothing was being ruled out at this stage, he said that the foundations for the collapsed tower “appeared to be stable”.

Likewise, *New Civil Engineer*’s founding editor Sydney Lenssen – who visited the site during its construction in 1965 – believes that other factors are more likely to have caused the collapse.

“At first look it doesn’t look like a fault in the foundations,” Lenssen said. “It appears to me that the structure has fallen down from above. So it looks like the structure has collapsed around the foundations, rather than the foundations causing the collapse.

“I suspect that one of the supports from underneath has given away. That or the cables above have suffered from corrosion.”

Likewise former president of the Institution of Structural Engineers Ian Firth said that corrosion of the cables was a likely cause of collapse.

“As this reinforced and prestressed concrete bridge has been there for 50 years, it is possible that corrosion of tendons or reinforcement may be a contributory factor,” he said. “In addition, ongoing work on the bridge may or may not be partly responsible for the collapse.”

The Italian government has now launched an investigation into Autostrade following the collapse, which claimed at least 38 lives.

Autostrade now has until the end of the month to produce a report detailing any works undertaken on the bridge to ensure its safety.

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Readers' comments (4)

- **Nick Thoday** 17 August, 2018 7:30 pm

  Between each of the cable stayed spans there was a short suspended span which appears to be half jointed. There was a similar short suspended span between the collapsed cable stayed span and the approach viaduct. In the video across the rooftop (in heavy rain) that shows the mast collapsing it appears that this suspended span had already dropped before the mast collapsed. It could have been a half joint failure that initiated a progressive collapse.

- **Ronald Drysdale** 21 August, 2018 4:47 pm

It now seems quite possible that the principal reason behind this catastrophic failure was the designer's decision, 50 years ago, to use steel tie bars clad in concrete as the bridge's main tension members.

This was essentially a cable stayed bridge design in which the steel tension cables were wrapped in concrete instead of paint (or a similar corrosion resisting medium). The concrete wrapping provided no structural benefit to the bridge and instead went on to prevent the ready inspection and maintenance of the main steel strength members it enclosed.

Concrete is excellent for compressive loads but useless in tension. Steel is excellent for tensile and compressive loads but needs a protective coating to prevent corrosion.

Also it seems that there was also no redundancy in the structure - a single member failure could lead to total collapse.

These are significant design failings in my view.

- **Alfredo M Claussen** 12 September, 2018 4:59 am

@Donald Drysdale : I agree with your appreciation. Having read some pages of books written in the 1960's on Riccardo Morandi's bridges, it is quite obvious that many persons of that era were praising too much Mr Morandi's designs and skill.

For me, it is a clear case of what I call "The Pygmalion Effect": when a creator of a given work becomes so enamored of his/her work that he/she ends up believing that his/her solution is not only the best, but the only way to go.

Back in the 50's and 60's, too many engineers were dazzled with the then new possibilities of reinforced concrete construction. Morandi probably became obsessed with the intensive substitution of steel with the much less expensive concrete. One thing is now clear: Morandi could be brilliant,but his obsession with the (ab)use of concrete over steel carried him and their companions to propose what now seems a very bad idea: the use of bridge stays made of prestressed concrete instead of using steel tendons WITHOUT any concrete. I'm no Civil Engineer (actually I'm a Chemical Eng.) but I've known since school days that a long slender member that works in compression is limited by buckling. Now, Morandi obsession with prestressed concrete for the stays of his bridges was a very bad decision, because the stays are very long and slender, so much that their prestressing HAD TO BE VERY LOW (unless risking to bucke them with the prestressing!), which opens the real possibility of cyclic stresses to cause concrete micro cracks that allow the humidity to penetrate and corrode the steel cables, which are not accesible for inspection as they are buried inside the concrete. Your comment on the amazing lack of redundancy is spot on. It appears that Morandi was so convinced of his skill that he disdained the use of several stays instead of his approach: just four stays per tower. a single stay failure DOES bring the entire tower down. In addition to the designer (Morandi), those who praised him and became too enthusiastic about his designs are equally guilty of this disaster: read the many books published in the 60's that praise the designer too much and you can see how everybody contributed to his designs being admired so much that NOBODY felt the need to revise the concept. As of today (2018), at least three of Morandis bridges have failed: the Wadi El Kuf bridge in Libya has been closed since 26 October 2017 when the Security Directorate of the Green Mountain region in east Libya called on the security services to close down the bridge, following recent inspections that identified potential fractures. Surprinsingly, the war-torn Libyans were much more careful than the Italians!, the second Morandi's bridge in Venezuela also has its share of problems, and the third is the Genoa one where almost 40 people died because of the overconfidence of that famous designer, now deceased. All of those bridges are of the very same design: Prestressed concrete stays, too few stays (No redundancy), and all of them were (stupidly) judged as "Works of Art". So, in my humble opinion, you can add petulance to overconfidence in a bad from the start design. Finally, I will risk to forward a prediction: One of these days, one of the "marvellous" bridge designs of Santiago de Calatrava (that are extremelly 'atractive') but absurd because those were designed to stretch the imagination, will come down, sooner or later. To design too fancy and Bizarre bridges is not only wasteful, but reliability suffers and failure mechanisms could be easily understimated. Bridges should NOT be artistic above being safe, reliable and functional.

