INTEGRAL BRIDGES

There is an old saying that, 'a chain is as weak as its weakest link'. Bearings and expansion joints are the weak links in an, otherwise, robust and sturdy structure. Hence, interest in integral bridges or jointless bridges is increasing and their performance has gained international attention. Presumably, the primary reason for this interest is due to the acceptance of integral bridges by many transportation departments throughout the world. Integral bridges are constructed without any bearings or joints between spans or between spans and abutments.

A look at some of the primary differences between integral bridges and their jointed counterparts clearly indicates why integral bridges are gaining widespread interest and acceptance. Firstly, integral bridges are built without bearings and expansion joints. Not only will this result in savings in initial costs, the absence of joints and bearings will also reduce maintenance efforts. This is an important benefit because expansion joint sealing devices and bearings have short effective service lives and need to be replaced periodically during the service life of a bridge. Secondly, simple characteristics of integral bridges make for rapid and economical construction as there is no need to construct cofferdams, make footing excavations, place bearings and deck joints etc. The most obvious reason why integral bridges have become so popular is their outstanding resistance to chemical corrosion and deterioration. Since these bridges do not have movable joints at abutments, deck drainage contaminated by chemicals cannot penetrate deck slabs and adversely affect the primary bridge members. The other advantage of integral bridges is simplified replaceability. When using multiple span integral bridges to replace single span structures with wall-type abutments, the greater adaptability of integral bridges allows them to span across existing foundations, thus avoiding the need to remove them.

Like most of the jointed bridge structures, integral bridges are subjected to secondary effects due to shrinkage, creep, thermal gradients, differential settlements and deflections. The stress levels generated by the secondary effects are generally understood, but as yet not well quantified. However, they could be controlled and be provided for, such that except for continuity connections at supports, they may not be considered when designing short single span or multiple span continuous bridges. This simplification is possible because design specifications usually permit higher stresses than these secondary stresses.

However, the attributes of integral bridges are accompanied by some limitations too. Although the characteristics of integral bridges provide many design simplifications, their unified structural system does require the design of continuous spans for multiple span bridges. Secondly, integral bridges have to be provided with approach slabs to prevent vehicular traffic from causing the adverse effect of consolidating backfill adjacent to abutments. Because of the continual cyclic movement of integral bridges, approach slabs must be anchored to the bridges; otherwise, continual bridge movement and joint infiltration may shift the slabs toward approach pavement, away from abutments and off the approach slab. Thirdly, care has to be exercised when using integral bridges for stream crossings because most deck type integral bridges are buoyant. Consequently, for those bridges with superstructures which can become submerged, air vents are to be provided and anchorage to piers has also to be considered in design. But, integral bridges are considered more resistant to end-span uplift than their continuous end-jointed bridge counterparts since the substantial weight of integral abutments provides the necessary uplift restraint.

Literature survey has revealed that in UK, the Highways Agency Departmental Standard, "Design for Durability", requires designers to consider designing all bridges with lengths of upto 60 meter and skew angles of less than 30 degrees as integral bridges. This advice is intended to prevent problems of joint leakage over supports and reinforcement corrosion which typically occur in non-integral forms of bridge construction. In USA, integral bridges have been built since the 1960s and are increasingly being used as replacement structures. The developed countries have mostly/are in the process of adopting integral bridge construction.

It is apparent that, in our country, there is still a great deal of research to be done on these structures. However, due to limited funding sources for bridge maintenance, it is desirable to establish strategies for eliminating joints as much as possible and converting/retrofitting bridges with troublesome joints to jointless design. Continuity and elimination of joints can also lead the way to more innovative and aesthetically pleasing solutions to bridge designs. As bridge designers, we should never take the easy way out, but consider the needs of the road user first.

(R.P. Indoria)
Secretary General