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STRUCTURAL STEEL ENABLES LARGE HOME ON SMALL SITE

The house on Pasadena Avenue in Auckland is a study in maximising land use. Owner, builder, developer and designer Matt Chernishov wanted an affordable home that his family could live and grow in, a home that offered space and privacy.

Situated on a subdivided site with the original home at the front, this was a very demanding project on a confined site with limited access. The new, steel-framed structure was built to the limits of council requirements and boundary limitations so there was very little scope for adjustments or errors in geometry.

The project showcases the strength, flexibility and durability of steel. Much of the intricate geometry of the fabricated material is proudly on display inside the finished house. The majority of the roof rafters and end-wall framing is exposed to view, and the clever use of steel plate is a feature of the stair stringers and balustrades, internally

THE FACTS

- 4 tonnes of structural steel
- $30,000 worth of steelwork
- 554sqm section for two homes
- 81sqm house footprint
- Just over one day to erect steel

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ENGINEER WILTON JOUBERT **ARCHITECT** ARK STUDIO **STEEL CONTRACTOR** JAY CEE WELDING
STEEL MODELLER ADVANCED STEEL SOLUTIONS **BUILDER** MATT CHERNISHOV **DEVELOPER** TREUN PROJECTS

The required spans couldn't be achieved with timber so the team used a steel portal frame system.

"TO HAVE THIS ONE MASSIVE GABLE AT THE REAR AND THE TWO DOUBLE GABLES AT THE FRONT COULD ONLY BE ACHIEVED WITH STEEL."

– RON KUMAR, ARCHITECTURAL DESIGNER, ARK STUDIO

and externally. The black painted stairs and rails contrast beautifully with the lighter hue of the natural timbers. This philosophy carries through into the kitchen and bathroom, with bespoke steel framing used for benches and cabinets.

The finished product is an outstanding family home and a striking example of what clever design and close collaboration can achieve.

ARCHITECT

The 554sqm section is wide at the front then tapers back to where the new home sits. Restricted by the existing house, the challenge was to design a home to fit on a triangular site.

Ultimately, it was the height in relation to boundary that determined what could be built. The team worked to the allowance of going up three metres, then applied a 45-degree angle back over the site to keep within the building envelope.

The design solution was an inspired gable structure using structural steel portal frames.

One gable-end structure could fit easily on the site. Following further research, it became clear that two gables could be joined together at the other end.

The house is divided into two wings, east and west. The geometry is mirrored for both, including the two big gables. Everything was modularised to keep construction for the tight site as simple as possible.

The result is a double-gable-end building that joins at one end, resembling a pair of pants from above. The two-storey house has an 81sqm footprint and covers close to 41 percent of the space. The team's target was to get as close to the 45 percent site cover allowance as possible.

The aim was to create a simple, slim structure with plenty of volume in the top floor. The result is a cathedral feeling with big open spaces.

The required spans couldn't be achieved with timber so the team used a steel portal frame system and spanned standard timber members between them.

To make the structure as lean as possible, the plasterboard ceiling is fixed directly to the underside of the rafter and the roof is fixed to the topside of the same rafter.

So, there was no double up on roof framing and purlins weren't necessary.

Steel was the major structural supporting element for the building. It features an intricate design with some unusual geometry, which required precise detailing.

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"COLLABORATION BETWEEN MEMBERS OF THE DESIGN TEAM MADE THIS PROJECT A SUCCESS. THEY SPENT TIME UP FRONT TO RESOLVE PROBLEMS AND GET IT RIGHT. AS A RESULT, IT FITTED TOGETHER WELL ON SITE AND THERE WAS NO REWORK."

– MIKE VINKENVLEUGEL, CONTRACTS MANAGER, JAY CEE WELDING

The rafters acted as fixings for the ceilings and fixings for the roof; it also solved problems with thermal bridging.

The finished product demonstrates the benefits of using structural steel portal framing. It is difficult to imagine how the clear spaces and vaulted ceilings could have been achieved using any other form of construction.

FABRICATOR

What stood out to fabricator Jay Cee Welding was the home's unusual design. It is shoehorned into a very tight space so the detailing had to be very elaborate to fit the site and to comply with regulations such as height to boundary.

Steel was the major structural supporting element for the skeleton of the building. From a workshop perspective the fabrication was not out of the ordinary, but every frame was different.

The intricate design features some unusual geometry and required precise detailing. The team worked with Advanced Steel Solutions to ensure the steel fit perfectly on site. The key was clearly communicating the design intent to the draftsman to resolve any issues before fabrication began.

Where it differs from other portal frames is in the complexity of how the two wings come together. Two sets of portal frames converge in a V configuration "like two wings". Where they meet, the portal frames need to tie in precisely.

The team spent a lot of time together to get it right. As a result, the fabrication flowed well and no rework was required when the steel was erected on site.

The home also features architecturally exposed structural steel. It required a lot more care in terms of the finish. The fabrication team had to ensure all the welds were tidy, there were no discontinuities, any splatter was cleaned off, and rough areas were removed and ground flush to produce a clean aesthetic.

The project boasted a well-coordinated and rapid superstructure installation that saw all of the structural steel for the house erected in just over a day.

"WORKING WITH STEEL WAS LIKE PIECING TOGETHER A BIG JIGSAW PUZZLE WHERE EVERYTHING FITTED TOGETHER PERFECTLY. IT WAS VERY SATISFYING."

– MATT CHERNISHOV, PROJECT MANAGER, TREUN PROJECTS

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BUILDER

The project boasted a well-coordinated and rapid superstructure installation that saw all of the structural steel for the house erected in just over a day – no small feat for what was a complicated design on a tiny site with only one point of access. The site was so constrained that the garage couldn't be erected until after all truck deliveries and crane work were completed on the main house.

The team used the crane on the back of the delivery truck to assemble the steel on site. The team had "fun" getting the huge valley beam into its position, running between the two gable ends.

During the installation it became clear that the scaffolding needed to be extended higher to reach the big gable end, which was 4.5m to the apex. The scaffolding crew was called back quickly to build a tower out the back so the team could finish bolting the last of the steel together.

One of the challenges the team had to solve related to sliding doors positioned at each of the three gable ends. Above these doors is about 200kg of glass. No joinery company was happy to install that without a steel beam so it was added as a minor variation – a 100x150mm rectangular hollow section. It was detailed in such a way that when the door was open, the bottom of the beam was perfectly aligned with the crosshairs of the door.

To fit a home of this size within the site, the team had to excavate right to the boundary and come up with a clever retaining wall solution. Structural steel's slender profile made it well suited for the task. Sixty-three, three-metre-long galvanised retaining universal columns were installed and fences built on top.

Using steel instead of timber meant the home could be built closer to the boundary and another 20-30sqm of floor area could be added to the house. The team made the best use of every square metre.