



Government of West Bengal
Office of the Superintending Engineer
WBSRDA, P&RD Deptt., North Bengal Circle
RRNMU Building (2nd Floor), Ward No- 08, Kingsaheb Ghat,
Jalpaiguri-735101
email: Superintending.engineer.nbc@gmail.com

Memo No. 604 /SE (NBC)/22-23

Dated: 24.02.2023

**NOTICE INVITING PRE-QUALIFICATION - CUM –
TENDER**

(TWO COVER SYSTEM) FOR RIDF PROJECTS (E-Procurement)
e-NIT No:15 of 2022-23

For and on behalf of Panchayats and Rural Development Department, Govt. of West Bengal, the Superintending Engineer (P&RD), NBC invites **E-Tender in percentage rates for each of the following RIDF works by two cover system. Resourceful and Bona-fide contractors of Government / Semi Government/ Undertaking/ Autonomous Bodies / Statuary Bodies and Local Bodies** who satisfy the terms and conditions set out in pre-qualification document and having registration in e-procurement portal (www.wbtenders.gov.in) under Govt. of West Bengal **may submit their bids. The intending contractors must have completed at least one work of similar nature in a single contract as a prime contractor within last five years** from the date of issue of this NIT, **value of which is not less than 40% of the amount put to tender.** The pre-qualification documents are to be uploaded in two separate folders. One of the folders shall contain technical documents. Financial Bids are to be uploaded in another folder. The Tenders shall be available for viewing in our website www.wbtenders.gov.in || **PANCHAYAT AND RURAL DEVELOPMENT || WBSRDA || RRNMU JALPAIGURI**

Table- 1: List of Works

Sl. No.	District	Name of the work under Admintrative Block	Estimated Cost put to Tender (Rs. In lakh)	Maintenace Cost (Rs. In lakh)	Earnest Money/Bid Security (Rs.)	Cost of Bid Document (Rs. In lakh)	Completi on Time (Months)	Defect liability Period
1	Kalimpong	Construction of Super-structure and Rectification of Sub-structures for 92.0m Span Steel Bridge over "Dawai Khola" at Gorubathan Block, Kalimpong Disitricth under WBSRDA, Kalimpong Division, Gorkhaland Territorial Administration	94600627	9554663	10,00,000	NIL	12	5 Years
			10,41,55,290					

- Intending bidders may download tender documents from e-procurement portal of our website: www.wbtenders.gov.in **from 25/02/2023 10:00 Hours to 20/03/2023 (upto 16:00 Hours)**. The pre-qualification bid documents duly filled and digitally signed in all respect may be submitted online before **16:00 hrs (as per server clock) on 20/03/2023**.
- Tender Inviting Authority will not take any responsibility for the delay caused due to non-availability of internet connection or traffic jam etc. for on-line bidding.
- **Earnest Money /Bid Security:** Cost of Bid Security/Earnest Money should be deposited
 - a) **Net banking (any of the banks listed in the ICICI Bank Payment gateway) in case of payment through ICICI Bank Payment Gateway or**
 - b) **In SBI, Jalpaiguri Main Branch, Club Road, Jalpaiguri vide Account Number: 11188172565 (IFSC: SBIN0000095) in favor of "The Executive Engineer, WBSRDA, Jalpaiguri Division" through RTGS/NEFT/CBS system only. The Serial number of NIT and UTR number should be clearly mentioned on the deposit challan. Payment made otherwise will be rejected.**
- The pre-qualification (Technical Bids) documents will be opened on **22/03/2023 at 17:00** hours by the authorized officers.
- Tender Inviting authority reserves the right to call for original document for verification from successful bidder(s) only in case of exceptional circumstances.
- The results of the technical evaluation shall be made public on e-procurement systems following which there will be a period of **02(Two) working days** during which any bidder may submit **complaint** which shall be considered for resolution before opening the financial bid.
- The Financial bid of the technically qualified bidders will be opened for evaluation and the financial bid of non-qualified bidders will remain unopened. No separate intimation will be given for this, unless the above date is changed. In case of change of date, due intimation will be given on-line only.
- Tender Inviting authority reserves the right to accept or reject any bid, and to cancel the bidding process and reject all bids, at any point of time prior to the issuance of work order, without thereby incurring any liability to the affected bidder or bidders or any obligation to inform the affected bidder or bidders of the grounds for the authority's action.
- Acceptance of Tender (AOT) will be issued after approval of competent authority.
- GST, Cess, Taxes and Duties if any at applicable rates will be deducted from the bill of the contractor.
- **L1 bidder to submit Rs. 5000 only (for Two Sets) for formal agreement cost at Executive Engineer office to Execute the formal agreement.**
- **Additional Performance Security in Road Projects**
 - The Additional Performance Security shall be obtained from successful bidder, if the accepted bid value is more than or equal to 20% less than the estimated amount put to tender, vide order no 4608-F(Y) dated 18-07-2018 of finance dept. Govt. of West Bengal.
- **Security Deposit**
 - ✓ **The Security Deposit / Performance security will be released to the contractor in two steps on the basis of performance. On expiry of 4 Years from the date of actual completion 30% of total**

security retained will be refunded to the Contractor subject to full satisfaction of DLP works. Balance 70 % will be refunded to the Contractor on expiry of 5 years from the date of actual completion of the work subject to full satisfaction of DLP Works

- ✓ Any damages occurred during defect liability period (DLP) beyond schedule **maintenance** will have to be done by the contractor at his **own cost**. The Contractor at his cost shall provide, in the joint names of the Employer and the Contractor, insurance cover (Contractor all Risk Insurance) from the start date of work to the date of Completion of Work.

➤ The intending Bidders should satisfy himself about the alignment of the proposed road site and other site condition before quoting their rates.

A) The eligibility criteria are given below:

1. The applicant in the same name and style should have achieved annual turnover in any of the year over the last five years (excluding current year) (50% of which is from civil engineering construction works and equivalent and to be supported by payment certificates).
 - a) 60% of amount put to bid, in case the amount put to bid is Rs.200 lakhs and less.
 - b) 75% of amount put to bid, in case the amount put to bid is more than Rs. 200 lakhs.
2. The applicant in the same name and style as prime contractor should have successfully completed at least one contract of same type of work at least 40% value of the proposed contract within the last 5 years from the date of Publication of this NIT.
3. The contractor should have sufficient technical manpower, tools and plants as mentioned in ITB to complete the work.
4. The prime contractor should have necessary bid capacity to execute the work.
5. Financial statements for the last 05 (Five) years (Audited if applicable).
6. Income Tax return should be submitted for last 5 years.
7. GST registration Certificate, Professional Tax registration certificate, Pan Card (Income Tax), Trade license should be furnished.
8. Joint venture will not be allowed
9. Proposal for sub-contracting is not allowed
10. No CONDITIONAL/INCOMPLETE TENDER will be accepted under any circumstances.
11. The bid of Any Black listed agency will not be accepted.
12. Arbitration will not be allowed in any case.
13. Prospective applicants are advised to note carefully the **documents to be uploaded** for qualification as mentioned in the “Instruction to Bidder’ before bidding.

The amount of **earnest money** is 2% of the estimated cost of construction or Rs 10.00 Lakhs whichever is lower (**Clause No 1 1.1 of GCC of Form No 2911**)

All duties, GST, taxes, royalties, cess, [including 1% cess under W.B. Road/Building and other Construction Workers (Regulation of Employments & Condition of Service) Act, 1996], toll, taxes and other levies payable by the Contractor under the Contract to the State / Central Government for any other cause, shall be included in the rates, prices and total Bid price submitted by the bidder.

To keep the constructed road/building in good condition during the next 05(Five) years after the completion of the construction if any work is required for routine maintenance beyond scheduled provisions, if any, the same will be treated as defect liability and the Contractor has to do the maintenance work at his own cost.

B) List of Important Dates of Bids: -

Sl No.	Particulars		Date	Time
1	Published Date		24/02/2023	18:00Hrs
2	Documents Download / Sale Start Date	From	25/02/2023	10:00 Hrs (As per Server Clock)
3	Documents Download / Sale End Date	To	20/03/2023	16:00 Hrs (As per Server Clock)
4	Bid Submission Start Date	From	25/02/2023	11:00Hrs (As per Server Clock)
5	Bid Submission End Date	To	20/03/2023	16:00Hrs (As per Server Clock)
6	Bid Opening Date (Technical)		22/03/2023	17:00 Hrs (As per Server Clock)
7	Bid Opening Date (Financial)	After Evaluation of technical Bid		
8	Place of Opening Bid	<u>Office of the Superintending Engineer, P&RD Dept, North Bengal Circle, Government of West Bengal, RRNMU Building (2nd Floor), Ward No-08, Near King Saheber Ghat, Jalpaiguri-735101</u>		
9	Officer Inviting Bid	<u>Superintending Engineer, P&RD Dept, North Bengal Circle, Government of West Bengal,</u>		
10	Last Date of Bid Validity	120 days from the date of opening		
11	Pre-Bid Meeting	<u>Date & Time : 02.03.2023, 14:00 Hrs</u> <u>Venue: Office of the Superintending Engineer, P&RD Dept, North Bengal Circle, Government of West Bengal, RRNMU Building (2nd Floor), Ward No-08, Near King Saheber Ghat, Jalpaiguri-735101</u>		

No separate intimation will be given for this, unless the above date is changed. In case of change of date, due intimation will be given on-line. No individual intimation will be given.

❖ This NIT and all other uploaded documents in this tender being uploaded from this office are part of contract and agreement and is to be treated as part of tender documents.

Instructions to Bidders (ITB)

A. Scanned copies of the following documents to be up-loaded in PDF format in e-portal website <https://www.wbtenders.gov.in>

1. Copy of Earnest money deposit challan with clearly written UTR/Txn number

2. GST registration certificate (GSTIN)
3. Pan card (IT)
4. Trade license (latest valid)
5. Income tax return for last 5 years
6. Professional Tax registration certificate
7. Valid Registration Certificate with EPF Organization under EPF and Misc. Provision Act 1952
8. Financial statement and Balance sheet of last 5 years (Audited if applicable). UDIN should be mentioned if applicable (**UDIN to be mentioned at least for the FY which will be considered for qualification in turnover and Bid capacity calculation**) reports submitted beyond 1st July 2019.
9. Payment certificates (Signed by Competent Authority) to be uploaded in support of Turnover. The turnover will be indexed at the rate of 8 percent simple interest for a year.
10. Credentials for successful completion (certificates from the officer not below the rank of Executive Engineer / or equivalent) of at least one contract of same type of work in the same name and style as prime contractor having a magnitude of at least **40% of the amount put to tender** of the proposed contract within the last 5 years from the date of publication of this NIT.
11. List of machineries possessed by own/arranged through lease deed along with authenticated copy of invoice/challan as per ITB.
12. List of ongoing works in hand and the Physical and financial progress of those works as per **Annexure-C**
13. Scanned copy of Bid Capacity calculation in his/her own letter head. (Calculation to be done as prescribed **annexure -B**)
14. Necessary Laboratory equipment leased or own along with authenticated copy of invoice/challan as per ITB
15. Tender form and NIT with all addendum and corrigendum to be uploaded will be (download and digitally signed. Quoting rate will only encrypted in the B.O.Q under financial bid. In case quoting any rate in printed tender form, the tender will be summarily rejected)
16. Special terms and conditions and specifications of work
17. Partnership firm shall furnish **partnership deed** and company shall furnish the Article of Association and Memorandum.
18. The registered cooperative societies should submit the registration certificate.
19. Power of attorney (in case of Partnership firm /Registered Co-Operative Society/Company) to be uploaded.
20. Details of the technical personnel proposed to be employed for the Contract having the qualifications as per ITB. Qualification Certificate and appointment letter of the technical personnel to be uploaded. **No part time employment will be allowed.**
21. Bank Credit Certificate of 10% of the Amount put to tender should be provided as per format. (Format Attached as **annexure D**).

22. Affidavit regarding non employment of any Government official under him, deployment of machineries, technical personnel, correctness of certificates, and investment of minimum cash up to 30% of estimated cost. As per **annexure-A**.
23. Letter head of the agency/contractor containing Name addresses and contact details. During the currency of the project and after completion if the address of the agency/contractor changes, it will be the responsibility of the contractor to intimate the authority regarding such changes.
24. Work program in terms of bar chart to be submitted.
25. **“Specifications_of_Bridge_Works_West_Bengal”** is also a part of this tender document along with SBD_2911 and the bidder should abide by the all-clause mention under it.
26. Conditions of this NIT will prevail over the conditions of the SBD in case of any inconsistency between the two.
27. Others (if any)

B. Bare Minimum requirements of machineries for Bridge construction works is as follows.
This list is only indicative. The bidder shall have to arrange for every necessary machinery, tools & plants for the intended job.

SI No	Name of Machineries		Required Minimum Number
General equipment required for construction Bridge work			
1	For overall bridge length of less than 200m. – Batch type concrete mixer diesel or electric operated, with a minimum size of 200 liters. automatic water measuring system and integral weigher (hydraulic/pneumatic type).		1 no.
2	For overall bridge length of 200 m or more - Concrete batching and mixing plant fully automatic, with minimum capacity of 15 cum per hour.		1 no.
3	Transit mixture - (For overall bridge length of 200m. or more)		1 no.
4	Steel Shuttering plates of 10 gauge thick or equivalent in mm. along with sufficient steel bracings.		Minimum 400Sqm.
5	Semi-automatic batch type mixer with min capacity of 15m³/hr		2 nos
6	Mechanized Concrete Pump		2nos
7	Excavator		2nos
8	Vibrator (Needle)	a. 20mm dia.	4 nos
		b. 40mm dia.	4 nos
		c. 60mm dia.	4 nos
9	Plate Vibrator		4 nos
Additional equipment required in case of construction Bridge with Pile foundation			
1	Tripod Winch Set with all accessories such as chisel, tremie pipe with funnel - (in case of Pile constructed by using tripod winch)		2 nos.
2	Hydraulic piling rig with all accessories such as cutter, diamond cutter, tremie pipe with funnel - (in case of Pile constructed by using hydraulic piling rig)		1 no.
Additional equipment required in case of construction Bridge with Well foundation			
1	Crane with grab buckets - capacity 0.5 cum to 2.0 cum		2 nos.
2	Air compressors, air locks and other accessories		2 nos.

3	Aqua-header for cutting rocky strata	2 nos.
4	Diving helmets and accessories	4 nos.

C. Bare Minimum requirements of machineries for Approach Road Works

This list is only indicative. The bidder shall have to arrange for every necessary machinery, tools & plants for the intended job.

SI No	Name of Machineries	Required Minimum Number
1	Mobile Hot Mix Plant	1 no
2	Static Roller	1 no
3	Vibratory Roller	1 no
4	Excavator cum loader 1.0/0.24 Cum	1 no

D. Bare Minimum Lab Equipment's

SI No	Name of Machineries	Required Minimum Number
1	Compressive Strength Testing Machine 200MT (With valid Calibration Certificate)	1 no
2	Cube Moulds With tampering rod of size 15 X 15 X 15 cm.	24 nos.
3	Non-Destructive Testing Apparatus. (For Rebound hammer Test)	1 set.
4	Slump Cone	3 sets.
5	Electronic/ Digital Balance Platform Balance 300 Kg Capacity	1 no.
6	Aggregate Impact Test Apparatus	1 set

E. Bare Minimum Survey Instruments

SI No	Name of Machineries	Required Minimum Number
1	Total station	1 no
2	Auto level with staff	2 nos

Note: All measuring devices of the equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be checked over the range in use, when set up at each site and thereafter, periodically as directed by the Engineer.

F. The Number of Technical personnel, Qualifications and Experience will be as follows:

The Technical Personnel are:

Technical Personnel	Number	Experience
A.Senior Bridge Engineer Degree Holder in Civil Engineering	One	Minimum 10 Years Exp. (5 years as Bridge Engineer with Construction & QA/QC experience of at least one bridge)
B.Site-in-Charge Degree Holder in Civil Engineering / Diploma Holder in Civil Engineering	One or more as per requirement	5(Five) years in Bridge & Road construction/10 (ten) years in Bridge & Road construction

C. Survey Engineer Diploma Civil Engineering	One	5 years Exp.
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G. Other instructions

- Before the deadline for submission of bids, the Employer may modify the bidding documents by issuing addenda.
- The unit rates and the prices shall be quoted by the bidder entirely in Indian Rupees up to **two decimal places**.
- No Mobilization Advance and Advance against purchase of equipments will be paid for the work
- No Advance of any kind will be paid for the work under any circumstances
- Under no circumstances Escalation in prices in materials, labour charges, cost of P.O.L. & arbitration will be entertained.
- The Employer requires the bidders / Contractors to strictly observe the laws against fraud and corruption in force in India, namely, Prevention of Corruption Act, 1988.
- There will be no price preference to any bidder.
- Bid of any Black listed bidder will be rejected.
- No interest claim will be admissible during refund of earnest money and security deposit.
- Uploaded documents of valid successful bidders may be verified with the original in due course. The valid successful bidders have to show the originals to the concerned authority as and when required.
- Any bill (running account/final) payment of proposed executed work may be made to Agency as per availability of fund under RIDF.
- The engaged contractor will have to get registered under BOCW (RECS) act and shall have to contribute towards " The West Bengal Building and other Construction Workers' welfare fund" @ 1% (One percent) of the gross amount of the work by way of deduction from Running and /or final bill.
- **Earnest Money & Security Deposit:** The Earnest Money (2% of amount put to tender) will be released to L1 bidder / contractor subject to submission of Performance Security (P. S.) (2.5 % of Tendered Amount) acceptable to the Employer (Executive Engineer concerned) in the form of an unconditional Bank Guarantee or Fixed Deposit Receipt in favour of Executive Engineer concerned from a scheduled Commercial bank. The remaining 7.5% / 0.5% (as per current order enforced till 31.03.2023) S.D. Money will be deducted from running account (R.A.) bills, so that the total amount of S.D/P.S. will become 10% (Ten Percent) / 3% (Three Percent) of the Contract Price, retained at the end the Employer at the time of settlement of Final Accounts on completion of Construction.
- Time allowed for completion of work will be measured from the date of issue of work order
- If any erroneous printing found after agreement or any time in the SOQ (Schedule of Quantity) Quantity or Rate, the Tender Inviting authority reserve the rights to correct the same as per approved original estimate.

- Bidding documents (NIT and SBD) is to be uploaded by the bidder. The bidder has to only agree/ disagree on the conditions in the bidding document. The bidders who disagree on the conditions of bidding document cannot participate in the tender and his /their bid will be treated as informal.
- ***Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:***
 - (i) Made misleading or false representations in the forms, statements, affidavits and attachments submitted in proof of the qualification requirements; and / or record of submission of any false / fake document(s).
 - (ii) Record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.
 - (iii) Participated in the previous bidding for the same work and had quoted unreasonably high or low bid prices and could not furnish rational justification for it to the Employer.
- Bidders who meet the minimum qualification criteria will be qualified only if their available bid capacity for construction work is equal to or more than the total bid value. The available bid capacity will be calculated as per **annexure -B**:
- **Labour license:** The contractor has to obtain labour license from the office of Labour Commissioner of the concerned district in which the location/Site of the work falls under the provision of **West Bengal Contract Labour (Regulation and Abolition rules 1972)** and a copy of the said license has to be submitted to this office within 30 days of the issuance of Work order failing which the undersigned will in no case be held responsible for any action initiated by labour department. The under signed being the principal employer for the work, will however issue a certificate in prescribed proforma of labour department in form V for doing the needful by the labour commissioner.
- The successful bidder shall have to abide by all the labour related and other rules, regulations and laws of the land and the Tender Inviting Authority in no way shall be held responsible for financial or any other consequences arising out of non his noncompliance of the same.
- **Intending Bidder should read carefully read the CI No 41 of GCC regarding the suspension and debarment policy before participating the tender.**
- **Tax Invoice needs to be issued by the agency/**contractor for raising claim showing separately the tax charged in accordance with the provisions of GST Act, 2017.
- The Contractor at his cost shall provide, in the joint names of the Employer (Executive Engineer) and the Contractor, insurance cover (**Contractor All Risk Insurance, CAR**) of the Work from the start date of work to the end date of successful completion of the work.
- **Priority of Documents:** The documents forming the contract are to be taken as mutually explanatory of one another. For purpose of interpretation, the priority of the documents shall be in accordance with the following sequence.
 - a. Notice to Proceed with the works;
 - b. Letter of acceptance;
 - c. Notice Inviting Tender
 - d. Special Conditions of Contract and General Conditions of Contract

- e. Specifications;
- f. Drawings;
- g. Bill of Quantities; and
- h. Any other document listed in the Contract Data as forming part of the Contract.

The routine maintenance standards shall meet the following minimum requirements for Bridge:-

- (i) Simple Cleaning by mechanical means or by hand (of carriageways footpath verges, joints, drains, gulleys, gutters etc.); removal of foreign material such as trash or parasitic vegetation and similar operations;
- (ii) Substitution of deteriorated elements by removal and replacement operations (e.g. safety barriers);
- (iii) Small restorations, repainting of masonry and brickwork, replacement of missing stones, sealing and repairs with cement or resin mortars;
- (iv) Localised repairs to pavements and waterproofing, using bituminous materials, fillers in expansion joints.
- (v) Clearing of vent holes in superstructures (Localised painting operations to protect against corrosion renewal of protective treatments on timber lubrication and greasing operations)
- (vi) Restoration of concrete (reinforced or otherwise) structural parts to be carried out with different techniques (simple or special cement mortars synthetic; mortars etc.)
- (vii) Restoration of brick or masonry structure
- (viii) Protection of concrete or masonry from degrading action by frost, sales or the atmosphere by means of painting (Protective films). impregnation. etc disinfections of timber structures;
- (ix) Injection of cement grout or thermosetting resin into cracks in brick stone reinforced or prestressed concrete structure.
- (x) Injection of cement grout or synthetic resin (pure or with additives) into sheaths containing prestressing tendons.
- (xi) Maintenance of bolts or welding of metal structures; cleaning greasing and substitution of wearing parts of same.
- (xii) Anti corrosion protection of metal structures entailing complete stripping and repainting of part or all of the surface.

(xiii) Repair or reconstruction of drainage systems (gullies channels collector and discharge pipes etc).

(xiii) Repair or reconstruction of pavements or waterproofing o deck.

(xv) Repair or reconstruction (partial or total) of expansion joints depending on their types.

(xvi) Maintenance of bearings by means of different operations depending on the type (repainting and graphing for example) setting of same also by raising decks.


(xvii) reclamation operations to river and sea heads to protect foundations structures.

(xviii) Repairs for dams to guide bunds aprons for raft foundation

(xix) Making up settlement on bridge approaches.

(xx) Replacement of any structural members (mainly for timber or steel structure.

Any other maintenance operation required to keep the traffic worthy all the times during the maintenance period.


Superintending Engineer (P&RD), NBC
Panchayats and Rural Development
Department
Government of West Bengal

Memo No.- 604 /1(7)/ SE(NBC)/22-23

Date- 24.02.2023

Copy forwarded for kind information to:-


1. Special Secretary to the Govt. of West Bngal, P&RD Dept.(HQ)
2. Additional Secretary to the Govt. of West Bngal, P&RD Dept.(HQ)
3. Chief Engineer, P&RD Dept.(HQ)
4. Financial Advisor, Govt. of West Bengal, P&RD Dept (HQ)
5. Superintending Engineer , SQC WBSRDA HQ
6. Superintending Engineer , Bridge
7. Office Notice Board.

Memo No:- 604/2(9)/SE(NBC)/22-23,

Date- 24.02.2023

Copy forwarded for kind information to:-

1. O.S.D to the Hon'ble Chief Executive, with a request to bring this to the notice of the Chief Executive, Gorkhaland Territorial Administration please.
2. MLA, Kalimpong.
3. Executive Member, Gorkhaland Territorial Administration.
4. Principal Secretary, Gorkhaland Territorial Administration.
5. Secretary/Executive Director, Finance Department, Gorkhaland Territorial Administration.
6. Secretary/Executive Director, Engineering Department, Gorkhaland Territorial Administration.
7. Chief Engineer, Gorkhaland Territorial Administration.
8. Superintending Engineer, Gorkhaland Territorial Administration.
9. Executive Engineer, WBSRDA, Kalimpong Division, He is requested to put up the matter under notice of all concerned.


Superintending Engineer (P&RD),NBC
Panchayats and Rural Development
Department
Government of West Bengal

ANNEXURE-A

SAMPLE FORMAT OF AFFIDAVIT

I, Sri....., S/o Sri..... aged..... years,
Residing at..... Proprietor/Partner/Director of....., do hereby solemnly
affirm and declare in connection with Construction of road from
..... is as
follows :

1. That I, the undersigned do certify that all the information furnished & statements made in the bid documents are true and correct to the best of my knowledge and belief.
2. That the undersigned also hereby verifies that neither any near relations of SE/EE/DE/AE/JE of the department nor any retired gazetted officers are in our employment.
3. The undersigned would authorize and request any bank, person, firm or corporation to furnish pertinent information as deemed necessary and or as requested by the department to verify this statement.
4. The undersigned understands and agrees that the bid shall remain open for Acceptance 120 days from the date of opening of financial bid.
5. The undersigned agrees to invest 30% of the contract price of works by cash during the implementation of the works.
6. The undersigned agrees to authorize the authority to seek references from the bankers of the undersigned.
7. If the contract is awarded to us, we will deploy at site all necessary T&P and equipments immediately on receipt of the work order. We would commence the work only on deployment of machineries at site to the full satisfaction of the Engineer-in-Charge. We would be duty bound to use those equipments at site to achieve the best result as per requirement of the contract. We would upkeep and maintain those equipments in running condition till completion of the Project. Any breakdown of any equipment will be replaced immediately. No part of equipment will be shifted to another site without the written permission of the E.I.C.
8. We would establish a site laboratory with minimum testing equipments/ apparatus to conduct the various tests on soil, aggregates and cement, concrete to maintain the quality at site. We will upkeep the laboratory set-up in good condition of the project.
9. We would deploy at site all necessary technical personnel for efficient contract management and supervision of works with a view to achieving best quality of works at site.
10. We would carry out all necessary tests of all major items at frequency spelled out in the contract document to achieve the best quality work at site. We will be contract bound to bring to the notice of the EIC any non-compliance of test results along with the action taken report.
11. Any departure whatsoever in any form will be considered as breach of contract. In such situation the department at his liberty may with hold our payment till we rectify the defects or fulfill our contractual obligation. In this connection, Departmental decision will be final and binding.
12. The undersigned also certifies that neither we have abandoned any work awarded to us, nor any penal action was taken against us by any department. The undersigned also declares that we do not have any running litigation with any department.

ANNEXURE-B

Assessed Available Bid capacity = (A*N*M – B)

Where,

A = Maximum value of civil engineering works executed in any one year during the last five years (updated to the price level of the last year at the rate of 8 percent simple interest a year) taking into account the completed as well as works in progress.

N = 1, if Completion time is more than 6 months , N=0.5 if completion time is less than equal to six months.

M = 3

B = Value, at the current price level, of existing commitments and on-going works to be completed during the period of completion of the works for which bids are invited.

ANNEXURE-C

Information on Bid Capacity as on the date of this bid.

a) Existing commitments and on-going works

Descript ion of Work	Place & State	Contract No & date	Name of Address of employer	Value o contract (Rs. In Lakh)	Stipulat ed period of complet ion	Value of works remaining to be completed (Rs. Lakhs)*	Anticipated date of Completion
1	2	3	4	5	6	7	8

N.B :Suppression of any fact regarding work-in-hand will be liable for non-responsive of bid

ANNEXURE-D

SAMPLE FORMAT FOR BANK CREDIT CERTIFICATE (BANK LETTER HEAD WITH ADRESS)

BANK CERTIFICATE

This is to certify that ----- is a reputed company with a good financial standing.

If the contract for the work, namely, _____ (Tender No. & Name of work) is awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of Rs. _____ to meet their working capital requirements for executing the above contract.

Signature of Senior Bank Manager _____
Name of the senior Bank Manager _____
Address of the Bank -----

Stamp of the Bank

ANNEXURE-E

BANK GURANTEE FOR ADDITIONAL PERFORMANCE SECURITY DEPOSIT

To
The Executive Engineer

Account Details	
Account Name	
Beneficiary Bank Account No	
IFSC Code	

(Signature)

(Name)

(Designation)

(Code Number)

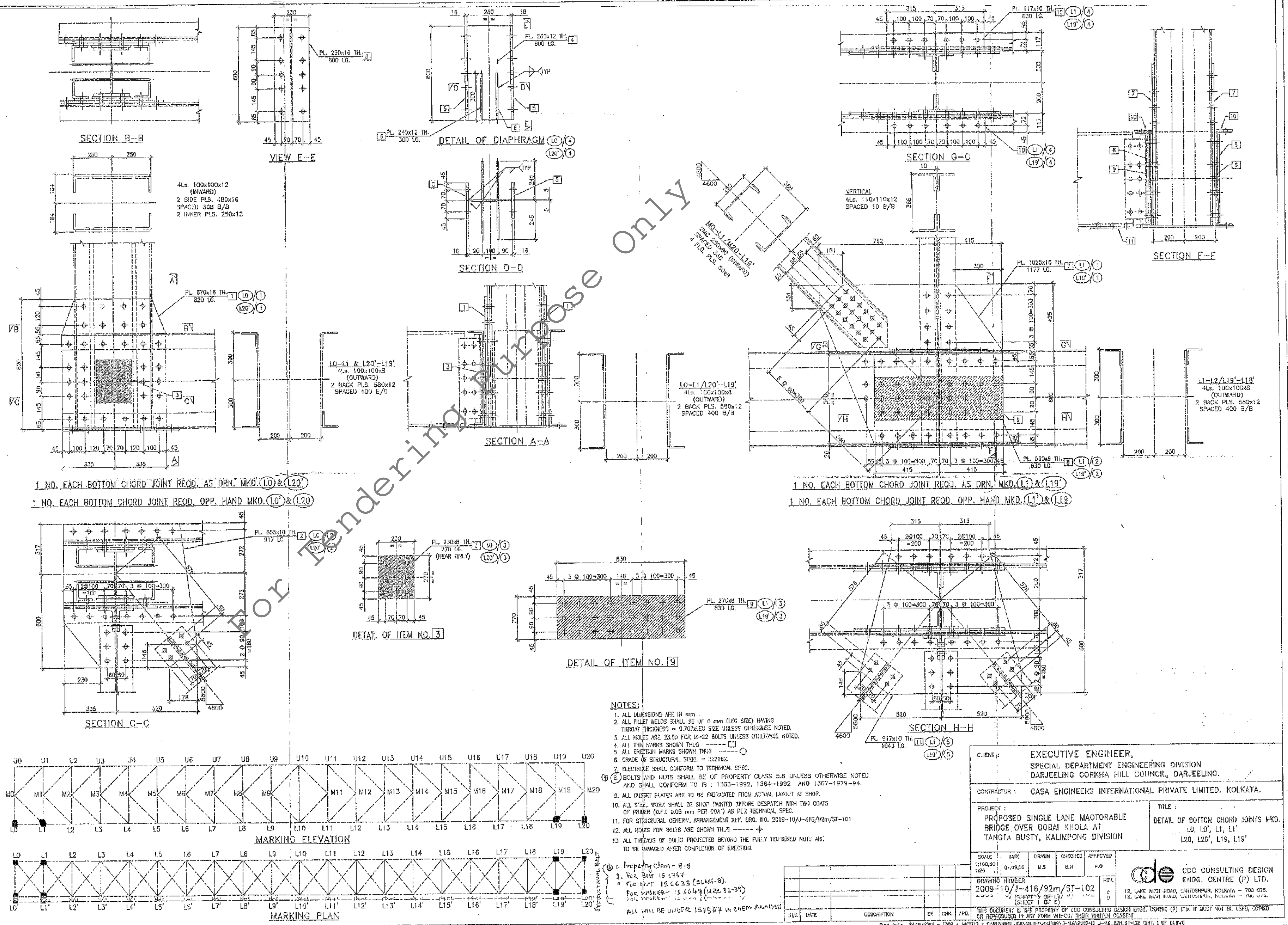
(Address)

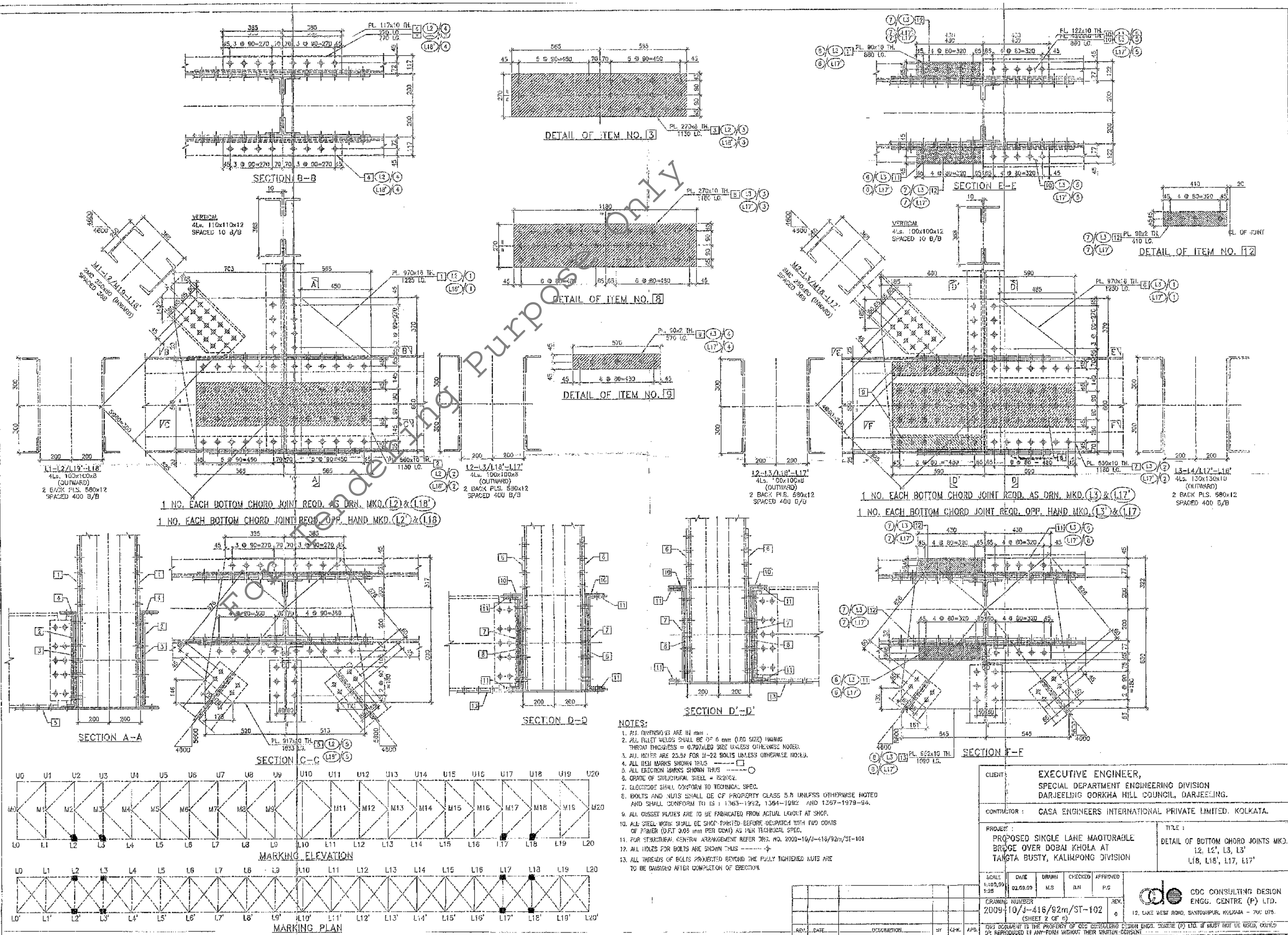
NOTES :

- (i) The bank guarantee should contain the name, designation and code number of the officer (s) signing the guarantee.

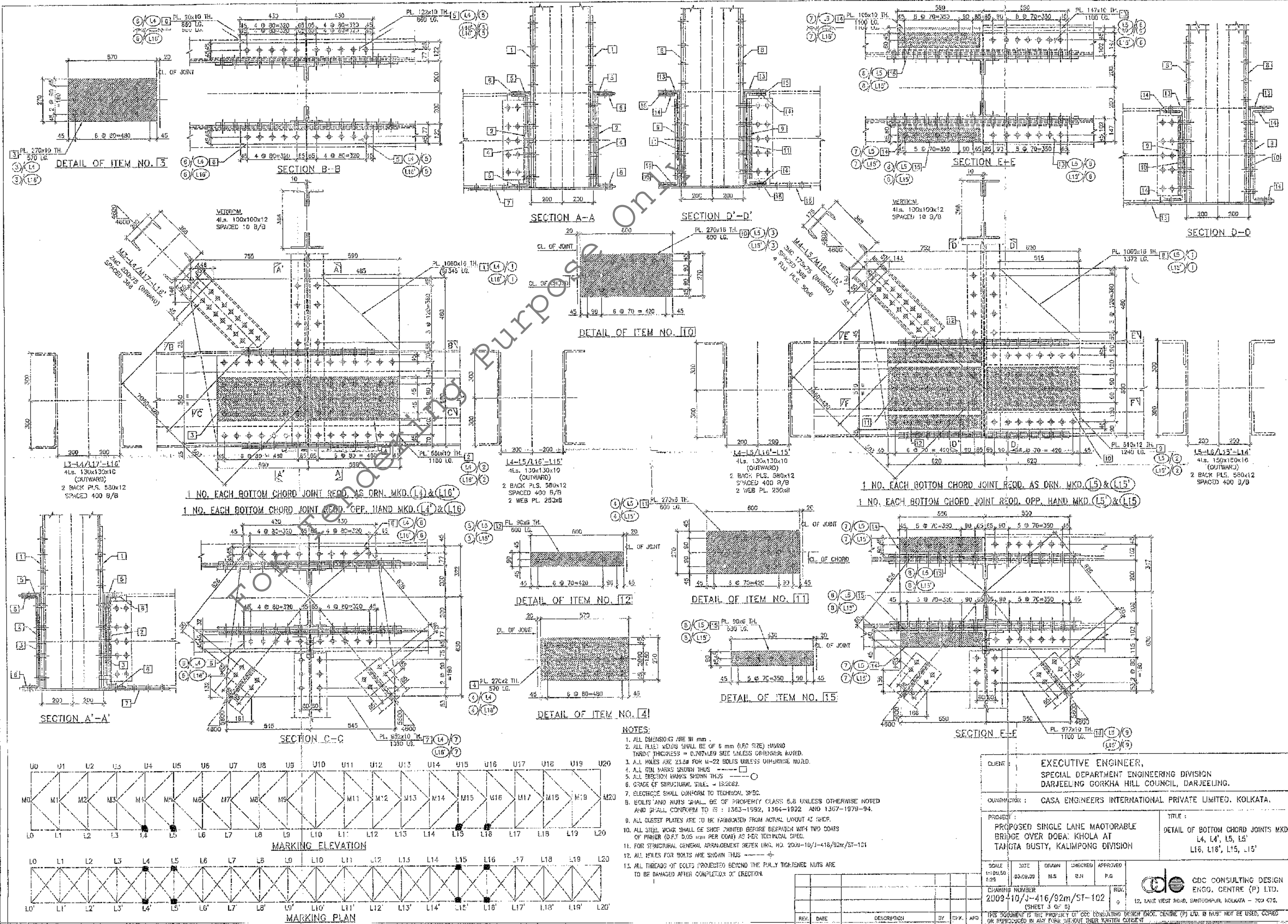
The address, telephone number and other details of the Head Office of the Bank as well as of issuing Branch should be mentioned on the covering letter of issuing Branch.

.....**END**.....

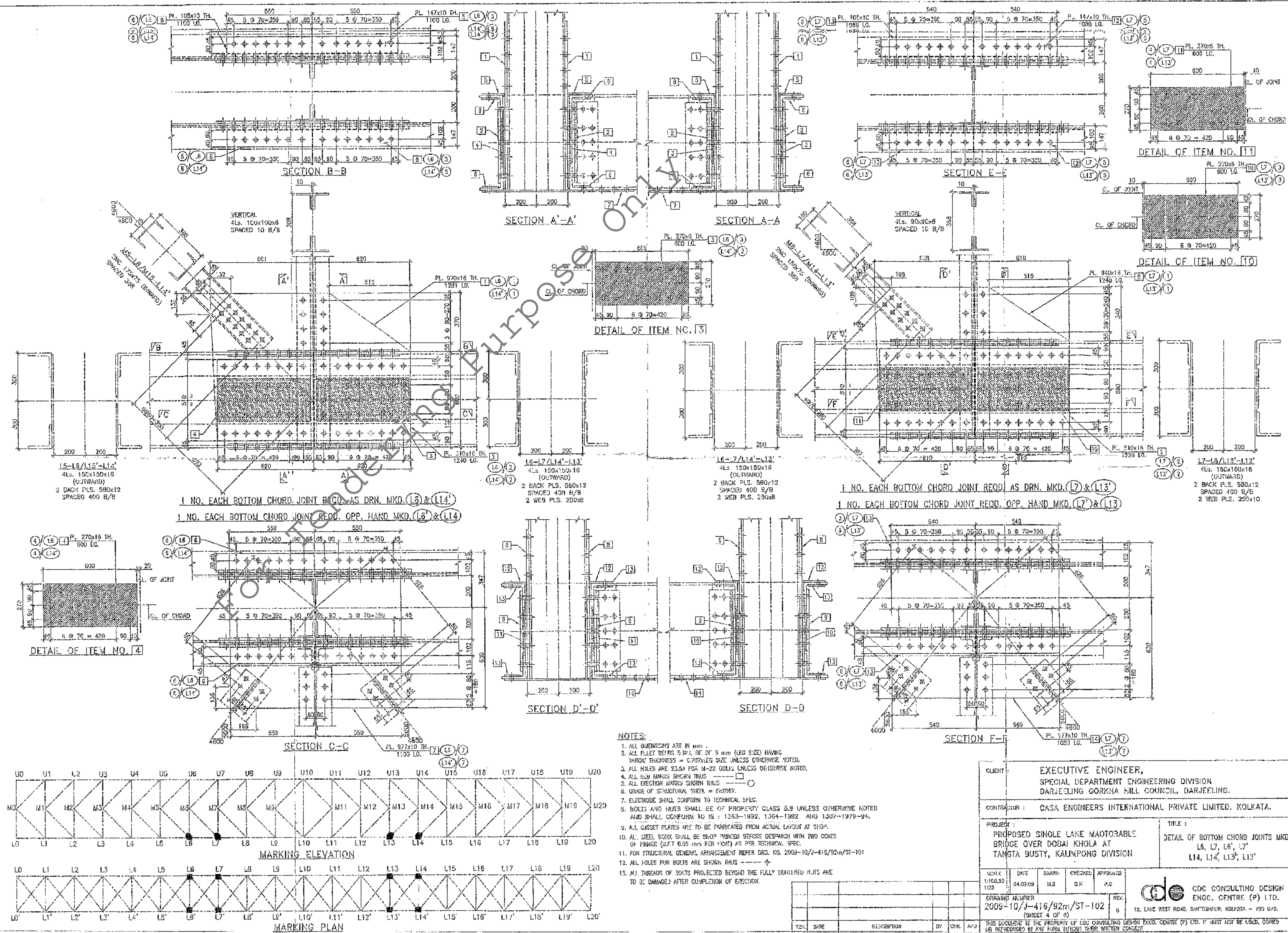




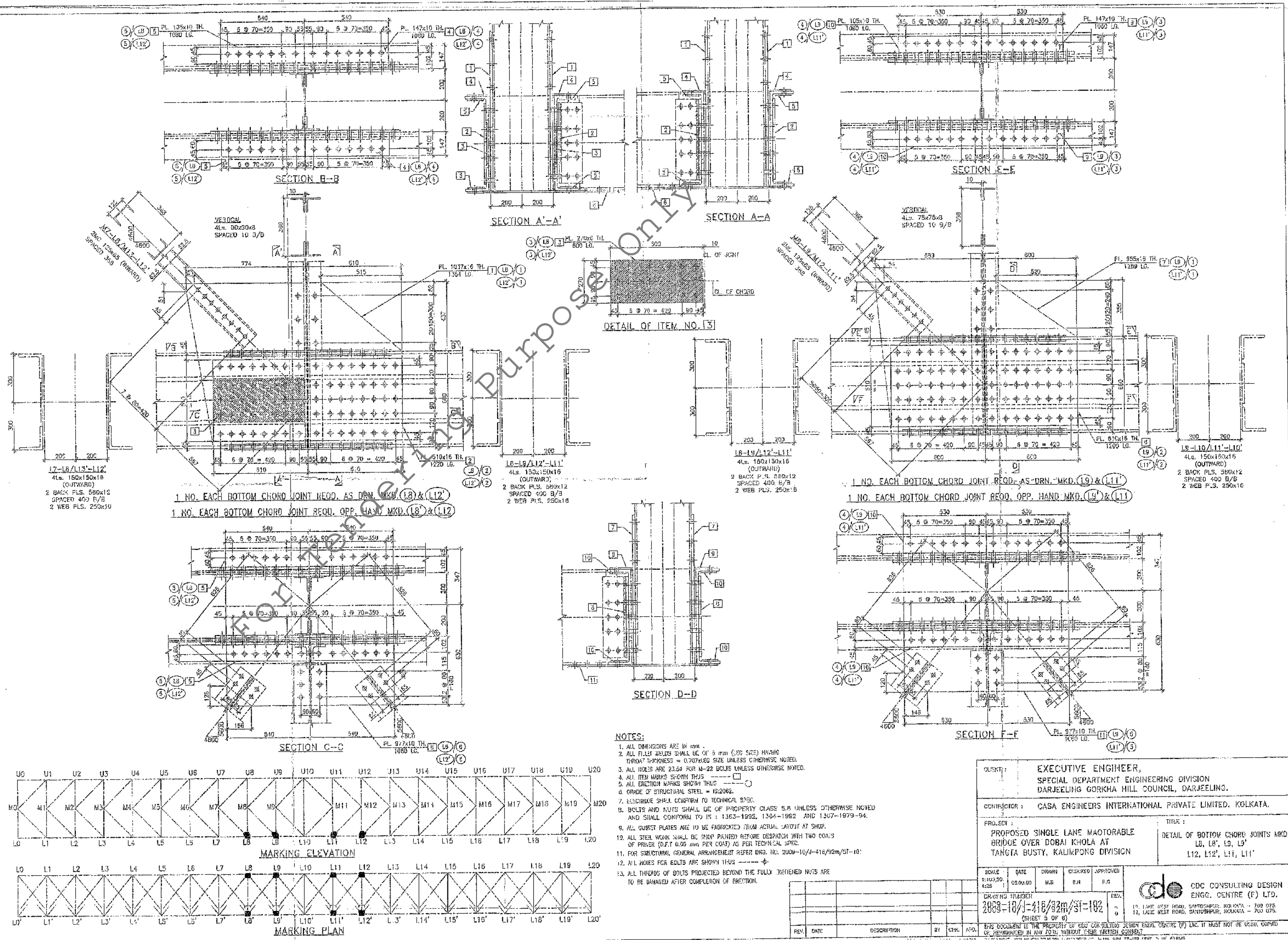
CLIENT		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE		DETAIL OF BOTTOM CHORD JOINTS MKD. 12, 12', 13, 13' 17, 17', 18, 18', 17, 17'	
SCALE	DATE	DRAWN	CHECKED
1:100, 1:25	02.09.09	M.S.	D.N.
DRAWING NUMBER		REV.	
2009-10/J-416/92m/ST-102 (SHEET 2 OF 3)		0	
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CLIENT:	EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.		
CONTRACTOR:	CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.		
PROJECT:	PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBA: KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	TITLE:	DETAIL OF BOTTOM CHORD JOINTS MKD. L4, L4', L5, L5' L16, L16', L15, L15'
SCALE:	1:100.00 1:25	DATE:	03/08/00
DRAWN:	M.S.	CHECKED:	B.N.
APPROVED:	P.G.	REV.	0
DRAWING NUMBER:		2009-10/J-416/92m/ST-102 (SHEET 3 OF 3)	
THIS DOCUMENT IS THE PROPERTY OF CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. IT MUST NOT BE USED, COPIED OR REPRODUCED IN ANY FORM WITHOUT THEIR WRITTEN CONSENT.			

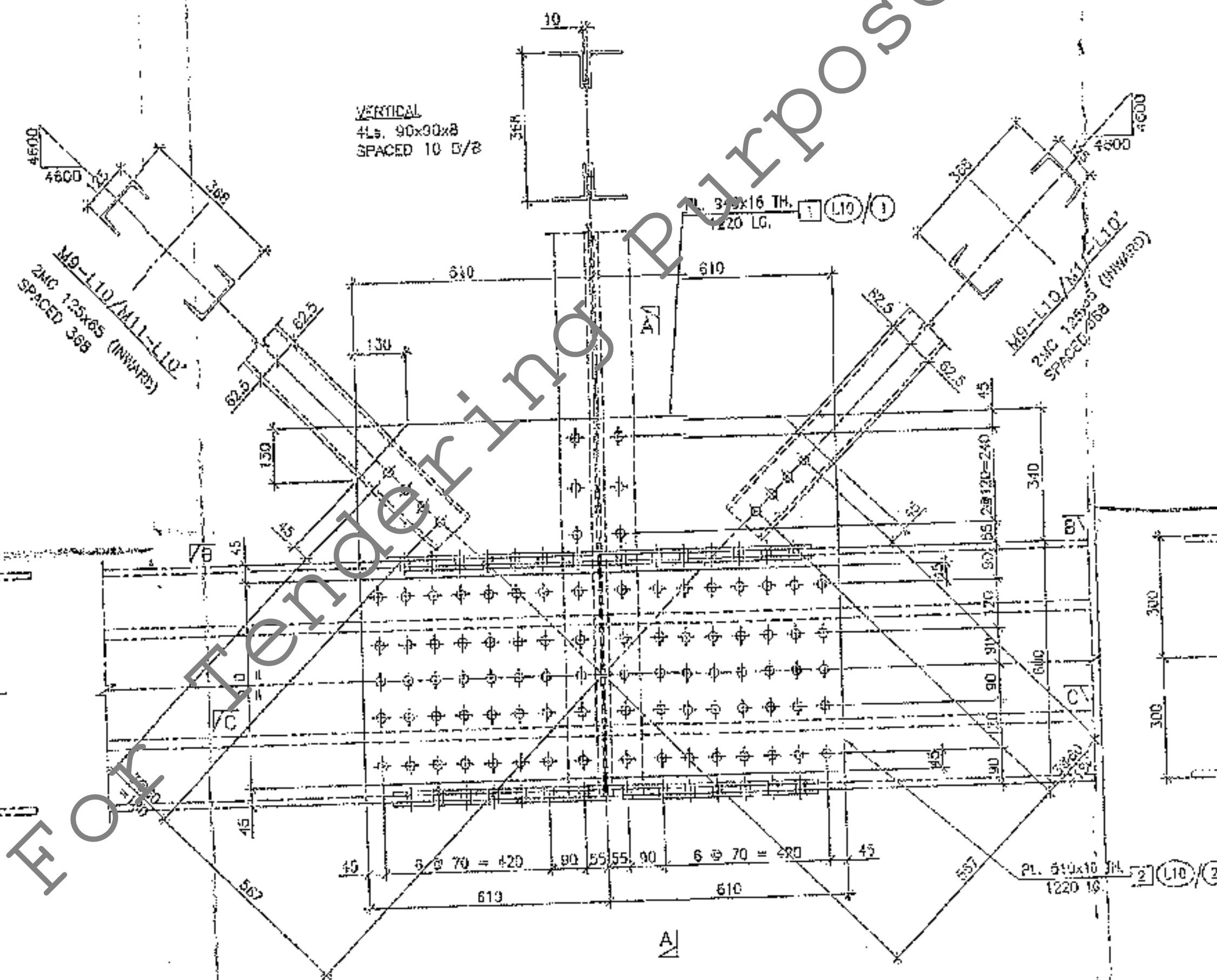
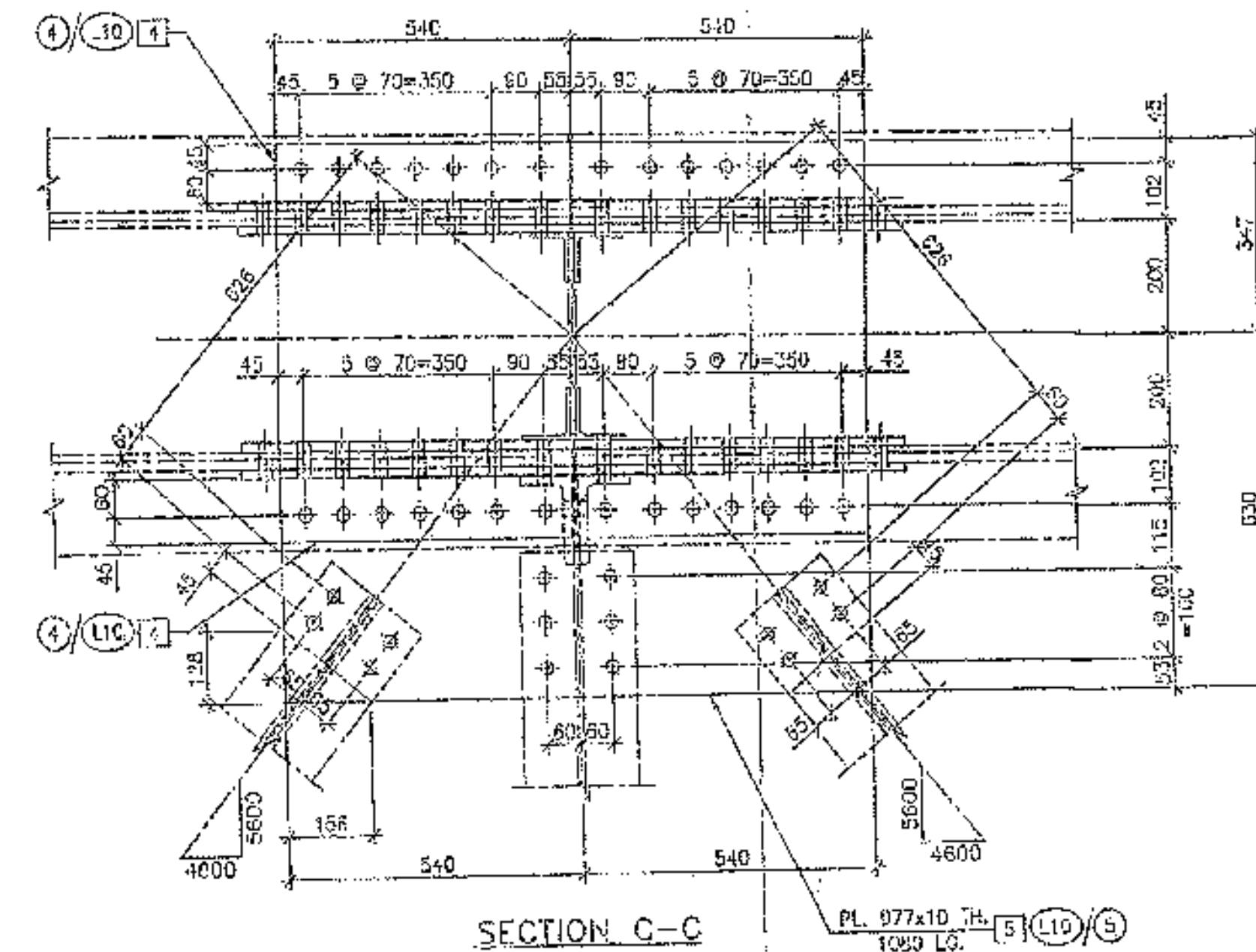
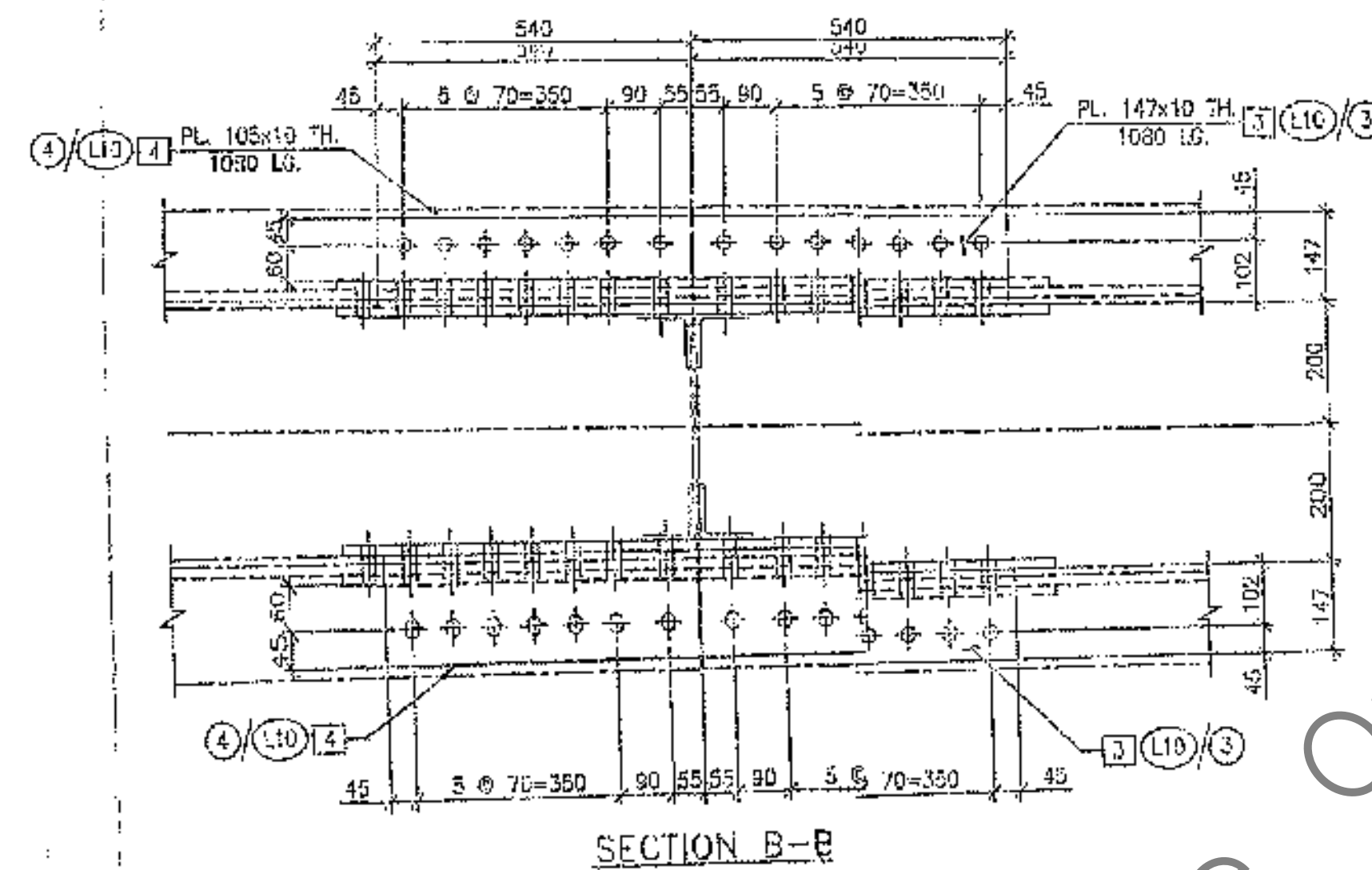


CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.			
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.			
PROJECT :		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION		TITLE : DETAIL OF BOTTOM CHORD JOINTS MKD. L6, L7, L8, L7' L14, L14', L13', L13'	
SCALE 1:100, 1:25	DATE 04.02.09	DRAWN M.S.	CHECKED D.K.	APPROVED P.G.	REV. 6
DRAWING NUMBER 2009-10/J-416/92m/ST-102 (SHEET 4 OF 6)		COC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LANE WEST ROAD, SHYAMSHUR, KOLKATA - 700 013.			
THIS DOCUMENT IS THE PROPERTY OF COC CONSULTING DESIGN ENGG. CENTRE (P) LTD. IT MUST NOT BE USED, COPIED OR REPRODUCED IN ANY FORM WITHOUT THEIR WRITTEN CONSENT.					



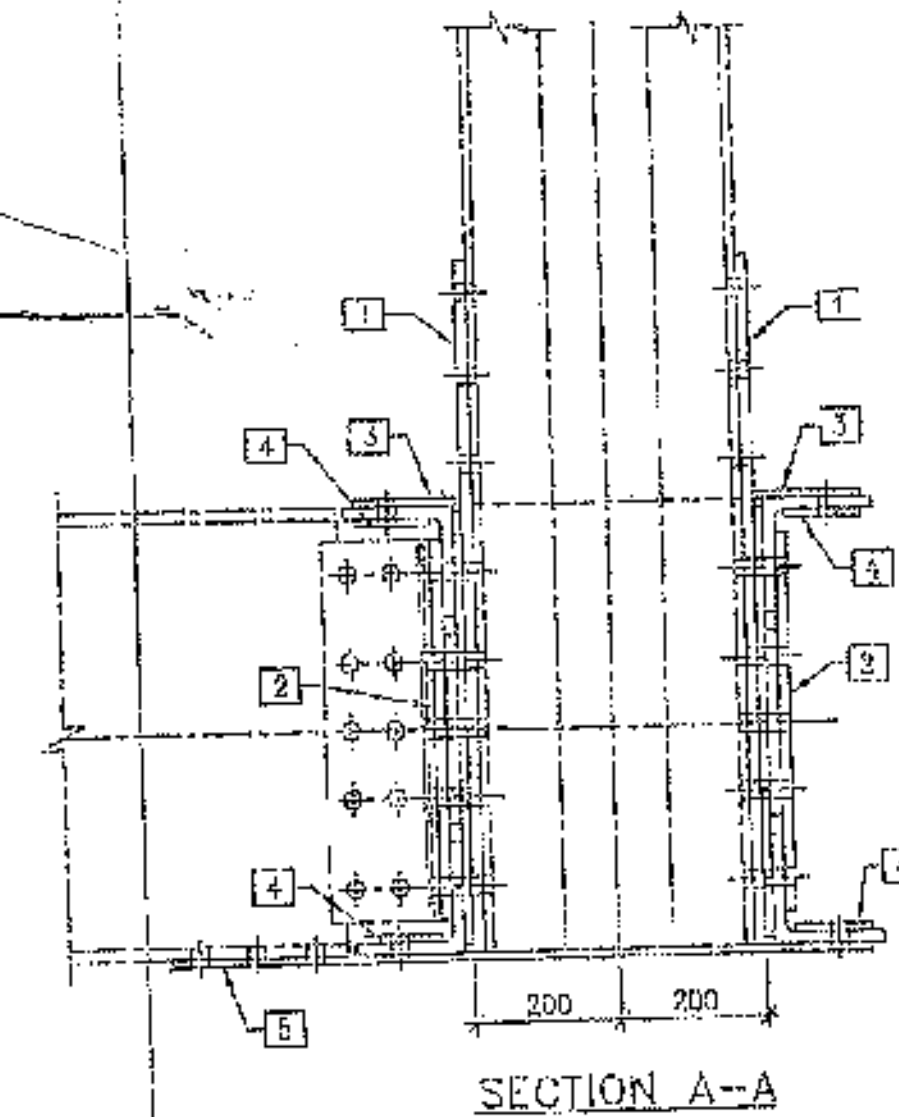
CLIENT:		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR:		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT:		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE:		DETAIL OF BOTTOM CHORD JOINTS MKD. L8, L8', L9, L9' L12, L12', L11, L11'	
SCALE:	DATE:	DRAWN:	CHECKED:
1:100, 50 425	08.09.00	M.S.	P.S.
DRAWING NUMBER:		REV.	
2009-10/J-416/92m/ST-102		0	
(SHEET 5 OF 9)			
THIS DOCUMENT IS THE PROPERTY OF CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED. IT MUST NOT BE USED, COPIED OR REPRODUCED IN ANY FORM WITHOUT THEIR WRITTEN CONSENT.			

CDC CONSULTING DESIGN
ENGG. CENTRE (F) LTD.
10, LAKE WEST ROAD, SANTOSHPOUR, KOLKATA - 700 075.
12, LAKE WEST ROAD, SANTOSHPOUR, KOLKATA - 700 075.



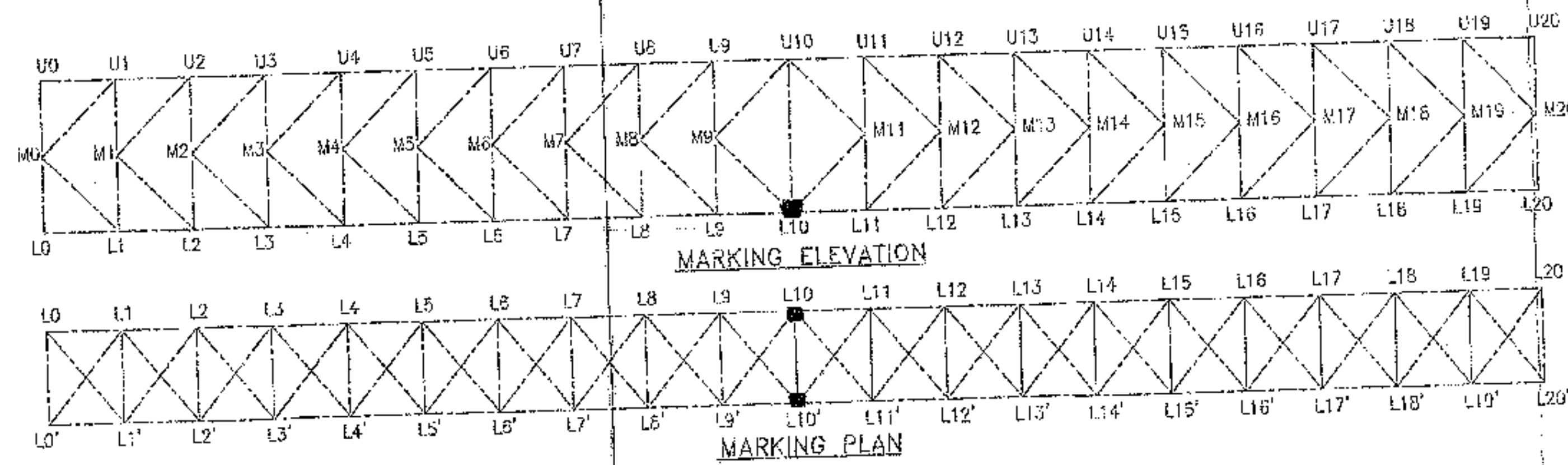
IS-110/L10-L11
4Ls. 150x150x16
(OUTWARD)
2 BACK PLS. 580x12
SPACED 400 B/B
2 WEB PLS. 250x16

IS-110/L10-L11
4Ls. 150x150x16
(OUTWARD)
2 BACK PLS. 580x12
SPACED 400 B/B
2 WEB PLS. 250x16

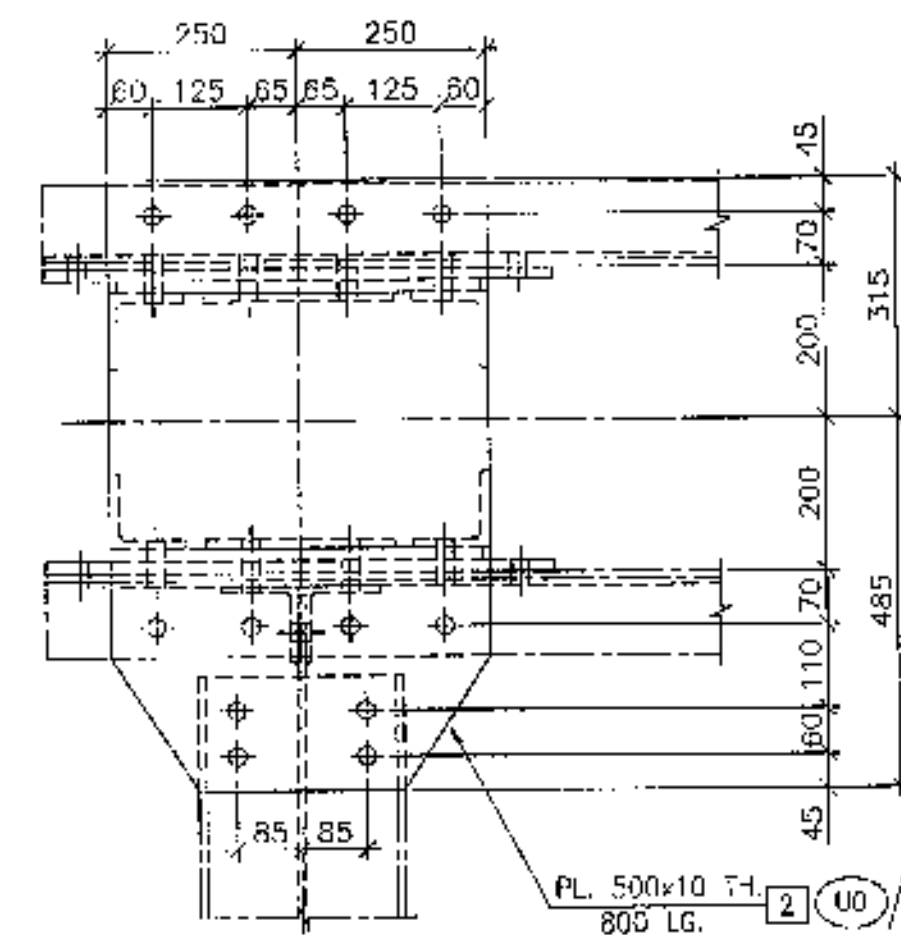


1 NO. EACH BOTTOM CHORD JOINT REQD. AS DRN. MKD. (L10)
1 NO. EACH BOTTOM CHORD JOINT REQD. OPP. HAND MKD. (L10')

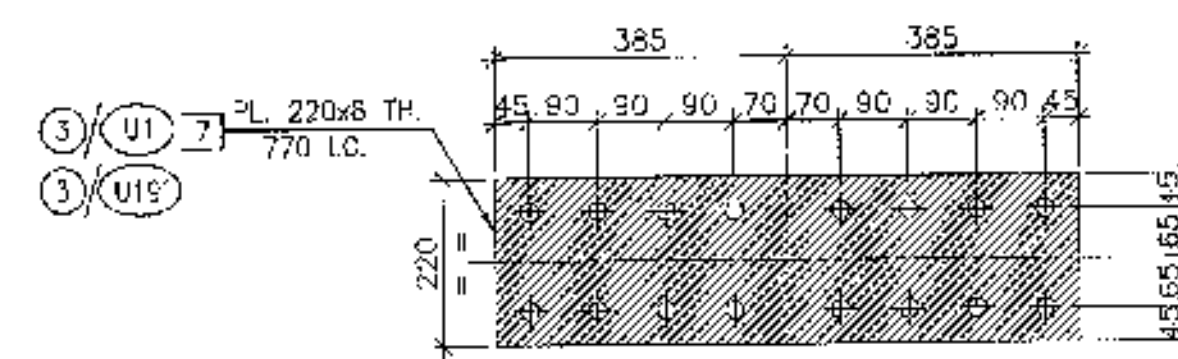
- NOTES:
1. ALL DIMENSIONS ARE IN mm.
 2. ALL RIVET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.70xLEG SIZE UNLESS OTHERWISE NOTED.
 3. ALL HOLES ARE 21.5% FOR 1/2-22 BOLTS UNLESS OTHERWISE NOTED.
 4. ALL ITEM MARKS SHOWN THUS \square
 5. ALL ERECTION MARKS SHOWN THUS \circ
 6. GRADE OF STRUCTURAL STEEL = IS-2002.
 7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
 8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1303-1992, 1394-1992 AND 1367-1979-94.
 9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
 10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
 11. FOR STRUCTURAL GENERAL ARRANGEMENT REFER DRG. NO. 2009-10/J-416/92m/ST-101
 12. ALL HOLES FOR BOLTS ARE SHOWN THUS \oplus
 13. ALL THREADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.



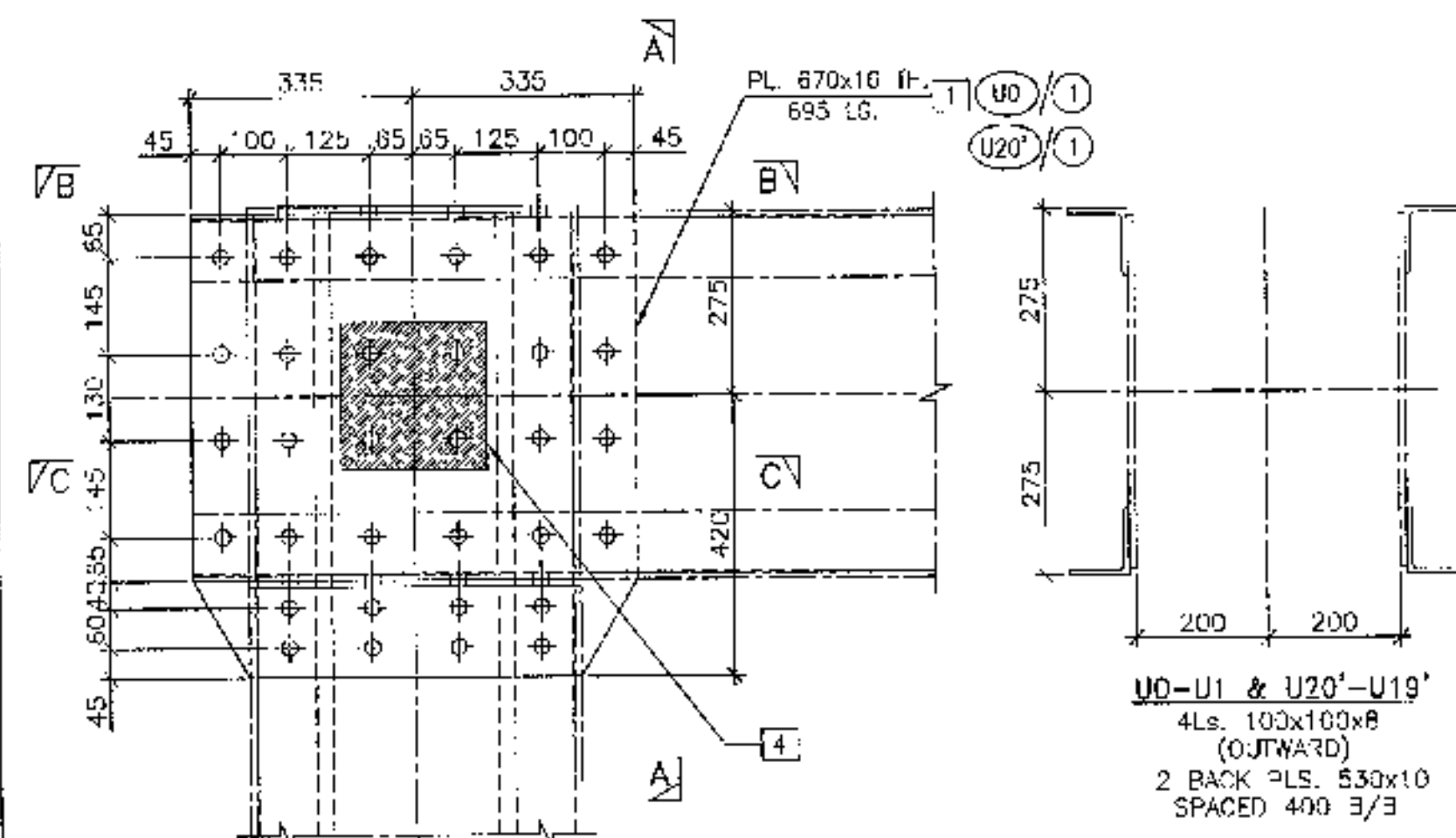
CLIENT : EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.		TITLE : DETAIL OF BOTTOM CHORD JOINTS MKD. L0, L0', L1, L1' L20, L20', L19, L19'	
CONTRACTOR : CASHA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.		PROJECT : PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
SCALE : 1:1000 1:25	DATE : 07.09.09	DRAWN : M.S.	CHECKED : B.N.
DRAWING NUMBER : 2009-10/J-416/92m/ST-102 (SHEET 6 OF 9)		APPROVED : P.O.	
CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SANTOSHPUK, KOLKATA - 700 076.			
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PLAN B-B



DETAIL OF ITEM NO. 7

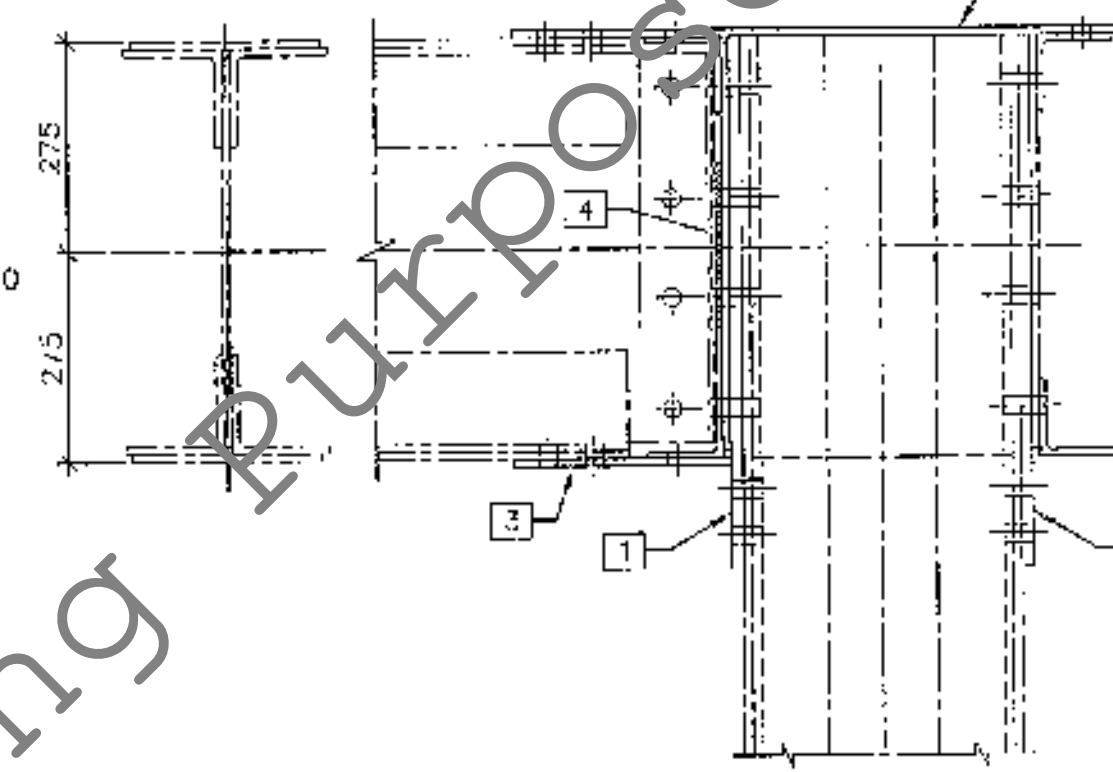


UO-U1 & U20'-U19'

4Ls. 100x100x8 (OUTWARD)
2 BACK PLS. 530x10
SPACED 400 B/B

PORTAL GIRDER

4Ls. 130x130x10
WEB PL. 510x10
2 FLG. PLS. 250x10



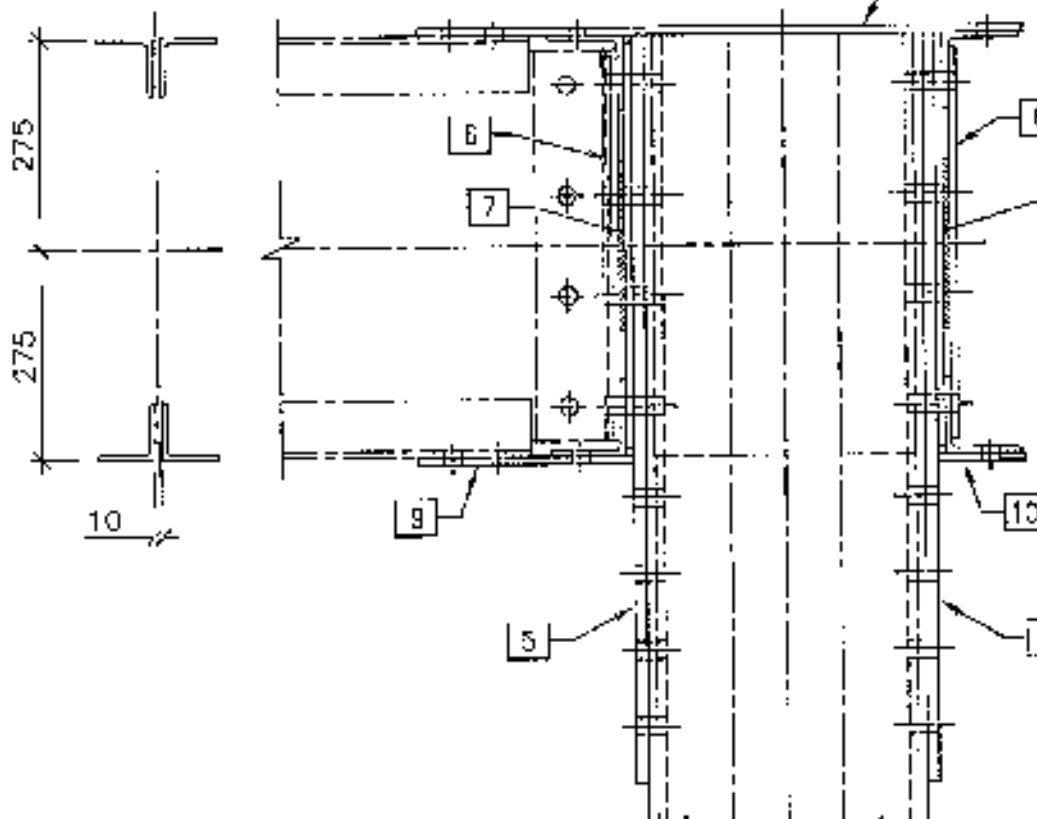
SECTION A-A

DETAIL OF ITEM NO. 4

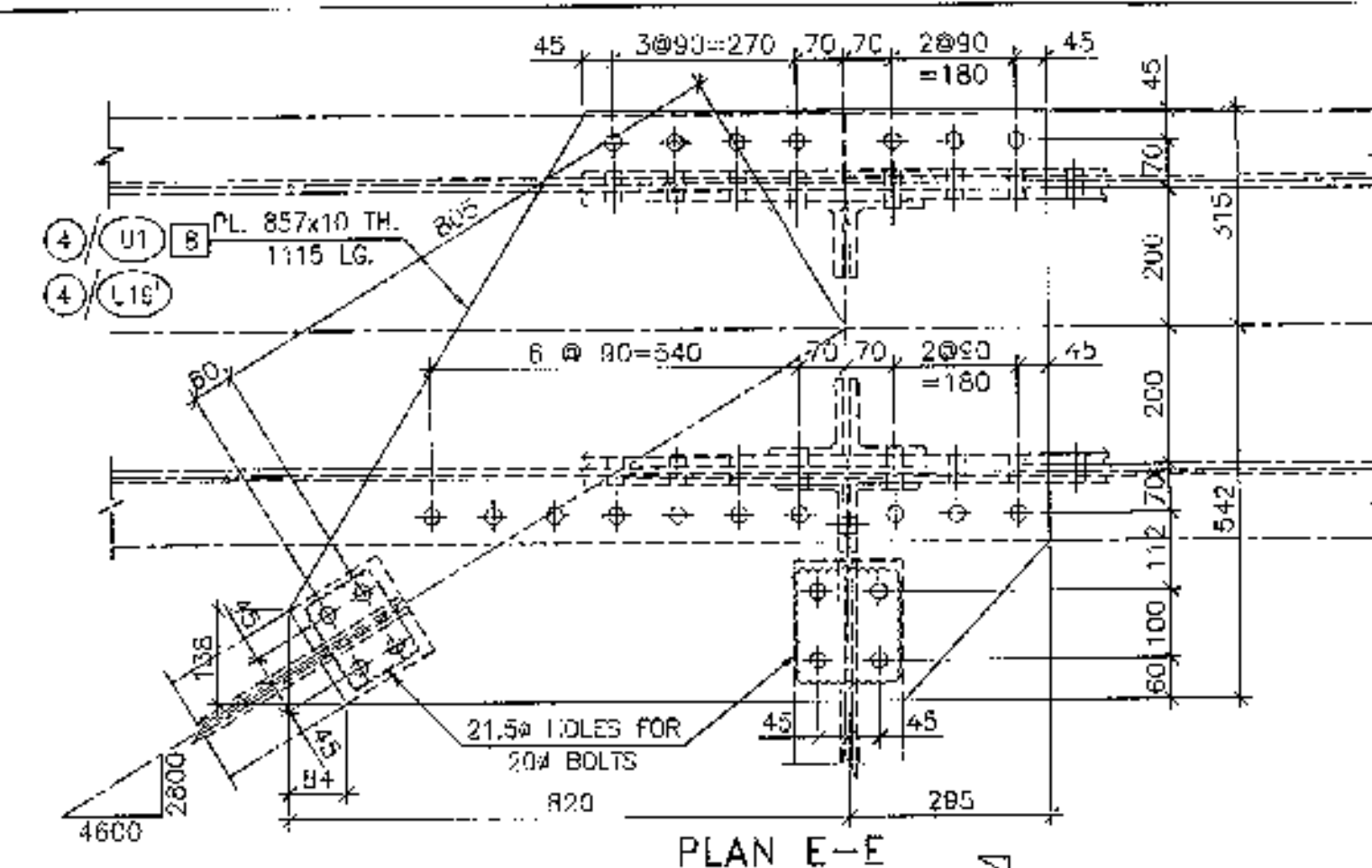
4Ls. 100x100x12 (INWARD)
2 SIDE PLS. 480x16
SPACED 365 B/B
2 INNER PLS. 250x12

SWAY GIRDER

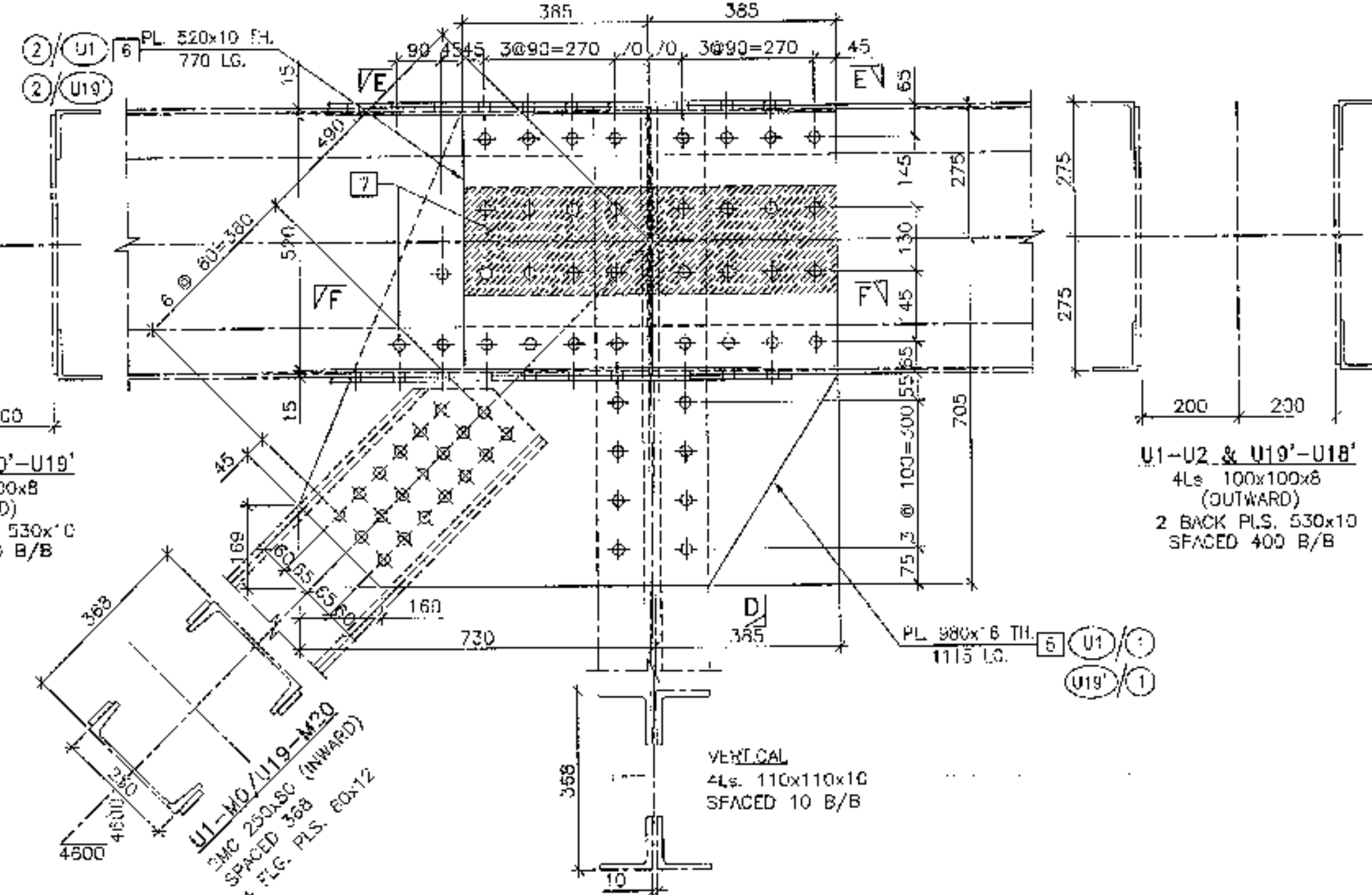
4Ls. 75x75x8
SPACED 10 B/B
BRACING
4Ls. 75x75x8
SPACED 10 B/B



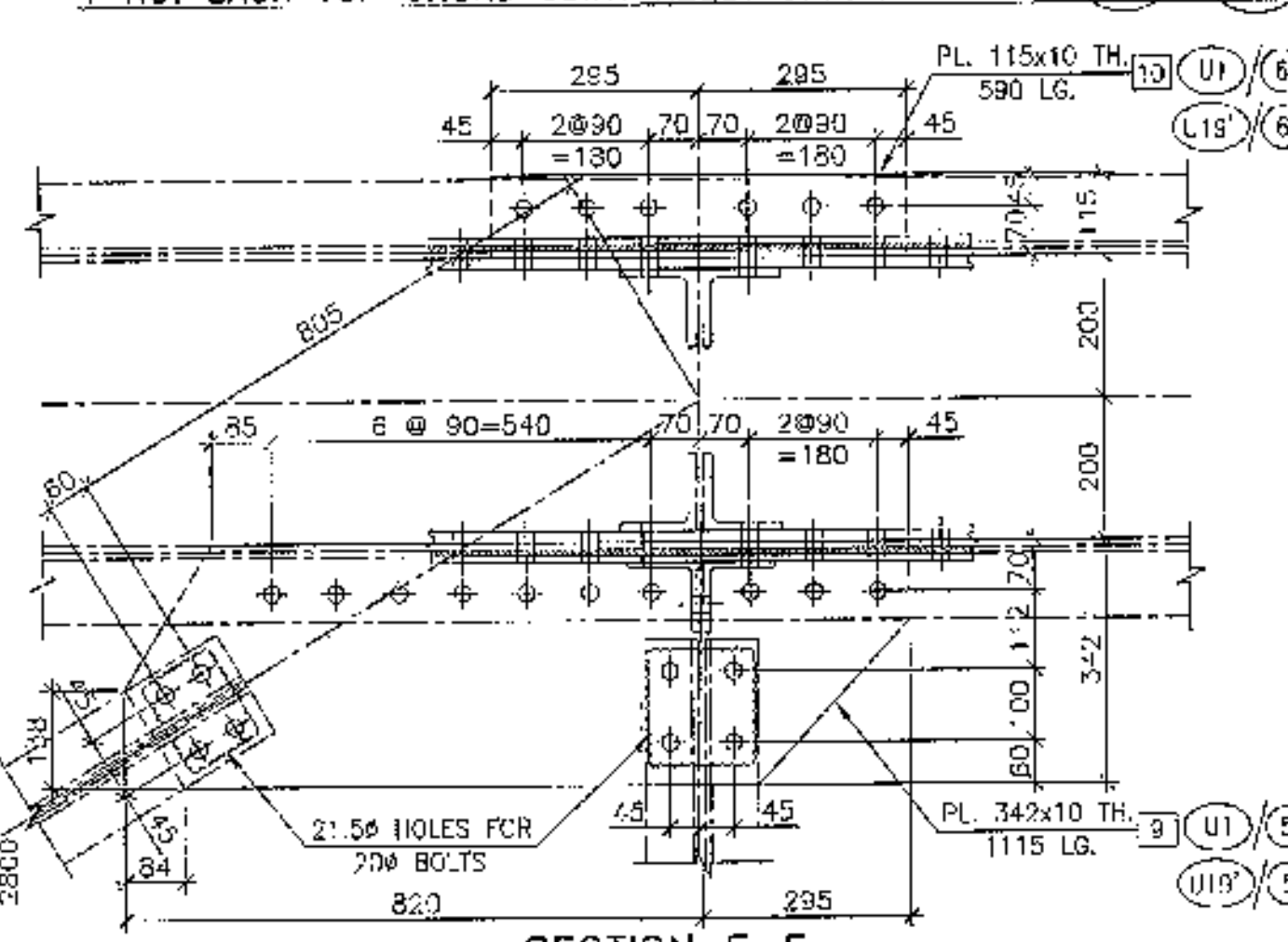
SECTION D-D



PLAN E-E



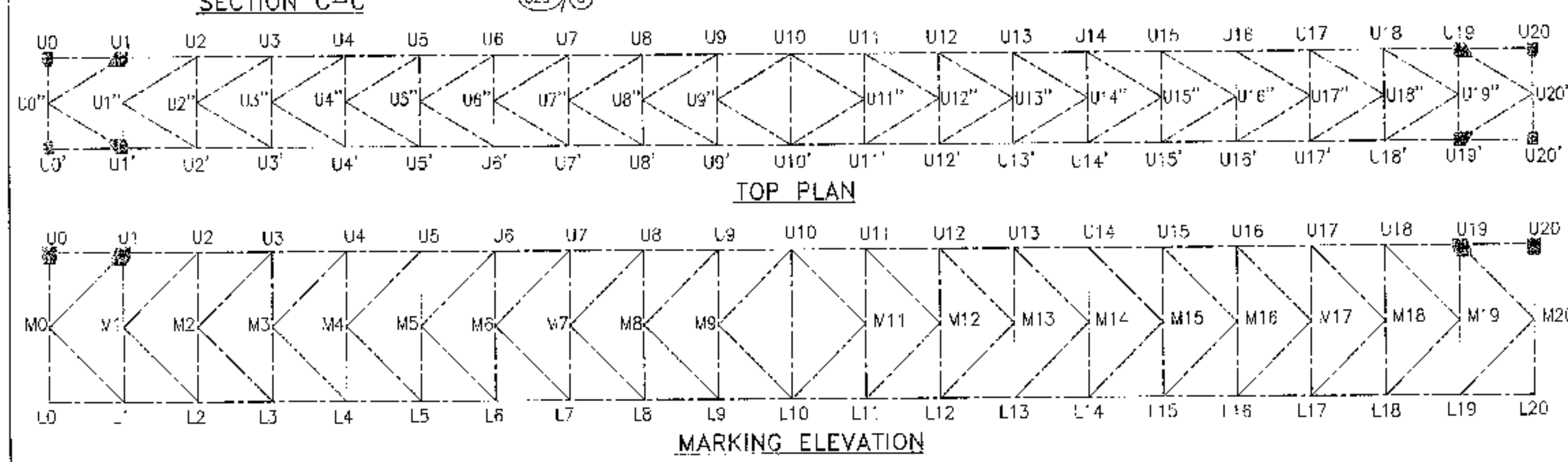
SECTION E-E



SECTION F-F

NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF 6 mm (EG 507F) HAVING THROAT THICKNESS = 0.7xLEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 23.5 FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THUS: [Symbol]
5. ALL ERECTION MARKS SHOWN THUS: [Symbol]
6. GRADE OF STRUCTURAL STEEL = IS-2062.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO S : 1363-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHIP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T. 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL GENERAL ARRANGEMENT REFER DRG. NO. 2005-10/J-416/32m/ST-101
12. ALL HOLES FOR BOLTS ARE SHOWN THUS: [Symbol]
13. ALL T-HEADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.



