



Thermal Panel  
Manufacturers Association

**GENERAL SPECIFICATION  
FOR THE  
DESIGN AND CONSTRUCTION  
OF  
COLD STORE ENVELOPES  
INCORPORATING  
PREFABRICATED INSULATING PANELS**

**September 2006**

administered by



AAAMSA  
Group

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## INTRODUCTION

**TPMA** will at all times endeavour to:

Develop and expand the Thermal Insulated Panel market by coordinated promotion of Thermal Insulated Panels.

Set and maintain appropriate standards of commercial conduct and quality in the interest of both the industry and its customers.

Educate members and specifiers in the development, manufacture and use of Thermal Insulated Panels products through publications, lectures and seminars.

Encourage mutual support, respect and fair dealings amongst members in all matters affecting their interest.

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## 1. SCOPE

This Guide deals with prefabricated insulating panels and their use in cold stores in Southern Africa. A cold store may be defined as a sealed structure the internal volume of which is maintained at a temperature generally below ambient and used for the storage of goods. The Guide is intended for cold stores larger than 20m<sup>3</sup>.

## 2. DEFINITIONS AND INTERPRETATION

2.1 Reference is directed to relevant standards, electrical codes and regulations such as the South African National Building Regulations and Building Standards Amendment Act No. 103 of 1977 (as amended), and the Occupational, Health and Safety Act No. 85 of 1993 as amended by the Occupational, Health and Safety Amendment Act No. 181 of 1993. Should additional national and international standards be applicable, at the time of tendering, the parties should acknowledge those standards that are to be included in the contract governing the building activities.

2.2 Throughout this Guide, the words “shall” and “should” have been used as follows:

Where “shall” or “shall not” is used for a specified requirement, that requirement is intended to be mandatory. Where “should” or “should not” is used for a specified requirement, that requirement is not intended to be mandatory but is recommended good practice.

2.3 Advice as to the intended meaning of this Guide or any part of it shall be the responsibility of the Chairperson of the TPMA for the time being or of such person or persons as he shall nominate.

2.4 In the event of a dispute, any information required from Members shall be made available to the TPMA.

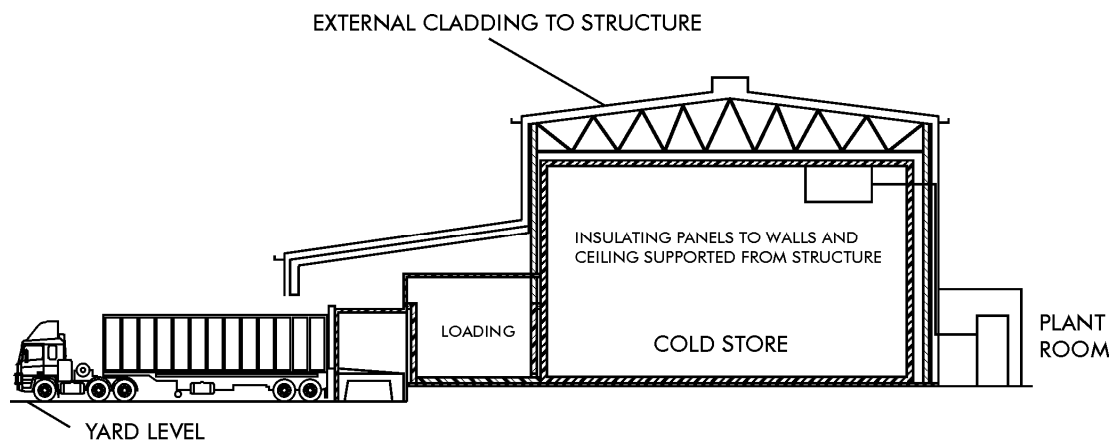
## 3 DESIGN

### 3.1 TYPES OF COLD STORES

For the purpose of this Guide, cold stores are classified in four groups, as listed below 3.1.1 to 3.1.4. Cold stores should have adequate weather protection, which may be in traditional or modern materials.

#### 3.1.1 INTERNAL INSULATION SYSTEM WITH FULL EXTERNAL WALL AND ROOF CLADDING

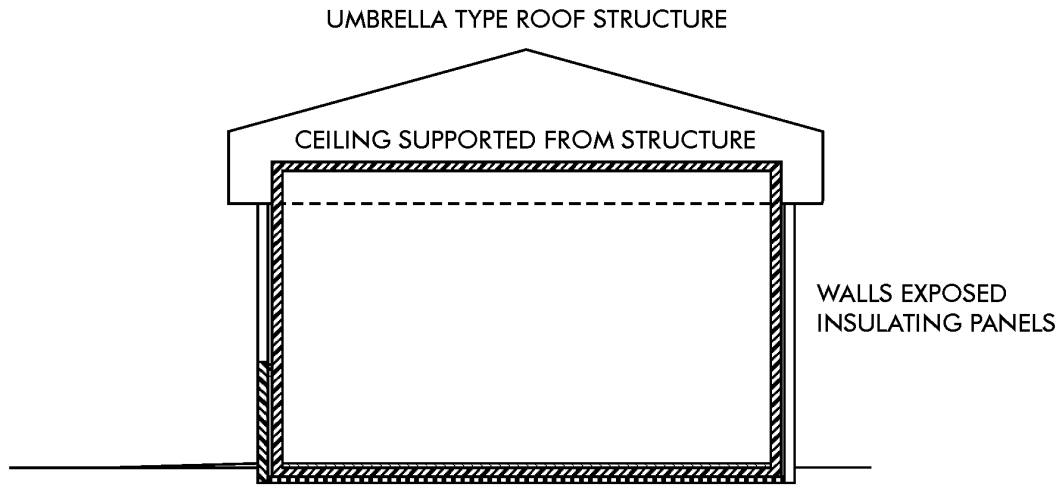
A suitable building structure incorporates and supports wall and roof cladding. The insulated panels are fitted to the inside of the structure, which also supports them.





### 3.1.2 INTERNAL INSULATION SYSTEMS WITH ROOF AND PARTIAL EXTERNAL WALL CLADDING

The panels are fitted to the inside of a structure, which also supports the roof and such wall cladding as is required.



### 3.1.3 INTERNAL INSULATION SYSTEMS WITHIN LARGER BUILDINGS

The insulating panels are either fitted to the outside of a structure, which supports the roof panels (fig a), or the insulating panels constitute a self-supporting structure to form the complete chamber (fig b).

