Light steel frame building in Southern Africa

SOUTHERN AFRICAN
LIGHT STEEL FRAME BUILDING ASSOCIATION

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INTRODUCTION

Light steel frame building is a well known building method in Australia, the US and Europe, and has been in use for more than 50 years. It is used for low and medium rise residential, commercial and office buildings, schools, colleges, clinics, hospitals - in fact it can be used for any type of building.

This building method has been introduced to the Southern African market from 2006, and has already made huge inroads into the building industry.

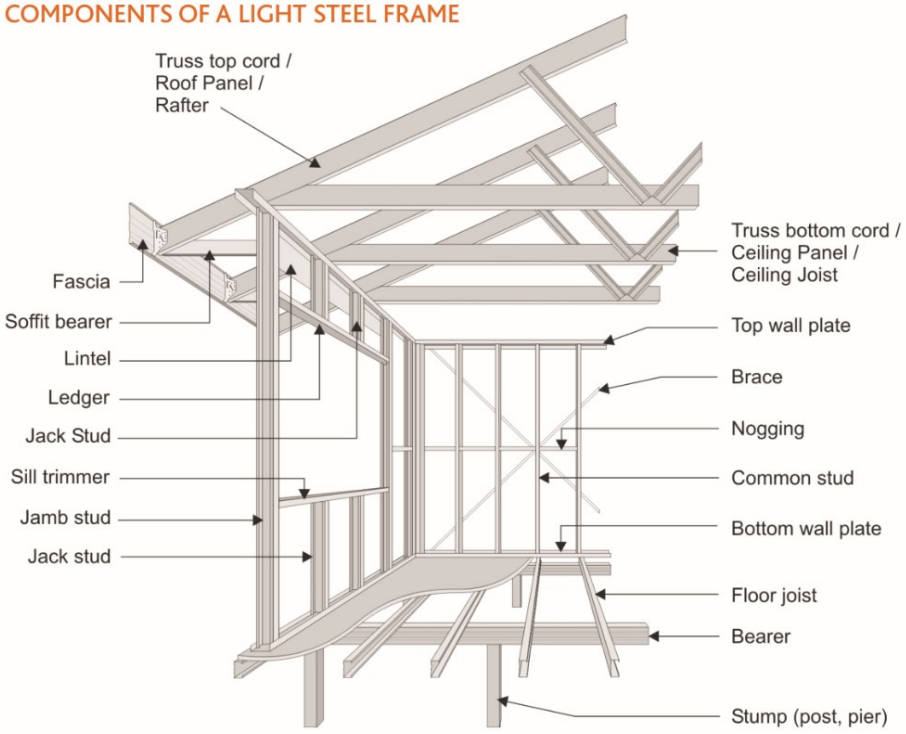
WHAT IS LIGHT STEEL FRAME BUILDING?

Light steel frame building (LSFB) is a building method, and should not be confused with prefabricated or 'kit' buildings. It can be described as 'off-site' building, as a lot of the manufacturing takes place in factories, and the components are assembled on site.

It consists of structural wall panels, trusses and floor joists, assembled using cold formed steel sections made from thin gauge high strength galvanized steel sheet. Sections are joined together - typically in a factory - using rivets or self tapping screws to form structural wall panels and roof trusses, which are transported to site for erection on foundations and floor slabs. Similar to timber frame construction, the wall frames are clad externally and internally on site with a range of alternative cladding materials, with services (electrical and plumbing) and insulation material installed in the wall cavity.

Any type of roofing material can be used – profiled metal roofing or concrete tiles. Light steel frame building offers environmentally friendly, structurally sound buildings; speed of construction; excellent thermal insulation; energy efficiency, dimensional accuracy and quality finishes.

COMPONENTS OF A LIGHT STEEL FRAME



THE PROCESS

Approval by building authorities:

As a first step, a normal building plan has to be drawn up by an architect or draughtsperson. This plan has to be submitted to the local authorities for approval, together with a rational design by a competent person, normally an engineer. The national standard for light steel frame building, SANS 517, can be used as basis for the design.

