



BITUMAT



**SYSTEMS DESIGN &
INSTALLATION
MANUAL**

INTRODUCTION

The Power to Perform



BITUMAT is one of the leading manufacturers of waterproofing products in the world.

BITUMAT's growth and development is a result of meticulous planning and execution. In 1995 BITUMAT was awarded the ISO9002 certification in recognition of its excellence in management and manufacturing techniques.

BITUMAT produces a wide range of selectively designed APP & SBS polymer modified waterproofing membranes which are widely recognized around the world and enjoy several technical approvals and certifications from renowned agencies and labs.

In this Systems Design & Installation Manual BITUMAT presents various waterproofing solutions for roofing over, the common type of decks.

Treatment of construction details have also been carefully covered in this manual in a way that serves the purpose of both the designer and the roofing contractor.

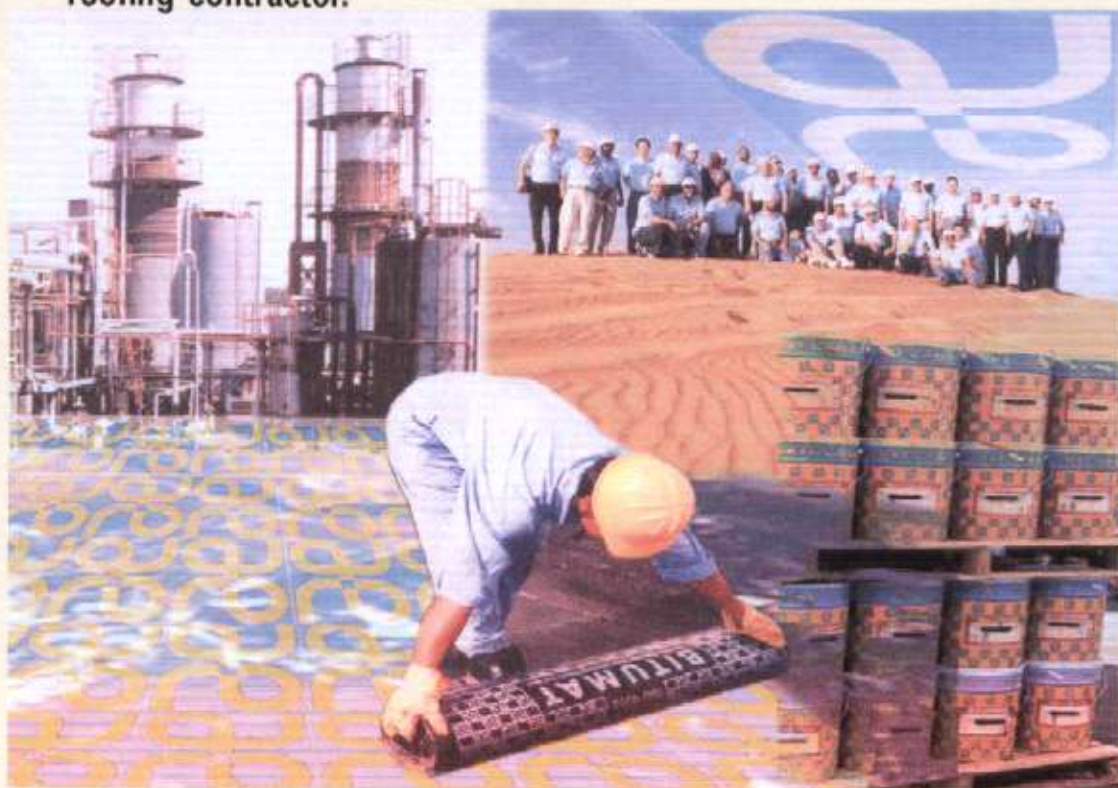


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1. Introduction

This manual is designed to assist and inform the designer professional, contractor or owner of BITUMAT's recommendation on Modified Bitumen roof systems and application methods, proven over time to provide superior performance. This manual contains the BITUMAT Roofing Systems and application specifications. These specifications are based on the best available knowledge & technology. In the roofing industry it is offered to assist the designer and applicator to specify and install roofing systems conforming to acceptable industry standards.

1.1 Approvals & Associations

This manual has been inspired from the following Codes of Practice:

France DTU 43.1, Roofing Works

DTU 20.12, Design of concrete

structure to receive roofing

DTU 26.2, Tolerances
in screening works

UK CP 144, Part 3 - Roofing Works

Germany Din 1833X, Roofing Works

USA NRCA Roofing Manual

FM Factory Mutual

Canada CGSB

USA ASTM

USA UL

1.2 International Compliance & Codes of Practice

All the typical values of the test results for the roof assembly elements must comply with international standards and codes of practices. It is worth noting that all BITUMAT waterproofing material / systems comply with the applicable requirements of the following associations or standards.

FM Factory Mutual, USA

BV Bureau Veritas, France

UL Underwriters Laboratories Inc.,

NRCA National Roofing Contractors
Association, USA

BRANZ, New Zealand

ASTM, USA

NHA, Kuwait

2. Scope

Scope of this manual is roofing over various types of roof decks. Only material applicable to these systems shall be used for the roofing system.

3. Limitations

BITUMAT as a manufacturer, is not

involved in the design or construction of buildings or structures. BITUMAT will under no circumstances accept responsibility for the performance of its products when damage to its products results from such things as improper building design, construction faults, or defects in workmanship. BITUMAT does not manufacture roof decks and is not responsible for their performance.

The various systems and their uses are shown within this manual are designed for a specific purpose; therefore, one system is not necessarily better than the other, and each should be utilized in its respective application according to each

sheets are typical median values and are within normal tolerance limits as stated in the UEAtc and other relevant standards, and may vary under normal manufacturing procedures as such and subject to change without notice.

5. Delivery, Handling, Protection and Storage

All Bitumat products are designed for application under specific conditions. Improper handling at any stage can alter the properties of the product. All Bitumat bitumen membranes and other products are intended to be installed on suitable, dry and smooth surfaces.



project's design requirements.

The design responsibility remains with the architect, engineer or owner, and construction details illustrated and described herein are furnished solely for guidance purposes. These guidelines should not be construed as being all-inclusive, nor should they be considered as a substitute for good application practices.

Some construction details may require special treatment to secure water tightness. Therefore, it is recommended that these details are brought to the attention of the manufacturer prior to design. BITUMAT suggests that designers and architects refer to the BITUMAT Technical Department prior and during the design of any waterproofing system. For information on sub-grade waterproofing and damp proofing, refer to other relevant BITUMAT Design and Installation Manual.

4. Physical properties

The typical properties of Bitumat products as stated in the Product data

All Bitumat membranes and other products are transported on wooden pallets, shrink wrapped for best protection.

Unload and handle all roofing materials with care.

Examine all materials as they are received. All Bitumat products display legible labels identifying the material. Look for any damaged or defective material and notify the carrier and manufacturer.

Do not expose material to moisture in any form before, during or after delivery to site. Usage of wet or damaged material can contribute to failure of the roofing system.

Always store roll goods on end on a clean, raised platform to keep the ends of the rolls free from foreign matter. Rolls stored on their sides will flatten and stick together, making them very difficult to apply and then may cause problems later. Take care to prevent damage to roll ends or ridges.

Do not double stack modified bitumen products.

Store all roofing materials in a dry,

shaded and properly ventilated area. Keep the temperature of all roll goods above 5°C (41°F) for 24 hours prior to application. Modified bitumen membranes are considerably easy to install when maintained at temperatures above 11°C (51.8° F).

When application of membrane occurs at low ambient temperatures, care should be taken that the rolls are not thrown on the deck or storage area. Sudden impact of the roll can cause cracking of the rolls.

It is suggested to use "breathable type covers such as canvas tarpaulins to allow venting and protection from the weather and moisture. Thus the possibility of rolls sticking is eliminated

6. Guarantees

BITUMAT Co. Ltd Guarantees on BITUMAT material, are available only when the BITUMAT membranes are installed in accordance with the installation guidelines set forth in this manual, and by a BITUMAT approved contractor who owns a written approval from BITUMAT Co. Ltd to install the BITUMAT material limited to any one project.

7. Maintenance

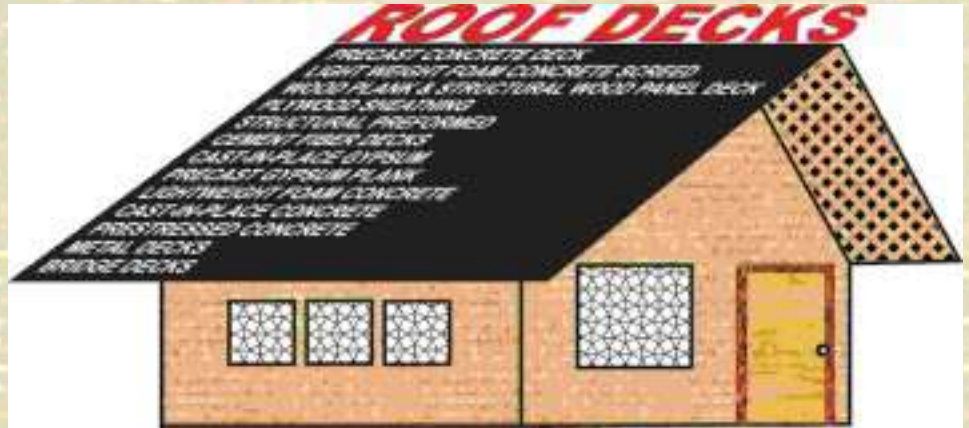
BITUMAT does not use or maintain a building owner's roof and shall not be responsible for their routine maintenance and care. Since BITUMAT has no control over a building's contents, type, quantity, positioning or protection, BITUMAT shall not be responsible for consequential damages in case of roof system failure. BITUMAT strongly recommends annual inspection and preventive maintenance to prolong the life of the system.

8. The Roofing Contractor

The roof is a very important part of the building. The money invested in buying roofing material are worthless unless installed by a professional roofing contractor. Therefore, BITUMAT recommends prequalification of the roofing contractor. A professional roofing contractor must have the following:

- A permanent place of business.
- Official registration documents.
- Knowledge of roofing systems.
- Good track record of application.
- Affiliated with a major waterproofing products manufacturer.

Since good workmanship in applying a roof system is essential, qualified



supervision of the application should be exercised. The roofing contractor has the sole responsibility for the quality of the application of the roof system.

9. Pre-Installation Meeting

A meeting between all parties concerned should be organized on site prior to installing any roofing materials, to approve the readiness of the roof surfaces and details design. BITUMAT strongly recommends that the above procedure must be followed to avoid misinterpretation and to ensure proper installation of the roof system. Agreement shall be reached on all points and particularly on the following :

a.) Drawings and specifications should be reviewed in detail. If there are differences between the specifications of the architect and the specifications of the material manufacturer, these differences should be incorporated into the job record either as field orders or as change orders.

b) In the event that waterproofing contractor does not agree completely with the architect's specifications, he should notify the architect in writing before bidding when possible, or commencing any works.

c) The clearances that will be required for areas adjacent to waterproofing areas should be established so that the handling of materials and application procedures can be performed in a safe manner. Agreements should be reached for backfilling operations and for use of scaffolding.

d) Installation procedures for mechanical devices that will penetrate the waterproofing membrane should be installed to prevent cutting the membrane after it is installed. Membrane penetrations should be minimized.

e) If the waterproofed surface will be used as a working platform after the waterproofing materials have been applied, an agreement must be reached on how and by whom the membrane will be protected during this construction period.

10. The Roof Deck

The roof deck acts as a base for the roof system. Therefore, it must conform with internationally recognized designs. Roof decks shall be designed to support all live and dead loads. There should be a provision for expansion joints to accommodate the structural movements. Such a provision is intended to protect the integrity of the structural system and the waterproofing membrane. If expansion and contraction is expected, but the deck design does not allow for it, roof area dividers, every 30 - 50 meters at the deck level, shall be considered. A positive slope to outlets must exist. Standing water shall not be permitted; a minimum slope of 2% is recommended. Insufficient drainage shall be deemed to exist on the deck if any area on the roof indicates stagnation of water for more than 24 hours after a water test or rain. All openings in the roof deck shall be completed prior to installing any roofing materials. No protrusions shall be permitted between the substrate and the roofing membrane. Care should be taken that the surface is dry, free from moisture, smooth, free from loose debris, laitance or any other alien matter. The irregularities should be rectified prior to application of Bitumat products. No electrical conduits, bolts, piping or similar equipment shall be placed on the surface of the roof deck. The roof systems cannot be properly installed and adhered around and/or over conduits etc. The deck should have a suitable design for HVAC and other accessories so that the application and then maintenance of the roofing materials is not hampered.

10.1 TYPES OF ROOF DECK

10.1.1 Precast Concrete Deck

Precast concrete deck units are poured into forms (usually off the job site). The deck elements must form a totally cured, unbroken surface. Open joints between sections must be grouted and made level. Cambers and deflections shall be within PCI Code tolerance.

Precast pre-stressed concrete may preferably be topped with cast-in-place concrete screed or lightweight insulating foam concrete screed.

Because of their manufacturing process, precast concrete units may vary in joint elevation when set in place. If any variations exist in the elevations of adjacent units exceeding 6mm, the deck should be leveled with a fibrous cementitious grout that has been feathered to a slope of 1% prior to roofing. Priming with BITUMAT BITUPRIME is required prior to application of the BITUMAT membrane system. (Refer to System Specifications In Appendix B)

10.1.2 Light Weight Foam Concrete Screed (L.W.FC)

Light Weight Foam Concrete screed is a light weight cellular concrete that is composed of Portland cement and air entraining agent. It should be applied over a stable substrate that permits curing beneath. It must be allowed to sufficiently cure to allow light foot traffic without damage to the surface. Five days of good curing time is recommended, though this may differ from place to place depending upon the environmenta

conditions like relative humidity etc. Ventilation from beneath the deck shall not be restricted until the deck is fully cured. This is provided by installing edge vent, breather or other approved venting methods located so that the maximum distance vapor must travel is approximately 10 meters or as recommended by the vents manufacturer. L.W.FC dry density shall not be less than 400 Kg/m³. The L.W.FC manufacturer shall submit his recommendations of the laying method on the main slab to avoid a rapid curing of the screed's surface. If no recommendations are provided then a "venting" base sheet should be used as the first ply of the membrane and should be adhered to the L.W.FC deck with approved mechanical fasteners or spot bonded with hot bitumen with overlaps also sealed with hot bitumen. Stack roof vents should also be installed. No case should the base ply of the membrane be adhered to L.W.FC decks in mopping of hot asphalt or with adhesives. This type of deck contains a large percentage of moisture and if **adequate precautions are not taken, blistering and damage to the membrane may result. This is due to the entrapment of moisture under the roof system.**

During curing or application, the deck must not be subjected to temperatures below 5°C. Frozen decks must be replaced.

Slope should not be too high, preferably below 8%. The cured surface should be smooth to the touch and free of depressions and ridging. The finished surface should not be left exposed for a

long time, otherwise cracks may develop on the surface. (Please refer Appendix A for details)

10.1.3 Wood Plank And Structural Wood Panel Deck

A wood plank roof deck is composed of solid-sawn dimensional lumber. Wood plank decks should be a nominal 25mm or thicker, and of tongue-and-groove, splinned joint, ship-lap, butt joint construction. . All cracks greater than 9.53 mm (3/8 in.) or knotholes greater than 2.54 cm (1 in.) in diameter shall be neatly covered with nailed sheet metal and fastened to the deck, if roof insulation is not used.

The lumber should be a minimum of 4inches and a maximum of 8 inches wide and a minimum of 1 inch thickness. All lumber decks must be securely fastened to the joints or trusses.

Decking should be kept dry and on raised skids or platforms, and roofer promptly after installation.

Glassfiber base sheet is required and shall be nailed in courses starting at the downhill edge of the roof deck, lapping ends 15.24 cm (6 in.) and edges 5.08 cm (2 in.). Both edges of all courses shall be nailed at maximum intervals of 45.72 cm (18 in.).

Bitumen or adhesives should not be used to adhere the membrane directly to a wooden deck, The use of mechanical fasteners is recommended for the attachment of the membrane to a wooden deck.

10.1.4 Plywood Sheathing

Shall be sound, well seasoned, exterior grade and shall be securely nailed to supporting structural members. Plywood sheathing shall be (1/2 in.)1.27 cm. in thickness. Joints shall be either supported by the structure or tied together with metal "H" clips, preventing unequal deflection. No edge of the plywood shall be exposed to moisture. All cracks greater than (9.53 mm) 3/8 in. in width shall be neatly covered with nailed sheet metal. The entire roof deck shall then be covered with Glassfiber base sheet to prevent seepage of roofing compounds through the deck and to protect the surface from fireflame...etc. The Base Sheet shall be nailed in courses starting at the downhill edge of the roof deck, lapping ends (15.24 cm) 6 in. (15.24 cm) and edges (5.08 cm) 2 in. Both edges of all courses shall be nailed at maximum intervals of (45.72 cm).18 in.



Lightweight Foam Concrete Being Poured.

10.1.5 Structural Preformed Cement-Fiber Decks

Shall be designed and erected according to the manufacturer's recommendations. All joints, except where tongue-and groove edges are used, and voids shall be grouted and all irregularities removed prior to installing any roofing materials. Boards shall be protected from moisture at all times and shall be dense enough to securely hold approved fasteners. If joints are not grouted or of tongue and-groove design, the entire roof deck shall be covered with glassfiber base sheet to prevent seepage of roofing compounds through the deck. The glassfiber base sheet shall be nailed in courses starting at the downhill edge of the roof deck, lapping ends 15.24 cm (6 in.) and edges 5.08 cm (2 in.). Both edges of all courses shall be nailed at maximum intervals of 45.72 cm (18 in.).

10.1.6 Cast-In-Place Gypsum

Shall be dry, smooth, free from deflections or ridges and shall be cured a minimum of 24 hours prior to installing any roofing materials. All high spots shall be made level, and all depressions greater than 1.27 cm (1/2 in.) shall be made level. Since cast in place gypsum decks contain a large percent of moisture, it is very important that all precautions should be taken to avoid entrapment of moisture under the roofing system. Ventilation from beneath, the top as well as the perimeter and the penetrations shall not be restricted until gypsum is completely cured. The deck shall have reached sufficient strength to achieve a 18.18 kg (40 lb) pull out strength per approved fastener. Gypsum shall not be used in buildings whereby occupancy creates a high relative humidity, unless justified by specific design criteria. The provision of roof vents installed through the roof membrane to allow for proper drying is strongly recommended.

Recommended thickness is 2 inches.

10.1.7 Precast Gypsum Plank

Shall be designed and erected according to the manufacturer's recommendations. All joints shall be flush and smooth. All irregularities shall be removed prior to installing any roofing material. Gypsum shall not be used in buildings whose occupancy creates a high relative humidity unless justified by specific design criteria. If joints are not grouted, the entire roof deck shall be covered with base sheet to prevent

seepage of roofing compounds through the deck. The base sheet shall be nailed in courses starting at the downhill edge of the roof deck, lapping ends 15.24 cm (6 in.) and edges 5.08 cm (2 in.). Both edges of all courses shall be nailed at maximum intervals of 45.72 cm (18 in.).

10.1.8 Lightweight Foam Concrete

Shall be dry and fully cured prior to installing any roofing materials. Five days of good curing time is recommended. All high spots shall be made level, and all depressions greater than 1.27 cm (1/2 in.) shall be made level.

Ventilation from beneath the deck shall not be restricted until the deck is fully cured.

Lightweight insulating concrete shall be applied over a stable surface that permits curing from beneath. The deck shall have reached sufficient strength to securely hold approved fasteners. Normally, a minimum density of 156.25 kg/m³ (32 lbs./ft³) is recommended and a 18.18 kg (40 lb.) pullout strength per nail is required. A minimum thickness of 5.08 cm. (2 in.) is recommended.

10.1.9 Cast-In-Place Concrete

Shall be dry and fully cured prior to installing any roofing materials. All high spots shall be made level, and all depressions greater than 1.27 cm. (1/2 inch) shall be made level. Treated wood nailers shall be installed at all edges, large protrusions, expansion joints, breaks in the deck, and areas where flashings are to be installed (Note: When using AQUASHIELD FX and BITUMAT membrane systems, the entire deck shall first be treated with BITUMAT primer at a coverage rate of 0.50 -1.00 ltr. per M²

Cracks greater than 3mm in width should be treated appropriately.

The deck must be properly cured prior to application of the roofing system. Improper or inadequate curing can lead to problems in the roofing system.

Decks with broomed, textured finishes are not acceptable if a membrane system is to be installed directly over the deck. Typical roof problems over such decks are attributable to lack of structural expansion joints, application of the roofing system before the deck has fully cured, or entrapment of moisture under the roofing system.

All necessary precautions must be taken to avoid moisture entrapment under the roofing system. If the deck is determined to be wet, then the application of the membrane must be delayed till the deck has dried out fully.

Bitumat shall not be liable or responsible for the damage to the roofing system caused by moisture entrapment under the roofing system from the concrete deck or any other source.

10.1.10 Prestressed Concrete

Shall be topped with cast-in-place concrete, lightweight insulating concrete or rigid board insulation. Cambers and deflections shall be within PCI code tolerances. Precast prestressed concrete shall be designed and erected according to the manufacturer differential camber shall be removed by the erector at the time of erection. All high spots shall be made level, and all depressions greater than 1.27 cm (1/2 in.) shall be made level. Treated wood nailers shall be installed at all edges, large protrusions, expansion joints, breaks in the deck, and areas where flashings are to be installed. The entire deck shall then be treated with BITUMAT Primer at a coverage rate of 0.50 - 1.00 ltr./m² to create a more bondable deck surface.

Variations in camber and thickness of pre-stressed concrete members may make securing of the roof system difficult. Grouting at joints has often proven unsatisfactory in attempting to compensate for uneven deck surface. Bitumat recommends a minimum 2 inches fill over all pre-stressed concrete decks prior to installation of the roof system. Lightweight fills can also be poured to provide slope in the deck to facilitate drainage. In such a case the usual precautions are to be followed as stated above in 7.1.2.

10.1.11 Metal Decks

The metal deck must be firm, capable of withstanding rooftop traffic and properly secured to the building's structural support system. Fluted metal decks shall have flat flute surfaces and shall be a minimum of 22 gauge (0.88 mm) and conform with the FM Loss Prevention Data I-28. Deflection from vertical plane within the flutes shall not be more than 1.52 mm (1/16 in.). Metal decks shall be insulated. When insulating concrete is used, provisions shall be made for ventilation. As a general rule, insulation thickness shall be equal to 1/2 the width

of the flute. Insulation may be installed to fluted metal decks with flat flute surfaces by BITUMAT AQUASHIELD FX adhesive only to the upper plane of flutes. (coverage rate as per technical datasheet). It is highly recommended, however, due to possible wind uplift, that insulation be fastened with approved mechanical fasteners, when flutes are not flat or deviate more than 1.52 mm (1/16 in.) from the vertical plane. If using BITUMAT AQUASHIELD FX adhesive, non corrosive fasteners should also be used 1.22m (4ft.) around the perimeter of the roof and 1.22 m (4 ft.) around any protrusions or interruptions in the roof and in areas where wind uplift is a special consideration.

Wood nailers of equivalent thickness of the roof insulation must be provided at perimeters and projection openings to act as an insulation stop and to provide nail holding capability for the nailing flanges of metal flashing.

The steel deck should preferably have either a shop coat of paint, be galvanized or similarly treated. Special care should be taken to ensure that the side and end laps are fastened to ensure that the deck functions as a unit. (See Appendix A, 22-32)

10.1.12 New and Unusual Decks and Surfaces

For application specifications not specifically covered in this guide, consult Bitumat Technical Department.

10.1.13 Bridge Deck

Bridge decks must conform to internationally recognized standards. They must be designed to support all live and dead loads without excessive movements. Provisions for expansion and contraction shall be made to protect the integrity of the structural system and the waterproofing membrane. Negative slope shall not be permitted. Precast concrete elements must form an unbroken surface. Open joints between sections must be grouted and made level. Cambers and deflections shall be within PCU code tolerance. Precast, prestressed concrete shall be topped with cast-in-place concrete screed.

11. The Roofing System Material

All materials used on the job should comply with material specifications for the specific project. All materials should be applied reasonably clean, visibly dry and undamaged. All the roof system material should be compatible with each other in order to ensure longer life

expectancy of the whole roof assembly.

- Membrane
- Primer
- Vapour Retarder
- Separation Layer
- Reflective Coating
- Thermal Insulation
- Gravel
- Concrete Pavers
- Screed
- Walkways
- Screws
- Base Flashing Strips
- Metal Flashing Strips
- Cant Strips
- Sealants
- Control Joints
- Expansion Joint Materials
- Pressure Relief Vents

11.1 Membrane

The ideal membrane for a workable roofing system must be either APP (Atactic Polypropylene) or SBS (Styrene Butadiene Styrene) polymer modified membranes depending on the weathering conditions and design requirements. The membrane should be resilient and resistant to UV rays and all damaging weathering conditions.

The membrane should conform to international standards. BITUMAT offers a considerable range of waterproofing membranes supplied in various thickness and finish. Users may refer to the product data sheet for more information on the following membranes manufactured by BITUMAT.



11.1.1 BITUMAT APP Modified Membranes POLYFLAME Etc

11.1.2 BITUMAT SBS Modified Membranes

PREMIERFLEX 4000 etc

11.2 Primer

The primer should be bituminous conforming to international standards.
BITUPRIME
CONCRETE PRIMER



Primer Application - Vertical

12. Vapor Retarders:

The need for a vapor retarder should be determined based on consideration of occupancy, indoor/outdoor temperatures and relative humidity utilizing accepted engineering practices. The need for a vapour retarder shall be the responsibility of the designer.

Bituminous or non-bituminous used to control the flow of moisture from interior of the building into the roof system. Generally, vapor retarder shall be considered when the mean temperature during the coldest winter month is less than 4°C (40°F) or whenever occupancy creates relative humidities greater than or equal to 45%. In addition, vapor retarder shall not be necessary when impermeable insulation or self-insulating decks are specified. Vapor retarder shall be placed on the warm - in winter - side of the assembly. Vapor retarder shall meet the specifications below:

1. Insulation applied over vapor retarder shall be vented by stack venting, edge venting, or other approved methods to eliminate moisture traps.
2. Base flashings shall be installed at the vapor retarder level at all interruptions in the membrane.
3. Extreme caution shall be taken to prevent puncturing the vapor retarder.

Note: Vapor retarders are not generally required where the roofing membrane is below the approved insulation. However, specifiers considering where the inverted roof system is installed over conventional rigid board insulation, should contact BITUMAT Technical Department.

13. Separation Layers

- Polyethylene sheets, 150 microns thick minimum, may be clear or coloured.

- Polyester Felts, non-woven polyester, 120-140 gm/m².

14. Reflective Coatings

BITUMAT ALUGARD ;aluminum roof coating, reduces heat gain in summer (due to its high reflectivity) and asphalt deterioration. It is possible to calculate the reduction in heat gain during summer conditions using heat flow calculations.

15. Thermal Insulation

The primary purpose of roof insulation is to provide thermal resistance. The roof is generally one of the largest areas of the building envelope through which interior heat escapes.

Most forms of insulation are compatible with Bitumat membranes, however, complete removal of spray urethane foam is required before installing any Bitumat membranes.

