This case study was written at the time when OneSteel was part of BHP. In that context, in some instances within this case study, reference may be made to BHP.

Energy e

Steel sandwich panels are providing designers and builders with a wider range of walling and roofing options in both architectural and industrial building uses. Until recently, steel sandwich panels were mainly used in construction of coldroom storage, but now sandwich panels have become one of the major wall cladding and ceiling materials used in facilities for the food and pharmaceutical industries, meeting both functional and aesthetic design criteria. Apart from architectural applications, sandwich panels are now being used in a variety of situations where consistent internal temperature, and energy efficiency and conservation are required. Recent significant projects utilising steel sandwich panels include sports, recreational, industrial and office facilities.

Generically, steel sandwich panels are a composite product with two outer skins of COLORBOND® pre-painted steel (usually either 0.7 mm or 0.6 mm), laminated to a core of either polyurethane (PU) or expanded polystyrene (EPS). Used as roofing or non-load bearing walling, the panels are available in thicknesses from 50 mm to 250 mm, providing different levels of insulation. Because of the lamination effects between the steel and core - which gains strength from the composite construction - spans are available up to 7 m depending on panel thickness. Larger spans therefore require less internal supporting structures and can create more open, internal spaces.

Steel equals hygiene

Recent projects in the food industry have incorporated significant use of steel sandwich panels. These vary from large projects such as the new Arnott's Biscuits and Street's Icecream factories, through to smaller food processing and retail outlets. In all projects, the functional requirements of cleanliness and efficient thermal control are very important. The skin of the Colorbond steel facing inside the structure provides a smooth factory-finished surface that is water resistant, can be washed repeatedly and so remain free of bacterial growth, while the outer Colorbond steel skin forms an effective barrier from the external environment.
The insulating properties of the core isolate conditions within the building structure from fluctuating external temperatures with the resulting benefit of minimising expenditure on heating and cooling systems.

Similar requirements for hygienic facilities have driven the growth in usage of steel sandwich panels in the pharmaceutical industry. Victorian based R. P Scherers Holdings have recently opened a $23 million, 14,000 square m facility which utilised steel sandwich panels for the external and internal

efficiently sandwiched in steel

walling. The two central design criteria for the plant were firstly, that the external appearance needed to complement the company's global technological image ; secondly, that functionally, the plant had to meet the latest Good Manufacturing Practice (GMP) requirements of the International Therapeutical Goods Authority. Use of sandwich panels both ensured the GMP standards and delivered a building solution capable of precise temperature control at minimum cost.

The packaging industry has also recognised the importance of producing a quality product under similar manufacturing conditions to their food industry clients. Containers Packaging Limited have extensively used sandwich panels in the walls and ceilings of their new Brendale production facilities in Queensland. Here temperatures in the manufacturing and warehouse areas need to be controlled at below 28°C, with positive internal air pressure being used to reduce dust entry. The use of sandwich panels enables effective isolation of the various processes and the smooth Colorbond surfaces facilitate regular cleaning.

Another excellent example of utilising the functional thermal and aesthetic design advantages of steel sandwich panels is the recently completed, award winning Cathay Pacific Data Centre in Sydney. In this case, Cathay Pacific required a fully insulated structure that would house computer facilities which represent the engine room of its world wide operations.

Steel panels designed for roofing

Although most often used as a lightweight walling system, steel sandwich panels are being increasingly used for roof cladding. Generally, the outer skin features a typical trapezoidal profile, while the inner steel face is flat thereby enabling easy fixing to the roof structurals. Further, the increased spanning capacity of sandwich panels allows fewer structural components to be used in the roof (ie, purlins).

With the advent of sandwich panel roofing systems, the construction shell can now also be fully, consistently and automatically insulated. Another advantage is that being completely encapsulated in steel sheet, the insulation material is protected against birds and infestation by vermin.

A recent advance in sandwich panel technology has been the development of both flat and curved, double-sided corrugated steel panels. As a result, designers can achieve either a unique cathedral or barrel-vaulted effect in ceilings. In a residential application, such panels offer a fully integrated roofing system as the panel modules not only offer the external cladding, full insulation and the ceiling lining, but also eaves and fascia through its ability to cantilever. In addition, because of their large spanning capacity, simple ridge beams (if required) can replace conventional trusses.

Reduced energy costs

Although energy efficiency requirements for residential and commercial construction are not mandatory, various organisations have now realised the huge potential savings that can be made over the life of a structure. The Property Council of Australia (formally BOMA) is one such organisation which has published energy efficiency guidelines for office buildings. These guidelines are particularly useful as they nominate energy targets in Megajoules (for gas) or Kilowatts (for electricity) per square metre per annum which can be directly monitored against regular gas and electricity bills.

One outstanding example where energy consumption has been reduced is the Perth Solar Energy Centre. Steel sandwich panels were used as the external, vertical wall spandrels thereby bringing into play the panels' high thermal resistance. Monitored results of energy consumption indicate that the building is operating at a rate of 159MJ / m^2 / year ($8.00 / m^2 / year). This compares favourably with the 1994 BOMA targets of 364MJ / m^2 / year ($18.31 / m^2 / year) - calculations based on 18.11 cents / kWh. The building has received a National Energy Award and has been featured as a case study in the 1995 RAIA Environment Design Guide.

Insulation values or thermal resistance are generally expressed as R Values (m^2.K / W), or alternatively as U values (W / m^2.K) (which is simply the reciprocal of the R value).

Above: Sandwich panel roofing at the Cooloola Sports Centre.
Top left: Sandwich panel wall system at Arnott's facility, Sydney.

Typical EPS cored, steel faced sandwich panels of 100mm thickness have an R value of 2.50. This compares with a typical 100mm thick concrete tilt-up panel which has an R value of 0.08. Thus sandwich panels have 30 times the thermal resistance, as measured in R values, as concrete of a similar thickness. From this simple comparison it easy to see why designers are now using sandwich panels more often when resident comfort is important and / or the building requires air conditioning.

In conclusion

Steel sandwich panels offer an economical walling, ceiling and roofing solution where issues of energy efficiency and conservation, and hygiene are important. The combination of Colorbond pre-painted steel skins and EPS or PU cores results in a lightweight product that provides both superior insulation and thermal resistance as well as a durable, attractive and easy to maintain surface.