STADIUM PROJECT A WINNER

Daniel Smith Industries was the winner of this year's Crane Project of the Year with its work in constructing the Forsyth Barr Otago Stadium in Dunedin.

The new Otago stadium is New Zealand's first full size pitch, under cover stadium and is the largest indoor multipurpose arena in the country. It will also be the worlds largest natural grass, permanently covered stadium, and largest EFTE roofed building in the world.

Construction of the 31,050 square metre stadium began in June 2009 and is on track for August 2011 completion, in time for the Rugby World Cup 2011.

Daniel Smith Industries (DSI) was contracted by Hawkins Construction to supply crane lifting services for the following:

The piling contract, which included the manufacture, delivery and installation of 730 piles between 18 and 25 metres long;

The lifting of all building components, including temporary works, formwork, personnel access and temporary bracings;

The lifting of 2278 precast concrete construction components from eight to 40 tonnes each;

The lifting of 3700 tonnes of prefabricated tubular steel truss and roof sections including, the primary truss, truss legs, roof segments and arch trusses.

The assembly of the precast concrete componentry required seven cranes, 26,300 hours of lifting work and intensive planning and communication amongst everyone involved to meet the project deadlines.

Once the precast lifting was complete, DSI was ready for the structural steel team to commence.

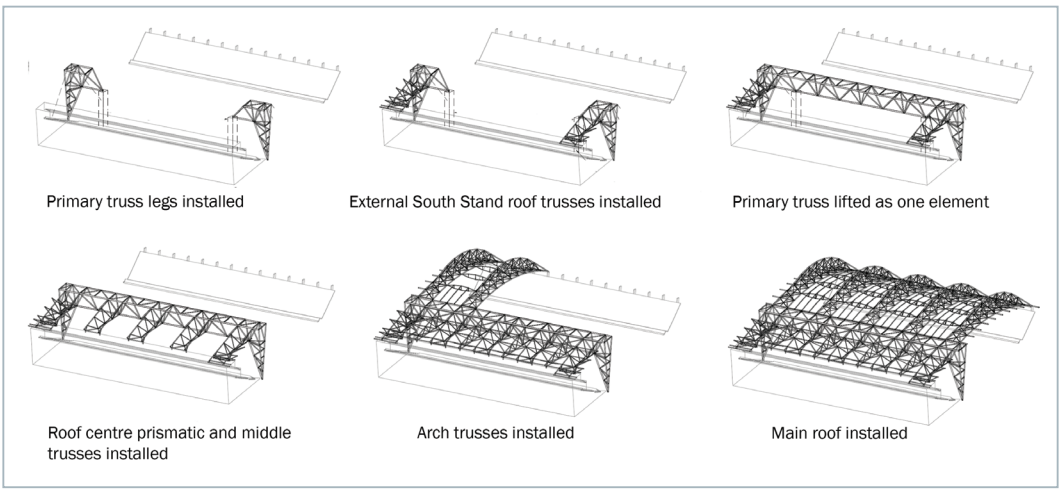
This part of the project included unloading the individual steel components of the superstructure from the transporters

Above: The second arch truss is lifted into place.

Right: A schematic of the construction process.

Facing page: The third arch truss is placed. Note the time mats in the wald zone to accommodate up to 700kp crane track loading

Previous page: In December 2009, the South Stand had been completed to level four, while on the North Stand the raking was placed.



to storage on site, then lifting them from storage to the fabrication site, once there they had to be lifted for welding. Once complete, they were lifted again from the fabrication site to pre-position lift site. Then came a number of critical lifts as the assembled steel compentry was placed into its final position as the stadium roof.

In total there were six critical lifts (in chronological order):

- Two primary truss support legs (one at each end),
- Two primary truss segments,
- Two external roof trusses,
- The primary truss,
- Three prismatic roof trusses,
- Five arch trusses.

Using its 280 tonne Liebherr LR1280 and 120 tonne Manitowoc M12000 cranes, DSI lifted the first 55-tonne primary truss support leg into a vertical position from the assembly area. The LR1280 finished the job by placing the support leg into the final grid on the western end of the stadium's South Stand.

Once in place, the braces were fitted to hold it into position and the LR1280 and M12000 completed this process again with the second support leg, placing it at the eastern end of the South Stand.

Next came the primary truss segments, which make up the ends of the primary truss itself, which spans the whole of the South Stand.

Each 122 ton steel structure was lifted onto the 23 metre high support leg. A temporary tower frame was erected to support one end of the weight of this truss segment. This was a single crane lift utilising the 400 tonne Liebherr LR1400/2 crawler crane.

The third critical lift comprised the two external roof trusses;

these connect the preinstalled primary truss end sections and the support legs to the South Stand.

Again DSI chose a single lift crane method utilising the Liebherr LR1400/2.

The 371 tonne primary roof truss was a structural steel giant, measuring 105 metres long by 10 metres wide and 11 metres tall. It was assembled in the middle of the pitch in front of the South Stand to necessitate the least amount of movement when placing it.

Once it was assembled, DSI had to get it into pre lift position. At this point it weighed 380 tonnes, including all the componentry, jigs, etc. All of this had to be repositioned to the pre-lift stage.

The big three cranes – Liebherr LR1400/2 and LR1280, and a 275 tonne Hitachi SCX2800 crawler – lifted this primary truss and its components to walk it to the front of the stand, in preparation for the big 36 metre high lift.

Getting the primary truss on to its support legs and temporary towers for permanent fixture to the South Stand was a complex job. It required an steady, even, equalised lift between the three cranes, and the weather had to behave – little or no wind and good visibility was necessary.

Lining up the primary truss onto the truss frames required very precise placement, with a tolerance of just 30mm each side of the primary truss leaving little room for error.

Further complicating matters, the lift plan meant the Hitachi crane had to be walked backward into the narrow space of the South Stand. Then had to get out once the truss was installed. This meant slewing the crane enough to lower the 45.7 metre long boom over the concrete stand and walk out underneath the primary truss and away from the South Stand. This was a difficult task as the crane had minimal clearance between the rear counterweights and the concrete grandstand.

The third arch truss is in place and the plastic SFTE roofing material is starting ot be placed

The actual lift started at 4pm and DSI worked (under lights) late into the night to ensure the primary truss was sufficiently secured to engineer's satisfaction.

Once the primary truss was installed, DSI then craned the three prismatic roof sections using the LR1400/2.

The final critical lift involved the placement of five arch trusses. These measured 105 metre each in length.

The Opoho Culvert runs through the middle of the job site. This is six metres wide, 500 metres long and three metres deep underground. To avoid damage to the culvert, at all times heavy cranes and equipment had to maintain a five metre clearance along the culvert site. There was only one access point across the culvert, and this had a weight limit of 380 tonnes. This culvert complicated the lifts of the five arch trusses significantly as, because of the location of the culvert, they had to be moved in two stages – from the assembly area to prelift position, then from there into place on the stand.

The fifth and final arch truss was placed in late November last year and both DSI and the main contractor, Hawkins Construction, were very pleased with the whole job.

In an email to DSI owner Daniel Smith, Hawkins senior site manager David James says, "the preplanning by your crew on site and the professional attidue they have is the reason we have been able to achieve these milestones.

"I've never seen a lift plan set out like this before and this truly sets the standard."

Robert Carden (centre) presented the Crane Project of the Year trophy and People's Choice award to Daniel Smith (left) and Michael (Baz) Hannan of Daniel Smith Industries

IMAGES: DANIEL SMITH INDUSTRIES, MARY SEARLE