The need for insulation (either On Deck or On Membrane), reflective coatings and other forms of thermal barriers shall be determined on the basis of good design principles and engineering judgment. Generally speaking, insulation (On Deck) installed beneath the waterproofing membrane provides increased thermal efficiency, (limits structural response to changes in temperature and creates a more suitable surface for the roofing membrane. While it may not provide as much thermal control as conventional insulation (on deck) installed under the waterproofing membrane, insulation (on membrane) applied over the waterproofing membrane, as in inverted roof systems, provides the additional advantage of protecting the membrane itself from thermal shock, natural weathering and abusive deck traffic. Reflective coatings increase thermal efficiency primarily in hot weather and help control weathering and thermal shock. **(For Calculation, Refer to Section 40)**

15.1 Conventional Roof System Rigid Board Insulation (ON DECK)

Shall be dimensionally stable, able to resist horizontal shear due to movements in the deck, able to withstand compression loads due to deck traffic and hail impact. Insulation shall be kept dry at all times; all wet or damaged boards shall be rejected. All insulation shall be completely covered with the finished BITUMAT Roofing System on the same day it is installed.

Temporary water cutoffs shall be installed at the end of each day's work to protect the exposed edges of insulation and shall be removed at the start of next roofing day. Joints shall be staggered, tight, and

flush. A double layer of insulation with staggered joints is highly recommended.

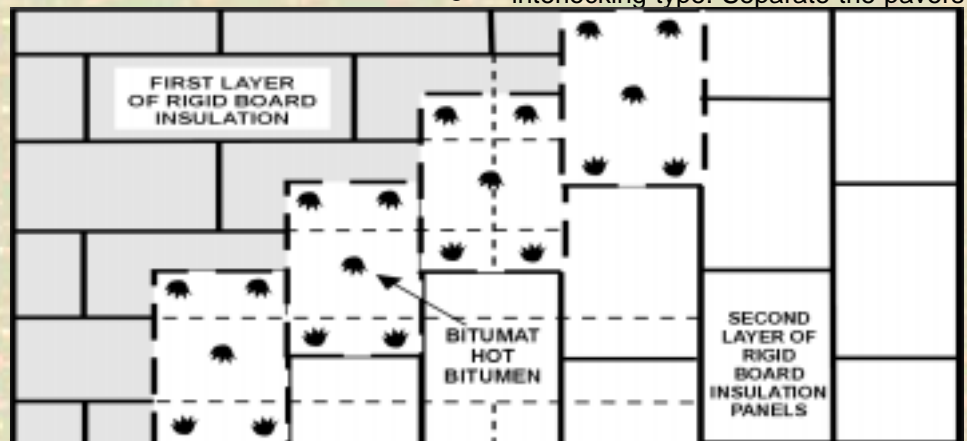
Insulation shall be vented when used in conjunction with a vapor retarder. Approved types of rigid board insulation include cellular glass, fiberglass, perlite, wood fiber board (coated on 6 sides), faced polyurethane (rigid board only not sprayed in place), faced polyisocyanurate and composite board manufactured from a combination of any of these acceptable types. Other insulations may be submitted to BITUMAT for evaluation. Proper attachment of rigid board insulation is essential to provide protection against wind uplift and stress concentrations. Installation of rigid board insulation shall be as directed by the manufacturer or the following methods maybe adopted: Some of the commonly used insulation are:

- Polyurethane
- Polyisocyanurate
- Cellular Glass
- Fiberglass
- Perlite
- Wood fibreboard

Installation of the insulation shall be in accordance with the insulation manufacturers recommendations and guidelines.

Bitumat recommends a double layer application of roof insulation, where design of FM specifications require mechanical attachment of the first layer. To reduce membrane stress and thermal loss at insulation joints and prevent thermal bridging between mechanical fasteners and the roofing membrane When the total thickness of insulation layer exceeds 7.5 cms, a second layer is required. It is recommended that the total insulation should not exceed 13 cms.

In cases of conventional application, Bitumat recommends the following



INSTALLATION OF INSULATION ON INSULATION

number of fasteners for each board size:

- 0.6 x 1.2 mtrs. = 4 Fasteners
- 0.9 x 1.2 mtrs. = 6 Fasteners
- 1.2 x 1.2 mtrs. = 9 Fasteners
- 1.2 x 2.4 mtrs. = 15 Fasteners

Consult the FM publications for 1-60, 1-90 approved fasteners and fastener patterns for wind uplift requirements.

(Refer to Section 28.2)

15.2 INVERTED ROOF SYSTEM RIGID BOARD INSULATION

Insulation shall be able to withstand weathering and retain its insulating value through prolonged exposure. Insulation shall be expanded extruded polystyrene insulation, foam-glass insulation or an approved substitute. It is recommended to use a single slip sheet of about 150 microns Polyethylene as a separation layer between the insulation and the waterproofing membrane .

All joints shall be tight and flush and shall be staggered. A filter sheet such as BITUMAT BITUTEX shall be installed over the insulation. Ballast shall then be installed according to specifications.

16. Gravel

Crushed type, clean washed, conforming to size #4 per ASTM D 448 using ASTM C 136 method of testing (nominal ¾" (19 mm) to 1 ½" (38mm) diameter and the thickness to be calculated depending upon the thickness of insulation used and the expected wind uplift factor. It is recommended to use at least 48 Kg/M² of gravel over the membrane.

17. Concrete pavers

Minimum 4cm thick Pavers can be interlocking or non interlocking, lightweight or heavyweight. If lightweight pavers(weighing less than 88Kg/M²) are being used, then they must be the interlocking type. Separate the pavers



Gravel and Walkways

from the membrane by suitable polyethylene slip sheet, 8 mils thick. It is recommended to stop installation of pavers at least 1" away from the vertical surfaces and fill where required.

18. Concrete screed

Minimum 4cm thick, reinforced.

19. Walkways

On roofing subjected to rooftop traffic such as servicing of Air conditioning units, cleaning of roof and drains, potable water tanks etc, Bitumat recommends the use of appropriate walkways so as to avoid any damage to the membrane.

20. Roofing Nails

For nailing on lightweight foam concrete screed, use only split shank fastener, with electro-zinc galvanized shanks spreading out when driven to provide back-out resistance.

21. Screw Head Shapes

Common terms for describing the head shape of screws are hex head, flat head, oval head, and pan head. Additional terms can be used in conjunction with head shape to describe the groove, slot, or driver recessment shape. Common grooves and driver recessment shapes are Philips, slot, and square.

22. Screw Sizes: Lengths and Gauges

Screw size is designated by both length and diameter. Length is designated in millimeters. Diameter is designated by a gauge number. Typical lengths available are from 6mm (1/4 inch) to 152mm (6 inches). Gauges available are 0 to 24 (19 mm 3/6 in.). If the label on a box of screws reads 1 x6m the box contains 25mm (1 inch) of No. 6 gauge. Most common gauges are Nos. 2 through 16.

The heavier the work required of the screw, the larger the gauge should be.

23. Screw Point Types

Common types of screw points are: self-drilling, and self-tapping. These screw points are sometimes used in combination with such names as Gimlet and pinch. For example, Pinch types are self-drilling (i.e., the point drills a pilot hole for the screw). Gimlet type refers to a self-piercing point that punches a hole for the threaded fastener. Nail and diamond point are varieties of non-drilling fasteners.

24. Metal Flashing Strips

Normally 1 mm thick Aluminum, 5-6 cms wide strips, with one or more bends, for counter flashing. This to be nailed on to the vertical parapet. Adequate fasteners should be provided to properly secure the metal flashing. It is recommended to use at least 3 fasteners per square metre. Metal end joints shall have adequate overlaps of about 3-5 cms, depending upon the local norms and shall not be soldered.

25. ROOFING DETAILS: Design Considerations (Appendix 9)



Base Flashing - Proper Torching

25.1 Cants

The bending radius of any bituminous roofing material is generally limited to 45 degrees. To allow for this limited bending radius, cant strips must be provided at 90 degree angle such as those created by roof-to-wall, roof-to-curb or other roof-to-curb vertical sections. Generally, the installation of cant strips to accommodate roof-to-wall or other horizontal-to-vertical plane change is

consistent with good roofing practice. Mortar performed fiber or wood cant strips shall be provided at all wall and curb type protrusion flashing. Cant strips are in the range of about 13 cms to 18 cms wide, depending upon the local building norms.

25.2 Flashings

Flashing leaks are the most common of roofing failures. To avoid this, proper design, installation and materials must be used. Flashing demands the designers close attention since the detailing must not be left to the roof mechanics employed by the roofing contractor.

Shall be designed according to good engineering practice to seal vulnerable interruptions in the waterproofing membrane.

BITUMAT has compiled details for most roofing needs, however, when the design must vary from conventional details, several precautions shall be observed: Membrane base flashing is generally composed of strips of BITUMAT membranes compatible with the specified BITUMAT membrane used to close in or flash roof-to-vertical surface intersections or transitions. It is recommended that the height of the membrane base flashing be not lower than 200mm (8 in.) and generally not higher than a nominal of 350 mm (14 in.). Walls

requiring flashing higher than 350mm (14 in.) should receive special moisture-proofing, membrane wall flashing/ waterproofing plies, or cladding. All membrane strips for flashing details are always fully bonded to primed substrate. The top of the membrane base flashing must be higher than the finished roof level by at least 100mm (4 in.) (sloping roofs) or 150mm (6 in.) (dead flat roof), and at least 5cm (2 in.) higher than the maximum expected water level. The upper horizontal joint of the base

the base flashing, lapping approximately 10.16 cm (4 in.).

- Protrusions shall be at least 50 cm away from curbs and walls to allow proper sealing.
- Parapet wall or raised edge flashings shall not be specified where they would inhibit proper drainage of the roof membrane unless an adequate number of scuppers (outlets) or drains are provided.
- Flat edge flashings shall not be

reinforcement. All “stripped in” material must be completely removed prior to torching the membrane.

25.3 Control Joints/ Expansion Joints

The need for, the design and location of control joints shall be determined by sound engineering criteria and good engineering judgment and are the responsibility of the owner, Architect, Engineer.

Roof expansion joints are used to minimize the effects of stresses and movements of building components and to prevent these stresses from splitting, buckling, ridging or damaging the roof system. They should be designed to accommodate contraction as well as expansion. Expansion joints shall be placed at the highest point of the fall, as far as the design of the structure will allow. If possible, they will be positioned on a double concrete curb joint. They must extend across the entire width of the roof; they must never terminate short of the roof edge or perimeter. In case of impossibility (roof with access), the covering of the joint will be removable to allow maintenance visits. The width of the joint in the concrete slab shall be at least 3cm, (1.2 in.) and a 3x3cm (1.2x1.2 in.) chamber shall be foreseen in the concrete edges. They should be detailed and constructed to a minimum raised height of 254mm (10 in.) Expansion joint covering shall be custom designed to face the specific stresses expected, and be compatible with BITUMAT membranes Provisions for expansion and contraction shall be made to protect the integrity of the structural system and waterproofing membrane. The function of an expansion joint is to minimize the effect of stresses and movements of building components and to prevent these stresses from



Proper Sealing of Flashings.

flashing strip must be protected by a counter flashing system. (metal strip, reglet, groove or drip in concrete) The membrane base flashing shall be protected by granule or aluminum foil surfaced membrane in a non-accessible roof application, whereas a cement mortar with wire mesh or precast kerb stone may be used for an accessible roof application.

used in BITUMAT Inverted Roof Systems because they would expose the edge of the rigid board insulation installed on the surface of the membrane. Where these roof systems do not terminate in wall flashings, raised edge flashings which extend above the ballast level shall be required.

- Insure that the water drains immediately away from all flashing
- When counter flashing cannot be installed on the same day membrane flashing is constructed, the top edge of all base flashing must be “stripped in” using flashing cement and glass fiber

- Flashings shall be located well above the highest expected water level. (This is especially important in BITUMAT Roof Systems, where insulation installed on top of the roof membrane actually raises the expected water level above the waterproofing membrane. In these systems, special care must be taken to insure that the flashings extend well above the finished surface of the insulation.
- Differential movement shall be allowed between the base and counter flashing.
- 90° bends and other areas where stress concentrations occur shall be avoided.
- Flashings shall be attached solidly so as to avoid weak connections.
- Counter flashings shall be designed to completely cover and shield



Base Flashing Needs Special Handling.

splitting or ridging the roofing membrane. Lack of or inadequate expansion joints can put excessive load on the waterproofing membranes and could possibly lead to premature failure of the roofing system. Areas where control joints shall be considered are:

1. Large structural decks.
2. Changes in building direction.
3. Changes in structural materials and framing direction.
4. Changes in building mass (such as from one story to two stories).

Where large expanses of structural decks do not justify structural control joints, roof area dividers may be installed to limit the membrane size. It is generally recommended that either control joints or area dividers be installed every 30-60 m (100 to 200 feet).

(Appendix A, 9 & 10)

25.5 Counter-Flashing

For all walls that receive membrane base flashing, metal counter-flashing should be installed in or on the wall above base flashing. The design of the counter-flashing detail consists of separate reglet and counter flashing pieces allowing installation of sheet metal counter-flashing after the membrane base flashing is complete. Projects where single piece counter-flashing has been installed will be difficult to baseflash properly during future roofing, and when membrane flashing maintenance is necessary, without deforming the metal. In case of flat edges, BITUMAT membranes will be stopped at the extreme corner, and a reinforcing strip will be installed below or under the main membrane depending upon slope. An acceptable ballast retainer shall be installed at the perimeter of the roof in case of covered systems. In case of accessible roof; the anchorage of the security hand rail to be installed at the perimeter of the roof is to be checked case by case.

25.6 Corners

All external and internal corners shall be cut and shaped using a second reinforcing piece at the central joint, and shall be fully heat-welded with resealed edges and seams as the rest of the flashing. (Appendix 6,7,8)

25.7 Ventilation Pipes & A/C Ducts

Ventilation pipes & A/C ducts should be surrounded by a concrete curb

(accessible roofs) or a metallic curb (non accessible roofs). A counter flashing system (as explained in counter-flashing section of this manual) shall be installed onto the duct by the Mechanical sub-contractor to cover the curbs and prevent water from leaking along the duct. Electrical cables shall pass through an elbow steel pipe fixed onto the roof deck. (Appendix A 2, 12 & Section 28.3.13)

25.8 Outlets & Overflows

The determination of the rain water down pipes diameter and quantity is to be done by Mechanical sub-contractor. Local conditions determine the diameter of the pipes. For example, when designing in Saudi Arabia it is advisable to use higher parameter than in Europe or in USA as, in Saudi Arabia, rains are short but strong and rain water usually carry dust, sand in big quantities, creating a significant flow of mud in the outlets. Each roof or portion of roof surrounded by roof dividers shall have at least 2 rain water outlets, or 1 rain water outlet and one overflow installed 5cm (20 in.) lower than the highest flashing level. To avoid ponding water around outlets, the opening shall be surrounded by a concrete depression of not less than the outlet radius. The rain water outlet could be designed in two ways:

Prefabricated lead 2.5mm (9 in.) thick or special rubber or PVC to be installed fully bonded between 2 layers of BITUMAT MEMBRANE. Cast iron, fixed onto the roof deck, properly sealed with BITUMAT POLYFLAME welded onto primed metal with at least 10cm (4 in.) overlaps between metal and POLYFLAME.

Outlets and overflows made of normal PVC are to be avoided as proper torch welding of bitumen membrane onto PVC is difficult. Cold applied self adhesive BITUMAT BITUSEAL membrane can be used in this context.



Vents

26. Pressure Relief Vents

Bitumat recommends the use of relief vents as and when necessary.

Ventilation shall be provided for new cast in place gypsum and light weight foam concrete decks. One relief vent may be applied for every 100 M2 area. One way metal vents are preferred over plastic vents. For best results, relief vents should be used in conjunction with a venting base sheet. For further details contact Bitumat Technical Department.

27. INSTALLATION REQUIREMENTS

The following requirements actually supplement the general requirements stated above and establish minimum specification requirements of Bitumat Co Ltd. The requirements are in compliance with good engineering practices and all personnel associated with the roof system installation are urged to read and understand this manual prior to application. If there is any doubt, please contact the Bitumat technical Dept. The roofing contractor must maintain qualified supervision on the job at all times. It is highly recommended that work should begin only after all the concerned parties are satisfied that all specs are workable as specified and that the contractor can meet the project requirements.

Roof system installation should not begin until all roof openings, curbs, pipes, sleeves, ducts, vents or other penetrations through the roof are solidly set, and that all flashing, tapered edges and cant strips, reglets, and wood nailers are secure and tight to the building. Observe fire and safety precautions. All work shall be performed as per the local code requirements.

It is highly recommended to conduct a pre roofing conference between all the parties concerned so that best possible communication and coordination is established. Matters that should be sorted out include, but are not restricted to, roof deck conditions, unusual project conditions, the complete roofing specifications, material storage at site, hoisting, documentation details including the lead time required for approvals. A minutes of the meeting to be prepared and circulated to all the concerned. This to become an official document for future reference.

27.1 Inspection and Surface Preparation

GENERAL

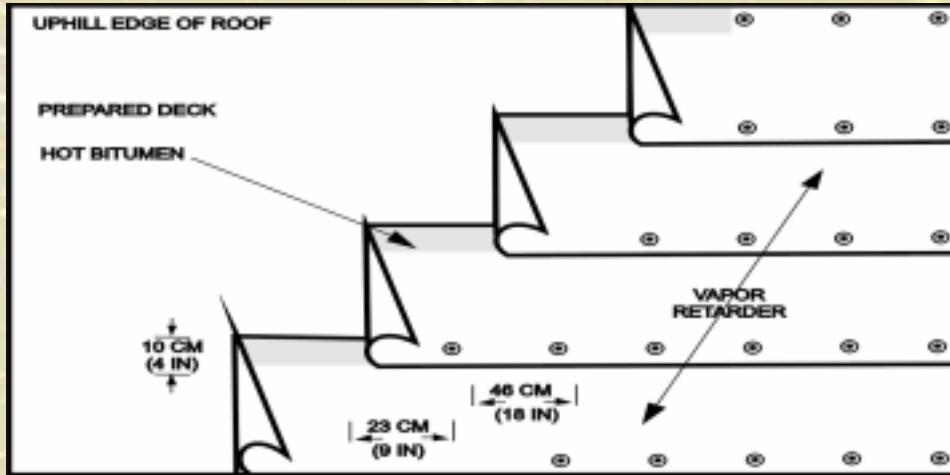
The contractor shall only begin roofing work when the substrates have been prepared as necessary, and are ready and acceptable to have materials installed.

The roof surface must be sound, smooth, dry, swept clean and made free from

system.

Particular attention should be paid to the design of upstands, expansion joints, A/C openings and rainwater outlets. BITUMAT Technical Department and/or the Roofing Contractor should be consulted for the design.

27.2 STEEL DECKS:



INSTALLATION OF VAPOR RETARDER ON NAILABLE DECK

edges and loose debris, points, nails, small stones and standing water. Projecting parts must be removed and all depressions greater than 10mm (1/3 in.) must be made level.

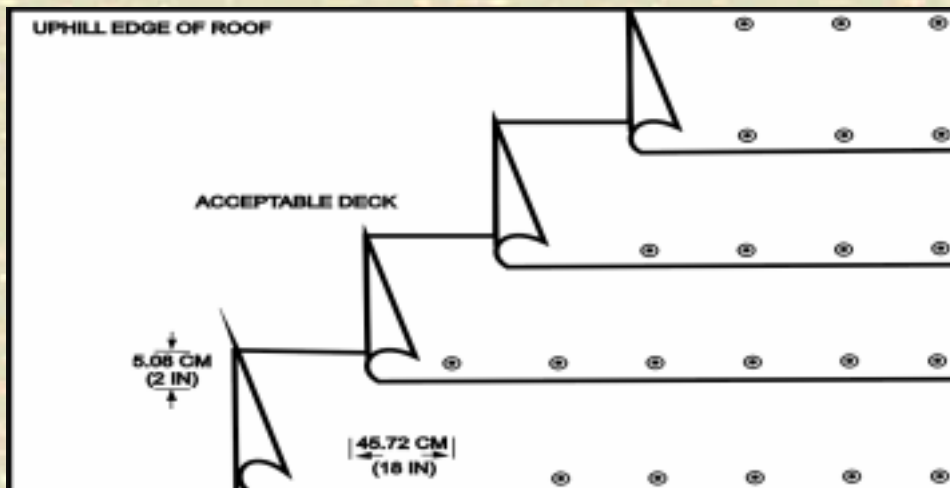
However, if the surface is rough, or contains cracks, then either an additional layer of screed should be installed and cured or an underlay of GLASFLAME 2mm membrane depending upon the roughness of the deck, may be laid to insure protection of the membrane from any projections existing in the roof deck. The underlay shall be stopped 20cm (8 in.) away from the parapet, edges and roof openings. Parapet, edges, curbs, expansion joints and all other areas, where the membrane terminates and flashing will be installed, must be primed one day before installation of the roof

Inspect the surface for any corrosion, holes or inadequately secured decking. Proceed only after adequate rectification done.

27.3 LIGHTWEIGHT OR CELLULAR CONCRETE AND POURED GYPSUM DECKS

Inspect the roof surface to see that the deck is smooth, DRY and free of depressions or projections. Inspect for one way moisture vents. Surface should not be crumbling due to inappropriate formulation. Surfaces indicating low density need to be repaired prior to application.

27.4 WOODEN DECKS



When roofing over a wood deck, provisions shall be made for repairs of cracks or holes, treatment of loose, warped or inadequately secured decking, and replacement of deteriorated, irreparable or otherwise defective decking.

28. INSTALLATION

28.1 VAPOUR BARRIER INSTALLATION

(Refer to Section 38, Appendix B-B)

The best vapour retarder material cannot be effective in reducing transmission of moisture if it is not properly installed, or if it is damaged or punctured during the time of the application. The vapor retarder should be installed with complete integrity throughout the system. Laps and joints must be securely sealed, all projections flashed and the integrity of the system maintained. All punctures must be repaired immediately. Insulation boards must be installed immediately over the vapour retarder. Thus the boards provide protection against physical damage.

28.1.1 Nailable Decks :

A: Over sheathing paper on wood decks and structural wood fiber decks. Over the deck and starting at the low point or drains.

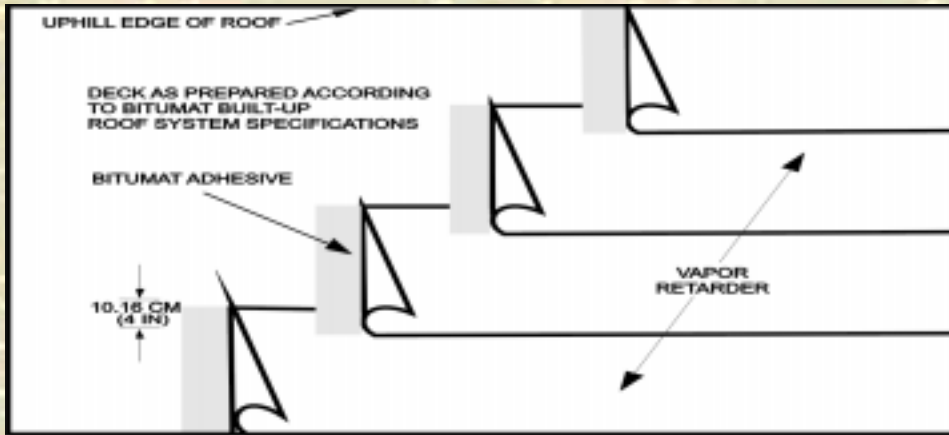
Mechanically fasten using approved fasteners.

Lap the sheathing paper 10cm (4") or align using lap lines, and mechanically fasten the three rows of fasteners. The first row of fasteners (on the seam) will be 38cm (1 1/2") from the leading edge and on 23cm (9") centers. Fasten the second row of fasteners 35cm (14") from the leading edge and on 146cm (8") centers. The last row of fasteners shall be 66cm (26") from the leading edge on 46cm (18") centers. The centers for the second and third rows will be staggered. The vapor barrier installed by either using in adhesive Bitumat such as hot bitumen mopping.

B: Lightweight or Cellular concrete/ Gypsum decks

Mechanically fasten using fasteners approved for lightweight or cellular concrete decks.

Lap the base sheet 5cm (2") or align using lap lines, and mechanically fasten the three rows of fasteners. The first row of fasteners (on the seam) will be 3.8cm (1 1/2") from the leading edge and on 23cm



INSTALLATION OF VAPOR RETARDER ON NON-NAILABLE DECK

(9") centers. Fasten the second row of fasteners 35cm (14") from the leading edge and on 46cm (18") centers. The last row of fasteners shall be 66cm (26") from the leading edge on 46cm (18") centers. The centers for the second and third rows will be staggered.

The second layer to be installed as above.

Single layer vapour barriers may also be installed. In this case, install a min. 1.25cm (1/2") rigid board insulation using a min. of six approved fasteners per 61cm x 122cm (2 X 4 ft) insulation board. A single ply vapour barrier may be fully adhered in courses starting at the downhill edge of the insulation with Bitumat adhesive, Bitumat Bitubond as per coverage stated in the data sheet, with 4" side laps and 6" end laps.

Single layer vapour barrier layer may be loose laid with only the side and end laps welded. The membrane will be fixed along the vertical, at least 5 cm (12") over the level of the insulating element.

28.1.2 Non-Nailable Decks

Prime the deck with Bitumat Bituprime at the rate of about 0.3 L /M². For details of application refer to the Bitumat Bituprime data sheet.

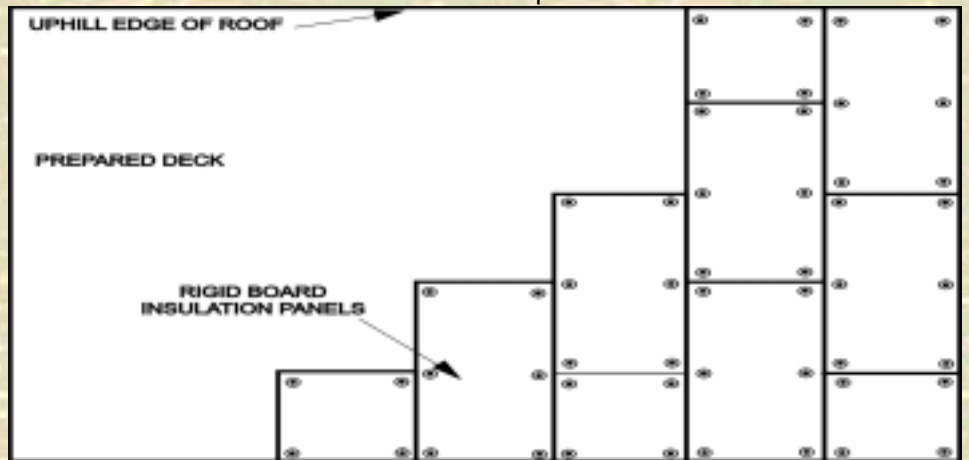
Do not prime the full surface, holding back about 7.6-13CM (3-5 inches) from precast concrete panel joints, cracks or roof openings. Allow the primer to dry to touch. Starting at the low point or drains, install the vapour barrier with about 10cm (4") side laps and 15cm(6") end laps. Bitumat Bitubond may be used as the adhesive for bonding at the coverage as stated in the data sheet of the adhesive or hot bitumen.

28.2 THERMAL INSULATION APPLICATION

The most suitable thermal insulation board shall be fixed on the vapour barrier (if the design specifies the vapour barrier)

than will be completely waterproofed each day when installing over a nailable deck but which has no vapour barrier, the insulation can be mechanically fixed using minimum of six fasteners per 61 cm x 122cm (2x4 ft.) insulation board. When installing over a non-nailable and without vapour barrier deck, use Bitumat hot bitumen to secure the insulation.

Over metal deck, use Bitumat hot bitumen to secure the insulation. When there is no vapour barrier installed, it is highly recommended to use mechanical fasteners as a security against possible wind uplift. When installing over a deck which is nailable and which has a vapour barrier.



INSTALLATION OF INSULATION ON NAILABLE DECK WITH NO VAPOR BARRIER

Do not install wet, damaged or warped boards.