This form of construction is generally used for small stores. Such stores are often constructed within much larger buildings or externally under a weatherproof cover.

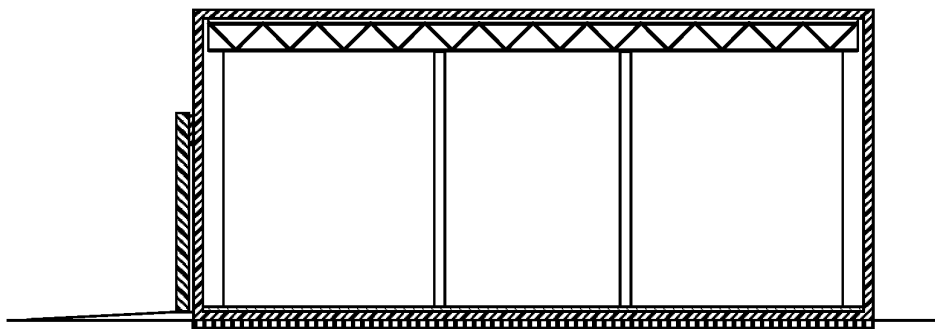


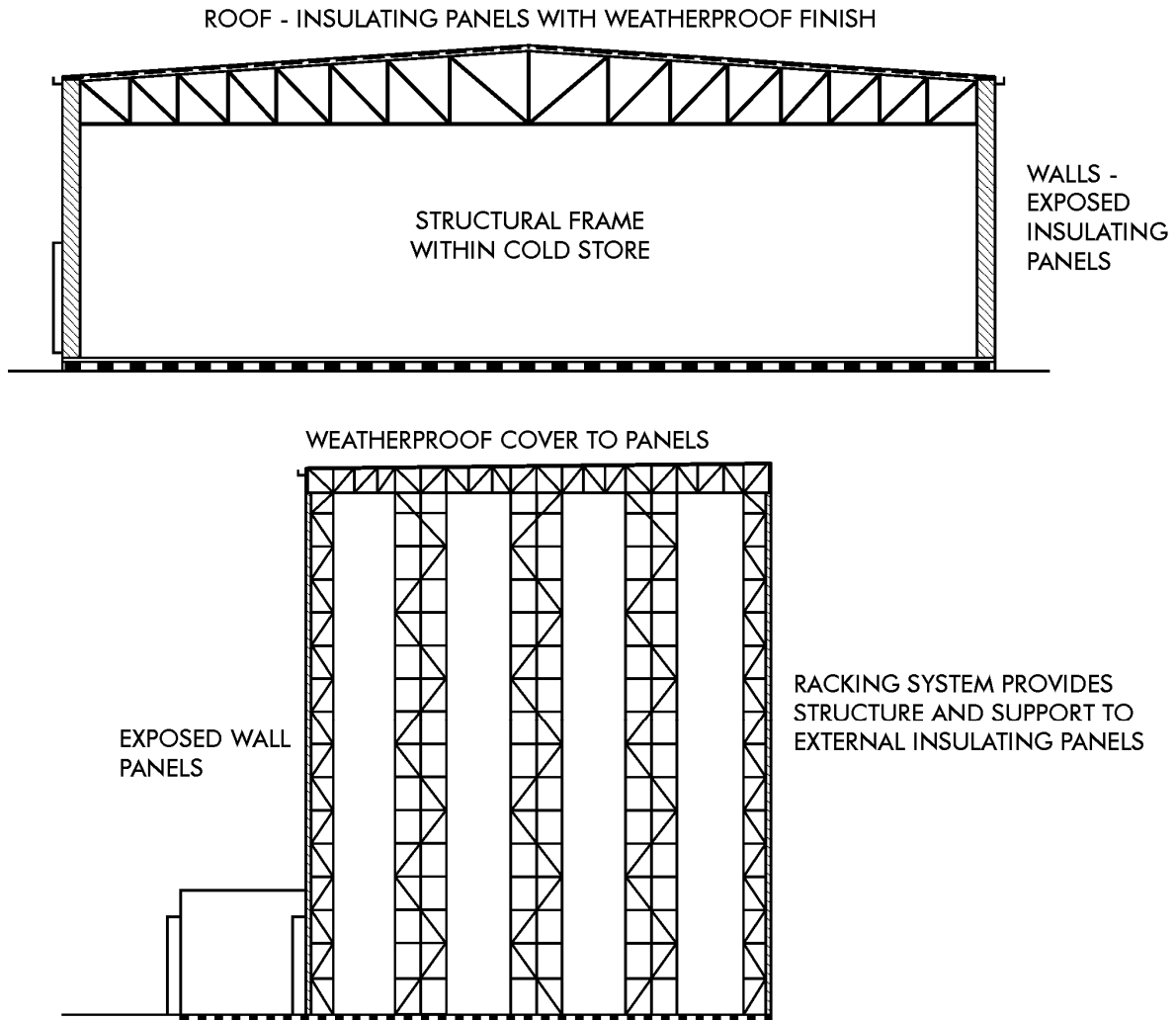
Figure a



Figure b

### 3.1.4 EXTERNAL INSULATION SYSTEMS

The panels are fitted to the outside of the structure or racking system and are suitably protected from the weather. The panels also form the base for the roof weather protection, which may be panels with the joints fully weatherproofed or roofing materials applied directly to the panels.





