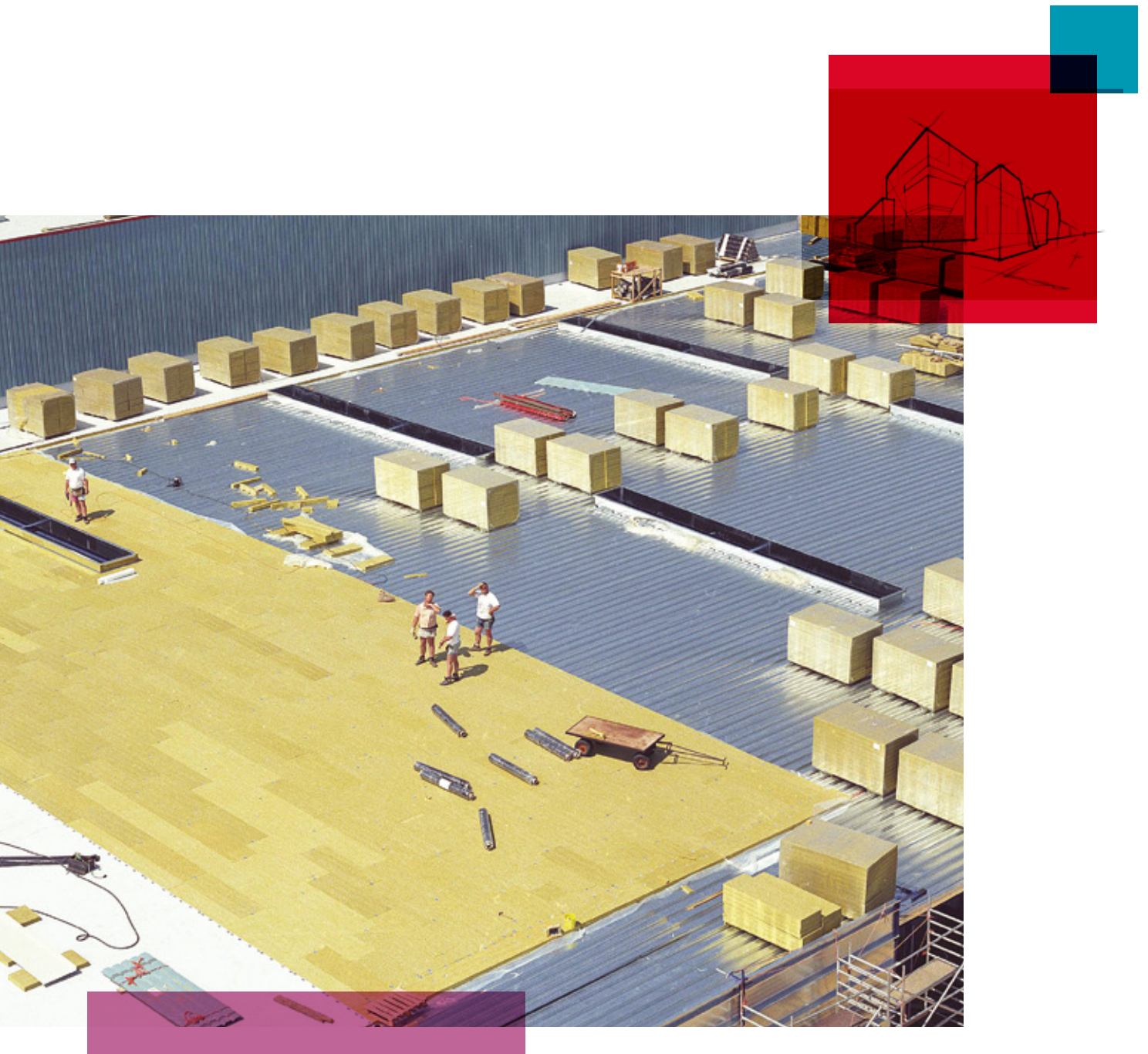


Flat Roof Insulation

High compression strength insulation for flat roofs



3

Introduction

10

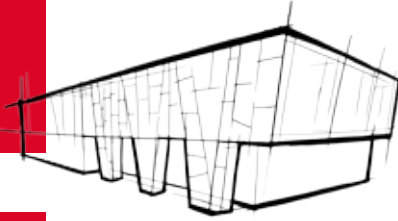
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Reference Projects



