A14 Orwell Bridge Safety Management – Closure Protocol

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- Construction of the bridge commenced in October 1979 and was completed in December 1982.
- The Bridge opened to road traffic in 1982 and carries the A14 over the River Orwell just south of Ipswich.
- The main span is 190 metres which, at the time of construction, was the longest pre-stressed concrete span in use.
- The total length is 1,287 metres with a width of 24 metres and a clearance at its highest point of 43 metres.
- Carries over 55,000 vehicles per day.
- Unique environment of Orwell Estuary.

Health and Safety

- Safety of those using, working and living in neighbouring communities is our highest priority.
- Multi-agency approach to proactive and reactive safety.
- Decisions taken to close the bridge due to inclement weather, incidents, or other issues always prioritises the safety of all concerned.

Health and Safety – road safety

- Road safety scheme introduced in 2016 with speed limit of 60mph, enforced with average speed cameras
- Number of incidents has reduced
- Severity of incidents has reduced
- Enforcement regime has seen improved compliance. However offences continue to occur. 6,146 prosecuted in 2016 compared to 2,011 in 2019

Current protocol for high winds

- Protocol developed in conjunction with stakeholders including Suffolk Police, Ipswich Borough Council and Suffolk County Council.
- Bridge will be closed to all traffic if wind gusts of 50mph+ are predicted perpendicular to the bridge and at 60mph+ in all other directions.
- Wind speed thresholds are based on historic data.
- The decision to close the bridge is based on the Met Office forecasts.
- Inform customers in advance of any potential closures and reduce the impact of traffic on the diversion route through Ipswich.

Current protocol for high winds

- Road closures must take place before the winds reach 50mph to enable the safe installation of signs and cones.
- When high winds are forecast we place resources on stand-by.
- Liaise with partners at an early stage to minimise impact.
- Fixed signage is installed for the road closures. These signs have reduced the amount of time it takes to close and re-open the carriageway - 20 minutes compared to over 50 minutes previously.
- 20 closures since 2013, totalling almost 7 days.

Closures of Orwell Bridge

Date	Duration (minutes)	Wind speed max (mph)
27 October 2013	541	74
23 December 2013	388	66
26 December 2013	541	61
14 February 2014	681	65
27 March 2016	381	67
22/23 November 2016	N/A*	50
23 February 2017	628	70
22/23 November 2017	435	60
2/3 January 2018	988	66
18 January 2018	N/A*	72
23 January 2018	261	49
29 April 2018	470	52
29 November 2018	N/A	N/A
13 March 2019	451	60.39
16 March 2019	371	51.89
2 November 2019	355	57.26
13 January 2020	341	46.08
14 January 2020	672	62.41
9 February 2020	1253	70.24
15/16 February 2020	1170	64.87

- 20 closures since 2013
- Almost 7 days in total

What can happen in high winds?

Frequently asked

Separation of high sided vehicles

- Requires stacking space for parked vehicles
- We do not have the ability to safely filter vehicles
- Neither the Police nor Highways England have the resource to carry out and enforce filtering
- Welfare issues for parked drivers