Install insulation boards with staggered board joints in one direction(unless taping joints) assuring that board sides and ends touch all along their lengths. Install insulation board with a gap between board joints not to exceed 16mm (1/4"). All gaps in excess must be filled with like insulation material.

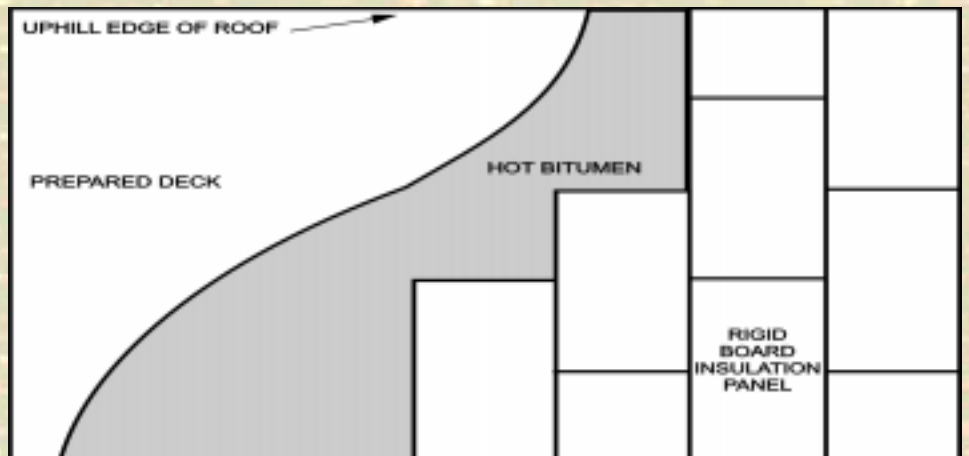
Install and fasten insulation board as per the manufacturers recommendation and requirements.

Do not install any more insulation than

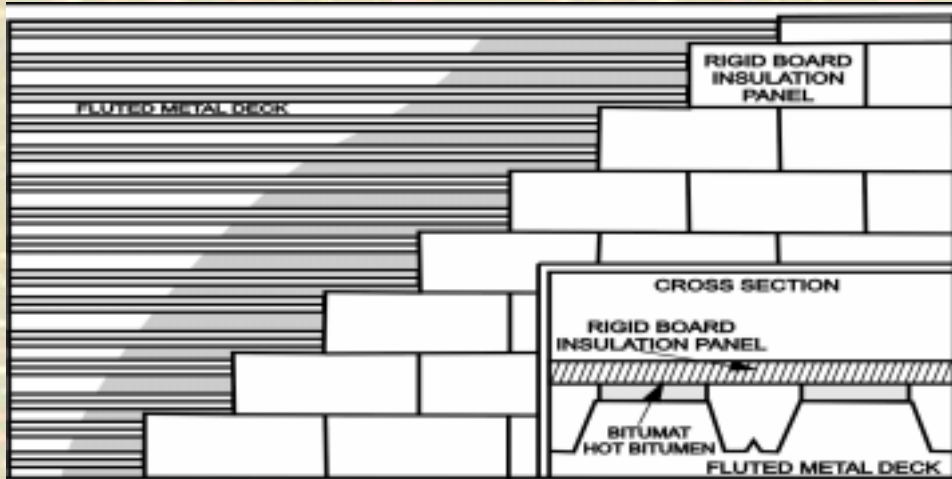
insulation shall be securely attached over the vapour barrier with Bitumat hot bitumen. If attaching insulation to insulation, use hot bitumen in five spots for ensuring spot bonding of the second layer to the first. Insulation is spot bonded to insulation to prevent forming a vapour barrier within the insulation.

In an inverted roof system the details are stated as below.

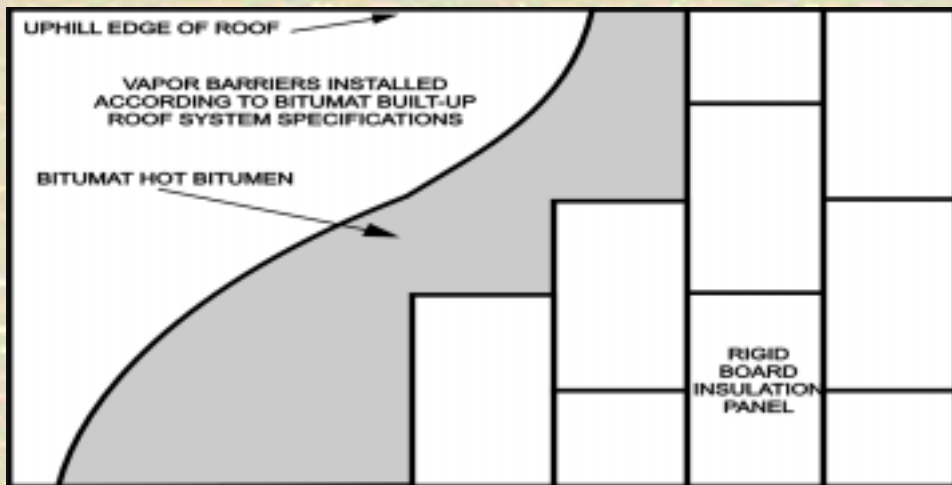
28.3 MEMBRANE SYSTEM INSTALLATION



INSTALLATION OF INSULATION ON NON-NAILABLE DECK WITH NO VAPOR BARRIER



INSTALLATION OF INSULATION ON FLUTED METAL DECK WITH NO VAPOR BARRIER



INSTALLATION OF INSULATION ON NAILABLE OR NON-NAILABLE DECK WITH VAPOR BARRIER

The rolls must be unrolled and left in this condition for a few hours so that the tension in the rolls is marginalized. Later the membrane is rolled again prior to application.

All the tools required during the days work should be made available and kept at the work site prior to application. The tools which should be available are but not restricted to :

- Filled Gas cylinder with regulator
- Hose
- Torch
- Trowel
- Working Gloves, both cloth and heavy duty
- Chalk Line
- Stanleys Knife with hook blades
- Bucket containing cold water(in case of burns)
- Fire Extinguisher
- Measuring Tape
- Misc Tools

Roofers are recommended to wear flat shoes(without heel) to diminish the possibility of leaving footprints on the

hot membrane.

Make sure that the material needed for the days work is on site prior to application. All material should be located at the pre-decided location thus making the work more scientific and increasing the efficiency of the labour. Chalk line where necessary to assure proper alignment and headlap width .



Tools Required For Installation.

Following a proper survey of the deck as stated in the beginning of the sub clause, start the work from the point of least traffic and progress toward the point of material storage. Minimize foot traffic over applied material. Use membrane or walk pads over applied material as walkway.

28.3.1 Application of Primer:

A.) The surface that is to receive the primer must be thoroughly cleaned, and all dust, debris, loose materials, oil or greasy substances removed. Use an air compressor in case of too much dirt, otherwise brooms and scrapers would be appropriate.

B.) The surface must be completely cured, smooth with no depressions or protrusions and dried to receive the primer.

C.) Shake the container well prior to opening and application.

D.) Apply one coat of primer using a roller brush/ rubber brush/ airless spray etc. at the rate of 0 .3 ltr / Sqm, depending upon the condition of the surface.

E.) Allow it to dry.

Once the primer is installed and cured, begin the installation of all membrane plies at the low point or drains, so that the flow of water is over or parallel to the plies, but NEVER AGAINST THE LAPS. It is recommended to dress the drains prior to installing the membrane.

28.3.2 Loose-Laid Installation (In Single Or Two Layer System)

A loose laid system does not require any priming on the horizontal area. Only the flashing area is primed.

Starting at the low edge of the roof, the BITUMAT membrane shall be unrolled and properly aligned along the parapet. The membrane should then be fairly stretched to remove any wrinkles, then

rolled back up to the middle of the sheet. The membrane roll shall be run perpendicular to the slope of the roof deck starting at the low point. All laps in the sheets shall be installed so as to avoid water edges. Provisions must be made for a 10cm (4 in.) side-lap and 15 cm (6 in.) end-lap.. Application process starts when the butane torch flame is directed towards the exposed outer surface of the roll, **at the overlaps area only i.e. about 10 cms side laps and 15 cms end laps.** until the membrane surface reaches the proper application temperature (generally 200°C) and shows a slight sheen. Another indication that the torchable surface has reached the desirable welding temperature is the observance of the burn-off PE film melting, leaving a glossy surface of modified coating. Welding temperature is correct when flow from all seams is 3mm-13mm (1/8 in. to 1/2 in.). No flow indicates too little heat and this is again



Application of Membrane.

undesirable as due to the low heat the adherence will be weak and suspect. Care should be taken to avoid over heating which may result in damage of the reinforcement. When this section of the roll has been securely installed, the remaining part of the membrane should be re-rolled up to the point of application and heat welded in the opposite direction. Installing additional rolls in a shingle fashion with 10cm (4 in.) side laps and 15cm end laps should be continued.

Heat welding should be done at the overlap only so as to weld the two layers together. Seams at overlaps must be secured for proper welding by running a heated trowel along the edge of the seam to reseal all possible voids in the laps. It is recommended to have 10 mm (0.4in.) flow of bitumen at the seam areas. The seam can be rolled with a hand roller, a trowel or walked in.

All edges must be sealed with the heated trowel by slightly melting the modified bitumen compound evenly creating a finally welded seam After covering the whole roof area, recheck to ensure that the membrane is fully heat welded at all laps and around the perimeter of the roof and all roof protrusions. All un-adhered seams shall be lifted with a heated trowel and resealed by lightly torching the seam area. Press or roll seam to achieve a minimum 10 mm (0.4 in.) compound flow-out of bitumen. **Never attempt to repair laps by heating the top surface of the membrane.**

Care should be exercised when creating the overlaps so as to ensure that the overlaps size is as per the stated dimensions. The roofer should make use of a chalk line or any other tools to ensure that the overlaps are straight. If the overlaps are not straight then in some areas the overlaps may be less than the stated specifications and this can make the joints weak. Higher overlaps means wastage of material and lesser productivity and profitability.

All end and side laps must be rechecked at the end of the work day for proper bonding. All suspect joints must be promptly resealed.

All end laps must be staggered so that no adjacent end laps coincide. If for any reason the end laps do coincide, a full width of Bitumat membrane must be installed over the end laps.

28.3.3 First Layer - Fully bonded (In Single Or Two layer System)

Clean the surface in case of dirt or dust has collected on the primed surface. The positioning of the first layer membrane roll shall be determined. Proceed as per first layer "Loose-laid" for roll handling and overlapping, but the membrane must be fully torched onto the deck by applying the butane torch flame to the whole width of the roll in order to burn off completely the polyethylene foil and melt superficially the bitumen. A small wave of melted bitumen may appear at the base of the roll in contact with the deck. Application process starts when the butane torch flame is directed towards the exposed outer surface of the roll until the membrane surface reaches the proper application temperature (generally 200°C) and shows a slight sheen. Another indication that the torchable surface has reached the desirable

welding temperature is the observance of the film burn-off sheet melting, leaving a glossy surface of modified coating to be bonded to the substrate. If flow of modified bitumen coating is observed before contact with the substrate, the welding temperature is too high. Welding temperature is correct when flow from all seams is 3mm (1/8 in.) to 13mm (1/2 in.). No flow indicates too little heat and this is again undesirable as due to the low heat the adherence will be weak and suspect. Care should be taken to avoid over heating which may result in damage of the reinforcement. Torching (the flame should be moved in the shape of an "L", i.e. applying about 75% of the flame to the roll and the remaining 25% to the substrate. This heat distribution ensure a proper torching which is balanced) should be done while gradually unrolling and at the same time pressing the membrane sheet towards the substrate to create a heat weld between the membrane, the perimeter of the roof and the cant strip. The flame should be moved from side to side and up the lap edge. When this section of the roll has been securely installed, the remaining part of the membrane should be re-rolled up to the point of application and heat welded in the opposite direction. Installing additional rolls in a shingle fashion with 10cm (4 in.) side laps and 15cm (6 in.) end laps should be continued.



Showing The Overlaps.



Using A Trowel To Seal Overlaps.

Seams at overlaps must be secured for proper welding by running a heated trowel along the edge of the seam to reseal all possible voids in the laps. It is recommended to have 10 mm flow of bitumen at the seam areas. The seam can be rolled with a hand roller, a trowel or walked in.

All edges must be sealed with the heated trowel by slightly melting the modified bitumen compound evenly creating a finally welded seam. After covering the whole roof area, recheck to ensure that the membrane is fully heat welded at all laps and around the perimeter of the roof and all roof protrusions. All un-adhered seams shall be lifted with a heated trowel and resealed by lightly torching the seam area. Press or roll seam to achieve a minimum 10 mm (0.4in.) compound flow-out of bitumen. **Never attempt to repair laps by heating the top surface of the membrane.**

Care should be exercised when creating the overlaps so as to ensure that the overlaps size is as per the stated dimensions. The roofer should make use of a chalk line or any other tools to ensure that the overlaps are straight. If the overlaps are not straight then in some areas the overlaps may be less than the stated specifications and this can make the joints weak. Higher overlaps means wastage of material and lesser productivity and profitability. All end and side laps must be rechecked at the end of the work day for proper bonding. All suspect joints must be promptly resealed. All end laps must be staggered so that no adjacent end laps coincide. If for any reason the end laps do coincide, a full width of Bitumat membrane must be installed over the end laps.

28.3.4 First Layer - Nailed (In Two Layer System)

Proceed as per "First layer Loose-laid". After placing of each roll, nail the requested amount of fasteners (for nail types refer to material section of this manual) at 30cm (12 in.) center, except the one at the higher edge of the roll which will be placed on the overlap after installation of the adjacent roll. The nailing pattern may emerge as a row of nails along the overlaps (at intervals of no more than 23 cm (9 in.). Stagger nails on centers at 30 cm (12 in.) along two lines located 30 cm (12 in.) from each edge of the base sheet. Wind conditions in some area may require increased fastening at critical areas. While proceeding overlaps and seams checking, make sure that sufficient amount of fasteners have been placed and in the proper pattern. The appropriate system is to be chosen according to the type of deck, the available slope and the designed roof finish.

28.3.5 First layer - Spot-bonded (In Two Layer System)

Proceed as per first layer "Loose-laid" While placing each roll, heat the part of the membrane which is in contact with the concrete deck to create a spot of bonding between membrane and deck. Repeat the "Spot-bonding" to ensure that spots are at 50 cm (20 in.) centers and approximately 20 cm (8 in.) wide. Torching details as stated above may be followed.

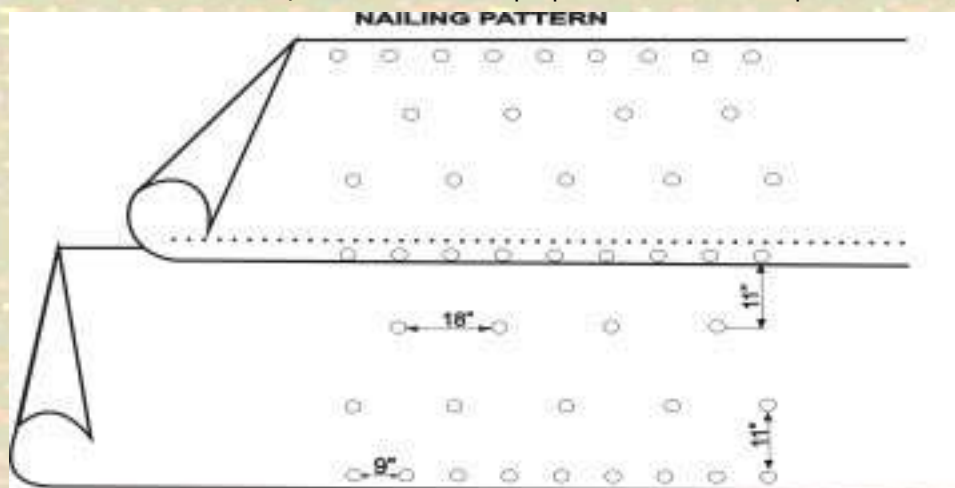
28.3.6 Second Layer - Fully Bonded (In Two Layer System)

BITUMAT membrane roll shall be run perpendicular to the slope of the roof

starter course at the low point. All laps in the sheets shall be installed so as to avoid water edges. End laps must be staggered. All side laps shall be 10 cm, (4 in.) and end laps 15cm (6 in.). Side laps of the first layer shall be in the center of the second layer never super imposed. The BITUMAT membrane shall be installed fully bonded onto 1st layer by applying the butane torch flame to the whole width of the roll in order to burn off completely the polyethylene foil and melt superficially the bitumen. A small wave of melted bitumen may appear at the base of the roll in contact with the first layer. After covering the whole floor area, recheck all seams and laps. Torching details as stated above may be followed.

28.3.7 Flashing

All protrusions shall be at least 50 cm (20 in.) away from curbs, walls and edges to provide adequate space for proper flashing. Prior to application of flashing, vertical concrete/surface or masonry surfaces require preparation. Ensure that the surface is DRY AND CURED , smooth, free of depressions and/or protrusions, solid and in a position to receive the primer. Apply primer on all the areas that are to receive the flashing at the rate of 0.3L/M². Depending on the exact state of the surface, the coverage may vary. Primer must be completely dry before application of the flashing commences. Material for base flashing may be Bitumat granules finished membrane or sand finish on which Bitumat coatings can be applied. Install base flashing starting at low points. Membrane flashing shall be installed by heat welding to attain full adhesion. BITUMAT membrane flashing shall be installed in strips not longer than 1 meter (39 in.) and cut to the width required for the flashing girth. Flashing strips shall be aligned and precut in the proper width according to the height required, with the top level of wall flashing. The flashing strip shall be held at the cant strip level, turning down the top portion of the flashing strip.. The butane flame shall be carefully applied towards the surface of the wall and the inner surface of flashing strip while pressing to ensure full bonding along the wall for the whole length of the strip. Turning the bottom portion of the flashing strip up, the flame shall be applied to the membrane over the cant strip, approximately 10 cm (4 in.) onto the flat area as well as the inner side of the flashing strip while pressing the strip carefully onto the cant strip and the



NAILING PATTERN

membrane to eliminate any voids between them and to avoid any loose installation at the flashing point. Torching the flashing should be done very carefully, minimum bitumen flow-out should be about 10 mm (0.4 in.) at all seams and a maximum compound flow-out not exceeding 25 mm (1 in.). An under-torched(less heating) flashing will not result in proper long term bonding. An over-torched flashing will tend to loose out on its mechanical properties due to damage to the reinforcement. The roofer has actually to "work" the flashing in place, using his hands(using gloves which allow for free movement of his fingers). All seams and edges shall be resealed with the heated trowel running it only once along all joints. Overheating and over-melting of surface bitumen must be avoided. All flashings extend a minimum 10mm (4 in.) onto the field of the roof.

28.3.8. Metal Counter Flashing

The metal flashing shall be installed once all the base flashing is completed. The metal may be installed just over the end of the vertical of the base flashing, the bends of the aluminium covering the base flashing end. The nails are drilled in the aluminium but not into the membrane. The other way is when the aluminum is installed in a way that the end of the metal flashing is just on top of the end of the base flashing and the lower end of the metal flashing covers a part of the base flashing. In this case the aluminium is set in the concrete by drilling screws through the base flashing membrane. In either case, the screws are drilled about 30 cm away.

28.3.9. Sealant

Once the aluminium is installed , the top open end is filled with appropriate sealer such as polysulfide or silicon and flushed at 45 degree angle(with the base flashing) so that the rain water flows away immediately and does not stay on the sealant. Please note that the width of the open Aluminium flashing mouth should be about 5 mm (0.2 in.) Depth also should be about 5 mm (0.2 in.). If more, then to be applied in two layers, the second layer coming after 24 hours.

28.3.10. Corners

Proper handling of the corners is a must. Both the internal and external corners are subjected to a lot of stress and should be suitably designed to absorb them. The dressing includes applying a reinforcing strip (mineral finish) at the central point, .

cut in a special zigzag design and fully bonded to the first layer. The width of the reinforcing strip is about 20 cms (8 in.) , with the wedges cut being 5 cm (2 in.) on either side of the strip, leaving 10 cm (4 in.) straight all along the length. **(For details Refer To Appendix A , 6,7,8)**

28.3.11. Edge Flashing

Handling of edge flashing is different from the way a vertical flashing is handled. In the case of edge flashing application, the membrane will be stopped at the extreme corner, and a reinforcing strip will be installed either on top or below the main membrane depending upon the slope, so as not to resist the flow of water. Torching will be done in exactly the same way as discussed earlier. The reinforcing strip shall be installed (fully bonded) about 15 cm (6 in.) on the horizontal and another 15 cm (6 in.) going below (vertical).

An acceptable ballast retainer shall be installed at the perimeter of the roof in case of a covered system. **(For details Refer To Appendix A, 10)**

28.3.12. Drains

Bitumat recommends the use of cast iron drains. First about 10-12 cm (4-4 1/2 in.) area surrounding the drain is properly primed with Bitumat Bituprime and then the Bitumat base layer is fully bonded onto the substrate. Following the installation of the drain, the Bitumat second layer follows on top of the drains flat area. About 10-12 cm (4-4 1/2 in.) overlapping is done over the cast iron drain.

and torch it properly and fold it BACK INTO THE DAIN , pressing properly to ensure a proper bonding with the inside of the already primed drain. Use hands for effective adhesion.

Complete this for all the eight triangles. Finally apply a heated trowel to create a uniform flow of bitumen inside.

Bitumat recommends that the drains be at least 1.5 cm (1/2 in.) lower than the substrate so that the thickness of the membrane is accommodated and unnecessary ponding of water is avoided. **(For details Refer To Appendix A,14,15,17)**

28.3.13. Ventillation and/ or other Pipes

All Pipes are to receive the flashing system in the same way as discussed earlier. The protruding pipe is dressed using a two layered system, the first being black finish membrane and the second being mineral finish. The black finish shall be 20 cm (8 in.) wide strip , installed 10 cm (4 in.) on the vertical and 10 cm (4 in.) along the horizontal. The protruding pipe is primed, dried and then the first black layer is installed over it. In case the protruding pipe is PVC, then the surface is roughed a little bit to enable better adhesion. The membrane strip is torched away from the PVC pipe and then hand worked in place. Direct flame on the pipe may result in burning the pipe. The mineral finish strip may also be installed likewise or this may be torched directly on the first layer. Bitumat



Dressing of Drains.

For circular pipe drains cut a piece of Bitumat membrane , say about 20 cm (4 in.) larger than the diameter of the drain. Torch this over the drain opening, as centered as possible. Using a heated trowel, cut the part that covers the drain opening into a star shape with 8 peaks, or triangles. Now, fold each one by one

recommend the use of adjustable screwable metal clips to keep the dressing in place. The black finish membrane is cut with its length being about 10-15 cm (4-6 in.) greater than the perimeter of the pipe. The lower part which will be about 10 cm (4 in.) and cut into many small triangles or

rectangles. When torching the rectangles, they are spread for best adhesion and strength. With a heated trowel, the bitumen of the rectangles is uniformly spread. (Appendix 12,13,14,22)

28.3.14. Expansion Joints

The surface shall be primed at least 20cm (8 in.) at both sides of the joint, and BITUMAT membrane 20cm (8 in.) strips shall be bonded onto the primed sides, leaving the joint free. Then the special joint covering shall be installed forming a U shape into the joint, each side of the joint covering being torch welded on the BITUMAT membrane base strips, and the U shape shall be filled with a proper backing rod or bituminous sealant. A protection layer shall then be installed over the joint. Exposed joints should be protected from weathering by BITUMAT membrane 4mm G. To avoid cracking of the protective membrane at the joint, it should be bonded only at the edges and loose-laid over the joints. Protected joints should be protected from mechanical stresses by a strip of membrane 4mm smooth finish, welded only at one side of the joint. The top covering of flat joints on accessible roofs shall be removable to allow maintenance visits. (Appendix A, 8,9,,20)

29. Dome Roofing

In case of Domes roofing, and to facilitate roll handling, both layers will be laid parallel to the slope. All installation procedures detailed above will be followed up. For a good final aesthetic aspect, the rolls may be cut in the "melon slices" fashion. It is to be noticed that such method increases the membrane wastage, but the purpose is to give a regular and acceptable design. The roll's cut being essential, the entire dome will be marked with aesthetic chalk line to allow proper measurements. Membrane rolls length may be reduced to allow proper handling, depending upon the dimension of the dome. Roll's cut of a second layer (granule finish) will eliminate part of the black selvage. Overlapping onto granule finish membrane is possible either by re-priming the concerned granule finish surface or by gently removing the granule with light heat and trowel. If necessary, black seams will be masked with extra granule bonded onto the heated black seam. Such roofing works request professional supervision and skilled manpower. The safest way is to insist on a professional roofing

contractor for the best result.

30. Cold Storage Roofing

BITUMAT waterproofing systems shall be installed to cold storage buildings ONLY when the refrigeration insulation is installed below the roof deck in a manner which will permit ventilation to outside air between the underside of the deck and the top of the refrigeration insulation.

31. Flood Test

After completion of all roofing works, the outlets shall temporarily be sealed and the roof shall be flooded with clean water (free from toxic or salt content) to a height below the top edge of the upstand flashing for a period of 48 hours. The objective of this test is to ensure that there is no leakage at all seamed areas. Check for leak/dampness from inside the flood test area. If any leakage is noticed, mark the damp area, remove the water and allow the roof to dry. Search for the spots from where water is entering the roof and then carry out remedial work immediately. Plug the drain water outlets and conduct the test again. This is repeated till a completely leak-proof installation is obtained. If there is no leakage in the roof, unplug and remove all the standing water and redress the outlets.

If the slope of the roof does not allow proper execution of the Flood Test, water tightness may be checked by a Running Water Test.

32. Covering

Covering of roof membrane should be done as soon as the Flood Test is completed but not later than 7 days. Special care must be taken not to damage the finished roof membrane during covering process. The roof membrane should never be used as a platform for other trade works. Covering of the membrane may proceed only after satisfactory water test on the entire roof surface. If the slope of the roof does not allow proper water test, water tightness could be checked by running water. In case of impossibility, a thorough visual inspection of all membrane installation is necessary before handing over. All laps, termination and flashing must be carefully checked for any evidence of incomplete adhesion, physical damage or other conditions that may be detrimental to the watertight integrity of the membrane. Special care must be taken not to damage the finished roof membrane.

32.1 Covering Insulated Roofs

Following recommendations are basic procedures. Generally, follow strictly the Insulation board manufacturer's Recommendations.

- Apply separation layer over BITUMAT membrane.
- Apply insulation boards, staggered joints, loose-laid over separation layer.
- Apply a filter layer loose-laid over insulation boards, overlapped by at least 10 cm (4 in.) Filter layoff shall be 120/140 gm (.26-.30 lb) polyester mat (gravel topping) or 150 (60 mil) microns polyethylene sheet (tiling or concrete topping). Prevent wind uplift covering only areas which shall be immediately ballasted the same day.

32.2 Covering Non-Insulated Roofs

Proceed directly to installation of top covering system after laying adequate separation layer over BITUMAT membrane.

32.3 Covering Non-accessible Roofs

Non-accessible roofs are roofs accessible only to maintenance crew, and not being equipped with heavy machinery (chillers, etc ...) The typical top covering is gravel, loose-laid over the filter layer with a minimum thickness of 5cm. In the case of insulated roofs, if insulation boards thickness is higher than 5cm (2 in.), gravel thickness, has to be increased proportionally.

