Raw material Requirements for manufacture of Columns and other structural Components by Sub contractors with their materials..

Rev no :00 ---Fresh issue.

Applicable Material Specifications : ASTM A 36, IS 8500 Fe 540, IS 2062 Gr.A & B (or As indicated in the Drawing)

REQUIREMENTS:

1. Materials shall be procured only from BHEL approved sources.

2. IS 2062 Gr A to be procured upto 20 mm thk. in killed or semi killed condition.
   IS 2062 Gr B to be procured above 20 mm thk. in killed condition
   IS 8500 Fe 540 shall be killed. Carbon Equivalent shall be < 0.48 ·
   A36 to be procured. in killed condition.

3. **Heat Treat ment**: As per material specification except for plates above 40mm which shall be procured in normalised condition

4. **Mechanical Properties:** As per material specification except for IS 8500 plates of thickness t > 63mm for which Min. Yield strength: :: 380 N/sq.mm.

5. **NON DESTRUCTIVE TEST AFTER HT :** Ultrasonic test: for Plates > 40 mm: ASTM A 435.

6. **Repairs** by fusion welding prohibited. Mechanical removal of defects permited subject to min. thickness & smooth surface

7. **CERTIFICATION :**
   Purchase Order No.(BHEL),TDC No., Test certificate number & Quantity.
   Specification and Grade with applicable year of code, Heat Number.
   Steel making process, Chemistry and heat treatment details.
   Mechanical, NDE & other test results with reference, acceptance standards

8. **Test certificate** meeting the above requirements shall be shown to BHEL/ its authorised Inspection Agency at the time of Inspection

9. **Marking:** The specification , rolling direction and Supplier identification shall be maintained for plates of thickness above 40 mm.

10. **Material control**: Material identification on receipt,storage and issue along with quantity reconciliation shall be ensured by the sub contractor.

K. Ganesan	V. Jayaraman	[illegible]
Prepared	Reviewed	Approved

QUALITY ASSURANCE Tiruchirappalli	STANDARD QUALITY PLAN ***STANDARD QUALITY PLAN - Column and Ceiling girder***	QP No.: SQP:NP:06 REV.: 02 DATE : 01/04/2003 PAGE : 1 of 6

Sl. No.	Component / Operation	Characteristics	Check			Reference Doc. / Acceptance Norm	Format of Record		Agency**			Remarks
			Cl	Type	Quantum				M	TPI	C	
1	2	3	4	5	6	7	8	D*	9			10
1.0	MATERIAL *											
	Plates,& Rolled Sections	Chemical &Mechanical Properties		Review of documents	100%	TDC/Mtl.Spec. & Note 1	TC		QC			* The materials used shall be as per Drg.
2.0	INPROCESS CONTROL					(Refer QCP 002 for details)						
2.1	Marking, Cutting, Edge Preparation. Att. plates and splicing of WF beams.	Shape, Size, Diagonal, Straightness		Visual & Measurement	100%	Drawings Note-2 & 3	R		QC			
		Gas cut edges		MPI/LPI	Note 4	BHE:NDT:PB:MT--01/PT-01	R		ND			
2.2	Welding	Procedure Qlfn.		Review of documents	100%	BHEL Procedure/ SIP:NP:07	WP		QC			
		Personnel Qlfn.		Review of documents	100%	WTC appd.list/ SIP:NP:07	R		QC			

LEGEND: Cl: Class(A: Critical, B: Major, C: Minor)
** TPI: Third Party Inspetion, C: Customer.
H: Hold Point, W: Witness,
V: Verification of Test reports/certificates
M: Performed by BHEL (For bought out items M: Performed by Vendor)
QC:Quality Control, ND:NDT Lab, SH:Shops
* D: Records for Data folder. R: Records

Prepared:	Reviewed:					Approved:
R.Arthanareeswara	C.R.Raju QA	S.Dhanabal Engineering.	S.Anbalagan OP & C	A.Kalyanaraman Production	N.G.Mohan QC	S.Viswanathan Head QA

Sl. No.	Component / Operation	Characteristics	Check			Reference Doc. / Acceptance Norm	Format of Record		Agency**			Remarks
			Cl	Type	Quantum			D*	M	TPI	C	
1	2	3	4	5	6	7	8		9			10
2.3	Weld Inspection	Weld size and finish		Visual Measurement	100%	Drawing SIP:NP:06	-		QC			
	1 Butt welds	Soundness		LPI/MPI RT	Note 4	BHE:NDT:PB:PT-01/MT-01 BHE:NDT:PB:SS:RT5	R		ND			
	2 T.Joints	Soundness		RT	Note 4	BHE:NDT:PB:SS:RT5	R		ND			
	3 Fillet welds	Soundness		LPI/MPI	Note 4	BHE:NDT:PB:MT-01/PT-01	R		ND			
2.4	DIMENSIONAL INSPECTION											
2.4.1	Individual pieces	Shape,Size, Straightness & Verticality		Visual Measurement	100%	Drawings & Note 5	R		QC			
2.4.2	Blue matching	Contact area		Visual Measurement	100%	SIP:NP:02	R		QC			
2.5	POST WELD HEAT TREATMENT(PWHT)	Time & Temp. ROH,ROC		Review of HT chart	100%	Note 6 QCP 002	R		QC			
3.0	FINAL INSPECTION											
3.1	Trial assembly	Matching, Water level Diagonals Dimensions & Verticality		Visual Alignment Measurement Plumb.	100%	Drawing SIP:NP:02 Note 5	R		QC			
3.2	Match marking, reference line & Level marking	Identification Dimension		Visual Measurement	100%	Drawings SIP:NP:02	R		QC			
3.3	Identification	WO/DU Number Designation & S/c code		Visual	--	Drawings SIP:NP:02	-		QC			
3.4	Painting and Preservation	Finish coat thickness		Visual Measurement	-- Random	SIP:PP:22	-		QC			
3.5	Packing and Protection	Stability Cover/shim plates		Visual	100%	Drawings SIP:NP:02 , Note7	-		QC			

Notes:

RECORD OF REVISIONS

Rev. No.	Clause No.	Details of revision
00	--	This document consolidates all requirements of various previous SQPs.
01	--	Totally revised incorporating all amendments issued and latest TDC numbers.
02	--	SIP nos updated.
	3.2 in Note 3	Tolerances for depth of section revised in line with AWS D1.1 (2002 edition)
	4.1.3 & 4.1.4 in Note 4	Modified to incorporate Amendment A3 to rev.01
	4.2.4	deleted under Fillet welds and included under Butt welds as 4.1.7
	4.3.4 in Note 4	Added to incorporate Amendment A4 to rev.01
	5.1 (Vi) in Note 5	Added to incorporate Amendment A2 to rev.01
	5.2.3 in Note 5	Out of straightness revised in line with AWS D1.1 (2002 edition)
	5.2.5	Revised in line with AWS D1.1
	P5 in Note 6	Modified to incorporate Amendment A1 to rev.01

NOTE 1

Material	Specification	TDC Nos.
Rolled sections	ASTM A36	0:301
	IS 2062 Gr A&B	As per Specifn.
Plates and sheets	IS 2062 Gr A&B	As per specifn.
	ASTM A36	0:301
	IS 8500	As per TDC
	DIN 17100 St 52.3	0:302
	SA 515 Gr 60 & 70	0:202
	SA 387 Gr.11 & 12	0:202
HSFG bolts, nuts & washers		5.037

NOTE 2

2.1 For ceiling girders, no temporary stiffeners /struts shall be provided for connecting web and flange during set up. If stiffeners are welded during forming I-section, MPI shall be done after removing the same.

2.2 Tension flanges are to be identified with hard stamping indicating tension flange.

2.3 CENTRE LINE MARKING

2.3.1 All I section columns shall be marked with centre lines, one on each flange and otheron one side of web. Box section columns will be marked on the web side. L section column shall be marked on the middle of leg.

2.3.2 Flange centre line shall be obtained by joining the centre point of web thickness at both ends.

2.3.3 Web centre line shall be obtained by joining the mid-points of the section depth at both ends.

2.3.4 After marking, the centre line shall be identified by legible centre punches of 25 mm length at an interval of 2mtrs. The punched portion of centre line shall be bordered with white paint.

NOTE 3

3.0 MARKING FOR BUILT UP COLUMNS/BEAMS / GIRDERS

3.1 The length and width of individual plates must be marked, punched at intervals of 2M. The diagonals shall be checked and the difference shall be within 2mm.

3.2 The column/Girder sections shall be fabricated by welding and ensured for dimensional tolerances as given below.

The tolerances for depth of section size are as follows.

Upto 1 M : ± 3.0 mm
1M to 2M : ± 5.0 mm
Above 2 M : + 8.0 mm / - 5.0 mm
Flange width : ± 3 mm
Web shift : 2mm

Notes:

3.3 MARKING AND PREPARATION OF ATTACHMENT PLATES

3.3.1 All attachment plates like base plates, top plates, gusset plates, bracings, bearing and guide plates shall be marked, cut to size and prepared by machining/shearing/grinding as per the drawing requirements.

3.3.2 The variation in length/width shall be within ± 2mm and diagonal difference shall be within 3mm.

3.3.3 The flatness shall be checked and shall not exceed 2mm for plate thickness of 50mm & below, and 3mm for plate thickness above 50mm.

3.3.4 The bolt holes and grout holes shall be correctly located and drilled as per drawing. Wherever specified in the drawing, match drilling shall be done with the mating part.The tolerance for finished holes are as follows:

1. Hole dia for friction grip bolts : +0.5/-0mm
2. Hole dia for other holes : +1mm/-0mm
3. Individual pitches : ±1mm
4. Cumulative pitch : ±2mm

3.3.5 Where splicing of rolled sections are envisaged,it shall be ensured that the rolled section is straightened and meets the requirements given below:

1. Straightness : 5mm
2. Splicing edge : Square to surface
3. Weld ends : Ground flush & LPI/MPI tested
4. Web centre line offset : 2mm max.