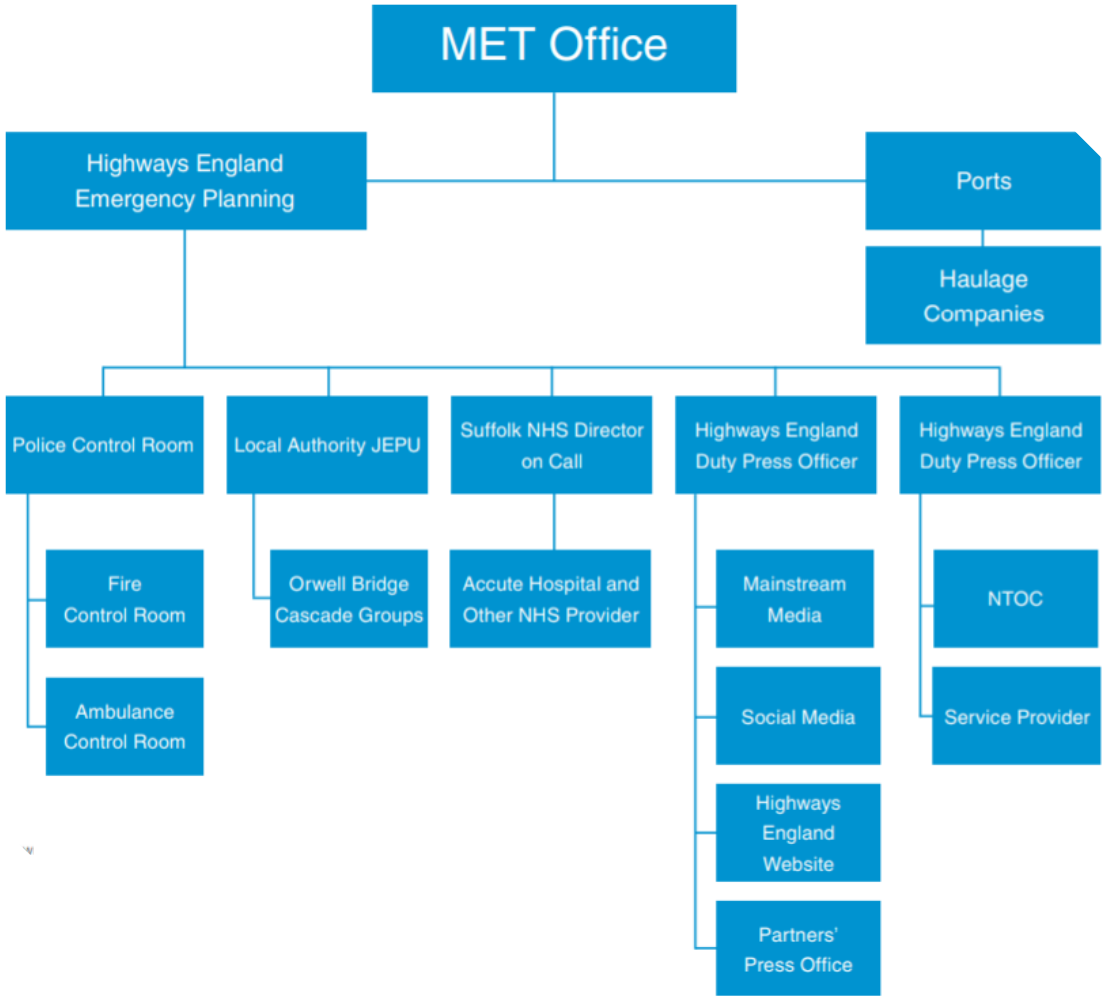
Additional parapets or wind deflectors

- Would be a major structure and introduce complex structural loading on the bridge
- Would cause additional wind loading issues
- Maintenance challenges

Communications

- We have developed a cascade plan identifying key stakeholders.
- The information is passed onto our stakeholders and then circulated to the wider community through their communication processes.
- We also use traditional media and social media to inform customers.
- The electronic messaging signs across the road network are utilised.

