Bisalloy Steels

bulletin

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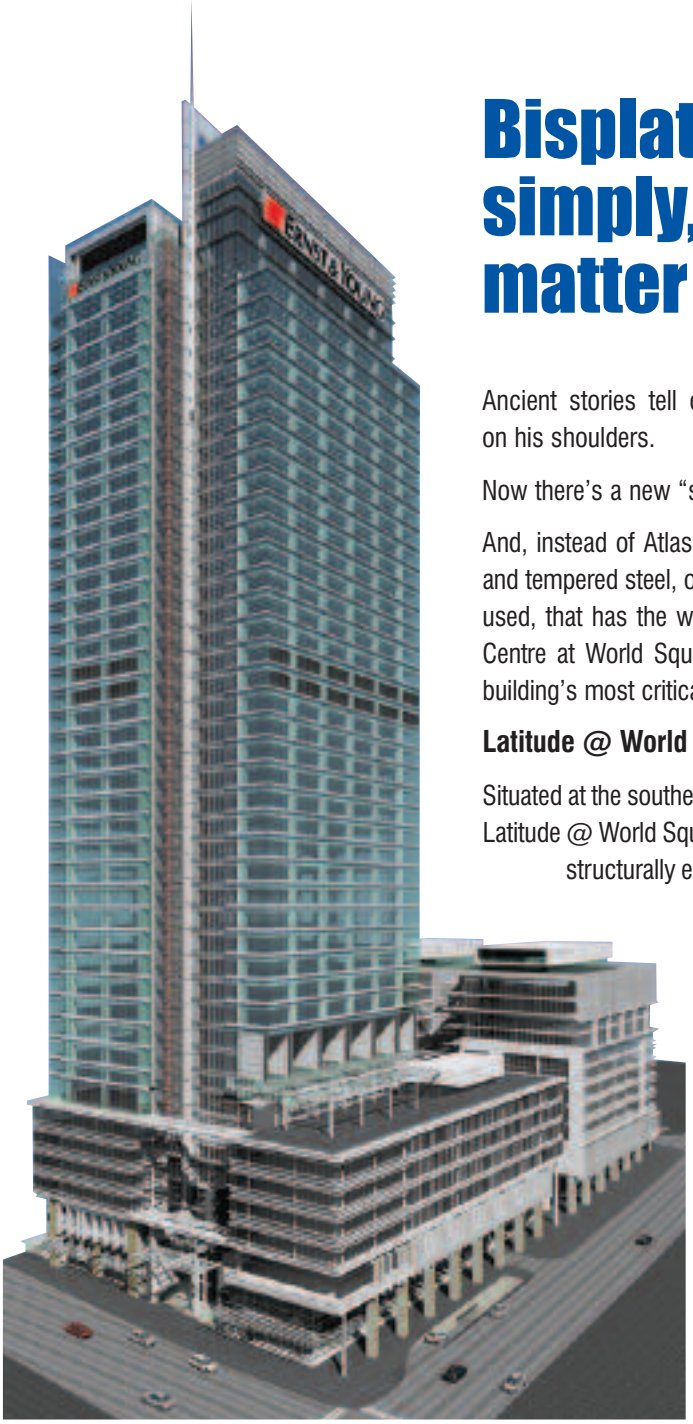

Bisplate80 high strength, quenched and tempered structural steel plate is a key component in the Latitude@World Square project being completed well ahead of schedule.

Bisplate . . . simply, a matter of truss

Ancient stories tell of Atlas bearing the weight of the world on his shoulders.

Now there's a new "storey" to tell. Or rather, 55 storeys.

And, instead of Atlas, it's just 280 tonnes of Bisalloy quenched and tempered steel, out of thousands of tonnes of standard steel used, that has the weight of the Latitude tower, Ernst & Young Centre at World Square, safely resting on its shoulders at the building's most critical stress-points.

Latitude @ World Square: The inside storey.

Situated at the southern end of Sydney's central business district, Latitude @ World Square is designed by architects Crone Nation, structurally engineered by Hyder Consulting, and is being constructed by Multiplex.

Due to be completed at the end of 2004, five months ahead of schedule, the entire World Square project is really a "storey" in two parts – the first part of which began more than 15 years ago.

But the first chapter of the "storey" didn't have a very happy ending.

Construction stopped at the World Square site with only the carpark and retail structure to level 14 completed.

It remained a concrete shell, mostly undeveloped, until 2002, when a new

vision of World Square began its renaissance – but this time with a new construction technique too – in composite steel, which represented a complete break from the original concrete design.

The change to steel, although slightly more expensive than the original concrete, came about when, during the design phase for the new World Square project, several areas of risk were identified:

- The risk of differential settlement with heavier concrete structure compared to steel.
- Increased time and cost to construct a transfer structure capable of carrying the much heavier concrete structure.
- Limited working hours on-site due to the dense residential and business development, now closely surrounding the site, that had taken place in the 15 years the original construction had lain largely untouched.

Getting a jump start on construction.

Another significant reason for the change to steel, was Multiplex's proposed "jump start" construction technique for the new design. This approach means construction can take place on multiple work faces and levels, and saves significant amounts of time.

Perhaps the best example of its advantages is shown in the fact that the existing level 13 and 14 concrete slabs at World Square were not viable with the new construction, and had to be demolished – yet this did not hold up work above those levels to the extent it normally would have.

Bisplate 80 plates, with shear studs, prior to forming into box sections.

The first level of the "jump start" was a structural deck installed at level 16 (six levels above the street) supported on concrete-filled steel tube columns, which were in turn founded on existing columns on level 14 of the previous works.

This construction deck could only have been built from structural steel because of the complex geometry and high load capacity required by the constraints of working with the existing structural support.

