TECHNICAL SPECIFICATION

FOR

FRP CABLE TRAYS & ACCESSORIES

SPECIFICATION NO:- TECI:MAIT:FRPCT

REVISION: 00

PREPARED	CHECKED	APPROVED
P.S.TARUN	A K PALANISAMY	M.JEYAMURUGANAND

SECTION-I

STANDARD TECHNICAL REQUIREMENTS

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 FRP 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.

2.5 All FRP type cable trays & accessories shall be corrosion/ chemical resistant, weather resistant, easy to drill & cut, lightweight, high strength & flame retardant. All the composite materials shall have UV light inhibiting chemical additives to resist degradation from ultra violet light.

2.6 The side runners and all accessories shall have the oblong holes on each end for fixing the coupler plates. The connection between two sections of the FRP cable trays or a section of cable tray with associated accessories shall be done by bolting only. Nuts, bolts and washers shall be of stainless steel SS 304.

3.0 QUALITY ASSURANCE, TESTING AND INSPECTION

3.1 Successful bidder shall submit 'Manufacturing Quality Plan' after award of contact, 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.

4.0 PACKING

The material shall be wrapped in polythene sheets before being placed in crates/cases to ensure protection against damage during transit, storage for prolonged periods and handling. Crates / cases shall have skid bottom for handling. Special notations such as 'This side Up', 'Centre of Gravity', 'Weight', 'Owner's particulars', 'Purchase order number' etc. shall be clearly marked on the package together.

DATASHEET-A

1.0 APPLICABLE STANDARDS

a) NEMA FG1-1993	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) BS 738	Classification & methods of tests for non-ignitable and self-extinguishing properties of solid electrical insulating materials
c) BS 353	Unsaturated polyester resin system for low pressure fibre glass reinforced plastic.
d) SS 245	Hot press moulded thermosetting glass fibre reinforced polyster 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

2.0 CABLE TRAYS & ACCESSORIES

2.1 Material	:	Light weight, high strength, Antistatic, anti-corrosion, chemical resistant & 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 resistant 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)
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)

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.

6.0 Test Requirements

6.1 Type test certificate shall be provided for following

a) Flame Spread (<=25mm and smoke density index=<450) as per ASTM E-84 Class 1

b) Very Low flammability as per IS 6746

c) Anti-Static, less surface resistivity as per ASTM D257 (10^9 ohms per square< Surface resistivity< 10^12 ohms per square)

d) UV resistance as per ASTM G154 (For 1000 hours minimum, with tensile strength test which shall not reduce by more than 7% after UV exposure)

e) Resistance to heat and fire as per IEC 60695 2 12 (at 960-degree temperature)

f) Oxygen index shall be minimum 30% as per ASTM-D-2863.

g) Type test report for electrical and mechanical properties as per 6.3, 6.4 & 6.5 below

6.2 FRP trays shall be tested as per NEMA-FGI-1993, ASTM D635, and ASTM-D2863 etc. Following test shall be carried out as acceptance test

a) Destruction load test
b) Deflection Test
c) Glass content test
d) Oxygen Index Test
e) Flammability Test

6.3 Mechanical Properties of FRP pultruded sections:

a) Ultimate tensile strength	:	30000 PSI Longitudinal Direction
b) Tensile modulus	:	2.5 X 10^6 PSI Longitudinal Direction
c) Flexural strength at break	:	30000 PSI Longitudinal Direction
d) Flexural Modulus	:	1.6 x 10^6 PSI Longitudinal Direction
e) Izod impact	:	25 Ft-LBS Longitudinal Direction
f) Compressive strength	:	30000 PSI Longitudinal Direction
g) Compressive modulus	:	2.5 X 10^6 PSI Longitudinal Direction
h) Bar col hardness	:	minimum 45 Longitudinal Direction

6.4 Electrical Properties of FRP pultruded sections:

a) Dielectric strength	:	Axial: 30-45 Kv/25mm
	:	Radial 10-15 Kv/mm
b) Arc Resistance	:	> 120 seconds

6.5 Water Absorption : 0.6% maximum by weight

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.