32.4 Covering Accessible Roofs

By accessible, we mean roofs opened to pedestrian access and public use (balconies, terraces, public areas) The top covering is either Cast-in-situ concrete screed minimum 4cm (1.8 in.) thick, reinforced or precast concrete pavers, minimum 4cm (1.8 in.) thick, laid onto a mortar bed or laid dry onto filter layer or supported by elevated bearings. In both cases, the top covering must be sectioned every 5 meters (16 ft.) in both directions by a 1cm (.4 in.) wide joint, and must be topped at parapets and all openings with a 3cm (2.2 in.) wide joint filled with a plastic material. The thickness of top covering may be increased if the thickness of the insulation boards is higher than 5cm. The upstands membrane shall be mechanically protected by reinforced plastering or by precast kerb stone.

32.5 Covering Exposed Membrane Systems: The Inverted Roof or the Protected Membrane Assembly

Covering of the roofing membrane may only be executed after satisfactory completion of Flood Test. The granule finish of BITUMAT exposed membrane systems provides efficient protection to the membrane against UV and weathering stresses. Access to roofs covered with exposed membrane systems shall be strictly restricted to well informed maintenance technicians wearing flat shoes. Tools and necessary equipment shall be handled with care to avoid any accidental physical damage to the membrane. Black exposed membrane shall be protect by a reflective coating to shield.

33. Covering Service Areas

In case of heavy equipment (chillers,..) to be installed over the top covering, the following precautions shall be considered. Roof deck shall be designed to receive extra load without damage, cracks or movements. Insulation boards shall not be less than 35kg/m³ density with an adequate compressive strength. Top covering beneath the mechanical equipment is designed as for a accessible roofs. Thickness could be increased, if necessary. Upstands membranes may be self protected (granules or aluminum). In case of light mechanical equipment (split-unit air conditioner,..) simple concrete supports and adequate walkways may be installed partially on the roofs, other parts being covered with gravel. Should loose laid membrane or Bitumat Bitutech can be used as walkway by spot bonding to the membrane.

34. Before Handing Over

In case of difficulty or impossibility to run the Flood Test, a thorough visual inspection of all membrane installation is necessary prior to handing over. All laps, termination, and flashing must be carefully checked for any evidence of incomplete adhesion to the substrate, physical damage or other conditions that may be detrimental to the water tightness integrity of the membrane.

35. Maintenance & inspection

The recommendations of this manual are intended to allow the execution of a quality roofing system. However, the life expectancy of the system may be drastically reduced by misuse of the roof or lack of maintenance. A roof shall not

be used for any other purpose than the one it has been designed for. Roofs accessible to pedestrians shall not be subjected to temporary load exceeding the designed limit. Non-accessible roofs shall not be used for storage, load or any public access. Exposed membrane systems shall not receive any extra load or any extra equipment. In case of roof modifications (new TV Antenna, new A/C system), a professional roofing contractor shall be consulted prior to any work.

Maintenance visits shall be done periodically, especially at the beginning of summer and winter seasons. Maintenance visit comprises of:

- Visual examination of apparent roofing membranes.
- Visual examination of apparent roof details (pipes, flashing,...).
- Checking and cleaning of rainwater outlets.
- Removal of grasses and wild plants.
- Checking and re-spreading of gravel.
- Checking and periodic replacement of sealant (counter flashing, joints,...)
- Checking and periodic replacement of roof coatings.
- Repair of accidental damages to the roofing membrane or to roof accessories.
- General cleaning of the roof.

Such maintenance visits could be done by the user or preferably, by a professional roofing contractor who could detect more easily any possible damage to the roofing system. An advisable option is to have a "Maintenance Contract" with the roofing contractor who originally installed your roofing system.

36. Safety Precautions

**Work Safely by Working Smart!
When in Doubt....Do Not Use !
Prevention is better than cure!
NEVER LEAVE A TORCH
UNATTENDED!**

As with any construction process, safety is key element. Therefore, BITUMAT recommends that all applicable safety standards and good roofing practices be followed. Fire ignition prevention is the applicator's responsibility.

Contact with molten asphalt and torch flames may cause burns. In case of contact with molten bitumen, apply ice or any other applicable cold liquid that is compatible with the skin and call for medical care immediately.

Torching devices should not be left unattended and should not be allowed to get in touch with flammable materials. Torch flames should be kept moving and properly monitored all the time. Keeping the torch flame directed towards one area for any period of time may result in ignition with surface or other flammable material. Don't torch anything that cannot be seen. Don't torch near gas lines, electrical wires or flammable vents. Follow the torch manufacturer's safety precautions prior to using the torching tools. All fittings for application tools must be thoroughly checked prior to starting the application process. Propane torch should not be used except in properly ventilated areas. Application staff must remain on site at least one hour after completion of installation to inspect for any possible flames, smoke, or smolders of any combustible material.

- Do not use trowel or other tools as a torch stand
- Do not use cigarette lighter or matches to test for leaks



- Do not keep the fire extinguisher next to LP tank
- Do not use hoses which are old and worn out
- Always check the equipments for safety before starting work
- Always wear the proper roofing dress, wearing full sleeves overalls only
- Always use soap solution to check for gas leaks before lighting
- Always keep a bucket of cold water handy in case of burns
- Conduct a safety drill on a frequent basis
- There should be a trained nurse on site who is familiar with the first aid procedures
- If working with scaffolding, ensure the sturdiness and proper placement
- Ensure safety of the side rails on the roof
- Always be alert to the site surroundings

37. SPECIAL CONSIDERATIONS: Cold Weather Application

Roofing materials cannot be applied unless correct asphalt application temperatures can be maintained. Roof membrane application shall not be continued during very cold weather conditions.

A.) When water in any form is present on the deck, application procedures must be suspended until the deck has dried. Any moisture present at the time the roofing is applied may result in poor adhesion and blistering of the membrane.

B.) Store membrane rolls and coatings in an area heated at a minimum temperature of 55°F (12.6°C) when the ambient temperature and wind chill factor is below 45°F (7.1°C). This will help in the ease of application, and reduce the potential of membrane coating cracking during their handling and application.

C.) Install membrane rolls immediately after removal from storage to avoid membrane cooling to below 45°F (7.1°C).

D.) During installation, if surface cracking appears in the membrane, discontinue installation immediately and contact Bitumat technical Dept.

E.) If temperatures at night are at or below 45°F (7.1°C), never start applying first thing in the morning. The surface over which the membrane is to be installed must be allowed to warm to a temperature above 55°F (12.6°C).

F.) On those days when ambient temperature is greater than 55°F

(12.6°C), remove from the protected storage area only those rolls that will be installed the same day. These rolls must be unrolled, with the back side up and allowed to relax and warm. Then re-roll to apply. If the outside temperature is less than 55°F (12.6°C), then remove only those rolls that can be applied immediately.

G.) Do not apply roofing materials when the ambient temperature and wind chill factor is below 45°F (7.1°C) unless the following recommendations for application during cold weather are followed:

1. Roofing installation at temperatures below 45°F (7.1°C) require special precautions to insure satisfactory performance of the finished roof. Remove all traces of moisture from the deck before applying roofing;

2. The use of an insulated, two-pipe circulating pumping system for asphalt is recommended for minimizing excessive application of asphalt in cold weather and for reducing use of heating fuel;

3. Do not overheat the bitumen above the Flash Point or above the Finished Blowing Temperature for prolonged periods, to try to offset rapid chilling;

4. Discontinue work if proper bitumen application temperatures cannot be consistently maintained or materials cannot be securely attached to their substrate;

5. Do not overheat APP membranes to compensate for cold temperatures.

6. When torching, unroll the membrane slowly to ensure proper flow of the coating.

7. Never throw rolls of membrane on the deck or storage surface. Sudden impact of the roll can possibly cause cracking of the coating. On guarantee roof system applications, Bitumat reserves the right to stop roofing installation, when in the opinion of the U.S. Intec representative, weather conditions or application methods are unacceptable.

38. Trouble Shooting

- Never start work if the deck is not satisfactory
- Ensure that there is positive slope on the deck, with no possibility of water ponding.

- Never start work if the deck is not fully dried, esp. in LWFC, Gypsum etc.
- Ensure that there is proper relief system over LWFC, Gypsum etc.
- Never use material which is wet or damaged
- Avoid exposing materials to moisture in any form before, during or after delivery to the site
- Always store goods on end in a clean, dry and ventilated area.
- Avoid storing materials at temperatures below 55 deg F (12.6 deg C)
- Do not begin work when inclement weather is forecast to occur prior to the anticipated time of completion of the work item
- Do not install materials during inclement weather, except for temporary work necessary to protect installation.
- Do not apply the membrane if the ambient temperature and the wind chill factor is below 45 deg F (7.1 deg C)
- During cold weather never throw rolls of membrane on the deck or storage area
- Always insist on a pre roofing conference with all the concerned parties
- Always "relax" the membrane prior to torching
- Special care to be exercised when torching, avoiding both under and over torching
- Always start installation of membranes at the low point or drains, so that the flow of water is over or parallel to the plies BUT NEVER AGAINST THE LAPS.
- Ensure staggering of laps when doing a two layer system, laps never coinciding.
- Appropriate precautions to be taken when torching on site
- Ensure proper seam integrity by rolling over the laps.
- Flashing are the most common of roofing failure, ensure that the flashing is properly designed and installed
- Never install base flashing on fresh plaster. It will lead to wrinkling and buckling
- Highly recommended to use Polyester reinforced membrane as flashing material
Maintain the right amount of overlaps and the length of the flashing should not be unmanageable
- Minimum height of the base flashing should be 8"
- Ensure proper protection of the membrane after water test.
- Cover immediately to avoid any damage
- Insist on proper safety programme on the site.

DETERMINING DEW POINT

In roofing applications, dew points are affected by a complex relationship between inside and outside temperature and relative humidity. Their relationship is expressed in the psychrometric chart, through which dew point at any given temperature and relative humidity can be determined.

In order to determine whether a vapour barrier is needed or not, the design engineer must determine the dew point of the warm side of the deck. In order to use the psychrometric chart, the designer needs to determine the building's interior relative humidity, and the temperature at point in question, which is normally at the vapour barrier, which is expressed by the following mathematical equation:

$$TX = Ti - \frac{ERX}{ERT} (Ti - To)$$

WHERE

TX = Temperature at point in question (at the vapour barrier)

Ti = Design temperature of inside air

To = Outside air temperature

Rx = Sum of the thermal resistance @ to point in question (recommended values) of thermal resistance, included in the appendix).

Rt = Sum of thermal resistance @ of materials in system including inside air temperature and outside air temperature.

If the designer decides on a vapour barrier, then one of the following membranes can be used:

1. Asphalt saturated and coated organic roll roofing.
2. Aluminum foil
3. Plastic sheeting

The concrete surface must be primed with a suitable asphalt base primer, then the vapour barrier is embedded with cold process asphalt adhesive or hot applied asphalt. (See Appendix A-A)

40. HEAT FLOW CONTROL

Heat flow is controlled by insulation which is defined as material or combination of materials either of which retards the transfer of heat or reflects heat.

Heat is a form of energy referred to as the British Thermal Unit (BTU). BTU is defined as the heat energy required to raise the temperature of 1 pound water 1°F.

Heat transfer occurs in three ways:

1. Conduction
2. Convection
3. Radiation

In roofing applications, insulation is used to prevent or retard heat conduction by providing numerous obstructions in the form of small air cells.

40.1. THERMAL CONDUCTIVITY (K) :

Defined as the amount of heat transmitted by conduction through 1 square foot of 1-inch thick material in one hour causing a difference of 1°F across the two surfaces.

$$K = \text{BTU} / \text{Square foot} / \text{inch} / \text{hour} / \text{°F}$$

40.2. THERMAL CONDUCTANCE @ :

A unit of heat flow used for specific thickness. In the roofing industry, roof insulation is rated by conductance rather than thickness.

$$C = \frac{K}{\text{Thickness in inches}}$$

40.3. THERMAL RESISTANCE @ :

Represents the thermal resistance of a material to heat flow or transmission, and is reciprocal of a heat transfer coefficient. (See table of Recommended Values of Thermal Resistance).

$$R = \frac{1}{C} \text{ or } R = \frac{1}{K} \text{ or } R = \text{Thickness in inches}$$

40.4. OVERALL COEFFICIENT OF THERMAL TRANSMISSION (U) :

Which represents the heat flow for the complete structure, including all associated air films, air spaces, and all materials in the assembly. The U-Factor is expressed mathematically as the reciprocal of the sums of the individual thermal resistance.

$$U = \frac{1}{R1 + R2 + R3 \text{ etc.}}$$

40.5. HEAT FLOW

U-Factors are used to calculate heat flow when outside and inside air temperature is known (to,ti). Heat flow (gain or loss) can be calculated:

Summer thermal conditions. When the temperature of the roof surface far exceeds the outside temperature, and substituting the temperature of roof surface (T) for the outside air temperature (to), the temperature of the roof surface can be calculated as follows, where:

T = Temperature of roof surface
to = Temperature of outside air
a = Coefficient of solar absorption (see table)

Temperature over a Low Heat Capacity Substrate (Insulation):

T = to + 100a
Temperature over a High Heat Capacity Substrate (Concrete):
T = to + 75a.

An example of calculating the heat efficiency of two types of surfaces is included in the box.

The extreme daytime heat and rapid drop in night temperature, and occasional cold winter temperatures in the Arabian Gulf region makes it mandatory to pay special attention to the insulation requirements of the roof in order to minimize thermal-shocks, and provide thermal stability to the roof assembly as well as to figure the air conditioning requirements to create an efficient and comfortable system.

The designer must take the following variables into consideration in determining the type and amount of insulation required as well as the type of surface. (6).

1. Building occupancy
 - a. required inside temperature
 - b. Required inside humidity
2. Climatic conditions.
 - a. Outside temperature
 - b. Rainfall
 - c. prevailing winds
3. Building structure
 - a. Structural system
 - b. Building materials

Taking the above variables into consideration and using the mathematical equation discussed earlier, the designer can determine the optimum insulation and surfacing requirements. (See Appendix B-B)

SAMPLE HEAT FLOW PROBLEM:

GIVEN: Roofing assembly as described above.

t_o = Outside air temp = 100°F

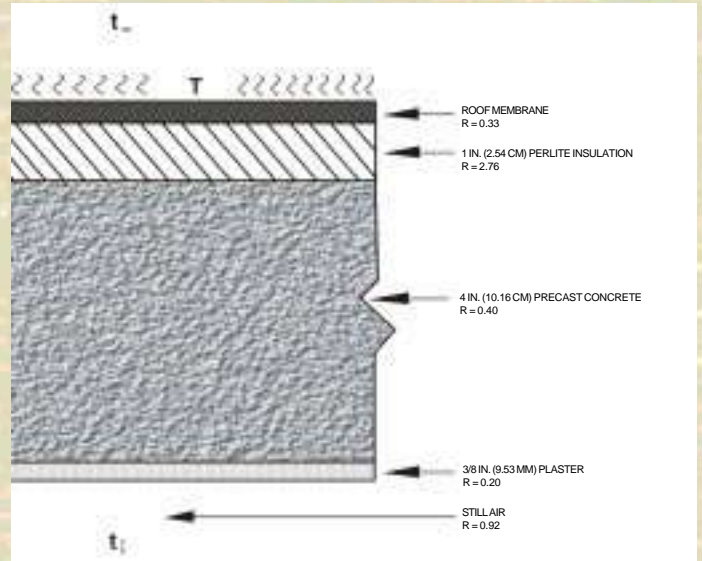
t_i = Inside air temp = 70°F

FIND: How much more energy efficient is Roof System coated with Aluminum Roof Coating when compared to a Roof System with no reflective coating?

RECOMMENDED VALUES OF THERMAL RESISTANCE, R

Roof Membrane.33
Rigid Board Insulation	6.25"
Perlite	2.76"
Polyurethane	3.85"
Fiber Glass	2.50"
Polysterene	4.00"
Wood or Cane Fiber	2.50"
Plywood 1/2"62"
Concrete P (2.54 cm)10"
Still Air Surface	
Heat Flow Downward	
(Summer Conditions)92
Heat Flow Upward	
(Winter Conditions)61
Outside Moving Air Surface Any Direction	
15 mph (24 km/hr) Winter17
75 mph (12km/hr) Summer25
Steel Roof Decks	Nil
Acoustical Tile 3,4"	1.78
Plaster 3,8"20

* These are "R" factors for 1" thickness. The "R" factor for other thicknesses may be calculated by multiplying the thickness by this value. Example: 4" Concrete "4 x 10 = 40.



CALCULATING "U":

$$U = \frac{1}{\text{SUM OF THE R's}}$$

$$= \frac{1}{0.33 + 2.76 + 0.40 + 0.20 + 0.92}$$

$$= 0.22$$

CALCULATING "T":

$$T(\text{Aluminum}) = t_o + 100a$$

$$= 100^\circ\text{F} + (100 \times 0.60)$$

$$= 160^\circ\text{F}$$

$$T(\text{Black}) = t_o + 100a$$

$$= 100^\circ\text{F} + (100 \times 0.95)$$

$$= 195^\circ\text{F}$$

CALCULATING "HEAT FLOW":

$$\text{HEAT FLOW (Black)} = U(T-t_i)$$

$$= 0.22 (195-70)$$

$$= 27.50 \text{ Btu / Hr / Sq Ft}^\circ\text{F}$$

$$\text{HEAT FLOW (Aluminum)} = U(T-t_i)$$

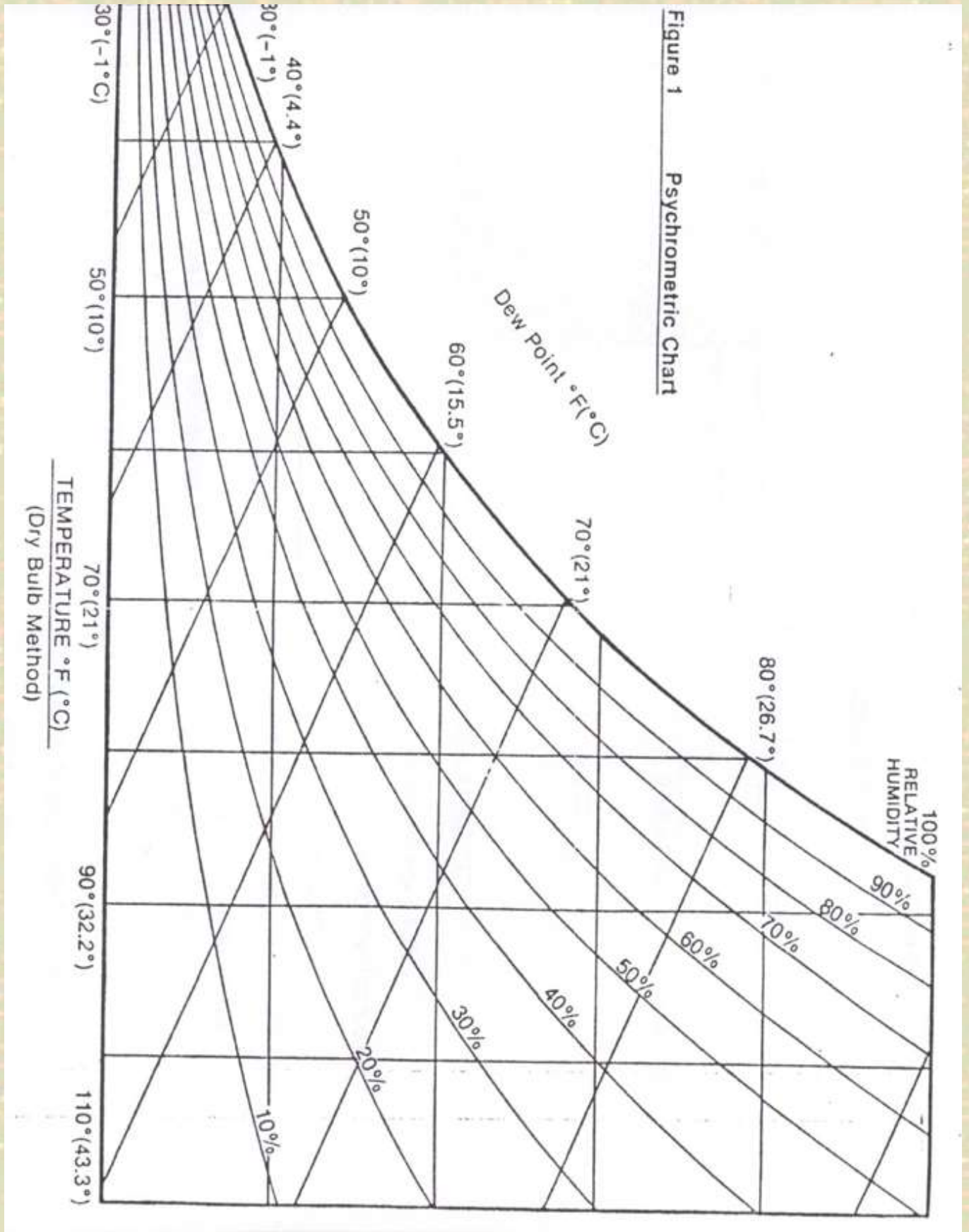
$$= 0.22 (160-70)$$

$$= 19.80 \text{ Btu / Hr / Sq Ft}^\circ\text{F}$$

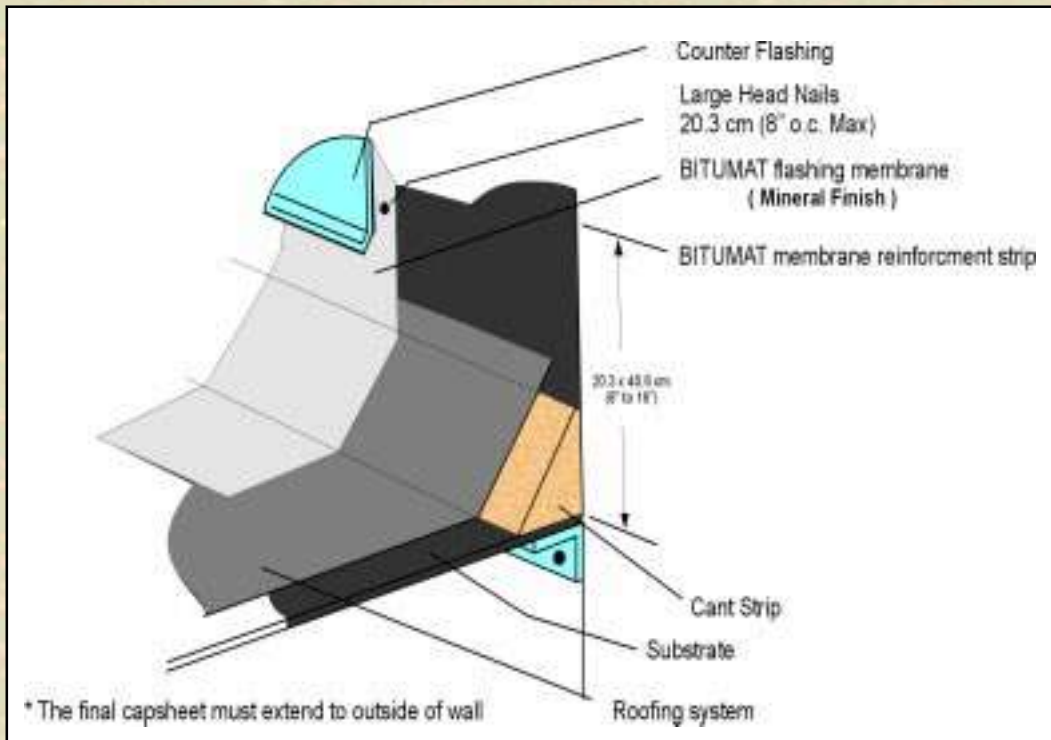
CONCLUSION:

The black surfaced roof permits 7.70 Btu / Hr / Sq Ft / °F or 39% more summertime solar heat gain than an identical roof coated with Aluminum Roof Coating.

