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Linear Programming Approach for Upgrading Bridge Infrastructure Networks

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Abstract

Bridges are important links in the road network. Over the years, bridges have been designed to various standards as they were built in different periods. As funds availability is tightened, road authorities around the world are facing challenges related to the implementation of optimal bridge management programs based on lifecycle cost, remaining life and bridge capacity considerations.

The road network in any country originated with roads connecting the capital city with regional centres. Next, the rural towns were connected with villages and regional centres. The road network grew as the population grew and settled in various parts of the country. In the past bridges were considered to be permanent ever since they were built and minimum maintenance was carried out. Now there is more awareness of the need for bridge maintenance and rehabilitation. Road authorities realise the need to allocate sufficient funds for this purpose.

Bridges are relatively more expensive to construct than road pavement, and are therefore designed for a longer service life. Failure of a bridge has more severe consequences than a road failure – none more spectacularly illustrated than by the loss of three spans of the Tasman Bridge in Hobart because of ship collision in 1975 (Bureau of Transport Communications Economics (BTCE), 1997).

As the road network grew over the years, different bridge design standards were used at different times of the development of the road network. Therefore the current road network in Australia consists of bridges of different standards, i.e. bridges with different load capacities and geometric configurations. Bridge Infrastructure Network is a collection of bridges in a region connected by a network of roads. These roads are identified by route numbers, and the load-carrying capacities of these routes are controlled by the individual structural capacities of the bridges.

The range of age and strength in Australia‟s bridge infrastructure network reflects the longer service life and the increase in mass and number of heavy vehicles. For example, bridges presently in service on national highways were designed and constructed more than 50 years ago for loads half the size of those applied by contemporary heavy vehicles (BTCE, 1997). It is the strength of these older bridges reaching the maximum use of their capacities, owing to increased mass of newly introduced heavy vehicles that limits the potential productivity enhancements associated with these increases.

Vehicle technology has also developed over the years. So has the demand for transportation of goods by road. Settlement of population also has been widely spread across the country. Therefore the road network has to be upgraded to meet current and future demands. This has not been the case in the past owing to lack of resources (Bureau of Transport Economics, 1984). Bridges were built when they were due for replacement or when a new route was added to the existing network.

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