TYPICAL DETAILS OF
FRP TYPE CABLE TRAYS AND ACCESSORIES

JOB NO.	BHARAT HEAVY ELECTRICALS LIMITED	SPECIFICATION NO:- TECI:MAIT:FRPCT
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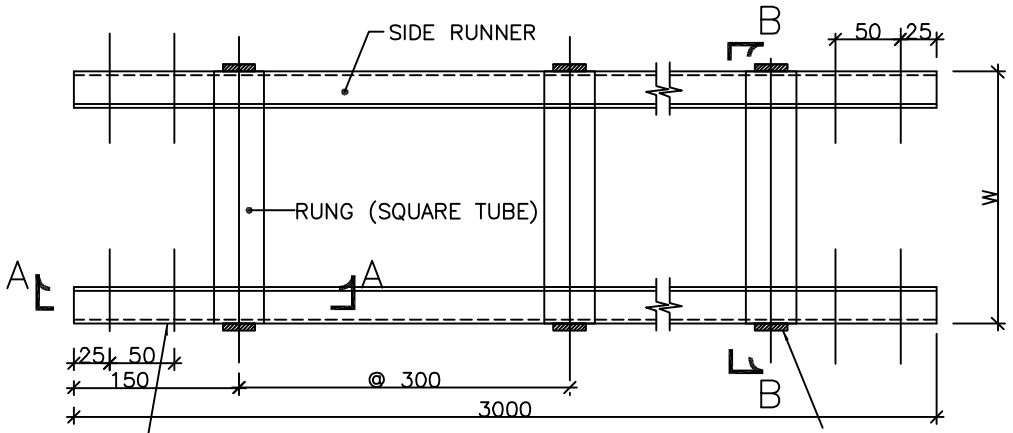
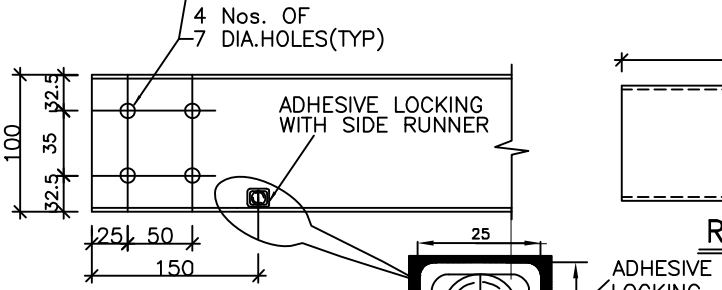


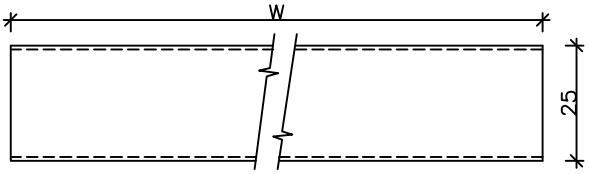
FRP LADDER TYPE CABLE TRAY

MECHANICAL LOCKING SUITABLE TO WITHSTAND LOADING SPECIFIED IN DATA SHEET–A

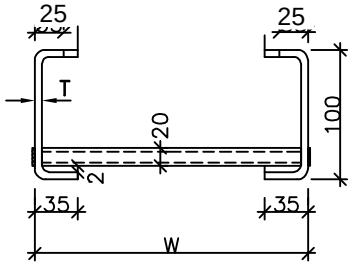


SEC–AA

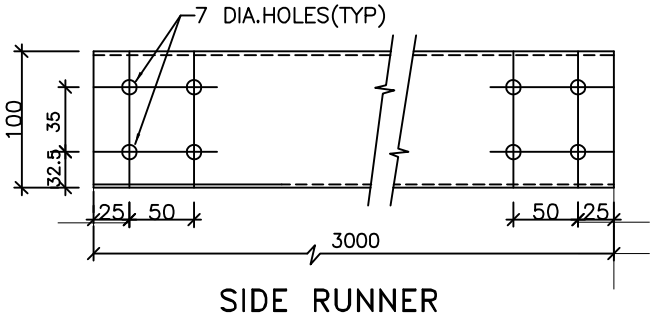
MECHANICAL LOCKING OF RUNG SQUARE TUBE WITH SIDE RUNNER



RUNG (SQUARE TUBE)