NOTE 4

4.0 Type and extent of NDE requirements:

4.1 BUTT WELDS

4.1.1 10% MPI for all thickness upto and including 25 mm.

4.1.2 100 % M P I. for thickness above 25 mm upto and including 32 mm.

4.1.3 100 % RT for Carbon steel if t>=32mm
SA 387 Gr12 if t>=16mm
SA 387 Gr22 if t>12mm

4.1.4 100% RT shall be carried out in the following for spliced joints before placing splice plates.
a) For thickness >= 32mm in case of built up columns
b) For section depth >= 600mm in case of rolled section columns.
100% MPI shall be carried out for sizes less than the above.

4.1.5 Spot RT for all "T" joints and splice joints of Ceiling girders. Spot RT shall be done minimum one Spot/joint.

4.1.6 In case of defect in any spot, two more spots in the same joint shall be radio graphed. In case of further defects,100%RT to be done. All defects shall be repaired.

4.1.7 100% LPI for back gouged / ground grooves before second side welding.

4.2 FILLET WELDS

4.2.1 100 % MPI if both plates are over 25 mm thickness.

4.2.2 10% MPI/LPI on all other fillet welds.

4.2.3 100% MPI for welds of tension flange with Web and bearing stiffeners.

4.3 GAS CUT EDGES AND WELD EDGE PREPARATION

4.3.1 100% MPI/LPI for all gas cut edges for t>=38mm.

4.3.2 10% MPI/LPI for all gas cut edges for t>= 20mm and below 38mm.

4.3.3 100% MPI/LPI for all bevel edges for t >= 20mm prior to welding.

4.3.4 100% UT to be done at shop for bevel edges meant for welding at site (for all thickness of flange and web butt joints) in ceiling girdor. This UT shall be done for a width of 100mm from the edge before edge preparation.

Notes:

5.0 TOLERANCES

5.1 Individual columns / girders.

(i) Length : ± 5mm

(ii) Twist : 0.005h per 5m length or 10mm whicheveris less where "h" is the height of beam / girder in mm.

(iii) Camber : 1mm/M and max of 10mm

(iv) Sweep : 1mm/M and max of 10mm

(v) Combined Warpage and tilt of flange : W/100 or 6 mm (whichever is greater) Where "W" is width of flange.

(vi) Bow in base : 3mm or 1mm / mtr. of diagonal plate of column. Whicever is higher.

5.2 TRIAL ASSEMBLY

5.2.1 Trial assembly shall be performed by butting of ends without providing any root gap.Variation in gap shall not be more than 2 mm.

5.2.2 Alignment of centre line of all the pieces of flanges and webs water level deviation shall be within 2mm.

5.2.3 i)Overall length of columns : ± 15mm

ii)Overall length of ceiling girders : + 8mm / + 15mm

iii)Out of straightness

For length upto 15 metres : 1 mm/M and Max. 10 mm

Length over 15 metres : 10mm + 1mm/M for the length in excess of 15 M

5.2.4 For ceiling girders location of load bearing stiffeners shall be maintained within ± 4mm from specified location.

5.2.5 Metallic contact between bearing stiffener and flange shall be ensured for atleast 75% of the stiffener bearing cross sectional area in contact with the inner surface of the flanges. The outer surface of the flanges when bearing against a steel base or seat shall fit within 0.25mm for 75% of the projected area of web and stiffeners and not more than 1mm for the remaining 25% of the projected area. Refer Figure 1.

NOTE 6

6.0 Post weld heat treatment (Stress relieving) shall be performed for:

P1	All butt welds when t>50mm or all welds to a tension member other than web-to-flange fillet welds and web stiffners at end bearing locations	600- 650°C
P4	All butt welds in tension members and all welds when t>16mm	650- 700°C
P5	All welds of P5 matl shall be post weld heat treated.In cases where the size of fillet/groove is less than 12mm, PWHT is not required for non load carrying members.	680- 730°C

All gas cut edges of load carrying members above 50mm thickness shall be heat treated at 600-650 °C for 30 minutes.Alternatively the gas cut edges shall be ground/machined to 3mm. Heat treatment is not required for gas cutting of column base plates.

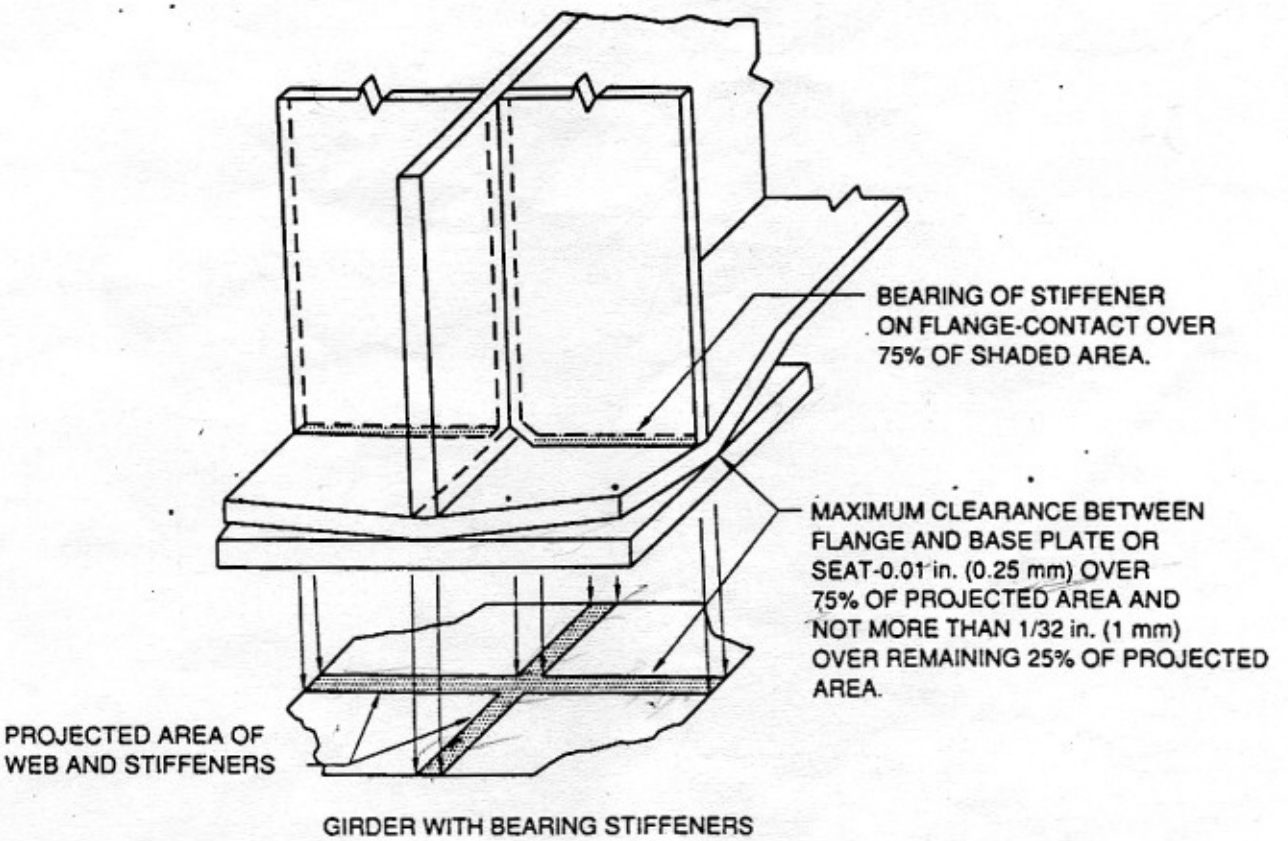
6.1 Refer QCP 002 for process controls and other details.

NOTE 7

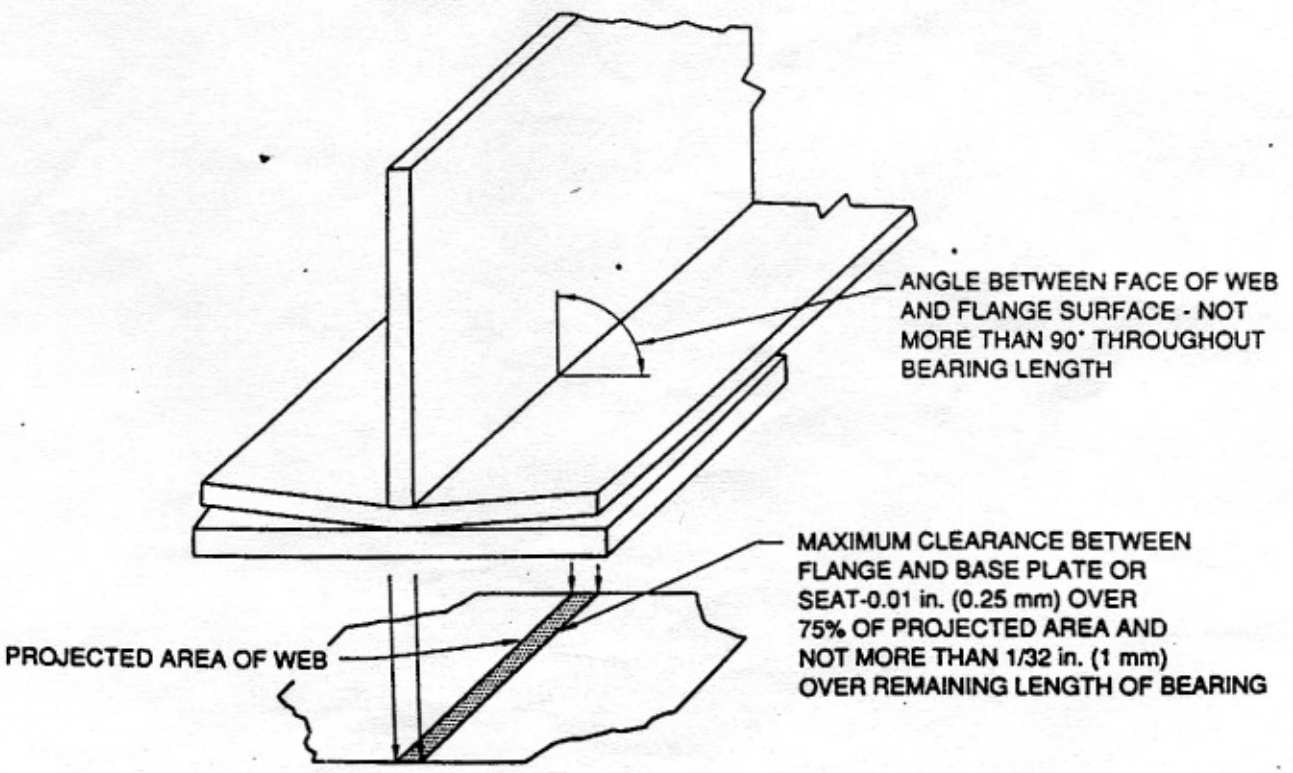
7.0 While stacking of columns, ensure that the flange portion of the column is kept horizontal and parallel to the firm ground. Adequate supports shall be provided so as to avoid sagging or distortion.

