

VOLUME II

TECHNICAL SPECIFICATION

FOR

FRP CABLE TRAYS & ACCESSORIES

SPECIFICATION NO: PE-TS-421-507-E022

REVISION: 00



BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, UP (INDIA) – 201301



**TECHNICAL SPECIFICATION FOR
FRP CABLE TRAYS &
ACCESSORIES**

SPECIFICATION NO. PE-TS-421-507-E022

REVISION 00

DATE: 11.12.2017

SHEET 1 OF 1

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TOTAL SHEETS INCLUDING COVER SHEET, CONTENT/SEPARATOR SHEET = 27



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SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS



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COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same
2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

BIDDER'S STAMP & SIGNATURE



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1.0 PURPOSE

This specification is intended for finalization of contract between BHEL PEM and Bidder for FRP Cable trays & Accessories. Standard technical detail as indicated in the specification shall be agreed upon between BHEL PEM and Bidder.

2.0 SCOPE OF ENQUIRY

2.1 Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of cable trays & accessories conforming to this specification.

2.2 It is not the intent to specify herein all the details of design & manufacture of material. However, the material shall, conform in all respects to high standard of design, engineering and workmanship and shall be capable of performing in continuous commercial operation at site conditions.

2.3 Technical requirements of FRP cable trays & accessories are indicated in Data Sheet-A & Section-II.

2.4 The stipulation of Data Sheet-A shall prevail in case of any conflict between the stipulations of Data Sheet-A & Section-II.

3.0 BILL OF QUANTITIES

The bidder to quote for items as per 'BOQ-cum-Price Schedule' attached with NIT.

4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

4.1 Following documents/drawings shall be submitted after placement of order for BHEL & customer's approval:-

Sl. No.	Drawings / Document Description	Document Number	Document Type	First Submission	Re submission
1	Technical Data Sheet for FRP Cable trays & Accessories	PE-V0-421-507-E022	Primary	Within 1 week of award of contract	Within 1 week of comments
2	GA drawings of FRP Cable Trays & Accessories	PE-V0-421-507-E023	Primary	Within 1 week of award of contract	Within 1 week of comments
3	Manufacturing Quality Plan for FRP Cable Trays & Accessories	PE-V0-421-507-E907	Primary	Within 1 week of award of contract	Within 1 week of comments
4	BOQ of Coupler plates, Bolts, Washers & Nuts for lot wise ordered quantity.	PE-V0-421-507-E024	Secondary	Within 1 week of lot clearance	Within 1 week of comments
5	Loading Calculations for each tray size	PE-V0-421-507-E025	Secondary	Within 2 week of award of contract	Within 1 week of comments
6.	Type Test Reports	PE-V0-421-507-E026	Secondary	Within 2 week of award of contract	Within 1 week of comments
7.	Field Quality Plan	PE-V0-421-507-E026	Secondary	Within 2 week of award of contract	Within 1 week of comments

4.2 Drawings/ documents shall be submitted through Document Management System (DMS).



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DATASHEET-A

1.0 APPLICABLE STANDARDS

a) NEMA FGI-1993	National Electrical Manufacture's Association – Fibre Glass Cable Tray System.
b) UL 94	Standard for safety of flammability of plastic materials for parts in devices and appliance testing.
c) IS: 4249*	Classification & methods of tests for non-ignitable and self-extinguishing properties of solid electrical insulating materials
c) IS: 6746*	Unsaturated polyester resin system for low pressure fibre glass reinforced plastic.
d) IS: 14399*	Hot press moulded thermosetting glass fibre reinforced polyester resin
d) ASTM -D 149	Standard test method for dielectric breakdown voltage and dielectric strength of solid electrical insulating materials at commercial power frequencies).
f) ASTM-D 256	Standard test methods for determining the izod pendulum impact resistance of plastics.
g) ASTM-D 570	Standard test method for water absorption of plastics
g) ASTM-D 635	Standard test method for rate of burning and/or extent and time of burning of plastics in a horizontal position.
h) ASTM-D 638	Standard test method for tensile properties of plastics.
h) ASTM-D 695	Standard test method for compressive properties of rigid plastics
i) ASTM-D 790	Standard test methods for flexural properties of unreinforced and reinforced plastics and electrical insulating materials.
j) ASTM-D 2863	Standard test method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (oxygen index).
k) ASTM - E 84	Standard test method for surface burning characteristics of building materials.
l) ASTM - G 154	Standard practice for operating fluorescent light apparatus for UV exposure of non-metallic materials
m) IEC 60695-2	Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products (GWEPT)
n) ASTM-D-257	D-C Resistance or Conductance of Insulating Materials

Note:*** Wherever Indian standard is mentioned, equivalent IEC/International standard (if available) should be followed else Indian standard can be followed.

2.0 CABLE TRAYS & ACCESSORIES

2.1 Material	:	Antistatic, anti-corrosion& ultraviolet resistant FRP					
2.2 Type	:	FRP Ladder Type					
		FRP Perforated Type					
2.3 Manufacturing Process:		Pultrusion using automated pultrusion machines					
2.4 Glass Content	:	minimum 55%					
2.5 Resin to be used	:	Corrosion & ultraviolet resin, Flame retardant polyester resin					
2.6 Standard Length of Straight Length of Cable Trays	:	3.0 meters					
2.7 Standard Width (mm)	:	600	450	300	150 (Ladder Type)		
		600	450	300	150	100	50 (Perforated Type)

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2.8 Construction	:	Conforming to enclosed drawing
2.9 Bending Radius of Accessories (in mm)	:	600 mm
2.10 Tolerance in length/width	:	As per NEMA FG-1-1993
2.11 Loading on cable trays at 1500mm support span	:	For ladder type trays 600mm Width tray: 90 Kg/m 450mm Width tray: 75 Kg/m 300mm Width tray: 60 Kg/m 150mm Width tray: 30 Kg/m In addition to 80Kg point load at mid span for trays other than 150W trays For perforated type trays 600mm Width tray: 90 Kg/m 450mm Width tray: 75 Kg/m 300mm Width tray: 60 Kg/m 150mm Width tray: 30 Kg/m 100mm Width tray: 15 Kg/m 50mm Width tray: 7.5 Kg/m In addition to 80Kg point load at mid span for 600mm, 450mm & 300mm wide trays

3.0 FITTINGS

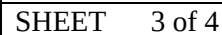
End connections	:	Through Coupler plates (Side Coupler Plates shall be provided as part of cable tray & accessories supply with bolts, nuts, washers etc)
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4.0 TRAY COVERS

a) Type	:	Non-Perforated type.
b) Material	:	Same as cable trays
c) Width	:	Suitable for width of cable trays.
d) Tolerance in length/width	:	Same as cable trays.

5.0 SHEET THICKNESS

a) For cable trays & Accessories	:	4.0 mm
b) For cable tray cover	:	3.0 mm
c) For Coupler plate	:	4.0 mm
d) Tolerance in Thickness	:	No negative tolerance is permitted.



6.5 Water Absorption : < 0.1-0.25%



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7.0 NUMBER OF COUPLER PLATES, BOLTS, WASHERS & NUTS REQUIRED FOR EACH CABLE TRAY SECTION (3.0 MTRS)

Sl. No.	NAME OF ITEM	COUPLER PLATE (nos.)	NUTS (nos.)	WASHERS (nos.)	BOLTS (nos.)
1	Cable tray of standard length 3.0 meters	4	16	32	16

NOTE: - Based on above table, no. of coupler plates, bolts, washers & nuts shall be calculated for the offered lot. Over & above the calculated quantity, additional 5% coupler plates & 10% bolts, washers & nuts shall be supplied by the bidder.



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SECTION-II

STANDARD TECHNICAL REQUIREMENTS



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1.0 CODES & STANDARDS

- 1.1 The material shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the material is to be installed.
- 1.2 The design, material, construction, manufacture, inspection, testing and performance of Cable Trays & Accessories shall conform to the latest revision of relevant standards and codes of practices as per Data sheet-A
- 1.3 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

2.0 TECHNICAL REQUIREMENTS

- 2.1 Cable trays & accessories shall be of two types, namely ladder type and perforated type. Technical particulars are specified in Data Sheet-A and drawings enclosed with this specification. Minor fabrication detail changes which do not affect the material /dimensional aspect of the equipment, shall be subject to BHEL/owner's approval without any commercial implication.
- 2.2 Coupler plates shall be provided for connecting tray ends to other straight trays, horizontal elbows, vertical elbows, tees, cross, reducers etc. The number of coupler plates, washers, nuts & bolts to be supplied shall be as per Data Sheet-A.
- 2.3 Necessary fasteners shall be provided along with each length of cable tray as specified in drawings enclosed.
- 2.4 The width of the tray covers (where provided) shall be suitable for the width of trays. Suitable bolting arrangement shall be supplied for attaching the cover to the cable trays, elbows, reducers, tees etc. as per the drawing enclosed.

