

# Lightweight steel construction in the residential market

Broadly speaking, traditionally there have been two technologies used for residential architecture, worldwide. One is traditional masonry, and the other is lightweight construction with predominantly timber or timber products.

Each of these technologies has evolved over thousands of years, influenced by climate, culture, and the technological advances and experience of the society that utilizes it.

This evolution has been accelerated by globalisation, bringing greater



Typical construction joint.

speeds of communication and increased movement of materials around the world. Universal trends in residential building construction now show a movement towards lightweight and modular construction, and in particular, lightweight steel.

## General description of lightweight steel construction

The main element of lightweight steel construction is a light gauge steel-framing member, made from structural quality sheet steel that is usually formed by cold rolling through dies. As implied, this production method does not involve heat input and its associated expense. Elements are thinner, production rate faster, and the finish is smoother. All these factors add up to lower production costs when compared with equivalent, but heavier hot rolled steel products such as I-beams or channels.

The wall and roof structure of a house would be built with these lightweight sections onto a floor slab. Cladding of the roof would

follow, providing a protected area for installing services and cladding the walls, typically with gypsum sheet. Wall exterior would then be constructed on the outside, materials being of a wide choice, examples being brick skin, fibre cement, timber, or metal sheet, as are the possibilities in the case of equivalent timber frame constructions.

There are two basic approaches to the construction of a steel frame:

- ◆ The American system has evolved directly from the popular 4"x2" timber frame method. Standard steel sections are commonly available to homebuilders, who can cut and assemble them on site to complete the steel frame required.
- ◆ The Australians, in contrast, submit their house plan to a framing company, who designs the framing system and manufactures all the structural components at their factory. The materials are then brought to site as a kit for assembly. This method has the advantage of superior quality control that can be offered by an experienced, clean and fully equipped professional fabricator, compared with the sometimes less-than-perfect resources, including wrong tools and poor workmanship that might prevail on a building site. Less steel is also used; as there are no off-cuts or wastage at the site for the client's account. This would appear to be the preferable alternative for South Africa, at least until local expertise has grown to a point where both methods could be competitive.



A light weight steel framed house, before cladding.

**Benefits and Challenges of Lightweight vs. Conventional Masonry Construction**

*Benefits:*

- ◆ Speed of erection
- ◆ Dimensional Accuracy (straight and erect walls with 90 degree corners),
- ◆ Predictability of end – product cost, quality, delivery appearance.
- ◆ An advantage for sites with problem soil conditions, remote sites or steep sites.
- ◆ Environmentally and economically advantageous, as steel is fully recoverable and recyclable. Lightweight homes are easy to modify, add to, or demolish, with minimal site impact.
- ◆ More stable than timber as a framing element and is resistant to cracking, rot, termites, and warping.



Inspecting stock steel coil strips to be used for subsequent profiling of light weight steel frames in Australia.

- ◆ Continuous hot dip galvanized sheet steel affords excellent corrosion resistance.

*Challenges:*

In comparison with America or Australia, South Africa has a limited history of lightweight home construction. Locally grown

construction timber tends to be of comparatively poor quality. Together with limited availability and expense, this has made masonry construction a first preference. Major investment in the education of the industry in the use of this new technology will be necessary. This task should not be underestimated, as conservatism



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Once the roof is completed, the non-conventional light weight steel framed building starts looking like a conventional South African home.

resists change, especially when there is the perception that current building methods are as good as anyone needs.

- ◆ General perceptions relate lightweight construction to temporary structures such as site offices and temporary accommodation.
- ◆ Accreditation: Local Authorities are not familiar with the technology. There will be delays and disputes during the process of drafting new building regulations and agrément certificates
- ◆ Established contractors and suppliers (bricks, sand, cement) to the traditional building sectors may see the new technology as a threat to their business.
- ◆ Builders have to familiarize themselves with new methods.

**Cost comparison**

A very basic comparison of costs was done by the South African Institute of Steel Construction (SAISC) on a conventional and lightweight steel frame house of 200m<sup>2</sup> floor area, and identical plan.

Cost per unit area in the case of the lightweight steel structure was about 3-5% less. This saving could be more

in practice, where the house structure, in the case of the lightweight method, would be altered specifically to exploit all the cost advantages that this technology can offer. Put another way, lightweight constructions cannot be optimized using a “brick and mortar” approach to design.

Time is saved in installing services. (Water and electrical reticulation) Chasing grooves and breaking holes in masonry walls, as well as replastering, are eliminated.

Not accounted for is the speed of construction, cutting labour cost, to the benefit of the developer, contractor and the homeowner.

**The way forward**

New technologies often begin by mimicking the older more trusted methods. As Ancient Greek Stone temples were built according to the known timber post and lintel system, with stone arch and vault structures evolving later, so many lightweight steel framed construction buildings are designed to look like standard masonry construction.

We have already seen exciting new developments in countries that are familiar and comfortable with lightweight technology e.g. USA, Europe and Australia. Lightweight

construction offers so many new ways of building, with more versatile options for design. The reduced mass of walls and roofs gives this flexibility. Cladding comes in wide and exciting ranges, an example being a durable terra cotta panel finish. Modular construction can also improve the form of buildings, where crafted, well-detailed units are assembled on site. Multi-storey structures can also exploit all these advantages.

Once the industry has become acquainted with this new technology, we can hopefully look forward to it growing in favour, to the benefit of our local architecture, as has been happening in Australia and elsewhere abroad.

*Acknowledgement and thanks are due to Sue Clark of Equilibrium Studio (Pty) Ltd and Dr. Hennie de Clercq of SAISC for information contained in this article.*



Light weight framed structures have many advantages.



Relatively sophisticated joints can be overcome by incorporating heavier guage steel, hot dip galvanized for corrosion protection.