This case study was written at the time when OneSteel was part of BHP. In that context, in some instances within this case study, reference may be made to BHP.

Showro

A composite slab and beam floor system met the key construction criteria of speed, economy and safety for National Capital Motors' showroom extension and new workshop.

In designing National Capital Motors' new 930 m^2 showroom and 1140 m^2 workshop in Tuggeranong, ACT, structural engineer John Dickson, principal of John Dickson Consultants Pty Ltd, presented four design alternatives for the suspended floor system to builder David Fleming of Providence Construction Pty Ltd.

"The builder was appointed prior to the final design and it was useful for him to have his input at the design stage," John said.

All four design alternatives for the suspended floor were fully produced and costed, each utilising a structural steel frame:

1. Composite slab and beam system using the partial shear theory
2. Precast concrete floor planks on a steel frame
3. Precast concrete floor system with infill concrete
4. Metal deck concrete slab on non-composite beams.

The composite beam system with a Condek slab was chosen as the preferred option because of its relatively low cost and constructability benefits for the builder.

"The current code [AS2327.1-1996], utilising the partial shear theory, makes a significant difference to the economics of composite design by requiring about 50 per cent fewer shear connectors than would have been required by the previous code," John said.

"This resulted in a 10 per cent saving on structural steel costs for the suspended floor."

In designing the system, John used COMPBEAM™ software, which enabled the design calculations for several options to be evaluated in half an hour, rather than half a day and several pages of manual calculations for each option when done by hand.

"The COMPBEAM™ program is of great assistance to the designer," John said. "It makes determining the most approp-riate beam a breeze. Within half an hour several trial sections can be evaluated, and a comprehensive results printout can be obtained for the chosen section.

"COMPBEAM™ makes the use of composite beams a readily accessible option for the designer," he added.

The composite beam system also improved safety on the job as fewer workers were required on site. It took only eight hours for two people to lay the metal deck and install the shear studs on the entire floor.

On another safety point, the metal decking at slab penetrations was not cut out until the walls or permanent handrails were built around the penetrations, thus eliminating the need for temporary handrails, while still providing a safe site.

Site Constraints

One of the main constraints on the site was the existing building and paving on the high side of the property. This dictated the required floor to floor height of the workshop. The depth of the floor beams and slab had to allow for the minimum required headroom in the workshop.

The use of composite secondary beams, supported by non-composite continuous primary beams raised into the depth of the composite slab, produced the shallowest floor system of the design alternatives.

The primary beams are spaced at 7.2 m centres and are continuous over spans of 8.4 and 7.0 m. The load carried by the beams, through the secondary beams, is that from a 120 Condeck slab supporting a 3.0 kPa live load and a 0.3 kPa superimposed dead load. The primary beams are non-composite and were designed by plastic analysis, the section size required being a 460UB67. The top of the non-composite beams was lifted within the depth of the slab to achieve headroom requirements and also to simplify the connection of the 250UB26 secondary beams by eliminating coping.

Another constraint on the design was that National Capital Motors continued

om of Steel

The new look National Capital Motors.

Underfloor steel framing, under construction.

to operate its existing business on the site during the construction period.

As the steel was fabricated off-site, the composite floor system required a lot less time and activity on site and therefore meant less disruption to National Capital Motors' business, when compared to a reinforced concrete floor.

Added speed was also achieved as the floor system did not require any propping. According to builder David Fleming, this was especially important as the site was subject to continual rain for two weeks following the construction of the footings.

"Had this been a reinforced concrete job we would have had to put plates under all the props to ensure the formwork would be okay with the waterlogged ground," he said.

With the composite system, the structure was erected as soon as there was a break in the weather, and work for the slab on ground took place under cover provided by the suspended deck.

Streamlined Shop Detailing

A significant cost advantage for the project was the fact that the design engineer was also the shop detailer.

This allowed the builder to let the tender on a full set of workshop drawings.

According to Doug Flynn from steel fabricator Walpett Engineering, this generally results in a more competitive quote from fabricators as they know exactly what is required and all coordination of the usual project documents is complete. Coordination problems that sometimes arise in structural and architectural drawings are resolved well before fabrication is due to start.

"The successful fabricator is able to start fabrication immediately after securing the job," Doug said. "This may fill a quiet period in his workshop or at least allow him to program his work with more certainty."

Another benefit of the composite system was that all the steelwork, including permanent slab formwork, shear studs and edge forms, was supplied and installed under the one contract by the steel fabricator. This arrangement resulted in at least one less sub-contract to administer. Also of significance to the builder was that, with only one erector required for the system, the conflicting needs of two erectors on site at the same time were avoided.

David did comment on one lesson learned during the project.

"The handrails around the edge of the slab were constructed from timber because it was used elsewhere on the site," he said. "In hindsight it may have been very easy for steel handrails to be fixed to the steel beams."

Project Participants

Client : National Capital Motors
Builder/Project Manager :
Providence Construction Pty Ltd
Structural Engineer :
John Dickson Consultants Pty Ltd
Steel Detailer :
John Dickson Consultants Pty Ltd
Design Concept Architects:
Giles Tribe Pty Ltd
Architectural Drawings :
Lindsay Hunter
Steel Fabricator :
Walpett Engineering Pty Ltd
Steel Erector :
BSB Erection Pty Ltd
Deck & Stud Installer :
Stud Welding International Pty Ltd