3.0 QUALITY ASSURANCE, TESTING AND INSPECTION

- 3.1 Successful bidder shall submit 'Manufacturing Quality Plan' after award of contract, which shall include various quality checks for the FRP Type Cable Tray & Accessories offered. The same shall be subject to the approval of BHEL/Customer without any commercial implication.
- 3.2 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.
- 3.3 The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all these tests for all the equipment & components shall be deemed to be included in the bid price.
- 3.2 Successful bidder shall submit type test reports for test mentioned in the Data sheet-A, carried out in within last five years of the date of bid opening. These reports should be for the tests conducted either in government approved third party laboratory or witnessed by client (such as major utilities/ industries) on identical/ similar item to those ordered under this contract
- 3.4 In case bidder is not able to submit report of type test(s) conducted in last five years, or in case type tests report(s) are not found to be meeting the specification/ relevant standard requirements, then all such tests shall be conducted under this contract by the bidder free of cost to BHEL, and reports shall be submitted for approval. No charges shall be paid for testing under such circumstances. BHEL reserves the right to witness the testing for which due notice shall be given by the vendor.



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4.0 PACKING

Packing shall be seaworthy complying with technical specification for seaworthy packing (PE-TS-888-100-A001). The material shall be packed to ensure protection against damage during transit, storage for prolonged periods and handling.

TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

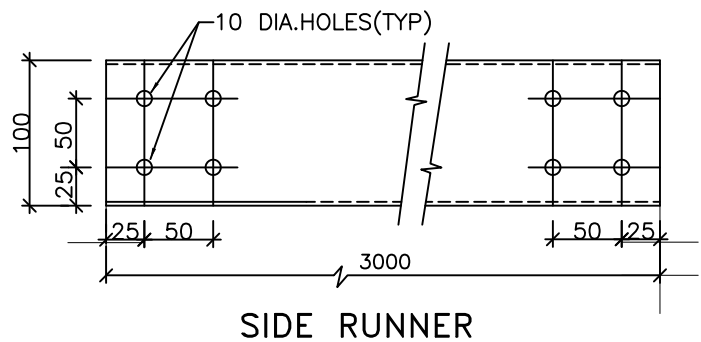
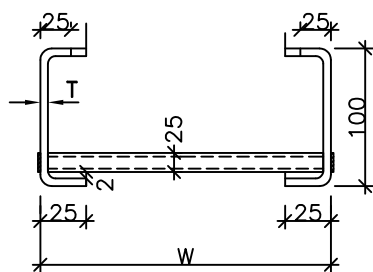
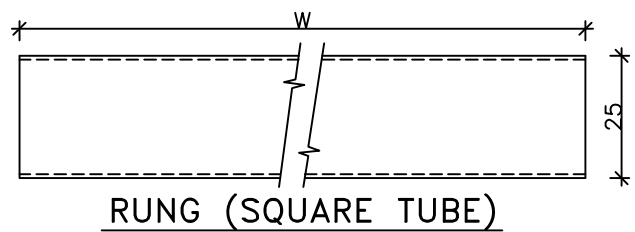
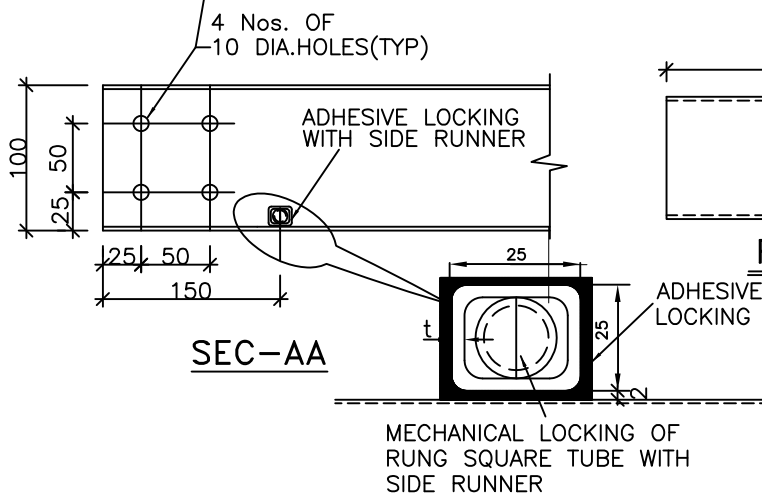
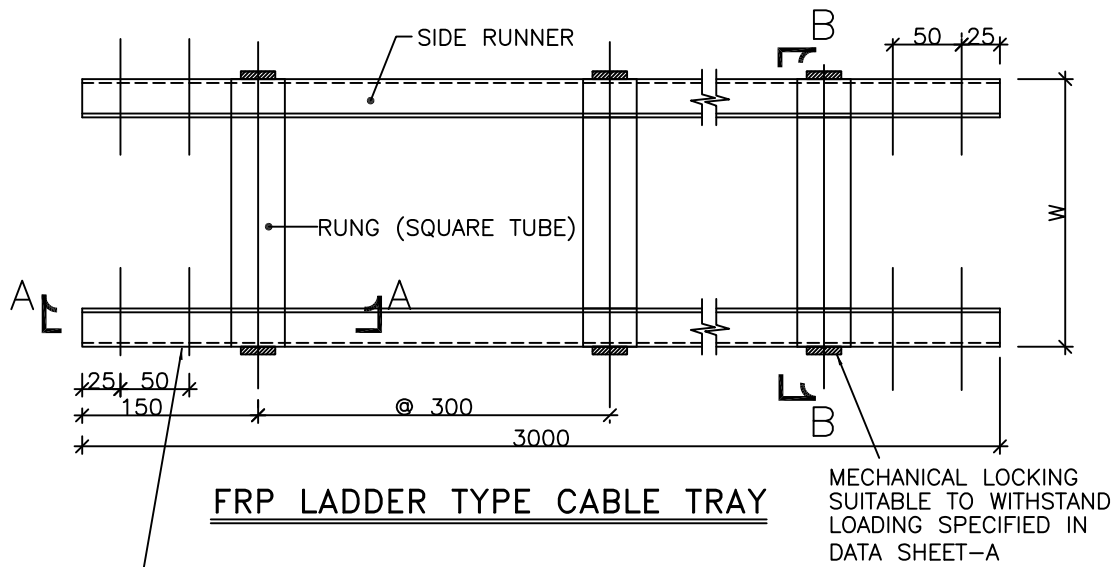


TYPICAL DETAILS OF FRP TYPE CABLE
TRAYS AND ACCESSORIES

DWG. NO.

Maitree-00-BTW-EDB
-421507E006-PEM-B

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W	150	300	450	600
T	4	4	4	4
t	4	4	4	4

FOR GENERAL NOTES REFER SHEET 15 OF 15



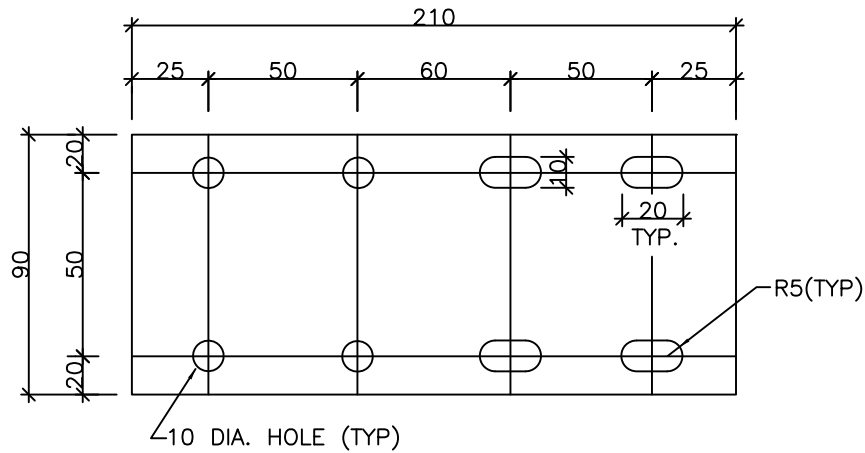
TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

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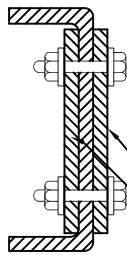
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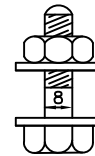
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**FRP SIDE COUPLER PLATE FOR
FRP LADDER/PERFORATED TYPE TRAYS**
(600/450/300/150W TRAYS)
QTY. REQUIRED/TRAY SECTION : 4 NOS.