### 3.2 DESIGN DETAILS

**If necessary a design engineer should be consulted to confirm calculations.**

- 3.2.1 Panels are prefabricated building components filled with insulation, clad on both sides with facing materials and arranged with a jointing means to connect panels. To keep panel joints to a minimum, panels are often the full height of the cold store, between 1 and 1.2 m wide and generally in excess of 50mm thick.
- 3.2.2 Connecting brackets, bolts, clips and other forms of fixing are used to connect the insulating panels to the supporting structural framework. These shall carry the maximum total loading, which may be imposed, without overstressing or distorting the supporting structural framework or the insulation panels.
- 3.2.3 Steel brackets supporting panel systems shall be designed to avoid excessive stress and movement as defined by the requirements of SANS 10162-2: 1993 or SANS 2001: 2005. The brackets shall be designed to avoid damage to the insulation panels and shall be corrosion resistant.
- 3.2.4 The Ceiling support system shall be connected to the main structure in a manner which takes into account:
- (a) the method of supporting the insulating ceiling panels,
  - (b) the position of the supports to avoid local over stress within the supports, the suspended ceiling or the main structure,
  - (c) the expansion and contraction of the main structure.
- 3.2.5 Non-corrodible hanger assemblies shall be used to support insulating ceiling panels. It is recommended that stainless steel, aluminium or hot dip galvanized steel be used; other materials such as nylon are less suitable. Hangers, slips, brackets and other supports shall be designed to support the maximum combination of loads and shall not be stressed beyond one-third of their ultimate strength.
- The components forming the ceiling support, which can cause condensation of moisture and formation of rust, shall be insulated and sealed.
- 3.2.6 It is recommended that cold stores should be designed without false ceilings for air distribution but if these are incorporated they shall be supported directly from the main structure.
- 3.2.7 The height of wall panels is often such that care must be taken to ensure that adequate stability of the wall panels is maintained.
- 3.2.8 The junction between an insulated wall and ceiling panel shall be designed and assembled in a manner that ensures the integrity of the interconnecting junction.
- 3.2.9 The use of dissimilar metals such as steel and aluminium in contact can cause accelerated corrosion due to electrochemical action and should be avoided.
- 3.2.10 The minimum base metal thickness for steel panel cladding and the galvanizing thickness should take into consideration both the structural design and environmental conditions, e.g. wind, humidity, corrosion.
- 3.2.11 As the strength of the panel is dependant on the bonding, due care must be taken in the laminating process. (see 5.2.2.1)



### 3.3 LOADS

## LOAD SPAN TABLE

Max Span to  
BS 6399  
(Note 3)  
(M)

Panel Thickness (mm)	Maximum allowable loads KN/m <sup>2</sup>																
	Span in Metres Wall								Span in Metres Ceiling								
	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	
EPS SD	5	0.76	0.42	0.25													2.61
EPS HD	5	0.93	0.48	0.28													3.14
PIR	5	0.73	0.41	0.24													2.57
Mineral fibre	5	0.80	0.45	0.27													2.64
XPS	5	1.01	0.52	0.29													3.29
EPS SD	7	1.34	0.79	0.49	0.32												4.12
EPS HD	7	1.71	0.95	0.56	0.35												4.61
PIR	7	1.27	0.76	0.48	0.32												4.15
Mineral fibre	7	1.44	0.85	0.54	0.35												4.10
XPS	7	1.89	1.02	0.60	0.38												4.75
EPS SD	10	1.96	1.20	0.78	0.52	0.37	0.26										5.34
EPS HD	10	2.59	1.49	0.92	0.60	0.40	0.28										6.00
PIR	10	1.86	1.15	0.75	0.51	0.36	0.26										5.49
Mineral fibre	10	2.12	1.31	0.85	0.58	0.40	0.29										5.40
XPS	10	2.88	1.63	0.98	0.63	0.43	0.30										6.04
EPS SD	12	2.60	1.53	0.98	0.68	0.50	0.38	0.29	-								6.16
EPS HD	12	3.50	2.08	1.32	0.87	0.60	0.42	0.32	-								7.13
PIR	12	2.45	1.56	1.02	0.71	0.52	0.38	0.28	-								6.71
Mineral fibre	12	2.85	1.80	1.20	0.83	0.59	0.43	0.32	-								6.49
XPS	12	3.94	2.29	1.42	0.93	0.64	0.45	0.33	-								7.23
EPS SD	15	3.25	1.84	1.17	0.81	0.60	0.46	0.36	0.29								5.89
EPS HD	15	4.45	2.72	1.75	1.18	0.83	0.59	0.44	0.34								8.25
PIR	15	3.06	1.92	1.23	0.85	0.62	0.48	0.37	0.30								7.82
Mineral fibre	15	3.72	2.39	1.61	1.12	0.81	0.60	0.45	0.35								7.53
XPS	15	5.04	3.04	1.91	1.27	0.87	0.62	0.46	0.35								8.32
EPS SD	18	3.82	2.14	1.37	0.95	0.70	0.53	0.42	0.34								7.56
EPS HD	18	5.42	3.18	2.03	1.41	1.04	0.77	0.57	0.43								9.28
PIR	18	3.68	2.24	1.43	0.99	0.73	0.56	0.44	0.35								8.85
Mineral fibre	18	4.54	2.96	1.90	1.32	0.97	0.74	0.58	0.46								8.26
XPS	18	6.17	3.76	2.43	1.63	1.14	0.82	0.61	0.46								9.35
EPS SD	20	4.36	2.45	1.57	1.09	0.80	0.61	0.48	0.39								8.19
EPS HD	20	6.40	3.64	2.33	1.62	1.19	0.91	0.72	0.56								10.3
PIR	20	4.30	2.56	1.64	1.14	0.73	0.64	0.50	0.51								9.54
Mineral fibre	20	5.47	3.40	2.18	1.51	1.11	0.75	0.67	0.54								8.76
XPS	20	7.32	4.54	2.97	2.03	1.43	1.04	0.77	0.59								10.3
EPS SD	25	5.46	3.06	1.96	1.36	1.00	0.76	0.60	0.49								9.31
EPS HD	25	8.09	4.55	2.91	2.02	1.49	1.14	0.90	0.76								11.7
PIR	25	5.55	3.20	2.05	1.42	1.04	0.80	0.63	0.51								10.7
Mineral fibre	25	7.22	4.25	2.72	1.89	1.39	1.06	0.84	0.68								9.62
XPS	25	9.60	6.16	4.13	2.88	2.06	1.52	1.14	0.88								12.0
Panel Weight kg/m <sup>2</sup>																	
Panel thickness (mm)	50	75	100	125	150	175	200	250									
EPS SD	10.4	10.7	11.1	11.5	11.9	12.2	12.6	13.4									
EPS HD	10.6	11.1	11.6	12.1	12.6	13.1	13.6	14.6									
PIR	11.6	12.6	13.6	14.6	15.6	16.6	17.6	19.6									
Mineral fibre	15.6	18.6	21.6	24.6	27.6	30.6	33.6	39.6									
XPS	11.0	11.7	12.4	13.1	13.8	14.5	15.2	16.6									

#### Notes:

1. Mineral Fibre, Polyurethane and Polyisocyanurate ceiling panels have 0.7mm thick top faces; load span data for other panels is based on 0.55mm thick faces.
2. Values have been calculated using the limit state method described in the \*European Recommendations for the Design of Sandwich Panels
3. Ceiling panels complying to BS6399 for "Walk-on Ceilings" have been designed to accommodate a Uniform Distributed Load of 0.25 KN/m<sup>2</sup> together with a Centre Point load of 0.9KN
4. Safety factors used – 1.50 live load, 1.35 dead load. The deflection limit is controlled by L/240.
5. The minimum support width for panels is 50mm
6. Refer to the company for load span information of other products
7. Panels' weights are for 0.55mm thick steel. Add 0.7 kg/m<sup>2</sup> for Mineral Fibre, Polyetherene and Polyisocyanurate ceilings panels



3.3.1 The structure and the insulation panel system shall be designed to resist the worse possible combination of forces considered under items 3.3.2 to 3.3.12. The span load table (see Page 8) gives details of maximum allowable loads for a range of materials and wall/ceiling spans.

