

# **Sensitivity of Structural Building Costs to Changes in Material Supply Costs**

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A range of international commodity price rises since November 2003 have impacted on the New Zealand construction market. These commodities include reinforcing steel and structural steel. Increases in processed steel products such as cold-formed metal decking have followed. Market constraints in New Zealand have also lead to an increase in the cost of concrete formwork, pre-cast concrete, proprietary concrete decking and concrete placement.

Steel Construction Industry-New Zealand commissioned the Steel Structures Analysis Service to investigate the sensitivity of variations of material supply price on the overall structural cost of multi-level buildings in New Zealand. A summary of the findings are as follows.<sup>i</sup>

The constructed cost of buildings consists of varying proportions of building materials and trades, depending on the design and configuration. It is therefore difficult to conclusively assess the combined effect of these price rises on all building structures. Price rises are also difficult to track accurately due to the competitive fluctuations of bidding and the time lag between tender bids and construction completion in the construction market. This study therefore identifies the estimated current cost and the cost sensitivity to various material supply price increases of three equivalent ten-storey buildings. These buildings have the same architectural envelope and are based on those designed for New Zealand loading conditions and published in 1991 by Bull<sup>ii</sup>. Both the superstructure and the foundation costs of each option have been assessed using current published estimating rates.<sup>iiiiv</sup>

The all steel option (EBFSGF), incorporating eccentrically braced frames and composite cold formed metal deck slab with steel beams and columns, is the most economical at \$2,843,000 or \$288 /m<sup>2</sup>. The foundation cost component being \$276,000 or \$28 /m<sup>2</sup>: 10% of this total.

The hybrid steel / concrete option (SWSGF), incorporating reinforced concrete shear walls and composite cold-formed metal-deck slab with steel beams and columns, is the next best at \$3,080,000 or \$312 /m<sup>2</sup>. The increased foundation cost makes up most of the difference against the all steel option (EBFSGF), being \$453,000 or \$46 /m<sup>2</sup>: 15% of this total.

The all concrete option (SWCGF), utilising reinforced concrete shear walls and timber in-filled, hollow-core slab on pre-cast concrete beams and reinforced concrete columns, is the most expensive at \$3,162,000 or \$320 /m<sup>2</sup>. The foundation cost is similar to that of the hybrid steel / concrete option (SWSGF) being \$482,000 or \$49 /m<sup>2</sup> : 15% of this total. Both options reflect the need for significant foundation works to support the concrete shear wall cores.

Building cost sensitivity curves have been derived for the three options. These have been used to assess the effect of changes in various material-only supply prices on overall structural cost.

A 10% rise, only in the supply price of structural steel sections, leads to a 2.6% rise in the structural cost of the all steel option (EBFSGF) and 1.5% rise in the hybrid steel / concrete option (SWSGF).

A 10% rise, only in the supply price of reinforcing steel, leads to a 0.4% rise in the structural cost of the all steel option (EBFSGF) ; 0.8% rise in the hybrid steel / concrete option (SWSGF); and 1.5% rise in the all concrete option (SWCGF).

A 10% rise, only in the supply price of in-situ ready mixed concrete, leads to a 0.7% rise in the structural cost of the all steel option (EBFSGF) ; 1.2% rise in the hybrid steel / concrete option (SWSGF); and 1.4% rise in the all concrete option (SWCGF).

Price increases of 10% each for reinforcing steel, proprietary metal or pre-stressed deck, structural steel sections and in-situ concrete, leads to overall cost structural cost increases of between 4.3 and 4.4%: \$123,000 for the all steel option; \$136,000 for the hybrid steel / concrete option; \$138,000 for the all concrete option.

In summary full steel construction options incorporating cold-formed metal-deck slabs for multi-storey buildings offer cost advantages over hybrid steel / concrete and full concrete options, particularly when foundation costs are included. The full steel options are also least affected by increases in the cost of reinforcing steel and in-situ concrete supply.

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<sup>i</sup> Hyland, C.W.K., Leong, C., Cowie, K.C., “The Sensitivity of New Zealand Multi-Storey Building Cost to Variations in Material Supply Costs”, HERA Report R4-124, New Zealand Heavy Engineering Research Association, Jan. 2005

<sup>ii</sup> Bull, D.K., “Evaluation of a 10-Storey Building Using Alternative Structural Systems”, New Zealand Concrete Construction, Nov. 1991.

<sup>iii</sup> Giddens, C., “2004 Rawlinsons New Zealand Construction Handbook: 19<sup>th</sup> Edition”, Rawlinsons Media Ltd, 2004

<sup>iv</sup> Bhatt, J., Hyland, C.W.K., Cowie, K.C., “Structural Steelwork Estimating Guide: Online”, HERA Report R4-96:2004, <http://www.hera.org.nz/steelest/index.asp>, Nov. 2004