Manufacturing and assembly:

Building plans – preferably in electronic format - are used by the manufacturer of the light steel frames to carry out the structural design and detailing of the frame. The dimensional data for the frame members is electronically transmitted to the sophisticated profiling equipment which is fed from a coil of galvanized steel strip. It forms the sections via a set of progressive rollers, cuts each section to exact length and punches holes for fasteners in the required places. These machines even indent the sections at fastener locations to provide a flat surface for the cladding materials! A unique reference number is automatically stenciled on each section to ensure that it is installed in the location specified on the structural layout drawings, also generated by the design software.

As the sections are produced, a team of factory workers assembles the frames and trusses under conditions ideal for quality control.

Wall frames are provided with bracing elements to ensure the frames are square and rigid. If the building site is in a remote location, the manufacturer may elect to transport the sections for the frames and trusses strapped in bundles for site assembly, thus saving on logistical costs.

Some truss manufacturers also produce sections in long lengths, to be cut and assembled on site according to supplied detail drawings.

Foundations and floors:

Foundations should be designed and built to comply with Chapter 8 of SANS 517 and/or SANS 10400. Due to the low mass of the walls, cost savings can be achieved when compared with foundations for heavy masonry buildings – depending on the soil conditions and the loads to be resisted by the foundations.

Care should be taken to set out and cast foundations and floor slabs accurately in terms of specified dimensions, squareness and levels. This is essential to facilitate quick erection of the frames, as it is costly and time consuming to adjust the frames to fit on imperfect foundations and slabs.

Suspended floors consist of light steel open web joists or cold-formed C-sections which span between load-bearing wall frames. Flooring boards are fixed to the floor beams using special self-drilling, self-tapping screws. Timber boards are often used in conjunction with high density fibre cement boards.

Erection of steel frames and trusses:

Due to the low mass of these components and the inherent dimensional accuracy, the frames and trusses can be erected quickly by a small team of skilled artisans. Frames are fixed to one another using hand held power tools and self-drilling, self-tapping screws. When all the wall panels have been erected, leveled and squared, the frames are anchored to the slab and foundations using the prescribed anchor bolts. At this stage, the cross bracing may need adjustment to ensure rigidity of the structure before the roof trusses, or the second floor beams, are installed.

Trusses and beams are fixed to the wall panels using galvanized steel brackets and screws.

Enclosing the structure:

The external wall frames are firstly covered by a vapour permeable membrane, to seal off the structure against air and water ingress. After fixing a thermal break on external frames, the cladding – typically fibre cement board or planks – is then fixed to the steel structure using special self drilling screws. With the external cladding erected, the roofing materials can be installed, providing a sheltered structure for internal completion of the building.

Services, insulation and internal lining:

The electrical wiring and plumbing can now be installed in the wall cavities. Plastic grommets are inserted in the pre-punched holes in the wall panel sections,

and flexible water pipes and electrical wiring are passed through the holes. Note that there is no need to cut and chisel walls to install the services, facilitating rapid completion. Plumbing for a normal house is typically completed within one day.

Insulation material is installed in the wall cavities and above the ceiling according to specification in SANS 517, after which the internal lining – typically gypsum board – is fixed to the light steel wall frames using special self drilling screws. Joints between panels are rendered according to the board manufacturer's specification, and the structure is ready for painting and floor finishes!

Cautionary note: While light steel frame building appears very simple, special skills are required to achieve satisfactory results – as is the case with masonry building – and owners are urged to make use of qualified, competent builders.

ADVANTAGES OF LIGHT STEEL FRAME BUILDING

Light steel frame building evolved to overcome the many disadvantages of heavy masonry construction.

Quality: Only quality certified materials are used. Components are manufactured, and generally assembled under controlled conditions in factories. Modern technology is used in manufacturing, and opportunity for human error is minimized. Designs are approved by a structural engineer.

Speed of construction:
As the building components, such as wall frames and trusses, are delivered to site in large, yet manageable units, installation can be carried out very quickly by a small competent team. The building can be enclosed within a few weeks, offering a protected shell for completion of the building. Time savings of up to 30% compared with conventional building have been reported.

Energy efficiency:
Light steel framed buildings are thermally insulated as part of the building process, to comply fully with the requirements of SANS204: Energy Efficiency in Naturally Ventilated Buildings. As result, less energy is required for heating and cooling of internal spaces. According to research by the CSIR, light steel frame buildings will require only half of the energy needed to heat and cool masonry buildings to comfortable temperatures*.