TOP PLAN

MARKING ELEVATION

CLIENT : EXECUTIVE ENGINEER,
SPECIAL DEPARTMENT ENGINEERING DIVISION
DARJEELING GORKHA HILL COUNCIL, DARJEELING.

CONTRACTOR : CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.

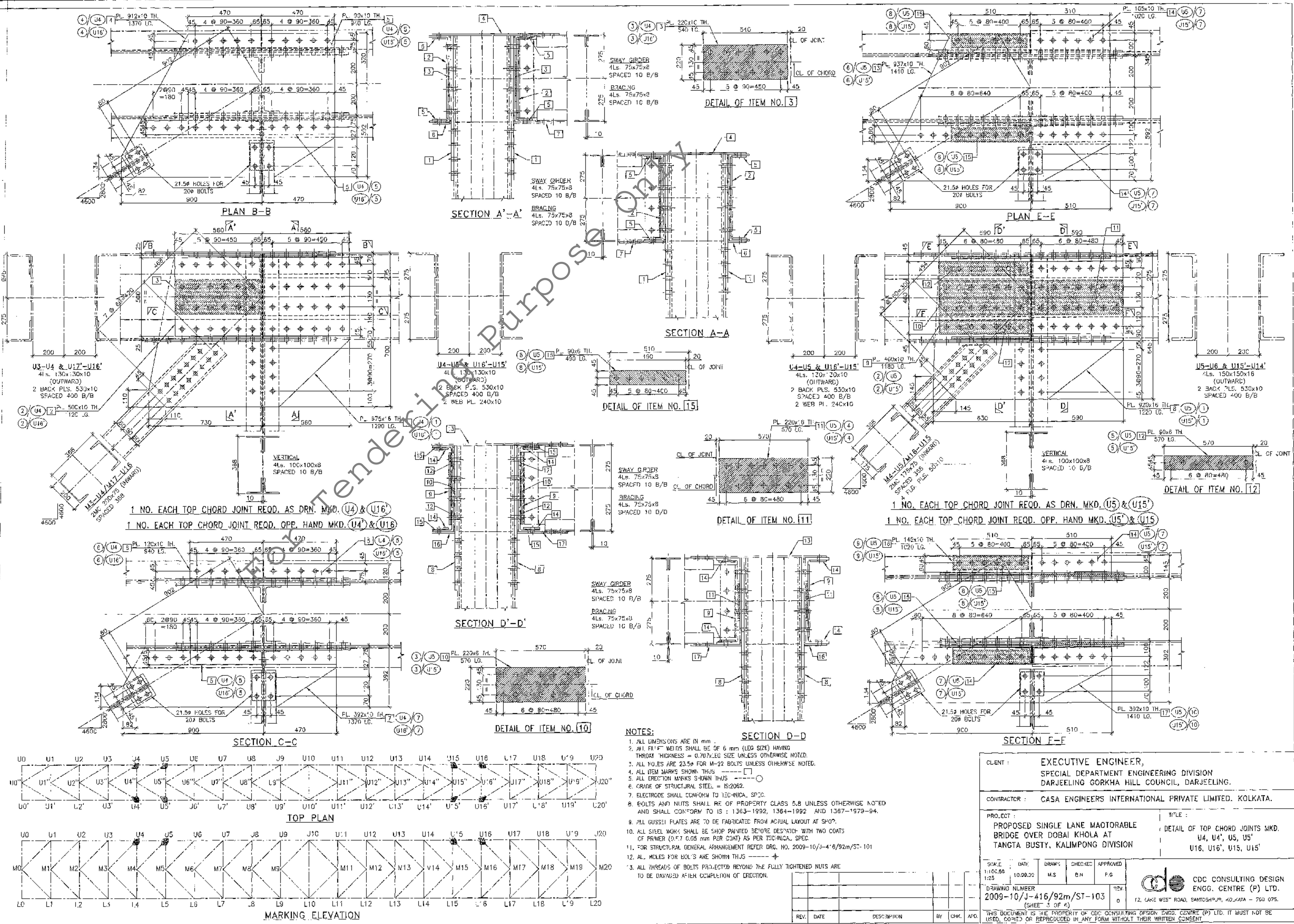
PROJECT : PROPOSED SINGLE LANE MAJORABLE
BRIDGE OVER DOBAI KHOLA AT
TANGTA BUSTY, KALIMPONG DIVISION

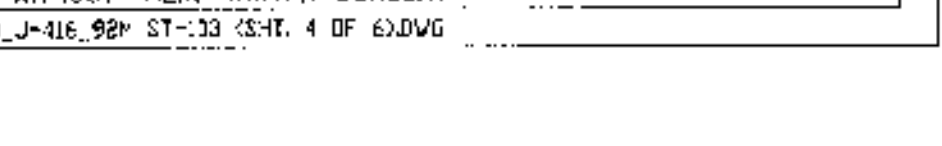
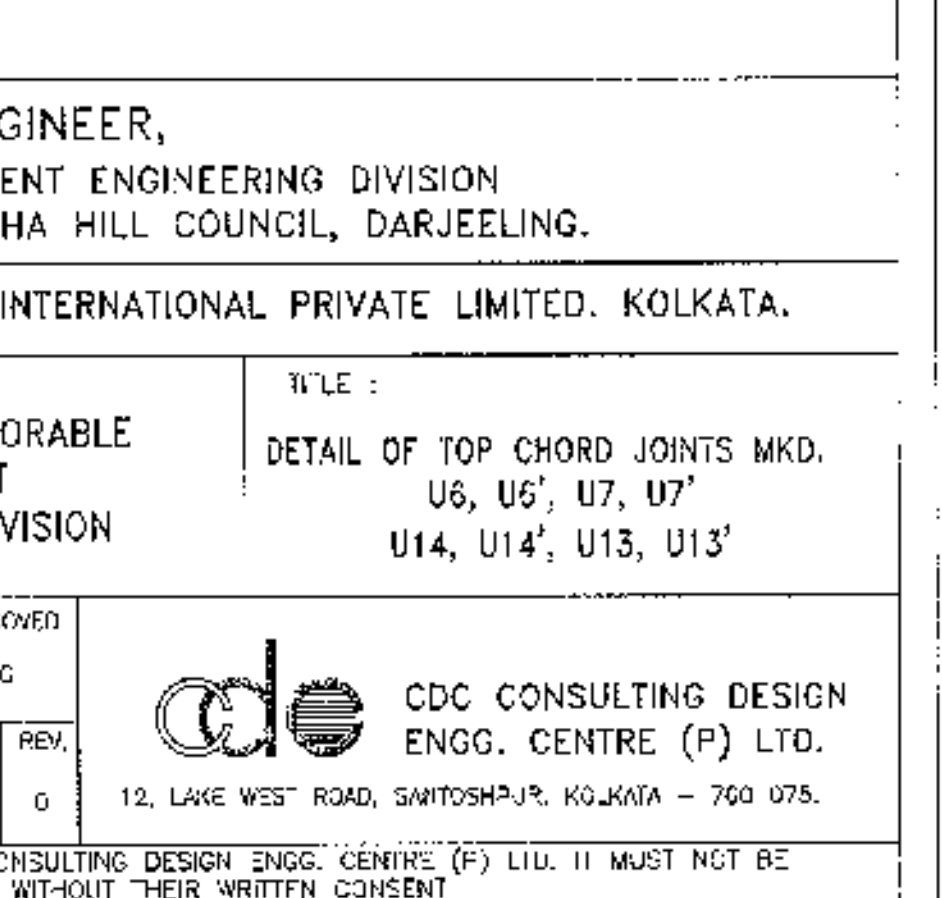
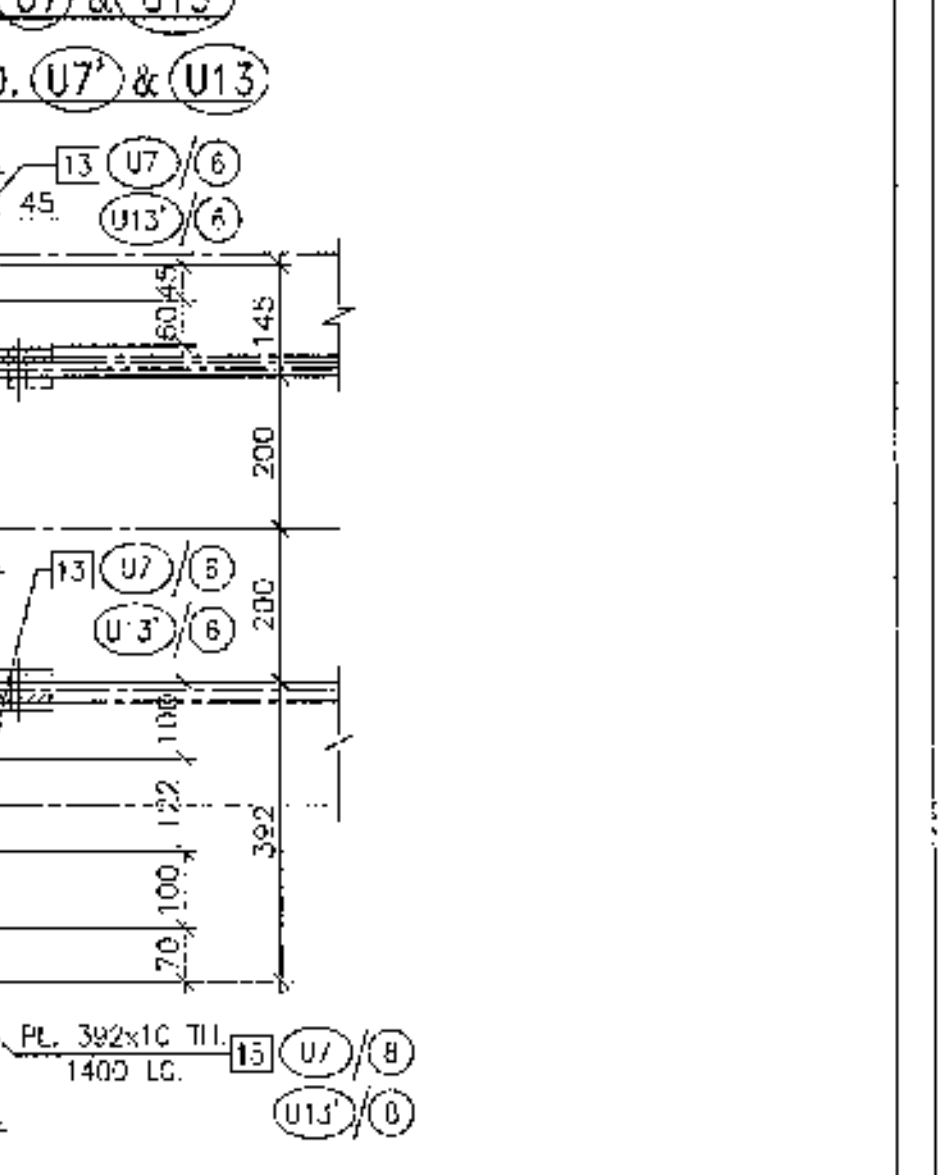
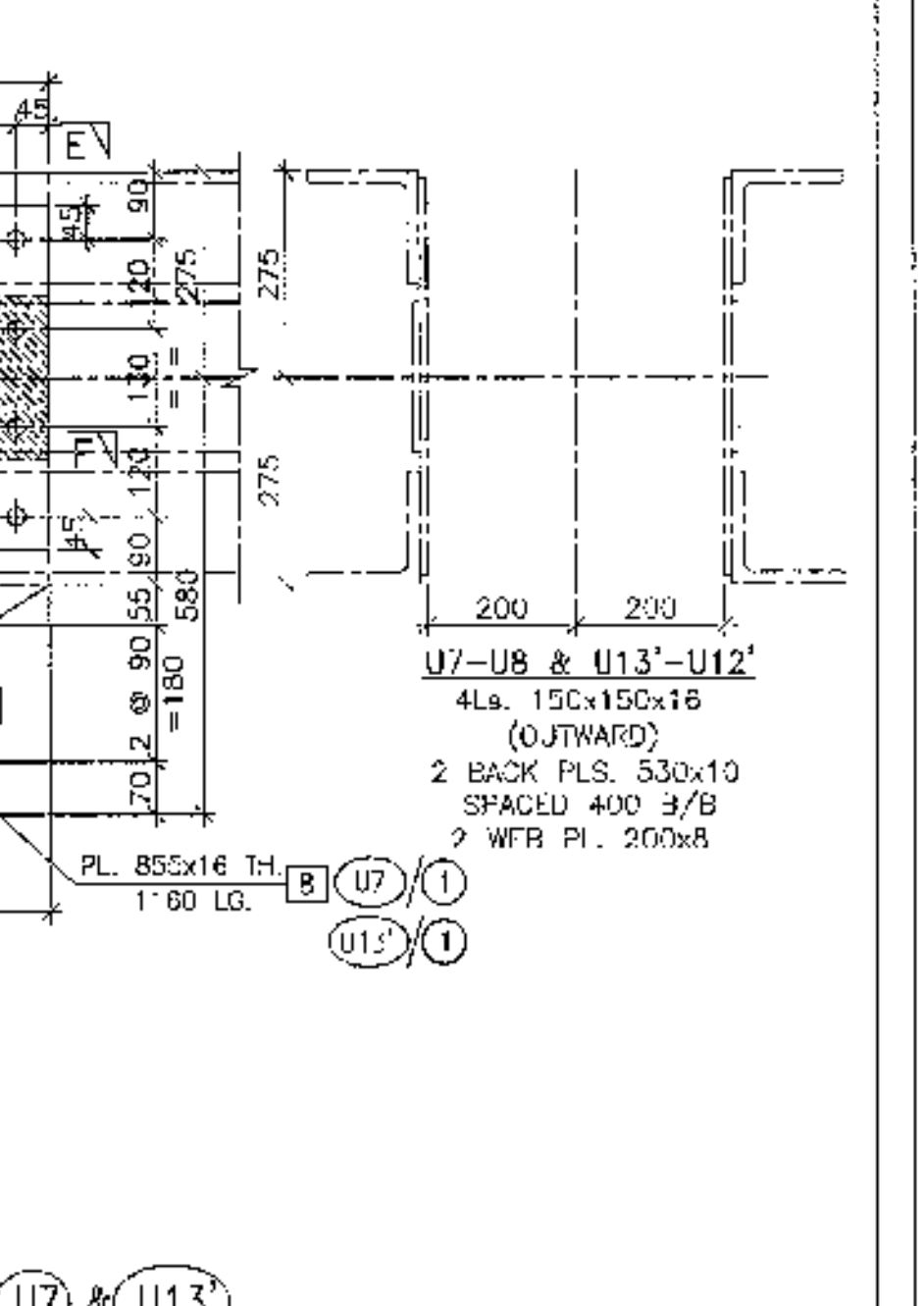
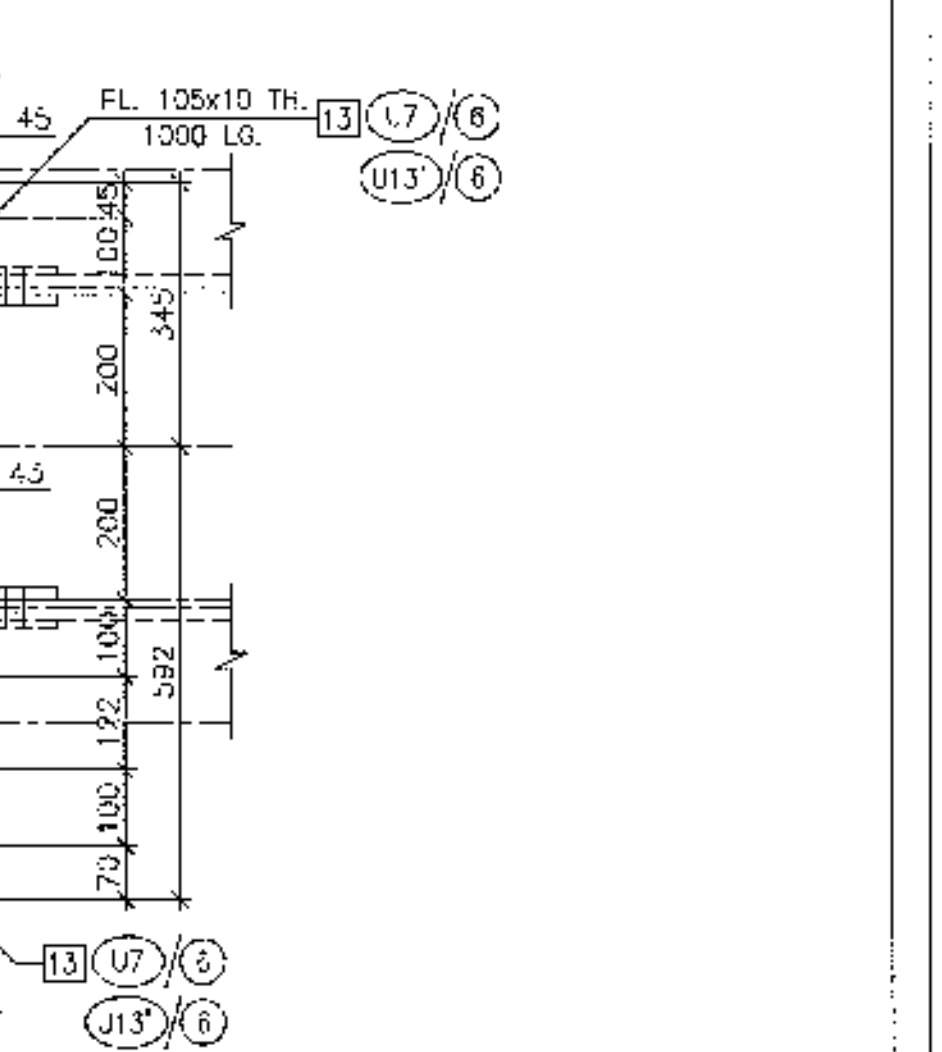
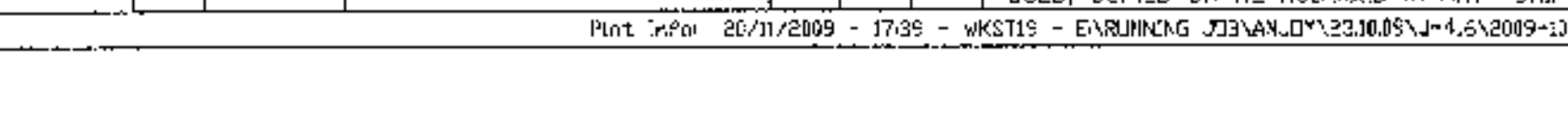
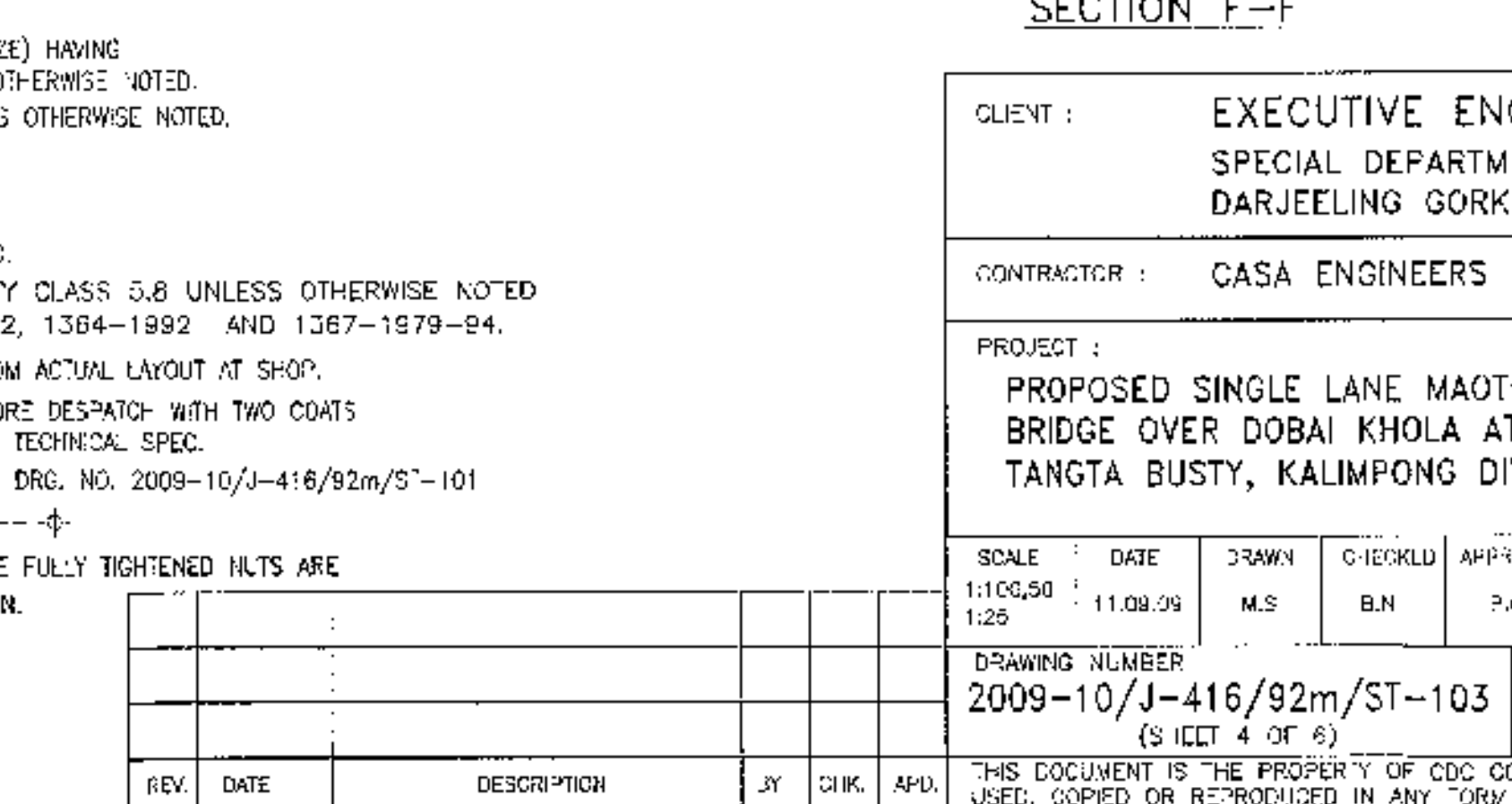
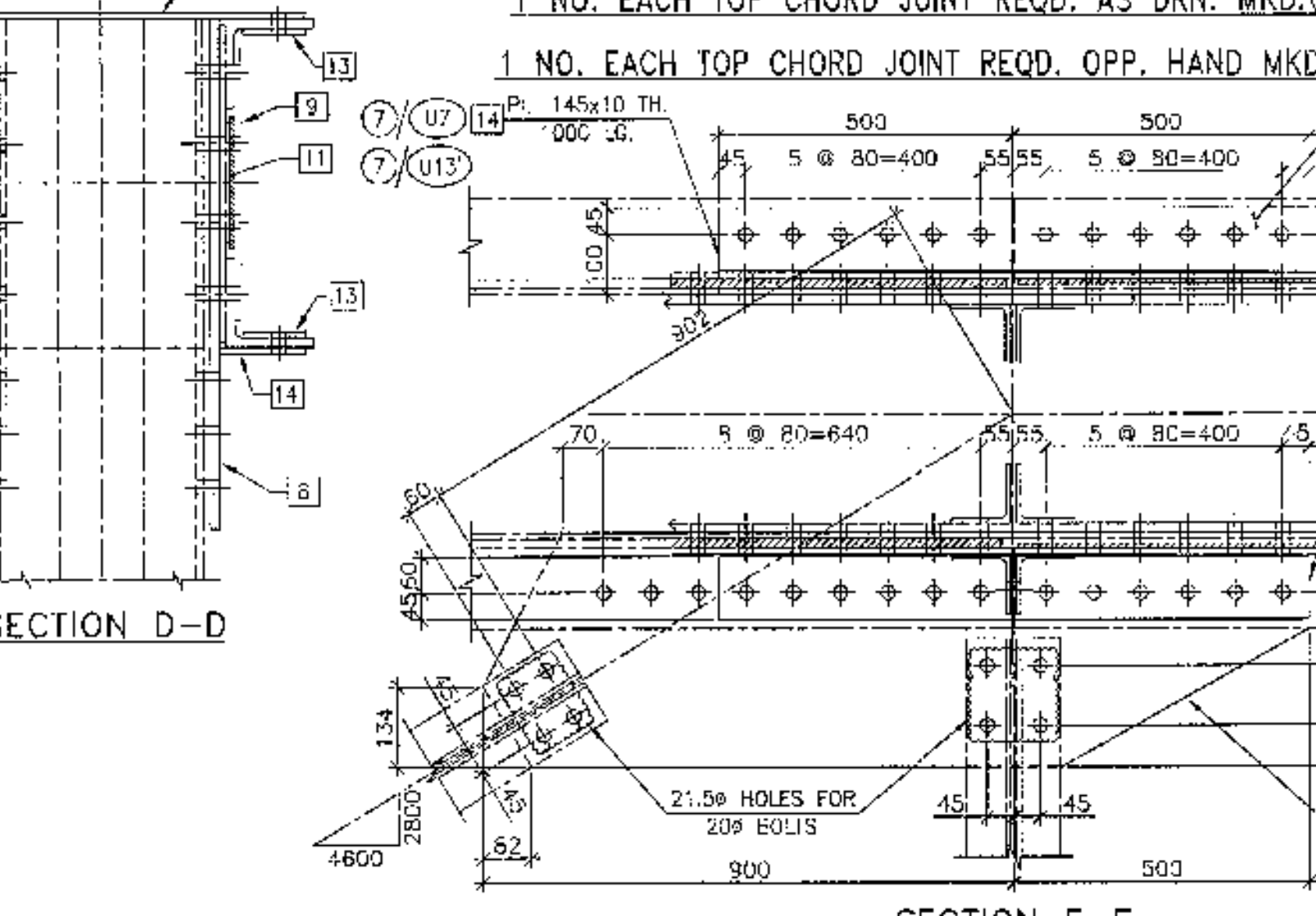
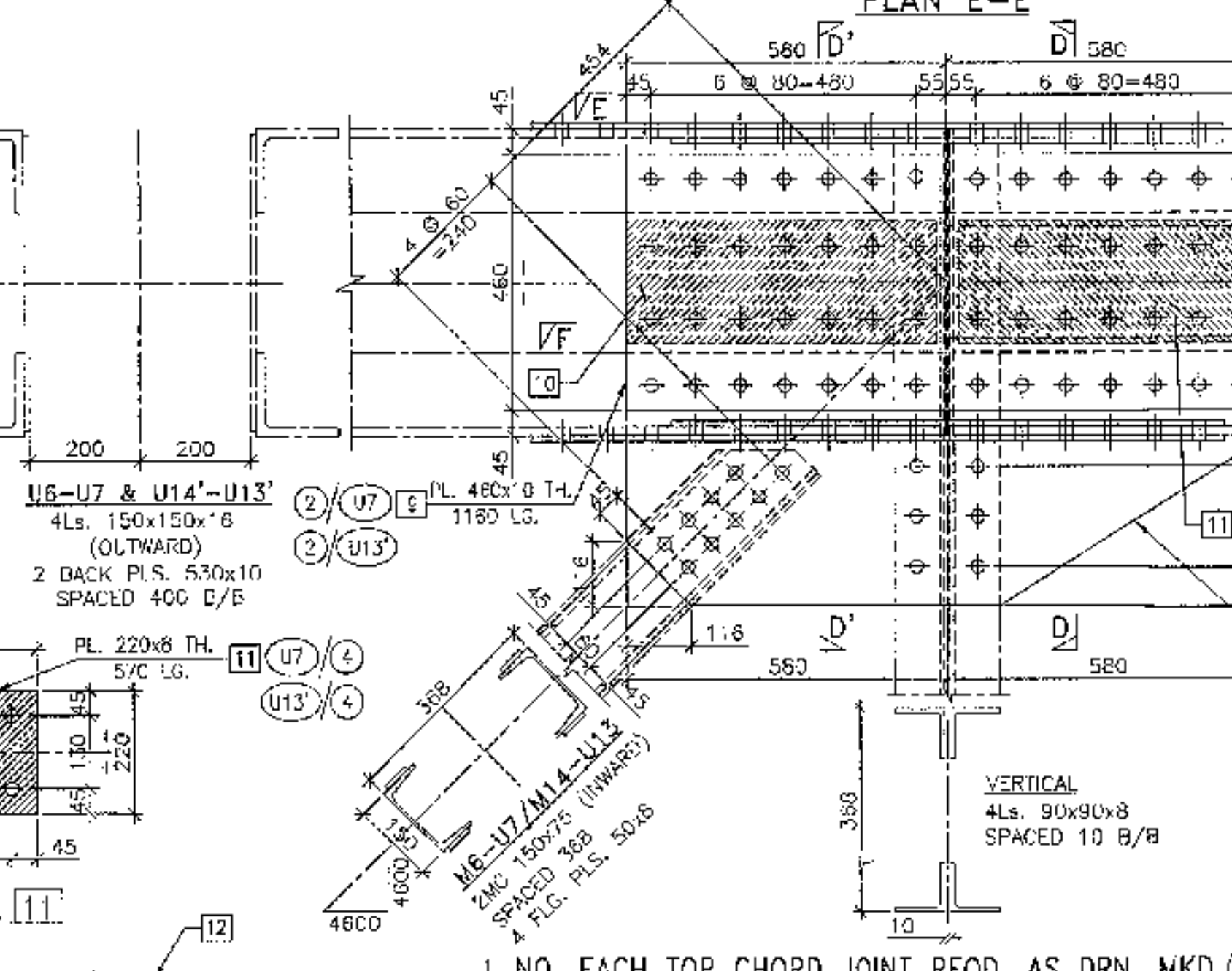
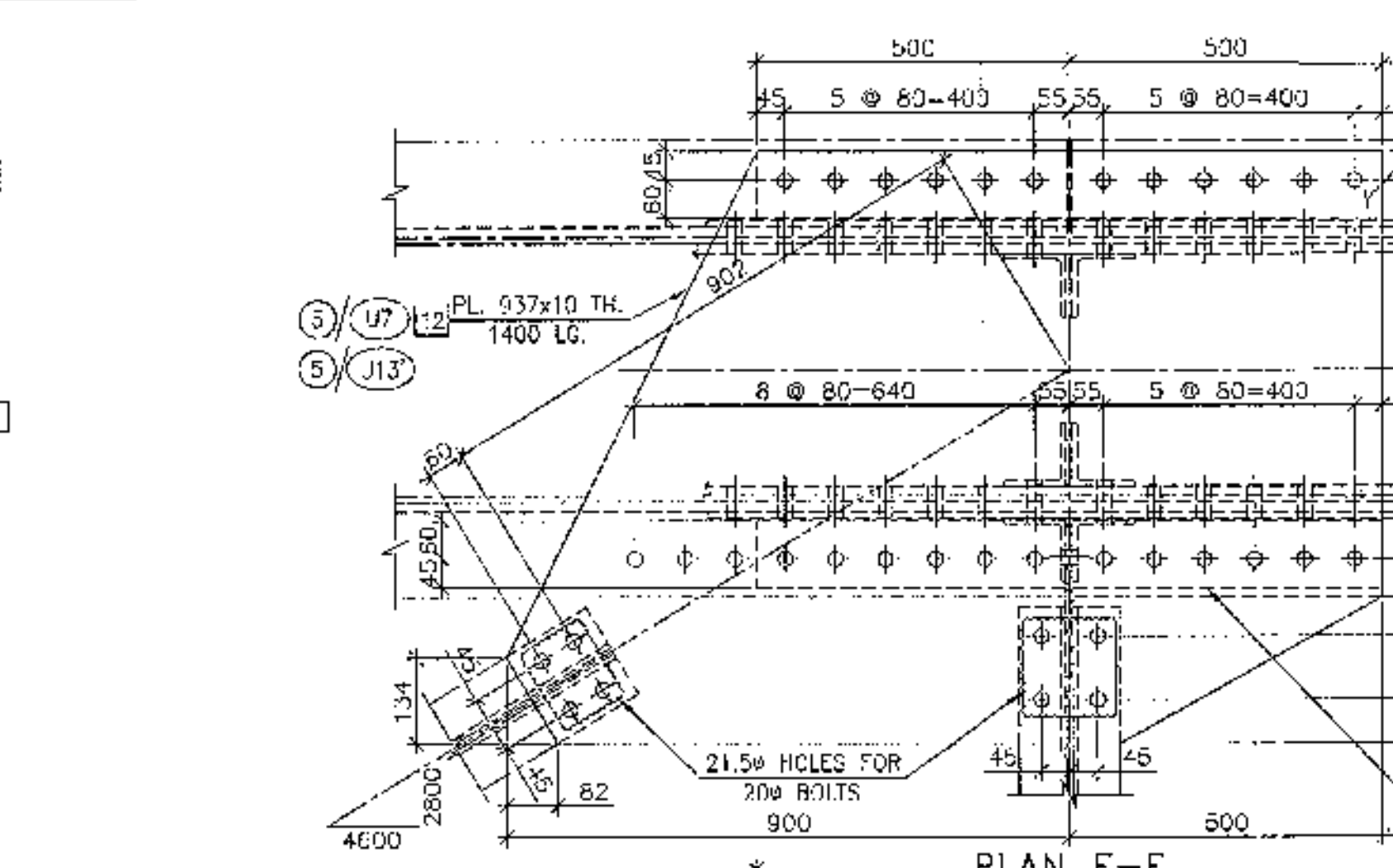
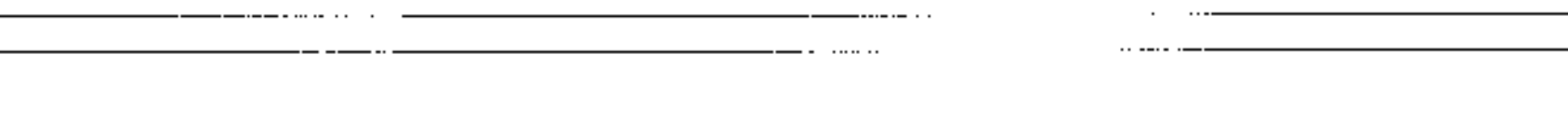
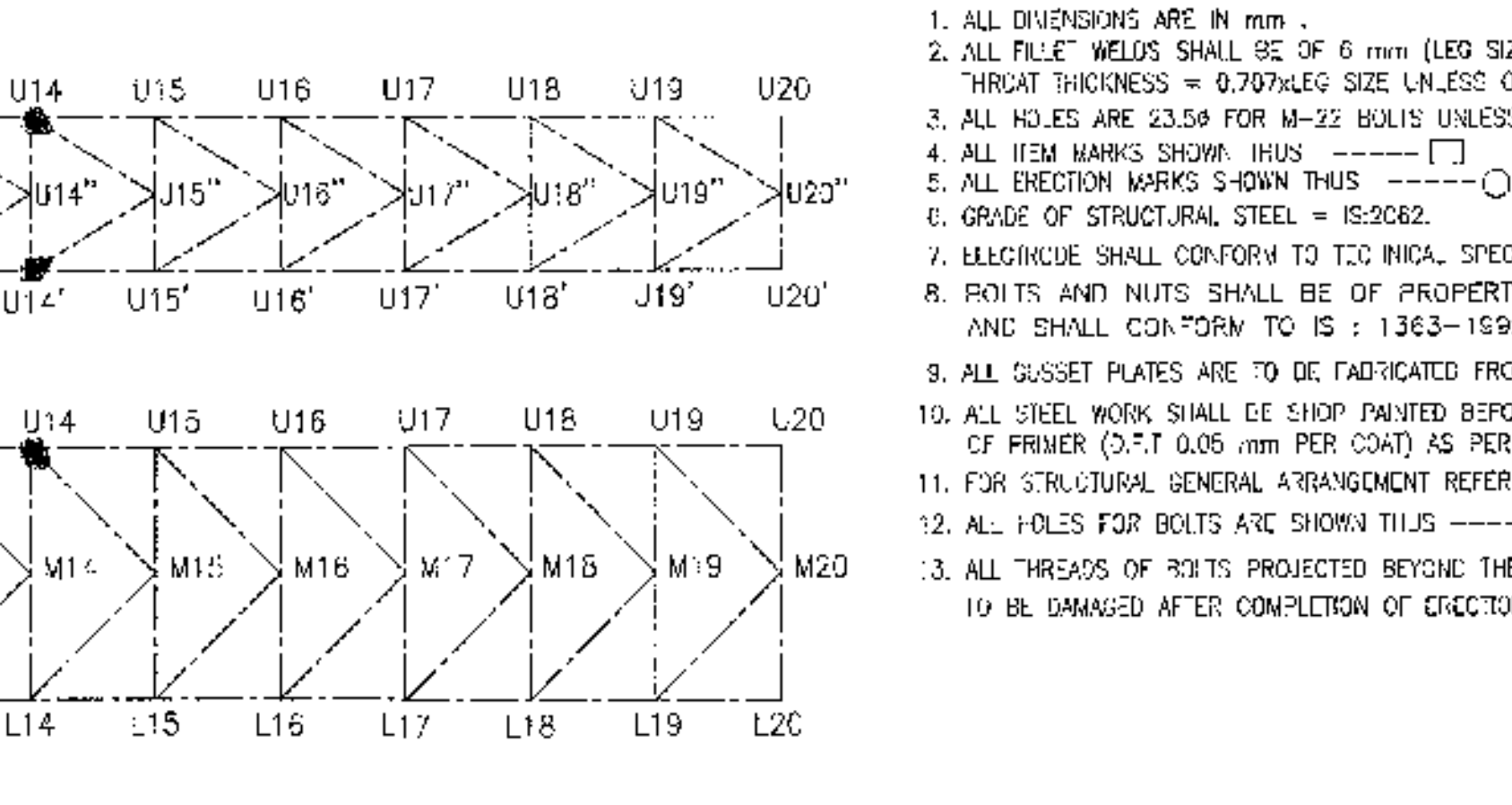
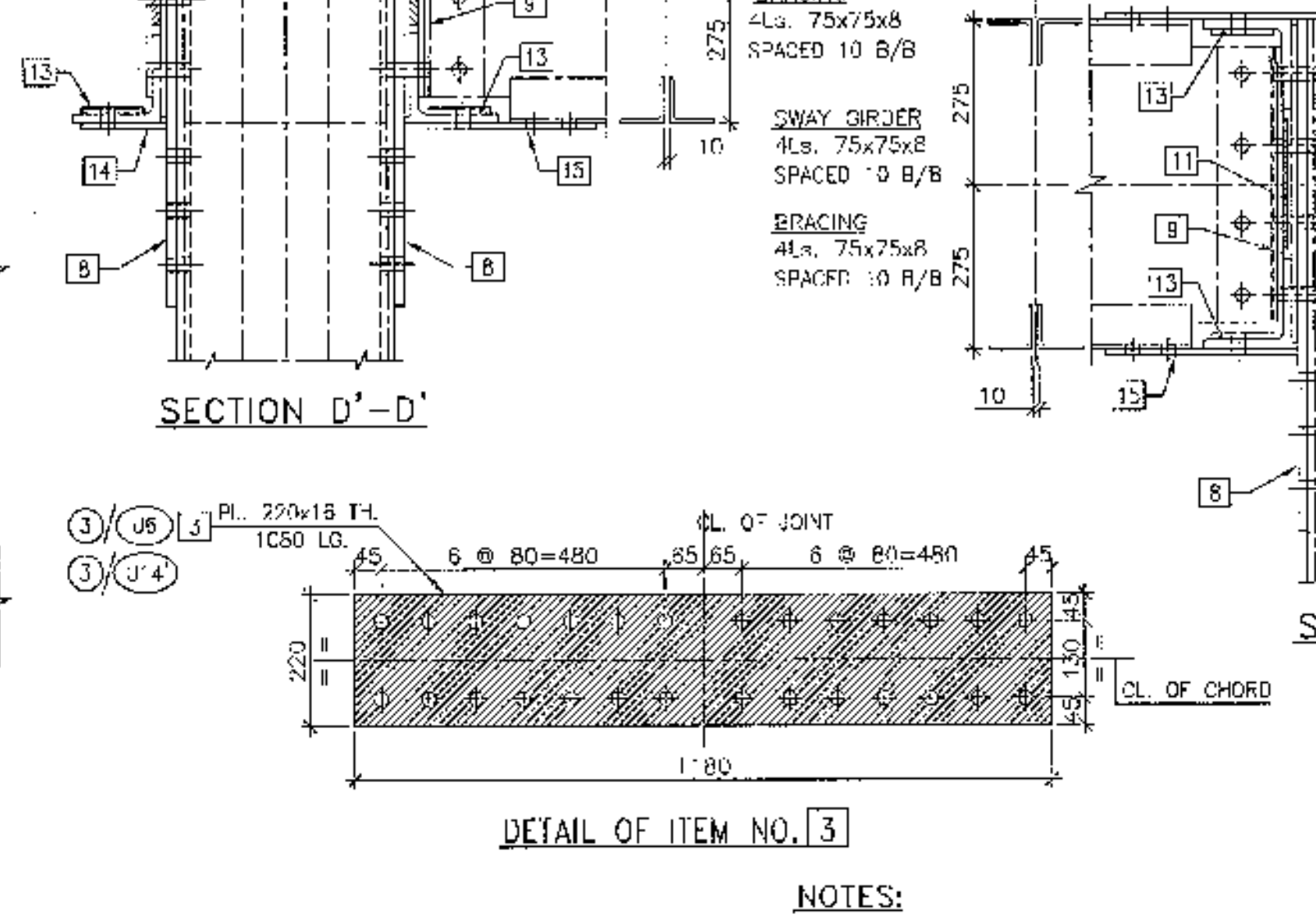
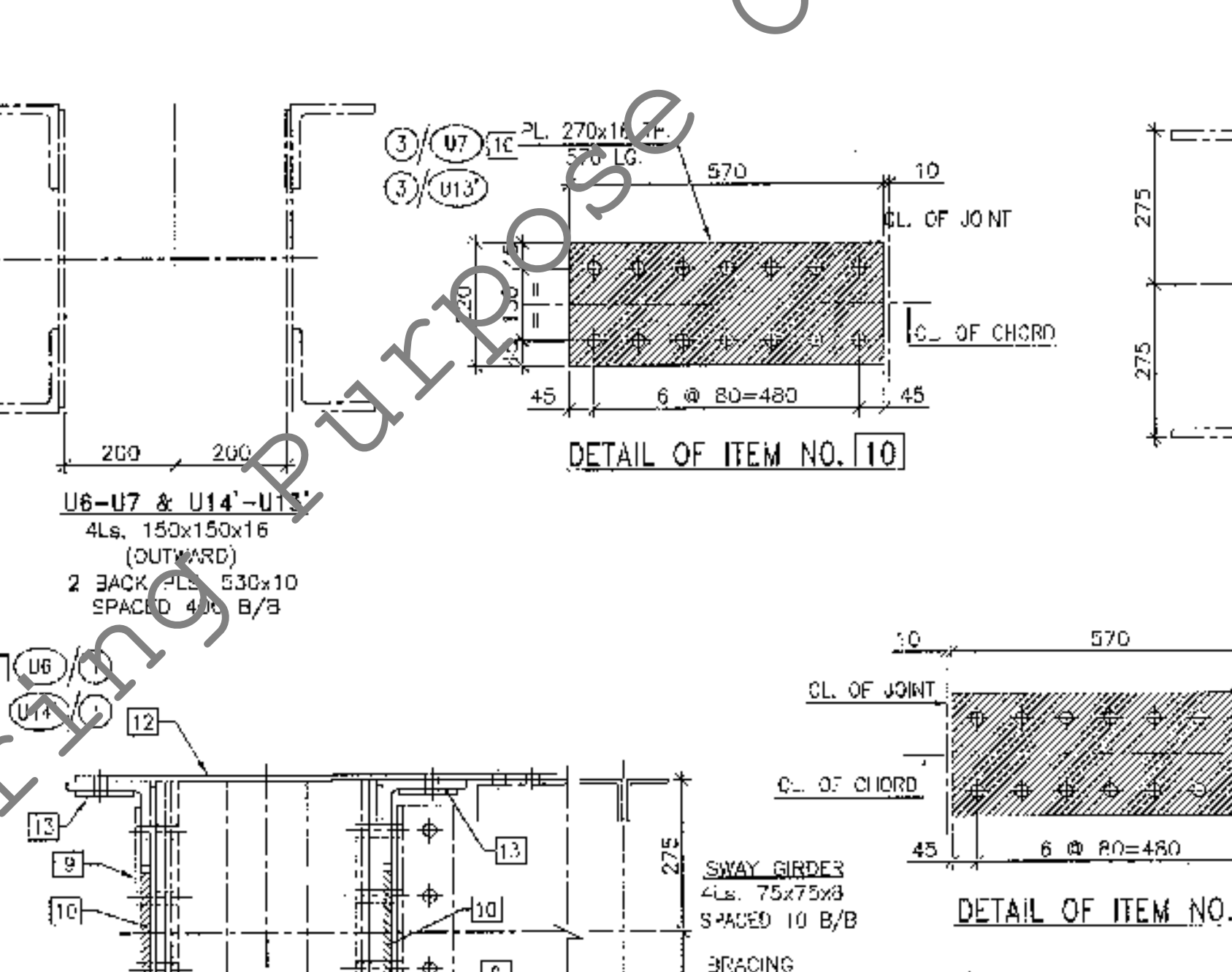
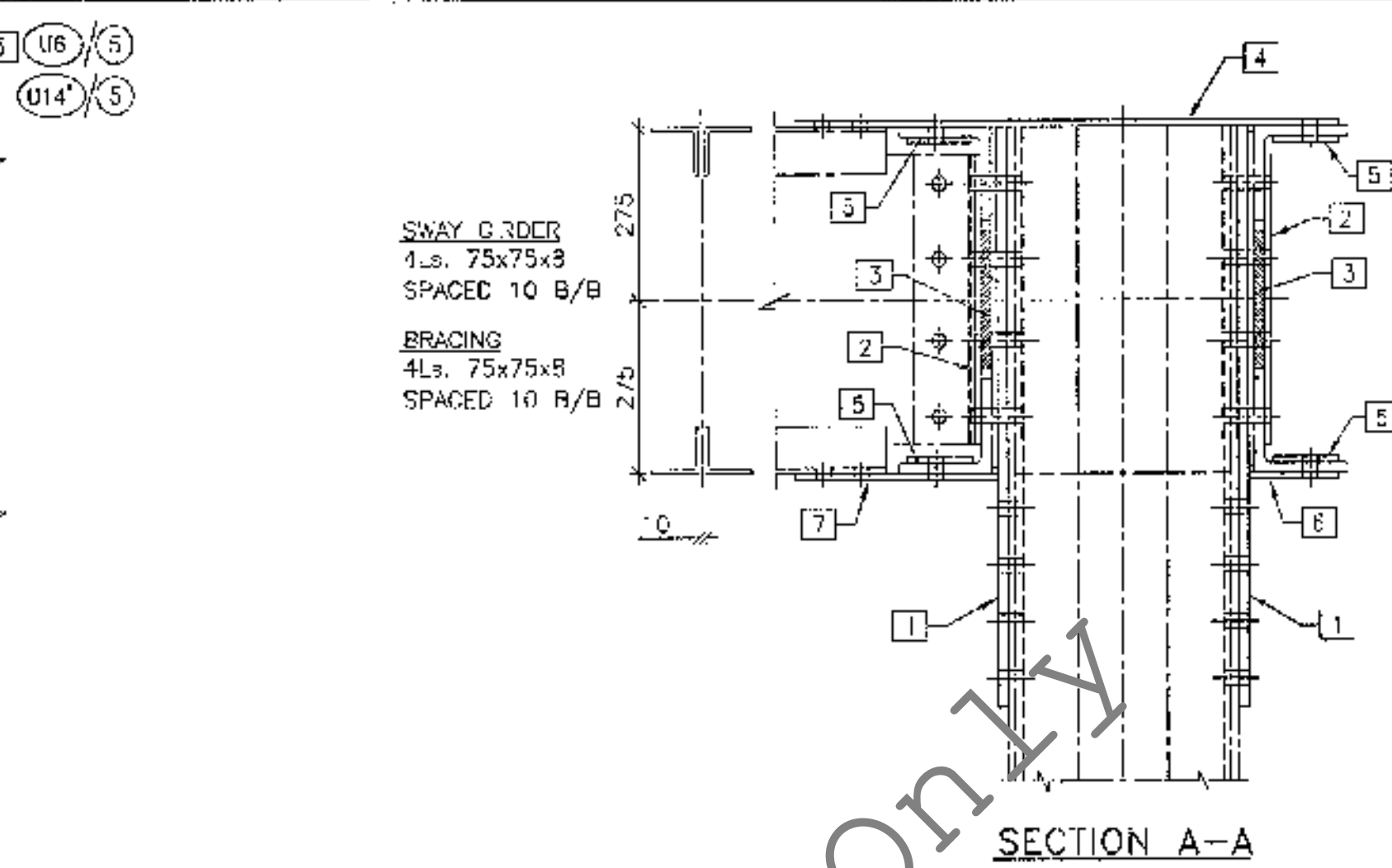
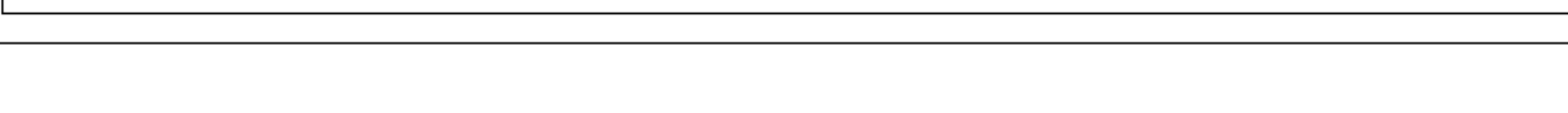
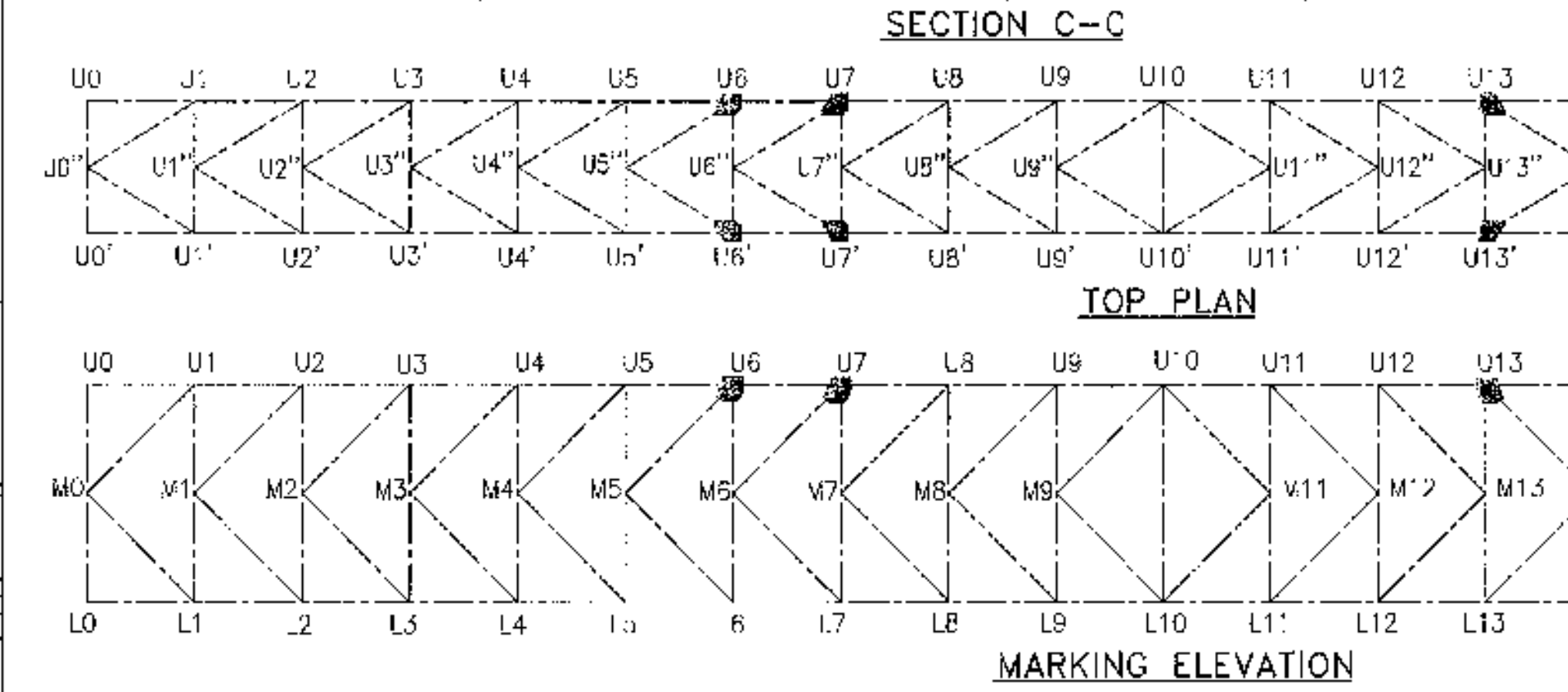
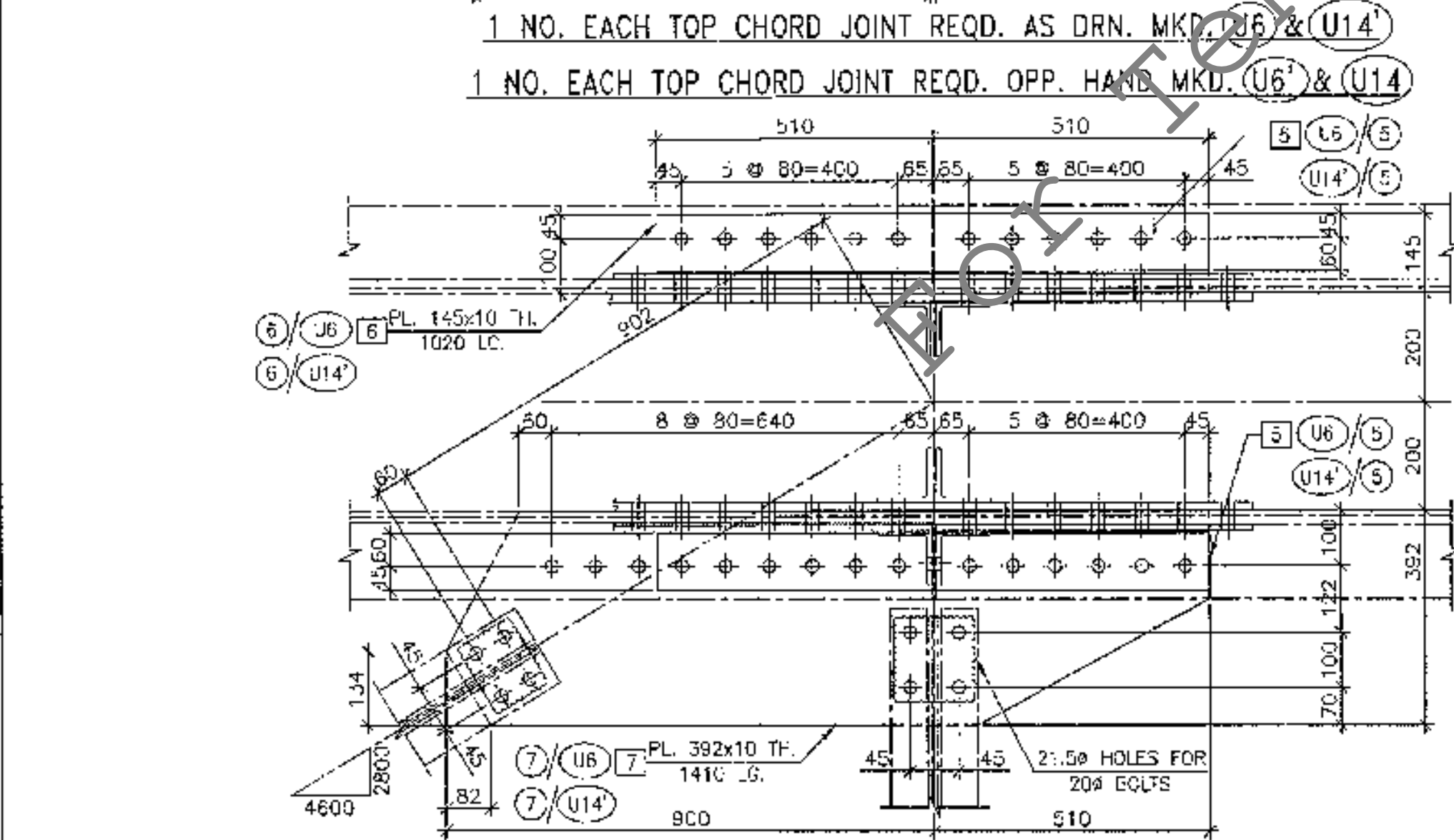
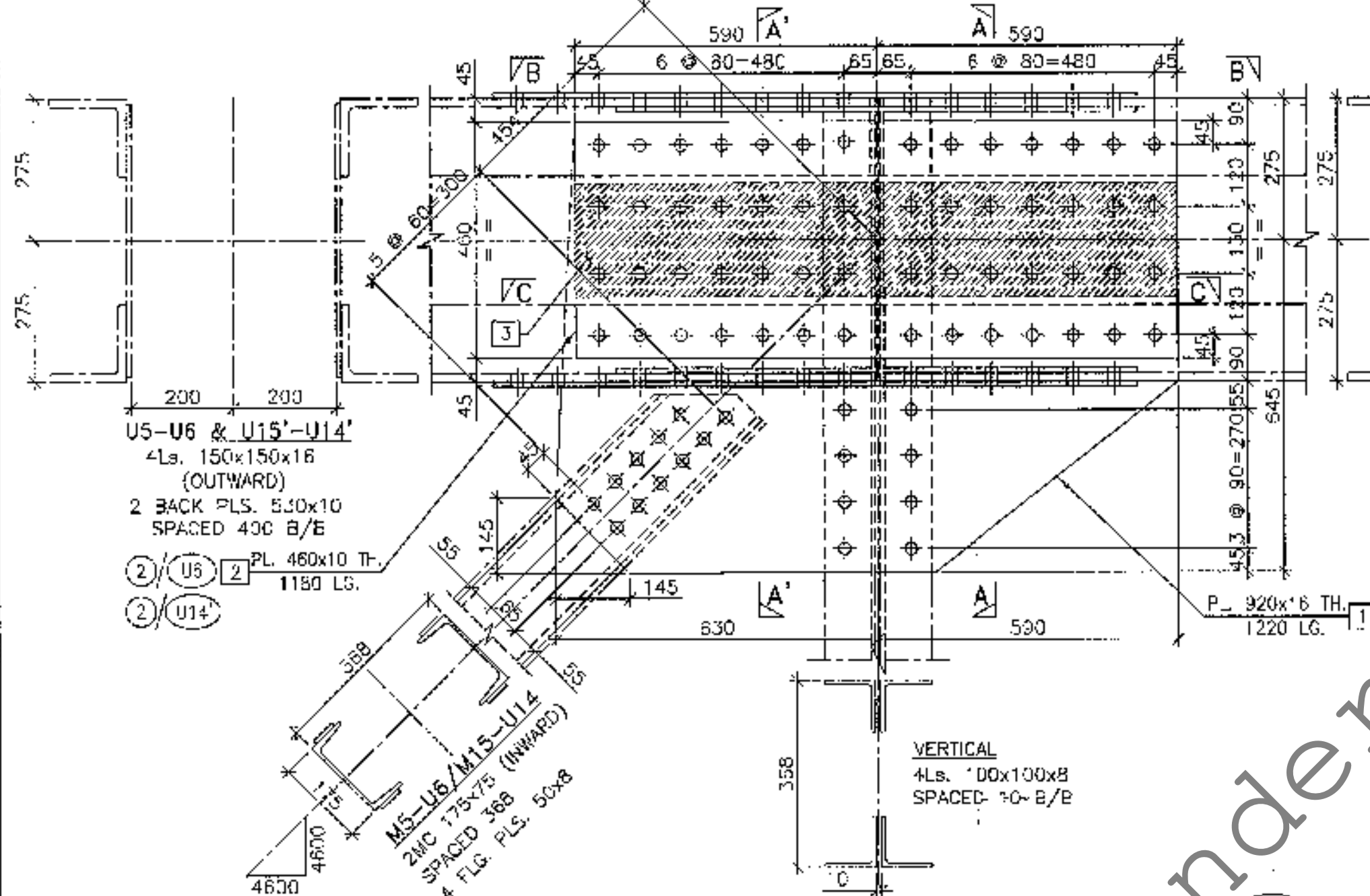
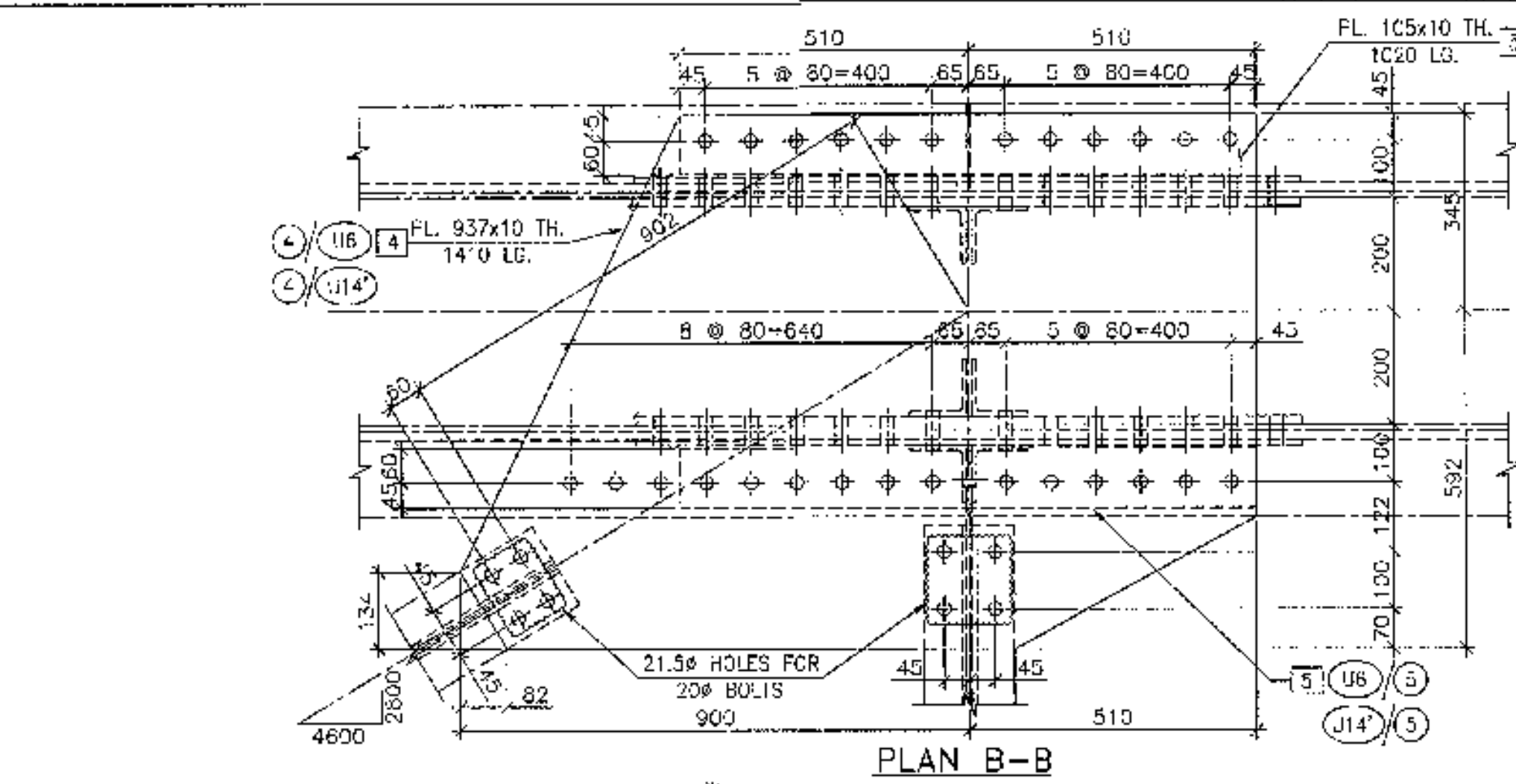
TITLE : DETAIL OF TOP CHORD JOINTS MKD.
UO, UO', U1, U1'
U20, U20', U19, U19'

SCALE : 1:100, 3/4
DATE : 08.08.09
DRAWN : U.S.
CHECKED : B.N.
APPROVED : P.S.
DRAWING NUMBER : 2009-10/J-416/92m/ST-103
(SHEET 1 OF 6)

CDL CDC CONSULTING DESIGN
ENGG. CENTRE (P) LTD.
12, LAKE WEST ROAD, SANTOSH P.L.R. KOLKATA - 700 075.

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Plot Info: 25/1/2009 - 1725 - WKST16 - ENVRNUNG JOIVANJY333009J-415X2009-10-1-416-92m-ST-103 (SHEET 1 OF 6) 6/2/09





NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707xLEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 23.50 FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THUS: (U6) (U14)
5. ALL ERECTION MARKS SHOWN THUS: (U6) (U14)
6. GRADE OF STRUCTURAL STEEL IS IS-2062.
7. BOLLING SHALL CONFORM TO T.C. INDIA SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1979-94.
9. ALL SUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (0.57 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL GENERAL ARRANGEMENT REFER DRG. NO. 2009-10/J-416/92m/ST-101
12. ALL HOLES FOR BOLTS ARE SHOWN THUS: (U6) (U14)
13. ALL THREADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.

CLIENT : EXECUTIVE ENGINEER,
SPECIAL DEPARTMENT ENGINEERING DIVISION
DARJEELING GORKHA HILL COUNCIL, DARJEELING.

CONTRACTOR : CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.

PROJECT : PROPOSED SINGLE LANE MAOTORABLE
BRIDGE OVER DOBAI KHOLA AT
TANGTA BUSTY, KALIMPONG DIVISION

FILE : DETAIL OF TOP CHORD JOINTS MKD.
U6, U6', U7, U7'
U14, U14', U13, U13'

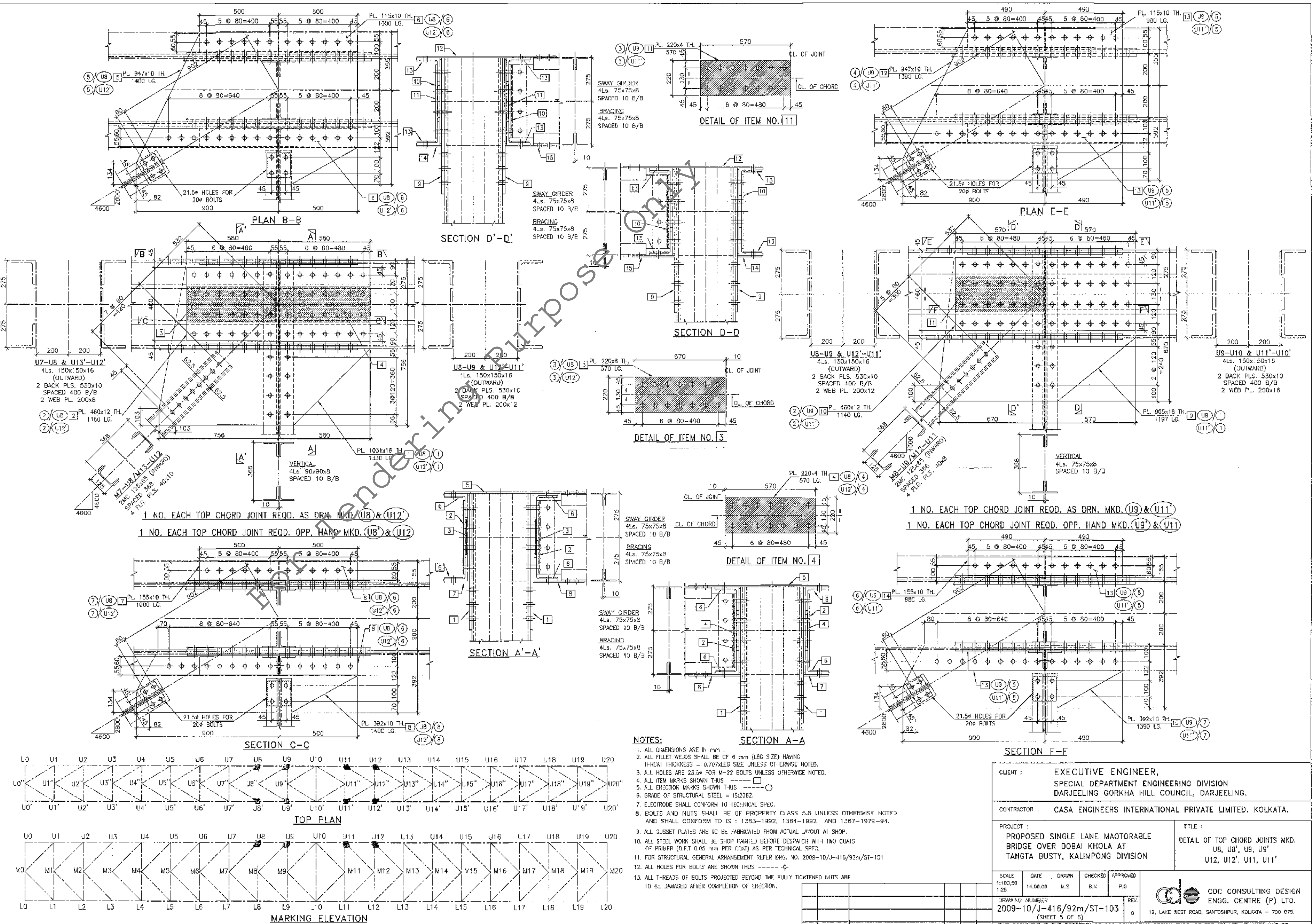
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DATE : 11.09.09
DRAWN : M.S.
CHECKED : B.N.
APPROVED : P.G.

DRAWING NUMBER : 2009-10/J-416/92m/ST-103
(SHEET 4 OF 6)

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REV. DATE DESCRIPTION BY CHK. APP.

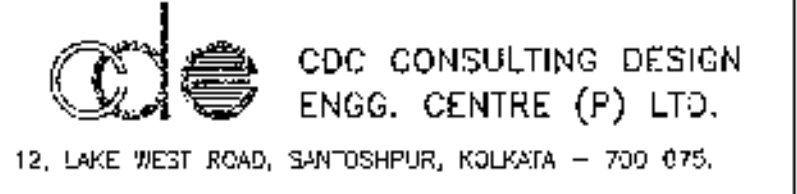
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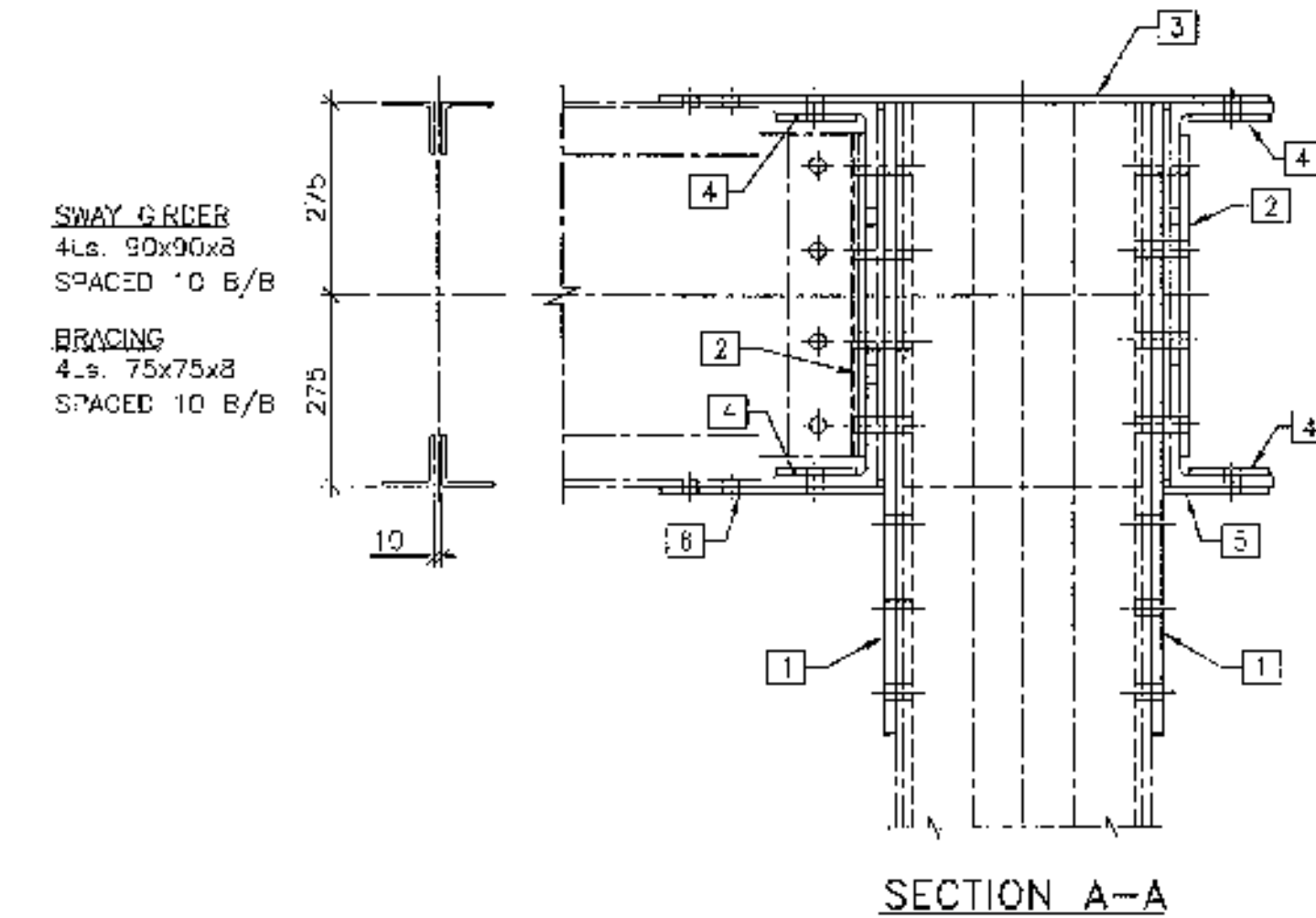
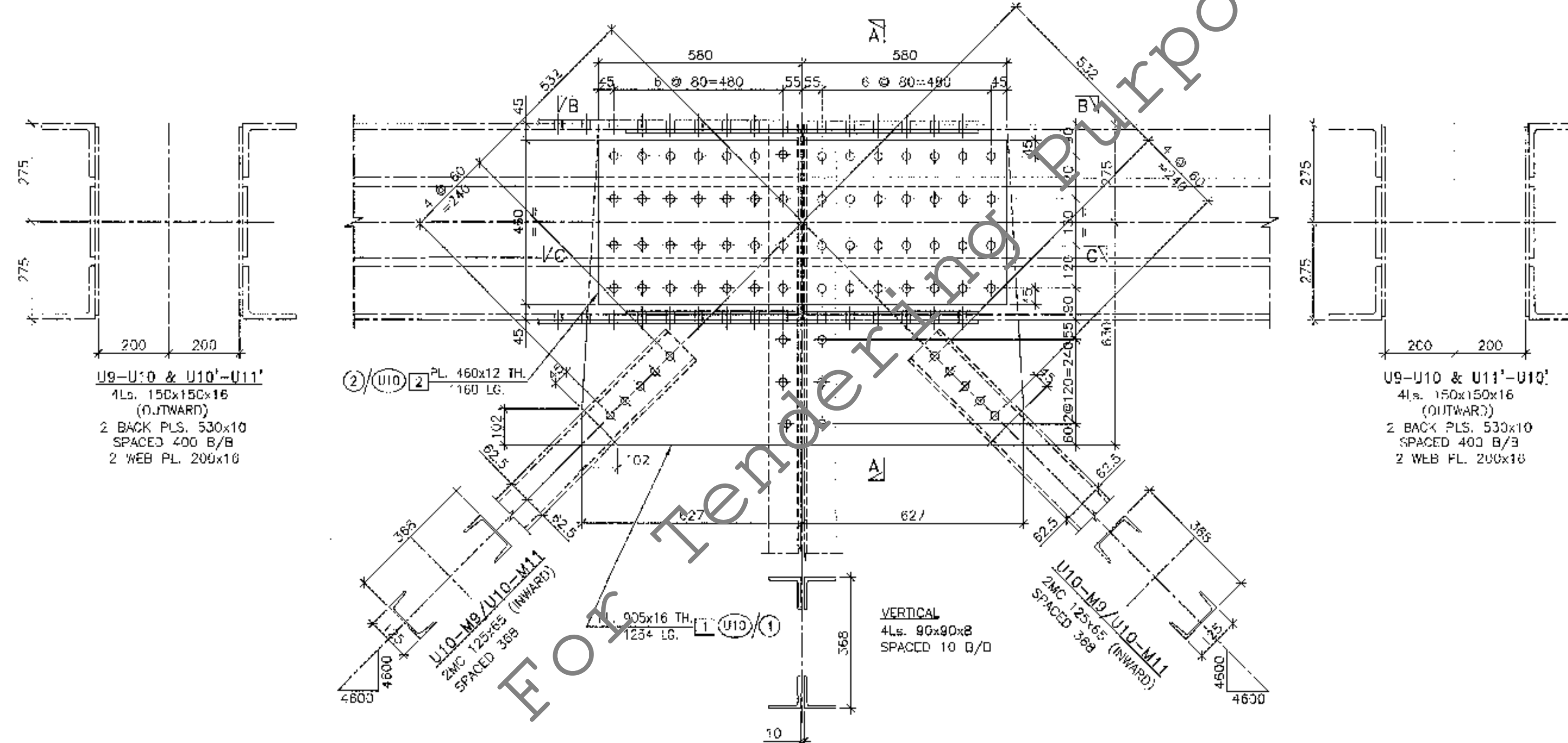
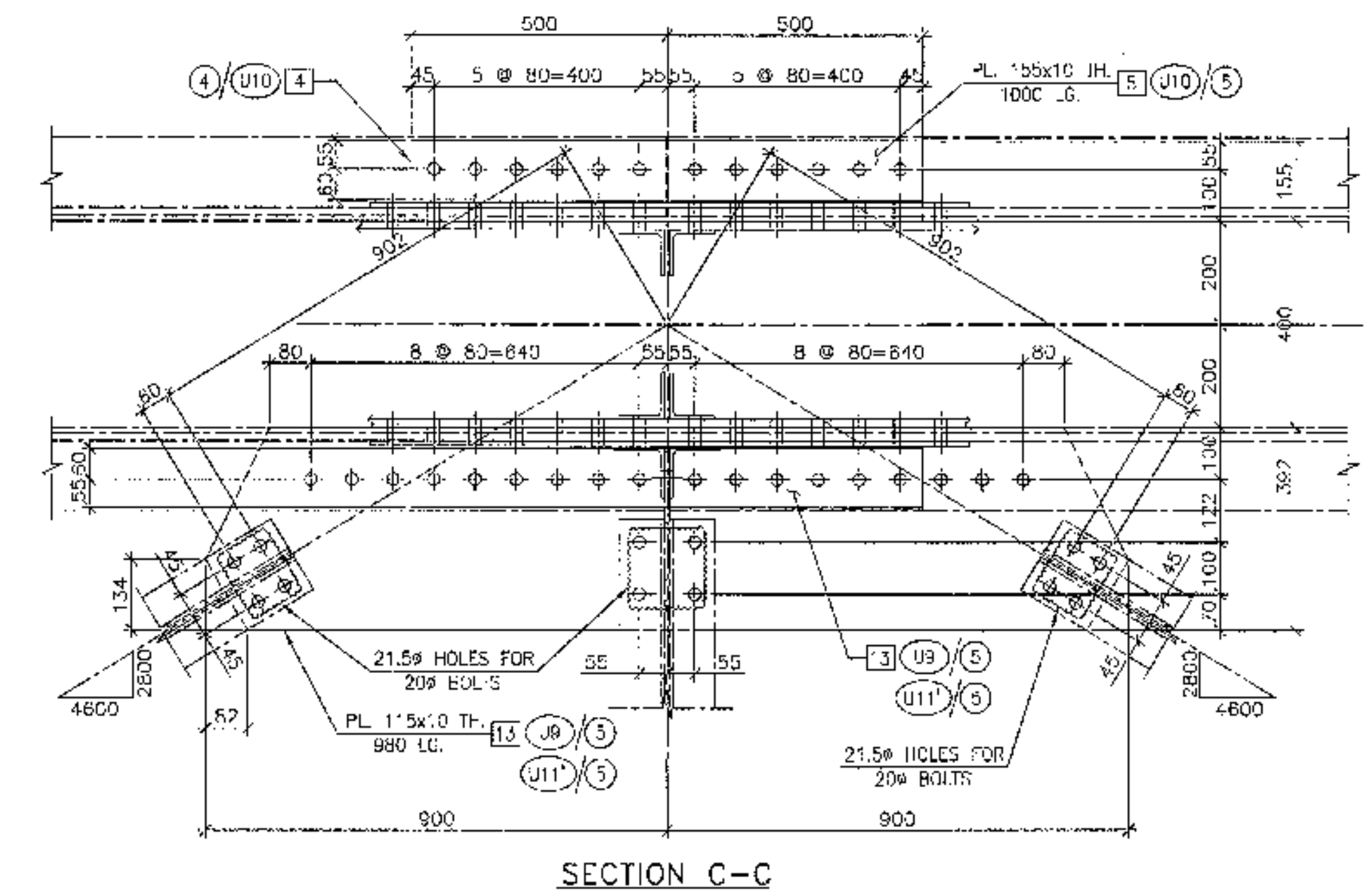
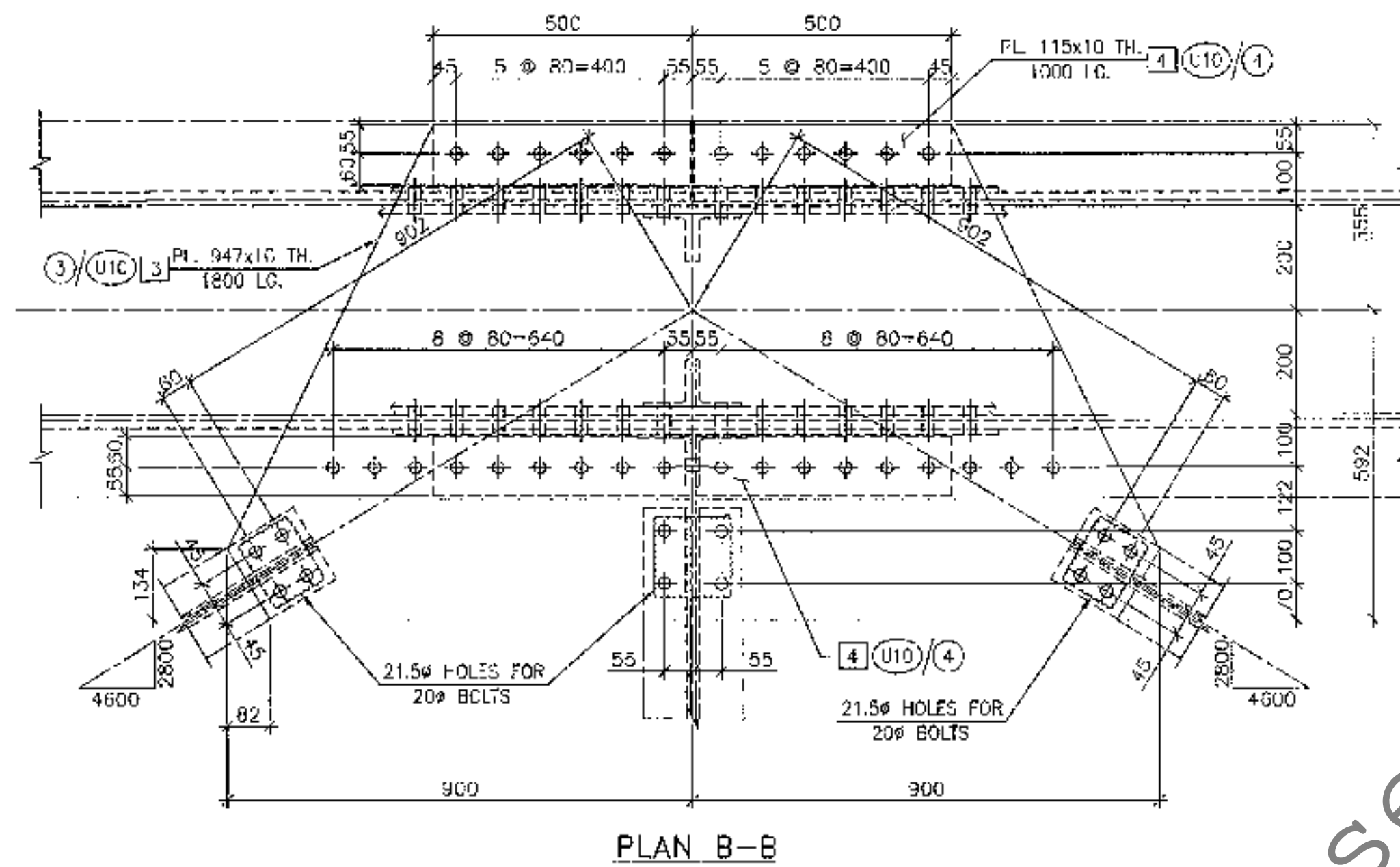


NOTES:

- 1. ALL DIMENSIONS ARE IN mm.
- 2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING MINIMUM THICKNESS = 0.70xLEG SIZE UNLESS OTHERWISE NOTED.
- 3. ALL HOLES ARE 25.5mm FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
- 4. ALL ITEM MARKS SHOWN THUS: [Symbol]
- 5. ALL ERECTION MARKS SHOWN THUS: [Symbol]
- 6. GRADE OF STRUCTURAL STEEL = IS 2062.
- 7. ELECTRODE SHALL CONFORM TO IS 10055.
- 8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1263-1992, 1364-1992 AND 1367-1979-94.
- 9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
- 10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (0.05 mm PER COAT) AS PER TECHNICAL SPEC.
- 11. FOR STRUCTURAL GENERAL ARRANGEMENT REFER DRG. NO. 2008-10/J-416/92m/ST-101
- 12. ALL HOLES FOR BOLTS ARE SHOWN THUS: [Symbol]
- 13. ALL THREADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MOTORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF TOP CHORD JOINTS MKD. UB, UB', US, US' U12, U12', U11, U11'	
SCALE 1:100, 50 1:25	DATE 14.08.09	DRAWN K.S.	CHECKED B.N.
DRAWING NUMBER 2009-10/J-416/92m/ST-103 (SHEET 5 OF 6)		APPROVED P.G.	
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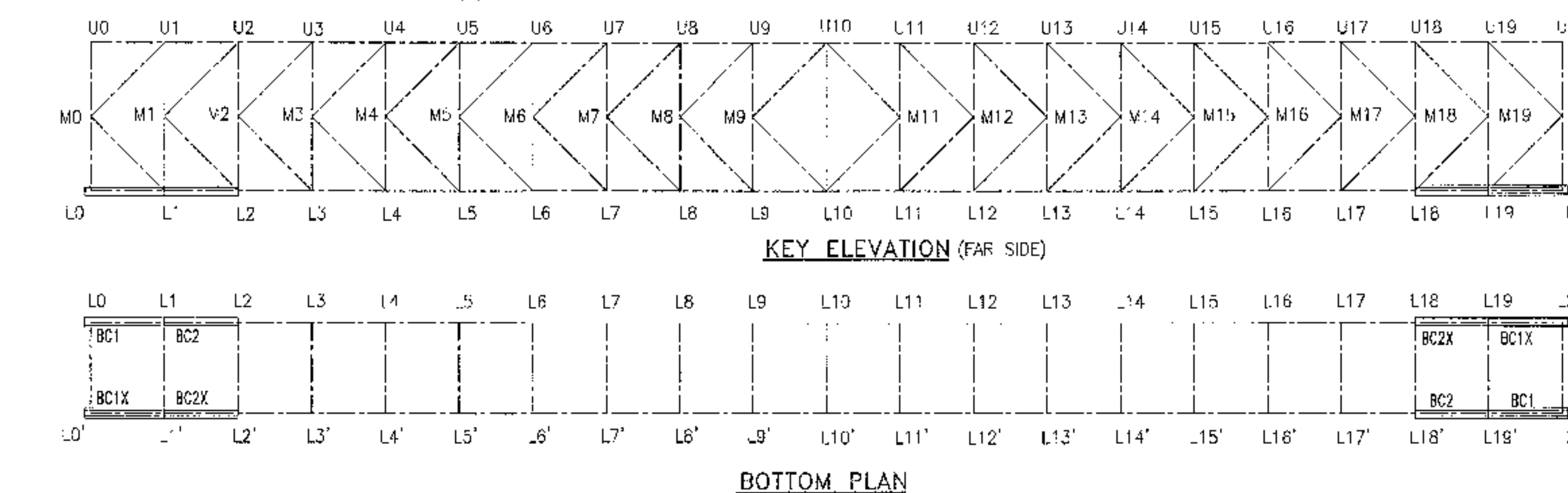
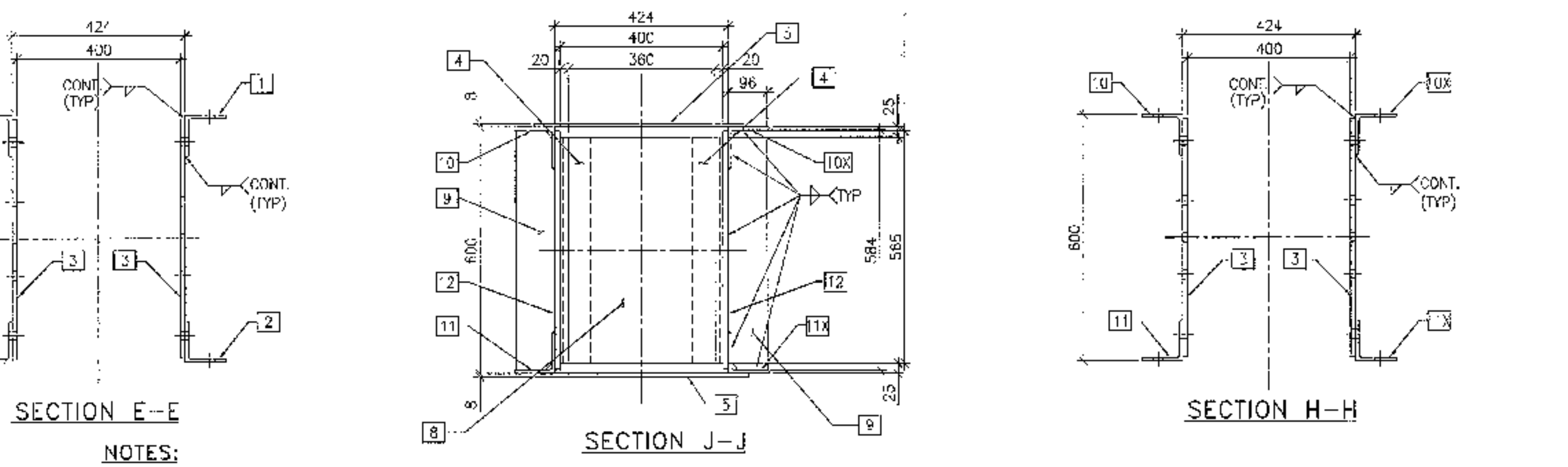
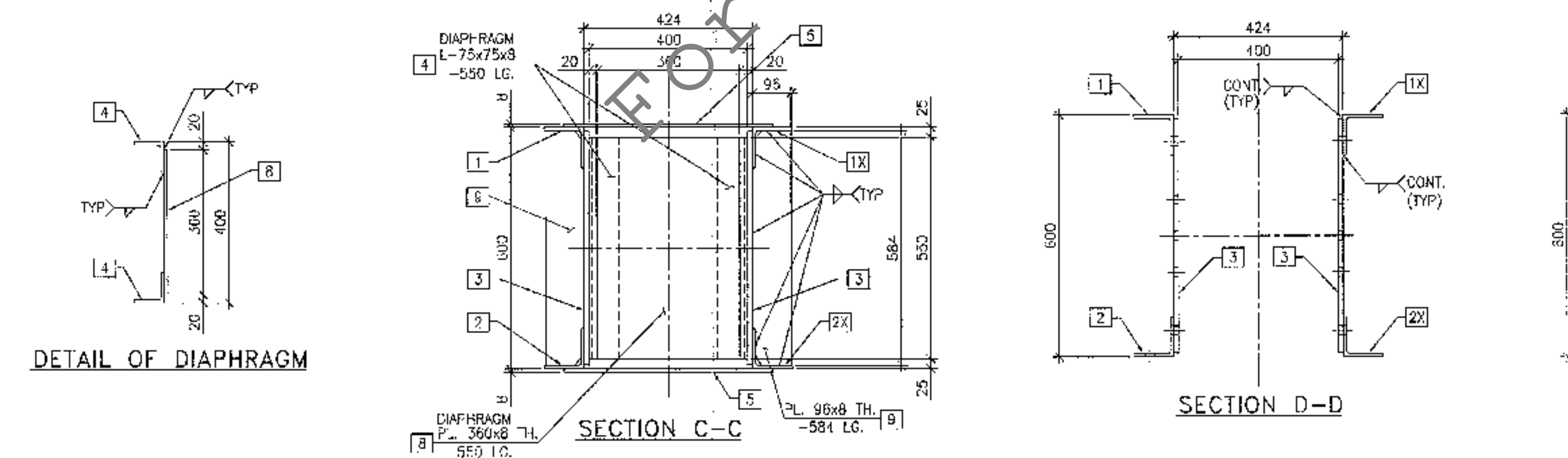
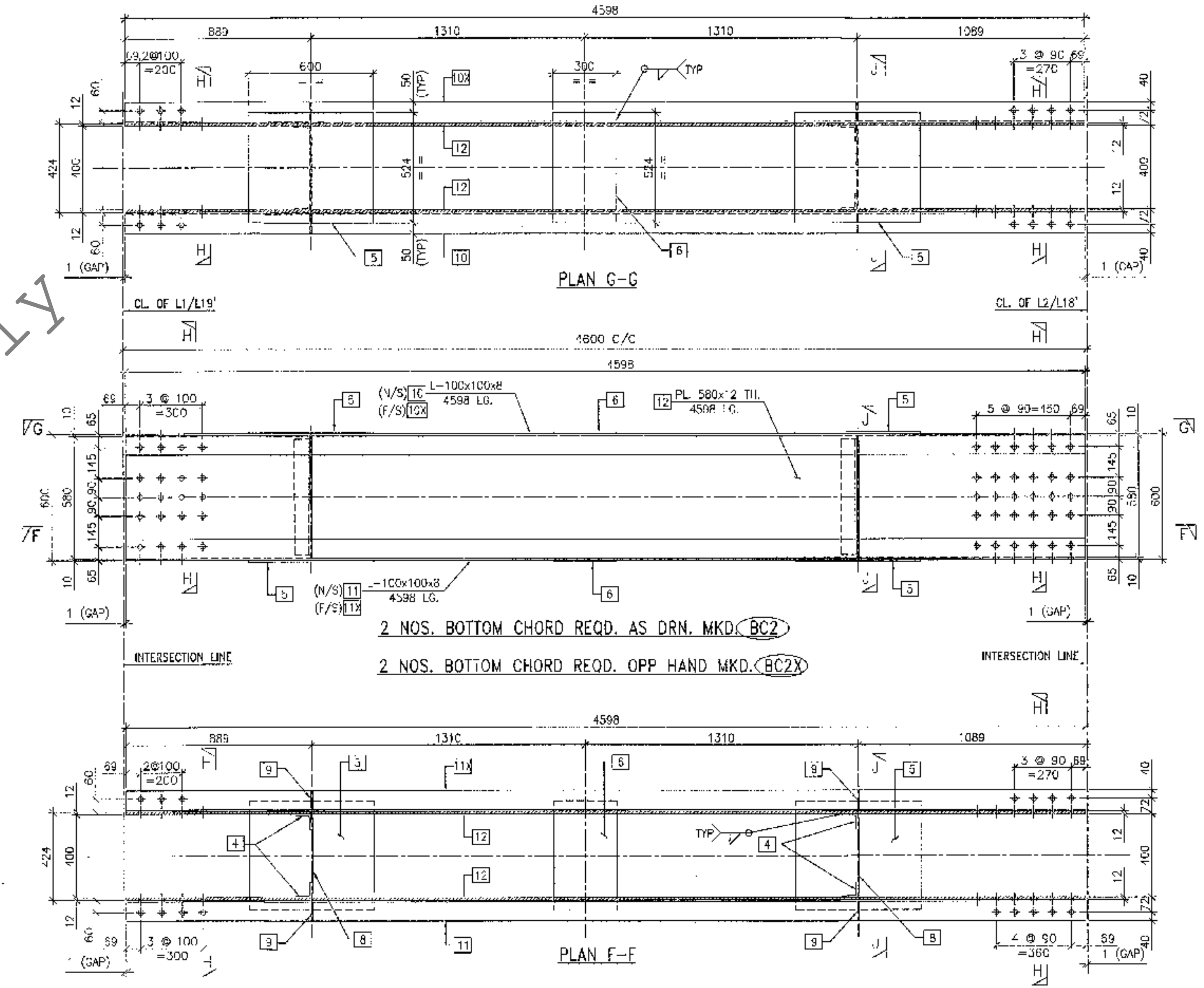
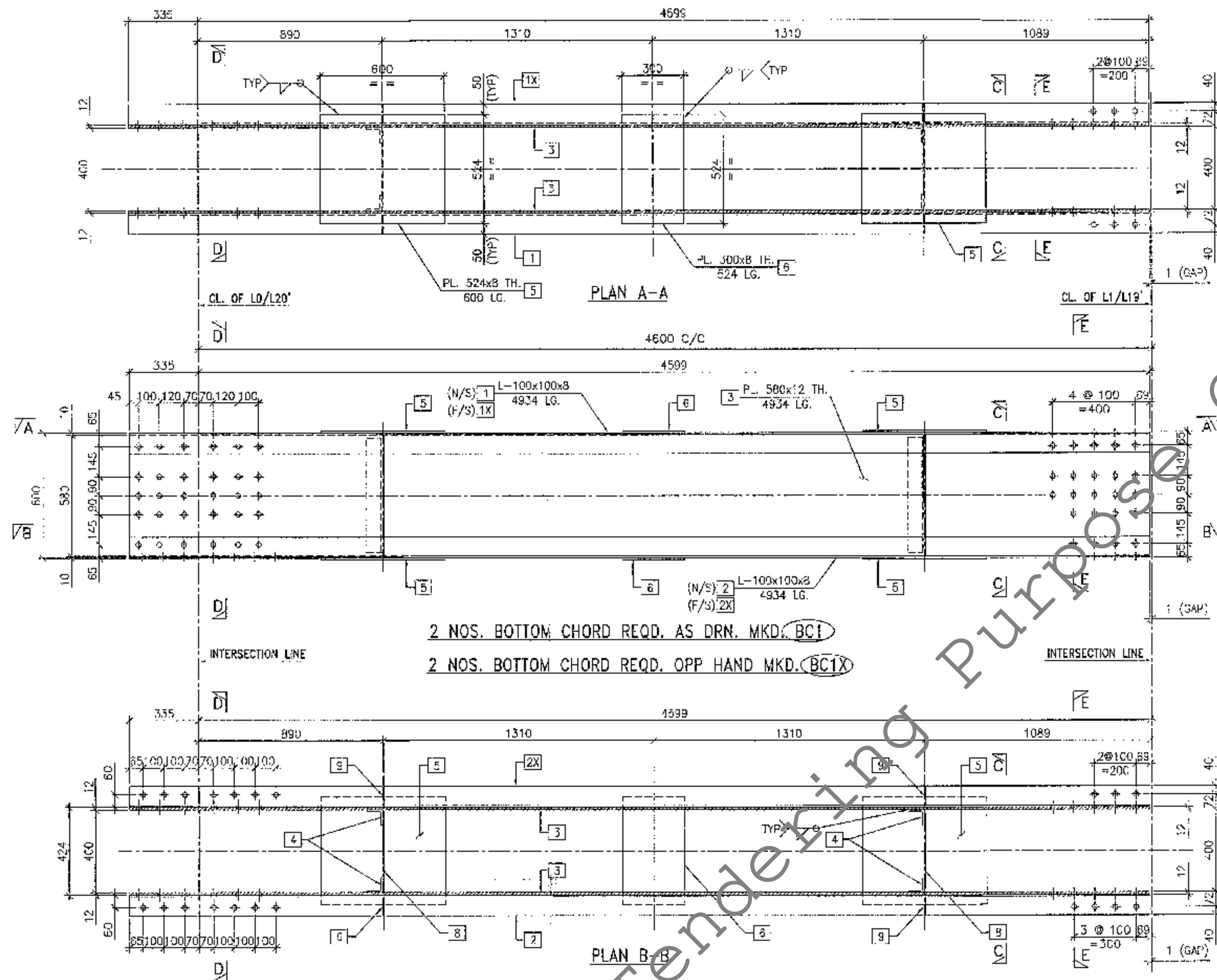
- 1 NO. EACH TOP CHORD JOINT REQD. AS DRN. MKD. (U10)
- 1 NO. EACH TOP CHORD JOINT REQD. OPP. HAND MKD. (U10)

NOTES:

- ALL DIMENSIONS ARE IN mm.
- ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707*LEG SIZE UNLESS OTHERWISE NOTED.
- ALL HOLES ARE 23.5mm FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
- ALL ITEM MARKS SHOWN THUS: []
- ALL ERECTION MARKS SHOWN THUS: []
- GRADE OF STRUCTURAL STEEL = IS-2062.
- ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
- BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1979-94.
- ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SITE.
- ALL STEEL WORK SHALL BE SHIP PAINTED BEFORE DISPATCH WITH TWO COATS OF PRIMER (D.F.I 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
- FOR STRUCTURAL GENERAL ARRANGEMENT REFER DRG. NO. 2009-10/J-416/92m/S-101
- ALL HOLES FOR BOLTS ARE SHOWN THUS: []
- ALL THREADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAINTAINABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF TOP CHORD JOINTS MKD. U10, AND U10'	
SCALE 1:100, 50 1:25	DATE 15.09.09	DRAWN I/S	CHECKED B.N
DRAWING NUMBER 2009-10/J-416/92m/ST-103 (SHEET 6 OF 8)		APPROVED P.G	REV. 0
CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SANTOSH PUR, KOLKATA - 700 075.			