### 3.3.2 MANUFACTURE

Stresses may be induced during manufacture due to curing of the insulation and handling of the panels. Procedures shall be adopted to keep stresses within design limits.

3.3.3 Erection procedures shall not cause abnormal stresses.

### 3.3.4 WIND PRESSURE - DURING ERECTION

Wind forces can impose excessive stress on an incomplete insulation system and any necessary temporary supports or propping shall be provided. Particular attention should be paid to the possibility of abnormal stresses being applied to panel clips during panel erection.

### 3.3.5 WIND PRESSURE – COMPLETED STRUCTURE

Wind forces imposed on the completed insulation envelope will vary with the locality of the store and the position of any dominant openings. Exposed panels and their fixing systems shall be designed to resist wind pressure in accordance with the latest edition of SANS 10160. The support system and fixings shall not damage the insulation panels when subjected to the effects of positive or negative wind pressure.

### 3.3.6 DEAD AND IMPOSED LOADING

The structure, suspended insulating ceiling and load bearing walls shall be capable of supporting the maximum combination of all loads.

#### 3.3.6.1 DEAD LOADS

These can include:

- Dry weight of the insulated panels
- Weight of the structure and fittings which support the insulating panels
- Weight of coolers and fans under working conditions
- Weight of pipe work supports, pipes, electrical conducts, lights and other fittings
- External weatherproof membrane and/or roof
- Weight of any false ceiling

#### 3.3.6.2 IMPOSED LOADS

These include the weight of any snow or ice that may form within any false ceiling void. It should however, be noted that significant formation of snow or ice in false ceiling voids is unacceptable.

For internal insulation systems detailed in paragraphs 3.1.1, 3.1.2 and 3.1.3 an allowance for miscellaneous items including loads due to occasional maintenance shall be the worst combination of (a) and (b):

- (a) a uniformly distributed load of  $0.23\text{kN/m}^2$  force applied to the complete area of the ceiling.
- (b) a point load of  $0.3\text{kN}$  force applied to any isolated square metre of ceiling.

For external insulation systems detailed in paragraph 3.1.4 the imposed loading conditions shall be as described in the latest editions of SANS 10160 and SANS 10237.



### 3.3.6.3 AVOIDING EXCESSIVE LOADING

Excessive loading on the insulating panels in areas such as those occupied by control equipment shall be avoided; suitable walkways, supported by the structural frame, should be provided above the panels.

### 3.3.7 INTERNAL PRESSURE

#### 3.3.7.1 INTERNAL PRESSURE DUE TO TEMPERATURE CHANGES

Variations in internal temperature will be accompanied by changes in internal pressure. Changes of internal pressure are generally dependent on the size of the store.

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 and for this purpose specially designed valves should be used (normally only required in freezers).

#### 3.3.7.2 INTERNAL PRESSURE DUE TO COOLER FANS

The insulation envelope shall be designed to ensure that air pressure created by fans does not affect the integrity of the cold store structure or the panel joints.

Care should be taken when positioning doors adjacent to fans to avoid ingress or egress of air as significant changes in store pressure can occur when such doors are opened.

### 3.3.8 TEMPERATURE VARIATIONS

The stresses caused by temperature variation between the inner and outer facing plates are considerable and will vary depending on the location of the insulation envelope. (see 3.3.9.1 to 3.3.9.3)

Provision should be made to control the stresses and movement caused by temperature variation between the inner and outer surface of the insulating panels by adequate bonding of the materials.

Ceiling panels are generally designed as free, simply supported, beams. The temperature difference between inner and outer surfaces causes upward camber, which tends to be counteracted by the weight of the panels. Consequently, the movement of simply supported ceiling panels will not, in general, affect the structural frame. Ceiling panels designed as continuous beams over supports may induce secondary stresses in the panels and supports and precautions should be taken to avoid these.

Wall panels are usually continuous for the full height of the store. Fixings shall be designed to accommodate the forces set up by differing movements of the facing materials.

### 3.3.9 MAXIMUM TEMPERATURES OF THE PANEL EXTERNAL SURFACE

#### 3.3.9.1 INTERNAL INSULATION SYSTEMS 3.1.1; 3.1.2 AND 3.1.3

The maximum temperature is dependent on the site location and the external fabric of the main building structure.

When the structure has uninsulated cladding the external face of the insulation panels may reach temperatures as high as 45°C. The ventilation referred to in 3.4.1 limits the maximum temperature.



### 3.3.9.2 EXTERNAL INSULATION SYSTEMS 3.1.4

The maximum temperature is dependant on such factors as site location and the type of external fabric. The unprotected face of insulation panels may reach temperatures as high as 90° C. The store should be designed and constructed allowing for this.

3.3.9.3 The maximum temperature of a panel external surface should be used when considering stress in a panel system. It is not intended as the design temperature with which to calculate heat flows.

### 3.3.10 COOLERS

The working load of ceiling mounted coolers shall be considered as dead load. It is important to allow for the weight of coolers and associated piping plus the weight of refrigerant within this part of the system and the weight of frost on the coolers.

Coolers shall be supported directly from the main structure or from an independent frame. Stainless steel or hot dip galvanised rods or bolts shall be used as fixings.

The cooler hanger bolts should be insulated and vapour sealed to prevent condensation or frost build-up on them. Structures with coolers located in vestibules or penthouses shall be designed for the load of the coolers.

Fixing of the cooler shall be arranged to avoid disturbance of the ceiling panel support system. Ceiling panels in the vicinity of the cooler units will be subjected to continual variations in temperature and therefore, relative movement during defrost cycles.

### 3.3.11 ACCIDENTAL DAMAGE

Wall and ceiling panel fixing systems and the supporting framework shall be designed and installed to avoid serious progressive collapse in the event of accidental damage. Particular attention shall be paid to the secure location of the base of the wall panel.