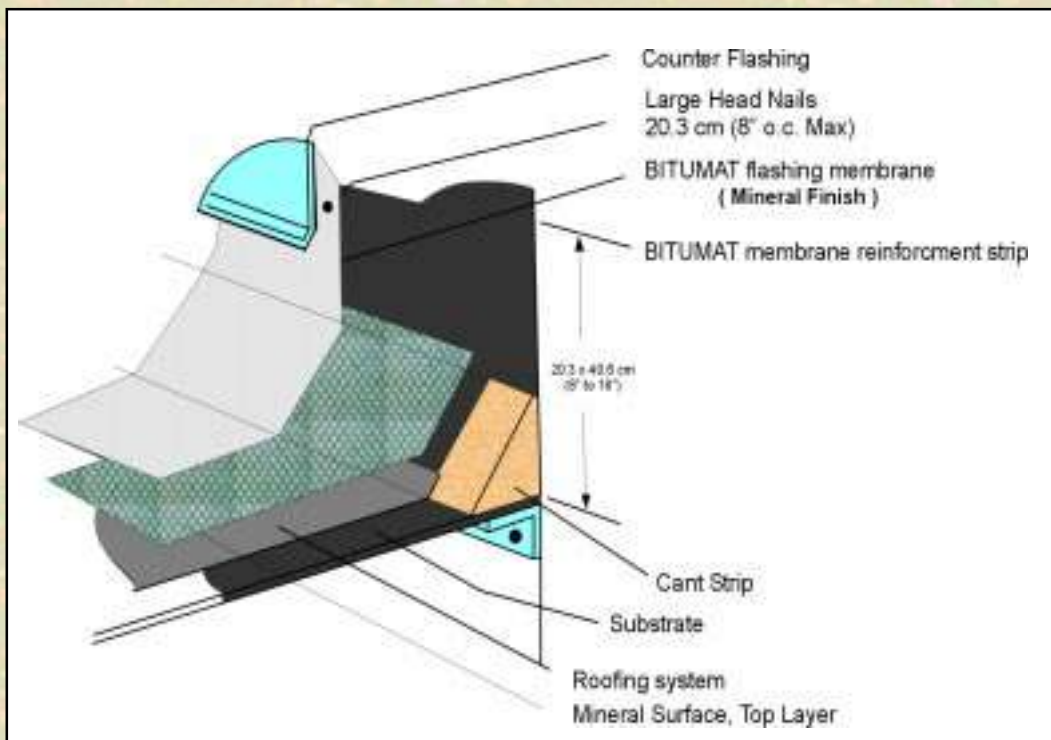
RECOMMENDED VALUES OF THE COEFFICIENT OF SOLAR ABSORPTION, a	
SURFACE COLOR	
BLACK	0.95
DARK GRAY	0.80
LIGHT GRAY	0.65
WHITE	0.45
WEATHERED METALS	
COPPER TARNISHED	0.80
COPPER PATINA	0.65
ALUMINUM	0.60
GALVANIZED IRON	0.90



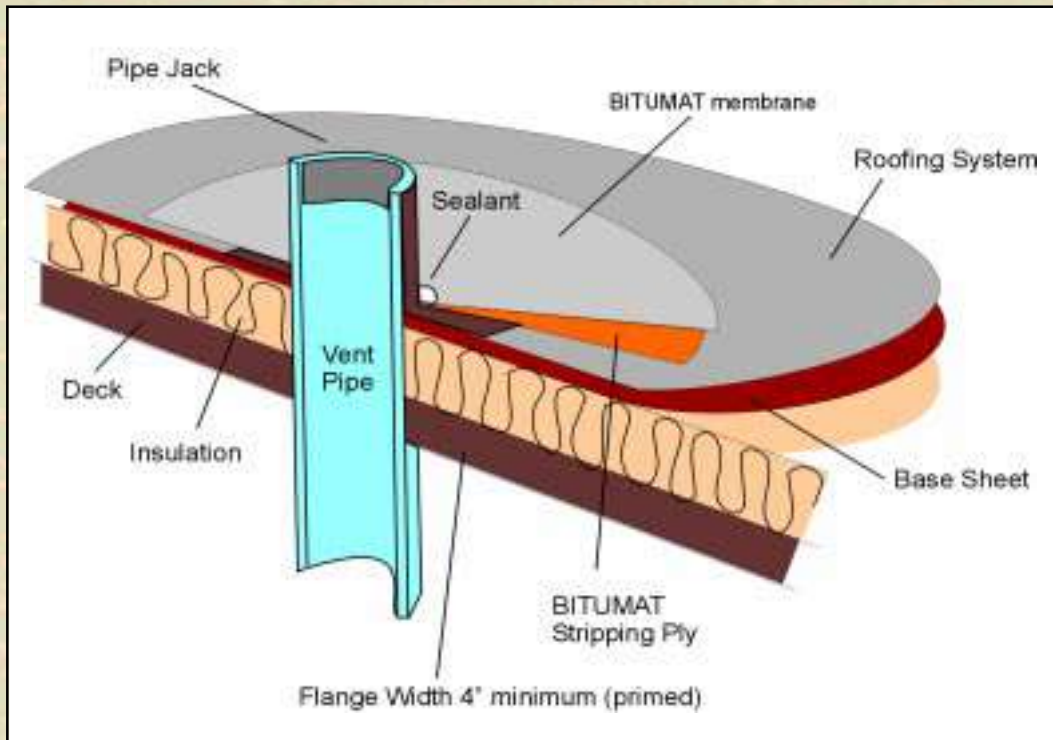
PSYCHROMETRIC CHART



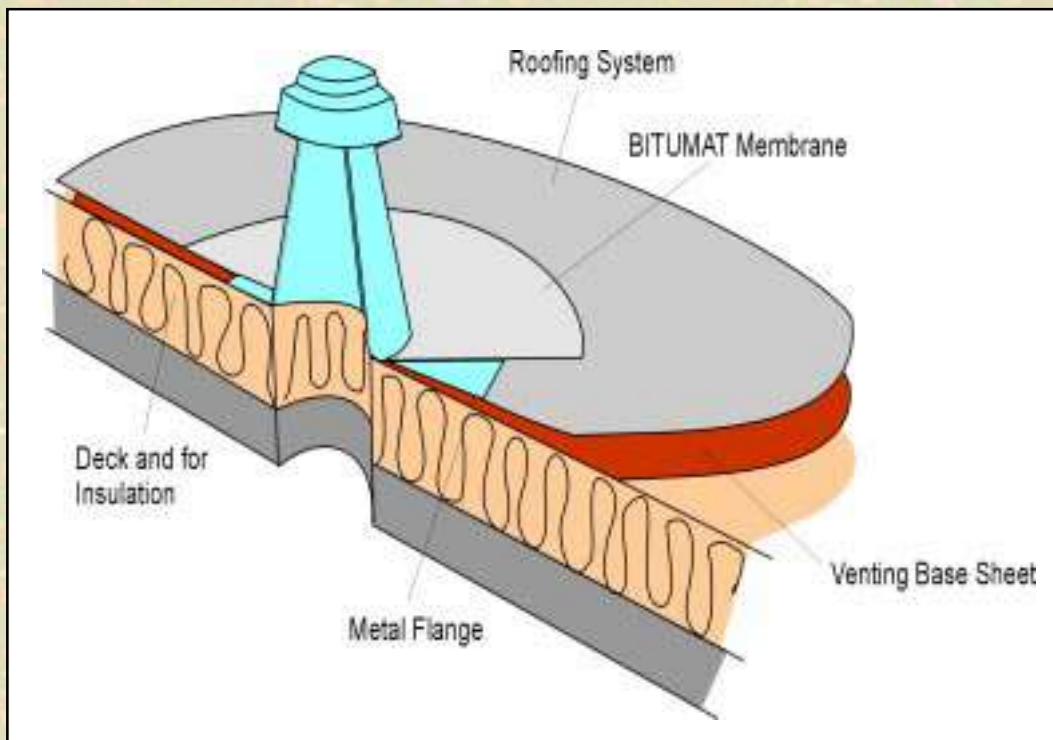
1a. SINGLE LAYER APPLICATION DETAILS



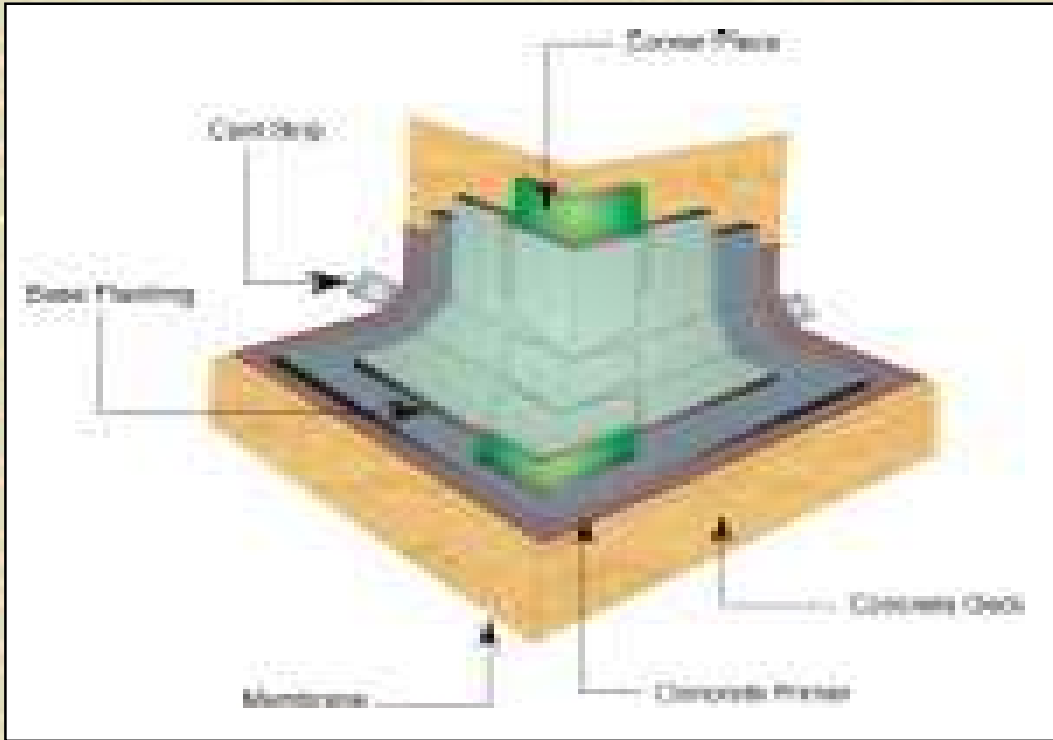
1b. TWO LAYERS APPLICATION DETAILS



2. VENT PIPE DRESSING DETAILS



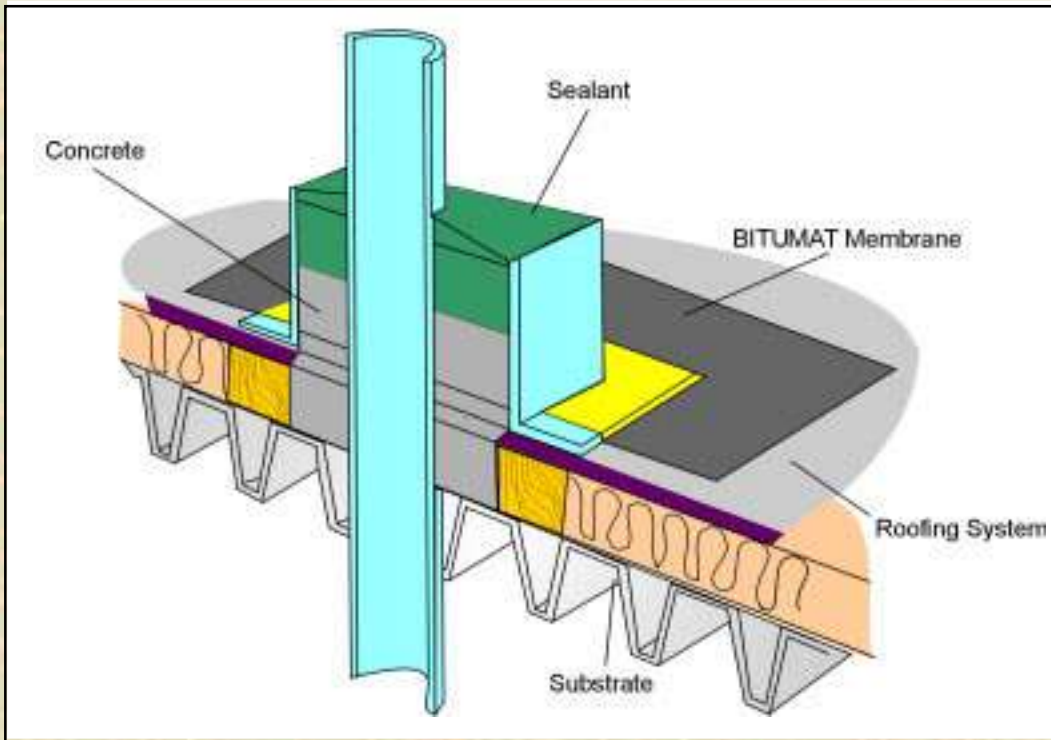
3. MOISTURE VENT FLASHING DETAILS



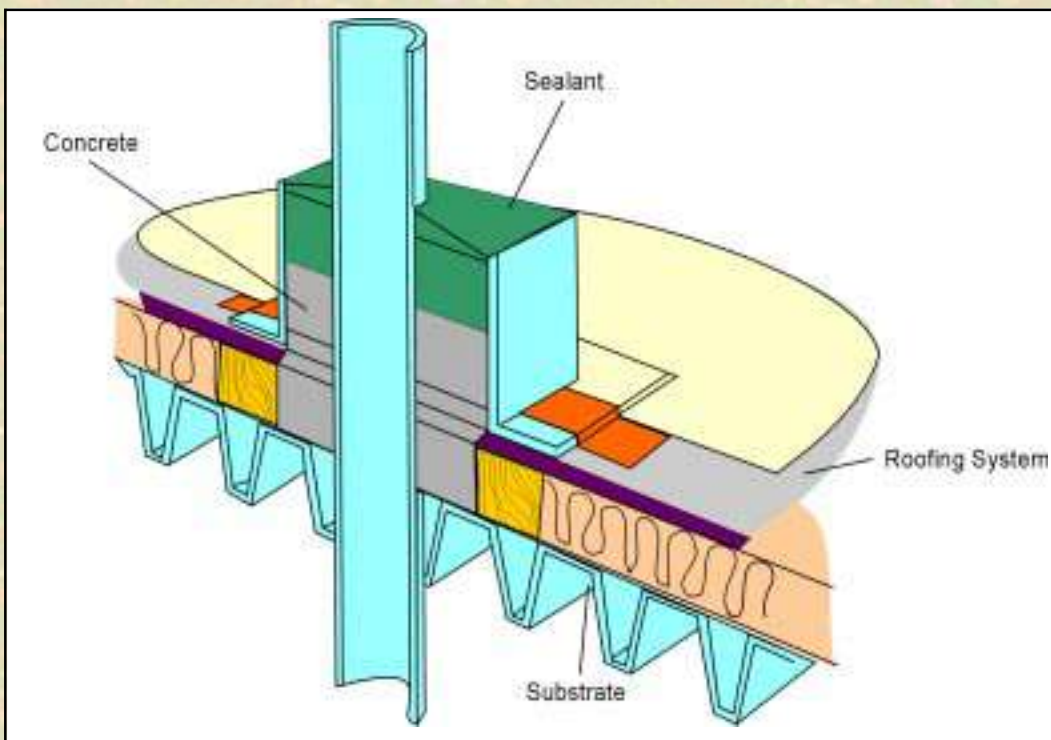
4a. CONCRETE DECK - EXTERNAL VIEW



4b. CONCRETE DECK - INTERNAL VIEW

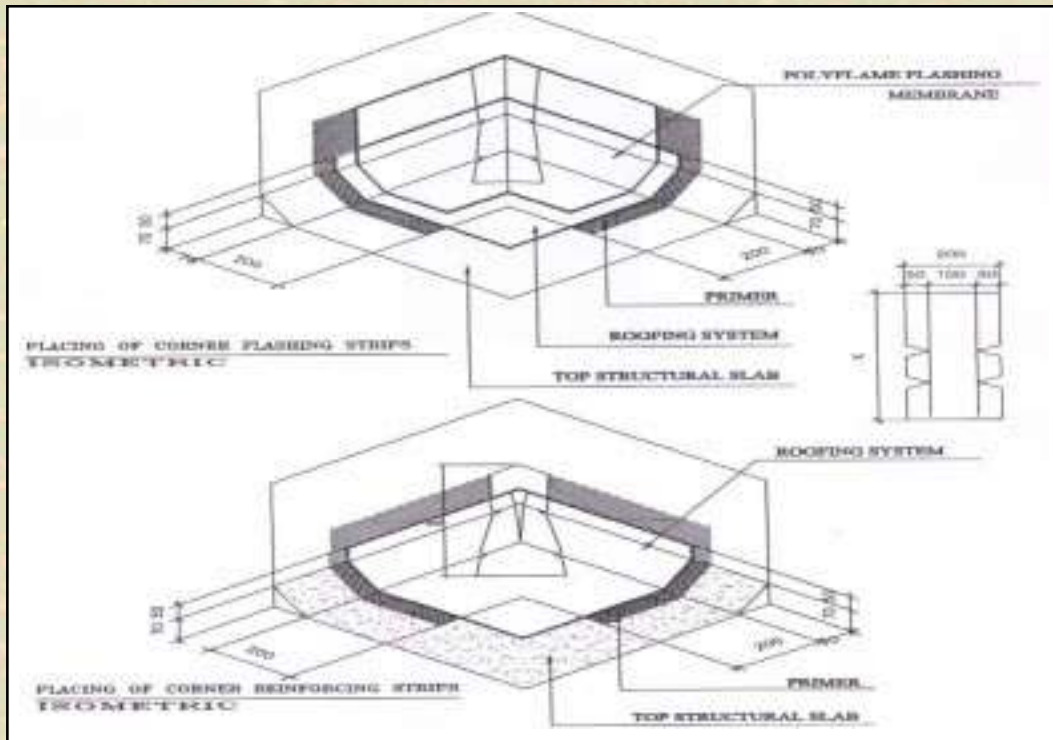


5a. PITCH POCKET FLASHING DETAILS

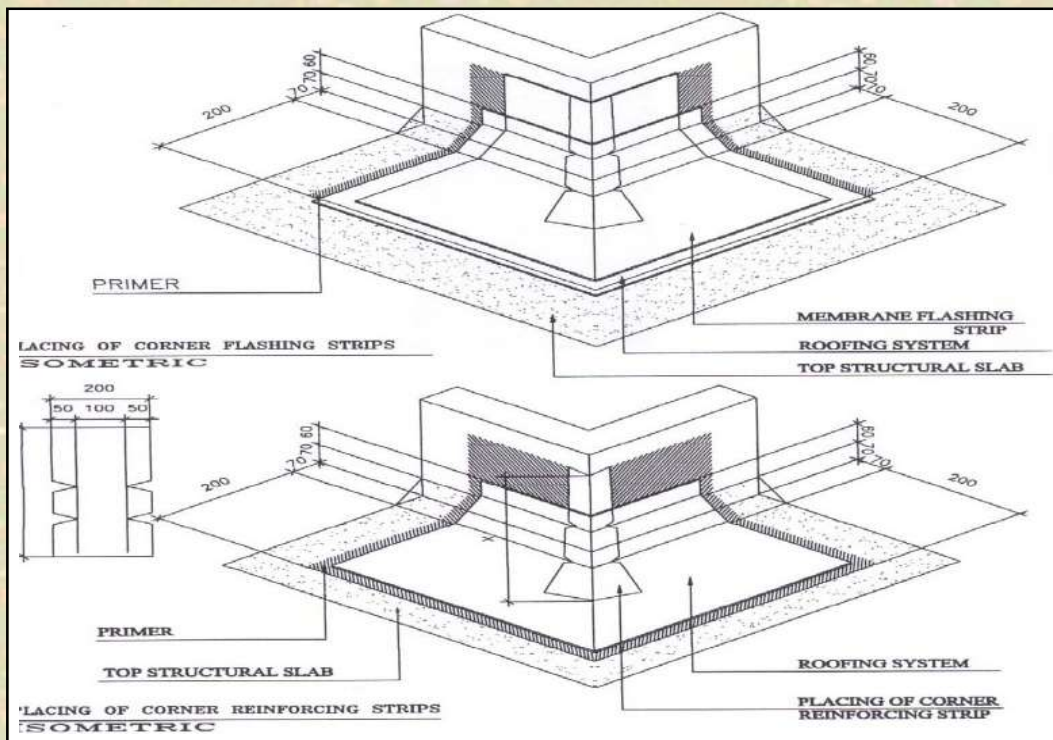


5b. PITCH POCKET FLASHING DETAILS

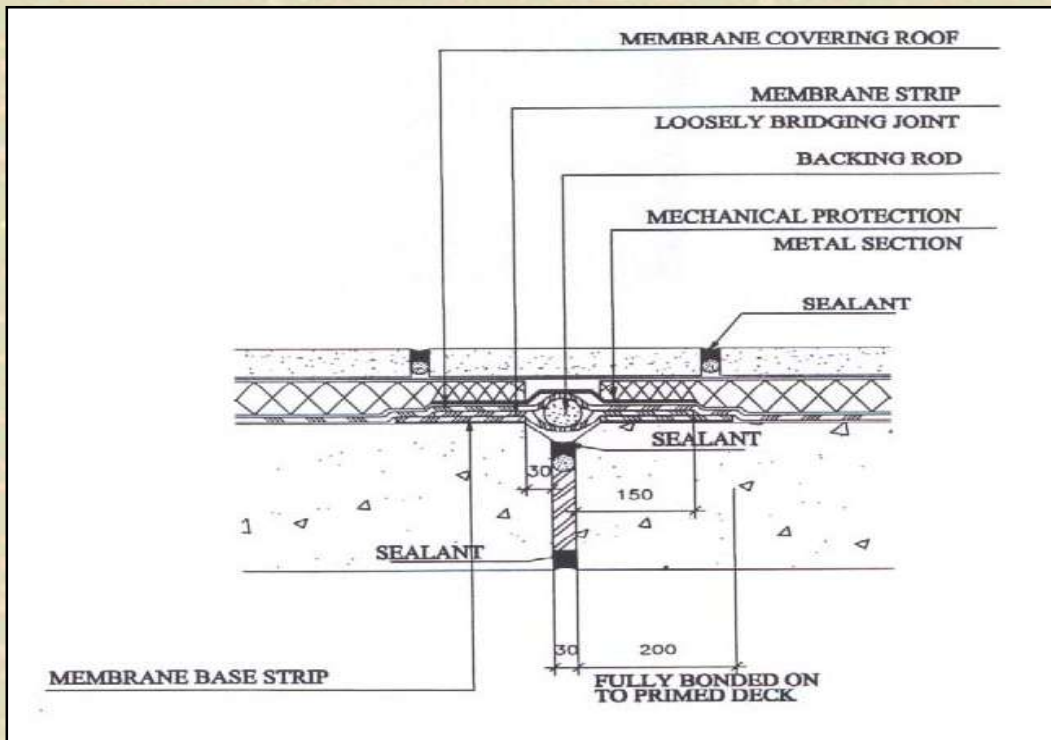
CONCRETE DECK



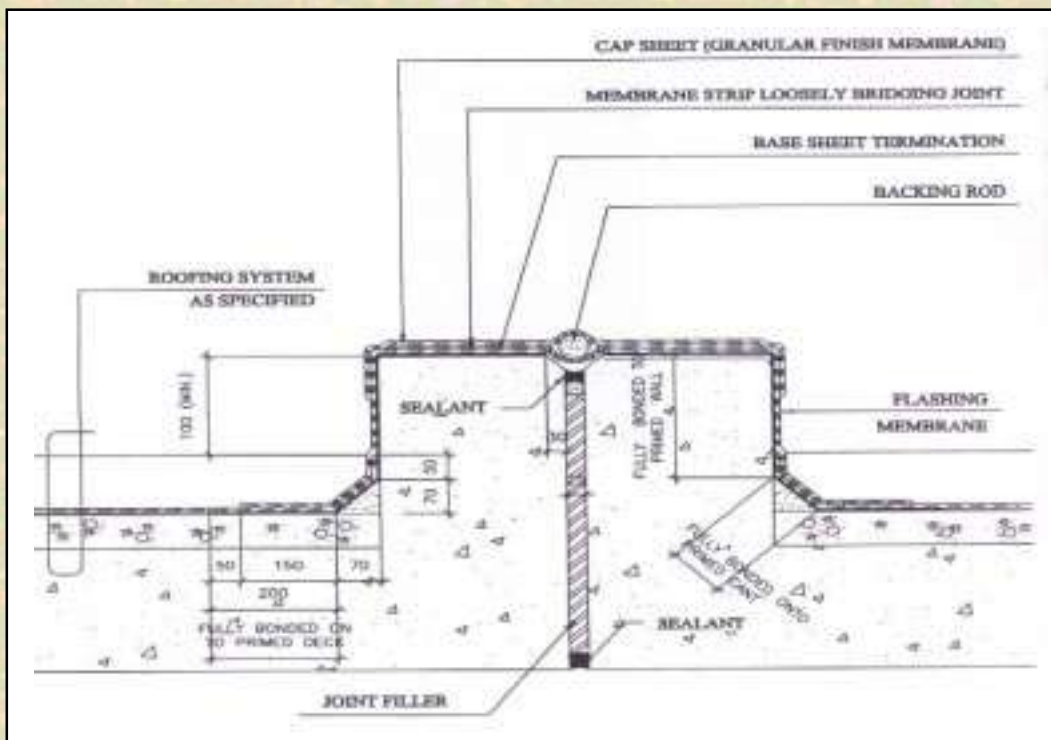
6. ROOFING OVER CONCRETE DECK INTERNAL CORNER TREATMENT