- **Alfredo M Claussen** 13 September, 2018 3:44 am

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New Civil Engineer

From the scene | Collapsed Italy bridge laid bare

17 August, 2018 **By Katherine Smale in Genoa**

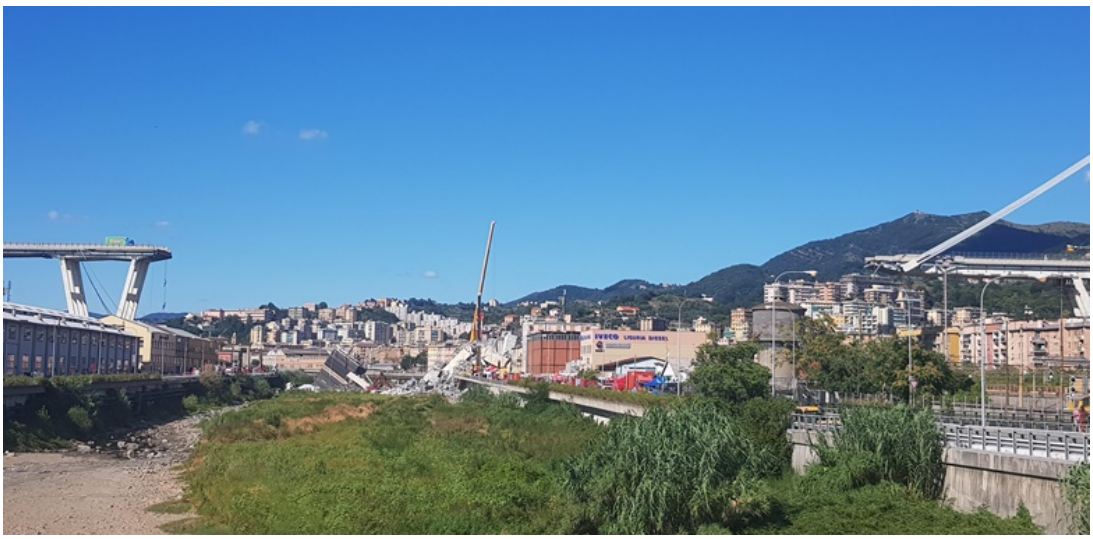
Arriving at the edge of the cordoned off zone, the police guard all access points to what remains of the motorway bridge leading out of Genoa.

The surrounding streets are eerily quiet. All roads surrounding the bridge have been closed, all residents living below and around the Polcevera Viaduct, more familiarly known as Morandi bridge, have been evacuated and told they may never be able to return to their homes.

With bright blue skies above, and mountains rising magnificently in the background the air is still and it is hard to believe that thunderstorms battered this area just two days before.

In contrast to the picturesque late Italian summer setting is the harsh marine environment with concrete industrial looking buildings, brown corrosion stains on their surface.

Rescue workers with hard hats, climbing gear and cutting equipment come and go in fortified four-by-fours. Helicopters and drones fly over the wreckage and sirens punctuate the silence.



The world's media has descended on the area and only journalists are allowed to pass onto the Via Renata Bianchi bridge, which affords a clear view of the foreboding wreckage above and below in the distance.