SEC–BB



SIDE RUNNER

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

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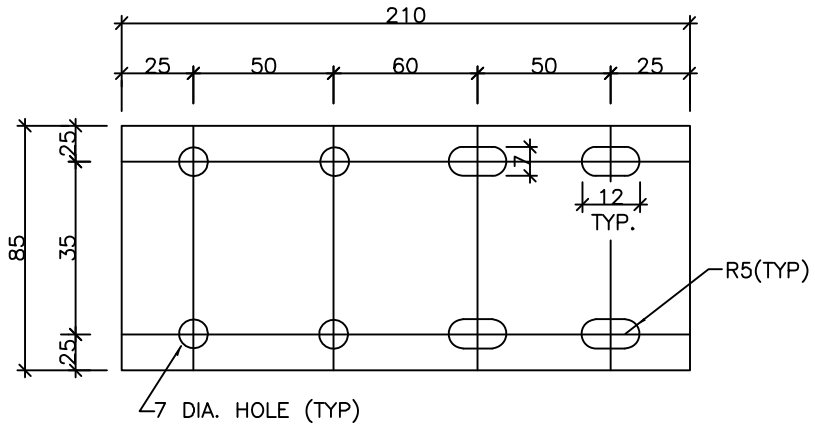
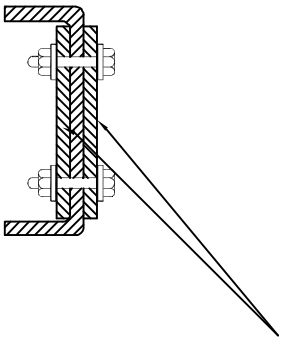
TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

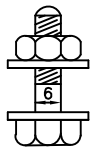
DWG. NO.
SPECIFICATION NO:- TECI:MAIT:FRPCT



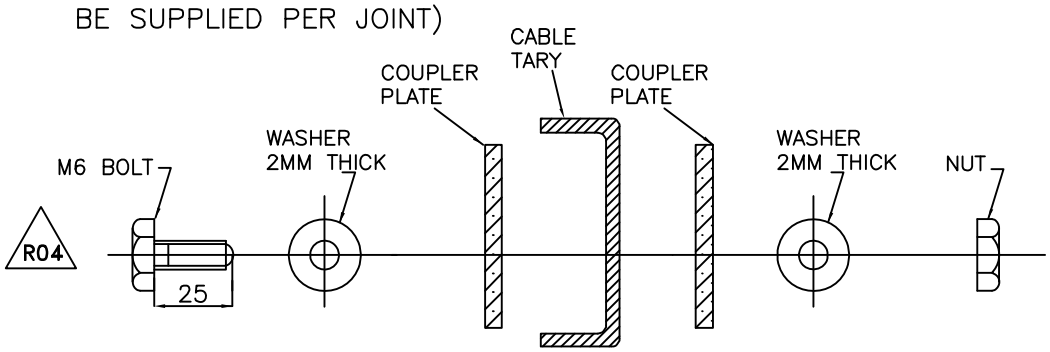
FRP SIDE COUPLER PLATE FOR
FRP LADDER/PERFORATED TYPE TRAYS
(600/450/300/150W TRAYS)
QTY. REQUIRED/TRAY SECTION : 4 NOS.