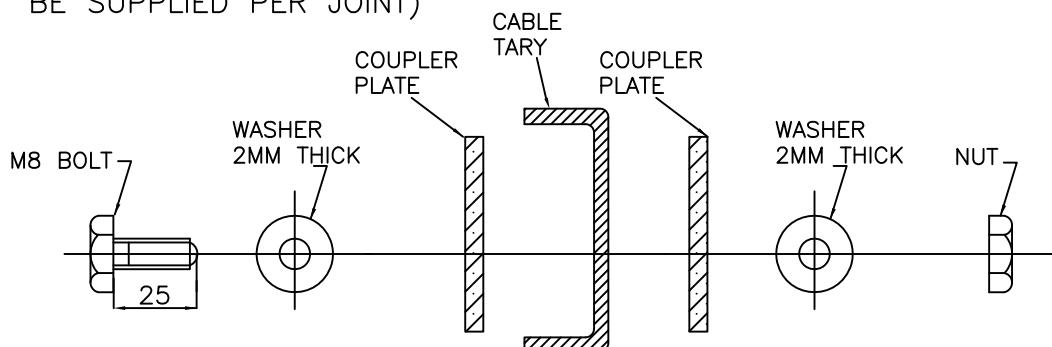


(2 NOS. COUPLER PLATES
OF 4 MM THICKNESS TO
BE SUPPLIED PER JOINT)



QTY. REQD/TRAY SECTION

- A) 16 NOS. M8 BOLTS
- B) 16 NOS. NUTS
- C) 32 NOS. WASHERS



SEQUENCE OF M8 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAY
FOR TYPICAL CABLE TRAY JOINT

FOR GENERAL NOTES REFER SHEET 15 OF 15



**TYPICAL DETAILS OF FRP TYPE CABLE
TRAYS AND ACCESSORIES**

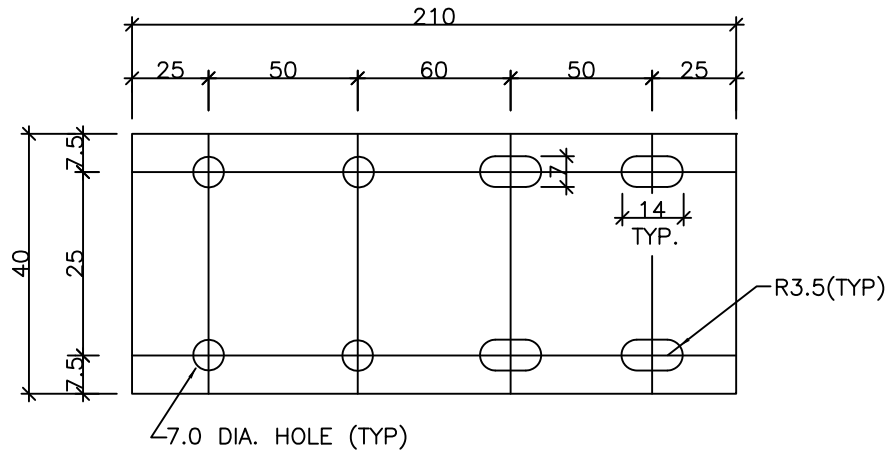
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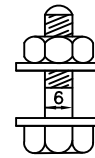
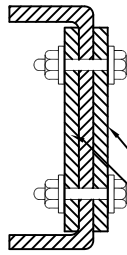
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FRP SIDE COUPLER PLATE FOR FRP PERFORATED TYPE TRAYS

(50/100W TRAYS)

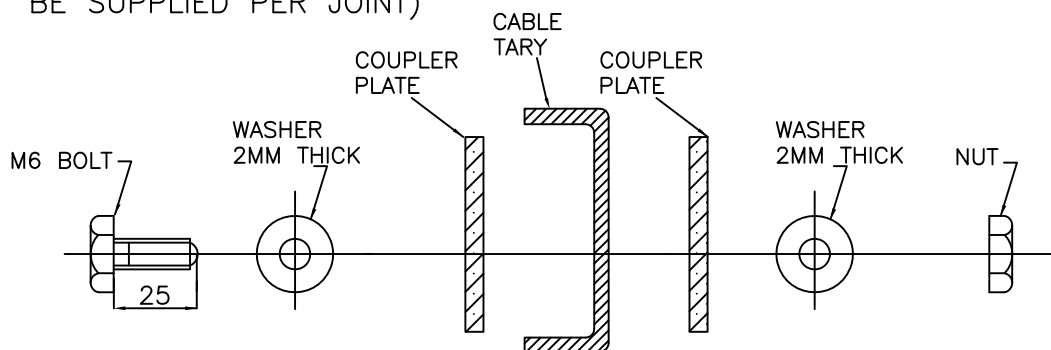
QTY. REQUIRED/TRAY SECTION : 4 NOS.



QTY. REQD/TRAY SECTION

- A) 16 NOS. M6 BOLTS
- B) 16 NOS. NUTS
- C) 32 NOS. WASHERS

(2 NOS. COUPLER PLATES
OF 4 MM THICKNESS TO
BE SUPPLIED PER JOINT)



