Key considerations for the design and construction of an efficient walk-in coldroom structure are the effective sealing of exterior joints and the use of hygienic finishes that resist moisture penetration (and any risk of toxic mould or bacterial growth).

Components of the walk-in coldroom structure are as follows:
- Wall and ceiling panels
- Floor panels
- Door(s)
- Window(s)
- Fixing systems and junctions
- Supporting profiles.

This Skills Workshop does not provide guidance on strategies to design or construct a more fire stable structure, or address the risk of fire, or consider risk management for structures. For further details regarding how to achieve a more fire stable structure and firefighter confidence in insulated sandwich panel (ISP) and expanded polystyrene fire retardant (EPS-FR) panel systems, refer to the Insulated Panel Council Australasia (IPCA) Code of Practice (IPCA 2014). The IPCA Code of Practice sets out the minimum principles and standards for the design specification, manufacture, construction, maintenance and risk management for structures built using EPS-FR panel systems and all IPS types.

**Minimum specification**

There is an economic trade-off between the thermal performance and integrity of the walk-in coldroom and the operating cost of the refrigeration system. The minimum recommended specifications for walk-in coldroom structures are as follows:
- Insulation panels for walls, ceilings and doors are to have an R-value of at least 4.5m²K/W, which equates to 100mm polyisocyanurate (PIR) or thicker than 140mm expanded polystyrene (EPS) on coolrooms, and 6.0m²K/W (thicker than 150mm PIR) on freezers
- Minimum thermal insulation ratings on floors of at least 4.9m²K/W for all walk-in coldrooms
- Transparent windows and doors to have double-glazed insulating glass units (IGUs) on coolrooms and triple-glazed on freezers
- all IGUs to have heat-reflective treatment and gas fill
- Proper sealing of room, which prescribes the joins of insulation panels, types of doors and door gaskets
- Mechanical door and strip curtain
- Energy-efficient interior lighting to have an efficiency equal to or better than LED lights
- Door alarm to minimise air infiltration when doors are opened for operational purposes
- Comply with the NCC and meet the minimum standards of Section J.

**Insulated sandwich panel**

Insulated sandwich panels are prefabricated building components comprising thermal insulation, clad on both sides with facing materials and a jointing arrangement to connect the panels. The panel core is typically made of expanded polystyrene (EPS), expanded polystyrene fire retardant (EPS-FR) or polyisocyanurate (PIR); or, less common, extruded polystyrene (XPS), polyurethane (PUR), mineral fibre (MRF) or EPS phenolic hybrid, syntactic (SPS). Where blown foam insulation is used, the blowing agent shall not be CFC- or HCFC-based.

The insulation core material used is usually covered on either side by hot-dipped zinc-coated steel sheeting, usually 0.55mm thick (older panels used 0.70mm) with a food-safe plastic coating on the outside face of the steel. The rate of heat ingress is determined by the thickness and type of insulation. Refer to Figure 1 for a typical insulation panel cross-section.
Insulated sandwich panel selection shall take account the following criteria:

- Thickness of panel to provide an economical solution while minimising heat loss.
- The climate in the installed location, if the WIC is exposed to the weather.
- Panel thickness to cover spans required, particularly for ceiling panels.
- To keep panels joints to a minimum, panels are often the full height of the cold store, between 1.0 and 1.5m wide (typically 1.2m wide).
- Insulation panel surfaces to meet hygiene requirements.
- Resistance to ambient weather conditions (where applicable).
- Fire regulation and insurance requirements (out of scope here).

(Source: IOR 2017)

Typical R-value properties of insulated sandwich panels are listed in Table 1 in order of thermal performance from best to worst for an equivalent panel thickness.

**Doors and windows**

There are two types of doors discussed in this manual: the main walk-in door used to access the coldroom; and transparent reach-in doors used in retail applications where the consumer reaches into the refrigerated space to access foodstuffs or liquor.

**Walk-in doors**

The walk-in door can comprise the following types:

- Hinged door
- Sliding door
- Swing door (door leaf can rotate in both directions)
- Roll shutter.

Doors can be fitted with mechanical closing devices that assist self-closing, preventing the door remaining ajar, reducing energy losses and helping to maintain the internal temperature of the coldroom.

A door switch device can be used to control evaporator fan motors, internal lighting, alarm and other devices when the door is open, improving energy saving.

The NCC has requirements on doors (refer Section D).

**Reach-in doors and windows**

The minimum requirement for reach-in doors and windows in coolrooms and freezers shall meet the following specification. Transparent reach-in doors for walk-in freezers and windows in walk-in coolroom doors shall be:

- Double-pane insulating glass units with heat-reflective treated glass and gas fill, or triple-pane insulating glass units with either heat-reflective treated glass or gas fill to AS/NZS 4666
- All accessible panes to be toughened safety glass in accordance with AS/NZS 2208
- Glass pack U-value to be no greater than 2.01 W/m²K
- Outer glass pane shall remain free of condensation (and fog) at all times.

If the walk-in coolroom or freezer has an anti-sweat heater without anti-sweat heat controls, the walk-in coolroom or walk-in freezer shall have a total door rail, glass and frame heater power draw of not more than 76 watts per square metre of door opening (for freezers) and 32 watts per square metre of door opening (for coolrooms).

If the walk-in coolroom or freezer has an anti-sweat heater with anti-sweat heat controls, and the total door rail, glass and frame heater power draw is more than 76 watts per square metre of door opening (for freezers) and 32 watts per square metre of door opening (for coolrooms), the anti-sweat heat controls shall reduce the energy use of the anti-sweat heater in a quantity corresponding to the relative humidity in the air outside the door or to the condensation on the inner glass pane.