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



QTY. REQD/TRAY SECTION
6A) 16 NOS. M6 BOLTS
B) 16 NOS. NUTS
C) 32 NOS. WASHERS



SEQUENCE OF M6 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAY

FOR TYPICAL CABLE TRAY JOINT

FOR GENERAL NOTES REFER SHEET 18 OF 18

	TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES	DWG. NO. SPECIFICATION NO:- TECI:MAIT:FRPCT
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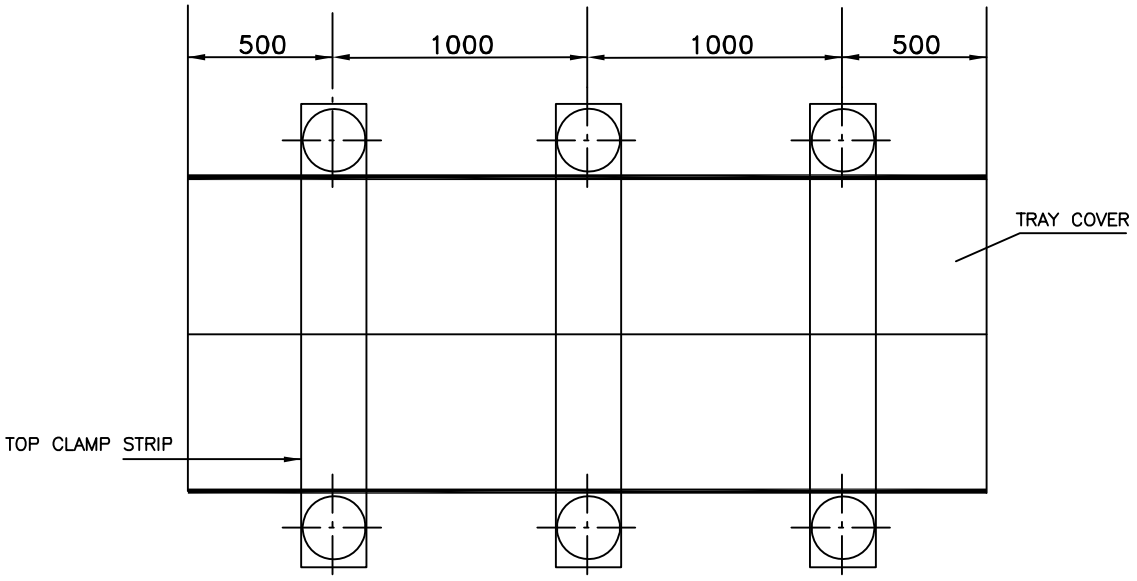
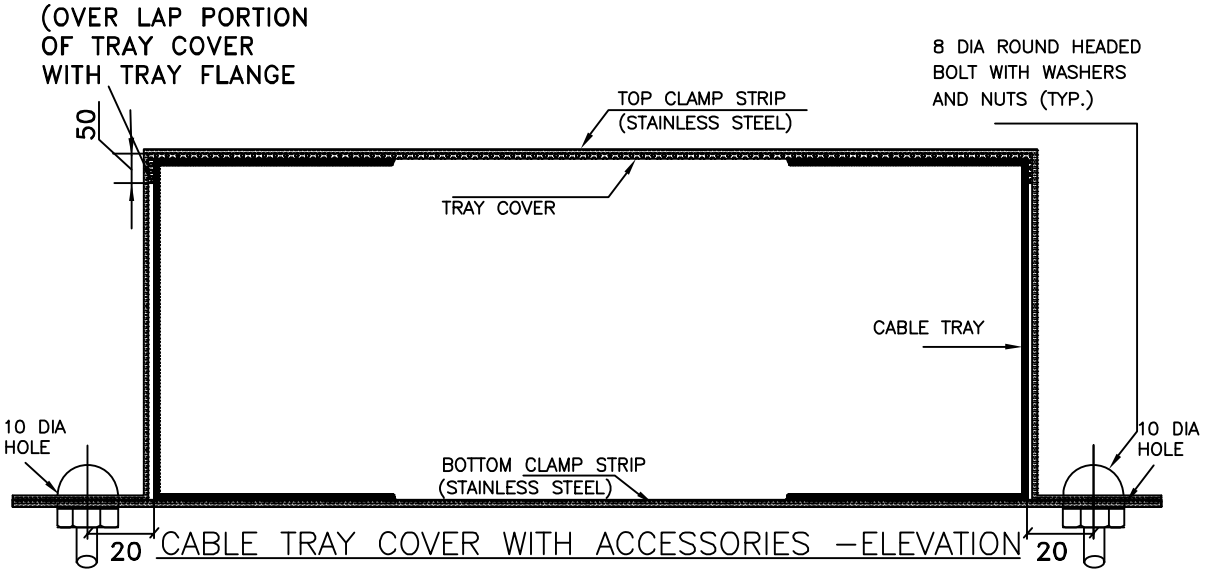


CABLE TRAY COVER WITH ACCESSORIES –PLAN



CABLE TRAY COVER WITH ACCESSORIES –ELEVATION

TRAY WIDTH(W)	TOP CLAMP SIZE (LxWxT)	BOTTOM CLAMP SIZE (LxWxT)
600	900X20X2	680X20X2
450	750X20X2	530X20X2
300	600X20X2	380X20X2
150	450X20X2	230X20X2

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.