SEQUENCE OF M8 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAY

FOR TYPICAL CABLE TRAY JOINT

FOR GENERAL NOTES REFER SHEET 15 OF 15

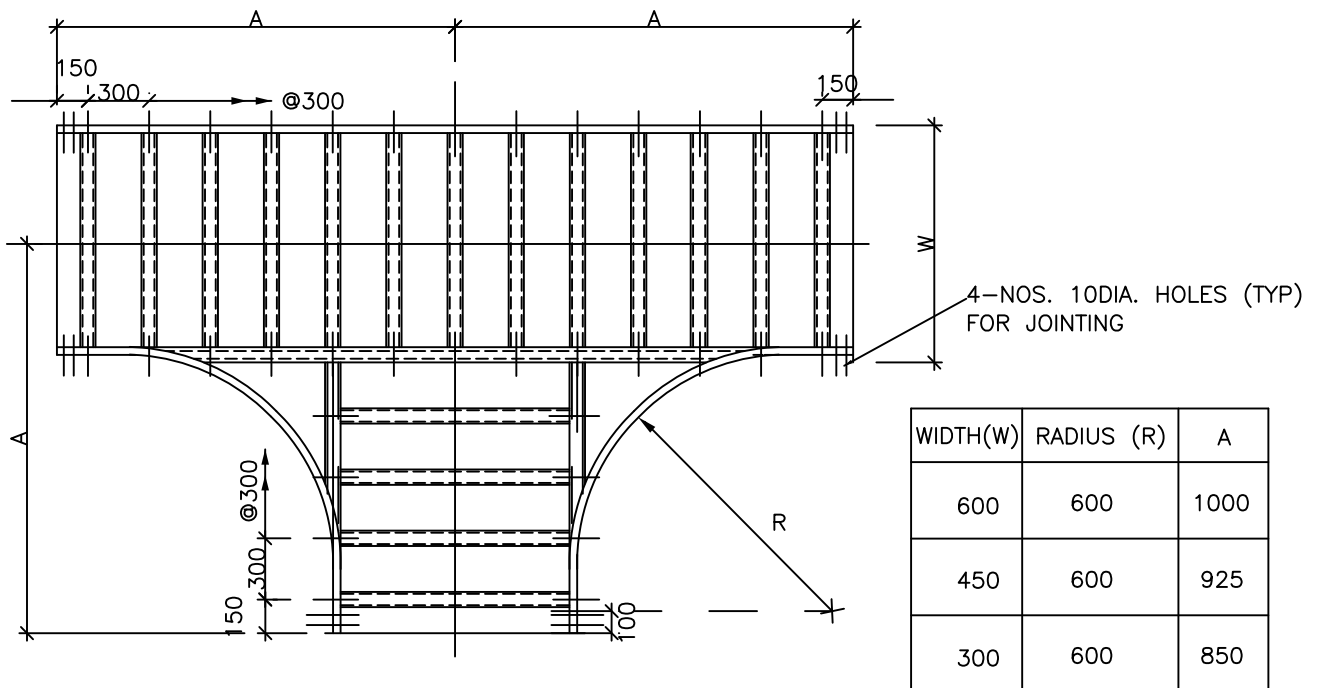


TYPICAL DETAILS OF FRP TYPE CABLE
TRAYS AND ACCESSORIES

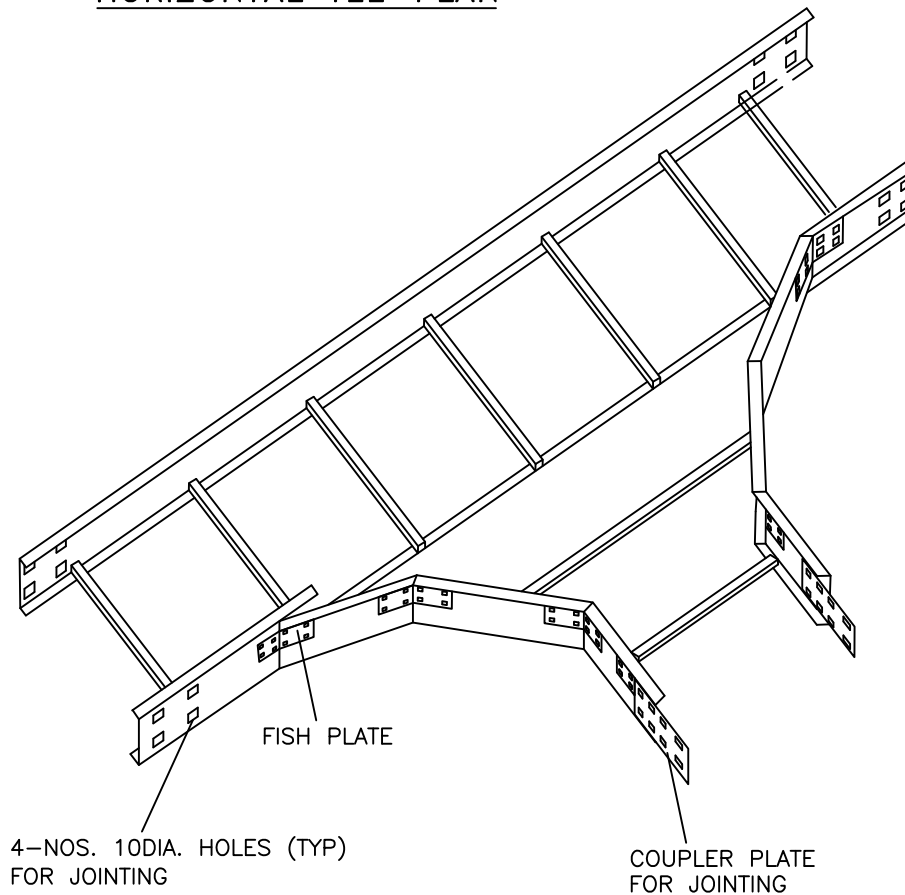
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HORIZONTAL TEE-PLAN



HORIZONTAL TEE

LADDER TYPE ACCESSORIES

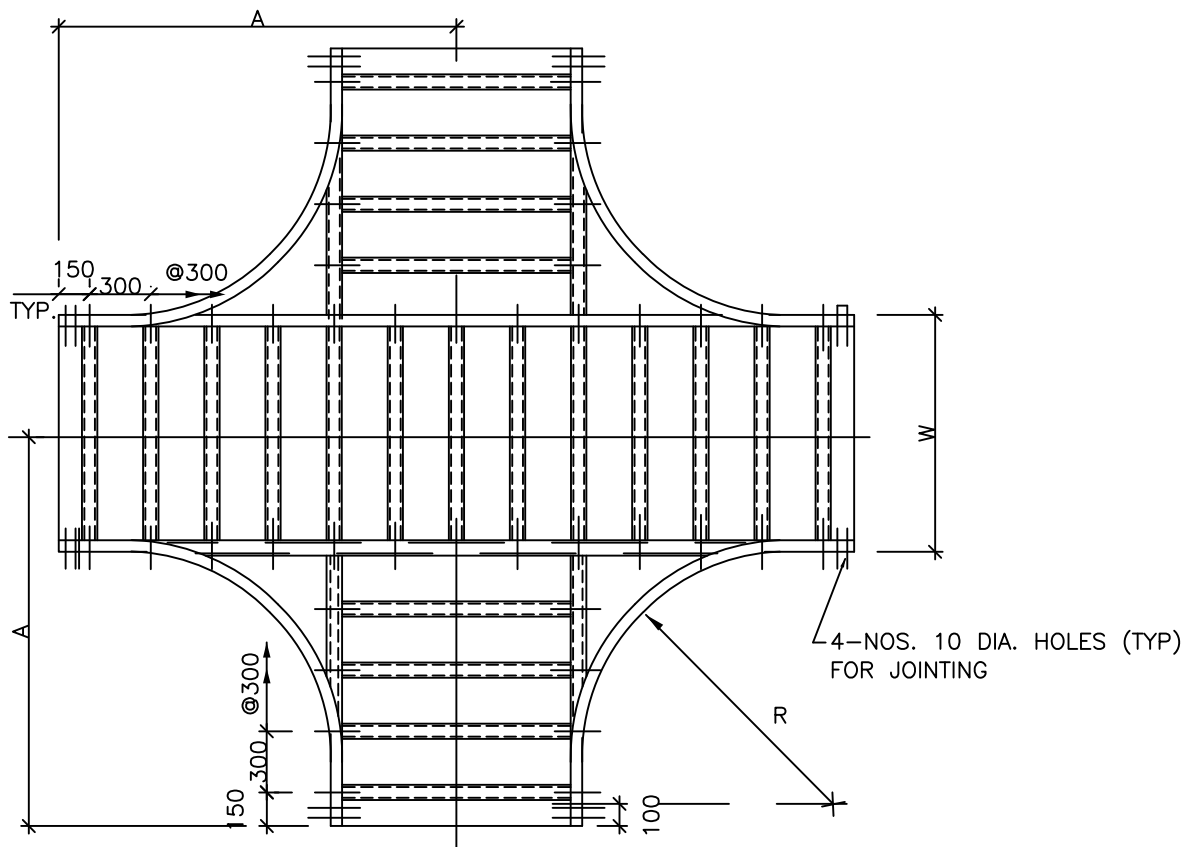
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TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

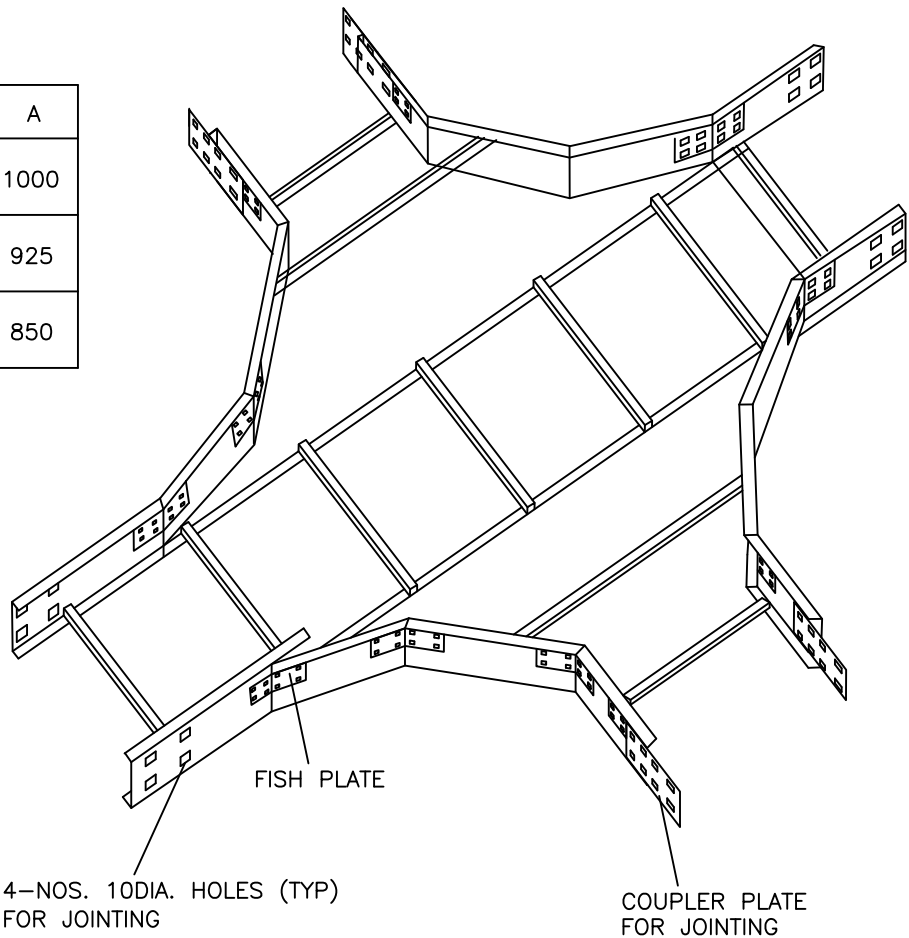
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HORIZONTAL CROSS-PLAN

