Research

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The BRITE PROJECT

A series of innovation case studies has been developed by the BRITE Project of the Cooperative Research Centre for Construction Innovation.

These case studies demonstrate the benefits of innovation in the Australian building and construction industry.

Concrete planking innovation saves over $300,000 on major sports stadium

A new method of manufacturing concrete planks and connecting them to supporting steel beams resulted in substantial benefits to the Suncorp Stadium project in Brisbane, Australia. The 'composite' connection method developed for this project generated estimated savings of:

- $260,000 in steelwork costs; and
- $70,000 in labour costs.

The Project

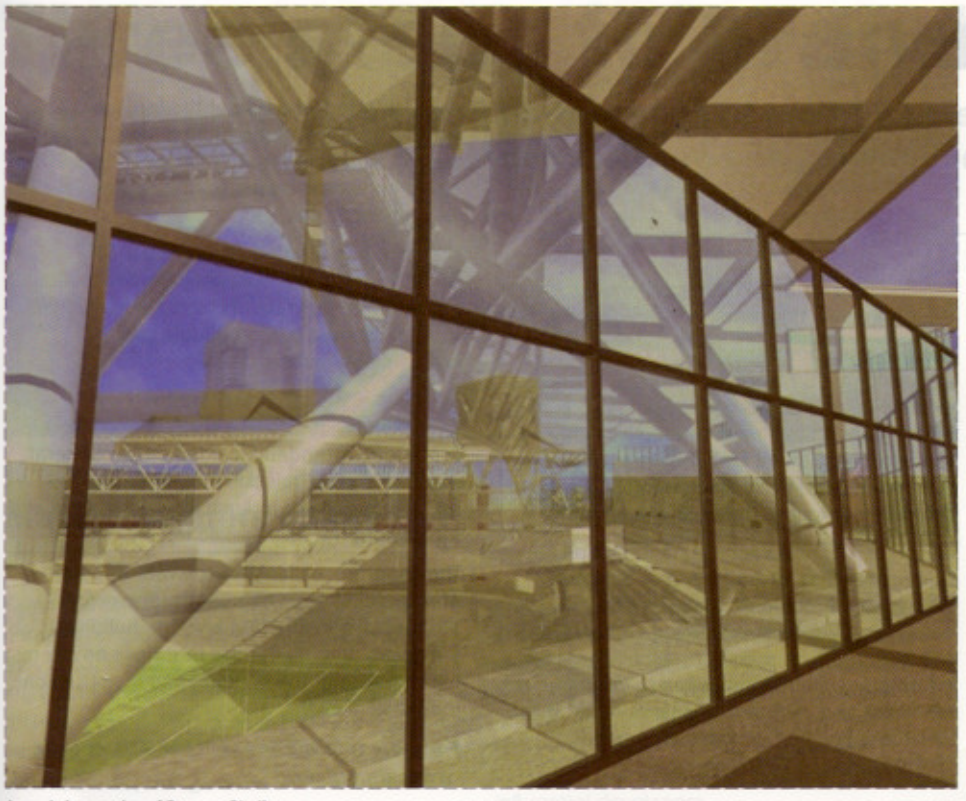
Suncorp Stadium is a 52,500-seat, world-class football facility, constructed by Multiplex Constructions and Watpac Australia, as the Lang Park Redevelopment Joint Venture.

The project was under a two stage, document and construct, guaranteed maximum price contract, with a budget of $280 million. The client was Sport and Recreation Queensland, with Queensland Department of Public Works managing and directing the project.

The stadium was opened in June 2003, delivered on time and within budget, after a two-year documentation and construction program.

The Achievement

The 'clever plank' innovation involves the design of formed rebates in the ends of precast prestressed polystyrene-voided concrete planks, together with the design of concrete topping and reinforcement details, to provide a crack-free, reliable composite



An early impression of Suncorp Stadium

Close-up of clever plank connection prior to the application of topping concrete showing rebates, steel studs and steel beam

Constructing Suncorp Stadium

The glass façade at Suncorp Stadium

connection between the planks and steel beams supporting the grandstands at Suncorp Stadium.

The two main elements of this innovation – the polystyrene-voided planks, and the formed rebate detail – have only been combined on a few occasions globally in the building industry. The particular planks supplied by Quickcell Technologies, and the particular rebate and associated details designed by Arup, are unique to the Stadium project and have resulted in substantial benefits.

The Innovation

Instead of saving plank weight through the more conventional extrusion process which creates a hollow core, Quickcell casts polystyrene blocks into the planks to create voids.

This technology is relatively common in the civil sector for bridge beams; however, it is only just beginning to be transferred and modified for use in the building industry.

Quickcell Technologies was the first company in Australia to manufacture precast prestressed polystyrene-voided concrete building planks (as opposed to bridge beams), and one of the first in the world to do so.

Compared to extruded building planks, 'clever planks' have flexibility in the positioning of voids within each plank. The voids in the cast planks provided by Quickcell Technologies can be positioned to keep the ends of the planks solid, providing enhanced shear resistance. Also, rebates could be formed at the ends of the panels to achieve reliable composite connection to steel beams.

The strength of the composite connection in turn created the opportunity to use lighter steel beams, which provided the key savings.

The efficiency of the clever plank, with its rebates and capacity for composite connection, was not covered by the Australian Building Code or available research data.

Arup, the designing engineers, therefore sponsored an engineering student to conduct full-scale prototype testing to verify the performance of the novel connection design. The testing confirmed its structural efficiency, and the Stadium concourses have been successfully constructed with crack-free concrete topping.

The Benefits

The use of clever planks reduced the weight of the Stadium grandstand steel floor beams by approximately 25%, due to the efficiency of the composite connection between the planks and the steel beams.

This translated to an estimated saving of $260,000, which represented approximately 8% of the cost of the grandstand steelwork. Further, the concrete topping detail resulted in toppings free of the cracking that normally occurs with use of standard planks. Not having to repair cracks resulted in an estimated saving of $70,000.

These combined benefits, totalling $330,000, have been estimated compared to precast prestressed polystyrene-voided concrete planks with a conventional non-composite connection to steel beams.

The Implementation Process

The original design included conventionally formed concrete beams and slabs. The Joint Venture pursued the idea of a steel beam and plank design, based on advantages related to time, risk and management of sub-contractors. It was found that while the components were more expensive for steel beam and plank construction, the timber and sub-contractor savings related to the absence of formwork were significant.

There were few obstacles to the implementation of clever planks on the Stadium project. The type of contract employed, allowed for the development of alternative designs and for shared benefits between the contractor and client if the project was delivered below the guaranteed maximum price. It seems this contractual driver helped to create an environment where innovative ideas were explored and embraced.

For further information regarding BRITE research, visit www.brite.crcci.info, or contact Dr Karen Manley, CRC for Construction Innovation, ph 07 3864 1762, email: k.manley@qut.edu.au