### 3.3.12 VERTICAL LOADING

Vertical wall panels shall be designed to resist the maximum combination of loads, which may be applied, including their own weight and the load (if any) imposed by the ceiling panels. (Partition wall panels may be removable depending on site usage). Vertical wall panels should be adequately restrained to avoid buckling and overstress of the facing plates.

When the panels act as a load-bearing member providing support to the ceiling then the junction between the wall and ceiling panels shall be formed in a manner that does not impair the stability of the wall or its junction with the ceiling.

## 3.4 MISCELLANEOUS

3.4.1 The void between the insulated ceiling panels and the main roof sheeting should be ventilated to reduce solar heat gain. Similarly any void between the cladding and the insulated wall panels should be ventilated.

3.4.2 Gutters should be located on the external face of the building and fitted with weir overflows to indicate blockages. Gutters and rain water pipes should be accessible for repair and maintenance.

3.4.3 The external sheeting to the building should be watertight. Roof leaks, however, may occur from time to time, and sufficient space should be allowed in the roof void for inspections to be carried out without difficulty.



Refrigeration, sprinkler and other pipe work shall be adequately supported and insulated. When refrigeration pipe work is located above insulation panels, ventilation shall be provided in the vicinity of the pipe work in order to reduce condensation. Pipe work should not be supported from the insulating panels but be separately bracketed from the structure unless it can be shown that the panel system can accommodate the additional load.

It should be possible to inspect and maintain the vapour seal (see 6.2.3) to all external panel joints. The cold store construction materials should be resistant to attack by insects, pests and vermin.

### **3.5 SUPPORTING STRUCTURE**

3.5.1 The supporting structural framework shall be designed and constructed in accordance with the requirements of the latest editions of the following current standard or codes:

- SANS 1200 H: 1990
- SANS 2001: 2005
- SANS 1200 HA: 1990
- SANS 10100-1,2
- SANS 10145
- SANS 10162-2: 1993
- SANS 10160: 1989
- SANS 10237: 1991

3.5.2 The supporting structural framework shall be suitably braced in order to restrict the transfer of both horizontal and vertical movements to and from the frame to the insulation system.

3.5.3 Simple portal frames should be used with caution particularly with large spans because this type of frame has considerable movement, which can disturb panel joints.

3.5.4 Stores to include meat rails or other load carrying devices shall be designed and constructed allowing for the loads from these devices.

### **3.6 FIRE PROTECTION**

All fire protection matters shall be discussed with and approved by the local Fire Prevention Officer. National Building Regulations and local statutory regulations must be complied with. In addition the following is recommended:

Various fire detection and prevention systems and devices are commercially available and use of these is good practice. They include detectors for heat and smoke; fixed water-sprinkling system, inert gas snuffing systems, smoke release valves, flameproof barriers, fire breaks formed by the separation of chambers, etc.

The adoption of such additional measures is generally commended but the evidence suggests that some such devices are not completely reliable in low temperature environments. All devices used shall have been tested at low temperatures and shown to be satisfactory.

## **4 MATERIALS USED IN COLD STORE CONSTRUCTION**

### **4.1 INTRODUCTION**

This section deals mainly with the various materials used for the cladding and insulation of pre-fabricated panels. The materials should comply with relevant South African Standards and should be utilized and handled in conformity with the manufacturer's recommendations.



## **4.2 TYPES OF INSULATION SYSTEM**

The following are the commonly utilized systems of panel insulation for the construction of cold stores.

4.2.1 Panels having a core of insulation joined to the outer facings with adhesive.

4.2.2 Pre-fabricated outer facings with an injected polyurethane core.

## **4.3 INSULANTS**

The first two are the main insulants used in prefabricated panels; the remaining products can also be used:

- (a) Expanded bead polystyrene
- (b) Polyurethane foam
- (c) Mineral wool
- (d) Polyisocyanurate foam
- (e) Phenolic foam
- (f) Extruded polystyrene

## **4.4 FACING MATERIALS**

One of the following coverings should be used:

The first three are used more frequently than the others and a minimum total coated thickness of 0,5 mm is recommended. A vapour seal shall be used on the outer facing of materials, which are permeable, such as (g):

- (a) Galvanized steel sheeting
- (b) Suitable plastic coated galvanized steel sheeting
- (c) Polyester coated galvanized steel sheeting
- (d) Stainless steel sheeting
- (e) Aluminium sheeting
- (f) Aluminium/zinc protected steel sheeting
- (g) Glass reinforced plastics

## **4.5 ADHESIVES**

4.5.1 Certain adhesives have a combustible solvent base which can be absorbed by and remain in the panel insulation. These solvents should, therefore, be avoided.

4.5.2 Certain adhesives should be stored under controlled conditions and the manufacturer's requirements should be strictly observed; many adhesives have a maximum shelf life.

4.5.3 Adhesives should not have a lingering taint.

## **4.6 VAPOUR BARRIER (See 6.2)**

## **4.7 FITTINGS**

Steel angles or channels connected to the main structure shall provide support for insulating wall and ceiling panels and restraint for all panels. Top and bottom restraint for wall panels shall be provided together with appropriate intermediate supports depending on the thickness and height of the panels (Refer to loan span table Page 8)

### **4.7.1 FINISHING**

All junctions between panels shall have vapour seals (see 6.2.2 & 6.2.3). Flashings are often provided over the vapour seal for cosmetic purposes.



## **4.8 GENERAL**

Paint and floor treatments should be allowed sufficient time to dry thoroughly before the cold store is brought into use to avoid lingering odours.

## **5 FABRICATION**

### **5.1 QUALITY CONTROL**

Manufacturers shall control the following and ensure their adequacy:

- (a) Testing of all materials involved
- (b) Methods of manufacture
- (c) Type of equipment used for manufacture and the quality control features built into the use of the equipment.
- (d) Step-by-step quality control
- (e) Newly formed panels should be handled as little as possible until fully cured.

### **5.2 MANUFACTURER'S TESTING AND INSPECTION**

5.2.1 The following items should be inspected on every panel before approval:

- (a) The edges of panels, as an indication of the insulation continuity and freedom from holes and gaps.
- (b) The edges of all panels as an indication of good adhesion.
- (c) Edges that will form part of a vapour barrier joint to ensure there are no dents or irregularities.
- (d) Dimensional accuracy of the panel.
- (e) The correct fit and alignment of the panel, gaskets and any locking devices.