WIDTH(W)	RADIUS (R)	A
600	600	1000
450	600	925
300	600	850



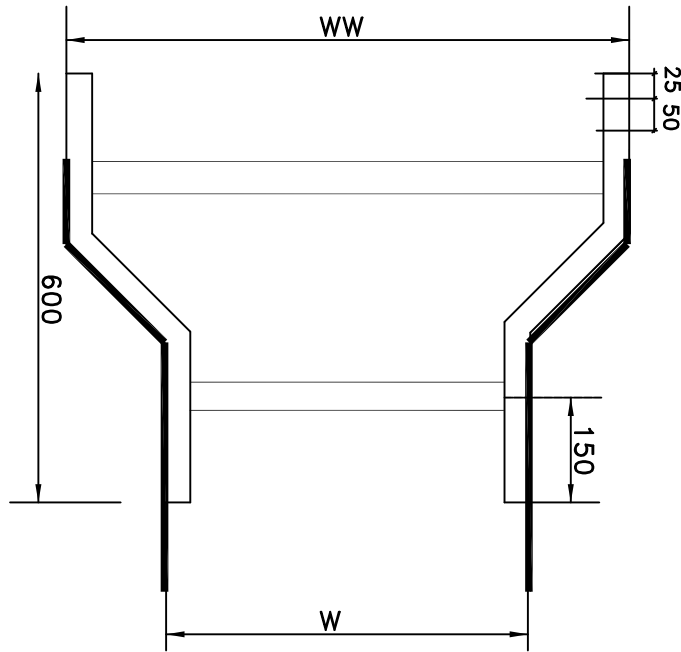
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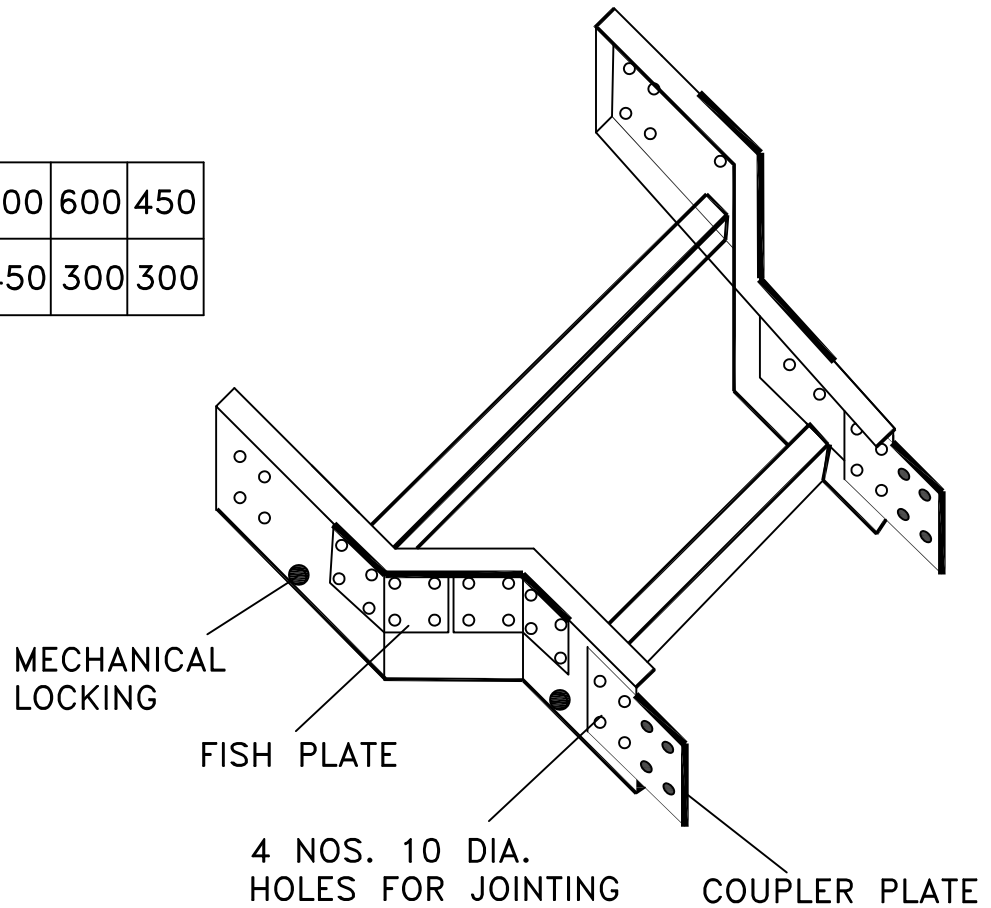
TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

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WIDTH	WW	600	600	450
	W	450	300	300



REDUCER-LADDER TYPE

LADDER TYPE ACCESSORIES

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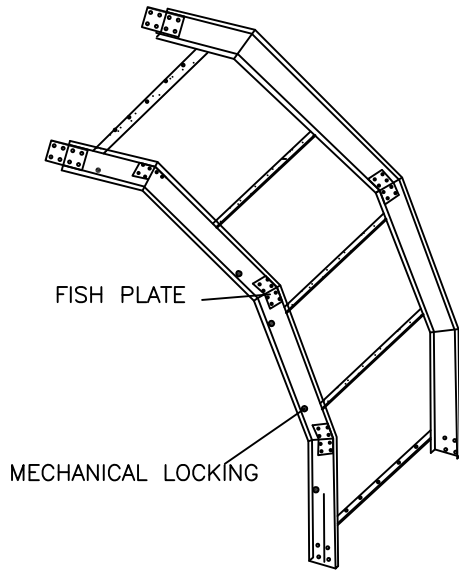
TYPICAL DETAILS OF FRP TYPE CABLE
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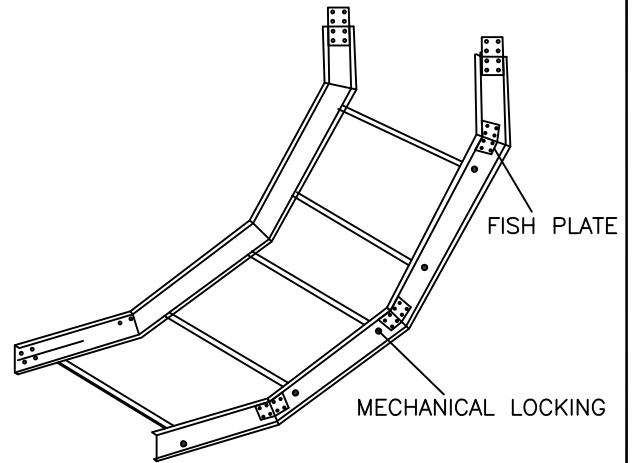
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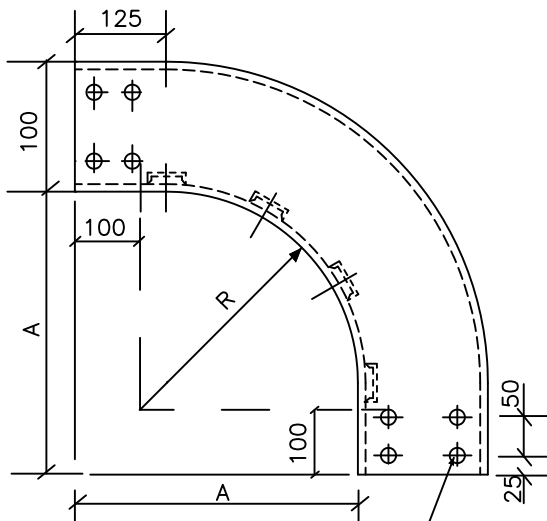
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90° VERTICAL BEND
(OUTSIDE)