The remaining two towers of the Morandi bridge can be seen around 300m away on the east side of a dry river bed. The twisted remains of the 250m long section lie below, with what appears to be a 15m section of the four lane road deck lodged in the river valley.

The deck must have mostly fallen out of view or broken up into smaller sections on impact, as the debris that can be seen form this vantage point does not seem to be enough to fill the vast gap which has been left above.

Looking down Via Giorgio Perlasca road on the eastern side of where I'm standing, the wreckage of the tower is just visible. Around 15m sections of the tower legs are heaped in a vast pile of rubble. What look like post-tensioning cables can be seen draping from one of the exposed faces of the concrete.

Two mobile cranes are helping with the rescue effort and peckers can be heard hammering away, trying to break up the larger lumps of concrete.

Looking up to the remaining towers, the deck of what should have been the middle pier now stands isolated on one side.

It is clear that the bridge deck has failed along its joint lines as the end of the still in place deck section is neat. The two still-standing piers look stable and no deflection of the remaining deck tip can be seen. Anchor blocks for the cable stays at deck level are still attached to the remaining towers with no signs of distress, although the twisted remains of the parapet can be seen hanging off the end.

Maintenance inspection platforms can be seen underneath the bridge deck at the point of the haunch on the underside of the deck.

Remains of Polcevera Viaduct

Remains of Polcevera Viaduct

At the top of what was the middle pier, steel housing for the concrete-encased main stays are brown and rusted.

Looking further east at the end pier, it is clear that work has taken place to strengthen the main stays. Black cables run alongside the original stays and over new grey saddles at the top of the tower.

The bases of the remaining piers are not visible. Looking north west, the other side of the collapsed bridge can be seen. Telecommunication wires hang down from the collapsed face.

Trucks and cars that narrowly escaped the fall still remain on top of the deck in a haunting reminder of the tragedy that occurred.

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HS2 civil works contracts £1bn over budget

As a reporter I have been following the High Speed 2 story for two years now. The project is costing the tax payer a huge £56bn and has had many positive impacts for the engineering community but it also affects a vast number of people along the route.

Over this time, I have built up an extensive contact base of those working on the project ranging from the client to engineers and contractors designing the different parts of the scheme.

As the project is currently under construction, I feel that being in the engineering press, I have a valuable role to play in holding the scheme to account through the specialist contacts I have made in the industry.

Through the contacts I managed to establish that estimates of how much the line will cost to build are currently £1bn over the target cost set in the budget. This is a huge and would have an impact for everyone in the country as money is diverted away from other services to pay for the scheme.

I also exclusively revealed the date set to give the contractors the notice to proceed, the permission to start building the line, had been pushed back by six months which could have an impact on the opening date of the line.

In the wake of the fallout of the Crossrail delays, it is even more important that the process is transparent.

Again, both stories were picked up by the national papers.

New Civil Engineer

Exclusive | HS2 civil works £1bn above target cost

12 June, 2018 **By** Katherine Smale

Initial costs for High Speed 2 (HS2) main civil works are coming in around £1bn over budget, *New Civil Engineer* can reveal.

Multiple sources close to the project have confirmed that interim costs submitted by contractors are currently above HS2's target cost of £6.6bn.

While one source said that the collective price was coming in at "around £1.2bn" over budget, another said that some bids were "as much as 30% to 40% higher" than their individual target price.

As a result, *NCE* understands that the notice to proceed has been pushed back from November until February 2019 with one source claiming that they had been told to "go away and sharpen their pencils" to cut costs.

It is understood that the joint ventures for all four of the main civil works are currently coming in above budget.

However, a HS2 spokesperson said that the project "remains on track, and within [the] original cost package".

Last month, *NCE*'s sister publication Ground Engineering reported how the cost of delivering HS2 could rise sharply as a result of the use of target cost contracts without geotechnical baseline reports (GBRs).

The JVs were appointed by HS2 in July last year to develop the main civil works designs for phase 1 of the line. On receiving the bids at an acceptable price, the teams will be given a notice to proceed allowing them to start building the line.

The work being carried out has been split into seven packages, two in the south, three in the central section of the line and two in the north. The packages vary in size and value depending on their complexity.

The contracts are one of the biggest packages of work handed out by the high speed line.