7. ROOFING OVER CONCRETE DECK EXTERNAL CORNER TREATMENT

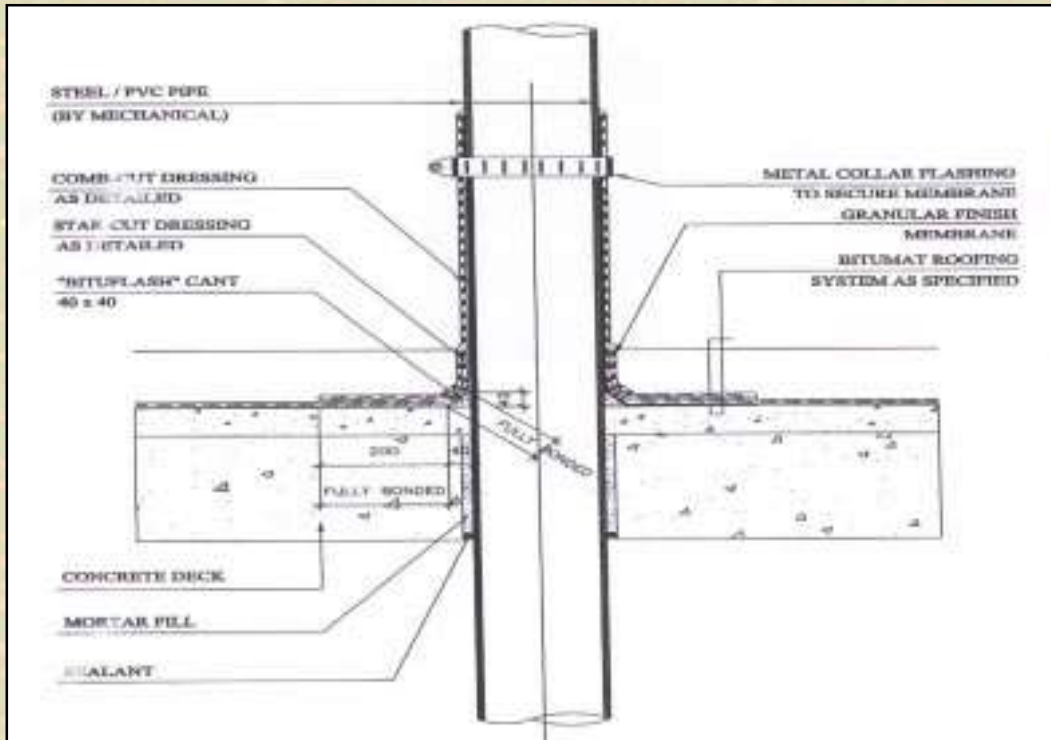


8. ROOFING OVER CONCRETE DECK FLAT EXPANSION JOINT

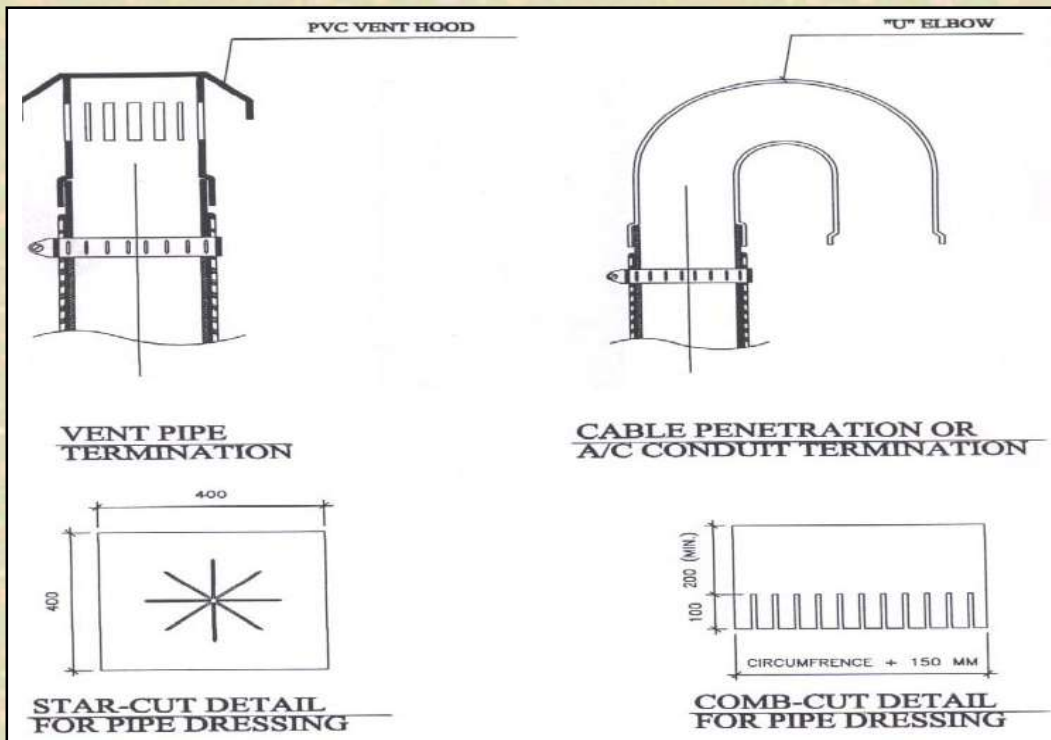


9. ROOFING OVER CONCRETE DECK EXPANSION JOINTS ON RIBS

PIPE PENETRATION

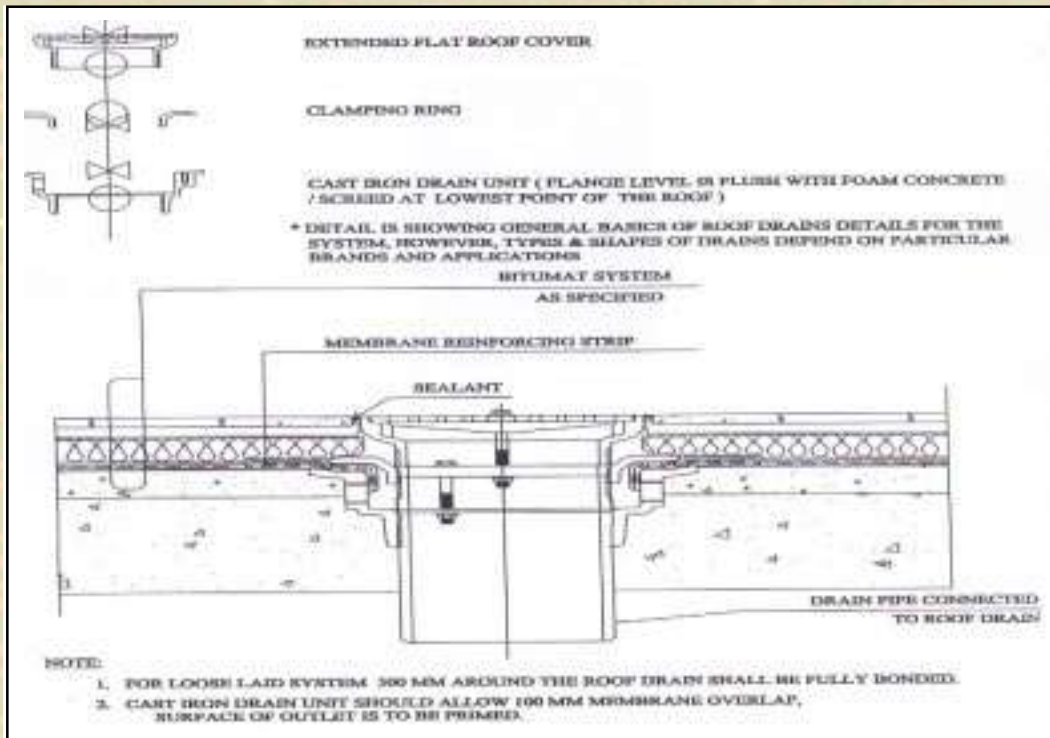


12. PIPE PENETRATION THRU CONCRETE DECK-TYPICAL

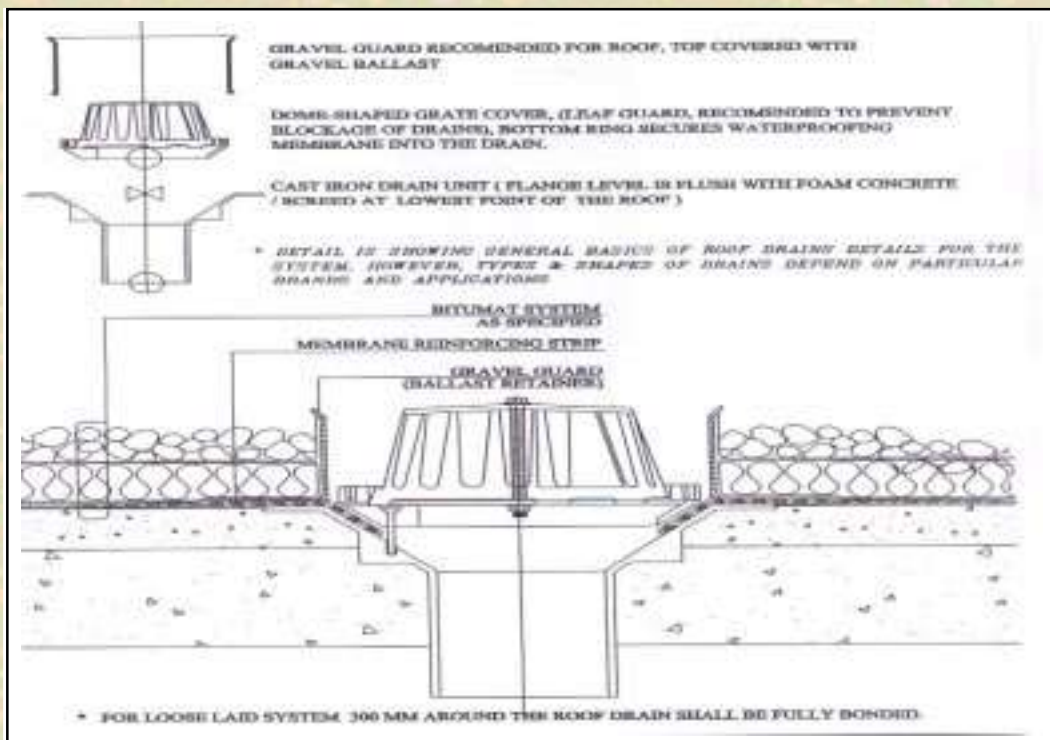


13. PIPE PENETRATION THRU CONCRETE DECK - DETAILS

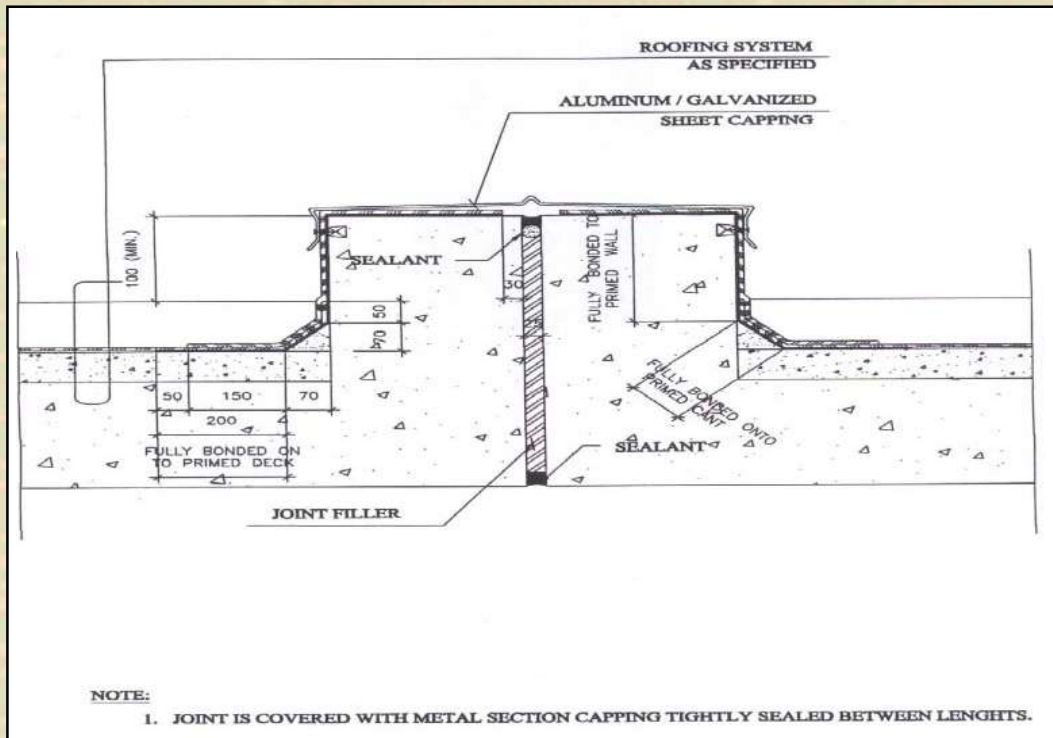
DRAIN DETAILS



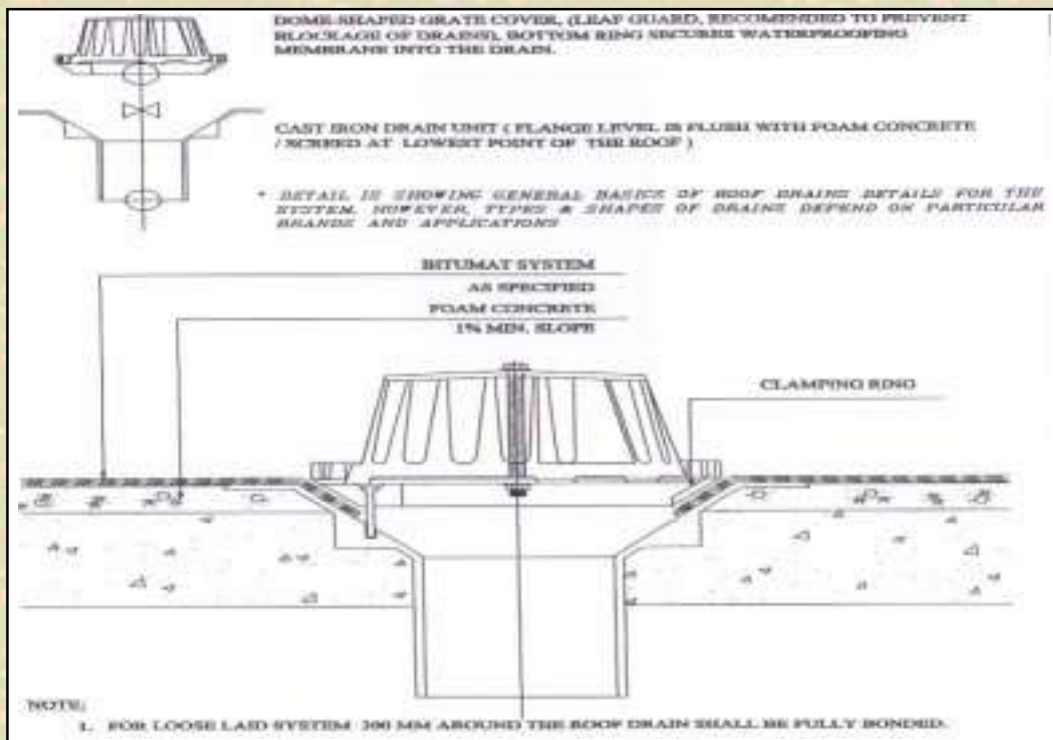
14. DRAIN DETAIL ACCESSIBLE / SERVICE ROOF



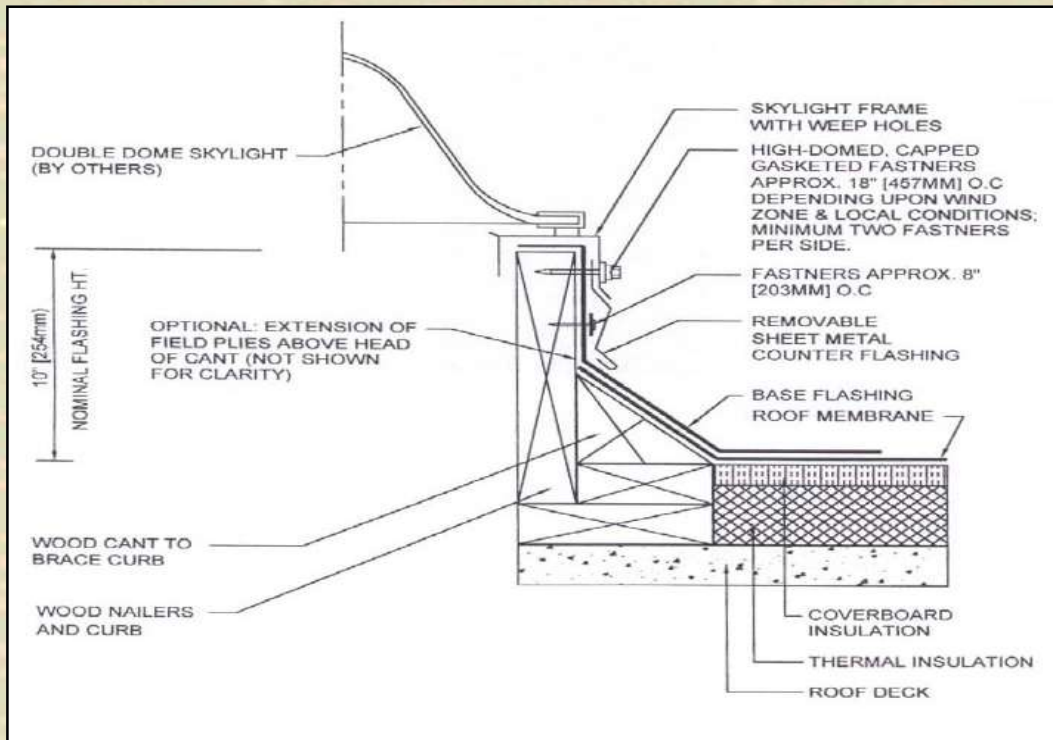
15. DRAIN DETAIL NON ACCESSIBLE ROOF



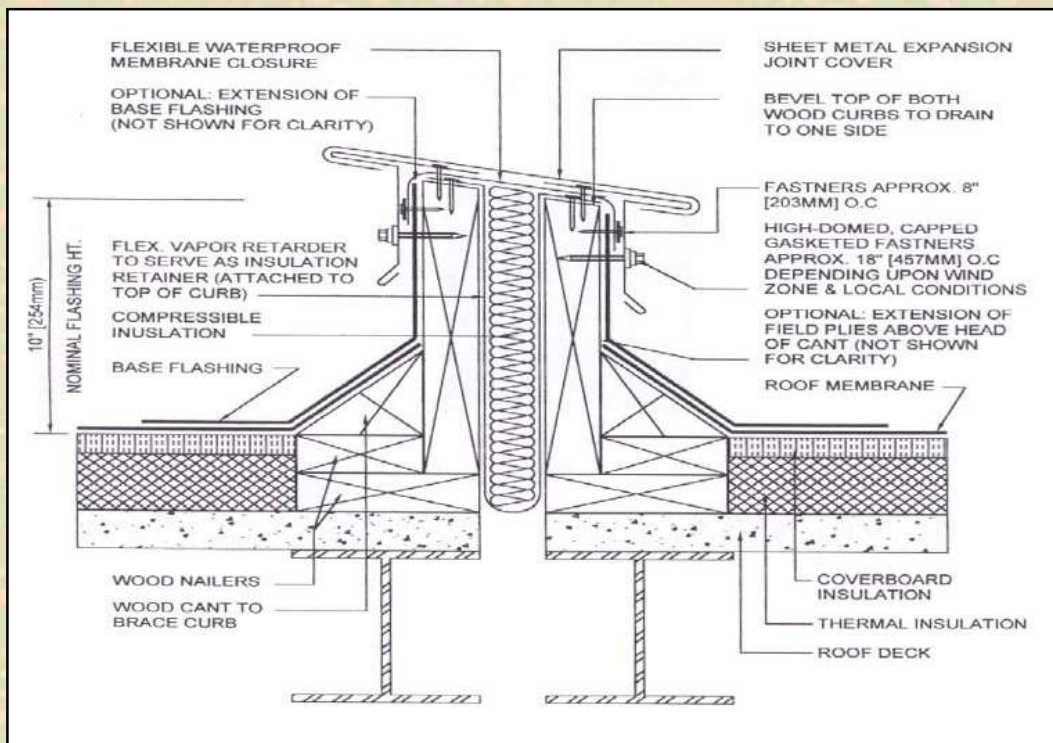
16. EXPANSION JOINTS WITH ALUMINIUM COVERING



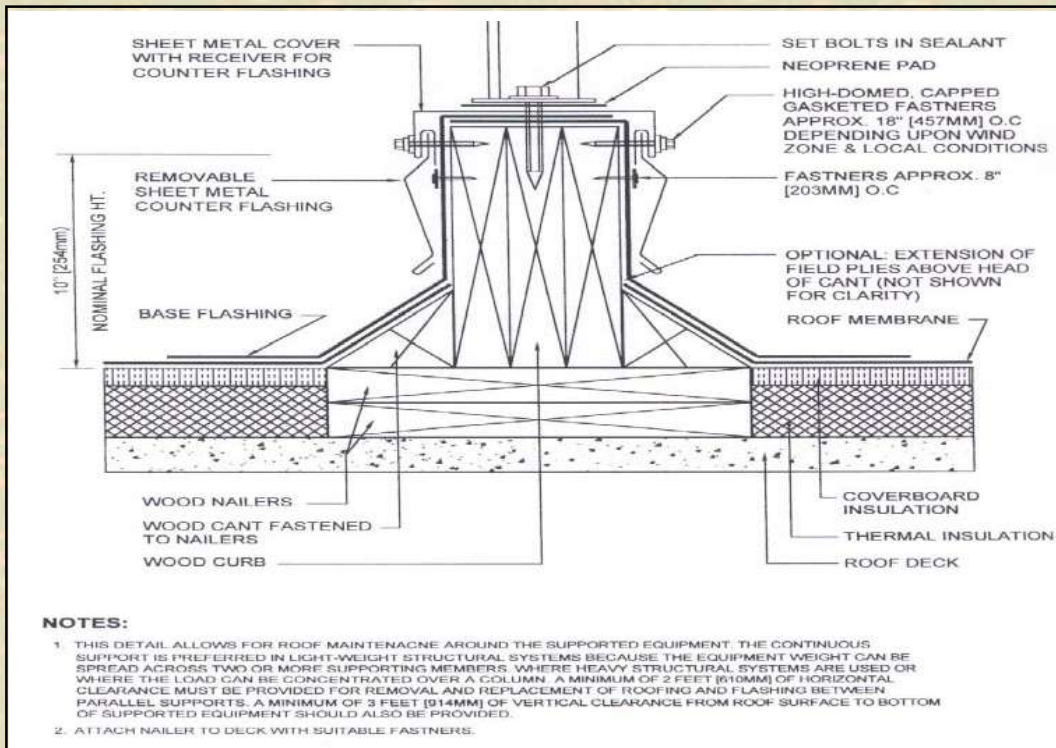
17. DRAIN DETAIL TWO LAYERS EXPOSED SYSTEM