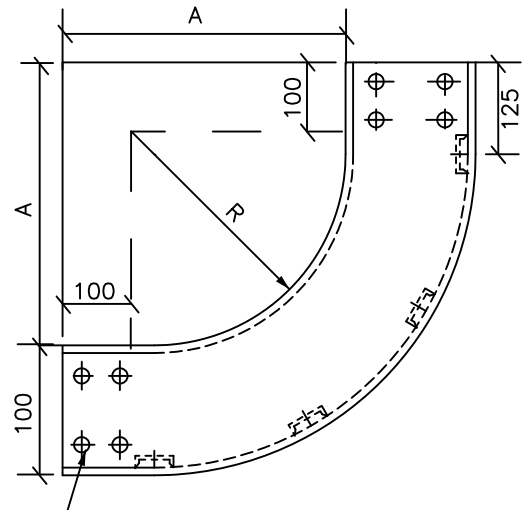


90° VERTICAL BEND
(INSIDE)



ELEVATION
90° VERTICAL BEND
(OUTSIDE)

4 NOS. 10 DIA. HOLES
FOR JOINTING



ELEVATION
90° VERTICAL BEND
(INSIDE)

WIDTH(W)	RADIUS (R)	A
600	600	700
450	600	700
300	600	700

LADDER TYPE ACCESSORIES

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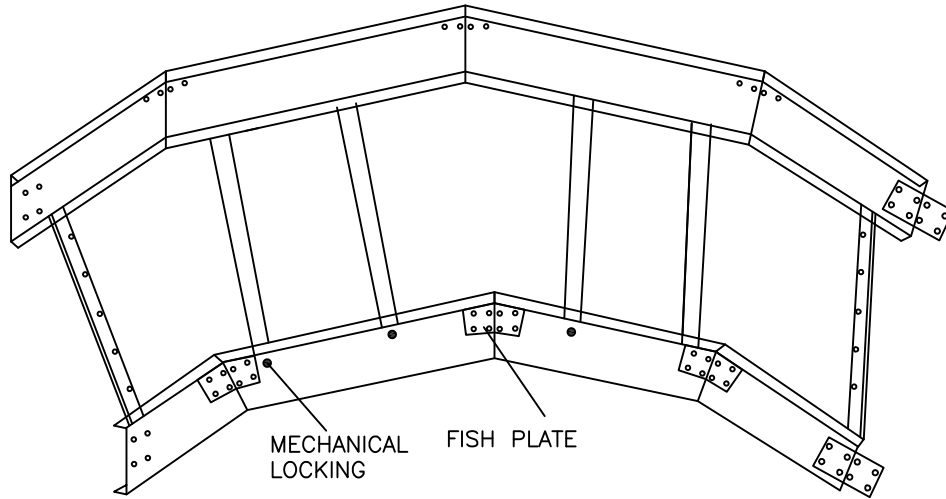


TYPICAL DETAILS OF FRP TYPE CABLE
TRAYS AND ACCESSORIES

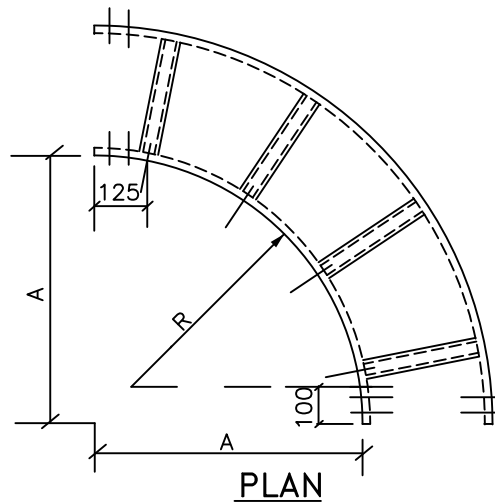
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90° HORIZONTAL BEND



90° HORIZONTAL BEND

WIDTH(W)	RADIUS (R)	A
600	600	700
450	600	700
300	600	700

LADDER TYPE ACCESSORIES

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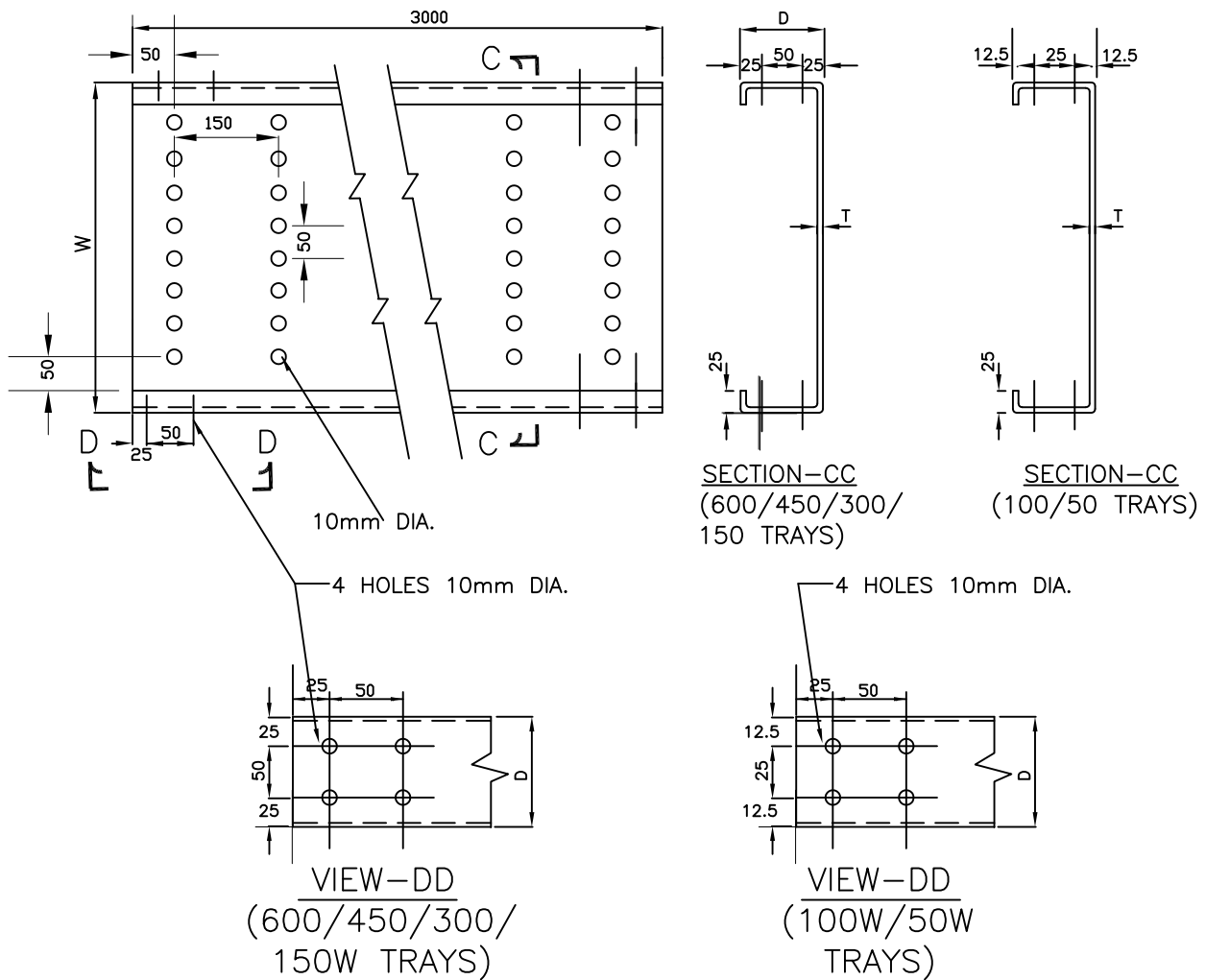
TYPICAL DETAILS OF FRP TYPE CABLE
TRAYS AND ACCESSORIES

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TRAY WIDTH W (mm)	600	450	300	150	100	50
TRAY DEPTH D (mm)	100	100	100	100	50	50
T (mm)	4	4	4	4	4	4

PERFORATED TYPE TRAY

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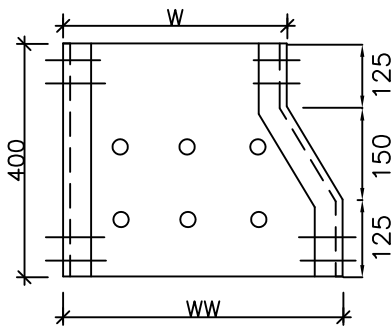
TYPICAL DETAILS OF FRP TYPE CABLE
TRAYS AND ACCESSORIES