Conformance to "Green Building" principles:
Apart from the savings in operational energy, the embodied energy of the light steel walling components is reported in Australian research reports to be less than 50% of that of conventional masonry walls **, making it significantly more environmentally friendly than conventional building. The materials used in light steel frame building are recyclable – more than 70% of used steel is recycled – and use is made of recycled products for the manufacture of insulation and cladding materials. With conventional buildings, it is not practical to recycle rubble when masonry buildings are demolished, and the rubble typically ends up as landfill.

Superior finishes and accuracy:
Very narrow dimensional tolerances (millimeters) can be achieved with light steel frame building, with the result that 'everything fits'- as example, door frames can be installed with the doors already hung, with factory fitted handles and locks. Corners of rooms are square and walls are vertical within tight tolerances.

Cost-efficiency:
Coupled to the speed of construction, reduced wastage and lower transport costs contribute to render this building method cost-efficient.

- Minimal wastage: As light steel frame building is an engineered process, minimal wastage of materials during manufacturing and the building process occurs.
- Lower logistical costs: Due to the low mass of the building elements, transport costs are much lower than for conventional building. After completion, it is also not necessary to remove truck loads of building rubble from the building site.

** T Kumirai and Dr D Coetzee: 'A predictive comparative thermal performance analysis for light steel frame and masonry residential buildings: indoor temperatures, loads and thermal comfort'. ** G Milne, 'Embodied energy', CSIRO*

Flexibility:
Light steel frame buildings can be built in stages, as additions can be effected easily, without a major disruption and heaps of building materials. It is also eminently suitable for adding a second or third floor to existing buildings, as the low added mass may be accommodated by existing foundations (to be confirmed by an engineer).

Durability:
Galvanised steel inside the building envelope will outlast the useful life of the building, provided the light steel frame and cladding were correctly erected. Tests carried out by IZA and ILZRO in the USA over a ten year period predicted a functional life for the light steel frame of several hundred years! External steelwork should however be maintained as required for the local environment.

SASFA, AND THE LIGHT STEEL FRAME BUILDING INDUSTRY IN SOUTHERN AFRICA

The Southern African Light Steel Frame Building Association, SASFA, was formed in October 2006 as a division of the Southern African Institute of Steel Construction. The founder members are ArcelorMittal (steel), Everite (fibre cement cladding), Saint-Gobain Construction Products (gypsum board lining and insulation), and Lafarge (gypsum board lining).

An Executive Committee, with representatives from the major material suppliers, manufacturers, equipment suppliers and the Institute of Steel Construction, guides and monitors the activities of the Association. Technical and Training committees deal with technical and training matters.

The **Mission** of the Association is to develop and grow the Southern African and export markets for light steel frame building. The **Aim** is to capture 10% of all low rise buildings in South Africa for light steel frame building.

A number of important milestones have already been achieved:

- SASFA has been established as the industry representative association for light steel frame building.
- SASFA facilitated the drafting of a national standard, and SANS 517 has been published by the SABS.
- The SASFA website has been established, and serves as the 'yellow pages' for the light steel frame building industry. See www.sasfa.co.za
- Well attended seminars and training courses are being offered in the major centres.
- In response to requests by the financial institutions and the NHBRC, SASFA has compiled an accreditation scheme for its members to recognize competency in the different fields of light steel frame building.
- SASFA currently has more than 80 company members – see Membership List on www.sasfa.co.za
- SASFA is an Associate Member of the Australian, New Zealand and North American sister organizations. Regular contact is being maintained to stay abreast of developments elsewhere in the world.

Growth of the light steel frame building industry in Southern Africa:
According to SASFA records, there are more than 30 companies manufacturing light steel frames on state-of-the-art profiling facilities in South Africa. They have a combined annual manufacturing capacity (single shift basis) in excess of 60 million linear metres of light steel sections, or 63 000 tons/ year of galvanized steel, of which a third is dedicated to the manufacture of light steel roof trusses.

Conservatively this means that South Africa has sufficient manufacturing capacity to annually produce light steel frames for 2,4 million m^2 of buildings and trusses for a further 2,6 million m^2 of floor area of building! Manufacturing facilities are also being established in neighbouring countries, and SASFA members are increasingly capturing export projects.

If you are serious about becoming involved in the light steel frame building industry, join SASFA today!

Membership application forms are available on www.sasfa.co.za

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