The Riddle of the Tay Bridge Disaster

Tom Martin's Tay Bridge analysis

Melissa Berry
Another solution to the riddle has been put forward by mathematician, Tom Martin.

He's long held a curiosity about the cause of the disaster and has applied a structural computer analysis to understand the failure, based on the test results of the broken pieces of the bridge which were carried out at the time.

Tom Martin
My first interest in the Tay Bridge disaster started when I read a book when I was school, that was the first catalyst that got me going on this. The second thing that started me on it was, I received a photocopy of the Court of Enquiry report from a colleague at work who was a metallurgist.

I took the report home, I read it on a number occasions and on reading it, I felt there was a lot of open questions still there to be answered. Years later, I noticed a flyer came through from the and one of the courses caught my eye. And it was entitled Computer Analysis and Structural Engineering given by Professor Iain McLeod.

Prof. Iain MacLeod
Tom was quite different from the other students in that he had a mission in life. The other students were there just to get background information. Tom had a real project to do and he was very dedicated to finding out what was the cause of the Tay Rail Bridge disaster.

Tom Martin:
One of the main criteria we used in trying to solve this problem, was using a very famous principle in engineering and science, which has served science and engineering very well over the past few centuries. It's called Okhams Razor, it's a principle of simplicity and economy. And it states that basically entity should not be multiplied beyond necessity.

There are still some people today who maintain that the train was necessary to bring the bridge down. The study shows clearly that you don't need to have the train on the bridge. You're just adding something extra into the analysis that's not really needed.

When I looked at the Court of Enquiry Report and the calculations that were done at the time of the Tay Bridge disaster, was very aware they were very simple calculations. So the main idea I had was this, I want to use the most modern methods available to reanalyse the structure as if you were analysing it today and see if any new light could be shed on the disaster. So, what I wanted to use was modern computer structure analysis, in conjunction with modern knowledge and wind effect on structures.

Prof. Iain MacLeod
In Bouch's day he would have been able to do some calculations and work out a rough estimates of things such as the bracing load. But what we now can do using computers and only have been able to do this within the last forty years, is to really make quite good predictions of how the thing will deflect and what the forces will be under wind loading.

This is an animated model of the pier of the bridge – up here the high girders, the train would run through here. Now, the foundation consists of two layers of stone masonry and below that the main caisson. Now the fundamental problem was that the bolts for the column were extended only into the second level of masonry and not directly into the caisson and because

of that, when the wind blew, this column here, the base, lifted. That caused the diagonal here, which is the most heavily loaded diagonal, not the bottom one but the one above that, that caused an increase in the load in the diagonals and this one, we believe, is the one that would first go. And then we get a zipping of the diagonals all the way to the top and the whole system topples away.

Melissa Berry
In this theory, the strong wind put an extra load on the bridge causing a failure to start from the bottom and to ripple upwards through the structure.

Another plausible explanation, but engineers should always work from the most up to date and complete evidence. This theory hinged on 100 year old data gathered from only a small number of bridge elements.