Project
**Tetra Pak Factory, Binh Duong,
Vietnam**

Completed: 2018
Owner: Tetra Pak

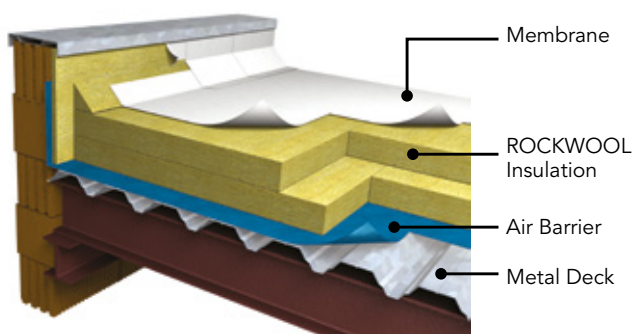
Photo courtesy of Tetra Pak

Introduction

ROCKWOOL roofing boards provide a one stop solution to roofing insulation requirements. They are suitable for new and re-roofing applications on metal deck or concrete deck. ROCKWOOL insulation is approved by Factory Mutual (FM Approval) for Class 1 roof construction in membrane roofing systems and has proven track records in various international projects. The roofing boards have been developed to offer three types of roofing performances to address the challenges in membrane and metal roofing design for roof designers.

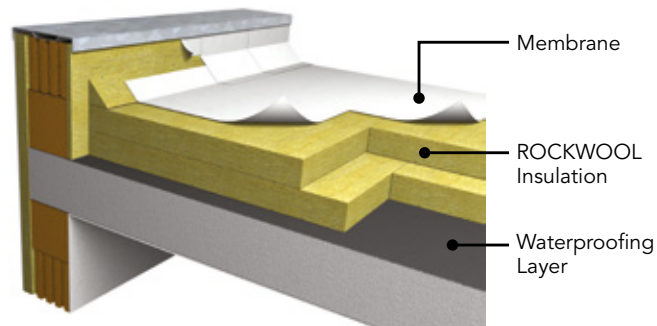
System Description

ROCKWOOL flat roof insulation solutions are specially designed for membrane and metal roof systems.



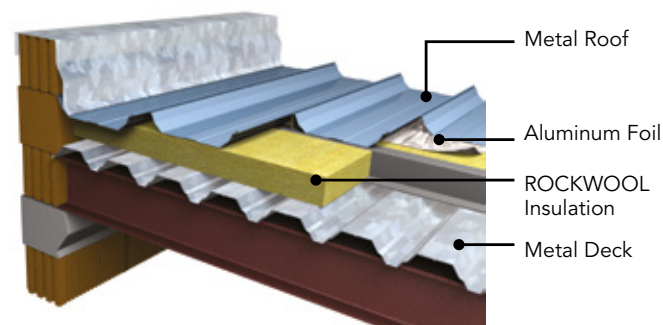
Steel Deck Roof System

ROCKWOOL roofing boards provides an unrivalled fire performance that combines with the excellent mechanical strength to meet all requirements and regulation needs. The superior properties of ROCKWOOL stone wool insulation enhances the overall performance of the membrane roof system in fire, thermal and acoustics, thus producing a durable and energy efficient roofing system. ROCKWOOL roofing boards with mechanically fixed single-ply roofing membrane system on metal deck is ideal for commercial and industrial buildings.



Concrete Deck Roof System

With the high thermal mass of the concrete roof deck, concrete roof have to be adequately protected during summer and winter periods. ROCKWOOL roofing boards provides excellent thermal properties to keep the interior temperature stable and comfortable. Furthermore, ROCKWOOL roofing boards is dimensionally stable and will not be affected by the variation of temperatures over time.