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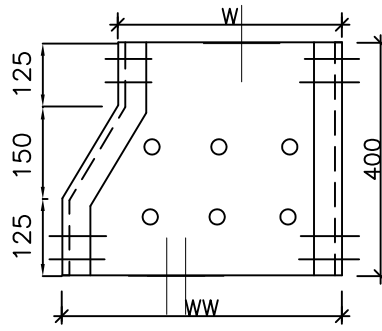
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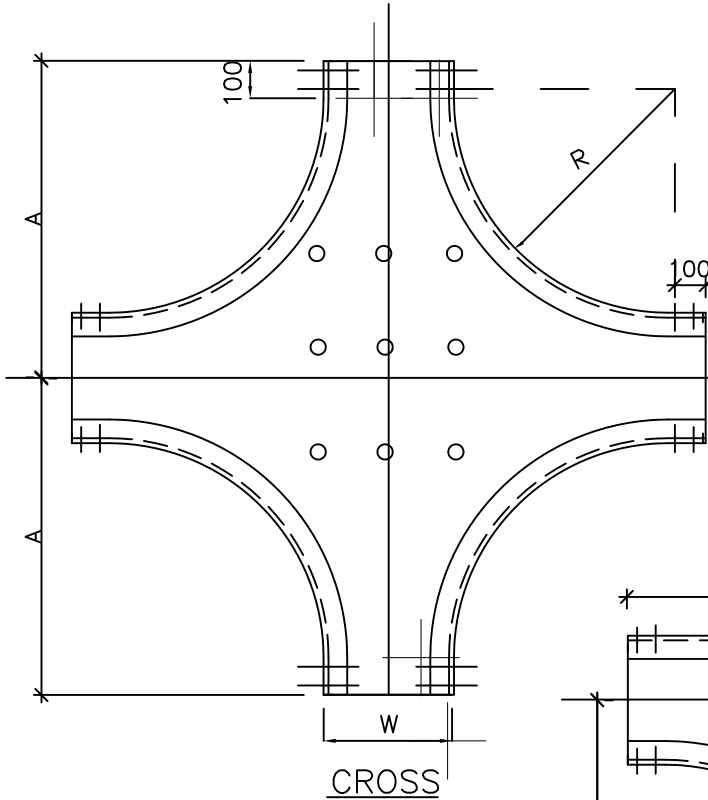
LEFT HAND REDUCER



RIGHT HAND REDUCER

PERFORATED TYPE

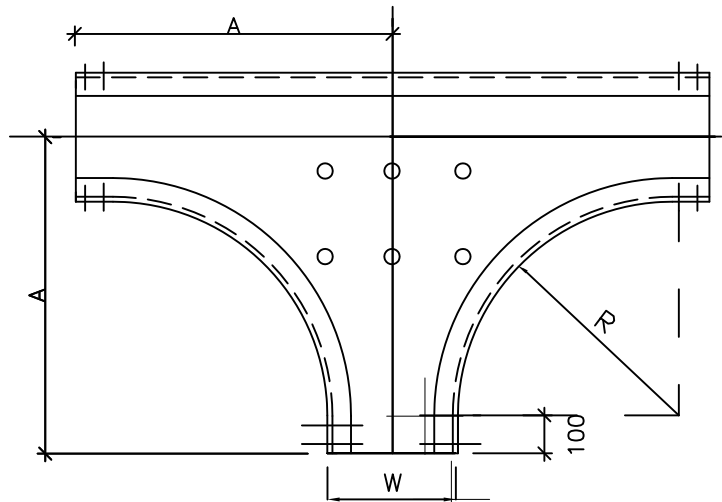
WW	W	DEPTH	THICKNESS
600	450	100	4
600	300	100	4
450	300	100	4



CROSS

PERFORATED TYPE

WIDTH(W)	RADIUS (R)	A	THICKNESS
600	600	1000	4
450	600	925	4
300	600	850	4



TEE

PERFORATED TYPE ACCESSORIES

FOR GENERAL NOTES REFER SHEET 15 OF 15



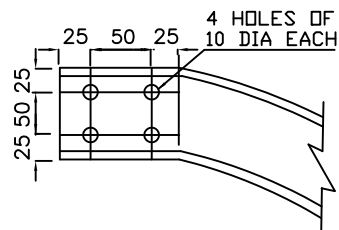
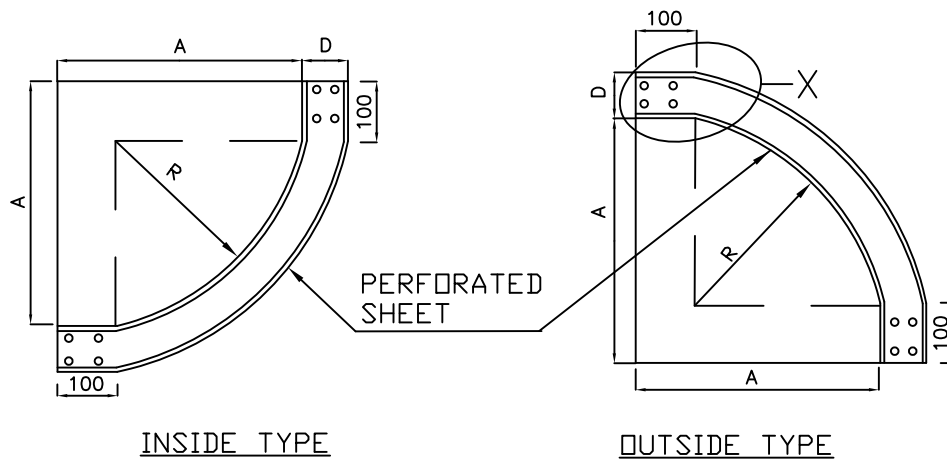
TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

DWG. NO.

Maitree-00-BTW-EDB
-421507E006-PEM-01

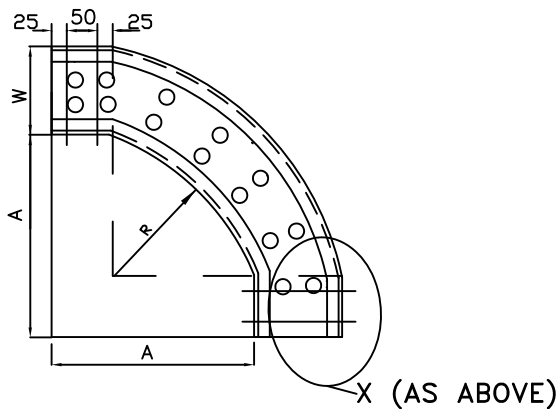
SHT. 11 OF 15

REV. 01



ENLARGED VIEW OF "X"

90° VERTICAL BEND - PERFORATED TYPE



90° HORIZONTAL BEND - PERFORATED TYPE

WIDTH(W)	RADIUS (R)	A	T
600	600	700	4
450	600	700	4
300	600	700	4

PERFORATED TYPE ACCESSORIES

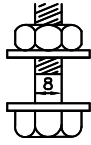
FOR GENERAL NOTES REFER SHEET 15 OF 15



TYPICAL DETAILS OF FRP TYPE CABLE
TRAYS AND ACCESSORIES

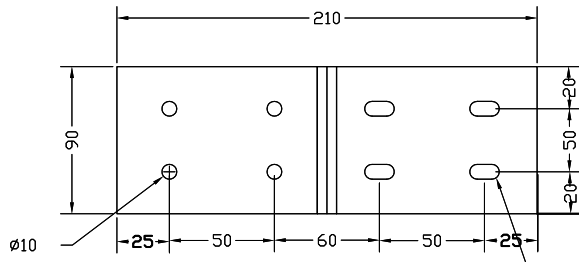
DWG. NO.
Maitree-00-BTW-EDB
-421507E006-PEM-01

SHT. 12 OF 15 REV. 00

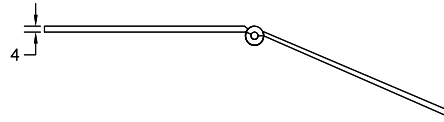


QTY. REQD/TRAY SECTION

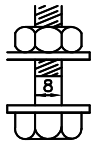
- A) 8 NOS. M8 BOLTS
- B) 8 NOS. NUTS
- C) 16 NOS. WASHERS



same as sheet no. 3 of 15

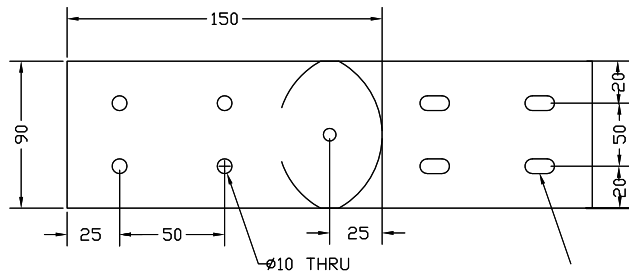


FRP ADJUSTABLE HORIZONTAL
SPLICE PLATE

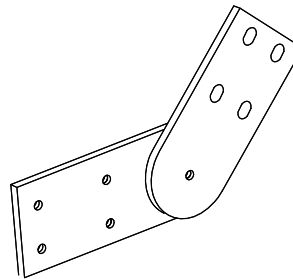
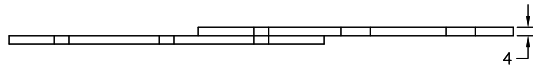


QTY. REQD/TRAY SECTION

- A) 8 NOS. M8 BOLTS
- B) 8 NOS. NUTS
- C) 16 NOS. WASHERS



same as sheet no. 3 of 15



FRP ADJUSTABLE VERTICAL
SPLICE PLATE

NOTES:

- ALL DIMENSIONS ARE IN MM.