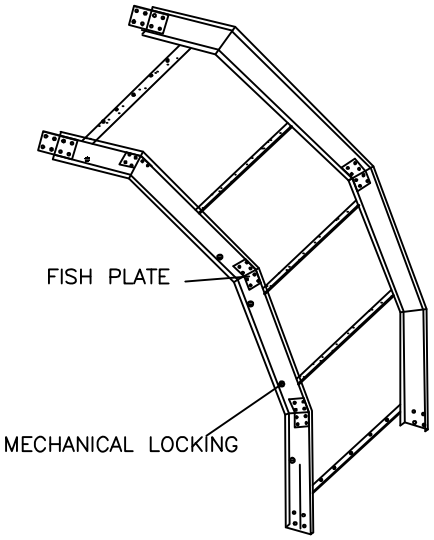
CABLE TRAY COVER

FOR GENERAL NOTES REFER SHEET 18 OF 18

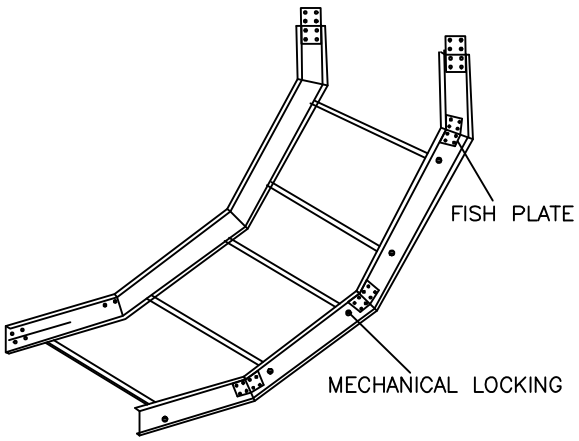
TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

DWG. NO.

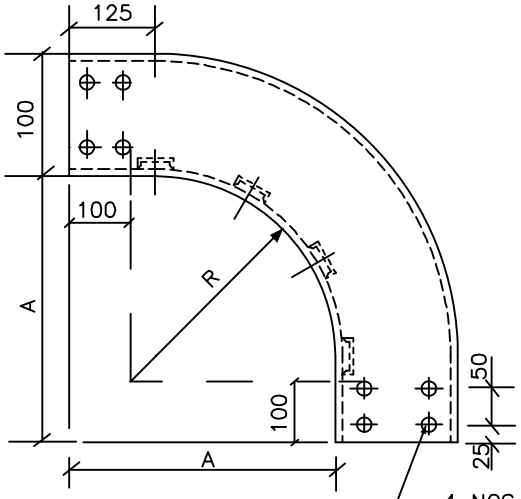
SPECIFICATION NO:- TECI:MAIT:FRPCT



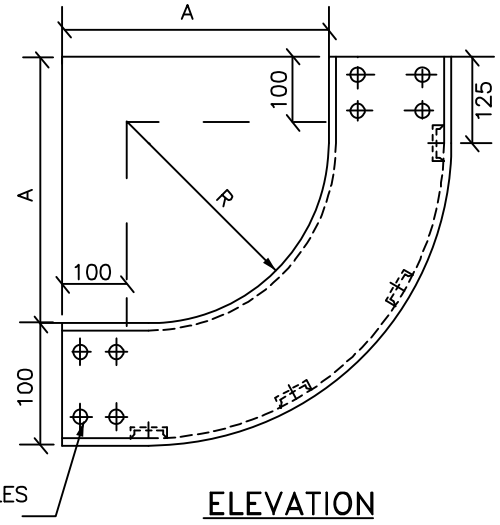
90° VERTICAL BEND
(OUTSIDE)



90° VERTICAL BEND
(INSIDE)



ELEVATION
90° VERTICAL BEND
(OUTSIDE)



4 NOS. 7 DIA. HOLES
FOR JOINTING

ELEVATION
90° VERTICAL BEND
(INSIDE)

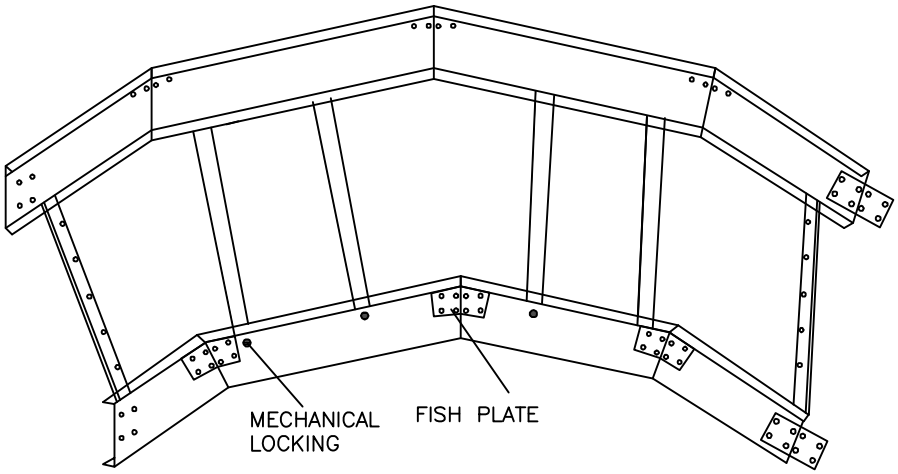
WIDTH(W)	RADIUS (R)	A
600	600	700
450	600	700
300	600	700

