

BRIDGES

UK BRIDGES BOARD

BACKGROUND BRIEFING ON HIGHWAY BRIDGES

Background

This note is written to assist the Press understand the nature of bridges and the manner in which they are designed and managed so as to preserve the safety of our communities and infrastructure.

Our transport infrastructure is reliant on bridges which form essential links in the highway and rail networks. Bridges represent a key economic and strategic asset and many provide prominent features in the landscape or contribute to our national heritage.

Nature of bridges in the UK

For historical reasons we have a rich heritage of bridge structures in the UK. Many were built centuries ago and reflect the materials and style of the times, specifically masonry arch structures. Modern bridges are usually concrete or steel or a combination of both materials designed to work in unison.

All bridges, of whatever type or age, rely on sound foundations in order to transmit the very heavy loads into solid ground strata. Most of these foundations are hidden below the ground surface or, in the case of river crossings, beneath the water.

Responsibilities

There are a variety of authorities and organisations responsible for bridges in the UK. Motorway and trunk road bridges are the responsibility of the Highways Agency in England and the regional governments in Scotland, Wales and Northern Ireland. Network rail is responsible for the majority of rail bridges whilst the responsibility for most of the bridges on the non-trunk and secondary road network falls to the Local Highway Authority.

Other organisations also own or manage significant numbers of bridges, for example British Waterways, BRB Ltd (formerly known as British Rail Property Board), Transport for London and Docklands Light Railway. The longest span bridges in the UK have either a separate authority to oversee the management of the structures e.g. the Humber Bridge Board and the Forth Estuary Transport Authority or else are operated and maintained by private companies e.g. the Severn River Crossing PLC.

Design criteria

Modern bridges are designed by engineering experts to sustain an agreed level of loading. This loading sometimes increases with time, for example, as lorries become heavier or more numerous.

In addition to carrying the agreed design loads (traffic, wind, flowing water and the structure's own weight) all bridges are required to have an excess capacity to

safeguard against the unexpected. These excesses or margins of safety are stipulated in mandatory design standards.

In deciding the level of design load and the excess to be provided a balance has to be struck (and a judgement made) between the minimum acceptable level of safety, and the cost of providing additional capacity. Thus, for example, it may be decided that a wind force likely to be exceeded only once in 100 years is sufficient and that designing for a 1000 year wind is unjustified. The same approach is used in designing flood defences.

All bridges are designed, or checked (if an old structure) for the reasonably foreseeable events that might occur over their lifetime. However, every so often an unexpected event occurs which can lead to severe damage or collapse such as during the extreme floods in November 2009 and with the Ynys-y-gwas bridge in Wales in 1985 which experienced extensive internal corrosion.

Thus there is no such thing as an absolutely safe structure (and the same principle applies to buildings). However, in 'day to day life' the public should expect the structures they use to be safe.

Management

All bridges deteriorate with time and events.

In order to avoid a level of deterioration which would give rise to a concern over the safety of the structure, and also in order to maintain the asset value for the benefit of the tax payer, all bridges are inspected at agreed intervals. Maintenance work is derived from these inspections. Although key safety work is given priority, maintenance work generally is subject to budgetary constraints as are all other work activities undertaken by public bodies.

Inspections

Highway bridges are generally inspected and maintained in accordance with a national code of practice to ensure that they are safe and able to support the traffic passing over them.

General Bridge Inspections which primarily involve a visual inspection of a structure are usually carried out at two-yearly intervals. Principal Inspections, which involve more detailed examinations at close range, are carried out every six years unless a risk based assessment has shown the period between inspections needs to be reduced or the period can be safely increased. Every part of the bridge is given a visual examination, the condition of each part is recorded separately and where necessary materials testing or structural load assessments are ordered.

The inspection results are used to identify repair works which are necessary in order to maintain the bridges. Higher priority is given to the parts of a bridge that have a direct bearing on its strength and safety.

Special Inspections are carried out following specific events occurring such as a bridge being struck by a vehicle or concerns being raised about the stability of a structure. They can be prompted by a flood or high river flow causing possible scour damage. Scour is the removal of the supporting ground around or beneath the foundations of a bridge caused by the turbulence in fast flowing rivers that may lead to catastrophic and sudden failure.

The programme of special inspections will be prioritised to ensure that the bridges which were subjected to the highest flood waters and are on strategic routes are inspected first.

Warning of failure

Bridge engineers design structures so that, whenever possible, if the bridge is grossly overloaded, or is in some other difficulty, it gives visual warning signs before actual collapse e.g. spalling (falling) concrete, sagging, misalignment. These are all signals that something is amiss and allow time for closure and examination.

However there are some limited events which can cause failure with less warning. Scour is one of these. The undermining of the bridge piers and/or abutments by scour can, particularly with older masonry structures, cause immediate collapse or collapse without the same visual warning signals as described above.

Climate Change

With climate change we might expect extreme weather events to take place more frequently in the future and thought must be given to how we can adapt our infrastructure to deal with their effects. However, the options for protecting the very many solid masonry bridges across the country are likely to be limited and it needs to be recognised that in extreme flooding they will be vulnerable.

Disruption

Historically, many towns have grown around river crossing points. The inevitable disruption that would occur if any bridges close through failure or damage highlights how communities are reliant on bridges for access to schools, work and hospitals. Bridges also carry utility pipes and cables and when these are severed additional problems are caused through lack of power or communications.

Although it is possible that, in the short term, temporary bridges can be provided to restore some of the missing links, it would take a considerable time before an area recovers from the social and economic impact of any flooding or similar adverse event.

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