FOR GENERAL NOTES REFER SHEET 15 OF 15



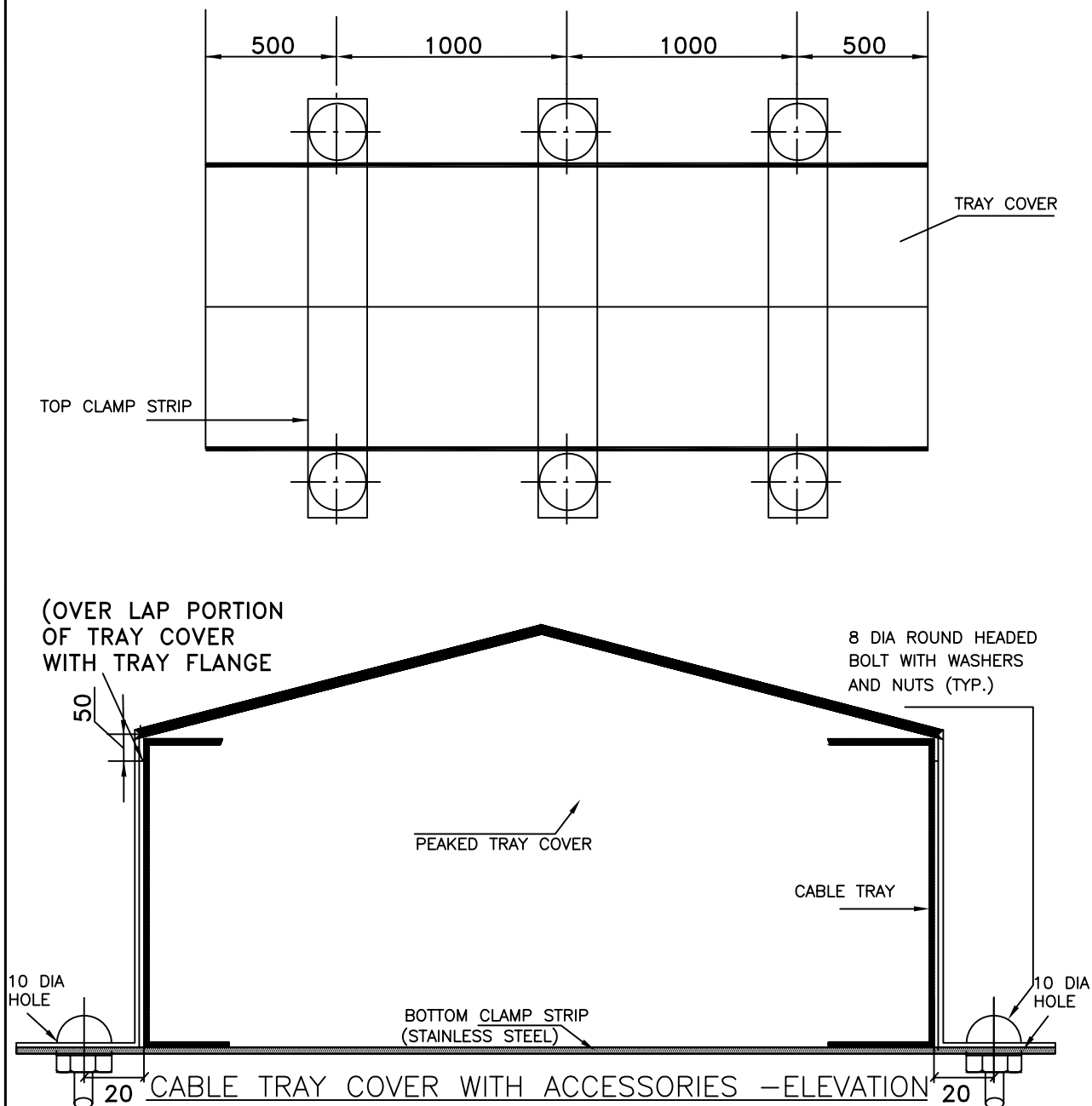
TYPICAL DETAILS OF FRP TYPE CABLE
TRAYS AND ACCESSORIES

DWG. NO.

Maitree-00-BTW-EDB
-421507E006-PEM-01

SHT. 13 OF 15

REV. 00



CABLE TRAY COVER SHALL INCLUDE 1 NO. OF TRAY COVER OF 3000MM LENGTH ALONG WITH 3 NOS. OF TOP CLAMP STRIP, 3 NOS. BOTTOM CLAMP STRIP AND 6 NOS. OF BOLTS ALONG WITH NUTS & WASHERS.

CABLE TRAY COVER

FOR GENERAL NOTES REFER SHEET 15 OF 15



TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

DWG. NO.

Maitree-00-BTW-EDB
-421507E006-PEM-01

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REV. 00

NOTES:—

1. THE FRP TYPE LADDER AND PERFORATED TYPE CABLE TRAYS AND ACCESSORIES (INCLUDING SIDE RUNNERS OF LADDER TYPE TRAYS & ACCESSORIES) SHALL BE MADE OF 4MM THICKNESS. COUPLER PLATE SHALL BE 4 MM THICK.
2. STANDARD TRAY ACCESSORIES SHALL BE WITH THE RADIUS INDICATED IN THIS DRAWING.
3. ALL CABLE TRAYS & ACCESSORIES CORNERS SHALL BE SMOOTH AND FREE OF SHARP EDGES.
4. THE CABLE TRAY COVER (FRP) SHALL BE OF 3MM THICKNESS SHALL BE PROVIDED ON OUTDOOR TRAYS. IT SHALL BE PROVIDED ON TOP MOST CABLE TRAY.
5. THE WIDTH, LENGTH & HEIGHT OF TRAYS & TRAY COVERS SHALL BE WITHIN A TOLERANCE AS SPECIFIED IN NEMA FG-1-1993. NO NEGATIVE TOLERANCE IS PERMITTED IN THICKNESS.
6. TO FACILITATE ASSEMBLY, ALL ACCESSORIES AT ENDS SHALL HAVE 100mm STRAIGHT PORTION.
7. ALL NUTS, BOLTS, WASHERS ETC., SHALL BE OF STAINLESS STEEL (SS 304).
8. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
9. WIDTH OF CABLE TRAYS PROPOSED TO BE USED FOR THE PROJECT ARE AS UNDER:
A) LADDER TYPE: 600W, 450W, 300W, 150W.
B) PERFORATED TYPE: 600W, 450W, 300W, 150W, 100W, 50W
10. THE DEPTH OF 600W, 450W, 300W, 150W TRAYS & ACCESSORIES SHALL BE 100MM WHILE DEPTH OF 100W & 50W CABLE TRAY SHALL BE 50MM.
11. FOLLOWING SHALL BE LOADING ON CABLE TRAYS AT 1500MM SUPPORT SPAN:—
FOR LADDER TYPE CABLE TRAYS:—
600W CABLE TRAY — 90KG/M
450W CABLE TRAY — 75KG/M
300W CABLE TRAY — 60KG/M
150W CABLE TRAY — 30KG/M

FOR PERFORATED TYPE CABLE TRAYS:—
600W CABLE TRAY — 90KG/M
450W CABLE TRAY — 75KG/M
300W CABLE TRAY — 60KG/M
150W CABLE TRAY — 30KG/M
100W CABLE TRAY — 15KG/M
50W CABLE TRAY — 7.5KG/M

IN ADDITION TO THIS 80KG POINT LOAD AT MID SPAN SHALL ALSO BE CONSIDERED.



TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

DWG. NO.

Maitree-00-BTW-EDB
-421507E006-PEM-01

SHT. 15 OF 15 REV. 00