Twin Skin Metal Deck Roof System

The superior sound absorption characteristics of ROCKWOOL roofing boards provides an effective damping of sound resonance within twin skin metal deck. Combined with the added mass of the insulation, ROCKWOOL roofing boards with twin skin metal deck roof system provides an effective acoustic solution for a wide range of applications. ROCKWOOL roofing boards with twin skin metal deck roof system is ideal for educational institutions, airports, convention centres and other buildings where acoustic performance is an important criteria in building performance.

General Insulation Benefits

ROCKWOOL roofing boards offer unrivalled combination of benefits for flat roof constructions.

a. Mechanical Strength

- ROCKWOOL roofing boards offer high resistance to compression and point loading in order to facilitate periodic maintenance of roof.
- The roofing boards effectively maintain a flat surface to allow rain water draining on the roof surface.

b. Fire

- ROCKWOOL roofing boards are non-combustible and can withstand at least 1000°C without melting according to ASTM E749.
- The roofing boards can effectively impede spread of fire and provide the critical extra minutes for occupants to escape.
- ROCKWOOL insulation also provides the highest Euro Fire Classification, A1 rating according to EN 13501-1, as a non-combustible product.
- ROCKWOOL boards do not produce any burning droplets, promote flashover or release excessive smoke during a fire.

c. Thermal

- ROCKWOOL roofing boards are dimensionally stable and ensure constant thermal resistance value. The roofing boards do not contain CFC's or HCFC' insulant that could diffuse from the board over time and reduce its R-value.
- The excellent thermal properties of the roofing boards assist the reduction of condensation built-up by the roofing system.
- ROCKWOOL roofing boards are compatible with all types of roofing membrane. No separation layer is required between the roof membrane and insulation to provide for an optimum design.

d. Acoustic

- The open fibre structure of ROCKWOOL insulation provides excellent sound absorbing properties.
- ROCKWOOL roofing boards are proven as the ideal acoustics insulation material to provide excellent sound insulation and reduced impact noise for flat roof constructions.
- When laid on perforated metal deck lining, the roofing boards are able to control room reverberation and enhance acoustic quality.

e. Dimensional Stability

- ROCKWOOL roofing boards are made from stone, therefore the thermal coefficient of expansion of the boards is virtually zero.
- The boards do not shrink, warp or deform over time, hence providing the most stable substrate without causing undesirable stress on the roofing membrane.
- The dimensional stability of ROCKWOOL roofing boards eliminates the need for additional mechanical fasteners to prevent differential thermal expansion.

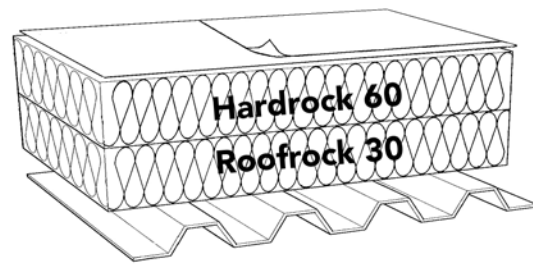


Solutions for Flat Roof Insulation

To provide flexibility in design, cost and usage of membrane roofing system, ROCKWOOL roofing boards offer three different types of roofing insulation system to allow owners, designers and installers to achieve the desired performances of an ideal roof.

Flatroof Lite

The Flatroof Lite insulation solution offers a cost effective solution for built up bitumen membrane roof system. It satisfies the basic requirement for thermal, acoustic and fire performances. The system introduces Hardrock and Roofrock series of products to allow roof designers to achieve the required mechanical performances of the membrane roof system using the combination of both products. In Flatroof Lite roof insulation system, Roofrock 30 roofing board with the compression resistance of 30kPa is introduced as the bottom layer of the system. With the superior mechanical strength of Hardrock 60 roofing board, the insulation board is employed at the top layer to provide the stability for the overall system. Flatroof Lite is FM approved using the combination of Hardrock and Roofrock 30 insulation.