Main civil works packages and contractors

S1: Euston Tunnels and Approaches – SCS JV (Skanska/Costain/Strabag) – £740M

S2: Northolt Tunnels - SCS JV (Skanska/Costain/Strabag) – £1.1bn

C1: Chiltern Tunnels and Colne Valley Viaduct - Align JV (Bouygues/Volker Fitzpatrick/Sir Robert McAlpine) £965M

C2: North Portal Chiltern Tunnels to Brackley - CEK JV (Eiffage/Kier) £724M

C3: Brackley to South Portal of Long Itchington Wood Green Tunnel - CEK JV (Eiffage/Kier) £616M

N1: Long Itchington Wood Green Tunnel to Delta Junction and Birmingham Spur – BBV JV (Balfour Beatty/Vinci) £1.3bn

N2: Delta Junction to WCML Tie-In – BBV JV (Balfour Beatty/Vinci) £1.15bn

Readers' comments (2)

- **Gary Ainsworth** 12 June, 2018 9:46 pm

  Here we go again with cost over runs on a major infrastructure project - and this is before construction even gets going.
  It will also be interesting to see what the actual passenger figures turn out to be compared to the predicted usage once up and running.
  Whilst avidly hoping that these will not be a repeat of the HS 1 situation, sadly the portents do not appear good. All a little worrying for the Civil Engineering Industry and future infrastructure investment.

- **John Griffiths** 13 June, 2018 3:50 pm

  Was anyone actually surprised by this news ???

Florida bridge collapse

On 16th March this year, the under-construction Florida International University bridge collapsed, killing six people. The bridge was being constructed using an innovative technique called accelerated bridge construction, because of which the collapse generated a large amount of interest around the world.

In the immediate aftermath of a collapse, being able to understand the mechanisms of failure quickly and accurately is crucial for engineers to ensure safeguards are put in place to avoid more loss of life.

In the immediate aftermath of the collapse, I wrote a number of stories following the information as it emerged.

However, talking to the network of engineers I have built up, I was able to use my engineering background to disseminate the large amount of technical information on the reasons for the failure to publish a clear and coherent story understandable for none engineers.

The mechanisms for the collapse were then later confirmed by the investigating bodies.

Following the coverage of the collapse, I also spoke on Radio 4 on the PM show to explain the structure, circumstances and factors surrounding the failure and sat on a panel debate at a conference talking about the bridge and the wider ramifications for the industry.