Communication cascade plan

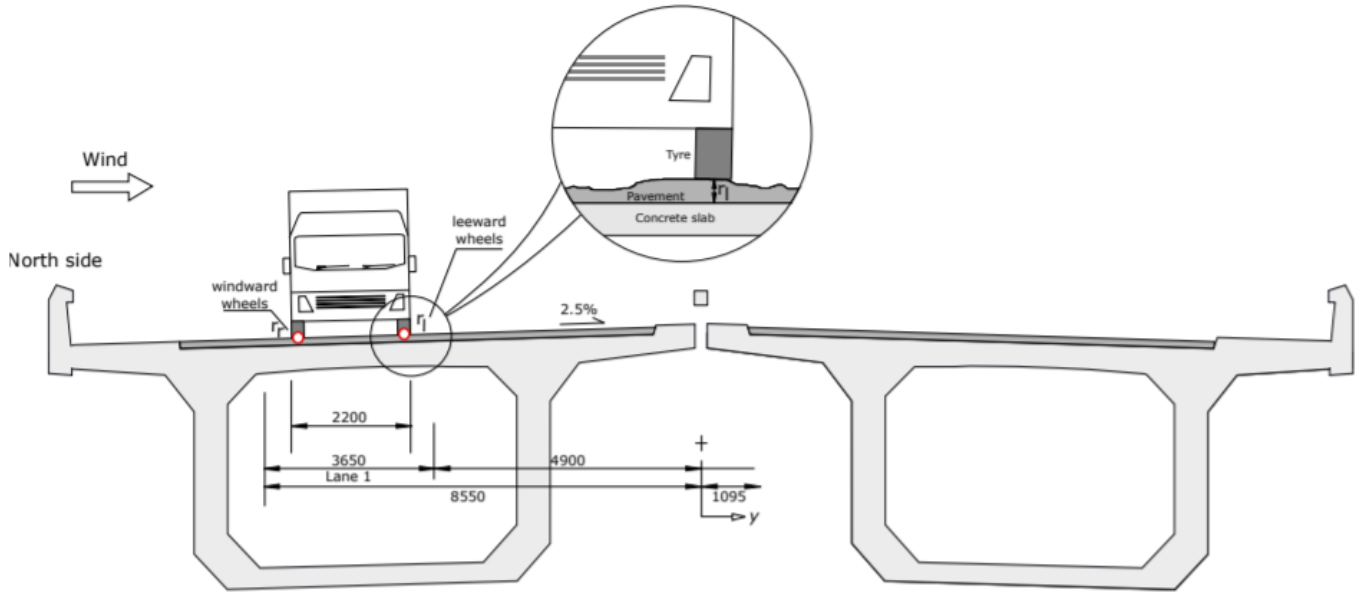


Aerodynamics study

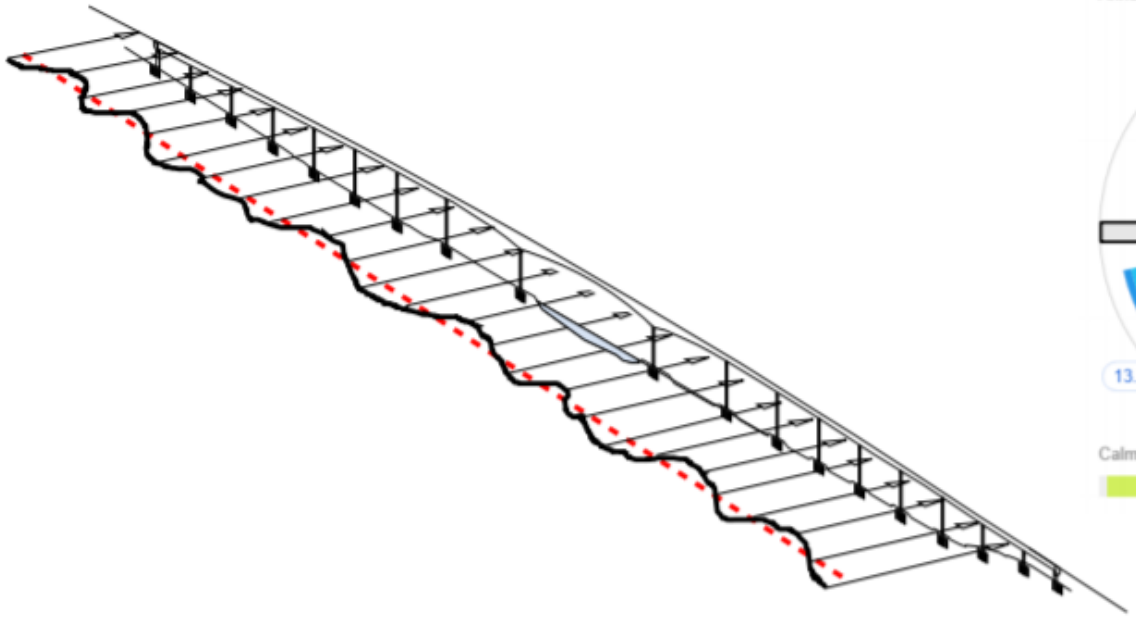
- Highways England wanted explore options for keeping the road open in high winds
- In October 2018, we appointed City University, London to carry out an aerodynamic study on Orwell Bridge.
- The study applied the latest computerised technologies with the objective of confirming that the current protocol is the safest option available and to explore any opportunities for keeping road open.
- The study reviewed vehicle stability under high winds through development of computer bridge models.

