Taking lightweight steel solutions to new level

Zinnia Apartments, Yarraville VIC

Rothelowman

A new high-end multi-level residential building project in Melbourne's inner suburbs is proving how lightweight steel can be used as the main structural element supporting multilevel builds, taking advantage of its lighter weight and higher tensile strength.

Believed to be the largest light gauge steel (LGS) apartment building in Australia, the three-level Zinnia Apartments development located in the inner-western suburb of Yarraville comprises an array of 39 one, two and three-bedroom architecturally-designed apartments.

Load-bearing LGS frames the whole building with structural steel in this case taking an ancillary role mainly to support cantilevered balconies and variations in inter-tenancy wall layouts from floor to floor.

The building's framing system comprises over 80 tonnes of high tensile TRUECORE® steel from BlueScope in 1.00 and 0.75mm thicknesses, covering a floor area of over 3200sqm. TRUECORE® is a zinc/aluminium/magnesium alloy coated steel with a distinctive blue resin surface finish specifically for the house framing market.

Structural Project Engineer and Associate at Wood and Grieve Engineers, **Ashley Willis** said the project was quite complicated structurally with three levels rising to a reasonably complex roof structure with multiple falls whilst maintaining multiple head heights throughout the top floor.

"The apartments are ostensibly framed with roof and floor joist trusses landing on load bearing walls fabricated from light-gauge steel sections," he said.

They practice requested testing as this was the first time it had worked with lightweight steel on a multi-level project and needed to confirm that the joists were stiff enough so floors wouldn't bounce which would transmit noise throughout the apartments.

To confirm that the steel frames and floor joists would meet the building's structural and acoustic requirements, the project's prime steel contractor, Dynamic Steel Frame (DSF) had the steel components built to the engineers' specifications and then independently tested for strength at the SMART technologies laboratory at Swinburne University.

Two floor systems were subjected to a four-point bending test: one with a 5.5-metre span and 300mm deep trusses at 450mm centres and another with a 6.3-metre span and 350mm deep trusses at 450mm centres.

The testing involved loading each floor system to 4kPa to check a fully loaded scenario deflection, then doubling that to 8kPa and testing for absolute worst case scenarios before unloading and checking the condition of the joist. The floor systems were then tested under load to breaking point to confirm the failure mode.

The steel passed comfortably with ultimate failure occurring only at reaching an equivalent applied UDL of 12.5kPa and a deflection of over 45mm which was three times the applied design load.

"The steel from BlueScope exhibited equal deflection characteristics to the highest quality wood joist products on the market achieving seven-millimetre deflection for a 4kPa applied load over a 6.3-metre span," Mr Willis said.

"This is in keeping with the maximum live load deflections that are expected to occur due to apartment usage."

At the engineer's request, DSF also built a full acoustic rig - essentially a four by four-metre dummy room with the entire acoustic system proposed on the project fitted to it and two layers of 19mm 'yellow tongue' wood flooring and 10mm underlay.

Other considerations regarding the steel's compliance with Australian Standards and the National Construction Code were addressed through additional testing at DSF's premises in Dandenong South, Victoria.

Mr Willis said that the structural steel was called up to complement the light steel framed schema to take account of sections where the design varied from the fundamental grid.

"Due to offsets in the floor-to-floor layouts, structural hot-rolled steel universal beams (UB) and pre-fabricated column (PFC) sections were required to transfer wall loads from above to offset wall positions below, which then had continuous structural steel support down to the ground floor concrete slab," he said.

"The apartment design also has cantilevered balconies and terraces with planters that required structural steel support. Lateral loads are resolved using braced inter-apartment and corridor walls."

The structural design required 3D frame analysis and verified using spreadsheets. Structural framing was shop-drawn using advanced Tekla Structures software which enabled exact dimensional set out and coordination with architectural, precast and other building elements.

In-house detailers at DSF provided an extensive amount of design optimisation around the structural and architectural designs.

Mr Willis indicated that the structural steel itself was little fuss, designed using conventional practice to Australian codes and standards.

The key advantage for the builder of using a light steel frame over alternative materials was in saving time and about $500,000 less in construction costs.

There was very little space to work with at Zinnia Apartments so limiting trades onsite was important. Being relatively light means minimal lifting and handling needed for loading and installation.

"Cranage was difficult due to difficult site access, but the light framing made moving trusses easier," said Intracon Director, **James Banks.**

It also allowed earlier access to floors for following trades as no curing or back-propping of the structure is required, enabling installation of internal wall cladding to be undertaken concurrently.

All the frames were fully installed in 11 weeks, about seven weeks faster than working with concrete.

Dynamic Steel Frame General Manager, **Peter Blythe** said all components were prefabricated off-site and delivered as walls, trusses or joists.

There are already some indications that this project could be somewhat of a game changer for the residential market with more multilevel builds already in the pipeline.

"We currently have two more multi-storey builds being awarded to us – three-storey townhouses in Essendon and a three-storey apartment building in Geelong," Mr Blythe said.

PROJECT TEAM

Architect: Rothelowman

Builder: Intracon

Structural Engineer: Woods and Grieve

Light Gauge Steel Engineer: Structerre

Light Gauge Steel Fabricator: Dynamic Steel Frame

Structural Steel Fabricator: Eltham Steel

Steel Detailer: Dynamic Steel Frame

Frame Carpentry: CNC Construction

ASI Steel Distributor: Vulcan Steel

ASI Steel Manufacturers: BlueScope, OneSteel