

Integral Precast Concrete Deck Panels in Bridge Deck Construction

The concept of precast concrete deck panels that provide stay-in-place formwork for bridge slabs has been around for decades, but despite the time saving advantages of quick placement and no removal, precast deck panels have not found widespread acceptance as formwork on bridges, because up to now they have added cost and dead weight without contributing to the structural capacity of the deck. However, building on recent research that has shown that laterally restrained deck slabs resist wheel loads through arching action, precast concrete deck panel forms have now been designed to be an integral structural component of the bridge deck when topped with a thin lightly reinforced cast-in-place concrete slab. The integral precast concrete deck panels are designed to incorporate the tie reinforcement that is necessary to develop arching action within the composite slab. This tie reinforcement projects beyond the deck panels and is developed over the supports, so it provides the axial stiffness that is necessary to ensure arching action between girders.

There is significant benefit in incorporating integral precast concrete deck panels in the deck, because they can be placed at rates of over 1 m²/crane minute, because they provide an instant working surface, because there is no weight penalty associated with them, and because they form part of the structural slab and do not have to be stripped out later. However, there is another significant benefit in the case of staged deck replacement work when the construction is subjected to vibration from traffic continuing to use a portion of the bridge. Although concrete is very vulnerable to cracking in the period between initial and final set because of its low strength at that age, the strain set up in a thin concrete deck due to traffic vibration is frequently low enough not to cause cracking. However, there is a tendency for traffic vibration to induce secondary vibration in the formwork over the length of the form, and this secondary vibration increases the surface strain in the concrete and the probability of cracking during the vulnerable period. Integral precast concrete deck panel forms have an advantage over conventional formwork, because after they have been made continuous by being grouted into place, they provide a stiff and continuous form. The increased stiffness reduces the amplitude of secondary vibration, and the form continuity eliminates potential points of high local strain at the ends of the form. Both of these effects reduce the strain in the concrete surface and thereby reduce the likelihood of cracking of the new concrete.

Prior to incorporation of integral precast prestressed concrete deck panels into the Capilano Bridge across the North Saskatchewan River in Edmonton, full scale load testing was carried out on an as-sembly of 2.9 m long precast prestressed panels at the ISIS Structures Laboratory at the University of Manitoba in Winnipeg to verify the arching action of the composite slab. The bridge remained open to traffic throughout the construction period, though during the deck pours traffic was reduced to one lane in each direction and heavy trucks were detoured around the site. Although the deck was subjected to traffic induced vibration, up to this point no visible cracking has been observed in the new cast-in-place concrete deck placed over the integral precast concrete deck panels.

We expect that integral precast concrete deck panels, designed to carry wheel loading by arching in the composite slab, will be chosen increasingly, not only to facilitate construction but also to minimize deck slab cracking due to vibration on bridges that cannot be closed to traffic during deck replacement.

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Capilano Bridge
Center Third under Construction



Demolition Complete



Deck Panels in Place



Steel in Topping Prior to Pour



Tie Steel Projecting
from Panels Over
Supports, Anchored
Around Studs