7.1 The requirements for cover and shim plate despatch is detailed out in SIP:NP:02

7.2 Storage, Preservation and Shipping shall be as per relevant Packing Instructions



GIRDER WITH BEARING STIFFENERS



GIRDER WITHOUT BEARING STIFFENERS

Figure - 1 — Tolerances at Bearing Points cl. 5·2·5

QUALITY ASSURANCE Tiruchirappalli	STANDARD QUALITY PLAN *STANDARD QUALITY PLAN - General Structurals*	QP No.: SQP:NP:07 REV.: 02 DATE : 01/04/2003 PAGE : 1 of 5

Sl. No.	Component / Operation	Characteristics	Check			Reference Doc. / Acceptance Norm	Format of Record		Agency**			Remarks
			Cl	Type	Quantum			D*	M	TPI	C	
1	2	3	4	5	6	7	8		9			10
1.0	MATERIAL											
	Plates,Sheets & Rolled Sections	Chemical &Mechanical Properties		Review of documents	100%	TDC/Matl. Spec. Note 1	TC		QC			
2.0	INPROCESS CONTROL					(Refer QCP 002 for details)						
2.1	Marking, Cutting, Edge Preparation	Shape, Size ,EP,Diagonal Straightness		Measurement	100%	Drawings, Note 2 & 5	R		QC			
		Gas cut edges		MPI/LPI	Note-4	BHE:NDT:PB:MT1/PT1	R		QC			
2.2	Welding	Procedure Qlfn.		Review of Documents	100%	BHEL Procedure SIP:NP:07	WPS		QC			
		Personnel Qlfn.		Review of Documents	100%	WTC approved list SIP:NP:07	R		QC			
2.3	Weld Inspection	Weld size & finish		Visual/ Measurement	100%	Drawing SIP:NP:06	-		QC			
	Butt welds	Soundness		LPI/MPI/ RT	Note 3	BHE:NDT:PB:PT1/MT1 BHE:NDT:SS:RT5	R		QC			
	T.Joints	Soundness		RT	Note 3	BHE:NDT:SS:RT5	R		ND			
	Fillet welds	Soundness		LPI/MPI	Note 3	BHE:NDT:PB:MT1/PT1	R		ND			

LEGEND: Cl: Class(A: Critical, B: Major, C: Minor)
** TPI: Third Party Inspetion, C: Customer.
H: Hold Point, W: Witness,
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M: Performed by BHEL (For bought out items M: Performed by Vendor)
QC:Quality Control, ND:NDT Lab, SH:Shops
* D: Records for Data folder. R: Records

Prepared:	Reviewed:					Approved:
R.Arthanareeswaran	C.R.Raju QA	S.Dhanabal Engineering.	S.Anbalagan OP & C	A.Kalyanaraman Production	N.G.Mohan QC	S.Viswanathan Head QA

Sl. No.	Component / Operation	Characteristics	Check			Reference Doc. / Acceptance Norm	Format of Record		Agency**			Remarks
			Cl	Type	Quantum				M	TPI	C	
1	2	3	4	5	6	7	8	D*	9			10
2.4	DIMENSIONAL INSPECTION											
2.4.1	Ladder	Length, Step position,Ends		Visual & Measurement	100%	Drawing	--		QC			
2.4.2	Buck stay beams	Corner piece,plate,pin connection,link-arrangements.Dimns.		Visual & Measurement	100%	Drawings NOTE-4	R		QC			
		Soundness		MPI/LPI	Note-4	BHE:NDT:PB:MT1/PT1	R		QC			
				RT	Note-4	BHE:NDT:SS:RT5	R		QC			
2.4.3	Roof beams	Shape,Size Straightness Verticality		Visual & Measurement Plumb	100%	Drawings NOTE-4	R		QC			
2.5	POST WELD HEAT TREATMENT(PWHT)	Temp.Soaking Time,ROH/ROC		Review of HT chart	100%	Note 5	R		QC			
3.0	FINAL INSPECTION											
3.1	**Trial assembly	Alignment, Matching, Diagonals, Orientation, & Inclination.		Visual/ Measurement/ Water level	100%	Drawings & SIP:NP:02 & SIP:NP:09	R		QC			*Applicable only if called for in the drg.
3.2	Matchmarking, Reference line & Level marking	Identification Dimension		Visual & Measurement	100%	Drawings & SIP:NP:02 & SIP:NP:09	R		QC			
3.3	Identification	WO.No.,DU No.& S/C code		Visual	100%	Drawings & QCP 002	-		QC			
3.4	Painting and Preservation	Finish Coat thickness		Visual Check	100% Random	SIP:PP:22	R		QC			
3.5	Packing and Protection	Stability Cover/Shimplates		Visual	100%	Drawings SIP:PP:22 & NOTE-6	-		QC			

Notes:

RECORD OF REVISIONS

Rev. No.	Clause No.	Details of revision
00	--	This document consolidates all requirements of various previous SQPs.
01	--	All amendments issued has been regularised and editorial corrections made for better clarity.Latest applicable TDC numbers incorporated.
02		SIP numbers updated
	2.4.1 in Note 2	Deleted. Cl.2.4.2 to 2.4.5 renumbered.
	Note 3	Deleted. Consequently, Note 4 to Note 7 renumbered as Note 3 to Note 6.
	3.2 & 3.2.1 in Note 3	Modified in line with QCP:002
	4.1.7 in Note 4	Out of straightness revised in line with AWS D1.1 (2002 edition)
	4.1.7.10(7)	Twist included

NOTE-1

MATERIAL	MATERIAL SPEC.	TDC No.
Rolled sections	IS 2062 Gr A/B	As per Spec.
	ASTM A36	0:301
Plates and sheets		
	IS 2062 Gr A / B	As per Specn.
	ASTM A36	0:301
	IS 8500	0.301
	DIN 17100 St 52.3	0:302
	SA387 Gr 12 & Gr 22	0:202
	SA 515 Gr 60 & 70	0:202

NOTE-2

2.0 MARKING

2.1 Wherever applicable squareness shall be ensured by checking Diagonals and reference lines shall be marked and punched.

2.2 For Rolled Column/Beams dimensional tolerances shall be as given below.

1) Depth of section
   a) Upto 1 M : ± 3 mm
   b) 1M to 2M : ± 4.5 mm
   c) Above 2 M : + 7.5 mm, - 4.5 mm

2) Flange width : ± 3 mm
3) Web shift : 2 mm
4) Length : 1 mm / M. Max.5mm

2.3 CENTRE LINE MARKING

2.3.1 All I section columns/Beams shall be marked with centre lines, one on flange and other on one side of web Box section columns will be marked on the web side.L section column shall be marked on the middle of leg.

2.3.2 Flange centre line shall be obtained by joining the centre point of web thickness at both ends.

2.3.3 Web centre line shall be obtained by joining the mid points of the section depth at both ends.

2.3.4 After marking, the centre line shall be identified by legible centre punching of size 10mm at the interval of 2 metres. The punched portion of centre line shall be bordered with white paint.

2.4 MARKING AND PREPARATION OF ATTACHMENT PLATES

2.4.1 The length/width variation shall be within ±2mm, diagonal difference within 3 mm.

2.4.2 The flatness shall be checked and shall not exceed 2mm for plate size 50mm & below and 3mm above 50mm.

2.4.3 The bolt holes and grout holes shall be marked and drilled

Notes:

as per drawing. Wherever specified in the drawing, match drilling shall be done with the mating part. The tolerance for finished holes are as follows:

1. Hole dia for friction grip bolts :+0.5 /-0 mm
2. Hole dia for other holes :+1 mm /- 0 mm
3. Individual pitches :±1 mm max.
4. Cumulative pitch :±2 mm max.

2.4.4 Where splicing of rolled sections are envisaged, it shall be ensured that the rolled section is straightened and meets the requirements given below:

1. Straightness : 5 mm
2. Splicing edge : Square to surface
3. Weld ends : Ground flush & LPI/MPI tested
4. Web centre line offset : 1.5 mm max

NOTE-3

3.0 TYPE AND EXTENT OF NDE
3.1 BUTT WELDS - MPI
3.1.1 100 % M P I. for thickness above 25 mm upto 32 mm.
3.1.2 100% MPI for Low alloy steel
P5 - Flame cut edges t > 12 mm before PWHT
P4 - Flame cut edges t > 16 mm before PWHT
3.1.2.1 All root groove areas after back chipping prior to welding second side.
3.1.2.2 All finished welds surface and adjacent plate surface following PWHT.
3.1.3 All fillet welds and adjacent plate following PWHT for P5.