REV.	DATE	DESCRIPTION	BY	CHK.	APP.



NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707 x LEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 23.50 FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THUS \square .
5. ALL ERECTION MARKS SHOWN THUS \bigcirc .
6. GRADE OF STRUCTURAL STEEL = IS-2062.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SP-02.
10. ALL STEEL WORK SHALL BE SLOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL C.A. REFER URG. NO. 2008-12/-416/92m/SI-101.
12. ALL HOLES FOR BOLTS ARE SHOWN THUS ϕ .

CLIENT : EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION, DARJEELING GORKHA HILL COUNCIL, DARJEELING.

CONTRACTOR : CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.

PROJECT : PROPOSED SINGLE LANE MAINTAINABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION

DATE : 2009-10/J-416/92m/ST-105 (SHEET : OF 5)

SCALE : 1:250, 1:10

DATE : 1.00.00

DRAWN : A.J.

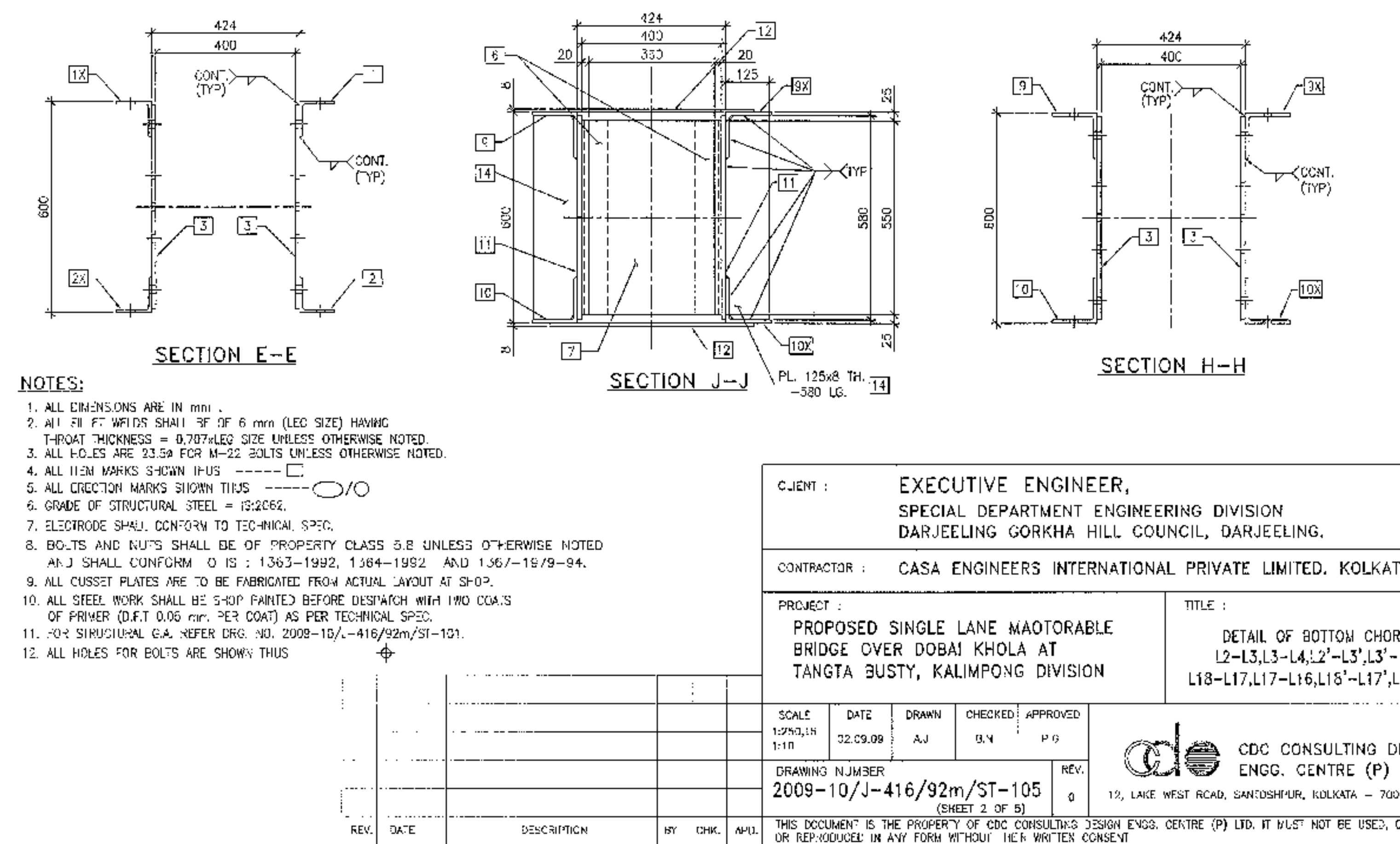
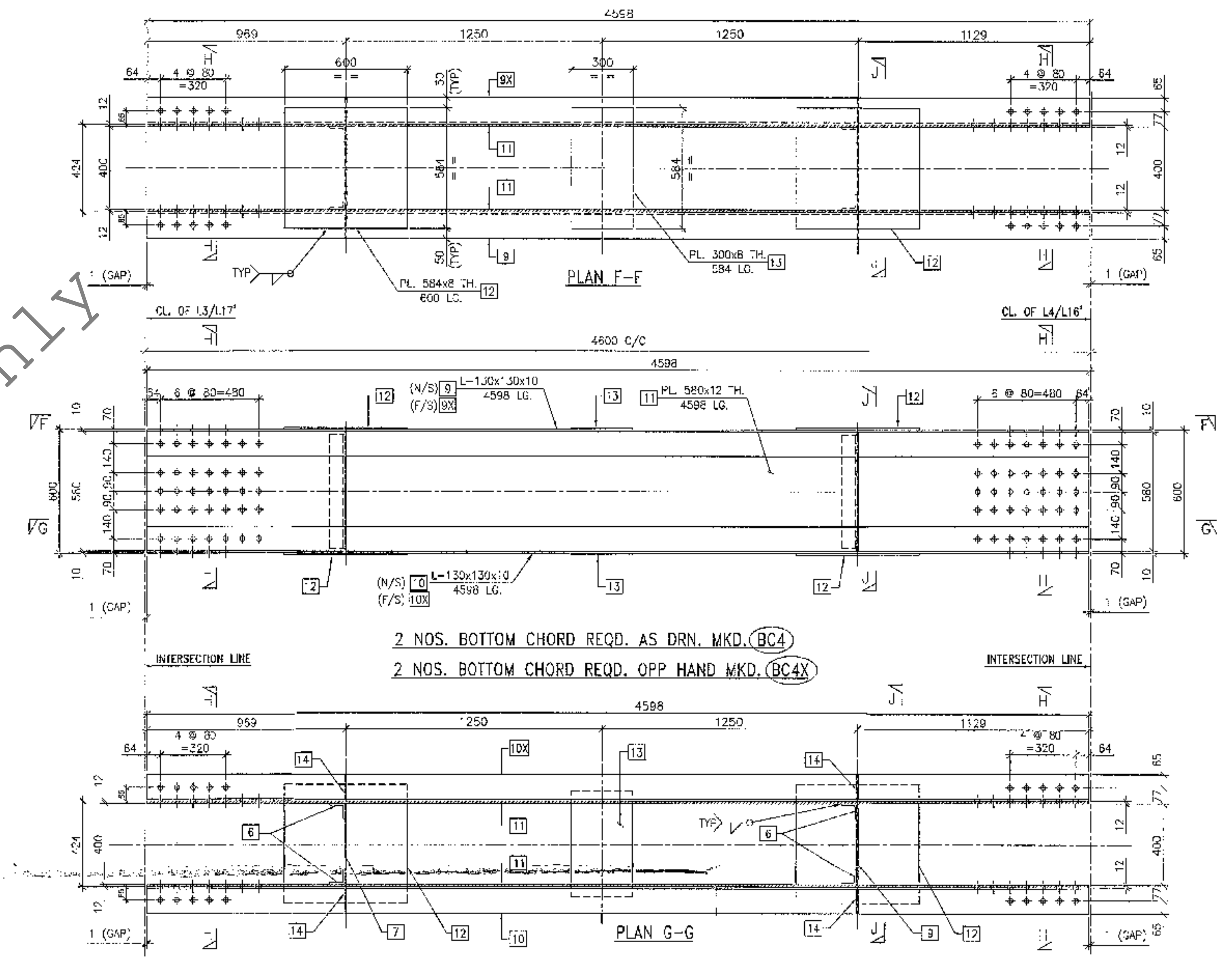
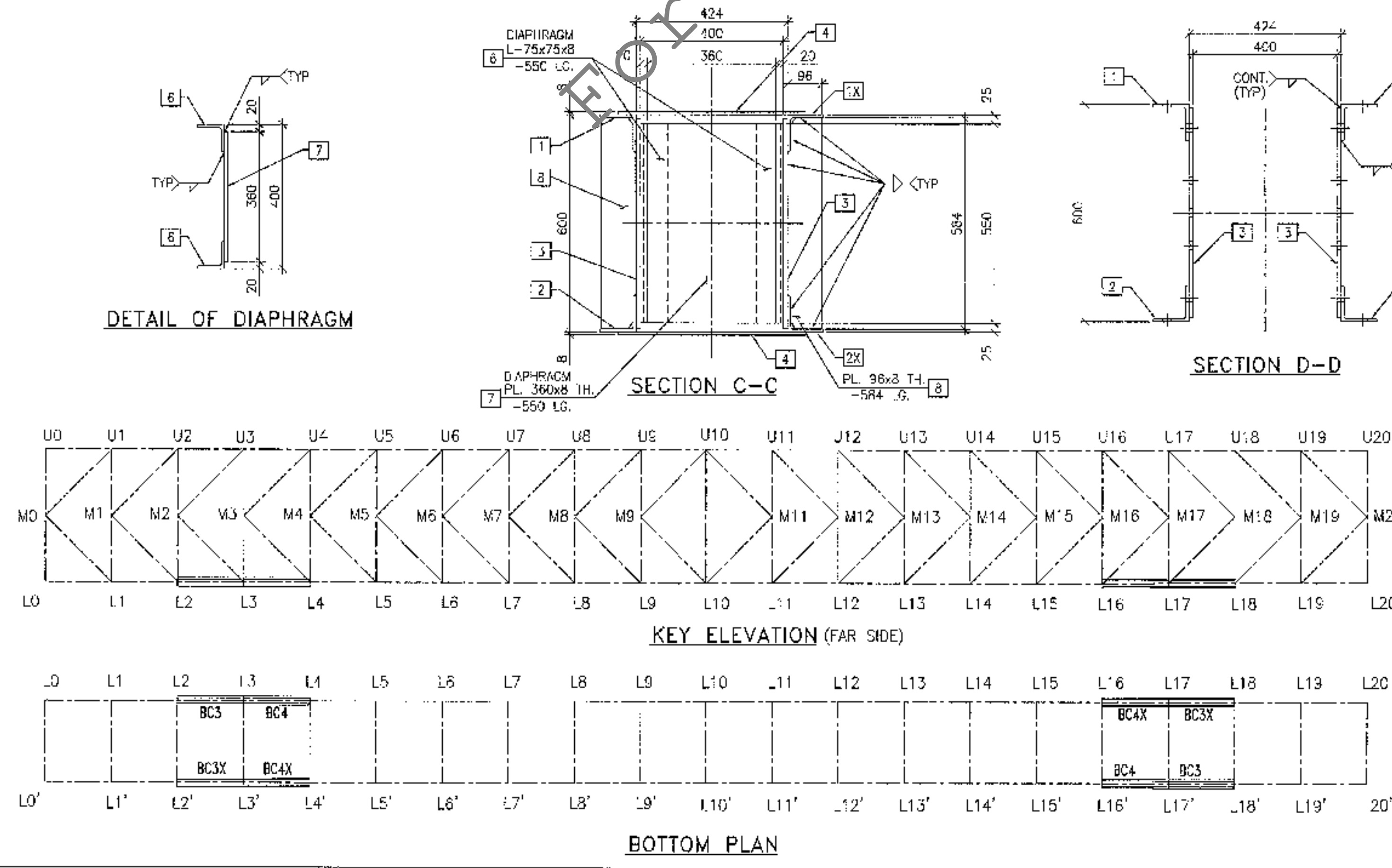
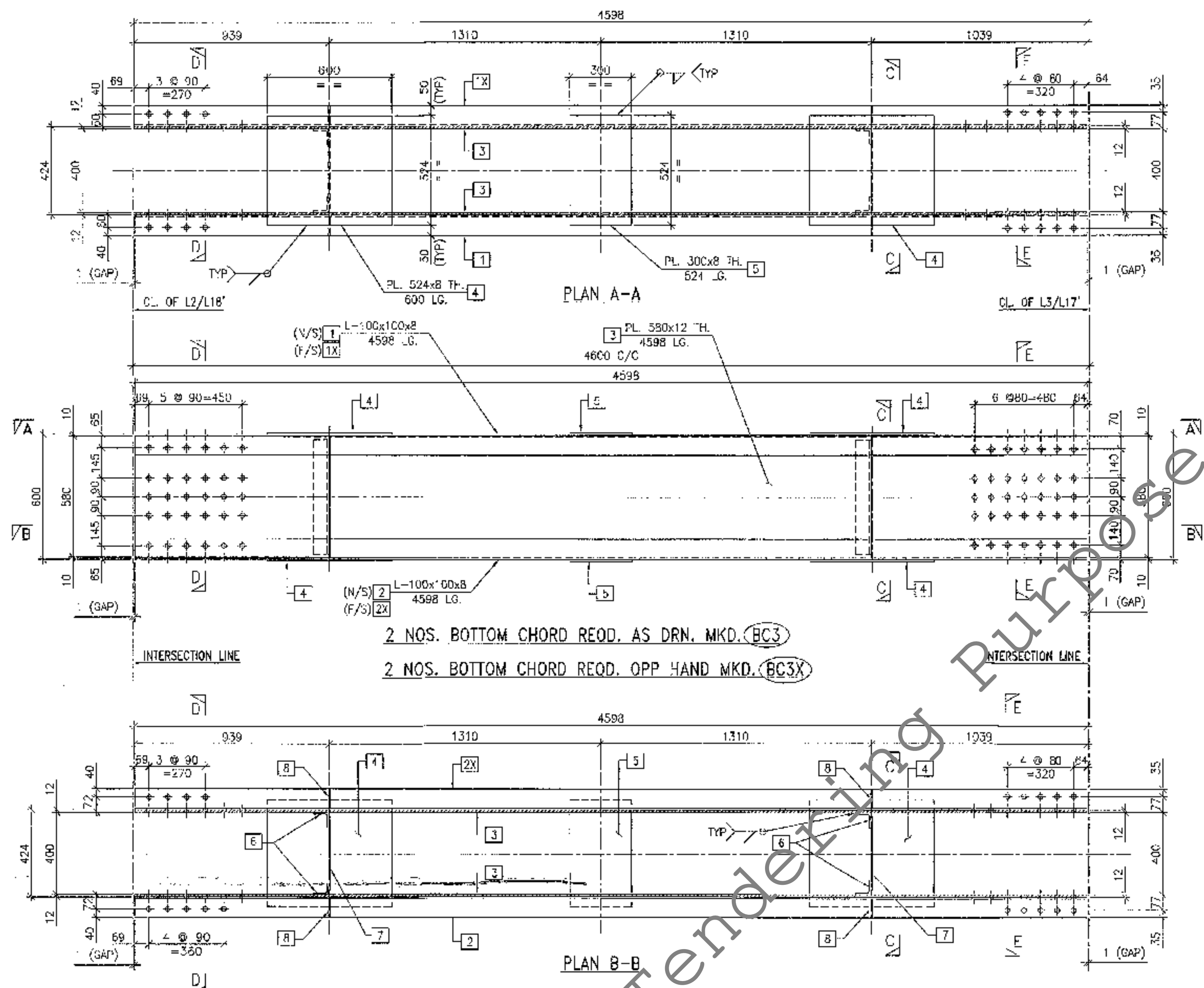
CHECKED : B.N.

APPROVED : P.C.

REV. : 0

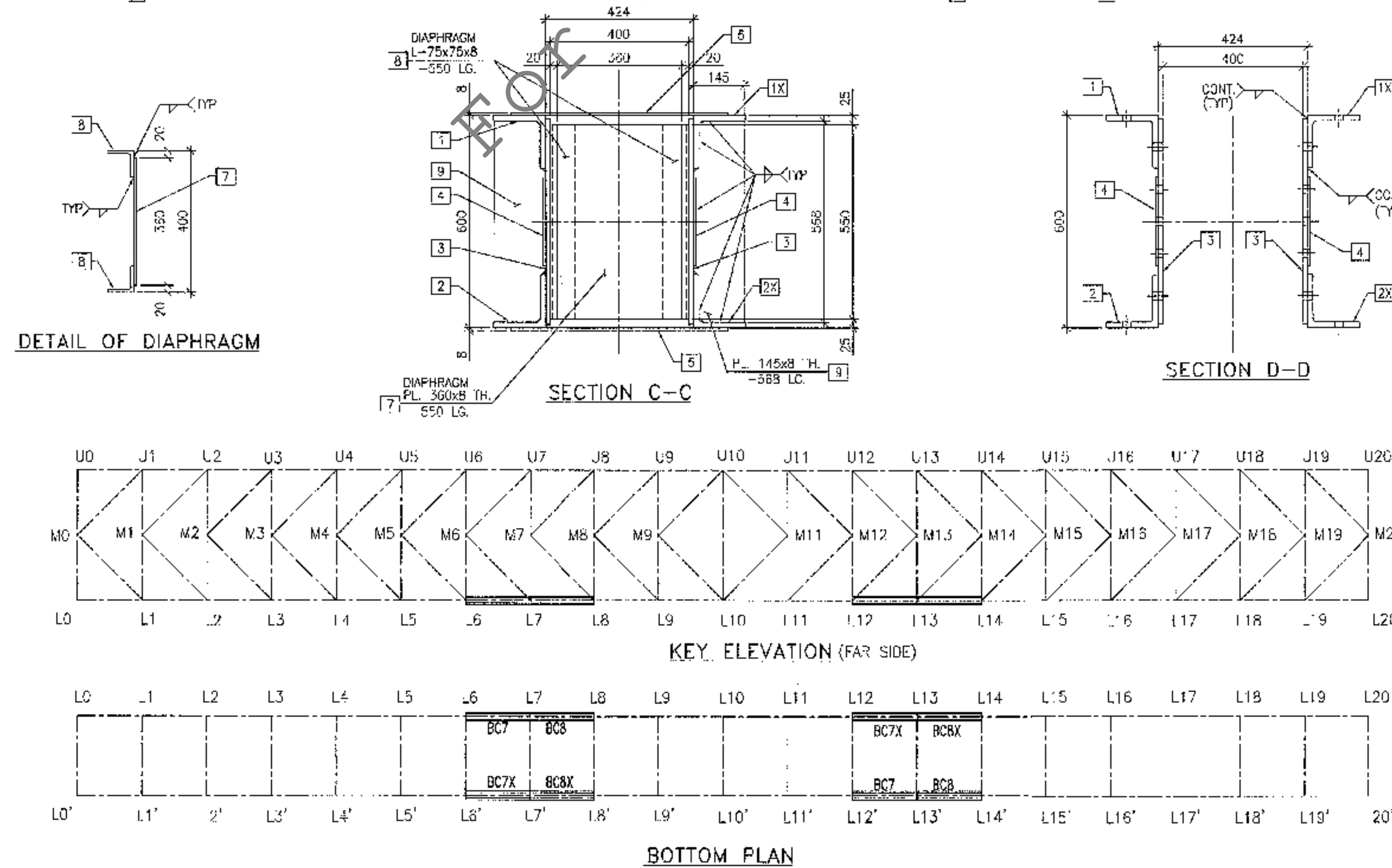
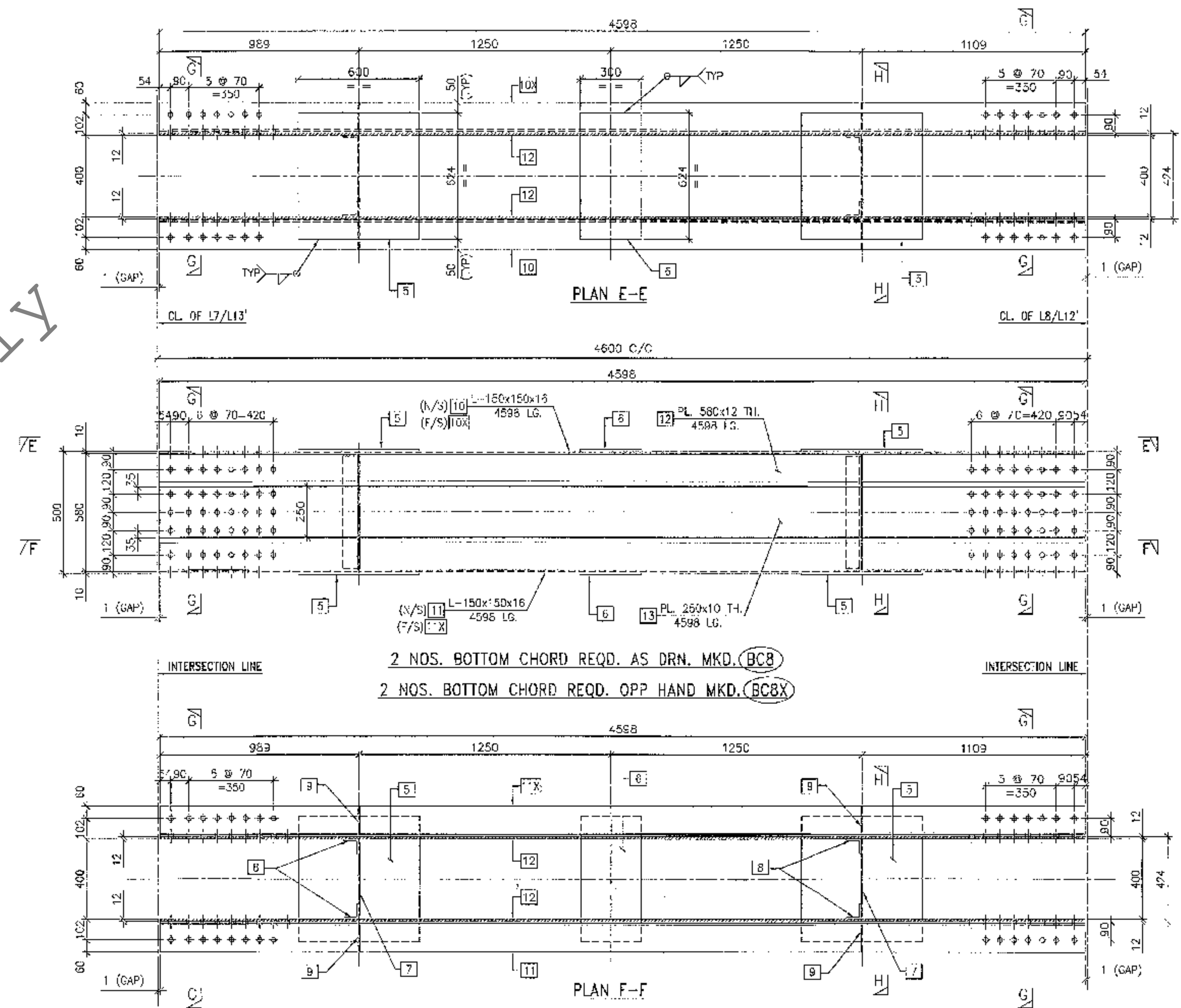
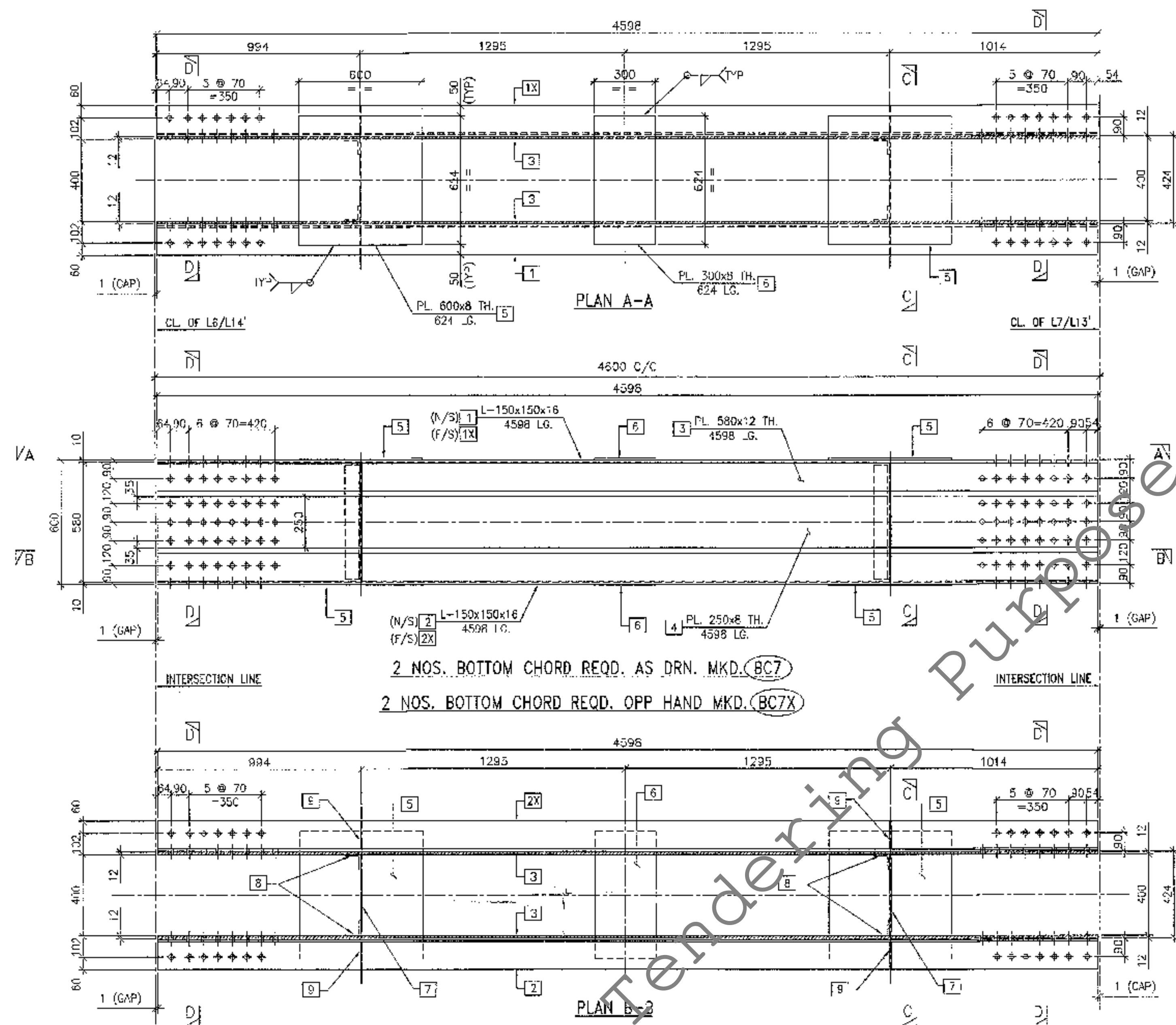
CDL CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SANTOSH PUR KOLKATA - 700 075.

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- NOTES:**
1. ALL DIMENSIONS ARE IN mm.
 2. ALL 100 mm WIDTS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707*LEG SIZE UNLESS OTHERWISE NOTED.
 3. ALL H.O.S ARE 23.5 mm FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
 4. ALL ITEM MARKS SHOWN IN US.
 5. ALL CRECTION MARKS SHOWN IN US.
 6. GRADE OF STRUCTURAL STEEL IS IS-2062.
 7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
 8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED. ALL SHALL CONFORM TO IS : 1363-1992, 1384-1992 AND 1367-1979-94.
 9. ALL CUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
 10. ALL STEEL WORK SHALL BE SHIP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T. 0.06 mm. PER COAT) AS PER TECHNICAL SPEC.
 11. FOR STRUCTURAL E.A. REFER DRG. NO. 2008-10/J-416/92m/ST-101.
 12. ALL HOLES FOR BOLTS ARE SHOWN THUS

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAOTORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF BOTTOM CHORD L2-L3,L3-L4,L2'-L3',L3'-L4' L18-L17,L17-L16,L15'-L17',L17'-L16'	
SCALE 1:200, 1:10	DATE 02.09.09	DRAWN A.J.	CHECKED B.N.
DRAWING NUMBER 2009-10/J-416/92m/ST-105 (SHEET 2 OF 5)		APPROVED P.G.	
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NOTES:

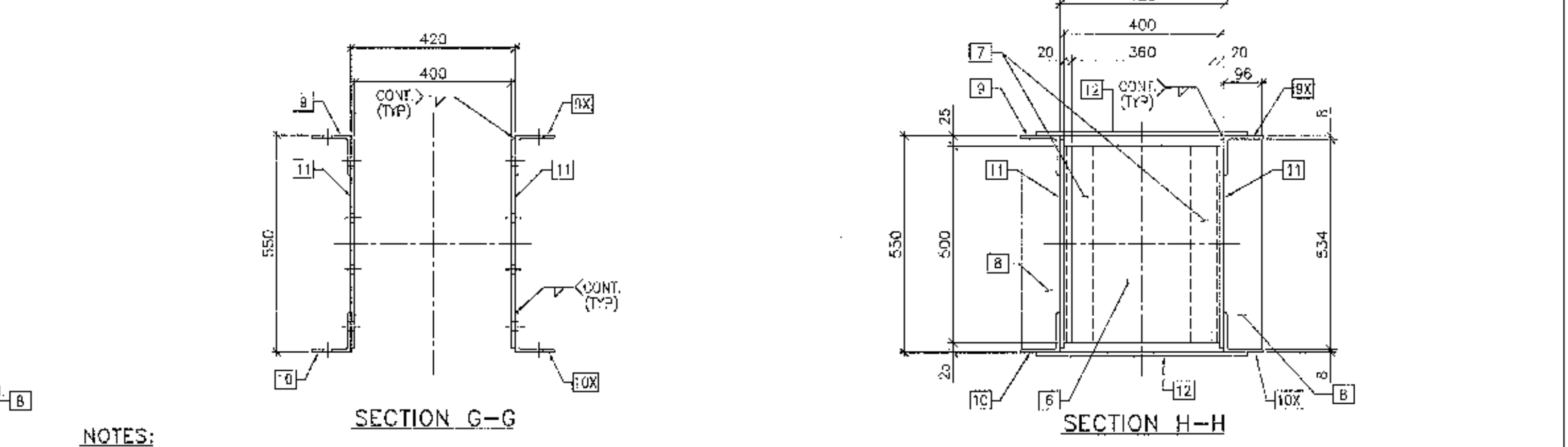
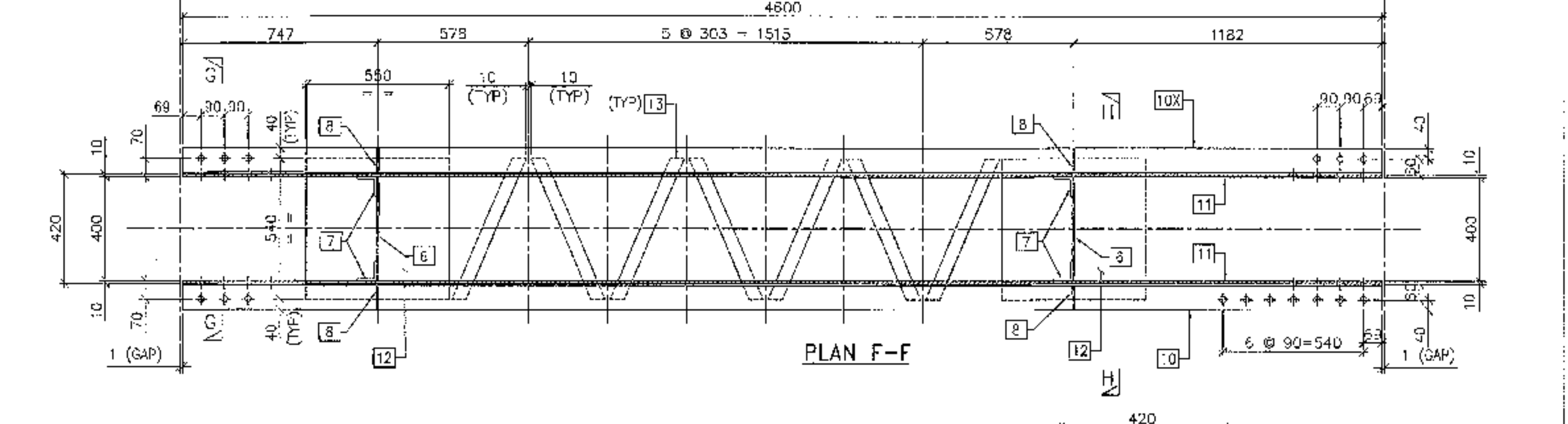
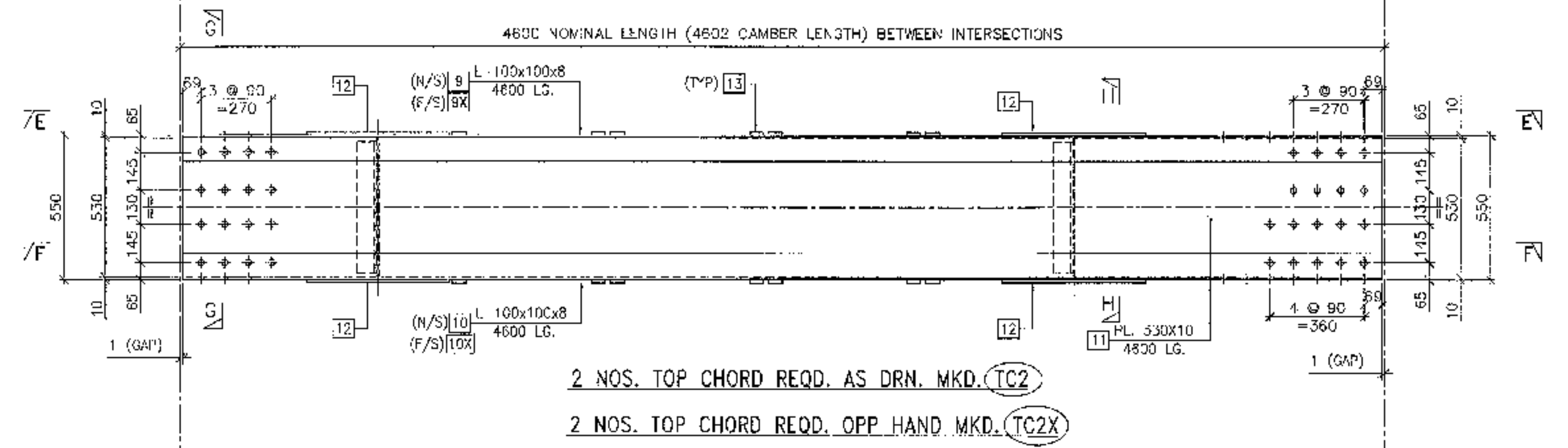
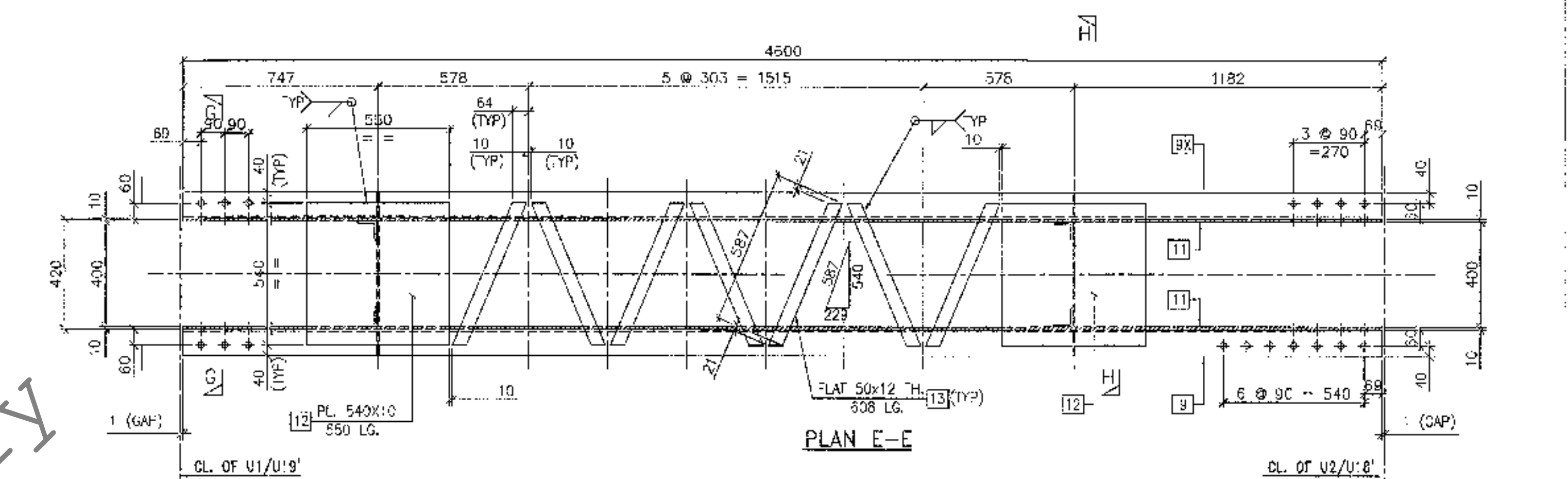
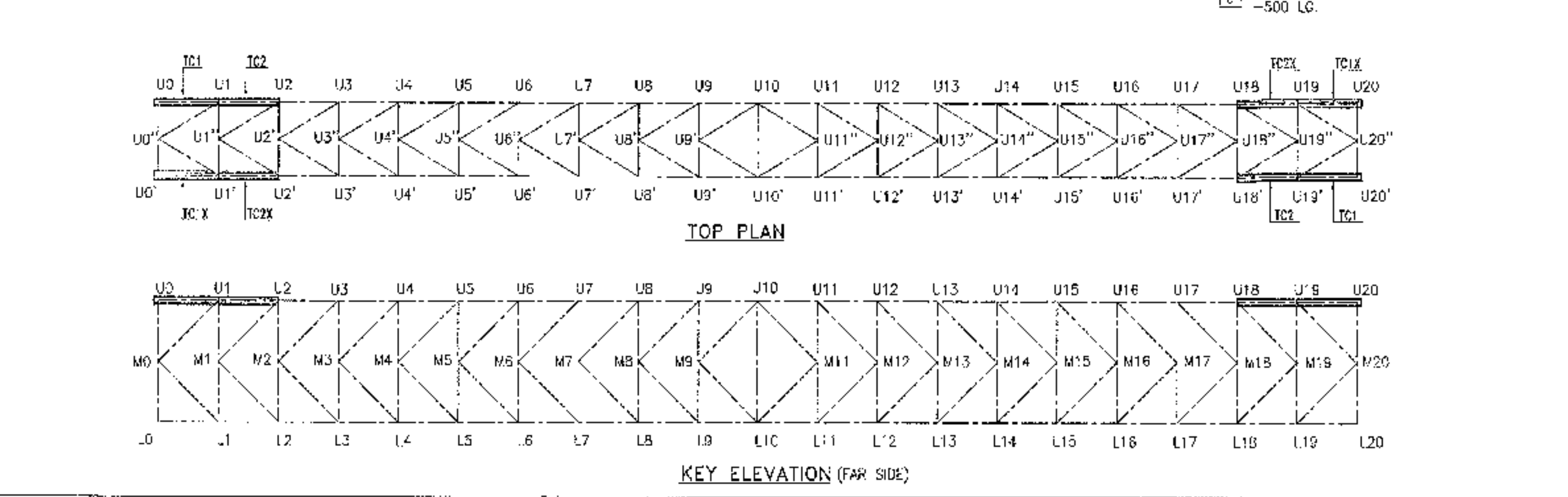
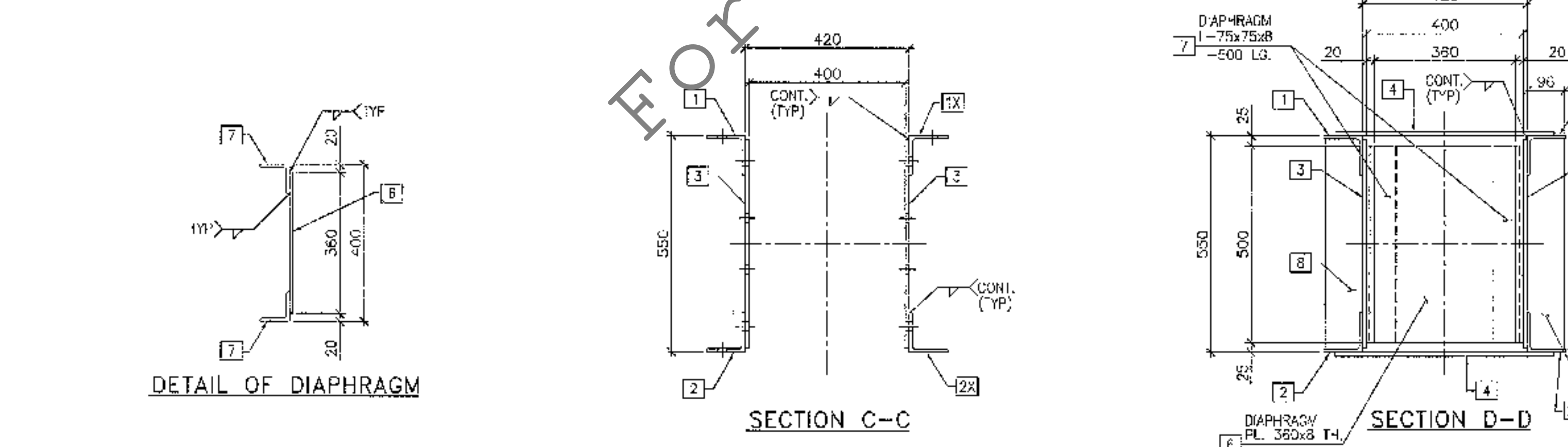
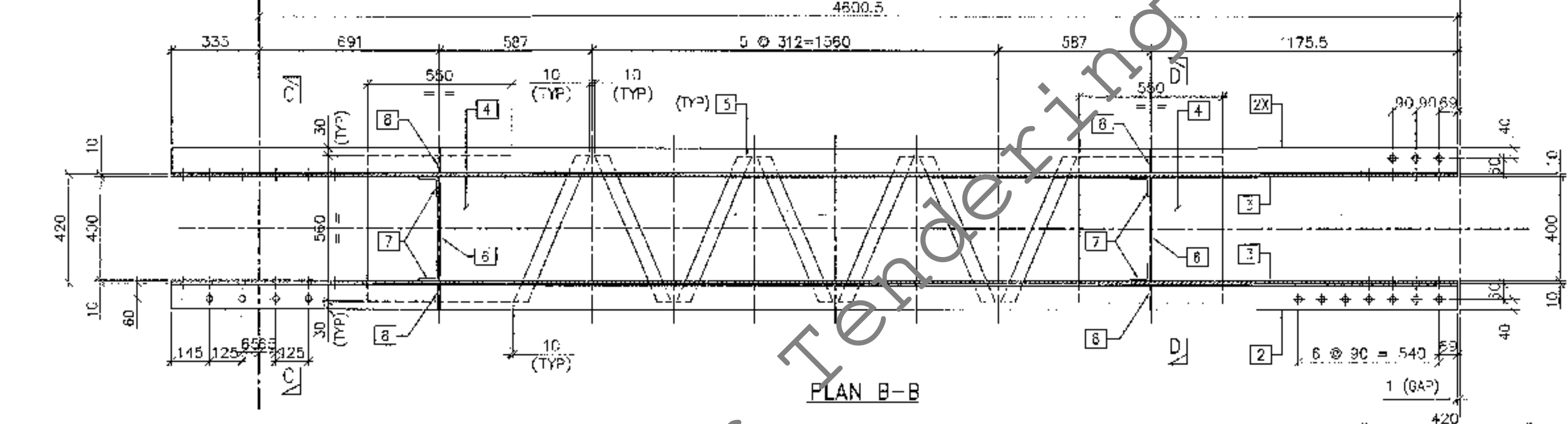
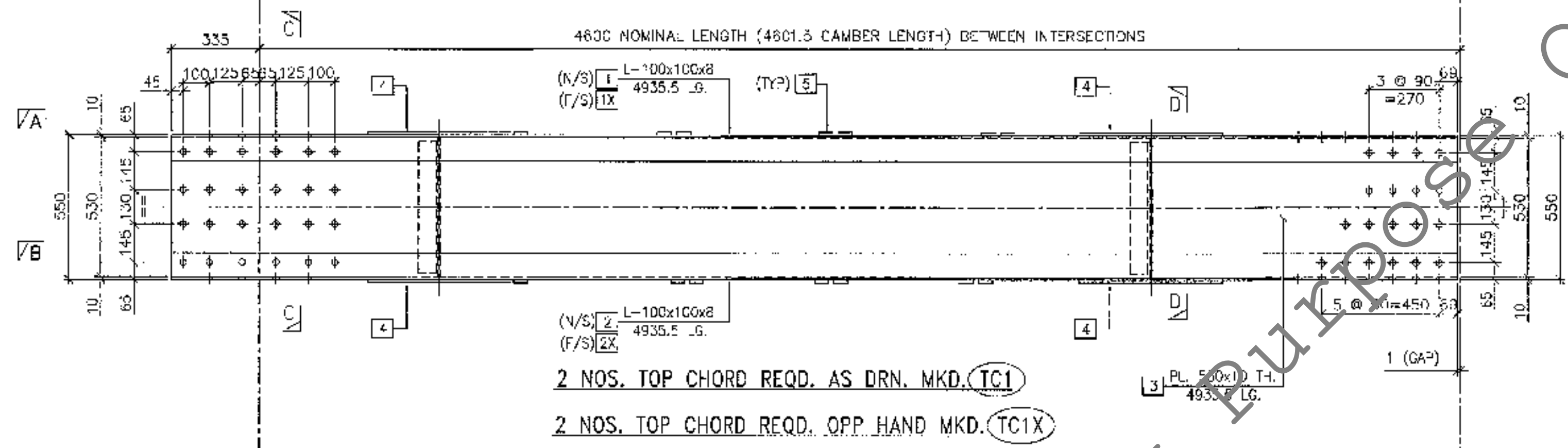
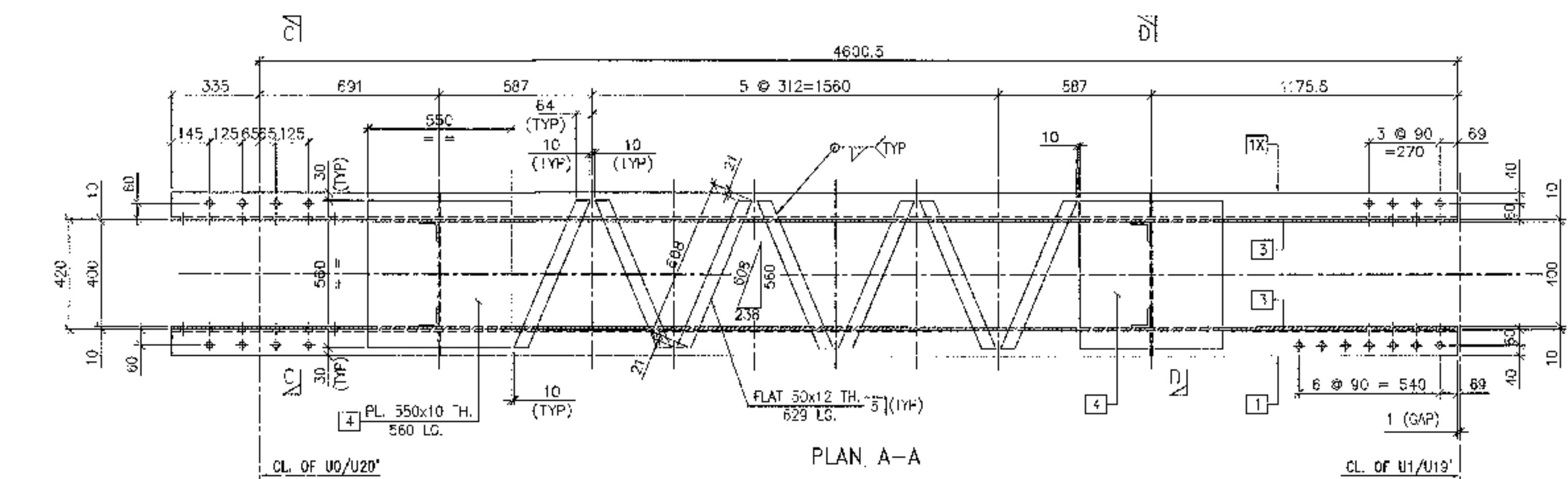
1. ALL DIMENSIONS ARE IN mm.
2. ALL PLATE WELDS SHALL BE 0-6 mm (LCS SIZE) HAVING THROAT THICKNESS = 0.707 x LEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 23.54 FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THUS \square
5. ALL ERECTION MARKS SHOWN THUS \bigcirc
6. GRADE OF STRUCTURAL STEEL IS IS-2062.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 354-1992 AND 1367-1979-54.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BS-0-12 DISPATCH WITH TWO COATS OF PRIMER (D.F.T 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL G.A. REFER DRC. NO. 2009-10/J-416/92m/ST-101.
12. ALL HOLES FOR BOLTS ARE SHOWN THUS \bigoplus

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF BOTTOM CHORD L6-L7, L7-L8, L6'-L7', L7'-L8' L14-L13, L13-L12, L14'-L13', L13'-L12'	
SCALE	DATE	DRAWN	CHECKED
1:250, 1:10	04.09.09	A.J.	B.N.
DRAWING NUMBER		APPROVED	
2009-10/J-416/92m/ST-105 (SHEET 4 OF 5)		P.G.	
REV.		DATE	
DESCRIPTION		BY	
CHK.		APD.	

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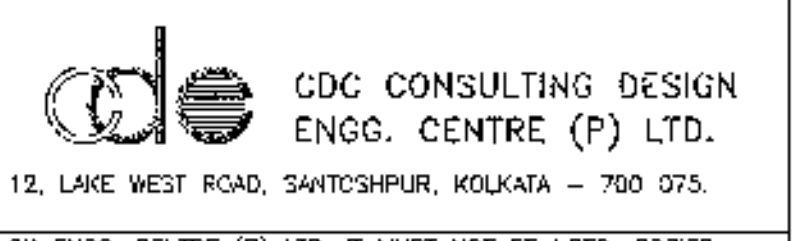
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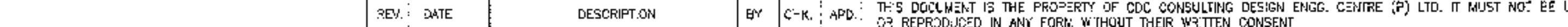
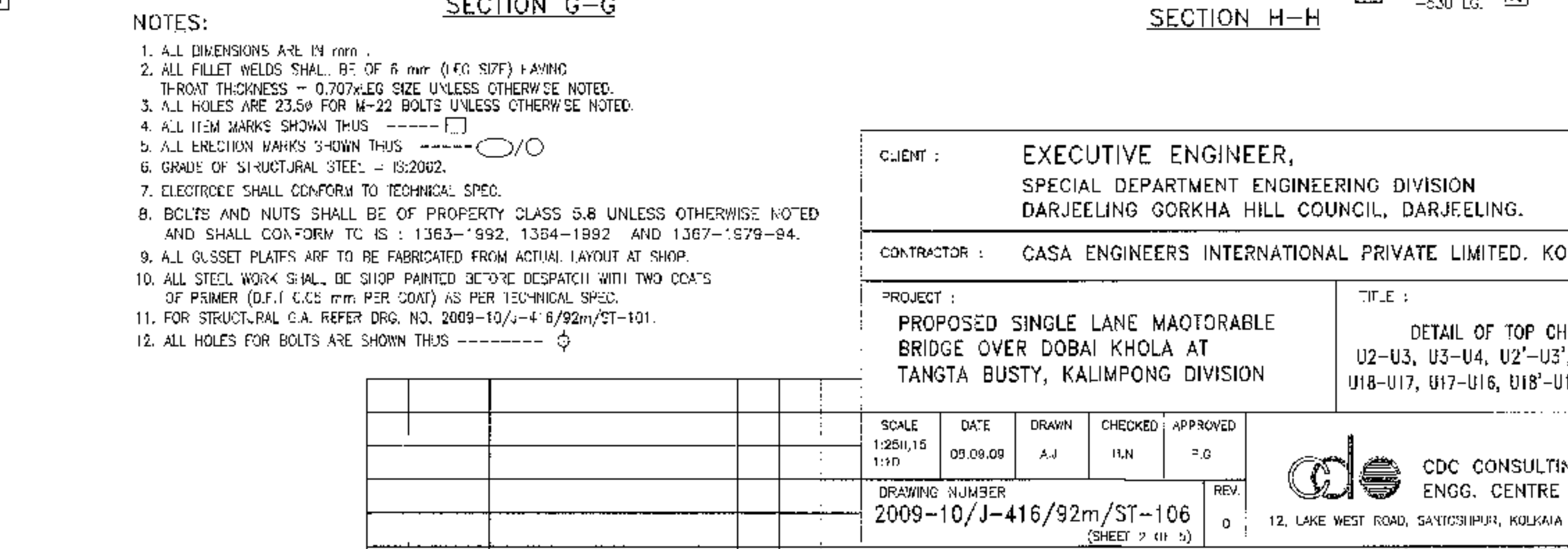
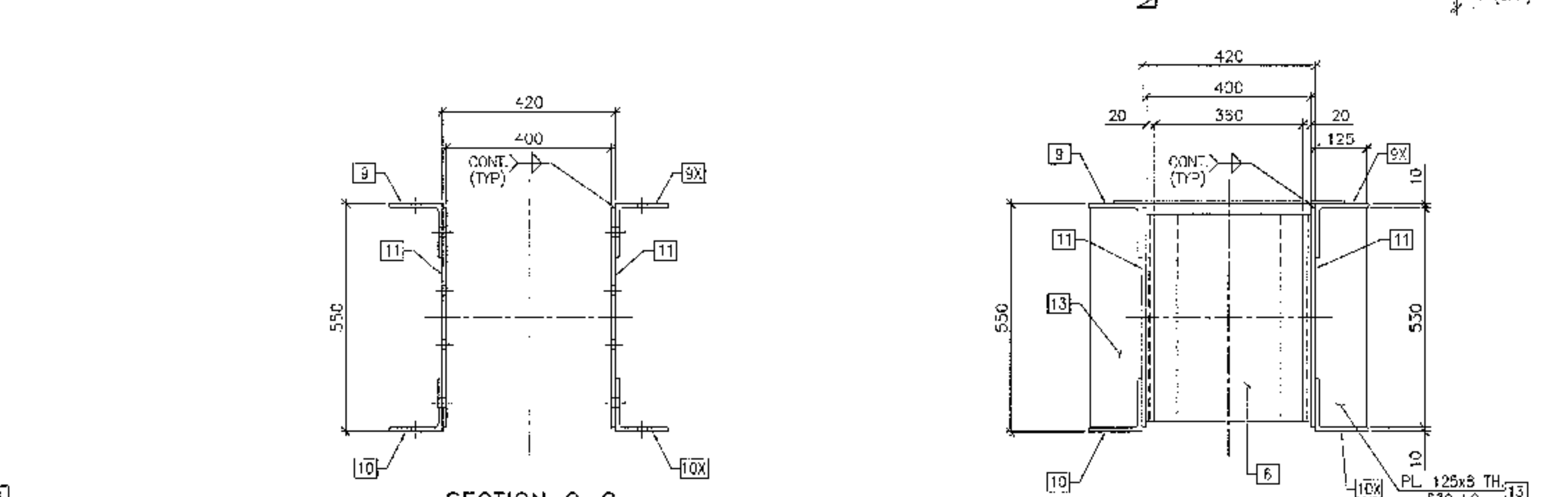
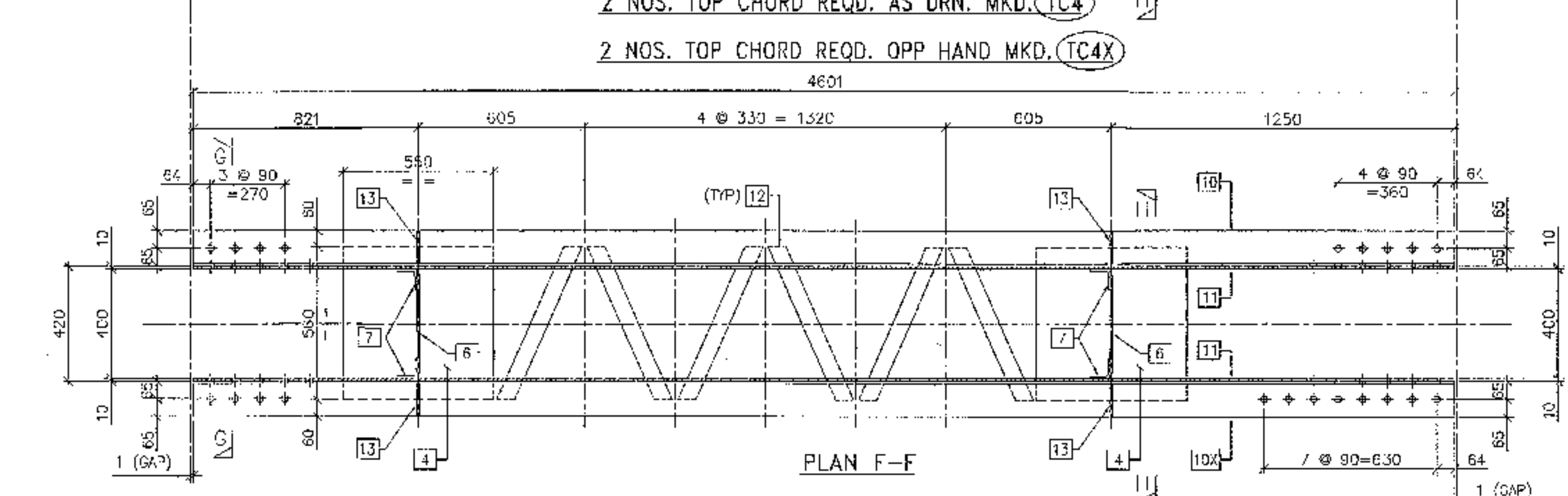
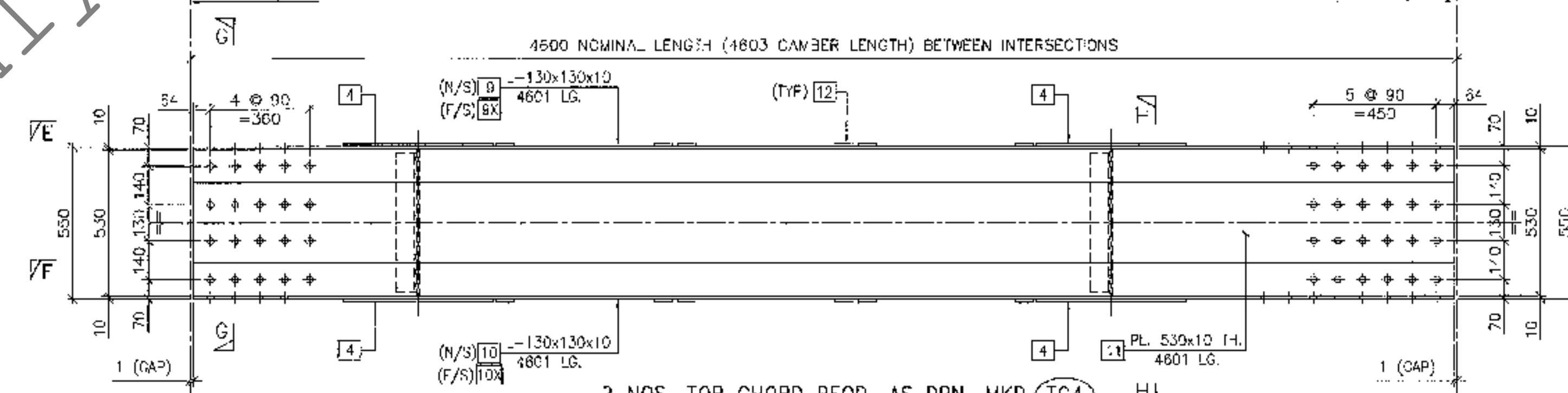
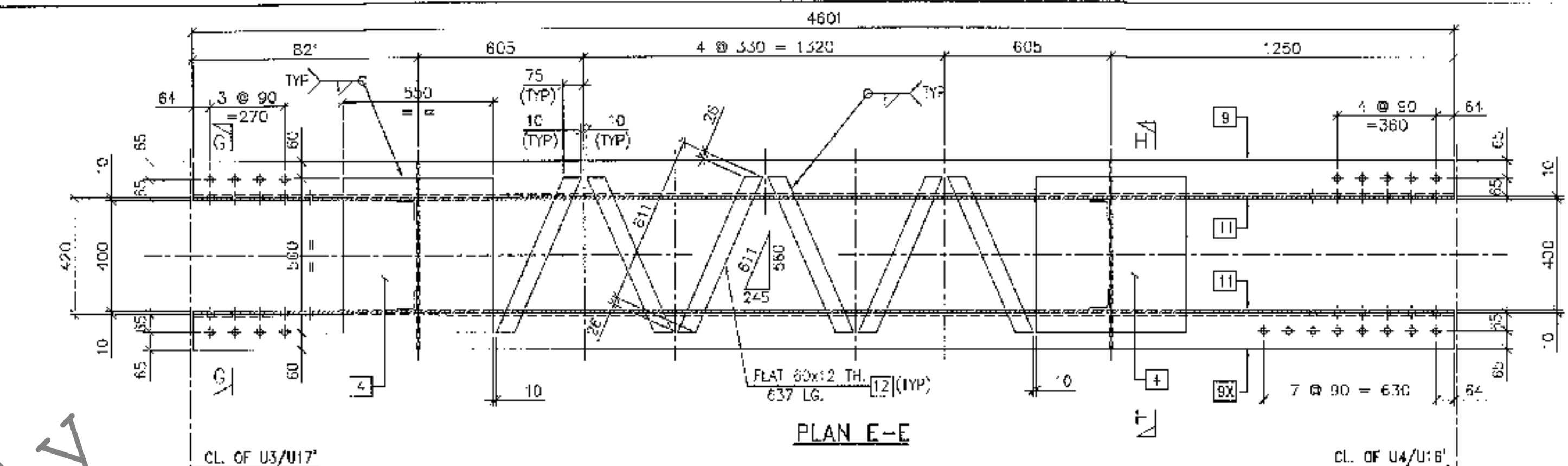
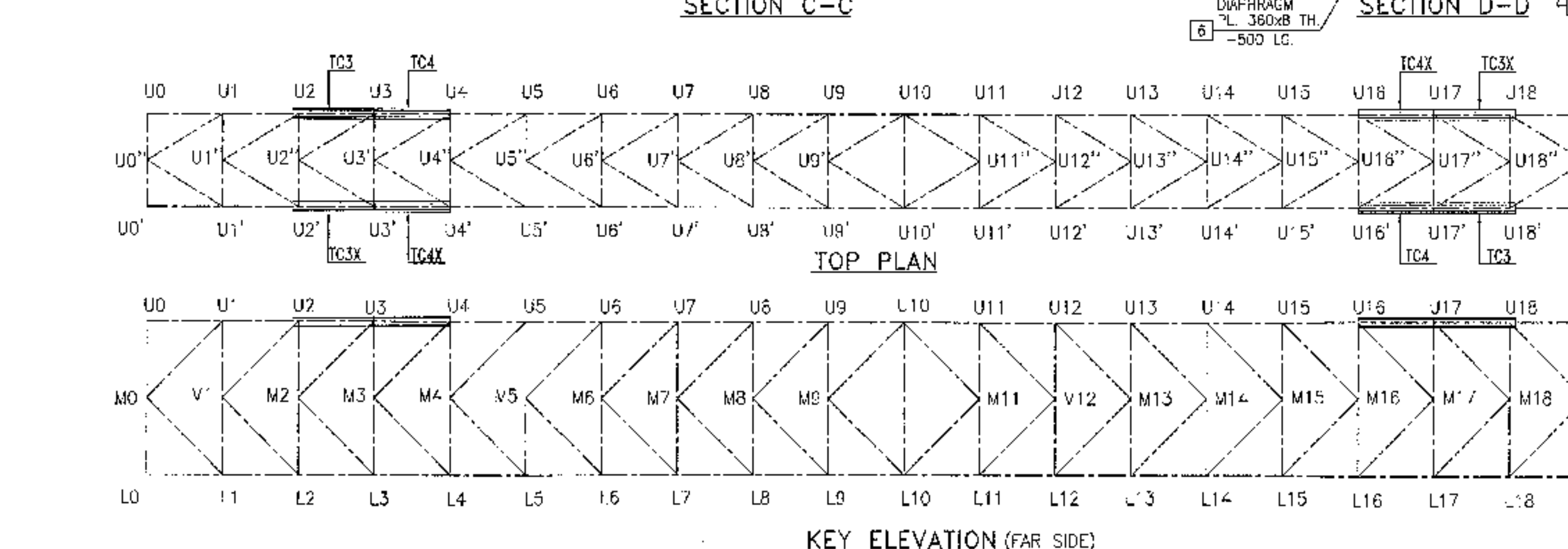
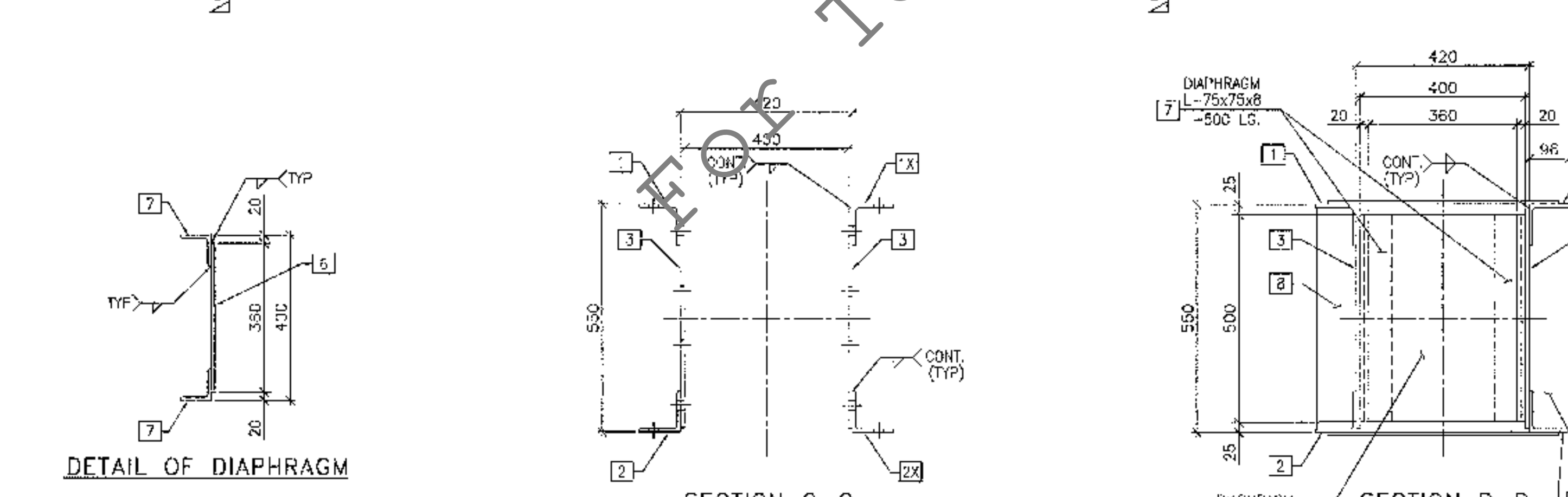
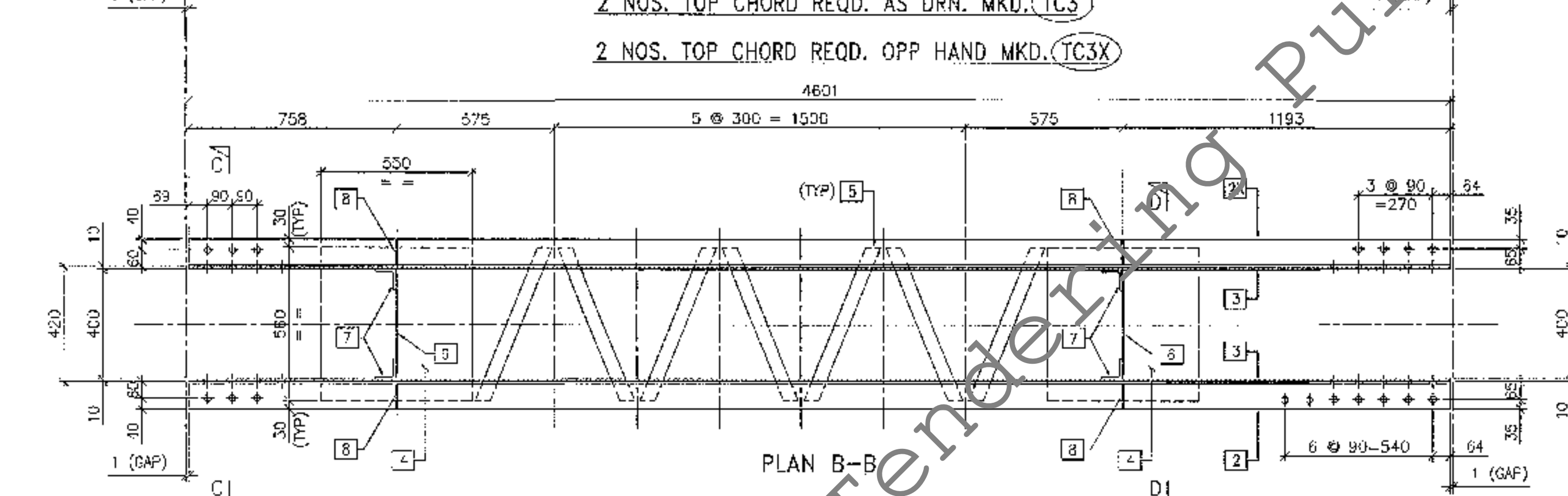
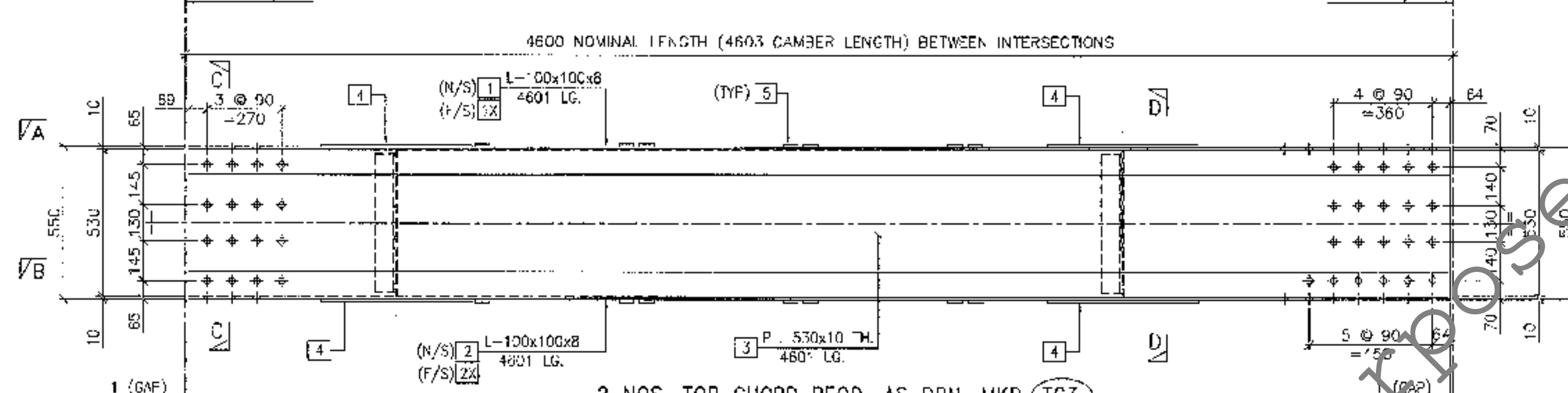
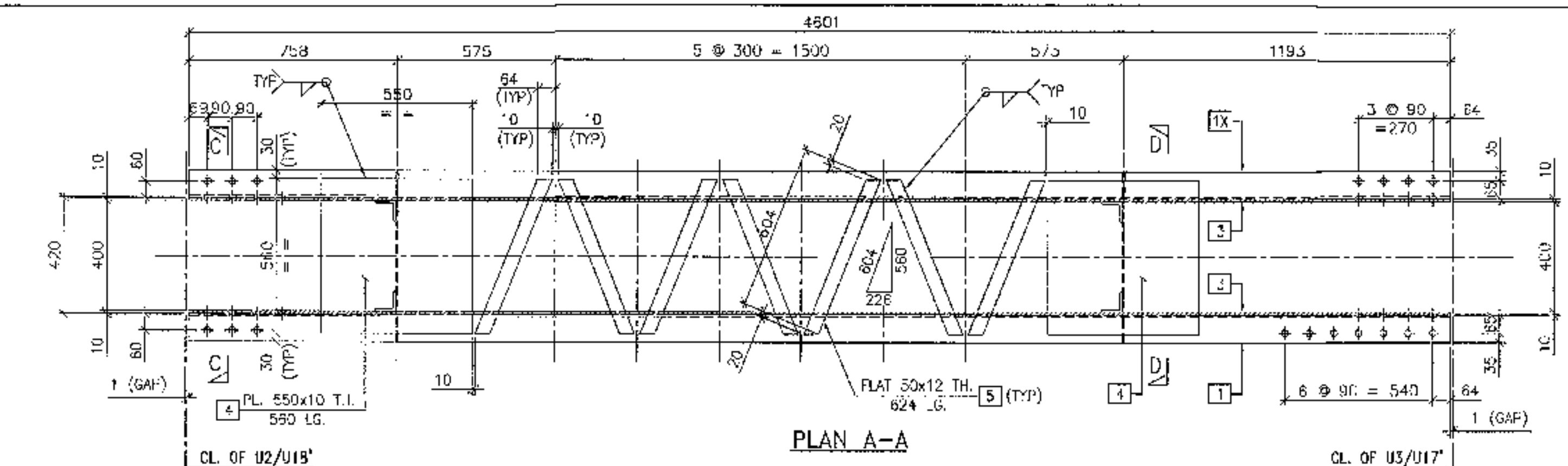
CDCE CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD.