LADDER TYPE ACCESSORIES

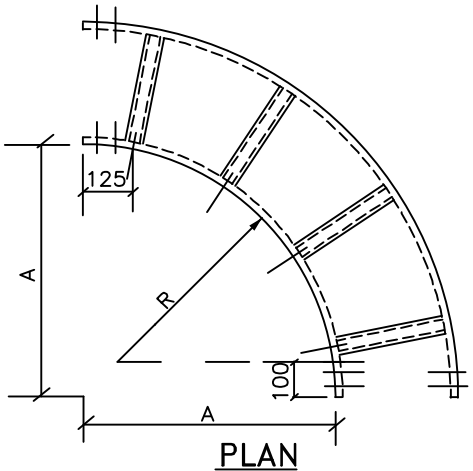
FOR GENERAL NOTES REFER SHEET 18 OF 18

TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

DWG. NO.
SPECIFICATION NO:- TECI:MAIT:FRPCT



90° HORIZONTAL BEND



PLAN
90°HORIZONTAL BEND

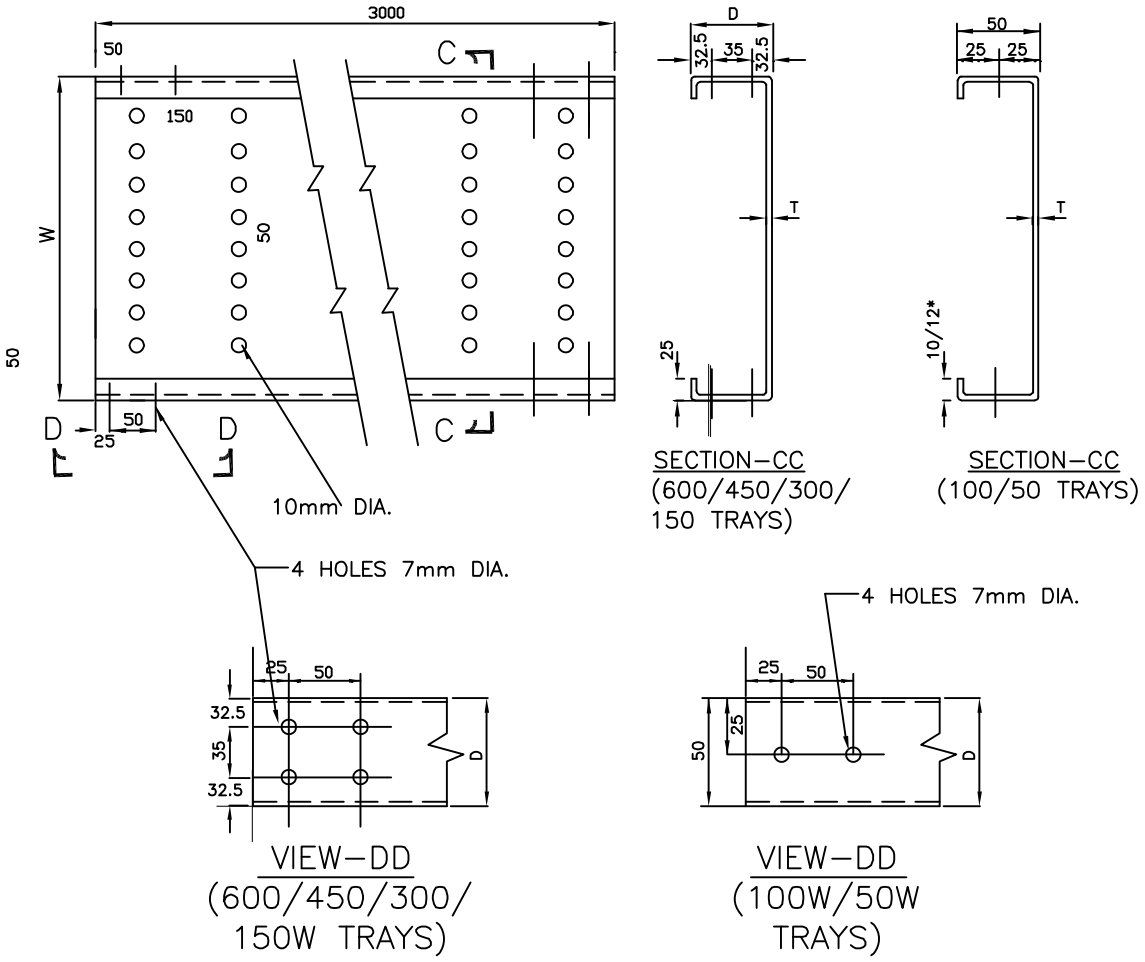
WIDTH(W)	RADIUS (R)	A
600	600	700
450	600	700
300	600	700