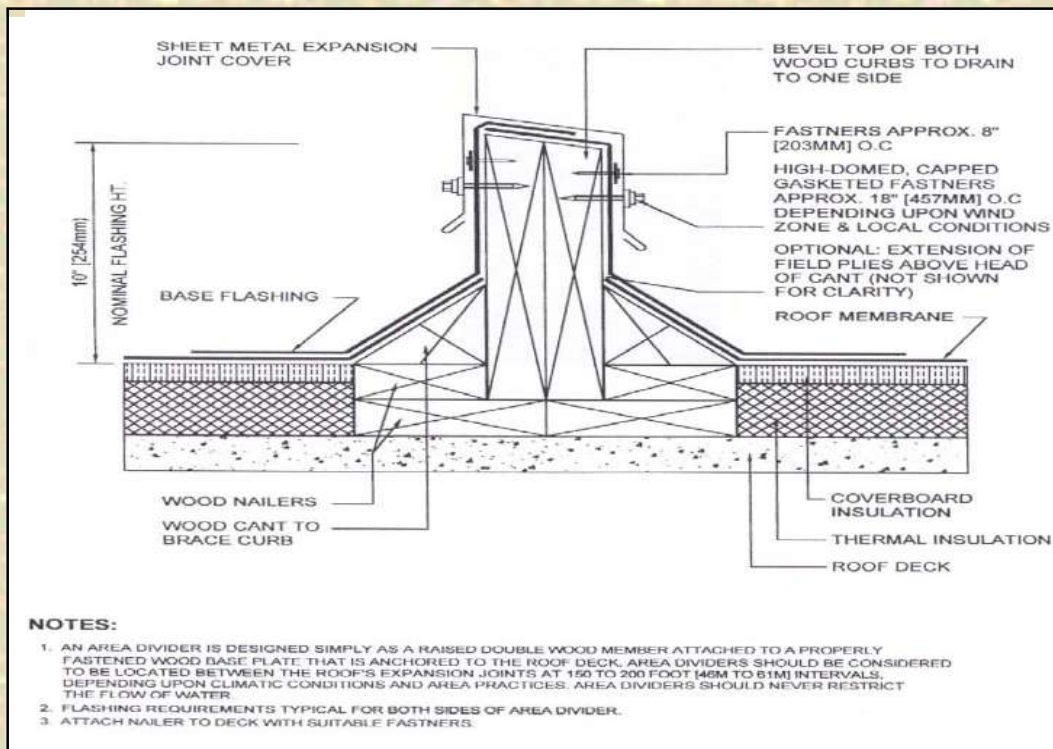
18. SKYLIGHT, SCUTTLE AND SMOKE VENT



19. EXPANSION JOINT WITH METAL COVER

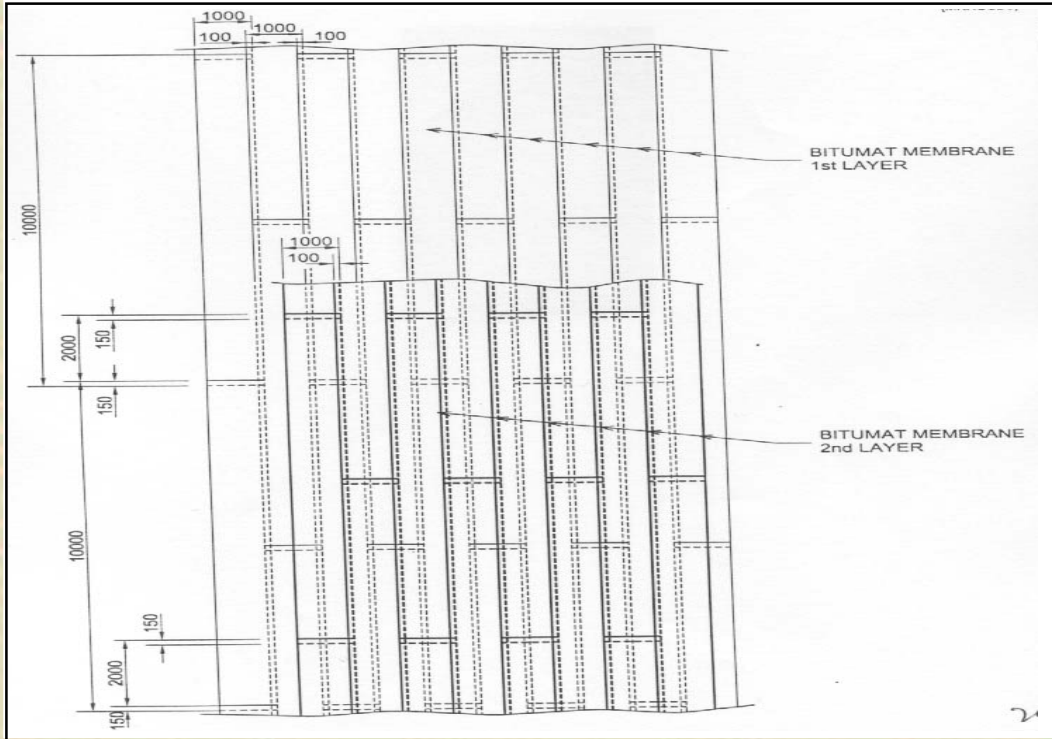


20. EQUIPMENT SUPPORT CURB

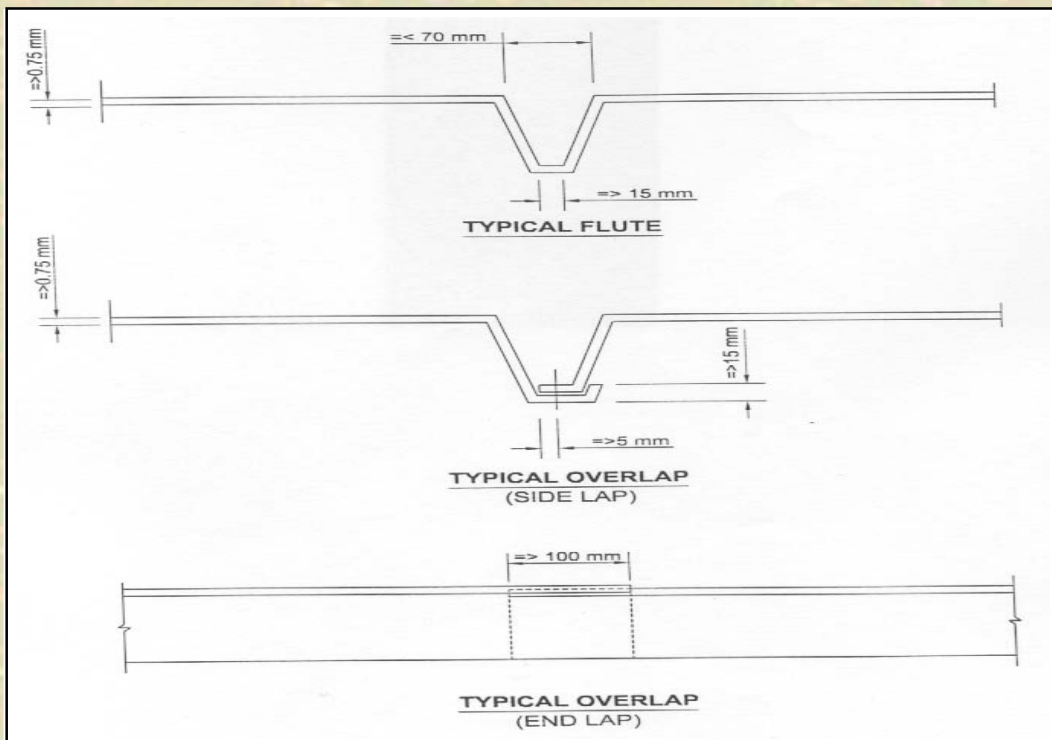


21. AREA DIVIDER IN ROOF SYSTEM

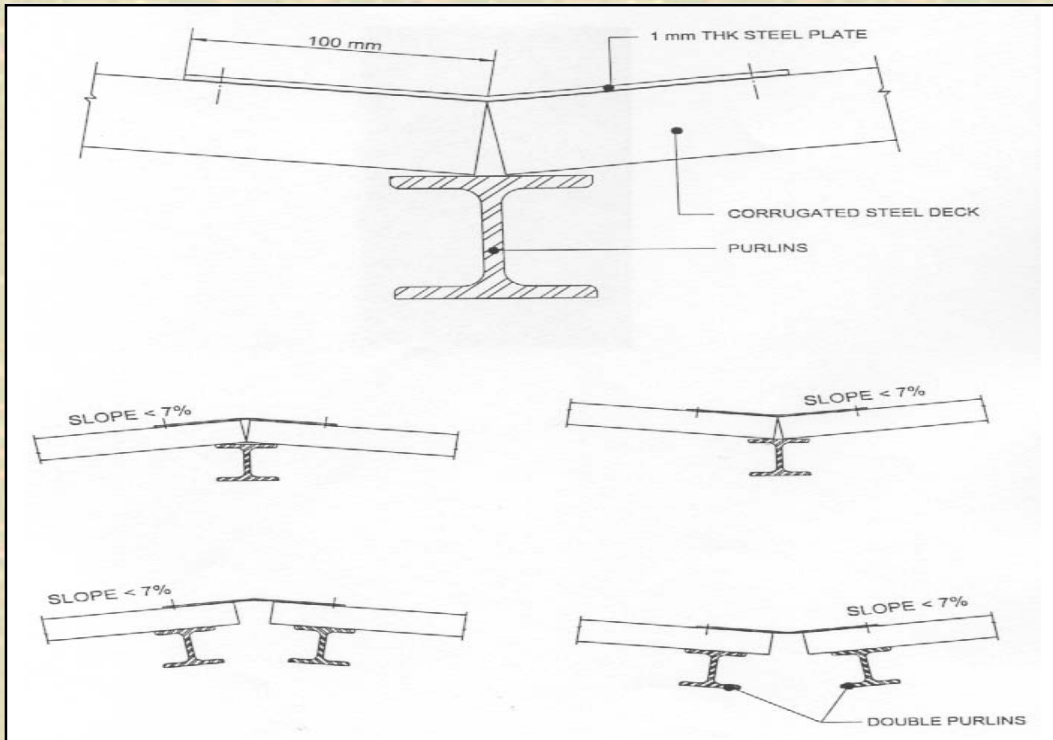
STEEL DECK



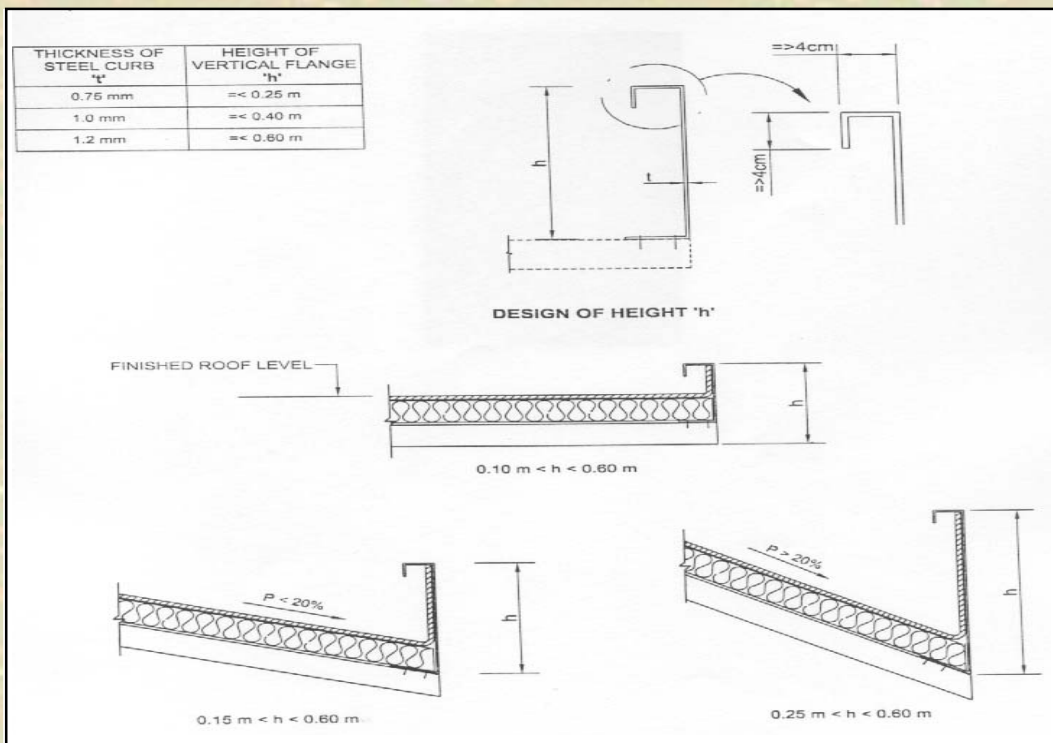
22. ROOFING OVER STEEL DECK TOP VIEW: TWO LAYERS SYSTEMS OVERLAPPING



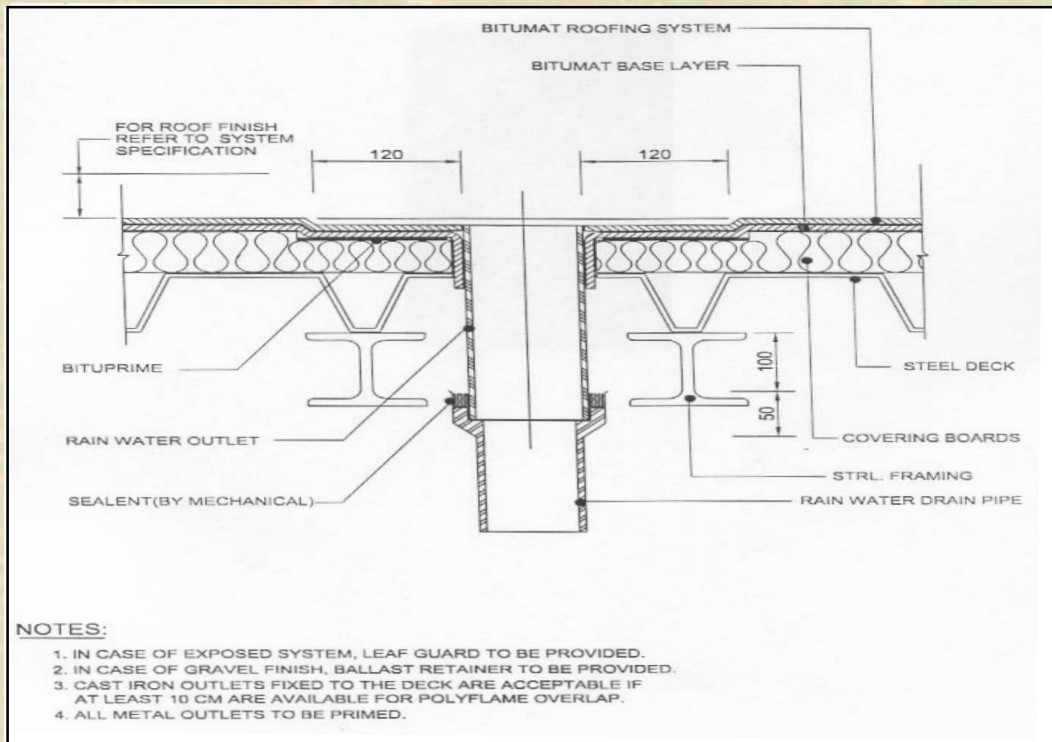
23. ROOFING OVER STEEL DECK CORRUGATED STEEL DECK DESIGN



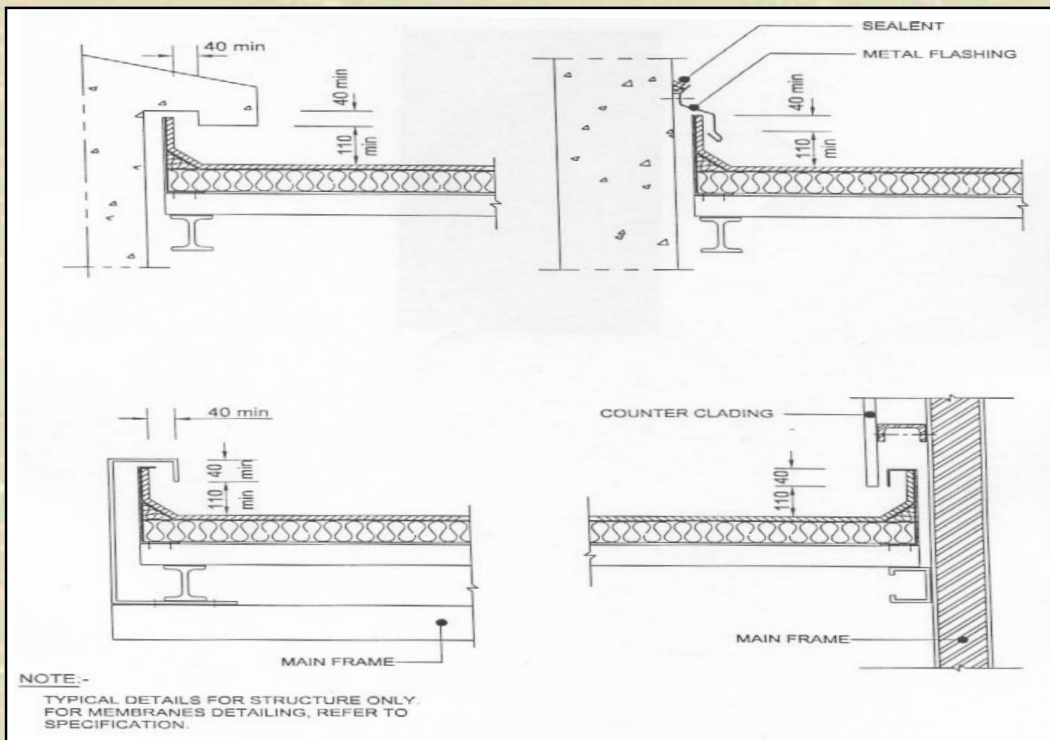
24. ROOFING OVER STEEL DECK RIDGES AND VALLEYS



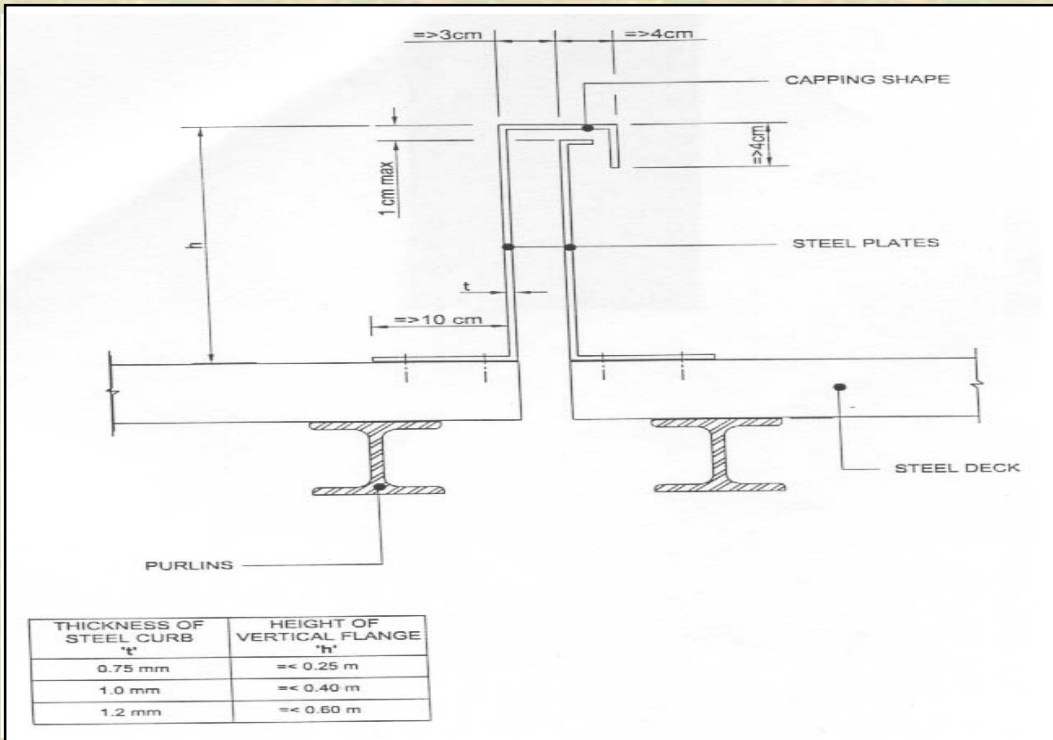
25. ROOFING OVER STEEL DECK DESIGN OF UPSTANDS STEEL CURBS



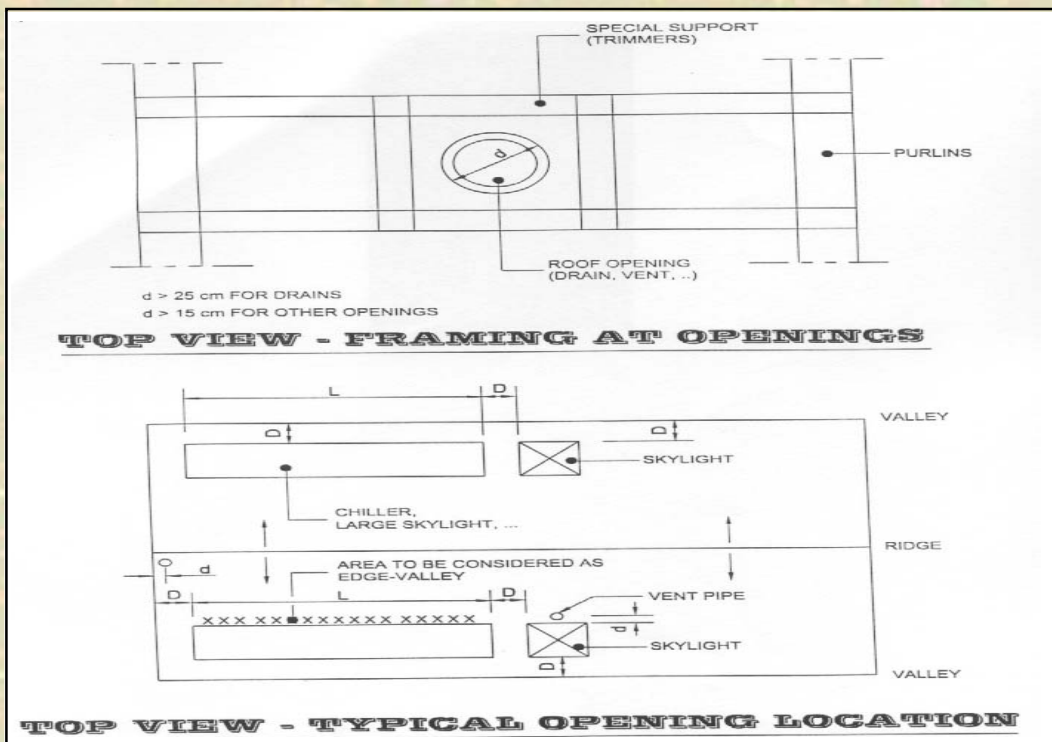
26. ROOFING OVER STEEL DECK RAIN WATER OUTLET



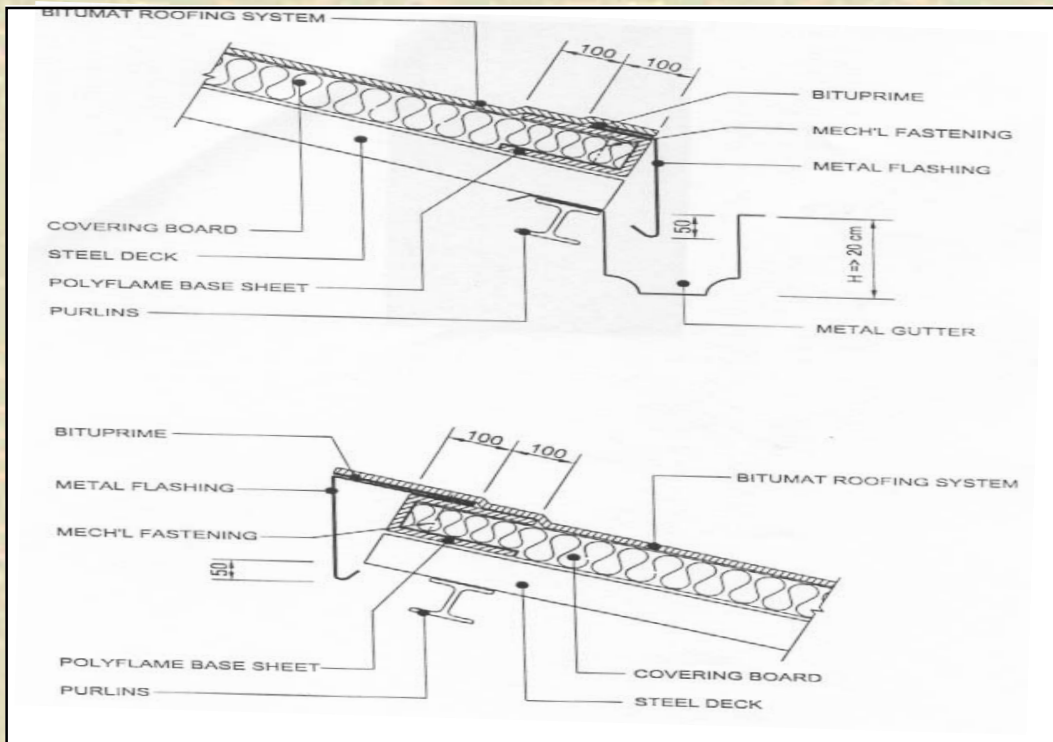
27. ROOFING OVER STEEL DECK COUNTER FLASHING / COUNTER CLADDING



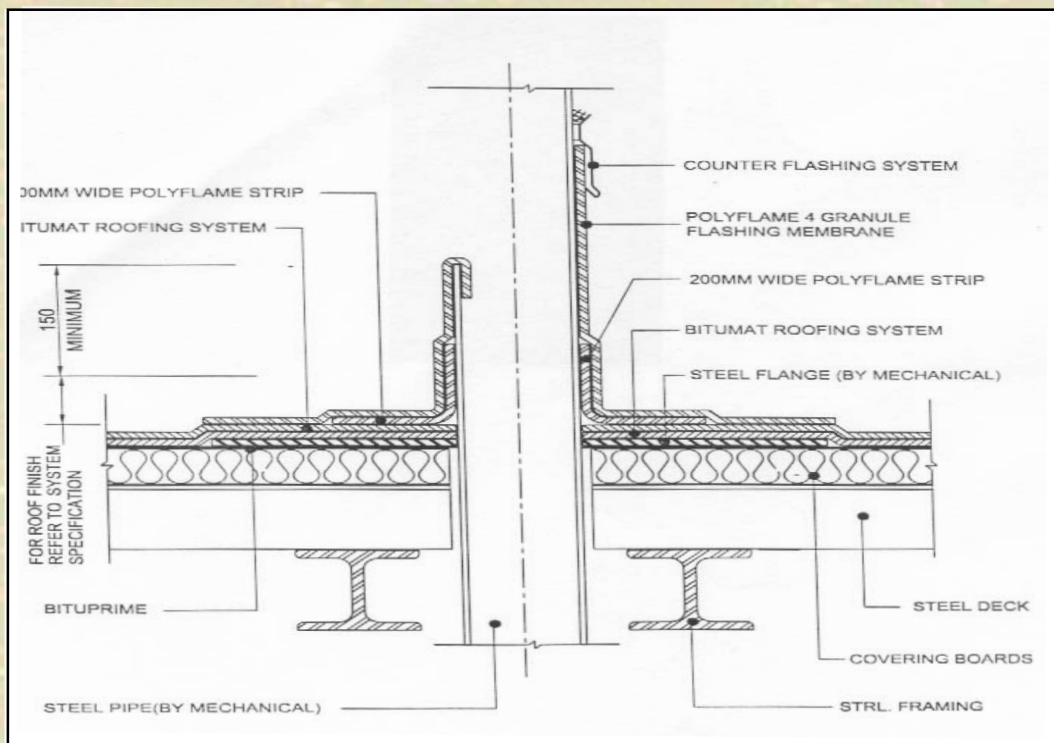
28. ROOFING OVER STEEL DECK EXPANSION JOINTS



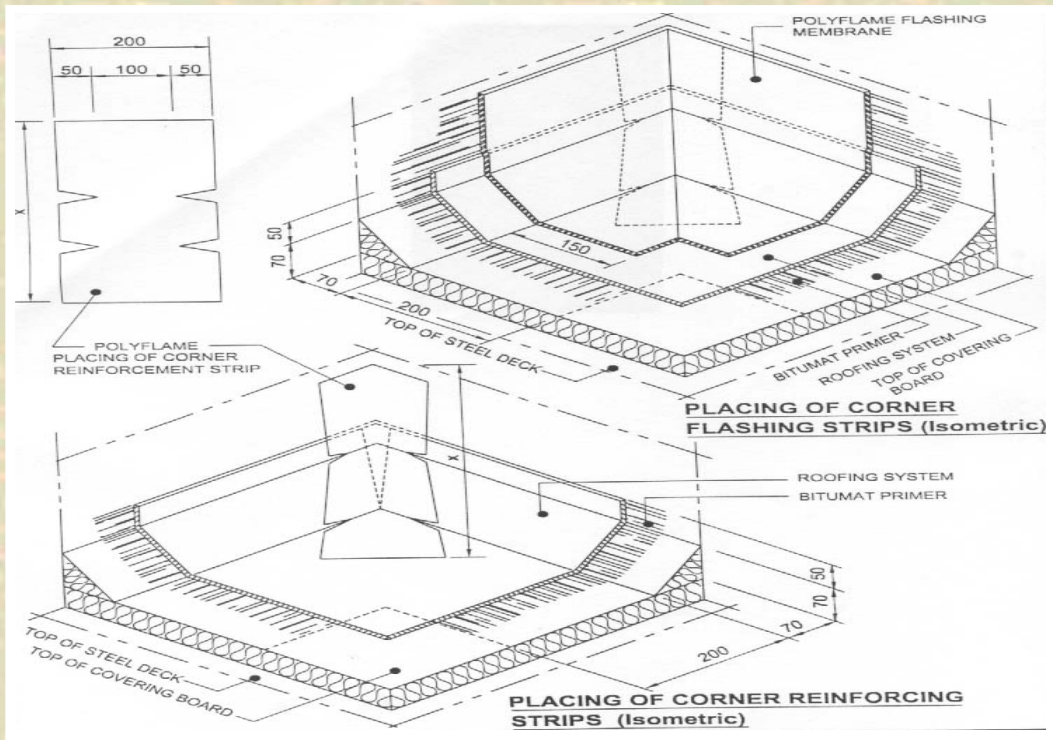
29. ROOFING OVER STEEL DECK ROOF OPENINGS



30. ROOFING OVER STEEL DECK EDGE FLASHING



31. ROOFING OVER STEEL DECK PIPE PENETRATION



32. ROOFING OVER STEEL DECK INTERNAL CORNER

DETAILS OF APPENDICES

Appendix B

DETAILS OF APPENDICES - APPENDIX B	Page 41
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SINGLE LAYER COVERED SYSTEM OVER CONCRETE DECK / NON-ACCESSIBLE ROOF Specification 112, No. 1	43
SINGLE LAYER COVERED SYSTEM OVER CONCRETE DECK / ACCESSIBLE ROOF Specification 112-A, No. 2	44
TWO LAYER EXPOSED SYSTEM OVER CONCRETE DECK / SLOPE FROM 1 TO 15% Specification 121, No. 3	45
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TWO LAYER EXPOSED SYSTEM OVER LIGHTWEIGHT FOAM CONCRETE SCREED Specification 221, No. 9	51
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TWO LAYER EXPOSED SYSTEM OVER STEEL DECK Specification 321, No.11	53
TWO LAYER COVERED SYSTEM OVER STEEL DECK Specification 322, No. 12	54

SPECIFICATION SHEET GUIDE

	DECK	LAYERS		COVERING	
		SINGLE	DOUBLE	EXPOSED	COVERED
Concrete	1	1	2	1	2
Foam Concrete	2	1	2	1	2
Metal Deck	3	1	2	1	2
Wood Deck	4	1	2	1	2

Eg: Specification No. 322 may be read as the first digit indicating the deck type, the second digit indicating the number of layers of waterproofing membrane and the last digit showing the covering. So, 322, may be read as metal deck, two layers and exposed system.

SINGLE LAYER COVERED SYSTEM

Over Concrete Deck / Non Accessible Roof

DECK:

The roofing system shall be installed on a dry, smooth and clean concrete deck with at least 1% positive slope to outlets.

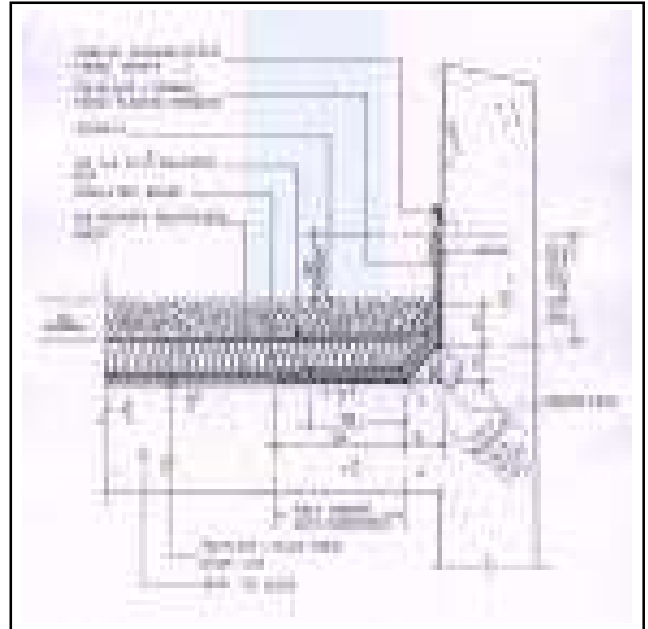
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * **Polyflame / Premierflex 4 black finish as roofing membrane**
 - * **Polyflame / Premierflex 4 granule finish as flashing membrane**
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION: (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A sand cement mortar cant strip, 7x7 cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, the can't strip and 20cm over the deck shall be primed.
- 3.) Starting at the low point of the roof, BITUMAT Polyflame shall be loose-laid over the deck, with 10cm side laps and 15cm staggered end laps fully torch welded and sealed. At all parapets and protrusions, BITUMAT Polyflame shall be fully torched welded 20cm over the deck, on cant and 5cm above cant. *(Refer to 28.3.2. of*



Bitumat Specification & Installation Manual)

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet wall.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 10cm above the top surface of the gravel and shall be protected by an adequate counterflashing system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

TOP COVERING:

- 1.) Install the separation layer and the insulation boards loose-laid. (If insulation is specified).
- 2.) Install the filter layer and a bed of gravel. (As specified)

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

SINGLE LAYER COVERED SYSTEM

Over Concrete Deck / Accessible Roof

DECK:

The roofing system shall be installed on a dry, smooth and clean concrete deck with at least 1% positive slope to outlets.

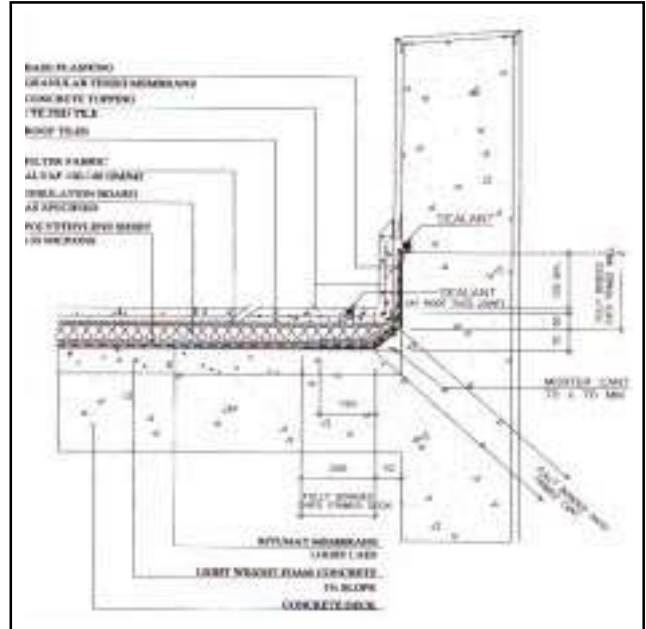
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * **Polyflame / Premierflex 4 black finish as roofing membrane**
 - * **Polyflame / Premierflex 4 granule finish as flashing membrane**
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION: (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A sand cement mortar cant strip, 7x7 cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, the can't strip and 20cm over the deck shall be primed.
- 3.) Starting at the low point of the roof, BITUMAT Polyflame shall be loose-laid over the deck, with 10cm side laps and 15cm staggered end laps fully torch welded and seamed. At all parapets and protrusions, BITUMAT Polyflame shall be fully torched welded 20cm over the deck, on cant and 5cm above cant. *(Refer to 28.3.2. of*



Bitumat Specification & Installation Manual)

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet wall.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 10cm above the top surface of the roof and shall be protected by an adequate counterflashing system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

TOP COVERING:

- 1.) Install the separation layer and the insulation boards loose-laid. (If insulation is specified).
- 2.) Install the filter layer and the top covering as specified.
- 3.) Flashing membrane shall be mechanically protected (Curb stone, reinforced plastering, tiles on mortar, ...)