- NOTES:**
1. ALL DIMENSIONS ARE IN mm.
 2. ALL FILLET WELDS SHALL BE OF 3 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.70 x LEG SIZE UNLESS OTHERWISE NOTED.
 3. ALL HOLES ARE 23.5mm FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
 4. ALL ITEM MARKS SHOWN THUS: [Symbol]
 5. ALL ERECTION MARKS SHOWN THUS: [Symbol]
 6. GRADE OF STRUCTURAL STEEL = IS-2062.
 7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
 8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1264-1992 AND 1367-1979-94.
 9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
 10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
 11. FOR STRUCTURAL G.A. REFER DRG. NO. 2009-10/J-416/92m/ST-101.
 12. ALL HOLES FOR BOLTS ARE SHOWN THUS: [Symbol]

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF TOP CHORD U0-U1, U1-U2, U0'-U1', U1'-U2' U20-U19, U19-U18, U20'-U19', U19'-U18'	
SCALE	DATE	DRAWN	CHECKED
1:300, 1:150	07.08.08	A.J.	B.N.
DRAWING NUMBER		REV.	
2009-10/J-416/92m/ST-106		0	
(SHEET 1 OF 5)			
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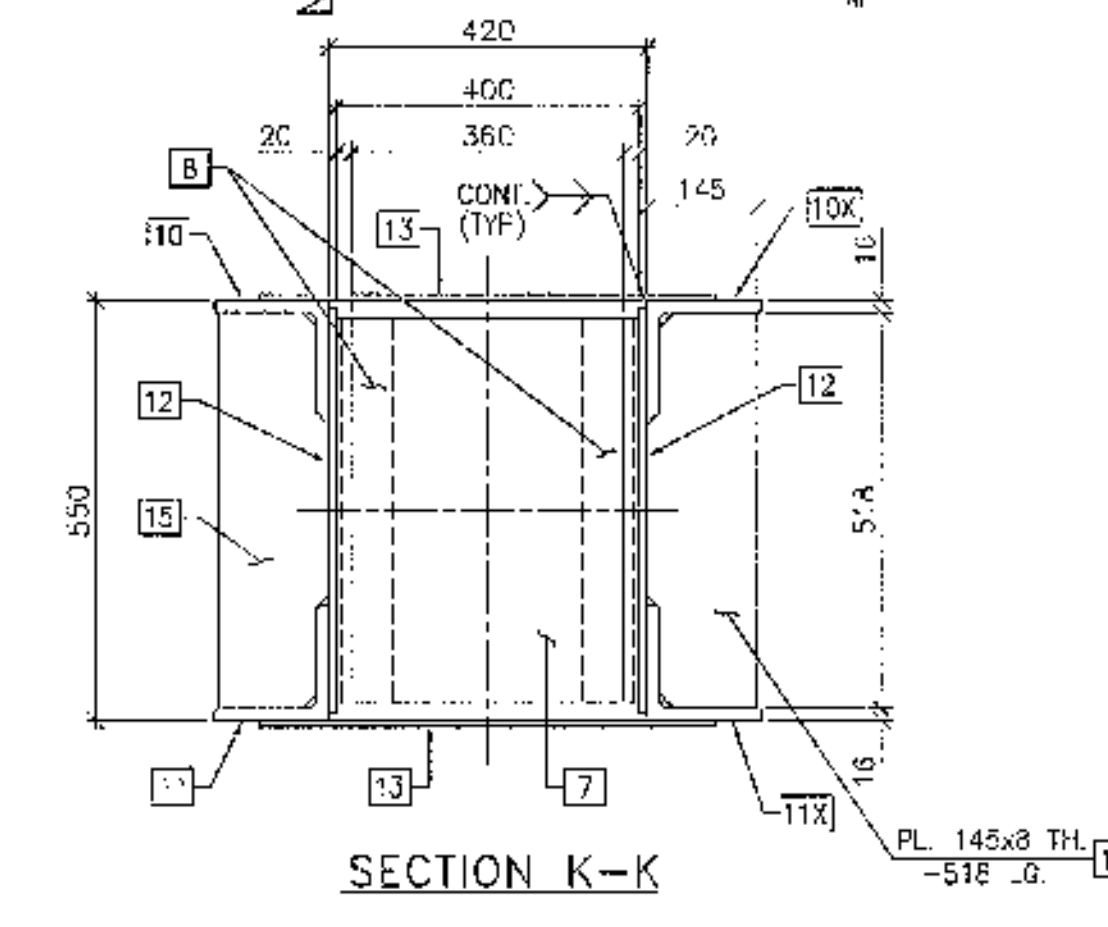




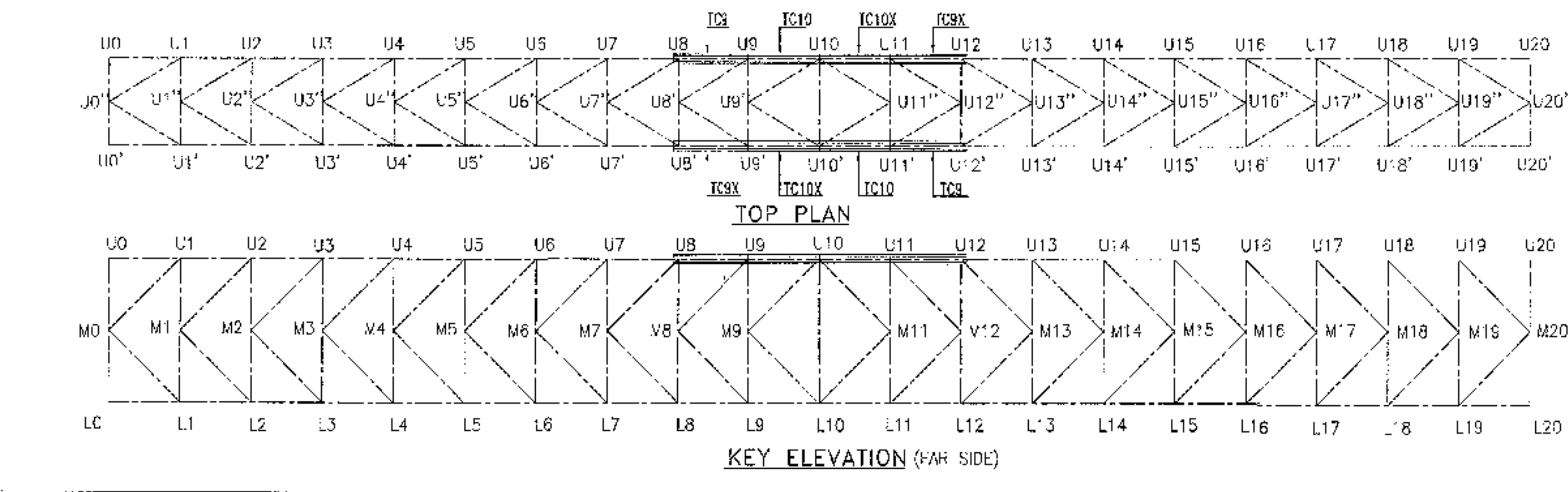
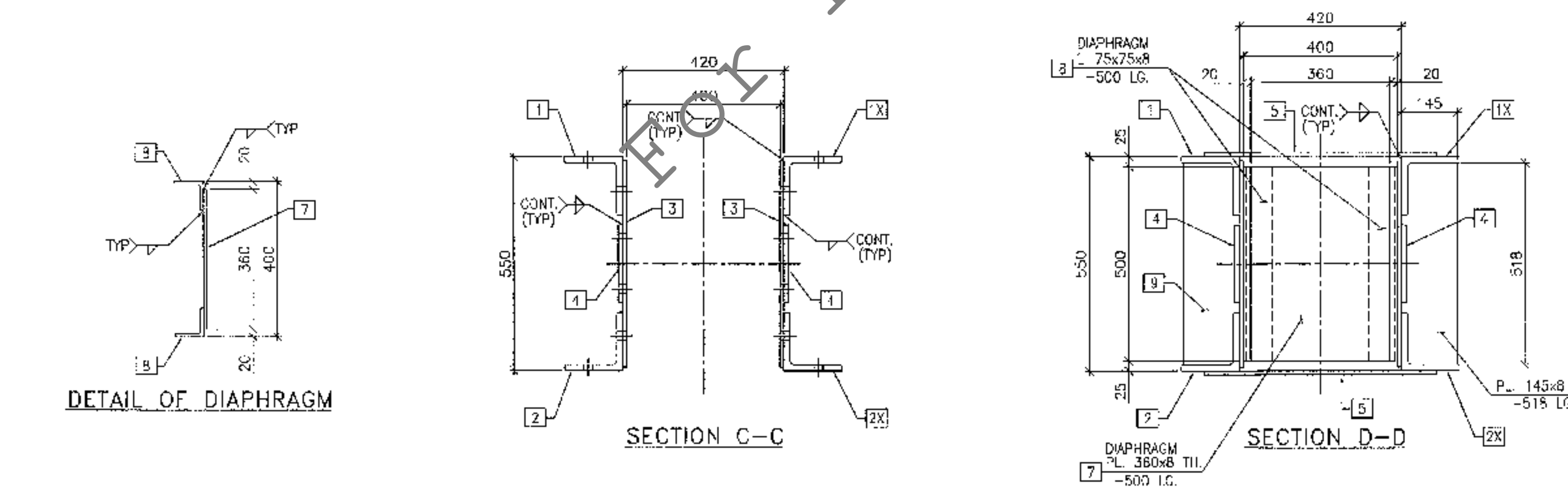
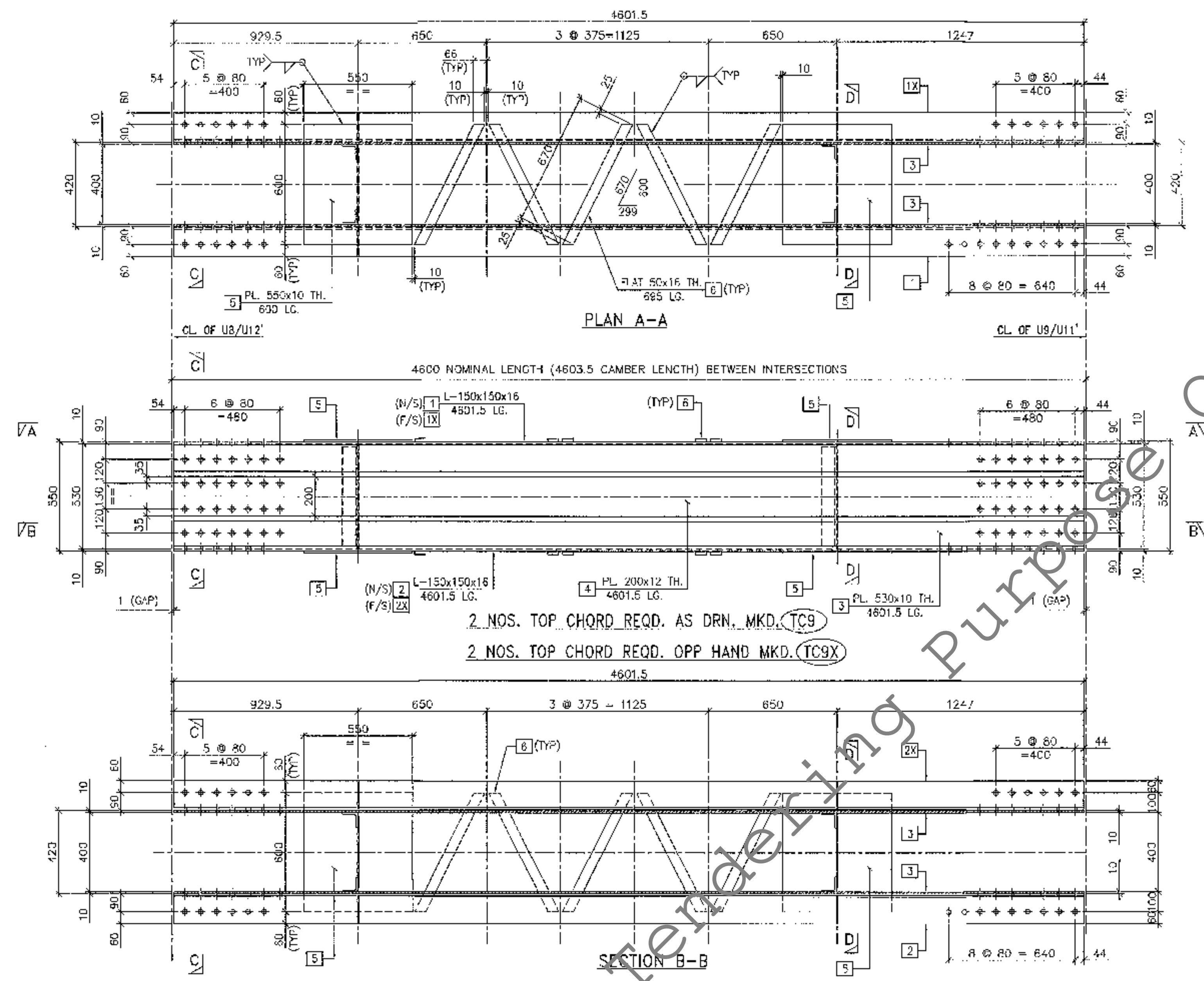
NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF R mm (R FC SIZE) TYPING.
3. ALL HOLES ARE 23.5mm FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL DIM MARKS SHOWN THUS: \square
5. ALL BRIDGE MARKS SHOWN THUS: \bigcirc/\bigcirc
6. GRADE OF STRUCTURAL STEEL: IS-2002.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS: 1363-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.I. 600 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL C.A. REFER DRG. NO. 2009-10/J-416/92m/ST-101.
12. ALL HOLES FOR BOLTS ARE SHOWN THUS: \bigcirc

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF TOP CHORD U2-U3, U3-U4, U2'-U3', U3'-U4' U18-U17, U17-U16, U16-U15, U15-U14	
SCALE	DATE	DRAWN	CHECKED
1:250, 1:500	09.09.09	A.J.	I.J.N.
DRAWING NUMBER		REV.	
2009-10/J-416/92m/ST-106		0	
12, LAKE WEST ROAD, SANTOSHIPUR, KOLKATA - 700 075.			
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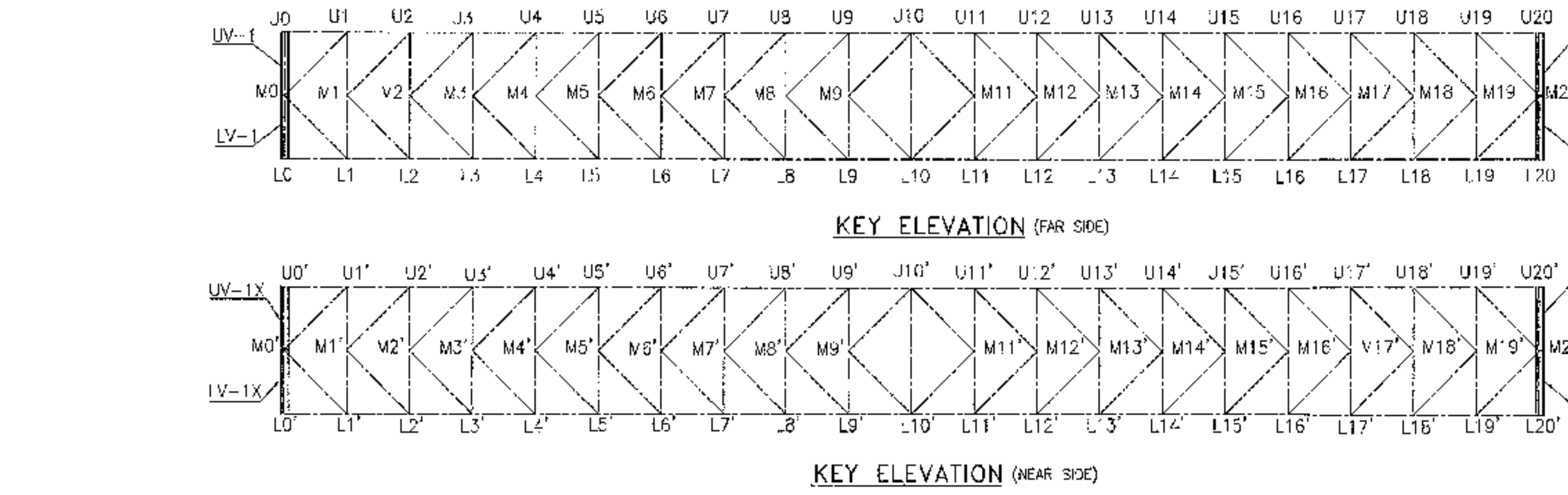
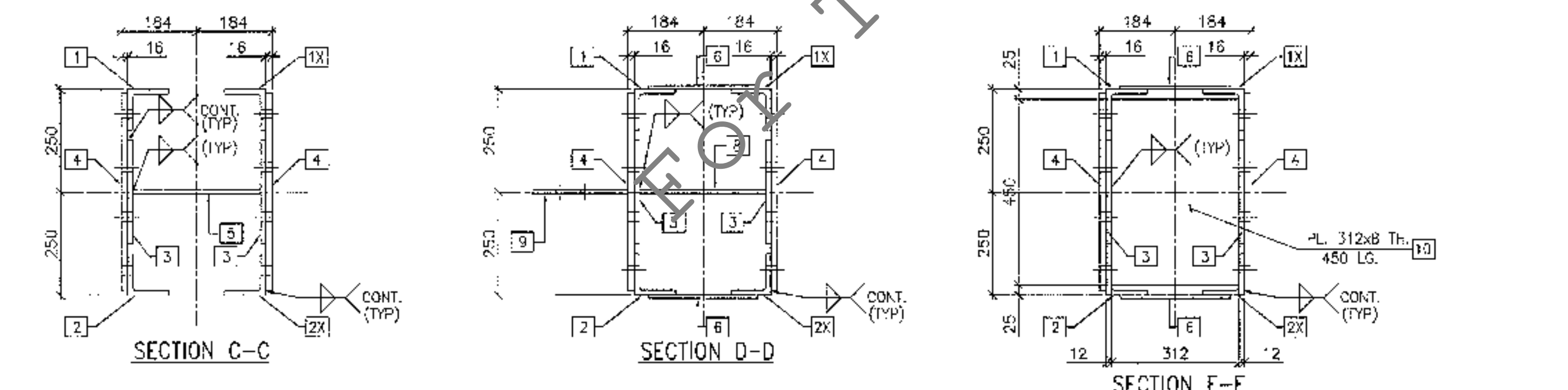
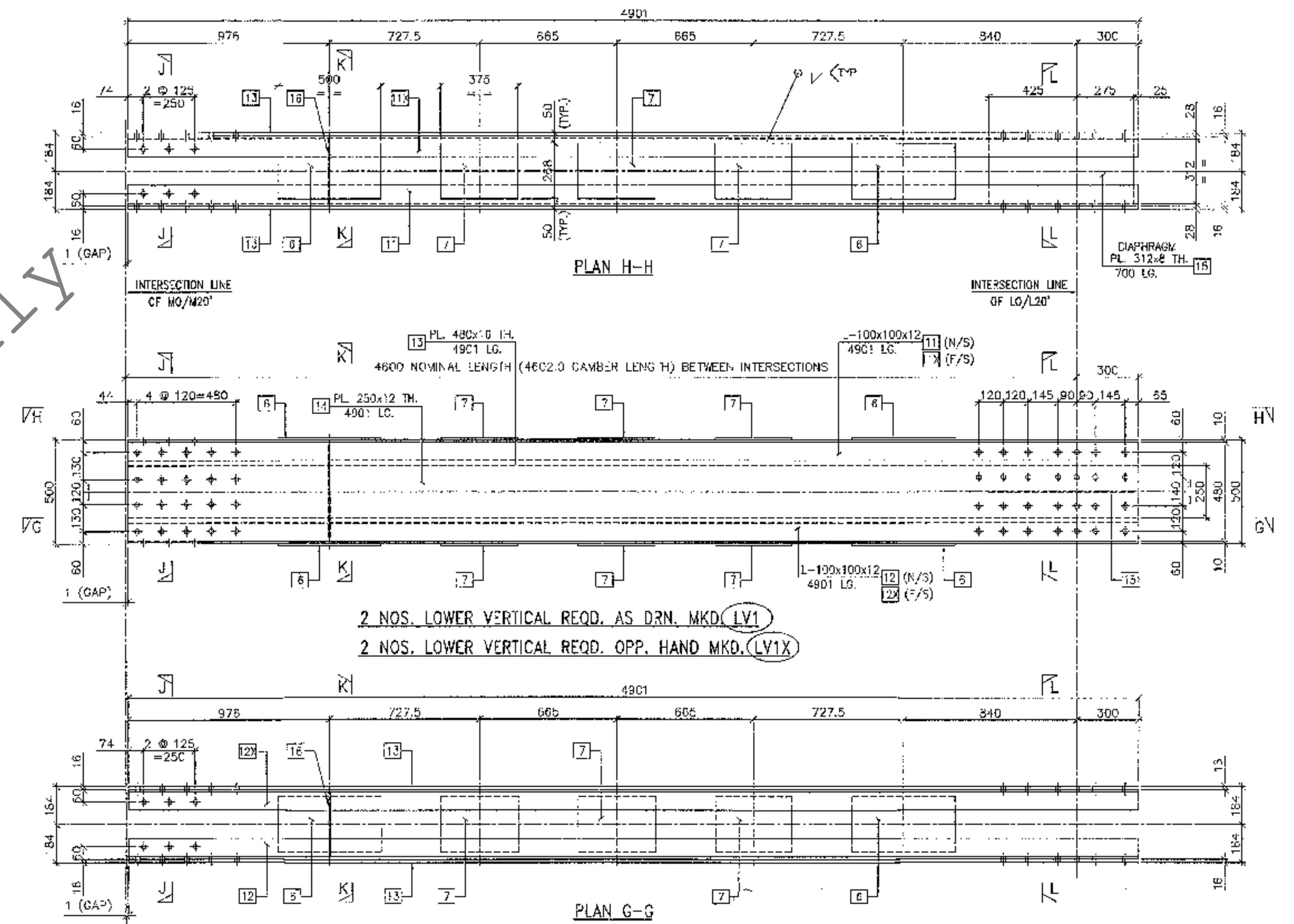
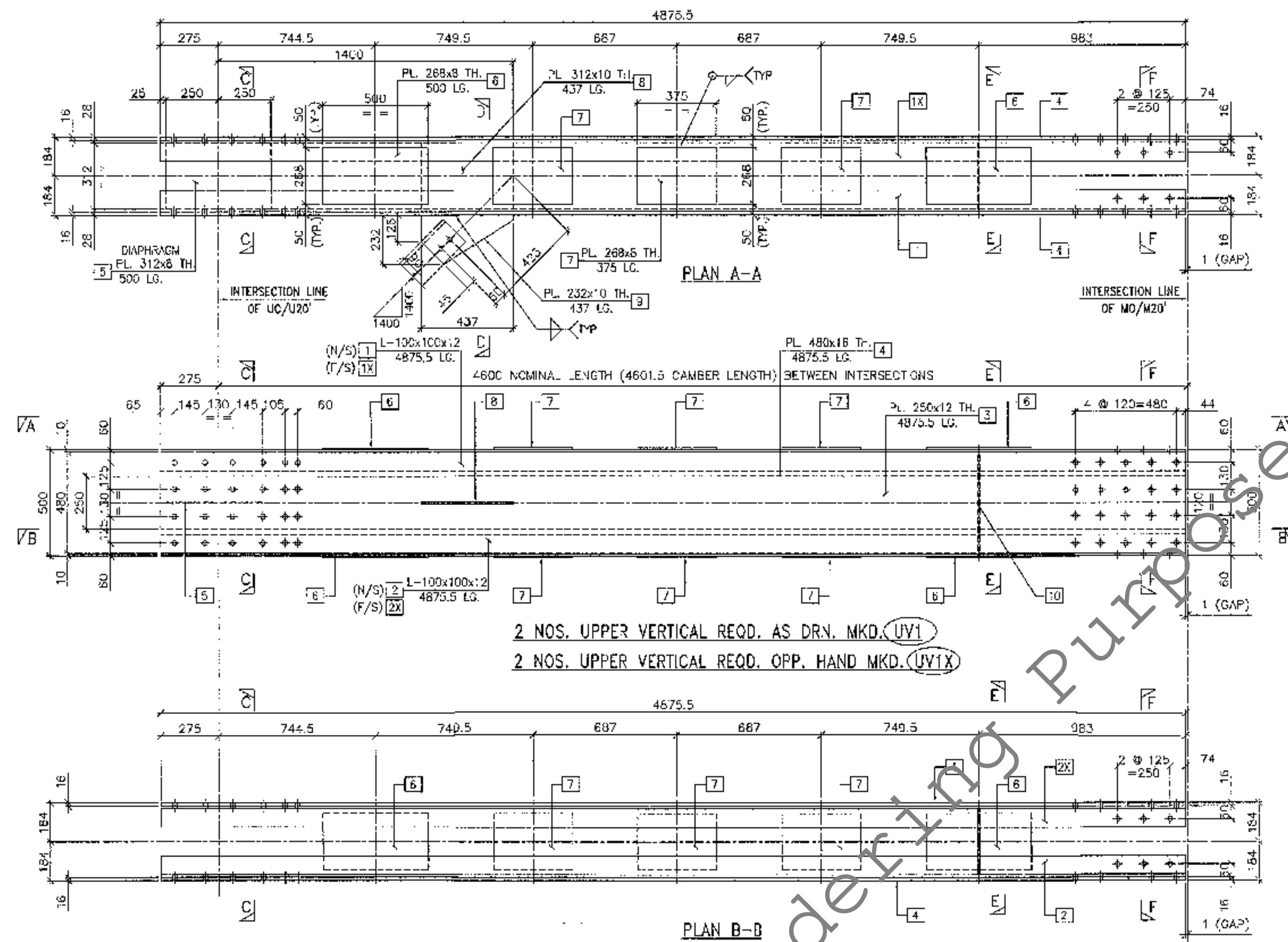


Port Info 18/11/2009 - 1751 - WKST19 - ENRUNKING JUEVANDUEY23:009F-4162009-18-J-416.52 H-ST-JUEVSTK 3 05 530MG



- NOTES:**
1. ALL DIMENSIONS ARE IN mm.
 2. ALL FILLER WEBS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707 x LEG SIZE UNLESS OTHERWISE NOTED.
 3. ALL HOLES ARE 23.5mm FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
 4. ALL ITEM MARKS SHOWN THUS \square
 5. ALL EJECTION MARKS SHOWN THUS \bigcirc/\bigcirc
 6. GRADE OF STRUCTURAL STEEL = IS:2062.
 7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
 8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363 1992, 1364 1992 AND 1387 1979-94.
 9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
 10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
 11. FOR STRUCTURAL S.A. REFER BRG. NO. 2009-10/J-416/92m/ST-101.
 12. ALL HOLES FOR BOLTS ARE SHOWN THUS \oplus

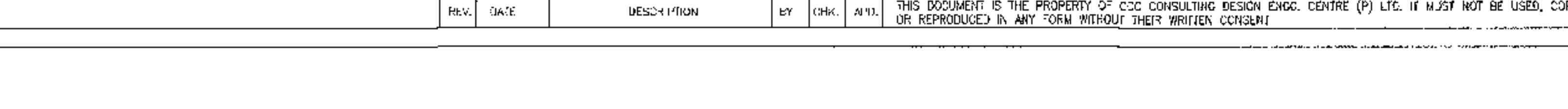
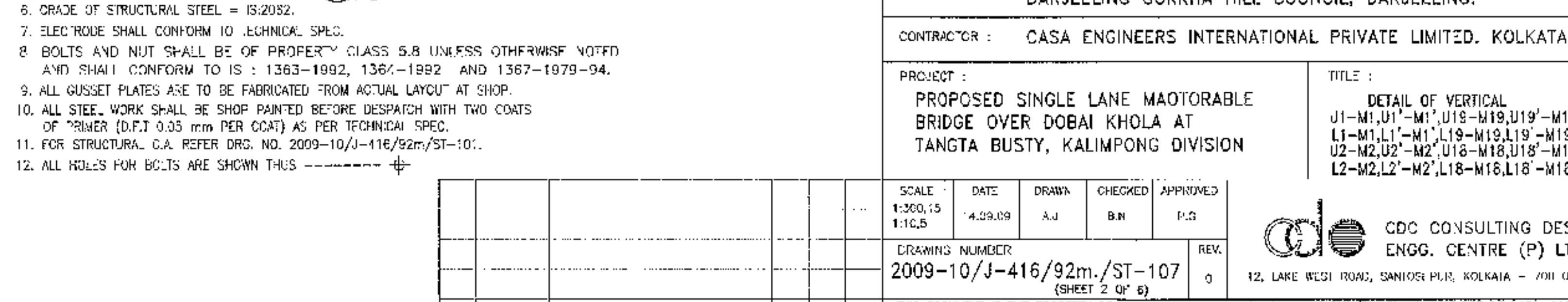
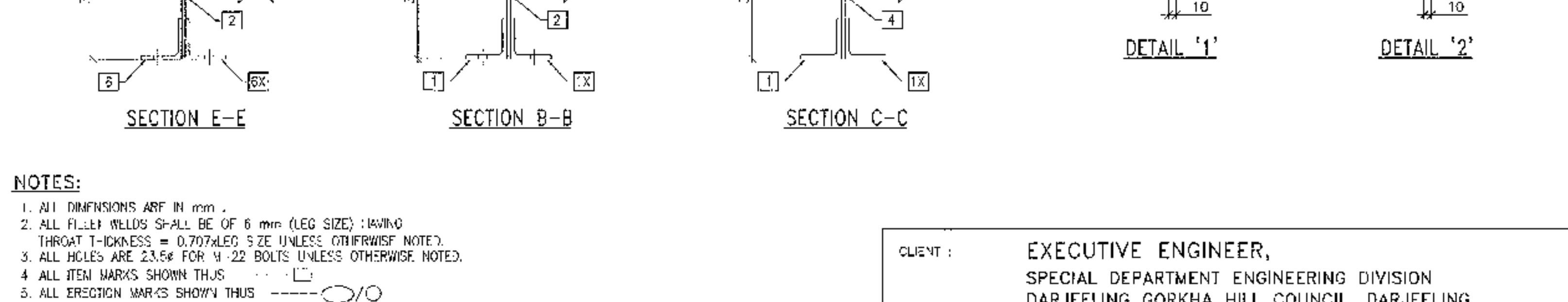
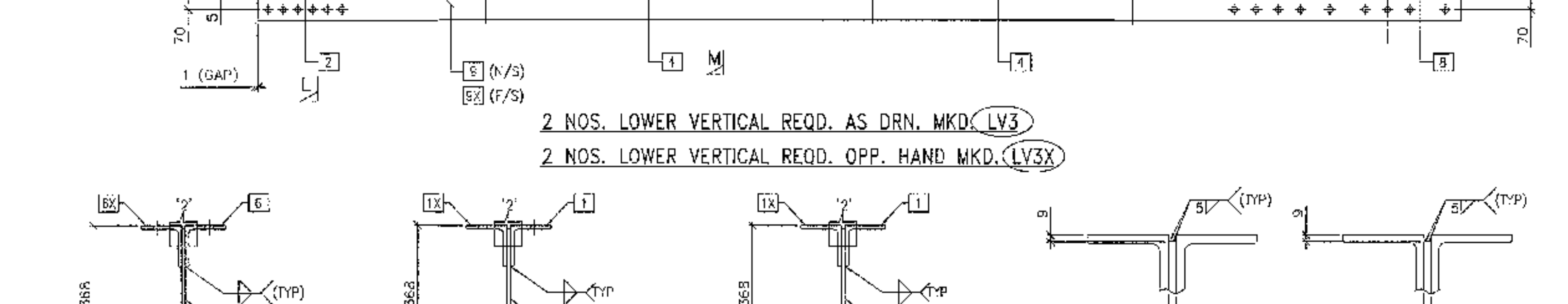
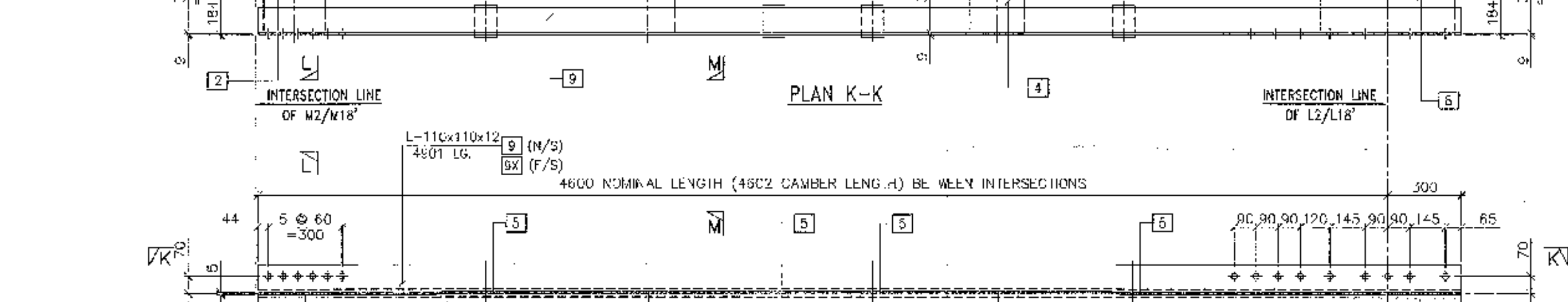
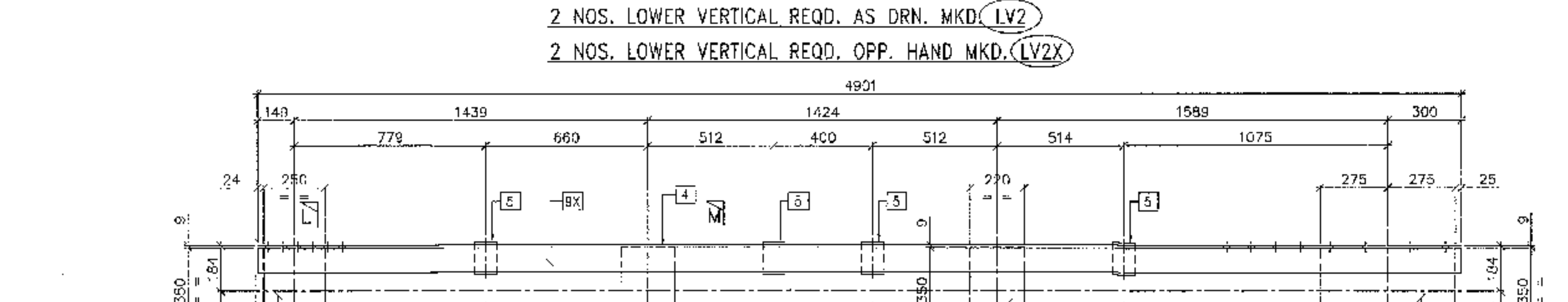
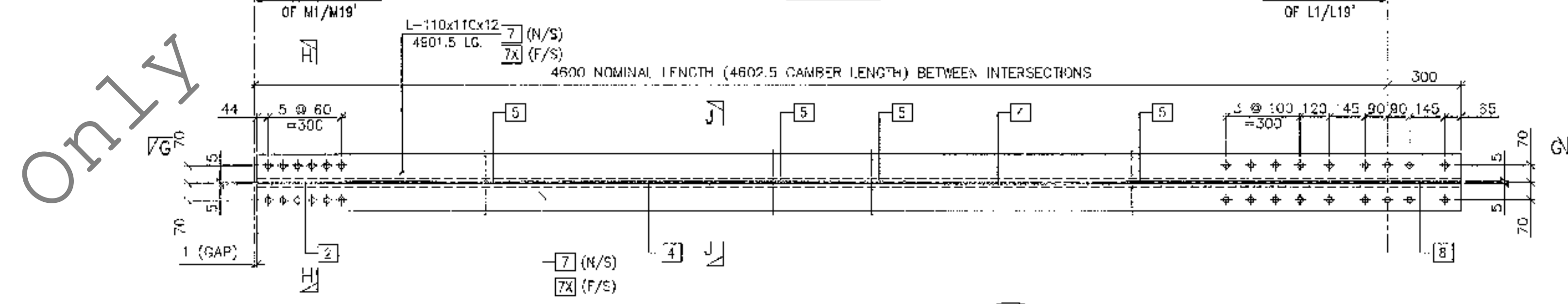
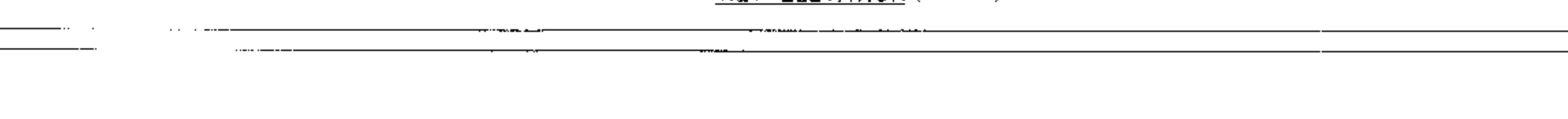
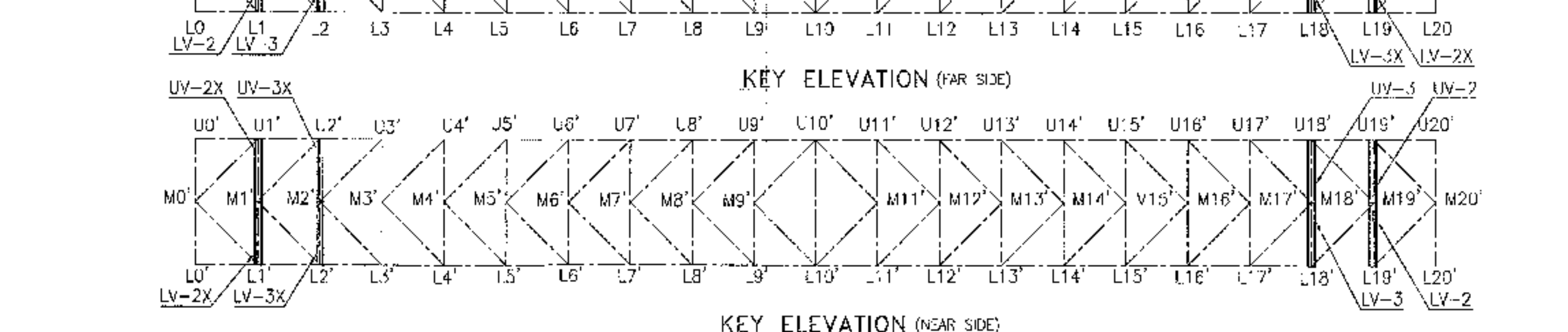
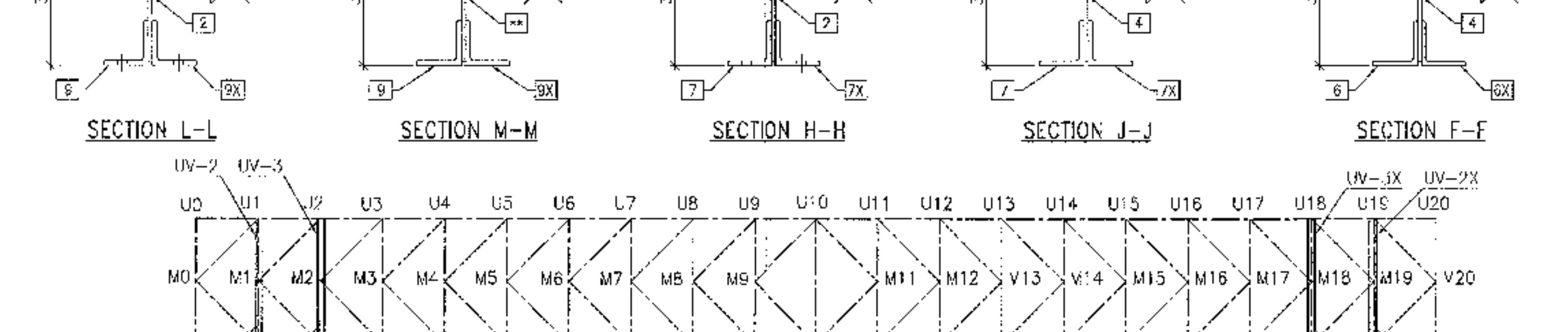
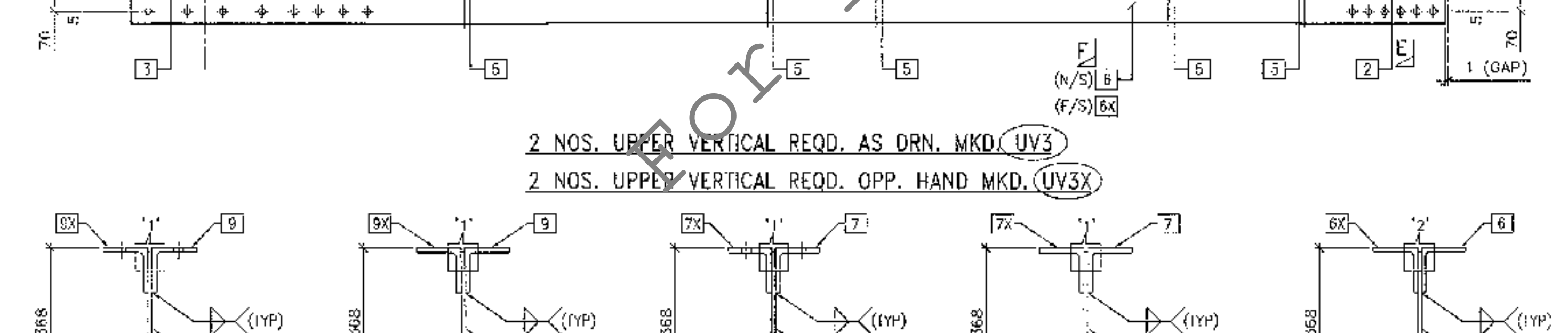
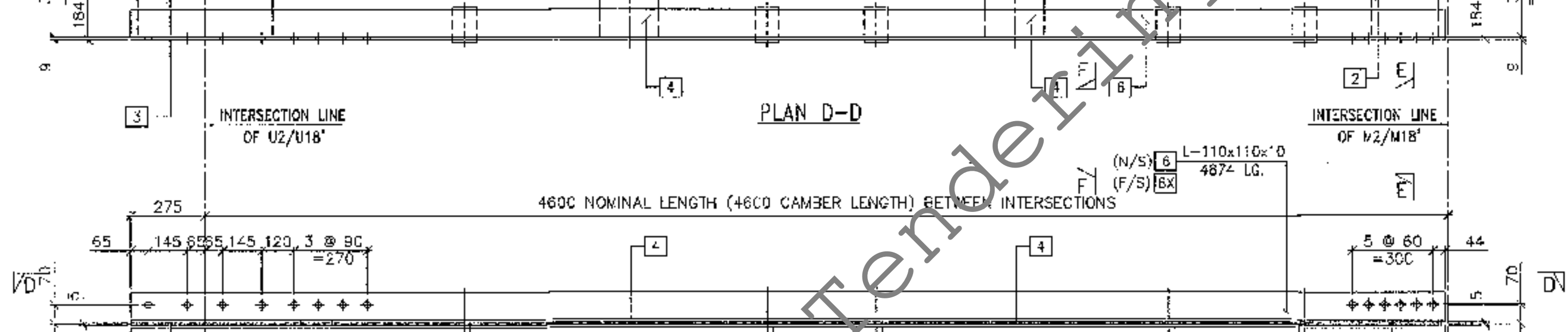
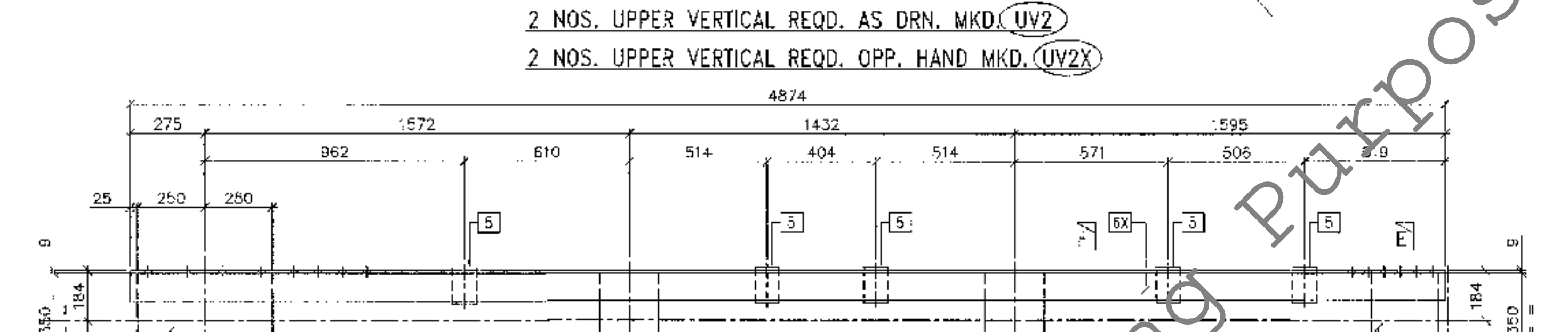
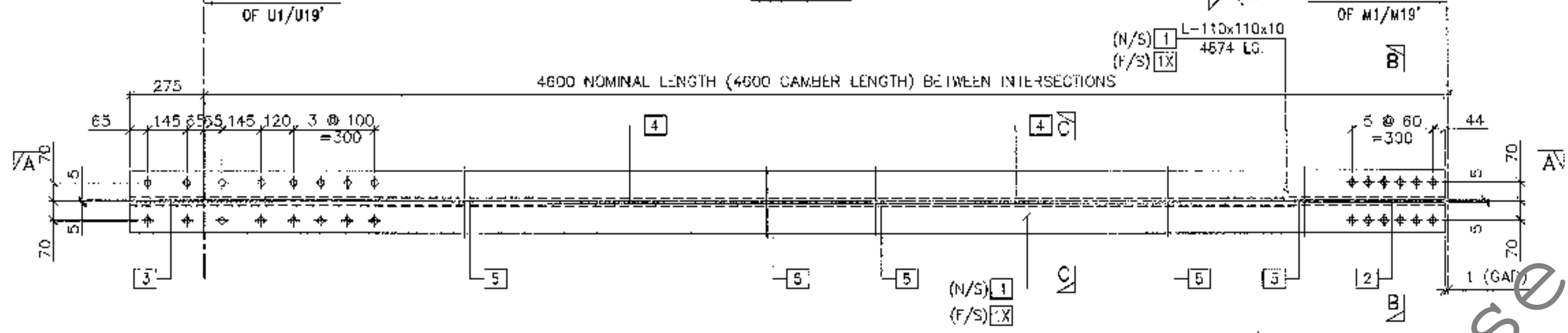
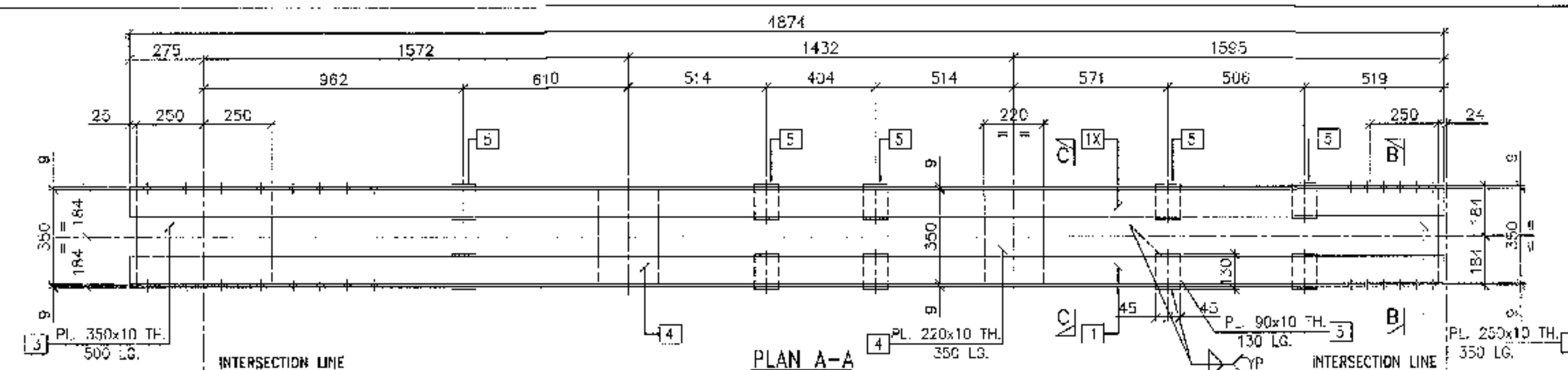
CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAOTORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF TOP CHORD U8-U9, U9-U10, U8'-U9', U9'-U10' U12'-U11', U12-U11, U11'-U10', U11-U10	
SCALE :	DRAWN :	CHECKED :	APPROVED :
1:250/15 1:10	10.09.09 A.J.	B.K.	P.G.
DRAWING NUMBER :		REV. :	
2009-10/J-416/92m/ST-106 (SHEET 8 OF 9)		0	
CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SANTOSHPUK, KOLKATA - 700 075.			
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NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.70XLEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 23.54 FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THUS $\text{---} \text{---} \text{---}$
5. ALL DIRECTION MARKS SHOWN THUS $\text{---} \text{---} \text{---}$
6. GRADE OF STRUCTURAL STEEL = IS-2052.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL G.A. REFER DRS. NO. 2009-10/J-416/92m/ST-101.
12. ALL HOLES FOR BOLTS ARE SHOWN THUS $\text{---} \text{---} \text{---}$

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF VERTICAL U0-M0,U0'-M0',U20-M20,U20'-M20' L0-M0,L0'-M0',L20-M20,L20'-M20'	
SCALE 1:300,1:5 1:10,5	DATE 15.09.09	DRAWN AJ	CHECKED 3N
DRAWING NUMBER 2009-10/J-416/92m/ST-107 (SHEET 1 OF 6)		REV. 0	
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- NOTES:
1. ALL DIMENSIONS ARE IN mm.
 2. ALL FLEET WELDS SHALL BE OF 6 mm (LEG SIZE) WELDING THROAT THICKNESS = 0.707 LEG SIZE UNLESS OTHERWISE NOTED.
 3. ALL HOLES ARE 23.5 mm FOR 1/2" BOLTS UNLESS OTHERWISE NOTED.
 4. ALL ITEM MARKS SHOWN THUS $\frac{1}{2}$
 5. ALL ERECTION MARKS SHOWN THUS $\frac{1}{2}$
 6. GRADE OF STRUCTURAL STEEL = IS-2002.
 7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
 8. BOLTS AND NUT SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1367-1992 AND 1367-1979-94.
 9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
 10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T. 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
 11. FOR STRUCTURAL C.A. REFER DRG. NO. 2009-10/J-416/92m/ST-101.
 12. ALL HOLES FOR BOLTS ARE SHOWN THUS $\frac{1}{2}$

CLIENT : EXECUTIVE ENGINEER,
SPECIAL DEPARTMENT ENGINEERING DIVISION
DARJEELING GORKHA HILL COUNCIL, DARJEELING.

CONTRACTOR : CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.

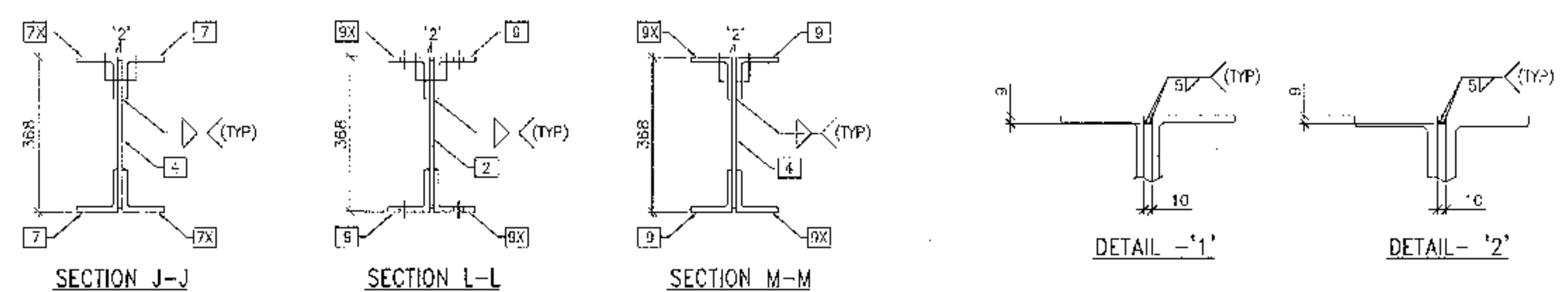
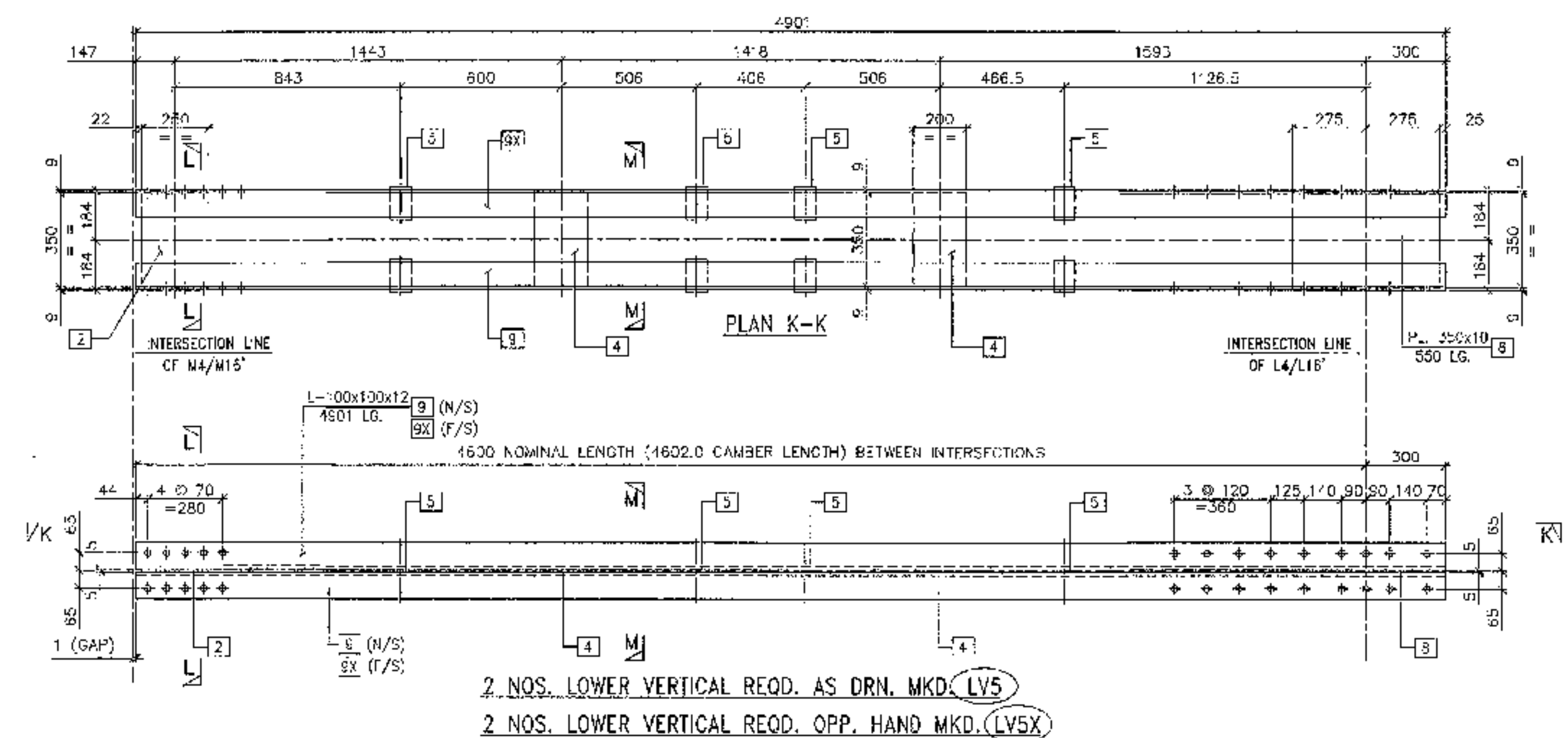
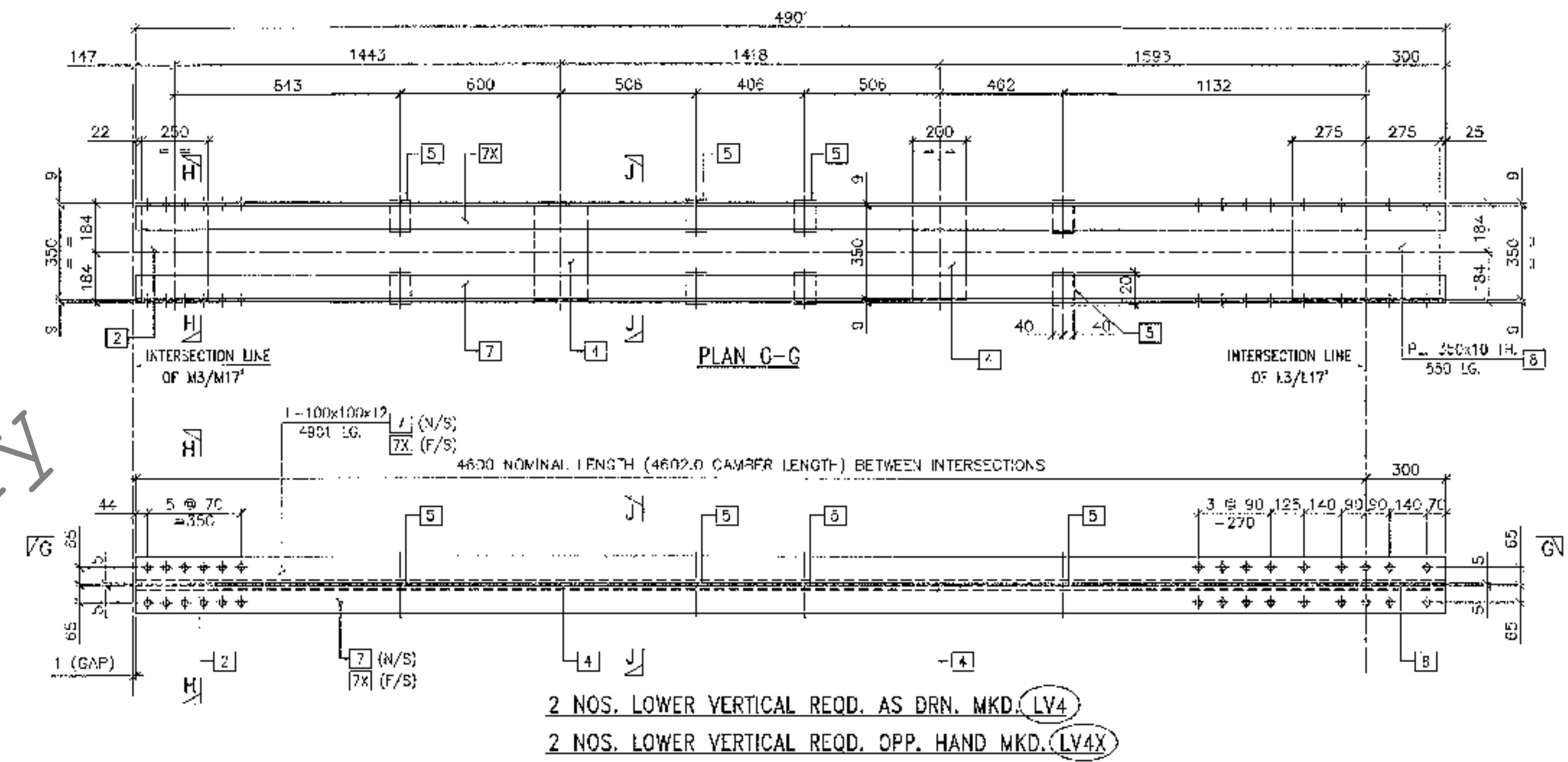
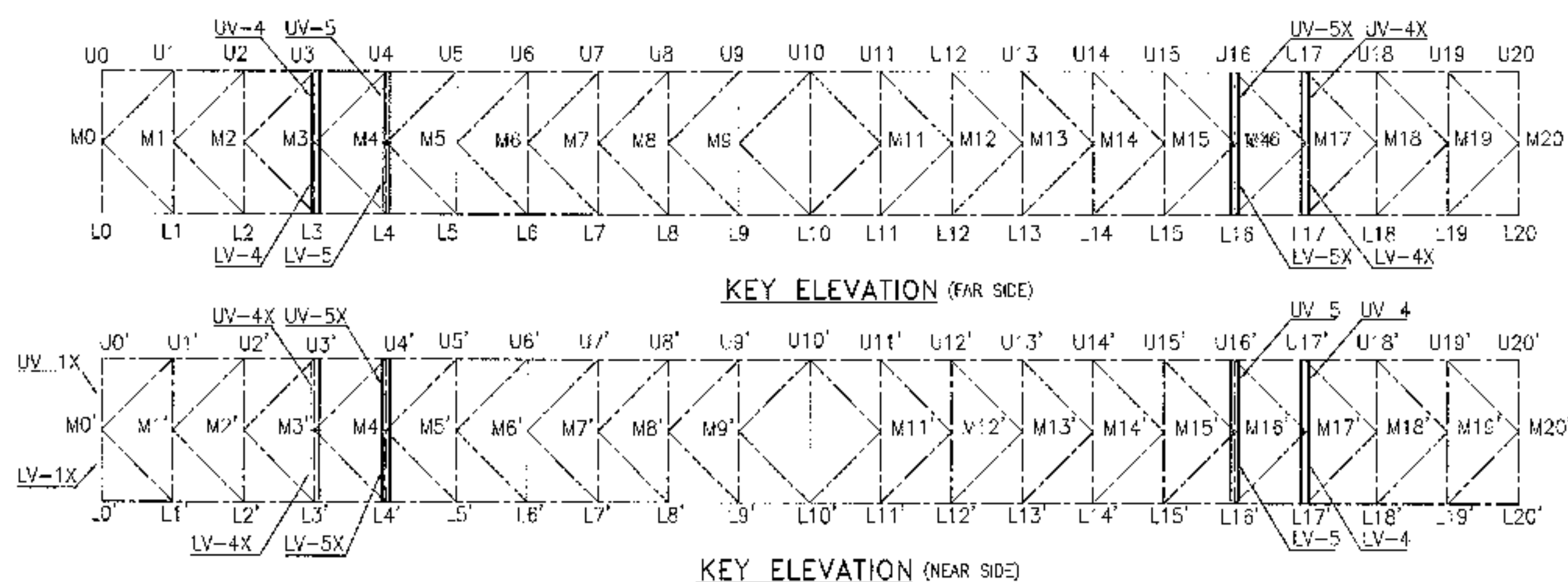
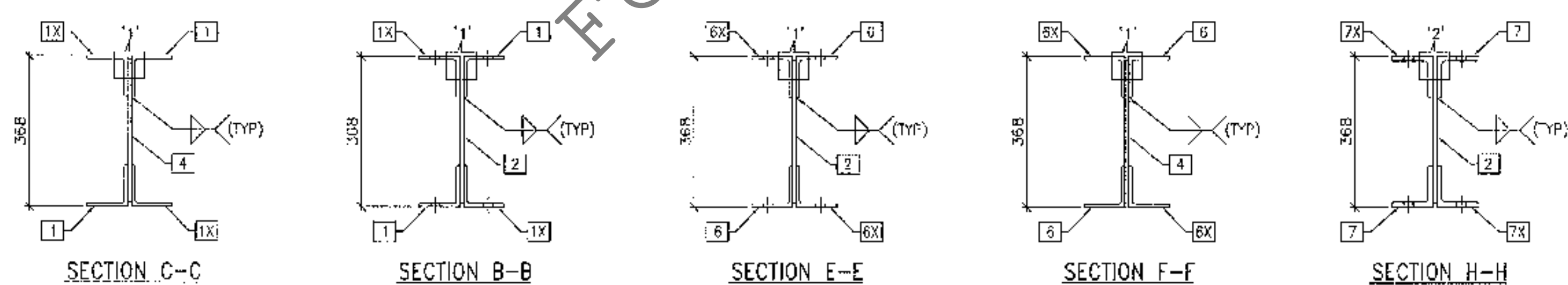
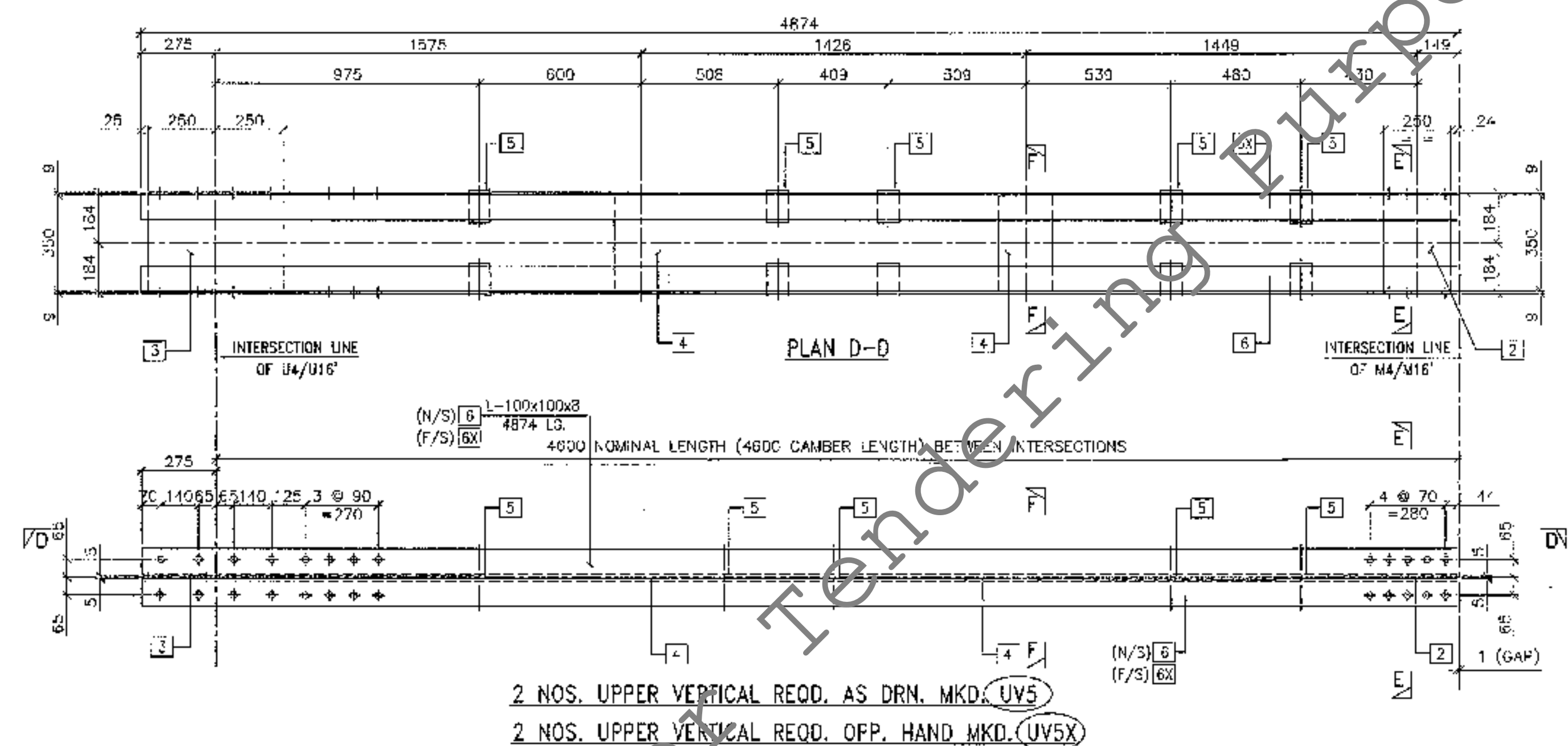
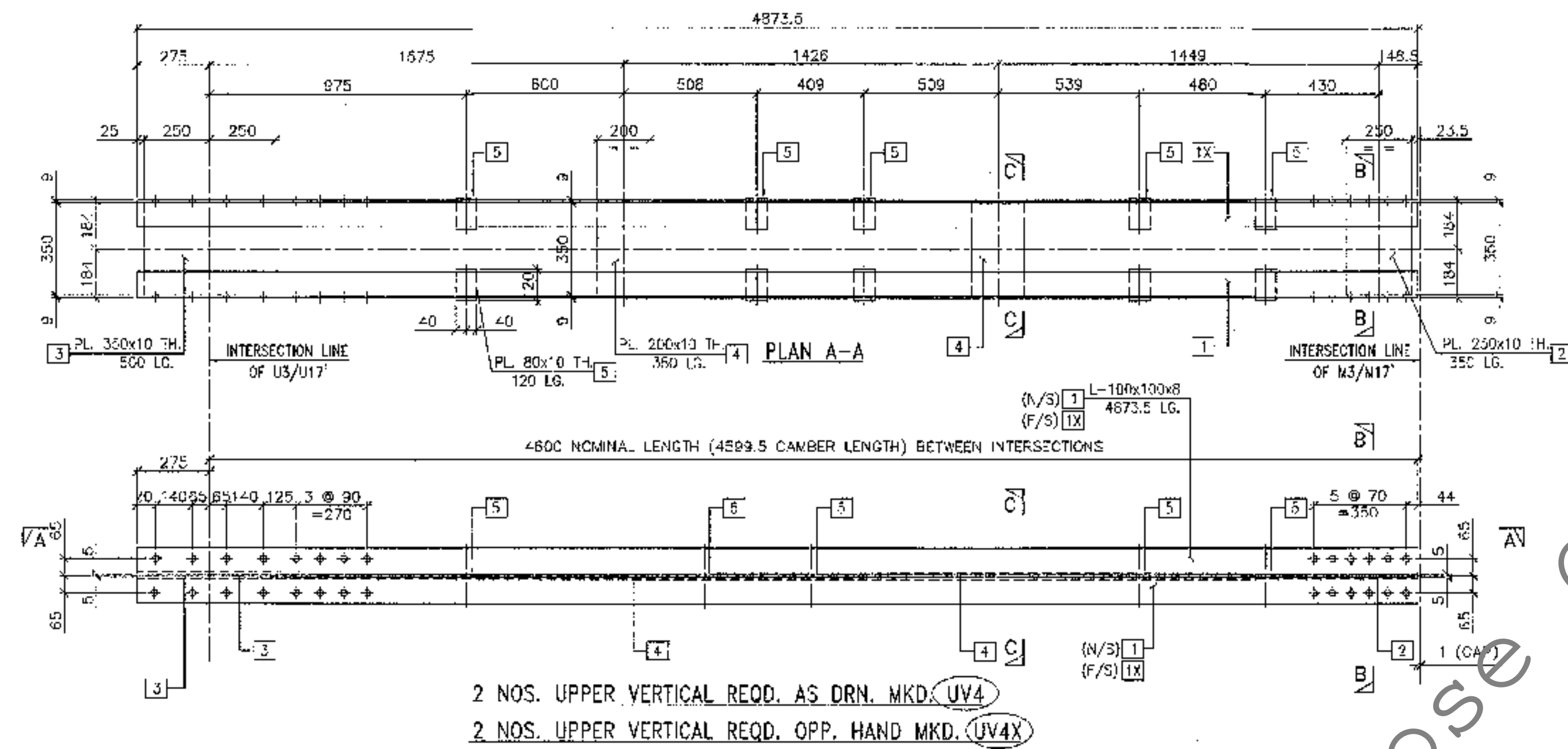
PROJECT : PROPOSED SINGLE LANE MAJORABLE
BRIDGE OVER DOBAI KHOLA AT
TANGTA BUSTY, KALIMPONG DIVISION

TITLE : DETAIL OF VERTICAL
J1-M1, U1'-M1', U18-M18, U19'-M19'
U2-M2, U2'-M2', U18-M18, U18'-M18'
L2-M2, L2'-M2', L18-M18, L18'-M18'

SCALE	DATE	DRAWN	CHECKED	APPROVED
1:200, 1:100	4.09.09	A.J.	B.N.	P.G.
DRAWING NUMBER	REV.			
2009-10/J-416/92m/ST-107	0			
(SHEET 2 OF 6)				

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ENGG. CENTRE (P) LTD.
12, LAKE WEST ROAD, SANTOSH PURI, KOLKATA - 700 015.

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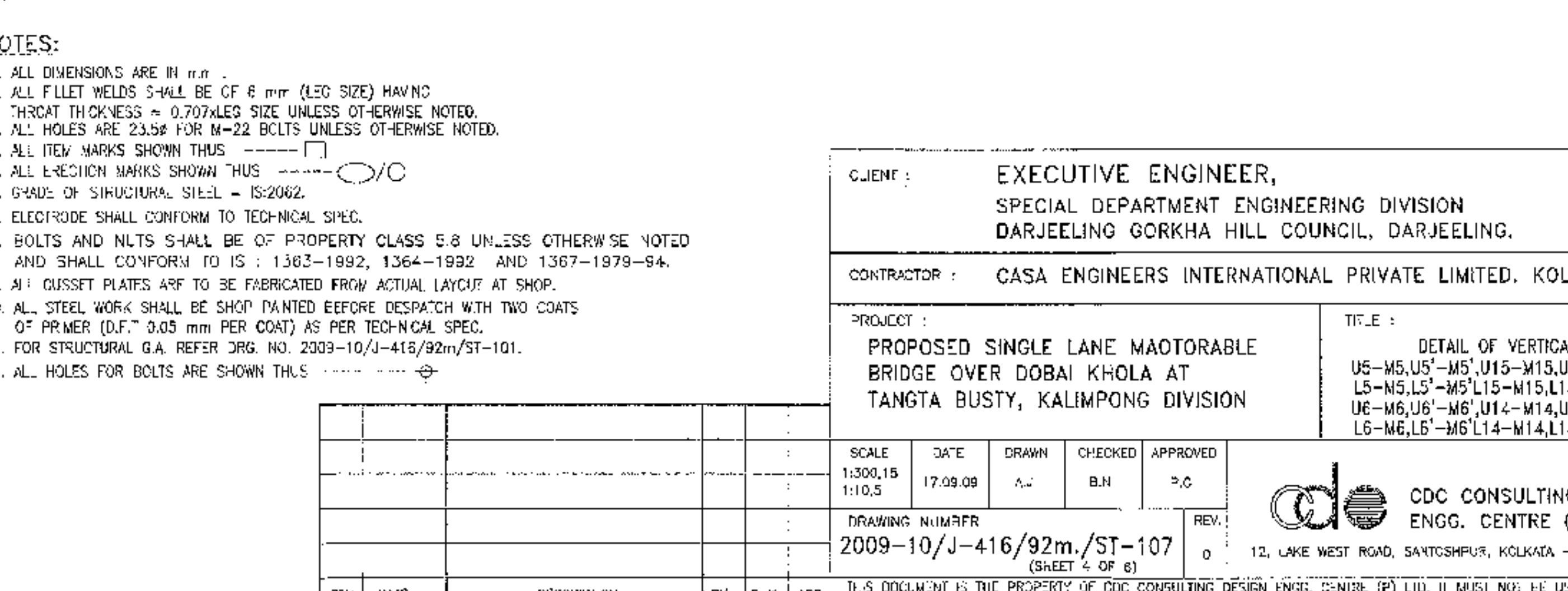
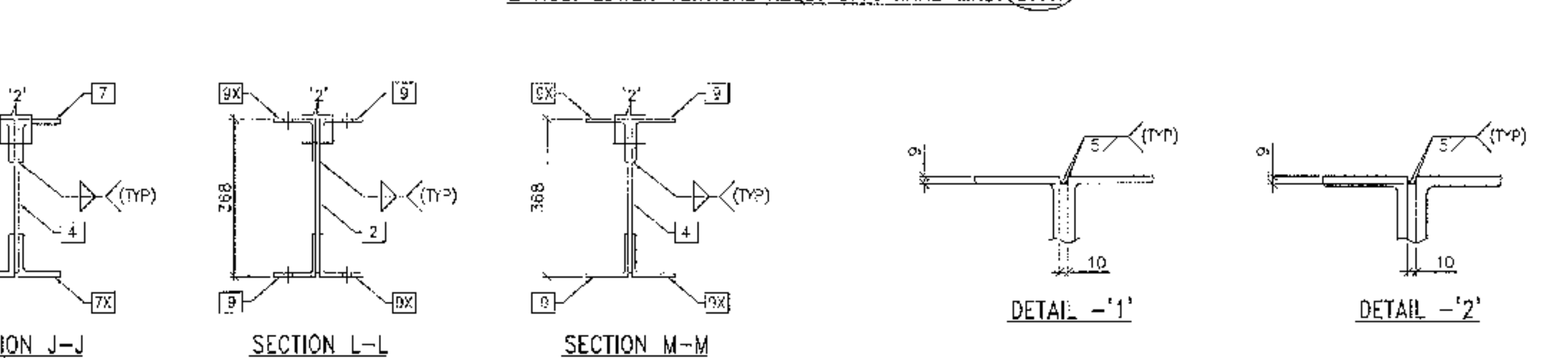
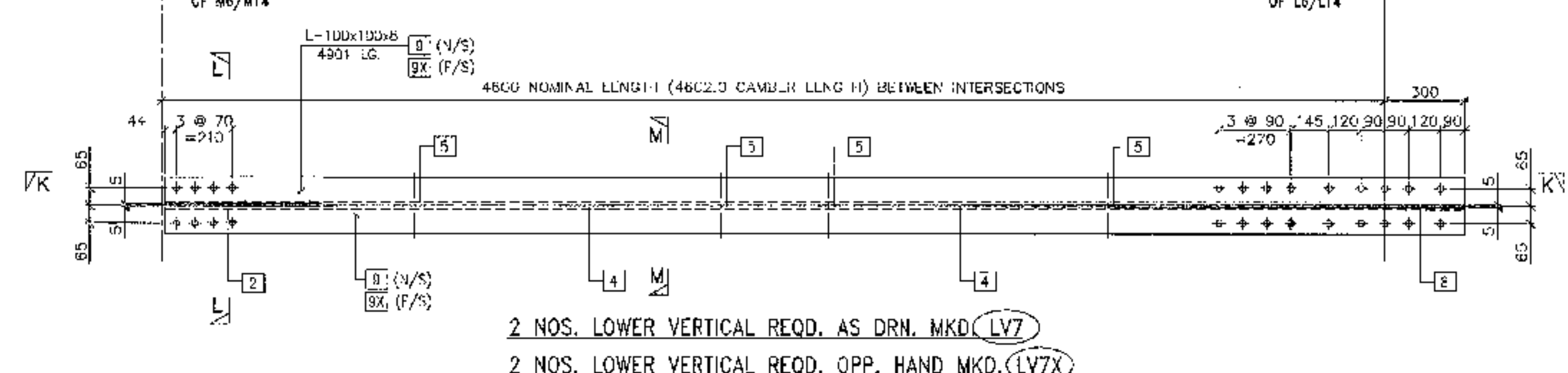
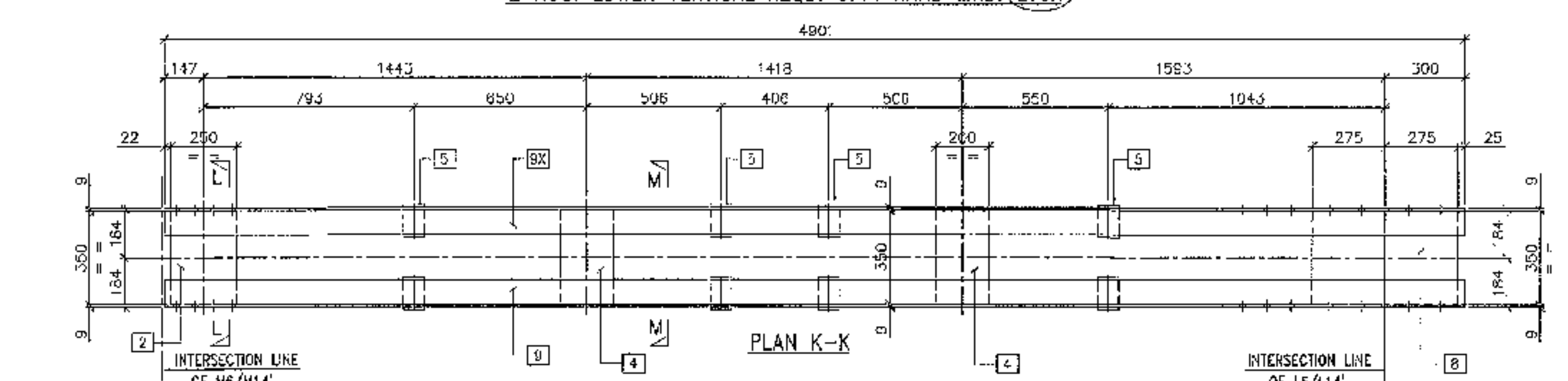
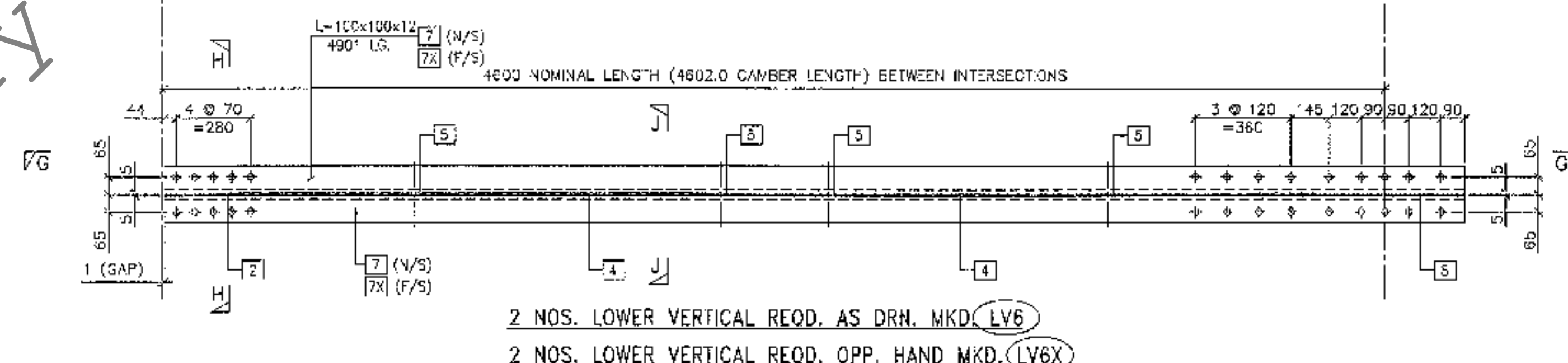
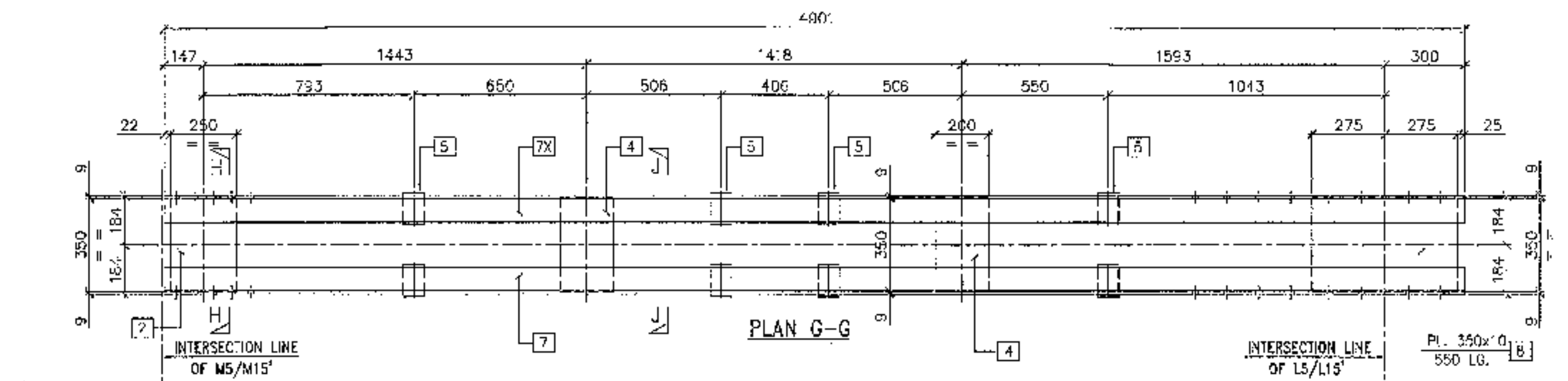
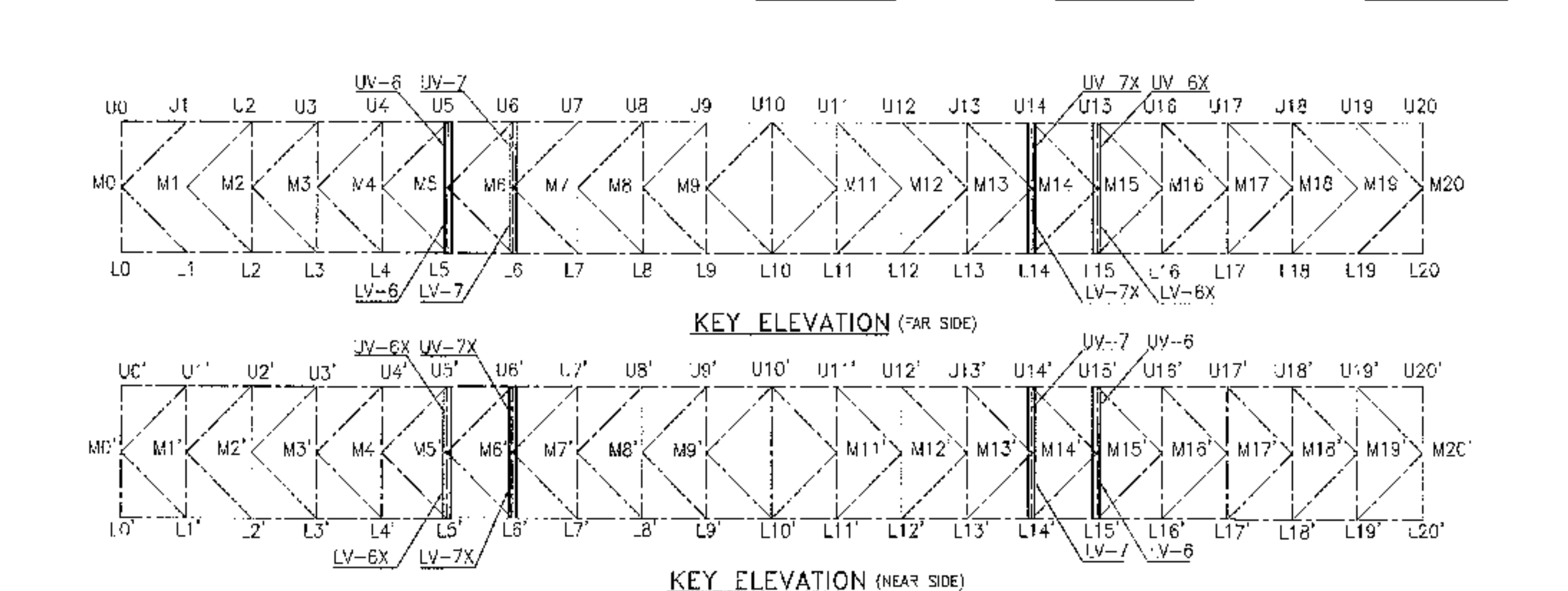
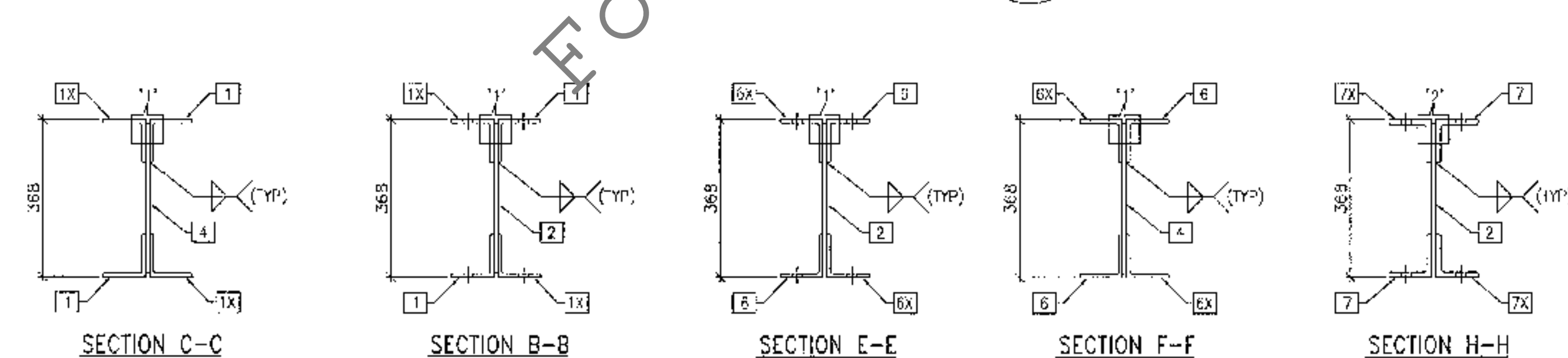
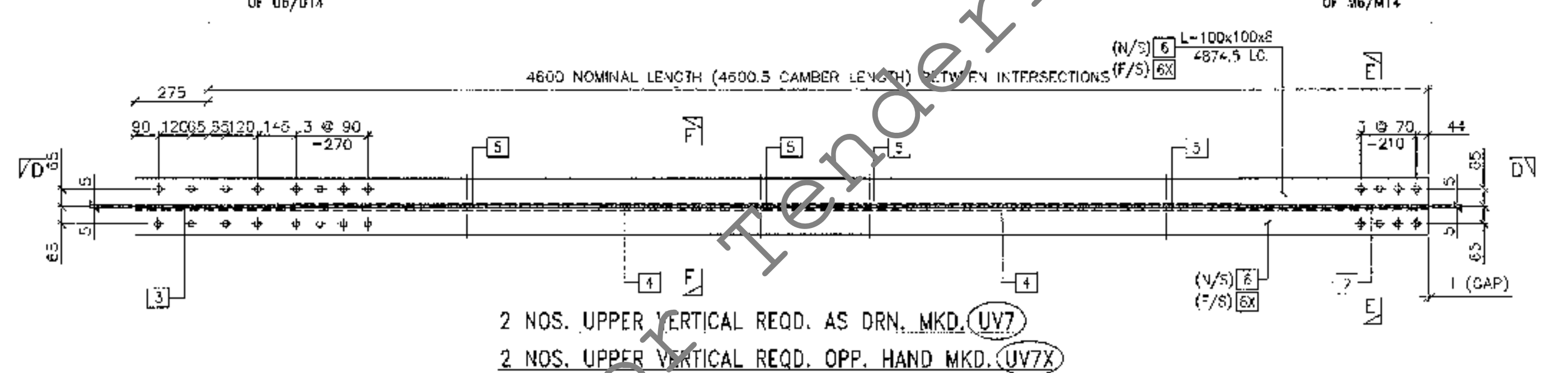
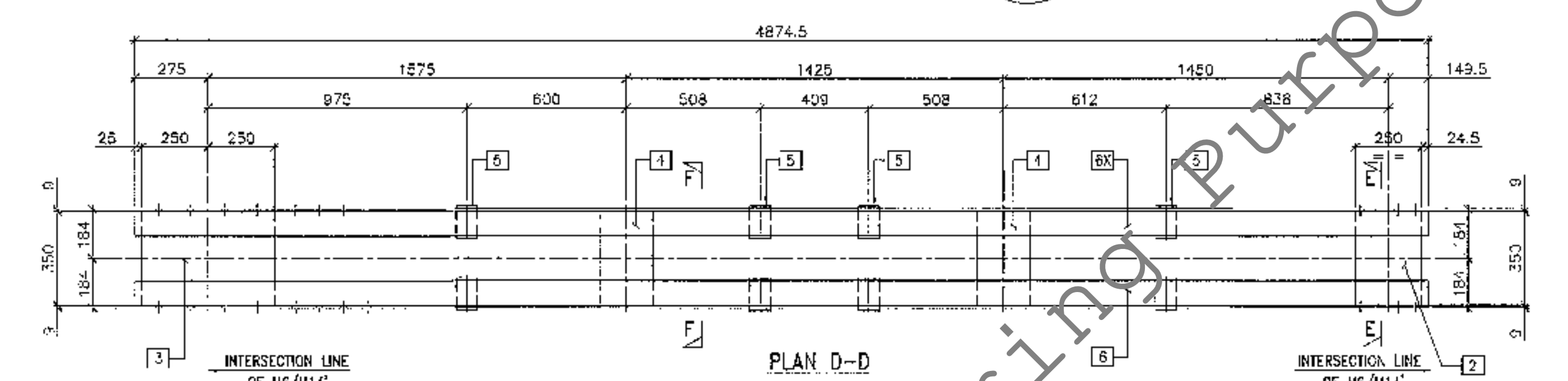
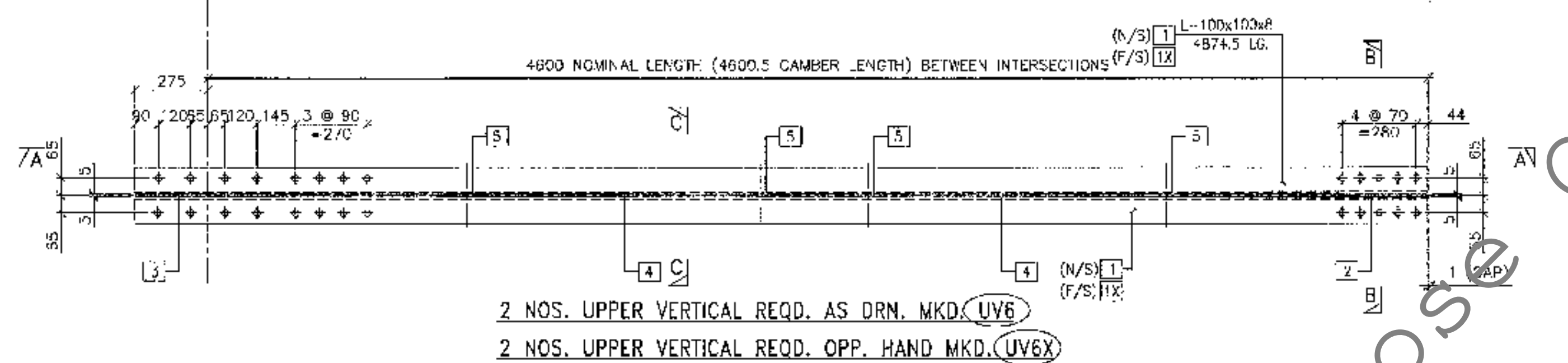
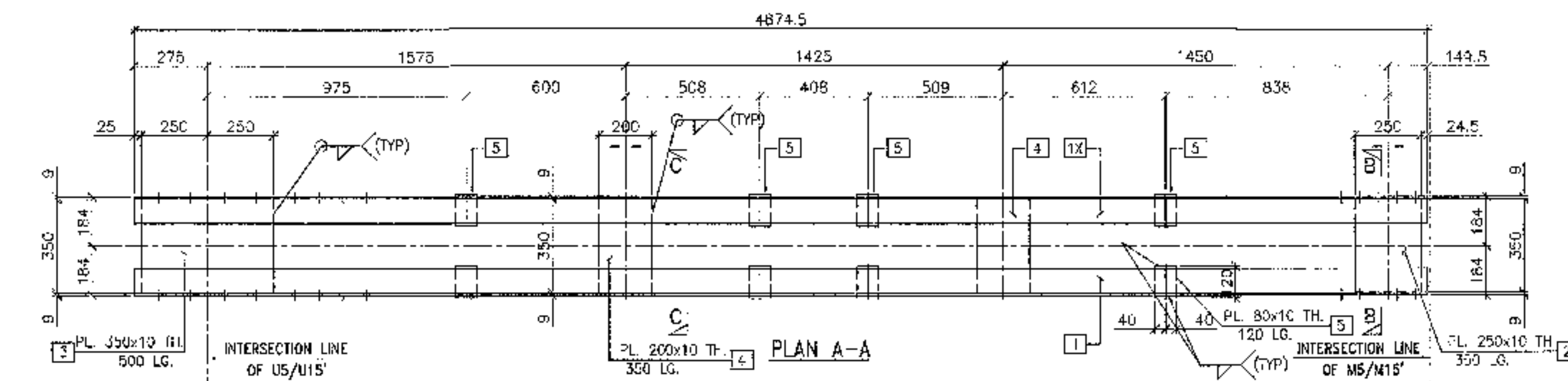


NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707 x LEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 25.50 FOR M-25 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THIS
5. ALL ERECTION MARKS SHOWN THIS
6. GRADE OF STRUCTURAL STEEL = IS-2062.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT S-07.
10. ALL STEEL WORK SHALL BE SHIP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T. 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL G.A. REFER DRG. NO. 2009-10/J-416/92m/ST-191.
12. ALL HOLES FOR BOLTS ARE SHOWN THIS

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAINTAINABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF VERTICAL U3-M3,U3'-M3',U17-M17,U17'-M17 L3-M3,L3'-M3',L17-M17,L17'-M17 U4-M4,U4'-M4',U6-M6,U6'-M6' L4-M4,L4'-M4',L16-M16,L16'-M16'	
SCALE	DATE	DRAWN	CHECKED
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DRAWING NUMBER		REV.	
2009-10/J-416/92m/ST-107		0	
(SHEET 3 OF 5)		12, JANE WEST ROAD, SANTOSHPUK, KOLKATA - 700 075.	
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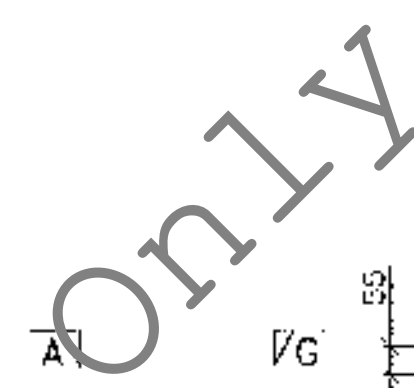
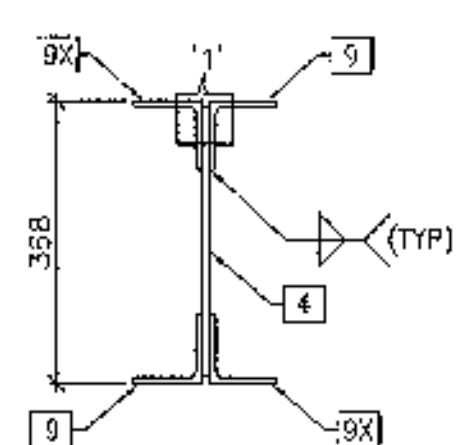
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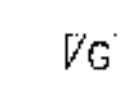
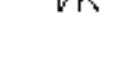
NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL FLEET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707 x LEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 23.5% FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL REIN. MARKS SHOWN THUS:
5. ALL REIN. MARKS SHOWN THUS:
6. GRADE OF STRUCTURAL STEEL = IS-2062.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1303-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F. 3.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL G.A. REFER DRG. NO. 2009-10/J-416/92m/ST-101.
12. ALL HOLES FOR BOLTS ARE SHOWN THUS:

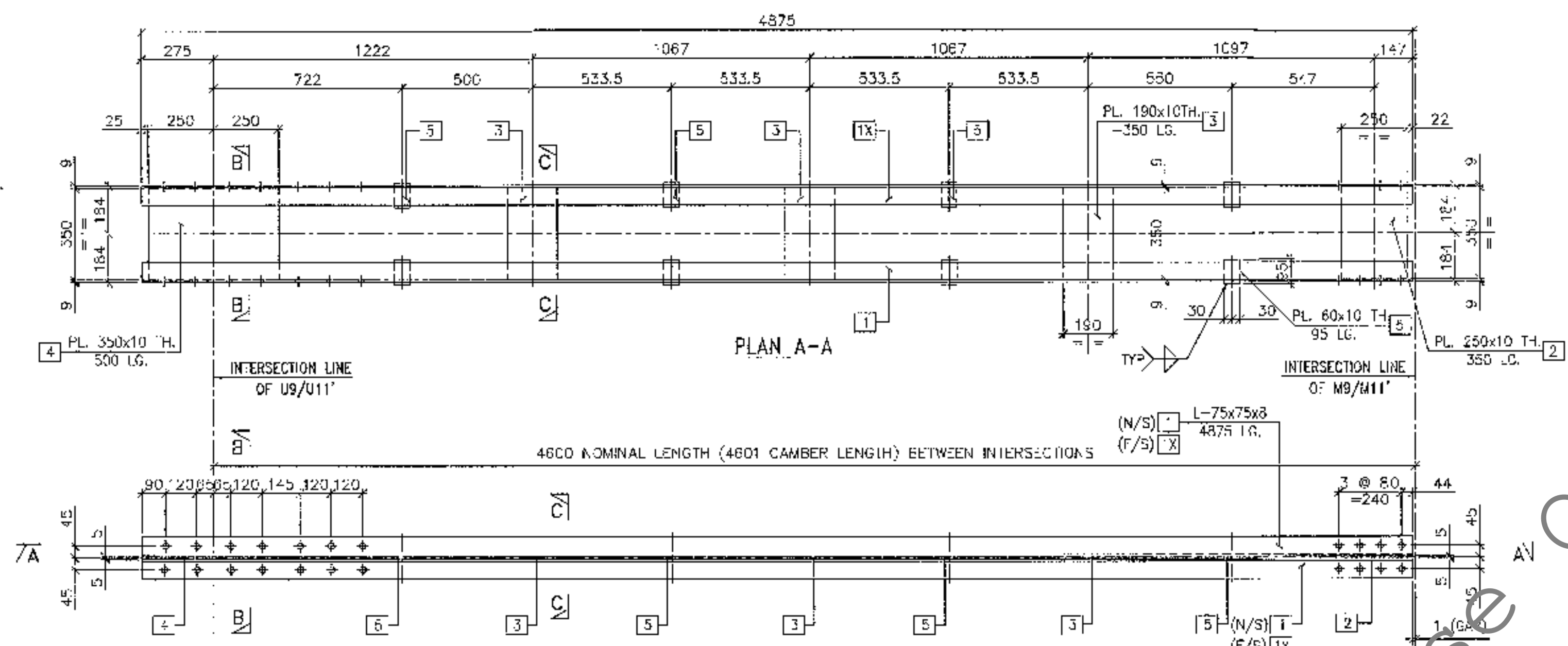
CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAINTORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF VERTICAL U5-M5,U5'-M5',U15-M15,U15'-M15' L5-M5,L5'-M5',L15-M15,L15'-M15' U6-M6,U6'-M6',U14-M14,U14'-M14' L6-M6,L6'-M6',L14-M14,L14'-M14'	
SCALE	DATE	DRAWN	CHECKED
1:300, 1:10, 1:5	17.09.09	A-2	B-1
DRAWING NUMBER		REV.	
2009-10/J-416/92m/ST-107 (SHEET 4 OF 6)		0	
12, LAKE WEST ROAD, SALTCHIMPUR, KOLKATA - 700 073.			
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 $\frac{A}{V_G}$ 

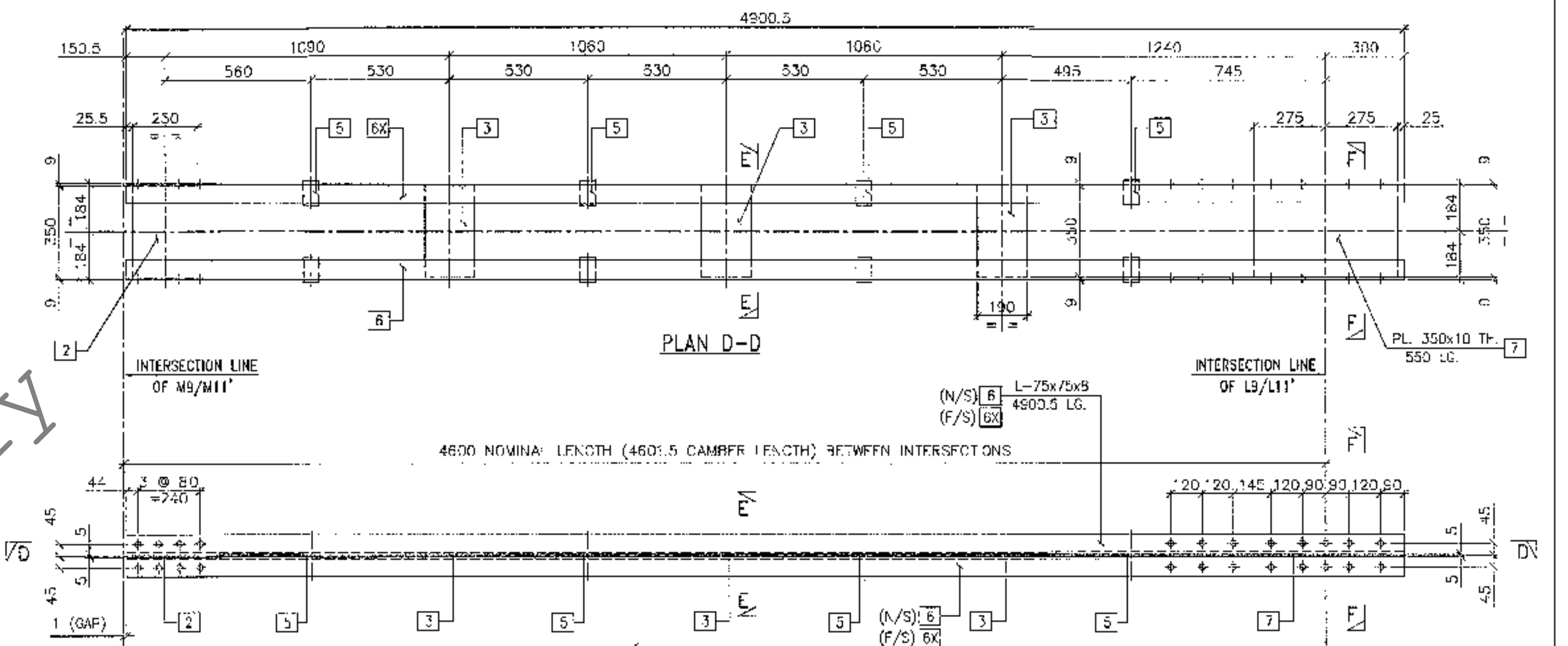
SECTION M-N

 \overline{K} 

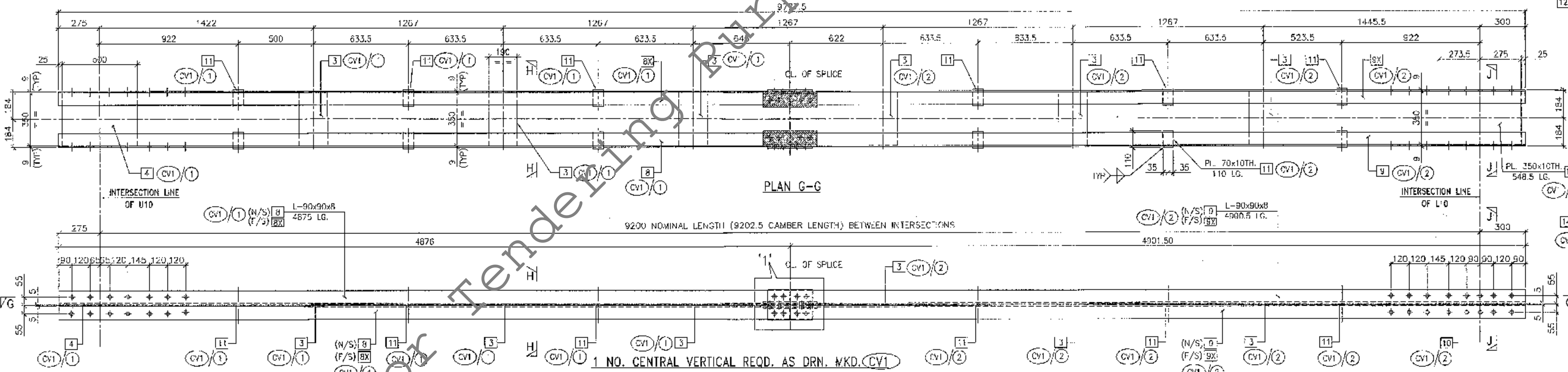
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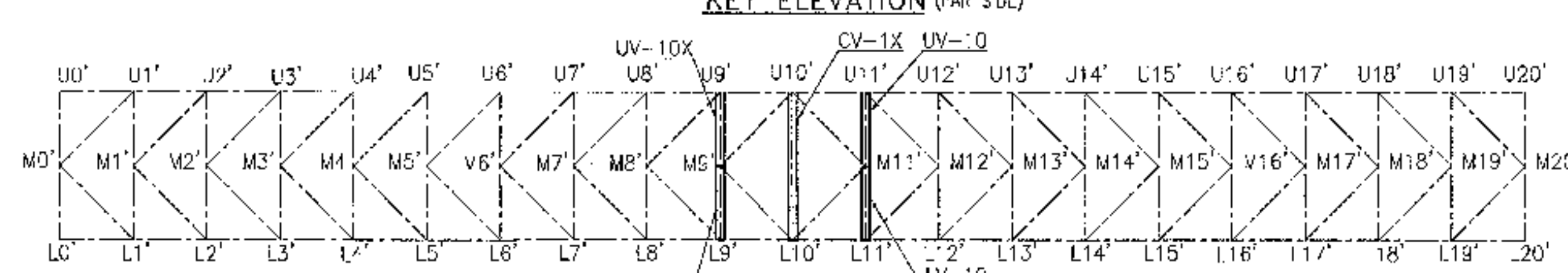
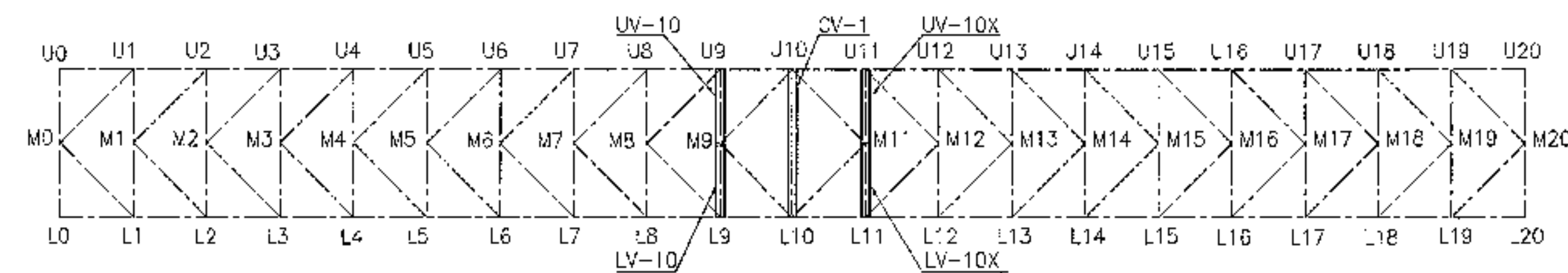
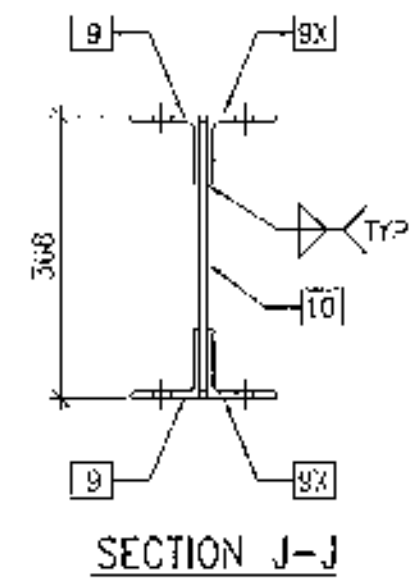
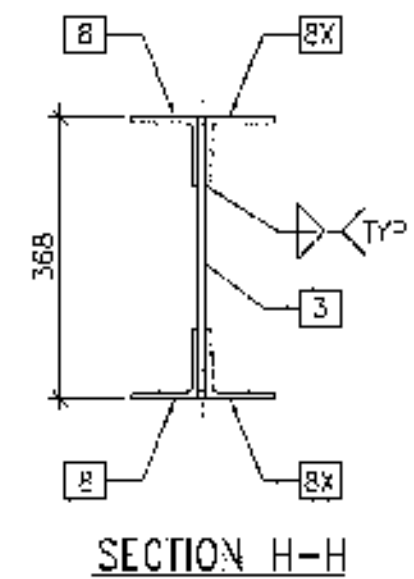
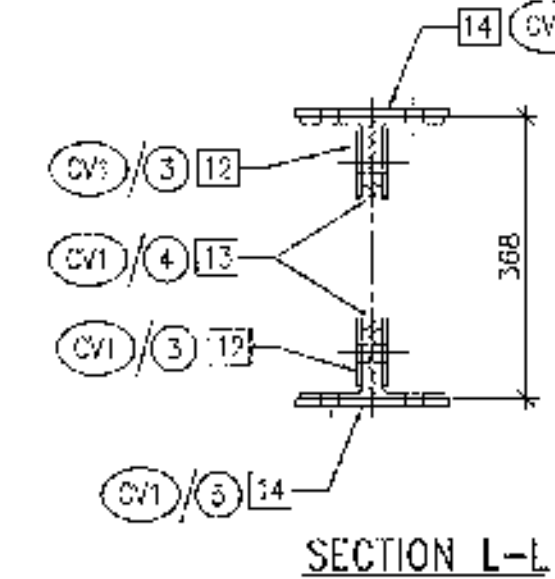
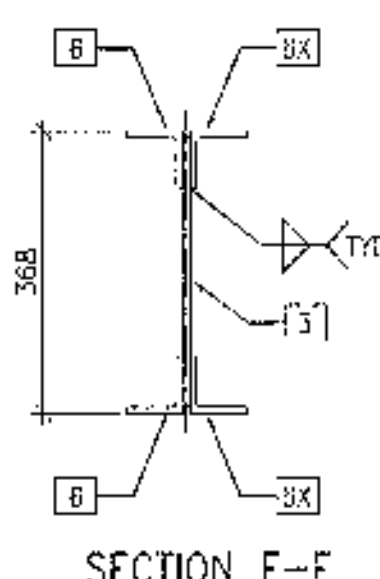
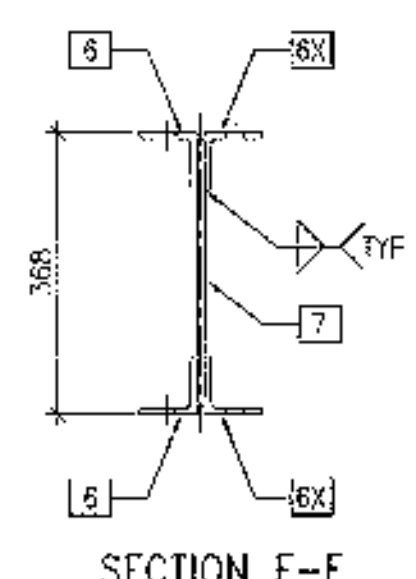
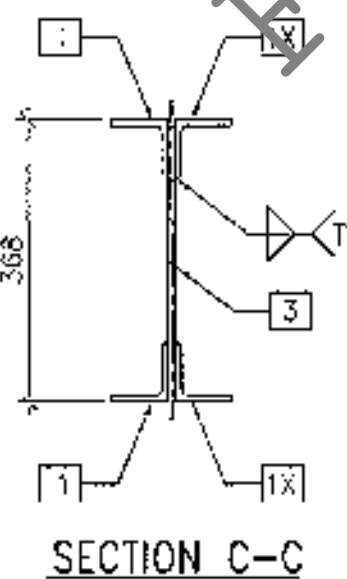
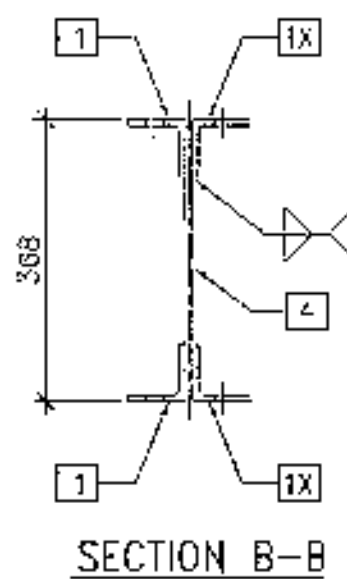
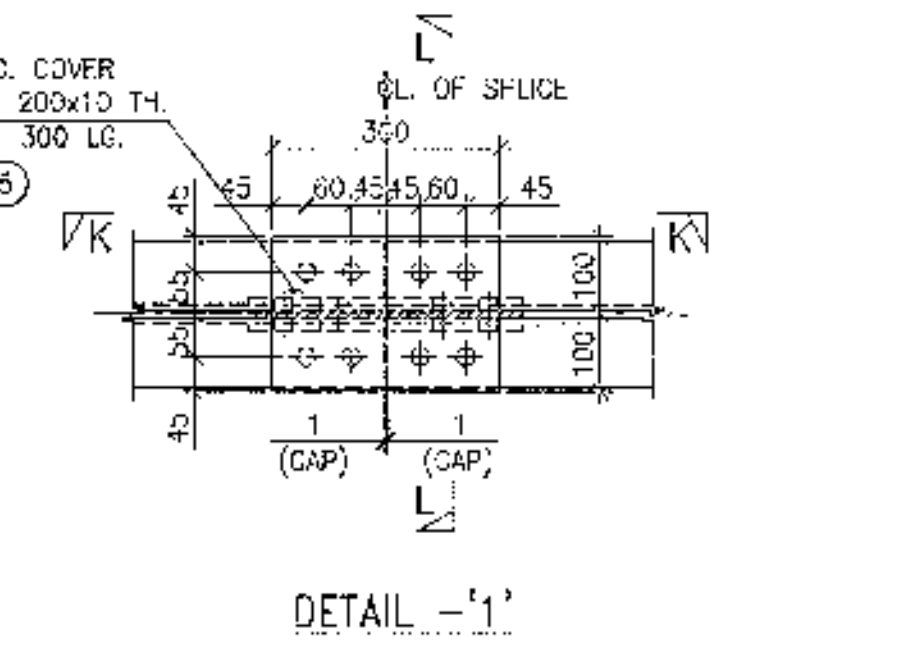
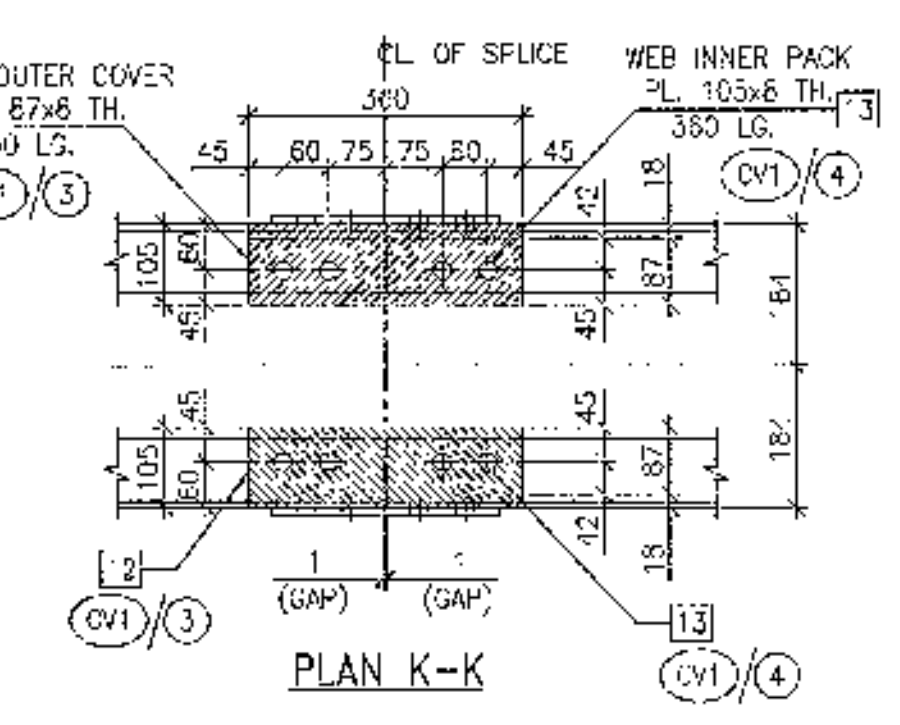
2 NOS. UPPER VERTICAL REQD. AS DRN. MKD. **UV10**
 2 NOS. UPPER VERTICAL REQD. OPP. HAND MKD. **UV10X**



2 NOS. UPPER VERTICAL REQD. AS DRN. MKD. **LV10**
 2 NOS. UPPER VERTICAL REQD. OPP. HAND MKD. **LV10X**

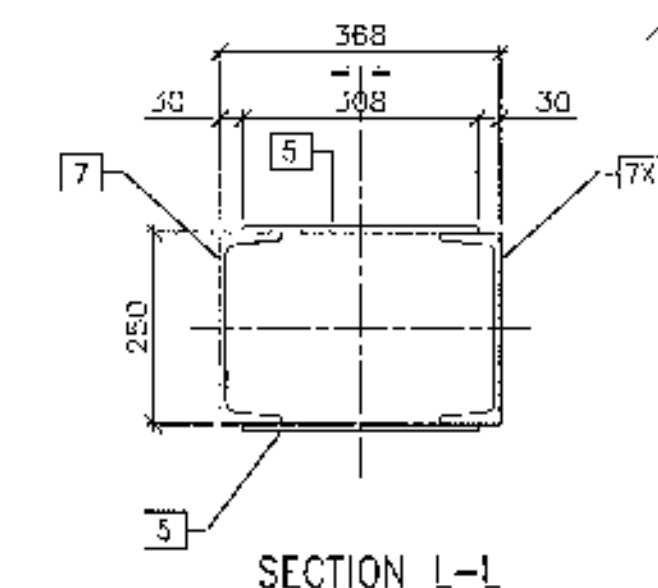
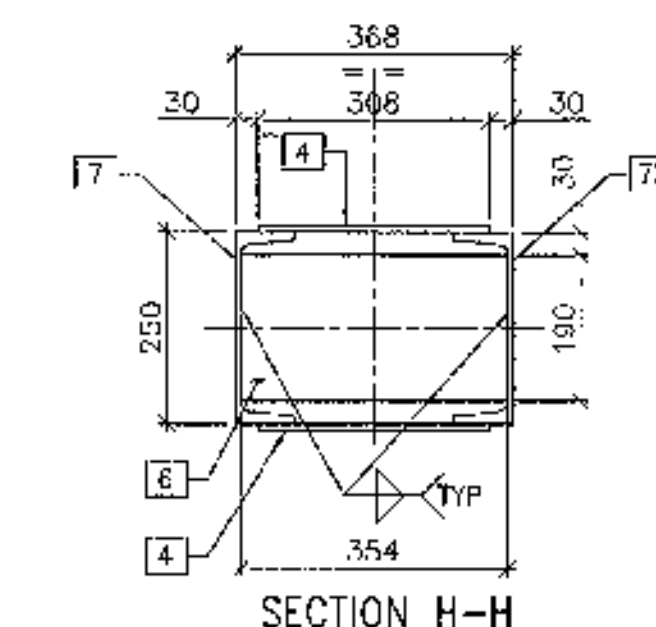
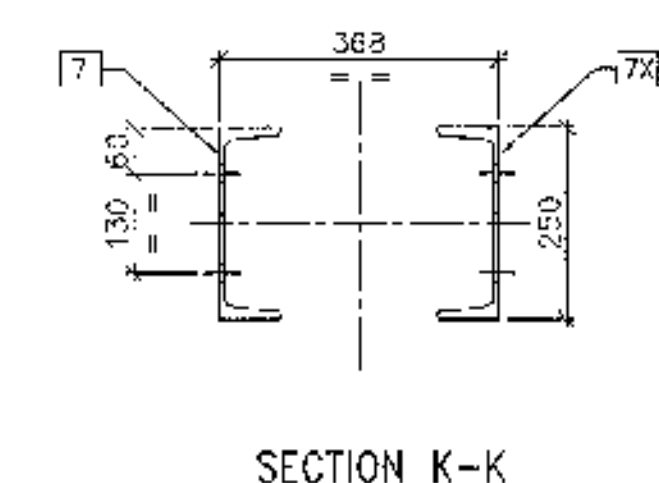
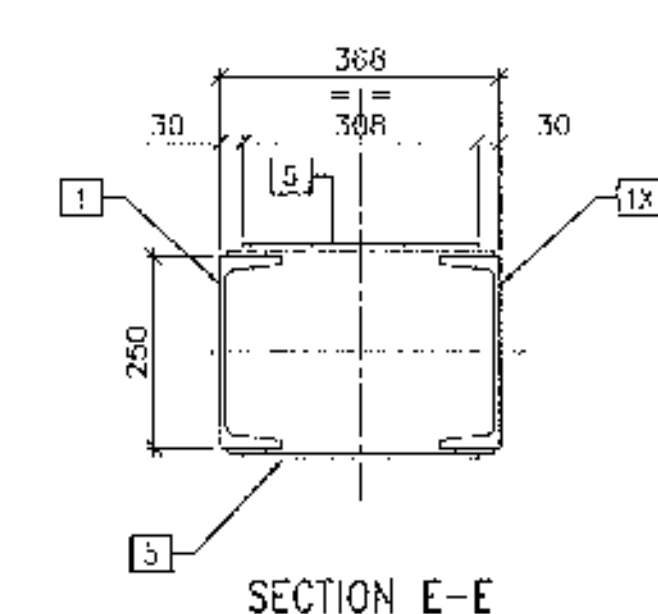
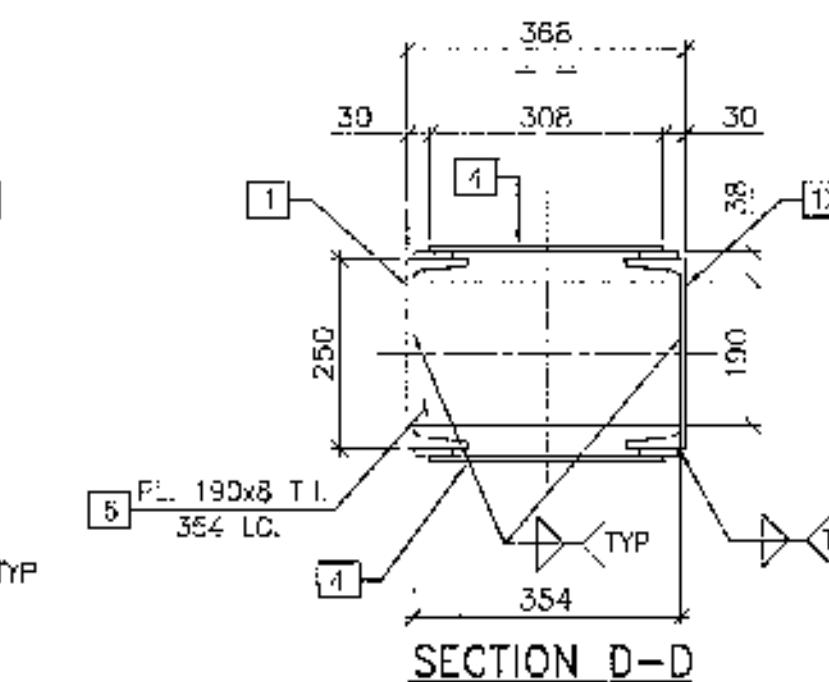
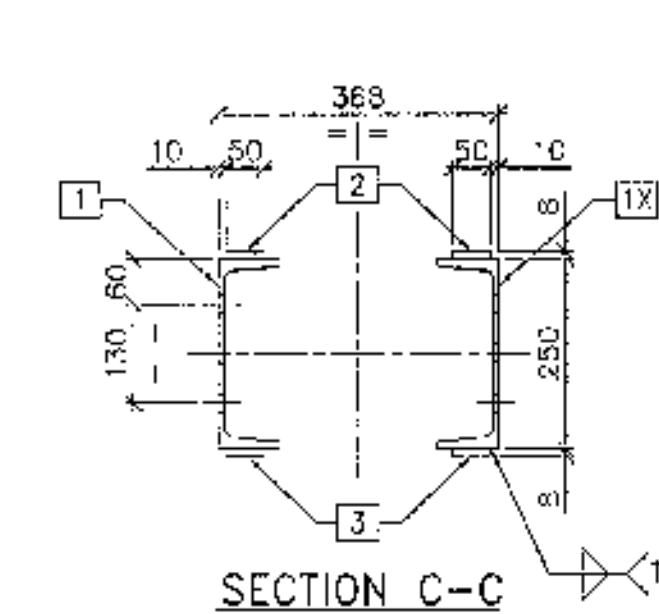
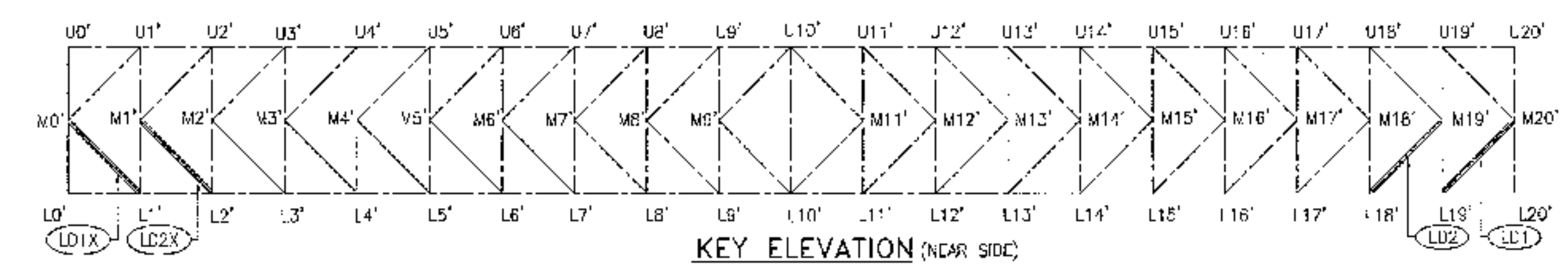
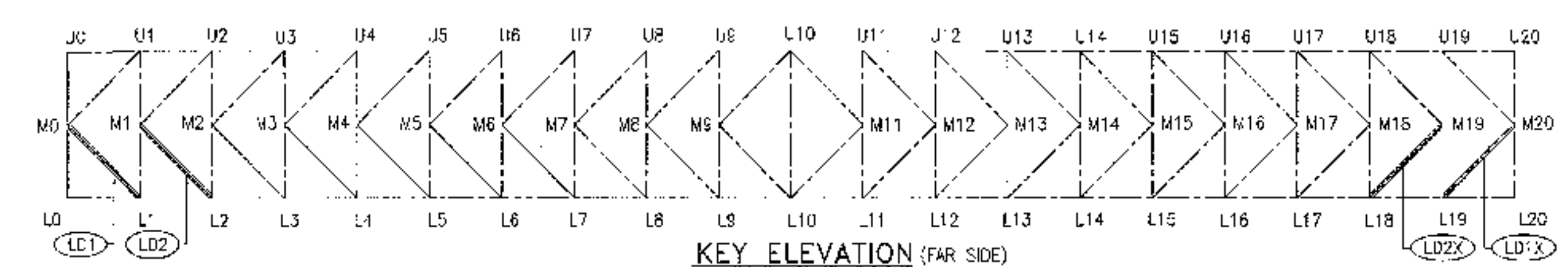
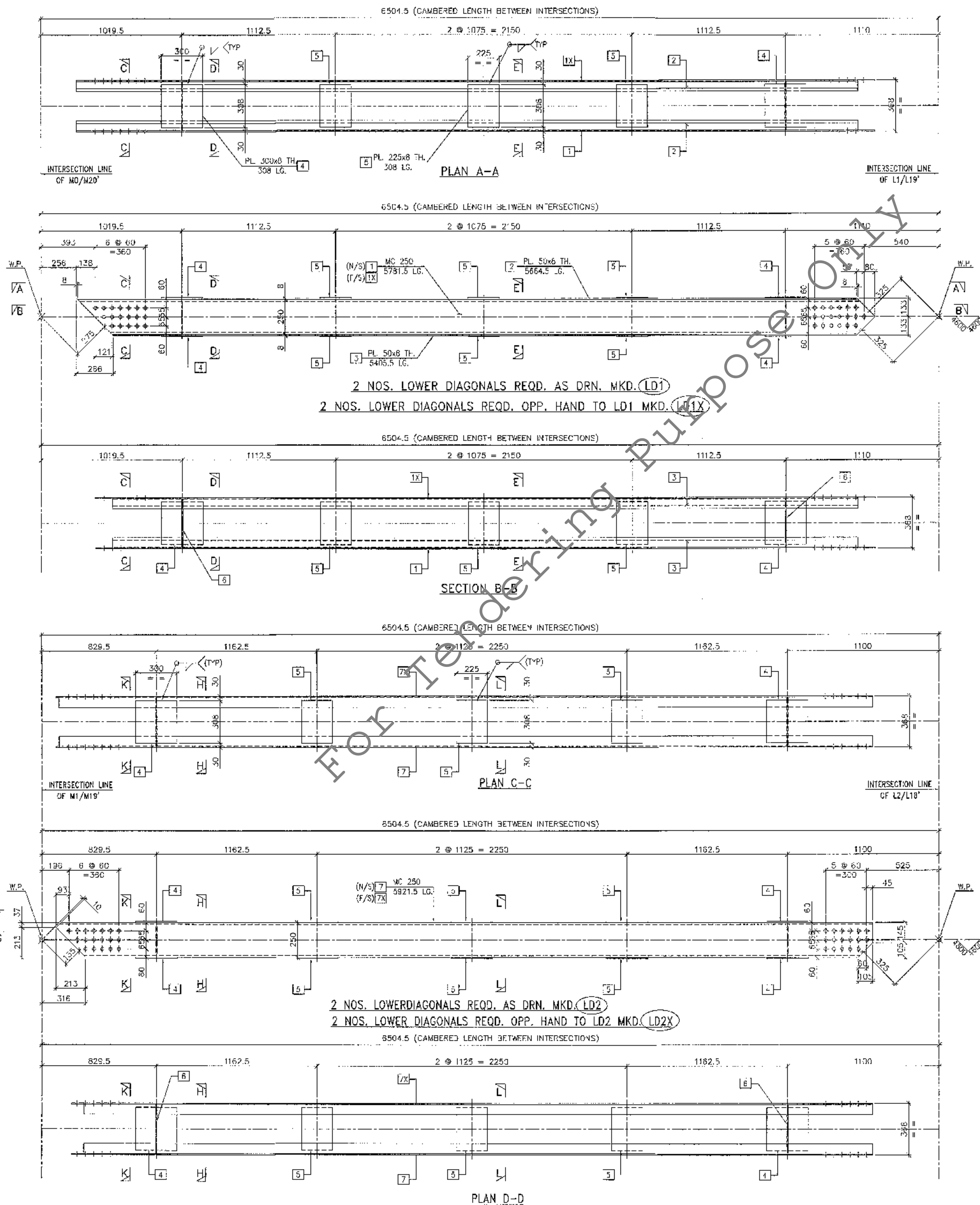


1 NO. CENTRAL VERTICAL REQD. AS DRN. MKD. **CV1**
 1 NO. CENTRAL VERTICAL REQD. OPP. HAND MKD. **CV1X**



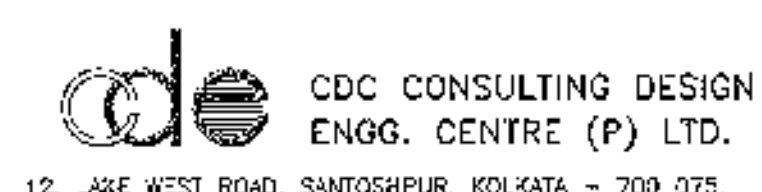
- NOTES:**
- ALL DIMENSIONS ARE IN mm.
 - ALL FLEET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707 x LEG SIZE UNLESS OTHERWISE NOTED.
 - ALL HOLES ARE 23.5 mm FOR M 20 BOLTS UNLESS OTHERWISE NOTED.
 - ALL ITEM MARKS SHOWN THUS: [Symbol]
 - ALL ERECTION MARKS SHOWN THUS: [Symbol]
 - GRADE OF STRUCTURAL STEEL = IS 2062.
 - ELECTRODE SHALL CONFORM TO IS 2062.
 - BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1361-1992 AND 1367-1979-94.
 - ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
 - ALL STEEL WORK SHALL BE SH-CP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.T 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
 - FOR STRUCTURAL G.A. REFER DRG. NO. 2009-10/J-416/92m/ST-101.
 - ALL HOLES FOR BOLTS ARE SHOWN THUS: [Symbol]
 - ALL THREADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.

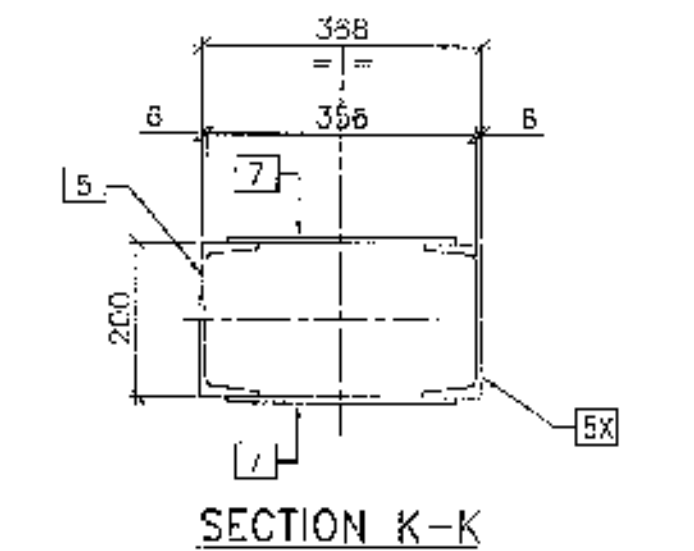
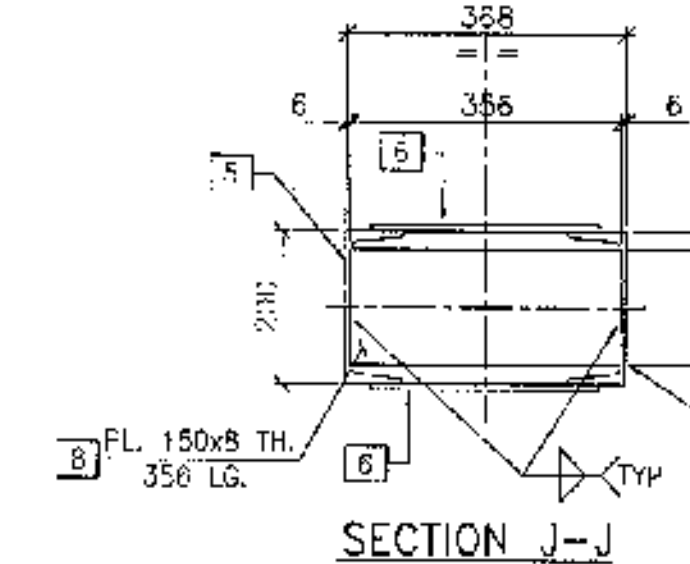
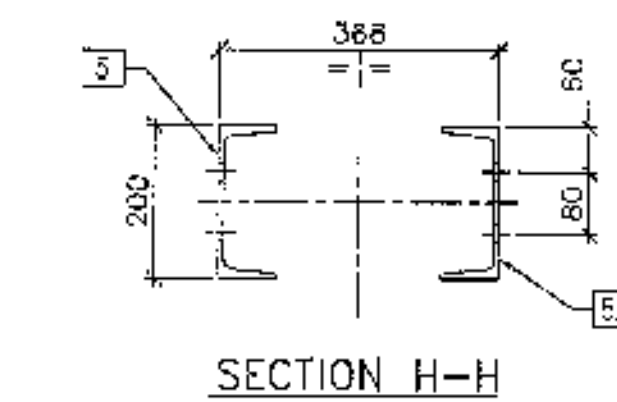
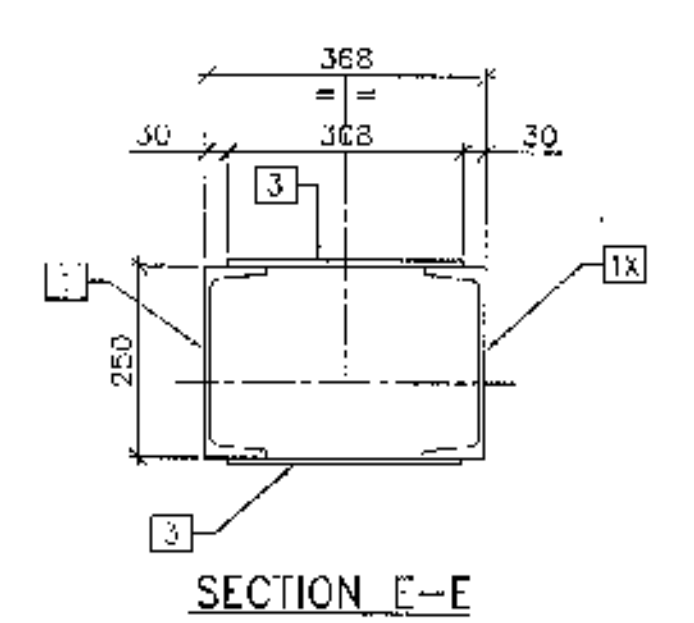
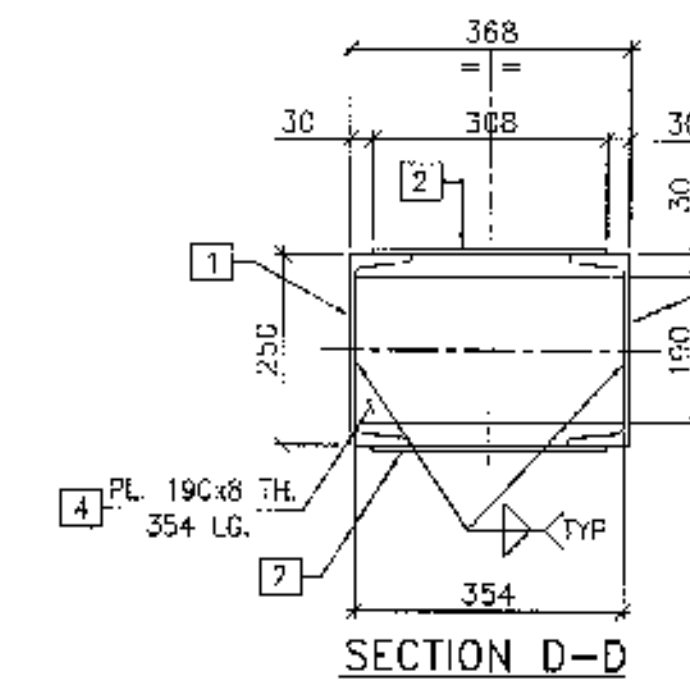
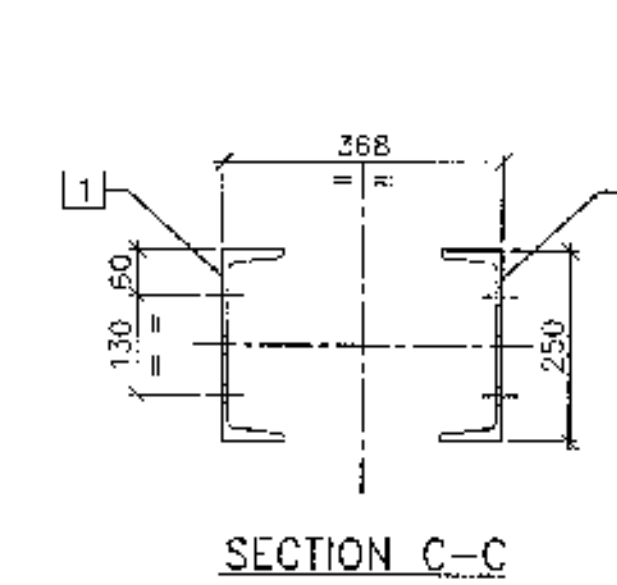
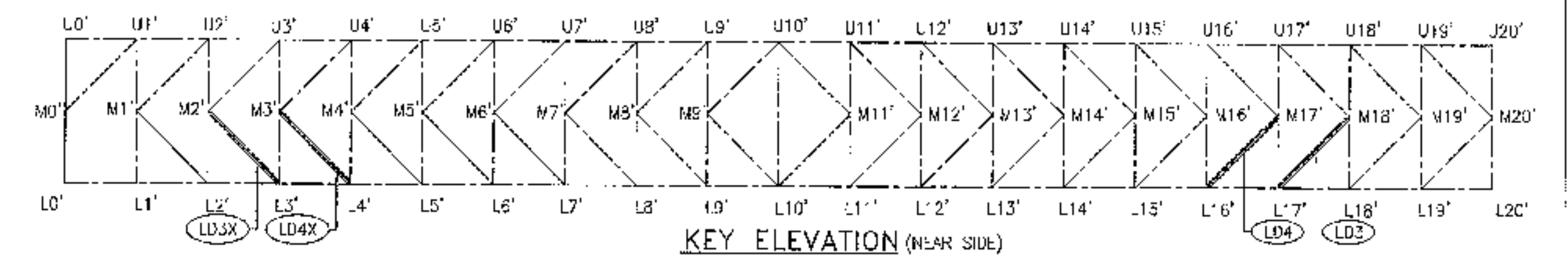
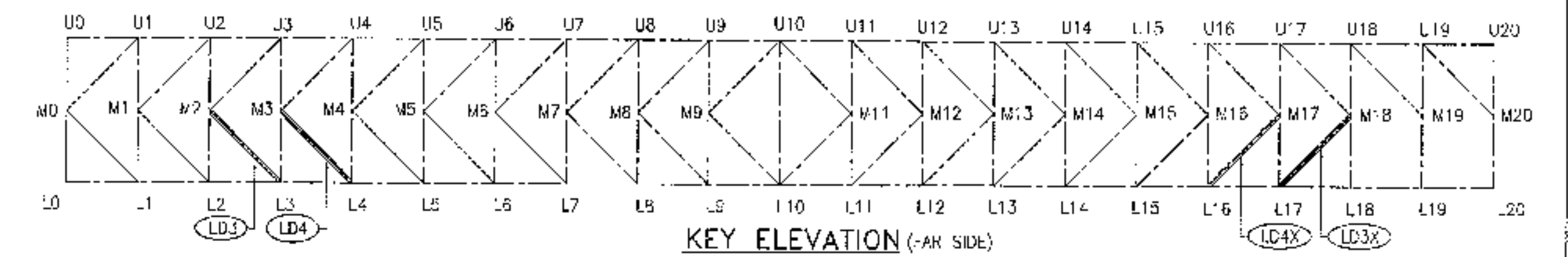
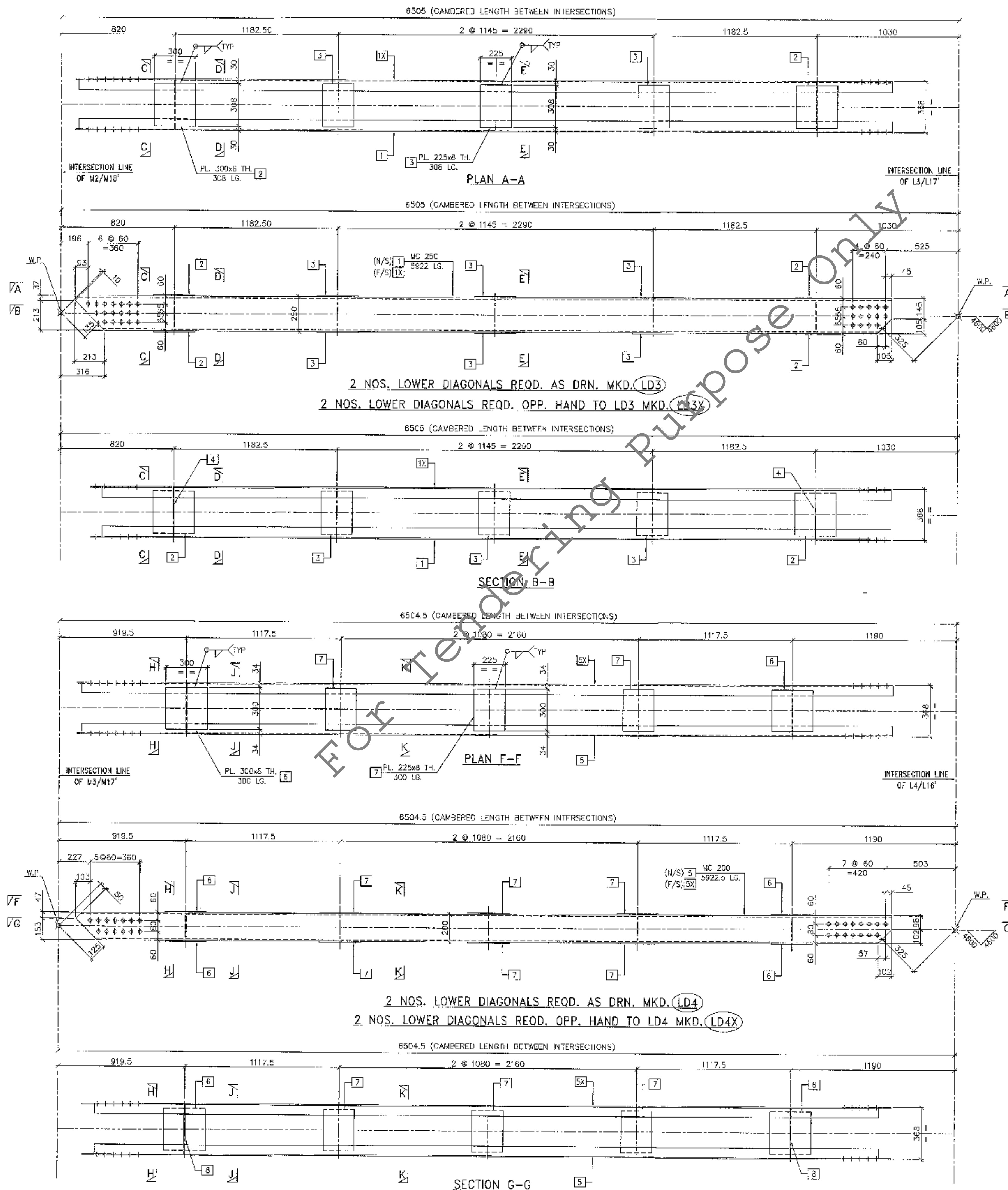
CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF VERTICAL U0-M9, U9-M9, U11-M11, U11'-M11' L3-M9, L9-M9, L11-M11, L11'-M11' U10-L10, U10'-L10'	
SCALE	DATE	DRAWN	CHECKED
1:100, 1:10, 1:10.5	19.09.09	A.J.	D.N.
DRAWING NUMBER		REV.	
2009-10/J-416/92m/ST-107 (SHEET 6 OF 6)		0	
CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SALTCHUPUR, KOLKATA - 700 075.			
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- NOTES:
1. ALL DIMENSIONS ARE IN MM.
 2. ALL FILLER METALS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = C/707 LEG SIZE UNLESS OTHERWISE NOTED.
 3. ALL POLES ARE 23.5A FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
 4. ALL ITEM MARKS SHOWN THUS: ---X---
 5. ALL ERECTION MARKS SHOWN THUS: ---O---
 6. GRADE OF STRUCTURAL STEEL = IS:2062.
 7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
 8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 8.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1353-1992, 1364-1992 AND 1357-1979-94.
 9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
 10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DISPATCH WITH TWO COATS OF PRIMER (D.F.T 0.05 mm PFR COAT) AS PFR TECHNICAL SPEC.
 11. FOR STRUCTURAL G.A. REFER D.G. NO. 2009-10/J-416/92m/ST-101.
 12. ALL HOLES FOR BOLTS ARE SHOWN THUS: ---X---

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF DIAGONALS M0-L1, M0'-L1', M20-L19, M20'-L19' M1-L2, M1'-L2, M19-L18, M19'-L18'	
SCALE	DATE	DRAWN	CHECKED
1:300, 1:15 1:10	28.09.09	A.C.	D.N.
DRAWING NUMBER		APPROVED	
2009-10/J-416/92m/ST-108 (SHEET 8 OF 13)		P.G.	
REV.		DATE	
DESCRIPTION		BY	
C.H.K.		A.P.D.	
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NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707 x LEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 25.5 mm FOR M 22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THUS
5. ALL ERECTION MARKS SHOWN THUS
6. GRADE OF STRUCTURAL STEEL = IS2082.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (DFT 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL G.A. REFER DRS. NO. 2009-10/J-416/92m/ST-101.
12. ALL HOLES FOR BOLTS ARE SHOWN THUS

CLIENT : EXECUTIVE ENGINEER,
SPECIAL DEPARTMENT ENGINEERING DIVISION
DARJEELING GORKHA HILL COUNCIL, DARJEELING.

CONTRACTOR : CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.

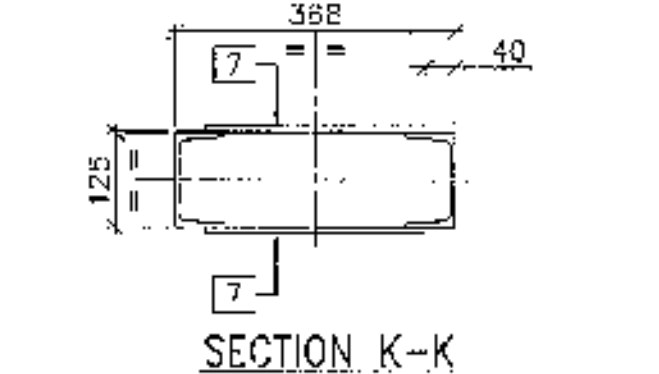
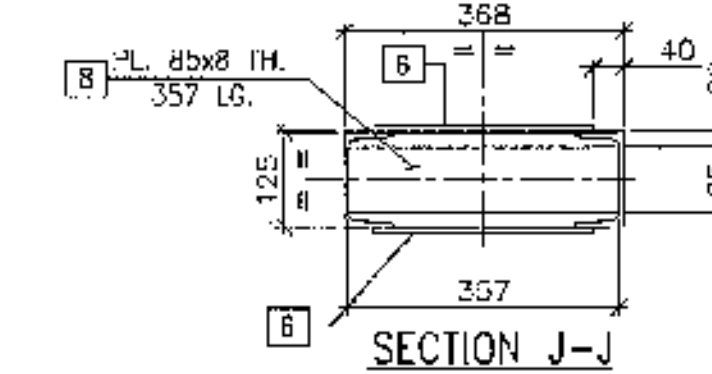
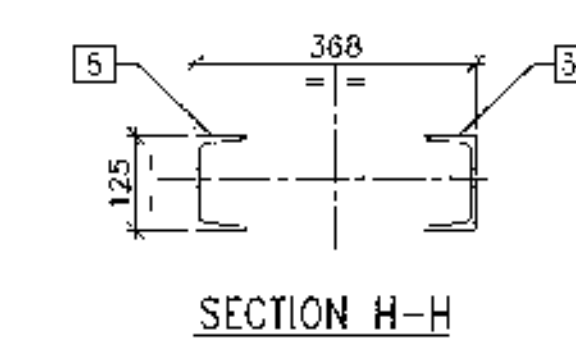
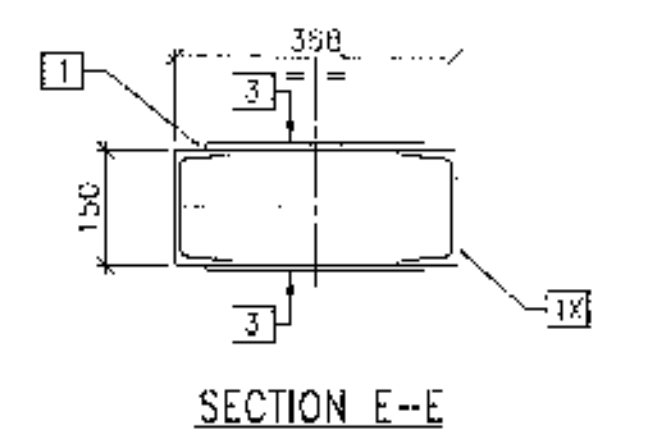
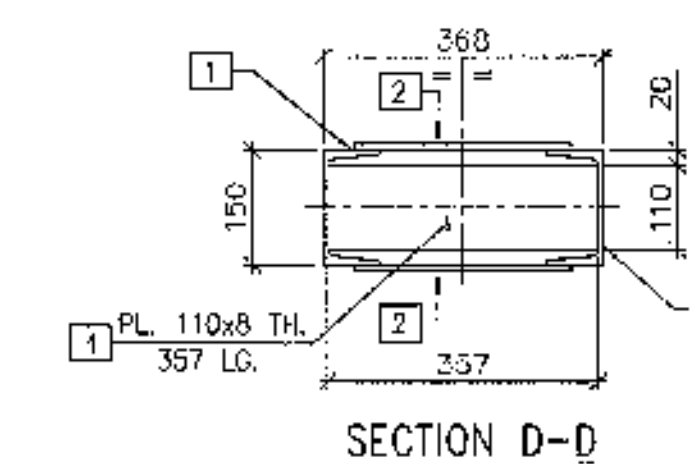
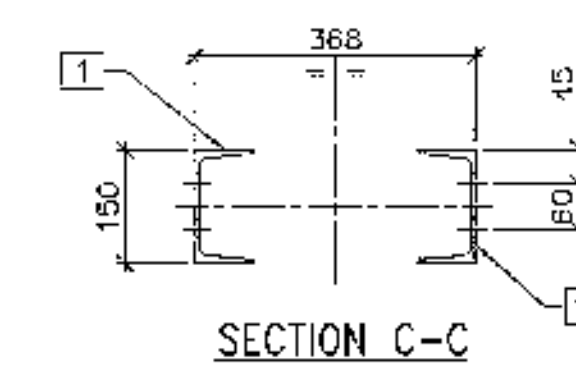
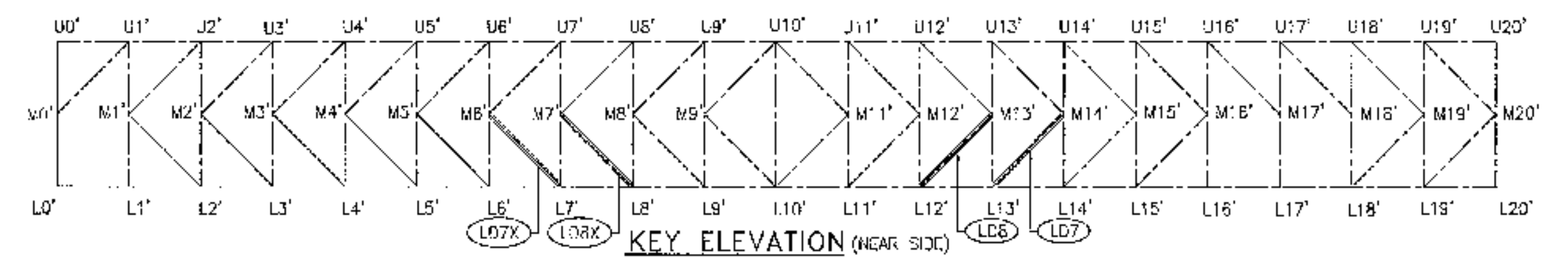
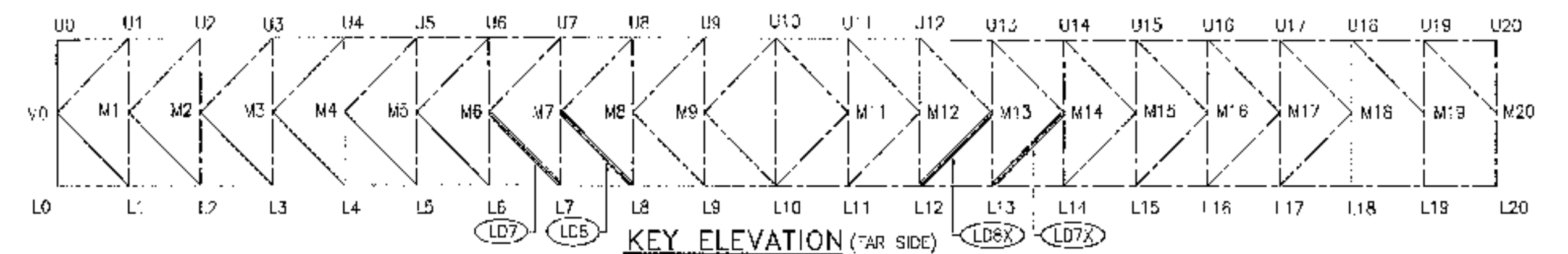
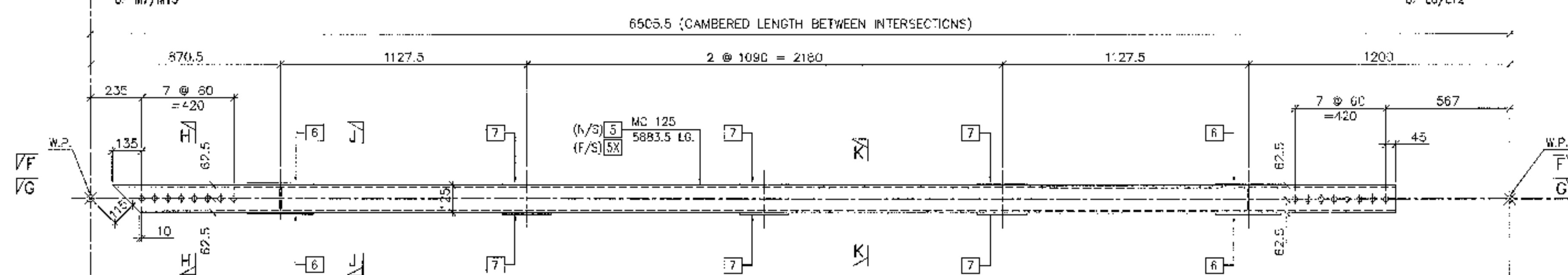
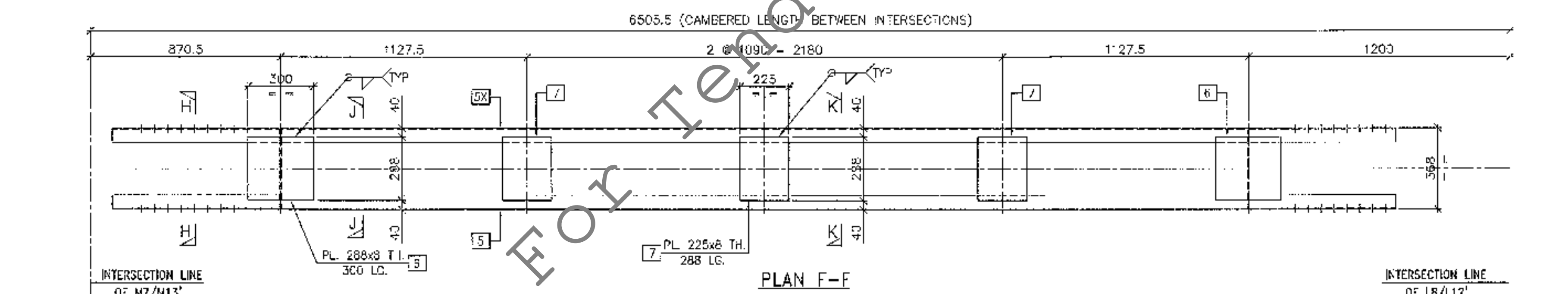
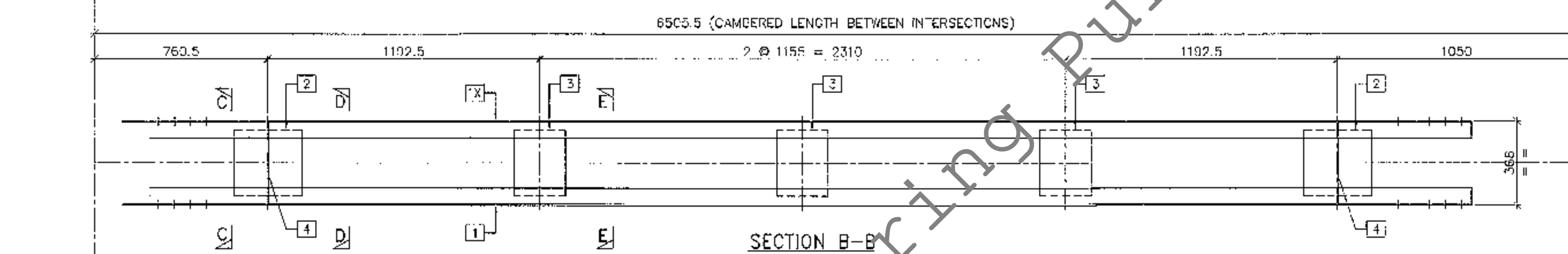
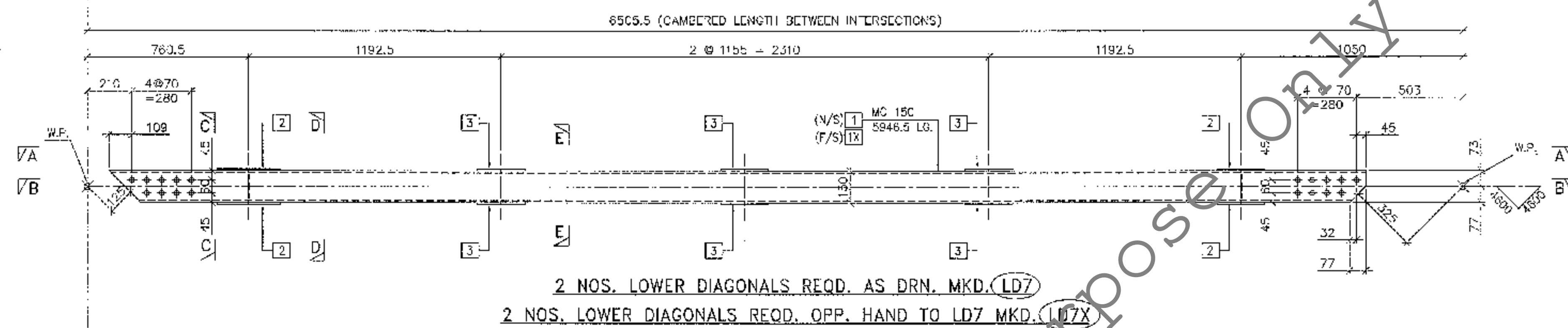
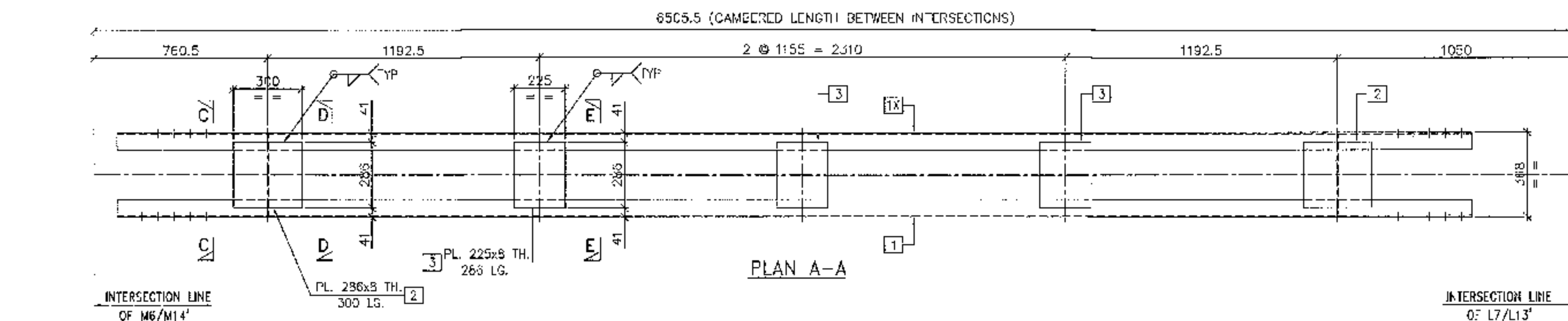
PROJECT : PROPOSED SINGLE LANE MAJORABLE
BRIDGE OVER DOBAI KHOLA AT
TANGTA BUSTY, KALIMPONG DIVISION

TITLE : DETAIL OF DIAGONALS
M2-L3, M2'-L3', M18-L17, M18'-L17'
M3-L4, M3'-L4', M7-L16, M7'-L16'

SCALE : 1:300, 1:150
DATE : 30.05.09
DRAWN : A.J.
CHECKED : B.N.
APPROVED : P.S.
DRAWING NUMBER : 2009-10/J-416/92m/ST-108
(SHEET 7 OF 10)

CDC CONSULTING DESIGN
ENGG. CENTRE (P) LTD.
12, LAKE WEST ROAD, SANTOSH-PUR, KOLKATA 700 075.

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NOTES:

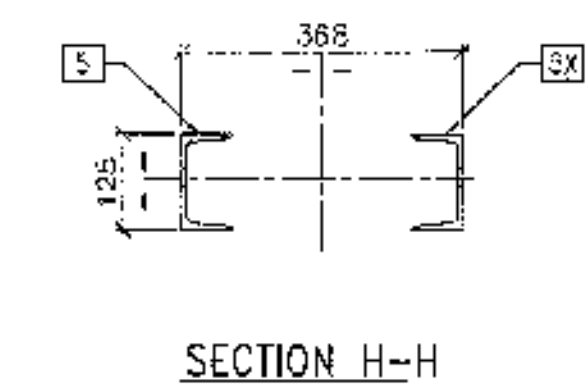
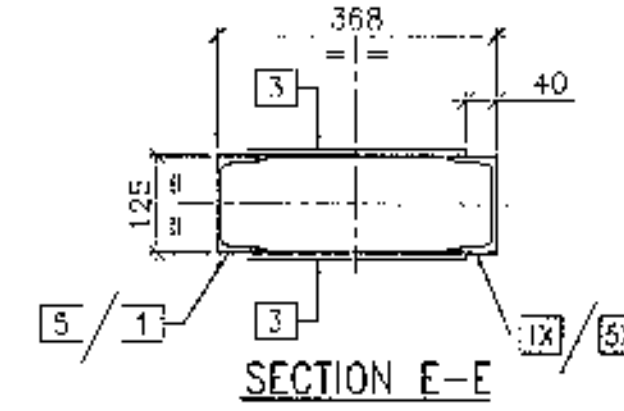
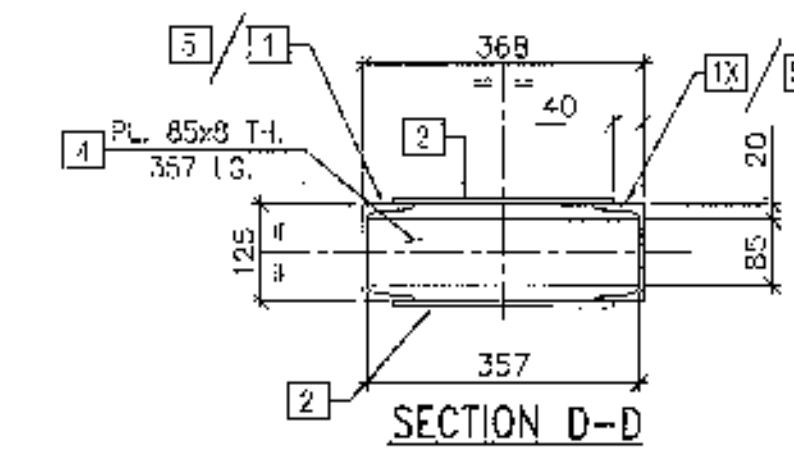
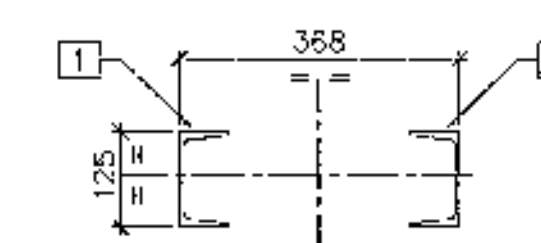
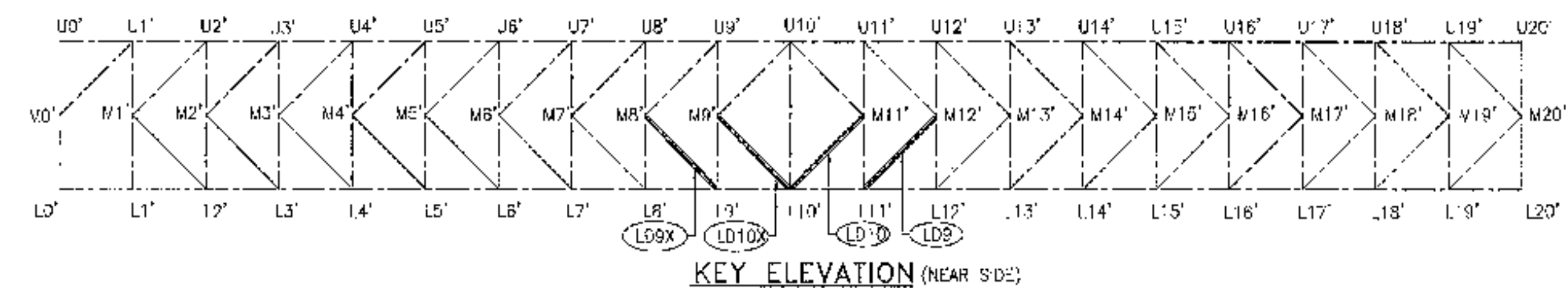
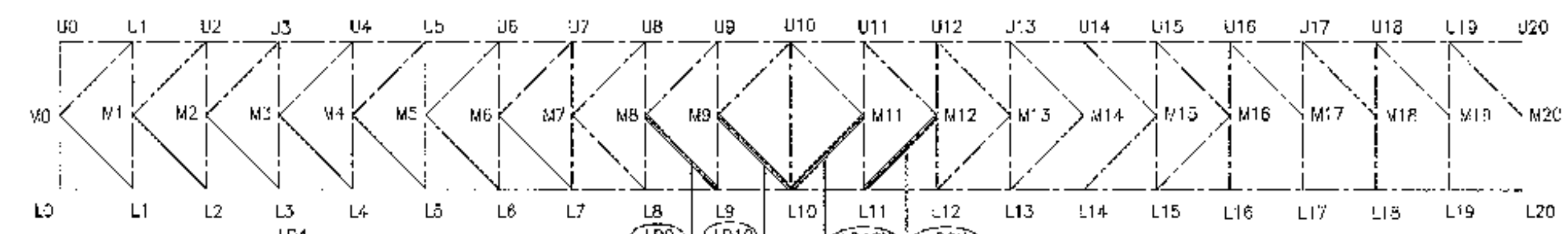
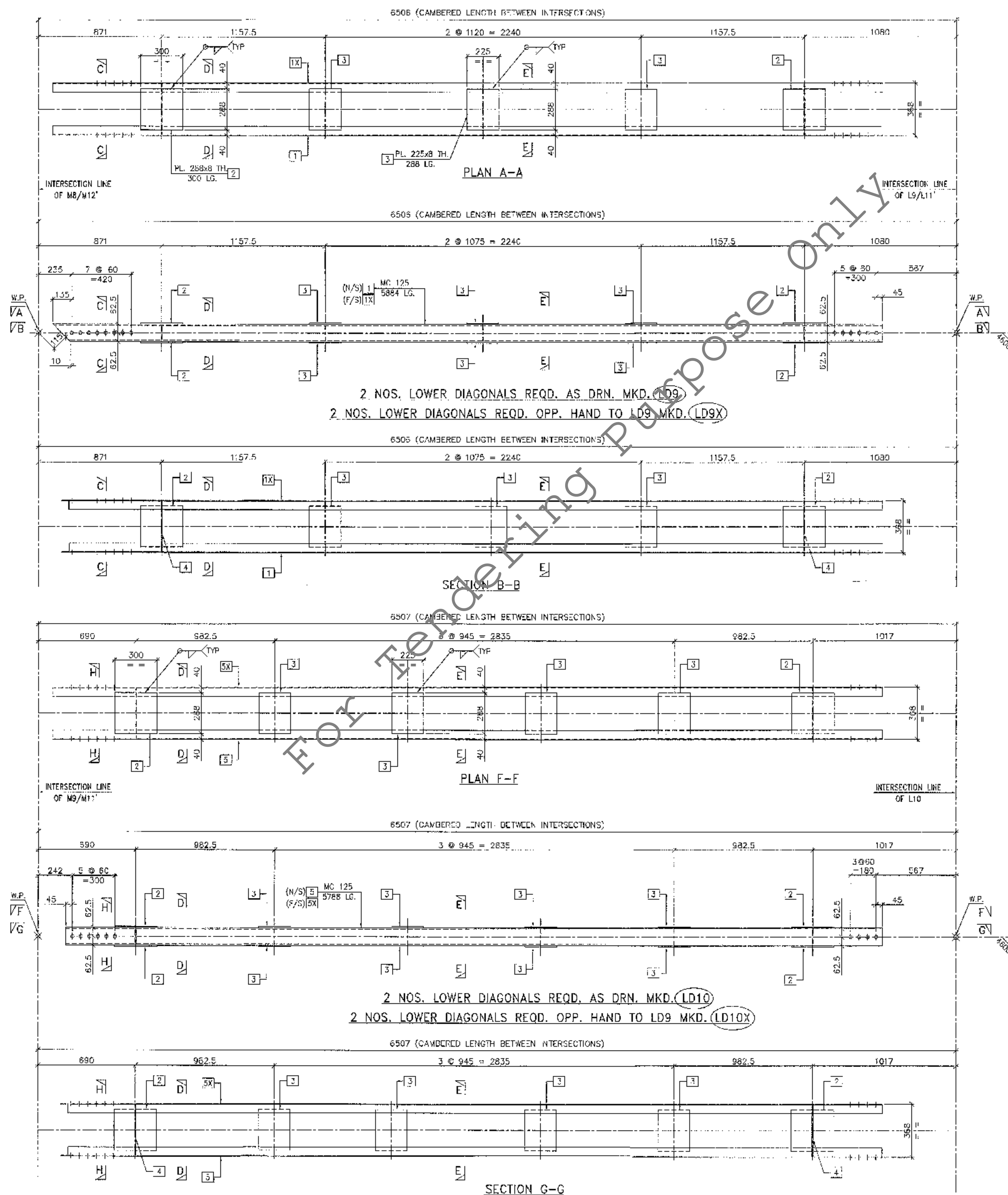
1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING MINOR THICKNESS = 0.075 LEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 23.5# FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THUS: ---○---
5. ALL CRACK MARKS SHOWN THUS: ---○/○---
6. GRADE OF STRUCTURAL STEEL = S2062.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL G.A. REFER CNG. NO. 2009-10/J-416/ST-101.
12. ALL HOLES FOR BOLTS ARE SHOWN THUS: ---○---

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAOTORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF LOWER DIAGONALS M6-L7, M6'-L7', M7-L8, M7'-L8' M14-L13, M14'-L13', M13-L12, M13'-L12'	


SCALE 1:300, 1:10	DATE 02.10.08	DRAWN A.J.	CHECKED B.N.	APPROVED P.R.
DRAWING NUMBER 2009-10/J-416/ST-108 (SHEET 9 OF 10)				
CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 17, 1 AND 2 WTS ROAD, SANTOSH, R. CO. KATA - 700 075.				

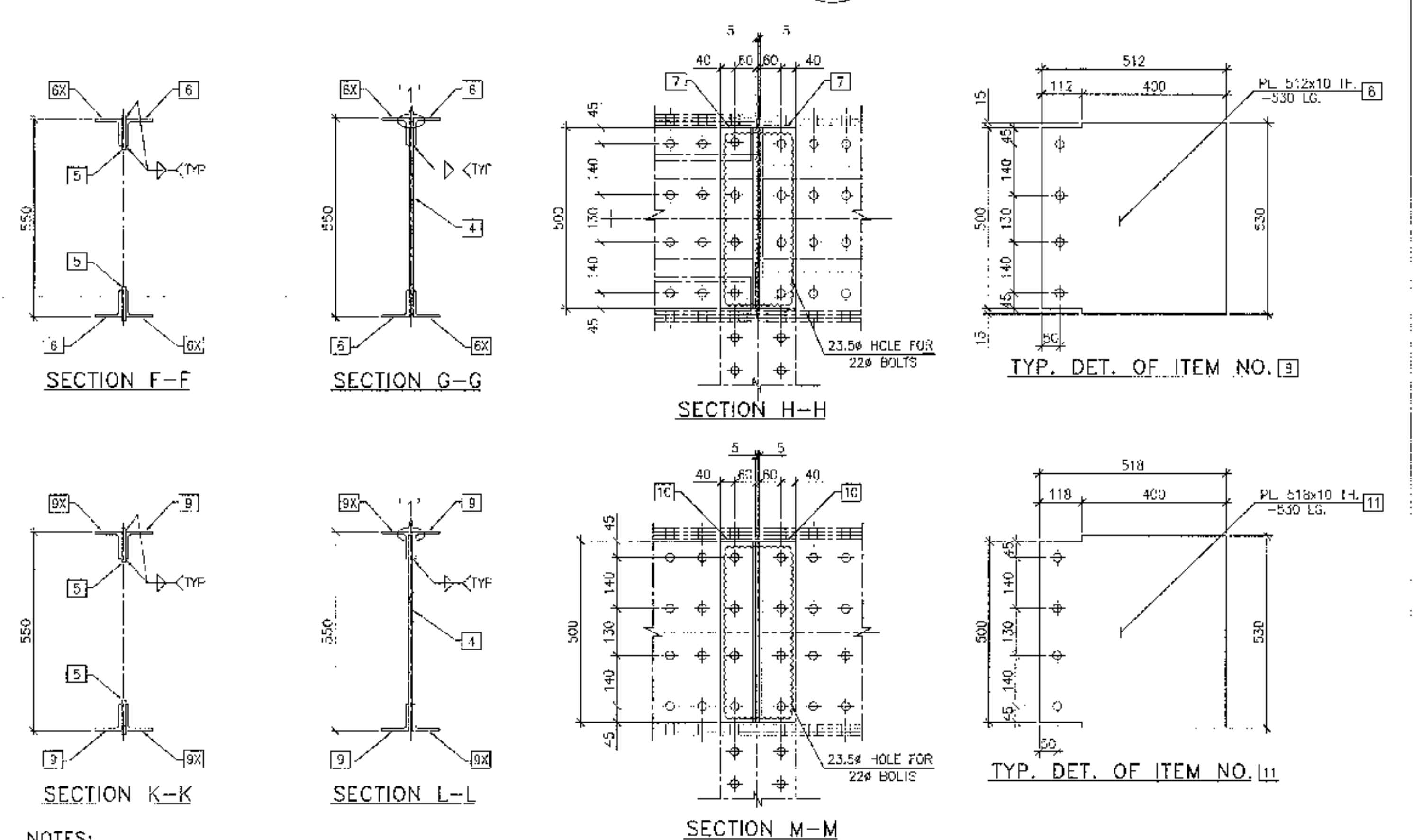
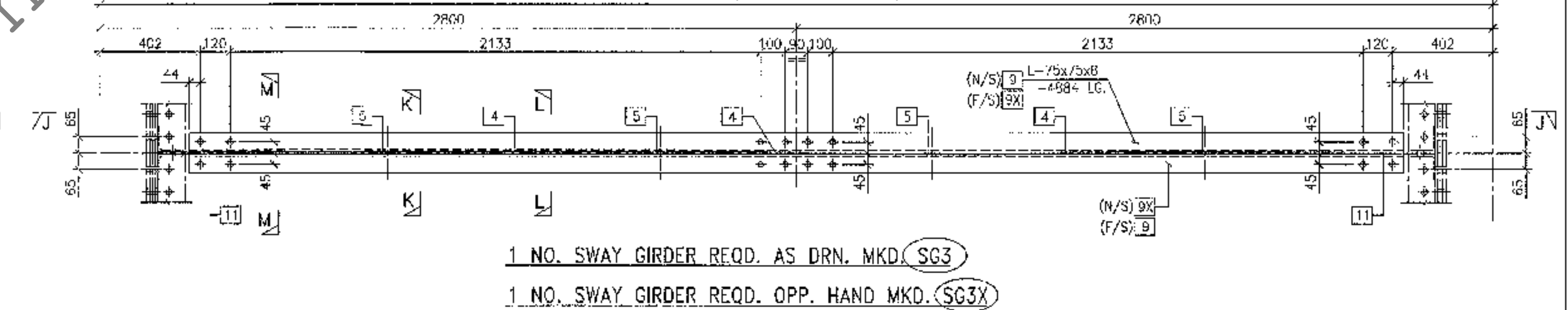
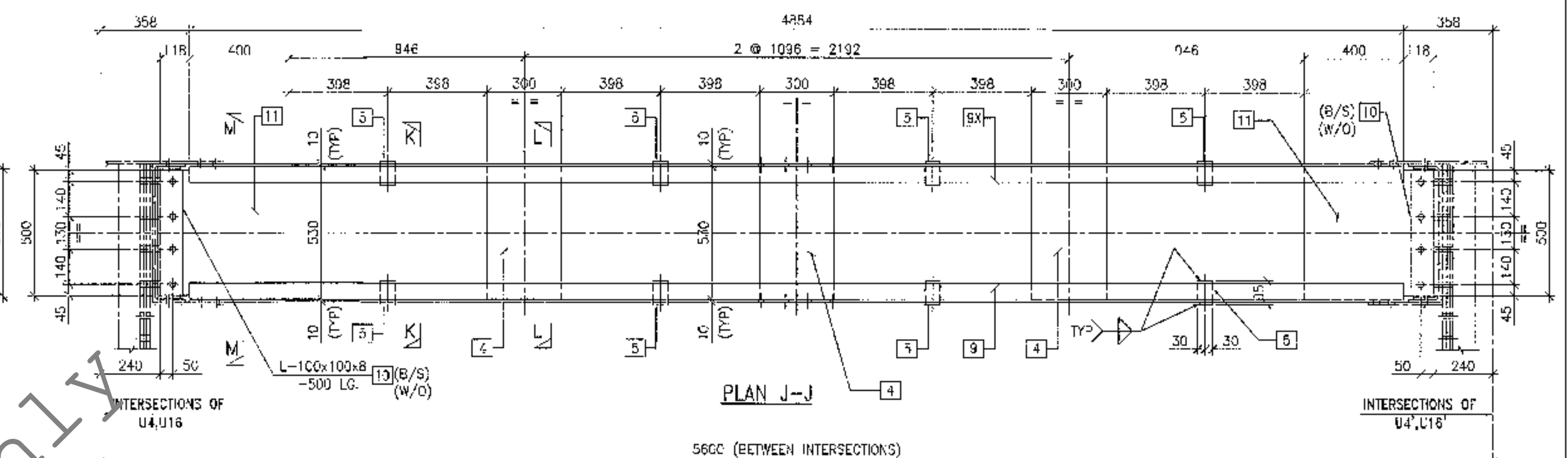
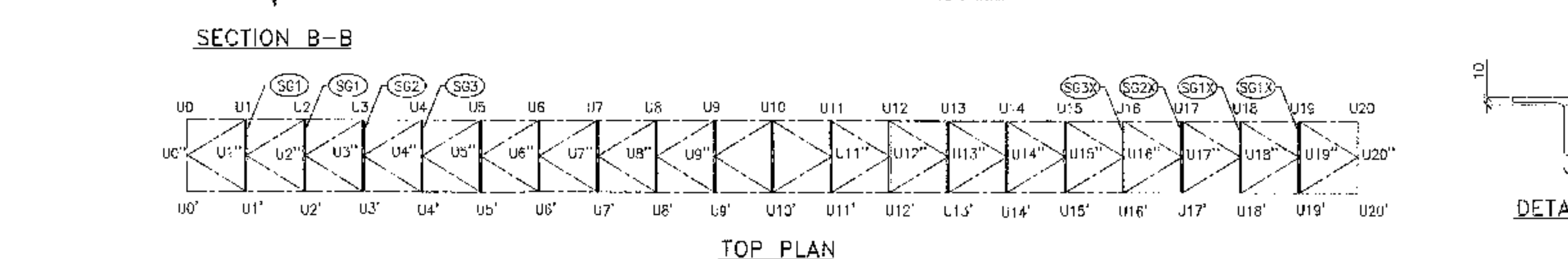
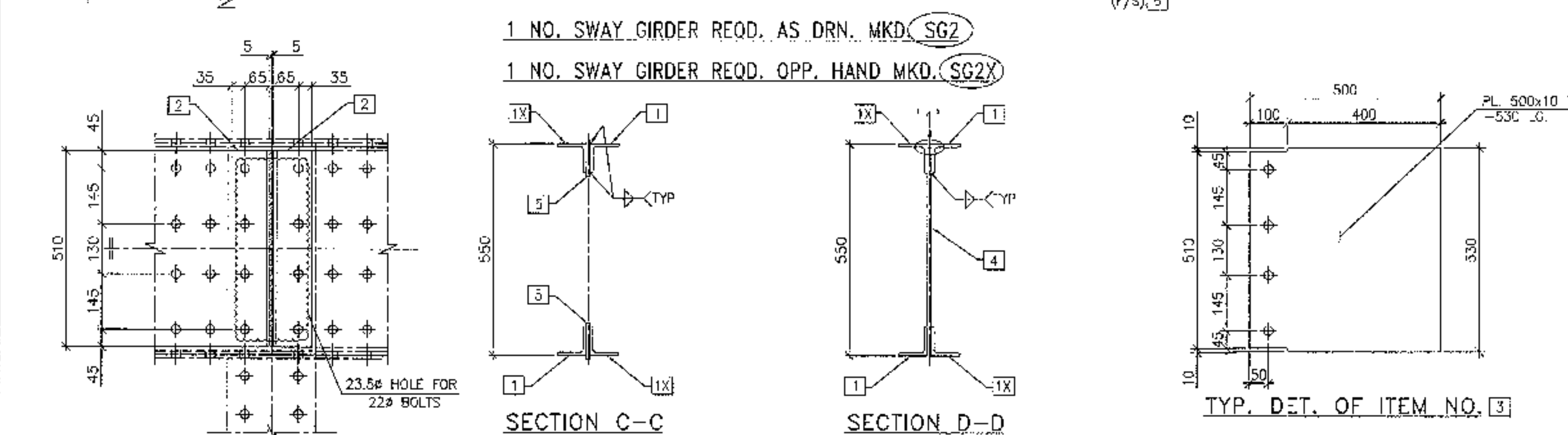
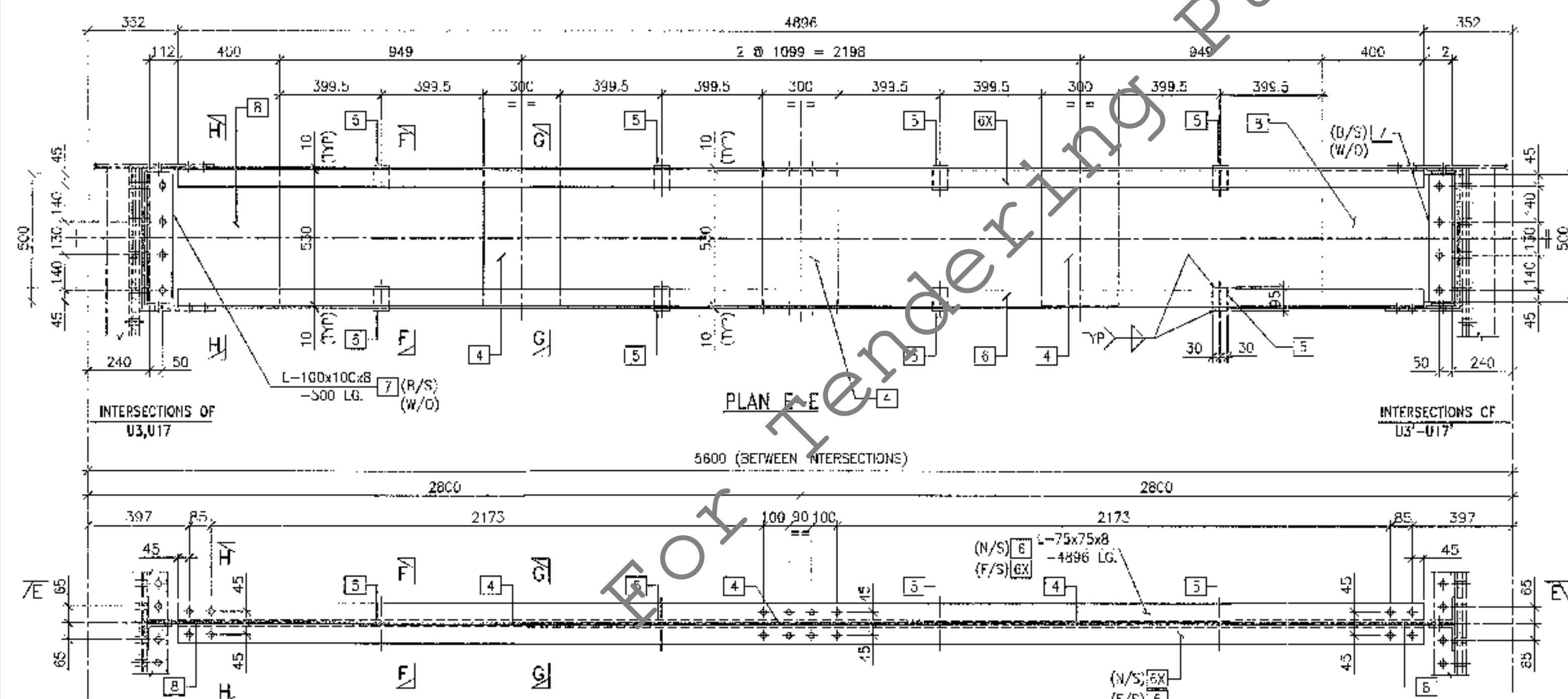
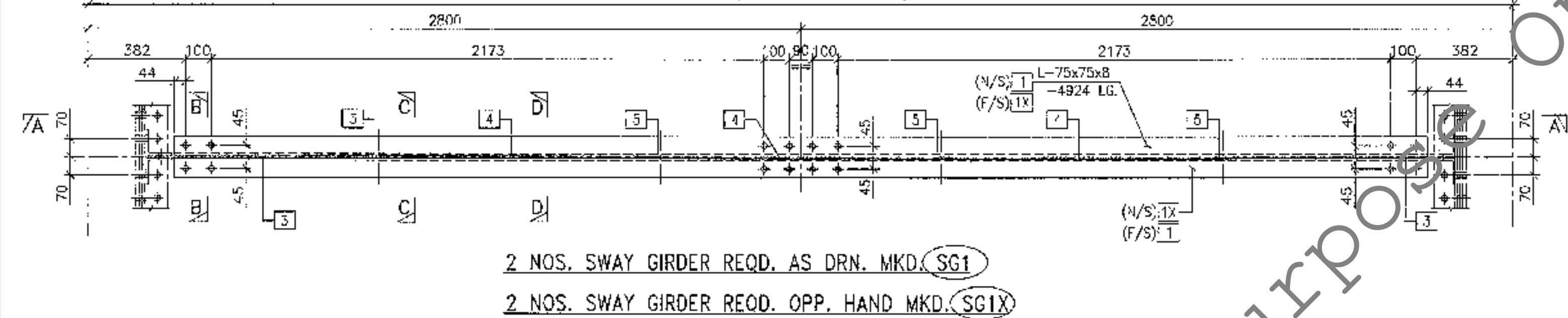
REV.	DATE	DESCRIPTION	BY	CHK.	APP.