3.2 BUTT WELDS
100% RT for carbon steel if t > = 32 mm
Low alloy steel P4 if t > 16 mm
Low alloy steel P5 if t > 12 mm

3.2.1 100% RT shall be carried out in the following for spliced joints before placing splice plates.
If thickness > = 32 mm in case of built up columns
If section depth >= 600 mm in case of rolled section columns.
3.2.1.1 100% MPI shall be carried out for sizes less than the above.
3.2.2 Spot RT for all "T" joints and splice joints
One spot/joint minimum shall be checked.
In case of defect in any spot, two more spots in the same joint shall be radiographed. In case of further defects, 100% RT is to be done. All defects shall be repaired.

3.3 FILLET WELDS

3.3.1 100 % MPI, if both plates are over 25 mm.thickness.
3.3.2 10% MPI/LPI on all other fillet welds.
3.3.3 100% LPI for back gouged/chipped area before second side welding of butt joints and fillet welds of splice plates with beams.

3.4 WELD EP

3.4.1 10% MPI/LPI for all gas cut edges for t>= 20 mm and below 38 mm.
3.4.2 100% MPI/LPI for all gas cut edges for t >= 38 mm and all bevel edges for t>= 20 mm

NOTE-4

4.0 FABRICATION TOLERANCES
4.1 The tolerances for fabrication shall be as per the relevant product drawing. However the following tolerances can be adopted, where not specified.
4.1.1 Length:
a) For members where ends are free : ± 1 mm / M subject to 5mm max.
b) Members connecting between two structural members : +0 mm - 3mm
4.1.2 Web shift : 2 mm

Notes:

4.1.3 Lateral deviation between the flange and web shall not exceed 2mm.

4.1.4 Combined warpage and tilt of flange of welded beams shall not exceed 1/100 of total width of flange or 6 mm whichever is greater.

4.1.5 The twisting of the beams or members shall not exceed 0.005h / 5M length subject to a maximum of 10 mm. (where "h" is the height of beam)

4.1.6 Flatness of web:
Permissible variations from flatness of webs having a depth`D' and thickness`t' in panels bounded by stiffeners or flanges or both whose least panel dimension `d' shall not exceed the following:

Where D/t < 150, maximum variation : d/115
Where D/t = > 150, maximum variation : d/92

4.1.7 Out of Straightness

Length upto 15 Mtr. : 1 mm/Mtr and max. 10mm.
Length over 15 mtr. : 10mm + 1mm/M for the length in excess of 15M

4.1.8 For Frames of General Structures the following tolerances shall apply:

Length and width	: ± 1.5 mm/Mmax. 6 mm
Difference between diagonals	: 2 mm/M max. 8 mm
Height	: + 1.5 mm/M max. 6 mm
Spacing of inter-mediate members	:± 3 mm

4.1.9 For handrails the variation permitted in length is ±3mm and bow is ±2mm per metre subject to a maximum of 10mm.

4.1.10 For monorail beams the following tolerances shall apply (clause Nos. 1 & 2 applies for all other beams also)

1.Depth of section	: ±3 mm
2.Flange width	: ±2 mm
3.Web shift	: 2 mm
4.Length:	
Runways connected in between	: +0 mm
two structures (Span upto 12m)	: -2 mm
5.Combined Warpage and tilt	: 3 mm max.
6.Sweep/Camber	: 5 mm max.

NOTE:5

5.0 PWHT shall be performed for:

P1	All butt welds when t > 50mm and any weld to a tension member t > 50mm	600-650° deg C
P4	All butt welds in tension members and all welds when t > 16mm All sheared edges for t > 16mm	650-700° deg C
P5	All welds of load carrying members All sheared edges for t > 12mm All welds of nonload carrying members for t > 12mm	680-720° deg C

5.1 Refer QCP 002 for process controls and other details

NOTE-6

6.0 While stacking of columns, ensure that the flange6 portion of the column is kept horizontal and parallel to the firm ground.Adequate supports shall be provided so as to avoid sagging or distortion.

6.1 The requirements for cover and shim plate despatch is detailed out in SIP:NP:02

6.2 Storage, preservation, shipping shall be as per the relevant packing instruction.

BHARAT HEAVY ELECTRICALS LIMITED

TIRUCHIRAPALLI 620 014

QUALITY ASSURANCE

SIP:NP:02 /02 PAGE : 1 Of 11

TRIAL ASSY OF COLUMNS, CEILING GIRDERS, MONORAIL & RUNWAY BEAMS

REV.	DATE	PREPARED	REVIEWED	APPROVED
				
02	31/03/2006	A.Francis	GSN Murthy	C.R.Raju

1.0 SCOPE

1.1 This procedure specifies the quality requirements for trial assembly of Ceiling Girders and columns including monorails and runway beams w.r.t match marking / level marking, and identification before dispatch.

2.0 **REFERENCE DOCUMENTS**

Relevant drawings/SQP/QCP

3.0 **PRE REQUISITES**

3.1 All the sub components to be trial assembled (on leveled surface) shall be fully completed (including NDE checks) and certified and/or cleared except those operations required to be done during or after trial assembly.

3.2 Flatness of bottom flange shall be within 1mm when a straight edge is kept at pad seating area of the crossbeam / ceiling girder.

4.0 **COLUMNS:**

METHODOLOGY		
Assembly sequence	Top to bottom or bottom to top	
No of stages	Single stage or two stage	Minimum 3 pieces required. Last piece to be assembled during 2nd stage assembly
		Cover plates to be match drilled before dismantling the trial assembly.

4.1 **TRIAL ASSEMBLY OF <u>WELDED TYPE "H" type COLUMNS</u>**

a. Assembly position: Flanges vertical, Web horizontal.

b. Ensure square ness of matching ends and straightness before trail assembly.

c. Web **section depth** differences at the matching faces shall be **equally distributed on both flange faces** and flange centerlines shall be aligned

d. Ensure proper preheating for tack welding during trial assembly.

e. The matching ends shall butt in trial assembly (**with 0 gap**) with local gaps not more than 2mm.

f. **Centerline alignment** of flange and web of adjacent sections shall be **within 2 mm** as checked by water level and piano wire at joints.

g. **Out of straightness:**

- 4 mm maximunm for single piece
- Full assembly: 18mm maximum.
- Part assembly: 10 mm maximum for 3 pieces.

h. **Overall length variation:**

- Individual length: within +/- 3 mm
- Full assembly: with in +/- 15 mm.
- Part assembly: with in +/- 5 mm

4.2 **TRIAL ASSEMBLY OF <u>BOLTED TYPE 'H' Columns</u>**

a. Assembly position: Flanges vertical, Web horizontal.

b. <u>End faces of individual pieces:</u> Flat and square to both web and flange axis.

c. Process: Milling / grinding / scraping.

d. Method of assembly: Shall be supported on rollers. Pulling individual column pieces using cleats and bolts for close contact during the trial assembly.

e. Method of checking surface contact/matching: By applying thin and semi transparent layer of Prussian blue on one matching face for each joint. The matching face of the other column piece shall be brought in close contact using cleats & bolts.

f. Acceptance criterion: Blue transfer (uniformly distributed) for 80% of the total area. Localized gap (by feeler gauge measurement) up to 0.2 mm considered as acceptable.

g. Blue matching between bottom face of pin connection and top face of column is not required.

4.3 Flange width off set above 3mm shall be ground to 1: 4 taper.

4.4 Upto 1 mm gap between cover plates and flange/web faces (in hand snug tight condition) is permissible. and < 3 mm gap between cover plates the rest plate is permissible.

4.5 Offset between adjoining flange, web faces shall leveled as detailed below ..

a. By grinding (unto 10% Thickness) flange, web faces (welded end of joint).

b. By using suitable shim plates(bolted end of joint)as shown in Fig 1.

4.6 **Out of straightness:** As per 4.1 g

4.7 **Overall length variation:** As per 4.1 h

4.8 The bolt holes in the joints shall be match drilled on rest, cover and shim plates (tack welded to main plate). Hole alignment within 0.5 mm Max.

4.9 **TRIAL ASSEMBLY OF PLUS COLUMN WITH END PLATES**:

- As per 4.1 a to 4.1 h
- End faces of individual pieces: Flat and square to both web and flange axis.

For octagonal rest plates the flatness shall be within 0.5 mm. Local depressions upto 0.5mm (within 20% of area) are acceptable. Upto 0.5 mm gap between rest plates is permitted. Gap <3 mm between cover plates the rest plate region is permissible.

- For rectangular extended rest plates: As above.
- Base plate verticality / out of square ness in trial assembled condition shall be within 4 mm.
- Top piece top out of verticality/ out of square ness in trial assembled condition shall be within 3 mm.

5.0 **CEILING GIRDER TRIAL ASSEMBLY:**

a. Scope: As below

   a. 2 and more consecutive main ceiling girders for full length
   b. Welded beams between main ceiling girders and
   c. Rolled beams with welded cleat angles bolted to welded beams.

b. Trial assembly position **"I"** (Web vertical).

c. Level checking: By setting to water level with in 3 mm. The verticality of the girders shall be checked by plumb.

d. The matching ends shall be butted in trial assembly (**with 0 gap**) with local gaps not more than 3 mm.
e. The girders shall be aligned for top face of the bottom flange.
f. After the first compartment trial assembly is completed with girder 1 & 2 girder 2 is taken for further trial assembly with girder 3 and so on.
g. Bottom of steel (BOS)reference shall be transferred to upper side of tension flange of ceiling girder. Elevation and level of welded beams shall be maintained w.r.t to the same.
h. On satisfactory completion of trial assembly, all the boltholes of cleats shall be match drilled on with Girders/welded beams as shown in drawing.
i. The assembly tolerances are as given below.

