



# ST ELMO rebuild demands innovation and precision



The new building features a unique structure of precast concrete columns and post-tensioned LVL beams.

***A building with a pioneering approach to seismic strengthening has presented some unique challenges both to the C. Lund & Son engineers and builders who are constructing it and to the Australian manufacturer who provided the specialised timber beams that are at its heart.***

The rebuild of the six-storey St Elmo Courts building in central Christchurch makes use of two technologies that give it more strength and allow it to flex in case of an earthquake: a base isolation system, and a post-tensioned frame structure of precast concrete columns and structural laminated veneer lumber (LVL) beams.

The LVL beams are up to 8.7m long. Interior ducts runs the length of the building through the beams and columns, and once they are in place a cable is run through the ducts and tensioned to give added strength to the building.

C Lund & Son general manager Andrew Macgregor says a number of issues had to be worked out to install and tension the LVL beams. Chief among them was propping.

"The timber beams actually become shorter when the huge post-tensioning load comes onto them. In order for the load to be transferred to the structure of the building, each column has to move toward the beam and not bend," Andrew

says.

"This means we could not anchor and grout the base of the columns until the specialist engineers had tensioned the beams. We had to come up with temporary propping that would hold the columns in place, even during an earthquake, but still allow them to move during tensioning. The sequence to install, tension and grout the beams and columns was carefully planned to ensure that the movement occurred where it was intended and the column locations were correct after tensioning was completed.

"The propping was far more complex than in a standard concrete structure. We built some of the props ourselves and modified proprietary systems. It also required a lot of planning and coordinating to get things done in precisely the right order."

Lining up the columns and beams so the cables could be fed through them without damage was also a key part of the operation. It required some very precise work on the part of the precast team and also some innovative steps by the builders.

C Lund & Son engineer James Green says the industry standard in precast concrete beams and panels is +/- 5.0mm and the Lunds precast team generally aims for +/- 3.0mm. For the St

Elmo Courts job they had to be +/- 1.0mm.

"The cable tendons pass through a line of several beams, and the ducts in the columns and the beams have to line up exactly. If there are sharp edges along any of the joins where the beams meet the columns, it could damage the cables when they are tensioned," James says.

Grout is used to make a seal where the beams meet the columns. This possibility of grout leaking into the conduits for the post tensioning tendons was another dilemma the Lunds team had to resolve.

The solution was to create a donut-shaped gasket made of polyethylene foam that would fit between the conduit in the column and the beam. Builder Tim 'Ringo' Fry experimented with the rings and came up with a way of making them more efficient and easier to insert by slicing them in half and adding a layer of ply to stiffen them.

Another inventive trick the Lunds team used to make sure all the ducts in the columns and beams lined up exactly prior to pouring grout and tensioning the cables was to use a drainage camera.

St Elmo Court is one of the first major rebuilds in the city centre and is on track to be completed in July 2014.

# LVL specialist steps up to big assignment

***When C Lund & Son came to source the LVL beams for the St Elmo Courts rebuild, there was no one in New Zealand with the capacity to manufacture them so they looked across the ditch.***

Timberbuilt Solutions is a Melbourne-based timber engineering specialist that has been manufacturing LVL building systems for more than 25 years.

Timberbuilt general manager Bruce Hutchings says the beams for this project were among the biggest and most technically complex the company has produced.

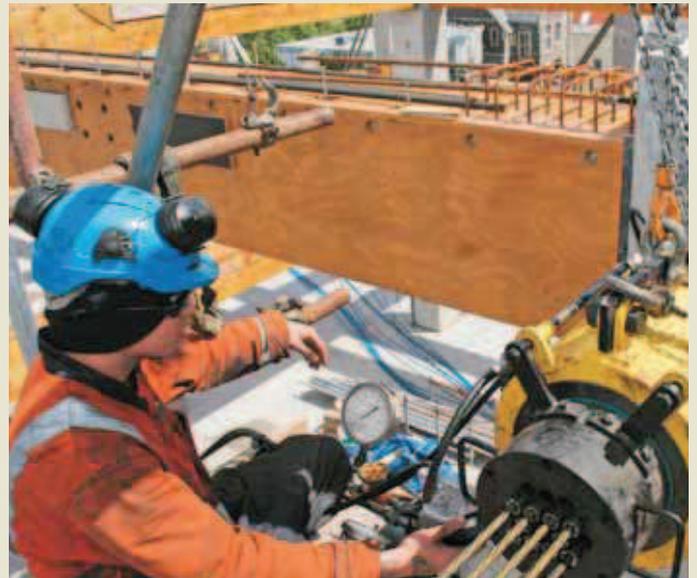
"Within the hollow box section we had to include post-tensioning cable ducts, deviators and blocks to ensure they could be precisely located to match the ducts in the concrete columns. There were also

holes for shear reinforcement, bolts and service ducts and notches for shear transfer to the overlying concrete slab.

"Our specialised CNC carpentry machine enables us to precisely cut, shape and bore each component before it is assembled. There were up to 44 separate LVL pieces in some beams and up to 1300 steps to make the components for a single beam."

"All these LVL pieces plus hardware had to be glue assembled within the very short time. A very significant challenge."

C Lund & Son general manager Andrew Macgregor says during visits to the factory during manufacture of the beams C Lund & Son staff came to fully appreciate the skills of the Timberbuilt engineers and technicians.



*A specialist team from Fulton Hogan post-tensions the LVL beams.*

"It required precise machining of the components and coordination during the complex gluing, screwing and bolting steps to successfully assemble the beams. It was clear that the job demanded many years of accumulated experience working with LVL," Andrew says.

Bruce says working with C Lund & Son was very positive.

"They are very professional and we were very happy dealing with them. We felt we were working as part of a team and didn't have everything just shoved down the line for us to sort out.

They were very receptive when it was necessary to work out what we needed to do to make improvements."