New Civil Engineer

Experts cite explosive joint failure as cause of Florida bridge collapse

20 March, 2018 **By Katherine Smale**

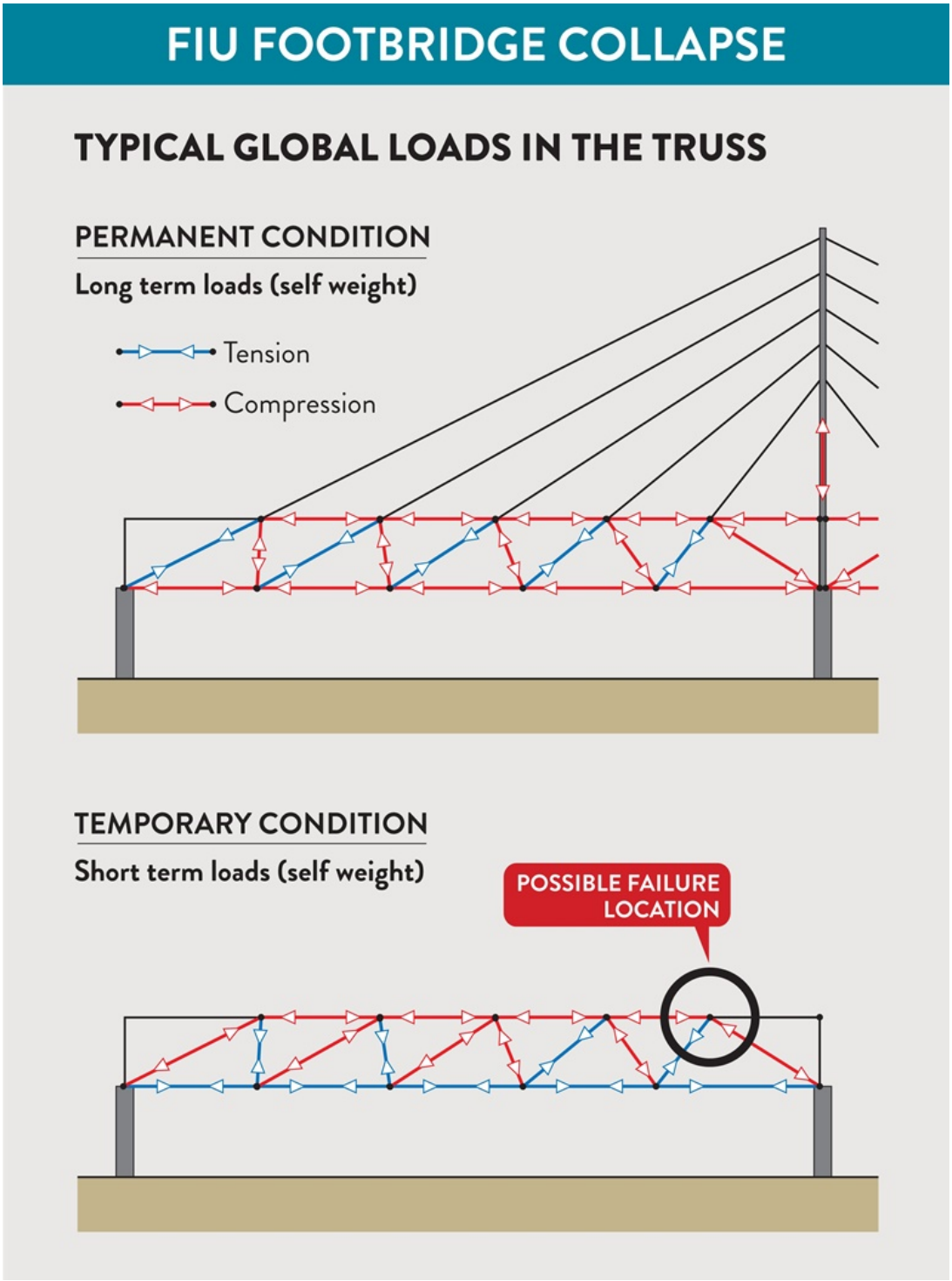
The collapse of the bridge in Florida was probably caused by an explosive failure of a key joint in the bridge's concrete truss, structural engineers have told *New Civil Engineer*.

The 862t concrete bridge over a highway at the Florida International University (FIU) in Miami collapsed last Thursday killing six people. Investigations are now underway to determine the exact cause.

But structural engineers who have spoken to *New Civil Engineer* have studied multiple photographs of the scene and believe the collapse was caused by an explosive failure of the north end, bottom joint – a critical connection in the bridge's structure.

In its final state, the FIU bridge was supposed to be a two span, concrete truss and cable stayed bridge – the main span over an eight lane highway and the backspan over a narrower waterway. However, at the time of the collapse, it was in a temporary configuration having only been partially constructed. Only the main trussed span was in place, with the backspan, central mast and cable stays yet to be installed.

The 53m concrete truss had been installed six days before its collapse. It had been built off site, wheeled into place and then lifted onto its supporting piers. At the time, the bridge appeared stable.



Florida International University (FIU) bridge collape diagrams permanent and temporary

Independent bridge consultant Simon Bourne said something would needed to have changed within the structure to have triggered a collapse.

“For a bridge which is sat there under self-weight, there’s something which has got to happen to cause it to collapse,” he said.

Florida senator Marco Rubio has said on social media that on the day of the collapse the contractor, Munilla Construction, was carrying out post tensioning of cables within one of the diagonal members of the bridge structure.

However, official investigators from the American National Transportation Safety Board said these reports had yet to be confirmed. Highway owner and operator Florida Department of Transportation (FDOT) also reported that it had at no time received a request to close the highway and was not aware of any scheduled “stress testing” of the bridge at the time of its collapse.

However, in photographs of the scene, a blue, post tensioning jack can be seen still attached to a bar which appears to run down the centre of diagonal member 10, the last diagonal closest to the middle pier at the north end.