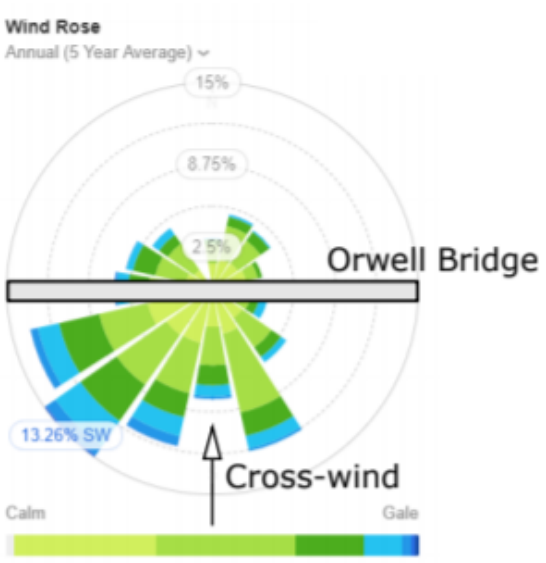
Vehicle stability

- Assessing cross section of bridge and characteristics of vehicles on the bridge deck

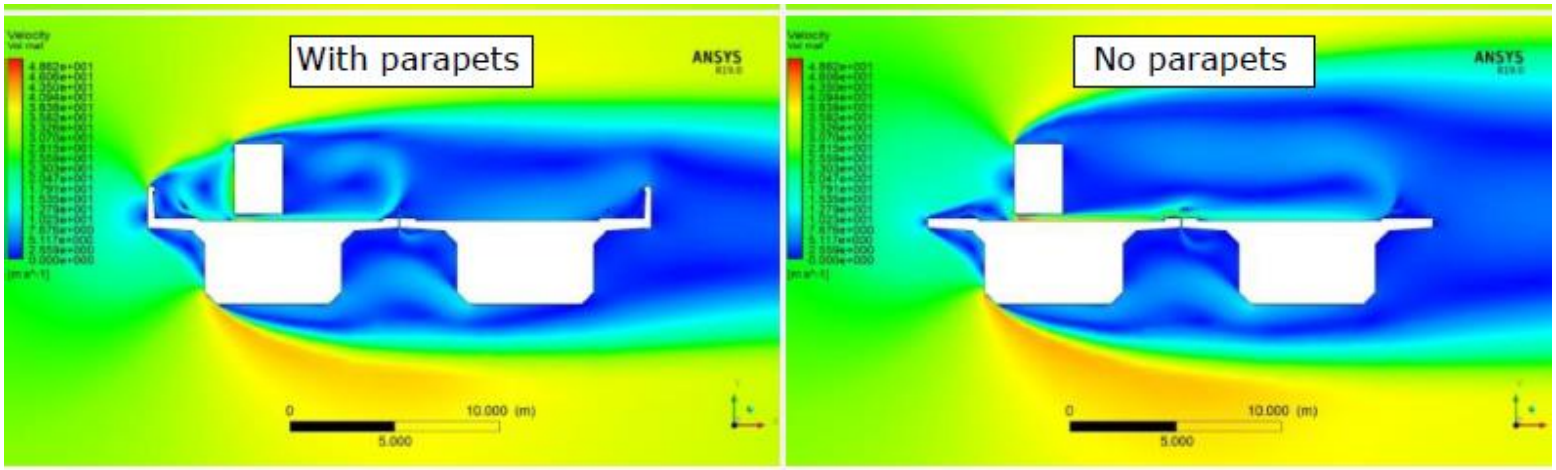


Wind modelling using historical data

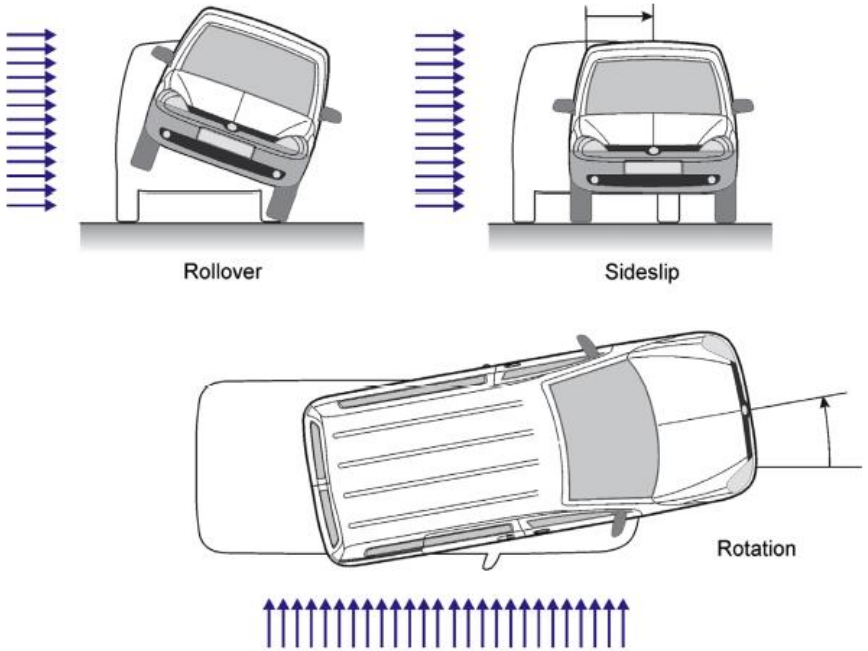




Computational Fluid Dynamics



Driving stability



Study

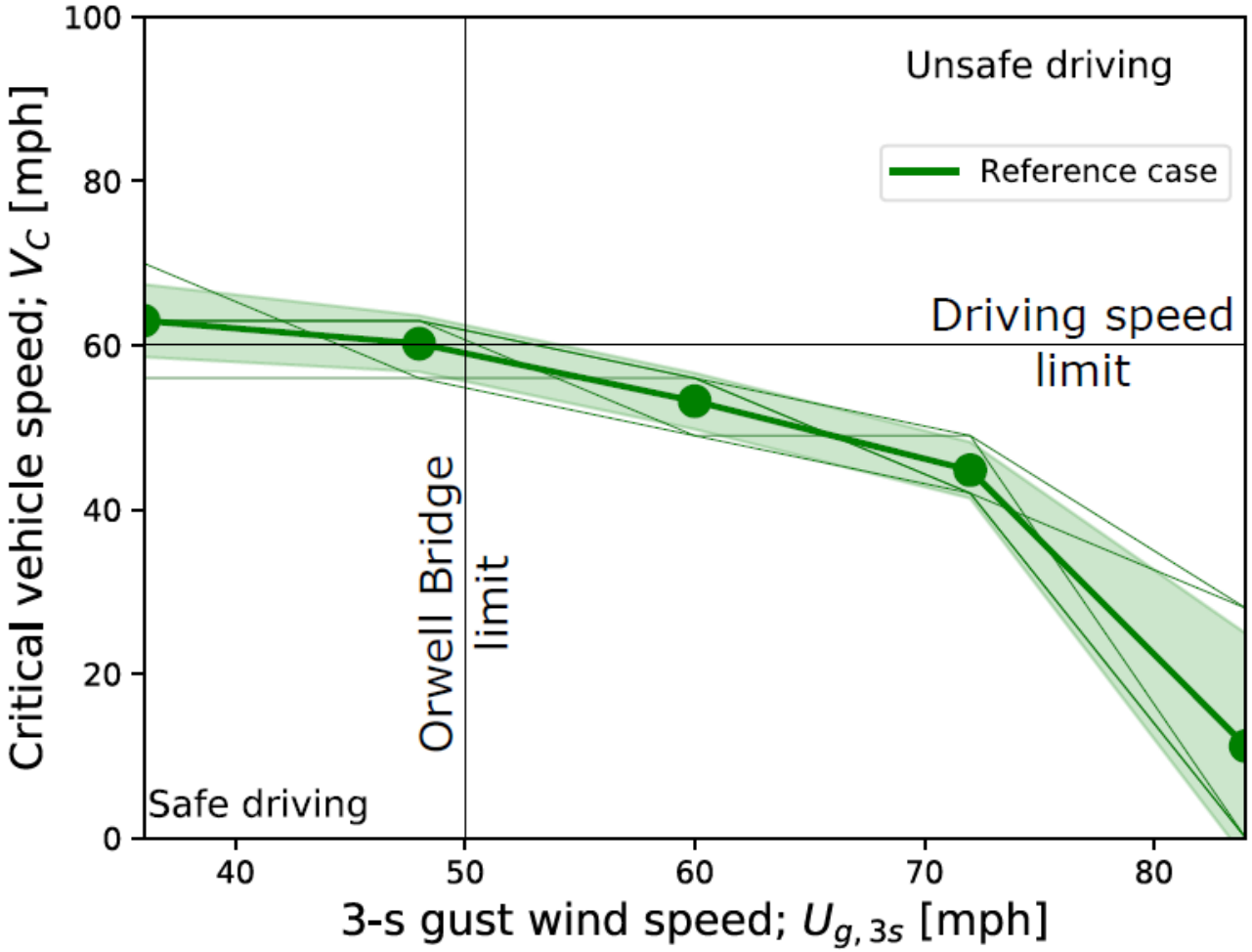
- The study looked at:
  - interaction between heavy goods vehicles (critical vehicles) movement of the bridge
  - bridge geometry
  - road surface irregularities
  - turbulent wind
  - historic wind patterns
- Results for different cases are presented in the form of Critical Wind Curves (CWC), which give for each wind speed the critical vehicle speed above which vehicle accidents occur.

Key Findings

