

## Unilog Cell Phone Towers

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### Design Brief

The Tongan Government required 30m high cell phone towers that could withstand cyclonic winds up to 200km/hr in a corrosive salt laden environment. This height was determined by the average height of the coconut palms on the islands. The Cell phone towers were required to be transported as kitset components to the islands and able to be erected using local labour and equipment. The structure was to use UniLog poles in clay/corral ground conditions.



*Completed Tower*

### Research

The components needed to be container sized i.e a maximum length of 8.0m and able to be packed economically into a container. The structure was designed for wind speeds of 50m/sec from 0 – 15m and 56m/sec for 15 – 30m with a drag force factor of 1.20 for the circular members. Several lattice designs were analysed first using horizontal members only but the leg and joint loads were excessive. Our own testing determined the characteristic bending stress at 42Mpa.

### Solution

The triangular shape was the logical design solution for equal loads in every direction. The final design used horizontal and diagonal braces. Ø200 H5 UniLog poles were used for the legs and ø125 and ø155 H5 UniLog poles were used for the horizontal and diagonal braces. The timber had a moisture content of 20%. The HDG steel connectors for the leg joints and braces were made from 3mm steel plate shaped into tubes each 610mm long. The tubes were made in two sections to accommodate the 60° angle of the tower shape with flanges to accommodate the 6mm HDG connector

plates. The tubes were tightly bolted around the legs with  $\phi 12\text{mm}$  SS bolts. All steel components were pre-formed and pre-drilled then HDG. They were then coated with Denso paste before and after assembly for the corrosive, salt laden Pacific Island environment. M16 HDG coach screws were used to take up the tension in each leg.

The tower design resulted in four 8.0m sections with 2.0m of the lower section anchored into the ground in a concrete foundation. Climbing spikes were inserted the full height on one leg. The design uplift for each leg was 34 tonnes. All braces were cut to length, slotted and pre-drilled before treatment. The braces are all different lengths meaning they can be placed in one position. Therefore construction mistakes are minimised. All components were numbered to allow simple construction of the UniLog Cell Phone Tower kitset.



*Connection at Base*



*Internal view of Brace*



*External view of Brace*

## Drawings

All components and connections were drawn and numbered with elevations showing correct placement and heights.

## Prototype

A prototype was assembled in New Zealand before shipping to Tonga. No problems were encountered.

## Evaluation

Ten towers were successfully constructed in Tonga. The pictured tower was fabricated on the ground in two pieces and lifted with a 25 tonne crane, taking four men two days. Allowance needed to be made for the rate of work in the islands which is much slower than that found in New Zealand. The Towers could be constructed without a crane using a hinge system at the bottom.



*Jointing Tower*



*Lifting Lower Section*



*Lifting Upper Section*



**View inside tower**