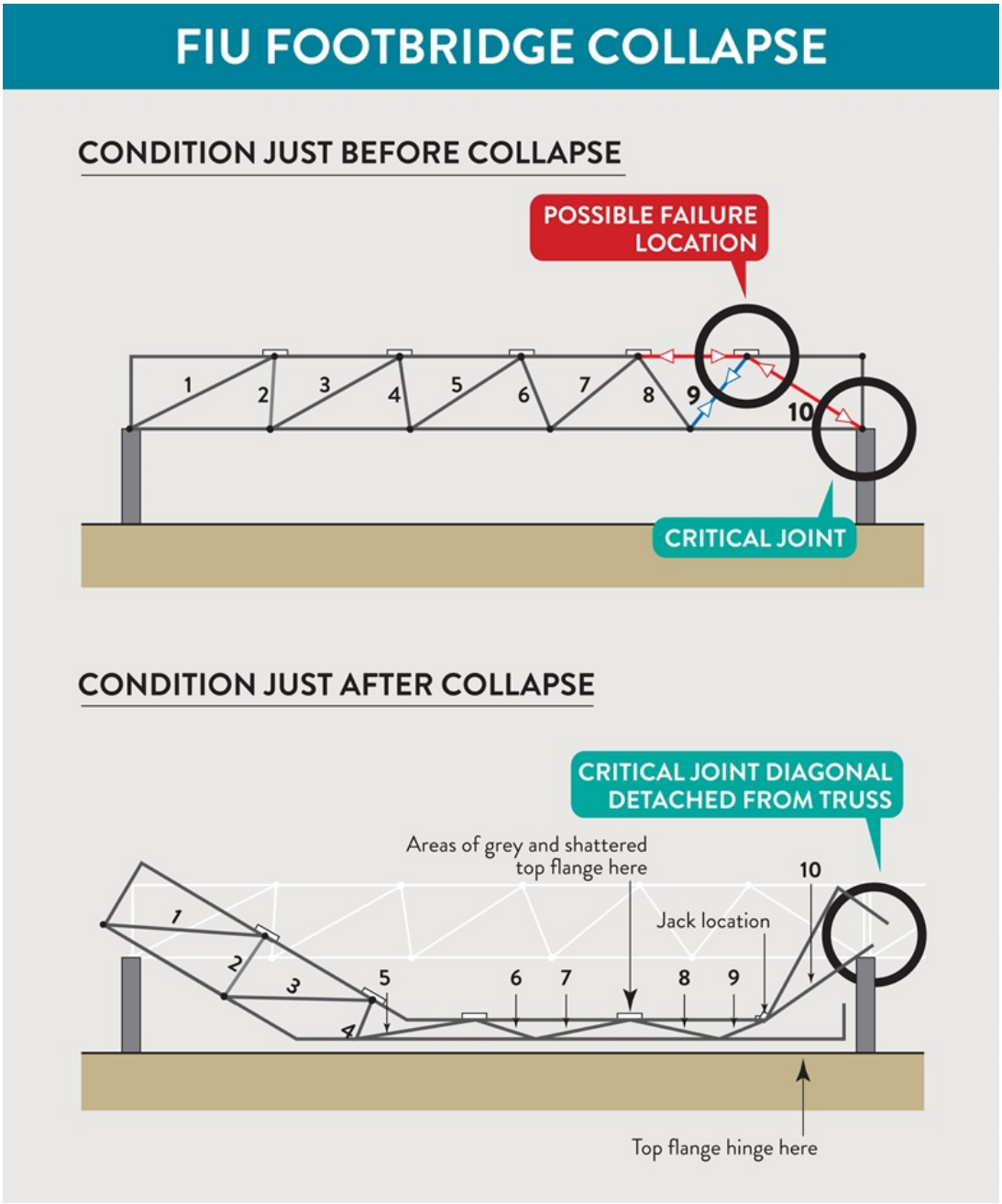
Collapsed end of florida bridge close up of blue jack pa

A blue jack still attached to the end of a bar feeding into diagonal member 10 can be seen on the collapsed bridge.

Bourne said this would indicate the team was carrying out tensioning work at the time.

“I think they probably were carrying out jacking works,” said Bourne. “You only have a jack connected to the bar on for the few minutes you’re stressing and it’s still on in the collapsed condition. If they weren’t stressing it, it wouldn’t be there.”

It is this additional force being put into the diagonal member during the jacking operation that Bourne thinks could have caused failure of the critical end joint.



