Maungatautari Tower

Roger L Williams FIPENZ

(Origin Timber Design Awards 2006:
Commercial/Public Engineering Excellence Award Winner)

Statistics

Height:	16 metres
Form:	Triangular, 4 metres leg
Stairs:	7 flights, 1 metre wide
Construction:	
Tower:	Poles 200/150mm dia Pinus Radiata H5.
Stairs:	Stringers 2/300x50 MSG8 Pinus Radiata H3 plus a central 6mm galvanized steel plate.
Fasteners:	Bolts and plates in contact with timber coated with Denso Paste to inhibit corrosion

Brief

The requirements are to provide an observation tower to view the forest canopy at varying levels for educational purposes and also as a tourist attraction.

Design Inspiration

Working on site really makes you appreciate the forest environment and why it is so important to save it. You see new things everyday you are there. The tower is located near some very fine 40 metre high Rata trees. The tower has been designed so that the pole frame structure is inconspicuous in the forest and the stairs, which cantilever outside the structure, wind up the canopy and appear to float in the forest canopy. The design just fell into place as soon as I saw the site and I could immediately visualize the tower and the stairs mimicking the Rata trees themselves.

The Rata starts as a vine that later takes over an existing tree. The original tree rots away leaving the Rata as a multi stemmed tree with holes through it. There are excellent examples of mature Ratas nearby as well as a Rewarewa that is being taken over by a Rata right beside the tower.

Roger says that when you visit the site you will find the stairs real easy to climb. If you have already made the 15 minute walk to the site then the climb up is no harder. There are six landings to rest at and look at the forest trees before reaching a spacious top deck where a seat has been built from where you can contemplate the forest canopy.

Roger says that even he was surprised at the changes to the trees and abundance of the ecology as you climb from the forest floor to the top of the canopy. To be surrounded with Rata, Tawa, Miro with Puketea and Rimu nearby and to look down on Punga and ferns is amazing. There are whole multistorey gardens growing on the trees. Earlier we saw Rata flowering and more recently we saw Clematis also in flower. There are native pigeons and fantails and tom tits and many other birds around.

Design Development

The tower provides enough room at the top up to 20 people and areas for two or three people at each of the six landings. Each landing will have a different storey to tell.

We deliberately did not try to go high enough to look out of the forest as this would distract from the objective of viewing the forest canopy itself.

The stairs are 'accessible' allowing the walking disabled to easily get to the top. Even those with a fear of heights have got to the top without difficulty as the trees surround the tower without the need to look down.

The 1 metre width of the stairs is comfortable for passing but narrow enough to feel secure.

The obvious preference was to design in timber so that it would fit in with the forest environment but we did not rule out steel. We just could not see any reason as to why it would be better. The form of the tower and the stair was immediately apparent and the symbolism of a Rata vine climbing through the forest to the upper canopy just fell into place.

The tower construction uses a sleeve and plate system developed by John Reelick of Tuakau Timber Treatment Limited. John gave a talk at a Timber Seminar about 3 years ago and as soon as I saw it I could see its potential and the care that had gone into the detailing. All I needed was to find the right application. A year later that application arrived.

I had designed similar triangular navigation towers, but using stainless steel tubes when I was working in Fiji in 1979 so had a good understanding of how these towers function. Triangular towers are more stable than square towers but the geometry can be a little tricky.

The challenge was to choose a good form for the stairs. I chose to go around the outside as it gave us more space and kept us in touch with the forest all the way up. The structure is very light and efficient so the stairs virtually float in the forest. The triangular shape presents both challenges and opportunities. It does require extra thought but the landings are wider and invite you to pause and look and enjoy the surroundings. To support the corners of the landings requires a cantilever on a cantilever. It was a little hard to explain so a model was made. Flitch beams were used for the stair stringers to cope with the cranks and the fairly high loads. Flitch beams are constructed with a steel plate sandwiched between timber stringers and have been in use for well over 100 years They were developed when rolled steel sections were not readily available. The steel plate provides the strength while the timber prevents it from buckling. Flitch beams were ideal as the steel plates are not visible. We used galvanized steel plates.

Technical Standard
To meet the requirements of the New Zealand Handbook Tracks and Outdoor Structures issued by Standards New Zealand. The design loading requirements are higher than for normal commercial structures.