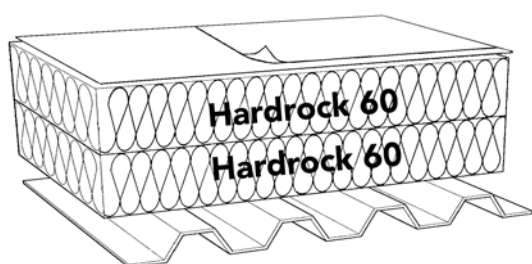
For Hardrock specifications, please refer to page 5

Performance of Flat Roof Lite Solution	
Insulation thickness	100mm
Installation layer / Thickness	HardRock 60 (Top) / 50mm RoofRock (Bottom) / 50mm
Thermal Resistance (R-Value, m ² K/W)	2.74
Compression Strength (Ø10) kPa at 10% deformation in accordance to EN 826	>30kPa
Point Load (Øp) N at 5mm deformation in accordance to EN 12430	>500N

Technical Specification for Roofrock 30	
Nominal Density	120kg/m ³
Thermal Conductivity	0.036W/mK at 20°C (ASTM C518)
Fire Performance	Non-Combustible, A1 (EN 13501-1)
Compression Strength	>30kPa at 10% deformation (EN 826) (Ø10)
Delamination Strength	>7.5kPa (EN1607)
Moisture Resistance	Moisture sorption < 1% Vol. (ASTM C1104/C 1104M-95)
Water Resistance	Short-term water absorption < 0.5kg/m ² (EN 1609:97)
FM Approval	Class 1 insulated steel deck roof (4450)

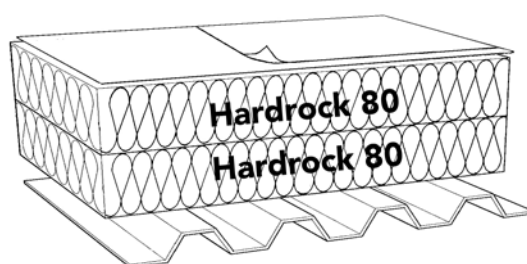
Flat Roof Plus

ROCKWOOL Flatroof Plus insulation system provides superior mechanical strength to meet all challenges on the roof. The 60kPa roofing boards provide resistance to foot traffic during periodic roof maintenance. With ROCKWOOL state-of-the-art technology, Hardrock 60 roofing boards delivers the combination of mechanical strength, lighter weight and resistance to fire. When tested to EN 1606, Flatroof Plus can withstand a permanent load of 3kPa.



Flat Roof Pro

ROCKWOOL Flatroof Pro insulation system provides an unsurpassed performance over a range of parameters. The fully tested system provides excellent acoustic performance due to the higher mass and damping ability of the boards. This roofing system is proven with excellent track records in Asia. When tested to EN 1606, Flatroof Pro can withstand a permanent load of 4kPa.



Technical Specification for Hardrock 60

Nominal Density	160kg/m ³
Thermal Conductivity	0.037W/mK at 20°C (ASTM C518)
Fire Performance	Non-Combustible, A1 (EN 13501-1)
Compression Strength	>60kPa at 10% deformation (EN 826) (Ø10)
Point Load (Ø p)	>500N at 5mm deformation (EN 12430)
Delamination Strength	>7.5kPa (EN1607)
Moisture Resistance	Moisture sorption < 1% Vol. (ASTM C1104/C 1104M-95)
Water Resistance	Short-term water absorption <0.5kg/m ² (EN 1609:97)
FM Approval	Class 1 insulated steel deck roof (4450)

Technical Specification for Hardrock 80

Nominal Density	175kg/m ³
Thermal Conductivity	0.038W/mK at 20°C (ASTM C518)
Fire Performance	Non-Combustible, A1 (EN 13501-1)
Compression Strength	>80kPa at 10% deformation (EN 826) (Ø10)
Point Load (Ø p)	>700N at 5mm deformation (EN 12430)
Delamination Strength	>7.5kPa (EN1607)
Moisture Resistance	Moisture sorption < 1% Vol. (ASTM C1104/C 1104M-95)
Water Resistance	Short-term water absorption < 0.5kg/m ² (EN 1609:97)
FM Approval	Class 1 insulated steel deck roof (4450)

FM Approvals

ROCKWOOL roofing insulation – Roofrock 30, Roofrock 40, Hardrock 60 and Hardrock 80 are approved products under Factory Mutual (FM).