5.2.2 Panels should be selected at random by the manufacturer and inspected and tested in accordance with clauses to 5.2.2.1 to 5.2.2.3

#### **5.2.2.1 ADHESION OF THE INSULATION TO THE FACING MATERIAL**

Either:

- (a) The standard determination of shear strength and shear modulus method 6 in BS 4370 – Part 2:1993, or
- (b) The force required to pull the panel apart may be measured using a fixing attached to each side of a section of panel and tested in accordance with the standard TPMA procedures.

#### **5.2.2.2 VOIDS AND GAPS IN THE INSULATION**

The facing material shall be removed from the selected panel. If voids exceed 25% of the thickness of the panel, the panel shall be rejected. After the manufacturing technique has been adjusted to eliminate the voids further tests shall be carried out.

The insulation shall be cut through at 75mm intervals. If voids exceed 5% of the cross sectional area or 25% of the thickness, the panel shall be rejected. After the manufacturing technique has been adjusted to eliminate the voids further tests shall be carried out.

#### **5.2.2.3 THERMAL CONDUCTIVITY OF THE INSULATION MATERIAL WITHIN THE PANEL**

The Thermal Conductivity shall fall within the range specified by the supplier and may be tested in accordance with ISO/FDIS 4898



### **5.3 STORAGE AT MANUFACTURER'S PREMISES**

5.3.1 Precautions should be taken to avoid:

- (a) Mechanical damage
- (b) Warping due to stacking
- (c) Water or condensation penetration
- (d) Discolouration
- (e) Moisture on galvanized sheeting covering the panels
- (f) Exposure to sunlight or ultraviolet light

5.3.2 Manufactured stock should be stored in covered warehouses with precautions to avoid excessive stresses, particularly on the corners of the panels.

5.3.3 When panels are stored horizontally the bottom panel should rest on a flat bed and be suitably supported.

### **5.4 TRANSPORTATION AND STORAGE AT SITE**

5.4.1 Panels shall not rest on top of each other without a protective separation layer between each panel, e.g. polythene sheeting or strips of expanded polystyrene.

5.4.2 If panels are stored on site in excess of 30 days they shall be protected against wet, heat and sunshine by, for example; a tarpaulin cover or black polythene.

## **6 CONSTRUCTION**

### **6.1 EXAMINING AND TESTING PANELS ON SITE**

6.1.1 The panels should be visually checked for de-lamination, fracture and damage and approved to be to specification, square and to correct dimensions before erection.

### **6.2 MIGRATION OF MOISTURE**

6.2.1 Water vapour will attempt to flow from a region of high vapour pressure to a region of low vapour pressure.

#### **6.2.2 VAPOUR BARRIER**

A continuous barrier, impervious to water vapour shall be provided around the whole of the outside of the cold store envelope and similarly over the warm face of any intermediate wall. The warm outside air has a higher water vapour pressure than the refrigerated air inside the room, and water vapour will, therefore, attempt to migrate through the vapour barrier into the insulation. Water vapour penetrating the vapour barrier and passing into the insulation can condense to water or ice, depending on the temperature within the insulation, and this will impair its insulating and structural properties.

#### **6.2.3 VAPOUR SEALS**

A continuous seal in the following materials, shall be provided between the panels:

- a. non hardening butyl mastic
- b. acetic acid curing silicone
- c. single pack polyurethane sealant
- d. intumescent mastics



#### 6.2.4 JOINT DESIGN CRITERIA

6.2.4.1 The water vapour tight joint shall have a permeance, sufficient to prevent the building-up of water or ice in the insulation under working conditions.

The whole joint including the vapour seal shall be:

- (a) Capable of accommodating the movement of the structure to which the panels are fixed and designed so that the panels are free to move. The movement of the panels and the structure shall not affect the integrity of the joint.
- (b) Provided with a sealant, which shall have good adhesive qualities, be compatible with the materials used in the joint and the elasticity to tolerate the joint movement without breakdown.
- (c) Provided with a sealant that shall have good ageing characteristics.
- (d) Should be repairable without dismantling the panels.

6.2.4.2 The sealant, if a curing material, should not cure so quickly that the process has progressed too far before the whole joint has been sealed.

6.2.4.3 The sealant should be suitable for storage, application and use within the respective temperature bands.

6.2.4.4 The sealant should not taint food.

Where possible the panel joints should be sealed internally and externally to prevent ingress of dirt etc. and enhance the aesthetics.

6.2.4.6 The store side of the joints should be left visible so that a regular check for any condensation or ice formation can be made and investigated, and the cause removed.

6.2.4.7 Where there is an outer cladding for weather protection, sufficient space should be provided to allow access for inspection and repair of the vapour barrier. Where this is not possible the outer cladding should be easily removable for this purpose.

#### 6.2.5 WORKMANSHIP

To secure an acceptable standard of vapour sealing, inspection and approval should be continuous during construction. Constant maintenance is subsequently essential and necessary (see 9.2).

### 6.3 SAFETY

Those using welding equipment should ensure that strict safety procedures are observed when working on site during construction of panel stores, during which time insulation is particularly vulnerable to be ignited by flame or arc.

## 7 ANCILLARY ITEMS

### 7.1 DOORS

7.1.1 The insulation of the doors should be comparable in value with the cold store wall insulation.

7.1.2 The door shall be strongly made, due account being taken of its size.

7.1.3 Where possible the door should be located on the external (warm side) of the cold store insulation.

7.1.4 Suitable gaskets shall be provided to form a seal around the door opening.



7.1.5 Heater tapes or other suitable heating devices shall be incorporated in the door edge and/or frame reveals and floor below the door in order to avoid build-up of ice or condensation on stores operating below 0°C.

7.1.6 Types of cold store doors:

- (a) Manual hinged
- (b) Manual sliding
- (c) Automatic sliding

The sliding doors can be:

- (a) Horizontal sliding (one-or two-leaf)
- (b) Vertical

7.1.7 Smooth opening and closing of doors shall be ensured.

Large doors shall be supported by a sub-frame independent of the insulating panels.

7.1.8 The integrity of the insulating envelope shall be maintained when the doorframes are fitted.

7.1.9 Door handles shall be located so that their use does not distort the door.

7.1.10 Door reveals should be constructed in a manner, which avoids cold tracking and the consequent formation of moisture or ice.

7.1.11 Equipment for doors operating below 0°C shall have appropriate gears and special consideration shall be given to the position and sealing of electrical controls.