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




- NOTES:
1. ALL DIMENSIONS ARE IN mm.
 2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707 x LEG SIZE UNLESS OTHERWISE NOTED.
 3. ALL HOLES ARE 23.5mm FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
 4. ALL ITEM MARKS SHOWN THUS \square
 5. ALL ERECTION MARKS SHOWN THUS \bigcirc
 6. GRADE OF STRUCTURAL STEEL IS IS2062.
 7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
 8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1979-94.
 9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
 10. ALL STEEL WORK SHALL BE SHOP PAINTED WITH ONE COAT OF PRIMER (D.F.T 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
 11. FOR STRUCTURAL G.A. REFER DRG. NO. 2009-10/J-416/ST-101.
 12. ALL HOLES FOR BOLTS ARE SHOWN THUS \oplus

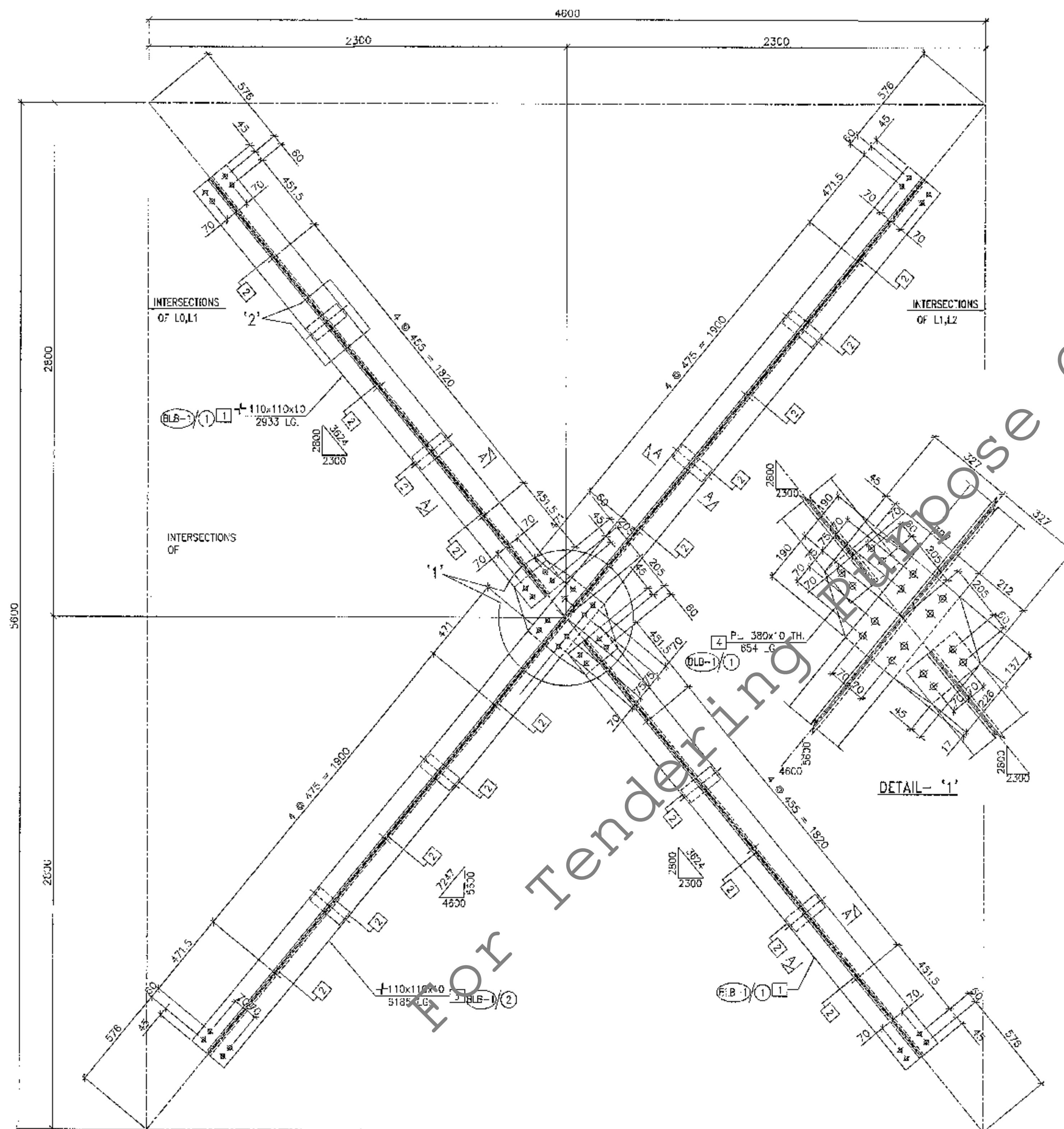
CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAINTAINABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF DIAGONALS M8-L9,M8'-L9',M12-L11,M12'-L11' M9-L10,M9'-L10',M11-L10,M11'-L10'	
SCALE 1:300,1:5 1:10	DATE 05.10.09	DRAWN A.J.	CHECKED B.A.
DRAWING NUMBER 2009-10/J-416/ST-108 (SHEET 10 OF 10)		REV. P.D.	
 CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SAN'OSHUPUR, KOLKATA - 700 075.			
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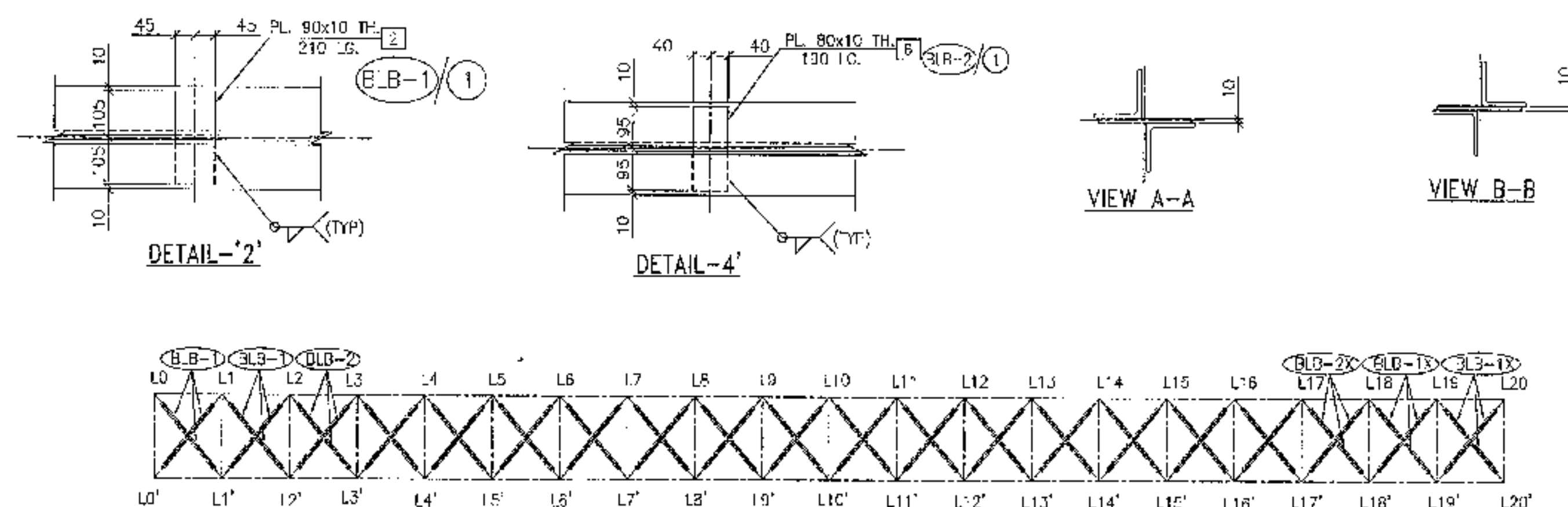
NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THIRION THICKNESS = C/2.5 (LEG SIZE) UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 21.9 - Ø2 M-20 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THUS .
5. ALL EJECTION MARKS SHOWN THUS .
6. GRADE 07 STRUCTURAL STEEL = IS2062.
7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS & NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1383-1992, 1584-1992 AND 1567-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T 0.35 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL S.A. E.L.Y. D.G. NO. 2009-07/J-416/92/ST-101.
12. ALL H.O.F.S FOR BOLTS ARE SHOWN THUS .
13. ALL THREADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.

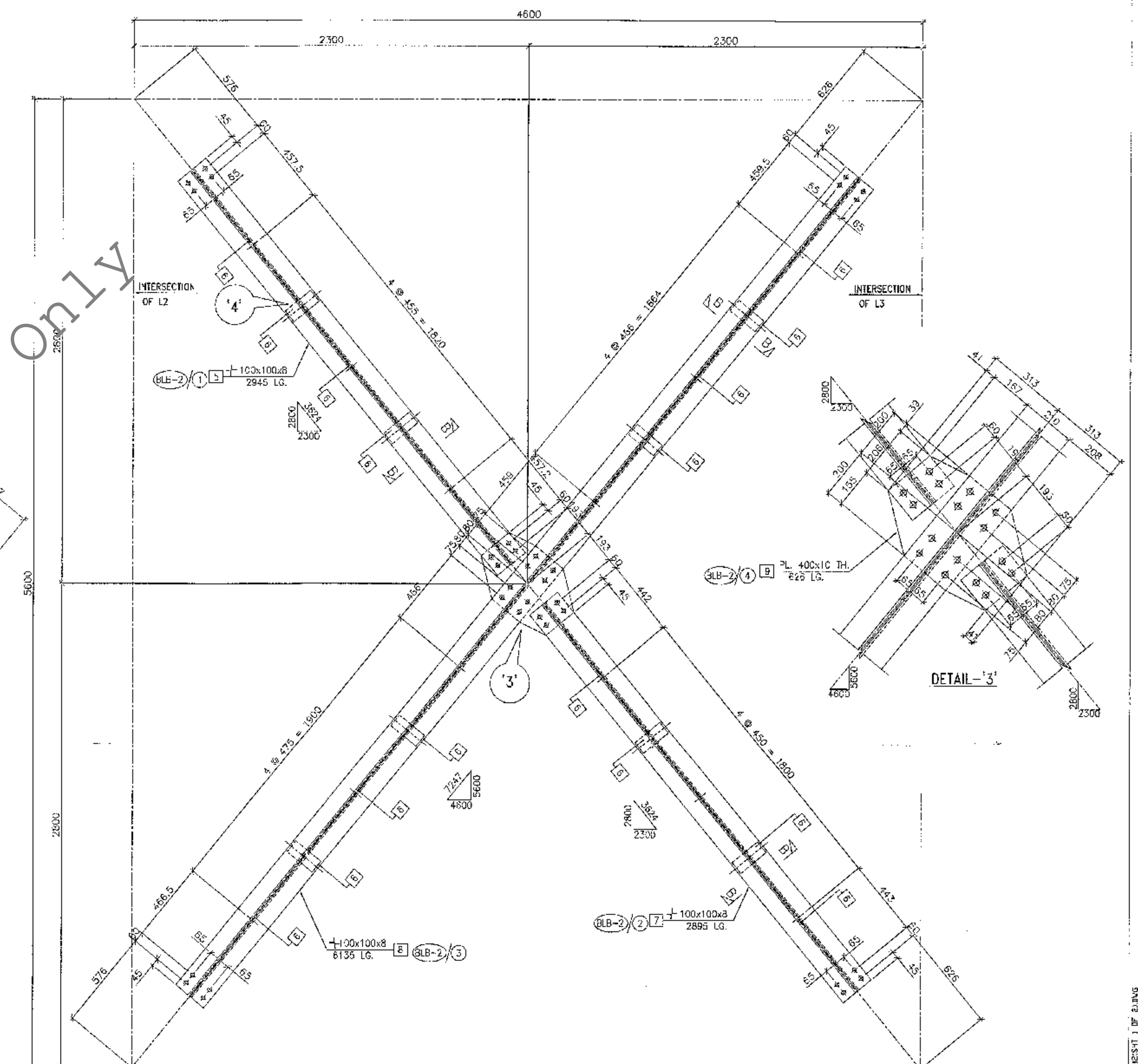
CLIENT :					EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.				
CONTRACTOR :					CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED. KOLKATA.				
PROJECT :					T.I.E. :				
PROPOSED SINGLE LANE MAOTORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION					DETAIL OF SWAY GIRDS U1-U1',U2-U2',U3-U3',U4-U4' U19-U19',U18-U18',U17-U17',U16-U16'				
SCALE 1:300,15 1:10,5	DATE 08.10.08	DRAWN M.S	CHECKED B.N	APPROVED P.G	 CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SALTCHSHPUR, KOLKATA - 700 075.				
DRAWING NUMBER 2009-10/J-416 (92mt./ST - 110 (SHEET - 1 OF 2))			REV. 0						
PD. THIS DOCUMENT IS THE PROPERTY OF CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. IT MUST NOT BE USED, COPIED OR REPRODUCED IN ANY FORM, WITHOUT THE WRITTEN CONSENT									



2 SETS. BOTTOM LATERAL BRACING REQD. AS DRN. MKD. (BLB-1)
2 SETS. BOTTOM LATERAL BRACING REQD. OPP. HAND MKD. (BLB-1X)



KEY PLAN OF BOTTOM LATERAL BRACING SYSTEMS




1 SET LATERAL BRACING REQD. AS DRN. MKD. (BLB-2)
1 SET BOTTOM LATERAL BRACING REQD. OPP. HAND MKD. (BLB-2X)

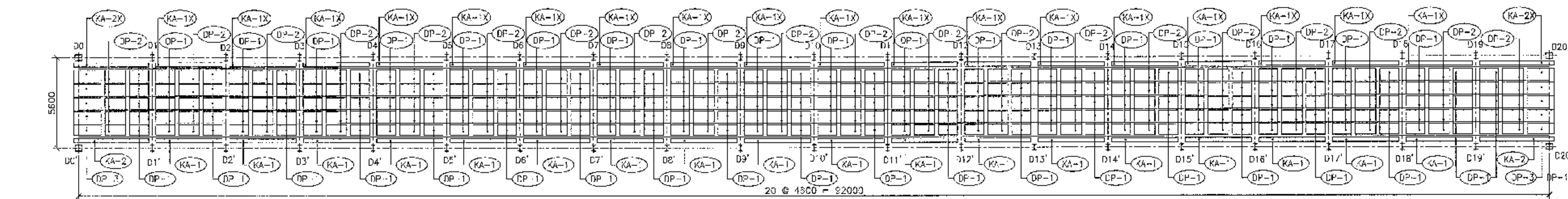
NOTES:

1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT DEPTH = 0.7 x LEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 25.5 mm FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL BOLT MARKS SHOWN THUS (M-22)
5. ALL ERECTION MARKS SHOWN THUS (M-22)
6. GRADE OF STRUCTURAL STEEL = S2062.
7. FITTING SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1553-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DISPATCH WITH TWO COATS OF PRIMER (D.F.T. 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL G.A. REFER DRS. NO. 2009-10/J-416/92m/ST-101.
12. ALL HOLES FOR BOLTS ARE SHOWN THUS (M-22)

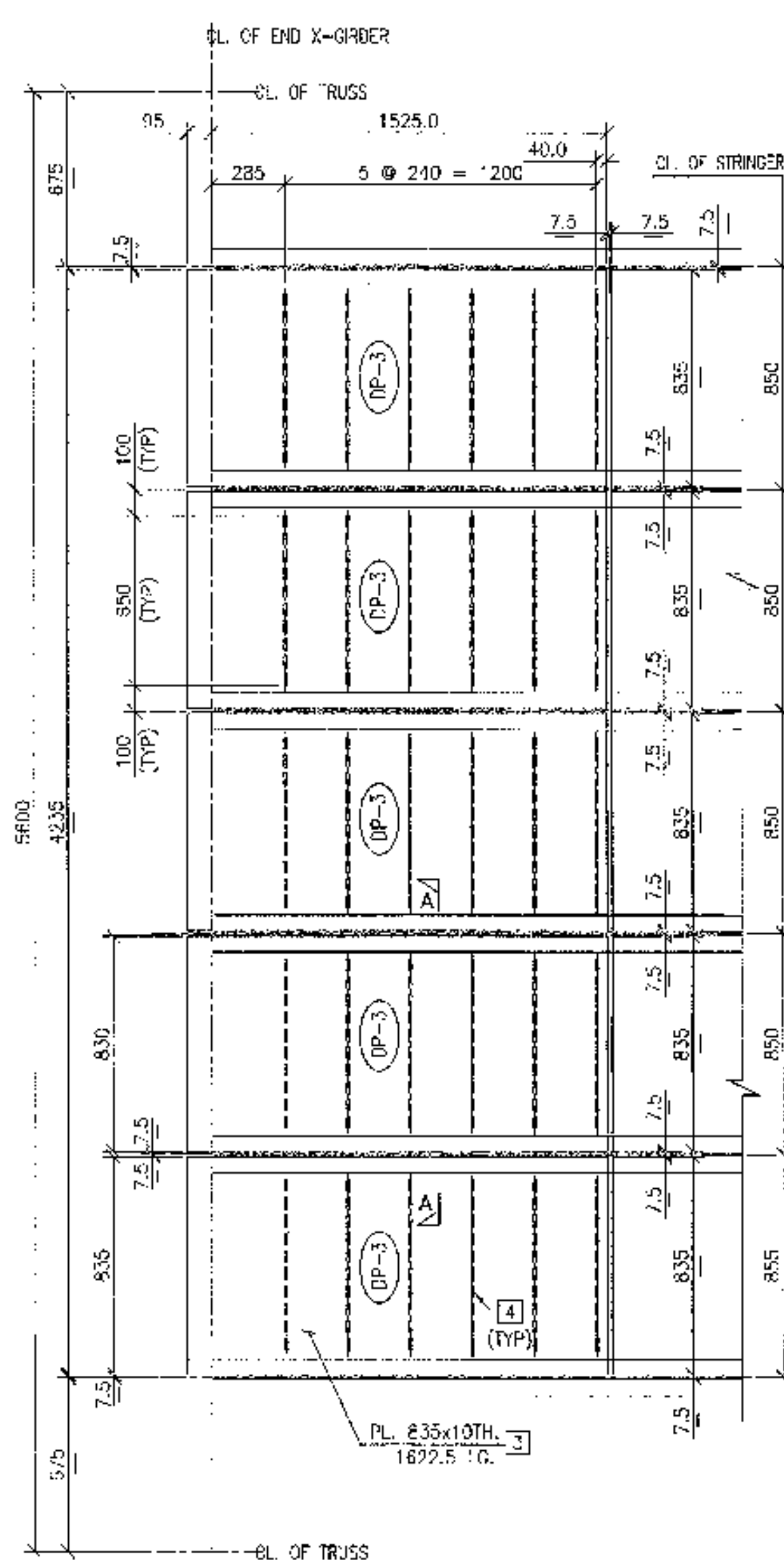
CLIENT :	EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.
CONTRACTOR :	CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.
PROJECT :	PROPOSED SINGLE LANE MOTORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION
TITLE :	DETAIL OF BOTTOM LATERAL BRACINGS

					TANGTA BUSTY, KALIMPONG DIVISION						
					SCALE	DATE	DRAWN	CHECKED	APPROVED	 CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SANTOSHPUUR, KOLKATA 700 075.	
					1:300, 1:10	09.10.08	A.J	B.N	P.G		
					DRAWING NUMBER				REV.		
					2009-10/J-416/92m/ST-112				0		
					(SHEET 1 OF 2)						
REV.	DATE	DESCRIPTION			BY	CHK.	APPD.	THIS DOCUMENT IS THE PROPERTY OF CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. IT MUST NOT BE USED, COPIED OR REPRODUCED IN ANY FORM WITHOUT THEIR WRITTEN CONSENT.			

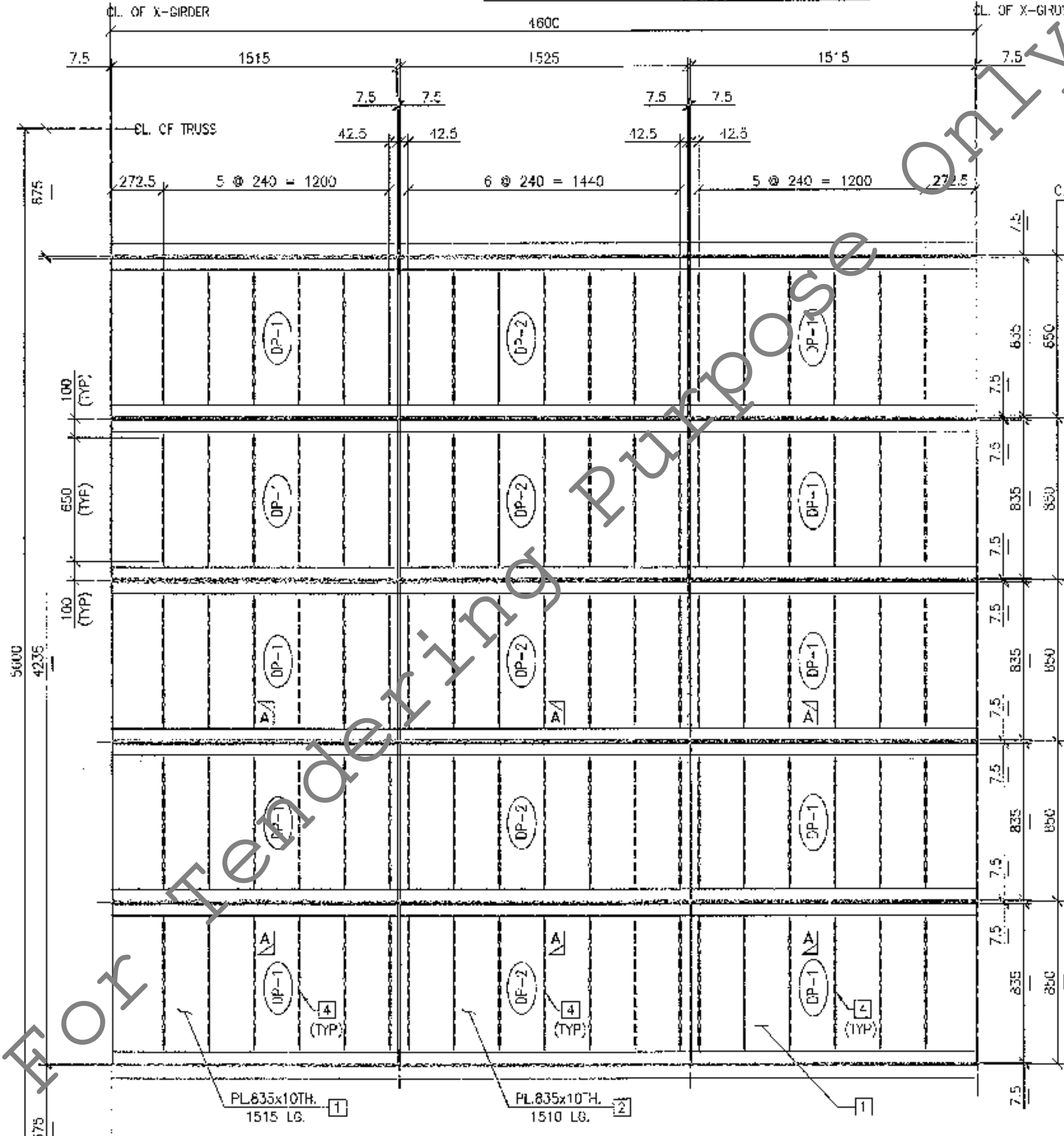
CDC CONSULTING DESIGN ENGINEERING CENTRE (P) LTD.
12, LAKE WEST ROAD, SANTOSH PUR, KOLKATA 700 075.



MARKING PLAN AT DECK SYSTEM

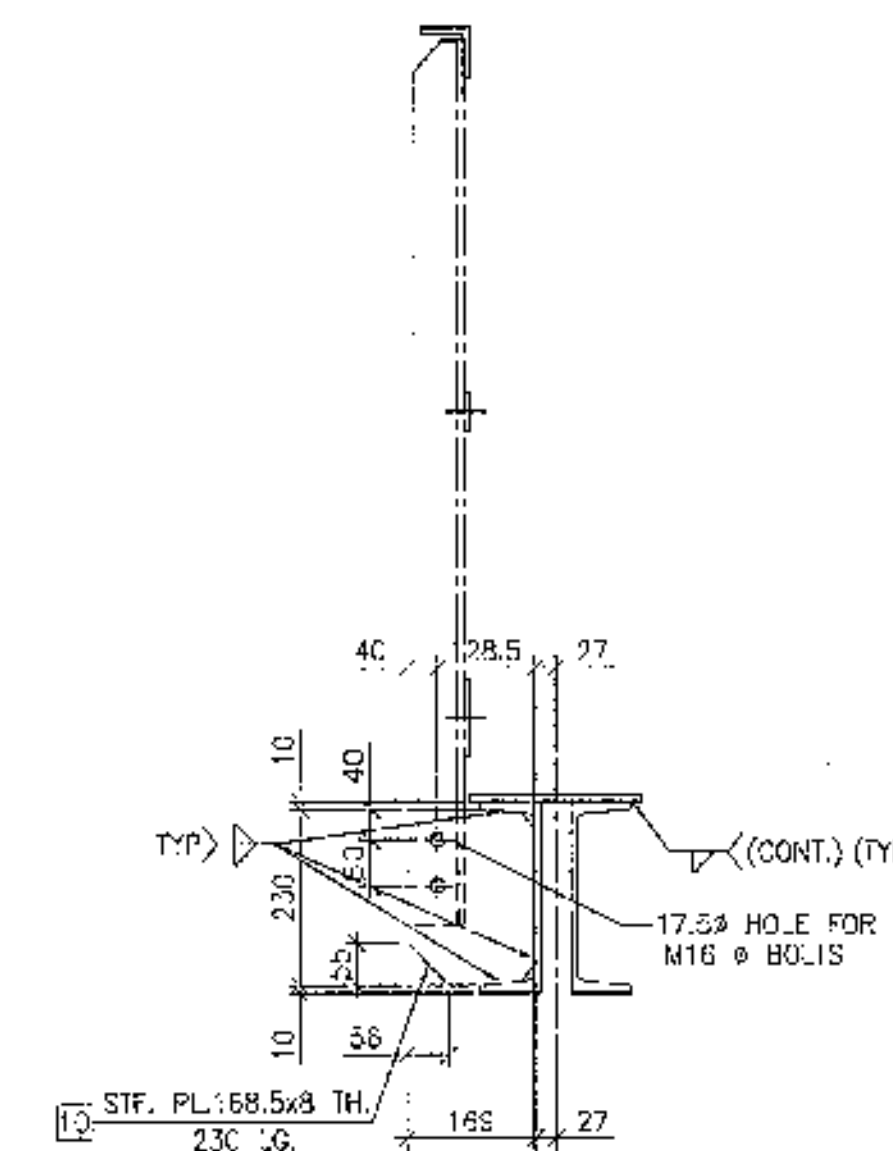


10 NOS DECK PLATE REQD. AS DRN. MKD. DP-3

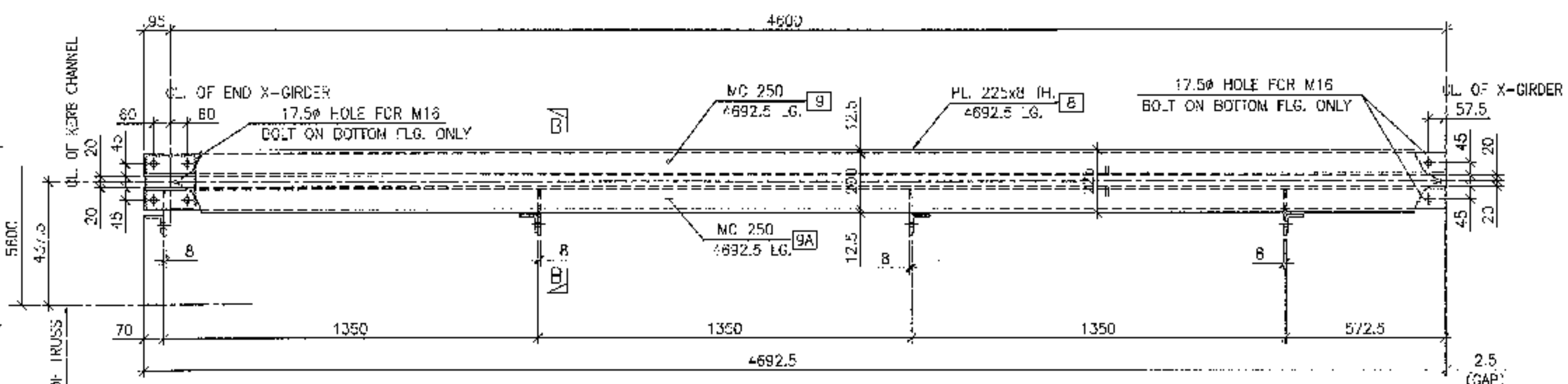


190 NOS. DECK PLATE REQD. AS DRN. MKD. DP-1

100 NOS. DECK PLATE REQD. AS DRN. MKD. DP-2

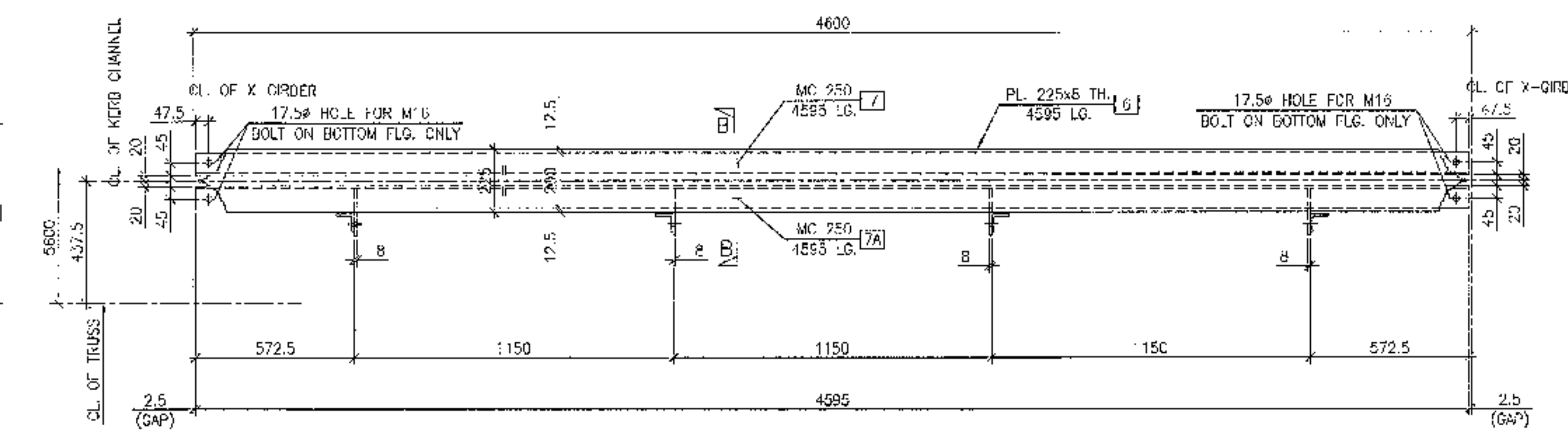


SECTION B-B



2 NOS. KERB ASSEMBLY REQD. AS DRN. MKD. KA2

2 NOS. KERB ASSEMBLY REQD. OPP. HAND TO KA2 MKD. KA2X

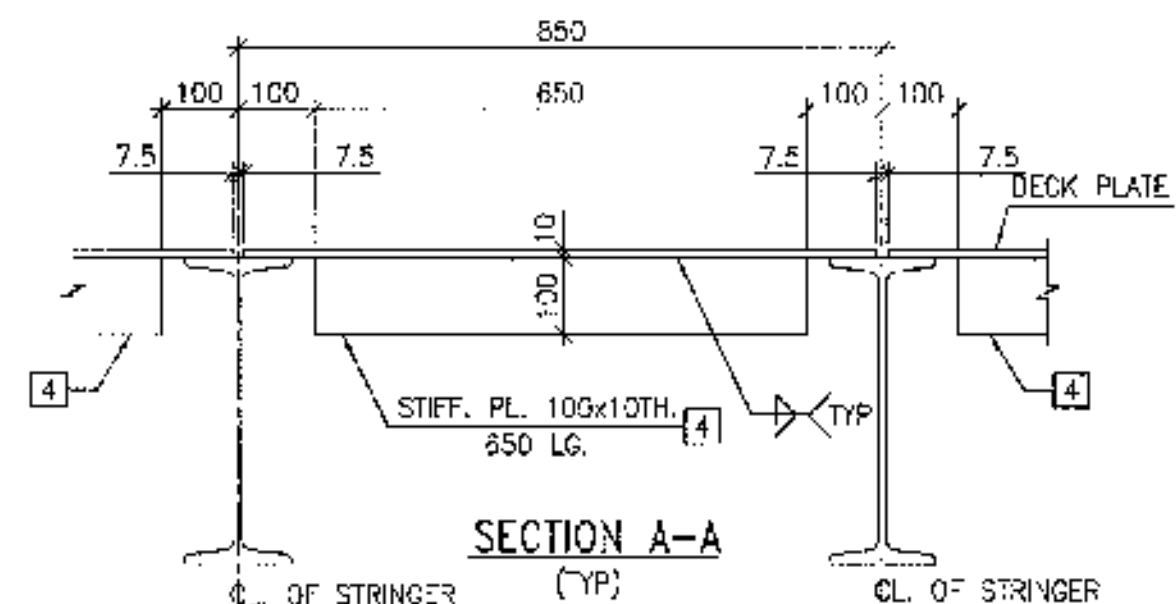


19 NOS. KERB ASSEMBLY REQD. AS DRN. MKD. KA1

19 NOS. KERB ASSEMBLY REQD. OPP. HAND TO KA1 MKD. KA1X

NOTES:

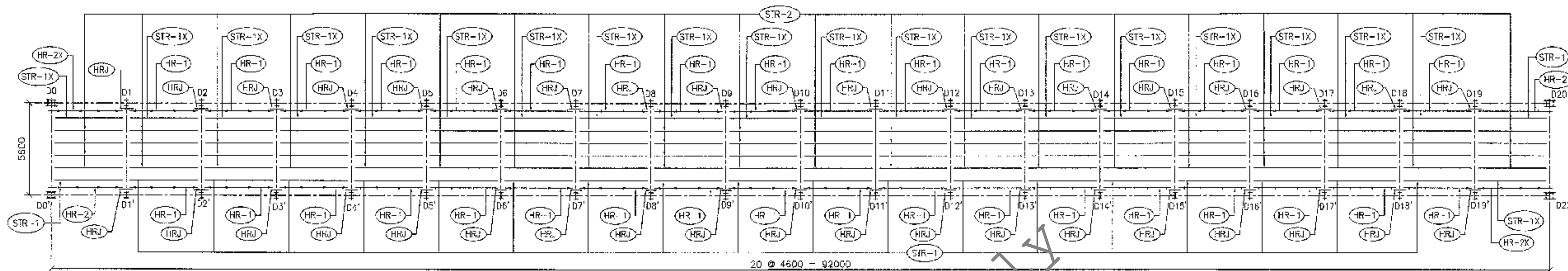
1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707XLEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 23.80 FOR M 22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL ITEM MARKS SHOWN THIS.
5. ALL DIRECTION MARKS SHOWN THIS.
6. GRADE OF STRUCTURAL STEEL = IS 2062.
7. FLECTRODE SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERLY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1979-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (3.00 mm PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL GENERAL ARRANGEMENT DRG. NO. 2009-10/J-416/92m/ST-101
12. ALL HOLES FOR BOLTS ARE SHOWN THIS.
13. ALL THREADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.



SECTION A-A (TYP)

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION	
TITLE :		DETAIL OF DECK PLATE & KERB ASSEMBLY (FOR DECK SYSTEM)	
SCALE 1:100, 1:25	DATE 16.09.09	DRAWN M/S	CHECKED B.N
DRAWING NUMBER 2009-10/J-416/92m/ST-113 (SHEET 1 OF 3)		APPROVED P.G	
REV.		DATE	
DESCRIPTION		BY	
CHK.		APP.	

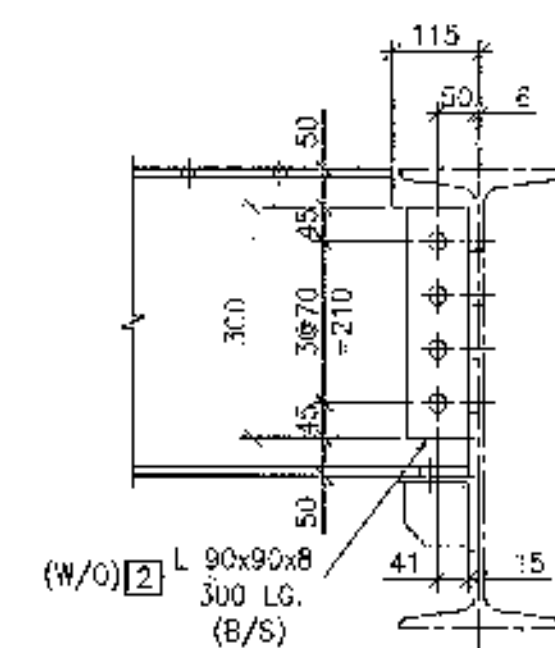
CDC CONSULTING DESIGN
ENGG. CENTRE (P) LTD.
12, LAKE WEST ROAD, SANTOSH PUR, KOLKATA - 700 075.



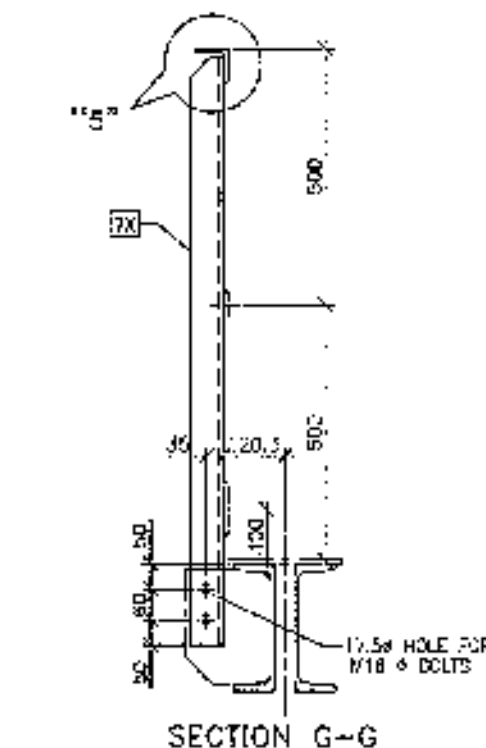
MARKING PLAN AT DECK SYSTEM

SECTION C-C

SECTION F-F

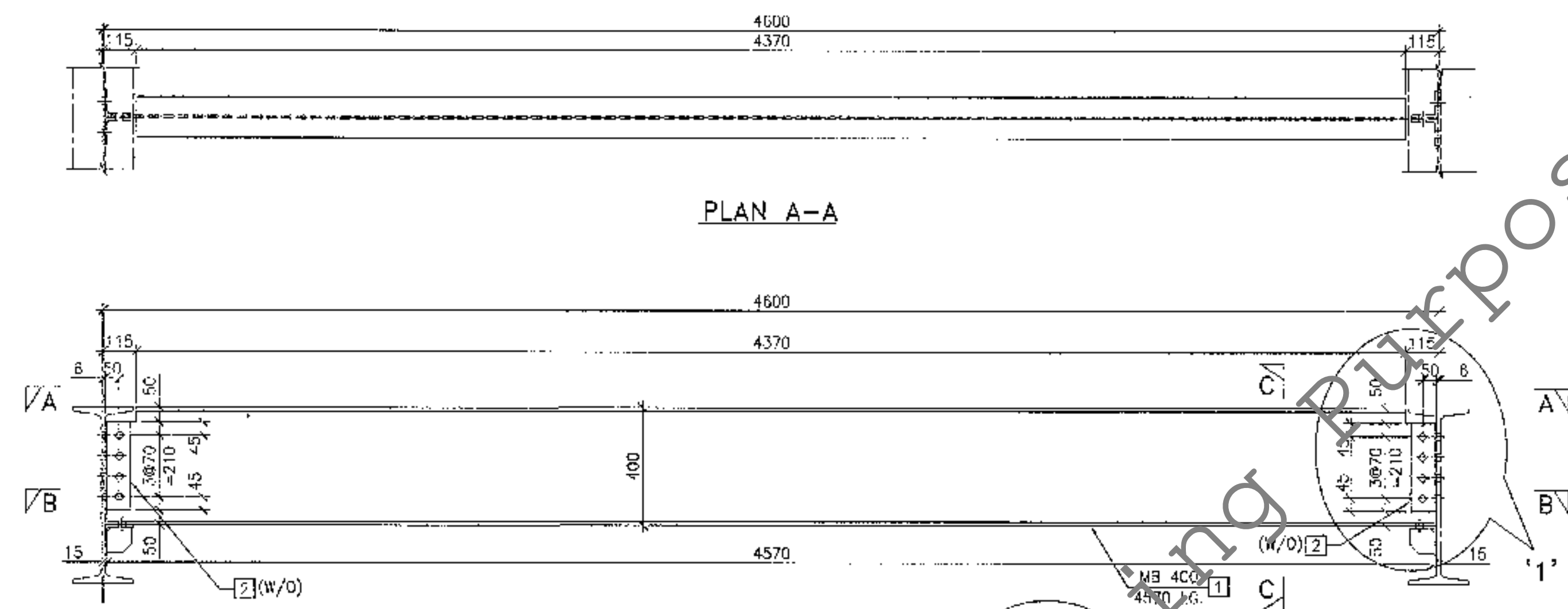


DETAIL '1'

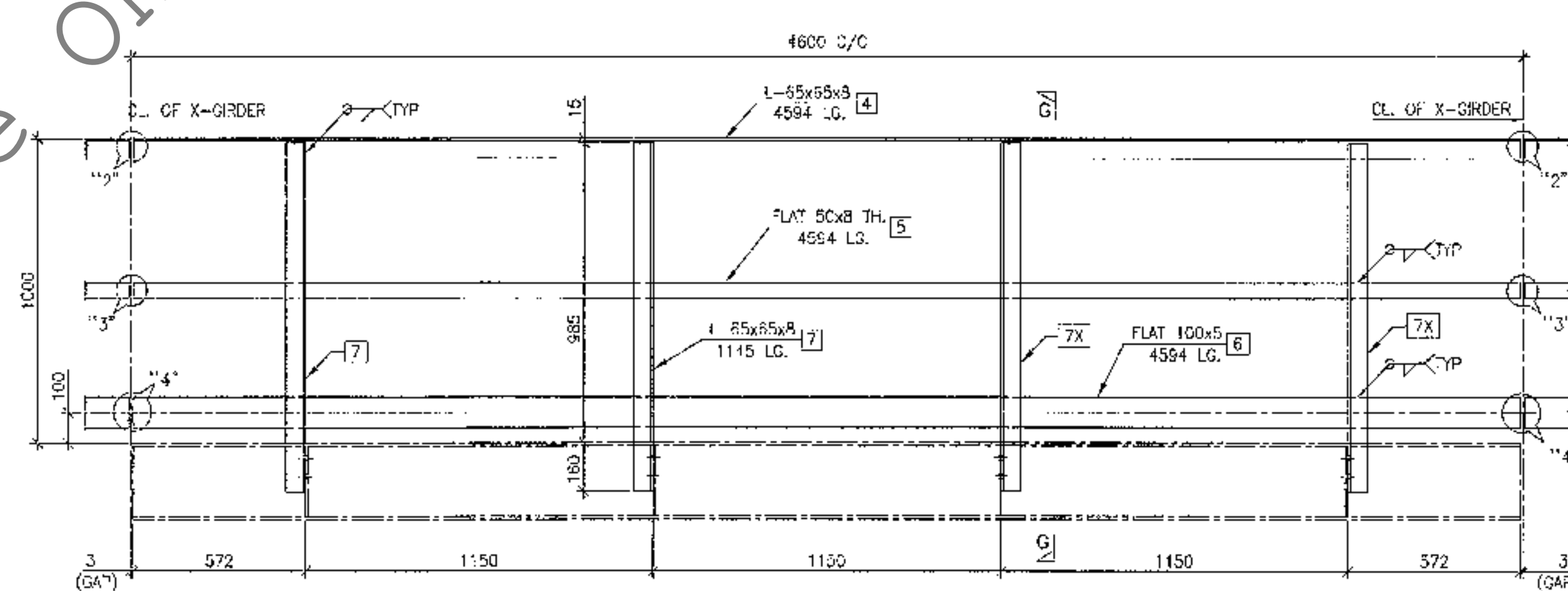


SECTION G-G

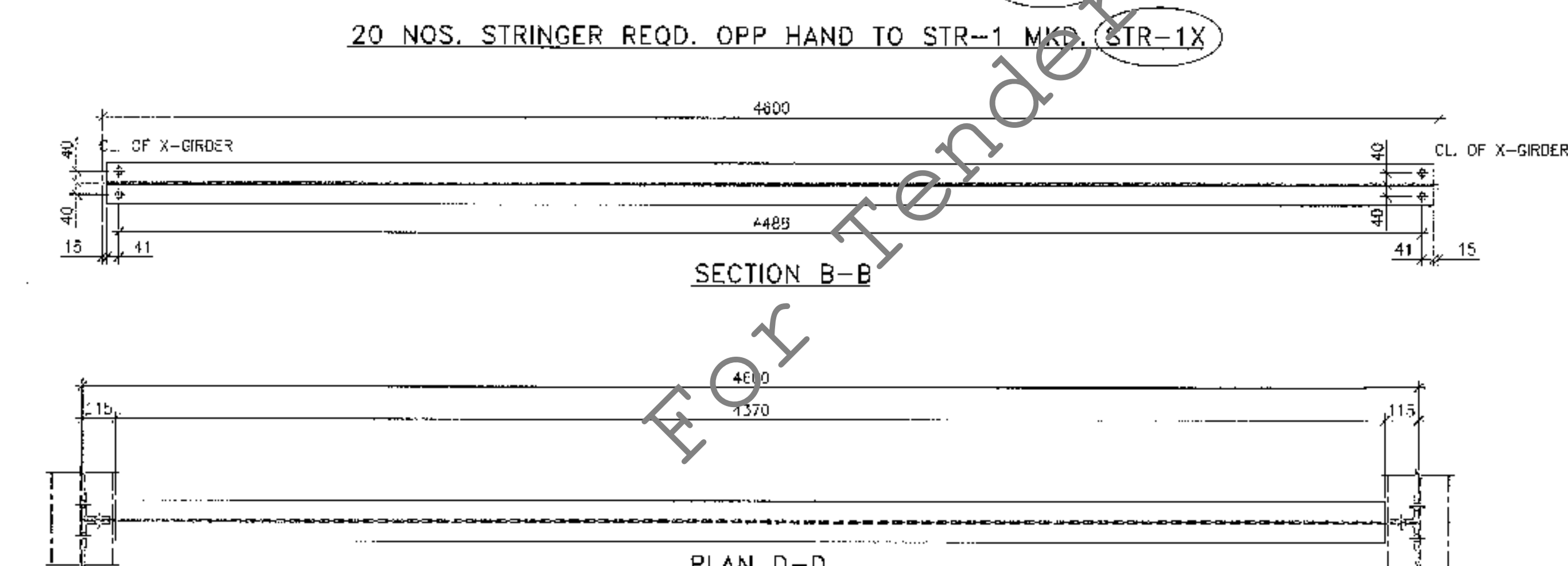
DETAIL '5'



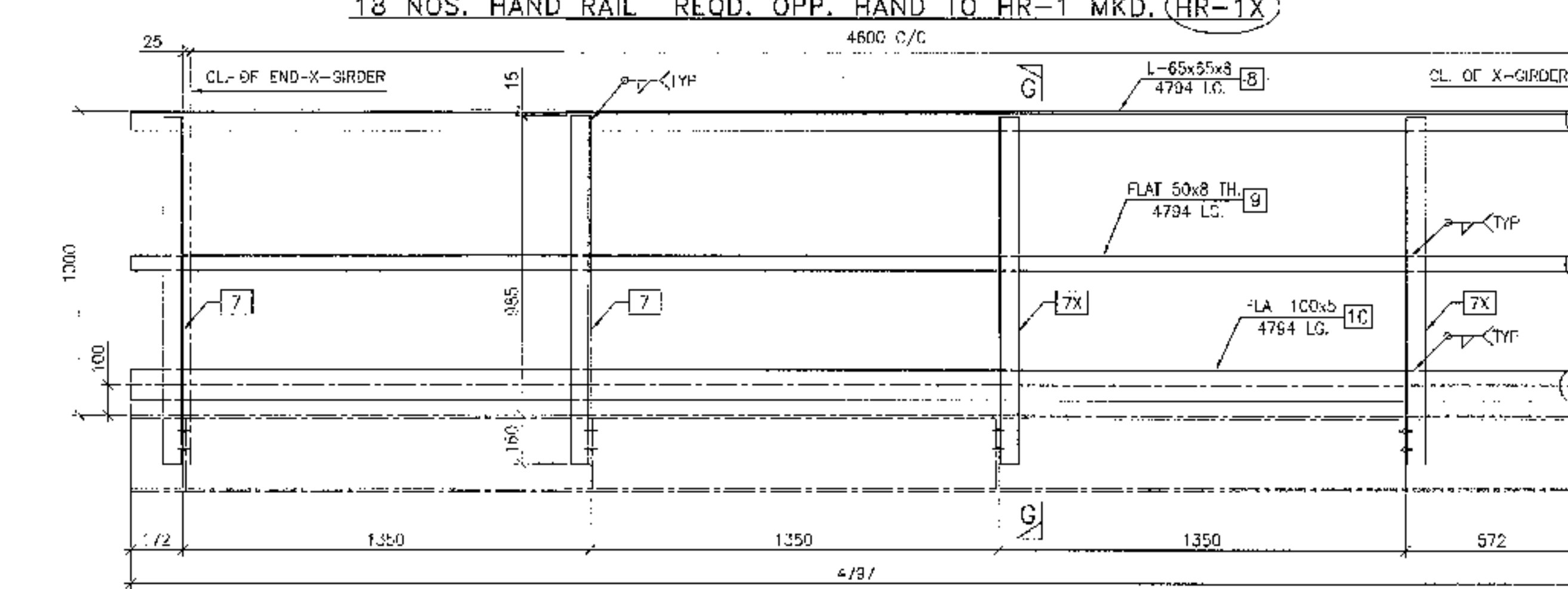
PLAN A-A



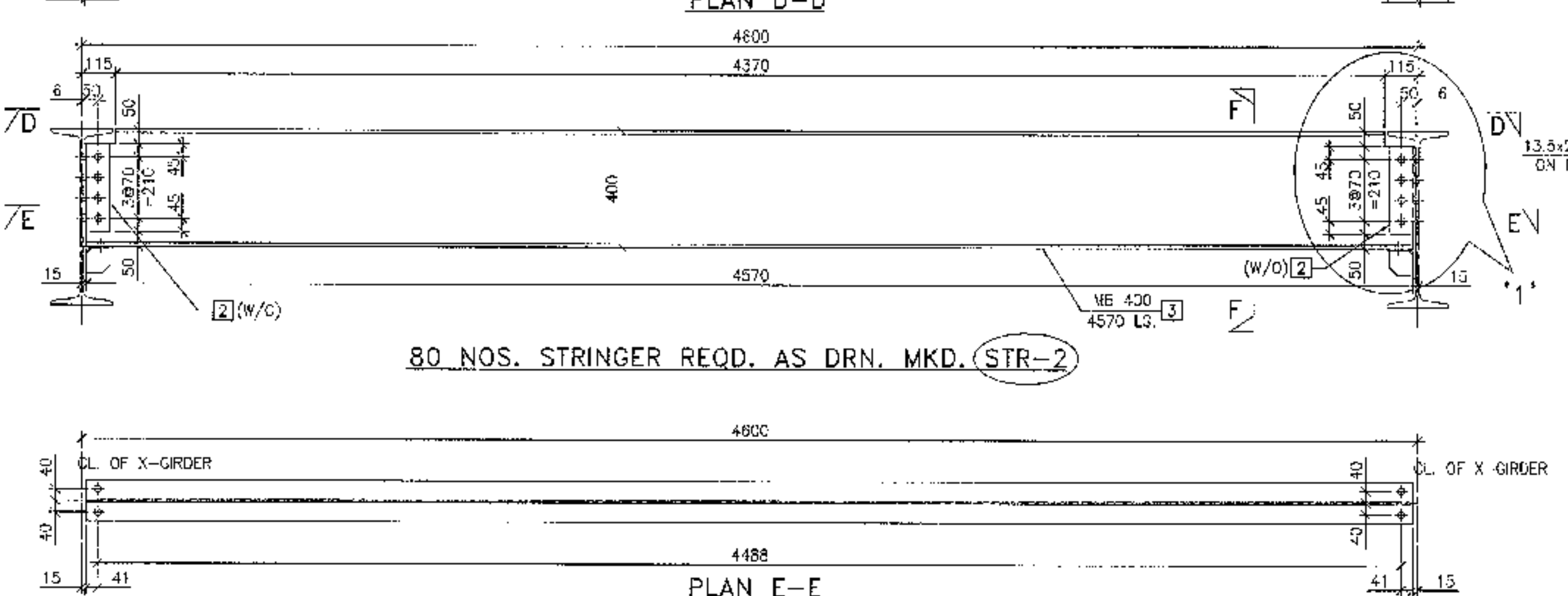
18 NOS. HAND RAIL REQD. AS DRN. MKD. (HR-1)
18 NOS. HAND RAIL REQD. OPP. HAND TO HR-1 MKD. (HR-1X)



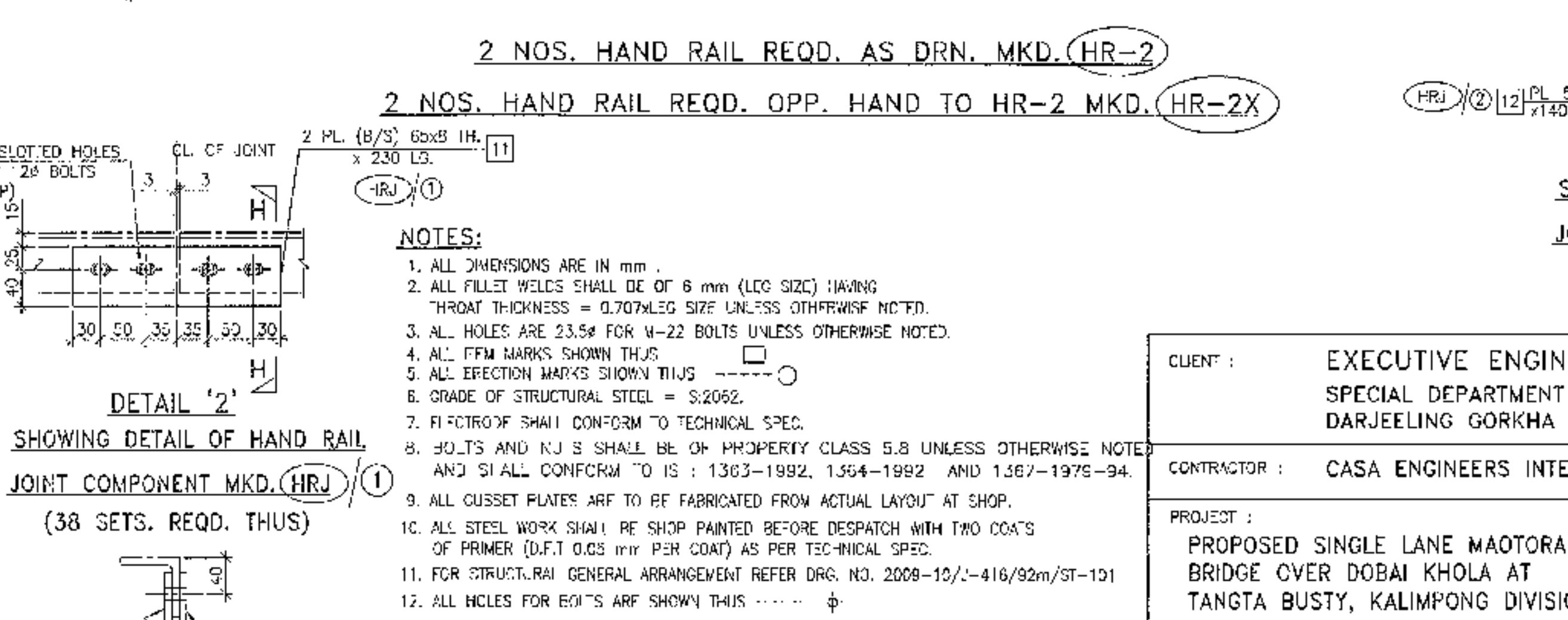
SECTION B-B



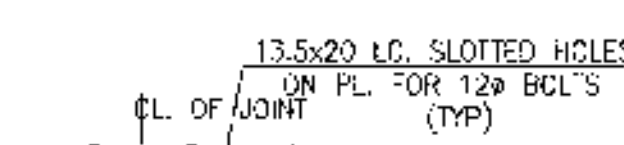
2 NOS. HAND RAIL REQD. AS DRN. MKD. (HR-2)
2 NOS. HAND RAIL REQD. OPP. HAND TO HR-2 MKD. (HR-2X)



PLAN D-D



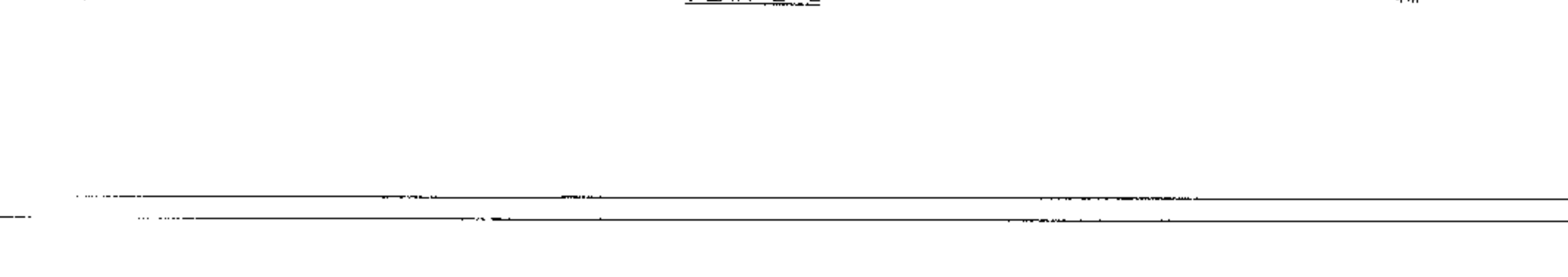
SHOWING DETAIL OF HAND RAIL
JOINT COMPONENT MKD. (HRJ) (2)
(38 NOS. REQD. THUS)



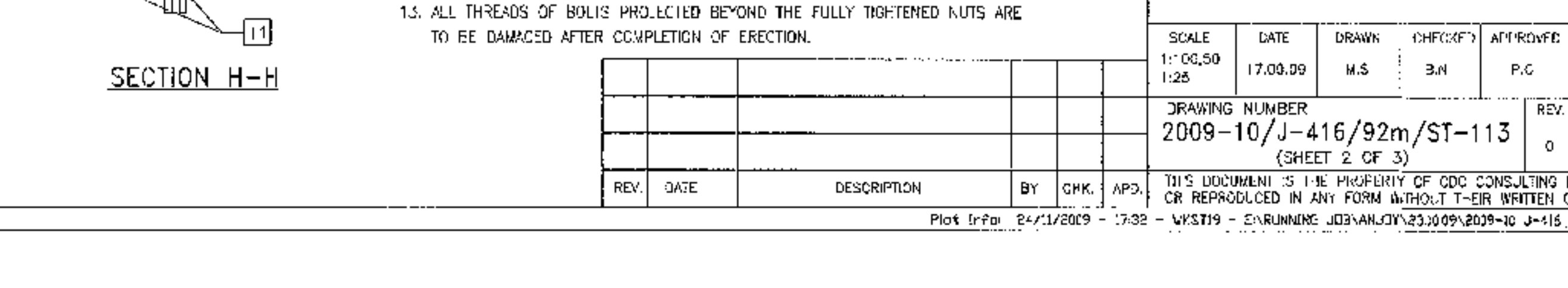
DETAIL '4'

SHOWING DETAIL OF HAND RAIL
JOINT COMPONENT MKD. (HRJ) (2)
(38 NOS. REQD. THUS)

DETAIL '3'



PLAN E-E




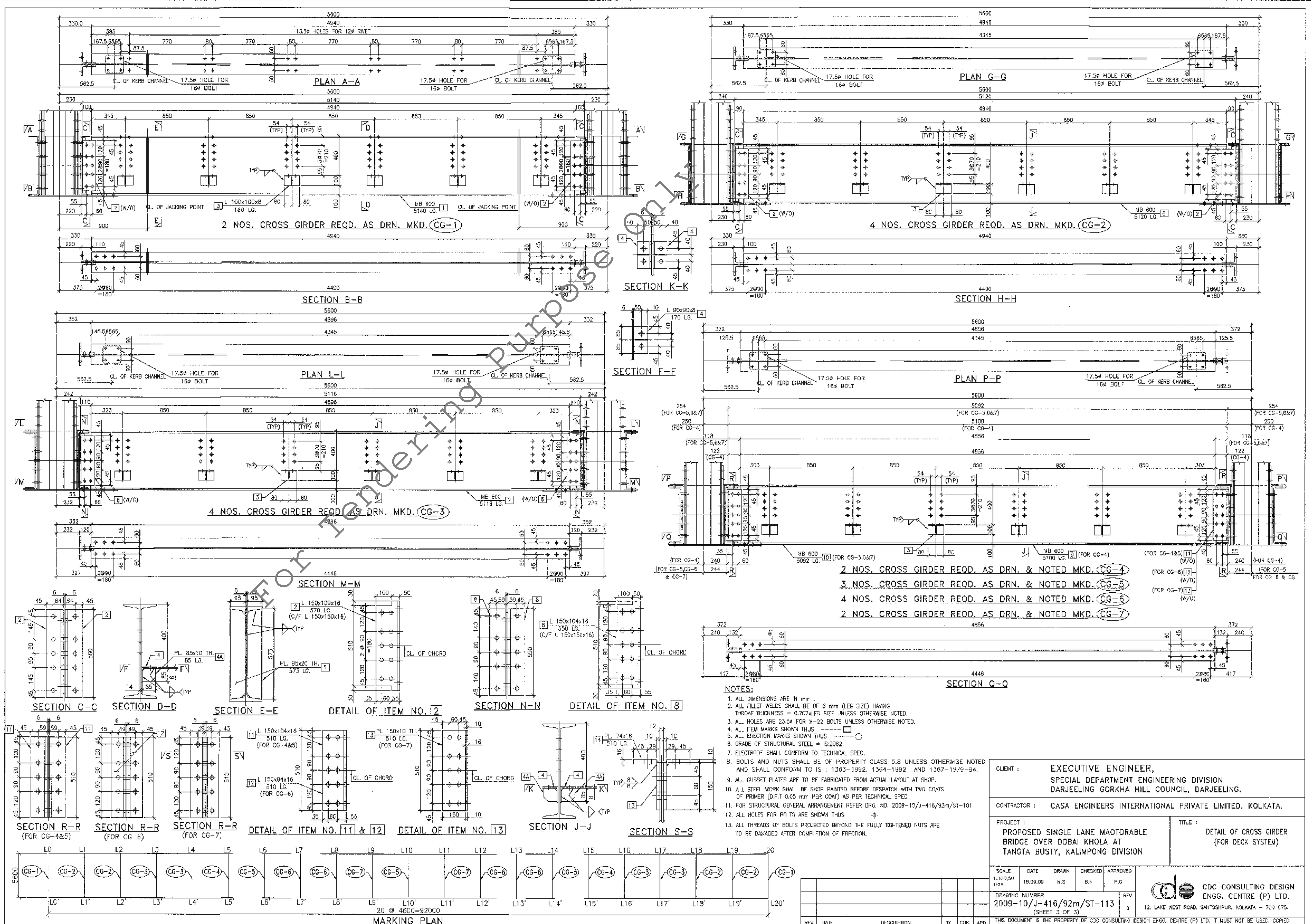
DETAIL '2'
SHOWING DETAIL OF HAND RAIL
JOINT COMPONENT MKD. (HRJ) (1)
(38 SETS. REQD. THUS)

SECTION H-H


NOTES:

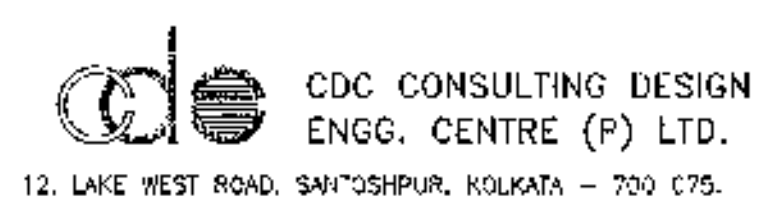
1. ALL DIMENSIONS ARE IN mm.
2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.707 LEG SIZE UNLESS OTHERWISE NOTED.
3. ALL HOLES ARE 23.5mm FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
4. ALL FPM MARKS SHOWN THIS.
5. ALL ERECTION MARKS SHOWN THIS.
6. GRADE OF STRUCTURAL STEEL = S2062.
7. FACTORY SHALL CONFORM TO TECHNICAL SPEC.
8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1363-1992, 1364-1992 AND 1367-1975-94.
9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DESPATCH WITH TWO COATS OF PRIMER (D.F.T. O.G.S. OR PER COAT) AS PER TECHNICAL SPEC.
11. FOR STRUCTURAL GENERAL ARRANGEMENT REFER DRG. NO. 2009-10/J-416/ST-101
12. ALL HOLES FOR BOLTS ARE SHOWN THIS.
13. ALL THREADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.

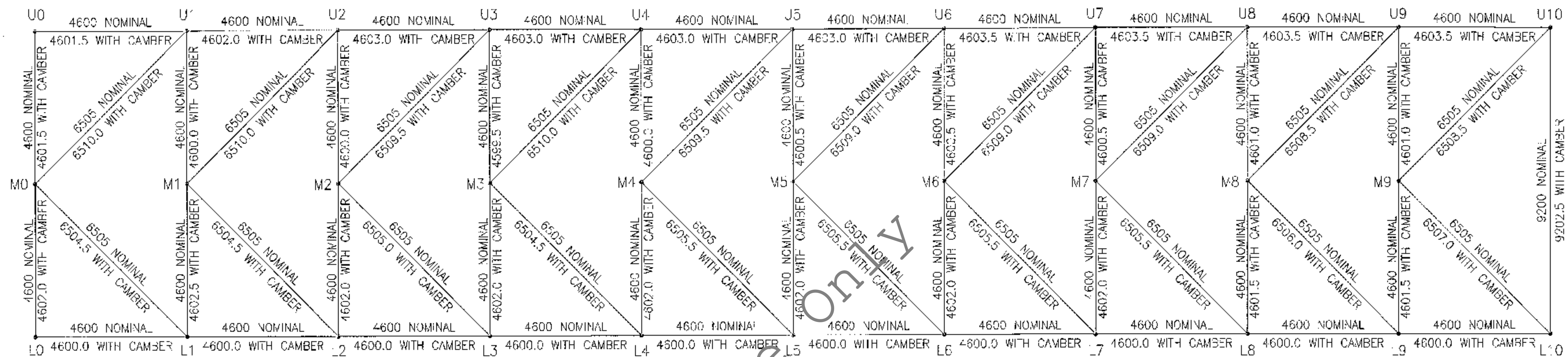
CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.			
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED. KOLKATA.			
PROJECT :		<div> <div> PROJECT : PROPOSED SINGLE LANE MAJORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION </div> <div> TITLE : DETAIL OF STRINGER & HAND RAIL DETAIL OF DECK SYSTEM </div> </div>			
SCALE 1"=100.00 1:25	DATE 17.09.09	DRAWN M.S.	CHECKED SUN	APPROVED P.C.	 <div> CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 2, LAKE WEST ROAD, SANTOSHIPUR, KOLKATA - 700 032. </div>
DRAWING NUMBER 2009-10/J-416/92m/ST-113 (SHEET 2 OF 3)			REV. 0		
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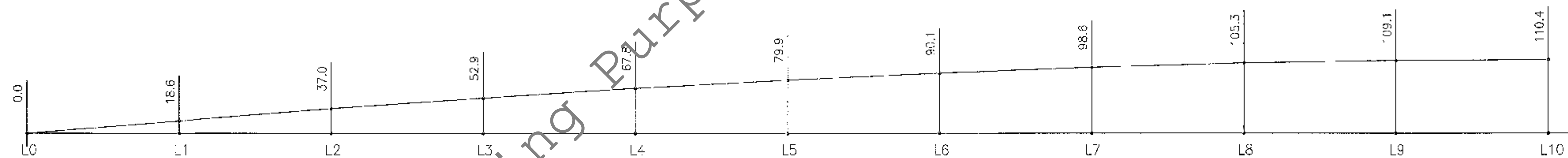
- NOTES:
1. ALL DIMENSIONS ARE IN mm.
 2. ALL FILLET WELDS SHALL BE OF 6 mm (LEG SIZE) HAVING THROAT THICKNESS = 0.7C+1.6 mm UNLESS OTHERWISE NOTED.
 3. ALL HOLES ARE 23.84 FOR M-22 BOLTS UNLESS OTHERWISE NOTED.
 4. ALL FEM MARKS SHOWN THUS
 5. ALL ERECTION MARKS SHOWN THUS
 6. GRADE OF STRUCTURAL STEEL IS IS 2082.
 7. ELECTRODE SHALL CONFORM TO TECHNICAL SPEC.
 8. BOLTS AND NUTS SHALL BE OF PROPERTY CLASS 5.8 UNLESS OTHERWISE NOTED AND SHALL CONFORM TO IS : 1303-1992, 1364-1992 AND 1367-1979-94.
 9. ALL GUSSET PLATES ARE TO BE FABRICATED FROM ACTUAL LAYOUT AT SHOP.
 10. ALL STEEL WORK SHALL BE SHOP PAINTED BEFORE DISPATCH WITH TWO COATS OF PRIMER (D.F.T. 0.05 mm PER COAT) AS PER TECHNICAL SPEC.
 11. FOR STRUCTURAL GENERAL ARRANGEMENT REFER DRG. NO. 2009-10/J-416/92m/ST-101
 12. ALL HOLES FOR RIVETS ARE SHOWN THUS
 13. ALL THREADS OF BOLTS PROJECTED BEYOND THE FULLY TIGHTENED NUTS ARE TO BE DAMAGED AFTER COMPLETION OF ERECTION.

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.	
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED, KOLKATA.	
PROJECT :		TITLE :	
PROPOSED SINGLE LANE MAINTAINABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION		DETAIL OF CROSS GIRDER (FOR DECK SYSTEM)	
SCALE 1:100, 5:1 1:25	DATE 18.09.09	DRAWN M/S	CHECKED B.H.
DRAWING NUMBER 2009-10/J-416/92m/ST-113 (SHEET 3 OF 3)		APPROVED P.G.	
		REV. 3	
		 CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SAHAGSHIPUR, KOLKATA - 700 075.	
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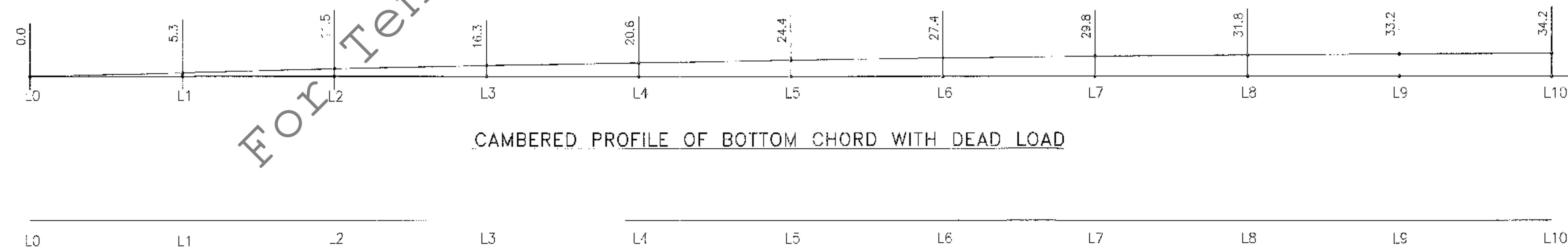




NOMINAL AND CAMBER GEOMETRY



CAMBERED PROFILE OF BOTTOM CHORD WITH NO LOAD



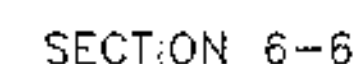
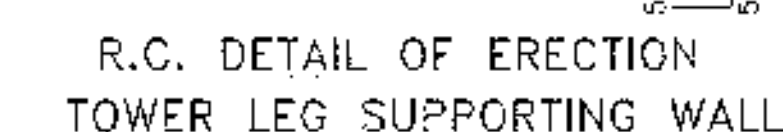
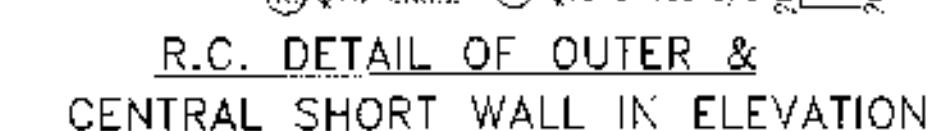
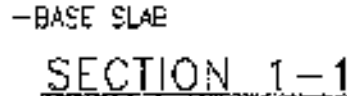
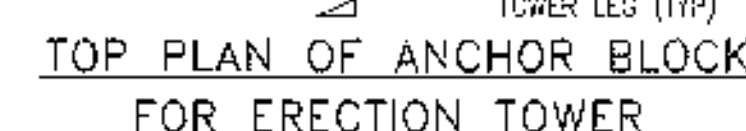
CAMBERED PROFILE OF BOTTOM CHORD WITH DEAD LOAD

CAMBERED PROFILE OF BOTTOM CHORD WITH (DL + 0.75 LL WITHOUT IMPACT)

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. THE ACTUAL MANUFACTURED LENGTHS OF MEMBERS ARE TO BE THE LENGTHS MARKED 'WITH CAMBER' ON THIS DIAGRAM BETWEEN INTERSECTIONS.
3. THE SMALL VARIATIONS IN LENGTHS OF MEMBERS NECESSARY TO PRODUCE THE REQUIRED CAMBER ARE MADE UP IMMEDIATELY OUT SIDE THE AREA OF THE GUSSET PLATES, BOTH IN THE CHORD MEMBERS AND WEB MEMBERS.
4. THE POSITIONS & ANGULAR SETTING OUT LINES OF ALL CONNECTION HOLES IN GUSSETS, PLATES ALSO THE POSITION OF CONNECTION HOLES IN THE CHORD JOINTS ARE TO BE EXACTLY AS SHOWN ON THE DRAWINGS WITHOUT ANY ALLOWANCE FOR CAMBER.
5. THE GROUPS OF CONNECTION HOLES AT THE ENDS OF ALL MEMBERS ARE TO BE AS SHOWN ON THE DRAWINGS i.e. WITHOUT ANY ALLOWANCE FOR CAMBER. THE NECESSARY ALLOWANCE FOR CAMBER IS ADJUSTED IN THE DISTANCE BETWEEN THE GROUPS.

CLIENT :		EXECUTIVE ENGINEER, SPECIAL DEPARTMENT ENGINEERING DIVISION DARJEELING GORKHA HILL COUNCIL, DARJEELING.			
CONTRACTOR :		CASA ENGINEERS INTERNATIONAL PRIVATE LIMITED. KOLKATA.			
PROJECT :		PROPOSED SINGLE LANE MAOTORABLE BRIDGE OVER DOBAI KHOLA AT TANGTA BUSTY, KALIMPONG DIVISION		TITLE : CAMBER DIAGRAM	
SCALE 1:100	DATE 18.09.09	DRAWN M.S	CHECKED B.N	APPROVED P.G	REV. 0
DRAWING NUMBER 2009-10/J-416/92m/ST-114					
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REV.	DATE	DESCRIPTION	BY	CHECK	APD.




1. ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN m
2. GRADE OF CONCRETE SHALL BE M20.
3. ALL REINFORCEMENT BARS SHALL BE HG4 STRENGTH DEFORMED BARS (FE 415)
4. MIN. DEVELOPMENT LENGTH SHALL BE AS FOLLOWS: S.1786
5. CLEAR COVER TO REINFORCEMENT BARS SHALL BE AS GIVEN BELOW:
FOR BASE SLAB AND WALLS = 50 mm.
FOR TOP SLAB = 25 mm.
6. LAP LENGTH OF REINFORCEMENT SHALL BE 35 TIMES OF DIAMETER OF BAR

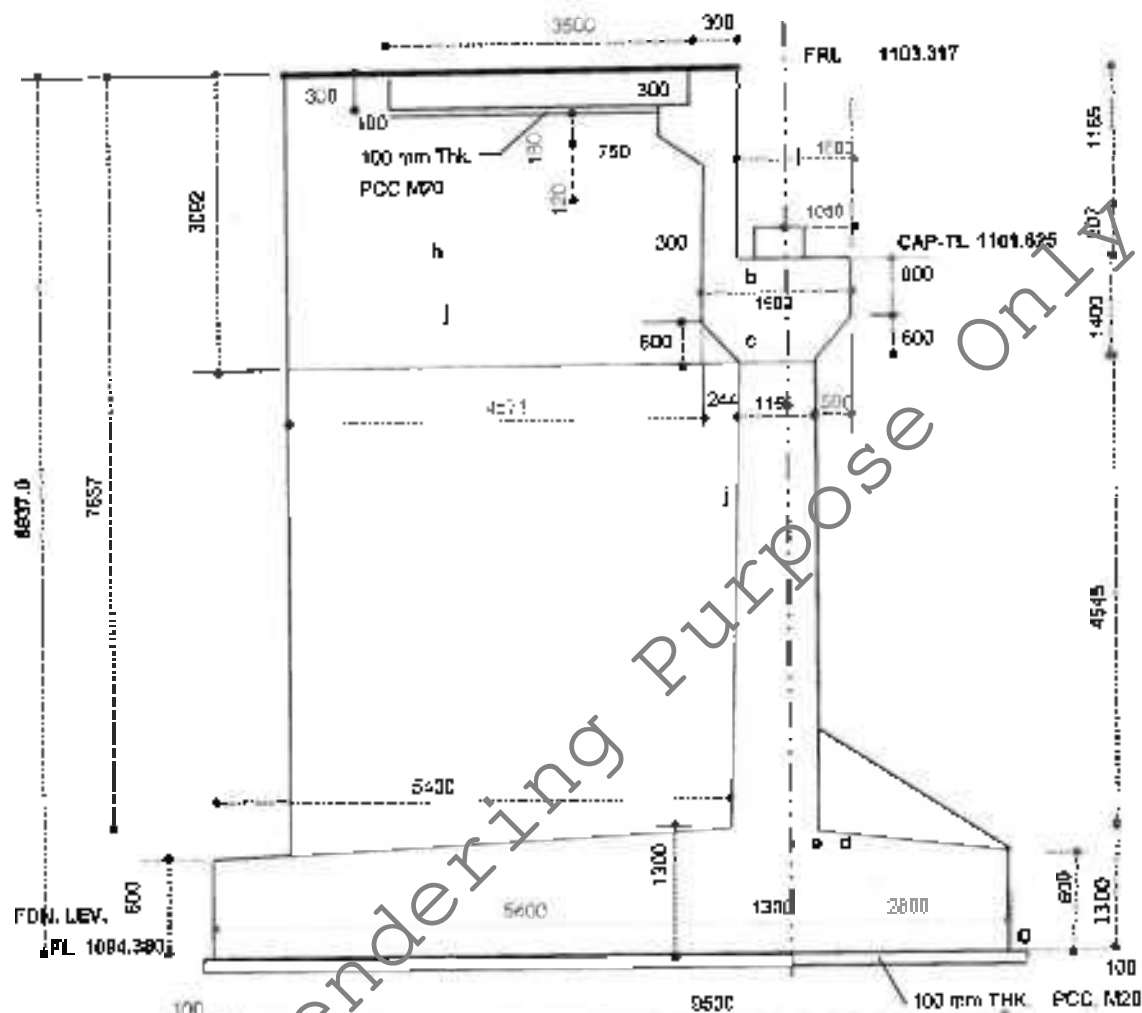
TOP / GEAR FACE REINFORCEMENT SHOWN THIS : -----
 BOTTOM / GEAR FACE REINFORCEMENT SHOWN THIS : _____

1. ERECTION SCHEME : 2009-10/J-416/92m/SCB-01.
2. DETAILS OF LOWER COMPONENTS :- 2009-10/J-416/92m/SCB-C2



						75.50,40	01.04.10	M.S	P.G	P.G	 CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. 12, LAKE WEST ROAD, SAN-JOSHUPUR, KOLKATA - 700 075.
						DRAWING NUMBER 2009-10/J-416/92m/SCH-03				RLY D	
REV.	DATE	DESCRIPTION	BY	CHK.	APD.	THIS DOCUMENT IS THE PROPERTY OF CDC CONSULTING DESIGN ENGG. CENTRE (P) LTD. IT MUST NOT BE USED, COPIED OR REPRODUCED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF THE COMPANY.					

TYP. CROSS SECTION OF RIGHT BANK ABUTMENT STRC. MKD. A1 FOR BRIDGE OVER "DAWALKHOLA"



SIDE VIEW OF ABUTMENT WALL MKD. A1

Amalendu
Sub-Assistant Engineer
Central Planning, Quality Control & Procurement
Engineering Division-II
Gorthaland Technical Administration

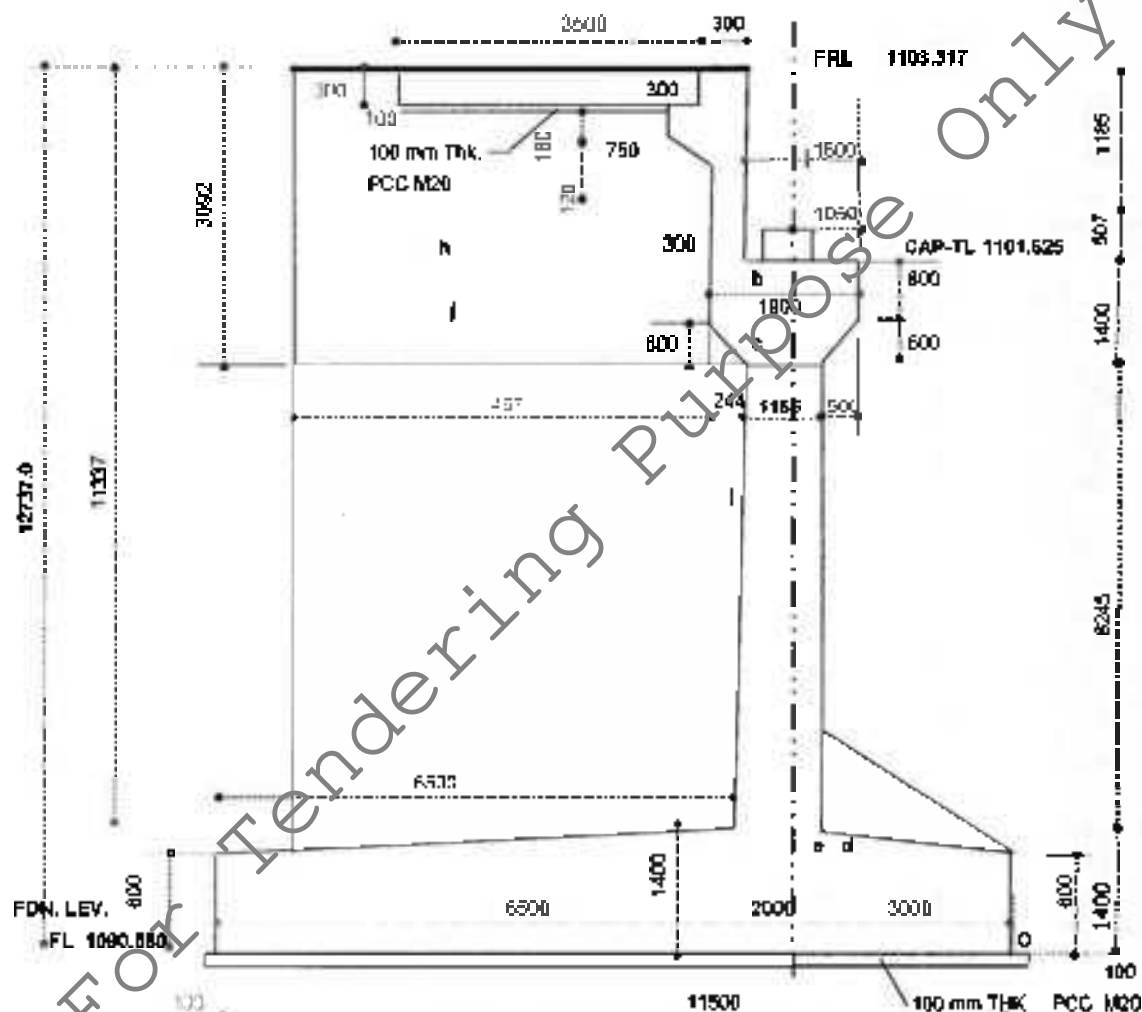
Uy
Sub-Assistant Engineer
Central Planning, Quality Control & Procurement
Engineering Division-II
Gorthaland Technical Administration

For Tendering Purpose Only

For Tendering Purpose Only

Depth of abutment cap	=	1.400 m
Depth of abutment wall	=	8.245 m
Number of bearings per support (Pot Cum PTFE)	=	8.0
Wearing coat (thickness with deck slab)	=	0.305 m
Thickness of return wall at top	=	0.400 m
Thickness of return wall at bottom	=	1.300 m

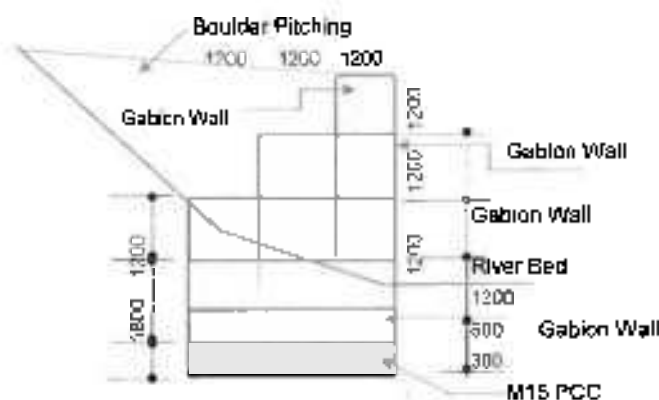
TYP. CROSS SECTION OF LEFT BANK ABUTMENT STRC. MKD. A2 FOR BRIDGE OVER "DAWA KHOLA"



SIDE VIEW OF ABUTMENT WALL MKD. A2

A. Guha
Sub-Assistant Engineer
Central Planning Quality Control & Procurement
Engineering Division-II
Gorkhaland Territorial Administration

[Signature]
Assistant Engineer
Central Planning Quality Control & Procurement
Engineering Division-II
Gorkhaland Territorial Administration



TYP CROSS SEC. FOR PROTECTION WALL.

S/L No	Description	Unit	Nos.	Length (m)	Width (m)	Depth (m)	Quantity
8	Sub-structure (Left Bank Abutment Structure)						
12.0	Dismantling of existing Abutment structure:						
12.1	For Dirt wall	Cum	1	6.700	0.300	0.355	1.92
12.2	For Bracket of dirt wall	Cum	1	6.700	0.300	0.240	0.43
12.3	For Abutment Cap	Cum	1	6.700	1.100	0.300	4.42
12.4	For Abutment stem	Cum	1	6.700	1.128	0.360	6.05
	Dismantling of existing Wing wall:						
12.5	Indivd portion of Wing wall	Cum	2	5.535	0.602	0.956	0.30
	T/Dismantling of existing Abt. Strc & wing wall						10.23
13.0	Filter media :						
13.1	Back fill with filter media	Cum	1	9.20	0.600	3.082	17.07
13.2	500THK. Stone pitching in apron side of Abt. wall		2	75.911		0.500	76.81
13.3	150THK. Filter media in apron both side of Abt. wall		2	75.911		0.150	23.04
13.4	500THK. Stone pitching in apron front of Abt. wall		1	3.606	9.20	0.500	18.59
13.5	150THK. Filter media in apron front of Abt. wall		1	3.608	9.20	0.150	4.98
	Filter media behind Abutment wall & Apron						138.49
14.0	M15 conc. for Toe wall / Drop wall		2	24.314	2.0	1.0	152.09
			2	24.314	1.300	0.800	78.40
	M15 conc. for Toe wall / Curtain wall						232.09
15.0	Back fill with compacted Granular Materials						
15.1	Backfill w/o filter media upto EGL	Cum	1	5.03	12.038	3.092	194.14
	Back fill w/o filter media						157.14
16.0	M35 conc. for sub-structure :						
16.1	For Dirt wall	Cum	1	9.200	0.300	1.692	4.67
16.2	For Bracket of dirt wall	Cum	1	8.400	0.300	0.240	0.80
16.3	For Bearing pedestal M35 Conc.	Cum	2	0.800	0.800	0.380	0.49
16.4	For pin Bearing pedestal M35 Conc.	Cum	1	1.000	1.000	0.285	0.30
16.5	For Seismic arrestor Long.	Cum	3	0.700	0.600	0.460	0.57
16.6	For Seismic arrestor Trns.	Cum	2	1.000	0.500	1.200	1.20

SPECIFICATION FOR BRIDGE WORKS

1. PILE FOUNDATIONS

1.1 Concrete in Piles (*cl. 1104 of MoRT&H*)

For both precast and cast in in-situ piles, the grade of concrete, minimum cement content, water cement ratio and slump at the time of placement shall be as per Table 1100-1:

Table 98: Requirements for Concrete in Piles (*Table 1100-1 of MoRT&H*)

	Cast in-situ Concrete by Tremie	Precast Concrete
Grade of concrete	M35	M35
Minimum cement content	400 kg/m ³	400 kg/m ³
Minimum water cement ratio	0.4	0.40
Slump (mm) as measured at the time of placement	150-200	50-75

The terms 'minimum cement content' and 'minimum water cement' ratio mentioned Table 1100-1, are to be based on total cementitious material (inclusive of all mineral admixtures called additives) mentioned in Clause 1007 of these Specifications. Maximum limits for such additives shall be as specified in Clause 1716.2 of these Specifications.

High alumina cements (i.e. quick setting cement) shall not be used in marine conditions. When both chlorides and sulphates are present, in soil or ground water, sulphate resistant cement shall not be used. For improving resistance against the penetration of chlorides and sulphates from surrounding soils or water, mineral admixtures such as fly ash, silica fumes, GGBS conforming to respective BIS/International Standards and as per IRC: 112, may be used.

1.2 TEST PILES (*cl. 1106 of MoRT&H*)

Test piles which are shown on the drawings or specified in the contract or installed by the Contractor on his own to determine the lengths of piles to be furnished, shall conform to the requirements for piling as indicated in these Specifications. Test piles which are used to arrive at the load carrying capacity shall not be incorporated in the structure.

All test piles shall be installed with the same type of equipment that is proposed to be used for piling in the actual structure.

Test piles which are not to be incorporated in the completed structure shall be removed to at least 600 mm below the proposed soffit level of pile cap and the remaining hole so formed shall be backfilled with earth or other suitable material.

The piles shall be load tested in accordance with provisions laid down in this Section.

2. CAST IN-SITU CONCRETE PILES (*cl. 1107 of MoRT&H*)

2.1 General

Cast in-situ concrete piles may be either installed by drilling a bore into the ground and removing the material or by driving a metal casing with a shoe at the tip and displacing the material laterally. The two types of piles are termed as "bored piles" and "driven piles" respectively. Cast in-situ concrete piles may be cast in metal shells which may remain permanently in place. However, other types of reinforced concrete cast in-situ piles, cased or uncased, may be used if in the opinion of the Engineer the soil conditions permit their use and if their design and the methods of placing are satisfactory.

Certain specific requirements regarding driving of cast in-situ driven piles shall be as per Clauses 1110 and 1111.

Any liner or borehole which is improperly located or shows partial collapses that would affect the load carrying capacity of the pile, shall be rejected or repaired as directed by the Engineer at the cost of the Contractor.

Boring shall be carried out using rotary equipment. Percussion type of equipment shall be used only if approved by the Engineer.

The diameter of the finished pile shall not be less than that specified. A continuous record shall be kept by the Engineer as to the volume of concrete placed in relation to the length of pile that is cast.

Defective piles shall be removed or left in place as judged convenient without affecting the performance of adjacent piles or pile cap. Additional piles shall be provided to replace the defective piles.

2.2 Concreting

Wherever practicable, concrete should be placed in a clean dry hole. Prior to the placing of the reinforcement cage, the pile shaft shall be cleaned of all loose materials. Before concreting of the pile is commenced, it is essential to ensure that no debris remains at the bottom of the shaft, as inadequate cleaning of the base can lead to formation of a soft base or soft toe which may result in reduction of load bearing capacity of the pile.