The success of the Latitude@ World Square construction process hinges on these huge "jump start" trusses, effective in large part due to the light weight and great strength of Bisplate 80.

From level 16, the rest of the vital transfer structure, at levels 18 to 20, was constructed, allowing construction of the upper tower floors to be started at the same time as demolition and major re-working of the old 11th, 13th and 14th levels took place below.

Andy Davids, Director of Structures, Hyder Consulting: "The 'jump start' system not only provided a new construction deck from which to launch the tower. Most importantly, it also incorporated an extensive set of steel transfer trusses, whose complex geometry allowed the new tower columns to be mated with those below level 14, which were previously unsuitable."

In Bisalloy, they truss.

As Australia's only manufacturer of quenched and tempered steel, Bisalloy is proud that Bisplate was specified by name in the design phase for use in the trusses.

The trusses themselves were fully seven metres – or two storeys – deep.

Each was composed of an innovative combination of Bisalloy high-strength quenched and tempered steel boxes and concrete-filled chords, and tension diagonals. In total, Bisplate 80 was used for the vital truss chords and nodes for levels 11, 16, 18, 20, and 34.

The manufacturing technique involved Bisplate 80 (AS3597 Grade 700) plates being cut to size, weld preparations made, and studs welded onto the inner faces, prior to the plates being formed into box sections.

The top chords were open at the upper face, fitted with stirrups to allow concrete to be poured, and shear connection made to the floor slab. Compression diagonals were concrete-filled steel tubes up to 1100 mm in diameter.

Bisplate 80: Heavyweight performance, light weight advantages.

At mid-height of the tower, a second set of outrigger Bisplate steel trusses provided additional stiffening against wind-induced motions.

These trusses were constructed from 16 mm thick Bisplate 80 quenched and tempered plate.

Bisplate 80 plate is minimum 690MPa yield stress – nearly three times the strength of 250 grade mild steel plate.

But it was Bisplate's combination of proven greater strength, allowing for significantly lighter weight, that was also a major factor in its being chosen for the transfer truss system.

It was an advantage that had significant benefits at every stage.

Had conventional 250/350 Grade steel been used, the huge trusses and node sections would have been considerably heavier to fabricate, transport, erect, position and weld on site.

Bisplate's lighter weight was especially valuable with the lifting capacity of cranes on the site being restricted to nine tonnes.

The large plates used, varying in thicknesses from 16mm to 40mm, and typically 2500mm by 8 metres, and 3100mm by 8 metres, were transported by truck from Bisalloy Steels' plant at Unanderra south of Sydney, to OneSteel Steel and Tube at Scoresby in Melbourne.

There, OneSteel profile-cut the plate into rectangular sections and delivered it to Alfasi Steel Constructions at Dandenong.

Alfasi Steel Construction's positive experience with Bisplate's ease of fabrication (above) made progess on the Latitude project (left) both predictable and reliable.

Properties of Bisplate Structural Steel Grades

Typical Guaranteed

Steel Grade	Plate Thickness (mm)	Carbon Equivalent (IIW)	Brinell Hardness (HB3000/10)	Mechanical Properties							
				Tensile				Charpy V-Notch Impact			
				Plate Thickness (mm)	0.2% Proof Stress (MPa-Min)	Tensile Strength (MPa-Min)	Elongation In 50mm GL (%-Min)	Plate Thickness (mm)	Energy (J-Min)	Test Temp (°C)	Test Direction
Bisplate 60 (AS 3597 Grade 500)	5-<16 ≥ 16-80 >80-100	0.40 0.50 0.58	210	5-100	500	590-730	20	5 6-<9.5 9.5-<12 12-100	By Agreement 45 60 80	-20 -20 -20 -20	L L L L
Bisplate 70 (AS 3597 Grade 600)	5-<16 ≥ 16-80 >80-100	0.40 0.50 0.58	230	5-100	600	690-830	20	5 6-<9.5 9.5-<12 12-100	By Agreement 40 60 75	-20 -20 -20 -20	L L L L
Bisplate 80 (AS 3597 Grade 700)	5-<16 ≥ 16-80 >80-100	0.40 0.50 0.58	255	5 6-65 70-100	650 690 620	750-900 790-930 720-900	18 18 16	5 6-<9.5 9.5-<12 12-100	By Agreement 20 30 40	-20 -20 -20 -20	L L L L

Alfasi shop fabricated the truss chords and nodes. This involved stud welding of studs, fillet and butt welding. Shop welding was done using both flux-cored and submerged-arc processes. Site welding was done using manual metal arc welding process. All welding was to AS/NZS 1554 (part 4) *Welding of High Strength Quenched and tempered Steels*.*

The company's role was to shop fabricate the actual truss chords and nodes – a job made more complicated than usual by the fact that there was an existing building and core being redeveloped, meaning every truss and node had to be different.

On a project of this size; facing time constraints and complex fabrication, Alfasi wanted to avoid delays relating to rectification and potential lack of fit.

Peter Jones, Project Manager for Alfasi: "Despite the many variants of trusses, the necessary tight tolerances required were able to be achieved, and the fabrication of the high strength steel went very smoothly."

Atlas would approve.

Now, it's true that, as an amount, just 280 tonnes of Bisplate 80, out of the thousands of tonnes of steel used in the total construction of the Latitude tower, is tiny.

But its contribution to the structural integrity of the entire building is just the opposite.

It's also true that the thousands of people who will soon begin working in the Latitude tower's 62,000 square metres of ultra-modern office space, will never know the inside "storey" of the Australian steel taking the load at their building's most critical points.

Still, at Bisalloy, it's enough for us to know that, at World Square, our name carries a lot of weight.

* Reference: Australian Steel Institute, *Steel Australia*, March 2004.

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