LADDER TYPE ACCESSORIES

FOR GENERAL NOTES REFER SHEET 18 OF 18

TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

DWG. NO.
SPECIFICATION NO:- TECI:MAIT:FRPCT



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

*10 MM FOR 50MM WIDE TRAY AND 12 MM FOR 100MM WIDE TRAY

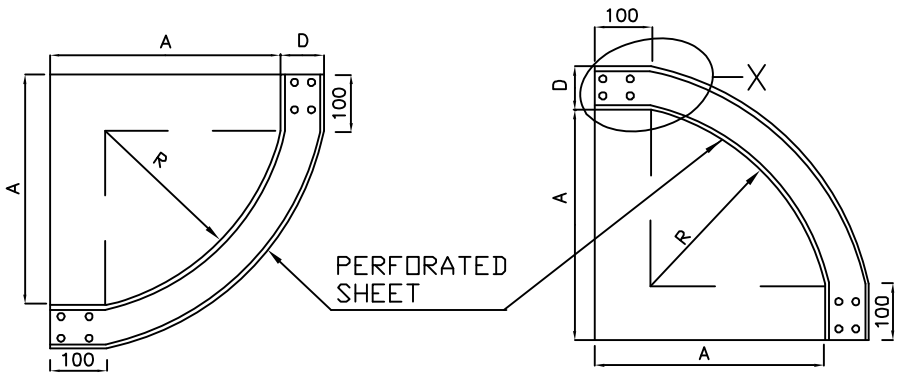
PERFORATED TYPE TRAY

FOR GENERAL NOTES REFER SHEET 18 OF 18

TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES

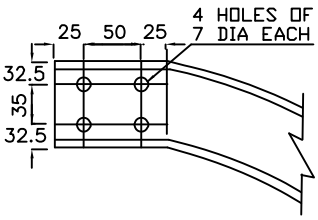
DWG. NO.

SPECIFICATION NO:- TECI:MAIT:FRPCT



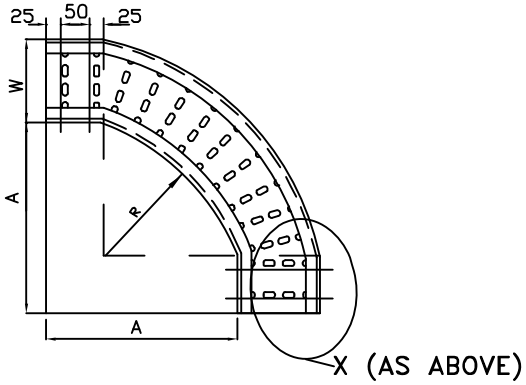
INSIDE TYPE

OUTSIDE TYPE



ENLARGED VIEW OF "X"

90° VERTICAL BEND - PERFORATED TYPE



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

90° HORIZONTAL BEND - PERFORATED TYPE

PERFORATED TYPE ACCESSORIES

FOR GENERAL NOTES REFER SHEET 18 OF 18

BHEL	TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES	DWG. NO. SPECIFICATION NO:- TECI:MAIT:FRPCT
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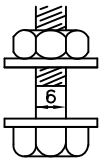
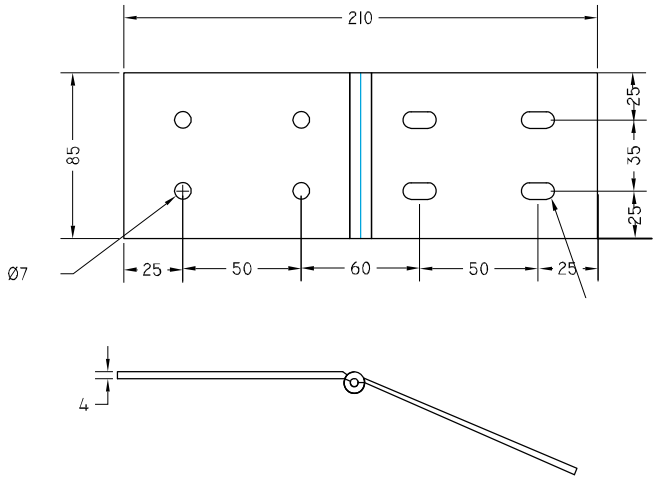
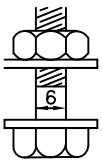


