



Structural Insulated Panels (SIPs) Design

Yarra Valley, VIC

Intrax Consulting Engineers show it's proficiency in the design of sustainable buildings using Structural Insulated Panels (SIPs) as a green building product.

About the Project

The project involved mixed construction with internal load bearing Rammed Earth Walls, external load bearing Structural Insulated Panels (SIPs) walls utilising foam insulating core and OSB strand board skins with a Tridek roofing system.

Methodologies & Technologies

In this case the proposed footing system needed Intrax Consulting Engineers to consider the requirements for both SIP walls and the varying types of walls construction which required specific design considerations including the potential of differential movement and the effects of that movement on the materials above.

In addition the connection design required a combination of traditional timber frame roofing for the suspended ceiling sections and specific details for the connection of Tridek roofing to the SIP walls & the Rammed earth walls.

System used

Intrax Consulting Engineers designed the dwelling utilising SIPs panels for the external walls combined with Rammed earth walls & Tridek Roofing panels. These panels together played a large part in achieving this energy efficient design. Rammed earth walls included superior thermal mass, temperature and noise control, strength and durability, low maintenance, fire proofing, load bearing and pest deterrence, as well as the beauty and pleasure of building with a natural and environmentally sound material.

This house has also been oriented optimally to the north with the Tridek roof at the appropriate angle and will use virtually no energy for heating and cooling.

The Challenge

Open plan living with full height sliding doors & windows provided a design challenge in engineering to ensure the overall stability of the structure in particular, as the structure sat in the top-third zone of a steep sloping hill. As SIPs panels have a structural limitation regarding the in-plane shear capacities, steel portal frames were integrated into the SIP system, which maintained the design aesthetics and remained consistent with the architect's design intent for the structure.

For the Performance requirements of earth buildings, the structure was designed to resist the forces and actions for which it was intended and had an acceptably low probability of failure. It was designed to be able to withstand deterioration due to natural weathering, insect attack, and general use that can be reasonably expected during its intended life, without undue maintenance.

Outcome

Assembly & installation was fast and efficient with factory manufactured pre-cut wall & roof panels.

Prefinished colorbond Tridek Roofing system reduced the amount of structural roof framing and bracing normally required. High thermal values, Good acoustic values, Low maintenance, BCA Group 1 fire rating and ongoing energy cost savings.

Less labour and trades were required on site, and there was significantly less site wastage and landfill.

This project utilising SIP- Panel wall system, Tridek roofing & rammed earth walls was designed by keeping energy efficiency in mind and affordable housing products will have a place in the future of residential housing design.