Florida International University (FIU) bridge collape diagrams before and after

In its temporary condition, diagonal member 10 (*see diagram*), was carrying half the dead load of the bridge. The joint at the bottom end of the member was critical as it had to transfer all of the load into a horizontal force in the bottom chord of the truss and vertical force in the supporting pier.

Bourne estimated the stresses in the concrete at this joint would have been within its limits, and noted failure of the concrete in compression was unusual. Therefore, he surmised the concrete in the joint may not have been properly compacted due to the high density of reinforcement needed to transfer the forces (the cross section of the diagonal is estimated to be around 700mm by 700mm).

This, combined with the additional tension from the jack could have triggered the joint to explode.

“The contractor looks to be stressing a bar which is only capable of putting 0.5MN into a member which is already carrying 8MN,” he said. “It’s not a significant increase, but if it was close to the edge of its capacity or the concrete hadn’t been compacted properly, then that could cause it to collapse.”

With the joint and diagonal member 10 failed, Bourne said there would have been nothing to carry the weight of the bridge. This would have then rapidly caused the whole top corner section to rotate and the bottom chord to collapse, as seen in the video footage of the collapse and photographs of the wreckage.

“In any event, the bottom node clearly exploded, in tri-axial compression, causing the rotation of the whole top corner section, and the fall of the bottom tensile flange,” he said. “Normally, concrete is much stronger in tri-axial compression with loads close to the cube strength being possible – so, that’s odd too,” said Bourne.

“Note that the tri-axial effects come from the diagonal 10-bearing reaction vertically, the bottom flange prestress longitudinally and the top compression in the end beam laterally.”

It is not clear why the jacking operation was being carried out as the member would have already been in compression. One theory is that the contractor was trying to put an additional compression into the member to close cracks which had appeared in the concrete.

Cracks in the concrete at the northern end near the middle pier were reported to FDOT by the bridge’s designer Figg Bridge Engineers two days before the collapse but not deemed to be of “safety concern”.

The exact location of the cracking is not known but, said Bourne, despite the diagonal member 10 being in compression, unexpected bending moments induced during the installation phase, could have caused one of its faces to crack.

Figg Bridge Engineers issued a statement saying it was stunned by the tragic collapse of the bridge.

“Our deepest sympathies are with all those affected by this accident,” it said. “We will fully cooperate with every appropriate authority in reviewing what happened and why. In our 40-year history, nothing like this has ever happened before. Our entire team mourns the loss of life and injuries associated with this devastating tragedy, and our prayers go out to all involved.”

Munilla Construction said it was “devastated” by the event and was doing everything it could to assist with the investigation.

“The new University City Bridge, which was under construction, experienced a catastrophic collapse cause injuries and loss of life…. ,” it said in a statement. “We will conduct a full investigation to determine exactly what went wrong and will cooperate with investigators on the scene in every way.”

Readers' comments (2)

- **Alistair Muir** 22 March, 2018 3:06 pm

  You may wish to see the following video which I hope is genuine; but includes the suggestion that the temporary supports were not positioned as planned, increasing the force in one diagonal member.
  https://www.youtube.com/watch?v=JvmvFQKTrMY
  It includes a dash-cam video of the actual collapse, and casts some (confusing) light on why the diagonals were pre-stressed.

- **JOhn NOrthcott** 25 March, 2018 8:07 pm

This article seems to pre-date the NTSB press conference where they stated that the cable-stayed configuration was purely cosmetic and that the bridge had been designed as a truss bridge. (NTSB video https://youtu.be/XIqeSkdxPdM)
In view of trusses' susceptibility to the single-point of failure mode of collapse, this form of construction should not have been chosen. The recent US history of the I-35 bridge collapse in Minneapolis should have been a reminder of this.
https://www.ntsb.gov/investigations/AccidentReports/Reports/HAR0803.pdf
The single-point of failure problem has been made worse by lack of ductility. There seems to have been a serious lack of reinforcing steel in this structure.
(See this NTSB video starting at 1:30 https://www.youtube.com/watch?v=aeJKqojmHgY)
I agree that "explosive joint failure" seems to be the most probable failure mode, but I think it was more likely to have occurred at the bottom end of the strut - in the zone of your diagram labelled "Critical Joint" - not at the top of the strut.