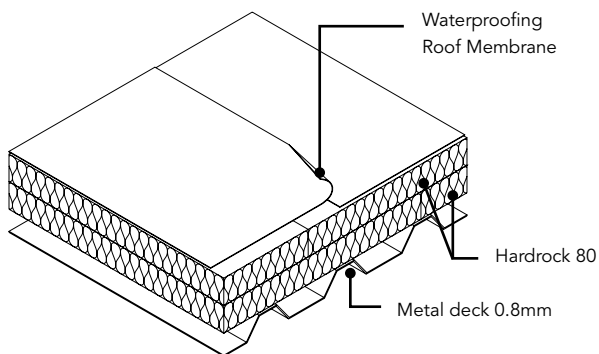
For FM requirements, ROCKWOOL roofing boards should be fixed in accordance with the specification for Class 1 steel deck constructions and in accordance with FM Approved Guide and appropriate FM data sheets. Additionally, the insulation boards should be mechanically fixed in accordance with FM pre-securement requirements. ROCKWOOL FM approved assemblies are available in www.roofnav.com.

Acoustic Performance

ROCKWOOL stone wool is the ideal material for use in achieving a desired acoustic performance. It is made up of fibroporous basalt stone with air-filled interconnected spaces. This structure gives excellent acoustic properties as it significantly diminishes occurrences of vertical sound waves on adjacent surfaces.

Membrane Roof System

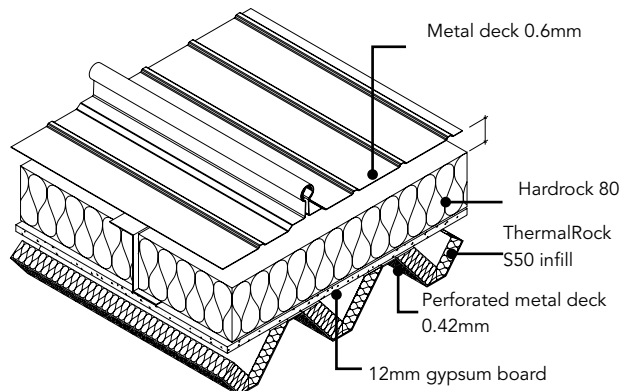
STC 33



With the high density of ROCKWOOL Hardrock roofing boards and the structure of the product, it provides the added mass necessary for effective sound insulation of membrane roof system. Additionally, the single-ply roof membrane coupled with ROCKWOOL stone wool insulation effectively minimizes rain impact noise on the roof system.

Membrane Roof System

STC 44



Laboratory testing have proven the added advantage of Hardrock roofing boards in metal roof system. With the high sound absorption characteristics of ROCKWOOL roofing boards, it provides an effective damping of sound resonance within the roofing system. To enhance the quality of sound, ROCKWOOL stone wool infills can be introduced inside the trapezoidal of the perforated metal deck to provide added sound absorption for reverberation control.

Thermal Performance

U-Value Calculations for Flatroof Lite, Flatroof Plus and Flatroof Pro Insulation Systems

Insulation System	Flatroof Lite		Flatroof Plus		Flatroof Pro	
Description	Hardrock 60 & Roofrock 30*		Hardrock 60		Hardrock 80	
Insulation Thickness	Metal Deck	Concrete Deck	Metal Deck	Concrete Deck	Metal Deck	Concrete Deck
100	0.345	0.341	0.350*	0.345*	0.359	0.345
120	0.209	0.287	0.294	0.291	0.302	0.298
140	0.251	0.248	0.254	0.251	0.260	0.258
160	0.220	0.218	0.223	0.221	0.229	0.227
180	0.197	0.195	0.199	0.198	0.204	0.203
200	0.177	0.176	0.180	0.179	0.185	0.183

Note:

* For Hardrock 60 & Roofrock 30 (Flatroof lite) insulation system, the total insulation thickness refers to the combined equivalent thickness of both products (I.E. 100mm thickness comprises of 50mm Hardrock 60 & 50mm Roofrock 30)

* Refer to sample U-value calculations below

(i) For details of metal deck and concrete deck construction refer to built-up in sample calculations below

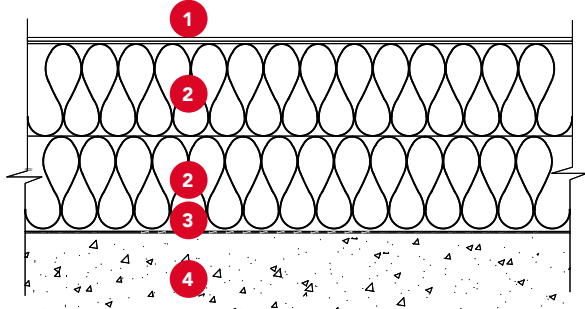
(ii) Fixings are not taken into consideration in the above calculations

Sample U-Value Calculations for Flatroof Plus Insulation System

Description	Thickness (mm)	Thermal Conductivity (W/mK)	Metal Deck Thermal Resistance (m²K/W)	Concrete Deck Thermal Resistance (m²K/W)
Outside surface resistance, R _{so}	-	-	0.040	0.040
Waterproofing membrane	2	0.160	0.013	0.013
Hardrock 60	100	0.037	2.703	2.703
Air Barrier	0.500	0.170	0.003	-
Metal Deck	0.7	50	0.000	-
Concrete Deck	100	2.300	-	0.403
Inside surface resistance, R _{si}	-	-	0.100	0.100
Total Thermal Resistance (R-Value)	-	-	2.858 m²K/W	2.899 m²K/W
Total Thermal Transmittance (U-Value)	-	-	0.350 W/m²K	0.345 W/m²K

Reference Projects

Project: Renewable Energy Corporation (REC) plant, Singapore

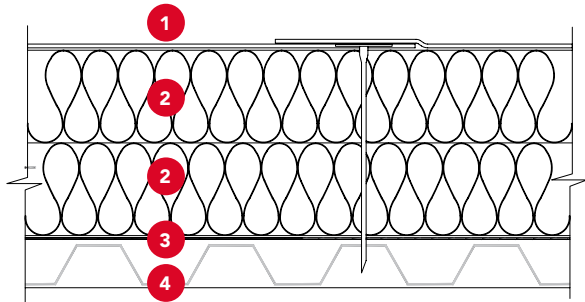


ROCKWOOL Flatroof Pro Concrete Deck System

- | | |
|------------------|------------------------|
| 1) Roof Membrane | 3) Waterproofing Layer |
| 2) Hardrock 80 | 4) Concrete Deck |

- ROCKWOOL roofing boards provide an unrivalled combination of thermal, acoustics and fire performances.
- The roofing boards were FM Approved, assuring a high standard of quality products while providing compliance towards insurance requirements.

Project : First Solar plant, Kulim, Malaysia



ROCKWOOL Flatroof Pro Metal Deck System

- | | |
|-----------------------------------|---------------------------|
| 1) Roof Membrane | 3) Air Barrier |
| 2) Hardrock 80 with Tissue Facing | 4) Trapezoidal Metal Deck |

- ROCKWOOL roofing boards have excellent acoustical properties and were able to achieve STC 41.
- The boards were secured with insulation fasteners into the concrete or metal deck, hence allowing fast installation to reduce construction time.