Distance between two girders	+/- 5mm
Distance between cross beams	
For individual	+/- 2mm
Overall from center line	+/- 5mm
Load bearing stiffener to boiler axis	+/- 4mm
Water level variation	
Girder	3mm
Cross beam	2mm
Girder Web verticality	Lesser of 0.005 H 10 mm
Distance between column connection holes	+/- 4 mm
Diagonal difference (See Figure 2)	
For each compartment	10mm max.
Total assembly	25mm max.

6.0 **MARKING**

6.1 MATCH MARKING OF COLUMNS

Each joint shall be identified by a unique letter A, B, C etc. Flange, web and cover plates of each joint will have an alpha numeric markings like A1-A1, A2-A2, etc. for the flange, web, cover plates. The match marks shall be hard stamped and stenciled shown in Figures 3, 3A, 3B & 3C (as applicable).

6.2 LEVEL MARKING OF COLUMNS (See figure 4)

a. All dimensions shall be measured from the top end only when all pieces of column are assembled at a time in one assembly. If part assembly from bottom is done, level marking shall be done from bottom.
b. For top to bottom sequence of trial assembly the OLV (Overall length variation) of the full column shall be marked on the bottom most piece and shall be marked as + * mm or - * mm w.r.t “0” level of the column.

c. When bottom to top sequence of trial assembly is done in two stages, the OLV (Overall length variation) of the full column shall be computed progressively based on actual measured values from bottom to top and should be marked on the top most piece and shall

be marked as + *mm or - *mm as per the actual measurement w.r.t TOS (Top of steel) level of the column. In such cases, the bottom piece should be marked at the "0" level as **" See 'OLV' on top piece"**. This shall also be written with white paint and hard punched and bordered with white paint.

d. When top to bottom sequence of trial assembly is done in two stages, the OLV of the full column shall be computed progressively based on actual measured values from top to bottom e. The OLV shall be marked on the bottom most piece (having base assembly) as + * mm or - * mm w.r.t "0" level of the column.

e. For partial TA from bottom to top the distance between top most face and immediate lower level marking shall be marked.(see figure 4)

f. For first partial started from top , the dimension of bottom end in the assembly from the nearest level mark above shall be recorded during the first partial TA. (see figure 4)

g. Even when OLV is found to be nil the same shall be marked as "0". (Applicable for both cases of trial assembly)

h. Levels in steps of 5 meters shall be punched on the column, taking `0' level as reference. The levels shall be identified by number punching like 0 M, 5 M, 10 M etc., on 3 flange faces in case of **+** type and box type, on 2 flanges and web in case of **I** type and shall be bordered with white paint as shown in Fig. 4. Arrow mark shall be stenciled along with level marks with the arrow pointing downwards.

i. All the cover plates for flange as well as web to be dispatched along with the respective columns. Shim plates to be properly set in position and tack welded with respective columns.

j. The cover plate should be turned by 180° then be bolted using two diagonally opposite bolts. The cover plate should also be tack welded after bolting as shown in **Figure 7**. The identification details to be punched/stenciled on flange and cover plates of flange and web are detailed in Figure 8.

6.3 MATCH MARKING OF CEILING GIRDERS

a. Prior to dismantling from ceiling girder trial assembly, joints shall be identified by girder designation (as per drawing) and match marked by hard stamping of each girder with unique suffix 1.2 .. 3.. etc. Flange & Web at the joint shall be marked with match marks as indicated below. (Example: For girder E: E1 - E1 and E2-E2 and so on. See Figure 5 for further information).

b. The location of the respective cross beam shall be marked on the web of the ceiling girder.

c. During trial assembly the cleat angles shall be tack welded/bolted with the main girder in the respective position and tack welded to the corresponding crossbeams. Cleat angle locations with girder shall be match marked in the trial assembled condition as indicated below.

d. Compartment E & F: Starting from L.H. end

a. "E" girnder	E1, E2, E3, E4...E13 AND E14	Compartment EF
b. "F" girder	F1, F2,F3,F4--F13 AND F14	
c. "F"girder	F15,F16,F17,F18..F27 & F28	Compartment FG

e. The match mark on girder web and cleat angle leg are to be hard stamped and bordered. On the other leg of cleat angle respective WB number shall be hard stamped and bordered.

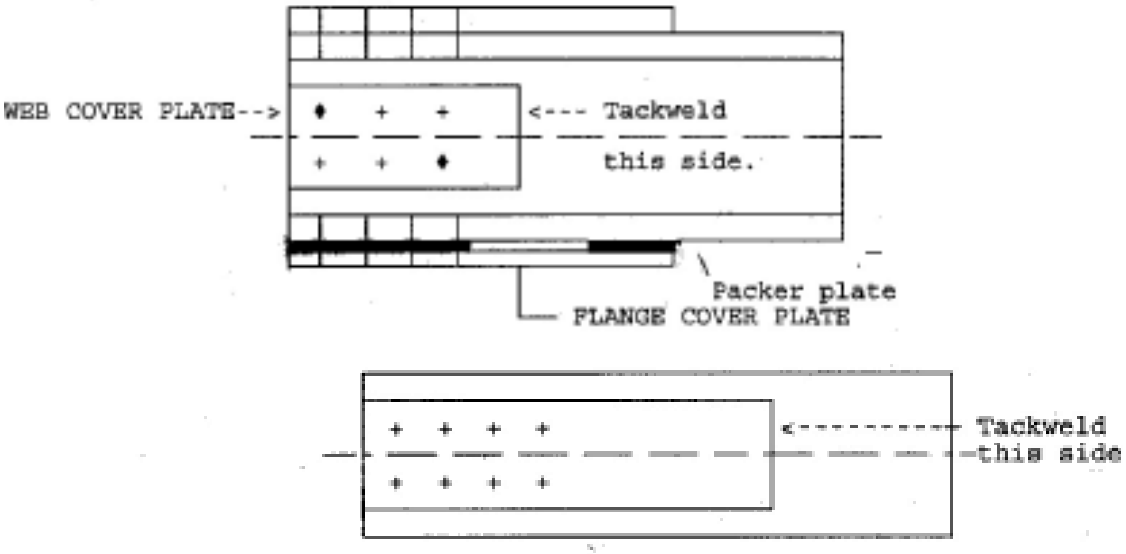
7.0 **TRIAL ASSEMBLY OF MONORAILS AND RUNWAY BEAMS**

a. Measure the I section size and web offset of the individual beams and select the matching ends before proceeding with any further operation.
b. All the beams shall be trial assembled on level surface (pertaining to single row). Trial assembly can be done in two stages when it is not possible to carry out in single row. All pieces of runway beams shall be trial assembled as per layout drawing.
c. Verify the matching of bottom flange inner surface at the joint of consecutive beam. The level difference between the flange face at bottom and top shall be adjusted by grinding to accommodate splice plate / beams.
d. Out of straightness on total length 10mm maximum.
e. Individual beam length between supports limited to +0 mm / -2 mm.

8.0 **IDENTIFICATION & CERTIFICATION**

8.1 The results of trial assembly shall be documented and signed off by inspection agency /QC before dismantling.

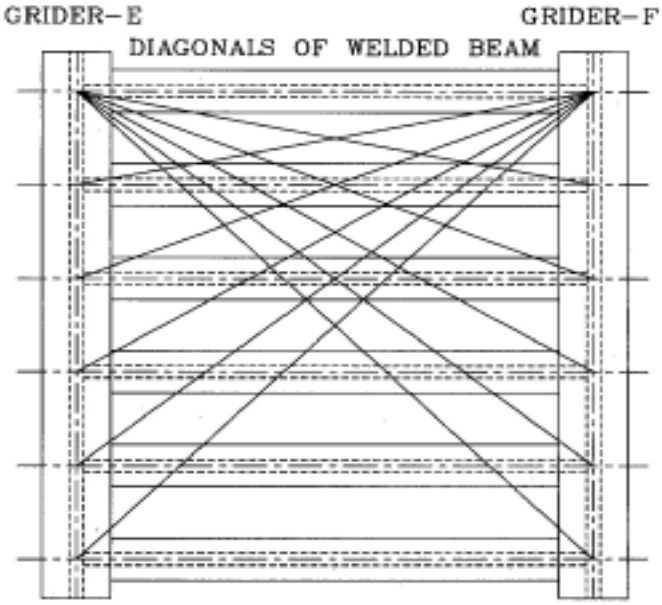
FIGURE 1: COVER PLATE/SHIM PLATE MARKING before dispatch.



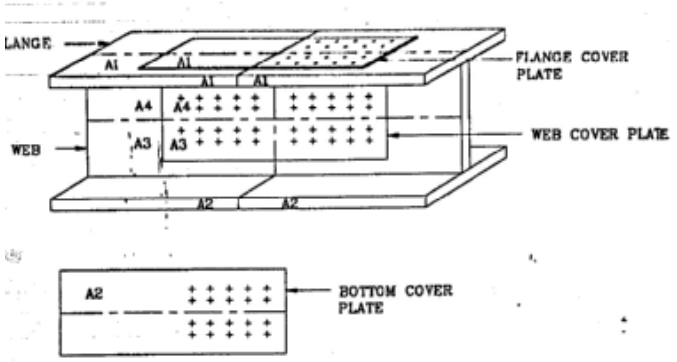
Note: 1) Lock the plates by Tackwelding at 3 locations (Tackweld of 10mm length each distributed equally).

