Effects of Heavy Vehicle Loading on Bridges

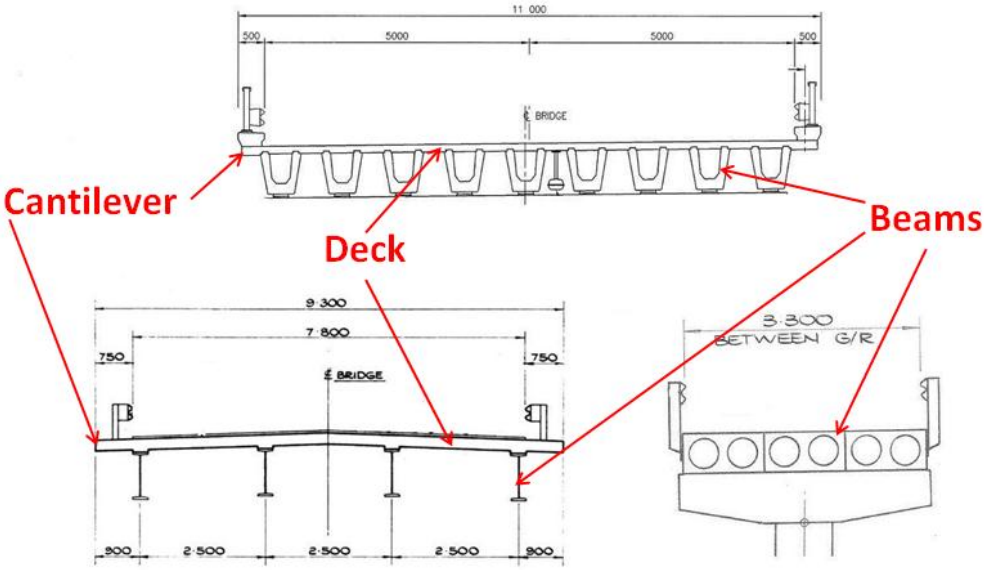
Why is the configuration a heavy vehicle important and how does it affect the performance of bridges?

No two bridges are identical. Foundations, road alignment, workmanship at construction, age or condition all affect the bridges capacity, which is why there may be different restrictions on permits for similar looking bridges…

But there are generally 3 parts of a bridge deck that will be affected by a heavy vehicle:

- the beams
- the deck and
- the cantilever.

All of these elements affect the load carrying capacity of the bridge.



The Beams

The beams are the main load carrying element. They are the strongest part of the deck and transfer the load from the bridge deck down into the foundations at either end of the beams. The length of the beams, or the span, affects the amount of load the bridge can carry – the longer the span, the longer the vehicle that will be able to fit on it, so the higher the load it will have to be able to carry.

So it is the ***GROSS LOAD*** of the vehicle, and how it is distributed along the beam, that has an effect on the beams. Concentrated loads have a worse effect than loads that are more evenly distributed along the length of the beam.

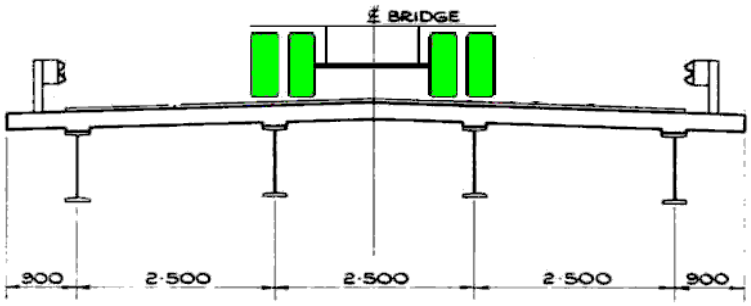
The Deck

The deck, which is usually concrete or timber, is the section of the bridge that vehicles actually drive on. The number and spacing of the beams determines the length of deck that will be loaded by a vehicle. The more beams and the closer the spacing, the lower the loads applied to the deck. The greater the beam spacing, the more of an axle will fit on it, so the higher the applied load.

So it is the ***AXLE LOAD*** of the vehicle, and how it is distributed across the deck, that has an effect on the deck. This is why axle configuration and number and size of wheels affect the performance of the deck.

When axle loads are too high to be taken by the deck, a restriction may be put on a permit, to locate the axle over the beams rather than the weaker deck element, to prevent the wheels punching through the deck. This is why a **CRAWL CENTRAL** restriction may be used.

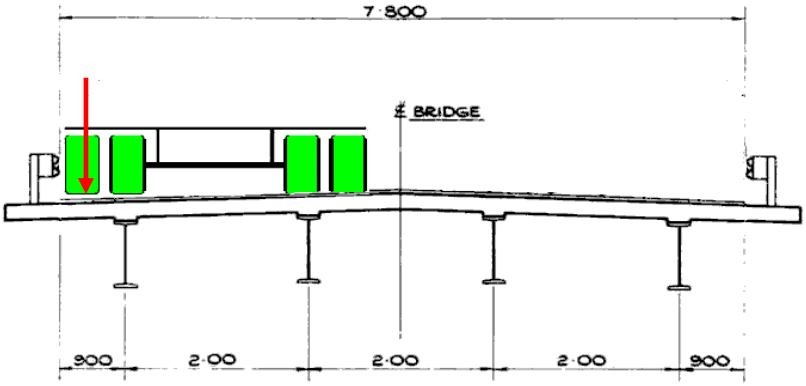
Using a CRAWL CENTRAL restriction to locate an axle load over stronger beams elements



The Cantilever

The third part of the deck affected by a load is the cantilever. The cantilever, or overhang beyond the edge beam, can vary greatly in length and is generally the weakest part of the deck. The overhang length determines what loading it will need to be able to take – the longer the cantilever, the more wheels will fit on it, so the greater the loading.

So it is the ***WHEEL LOAD*** (and size) that has an effect on the performance of the cantilever.



Summary

Vehicle configuration affects the performance of a bridge in a number of ways.

The gross load of a vehicle affects the beams of the bridge, with distributed loads causing less stress on the beams than concentrated loads.

The axle load and layout affects the deck of the bridge. Heavy axle loads can overstress decks, particularly where beam spacing's are wide. Restrictions, such as 'crawl central' may be required to reposition vehicles away from weak deck sections and onto the stronger beam elements.

Wheel size and loading will affect the cantilever of the bridge, with high wheel loads and small tyre sizes causing the worst effects on the weak cantilever sections.

So it is important that, when applying for a permit, the correct configuration, including length, axle spacing, track width and wheel size is entered onto the application, as all of these things will affect the performance of a bridge.

Overloading of vehicles, or non-compliance with permit restrictions, should obviously be avoided, as these can have a severe effect on bridge elements, which may result in extensive repair works or permanent weight restrictions having to be applied to the bridge in the future.