FROM THE EDITOR'S DESK

INTEGRAL BRIDGE

An Integral Bridge (IB) is a structure where there are no bearings over the abutments and no expansion joints in the superstructure. Integral Bridges worldwide have shown saving in initial cost and life cycle cost through reduced maintenance. As Integral Bridges have demonstrated better performance under earthquake loads, their use needs to be encouraged. In addition, Integral Bridges eliminate expansion joints and provide better riding quality thereby adding comfort to the road users. Because of advantage of reduced initial cost and maintenance cost and better service performance/riding quality, the engineers worldwide in countries like USA, UK, New Zealand, Australia, Japan, China etc. are preferring to use Integral Bridges. In UK, bridges up to a length of 60 m are mandatory to be of integral type. However, because of complexity in design of long Integral Bridges, their use is generally limited in length to about 100 m.

Integral bridges are characterized by monolithic connection between the superstructure and the substructure (piers and abutments), unlike the traditional bridge construction, where the superstructure is supported on bearings and transfers all the forces to substructure and foundation through bearings. Provision of expansion joints and bearings in traditional bridges allows movement and rotation of the bridge deck, without transferring any force to abutment/pier and foundation due to thermal/creep/shrinkage induced movements. In case of IB's, the deck carries the movement of deck to the abutment as well as to the backfill soil behind the abutment. The approach slab between the bridge end and the pavements accommodate the necessary movements, which leads to a strong soil-structure interaction.

Apart from the fully integral solutions without expansion joints or bearings, it is also possible to have structural solution, where only the expansion joints at abutments are omitted, but the bearings are provided. The back-wall portion of the substructure is directly connected with the superstructure in such case and the superstructure, back-wall and approach slab moves together 'towards' and 'away' from the backfill during the thermal expansion and contraction. Such solutions, known as 'Semi-Integral Bridges' (SIB's), are often appropriate particularly for the rehabilitation of bridges.

Advantages of using Integral Bridges are added redundancy, improved seismic performance, improved structural reliability, improved riding-quality and noise reduction, improved durability due to absence of expansion joints, reduced maintenance cost, reduced traffic disruption required for change of joints, useful concept for strengthening of existing bridges, etc.

Disadvantages of adopting Integral Bridge concept are limited span range due to restraints to movements caused by thermal, creep and shrinkage, chances of cracking in case of differential settlement between foundations resting on varying strata or varying scour conditions in case of river bridges, complex structural analysis as it involves soil-structure interaction.

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The IB's, are complicated structural systems for design. Apart from considering the primary loads (i,e. dead, live, wind etc.), secondary loads (such as creep, shrinkage, settlement, temperature effects etc.) need also to be considered under serviceability limit state as well as ultimate limit state. Methods of analysis, methods of modelling of structure for analysis, as given in existing code IRC:112 (For reinforced/prestressed concrete structures), IRC:22 (For composite structures) and IRC:24 (For steel structures) will be applicable for integral bridges as well. Linear Elastic analysis may be used for both the serviceability and ultimate limit state.

IRC has recently published a new document IRC:SP:115-2018 entitled "Guidelines for Design of Integral Bridges". These guidelines are applicable to fully Integral Bridges, with structural deck made of steel, concrete or composite construction, including precast and prestressed concrete.

These bridges are easier to construct. Time dependent stresses such as creep, shrinkage, settlement and temperature effects are considered in design. More efforts are required in design of such bridges and the benefits are worth the inputs in design. Since literature for their design are available, therefore, bridge engineers may consider adopting integral bridges.

(Sanjay Kumar Nirmal)
Secretary General

"Safety first... because accidents last."

"Safety: expect the unexpected"

"Chance takers are accident makers."

"Hug your kids at home, but belt them in the car!"

"The essence of road safety is to live healthy"

"Safety is Key, it is Up To You And Me!"