2) Use packer plates whenever shim plates are used.

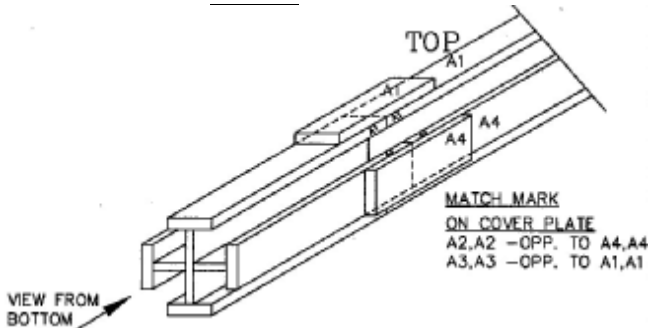
Figure 2



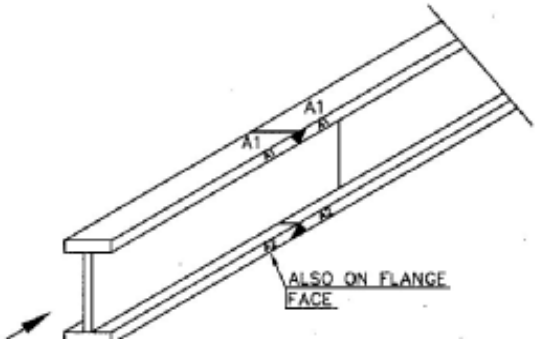
MATCH MARKING OF COLUMNS – FIG 3 A: I TYPE - BOLTED



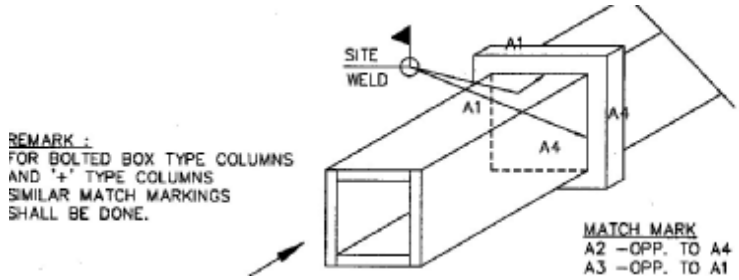
MATCH MARKING OF COLUMNS – FIG 3B: PLUS TYPE - BOLTED



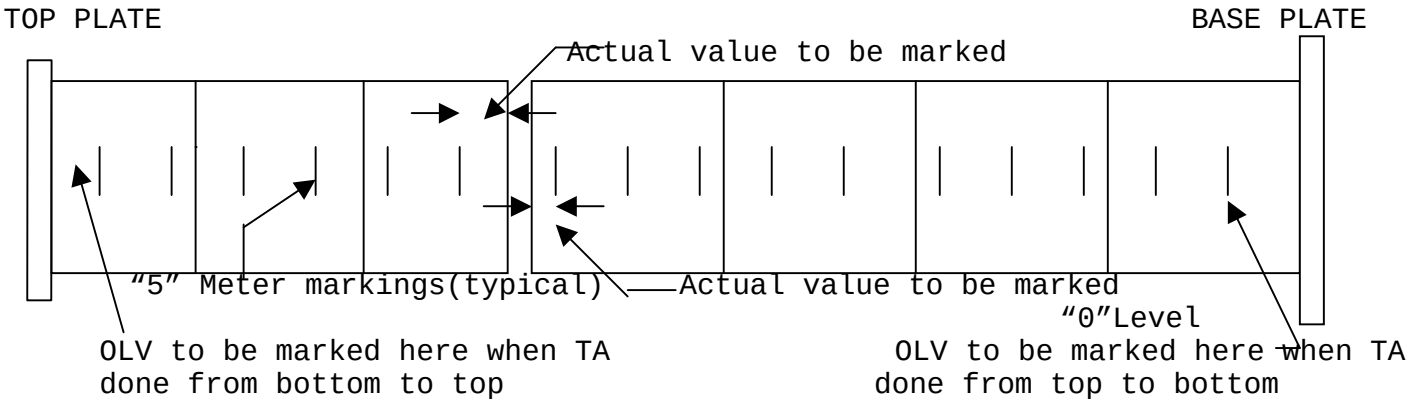
MATCH MARKING OF COLUMNS – FIG 3C : I type – welded



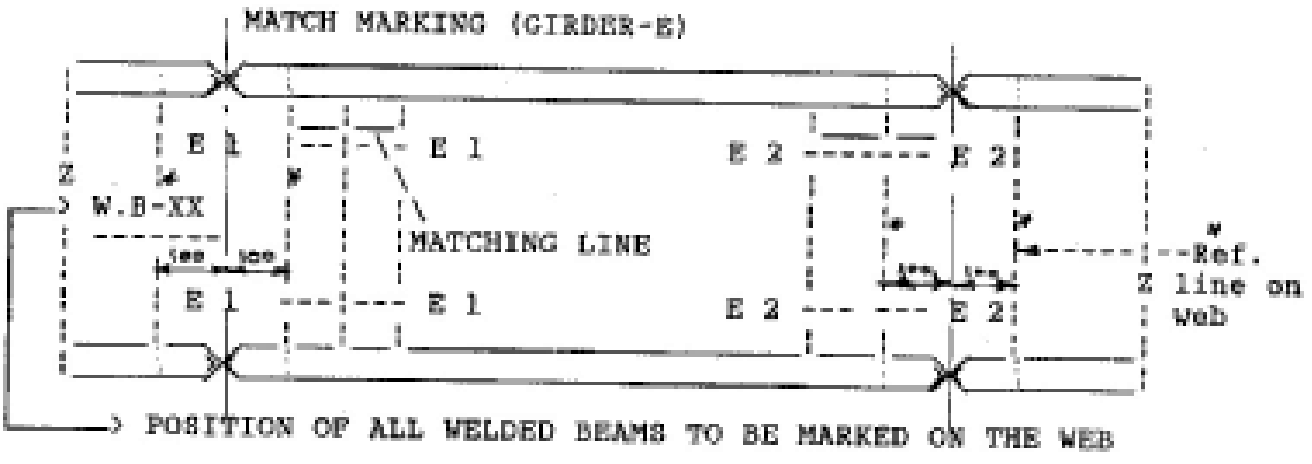
MATCH MARKING OF COLUMNS – FIG 3 D : Box type – welded

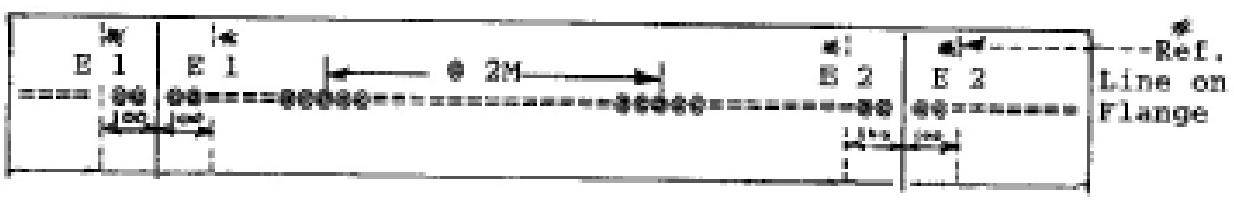


COLUMN LEVEL MARKING FIGURE 4



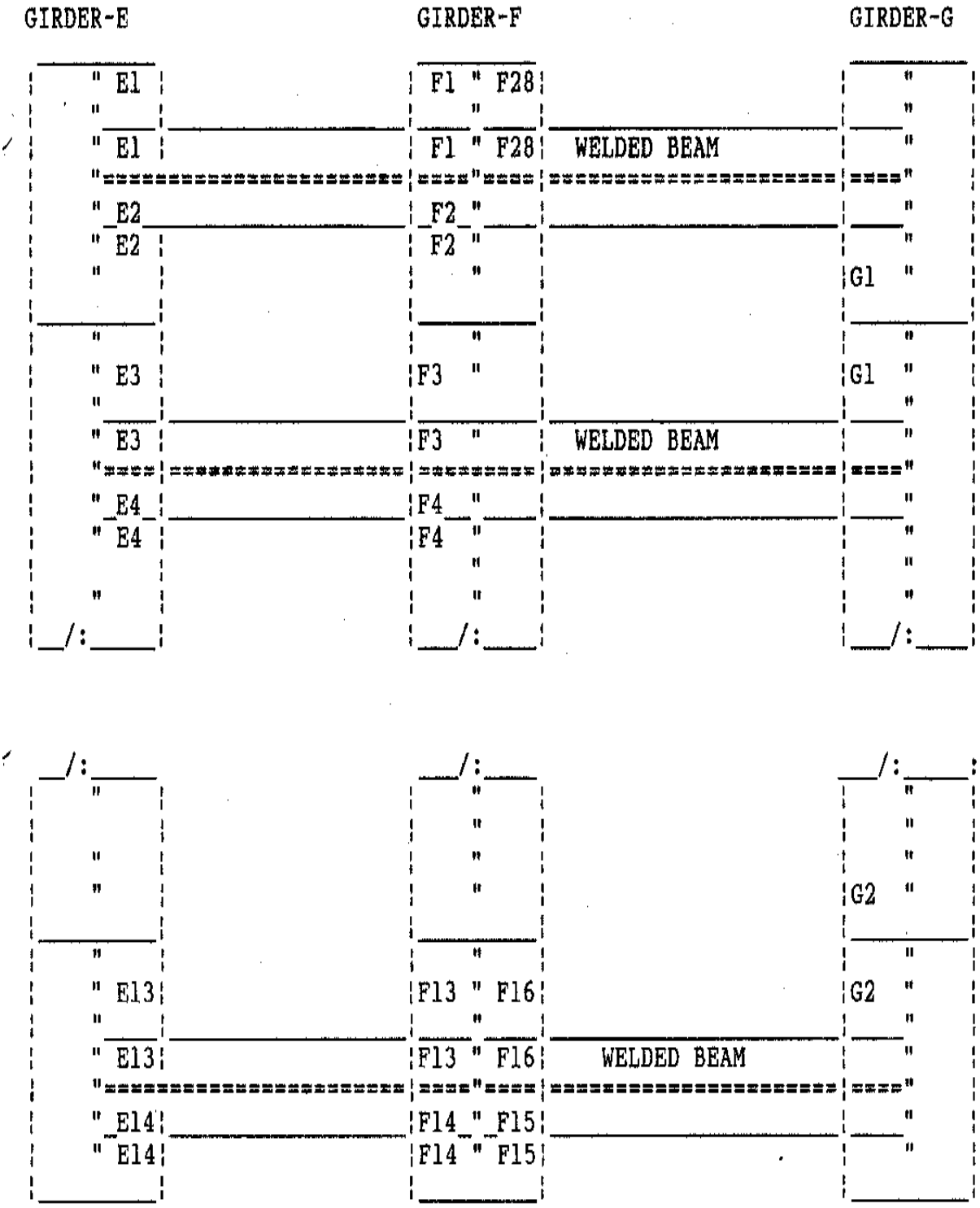
MATCH MARKING OF CEILING GIRDERS : FIGURE 5