7.1.12 Compressed air supplied for pneumatically operated doors shall be adequately dry so that ice does not form in the air supply pipe work.

7.1.13 Automatic doors shall open and close promptly.

7.1.14 The door threshold shall be designed to accommodate the expected traffic and to make due allowance for the variations in temperature.

7.1.15 Automatic doors shall incorporate a safety device to avoid injury to personnel or damage to product in the case of accidental closure.

7.1.16 The lock on an automatic door should isolate the drive mechanism when the door is locked.

7.1.17 All doors required for means of escape purposes shall be easily and immediately operable from the inside at all times. Doors, which open automatically, are not acceptable for means of escape unless they have a manual override and can be opened manually in the event of a power failure.

7.1.18 Protection barriers should be provided to avoid damage to the door track, door and reveals. The barriers shall be securely fixed to the floor. The design of the barriers shall allow for their simple removal and repair.

7.1.19 Floor guide brackets shall be strong enough to hold the door firmly against the jambs when the door is closed and should be so located that they cannot be damaged by the normal use of product handling equipment.

7.1.20 Strip curtains or other means may be provided at door openings to reduce ingress of warm air.

7.1.21 Emergency doors should be provided with emergency lighting illuminated exit signs.



## **8 FLOORS**

A typical floor construction is detailed below:

### **8.1 BASE SLAB**

The common elements of construction of a cold store floor are:

- (a) Sub-base
- (b) Base slab
- (c) Frost heave prevention
- (d) Vapour seal
- (e) Insulation
- Wearing floor

The base slab and wearing floor shall be designed to accommodate the maximum load and constructed in accordance with BS 6399 Pt 1 and SANS 10160.

The standard of finish to the base slab is of considerable importance to the successful erection and alignment of the insulation panels.

Site investigations, excavation, drainage and foundations shall be in accord with the National Building Regulations. The design shall be such as to ensure that normal movement of the building foundations cannot cause damage to the insulation envelope.

### **8.2 FROST HEAVE PREVENTION**

Cold stores designed to work below 0°C, as well as cold rooms built on suspended slabs in multi-storey buildings, shall be insulated and protected against frost heave.

There are four generally accepted methods (method 8.2.1.3 and 8.2.1.4 require heat to the base slab).

8.2.1.1 A structural raised base slab above ground level with a ventilated space through which ambient air can pass between the base slab and the ground. This solution is particularly applicable if the site requires to be piled.

8.2.1.2 Ventilation ducts laid beneath the base slab during construction. This method is not widely used in South Africa.

8.2.1.3 Under floor heating by glycol or other fluid. The fluid is circulated through suitable plastic pipes, which are generally laid in parallel in the base slab or within a separate screed upon the base slab. The pipes, which are usually polyethylene, are connected to flow and return headers, the fluid being heated by waste heat from the refrigerating system or other available sources of heat. A method of measuring the temperature of the circulating fluid shall be provided.

8.2.1.4 Under floor heating by low voltage electric heater mats. This method is particularly applicable where a cold store is to be constructed inside an existing building or where a glycol mat would be disproportionately expensive.

8.2.2 A method of measuring the temperature below the base slab shall be provided. Where mechanical/electrical systems are used to prevent frost heave, they shall be designed so that failure of any circuit does not lead to frost heave.



### **8.3 VAPOUR SEAL**

Floor insulation shall be sealed against vapour penetration. This is generally achieved by laying a heavy duty polythene sheet of minimum thickness 250 microns over the base slab ensuring that all the joints are well lapped and sealed. In order to avoid perforation of this polythene sheet, the base slab should have a smooth finish. The wall to floor joint shall be sealed against vapour penetration.

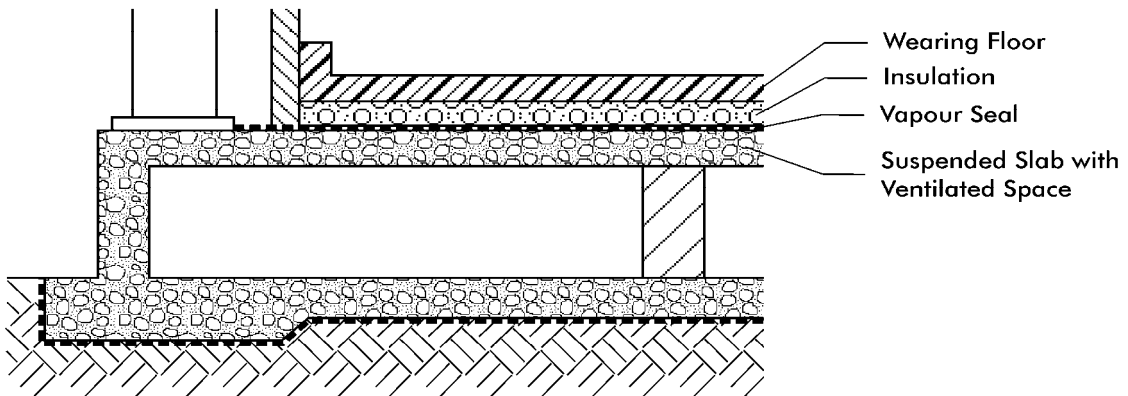
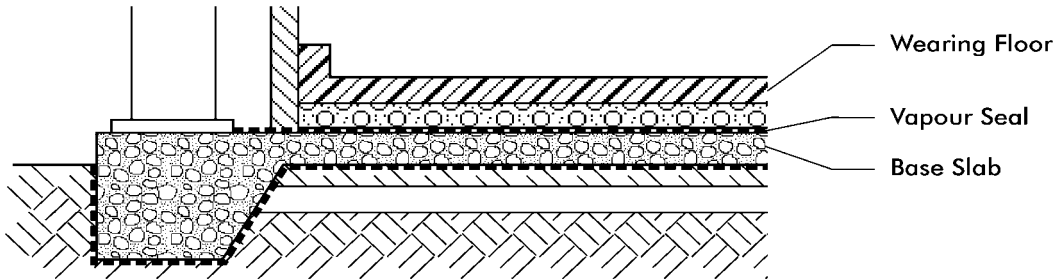
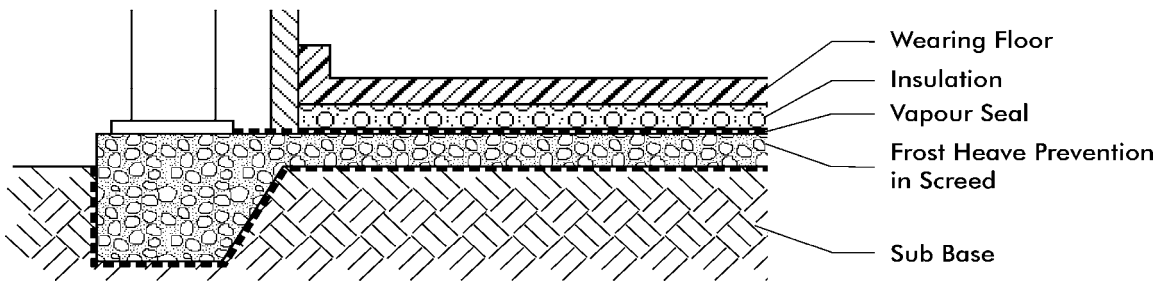
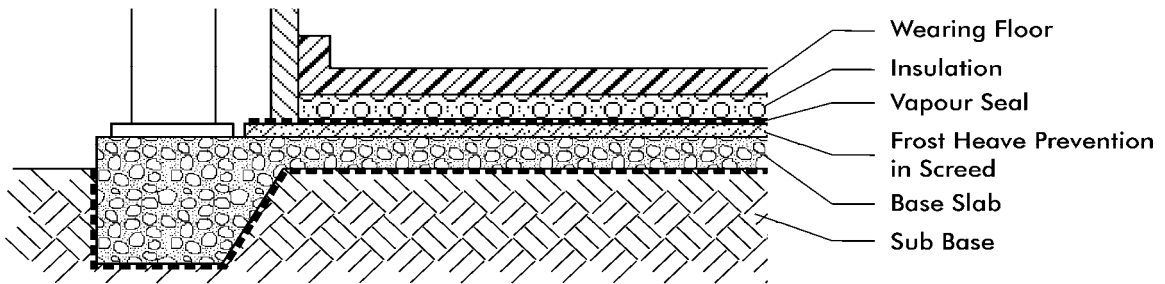
### **8.4 FLOOR INSULATION**