Kuala Lumpur Convention Centre, Malaysia



Intel semiconductor plant, Singapore



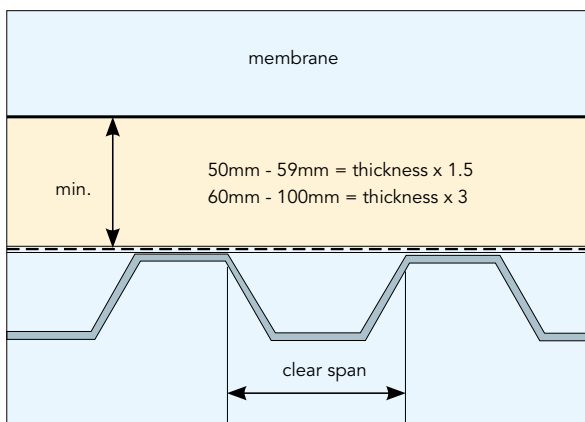
First Solar photovoltaic plant, Kulim, Malaysia

Design Considerations

Clear Span

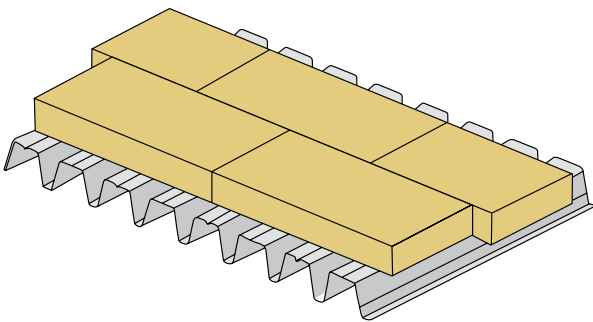
ROCKWOOL roofing boards between the thickness of 50mm and 59mm shall have the maximum clear span of = thickness of insulation board x 1.5

ROCKWOOL roofing boards between the thickness of 60mm to 100mm shall have the maximum clear span of = thickness of insulation board x 3



Crown and Trough Position

ROCKWOOL roofing boards must be laid with the long edge at right angles to the profiles of the metal deck. Butt joints can be made freely on the roof, if rules for cantilevering have been adhered to. If cantilevering has not been adhered to butt joints should occur at the mid-crown.



Cantilevering

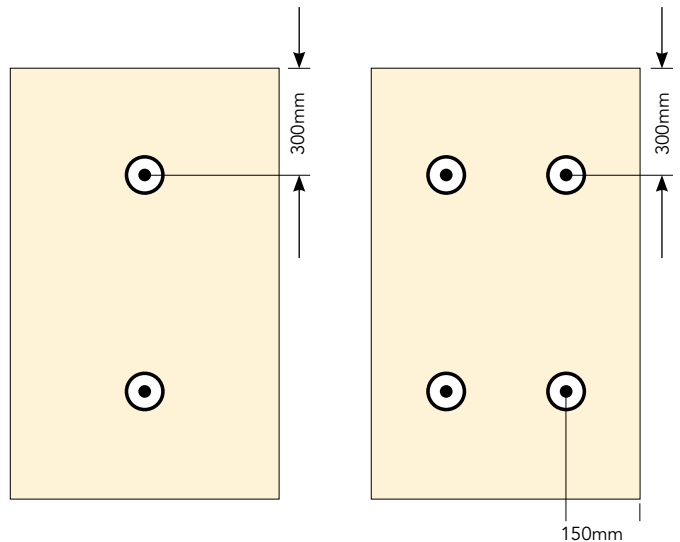
ROCKWOOL roofing boards of 60 mm or greater thickness may cantilever over a trough, provided that the maximum trough width does not exceed twice the board thickness.

For example, 80 mm thick Hardrock roofing board may cantilever over a maximum trough width of 160 mm.

Mechanical Fastening of Insulation

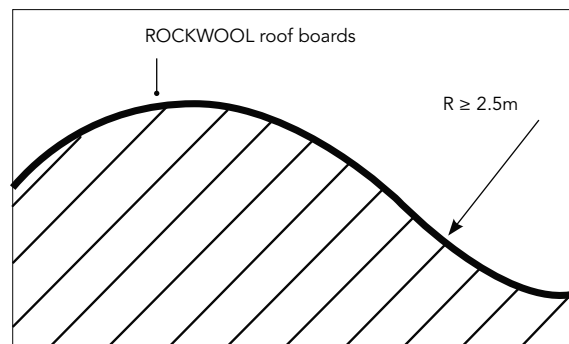
Where the roofing system is mechanically fastened, 2 fasteners per 0.72m^2 (1200mm x 600mm board size) is recommended for membrane roof system.