Construction
The challenge was that the site was a 10 - 15 min walk into the forest. Helicopters and cranes were out of the question so many tons of materials and equipment had to be transported on small trailers behind a mini tractor and then be pulled up into position by block and tackle. Slow but certainly environmentally friendly. The construction sequence was critical as each stair flight supports another. The stair construction had to start from the top and each flight rendered to the flight above. Working in the forest in a wet Waikato winter was not ideal. Being mainly volunteers we tried to pick the better days as we were not in a hurry. It took about four months to build. A-Z Rigging and Scaffolding of Hamilton erected scaffolding up the centre and lifted the stairs. They saw the task as a good training exercise and the men enjoyed working in the forest.

Environmental
Care was needed not to destroy the forest that we were trying to provide access to. Only one small tree was removed and within two weeks of completion of the tower the planting team had been in and it was hard to see where we had been. The tower is right in the canopy and the trees are close enough to touch. It is just like climbing a tree without the effort or danger. The tower completely blends into the forest and is only visible when you get right up to it.

Location
The southern enclosure of Mangatautari is halfway between Te Awamutu and Putaruru and is ideally located as a tourist attraction being on the direct route from Waitomo Caves to Rotorua. The tower is a 10-15 minute walk in from the end of Tari Road, Pukeatua.

Client
The Maungatautari Ecological Island Trust (PO Box 476, Cambridge or see www.maungatrust.org) has created a 50 km pest proof fence around 3300 Ha of native forest and is creating the largest pest free enclosure on the mainland. It is removing forever 'introduced mammalian pests and predators from Maungatautari and will restore to the forest a healthy diversity of indigenous plants and animals not seen in our lifetime'. The southern enclosure was developed initially as a trial area for pest eradication and is now an educational and tourist area with several splendid walks through the forest. It has to be one of the best and most accessible areas of native forest in the North Island of New Zealand. The tower is to give a new dimension to the forest so that people can experience both the forest floor and the forest canopy.

Future plans for the southern enclosure include a tree top walk and a visitor and interpretation centre. The tree top walk will be constructed near the tower by taking one of the paths out over a gully so that the experience can be wheelchair accessible.

Designer Comment on use of Timber
Most designers have a natural affinity to timber. It is noticeable that timber design seminars are always better attended than any other material seminar so it is disappointing that so few structures are built in timber.

Excuses given for this include:

- It is not easy to get timber in the larger sizes at short notice. We had no difficulty so maybe it is a historical problem.
- Quality variable. The poles are Unilog and these are machined perfectly round. The sawn timber supplied was perfectly straight and very clear. I think this problem has also largely disappeared.
- Difficult to design- Lack of familiarity and design aids. Designers are under a lot of competitive pressure on fees. Steel is too easy and shop drawings are usually passed on to the fabricator to save fees. Choice of materials is often fee driven rather than looking at the total cost or the appearance of the finished job.
- Easy to make mistakes during construction. Too often this is either lack of detailing or a failure to read the plans. Unfortunately supervision is a thing of the past.

My philosophy is that smart design is to ***always use the structure as part of the architecture.*** The structural engineer must work on the concept design with the architect. If you don't do this the structure becomes an after thought, and looks like it. It almost always makes the structure become an extra cost.

Always look at exposing the structure. It is just too easy to cover up the structure. But this adds more trades and usually more cost.

Good design is always integrated design.
Good design needs good details.
Good design is worth paying for.

Cost

Actual cost was $NZ 65,000 but if the full costs of volunteers are included and trade discounts omitted, the full cost would have been about twice this. The funds for the tower were raised and sponsored by the Lions Clubs of the 2o2c Waikato Region.

Acknowledgements

Designer/Construction Manager:	Roger Williams FIPENZ, Civil/Structural Engineer, Cambridge,
Volunteers:	About 15 including Roger from many walks of life but mainly retired farmers.
Sub Contractors:	
Tower Supply:	Tuakau Timber, Tuakau, NZ
Stair Fabrication:	Torrington Stairways, Cambridge
Steel Fabrication:	Ludwig Engineering Ltd, Huntly
Scaffolding and Rigging:	Scaffolding and Rigging, Hamilton