Queensland Uni's skyw

Architects, Peddle Thorp Pty Ltd recently completed a challenging project at Queensland University of Technology (QUT), Gardens Point Campus. Faced with a growing need for additional office space for administration and student services staff, and an extremely restricted site, the architect's creatively added an additional two storeys to the top of the podium of the existing eight storey "O" Block tower. The existing two storey podium includes a foundry, heavy engineering facilities, and a thermodynamics laboratory.

The extension, constructed by Graham Evans Pty Ltd, incorporates the conversion of the Level 2 podium roof to office space, a 3.5m wide extension of the Level 2 floor in the form of a walkway, and a new level of office space above (Level 3). In addition, the Level 2 walkway links at the north-west end with a new podium walkway extension, and at the south-east end with a bridge (see fig 1) which spans over the existing roadway and courtyard to the adjacent Civil Engineering Block. The walkway is supported at the outside by raking struts which transfer the load back to the wall line at Level 2, thereby ensuring clear access to the carpark below. The walkway balustrade is of lightweight steel construction which minimises the superimposed load on the walkway supports.

The steel portal frame roof, clad in BHP Building Products Klip-Lok 700, Colorbond 'Heritage Red', and curved to a radius of 36m, provides a visually attractive element when viewed from the adjacent roadway and neighbouring buildings. Exterior walling consists of rendered concrete and fibre-cement panels painted to match the existing lower storeys.

In conjunction with Consulting Engineers, Alexander Browne Cambridge & Partners, the Architects adopted a structural steel framed, composite floor solution for the two additional floors, which provided a number of benefits:

1. fast construction due to off-site fabrication of steelwork and quick erection of steel components, potentially enabling earlier occupation by the client,
2. lighter mass of steel composite floors which minimises the additional load on footings, existing concrete waffle floor structure, and in particular, existing concrete columns some of which are unbraced over two storeys,
3. reduced on-site congestion on what is a restricted site with difficult access,

4. lighter erection lifts enabling smaller capacity mobile cranes to be utilised.

Existing foundations comprise piles bearing on rock and are adequate to carry the increased loading from two additional steel composite floors. External stairs are also constructed in steel for speed of construction, and to minimise the extent of foundation work required so as to avoid existing in-ground services in the area.

The existing podium roof (Level 2) comprised a concrete slab covered by a waterproof membrane. The membrane was retained and topped with a 180mm thick lightweight concrete screed followed by a 50mm thick normal density concrete topping, to match the floor level in the existing tower section. The new Level 3 floor (see fig 2) typically comprises a central line of support comprising two 530UB92 Primary Beams, spaced 3.5m apart, and spanning 8.5m longitudinally along the centre of the podium extension. Primary beams at the outer wall locations consist of 310UB40's spanning 4.25m between columns. Primary beams support 360UB51 secondary beams which are spaced at 2.8m centres, span 8.6m, and support a 120mm thick insitu concrete slab on 0.75mm Bondek. Both primary and secondary beams act compositely with the slab due to the action of 19mm diameter shear studs, which are installed in pairs, and are spaced at 200 centres and 400 centres respectively. The steel columns are typically light erection columns (200UC46 or 200UC60) and are concrete encased for fire protection.

Beams were unpropped during construction but the slab was propped at midspan. Since the existing floor comprised a waffle slab having a 75mm thick slab, care was taken to avoid overloading the existing slab. The Level 2 walkway floor comprises 200UB25 beams at 2.1m centres, supporting a variable thickness insitu concrete slab on 1.0mm Bondek. Beams are supported at the inner end by fin plates which are connected to the existing concrete edge beam by chemical anchors, and at the outer end by diagonal struts which connect at the base to the existing concrete edge beam at Level 1 below. Diagonal struts comprise 'starred' 100x100x10 Equal Angles which are joined

vard expansion

Fig 1 (Top): Pedestrian bridge during construction.

Fig 2 (Above): Level 3 steel composite floor.

at the heels. Angles are enclosed in a 300mm diameter fibre reinforced cement tube and the assembly was concrete filled prior to erection, to provide the necessary fire rating.

The building structure is designed for an ultimate design wind velocity of 54m/s. Lateral stability is provided at the south-east end by end wall bracing in the two additional storeys and a new 150SHS diagonal bracing member between concrete columns in the two existing storeys. At the north-west end of the building, diagonal steel bracing is utilised in the new storeys which transfers loads to the existing concrete frame at lower levels.

Bridge construction consists of vertical trussed sides, a 120mm thick Bondek slab floor on cross braced steel framing, and a curved, steel framed roof. Sides are enclosed by steel mesh infill panels. The bridge structure is 2.4m wide, spans a maximum distance of 16m, has an overall length of 29m, and is supported near the midspan point on inclined tubular struts which in turn are supported on a piled foundation. In the cross direction, bridge superstructure relies on rigid frame action for stability, and resultant lateral forces are transferred to the existing buildings at each end.

In accordance with the Building Code of Australia, the building is 4 storey, Class 9B, requiring Type A Construction. Steel beams were fire sprayed and steel columns were concrete encased to achieve the necessary Fire Resistance Level of 120minutes.

Fabrication and erection

A total of 130 tonnes of structural steel was fabricated for the project by James Engineering Pty Ltd, with 116 tonnes required for the building and 14 tonnes for the bridge. The building features double-curved, steel framed fascias which were fabricated in two planes. Tapered beams in the Terrace walkway roof structure were fabricated from 360UB's which were split and rewelded to achieve the desired profile. James Engineering cut and holed all connection plates using their in-house laser cutter. The curved roof profile was achieved by varying the purlin cleat heights.

The bridge structure was fabricated in six segments, delivered to site and pre-assembled, and then erected in one piece. Erection of all steelwork was carried out by Active Construction Services using a 35 tonne Lima pin jib mobile crane and a 20 tonne hydraulic Kato mobile crane. Structural steel shop detail drawings were prepared by QEI Pty Ltd.

Protective Coating

Due to the public nature of the facility all exposed steelwork, including the bridge and balustrading, is hot dipped galvanised to provide superior resistance to graffiti and abrasive damage. Internal steelwork is prime coated with Dulux "Luxaprime" Zinc Phosphate urethane alkyd primer. Internal steelwork that required fire spray protection was not painted beforehand.

Project participants

Architect:	Peddle Thorp Pty Ltd
Construction:	Graham Evans Pty Ltd
Consulting Engineers:	Alexander Browne Cambridge & Partners
Fabrication:	James Engineering Pty Ltd
Erection:	Active Construction Services
Detail Drawings:	QEI Pty Ltd