For both the field area and the edge region of flat roofs sufficient stability is achieved when using 2 fasteners. However, for the corner region of flat roofs, it is universal practice to increase the number of membrane fasteners per m^2 , and also to reduce the distance between the rows of fasteners.



Mechanical Fastening of Insulation for Roof with Curvatures

ROCKWOOL roofing boards can be installed in curved roof with a radius as low as 2.5 m. For application at curved roofs, a minimum of 4 fasteners per board to locate and secure the boards during installation (see under 'mechanical fastening').



Additional Roof Loads

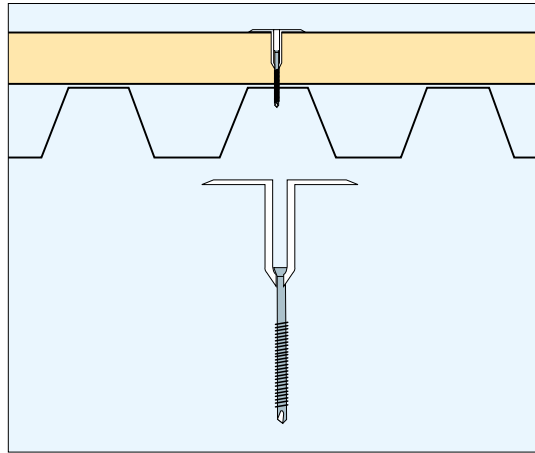
Plant and Machinery

Wherever possible, any roof-mounted plant, such as air handling and refrigeration units, should be positioned on independent upstands bearing directly onto the substrate.

Where this is not possible and the equipment is to be placed directly onto the finished roof, ROCKWOOL Megarock roofing boards should be used and further protection to spread the load may be required.

Mechanical Fastening of Roofing Boards

For the mechanical fastening of ROCKWOOL roofing boards to metal, concrete or timber decks, ROCKWOOL recommends the use of fasteners incorporating a plastic tube washer.



Plastic Tube Fastener

Sitework

Installation

ROCKWOOL roofing boards should be laid with staggered joints wherever possible and tightly butted to avoid gaps. The use of small pieces of insulation board should be avoided. Care should be taken to clean off all surfaces prior to the laying of insulation boards and membrane. Appropriate stop battens should be installed to protect open edges of boards.

Water Absorption

ROCKWOOL stone wool consists of randomly oriented waterrepellent fibres. Wetting will therefore only occur in proximity to its surface.

As the stone wool is diffusion open, boards that become wet during installation must be allowed to dry out naturally, prior to the application of the roof membrane.

Installation of ROCKWOOL roofing boards during rain should be strictly avoided. Force water such as rain water will penetrate through the product and weaken the wool structure. The installation sequence shall follow the membrane installation. Any exposed insulation boards should immediately be covered with waterproof covering to avoid penetration of rain water.

Cutting Roofing Boards

ROCKWOOL roofing boards are easy to cut or shape using a sharp knife or panel saw. The boards are non-brittle and will not crumble when cut.

Protection of Roofing Boards during Installation

Adequate temporary protection must be provided above the installed ROCKWOOL roofing boards where any of the following occur: unloading or access points, temporary walkways, stockpiles of roofing materials, waste skips or any other activities that might cause damage to the insulation.

Under no circumstances should the finished roof be used as a working platform without adequate protection being provided. If an area is required to be designated as a working platform, it is recommended to install ROCKWOOL Megarock around the location.

ROCKWOOL Asia recommends that either the main contractor or the roofing contractor operate a 'permit to work' system for any follow-on trades in areas where the roof installation is complete.

Preparation Work for Refurbishment

Unless the existing roof finish is known to be sound and watertight, all previously applied finishes and, if necessary, insulation layers should be removed. It is recommended that the designer or contractor checks existing levels to ensure that the falls are correct.

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*Note: EUCEB only applicable for products produced in Malaysian factories

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