Insulation should be laid in layers with staggered joints. Due attention should be given to:

- (a) Floor loading, including areas of high loading to carry mobile racking or mezzanine floors.
  - Personnel only - 100 kPa compressive strength
  - Dynamic loads - 165 kPa compressive strength
- (b) Temperature within the cold store.
- (c) The effect of concrete poured on the insulation, which can be avoided by a building paper slip- sheet between the wearing floor and the insulation.
- (d) The prevention of damage to insulation by vehicles during concrete pouring.



## 8.5 TYPICAL FLOOR CONSTRUCTIONS





## **9 PERFORMANCE**

### **9.1 COMMISSIONING**

Prior to use of the cold store correct functioning of the following shall be established:

- (a) Internal and external joints and panel seals.
- (b) Doors, door seals and door heaters.

Before proceeding any observed defects shall be rectified promptly.

### **9.2 MAINTENANCE**

On regular inspections attention should be drawn to the following:

#### **9.2.1 WALLS**

- (a) Impact or other damage
- (b) Joints and vapour seals for snow condensation

#### **9.2.2 CEILING AND ROOF VOIDS**

- (a) As for walls 9.2.1 (a) and (b)
- (b) Light-fitting connections for snow or condensation
- (c) Corrosion and misalignment of ceiling supports and steelwork
- (d) Water leaks from roof and condensation from refrigeration pipe work
- (e) Removal of snow or ice in false ceilings

#### **9.2.3 DOORS**

- (a) Gaskets and door heaters
- (b) Automatic door opening equipment
- (c) Safety mechanisms
- (d) Emergency release

#### **9.2.4 VAPOUR SEAL**

The vapour seal has a definite life and requires repairing and replacing when it deteriorates.

Vapour seal leaks will show in low temperature stores as a formation of snow at the joints between panels where the deterioration has occurred. Repair should be effected from the outside of the store. The snow formed at the leak should be removed so that the repair of the leak can be checked. Vapour seal leaks are less easy to detect in higher temperature rooms.

## **10. RECOMMENDATIONS**

10.1 The minimum insulation panel thickness should be based on a 10 W/m<sup>2</sup> heat gain. Improved insulation performance will be dependant on relevant economic factors.

10.2 Certain insulation systems have been developed which minimize the degree of weather protection required but consequent possible increase in maintenance costs should be critically analysed.

10.3 Light coloured surface finishes on exposed panels reduce heat gain and therefore should be used in preference to dark coloured surface finishes.

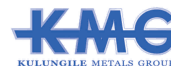


## 11. LIST OF REFERENCES

- i. The National Building Regulations and Building Standards Amendment Act No. 103 of 1977 (as amended)
- ii. Occupational, Health and Safety Act No. 85 of 1993 as amended by the Occupational, Health and Safety Amendment Act No. 181 of 1993.
- iii. SANS 10162-2: 1993 – The structural use of steel Part 2: Limit-states design of cold-formed steelwork.
- iv. SANS 2001: 2005 – Construction works Part CSI: Structural steelwork.
- v. SANS 1200 H: 1990 Standardized specification for civil engineering construction – Section H: Structural steelwork
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- vii. SANS 10100-1 - The structural use of concrete Part 1: Design
- viii. SANS 10100-2 – The structural use of concrete Part 2: Materials and execution of work
- ix. SANS 10145 – Concrete masonry construction
- x. SANS 10160: 1989 – The general procedures and loadings to be adopted in the design of buildings
- xi. SANS 10237: 1991 – Roof and side cladding
- xii. BS 6399: Pt 1 – 1996 Loadings for buildings. Code of practice for dead and imposed loads.
- xiii. BS 4370 – Pt 1: 1988 Methods of test for rigid cellular material: Methods 1 to 5
- xiv. BS 4370 – Pt 2: 1993 Methods of test for rigid cellular materials: Methods 7 to 9.
- xv. ISO 4898 - Rigid cellular plastics – Thermal insulation products for buildings - Specifications
- xvi. The Cement and Concrete Institute – [www.cnci.org.za](http://www.cnci.org.za) - ☎ (011) 315-0300
- xvii. Fire Protection Association of Southern Africa – ☎ (011) 397-1618



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..... why roses need to get to the market looking as good as just picked.



### ...Cold Room Design and Construction

- Climate Change
- Energy Efficiency
- Power Saving



.....why some milk travels better.



.....why beef should be well hung



...why fruit and vegetables need to be fresh and crisp



.....why wine should be chilled and beer served ice cold.



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