- High sided unladen box vehicles are the most at risk travelling over the bridge in high winds.
- Results confirmed that lane 1 west bound is the most at risk in high wind conditions.
- Speed at which vehicles travel along the structure has a significant effect on their stability in high wind. The difference between travelling at 40mph and 60mph is significant.
- Existing parapets appear to offer a degree of shielding from the wind. Further work required to establish level of shielding, forces on vehicles etc.

Critical Wind Curve

- This is the reference critical wind curve obtained in the dynamic analysis of the Orwell Bridge. It is based on unladen HGV and it ignores the possible shielding of the deck on the vehicles.



Key Findings

- Report is an academic assessment of an operational environment
- Work to translate this and to apply it operationally now required.
- Results show that current wind speed limit is appropriate in safely protecting traffic driving at the maximum allowed speed.
- Initial indications suggest reducing the speed of vehicles could extend the operability of the bridge in high winds.
- Results also suggest that the parapets may provide some level of shielding. This needs further testing.

Key recommendation/next steps

- Consider feasibility of safely implementing a reduced speed limit on the bridge during high winds.
  - Enforcement
  - Signage
  - Statutory Processes
- Investigate feasibility of safely running traffic in lane 2 in both directions during high winds.
- Review the feasibility of safely allowing the eastbound carriageway to stay open under high wind events.
- Further work to validate results required.

Questions