Any condensation or fog on the inner pane of glass has very little to do with the anti-sweat heaters; the inner pane will normally only fog during or after a door opening.

**Vapour seal**

One of the most important considerations in the construction of temperature-controlled environments is the integrity of the vapour barrier/seal and its effectiveness in preventing moisture ingress into the panels or insulation structure, which in time will cause deterioration of the insulation properties, increasing the load on the refrigeration system and therefore reducing the efficiency of the coldroom as a whole.

The insulation envelope shall be effectively vapour-sealed on its outside surfaces so that water vapour in the atmosphere is not drawn into the panels.

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### Table 1: Typical R-value properties of insulated sandwich panels at 23°C

<table>
<thead>
<tr>
<th>General properties</th>
<th>PIR</th>
<th>PUR</th>
<th>XPS</th>
<th>EPS (including MRF)</th>
<th>MRF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>Polyurethane modified isocyanurate foam</td>
<td>Rigid Polyurethane foam</td>
<td>Rigid board of extruded polystyrene</td>
<td>Moulded block formed from beads of polystyrene</td>
<td>Structural grade mineral rock fibre</td>
</tr>
<tr>
<td>Thermal conductivity (W m⁻¹K⁻¹)</td>
<td>0.020</td>
<td>0.022</td>
<td>0.028</td>
<td>0.038</td>
<td>0.043</td>
</tr>
<tr>
<td>Panel thickness</td>
<td>R-value (m²K/W)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50mm</td>
<td>2.5</td>
<td>2.27</td>
<td>1.79</td>
<td>1.32</td>
<td>1.16</td>
</tr>
<tr>
<td>75mm</td>
<td>3.75</td>
<td>3.41</td>
<td>2.68</td>
<td>1.97</td>
<td>1.74</td>
</tr>
<tr>
<td>100mm</td>
<td>5.00</td>
<td>4.55</td>
<td>3.57</td>
<td>2.63</td>
<td>2.33</td>
</tr>
<tr>
<td>125mm</td>
<td>6.25</td>
<td>5.68</td>
<td>4.46</td>
<td>3.29</td>
<td>2.91</td>
</tr>
<tr>
<td>150mm</td>
<td>7.50</td>
<td>6.82</td>
<td>5.36</td>
<td>3.95</td>
<td>3.79</td>
</tr>
<tr>
<td>Coolroom R (4.5m²K/W)</td>
<td>100mm</td>
<td>100mm</td>
<td>150mm</td>
<td>200mm</td>
<td>200mm</td>
</tr>
<tr>
<td>Freezer R (6.0m²K/W)</td>
<td>125mm</td>
<td>150mm</td>
<td>200mm</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Notes:
1. Typical facing is 0.5mm hot-dipped galvanised steel such as zinc-coated steel to AS 1397.
2. Typical coatings 40 to 120µ food-safe laminate or 15 to 25µ polyester.
3. For density, typical panel weight and structural details, refer to manufacturer’s specifications.
4. Aged closed cell foam material includes a derating value of 0.0015 Wm⁻¹K⁻¹.
be compatible with the materials used in the interlock or joint system, and have sufficient elasticity to tolerate any joint movement without breakdown. The sealant shall not taint food,
- Repairable without dismantling the panels.

Pressure relief valves

Variations in internal temperature will be accompanied by changes in internal pressure. Changes of internal pressure are generally dependent on the size of the walk-in coldroom structure, the rate of temperature change, the use to which it is put, and the type of defrost system. The forces created are such that it is impractical to include them within the normal design parameters of either the insulation or the structural framework. The resulting pressures shall be safely relieved using purpose-designed pressure relief valves and/or door gaskets. For low-temperature applications, pressure relief valves may require heaters to prevent freezing.

The insulation envelope shall be designed to ensure that air pressure created by fans does not affect the integrity of the cold-store structure, panel joints or vapour sealing. Doors should not be located adjacent to fans in order to minimise ingress or egress of air, as significant changes in store pressure can occur when such doors are opened.

Every sub-zero temperature room shall have a specific pressure relief valve. There are various suppliers of such devices and these are usually supplied through the project insulation panel contractor. The device is fitted in a specific wall panel hole, and the number of such devices per room must be determined according to flow cross-sectional area of the valve.

The following equation determines the area of the venting needed:

\[ A = \frac{0.063Q}{\sqrt{(T+273)\Delta P}} \]

Where:
- \( A \) = Required vent area (m\(^2\))
- \( Q \) = Rate of heat production or extraction in the chamber (kW)
- \( T \) = Temperature in chamber (°C)
- \( \Delta P \) = Allowable design pressure difference between interior and ambient

A typical value of \( \Delta P \) is 125 N m\(^{-2}\). For small stores, those in humid or tropical climates and blast freezers, it may be appropriate to increase the vent area by as much as a factor of 2 to account for the greater cooling/heating rate relative to the room volume, the reduced air seepage due to the shorter length of seams, and the likely lower number of doors and other openings. (Source: IOR 2017).

Installation

In accordance with EN 16855-1, Annex D, the main installation issues to be considered to enhance the overall thermal performances and ensure the integrity of the structure are:
- Suitability of the location
- Positioning of the floor, wall and ceiling panels
- Positioning and adjustment of doors and windows
- Positioning of pressure relief valves
- Sealing and finishing.