Permits for heavy vehicle access

Load assessment of bridges for Road Managers

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Abstract

Most road network asset owners know *what* structures they own, *where* they are located and what *condition* they are in. Less understood, is the *capacity* of those structures to cope with modern vehicles and permit vehicles.

In Australia, responsibility for the management, maintenance and development of road networks rests with asset owners comprising State Road Authorities, municipal councils and private road network owners, collectively known as Road Managers.

Over the last 100 years, vehicle loading has increased significantly. The first vehicle bridges were designed for loading of only ten to 15 tonnes. Now, vehicles on road networks often carry loads in excess of 45 tonnes as standard practice and much higher loads under permit.

Increased loading means increased risk for asset owners. Overloading can lead to structural damage, asset under-performance and failure. For asset owners, resulting injuries to road users, related liabilities and network disruption are a very real concern.

To manage the risk of structural failure, Road Managers (Councils in particular) seek to understand the design capacity of individual structures so that appropriate control mechanisms can be established. Knowing the design capacity is also essential for Road Authorities when evaluating heavy vehicle permit applications (from the National Heavy Vehicle Regulator) to determine what access is permitted to the network.

pitt&sherry has developed a tool that for bridge assessment which stores the relevant load capacity information. This facilitates efficient assessment of permits with complicated axles spacing's and masses. The tool brings together a range of information to make the task quicker and more reliable.

Introduction

pitt&sherry has undertaken heavy vehicle load assessments of bridges for many years. Traditionally, assessments have been conducted for state road authorities, rail agencies and councils.

In recent years **pitt&sherry** has performed extensive work to load assess permit vehicles on Tasmanian state controlled and local government roads for a vast number of bridges types.

Tasmania's Department of State Growth licenses **pitt&sherry**'s asset management software, AssetAsyst®. The opportunity arose to bolster AssetAsyst® and provide the Department with an integrated tool that stores asset inventory, condition, financial, risk and works data as well as information required to quickly and efficiently manage permit requests from the National Heavy Vehicle Regulator.

Currently, permit assessments are managed largely through a sophisticated Excel spreadsheet. Spreadsheet disadvantages include data integrity risks, data sitting outside the asset register, multiple parties are unable to access the system at the same time and the structure of the spreadsheet is cumbersome to program.

With the support of the Department of State Growth, **pitt&sherry** has developed a Heavy Vehicle Assessment module within AssetAsyst® which is expected to replace the spreadsheet process by early 2018. The module is currently undergoing beta testing by **pitt&sherry**'s engineers and is expected to be made available for Councils to use around Australia by mid 2018.

What vehicles need permit assessments?

Under relevant Federal Legislation General Mass Limit (GML) vehicles such as buses, semi-trailers and B-doubles do not require specific permits to cross most bridges.

Higher Mass Limit (HML) vehicles need to observe relevant designated networks during their travels. Most state government roads provide access to HML vehicles, however there is limited access to local roads.

All vehicles need to observe posted load limit signs for bridges.

Permit assessments are required for oversize and over-mass vehicles, along with special purpose vehicles. Over-mass vehicles may have an axle tonnage greater than that allowed for under general operation or a mass density (close axle spacing) exceeding the provisions of a GML vehicle. The National Heavy Vehicle Law provides for three classes of heavy vehicle of which special purpose vehicles reside in Class 1. Further details can be found from the law or visiting the National Heavy Vehicle Regulators website.

Heavy Vehicle Operator needs to apply for a permit through the National Heavy Vehicle Regulator (NHVR). Permit requests are made online and the Heavy Vehicle Operator indicates the vehicle type with relevant registration details, axle masses, axle spacing and wheel configuration. The Operator is also required to state the route for which they desire the permit.

The NHVR distributes permit requests through to relevant authorities to perform the permit assessment. Authorities need to determine whether it is safe to grant access and if such access would cause a detrimental effect to other road users. A request may be denied if it would lead to an unsafe situation or adversely affect the functionality of a bridge or culvert asset.

What are the benefits of a permitting system?