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

TWO LAYER EXPOSED SYSTEM

Over Concrete Deck / Slope from 1 to 15%

DECK:

The roofing system shall be installed on a dry, smooth and clean concrete screed with a positive slope to outlets (Maximum 15%)

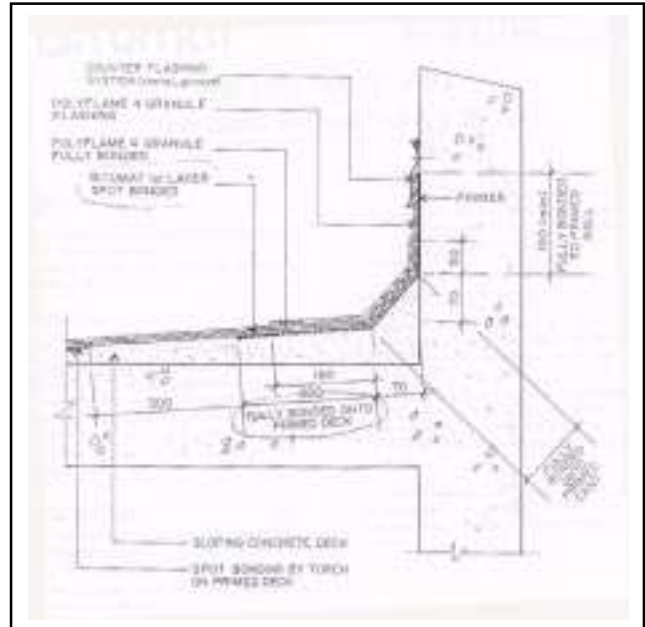
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * **Polyflame / Premierflex 4 black finish as roofing membrane**
 - * **Polyflame / Premierflex 4 granule finish as flashing membrane and as the top layer.**
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION: (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A sand cement mortar cant strip, 7x7 cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, cant strip and the entire deck shall be primed.
- 3.) Bitumat first layer membrane shall be applied over the deck with 10cm side laps and 15cm staggered end laps fully torch welded and seamed. While unrolling BITUMAT first layer, spots of bonding shall be created by spot torching the membrane. Spots shall be at 50cm center, and approximately 20cm wide. At all parapets and protrusions BITUMAT first layer shall be fully bonded



20cm over the primed deck and over the primed cant. Starting at the low point of the roof, BITUMAT Polyflame 4 granule second layer shall be fully torch welded over the first layer with 10cm side laps and 15cm staggered end laps. At all parapets and protrusions, BITUMAT Polyflame 4 granule second layer shall be extended fully bonded 5cm above the cant strip. First and second layer side laps shall be staggered or crossed. (Refer to 28.3.2. of Bitumat Specification & Installation Manual)

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet wall.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 10cm above the top surface of the roof and shall be protected by an adequate counterflashing system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

TWO LAYER EXPOSED SYSTEM

Over Concrete Deck / Slope from 15 to 30%

DECK:

The roofing system shall be installed on a dry, smooth and clean concrete screed with a positive slope to outlets (Maximum 30%)

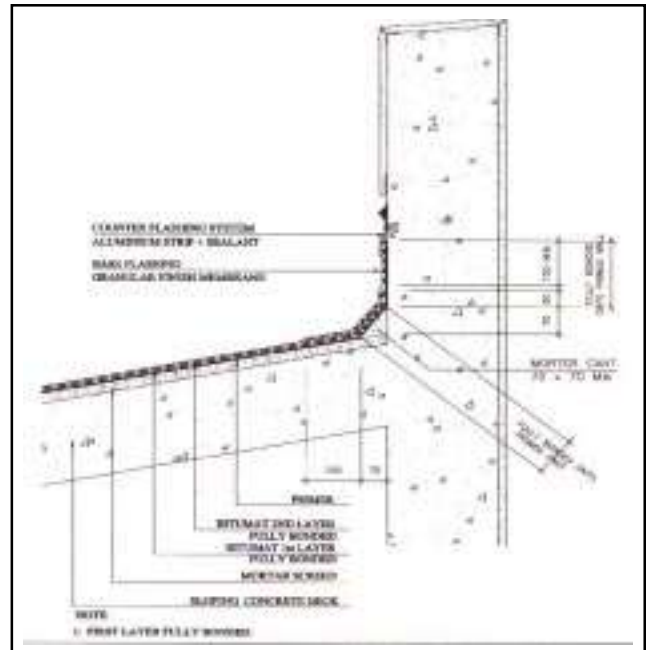
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * Polyflame / Premierflex 4 black finish as roofing membrane
 - * Polyflame / Premierflex 4 granule finish as flashing membrane and as the top layer.
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION: (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A sand cement mortar cant strip, 7x7 cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, cant strip and the entire deck shall be primed.
- 3.) Bitumat first layer membrane shall be fully torch welded onto the deck with 10cm side laps and 15cm staggered end laps fully torch welded and seamed. At all parapets and protrusions BITUMAT first layer shall be extended over the primed cant. *(Refer to 28.3.2. of Bitumat Specification & Installation Manual).*



- 4.) Starting at the low point of the roof, BITUMAT Polyflame 4 granule second layer shall be fully torch welded over the first layer with 10cm side laps and 15cm staggered end laps. At all parapets and protrusions, BITUMAT Polyflame 4 granule second layer shall be extended fully bonded 5cm above the cant strip. First and second layer side laps shall be staggered or crossed.

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet wall.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 10cm above the top surface of the roof and shall be protected by an adequate counterflashing system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual.**

TWO LAYER EXPOSED SYSTEM

Over Concrete Deck / Slope over 30%

DECK:

The roofing system shall be installed on a dry, smooth and clean lightweight foam concrete screed with a minimum 30% slope outlets.

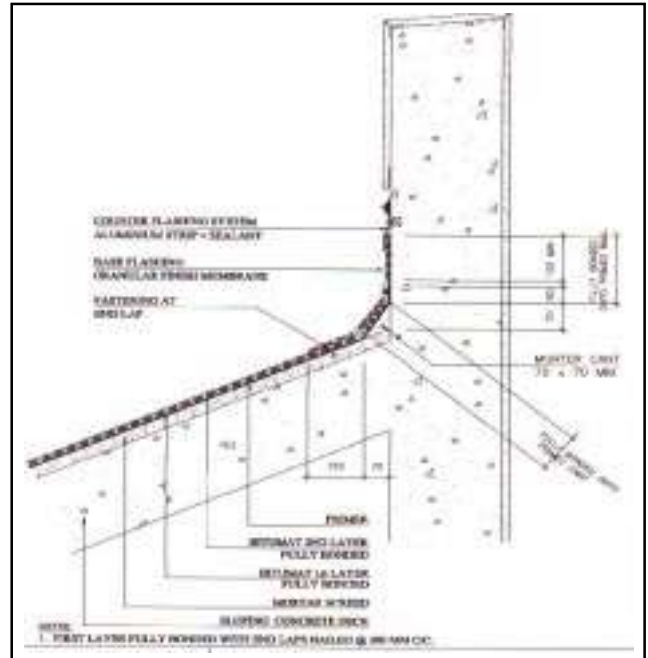
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * **Polyflame / Premierflex 4 black finish as roofing membrane**
 - * **Polyflame / Premierflex 4 granule finish as flashing membrane and as the top layer.**
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION: (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A sand cement mortar cant strip, 7x7 cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, cant strip and the entire deck shall be primed.
- 3.) Bitumat first layer membrane shall be fully torch welded onto the deck with 10cm side laps and 15cm staggered end laps fully torch welded and seamed. At all parapets and protrusions BITUMAT first layer shall be extended over the primed cant. *(Refer to 28.3.2. of Bitumat Specification & Installation Manual)*
- 4.) BITUMAT first layer membrane shall be secured at all end laps with approved roofing nails fastened at 30cm



center. Starting at the low point of the roof, BITUMAT Polyflame 4 granule second layer shall be fully torch welded over the first layer with 10cm side laps and 15cm staggered end laps. At all parapets and protrusions, BITUMAT Polyflame 4 granule second layer shall be extended fully bonded 5cm above the cant strip. First and second layer side laps shall be staggered or crossed.

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet wall.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 10cm above the top surface of the roof and shall be protected by an adequate counterflashing system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

TWO LAYER COVERED SYSTEM

Over Concrete Deck / Service Roof

DECK:

The roofing system shall be installed on a dry, smooth and clean concrete deck without negative slope.

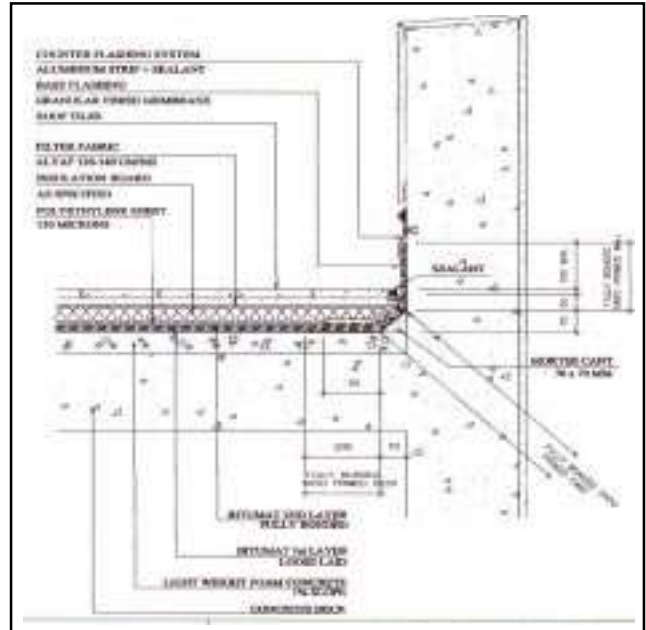
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * Polyflame / Premierflex 4 black finish as roofing membrane
 - * Polyflame / Premierflex 4 granule finish as flashing membrane
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION: (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A sand cement mortar cant strip, 7x7 cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, cant strip and 20cm over the deck shall be primed.
- 3.) Starting at the low point of the roof, BITUMAT first layer shall be loose-laid over the deck, with 10cm side laps and 15cm staggered end laps fully torch welded and seamed. At all parapets and protrusions, BITUMAT first layer shall be fully bonded 20cm over the primed cant. (Refer to 28.3.2. of Bitumat Specification & Installation Manual)


FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet wall.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 10cm above the top surface of the roof and shall be protected by an adequate counterflashing system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

TOP COVERING:

- 1.) Install the separation layer and the insulation boards loose-laid (if insulation is specified)
- 2.) Install the filter layer and the top covering as specified.

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

TWO LAYER COVERED SYSTEM

Over Concrete Deck / Non Accessible Roof

DECK:

The roofing system shall be installed on a dry, smooth and clean concrete deck without negative slope.

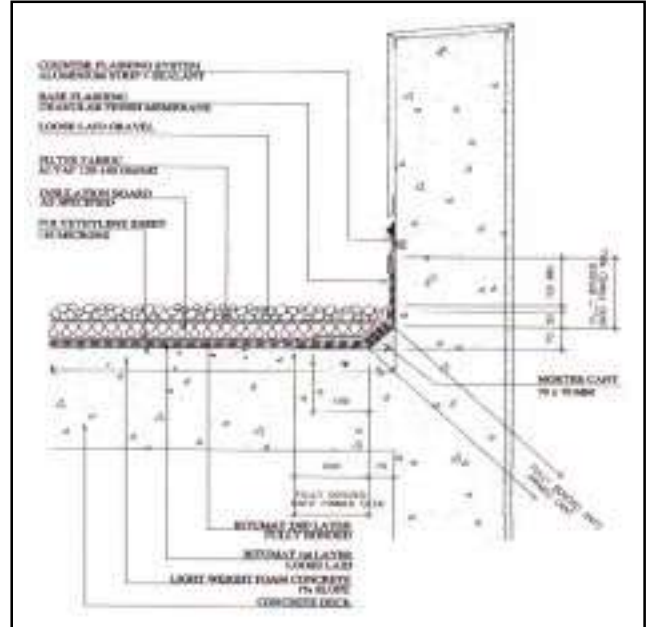
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * Polyflame / Premierflex 4 black finish as roofing membrane
 - * Polyflame / Premierflex 4 granule finish as flashing membrane
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION: (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A sand cement mortar cant strip, 7x7 cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, cant strip and 20cm over the deck shall be primed.
- 3.) Starting at the low point of the roof, BITUMAT Polyflame shall be loose-laid over the deck, with 10cm side laps and 15cm staggered end laps fully torch welded and seamed. At all parapets and protrusions, BITUMAT first layer shall be fully bonded 20cm over the primed deck and over the primed cant. *(Refer to 28.3.2. of Bitumat Specification & Installation Manual)*
- 4.) BITUMAT Polyflame second layer shall be fully torch welded onto first layer with 10cm side laps and 15cm



staggered end laps. Side laps of first and second layer shall be staggered. At parapets and protrusions, BITUMAT Polyflame 2nd layer shall be extended fully bonded 5cm above the cant on the primed parapet.

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet wall.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 10cm above the top surface of the gravel and shall be protected by an adequate counterflashing system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

TOP COVERING:

- 1.) Install the separation layer and the insulation boards loose-laid. (If insulation is specified).
- 2.) Install the filter layer and a bed of gravel (As specified).

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

TWO LAYER COVERED SYSTEM

Over Concrete Deck / Accessible Roof

DECK:

The roofing system shall be installed on a dry, smooth and clean concrete deck without negative slope.

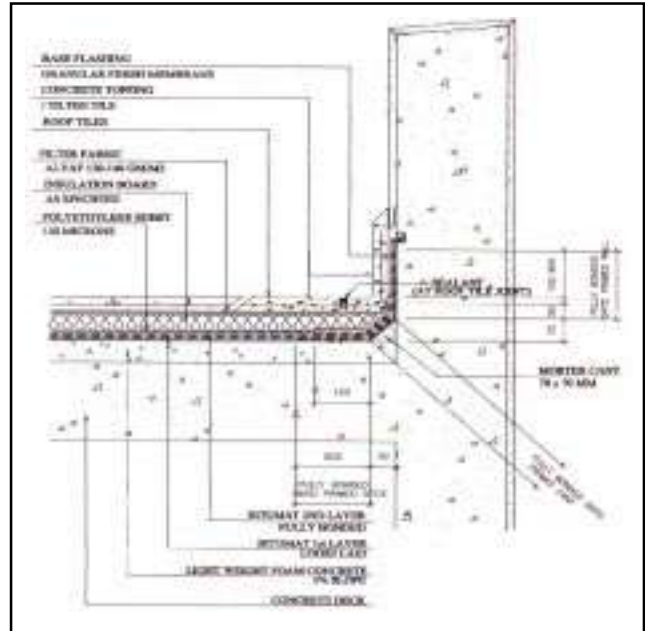
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * **Polyflame / Premierflex 4 black finish as roofing membrane**
 - * **Polyflame / Premierflex 4 granule finish as flashing membrane**
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION: (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A sand cement mortar cant strip, 7x7 cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, the can't strip and 20cm over the deck shall be primed.
- 3.) Starting at the low point of the roof, BITUMAT Polyflame shall be loose-laid over the deck, with 10cm side laps and 15cm staggered end laps fully torch welded and seamed. At all parapets and protrusions, BITUMAT first layer shall be fully bonded 20cm over the primed deck and over the primed cant. *(Refer to 28.3.2. of Bitumat Specification & Installation Manual)*
- 4.) BITUMAT Polyflame second layer shall be fully torch welded onto first layer with 10cm side laps and 15cm



staggered end laps. Side laps of first and second layer shall be staggered. At parapets and protrusions, BITUMAT Polyflame 2nd layer shall be extended fully bonded 5cm above the cant on the primed parapet.

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet wall.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 10cm above the top surface of the roof and shall be protected by an adequate counterflashing system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

TOP COVERING:

- 1.) Install the separation layer and the insulation boards loose-laid. (If insulation is specified).
- 2.) Install the filter layer and the top covering as specified.
- 3.) Flashing membrane shall be mechanically protected (Curb stone, reinforced plastering, tiles on mortar,...)

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

TWO LAYER EXPOSED SYSTEM

Over Lightweight Foam Concrete Screed

DECK:

The roofing system shall be installed on a dry, smooth and clean concrete deck with at least 1% positive slope to outlets.

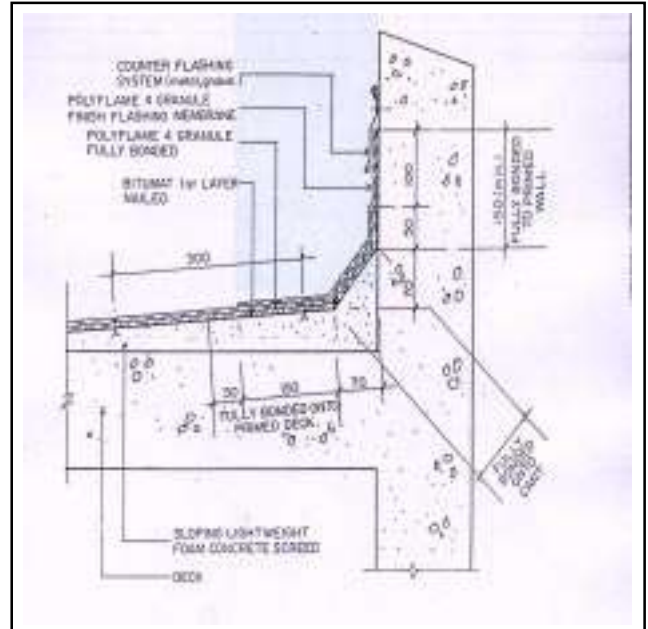
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * **Polyflame / Premierflex 4 black finish as roofing membrane**
 - * **Polyflame / Premierflex 4 granule finish as flashing membrane**
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION: (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A sand cement mortar cant strip, 7x7 cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, can't strip and 20cm over the deck shall be primed.
- 3.) Starting at the low point of the roof, BITUMAT Polyflame shall be loose-laid over the deck, with 10cm side laps and 15cm staggered end laps fully torch welded and seamed. At all parapets and protrusions, BITUMAT Polyflame shall be fully torch welded 20cm over the deck, on cant and 5cm above cant. *(Refer to 28.3.2. of Bitumat Specification & Installation Manual)*


FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet wall.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 10cm above the top surface of the roof and shall be protected by an adequate counterflashing system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

TOP COVERING:

- 1.) Install the separation layer and the insulation boards loose-laid (if insulation is specified)
- 2.) Install the filter layer and the top covering as specified.
- 3.) Flashing membrane shall be mechanically protected (Curb stone, reinforced plastering, tiles on mortar....)

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

SINGLE LAYER COVERED SYSTEM

Over Steel Deck

DECK:

The corrugated steel sheets shall be properly attached to the main structural framing as per specification.... A positive slope to drain must exist. The steel deck shall be covered with covering / or insulation boards mechanically fastened to the steel deck as per specification ...The board surface shall be clean, dry, smooth and properly levelled.

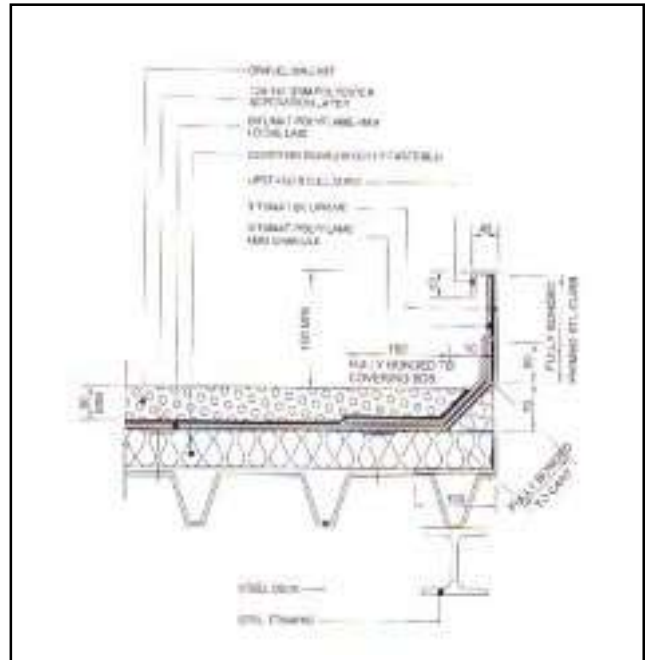
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * **Polyflame / Premierflex 4 black finish as roofing membrane**
 - * **Polyflame / Premierflex 4 granule finish as flashing membrane**
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION : (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A fiber or insulation cant strip, 7x7cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, the cant strip and 20cm over the board shall be primed.
- 3.) Starting at the low point of the roof, BITUMAT Polyflame shall be loose-laid over the deck, with 10cm side laps and 15cm staggered end laps fully torch welded and seamed. At all parapets and protrusions, BITUMAT



Polyflame shall be fully torch welded 20cm over the boards, on cant and 5cm above cant. (Refer to 28.3.2. of Bitumat Specification & Installation Manual)

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet steel curb.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 15cm above the top surface of the gravel and shall be protected by an adequate counterflashing or countercladding system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

TOP COVERING:

- 1.) Install the separation layer and the insulation boards loose-laid (If insulation to be specified).
- 2.) Install the filter layer and a bed of gravel (As specified).

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

TWO LAYERS EXPOSED SYSTEM Over Steel Deck

DECK:

The corrugated steel sheets shall be properly attached to the main structural framing as per specification.... A positive slope to drain must exist. The steel deck shall be covered with covering / or insulation boards mechanically fastened to the steel deck as per specification ...The board surface shall be clean, dry, smooth and properly levelled and of a torchable surface grade.

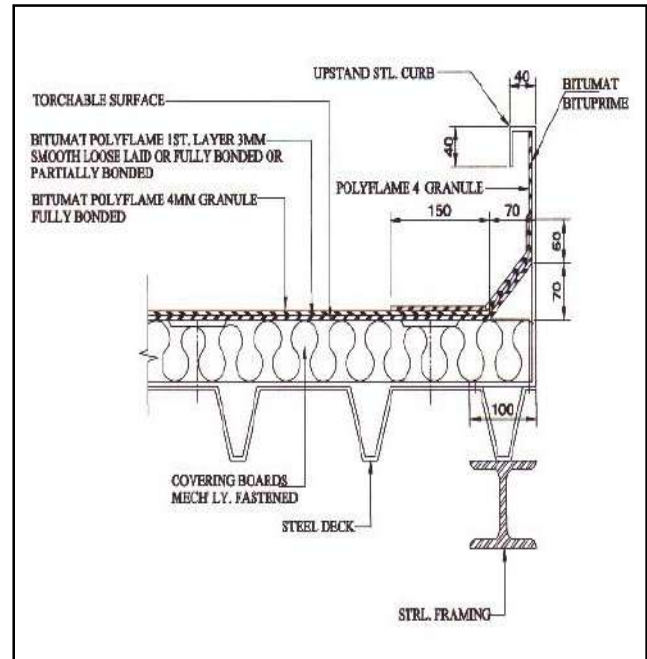
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * **Polyflame / Premierflex 4 black finish as roofing membrane**
 - * **Polyflame 4 / Premierflex granule finish as flashing membrane**
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION : (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A fiber or insulation cant strip, 7x7cm, shall be provided at all parapets and protrusions.
- 2.) The parapets, the cant strip shall be primed.
- 3.) BITUMAT first layer membrane shall be fully torch welded onto first layer with 10cm side laps and 15cm staggered end laps fully torch welded and seamed /



nailed. At all parapets and protrusions BITUMAT first layer shall be extended over the primed cant. (Refer to 28.3.2. of Bitumat Specification & Installation Manual)

4.) Starting at the low point of the roof, BITUMAT Polyflame 4 granule second layer shall be fully torch welded over the first layer with 10cm side laps and 15cm staggered end laps. At all parapets and protrusions, BITUMAT Polyflame 4 granule second layer shall be extended fully bonded 5cm above the cant strip. First and second layer side laps shall be staggered or crossed

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet steel curb.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 15cm above the top surface of the gravel and shall be protected by an adequate counterflashing or countercladding system. (For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.

TWO LAYERS COVERED SYSTEM Over Steel Deck

DECK:

The corrugated steel sheets shall be properly attached to the main structural framing as per specification.... A positive slope to drain must exist. The steel deck shall be covered with a wood panel or insulation boards mechanically fastened to the steel deck as per specification ...The board surface shall be clean, dry, smooth and properly levelled.

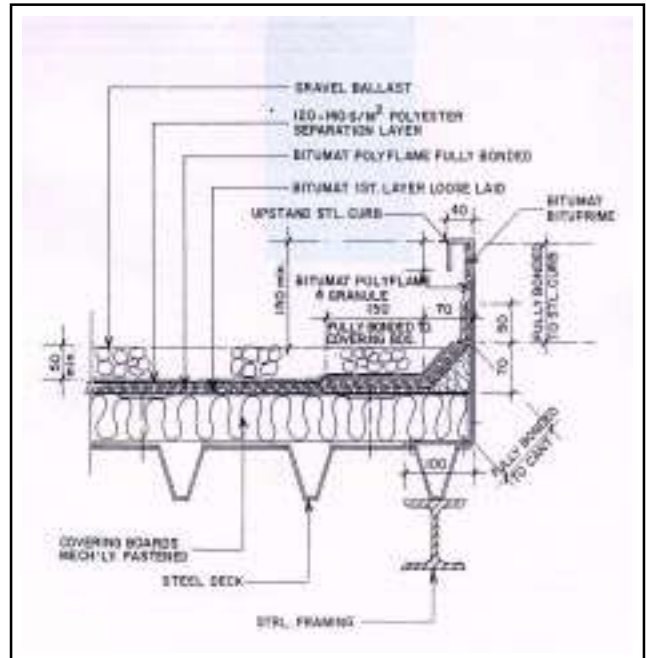
MATERIALS:

The roofing materials shall be:

- 1.) **BITUMAT Polyflame / Premierflex**
 - * **Polyflame / Premierflex 4 black finish as roofing membrane**
 - * **Polyflame 4 / Premierflex granule finish as flashing membrane**
- 2.) **BITUMAT Bituprime Primer**, complying with ASTM D41
- 3.) Base Sheet: (Optional if specified)
- 4.) Separation Layer: 150 microns polyethylene sheet (if insulation to be laid in inverted roof system).
- 5.) Insulation Board / Wooden Panel: (Optional-as specified)
- 6.) Filter Layer: 120-140gm/m² polyester felt
- 7.) Topping: Crushed stones, washed clean, 25/35mm size, minimum 5cm thick or more governed by the thickness of insulation board.

INSTALLATION : (Refer to section 28.3.2. of Bitumat Systems Design and Installation Manual)

- 1.) A fiber or insulation cant strip, 7x7cm, shall be provided at all parapets and protrusions.
- 2.) The parapet, the cant strip and 20cm over the board shall be primed.
- 3.) Starting at the low point of the roof, BITUMAT first layer shall be loose-laid over the deck, with 10cm side laps and 15cm staggered end laps fully torch welded and seamed / nailed. At all parapets and protrusions, BITUMAT first layer shall be fully bonded 20cm over the primed deck and over the primed cant. *(Refer to 28.3.2. of Bitumat Specification & Installation Manual)*



4.) BITUMAT Polyflame second layer shall be fully torch welded onto first layer with 10cm side laps and 15cm staggered end laps. Side laps of first and second layer shall be staggered. At parapets and protrusions, BITUMAT Polyflame 2nd layer shall be extended fully bonded 5cm above the cant on the primed parapet steel curb.

FLASHING: (Refer to Section 28.3.7. of Bitumat Systems Design and Installation Manual)

- 1.) The flashing membrane shall be installed in 1m wide strips, fully torch welded 10cm on the horizontal membrane, on the cant and on the parapet steel curb.
- 2.) The upper horizontal joint of the flashing membrane shall be at least 15cm above the top surface of the gravel and shall be protected by an adequate counterflashing or countercladding system. *(For Counter Flashing, Sealants & Other relevant details, Refer to Section 28.3.8., 28.3.9., 28.3.10., 28.3.11., 28.3.12., 28.3.13., 28.3.14.)*

TOP COVERING:

- 1.) Install the separation layer and the insulation boards loose-laid (If insulation is specified).
- 2.) Install the filter layer and a bed of gravel (As specified).

All membrane laying and detailing shall be in accordance with BITUMAT **Systems Design and Installation Manual**.