QTY. REQD/TRAY SECTION

A) 8 NOS. M6 BOLTS
B) 8 NOS. NUTS
C) 16 NOS. WASHERS

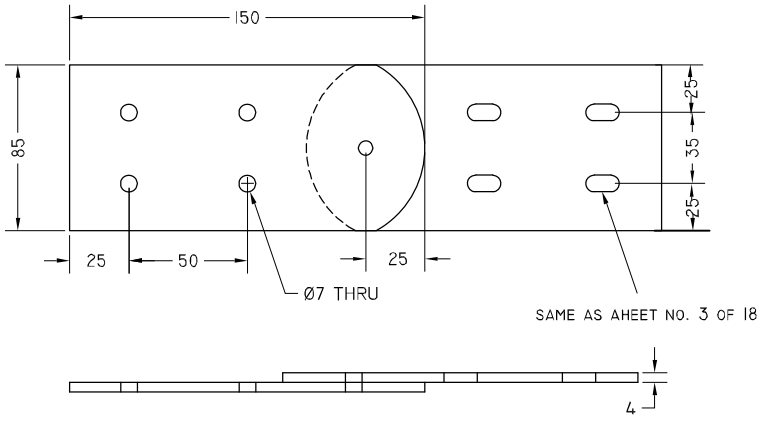


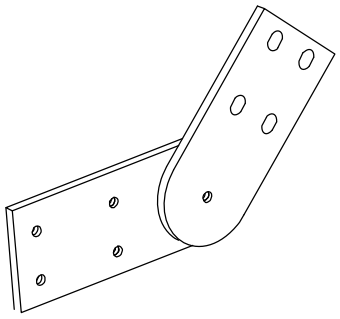
FRP ADJUSTABLE HORIZONTAL SPLICE PLATE



QTY. REQD/TRAY SECTION

A) 8 NOS. M6 BOLTS
B) 8 NOS. NUTS
C) 16 NOS. WASHERS





FRP ADJUSTABLE VERTICAL SPLICE PLATE

NOTES:

- ALL DIMENSIONS ARE IN MM.

FOR GENERAL NOTES REFER SHEET 18 OF 18

TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES	DWG. NO. SPECIFICATION NO:- TECI:MAIT:FRPCT
	SHEET 17 OF 18

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. FOR LADDER TYPE CABLE TRAYS AND ACCESSORIES, ALL RUNGS SHALL BE SQUARE TUBE.
3. STANDARD TRAY ACCESSORIES SHALL BE WITH THE RADIUS INDICATED IN THIS DRAWING.
4. ALL TRAY CORNERS SHALL BE SMOOTH AND FREE OF SHARP EDGES.
5. THE CABLE TRAY COVER SHALL BE OF 3MM THICKNESS AND SHALL BE OF FRP.
6. THE WIDTH, LENGTH & HEIGHT OF TRAYS & TRAY COVERS SHALL BE WITHIN A TOLERANCE OF (+) 2 mm. THE THICKNESS TOLERANCE SHALL BE (+) 0.5 mm. NO NEGATIVE TOLERANCE IN THICKNESS, WIDTH, HEIGHT OR LENGTH IS PERMITTED.
7. TO FACILITATE ASSEMBLY, ALL ACCESSORIES AT ENDS SHALL HAVE 100mm STRAIGHT PORTION.
8. ALL NUTS, BOLTS, WASHERS ETC., SHALL BE OF STAINLESS STEEL (SS 304).
9. COUPLER PLATES AND SPLICE PLATES SHALL BE OF FRP.
10. FINISHED TRAYS & COVERS SHALL BE FREE FROM BURRS AND SHARP EDGES.
11. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
12. 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
13. THE DEPTH OF 600W, 450W, 300W, 150W TRAYS & ACCESSORIES SHALL BE 100MM WHILE DEPTH OF 100W & 50W CABLE TRAY SHALL BE 50MM.
14. 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.

भेल BHEL	TYPICAL DETAILS OF FRP TYPE CABLE TRAYS AND ACCESSORIES	DWG. NO. SPECIFICATION NO:- TECI:MAIT:FRPCT
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