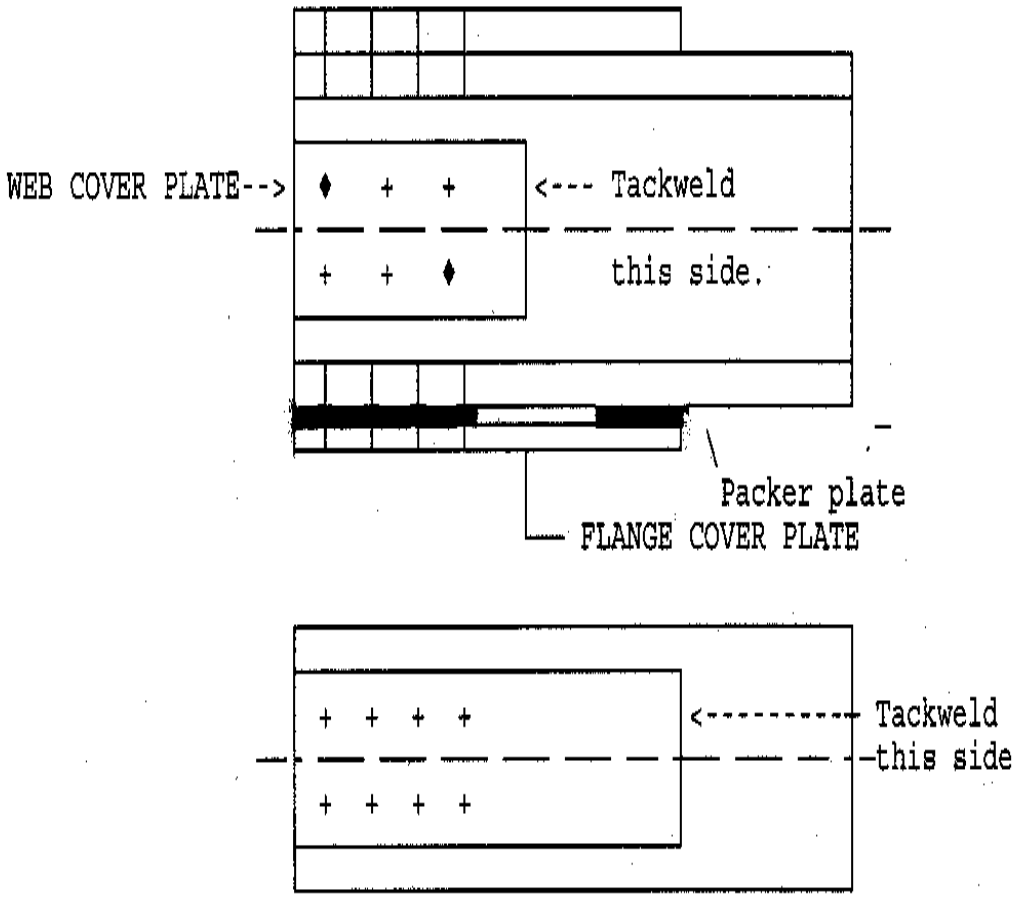


CENTRE LINE PUNCHING OF FLANGE AT INTERVALS OF EVERY TWO METRES

SCHEME OF MATCH MARKING FOR CEILING GIRDERS : FIGURE 6



DESPATCH OF COVER PLATES AND SHIM PLATES : FIGURE 7

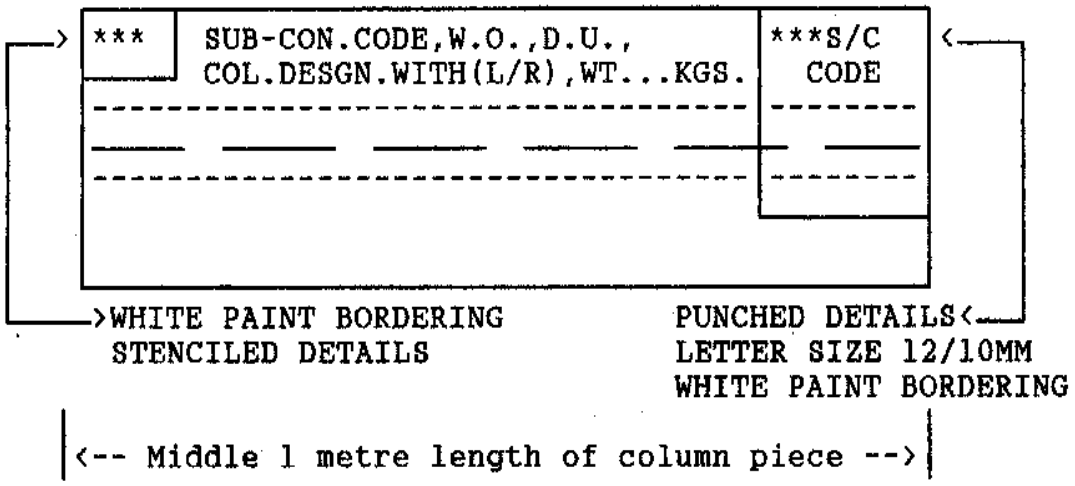


Note: 1) Lock the plates by Tackwelding at 3 locations (Tackweld of 10mm length each distributed equally).

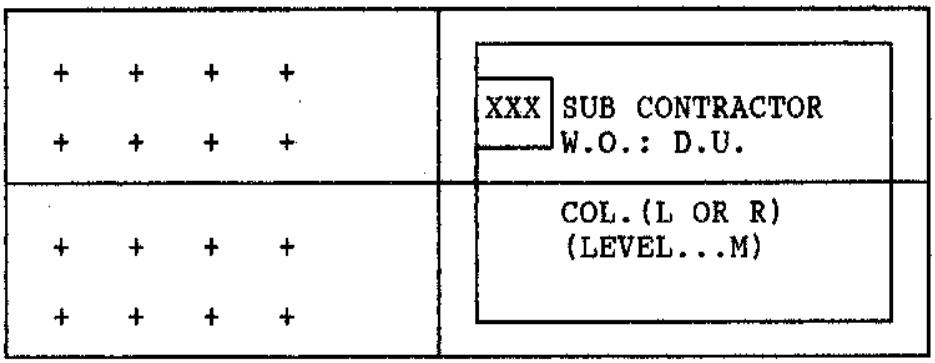
2) Use packer plates whenever shim plates are used.

IDENTIFICATION DETAILS : FIGURE 8

IDENTIFICATION DETAILS FLANGE PORTION

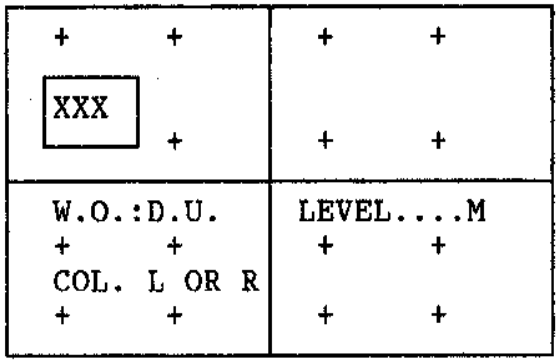


FLANGE COVER PLATE



WEB COVER PLATE

PUNCHED DETAILS
BORDERED WITH WHITE PAINT



BHARAT HEAVY ELECTRICALS LIMITED

TIRUCHIRAPALLI 620 014

QUALITY ASSURANCE

SIP:NP:09 /01 PAGE : 1 Of 6

TRIAL ASSEMBLY OF DIAGONAL BRACING (BOLTED CONNECTION)

REV.	DATE	PREPARED	REVIEWED	APPROVED
				
01	05/04/2004	A.Francis	GSN Murthy	C.R.Raju

REVISION STATUS

REVISION NO:	CLAUSE NO	DETAIL OF REVISION
01	1.0,	Modified for better clarity.
	6.5, 6.6, 6.7	Added based on site feed back.
	7.1.1	Modified for better clarity.

1.0 SCOPE

This procedure details out the requirements for trial assembly of diagonal bracings (including gusset plates) of bolted type with columns, match marking and identification prior to dispatch.

2.0 REFERENCE DOCUMENTS

Relevant drawings/SQP:NP:06 & SQP:NP:07/OPS and SIP:NP:02

3.0 PRE REQUISITES

3.1 The bracings to be trial assembled shall be fully completed except for those operations which are necessarily to be done during or after trial assembly.