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Architect

Solar Solutions Design

Builder

Hunter Constructions

Segment

Project Housing

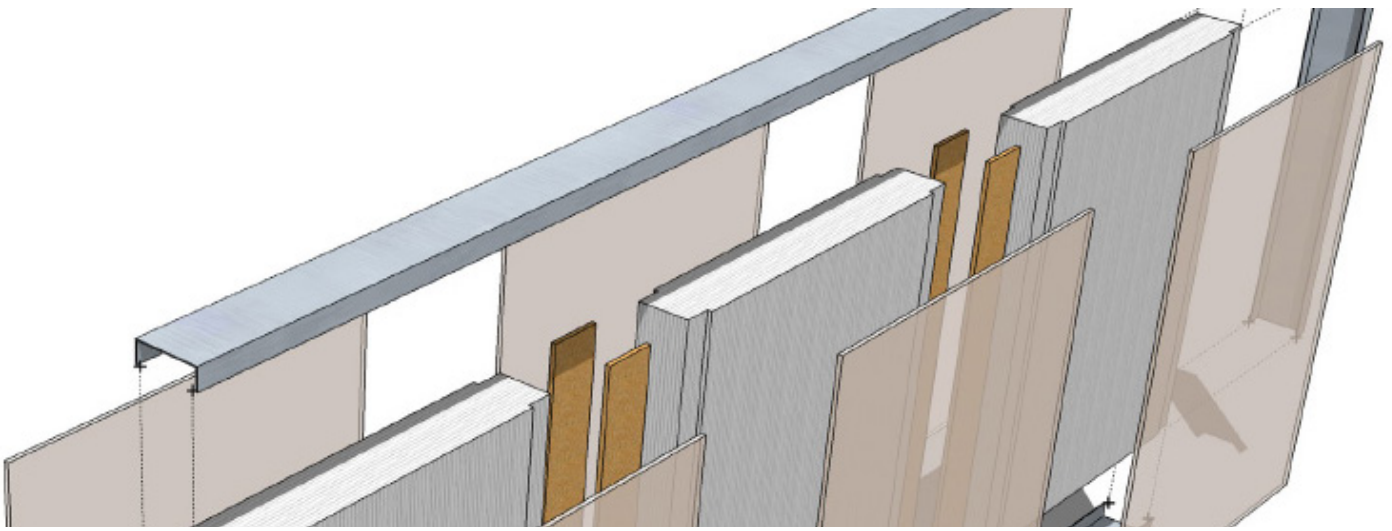
Services Provided

Structural Engineering

Engineer Thoughts

"The climatic conditions varied widely because of its siting and its location on a hill, and working with climate extremes drove innovation and expertise for a much more sustainable building and efficient build time than traditional building methods"

Sunayana Kankanady
Structural Engineer



Characteristics and Benefits of Structural Insulated Panels

Australia is at the forefront of green building and sustainable building practices using design and planning processes that are environmentally responsible and resource efficient.

Buildings use a tremendous amount of natural resources to construct and operate. For a sustainable future constructing sustainable buildings that use less energy, while minimizing pollution that can harm renewable natural resources is becoming crucial to combat global climate change.

Out of all the systems used for building construction, SIPs are one of the most airtight and well insulated building systems available, making them a product that when designed and constructed correctly leads to an inherently green building system. An airtight SIP building will use less energy to heat and cool, allow for better control over indoor environmental conditions, and reduce construction waste.

The major components of SIPs panels are a central insulated core utilising expanding polystyrene foam and outer skin of Magnesium Oxide (MgO) or Oriented Strand Board (OSB).

Traditionally, SIPs comprise Oriented Strand Board ("OSB") and this type is most commonly used. However, the timber-based face sheets, often combined with internal timber framing elements, yield the numerous problems that come with any organic element, i.e., dimensional changes with moisture changes, warpage, cracking of applied finish materials, a fuel source in a fire, a potential food and nesting source for insects & mould development. They are also a relatively poor insulator and act as a thermal bridge between the exterior and interior spaces, losing insulation value.

Using OSB face sheets on the interior of a building typically necessitates covering the OSB with gypsum board to obtain an acceptable finish, which adds unnecessary costs.

To achieve a Code-compliant fire-resistance rating, gypsum board is also typically used over OSB faces, both on the interior and exterior of the panel. The Magnesium oxide ("MgO") boards avoid the additional expense, time, and effort of cladding a timber-faced SIP system with gypsum board and they are also fire resistant face sheets.

Besides, the use of magnesium oxide face sheets has met with a very favourable response in the SIP industry. Furthermore, they are considered by many in the industry to be the most responsible and sensible way to make SIPs as they are very simple to make, are very durable, and avoid the complications and risks of most other materials.

These structural panels can take less energy and raw materials to produce than other structural building systems. SIPs are also fabricated in a controlled environment, allowing for greater efficiency than site-built framing. SIPs have the ability to drastically reduce the waste generated during construction by using advanced optimization software and automated fabrication technology to ensure the most efficient use of material.

The structural components SIPs, when properly used, will meet or exceed the requirements of the Building Code of Australia. However, SIPs are just one portion of a well designed and built building. Naturally, it remains the design professional's obligation to thoroughly design and detail the particular building, and the builder's obligation to build it correctly, to comply with the provisions of the BCA.

As has been documented by structural engineering calculations and testing, SIPs are inherently stronger, especially in shear strength, than conventional timber and plasterboard walls. The load bearing capabilities of SIPs are also inherently greater than conventionally "stick-framed" walls, and so using SIPs for bearing walls is a natural choice.

The loading requirements for structures constructed in Australia are outlined in the Structural Design Actions series of Australian Standards (AS/NZS 1170) and the Bracing of a structure is an important design consideration to ensure long-term stability. For Durability of the structure, the expected level of corrosion of steel used in buildings is dependent primarily on the distance to a salt water expanse as well as if it contains breaking surf or not. However, regarding the SIPs, they contain no steel except for the fixings used in the connection between the structure elements and panels are not intended to be exposed to the weather.

The intention is that a roof covering, e.g. sheet metal (tridek roofing system) or tile, will be installed on top of the roof panel and an external wall cladding will be fixed to the external face of the SIP wall panel. Thus, exterior coverings allowing the SIP fixings will have a very low susceptibility to corrosion.



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