Reinforcement for the pile as shown on the drawing shall be tied in place to form a cage which is lowered into the pile shaft. Suitable spacers shall be provided to maintain the required cover to reinforcing steel. Reinforcements at the bottom should not be provided with L-bends as these may interfere with cleaning of the pile base.

Where concrete is placed in dry and a casing is present, the top 3 m of the pile shall be compacted using internal vibrators.

Where the casing is withdrawn from cohesive soils for the formation of cast in-situ pile, the concreting should be done with necessary precautions to minimize the softening of the soil by excess water. Where mud flow conditions exist, the casing of cast in-situ piles shall not be allowed to be withdrawn.

Care shall be taken during concreting to prevent the segregation of the ingredients. The displacement or distortion of reinforcement during concreting and while extracting the casing, shall also be avoided.

If the concrete is placed inside precast concrete tubes or consists of precast sections, these shall be free from cracks or other damage before being installed.

The concrete shall be properly graded, shall be self-compacting and shall not get mixed with soil, excess water, or other extraneous matter. Special care shall be taken in silty clays and other soils which have the tendency to squeeze into the newly deposited concrete and cause necking. Sufficient head of green concrete shall be maintained to prevent inflow of soil or water into the concrete.

The placing of concrete shall be a continuous process from the toe level to the top of the pile. To ensure compaction by hydraulic static heads, rate of placing concrete in the pile shaft shall not be less than 6 m (length of pile) per hour.

2.3 Casing

When concreting is carried out for a pile, a temporary casing should be installed to sufficient depth so as to ensure that fragments of soil from the sides of the hole do not drop into the concrete as it is placed. When the bore hole is stabilized using drilling mud, the temporary casing is not required except near the top.

The metal casing shall be of sufficient thickness and strength to hold its original form and show no harmful distortion while driving or when adjacent casings are driven.

Cast in-situ concrete driven piles shall be installed using a properly designed detachable shoe at the bottom of the casing.

Bored cast in-situ piles in soils which are stable, may often be installed with only a small casing length at the top. A minimum of 2 m length of top of bore shall invariably be provided with casing to ensure against loose soil falling into the bore. In cases in which the side soil can fall into the hole, it is necessary to stabilize the side of the bore hole with drilling mud, or a suitable steel casing. Permanent steel liner shall be provided at least up to maximum scour level. The minimum thickness of steel liner shall be 6 mm.

Permanent steel liner shall be provided for the full depth of the pile in the following situations where:

- The surrounding soil is marine clay

- Soft soil is present

- Surrounding soil has sulphate content equal to or more than 1%

- Surrounding water has sulphate content equal to or more than 2500 ppm

- Leakage of sewage is expected

For bored cast in-situ piles, casing/liner shall be driven open ended with a pile driving hammer capable of achieving penetration of the liner to the depth shown on the drawing or as approved by the Engineer. Materials inside the casing shall be removed progressively by air lift, grab or percussion equipment or other approved means.

Where bored cast in-situ piles are used in soils liable to flow, the bottom of the casing shall be kept sufficiently in advance of the boring tool to prevent the entry of soil into the casing, leading to formation of cavities and settlements in the adjoining ground. The water level in the casing should generally be maintained at the natural ground water level for the same reasons. The joints of the casing shall be made as leak-tight as possible to minimize inflow of water or leakage of slurry during concreting.

The diameter of the boreholes shall not be more than the inside diameter of the liner when the liners are installed before boring. When the liners are installed after boring, the diameter of the boreholes shall not be more than the outside diameter of liner + 2 mm, unless otherwise approved by Engineer.

2.4 Use of Tremie

The concrete should invariably be poured through a tremie with a funnel, so that the concrete can be properly deposited in the hole without segregation. For concreting done by tremie, the following requirements which are particularly applicable shall be ensured:

The hopper and tremie should be a leak proof system.

Diameter of tremie shall be not less than 200 mm for use with 20 mm diameter down aggregate.

The first charge of concrete should be placed with a sliding plug pushed down the tube ahead of it or with a steel plate with adequate charge to prevent mixing of concrete and water. However, the plug should not be left in the concrete as a lump.

The tremie pipe should always penetrate well into the concrete with an adequate margin of safety against accidental withdrawal of the pipe. The tremie should be always full of concrete.

The pile should be concreted wholly by tremie and the method of deposition should not be changed part way up the pile, to prevent laitance from being entrapped within the pile.

All tremie tubes shall be thoroughly cleaned after use.

For concrete placed through tremie, there is no need to add 10 percent extra cement.

Concreting of piles shall be carried out continuously. In exceptional cases of interruption of concreting the tremie shall not be taken out of the concrete under any circumstances. The tremie pipe shall be raised and lowered slowly from time to time to prevent it from getting stuck in the concrete while ensuring its lower end does not come out of concrete. The concreting shall be resumed before final setting time of concrete, which shall be established before the start of the piling operation. For achieving longer setting time of the concrete, super plasticizers having retarding properties/retarders can be used. If any of these requirements are not met, the pile shall be rejected.

2.5 Removal of Concrete above Cut-off Level

It is desirable that the concrete above cut-off level, is removed before the concrete is set. This may be done manually or by specially made bailer or other device. Such removal of concrete helps in preventing the damage of the good concrete below the cut-off level, which results from chipping by percussion method.

The removal of concrete shall be within ± 25 mm from the specified cut off level, preferably on the minus side. After removal of such concrete, the concrete shall be compacted with rammer with spikes or vibrated.

In case the concrete is not removed before setting, a groove shall be made on outer perimeter by rotary equipment before chipping by percussion method.

The minimum embedment of cast in-situ concrete piles into pile cap shall not be less than 50 mm. Any defective concrete at the head of the completed pile shall be cut away and made good with new concrete. The clear cover between the bottom reinforcement in pile cap from the top of the pile shall be not less than 25 mm. The reinforcement in the pile shall be exposed for full anchorage length to permit it to be adequately bonded into the pile cap. Exposing such length shall be done carefully to avoid damaging the rest of the pile.

3. PILE TESTS (cl. 1113 of MoRT&H)

3.1 Initial Load Test

The number of initial tests shall be determined by the Engineer taking into consideration the bore log and soil profile, design length, pile diameter and design pile capacity. However, it shall not be less than two for each category.

Initial load test for axial load capacity, including uplift capacity if required, on trial piles of the same diameter as of the design pile, shall be carried out after 28 days design strength is

achieved. The testing shall be done as per the procedure laid down in IS:2911, Part-IV. The load test shall be conducted for not less than 2 1/2 times the design load. The initial load test shall be cyclic load test for piles deriving strength from end bearing and side friction. The maintained load test can be performed for end bearing piles which do not rely on friction and for piles socketed in rock; as initial load test value. The number of initial tests shall be determined by the Engineer taking into consideration the bore log and soil profile.

Lateral load tests shall be carried out for estimating the lateral load capacity of the piles. The test procedure shall be carried out as per IS 2911 Part IV. However, the permissible deflection shall be as per IRC:78.

In particular cases where upper part of pile is likely to be exposed later due to scour, then the capacity contributed by that portion of the pile during load test, shall be accounted for.

If the initial load test gives a capacity greater than 25 percent of the capacity calculated by static formula and if it is desired to take benefit of the higher capacity, another two load tests shall be carried out to confirm the earlier value and minimum of the three shall be considered

3.2 Routine Load Tests

Routine load test shall be carried out at actual locations of foundations of bridges to re-confirm or modify the allowable loads. The lateral load test may be conducted on two adjacent piles. However, results of routine load tests shall not be used for upward revision of design capacity of piles. The minimum number of tests to be conducted for confirming the capacity shall be as per Table 1100-3.

3.3 Permissible Overload

While conducting routine test on one of the piles belonging to a pile group, if the pile capacity is found to be deficient (based on the settlement criteria of 12 mm for piles of diameter up to and including 600 mm and 2 percent of the pile diameter for piles of diameter more than 600 mm at 1.5 times the design load) an overload up to 10 percent of the capacity may be allowed.

3.4 For a quick assessment of pile capacity, strain dynamic tests may be conducted after establishing correlation using the results of load tests. However, results of strain dynamic tests shall not be used for upward revision of design capacity of pile. Detailed guidelines and references are given in IRC:78. These methods can be followed.

To have a fairly good idea about the quality of concrete and construction defects like voids, discontinuities etc., pile integrity tests are extensively conducted. Detailed guidelines in this connection are given in IRC:78.

4. PILE CAP (cl. 1114 of MoRT&H)

Casting of pile cap should be at a level higher than low water level unless functionally required to be below low water level. In such cases dewatering shall be resorted to allow concreting in dry conditions. Pile caps shall be of reinforced concrete. A minimum offset of 150 mm shall be provided beyond the outer faces of the outermost piles in the group. If the pile cap is in contact with earth at the bottom, a leveling course of minimum 80 mm thickness of M 15 nominal mix concrete shall be provided. In marine conditions or areas exposed to the action of harmful chemicals, the pile cap shall be protected with a coating such as bituminous based coal tar epoxy or epoxy-based coating or with suitable anti corrosive paint. Concrete with high alumina cement, shall not be used in marine environment.

The attachment of the pile head to the cap shall be adequate for the transmission of loads and forces. A portion of pile top may be stripped of concrete and the reinforcement anchored into the cap. Manual chipping may be permitted three days after casting of pile, while pneumatic tools for chipping shall be permitted only seven days after casting of pile. The top of pile after stripping shall project at least 50 mm into the pile cap.

The top of concrete in a pile shall be brought above cut-off level to permit removal of all laitance and weak concrete before pile cap is laid. This will ensure good concrete at the cutoff level.

5. IMPORTANT CONSIDERATIONS, INSPECTION / PRECAUTIONS FOR DIFFERENT TYPES OF PILES (cl. 1115 of MoRT&H)

5.1 Driven Cast In-Situ Piles

5.1.1 Specialist literature and the guidelines from the pile construction industry shall be consulted regarding the method of installation, equipment and accessories for pile driving and recording of data.

5.1.2 During installation of piles, the final "set" of penetration of pile per blow of hammer shall be checked taking an average of last 10 blows.

The pile shoes which may be of either cast iron conical type or mild steel flat type shall have double reams for proper seating of the removable casing tube inside the space between the reams.

5.1.3 Before commencement of pouring of concrete, it shall be ensured that there is no ingress of water in the casing tube from the bottom. Further, adequate control during withdrawal of the casing tube is essential so as to maintain sufficient head of concrete inside the casing tube at all stages of withdrawal.

5.1.4 Concrete in piles shall be cast up to a minimum height of 600 mm above the designed top level of pile, which shall be stripped off at the time of construction of pile cap.

5.2 Bored Cast In-Situ Piles.

5.2.1 While concreting uncased piles, voids in concrete shall be avoided and sufficient head of concrete is to be maintained to prevent inflow of soil or water into the concrete. It is also necessary to take precautions during concreting to minimize the softening of the soil by excess water. Uncased cast in-situ piles shall not be allowed where mudflow conditions exist.

5.2.2 The drilling mud such as bentonite suspension shall be maintained at a level sufficiently above the surrounding ground water level throughout the boring process, to ensure the stability of the strata which is being penetrated until the pile has been concreted.

5.2.3 Where bentonite suspension is used to maintain the stability of the borehole, it is essential that the properties of the material be carefully controlled at stages of mixing, supply to the borehole and immediately before concrete is placed. It is usual to limit:

- The density of bentonite suspension to 1.05 g/cc
- The marsh cone viscosity between 30 and 40
- The pH value between 9.5 and 12
- The silt content less than 1 percent
- The liquid limit of bentonite not less than 400 percent

These aspects shall act as controlling factors for preventing contamination of bentonite slurry for clay and silt.

5.2.4 The bores shall be washed by bentonite flushing to ensure clean bottom at two stages viz. after completion of boring and prior to concreting after placing of reinforcement cage. Flushing of bentonite shall be done continuously with fresh bentonite slurry till the consistency of inflowing and outflowing slurry is similar.

5.2.5 For concreting of piles using tremie, Clause 1107 of MoRT&H Specifications may be referred.

For very long or large diameter piles, use of retarding plasticizer in concrete is desirable.

5.2.6 For large diameter piles, it may be essential to conduct non-destructive pile integrity tests to evaluate integrity of the pile.

5.2.7 Where possible, it may be desirable to grout the base of pile with cement slurry under suitable pressure after concrete in the pile attains the desired strength. For this purpose, conduit pipes with easily removable plugs at the bottom end, should be placed in the bore along with reinforcement cage before concreting.

6. TOLERANCES (cl. 1116 of MoRT&H)

6.1 Permissible Tolerances for Piles

Bored Piles:

- Variation in cross-sectional dimensions : + 50 mm, -10 mm
- Variation from vertical for vertical piles : 1 in 150
- Variation in the final position of the head in plan : 75 mm
- Variation of level of top of piles : ± 25 mm

7. WELL FOUNDATIONS

7.1 GENERAL

7.1.1 Wells may have a circular, rectangular or D-shape in plan and may consist of one, two or more compartments in plan.

7.1.2 In case of well foundations of size larger than 12 m diameter, supplemental construction specifications will be necessary.

7.1.3 The subsurface geotechnical investigations to be carried out before commencement of work of well foundations shall be in accordance with relevant clauses of Section 1900 of MoRT&H Specifications.

7.1.4 In case blasting is anticipated for facilitating sinking through difficult strata such as boulders and rock, special protective/strengthening measures for the curb and steining of the well will be required.

7.1.5 Pneumatic sinking may have to be resorted to in cases where the well has to be sunk through rock/hard strata or where there are obstacles such as tree trunks, large sized boulders etc., which cannot be removed by open dredging. In such cases, the decision regarding adoption of pneumatic sinking shall be taken on the basis of results of confirmatory bores and as directed by the Engineer.

7.2 SETTING OUT AND PREPARATIONS FOR SINKING (cl 1203 of MoRT&H)

7.2.1 Necessary reference points shall be accurately fixed to mark x-x axis along the direction of traffic and y-y axis normal to direction of traffic. Such reference points shall be away from the zone of blow-ups or possible settlements which may result from well sinking operations and shall be connected to the permanent stations with the base line on the banks. The centre of the individual wells shall be marked with reference to these stations. The distances between the wells shall be checked with the help of precision instruments.

7.2.2 A temporary benchmark shall be established near the well foundation, away from the zone of blow-ups or possible settlement. The bench mark shall be checked regularly with respect to the permanent bench mark established at the bridge site.

7.2.3 For wells located on the banks of the river or in dry area, the bed may be prepared by excavating the soil up to 1.5 m, followed by levelling and dressing before placing the cutting edge.

7.2.4 For wells which are to be located in water, a sand island shall be constructed for laying the cutting edge and well curb. Sand islands are practicable for water depths of up to 5 m under stable bed soil conditions. Where the depth of water is greater than 5 m or in flowing rivers or for locations where soil is too weak to sustain sand island, floating caissons may have to be adopted.

The plan dimensions of sand islands shall be such as to have a working space of at least 2 m all around the steining of the well. Sand islands shall be maintained to perform their functions, until the well is sunk to a depth below the original bed level at least equal to the depth of water at that location.

The sand island shall be held in position and protected against scour by means of wooden ballies properly braced or sheet piles. The top level of the sand island to be decided by the Engineer, shall be sufficiently above the prevailing water level so that it is not affected by wave action.

7.2.5 Equipment shall be deployed for construction of well foundation as required and as directed by the Engineer. Generally, the following equipment may be required for the work:

- a) crane with grab buckets - capacity 0.5 cum to 2.0 cum
- b) submersible pump
- c) air compressors, air locks and other accessories where pneumatic Sinking of well is anticipated
- d) chisels of appropriate sizes
- e) aqua-header for cutting rocky strata
- f) diving helmets and accessories
- g) batching plants for concrete production
- h) equipment for transportation, placing and compaction of concrete

7.3 CUTTING EDGE (cl 1204 of MoRT&H)

7.3.1 The cutting edge shall be made from structural steel sections conforming to

7.3.2 Section 1900 of these Specifications and shall be strong enough to facilitate sinking of the well through the type of strata expected to be encountered. The weight of the cutting edge shall not be less than 40 kg per metre length. It shall be properly anchored into the well curb as shown on the drawing.

7.3.3 When there are two or more compartments in a well, the bottom of the cutting edge of the inner walls shall be kept at about 300 mm above that of outer walls.

7.3.4 In V shaped cutting edge, the inclined plate should meet the vertical plate in Such a way that full strength connection by welding is feasible.

7.3.5 The parts of cutting edge shall be erected on level firm ground about 300 mm above prevalent water level. Temporary supports shall be provided to facilitate fabrication and for maintaining the assembly in true shape. The fabrication may be carried out in the shop or at site. Steel sections shall not be heated and forced into shape. However, "V" cuts may be made in the horizontal portion, uniformly throughout the length, to facilitate cold bending. After bending, such "V" cuts should be closed by welding. Joints in the lengths of structural sections, unless otherwise specified, shall be fillet welded using single cover plate to ensure the requisite strength of the original section.

7.4 WELL CURB (cl 1205 of MoRT&H)

7.4.1 The well curb shall be such that it will offer minimum resistance while sinking but will be strong enough to be able to transmit superimposed loads from the steining to the bottom plug. The shape and outline dimensions of the curb shall be as shown in IRC:78. The internal angle of the curb shall be about 30° to 37° depending upon geotechnical data of the strata through which the well is to be sunk.

7.4.2 The well curb shall be in reinforced concrete having concrete mix in accordance with Table 1700-2 and Table 1700-3 and with minimum reinforcement of 72 kg/cum excluding bond rods. The steel shall be suitably detailed to prevent spreading and splitting of curb during sinking. The outer face of the curb shall be vertical. The bottom ends of vertical bond rods of steining shall be fixed securely to the cutting edge with check nuts or by welds. Concreting of the well curb shall be done in one continuous operation.

7.4.3 Steel formwork for well curb shall be fabricated strictly in conformity with the drawing. The formwork on outer face of curb may be removed within 24 hours after concreting while that on inner face shall be removed only after 72 hours.

In case blasting is anticipated, the inner face of the well curb shall be protected with steel plates of thickness not less than 10 mm up to the top of the well curb. If considered necessary, the inner face of steining may also be protected with steel plates of 6 mm thickness up to a height of 3 m above the top of the well curb or as specified by the Engineer. The curb as well as 3 m height of steining above the curb, shall be provided with additional hoop reinforcement of 10 mm diameter bar at 150 mm spacing. Additional hoop reinforcement shall be provided in the steining for a further height of up to two times the thickness of steining above the plates, so as to avoid cracking which may arise on account Of Sudden change in the effective section due to curtailment of plate.

7.5 FLOATING CAISSONS (cl 1206 of MoRT&H)

7.5.1 Floating caissons are generally fabricated at or near the banks on dry and or in dry docks and then towed into position. For floating caissons, a detailed method statement covering fabrication, floating and sinking operations, shall be prepared and furnish the Engineer. Such statement shall include the total tonnage of steel involved, fabrication and welding specifications, list of materials and plant and a description of operations and manpower required for the work.

7.5.2 Floating caissons shall be of structural steel conforming to Section 1900 of these Specifications. The joints of the fabricated structure shall be absolutely leak-tight and shall be checked against leakage before floating and being towed to site. The reinforcement of the curb and steining of the well shall be fixed inside the shell by welding before the caisson is floated. Stability of floating caissons shall be ensured against overturning and capsizing under the action of water current, wave pressure and wind while being towed and kept in position. To maintain the stability of the shell while being floated, it may be provided with ballast in the form of water filling up to required level or filling with small amount of concrete. It shall be ensured that the draught of the floating caisson is always less than the depth of water available, so as to facilitate its smooth hindrance-free movement while being towed.

7.5.3 Height of caisson shall be planned to ensure that at any given time, at least one metre of the shell shall be above water level. In case the location is affected by the action of waves, the height shall be suitably increased to avoid water spilling into the caisson. In case the bed has soft soil, the caisson shall be provided with 3 to 5 metres of additional height, as it may sink by itself after grounding in bed. Simultaneous sinking and concreting is required to prevent caisson from tilting. In sandy stratum especially with strong water current, appropriate additional height of caisson is necessary for accommodating local scour.

7.5.4 The floating caisson shall be held in position against untoward movement by wire ropes/chains, using winches mounted on stationary suitable platforms/buoys or similar anchoring systems. Anchoring in minimum three directions, shall be provided to prevent unacceptable longitudinal and lateral movement. The anchoring system shall permit small movements in order to facilitate correct positioning of the caisson at the exact location of the well and until the stage when it is just getting grounded. Special care is necessary where variation in water level is frequent, e.g. in tidal zones.

7.5.5 After being held in correct position, concreting of the floating caisson shall be commenced. The concrete mixed in batching plants, shall be carried to the floating caisson on barges and placed in position through concrete pumps or tremie. When large volumes of concreting are involved, the batching plant concrete pump, crane etc, may all be mounted on a barge kept in the vicinity of the caisson. As no vibration is possible inside the shell, it shall be ensured that the concrete has a slump of 150 to 200; alternatively, self-compacting concrete can be used. The concrete shall be carefully placed uniformly all around the caisson that it settles vertically without any tendency to tilt.

7.6 WELL STEINING (Cl 1207 of MoRTH)

7.6.1 The dimensions, shape, concrete strength and reinforcements of the well steining shall strictly conform to those shown on the drawings. The formwork shall preferably be of M.S. sheets shaped and stiffened suitably. In case timber forms are used, they shall be lined with plywood or M.S. sheets.

7.6.2 The height of the first lift of steining to be cast above the well curb shall not be more than 2 m and subsequent lifts shall not exceed the diameter of the well or the depth of well to be sunk below the bed level at any time. For stability, the first lift of steining shall be cast only after sinking the curb at least partially. Concreting of steining may be carried out in subsequent lifts of about 2 to 2.5 m. Attempts should be made to minimize the number of construction joints. The concreting layers shall be limited to 450 mm restricting the free fall of concrete to not more than 1.5 m. Laitance formed at the top surface of a lift shall be removed to expose coarse aggregates before setting of concrete at the proposed construction joint. As far as possible, construction joints shall not be kept at the location of laps in the vertical steining bars.

7.6.3 The steining of the well shall be built in one straight line from bottom to top Such that if the well is tilted, the next lift of steining will be aligned in the direction of the tilt. The work will be checked carefully with the aid of straight edges of lengths approved by the Engineer. Plumb bob or spirit level shall not be used for alignment. After sinking of a stage is complete, damaged portions if any, of steining at top of the previous stage shall be properly repaired before constructing the next stage.

7.6.4 For measuring the height of steining, it shall be marked with at least 4 gauges, two in traffic direction and two normal to traffic direction, distributed equally on the outer face of the well. The marking shall be in the form of a 100 mm wide strip painted on the steining with every metre marked in black paint. Marking of the gauges shall be done carefully and accurately with a steel tape, starting with zero at the bottom of the cutting edge. The marking shall be continued upwards as each lift of steining is added.

7.6.5 After reaching the founding level, the well steining shall be inspected to check for any damage or cracks. The Engineer will direct and the Contractor shall execute the remedial measures, if required, before acceptance of the well steining. In case the well is found to be unacceptable even after remedial measures are carried out, then it shall stand rejected.

7.7 WELL SINKING (cl 1208 of MoRTH)

7.7.1 General

The well shall be sunk true and vertical through all types of strata. No well shall be permitted to be placed in a pre-dredged hole.

Sinking or loading of the well with kentledge shall be commenced only after the steining has been cured for at least 48 hours or as specified in the drawings.

The well shall be sunk by excavating the material uniformly from inside the dredge hole using cranes with grab buckets of appropriate capacity. Use of water jetting, explosives and divers may be adopted for sinking of

wells through difficult strata, with prior approval of the Engineer. Well sinking can also be carried out by jack down method.

Normally dewatering of well should not be permitted as a means for sinking the well. It shall never be resorted to if there is any danger of sand blowing under the well. Dewatering shall however be done when well is to be founded in rock. Pneumatic sinking may have to be resorted to where obstacles such as tree trunks, large sized boulders etc. are met or when there is hard strata which cannot be removed by open dredging. The necessity for adopting pneumatic sinking shall be decided by the Engineer.

Complete history of sinking of each well giving details of concreting, sinking and problems met, if any, shall be maintained in the format given in Appendix 1208.2 MoRTH Specifications

7.7.2 Sand Blows in Wells

Dewatering of the well shall not be carried out if sand blows are expected. Any equipment or men working inside the well, shall be brought outside the well as soon as there are any indications of sand blow occurring. Sand blow can often be minimized by keeping the level of water inside the well higher than the water table and also by adding heavy kentledge.

7.7.3 Use of Kentledge for Sinking of Well

Kentledge shall be placed in an orderly and safe manner on the loading platform and in such a way that it does not interfere with the excavation of the material from inside the dredge hoe and also does not in any way damage the steining of the well.

Where tilt has occurred or there is a danger of well developing a tilt, the position of the load shall be regulated in such a manner as to provide greater sinking effort on the higher side of the well.

7.7.4 Use of Water Jetting

Water jetting can be used to facilitate sinking of wells through clay/hard strata. The decision regarding use of water jetting shall be taken at the design stage itself, based on geotechnical investigations which may be indicating presence of hard, clayey strata. For carrying out water jetting, the required number of steel pipes of 40 to 50 mm diameter shall be embedded in the steining of the well, spaced evenly around its periphery. The bottom of the steel pipe shall taper down to a nozzle exiting in the sloping face of the well curb. The diameter of the nozzle shall be 6 mm. The steel pipe shall be kept about 1m above the top of each lift of steining, so that it can be extended by means of suitable couplers before the next lift of steining is cast. When the well reaches the hard strata and the need for water jetting arises, the tops of the embedded pipes shall be connected to pumps of required capacity for pumping in water at high pressure. The water jet issuing from the nozzle of the pipe under high pressure, cuts through the hard material and loosens it, permitting the well to sink at a faster rate than would otherwise have been possible. When water jetting is to be adopted, the Contractor shall furnish a method statement for approval of the Engineer covering all aspects of the work including the number, capacity and location of the high-pressure pumps and other ancillaries required for executing the work.

7.7.5 Use of Jack Down Method

The jack down method of sinking shall be adopted as per requirement or as directed by the Engineer. The first step shall be to install ground anchors outside the periphery of the well. The number, location and depth of ground anchors are decided based on the properties of the surrounding soil to develop the necessary resisting force through skin friction. The drill holes of about 150 mm diameter along with casings shall be taken down to a depth of about 20 m or more below the founding level of the well, depending on requirements of design. After the holes have been drilled to the required depth, prestressing strands of adequate diameter and capacity are cut to the desired length and lowered into the holes. The holes shall then be grouted with cement slurry with non-shrink additive. Once the grouting is completed till the ground level, the casing is removed. The removal of the casing shall be done before the grout sets. In case rock is met with, the anchors shall be socketed into rock.

Heavy duty pressurization girders fabricated of steel, shall be placed over stools resting on the steining of the well, against which the hydraulic jacks connected to the ground anchors, can exert pressure to push the well down. The hydraulic jacks shall be of capacity 500 Ton or more as per requirement. Before applying pressure from the jacks, 1 m deep sump is created inside the well by dredging. Pressure on different jacks is exerted in such a manner as to neutralize any tendency of the well to tilt. With the use of the jacks and controlled dredging, high rates of sinking can be achieved and the chances of sand blowing can also be reduced.

For use of jack down method of sinking, the Contractor shall furnish a method statement for approval of the Engineer, giving full details of construction of ground anchors, fabrication of pressurizing girder, type, number

and capacity of jacks to be used, method of dredging and application of jack down force and all other relevant aspects for proper execution of the Work.

7.7.6 Use of Explosives

Mild explosive charges may be used as an aid for sinking of the well. All prevalent laws concerning handling, storing and using of explosives shall be strictly followed. All Safety precautions shall be taken as per IS:4081 "Safety Code for Blasting and related Drilling Operations", to the extent applicable, whenever blasting is resorted to.

When the likelihood of resorting to blasting is predicted in advance, protection of the bottom portion of the well shall be done as per Clause 1205.4.

Blasting of any sort shall be done only with prior permission and in the presence of the Engineer. Blasting shall not be done before the concrete in the steining has hardened sufficiently and is more than 7 days old.

After blasting operations are completed, the well curb and steining should be examined for any cracks and remedial measures taken if required.

If blasting has been done after the well has reached the design foundation level, normally 24 hours shall be allowed to lapse before the bottom plug is laid.

The charges shall be exploded well below the cutting edge by making a sump so as to avoid chances of any damage to the curb or to the steining of the well. A minimum sump of 1 m depth should be made before resorting to blasting. Use of large charges, 0.7 kg or above, may not be allowed, except under expert direction and with the permission of the Engineer. The pattern of charges may be suitably arranged with delay detonators so as to reduce the number of charges fired at a time. The burden of the charge may be limited to 1 m and the spacing of holes may normally be kept as 0.5 m to 0.6 m.

There should be no equipment inside the well nor shall there be any worker in the close vicinity of the well at the time of exploding the charges.

If rock blasting is to be done for seating of the well, the damage caused by flying debris should be minimized by covering blasting holes with rubber mats before detonating the charge.

7.7.7 Use of Divers

Divers may be used for removal of obstructions during sinking, carrying out rock blasting and for inspection. All safety precautions shall be taken as per any acceptable safety code or any statutory regulations in force, when divers carry out work under water in the well.

Only persons trained in diving operations shall be employed after being certified fit for diving by an approved doctor. They shall work under expert supervision. The raising of the dive from the bottom of wells shall be controlled so that decompression rate conforms to the rate as laid down in relevant regulations.

The diving and other equipment shall be of acceptable standard and certified to this effect by an approved independent agency. They shall be well maintained as per requirements safe use.

Arrangement for ample supply of low pressure clean cool air shall be ensured through an armoured flexible hose pipe. Standby compressor shall be provided to cover the contingency of breakdown of the compressor.

Separate high-pressure connection shall be made for use of pneumatic tools. Electric lights where provided shall be at 50 volts (maximum).

7.8 Use of Pneumatic Sinking

7.8.1 General

The Engineer shall familiarize himself with particular reference to 'caisson diseases' and working of the medical air-lock. A doctor competent to deal with cases of 'caisson diseases' or other complications arising as a result of working under high pressure, shall be stationed at the construction site when pneumatic sinking is under progress.

The Contractor shall provide complete facilities and ensure strict enforcement of the requirements outlined in these specifications.

Safely provisions as contained in IS:4138 and in these specifications shall be strictly followed.

Pneumatic sinking shall be limited to a depth of 30 m below ground level.

7.8.2 Man Locks and Shafts

Locks, reducers, and shaft used in connection with caissons shall be of riveted construction throughout. The material used in their manufacture shall be steel plate with thickness not less than 6 mm.

Shafts shall be subjected to hydrostatic or air pressure test so as to ensure leak-tightness at a pressure of at least 0.5 MPa. The pressure at which testing has been done shall be clearly and visibly displayed.

The shaft shall be provided with safe, proper and suitable staircase for its entire length including landing platforms which shall be not more than 6m apart. Where this is impracticable due to space constraints, suitable ladders along with landing platforms shall be installed. These shall be kept clear and in good condition at all times and shall be Constructed, inspected and maintained to the entire satisfaction of the Engineer.

A 1 m wide platform with 1 m high railing shall be provided all-round the caisson air locks.

Where 15 or more men are employed, caissons shall have two locks, one of which Used as a man-lock.

Locks shall be located so that the lowest part of the bottom door shall not be less than 1 m above the highest water level in the well.

The supply of fresh air to the working chamber shall at all times be sufficient to permit work to be done without any danger or excessive discomfort. All air supply lines shall be fitted with check valves.

A man lock shall be used solely for the compression or decompression of workers and not for the passage of plant and material and shall be maintained in a reasonably clean and sufficiently warm state. However, any hand tool or hand instruments used for the purpose of the work may be carried into the man lock.

Where it is not reasonably practicable to provide a separate man lock for use by workers only, the lock when it is in actual use for compression or decompression of a person, shall be in a reasonably clean and sufficiently warm state and shall not be put simultaneously to any other use.

7.8.3 Valves

Exhaust valves shall be provided, having risers extending to the upper part of the chamber. These shall be operated, whenever necessary specially after a blast. Precautions shall be taken that men are not allowed to resume work after a blast, until the gas and smoke have cleared.

7.8.4 Medical Supervision and Certification

Every employee absent from work for 10 or more consecutive days due to illness or any other disability, shall be required to pass the regular physical examination by the doctor before being permitted to return to work.

After a person has been employed continuously in compressed air for a period of 2 months, he shall be re-examined by the doctor and shall not be permitted to work until such re-examination has been made and the report is satisfactory.

No person known to be addicted to the excessive use of intoxicants shall be permitted to work in compressed air

The doctor shall, at all times, keep a complete and full record of examination made by him, which shall contain dates of examinations, a clear and full description of the persons examined, his age and physical condition at the time of examination and a statement as to the period for which he has been engaged in such work. Records shall be kept at the place where the work is in progress and shall be subject to inspection by authorized officers.

Every man lock shall always have a doctor or a responsible person in attendance. In case the person in charge is not a doctor, he must have positive means of promptly communicating with and securing the services of a competent doctor in case of emergency. Such arrangements shall invariably be subject to the approval of the Engineer.

All cases of compressed-air illness shall be reported and copies of all such reports shall be kept in file at the place of work.

7.8.5 Lighting

All lighting in compressed air chambers shall be operated only by electricity. Two independent electric lighting systems with independent sources of supply shall be used. These shall be so arranged that the emergency source shall become automatically operative in case of failure of the regularly used source.

The minimum intensity of light on any walkway ladder, stairway, or lower working level shall be one-quarter (1/4) candlepower. In all work places, the lighting shall always be such as to enable workmen to see their way about clearly. All external parts of lighting fixtures and electrical equipment lying within 2.5 m above the floor shall be constructed of non-combustible, non-absorbing insulating materials. If metal is used, it must be effectively earthed. Portable lamp shall have non-combustible, non-absorbing insulating sockets, approved handles, basket guards and approved cables. The use of worn out or defective portable and pendant conductors is prohibited.

7.8.6 Safety Against Fire Hazard

No oil, gasoline, or other combustible material shall be stored within 30 m of any shaft, caisson or tunnel opening. It shall be positively ensured that leaking flammable liquids do not flow into such areas. Oil may be

stored in suitable tanks in isolated fireproof buildings, which are not less than 15 m away from any shaft, caisson, or tunnel opening or any building directly connected thereto.

Where feasible, a fire hose connected to a suitable source of water shall be provided at the top of every caisson. Where fire mains are not accessible, water shall be stored in tanks near the top of every caisson, provided fire pails or suitable pumps are kept available. Approved fire extinguishers shall also be provided.

7.8.7 Sanitation

Properly heated, lighted and ventilated dressing rooms shall be provided for all employees engaged in compressed air work. Such rooms shall contain lockers and benches and be open and accessible to person during intermissions between shifts. Adequate toilet accommodation Or one for every twenty-five employees shall be provided.

Care shall be taken to keep all parts of the caissons and other working compartments, including working compartments including free locker rooms, dry rooms, rest rooms and other equipment in good sanitary condition and from refuse, decaying or other objectionable matter.

Smoking shall be strictly prohibited and matches and smoking materials shall not be allowed to be brought into the locker rooms.

A separate dry room shall be provided where working clothes may be dried in a reasonable time.

7.8.8 Protection Against Gases

In all cases where release of gas is expected as in the case of sinking through alluvium impregnated with decayed vegetable matter, the use of Davy Safety Lamp shall be compulsory.

7.8.9 Additional Safety Provisions

a) The weight of the pneumatic platform and that of steining and kentlege, if any, shall be sufficient to resist the uplift from air inside, skin friction being neglected in this case. If at any section, the total weight acting downwards is less than the uplift pressure of air inside, additional kentledge shall be placed on the well. If it is not possible to make the well heavy enough during excavation, "blowing down" may be used. The men should be withdrawn and air pressure reduced. The well should then begin to move with small reduction in air pressure. "Blowing down" should only be used when the ground is such that it will not heave up inside the chamber when the pressure is reduced. When the well does not move with the reduction in air pressure, kentledge should be added. "Blowing down" should be in short stages and the drop should not exceed, 0.5 m at any stage. To control sinking during blowing down, use of packing is recommended.

b) The pneumatic sinking plant and other allied machinery shall not only be of proper design and make, but also shall be operated by compete and well-trained personnel. Every part of the machinery and its fixtures shall be minutely examined before installation and use. Availability appropriate spares, standbys, safety of personnel as recommended I IS:4138 for working in compressed air must be ensured at site. Codes for safety and for working in compressed air and other labour laws a practices prevalent in the country, as specified to provide safe, efficient and expeditious sinking shall be followed.

c) Inflammable materials shall not be taken into air locks and smoking shall be prohibited. Wherever gases are suspected to be issuing out of dredge hole, the same shall be analysed by trained personnel and necessary precautions adopted to avoid hazard to life and equipment.

d) Where blasting is resorted to, it shall be carefully controlled and all required precautions shall be observed. Workers shall be allowed inside after blasting only when a competent and qualified person has examined the chamber and steining thoroughly and found the same to be safe.

7.8.10 Precautions During Sinking

a) When wells have to be sunk close to each other and clear distance between them is less than the diameter of wells, sinking shall be taken up on all wells and they shall be sunk alternately so that the sinking proceeds uniformly. Simultaneous and even dredging shall be carried Out in the wells in such a manner that the difference in the levels of the sump and cutting edge in the adjacent wells does not exceed half the clear gap between them. Plugging of all the wells shall be done together.

b) During sinking of double D-shaped wells, the excavation in both the dredge holes should be carried out simultaneously and equally.

- c) Bore chart shall be referred to constantly during sinking for taking adequate care while piercing different types of strata. The type of soil as obtained during the well sinking should be compared with bore chart so as to take prompt decisions.
- d) Before seasonal floods, all wells on which sinking is in progress shall be sunk to sufficient depths below the designed scour level. Further, they shall be temporarily filled and plugged so that they do not suffer any tilt or shift during the floods.
- e) All necessary precautions shall be taken against any possible damage to the foundations of existing structures in the vicinity of the wells, prior to commencement of dredging from inside the well.
- f) The dredged material shall not be allowed to accumulate around the well. It shall be dumped and spread, as far away as possible, and then continuously and simultaneously removed, as directed by the Engineer. In case the river stream flows along one edge of the well being sunk, the dredged material shall not be dumped on the dry side of the bank but on the side on which the river current flows.
- g) Very deep sump shall not be made below the well curb, as it entails risk of jumping (sudden sinking) of the well. The depth of sump shall be generally limited to one-sixth of the outer diameter/least lateral dimension of the well in plan. Normally the depth of sump shall not exceed 3.0 m below the level of the cutting edge unless otherwise specially permitted by the Engineer.
- h) In case a well sinks suddenly with a jerk, the steining of the well shall be examined to the satisfaction of the Engineer to see that no damage has occurred to it.
- i) In pneumatic sinking, the well shall not, at any time, be dropped to a depth greater than 500 mm by the method of "blowing down".
- j) Dewatering shall be avoided if sand blows are expected. Any equipment and men working inside the well shall be brought out of the well as soon as there are any indications of a sand-blow.
- k) Sand blowing in wells can often be minimized by keeping the level of water inside the well higher than the water table and also by adding heavy kentledge.
- i) In soft strata prone to settlement/creep, the construction of the abutment wells shall be taken up only after the approach embankment for a sufficient distance near the abutment, has been completed.

7.8.11 Tilts and Shifts

Unless otherwise specified, the tilt of any well i.e., its inclination from the vertical, shall not exceed 1 (horizontal) in 80 (vertical). The shift of the well i.e. the horizontal displacement of, the centre of the well at the founding level from its theoretical position, shall not be more than 150 mm in any resultant direction.

Tilts and shifts shall be carefully checked and recorded regularly during sinking operations in the format given in Appendix 1200/1. For the purpose of measuring the tilts along the two axes of the bridge, reduced level of the marks painted on the surface of the steining of the well shall be taken. For determination of shift, locations of the ends of the two diameters shall be precisely measured along the two axes, with reference to fixed reference points.

Whenever any tilt is noticed, adequate corrective measures like placing eccentric kentledge: pulling, strutting, anchoring or depositing more dredged material outside the tilted face, water/air jetting, shall be adopted before any further sinking. After correction, the dredge material shall be removed and disposed of sufficiently away from the affected well. In case of sinking by jack down method tilt can be controlled by suitably adjusting jack down pressure on one side.

A pair of wells close to each other have a tendency to come closer while sinking. Limostruts may be introduced in between the steining of these wells to prevent such movement.

Tilts occurring in a well during sinking in dipping rocky strata can be controlled by suitably supporting the curb.

In the event of a well developing tilt or shift beyond the specified permissible values, the Contractor shall have to carry out, at his own cost, suitable remedial measures to the satisfaction of the Engineer, to bring the tilt and shift within permissible values.

If the resultant tilt and shift of any well exceeds 1 in 80 or 150 mm respectively the well so sunk shall be regarded as not conforming to specification and classified as substandard work. The Engineer in his sole discretion, may consider accepting such a well, provided:

- i) Calculations for foundation pressures and steining stresses, accounting for the actual tilt and shift furnished by the Contractor show that the well is safe. remedial measures required to bring the

stresses within permissible values (such as increase in the dimension of the well cap, provision of dummy weights on the well cap etc.), shall be carried out by the Contractor at his own cost.

- ii) The Contractor shall be subjected to reduction in rates as a penalty in accordance with Clause 1215(g).

In case the Engineer, in his discretion, rejects the well, the Contractor shall dismantle the rejected well to the extent directed by the Engineer and remove the debris. Further, the Contractor shall at his own risk and cost, complete the bridge with modified span arrangement acceptable to the Engineer.

7.8.12 Seating of Wells

The well shall be uniformly seated on the founding strata. It shall be ensured by test borings that the properties of the soil encountered at the founding level and up to a depth of one and a half times the well diameter, is identical to that adopted in the design. The procedure for test boring shall be in accordance with the provisions of these Specifications. In case the soil encountered is inferior to that adopted in design, the well shall be re-designed by the Engineer adopting the soil properties actually encountered and the founding level intimated to the Contractor, who shall carry out the work accordingly.

in case of seating of wells in hard rocky strata, where the rock profile is steeply sloping, pneumatic methods of sinking may be adopted to seat the well evenly as directed by the engineer. The decision of adopting pneumatic sinking shall be taken by the Engineer. The Cutting edge may also be embedded for a suitable depth in the rocky strata, as decided by the Engineer keeping in view the quality of rock. A sump of depth 300 mm in hard rock or 600 mm in ordinary rock shall be made inside the well by chiseling or blasting as approved by Engineer. Diameter of sump shall be 1.5 m to 2 m less than that of the dredge hole. After the well has been evenly seated on good hard rock, arrangements shall be made to facilitate proper inspection in dry and visible conditions before the bottom plug is laid.

7.9 BOTTOM PLUG (cl 1209 of MoRT&H)

A bottom plug of concrete shall be provided in all wells, the top level of which shall be kept a minimum of 300 mm above the top of the curb, as shown in IRC:78. A suitable sump shall be made below the level of the cutting edge. Before concreting the bottom plug, it shall be ensured that the inside faces of curb and steining have been cleaned thoroughly.

The concrete mix used in bottom plug shall have a minimum cement content of 330 kg per Cu.m with a slump about 150 mm, to permit easy flow of concrete through tremie to fill up all cavities. Concrete shall be laid in one continuous operation till the dredge hole is filled to the required height. For under water concreting, the concrete shall be placed by tremie under still water condition and the minimum cement content shall not be less than 330 kg/m³ inclusive of all mineral admixtures, if added.

In case of grouted concrete, the grout mix shall not be leaner than 1:2. It shall be ensured that the grout fills up all interstices upto the top of the bottom plug by suitable means such as, controlling the rate of pumping etc.

Any dewatering required, shall only be done 7 days after casting of bottom plug.

The concrete production and placement equipment should be sufficient to enable under water concreting within stipulated time. Necessary standby equipment should be available for emergency situation.

Before commencing plugging, all loose material from the bottom of the well shall be removed. Concreting shall be done in one continuous operation till the dredge hole is filled up to the required height and thereafter soundings shall be taken to ensure that the concrete has been laid to the required height. Least disturbance shall be caused to the water inside the well while laying concrete in the bottom plug. The concrete after placing, shall not be disturbed in any way for at least 7 days.

In order to check whether there is any rise in the level of the bottom plug, soundings should be taken at the close of concreting and once every day for the next 3 days.

The soundness of the bottom plug may be tested by dewatering the well to a level 5 m below the surrounding water level and checking the rise of water. For foundation subjected to artesian pressure, the depth of dewatering by 5 m shall be measured from the still water level created inside the well by the construction of false steining. The rate of rise shall preferably be less than 10 cm per hour. In case the rate is higher, suitable remedial measures as directed by the Engineer, shall be taken by the Contractor at his own cost.

7.10 SAND FILLING (cl 1210 of MoRT&H)

Sand filling shall commence 7 days after laying of bottom plug. The level of the top of the bottom plug shall be verified before starting sand filling.

The sand shall be clean and free from earth, clay clods, roots, boulders, shingles, etc. and shall be compacted as directed. Sand filling shall be carried out up to the level shown on the drawing or as directed by the Engineer.

7.11 TOP PLUG (cl 1211 of MoRT&H)

After filling sand up to the required level, a top plug of 300 mm thick concrete of grade M 15, shall be provided over it as shown on the drawing or as directed by the Engineer.

7.12 WELL CAP (cl 1212 of MoRT&H)

A reinforced cement concrete well cap will be provided over the top of the steining in accordance with the drawing. Formwork will be prepared conforming to the shape of well cap. In case sand filling has been carried out up to the top of the well, the concrete of the well cap may be laid directly on it after it has been suitably levelled. Otherwise, suitable shuttering supported on the inside of the steining, shall be provided for carrying the weight of the green concrete of the well cap.

Concreting shall be carried out in dry condition. A properly designed false steining may be provided where required, to ensure that the well cap is laid in dry condition.

The bottom of the well cap shall be laid preferably as low as possible but above the LWL in the active channel. Where the bed level is higher than the LWL, the top of the well cap may be suitably raised and kept 1m below existing ground level.

Bond rods of steining shall be anchored into the well cap.

7.13 TOLERANCES (cl 1213 of MoRT&H)

The permissible tilt and shift shall not exceed 1 (horizontal) in 80 (vertical) and the shift at the well base shall not be more than 150 mm in any resultant direction.

For the well steining and well cap, the permissible tolerances shall be as follows:

a) Variation in dimension	:	+50 mm, -10 mm
b) Misplacement from specified position in plan	:	15 mm
c) Surface unevenness measured with 3 m straight edge	:	5 mm
d) Variation of level at the top	:	+25 mm

8. FORMWORK

8.1 MATERIALS (cl. 1502 of MoRT&H)

AH materials shall comply with the requirements of IRC:87. Materials and components used for formwork shall be examined for damage or excessive, deterioration before use/re-use and shall be used only if found suitable after necessary repairs. In case of timber formwork, the inspection shall not only cover physical damages but also signs of attacks by decay, rot or insect attack or the development of splits.

Forms shall be constructed with metal or timber. The metal used for forms shall be of such thickness that the forms remain true to shape. All bolts should be countersunk. The use of approved internal steel ties or steel or plastic spacers shall be permitted. Structural steel tubes used as support for forms shall have a minimum wall thickness of 4 mm. Other materials conforming to the requirements of IRC:87 may also be used if approved by the Engineer.

8.2 DESIGN OF FORMWORK (cl. 1503 of MoRT&H)

The design, erection and removal of formwork shall conform to IRC:87 "Guidelines for Formwork, False work and Temporary Structures" and these specifications. The forms shall be such as to ensure that they can be conveniently removed without disturbing the concrete. The design shall facilitate proper and safe access to all parts of formwork for inspection.

The Contractor shall furnish the design and drawing of complete formwork (i.e. the forms as well as their supports) for approval of the Engineer before any erection is taken up. If

proprietary system of formwork is used, the Contractor shall furnish detailed information as per Appendix 1500/1, to the Engineer for approval.

Notwithstanding any approval or review of drawing and design by the Engineer, the Contractor shall be entirely responsible for the adequacy and safety of formwork.

1503.3 In the case of prestressed concrete superstructure, careful consideration shall be given to redistribution of loads on props due to prestressing.

8.3 WORKMANSHIP (*cl. 1504 of MoRT&H*)

8.3.1 The formwork shall be robust and strong and the joints shall be leak-proof. Ballies shall not be used as staging. Staging must have cross bracings and diagonal bracings in both directions. Staging shall be provided with an appropriately designed base plate resting on firm strata.

8.3.2 The number of joints in the formwork shall be kept to a minimum by using large sized panels. The design shall provide for proper "soldiers" to facilitate alignment. All joints shall be leak proof and must be properly sealed. Use of PVC joint sealing tapes, foam rubber or PVC T-section, is essential to prevent leakage of grout.

8.3.3 As far as practicable, clamps shall be used to hold the forms together. Where use of nails is unavoidable, minimum number of nails shall be used and these shall be of the double-headed type. Alternatively, if the nails are of the normal type, they shall be left partially projecting without being driven to their full length, so that they can be withdrawn easily.

8.3.4 Use of ties shall be restricted, as far as practicable. Wherever ties are used they shall be used with HDPE sheathing so that they can easily be removed. No parts prone to corrosion shall be left projecting or near the surface. The sheathing shall be grouted with cement mortar of the same strength as that of the structure.

8.3.5 Unless otherwise specified, or directed, chamfers or fillets of size 25 mm x 25 mm shall be provided at all angles of the formwork to avoid sharp corners. The chamfers, beveled edges and mouldings shall be made in the formwork itself. Opening for fixtures and other fittings shall be provided in the shuttering as directed by the Engineer.

8.3.6 Shuttering for walls, sloping members and thin sections of considerable height shall be provided with temporary openings to permit inspection and cleaning out before placing of concrete.

8.3.7 The formwork shall be constructed with pre-camber to the soffit to allow for deflection of the formwork. This shall be in addition to the pre-camber for the permanent structure as shown on the drawings.

8.3.8 Where centering trusses or launching trusses are adopted for casting of superstructure, the joints of the centering trusses, whether welded, riveted or bolted shall be thoroughly checked periodically. Also, various members of the centering trusses should be periodically examined for proper alignment and unintended deformation before proceeding with the concreting. They shall also be periodically checked for any deterioration in quality due to steel corrosion. Launching truss, casting truss of span more than 40 m and travelling forms, shall be load tested before they are put to use.

8.3.9 The formwork shall be so made as to produce a finished concrete true to shape, line and levels and dimensions as shown on the drawings, subject to the tolerances specified in respective Sections of these specifications, or as directed by the Engineer.

8.3.10 Where metal forms are used, all bolts and rivets shall be countersunk and well ground to provide a smooth, plane surface. Where timber is used it shall be well seasoned, free from loose knots, projecting nails, splits or other defects that may mar the surface of concrete.

8.3.11 Forms shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration during and after placing the concrete. Screw jacks or hard wood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete.

8.3.12 The formwork shall ensure the correct final shape of the structure, with the calculated amount of positive or negative camber. The deformation of false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes arising in prestressed structures shall be properly accounted for.

8.3.13 Suitable camber shall be provided to horizontal members of structure, specially in long spans, to counteract the effects of deflection. The formwork shall be so fixed as to provide for such camber.

8.3.14 The formwork shall be coated with an approved release agent that will effectively prevent sticking and will not stain the concrete surface. Lubricating oils (machine oils) shall be prohibited for use as coating.

8.4 LINING OF FORMWORK *(cl. 1505 of MoRT&H)*

The formwork shall be lined with material approved by the Engineer so as to provide a smooth finish of uniform texture and appearance. This material shall leave no stain on the concrete and shall be so fixed to its backing as not to impart any blemishes. It shall be of the same type and obtained from only one source throughout for the construction of any one structure. The contractor shall make good any imperfections in the resulting finish as required by the Engineer. Internal ties and embedded metal parts shall be carefully detailed and their use shall be subject to the approval of the Engineer.

8.5 PRECAUTIONS *(cl. 1506 of MoRT&H)*

The following precautions shall be observed:

It shall be ensured that any cut-outs or openings provided in any structural member to facilitate erection of formwork, are closed with the same grade of concrete as that of the structure, after formwork is removed.

Provision for safe access to the formwork shall be made at all levels as required.

Close watch shall be maintained to check for settlement of formwork during concreting and any settlement shall be promptly rectified.

Natural ground shall be checked for bearing capacity and likely settlement before erection of the staging.

It shall be ensured that water used for curing or rain water does not stagnate near the base plate of the staging.

For shutters used for deep and narrow member, temporary openings in the sides shall be provided to facilitate pouring and compaction of concrete.

8.6 PREPARATION OF FORMWORK BEFORE CONCRETING *(cl. 1507 of MoRT&H)*

The inside surfaces of forms shall, except in the case of permanent formwork or where otherwise agreed to by the Engineer, be coated with a release agent supplied by approved manufacturer or of an approved material to prevent adhesion of concrete to the formwork. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not be allowed to come in contact with any reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in formwork for exposed concrete.

Before re-use of forms, the following actions shall be taken :

The contact surfaces of the forms shall be cleaned carefully and dried before applying a release agent.

It should be ensured that the release agent is appropriate to the surface to be coated. The same type and make of release agent shall be used throughout on similar formwork materials and different types should not be mixed.

The form surfaces shall be evenly and thinly coated with release agent. The vertical surface shall be treated before horizontal surface and any excess wiped out.

It shall be ensured that the reinforcement or the surface of the hardened concrete shall not come in contact with the release agent.

All forms shall be thoroughly cleaned immediately before concreting.

The Contractor shall give the Engineer due notice before placing any concrete in the forms to permit him to inspect and approve the formwork. However, such inspection shall not relieve the contractor of his responsibility for safety of formwork, men, machinery, materials and finish or tolerances of concrete.

8.7 REMOVAL OF FORMWORK *(cl. 1508 of MoRT&H)*

The scheme for removal of formwork (i.e. de-shuttering and de-centering) shall be planned in advance and furnished to the Engineer for scrutiny and approval. No formwork or any part thereof shall be removed without prior approval of the Engineer.

The formwork shall be so removed as not to cause any damage to concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually to avoid any shock or vibration.

Form work shall not be released unless the concrete has achieved strength of at least twice the stress the concrete may be subjected at the time of the removal of formwork. When no test is conducted for determination of strength of concrete and where the time of removal of formwork is not specified, the same shall be as under:

a)	Walls, piers, abutments, columns and vertical faces of structural members	12 to 48 hours as may be decided by the Engineer
b)	Soffits of Slabs (with props left under)	3 days
c)	Props left under slabs	14 days
d)	Soffits of Girders (with props left under)	7 days
e)	Props (left under girders)	21 days

The above time schedule is applicable when ordinary Portland Cement is used without any admixtures at an ambient temperature exceeding 10°C.

For concrete made with Portland pozzolona cement, Portland slag cement or mineral admixtures, additional cube samples shall be taken for verifying the strength of concrete to decide the time of deshuttering.

Where there are re-entrant angles in the concrete sections, the formwork should be removed at these sections as soon as possible after the concrete has set, in order to avoid cracking due to shrinkage of concrete.

Additional precautions as given in Clause 8.17 of IRC: 87, shall also be followed.

8.8 RE-USE OF FORMWORK *(cl. 1509 of MoRT&H)*

When the formwork is dismantled, its individual components shall be examined for damage and damaged pieces shall be removed for rectification. Such examination shall always be carried out before their use again. Before re-use all components shall be cleaned of deposits of soil, concrete or other unwanted materials. Threaded parts shall be oiled after cleaning.

All bent steel props shall be straightened before re-use. The maximum permissible deviation from straightness is 1/600 of the length. The maximum permissible axial loads in used props shall be suitably reduced depending upon their condition. The condition of the timber components, plywood and steel shuttering plates shall be examined closely for distortion and defects before re-use.

8.9 SPECIALISED FORMWORK *(cl. 1510 of MoRT&H)*

Specialised formwork such as slip form, floating caisson and travelling form, wherever used shall be designed and detailed by competent agencies and a set of complete working drawings and installation instructions supplied to the Engineer. In case proprietary equipment is used, the supplier shall furnish drawings, details, installation instructions etc, in the form of manuals along with the formwork.

For slip form, the rate of climb of the formwork shall be designed for each individual case taking into account various parameters including the grade of concrete, concrete strength, concrete temperature, ambient temperature and concrete admixtures.

For floating caisson, the details of fabrication, floating to site and placing in position shall be as given in Clause 1203.5 of MoRT&H Specifications.

In order to verify the time and sequence of striking/removal of specialised formwork, routine field tests for the consistency and strength development of concrete are mandatory.

For specialised formwork, the form lining material may be either plywood or steel sheet of appropriate thickness.

9. STEEL REINFORCEMENT

9.1 GENERAL

Steel for reinforcement shall meet the requirements of Section 1000 of MoRT&H Specifications.

Reinforcements may be either mild steel or high strength deformed bars. They may be uncoated or coated with epoxy.

9.2 PROTECTION OF REINFORCEMENT *(cl. 1603 of MoRT&H)*

Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or by thoroughly cleaning it using any suitable method such as sand blasting, mechanical wire brushing etc., as directed by the Engineer. Reinforcements shall be stored above the ground in a clean and dry condition, on blocks, racks or platforms and shall be suitably marked to facilitate inspection and identification.

Portions of uncoated reinforcing steel and dowels projecting from concrete, shall be protected within one week after initial placing of concrete, with a brush coat of neat cement mixed with water to a consistency of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week

before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

In case of fusion bonded epoxy coated reinforcement or hot dipped galvanized bars used, reference shall be made Clause 1010.3.2 of Section 1000 of these specifications.

9.3 BENDING OF REINFORCEMENT *(cl. 1604 of MoRT&H)*

Bar bending schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.

Reinforcing steel shall conform to the dimensions and shapes given in the approved Bar Bending Schedules.

Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer using a proper bar bender, operated by hand or power to obtain the correct shape and radii of bends.

Bars shall not be bent or straightened in a manner that will damage the parent material or the coating.

Bars bent during transport or handling shall be straightened before being used on work. They shall not be heated to facilitate straightening.

9.4 PLACING OF REINFORCEMENT *(cl. 1605 of MoRT&H)*

The reinforcement cage should generally be fabricated in the yard at ground level and then shifted and placed in position. The reinforcement shall be placed strictly in accordance with the drawings and shall be assembled in position only when the structure is otherwise ready for placing of concrete. Prolonged time gap between assembling of reinforcement and casting of concrete, which may result in rust formation on the surface of the bars, shall not be permitted.

Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS:280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1 mm.

Bars shall be kept in position usually by the following methods:

In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover, shall be placed between the bars and formwork, subject to satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

In case of dowels for columns and walls, the vertical reinforcement shall be kept in position by means of timber templates with slots cut in them accurately, or with cover blocks tied to the reinforcement. Timber templates shall be removed after the concreting has progressed upto a level just below their location.

Layers of reinforcements shall be separated by spacer bars at approximately one metre intervals. The minimum diameter of spacer bars shall be 12 mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.

Necessary stays, blocks, metal chairs, spacers, metal hangers, supporting wires etc. or other subsidiary reinforcement shall be provided to fix the reinforcement firmly in its correct position.

Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc., as devices for positioning reinforcement shall not be permitted.

Bars coated with epoxy shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose. Refer Section 1000 of these Specifications for other requirements. Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concreting is commenced.

9.5 BAR SPLICES (cl. 1606 of MoRT&H)

9.5.1 Lapping

All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, shall be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or 1.25 times the maximum size of coarse aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points along the span where stresses are low.

9.5.2 Welding

9.5.2.1 Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

9.5.2.2 While welding may be permitted for mild steel reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than Fe 240 grade including special welding grade of Fe 415 grade bars conforming to IS: 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from "the chemical composition using the formula :

$$CE = C + \frac{Mn}{6} + \frac{Cr+Mg+V}{5} + \frac{Ni+Cu}{15}$$

is 0.4 or less.

9.5.2.3 The method of welding shall conform to IS:2751 and IS:9417, any supplemental specifications and Clause 1904.8 of these Specifications to the satisfaction of the Engineer.

Welding may be carried out by metal arc welding process. Oxy-acetelene welding shall not be permissible. Any other process may be used subject to the approval of the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on overheating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

All bars shall be butt welded except for smaller diameter bars (diameter of less than 20 mm) which may be lap welded.

Single-V or Double-V butt joints may generally be used. For vertical bars single bevel or double bevel joints may be used.

Welded joints shall be located well away from bends and shall be not less than twice the bar diameter away from a bend.

Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment, process, consumables, operators and welding procedure, are adequate to produce and maintain uniform quality at par with that attainable in shop welding, to the satisfaction of the Engineer.

Joint welding procedures which are to be employed shall invariably be established by a procedure specification. All welders and welding operators to be employed shall be qualified by tests prescribed in IS:2751. Inspection of welds shall conform to IS:822 and destructive or non-destructive testing may be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection, shall not be accepted.

Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in two or three stages, the surface shall be cleaned properly after each stage. Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Only competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars.

M.S. electrodes used for welding shall conform to IS:814.

9.5.2.4 Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section, not more than 20 percent of the bars are welded.

9.5.2.5 Specimens of welded pieces of reinforcement taken from the site, shall be tested. The number and frequency of tests shall be as directed by the Engineer.

9.5.3 Mechanical Couplers and Anchorages

9.5.3.1 Mechanical Couplers

Bars may be joined with approved patented mechanical devices as indicated on the drawing or as approved by the Engineer e.g. by special grade steel sleeves swaged on to bars in end to end contact or by screwed couplers. In case such devices are permitted by the Engineer, they shall develop at least 125 percent of the characteristic strength of the reinforcement bar.

9.5.3.2 Anchorages

Bars may be anchored with approved patented mechanical anchorages as indicated on the drawing or as approved by the Engineer. The anchorages shall be connected to the reinforcing bar by the use of taper thread system. The anchorage shall be capable of developing the characteristic strength of reinforcement without damage to concrete and shall have sufficient diameter and width to develop adequate shear cone strength. The connection shall develop 125% of the characteristic strength of reinforcement bar.

10. STRUCTURAL CONCRETE

10.1 GRADES OF CONCRETE (cl. 1703 of MoRT&H)

10.1.1 The grades of concrete shall be designated by the characteristic strength as given in Table 1700-1, where the characteristic strength is defined as the strength of concrete below which not more than 5 percent of the test results are expected to fall.

Table 99 : Grades of Concrete (Table 1700-1 of MoRT&H)

Nominal Concrete	Mix	Type of Concrete/Grade Designation		Characteristic Strength in MPa
		Standard Concrete	High Performance Concrete	
M15		M15		15
M20		M20		20
		M25		25
		M30	M30	30
		M40	M35	35
		M45	M40	40
		M50	M45	45
			M50	50
			M55	55
			M60	60
			M65	65
			M70	70
			M75	75
			M80	80
			M85	85
			M90	90

Normal Mix Concrete is made on the basis of nominal mix proportioned by weight of its main ingredients - cement, coarse and fine aggregates and water.

Standard concrete is made on the basis of design mix proportioned by weight of its ingredients, which in addition to cement, aggregates and water, may contain chemical admixtures to achieve certain target values of various properties in fresh condition, achievement of which is monitored and controlled during production by suitable tests. Generally, concrete of grades up to M50 are included in this type.

High Performance Concrete is similar to standard concrete but contains additional one or more mineral admixtures providing binding characteristics and partly acting as inert filler material which increases its strength, reduces its porosity and modifies its other properties in fresh as well as hardened condition. Concrete of grades upto M90 are included in this type.

For concrete of grades higher than M90, the design parameters may be obtained from specialized literature and experimental results.

10.1.2 The minimum grades of concrete and corresponding minimum cement content and maximum water/cement ratios for different exposure conditions shall be as indicated in Table 1700-2 of MoRT&H.

10.1.3 For concrete subjected to sulphate attack the minimum grades of concrete, minimum cement content and maximum water/cement ratios and types of cement for different concentration of sulphate content shall be as indicated in Table 1700-3.

Table 100 : Requirement of Concrete for Different Exposure Condition using 20 mm Aggregate (Table 1700-2 of MoRT&H)

Exposure Condition	Maximum Cement Ratio	Water	Minimum Cement Content, kg/m ³	Minimum Grade of Concrete
Moderate	0.45		340	M25
Severe	0.45		360	M30
Very Severe	0.40		380	M40

Note :

1. All three provisions given in the above table for a particular exposure condition shall be satisfied.
2. The term cement for maximum w/c ratio and minimum cement content shown in Table includes all cementitious materials mentioned in Clause 1715.2. The maximum limit of flyash and ground granulated blast furnace slag in the blended cement shall be as specified in IS: 1489 (Part 1) and IS: 455 respectively.
3. For plain cement concrete, with or without surface reinforcement, the minimum grade of concrete can be lowered by 5 MPa and maximum water/cement ratio exceeded by 0.05.

Cement content shown in the above table shall be increased by 40 kg/m³ for use of 12.50 mm nominal size aggregates and decreased by 30 kg/m³ for use of 40 mm nominal size aggregates.

The maximum cement content excluding any mineral admixtures (Portland cement component alone) shall not exceed 450 kg/cu.m.

10.2 Requirements of Consistency

The mix shall have the consistency which will allow proper placement and compaction in the required position. Every attempt shall be made to obtain uniform consistency. Slump test shall be used to measure consistency of the concrete.

The optimum consistency for various types of structures shall be as indicated in Table 1700-4, or as directed by the Engineer. The slump of concrete shall be checked as per IS: 516.

Table 101 : Requirements of Consistency (Table 1700-4 of MoRT&H)

Type		Slump (mm) (at the Time of Placing of Concrete)
1)	a) Structure with exposed inclined surface requiring low slump concrete to allow proper compaction	25
	b) Plain cement concrete	25
2)	RCC structure with widely spaced reinforcements; e.g. solid columns, piers, abutments, footings, well steining	40-50
3)	RCC structure with fair of congestion of reinforcement; e.g. degree pier and abutment caps, box culverts, well curb, well cap, walls with thickness greater than 300 mm	50-75
4)	RCC and PSC structure highly congested reinforcements e.g. with deck slab girders, box girders, walls with thickness less than 300 mm	75-125
5)	Underwater concreting through tremie e.g. bottom plug, cast in-situ piling	150-200

Notwithstanding the optimum consistency indicated against SI. No. 1 to 3, the situation should be properly assessed to arrive at the desired workability with the adjustment of admixture in each case, where the concrete is to be transported through transit mixer and placed using concrete pump. Under these circumstances, the optimum consistency during placement for the items of work of SI. No. 1 to 3, can be considered ranging from 75 mm to 150 mm. This is, however, subject to satisfying the other essential criteria of strength, durability etc. and approval of the Engineer.

10.3 Requirements for Design

10.3.1 Target Mean Strength

The target mean strength of specimen shall exceed the specified characteristic compressive strength by at least the current margin.

The current margin for a concrete mix shall be determined by the Contractor and shall be taken as 1.64 times the standard deviation of sample test results taken from at least 40 separate batches of concrete of nominally similar proportions produced at site by the same plant under similar supervision, over a period exceeding 5 days, but not exceeding 6 months.

Where there is insufficient data to satisfy the above, the current margin for the initial design mix shall be taken as given in Table 1700-5 of MoRT&H

The initial current margin given in Table 1700-5 shall be used till sufficient data is available to determine the current margin as per Sub-Clause 1704.2.1 (i).

10.3.2 Trial Mixes

The Contractor shall give notice to the Engineer to enable him to be present at the time of carrying out trial mixes and preliminary testing of the cubes. Prior to commencement of trial mix design, all materials forming constituents of proposed design mix should have been tested and approval obtained in writing from the Engineer. Based on test results of material, draft mix design calculation for all grades of concrete to be used in the works, shall be prepared after taking into account the provisions in the Contract Technical Specifications, Guidelines of IS:10262, IS:SP:23 and IRC:112 and submitted to the Engineer for approval. Prior to commencement of concreting, trial mix design shall be performed for all grades of concrete and trial mix which has been found successful, shall be submitted by the Contractor and approval obtained. During concreting with the approved trial mix design, if source of any constituents is changed, the mix design shall be revised and tested for satisfying the strength requirements.

The initial trial mixes shall be carried out in a laboratory approved by the Engineer. However, Engineer may permit the initial trial mixes to be prepared at the site laboratory of the Contractor, if a full-fledged concrete

laboratory has been established well before the start of construction, to his entire satisfaction, Sampling and testing procedures shall be in accordance with these Specifications.

When the site laboratory is utilized for preparing initial mix design, the concrete production plant and means of transport employed to make the trial mixes shall be similar to those proposed to be used in the works.

For each trial mix, a set of six cubes shall be made from each of three consecutive batches for purposes of testing. Three cubes from each set of six shall be tested at an age of 28 days and three at an earlier age approved by the Engineer. The cubes shall be made, cured, stored, transported and tested in accordance with these Specifications. The mean strength of the nine cubes at 28 days shall exceed the specified characteristic strength by the current margin minus 3.5 MPa.

10.3.3 Control of Strength of Design Mixes

Adjustment to Mix Proportions

Adjustment to mix proportions arrived at in the trial mixes, shall be made subject to the Engineer's approval, in order to minimize the variability of strength and to maintain the target mean strength. Such adjustments shall not be taken to imply any change in the current margin.

Change of Current Margin

When required by the Engineer, the Contractor shall recalculate the current margin in accordance with Clause 1704.2.1. The recalculated value shall be adopted as directed by the Engineer, and it shall become the current margin for concrete produced thereafter.

Additional Trial Mixes

In case any changes are observed in the properties of fresh concrete and/or strength of hardened concrete on the basis of early age tests, additional mixes and tests shall be carried out during production, so as to control and bring the quality of concrete within acceptable limits. In case of any change in the source or properties of materials, the design of mix shall be established afresh.

10.4 Requirements of Nominal Mix Concrete

Requirements for nominal mix concrete unless otherwise specified shall be as given in Table 1700-6 of MoRT&H.

Table 102 : Requirements for Nominal Mix Concrete (Table 1700-6 of MoRT&H)

Concrete Grade	Total Quantity of Dry Aggregate by Mass per 50 kg of Cement to be taken as the Sum of Individual Masses of Fine and Coarse Aggregates (kg)	Proportion of Fine to Coarse Aggregate (by Mass)	Maximum Quantity of Water for 50 kg of Cement (Litres)	
			PCC	RCC
M 15	350	Generally 1:2, subject to upper limit 1:1.5 and lower limit of 1:2.5	25	
M20	250		25	22

10.5 Grading of Aggregates for Pumped Concrete

Materials for pumped concrete shall be batched consistently and uniformly. Maximum size of aggregate shall not exceed one-third of the internal diameter of the pipe.

The grading of aggregates shall be continuous and shall have sufficient ultra-fine materials (material finer than 0.25 mm). Proportion of fine aggregates passing through 0.25 mm shall be between 15 and 30 percent and that passing through 0.125 mm sieve shall not be less than 5 percent of the total volume of aggregate. Admixtures to increase workability can be added. When pumping long distances and in hot weather, set-retarding admixtures can be used. Fluid mixes can be pumped satisfactorily after adding plasticisers and super plasticisers. Suitability of concrete shall be verified by trial mixes and by performing pumping test.

10.6 ADMIXTURES (cl. 1705 of MoRT&H)

10.6.1 Chemical Admixtures

Chemical admixtures such as superplasticisers, or air entraining, water reducing, accelerating and retarding agents for concrete, may be used with the approval of the Engineer.

As the selection of an appropriate concrete admixture is an integral part of the mix design, the manufacturers shall recommend the use of any one of their products only after obtaining complete information of all the actual constituents of concrete as well as methodologies of manufacture, transportation and compaction of concrete proposed to be used in the work. Admixtures/additives conforming to IS:9103 may be used subject to approval of the Engineer. However, admixtures/additives generating hydrogen or nitrogen and containing chlorides, nitrates, sulphides, sulphates or any other material likely to adversely affect the steel or concrete, shall not be permitted.

The general requirements for admixtures are given in Clause 1007 of these Specifications.

Compatibility of the admixtures with the cement and any other pozzolona or hydraulic addition shall be ensured by for avoiding the following problems

- Requirement of large dosage of superplasticiser for achieving the desired workability,
- Excessive retardation of setting,
- Excessive entrainment of large air bubbles,
- Unusually rapid stiffening of concrete,
- Rapid loss of slump
- Excessive segregation and bleeding.

10.6.2 Mineral Admixtures

For use of mineral admixtures, refer Clauses 1714.1 and 1715.2.

10.7 SIZE OF COARSE AGGREGATES (cl. 1706 of MoRT&H)

The size (maximum nominal) of coarse aggregates for concrete to be used in various components shall be as given in Table 1700-7.

Table 103 : Maximum Nominal Size of Coarse Aggregates (Table 1700-7 of MoRT&H)

Components	Maximum Nominal Size of Coarse Aggregate (mm)
i) RCC well curb	20
ii) RCC/PCC well steining	40
iii) Well cap or Pile Cap Solid type piers and abutments	40
iv) RCC work in girder, slabs wearing coat, kerb, approach slab, hollow piers and abutments, pier/abutment caps, piles	20
v) PSC Work	20
vi) Any other item	As specified by the Engineer

Maximum nominal size of aggregates shall also be restricted to the smaller of the following values :

- 10 mm less than the minimum lateral clear distance between individual reinforcements
- 10 mm less than the minimum clear cover to the reinforcement
- One quarter of minimum thickness of member

The proportions of the various individual sizes of aggregates shall be so adjusted that the grading produces the densest mix and the grading curve corresponds to the maximum nominal size adopted for the concrete mix.

10.8 EQUIPMENT (cl. 1707 of MoRT&H)

Unless specified otherwise, equipment for production, transportation and compaction of concrete shall be as under:

Production of Concrete :

For overall bridge length of less than 200 m - batch type concrete mixer, diesel or electric operated, with a minimum size of 200 litres automatic water measuring system and integral weigher (hydraulic/pneumatic type).

For overall bridge length of 200 m or more - concrete batching and mixing plant fully automatic, with minimum capacity of 15 cum per hour.

All measuring devices of the equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be checked over the range in use, when set up at each site and thereafter, periodically as directed by the Engineer.

The accuracy of the measuring devices shall fall within the following limits :

Measurement of Cement	± 3 percent of the quantity of cement in each batch
Measurement of Water	± 3 percent of the quantity of water in each batch
Measurement of Aggregate	± 3 percent of the quantity of aggregate in each batch
Measurement of Admixture	± 3 percent of the quantity of admixture in each batch

Transportation of Concrete:

- i) Concrete dumpers minimum 2 tonnes capacity
- ii) Powered hoists minimum 0.5 tonne capacity

Chutes
Buckets handled by cranes
Transit truck mixer
Concrete pump
Concrete distributor booms
Belt conveyor
Cranes with skips
Tremies

For Compaction of Concrete :

- | | |
|-----------------------|--|
| i) Internal vibrators | size 25 mm to 70 mm |
| ii) Form vibrators | minimum 500 watts |
| iii) Screed vibrators | full width of carriageway (upto two lanes) |

10.9 BATCHING, MIXING, TRANSPORTING, PLACING AND COMPACTION

(cl. 1708 of MoRT&H)

10.9.1 General

Prior to start of concreting, the Contractor shall submit for approval of the Engineer, his programme along with list of equipment proposed to be used by him for batching, mixing, transporting and placing concrete.

10.9.2 Batching of Concrete

In batching concrete:

- i) The quantity of cement, aggregate and mineral admixtures, if used, shall be determined by mass.
- ii) Chemical admixtures, if solid, shall be determined by mass.
- iii) Liquid admixtures may be measured in volume or mass, and
- iv) Water shall be weighed or measured by volume in a calibrated tank.

The concrete shall be sourced from on-site or off-site batching and mixing plants, or from approved Ready Mixed Concrete plants, preferably having quality certification.

Except where supply of properly graded aggregate of uniform quality can be maintained over a period of work, the grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions when required, the different sizes being stocked in separate stock piles. The materials should be stock piled several hours, preferably a day before use. The grading of coarse and fine aggregate should be checked as frequently as possible to ensure that the specified grading is maintained.

The water/cement ratio shall always be maintained constant at its correct value. To this end, determination of moisture content in both fine and coarse aggregates shall be made as frequently as possible, depending on weather conditions. The amount of added water shall be adjusted to compensate for any observed variations in the moisture content. To allow for the variation in mass of aggregate due to variation in moisture content, suitable adjustment in the mass of aggregate, shall also be made. Accurate control shall be kept on the quantity of mixing water, which when specified, shall not be changed without approval.

2.50.9.3 Mixing Concrete**10.9.3.1 Mixing at Site**

All concrete shall be machine mixed. In order to ensure uniformity and good quality of concrete the ingredients shall be mixed in a power driven batch mixer with hopper and suitable weigh batching arrangement or in a central mix plant. Hand mixing shall not be permitted. The mixer or the plant shall be at an approved location considering the properties of the mixes and the transportation arrangements available with the Contractor. The mixer or the plant shall be approved by the Engineer.

Mixing shall be continued till materials are uniformly distributed, a uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall mixing be done for less than 2 minutes. It shall be ensured that the mixers are not loaded above their rated capacities and are operated at a speed recommended by the manufacturer. When mineral admixtures are added at the mixing stage, their thorough and uniform blending with cement shall be ensured, if necessary by longer mixing time. The addition of water after the completion of the initial mixing operation, shall not be permitted.

Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch and also before changing from one type of cement to another.

10.9.3.2 Ready Mix Concrete

Use of ready mix concrete proportioned and mixed off the project site and delivered to site in a freshly mixed and unhardened state conforming to IS:4926, shall be allowed with the approval of the Engineer.

10.9.4 Transporting Concrete

Mixed concrete shall be transported from the place of mixing to the place of final deposit as rapidly as possible by methods which will prevent the segregation or loss of the ingredients. The method of transporting or placing of concrete shall be approved by the Engineer. Concrete shall be transported and placed as near as practicable to its final position so that no contamination, segregation or loss of its constituents materials take place.

Concrete may be transported by transit mixers or properly designed buckets or by pumping. Transit mixers or other hauling equipment when used should be equipped with the means of discharge of concrete without segregation. During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to be reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

When concrete is conveyed by chute, the plant shall be of such size and design as to ensure practically continuous flow. Slope of the chute shall be so adjusted that the concrete flows without excessive quantity of water and without any segregation of its ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork.

In case concrete is to be transported by pumping, the fresh concrete should have adequate fluidity and cohesiveness to be pumpable. Proper concrete mix proportioning and initial trials should ensure this. The conduit shall be primed by pumping a batch of mortar through the line to lubricate it. Once the pumping is started, it shall not be interrupted, as concrete standing idle in the line is liable to cause plug. The operator shall ensure that some concrete is always there in the pump's receiving hopper during operation. The lines shall always be maintained clean and free of dents.

Pipelines from the pump to the placing area shall be laid with minimum bends. For large quantity placements, standby pumps shall be available. Suitable air release valves, shutoff valves etc. shall be provided as per site requirements. The pumping of priming mix i.e. rich mix of creamy consistency, to lubricate the concrete pump and pipelines, shall precede the pumping of concrete. Continuous pumping shall be done to the extent possible. After concreting, the pipelines and accessories shall be cleaned immediately. The pipes for pumping shall not be made of material which has adverse effect on concrete. Aluminium alloy pipelines shall not be used.

10.9.5 Placing of Concrete

All formwork and reinforcement contained in it shall be cleaned and made free from standing water, dust, snow or ice immediately before placing of concrete.

No concrete shall be placed in any part of the structure until the approval of the Engineer has been obtained. If concreting is not started within 24 hours of the approval being given, the approval shall have to be obtained again from the Engineer. Concreting shall proceed continuously over the area between the construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes, unless a proper construction joint is formed.

The concrete shall be deposited as nearly as practicable in its original position to avoid re-handling. Methods of placing should be such as to preclude segregation. Care should be taken to avoid displacement of reinforcement or movement of formwork. To achieve this, concrete should be lowered vertically in the form and horizontal movement of concrete inside the forms should, as far as practicable, be minimised.

The concrete shall be placed and compacted before its initial setting so that it is amenable to compaction by vibration. The workability of concrete at the time of placement shall be adequate for the compaction equipment to be used. If there is considerable time gap between mixing and placing of concrete, as in the case of ready mixed concrete plants or off-site batching and mixing plants, concrete mix shall be designed to have appropriately higher workability at the time of discharge from the mixer, in order to compensate the loss of workability during transit. This is generally achieved by suitable chemical admixtures. Keeping these considerations in view, the general requirement for ready mixed concrete plants or off-site batching and mixing plants, is that concrete shall be discharged from the truck mixer within two hours of the time of loading. A longer period may be permitted if suitable retarding admixtures are used.

In wall forms, drop chutes attached to hoppers at the top should preferably be used to lower concrete to the bottom of the form. As a general guidance, the permissible free fall of concrete may not exceed 1.5 metres and under no circumstances shall it be more than 2 metres. When free fall of larger height is involved, self-compacting concrete having adequate fluidity, cohesiveness and viscosity and which uniformly and completely fills every corner of the formwork by its own weight without segregation, shall be used.

Except where otherwise agreed to by the Engineer, concrete shall be deposited in horizontal layers to a compacted depth of not more than 450 mm when internal vibrators are used and not more than 300 mm in all other cases.

Concrete when deposited shall have temperature of not less than 5°C and preferably not more than 30°C and in no case more than 40°C. In case of site mixing, fresh concrete shall be placed and compacted in its final position within 30 minutes of its discharge from the mixer. When the concrete is carried in properly designed agitator operating continuously, the concrete shall be placed and compacted within 1 hour of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. It may be necessary to add retarding admixtures to concrete, if trials show that the periods indicated above are unacceptable. In all such matters, the Engineer's decision shall be final.

10.9.6 Compaction of Concrete

Concrete shall be thoroughly compacted by vibration or other means during placing and worked around the reinforcement, tendons or duct formers, embedded fixtures and into corners of the formwork to produce a dense homogeneous void-free mass having the required surface finish. When vibrators are used, vibration shall be done continuously during the placing of each batch of concrete until the expulsion of air has practically ceased and in a manner that does not promote segregation. Over-vibration shall be avoided to minimize the risk of forming a weak surface layer. When external vibrators are used, the design of formwork and disposition of vibrator shall be such as to ensure efficient compaction and to avoid surface blemishes. Vibrations shall not be applied through reinforcement and where vibrators of immersion type are used, contact with reinforcement and all inserts like ducts etc., shall be avoided.

When internal vibrators are used, they shall be inserted vertically to the full depth of the layer being placed and ordinarily shall penetrate the layer below for a few centimetres. The vibrator should be kept in place until air bubbles cease escaping from the surface and then withdrawn slowly to ensure that no hole is left in the concrete, care being taken to see that it remains in continued operation while being withdrawn. The internal vibrators shall be inserted in an orderly manner and the distance between insertions should be about one and half times the radius of the area visibly affected by vibration. Additional vibrators in serviceable condition shall be kept at site so that they can be used in the event of breakdown. Mechanical vibrators used shall comply with IS:2502, IS:2506, IS:2514 and IS:4656.

10.10 CONSTRUCTION JOINTS (cl. 1709 of MoRT&H)

Construction joints shall be avoided as far as possible. In no case shall the locations of such joints be changed or increased from those shown on the drawings except with the express approval of the Engineer.

Joints should be positioned where they are readily accessible for preparation and concreting. Construction joints should be positioned to minimize the effects of the discontinuity of the durability, structural integrity and appearance of the structure. As far as possible, joints should be provided in non-aggressive zones, but if joints in aggressive zones cannot be avoided, they should be sealed. Joints should be located away from the regions of maximum stress caused by loading; particularly where shear and bond stresses are high.

In beams and slabs joints should not be near the supports. Construction joints between slabs and ribs in composite beams, shall be avoided. For box girders, there shall be no construction joint between the soffit and webs.

Joints should be either vertical or horizontal. For a vertical construction joint, the lifts of concrete shall finish level or at right angles to the axis of the member. Concreting shall be continued right up to the joint.

Before resuming work at a construction joint when concrete has not yet fully hardened, all laitance shall be removed thoroughly. The surface shall be roughened, taking care to avoid dislodgement of coarse aggregates. Concrete shall be brushed with a stiff brush soon after casting, while the concrete has only slightly stiffened. If the concrete has partially hardened, it may be treated by wire brushing or with a high pressure water jet, followed by drying with an air jet, immediately before the new concrete is placed. Fully hardened concrete shall be treated with mechanical hand tools or grit blasting, taking care not to split or crack aggregate particles. The practice of first placing a layer of mortar or grout when concreting joints, shall be avoided. The old surface shall be soaked with water, without leaving puddles, immediately before starting concreting. The new concrete shall be thoroughly compacted against it.

Where there is likely to be a delay before placing the next concrete lift, protruding reinforcement shall be protected. In all cases, where construction joints are made, the joint surface shall not be contaminated with release agents, dust, or sprayed curing membrane and reinforcement shall be firmly fixed in position at the correct cover.

The sequence of concreting, striking of forms and positioning of construction joints for every individual structure, shall be decided well in advance of the commencement of work.

10.11 CONCRETING UNDER WATER (*cl. 1710 of MoRT&H*)

When it is necessary to deposit concrete under water, the methods, equipment, materials and proportions of mix to be used, shall be got approved from the Engineer before any work is started.

Concrete shall not be placed in water having a temperature below 5°C. The temperature of the concrete, when deposited, shall not be less than 16°C, nor more than 30°C.

Coffer dams or forms shall be sufficiently tight to ensure still water conditions, if practicable, and in any case to reduce the flow of water to less than 3 m per minute through the space into which concrete is to be deposited. Coffer dams or forms in still water shall be sufficiently tight to prevent loss of mortar through the joints in the walls. Pumping shall not be done while concrete is being placed, or until 24 hours thereafter. To minimise the formation of laitance, care shall be exercised not to disturb the concrete as far as possible while it is being deposited.

All under water concreting shall be carried out by tremie method only. The number and spacing of the tremies should be worked out to ensure proper concreting. However, it is necessary to have a minimum number of 2 tremies for any concreting operation, so that even if one of the tremies goes out of commission during concreting, the other one can be used to complete the work. The tremie concreting when started, should continue without interruption for the full height of the member being concreted. The capacity of the concrete production and placement equipment should be sufficient to enable the underwater concreting to be completed uninterrupted within the stipulated time.

The top section of the tremie shall have a hopper large enough to hold one full batch of the mix or the entire contents of the transporting bucket, as the case may be. The tremie pipe shall not be less than 200 mm in diameter and shall be large enough to allow a free flow of concrete and strong enough to withstand the external pressure of the water in which it is suspended, even if a partial vacuum develops inside the pipe. Preferably, flanged steel pipe of adequate strength shall be used. A separate lifting device shall be provided for each tremie pipe with its hopper at the upper end. Unless the lower end of the pipe is equipped with an approved automatic check valve, the upper end of the pipe shall be plugged with a wadding of gunny sacking or other approved material before delivering the concrete to the tremie pipe through the hopper, so that when the concrete is forced down from the hopper to the pipe, it will force the plug (and along with it any water in the pipe) down the pipe and out of the bottom end, thus establishing a continuous stream of concrete. It will be necessary to raise the tremie slowly in order to allow a uniform flow of concrete. At all times after placing of concrete is started and until all the required quantity has been placed, the lower end of the tremie pipe shall be kept below the surface of the plastic concrete and shall not be taken out of concrete. This will cause the concrete to build up from below instead of flowing out over the surface and thus avoid formation of layers of laitance. It is advisable to use retarders or suitable superplasticizers to retard the setting time of concrete, which shall be established before the commencement of work.

10.12 Concreting in Cold Weather

Where concrete is to be deposited at or near freezing temperature, precautions shall be taken to ensure that at the time of placing, it has a temperature of not less than 5°C and that the temperature shall be maintained above 4°C until the concrete has hardened. When necessary, concrete ingredients shall be heated before mixing but cement shall not be heated artificially other than by the heat transmitted to it from other ingredients of the concrete. Stockpiled aggregate may be heated by the use of dry heat or steam. Aggregates shall not be heated directly by gas or on sheet metal over fire. In general, the temperature of aggregates or water shall not exceed 65°C. Salt or other chemicals shall not be used for the prevention of freezing. No frozen material or materials containing ice shall be used. All concrete damaged by frost shall be removed. Concrete exposed to freezing weather shall have entrained air and the water content of the mix shall not exceed 30 litres per 50 kg of cement. To counter slower setting of concrete, accelerators can be used with the approval of the Engineer. However, accelerators containing chloride shall not be used.

10.13 Concreting in Hot Weather

When depositing concrete in hot weather, precautions shall be taken so that the temperature of wet concrete does not exceed 30°C while placing. This shall be achieved by using chilled mixing water, using crushed ice as a part of mixing water, shading stock piles of aggregates from direct rays of the sun, sprinkling the stock piles of coarse aggregate with water to keep them moist, limiting temperature of cement below 30°C at the time of use, starting curing before concrete dries out and restricting time of concreting as far as possible to early mornings and late evenings. When ice is used to cool mixing water, it will be considered as part of the water in design mix. Under no circumstances shall the mixing operation be considered complete until all ice in

the mixing drum has melted. The Contractor will be required to state his methodology for the Engineer's approval when temperatures of concrete are likely to exceed 30°C during the work.

10.14 PROTECTION AND CURING (cl. 1712 of MoRT&H)

10.14.1 General

Concreting operations shall not commence until adequate arrangements for concrete curing have been made by the Contractor. Curing and protection of concrete shall start immediately after compaction of the concrete.

The concrete shall be protected from:

- Premature drying out particularly by solar radiation and wind
- High internal thermal gradients
- Leaching out by rain and flowing water
- Rapid cooling during the first few days after placing
- Low temperature or frost
- Vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.
- Vibration caused by traffic including construction traffic.

Concrete shall be protected, without allowing ingress of external water, by means of wet (not dripping) gunny bags, hessian etc. Once the concrete has attained some degree of hardening (approximate 12 hrs after mixing), moist curing shall commence and be continued through the requisite period. Where members are of considerable size and length, with high cement content, accelerated curing methods may be applied, as approved by the Engineer.

10.14.2 Water Curing

Water for curing shall be as specified in Section 1000 of these specifications.

Sea water shall not be used for curing. Sea water shall not come into contact with concrete members before they have attained adequate strength.

The concrete should be kept constantly wet by ponding or covering or use of sprinklers/ perforated pipes for a minimum period of 14 days after concreting, except in the case of concrete with rapid hardening cement, where it can be reduced to 5 days. Water should be applied on surfaces after the final set. Curing through watering shall not be done on green concrete. On formed surfaces, curing shall start immediately after the forms are stripped. The concrete shall be kept constantly wet with a layer of sacking, canvas, hessian or similar absorbent material.

10.14.3 Steam Curing

Where steam curing is adopted, it shall be ensured that it is done in suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall be after about four hours of placement of concrete to allow the initial set of the concrete to take place.

Where retarders are used, the waiting period before application of the steam shall be increased to about six hours.

The steam shall be at 100 percent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. The application of steam shall not be directly on the concrete. Steam curing is applied in enclosures or tunnels through which concrete members are transported on a conveying system. Alternatively, portable enclosures or plastic covers are placed over precast members and steam is supplied to the enclosures. The rate of increase or decrease of temperature should not be more than 10°C to 20°C per hour and the maximum temperature shall be about 70°C. The maximum temperature shall be maintained until the concrete has attained the desired strength required at the end of steam curing period and shall be decided by prior trials. When steam curing is discontinued, the air temperature shall not drop at a rate exceeding 10°C per hour, until a temperature of about 10°C above the ambient temperature outside has been reached. Steam curing of concrete shall be followed by water curing for at least 7 days. The concrete shall not be exposed to temperatures below freezing for at least six days after curing.

10.14.4 Curing Compound

Membrane forming curing compounds consisting of waxes, resins, chlorinated rubbers etc. may be permitted by the Engineer in special circumstances. Curing compounds shall not be used on any surface which requires

further finishing to be applied. All construction joints shall be moist cured and no curing compound shall be permitted in locations where concrete surfaces are required to be bonded together.

Liquid membrane forming compounds shall conform to ASTM C 309 and the curing efficiency shall be as per ASTM C 156.

Curing compounds shall be continuously agitated during use. All concrete cured by this method shall receive two applications of the curing compound. The first coat shall be applied immediately after acceptance of concrete finish. If the surface is dry, the concrete shall be saturated with water and curing compound applied as soon as the surface film of water disappears. The second application shall be made after the first application has set. Placement in more than two coats may be required to prevent streaking. The membrane formed shall be stripped off after 14 days, when curing is complete.

Impermeable membranes, such as sheet materials for curing concrete conforming to ASTM C 171 or polyethylene sheeting covering closely the concrete surface, may also be used to provide effective barrier against evaporation.

10.15 FINISHING *(cl. 1713 of MoRT&H)*

Immediately after the removal of forms, exposed bars or bolts, if any, shall be cut inside the concrete member to a depth of at least 50 mm below the surface of the concrete and the resulting holes filled with cement mortar. All fins caused by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners, and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar. The mortar shall be of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as possible. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. Special pre-packaged proprietary mortars shall be used where appropriate or where specified in the drawing.

All construction and expansion joints in the completed work shall be left carefully tooled and free from any mortar and concrete. Expansion joint filler shall be left exposed for its full length with clean and true edges.

Immediately on removal of forms, the concrete work shall be examined by the Engineer before any defects are made good. The work that has sagged or contains honeycombing to an extent detrimental to structural safety or architectural appearance of the member, shall be rejected. Surface defects of a minor nature may be accepted. On acceptance of such work, the same shall be rectified as directed by the Engineer.