3.2 Necessary NDE checks shall be completed before taking the components for trial assembly.

3.3 Necessary certification shall be completed before taking the components for trial assembly and clearance of concerned inspection agency shall be obtained for trial assembly, wherever envisaged.

3.4 Trial assembly shall be laid out on a level surface.

4.0 LAYOUT MARKING

4.1 Full scale layout of the columns and the diagonal bracings and gusset plates for each tier shall be made as per drawing dimensions. Size and squareness of the layout shall be ensured by verifying the width, length and diagonals.

4.2 Care shall be taken to suitably overlap the 25mm site allowance provided in the gusset plates on the column flanges while marking the layout.

4.3 Sufficient size of plates/sheets shall be used on all the four corners of the layout so that full details of the gusset plates, bracing size, drill pitches and work points are marked as per drawing dimensions.

4.4 Gusset plate to be cut / trimmed to the required shape only after verifying the gusset plate size in the full scale layout.

4.5 Bracing along with the gusset plates shall be laid out on the layout. Bolt hole locations shall be marked on the gusset plates.

4.6 Bolt holes on the gusset plate and bracing shall be drilled together in matched condition.

5.0 TRIAL ASSEMBLY OF BRACING AND GUSSET PLATES

5.1 After match drilling, diagonal bracing along with gusset plate shall be laid out on the layout for inspection.

5.2 Layout dimensions shall be marked on the top side of the assembly also.

5.3 After ensuring the width, length and diagonals, the dimensions of work point, bolt hole locations and pitches and orientation of bolt holes with respect to center lines and gusset plates shall be verified.

5.4 For the bottom most bracing, where the bracing joins with the column base, the verticality and co-axiality of the holes shall be verified by plumb after water leveling the bracing. The co-axiality shall be maintained within 1mm.

6.0 TOLERANCES

6.1 Diagonal difference = 5mm max.
6.2 Work point dimension = + / - 2mm
6.3 Bolt hole pitches
Individual = + / - 1mm
Cumulative = + / - 2mm

6.4 Hole size and verticality shall be checked with a **'Go'** and **'No Go'** gauges. (Refer sketch-1)

6.5 Inside Distance between Gusset plates : - 0 , + 3 mm

6.6 Distance between bracing seating faces: + 0 , - 3 mm

6.7 Gauge/template for checking should confirm to 6.5 and 6.6 requirements.

7.0 MATCH MARKING

7.1 Bracing and gusset plates and shim plates shall be match marked before dismantling.

7.1.1 All bracings and gussets will be match marked with an alphabet followed by numerals such as .

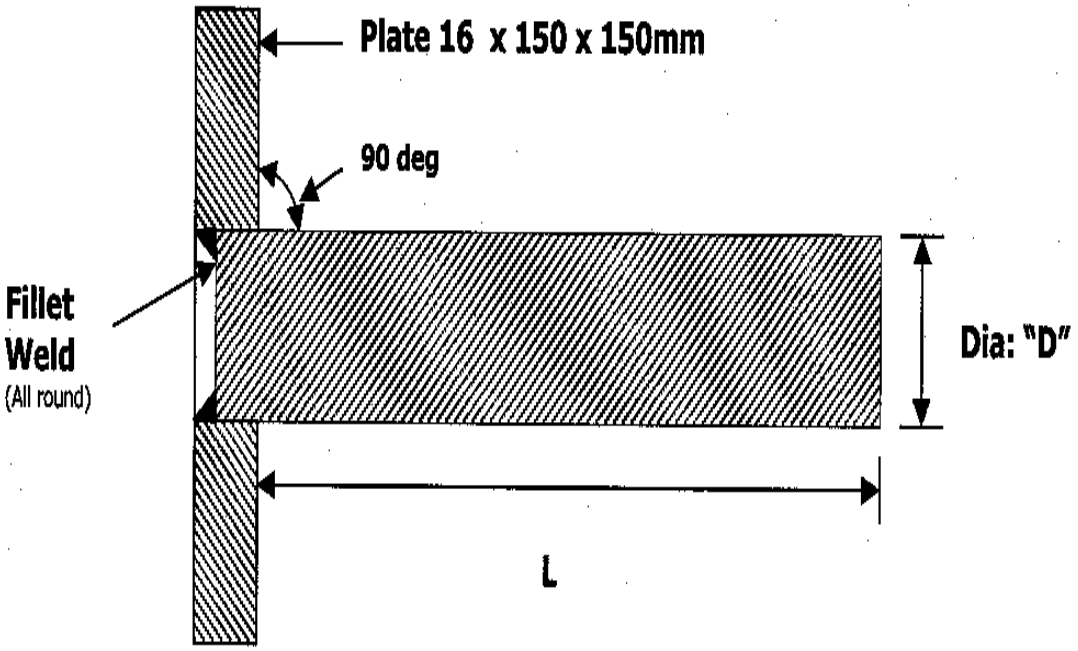
Lower bracing as 'A' with running Sl.No. like A1,A2 etc.,
Middle bracing as'B' with running Sl.No. like B1,B2 etc.,
Upper bracing as 'C' with running Sl.No. like C1,C2 etc.,
as per Sketch-2

Where more than one identical gussets are envisaged under same DU, additional alphabet like L (for LHS), R (for RHS), F (for Front) , R (for Rear) can be added (as necessary) to the existing identification for extra clarity.

Refer Clause 6.4

SKETCH – 1

SIP:NP:09/00
Page 05 of 06



Dia : "D" = 25mm for 'Go' Gauge

Dia : "D" = 26mm for 'No Go' Gauge

L = Length =Thickness of (Gusset + Bracing) + 10 mm Min.

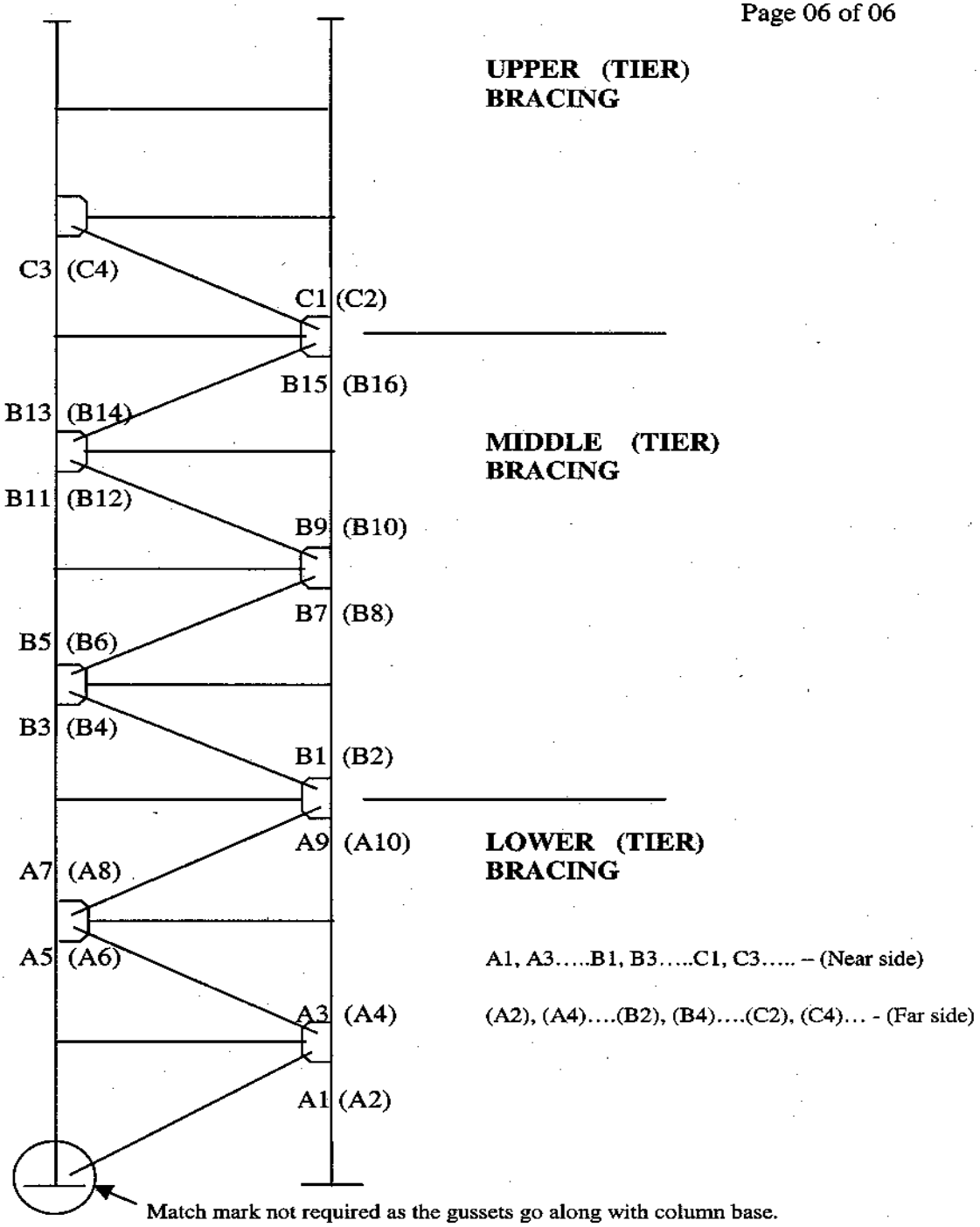
7.1.2 The match marks shall be hard stamped on gusset plates and bracings

before dismantling the trial assembly.

7.1.3 The match marks shall also be stenciled after painting.

SKETCH - 2

SIP:NP:09/00
Page 06 of 06



TYPICAL VIEW .