The permit system provides Operators with reassurance that a proposed vehicle can safely travel on the network and protects the safety of other road users and the wider community.

In 1996 the National Road Transport Commission determined that even allowing minor increases of axle masses to GML vehicles could lead to significant saving to the community. The benefits included the ability to carry heavier loads, lower export costs, fewer vehicles, improved safety and improved environmental performance.

Like the benefits obtained from GML to HML vehicles, similar benefits extend to granting of permit vehicles access, provided the bridges have sufficient capacity to support the loading.

Permit vehicles often carry indivisible loads that can't simply be split and are common place in heavy construction such as mining and civil infrastructure.

What needs to be assessed?

When a heavy vehicle operator requests a permit there is an associated list of bridges and culverts that need to be assessed. As bridge construction technology has evolved, these structures can be expected to take a range of forms.

Pre 1940 structures were designed for loads typical of a steam roller of 15 tonnes hauling a number of wagons. Due to the comparatively light loading, structures were typically designed from short spans of timber girders.

It was not until 1946 that the design load increased to reflect newly designed vehicles representing approximately 32 tonnes. At that stage, concrete cast in places and precast concrete bridges become popular.

In 1967 there was a 30% increase in the design loads to approximately 44 tonnes. Structures were developed with new precast concrete forms to accommodate the increased loading along with a need to allow structures to span further.

In 2004 the design load increased to approximately 160 tonnes with the intent of catering for the loading requirements of another 100 years.

What are the risks?

The risk of heavy vehicle permits was highlighted in 2016 with the collapse of a bridge in Italy while a 108 tonne permit vehicle was crossing. The collapse caused the death of one person and the injury of another ten.

What guidelines are available?

Permit assessment have typically been undertaken by State Road Authorities. To assist Councils and local government authorities, limited information is published externally.

pitt&sherry has drafted guidelines for heavy vehicle assessment in order to obtain consistency across assessors. These guidelines provide definitions for inputs into the assessment and outline the assessment approach required to streamline the process.

pitt&sherry have determined five levels of assessment:

BAL 1: The capacity available for live load based on original design standard

BAL2: Capacity is calculated for each structural element, with distribution factors determined from formulae

BAL 3: An extension of BAL 2 for specific purposes

BAL 4: Distribution factors from a grillage or similar model

BAL 5: Advanced assessment that may utilise finite element models or load test data.

In developing a heavy vehicle route assessment module, the software enables use of up to BAL 4, while the results of a more advanced BAL 5 model may be stored for later assessment.

Inputs into the assessment

To undertake an analysis in AssetAsyst® the following inputs are required.

1. Customer details.
2. Vehicle configuration
3. Structure capacity information
4. Vehicles and structures to be analysed

The software module has been configured to take the information provided by the NHVR or to be manually entered by the end user.

The structure capacity information is entered into AssetAsyst® by a bridge engineer. Information is required relating to the shear forces, positive and negative bending moments. The capacities are provided at points of interest along each span and support capacities and arrangement are also entered.

To streamline the process a generic capacity input can be used whereby the capacity information is modelled of the assumption that the original design load capacity is achieved.

Once structure information is entered by the Bridge Engineer the Permitting Officer may enter the vehicle details for assessment and choose the structures to be analysed on the route indicated by the Operator.

Results

Assuming a vehicle passes all checks, it would be permitted to travel. The assessment may highlight a travel restriction is required, such as marked lane or centreline travel. If the checks aren't passed then the outcome is either to deny a permit for the vehicle to travel or to undertake further engineering assessment, such as a BAL 5 check.

What are the benefits of automation

Automation provides a range of benefits to the network wide assessment of permits. These benefits include:

- Information from previous assessments can be used for future assessments
- Using an automated process provides for consistency of results
- Undertaking assessment in an asset management system allows for integration with other systems as well as historical retention of permits stored against each customer and asset
- Less experienced staff may participate in the heavy vehicle checks.

Minimising the potential for death or injury from inadvertently permitting a vehicle to cross a bridge with inadequate capacity is the greatest benefit of implementing a rigorous automated process.