10.16 CONCRETE WITH BLENDED CEMENTS OR MINERAL ADMIXTURES *(cl. 1714 of MoRT&H)*

10.16.1 Production of Concrete

In order to improve the durability of the concrete, use of blended cement or blending of mineral admixtures, is permitted.

The maximum limit of flyash and ground granulated blast furnace slag in concrete, shall be as specified in Clause 1715.2. Blending at site shall be permitted only through a specific facility with complete automated process control to achieve the specified design quality or through RMC plants with similar facility.

10.16.2 Modified Properties

For concrete made with Portland Pozzolona Cement, Portland Blast furnace slag cement or mineral admixtures, the setting time and rate of gain of strength are different from those of concrete made with OPC alone. Cognizance of such modified properties shall be taken in deciding de-shuttering time, initial time of prestressing, curing period and for early age loading.

10.16.3 Compatibility of Chemical Admixtures

Compatibility of chemical admixtures and superplasticizers with Portland Pozzolona cement, Portland blast furnace slag cement and mineral admixtures shall be ensured by trials outlined in Clause 1705 of MoRT&H.

10.17 TESTS AND STANDARDS OF ACCEPTANCE *(cl. 1717 of MoRT&H)*

10.17.1 Concrete shall conform to the surface finish and tolerance as prescribed in these Specifications for respective components.

10.17.2 Random sampling and lot by lot acceptance inspection, shall be made for the 28 days cube strength of concrete.

10.17.3 Concrete under acceptance, shall be notionally divided into lots for the purpose of sampling before commencement of work. The basis of delimitation of lots shall be as follows:

No individual lot shall be more than 30 cu.m in volume

Different grades of mixes of concrete shall be divided into separate lots.
Concrete of a lot shall be used in the same identifiable component of the bridge.

10.17.4 Sampling and Testing

Concrete for preparing 3 test cubes shall be taken from a batch of concrete at point of delivery for construction, according to procedure laid down in IS:1199.

A random sampling procedure shall be adopted which ensures that each of the concrete batches forming the lot under acceptance inspection has equal chance of being chosen for taking cubes.

150 mm cubes shall be made, cured and tested at the age of 28 days for compressive strength in accordance with IS:516. The 28 day test strength result for each cube shall form an item of the sample. Tests at other age shall also be performed, if specified.

Where automated batching plant/Ready Mixed Concrete Plant is located away from the place of use and the time gap between production and placement is more than the initial setting time or where any ingredients are added subsequent to mixing, separate sets of samples shall be collected and tested at batching plant and at location of placement. The results shall be compared and used to make suitable adjustment at batching plants so that properties of concrete at placement are as per the requirements.

10.17.5 Test Specimen and Sample Strength

Three test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 days or for any other purpose.

The test strength of the sample shall be the average of the strength of 3 cubes. The individual variation should not be more than ± 15 percent of the average. If variation is more, the test results of the sample are invalid.

10.17.6 Frequency

The minimum frequency of sampling of concrete of each grade shall be in accordance with Table 1700-9 of MoRT&H.

10.17.7 Acceptance criteria

10.17.7.1 Compressive Strength

1) Cubes

The concrete shall be taken as having the specified compressive strength when both the following conditions are met:

The mean strength determined from any group of four consecutive non-overlapping samples exceeds the specified characteristic compressive strength by 3 MPa.

Strength of any sample is not less than the specified characteristic compressive strength minus 3 MPa.

The quantity of concrete represented by the test results include the batches from which the first and last samples were taken, together with all intervening batches.

2) Cores

When the concrete does not satisfy both the conditions given in (1) above, representative cores shall be extracted from the hardened concrete for compression test in accordance with the method described in IS:1199 and tested to establish whether the concrete satisfies the requirement of compressive strength.

Evaluation of compressive strength by taking cores may also be done in case of doubt regarding the grade of concrete used either due to poor workmanship or based on results of cube strength tests.

The locations from which core samples are to be taken and their number shall be decided so as to be representative of the whole of the concrete under consideration. However, in no case shall fewer than three cores be tested. Cores shall be prepared and tested as described in IS: 516. Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85 percent of the cube strength of the grade of concrete specified for the corresponding age and no individual core has strength less than 75 percent of the specified strength.

10.17.7.2 Chloride and Sulphate Content

The total chloride and sulphuric anhydride (SO₃) content of all the constituents of concrete as a percentage of mass of cement in the mix, shall not exceed the values given in this Section.

10.17.7.3 Density of Fresh Concrete

Where minimum density of fresh concrete is specified, the mean of any four consecutive non-overlapping samples shall not be less than the specified value and any individual sample result shall not be less than 97.5 percent of the specified value.

10.17.7.4 Density of Hardened Concrete

Where minimum density of hardened concrete is specified, the mean of any four consecutive non-overlapping samples shall not be less than the specified value and any individual sample result shall not be less than 97.5 percent of the specified value.

10.17.7.5 Permeability Test

Water permeability test as per DIN: 1048 Part 5-1991 shall be carried out as described below:

A cylindrical test specimen 150 mm dia and 160 mm high shall be prepared.

After 28 days of curing, the test will be conducted between 28 and 35 days. The test specimen shall be fitted in a machine such that specimen can be subjected to a water pressure of up to 7 bars. Atypical machine is shown in Appendix-1700/1.

The concrete specimen shall be subjected to a water pressure of 0.5 N/mm² from the top for a period of 3 days. The pressure shall be maintained constant throughout the test period. If the water penetrates through to the underside of the specimen, the test may be terminated and the specimen rejected as failed.

After 3 days, the pressure shall be released and the sample shall be taken out. The specimen shall be split in the middle by compression applied on two round bars on opposite sides above and below.

When the split faces show signs of drying (after 5 to 10 minutes), the maximum depth of penetration in the direction of height shall be measured with the scale and extent of water penetration established.

The mean of maximum depth of penetration obtained from three specimens thus tested, shall be taken as the test result and it shall not exceed 25 mm.

10.17.7.6 If the concrete is not able to meet any of the standards of acceptance as prescribed, the effect of such deficiency on the structure shall be investigated by the Contractor as directed by the Engineer. The Engineer may accept the concrete as sub-standard work. Any additional work required by the Engineer for such acceptance, shall be carried out by the Contractor at his cost. In case the concrete is not found to be acceptable even after investigation, the Contractor shall remove the rejected concrete forthwith.

10.17.7.7 When durability of concrete is desired the rapid chloride ion permeability test as stated under Clause

1714.3.1 shall also be performed in addition to above tests.

11. STRUCTURAL STEEL

11.1 GENERAL (*cl. 1902 of MoRT&H*)

General requirements relating to the supply of material shall conform to the Specifications of IS: 1387, for the purpose of which the supplier shall be the Contractor and the purchaser shall be the Engineer.

Unless otherwise specified, high tensile steel rivets conforming to IS: 1149 shall be used only for members of high tensile steel conforming to IS:961 and shall not be used for members of mild steel.

Unless otherwise specified, bolted connection of structural joints using high tensile friction grip bolts shall comply with requirements of IS:4000.

11.2 MATERIALS (*cl. 1903 of MoRT&H*)

11.2.1 All materials shall conform to Section 1000 of these Specifications. Special requirements are given below:

Mild steel for bolts and nuts shall conform to IS:226 but have a minimum tensile strength of 44 kg/sq.mm and minimum percentage elongation of 14.

High tensile steel for bolts and nuts shall conform to IS:961 but with a minimum tensile strength of 58 kg/sq.mm.

Use of high strength friction grip bolts shall be permitted only on satisfactory evidence of performance to the requirements (not covered by these Specifications) specified by the Engineer or as laid down in special provisions.

11.2.2 Castings and Forgings

Steel castings and forgings shall comply with the requirements of the following Indian Standards, as appropriate:

IS: 1030, IS: 1875, IS: 2004, IS: 2644, IS: 2708, IS: 4367

11.2.3 Fasteners

Bolts, nuts washers and rivets shall comply with the following or relevant Indian Standards as appropriate:

IS: 1148, IS: 1149, IS: 1363, IS: 1364, IS: 3640, IS: 3757, IS: 4000, IS: 5369, IS: 5370, IS: 5372, IS: 5374, IS: 5624, IS: 6610, IS: 6623, IS: 6639, IS: 6649, IS: 7002

11.2.4 Welding Consumables

Welding consumables shall comply with the following Indian Standards as appropriate :

IS: 814, IS: 1395, IS: 3613, IS: 6419, IS: 6560

11.2.5 Welding

IS: 816, IS: 822, IS: 1024, IS: 1182, IS: 4853, IS: 5334, IS: 7307, IS: 7310, IS: 7318, IS: 9595

11.2.6 Paints

All materials for paints and enamels shall conform to the requirements specified on the drawings or other special provisions laid down by the Engineer.

The type of paints which can be used shall be as follows :

- Ordinary i.e. paints based on drying oils, alkyd resin, modified alkyd resin, phenolic varnish epoxy
- Chemical Resistant - one pack type (ready for use) or two pack type (mixed before use).
- Vinyl
- Chlorinated rubber
- e) Bituminous - (IS:9862)
-
- f) Epoxy (IS:14925)
-
- g) Polyurethane (IS:13759)
- h) Zinc rich -(IS:14589)

Unless otherwise specified, paints shall conform to the relevant Indian Standards. Paints shall be tested for the following qualities as per Specifications given in the relevant IS codes:

- Weight (for 10 litres of paint, thoroughly mixed)
- Drying time
- Consistency
- Dry thickness and rate of consumption

11.3 FABRICATION (cl. 1904 of MoRT&H)

11.3.1 General

All work shall be in accordance with the drawings and as per these Specifications. Fabrication work shall be taken up only after receipt of approved fabrication/working drawings. It shall be ensured that all parts of an assembly fit accurately together. All members shall carry mark number and item number and, if required, serial number. Method of marking shall be commensurate with the process of manufacture and such as to ensure retention of identity at all stages.

Unless specifically required under the contract, corresponding parts need not be interchangeable, but the parts shall be match marked as required under Clause 1904.9 of MoRT&H.

Templates, jigs and other appliances used for ensuring the accuracy of the work shall be of mild steel; where specially required, these shall be bushed with hard steel. All measurements shall be made by means of steel tape or other device properly calibrated. Where bridge materials have been used as templates for drilling, these shall be inspected and passed by the Engineer before they are used in the finished structure.

All structural steel members and parts shall have straight edges and plane surfaces. They shall also be free from twist. If necessary, they shall be straightened or flattened by pressure unless they are required to be of curvilinear forms. Adjacent surfaces or edges shall be in close contact or at uniform distance throughout.

The Contractor shall submit his programme of work to the Engineer for his approval at least 15 days before the commencement of fabrication, which shall include the proposed system of identification and erection marks together with complete details of fabrication and welding procedures. He shall also submit for approval of Engineer, a Quality Assurance Plan according to the nature of fabrication work (whether welded or riveted) which should clearly define the points of checking and inspection during the stages of fabrication as well as supply of materials.

The Contractor shall prepare shop drawings for fabrication of any member and obtain approval of the Engineer before the start of work. Complete information regarding the location, type, size and extent of all welds shall be clearly shown on the shop drawings. These drawings shall distinguish between shop and field welds.

11.3.2 Preparation of Holes

11.3.2.1 Drilling and Punching

Holes for rivets, black bolts, high strength bolts and countersunk bolts/rivets (excluding close tolerance and turn fitted bolts) shall be either punched or drilled. For bolts/rivets less than 25 mm dia, the diameter of holes shall be 1.5 mm larger while for those of 25 mm dia or more, the diameter of holes shall be 2 mm larger than the diameter of the bolt/rivet.

All holes shall be drilled except those for secondary members such as floor plates, hand rails etc. Members which do not carry the main load can be punched subject to the thickness of member not exceeding 12 mm for material conforming to IS:2062 up to Grade E250 (Fe 410w).

Holes through material of more than one thickness or through main material thickness exceeding 20 mm for steel conforming to IS:2062 up to Grade E250 (Fe 410w) or 16 mm for steel conforming to IS:2062 up to Grade E300 (Fe 440w) and above, shall either be sub-drilled or sub-punched to a diameter of 3 mm less than the required size and then reamed to the required size. The reaming of material more than one thickness shall be done after assembly.

Where several plates or sections form a compound member, they shall, where practicable, be firmly connected together by clamps or tacking bolts and the holes shall be drilled through the group in one operation. Alternatively, and in the case of repetition work, the plates and sections may be drilled separately from jigs and templates. Jigs and templates shall be checked at least once after every 25 operations. All burrs shall be removed.

In the case of repetition of spans, the erection of every span shall not be insisted upon, except where close tolerance or turned bolts are used, provided that methods are adopted to ensure strict interchange ability. In such cases, one span in ten or any number less than ten of each type shall be erected from pieces selected at random by the Engineer and should there be any failure of the pieces to fit, all similar spans shall be erected complete. In the event of spans being proved completely interchangeable, all corresponding parts shall carry the same mark so that sorting of the materials at site is facilitated.

11.3.3 Size of Holes

The diameters of rivet holes in millimetres are given in Table 1900-1 of MoRT&H.

11.3.4 Close Tolerance Bolts and Barrel Bolts

For close tolerance or turn fitted bolts, the diameter of the holes shall be equal to the nominal diameter of the bolt shank + 0.15 mm to - 0.0 mm.

11.3.5 Holes for High Strength Friction Grip Bolts

All holes shall be drilled after removal of burrs. Where the number of plies in the grip does not exceed three, the diameters of holes shall be 1.5 mm larger than those of bolts. Where the number of plies in the grip exceeds three, the diameters of holes shall be as follows, unless otherwise specified by the Engineer:

In outer plies	1.5 mm larger than diameter of bolts
----------------	--------------------------------------

In inner plies not less than 1.5 mm and not more than 3.0 mm larger than diameter of bolts

11.3.6 Rivets and Riveting

11.3.6.1 The riveting shall be done by hydraulic or pneumatic machine unless otherwise specified by Engineer. The driving pressure shall be maintained on the rivets for a short time after the upsetting is completed.

11.3.6.2 The diameter of rivets shown on the drawings shall be the size before heating. Each rivet shall be of sufficient length to form a head of the standard dimensions as given in IS handbook on Steel Sections, Part-I. The underside of the head shall be free from burrs.

11.3.6.3 The tolerance on the diameter of rivets shall be in accordance with IS: 1148 for mild steel rivets and IS:1149 for high tensile steel rivets. Unless otherwise specified, the tolerance shall be minus.

11.3.6.4 When countersunk head is required, the head shall fill the countersunk hole and projection after countersinking shall be ground off wherever necessary. The included angle of the head shall be as follows:

- | | |
|--|------------|
| a) For plates over 14 mm thickness | 90 degree |
| b) For plates upto and including 14 mm thickness | 120 degree |

11.3.6.5 Mild steel rivets shall be heated uniformly to a light cherry red colour between 650°C to 700°C for hydraulic riveting and orange colour for pneumatic riveting. High tensile steel rivets shall be heated up to 1100°C. The rivets shall be red hot from head to the point when inserted and shall be upset in its entire length so as to fill the hole as completely as possible when hot. After being heated and before being inserted in the hole, the rivet shall be made free from scale by striking it on a hard surface. Any rivet whose point is heated more than the prescribed limit, shall not be driven.

Where flush surface is required, any projecting metal shall be chipped or ground off.

11.3.6.6 Before riveting is commenced, the parts/members to be riveted shall be firmly drawn together with bolts, clamps or tack welds so that the various sections and plates are in close contact throughout. Every third hole of the joint shall have assembly bolts till riveted. Drifts shall only be used for drawing the work into position and shall not be used to such an extent as to distort the holes. Drifts of a larger size than the nominal diameter of the hole shall not be used.

11.3.6.7 Driven rivets, when struck sharply on the head by a quarter pound rivet testing hammer, shall be free from movement and vibrations. Assembled riveted joint surfaces, including those adjacent to the rivet heads, shall be free from, dirt, loose scale, burrs, other foreign materials and defects that would prevent solid seating of parts.

11.3.6.8 All loose or burnt rivets, rivets with cracked or badly formed defective heads or rivets with heads which are unduly eccentric with the shanks, shall be removed and replaced. In removing rivets, the head shall be sheared off and the rivet punched out so as not to damage the adjacent metal. If necessary, the rivets shall be drilled out. Re-cupping or re-caulking shall not be permitted. The parts not completely riveted in the shop shall be secured by bolts to prevent damage during transport and handling.

11.3.7 High Strength Friction Bolts and Bolted Connections

The general requirement shall be as per relevant IS Specifications mentioned in Clause 1903.2.2. Unless otherwise specified by the Engineer, bolted connections of structural joints using high tensile friction grip bolts shall comply with requirements mentioned in IS:4000.

11.4 Welding

11.4.1 All welding shall be done with the prior approval of the Engineer and the workmanship shall conform to the specifications of the relevant Indian Standards as appropriate.

When material thickness is 20 mm or more, special precautions like pre-heating shall be taken as laid down in IS:9595. Surfaces and edges to be welded shall be smooth, uniform and free from fins, tears, cracks and other discontinuities. Surface shall also be free from loose or thick scale, slag rust, moisture, oil and other foreign materials. Surfaces within 50

of any weld location shall be free from any paint or other material that may prevent proper welding or cause objectionable fumes during welding.

The general welding procedures including particulars of the preparation of fusion faces for metal arc welding, shall be carried out in accordance with IS:9595.

The welding procedures for shop and site welds including edge preparation of fusion faces shall be as per details shown on the drawings and shall be submitted in writing for the approval of the Engineer, in accordance with Clause 22 of IS:9595, before commencing fabrication.

Any deviation from this procedure has to be approved by the Engineer. Preparation of edges shall, wherever practicable, be done by machine methods.

Machine flame cut edges shall be substantially as smooth and regular as those produced by edge planing and shall be left free of slag. Manual flame cutting shall be permitted by the Engineer only where machine cutting is not practicable.

Electrodes to be used for metal arc welding shall comply with relevant Indian Standards mentioned in Clause 1903.2.3.

Procedure test shall be carried out as per IS:3613 to find out suitable wire-flux combination for welded joint.

Assembly of parts for welding shall be in accordance with provisions of Clauses 14 to 16 of IS:9595.

Welded temporary attachment should be avoided as far as possible. If unavoidable, the method of making any temporary attachment shall be as approved by the Engineer. Any scars from temporary attachment shall be removed by cutting and chipping and surface shall be finished smooth by grinding to the satisfaction of the Engineer.

Welding shall not be carried out when the air temperature is less than 10°C, when the surfaces are wet, during periods of strong winds and in snowy weather, unless the work and the welding operators are adequately protected.

11.4.2 For welding of any particular type of joint, welders shall undergo the appropriate welders qualification test as prescribed in any of the relevant Indian Standards IS:817, IS:1966, IS:1393, IS:7307 (Part I), IS:7310 (Part I) and IS:7318 (Part I) to the satisfaction of the Engineer.

11.4.3 In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as to avoid distortion and minimize shrinkage stress.

All requirements regarding pre-heating of parent material and interpass temperature shall be in accordance with provisions of IS:9595.

11.4.4 Peening of weld shall be carried out wherever specified by the Engineer:

If specified, peening may be employed to be effective on each weld layer except the first filling layer.

After weld has cooled, the peening should be carried out by light blows from a power hammer using a round nosed tool. Care shall be taken to prevent scaling or flaking of weld and base metal from over peening.

11.5 Tolerances

Tolerances in dimensions of components of fabricated structural steel work shall be specified on the drawings and shall be subject to the approval of the Engineer before fabrication. Unless otherwise specified, all parts of an assembly shall fit together accurately within tolerances specified in Table 1900-2 of MoRT&H.

11.6 Non-Destructive Testing of Welds

One or more of the following methods may be applied for inspection or testing of weld :

Visual Inspection

Magnetic Particle and Radiographic Inspection

Ultrasonic inspection

Liquid Penetration Inspection

11.7 PAINTING (cl. 1906 of MoRT&H)

11.7.1 General

Unless otherwise specified, all metal work shall be given approved shop coats as well as field coats of painting. The item of work shall include preparation of metal surfaces, application of protective covering and drying of the paint coatings along with all tools, scaffolding, labour and materials necessary.

Coatings shall be applied only to dry surfaces and the coated surfaces shall not be exposed to rain or frost before they are dry. The coatings shall be applied to all surfaces excluding shear connectors and inner surfaces of fully sealed hollow sections. While coating adjacent surfaces, care shall be taken to ensure that primer is not applied on the shear connectors.

11.7.2 Types of Paints

i) Ordinary Paints

These include paints based on drying oils, alkyd resin, modified alkyd resin, phenolic varnish epoxy, etc.

Ordinary painting can generally be sub-divided into two types:

a) Primary Coats :

This shall be applied immediately after the surface preparation and should have the properties of adhesion, corrosion inhibition and imperviousness to water and air.

b) Finishing Coats :

This shall be applied over the primary coat and should have the properties of durability, abrasion resistance, aesthetic appearance and smooth finish.

ii) Chemical Resistant Paints

The more highly corrosion resistant paints can be divided into two main groups :

a) One pack paints (ready for use)

b) Two pack paints (mixed before use)

The two pack paints shall be mixed together just before use since they remain workable thereafter only for a restricted period of time.

iii) Other types of paints as mentioned in Clause 1903.4 of MoRT&H Specifications may also be used, subject to approval by the Engineer.

All paints shall conform to relevant IS Standards as appropriate.

11.7.3 Surfaces which are inaccessible for cleaning and painting after fabrication shall be painted as specified before being assembled for riveting.

All rivets, bolts, nuts, washers etc., are to be thoroughly cleaned and dipped into boiling linseed oil conforming to IS:77.

All machined surfaces are to be well coated with a mixture of white lead conforming to IS: 34 and mutton tallow conforming to IS: 887.

In site painting, the whole of the steel work shall be given the second cover coat after final passing and after touching up the primer and cover coats, if damaged in transit.

11.7.4 Quality of Paint

Only paints which have been tested for the following qualities as per the specifications given in the relevant IS codes, should be used :

- Weight test (weight per 10 litre of paint thoroughly mixed)
- Drying time
- Flexibility and adhesion
- Consistency
- Dry thickness and rate of consumption

11.7.5 Unless otherwise specified, all painting and protective coating work shall be done in accordance with IS:1477 (Part I).

11.7.6 Surface Preparation

Steel surface to be painted either at the fabricating shop or at the site of work shall be prepared in a thorough manner with a view to ensuring complete removal of mill scale by one of the following processes as agreed to between the fabricator and the Engineer:

- Dry or wet grit/sand blasting
- Pickling which should be restricted to single plates, bars and sections
- Flame cleaning

Primary coat shall be applied as soon as practicable after cleaning and in case of flame cleaning, while the metal is still warm.

All slag from welds shall be removed before painting. Surfaces shall be maintained dry and free from dirt and oil. Work out of doors in frosty or humid weather shall be avoided.

11.7.7 Coatings

Prime coat to be used shall conform to the specification of primers approved by the Engineer. Metal coatings shall be considered as prime coats. Primer shall be applied to the blast cleaned surface before any deterioration of the surface is visible. In any case, the surface shall receive one coat of primer within 4 hours of abrasive blast cleaning.

a) Epoxy Based Painting

- i) Surface preparation : Remove oil/grease by use of petroleum hydrocarbon solution (IS:1745) and grit blasting to near white metal surface.
- ii) Paint system : 2 coats of epoxy zinc phosphate primer = 60 micron: Total 5 coats = 200 micron

b) Conventional Painting System for areas where corrosion is not severe Priming Coat:

One coat of ready mixed, red lead primer conforming to IS: 102

or

One coat of ready mixed zinc chrome primer conforming to IS: 104 followed by one coat of ready mixed red oxide zinc chrome primer conforming to IS:2074

or

Two coats of red oxide zinc chrome primer conforming to IS:2074. Finishing Coats:

Two cover coats of red oxide paint conforming to IS: 123 or any other approved paint shall be applied over the primer coat. One coat shall be applied before the fabricated steel work leaves the shop. After the steel work is erected at site, the second coat shall be given after touching up the primer and the cover coats, if damaged in transit.

c) Conventional Painting System for areas where corrosion is severe Priming Coat:

Two coats of ready mixed red lead primer conforming to IS: 102

or

One coat of ready mixed zinc chrome primer conforming to IS: 104 followed by one coat of ready mixed zinc chrome primer conforming to IS:2074.

Finishing Coats :

Two coats of aluminium paint conforming to IS:2339 shall be applied over the primer coat. One coat shall be applied before the fabricated steel work leaves the shop. After the steel work is erected at site, the second coat shall be given after touching up the primer and the cover coats, if damaged in transit.

11.7.8 Painting in the Shop

All fabricated steel shall be painted in the shop after inspection and acceptance with at least one priming coat, unless the exposed surfaces are subsequently to be cleaned at site or are metal coated. No primer shall be applied to galvanised surfaces.

Shop contact surfaces, if specifically required to be painted, shall be brought together while the paint is still wet.

Field contact surfaces and surfaces to be in contact with cement, shall be painted with primer only. No paint shall be applied within 50 mm of design location of field welds. Paint shall be completely dry before loading and transporting of the fabricated steel work to site.

Surfaces not in contact but inaccessible after shop assembly shall receive the full specified protective treatment before assembly.

Where surfaces are to be welded, the steel shall not be painted or metal coated within a suitable distance from any edges to be welded, if the specified paint or metal coating would be harmful to welders or is likely to impair the quality of site welds.

Exposed machined surfaces shall be adequately protected.

11.7.9 Painting at Site

Surfaces which will be inaccessible after site assembly shall receive the full specified protective treatment before assembly.

Surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop priming) and shall be brought together while the paint is still wet.

Damaged or deteriorated paint surfaces shall be first made good with the same type of coat as the shop coat.

Where steel has received a metal coating in the shop, this coating shall be completed on site so as to be continuous over any welds, bolts and site rivets.

Specified protective treatment shall be completed after erection.

11.7.10 Methods of Application

The methods of application of all paint coatings shall be in accordance with the manufacturer's written recommendation and shall be as approved by the Engineer. Spray painting may be permitted provided it will not cause inconvenience to the public and is appropriate to the type of structure being coated. Areas inaccessible for painting and areas shaded for spray application shall be coated first by brushing.

11.7.11 Protective Coatings in Different Environments

Table 1900-3 gives guidelines for various types of coatings to be used in various environmental conditions. Approximate life to first maintenance is also indicated.

Table 105 : Guidelines for Selection of Types of Protective Coatings (*Table 1900-3 of MoRT&H*)

	Type of Coating	Exposure Condition
i)	Wire brush to remove all loose rust and scale; 2 coats drying oil type primer, and 1 under coat alkyd type paint; 1 finishing coat alkyd type. Total dry thickness = 150 urn	Moderate
ii)	Wire brush to remove all loose rust and scale; 2 coats drying oil type primer; 2 under coats micaceous iron oxide (MXO) pigmented phenolic modified drying oil. Total dry film thickness = 170 µm (life up to 5 years)	Polluted inland environment
iii)	Blast clean the surface; 2 coats of quick drying primer; undercoat alkyd type paint; 1 finishing coat alkyd type. Total dry film thickness : 130-150 urn	Moderate
iv)	Blast clean the surface; 2 coats of drying type oil primer; 1 under coat micaceous iron oxide pigmented drying oil type paint. Total dry film thickness : 165-190 urn	Polluted inland environments
v)	Blast clean the surface; 2 coats of metallic lead pigmented chlorinated rubber primer, 1 undercoat of high build chlorinated rubber primer, 1 under coat of high build chlorinated rubber; 1 finishing coat of chlorinated rubber. Total dry film thickness : 200 um	Severe coastal and non-coastal interior situations
vi)	Blast clean the surface; 350 - 450 um thickness coal tar epoxy.	Severe
vii)	Pickle; hot dip galvanised (Zinc). Total thickness : 85 um (life up to 15-20 years)	Moderate
viii)	Grit blast, hot dip galvanised. (Zinc). Total thickness = 140 um (life more than 20 years)	Moderate
ix)	Grit blast; 1 coat of sprayed zinc/aluminum followed by suitable sealer Total thickness = 150 um (life up to 15-20 years)	Severe

12. BEARINGS

12.1 GENERAL (*cl. 2002 of MoRT&H*)

- Bearing plates, bars, rockers, assemblies and other expansion or fixed devices shall be in accordance with the details shown on the drawings.
- The bearings may either be supplied directly to the Engineer by the manufacturer to be installed by the Contractor or supplied and installed by the Contractor as part of the contract. In the former case, the manufacturer shall be associated with the installation of the bearings to the full satisfaction of the Engineer, whereas in the latter case, the Contractor shall be solely responsible for the satisfactory supply and installation of the bearing. In the detailed description of the specification, a general reference shall be made to the Contractor or manufacturer and the interpretation shall be as per terms of contract.
- The Contractor shall exercise the utmost care in setting and fixing all bearings in their correct positions and ensuring that uniformity is obtained on all bearing surfaces.
- Bearings shall be handled with care and stored under cover.
- When bearing assemblies or plates are shown on the drawings to be placed (not embedded) directly on concrete, the concrete bearing area shall be constructed slightly above grade (not exceeding 12 mm) and shall be finished by grinding.

- f) It shall be ensured that the bearings are set truly level and in exact position as indicated on the drawings so as to have full and even bearing on the seats. Thin mortar pads (not exceeding 12 mm thickness) may be provided for this purpose.
- g) It shall be ensured that the bottoms of girders to be seated on the bearings are plane at the locations of the bearings and that the bearings are not displaced while placing the girders.
- h) M.S bearings sliding on M.S. plates shall not be permitted. For sliding plate bearings, stainless steel surface sliding on stainless steel plate with mild steel matrix shall be used. The other option shall be to provide PTFE surface sliding on stainless steel.
- i) Segmental rollers are not permitted; only full cylindrical rollers shall be used. Adequate width of base plate shall be provided to cater for anticipated movements of the supporting structure.
- j) For seismic Zones IV and V, roller and rocker bearing components shall have guides to prevent them from being displaced during earthquakes.
- k) For bridges with skew angle less than 20°, the bearings shall be placed at right angles to the longitudinal axis of the bridge. For bridges with skew angle greater than 20°, very wide bridges and curved bridges, the location of bearings shall be ensured as shown on the drawings.
- l) Easy access to the bearing shall be made available for purposes of inspection and maintenance.
Provision shall also be made for jacking up of the superstructure so as to allow repair/replacement of bearings.
- m) For types of bearings not covered in this Section, required specifications shall be as laid down in the contract.

12.2 STEEL BEARINGS *(cl. 2003 of MoRT&H)*

12.2.1 Mild Steel

Mild steel to be used for components of bearings shall comply with IS: 2062, Steel for General Structural Purposes.

12.2.2 Forged Steel

Forged steel to be used in components of bearings shall be in accordance with Clause 1009.5 of MoRT&H Specifications.

12.2.3 High Tensile Steel

High tensile steel shall comply with IS: 961.

12.2.4 Cast Steel

Cast steel shall be in accordance with Clause 1009.1 of MoRT&H Specifications.

For the purpose of checking the soundness, castings shall be ultrasonically examined following procedures as per IS:7666, with acceptance standard as per IS:9565. The castings may also be checked by any other accepted method of non-destructive testing as specified in IS:1030.

12.2.5 Stainless Steel

Stainless steel shall be in accordance with Clause 1009.7 of MoRT&H Specifications.

12.3 ELASTOMERIC BEARINGS *(cl. 2005 of MoRT&H)*

Elastomeric bearings shall cater for translation and/or rotation of the superstructure by elastic deformation.

12.3.1 Materials

- a) Chloroprene Rubber (CR) only shall be used.
- b) Grades of raw elastomer of proven use in elastomeric bearings, with low crystallization rates and adequate shelf life viz. Neoprene WRT, Neoprene W, Bayprene 110, Bayprene 210, Skyprene B-5, Skyprene B-30, Denka S-40V and Denka M-40, shall be used.
- c) No reclaimed rubber or vulcanized wastes or natural rubber shall be used.
- d) The polychloropene content of the compound shall not be lower than 60 per cent. The ash content shall not exceed 5 per cent of its weight. Polychloropene content shall be determined in accordance with ASTM-D297 and ash content as per IS:3400-Part XXII.

e) Use of synthetic rubber-like materials such as Ethyl Propylene Dimonomer (EPDM), Isobutane Isoprene Copolymer (IIR) and Chloro-Isoprene Copolymer (CIIR) shall not be permitted.

12.3.2 Properties of Elastomer

The elastomer shall conform to the properties specified in Table 2000-1.

Laminates of mild steel conforming to IS:2062/IS:1079 or equivalent international grade, shall only be permitted. The yield stress of the material shall not be less than 250 MPa. Use of any other material like fibre glass or similar fabric as laminates, shall not be permitted.

The manufacturers of elastomeric bearings shall satisfy the Engineer that they have in-house facilities for carrying out the following tests on elastomer in accordance with the relevant provisions of ASTM D-297.

12.3.3 Manufacturing Tolerances

The bearings shall be fabricated/manufactured with the tolerances specified in Table 2000-3. Tolerances of thickness of individual layer of elastomer, dimension of laminates, and flatness of laminates are primarily meant for quality control during production. In order to measure thickness of individual layer of elastomer, dimension of laminates and flatness of laminates of a finished bearing, it is essential to cut the bearing, which may be done if agreed upon between the manufacturer and the buyer.

12.3.4 Acceptance Specifications

The manufacturer shall have all the test facilities required for the process and acceptance control tests installed at his plant to the complete satisfaction of the Engineer. The test facilities and their operation shall be open to inspection by the Engineer on demand.

All acceptance and process control tests shall be conducted at the manufacturer's plant. Cost of all materials, equipment and labour shall be borne by the manufacturer unless otherwise specified or specially agreed to between the manufacturer and Engineer.

A testing programme shall be submitted by the manufacturer to the Engineer and his approval obtained before commencement of acceptance testing.

Any acceptance testing delayed 180 days beyond the date of production shall require special approval of the Engineer and modified acceptance specification, if deemed necessary by him.

All acceptance testing shall be conducted by the Inspector with the aid of the manufacturer's personnel having adequate expertise and experience in rubber testing, working under the supervision of the Inspector and to his complete satisfaction.

Inspection and acceptance shall be carried out lot by lot.

12.4 POT BEARINGS (cl. 2006 of MoRT&H)

12.4.1 General

Pot bearings shall consist of a metal piston supported by a disc of unreinforced elastomer confined within a metal cylinder to take care of rotation. Horizontal movement, if required, shall be provided by sliding surfaces of PTFE pads sliding against stainless steel mating surfaces, with a system of sealing rings. Pot bearings shall consist of cast steel assemblies or fabricated structural steel assemblies.

12.4.2 Materials

12.4.2.1 Structural steel, mild steel, high tensile steel and steel for forging shall conform to the requirements of Section 1009 of MoRT&H Specifications.

12.4.2.2 Cast steel shall comply with Grade 280-520W or 340-570W of IS:1030.

12.4.2.3 Stainless steel shall conform to AISI 316 L or 02Cr17Ni12M02 of IS:6911.

12.4.2.4 PTFE

The raw material for PTFE used in bearings shall be pure polytetrafluoroethylene, free sintered without regenerated materials or fillers. The mechanical and physical properties of unfilled PTFE shall comply with Grade A of BS:3784 or equivalent. PTFE shall be either in the form of solid rectangular modules or large sheets with dimples formed by hot pressing or moulding. Sheet with dimples formed by machining or drilling from a solid PTFE sheet, shall not be permitted. The surface of PTFE sheets/modules which are to be in contact with metal backing plates shall be provided with suitable chemical treatment for proper bonding.

Adhesives used for bonding PTFE to backing plates, shall produce a bond with minimum peel strength of 4 N/mm width when tested in accordance with BS:5350 (Part C9).

12.4.2.5 Elastomer

The elastomer to be used for the components of bearings shall comply with provisions of Table 2000-1 of MoRT&H.

The confined elastomer inside the pot shall have the properties as given in Table 2000-4 of MoRT&H.

12.4.2.4 Certification and Marking

Bearings should be transported to bridge site after final acceptance by the Inspector/inspection agency appointed by the concerned authority, along with an authenticated copy of the certificate of acceptance. An information card listing the required bearing characteristics, duly certified by the manufacturer should also be appended with the certificate.

All bearings shall have suitable index markings in indelible ink or flexible paint, which if practicable, shall be visible even after installation, giving the following information:

- Name of manufacturer
- Month and year of manufacture
- Bearing designation
- Type of bearing
- Load and movement capacity
- Centre line markings to facilitate installation
- Direction of major and minor movement, if any
- Preset, if any

12.4.3 Installation

12.4.3.1 General

Bearings shall be so located as to avoid the accumulation of dirt and debris on or around them. Detailing of the structure shall be such that water is prevented from reaching the bearings.

In order to avoid contamination of moving surfaces, bearings should not normally be dismantled after leaving the manufacturer's workshop. However, if for any reason, a bearing is required to be dismantled, it shall be done only under expert supervision for which the manufacturer's help may be sought.

Transfer of load from the superstructure to the bearings should not be allowed until the bedding material has developed sufficient strength. Temporary clamping devices should be removed at the appropriate time before the bearings are required to accommodate movement. The holes exposed on removal of temporary transit clamps should be filled with selected material. Where re-use of these fixing holes may be required, the material used for filling the holes should be capable of being easily removed without damaging the threads.

Suitable temporary supporting arrangements under bearing base plates should be made to accommodate thermal movement and elastic deformation of the incomplete superstructure. Such temporary supports, if provided, should be removed once the bedding material has reached its required strength. Any voids left as a consequence of their removal should be made good using the same bedding material. Steel folding wedges and rubber pads are suitable for use as temporary supports under bearing plates.

12.4.3.2 Bedding

The bedding material shall be selected keeping in view a number of factors such as the type and size of bearing, construction sequence, load on the bearing, required setting time, friction requirements, access around bearings, design and condition of surface in the bearing area and thickness, strength and shrinkage of bedding material.

Commonly used bedding materials are cementitious or chemical resin mortar and grout. In some cases, it may be necessary to carry out trials to ascertain the most suitable material.

The bedding material, whether above or below the bearing, should extend over the whole area of the bearing in order to ensure even loading. After installation, there shall be no voids or hard spots. The top surface of any extension of the bedding beyond the bearing shall have a downward slope away from the bearing.

The bedding material shall be capable of transmitting the applied load to the structure without being damaged. Surfaces to receive bedding mortar shall be suitably prepared so as to be compatible with the mortar chosen.

12.4.3.3 Fixing of Bearings

Bearings should be anchored in order to counter vibration and accidental impact. Anchorage should be accurately set into recesses cast into the structure using templates. The remaining space in the recesses should be filled with material capable of withstanding the loads.

Bearings that are to be installed on temporary supports should be firmly fixed to the substructure by anchorage or other means to prevent disturbance during subsequent operations. Voids beneath the bearings should be completely filled with bedding material using the appropriate method.

Bearings may be fixed directly to metal bedding plates that may be cast in or bedded on top of the supporting structure to the correct level and location.

If the structure is of steel, the bearings may be bolted directly onto it. Care shall be taken to ensure that there is no mismatch between the bolt holes of the structure and those of the bearing.

Threaded fasteners shall be tightened uniformly to avoid overstressing of any part of the bearing.

12.4.3.4 Bearings Supporting In-situ Concrete Deck

Where bearings are installed prior to casting of an in-situ concrete deck, formwork around bearings should be properly sealed to prevent grout leakage. It is essential that the bearings and particularly the working surfaces are protected during concreting operations. Sliding plates should be fully supported and care taken to prevent tilting, displacement or distortion of the bearings under the weight of green concrete. Any mortar contaminating the bearings should be completely removed before it sets.

For bearings supporting precast concrete or steel beams, a thin layer of synthetic resin mortar should be used between bearings and the beams. Bearings shall be bolted to anchor plates or sleeves embedded in precast concrete elements or to machined sole plates on steel elements.

13. EXPANSION JOINTS

13.1 GENERAL (*cl. 2602 of MoRT&H*)

13.1.1 The type of expansion joint proposed to be used shall conform to the design and got approved by the Engineer.

13.1.2 Expansion joints shall be robust, durable, water-tight and easy for inspection, maintenance and replacement. Site fabricated expansion joints shall be prohibited. Expansion joints shall be procured from approved manufacturers and shall be of proven type.

13.1.3 Alternative proprietary type deck joints proposed by the Contractor in lieu of the type specified shall comply in all respects with the manufacturer's specifications and meet the required range of movements and rotations and be fit for the purpose of ensuring satisfactory long term performance. For such proprietary type deck joints the following information shall be provided.

Name and location of the proposed manufacturer.

Dimensions and general details of the joint including material specifications, holding down bolt or anchorage details and installation procedures.

Evidence of satisfactory performance under similar environmental conditions of similar joints being produced by the manufacturer.

Acceptance of any alternative type of expansion joint shall be at the sole discretion of the Engineer. Such deck joints shall be installed in accordance with the manufacturer's recommendations and to the requirements of these Specifications.

Vehicular traffic shall not be allowed over expansion joints after their installation for such period as may be determined by the Engineer.

13.1.4 The expansion joint shall be provided to cover the entire carriageway, kerb and footpath, wherever provided. It shall follow the profile of the deck including the kerb, footway and fascia. The expansion joint for kerb, footway and fascia may be of different type and specification from that used for the carriageway and it shall cater to all movements and rotations for which the carriageway expansion joint is designed and shall be water tight.

13.2 FILLER JOINTS (*cl. 2604 of MoRT&H*)

13.2.1 Components

The components of this type of joint shall be corrugated copper plate at least 2 mm thick placed slightly below the wearing coat, 20 mm thick compressible fiber board to protect the edges, 20 mm thick pre-moulded joint filler filling the gap up to the top level of the wearing coat and sealant of suitable joint sealing compound.

13.2.2 Material

- i) The material used for filling expansion joint shall be bitumen impregnated felt, elastomer or any other suitable material, as specified on the drawings, impregnated felt shall conform to the requirements of IS:1838, and shall be got approved from the Engineer. The joint filler shall consist of large pieces. Assembly of small pieces to make up the required size shall be avoided.
- ii) Expansion joint materials shall be handled with care and stored under cover by the Contractor to prevent damage.
- iii) Any damage occurring after delivery shall be made good to the satisfaction of the Engineer and at the expense of the Contractor.

13.2.3 Fabrication and Installation

- i) Joint gaps shall be constructed as shown on the drawings. Surfaces of joint grooves shall be thoroughly cleaned with a wire brush to remove all loose materials, dirt and debris, then washed or jetted out.
- ii) Pre-moulded expansion joint filler shall not be placed in position until immediately prior to the placing of the abutting material. If the two adjacent faces of the joint are to be installed at different times, the joint filler shall be placed only when the second face is ready to be kept in position
- iii) Sealants shall be installed in accordance with the manufacturer's recommendations.
- iv) Sealants shall be finished approximately 3 mm below the upper surfaces of the joint.
- v) Joint materials spilt or splashed onto finished surfaces of the bridge during joint filling operations shall be removed and the surfaces made good to the Engineer's approval.
- vi) No joint shall be sealed until inspected by the Engineer and approval is given to proceed with the work.

12.3 REINFORCED ELASTOMERIC JOINT

(*cl. 2605 of MoRT&H*)

13.3.1 Components

Reinforced elastomeric expansion joint shall comprise of following components:

- i) Steel Inserts : The elastomeric slab units shall be fixed to the steel inserts properly anchored in the deck concrete. Fixing of elastomeric slab units with anchoring bolts directly embedded in deck concrete shall not be permitted. Steel inserts along with anchorage shall be fabricated at manufacturer's workshop and not at site.
- ii) Anchorage : The anchorage shall either be loop anchors connected to the inserts by anchor plate or sinusoidal anchor bars welded with the horizontal leg of the steel inserts. For loop anchors with anchor plate, the thickness of the anchor plate shall not be less than 12 mm. Diameter of anchor loops shall not be less than 16 mm and the spacing of anchors shall not be more than 250 mm. For sinusoidal anchors, diameter of bar shall not be less than 12 mm.
- iii) Fixing Bolts : Fixing bolts and nuts shall be made of stainless steel. Tightened nuts shall be locked by using lock washers.
- iv) Elastomeric Plugs : The plug holes provided in elastomeric slab units to house fixing bolts shall be plugged with elastomeric plugs pressed in position after applying adhesive on the surfaces.
- v) Adhesives and Sealants : Special sealant to be poured into the plug holes before plugging and special adhesive to be used for installation, shall be as per the recommendation of manufacturer.
- vi) Necessary spacer bars to ensure proper positioning of bolts and leveling and aligning steel inserts during fixing with deck as well as special jigs to be used to preset the elastomeric slab units, shall be provided by the manufacturer.

13.3.2 Material

- i) Mild steel to be used for manufacture of steel reinforcing plates, inserts and anchorage shall comply with Grade B of IS:2062.
- ii) Cast steel to be used for manufacture of steel reinforcing plates shall comply with IS:1030.
- iii) The elastomer to be used for manufacture of elastomeric slab units shall comply with Clause 915.1 of IRC:83 (Part II), compounded to give hardness IRHD 60 ± 5 .

13.3.3 Fabrication

- i) All surfaces of the steel inserts and anchorage including the surfaces to be in contact with or embedded in concrete shall be sand/shot blasted to SA 2½ and provided with a coat of epoxy primer enriched with metallic zinc. Surfaces not to be in contact with or embedded in concrete shall be provided with an additional coat of epoxy primer enriched with metallic zinc, one intermediate coat of high build epoxy paint reinforced with MIO (Micaceous Iron Oxide) and one coat of high performance epoxy finish paint as per manufacturer's specification with minimum total dry film thickness of 150 micron.
- ii) Elastomeric slab units shall be fully moulded to the required size in one single vulcanizing operation including the reinforcing plates and encasing layers as one integral and homogeneous unit. Edges of reinforcing steel sections shall be rounded. The elastomeric slab units shall be manufactured generally as per the stipulations laid down in Clause 917 of IRC: 83 (Part II). Adjoining portions of elastomeric slab units shall be provided with suitable male-female groove to ensure water tightness.

iii) Permissible tolerances of fabrication shall be as follows:

Plan dimension	± 5 mm
Total height	± 3 mm

13.3.4 Supply and Handling

- i) The Contractor shall supply all steel-reinforced elastomeric expansion joints including bolts, nuts, sealant, plugs and all other accessories for the effective installation of the joints including angled jointing sections for kerbs.
- ii) Expansion joint material shall be handled with care and stored under cover by the Contractor to prevent damage. Any damage occurring after delivery shall be made good at the expense of the Contractor to the satisfaction of the Engineer.

13.4. SINGLE STRIP/BOX SEAL JOINT (*cl. 2606 of MoRT&H*)

13.4.1 Components

Strip seal expansion joint shall comprise the following:

- i) Edge Beam :** This shall be either extruded or hot rolled steel section including continuously shop welded section with suitable profile to mechanically lock the sealing element in place throughout the normal movement cycle. Further, the configuration shall be such that the section has a minimum thickness of 10 mm all along its cross section (flange and web). Thickness of lips holding the seal shall not be less than 6 mm. The minimum height of the edge beam section shall be 80 mm. The minimum cross sectional area of the edge beam shall be 1500 mm².
- ii) Anchorage :** The edge beams of single strip/box seal joints shall be anchored in the concrete with rigid loop anchorage. The anchor loops shall be connected to the edge beam by means of anchor plate welded to the edge beam. Total cross sectional area of anchor loop on each side of the joint shall not be less than 1600 mm² per metre length of the joint and the centre to centre spacing shall not exceed 250 mm. The thickness of anchor plate shall not be less than 0.7 times the diameter of anchor loop or 12 mm whichever is higher. The anchor loop at the edge profiles should be at right angles to the joint. Planned deviations of this direction are allowable only for the range of $90^{\circ} \pm 20^{\circ}$. The anchoring reinforcement of the construction must lie parallel to the anchor loops.
- iii) Sealing Element :** This shall be a preformed/extruded single strip of such a shape as to promote self-removal of foreign material during normal joint operation. The seal shall possess high tear strength and be insensitive to oil, gasoline and ozone. It shall have high resistance to ageing. The specially designed proprietary type of locking system of seal in the housing of edge beam shall be such as to ensure 100% water tightness as well as ease of installation and replacement. Mechanical fastening of sealing element with edge beam shall not be permitted. Sealing element shall be continuous over the entire joint

The working movement range of the sealing element shall be at least 80 mm with a maximum of 100 mm at right angles to the joint and ± 40 mm parallel to the joint.

Minimum gap for inserting the Chloroprene seals in the expansion joint shall be 25 mm.

13.4.2 Material

- i) The steel for edge beams shall conform to any of the steel grade equivalent to RST 37-2 or 37-3 (DIN), S235JRG2 or S355K2G3 of EN 10025 (DIN 17100), ASTM A 36 or A 588, CAN/CSA Standard G40.21 Grade 300 W and Grade B of IS:2062. For subzero condition, material for steel shall conform to IS:2062 Grade C.
- ii) The sealing element shall be made of Chloroprene Rubber (CR). The properties of CR shall be as specified in Table 2600-1 of MoRT&H.
- iii) Anchorage steel shall conform to Grade B of IS: 2062 or equivalent standard.

13.4.3 Fabrication (Pre-installation)

- i) Rolled steel profiles for edge beams shall be long enough to cater for the full carriageway width. These shall be cut to size as per actual requirements. Alignment of the steel profiles shall then be made on work tables in accordance with the actual bridge cross-section. For this purpose, the contour of bridge cross-section shall be sketched on the tables. After the steel profiles are aligned, these will be fixed to the tables by means of screw clamps and tacked by arc welding.
- ii) Anchor plates shall be cut to the required size by gas cutting. These shall be welded to the edge beams.

- iii) Anchor loops shall be bent to the required shape and welded to anchor plates.
- iv) All steel sections shall be protected against corrosion by either hot dip galvanizing with a minimum thickness of 150 micron or by epoxy coating.
- v) All surfaces of the steel inserts and anchorage including the surfaces to be in contact with or embedded in concrete shall be given treatment as mentioned in Clause 2605.3 (i) of MoRT&H.
- vi) The finally assembled joints shall then be clamped and transported to the work site.

13.4.4 Handling and Storage

- i) For transportation and storage, auxiliary brackets shall be provided to hold the joint assembly together.
- ii) The manufacturer shall supply either directly to the Engineer or to the Contractor all the materials of strip seal joints including sealants and all other accessories for the effective installation of the joint.
- iii) Expansion joint material shall be handled with care. It shall be stored under cover on suitable wooden padding to prevent damage. Any damage occurring after delivery shall be made good at the cost of Contractor to the satisfaction of the Engineer

13.5. MODULAR STRIP/BOX SEAL EXPANSION JOINTS (*cl. 2607 of MoRT&H*)

13.5.1 Components

A modular expansion joint shall consist of two or more modules/cells of individual capacity 80 mm to cater to a horizontal movement in excess of 80 mm. It shall allow movements in all three directions and rotation about all three axes as per the design requirements. The structural system shall consist of two edge beams, one or more central/separation beams or lamellas and cross support bars supporting individuals or multiple central beams to transfer the loads to the bridge deck through the anchorage system.

- i) Edge Beams and Central Beams/Lamella : These shall be as per Clause 2606.1(i) of MoRT&H.
- ii) Anchorage : Anchorage of edge beam shall be as per Clause 2606.1 (ii). Studs and/or loop anchors with anchor plate may be used as anchorage of other components like joist box and covers of controlling system.
- iii) Sealing Element : This shall be as per Clause 2606.1 (iii). Minimum gap for inserting the neoprene seals in the expansion joint shall be 25 mm.
- iv) Support and Control System : The control system should allow closing and opening of the joint and also ensure that all modules open and close equally during all movement cycles of the joint. The overall support and control system shall be either single/multiple support bar control system or swivel joint system comprising of resilient/shock absorption components and elastic/sliding control system conforming to the specifications recommended by the manufacturer. The gap between the consecutive centre beams at the joint surface shall be limited to 80 mm when the joint opens fully due to maximum contraction of deck.

13.5.2 Material

- i) The steel for edge beams, centre beam/lamella, transverse support bar and other steel components shall conform to any of the steel grade corresponding to RST 37-2 or 37-3 or 52-3 (DIN), S235JRG2 or S355K2G3 of EN10025 (DIN 17100), ASTM A36 or A588, CAN/CSA standard G40.21 Grade 300 W.
- ii) The sealing element shall be of Chloroprene Rubber (CR). The properties of CR shall be as specified in Table 2600-1 of MoRT&H.
- iii) The specification for all other materials shall be as per manufacturer's recommendation.

13.5.3 Fabrication (Pre-installation)

- i) Profile of edge beam, centre beam/lamella shall be long enough to cater for full carriageway width.
- ii) The fabrication of all components of the joints including anchorage system and transportation of assembled joints shall be as per manufacturer's specification.
- iii) All steel sections shall be suitably protected against corrosion as stated in Clause 2606.3 (iv).

iv) All surfaces of the steel inserts and anchorage including the surfaces to be in contact with or embedded in concrete shall be given treatment as mentioned in Clause 2605.3 (i) of MoRT&H.

13.5.4 Handling and Storage

- i) Arrangement for transportation and storage shall be as per manufacturer's specification.
- ii) The manufacturer shall supply either directly to the Engineer or to the Contractor all the materials of strip seal joints including all sealants and other accessories for the effective installation of the joint.

13.6 ASPHALTIC PLUG JOINT (cl. 2608 of MoRT&H)

13.6.1 General

- i) This joint shall consist of a polymer modified bitumen binder, carefully selected single size aggregate, closure/bridging metallic plate and heat resistant foam caulking/backer rod.
- ii) The joint shall be capable of performing satisfactorily, within the temperature (ambient) range of -5°C to +50°C.

13.6.2 Material

i) Binder: The polymer modified bitumen binder shall have the capacity to fill the gaps and voids between single size aggregates and to impart flexibility to accommodate various design movements. It shall be a patented blend of bitumen, synthetic polymer, filler and surface active agent and shall be so formulated as to combine necessary fluidity for the installation process, low temperature flexibility and flow resistance at high ambient temperature. The binder shall satisfy following requirement:

- Softening point : 100°C minimum
- Cone penetration at 25°C, 0.1 mm (BS:2499) : 100 mm max
- Flow resistance at 70°C, 5 hours (BS:2499) : 3 mm max
- Extension Test
- 5 cycle of extension to 50% (blocks prepared to ASTM D1190 at rate of 3.2 mm/hour at and tested to limits BS:2499) : 25°C
- Safe heating temperature. : 210°C

ii) Aggregates : The aggregate shall be of single size chosen from basalt granite, grit stone or gabro group. The nominal size of aggregate shall be 12.5 mm for joints up to 75 mm depth and 20 mm for joints of larger depth. The flakiness index shall not be more than 25 percent. The aggregate shall satisfy grading requirements stipulated in Table 2600-2 of MoRT&H.

Table 108 : Grading Requirements of Aggregate (Table 2600-2 of MoRT&H)

IS Sieve Designation	Nominal Size of Aggregate	
	20mm	25 mm
	Percentage by Weight Passing the Sieve	
26.5 mm	100	-
19.9 mm	85- 100	100
13.0 mm	0-35	85-100
9.5 mm	0-7	0-35
6.3 mm	-	0-7
2.3 mm	0-2	0-2

75 micron	0- 1	0-1
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The Polished Stone Value (PSV), Aggregate Abrasion Value (AAV), Aggregate Impact Value (AIV) and Aggregate Crush Value (ACV) shall be as below:

- PSV > 60
- AAV > 05
- AIV < 18
- ACV = 10-25

The surface characteristics should promote proper adhesion,

iii) Closure Plate : The closure plate shall be weld able structural steel conforming to IS:2062. The minimum thickness of steel plate shall be 6 mm and the width shall not be less than 200 mm. Closure plate shall preferably be of single length but it shall not have more than 2 pieces per traffic lane width which shall be welded together to form the required length. It shall be provided with equidistant holes at a maximum spacing of 300 mm centers for anchorage to the caulking/ backer rod along the longitudinal centre line of the plate. The plate shall be protected against corrosion by galvanizing or by any other approved anti-corrosive coating paint with a minimum thickness of 100 micron.

iv) Foam Caulking/Backer Rod: The foam caulking shall be closed cell polyolefin or open cell polyurethane foam cylindrical type. The backer rod shall be of diameter equal to 150 percent of the joint opening. It shall be heat resistant and possess good flexibility and recovery characteristics with density of 25 kg/m³ to 30 kg/m³.

14. WEARING COAT AND APPURTENANCES

14.1 WEARING COAT (*cl. 2702 of MoRT&H*)

14.1.1 Bituminous Wearing Coat

Bituminous wearing coat shall comprise of following types:

- | | |
|---------|--|
| Type 1: | Bituminous Concrete 50 mm thick laid in single layer |
| Type 2: | Bituminous Concrete 40 mm thick overlaid with 25 mm thick mastic asphalt |
| Type 3: | Stone Matrix Asphalt 50 mm thick laid in single layer |
| Type 4: | Mastic Asphalt 50 mm thick laid in single layer |

Before laying wearing coat the deck surface shall be thoroughly cleaned and tack coat shall be applied. The construction operations and bituminous mixes and tack coat shall conform to Section 500 of MoRT&H Specifications.

14.1.2 Cement Concrete Wearing Coat

Cement concrete wearing coat shall be laid separately over the bridge deck. The thickness of wearing coat shall be 75 mm. The concrete shall be of minimum M30 grade. Steel reinforcement of 8 mm diameter at 150 mm spacing in both directions shall be provided at the mid depth of the wearing coat. In a length of 1 m near the expansion joint additional reinforcement of 8 mm diameter bars shall be provided in both directions to make the spacing as 75 mm.

Cement concrete and steel reinforcement shall conform to Section 1700 and Section 1600 respectively of MoRT&H Specifications.

Curing of wearing coat shall start as early as possible.

All carriageway and footpath surfaces shall have non-skid characteristics.

14.1.2.1 The cross slope in the deck shall be kept as 2.5 percent.

14.1.2.2 For the structures with flat deck surface, camber/super elevation in the wearing coat shall be achieved as below:

- i) In bituminous wearing coat provide profile making course before laying wearing coat. The profile making course shall be of the same material as of wearing coat. The thickness of wearing coat at any point shall not be less than that given in Clause 2702.1 of these Specifications.
- ii) In case of cement concrete wearing coat provide profile corrective course along with wearing coat in single layer.

14.1.2.3 Overlay on the existing wearing coat on bridge decks shall not be permitted.

In case the wearing coat is damaged, it shall be repaired or replaced. The dismantling of wearing coat shall be as per Section 2800 of these Specifications.

14.2 RAILING AND CRASH BARRIER (*cl. 2703 of MoRT&H*)

14.2.1 General

- a) Bridge railing/crash barrier includes the portion of the structure erected on and above the kerb.
- b) Railing/crash barrier shall not be constructed until the centering false work for the span has been released and the span is self-supporting.
- c) For concrete with steel reinforcement, specifications for the items of controlled concrete and reinforcement mentioned under relevant Sections of these Specifications shall be applicable.
- d) The railing/crash barrier shall be carefully erected true to line and grade. Posts shall be vertical with a tolerance not exceeding 6 mm in 3 m. The pockets left for posts shall be filled with non-shrink mortar.
- e) The type of railing/crash barrier to be constructed shall be as shown on the drawings and shall conform to IRC:5 and IRC:6.
- f) Care shall be exercised in assembling expansion joints in the railing/ crash barrier to ensure that they function properly.
- g) The railing/crash barrier shall be of such design as to be amenable to quick repairs.
- h) The material of metal railing/crash barrier shall be handled and stored with care, so that it remains clean and free from damage. Railing/crash barrier materials shall be stored above the ground on platforms, skids, or other supports and kept free from grease, dirt and other contaminants.

Any material which is lost, stolen or damaged after delivery shall be replaced or repaired by the Contractor. Methods of repairs shall be such that they do not damage the material or protective coating.

14.2.2 Metal Railing/Crash Barrier

Materials, fabrication, transportation, erection and painting for bridge railing/crash barrier shall conform to the requirements of Section 1900 of these Specifications.

All steel railing elements, pipe terminal Sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanised or painted with an approved paint.

If galvanised, all elements of the railing/crash barrier shall be free from abrasions, rough or sharp edges, and shall not be kinked, twisted or bent. If straightening is necessary, it shall be done as per method approved by the Engineer.

Damaged galvanised surfaces, edges of holes and ends of steel railing/crash barrier cut after galvanising shall be cleaned and re-galvanised.

The railing/crash barrier shall be carefully adjusted prior to fixing in place to ensure proper matching at abutting joints and correct alignment and camber throughout its length.

Holes for field connections shall be drilled with the railing/crash barrier in place in the structure at proper grade and alignment.

Unless otherwise specified on the drawings, metal railing/crash barrier shall be given one shop coat of paint and three coats of paint after erection, if sections are not galvanised.

Railing/crash barrier shall follow the alignment of the deck. Where required as per the drawings, the rail elements shall be before erection.

14.2.3 Cast In-Situ Concrete Railing/Crash Barrier

The portion of the railing/crash barrier or parapet which is to be cast in-situ shall be constructed in accordance with the requirements for Structural Concrete Section and reinforcement conforming to Sections 1600 and 1700 of these Specifications.

Forms shall be fabricated conforming to the shape of railing/crash barrier shown on the drawings. It shall be ensured that no form joint appears on plane surfaces. For bridges/viaducts of length more than 500 m horizontal slip forms shall be used for casting of crash barriers.

All mouldings, panel work and bevel strips shall be constructed according to the details shown on the drawings. All corners in the finished work shall be true, sharp and clean-cut and shall be free from cracks, spalls or other defects. Castings of posts shall be done in single pour.

14.3 APPROACH SLAB *(cl. 2704 of MoRT&H)*

Reinforced concrete approach slab with 12 mm dia bars at 150 mm c/c in each direction both at top and bottom in M30 grade of concrete covering the entire width of the roadway, shall be provided as per details given on the drawings or as approved by the Engineer. Minimum length of approach slab shall be 3.5 m and minimum thickness 300 mm.

The cement concrete and reinforcement shall conform to Sections 1700 and 1600 respectively of these Specifications.

The approach slab shall rest on a base of 150 mm thick M15 grade concrete or as shown on the drawings or as directed by the Engineer.

14.4 DRAINAGE SPOUTS *(cl. 2705 of MoRT&H)*

Drainage along longitudinal direction shall be ensured by sufficient number of drainage fixtures embedded in the deck slab. The spouts shall be of not less than 100 mm in diameter and shall be of corrosive resistant material such as galvanised steel with suitable cleanout fixtures. The spacing of drainage spouts shall not exceed 10 m. The discharge from drainage spout shall be kept away from the deck structure by means of suitable down pipes upto 500 mm above High Flood Level. In case of viaducts in urban areas, the drainage spouts should be connected with suitably located runners and down pipes to discharge the surface run-off into drains provided at ground level.

14.5 WEEP HOLES *(cl. 2706 of MoRT&H)*

Weep holes shall be provided on all plain concrete, reinforced concrete, brick masonry and stone masonry structures such as, abutment, wing wall and return walls as shown on the drawings or as directed by the Engineer to permit water to flow out without building up pressure in the backfill. Weep holes shall be provided with 100 mm diameter AC/PVC/HDPE pipe for structures in plain/reinforced concrete or brick masonry. In case of stone masonry, weep holes shall be of rectangular shape 80 mm wide, 150 mm high or circular with 150 mm diameter. Weep holes shall extend through the full width of concrete/masonry with slope of about 1 vertical: 20 horizontal towards the draining face. The spacing of weep holes shall be 1 m in either direction or as shown in the drawings with the lowest at 150 mm above the low water level or ground level whichever is higher or as directed by the Engineer.

Quality Control Test for Basic Construction Materials

For Concrete Works

1.1 Coarse Aggregate :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards															
1)	Particle Size and Shape a) Sieve Analysis b) Flakiness Index and Elongation Index	1. At the beginning for approval of each source and change of source. 2. Once in a week.	IS: 383-1970 IS: 2386 (Part I)-1963	As per Table 1000-1 of MoRT&H. 35 % Maximum value of combined Elongation and Flakiness Index															
2)	Deleterious Materials	1. At the beginning for approval of each source and change of source. 2. Once in 3 months.	IS: 383-1970 IS: 2386 (Part II)-1963	<table><thead><tr><th>Deleterious Material</th><th>Percentage by (maximum)</th></tr></thead><tbody><tr><td>1. Coal & lignite</td><td>1</td></tr><tr><td>2. Clay Lumps</td><td>1</td></tr><tr><td>3. Material finer than 75 micron IS Sieve</td><td>3</td></tr><tr><td>4. Soft fragment</td><td>-</td></tr><tr><td>5. Shale</td><td>-</td></tr><tr><td>Total</td><td>5</td></tr></tbody></table>	Deleterious Material	Percentage by (maximum)	1. Coal & lignite	1	2. Clay Lumps	1	3. Material finer than 75 micron IS Sieve	3	4. Soft fragment	-	5. Shale	-	Total	5	weight
Deleterious Material	Percentage by (maximum)																		
1. Coal & lignite	1																		
2. Clay Lumps	1																		
3. Material finer than 75 micron IS Sieve	3																		
4. Soft fragment	-																		
5. Shale	-																		
Total	5																		
3)	Specific Gravity & Density	1. At the beginning for approval of each source and change of source. 2. Once in a Fortnight.	IS: 383-1970 IS: 2386 (Part III)-1963	Test is required for maintaining uniformity of material brought from the source.															
	Mechanical Properties Aggregate Crushing Value a) Value b) Impact Value c) 10 per cent Fines d) Abrasion Value	1. At the beginning for approval of each source and change of source. 2. Once in a week. 1. At the beginning for approval of each source and change of source. 2. Once in 3 months.	IS: 383-1970 IS: 2386 (Part IV)-1963	45 % Maximum by Weight 45 % Maximum by Weight 5T Minimum 50 % Maximum by Weight															
5)	Soundness	1. At the beginning for approval of each source and change of source.	IS: 383-1970 IS: 2386	Maximum Average Loss of Weight after 5 cycles (i) tested with Sodium-12%															

2. Once in 3 months.

(Part V)-1963

Sulphate
(ii) tested with Magnesium Sulphate -18%

6)	Surface moisture content	1.	At the beginning for approval of each source and change of source.	IS: 383-1970 IS: 2386 (Part III)-1963	Test required to adjust the water content in the mix design before starting any concrete mixing.
		2.	At every change of mix design		
		3.	Every time making the concrete		
7)	Alkali Reactivity	1.	At the beginning for approval of each source and change of source.	IS: 383-1970 IS: 2386 (Part VII)-1963	Innocuous Aggregate.
		2.	Once in 3 months.		

1.2 Fine Aggregate :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards														
1)	Particle Size and Shape	At the beginning for approval of each source and change of source. 1. source 2. Once in a month.	IS: 383-1970 IS: 2386 (Part I)-1963	Fine Aggregate should be of grading from Zone-I to Zone-III as per Table 1000-1 of MoRT&H.														
2)	Deleterious Materials	At the beginning for approval of each source and change of source. 1. source 2. Once in a month.	IS: 383-1970 IS: 2386 (Part II)-1963	<table><tr><th>Deleterious Material</th><th>Percentage by weight (maximum)</th></tr><tr><td>1. Coal & lignite</td><td>1</td></tr><tr><td>2. Clay Lumps</td><td>1</td></tr><tr><td>3. Material finer than 75 micron IS Sieve</td><td>3</td></tr><tr><td>4. Soft fragment</td><td>-</td></tr><tr><td>5. Shale</td><td>-</td></tr><tr><td>Total (1 to 5 above)</td><td>5</td></tr></table>	Deleterious Material	Percentage by weight (maximum)	1. Coal & lignite	1	2. Clay Lumps	1	3. Material finer than 75 micron IS Sieve	3	4. Soft fragment	-	5. Shale	-	Total (1 to 5 above)	5
Deleterious Material	Percentage by weight (maximum)																	
1. Coal & lignite	1																	
2. Clay Lumps	1																	
3. Material finer than 75 micron IS Sieve	3																	
4. Soft fragment	-																	
5. Shale	-																	
Total (1 to 5 above)	5																	
3)	Silt Content	At the beginning for approval of each source and change of source. 1. source 2. Once daily.		Maximum 8 % or as specified in the tender.														
4)	Specific Gravity & Density	At the beginning for approval of each source and change of source. 1. source 2. Once in 3 months.	IS: 383-1970 IS: 2386 (Part III)-1963	Test is required for maintaining uniformity of material brought from the source.														

5)	Water Absorption	1. At the beginning for approval of each source and change of source. 2. Once daily.	IS: 383-1970 IS: 2386 (Part III)-1963	Test required for adjusting the water content in the mix design before starting any concrete mixing.
6)	Soundness	1. At the beginning for approval of each source and change of source. 2. Once in 3 months.	IS: 383-1970 IS: 2386 (Part V)-1963	Maximum Average Loss of Weight after 5 cycles (i) tested with Sodium Sulphate -10% (ii) tested with Magnesium Sulphate -15%

1.3 Water :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Chemical Analysis a) pH value b) Chlorides (as Cl) c) Sulphates (as SO ₃) Neutralisation with NaOH d) (with phenolphthalein as indicator) Neutralisation with e) H ₂ SO ₄ (with mixed indicator)	1. At the beginning for approval of each source and change of source. 2. Once in 3 months. 3. Chemical Tests daily in the site Laboratory with testing kits.	IS: 456-2000 IS:3025 (Part 24) IS:3025 (Part 32) IS:3025 (Part 22) IS:3025 (Part 23)	Fine Aggregate should be of grading from Zone-I to Zone-III as given below. Minimum 6. 500 mg/l. 400 mg/l Maximum 5 ml of .02 normal NaOH to neutralise 100 ml of water. Maximum 25 ml of .02 normal H ₂ SO ₄ to neutralise 100 ml of water.

2)	Physical Properties a) Suspended matter b) Organic matter c) Inorganic matter	1. At the beginning for approval of each source and change of source. 2. Once in 3 months.	IS:3025 (Part 17) IS:3025 (Part 18) IS:3025 (Part 18)	2000 mg/l maximum 200 mg/l maximum 3000 mg/l maximum

Steel / Iron

2.1 Reinforcement bars (CTD, TMT)

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Chemical Tests a) Carbon b) Sulphur c) Phosphorus d) Sulphur + Phosphorus	1. At the beginning for approval of each source and change of source. 2. Once for every lot. 3. Once in 3 months.		0.30 maximum 0.06 maximum 0.06 maximum 0.11 maximum
2)	Physical Test a) Ultimate Tensile Strength. b) 0.2% Proof stress c) Percentage Elongation d) Bend and Rebend Test e) Mass per meter run (Kg)	1. At the beginning for approval of each source and change of source 2. Once for every lot 3. Once in 3 months	IS: 1786-2008	10% more than the actual 0.2% proof stress but not less 485 MPa. 415 MPa minimum 14.5 minimum To be satisfactory - 6.31 ± 3% for 32 mm dia, 4.830 ± 3% for 28 mm dia, 3.85 ± 3% for 25 mm dia, 2.470 ± 3% for 20 mm dia 1.58 ± 5% for 16 mm dia, 0.888 ± 5% for 12 mm dia

2.2 Cast Steel (For bearings grade 280-520W)

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Chemical Tests	1. Once in the beginning for source. During execution depending upon the nature of use. 3. Once in a project for every source.	IS: 1030-1989	C- 0.25% Maximum Mn- 1.20 Si - 0.60 P- 0.0.10 S - 0.035 Ni - 0.40 Cr - 0.35 Cu - 0.40 Mo- 0.15 V - 0.05
2)	Physical Test a) Ultrasonic Tests. b) Magnetic Particle Examination c) Liquid Penetration Examination d) Radiographic Examination	1. Once in the beginning for source. During execution depending upon the nature of use. 3. Once in a project for every source.	IS: 1030-1989	No deformations should be observed.

2.3 Mild Steel

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards							
1)	Chemical Composition	1. At the beginning for approval of each source and change of source.	IS: 2062-1999	Grade	Designation value maximum	C	Mn	S	P	Si	Carbon

		2. Once in a project for every source.						
A	Fe410 WA		0.23	1.5	0.005	0.05	0.04	0.42
B	Fe410 WB		0.22	1.5	0.046	0.045	0.04	0.41
C	Fe410 WC		0.20	1.5	0.040	0.04	0.04	0.39
Nitrogen Content P 0.012% Nb, V & Ti content (all or any) 0.2%								

3. Cement

3.1 Cement (OPC-53 grade)				
Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Chemical Tests a) Chlorides (as cl) b) Ratio of Alumina to that of Iron c) Oxide d) Magnesium (MgO) e) Total sulphate content f) Loss on Ignition g) Insoluble Residue h) Lime saturation factor.	1. At the beginning for approval of each source and change of source. 2. Once for every lot. 3. Once in 3 months.	IS: 12269-1987	0.05% max 0.66 min 6.0% max 3.0% max 4.0% max 3.0% max 0.8-1.02
2)	Physical Test a) Setting Time i) Initial ii) Final b) Soundness (Le Chatelier Expansion)	1. At the beginning for approval of each source and change of source 2. Once for every lot	IS: 12269-1987	Not less than 30 minutes. Not more than 10 hours. 10mm (maximum) and 0.8% (maximum)

c) Compressive Strength

3. Once in 3 months

i) At 3 Days

Not less than 27 MPa
Strength

ii) At 7 days

Not less than 37 MPa
Strength

iii) At 28 days

Not less than 53 MPa
Strength

d

) Fineness

225 m³ / Kg Minimum.

3.2 Cement (OPC-43 grade)

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Chemical Tests a) Chlorides (as cl) b) Ratio of Alumina to that of Iron Oxide c) Magnesium (MgO) d) Total sulphate content e) Loss on Ignition f) Insoluble Residue g) Lime saturation factor.	1. At the beginning for approval of each source and change of source. 2. Once for every lot. 3. Once in 3 months.	IS: 8112-1989	0.05% max 0.66 min 6.0% max 3.0% max 5.0% max 2.0% max 0.66-1.02
2)	Physical Test a) Setting Time i) Initial ii) Final	1. At the beginning for approval of each source and change of source 2. Once for every lot 3. Once in 3 months	IS: 8112-1989	Not less than 30 minutes. Not more than 10 hours.

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
	b Soundness (Le Chatelier			10mm (max.)

) Expansion) c) Compressive Strength i) At 3 Days ii) At 7 days iii) At 28 days d) Fineness			and 0.8% (max.) Not less than 23 MPa Strength Not less than 33 MPa Strength Not less than 43 MPa Strength 225 m ² / Kg Minimum.
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3.4 Portland Slag cement

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Chemical Tests a) Magnesium oxide (MgO) b) Sulphur Trioxide (SO ₃) c) Sulphide Sulphur(S) d) Loss on Ignition e) Insoluble Residue f) Chloride Content	1. At the beginning for approval of each source and change of source. 2. Once for every lot. 3. Once in 3 months.	IS: 455-1989 IS: 4032-1985	8.0 % Maximum 3.0 % Maximum 1.5 % Maximum 5.0 % Maximum 4.0 % Maximum 0.05 % Maximum

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
2)	Physical Test a) Fineness (Blain's Air permeability method) b) Soundness i) Le-Chateliers Method ii) Auto clave expansion c) Setting time i) Initial	1. At the beginning for approval of each source and change of source 2. Once for every lot	IS: 4031 (Part 2): 1988 IS: 4031 (Part 3): 1988	Specific Surface shall not be less than 225 m ² /Kg Expansion shall not be more than 5 mm Expansion shall not be more than 0.6% Initial setting time not less than 30 minutes

		3. Once in 3 months		
	ii) Final d) Compressive Strength i) 72 ± 1 h ii) 168 ± 2 h iii) 672 ± 4		IS: 4031 (Part 5): 1988 IS : 4031 (Part 6): 1988	Final setting time not more than 60 minutes Not Less than 16 MPa Not Less than 22 MPa Not Less than 33 MPa

4. Plasticiser (Normal and Retarding Type Super Plasticiser)

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Water content, per cent of control sample			80 Maximum
2)	Slump			Not more than 15 mm below that of the control mix concrete
3)	Time of Setting, allowable deviation from control sample a) Initial b) Final			Maximum +4 for Retarding type and nil for Normal Minimum +1 for Retarding type and +1.5 for Normal Maximum ± 3 for Retarding type and ± 1.5 for Normal
4)	Compressive strength, per cent of control sample a) 1 day b) 3 days c) 7 days d) 28 days e) 6 months f) 1 year	1. At the beginning for approval of each source and change of source. 2. Once for every lot. 3. Once in 3 months.	IS: 9103-1999	140 minimum for Normal only 125 minimum for Normal as well as Retarding type 125 minimum for Normal as well as Retarding type 115 minimum for Normal as well as Retarding type 100 minimum for Normal as well as Retarding type 100 minimum for Normal as well as Retarding type
5)	Flexural Strength, per cent of control sample a) 3 days b) 7 days c) 28 days			110 minimum 100 minimum 100 minimum
	Length change per cent increase over control sample a) 28 days			0.01 maximum

- b) 6 months
c) 1 year

0.01 maximum
0.01 maximum

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
7)	Bleeding, per cent increase over control sample.	1. At the beginning for approval of each source and change of source. 2. Once for every lot. 3. Once in 3 months.	IS: 9103-1999	5 maximum
8)	Loss of workability			At 45 minutes for Normal type admixture and at 2 hours for Retarding type admixture, the slump shall not be less than that of control mix concrete at 15 minutes.
9)	Air content (%) over control specimen			1.5 maximum
10)	Uniformity Tests a) Dry Material Content b) Ash content c) Relative Density d) Chlorides ion content e) pH			Within 3% of the value stated by the manufacturer. Within 1% of the value stated by the manufacturer. Within 0.02 of the value stated by the manufacturer. Within 10% of the value or within 0.2 % whichever is greater as stated by the manufacturer. 7 – 8

5. Water Proofing Compound

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Permeability			Permeability to water of the standard cylindrical specimens prepared with the recommended proportion of the water proofing compound shall be less than 50% of permeability similar specimens prepared without waterproofing compound

2)	Setting Time	At the beginning for approval of each 1. source and change of source. 2. Once in a project for every source.	IS: 2645-1975	Initial Setting Time - Not less than 30 minimum Final Setting time - Not more than 600 minimum
3)	Compressive Strength			Compressive strength at 72 hrs. - Not less than 160kg/cm ² or 80% of the 3 day Compressive strength of cubes prepared without waterproofing compound. Compressive Strength at 168 hrs. - Not less than 220 kg/cm ² or 80% of the 7 day compressive strength of cubes prepared without waterproofing compound.
4)	Chloride Content			As per the values given by the manufacturer
5)	Sulphate Content			As per the values given by the manufacturer

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Bentonite

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Density	At the beginning for approval of each 1. source and change of source. 2. Once for every day of Pilling.	MOST Specification for Road & Bridge Works	1.05g/cc
2)	Marsh Cone Viscosity			30 to 40
3)	pH value			9.5 to 12
4)	Silt content			less than 1 %
5)	Liquid limit			not less than 400%

Quality Control Test for Site Activities

1. Mix Design including Trial Mix and Acceptance Criteria

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
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1)	Trial Mix a) Target Mean Strength	1. For every design Mix. 2. For every change in source of any material.	IRC : 21-2000	Initially. Target Mean Strength = specified Characteristic Strength + current Margain Current Margain = 1 1 M Pa for M 25, 12 MPa for M30, M 35 and M 40, 1 3 MPa for M 45 and M 55 & 14 MPa for M 55 and M 60 Later on Target Mean Strength = specified Characteristic Strength + 1 .64 x Standard Deviation from at least 40 samples.
2)	Acceptance Criteria	Qty. of Concrete (m3) No. of Samples 1-5 1 6-15 2 16-30 3 31-50 4 51 and 4+ above each Plus 1 for 50 m ³ or part thereof	IRC : 21-2000	1. Mean strength of any group of 4 consecutive samples = Specified Characteristic Strength + 3Mpa 2. Strength of any sample Specified > Characteristic Strength - 3 Mpa

2. R.C.C. work

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Workability	Every Transit Mixer	IRC 516-1959	As per requirement of the item under execution
2)	Compressive Strength a) 7 Days Strength b) 28 Days Strength	As per clause 25.	IRC : 21	As per clause 25.
3)	Flexure Test	Once for every design Mix	MOST Specification for Road & Bridge	
4)	Permeability Test	Once in a month		Maximum 25mm on a specimen of 150mm<j) and 160mm height
5)	Density a) Fresh concrete b) Hardened concrete	Once in a month	Works	97.5% of the specified value 97.5% of the specified value

3 Piling

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Initial Tests a) Vertical	Minimum 2 tests	IS : 2911 (Part-4) - 1985	The safe vertical load shall be minimum of i) 50% of the final load corresponding to 12mm displacement ii) Final load at which displacement in 5mm iii) Load corresponding to any other specified displacement as per performance requirements
2)	Routine Tests a) Vertical Test b) Lateral Load Test c) Integrity Test	Upto 2% of total piles Upto 2% of total piles Upto 2% of total piles	IS : 2911 (Part-4) - 1985	Maximum settlement at a test load of 1.5 times the working load shall not exceed 12mm Safe Lateral load shall be the minimum of i) 50% of the final load corresponding to 12mm displacement ii) Final load at which displacement is 5mm. iii) Load corresponding to any other specified displacement as per performance requirements. There shall be no unacceptable flaws in concrete as per the recommendation of the specified agency carrying out the test.

4 Embankment Construction

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Atterberg Limits a) Liquid Limit b) Plasticity Index	1. Once for each kind of soil. 2. Once at beginning of supply. 3. 2 tests per 3000 m³.	IS : 2720 (Part 5)	Maximum 70 Maximum 45
2)	Clay Content		IS:2720 (Part 4)	Maximum 10 %.
3)	Deleterious Content Test		S: 2720 Part 27	Material should be free from swamp, marshes and bogs It should not be Peat, log, sump and perishable material
4)	Classification of Soil		S:1498	Soil should not be classified as OL, OI, OH or Pt

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
5)	CBR	1. Once for each kind of soil. 2. Once at beginning of supply. 3. 2 tests per 3000 m ³ .	S- 2720 Pan 16	Minimum 4% (under fully soaked condition)
6)	OMC and Maximum Dry Density		S: 2720 Part 8	Determined to control water content for achieving maximum density.
7)	Density		S: 2720 Part 8	1.80 to 2.15gm/cc
8)	Grading		S: 2720 Part 4	The size of coarse material should not exceed 75 mm in embankment and 50 mm in subgrade
9)	Moisture Content	One test to be conducted for every 1000 m ² of embankment in the lower layers and 500 m ² in the top 60 cm of the embankment (20cm thickness). Each test shall comprise of tests at five locations.	MORTH Specification for Road & Bridge Works	The moisture content shall be in the range of -1 % to +2% of the OMC.
10)	Dry Density		IS: 2720 (Part -2) IS: 2720 (Part-8)	The dry density shall be 95% of the Maximum Dry Density (MOD) in the lower layers of embankment and 100% of MDD in the top 60 cm of the embankment

Sub-Bases And Bases (Excluding Bitumen Bound Bases)

5.1 Granular and mechanically Stabilised Soil Sub Base :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Gradation	1. At the beginning for approval of each source and change of source. 2. One test per 400 m ³ .	IS: 383-1970 IS: 2386 (Part I)-1963	As per Table 400-1 of MORT&H.
2)	Atterberg's limits. a) Liquid Limit b) Plasticity Index		IS : 2720 (Part V)	Maximum 25 % Maximum 6 %
3)	Moisture content prior to compaction			2% Maximum.
4)	Density of compacted layer			
5)	Deleterious constituents.	As required	IS: 383-1970	Free from Organic and other deleterious constituents.

			IS: 2386 (Part II)-1963	
6)	CBR	-do-	IS:2720 (Part V)	At 98% dry density - Minimum 30 unless otherwise specified in the Contract

5.2 Lime/Cement Stabilised Soil Sub-base :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Quality of lime/cement -	One test for each consignment subject to a minimum of one test per 5 tonnes	IS: 1514 / IS:269, 455 or 1489	Lime shall have purity of not less than 70% by wt. of Quick-lime (CaO) / Cement for stabilization shall either is OPC, PSC or PPC.
2)	Lime/Cement content	Regularly through procedural checks		The mix design shall be done to arrive at the appropriate qty. of lime to be added.
3)	Degree of pulverization	Periodically as considered necessary		Minimum percent by weight passing the sieve: 26.5 mm – 100% & 5.6 mm – 80%.
4)	CBR or Unconfined Compressive Strength test on a set of 3 specimens	As required		The laboratory CBR/UCS value shall be at least 1.5 times the min. field value of CBR/UCS.
5)	Moisture content prior to compaction	One test per 500 m2	IS:2720 (Part II)	Neither be less than the optimum moisture content corresponding to IS:2720 (Part VIII) nor more than 2 % above it.
6)	Density of compacted layer	One test per 500 m2	IS:2720 (Part VIII)	At least 98 percent of the maximum dry density
7)	Deleterious constituents	As required		

5.3 Water Bound Macadam :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Grading of aggregate	One test per 250 m ³ of aggregate	IS: 383-1970 IS: 2386 (Part I)-1963	As per Table 400-9 & 400-10 of MORT&H.
1)	Aggregate Impact Value	One test per 1000 m ³ of aggregate	IS: 2386 (Part IV)	30 % Maximum by Weight
3)	Combined Flakiness & Elongation Indices	One test per 500 m ³ of aggregate	IS: 2386 (Part I)	35 % Maximum by Weight
Sl.	Test	Frequency	Ref. Codes	Acceptance Standards

4)	Atterberg Limits of binding Material	One test per 50 m ³ of aggregate.	IS:2720 (Part V)	PI ≤ 6
5)	Atterberg's limit of screenings	One test per 100 m ³ of aggregate	IS: 383-1970 IS: 2386 (Part I)-1963	Maximum 10%

Bituminous Construction Works

6.1 Prime coat :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Quality of binder	Number of samples per lot.	IS: 73: 2013,	Cationic Bitumen Emulsion SS1 grade conforming to IS: 8887.
2)	Binder temperature for application	At regular close intervals	IS: 217 & IS: 8887	140-160 for VG-10, 145-165 for VG-20, 150-165 for VG-30 & 160-170 for VG-40
3)	Rate of spread of Binder	Three tests per day		For WBM/WMM Surface: 0.7-1.0 kg/sq.m & For Stabilised soil base/Crusher Run Macadam Surface: 0.9-1.2 kg/sq.m.

6.2 Tack coat :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Quality of binder	Number of samples per lot.	IS: 73: 2013,	Cationic Bitumen Emulsion RS1 grade conforming to IS: 8887/IS: 217
2)	Binder temperature for application	At regular close intervals	IS: 217 & IS: 8887	140-160 for VG-10, 145-165 for VG-20, 150-165 for VG-30 & 160-170 for VG-40
3)	Rate of spread of Binder	Three tests per day		Bituminous surfaces: 0.20-0.30 Kg per sq.m, Granular surfaces treated with primer: 0.25-0.30 Kg per sq.m & Cement concrete pavement: 0.30-0.35 Kg per sq.m

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6.9 Open-graded Premix Surfacing :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Quality of binder	Number of samples per lot.	IS: 73: 2013, IS: 217 & IS: 8887	The binder shall be bitumen conforming to IS: 73
2)	Aggregate Impact Value/ Los Angeles Abrasion Value	One test per 200 m3 of aggregate of each source and whenever there is change in the quality of aggregate.	IS : 2386 (Part IV)	Max. 30% Max. 40%
3)	Combined Flakiness and Elongation Indices	One test per 100 m3 of aggregate of each source and whenever there is change in the quality of aggregate.	IS : 2386 (Part I)	Max. 35%
4)	Stripping Value of aggregates	One test for each source and whenever there is change in the quality of aggregates	IS: 6241	Minimum retained coating 95%

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
5)	Water absorption of aggregates	- do -	IS : 2386 (Part III)	Maximum 1%
6)	Water sensitivity of mix	- do -	AASHTO 283	Min 80%
7)	Grading of aggregates	Two tests per day		As per Table 500-23 of MoRT&H.
8)	Soundness (Magnesium Sulphate/ Sodium Sulphate)	One test for each source and whenever there is change in the quality of aggregates	IS : 2386 (Part V)	Maximum Average Loss of Weight after 5 cycles, tested with (i) Sodium Sulphate - 12% & (ii) Magnesium Sulphate -18%
9)	Polished Stone Value	- do -	BS:812-114	Not less than 55
10)	Temperature of binder at	At regular intervals		140-160 for VG-10, 145-165 for VG-20, 150-165

	application			for VG-30 & 160-170 for VG-40
11)	Binder content	Two tests per day per plant		a) For 0.1 8m3 of 13.2 mm nominal size stone of 52 kg bitumen per m3
				b) For 0.09m3 of 11.2 mm nominal size stone of 56 kg bitumen per m3
12)	Percentage of fractured faces	One test per 100 m3 of aggregate		

6.10 Seal coat :

Sl.	Test	Frequency	Ref. Codes	Acceptance Standards
1)	Quality of binder	Number of samples per lot.	IS: 73: 2013, IS: 217 & IS: 8887	The binder shall be bitumen conforming to IS: 73 & Cationic bitumen emulsion of Medium Setting (MS) grade complying with IS: 8887.
2)	Aggregate Impact Value/ Los Angeles Abrasion Value	One test per 200 m3 of aggregate of each source and whenever there is change in the quality of aggregate.	IS : 2386 (Part IV)	Max. 27% Max. 35%
3)	Combined Flakiness and Elongation Indices	One test per 100 m3 of aggregate of each source and whenever there is change in the quality of aggregate.	IS : 2386 (Part I)	Max. 35%
4)	Stripping Value of aggregates (immersion Tray Test)	One test for each source and whenever there is change in the quality of aggregates	IS: 6241	Minimum retained coating 95%
5)	Water absorption of aggregate	- do -	IS : 2386 (Part III)	Maximum 1%
6)	Water sensitivity of mix	- do -	AASHTO 283	Min 80%
7)	Grading of aggregate	Two tests per day		Type A - Stone chips shall be of 6.7 mm size defined as 100 % passing through 11.2 mm sieve and retained on 2.36 mm sieve Type B - The aggregate shall pass 2.36 mm sieve & be retained on 180 micron sieve.
8)	Soundness (Magnesium Sulphate / Sodium Sulphate)	One test for each source and whenever there is change in the quality of aggregates	IS : 2386 (Part V)	Maximum Average Loss of Weight after 5 cycles, tested with (i) Sodium Sulphate - 12% & (ii) Magnesium Sulphate -18%
9)	Polished Stone Value (not applicable for	- do -	BS:812-114	Not less than 55

	SAM/SAMI)			
10)	Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction.	At regular intervals		Same as mentioned in 6.4 (Bituminous Macadam)
11)	Rate of spread of materials	Three tests per day		9.8 kg/10 sq.m for Type A, and 6.8 kg for Type B seal coat. Where bituminous emulsion is used as a binder, the quantities for Type A and Type B seal coats shall be 15 kg and 10.5 kg respectively.
12)	Percentage of fractured faces (When gravel is used)	One test per 100 m ³ of aggregate		

14. Approximate requirement of materials for different items of Works

Approximate requirement of materials different items of works:

General Notes:

1. Consumption of materials of construction in the corresponding contract items of works shall be computed on the basis of the quantities shown in the following sections, subject to a variation of plus / minus five percent except for Bitumen/CRMB/Emulsion. The variation in consumption of Bitumen/CRMB/Emulsion may be allowed upto plus/minus one percent. Where, however, the circumstances of work so required, the Engineer-in-charge shall have the authority to allow (with recorded reasons) for a greater variation.

For open graded mixes, having no specific job mix formula, the quantities as shown in the following tables shall be applicable for estimating the rate of the items.

2. In case of any design mix, the consumption shall be guided by the specific approved job mix formula and relevant provisions of "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS" published by MoRT&H (5th Revision). However, for Preliminary estimating purposes, the following quantities may be considered for all cases. However it is advisable to have a mix design with source and type of materials intended to be used in the work and the estimate should be framed according to the quantities of materials as determined in mix design.

13.1 Approximate requirement of materials for Design Mix Concrete Works items

TABLE 3.2-1: APPROXIMATE QUANTITIES OF MATERIALS REQUIRED FOR DESIGN MIX CONCRETE ITEMS

Concrete Grade	Cement Content / m ³ of Concrete	Recommended type of Cement	Coarse Aggregates & Fine Aggregate/ m ³ of Concrete	Remarks
1	2	3	4	5
M-10	280.00 kg	OPC 33 /PSC / PPC	Stone aggregates 0.9 m ³ Sand 0.45 m ³	<p>1. The quantities given in the table are only for estimating purpose. Actual quantities however, shall be ascertained by proper Mix Design following BSI / IRC/ACI or any standard method approved by Engineer in charge.</p> <p>2. During the execution of the item necessary quantity of approved plasticizers to obtain the desired workability and strength is to be added, cost of which has been incorporated in the rate of the item.</p> <p>3. For under water concrete</p>
M-15	350.00 kg	OPC 33 /PSC / PPC	Do	
M-20	400.00 kg	OPC 33 /PSC / PPC	Do	
M-25	420.00 kg	OPC 33 /PSC / PPC	Do	
M-30	430.00 kg	OPC 33 /PSC / PPC	Do	
M-35	440.00 kg	OPC 43/53	Do	

M-40	450.00 kg	OPC 43/53	Do	<i>10% extra cement over the quantity stated in col.2 is to be added.</i> <i>4. Add the cost of 60 kg, 75 kg and 90 kg Silica fume for M45, M50 & M55 grade of concrete respectively.</i>
M-45	450.00 kg	OPC 53	Do	
M-50	450.00 kg	OPC 53	Do	
M-55	450.00 kg	OPC 53	Do	

Major plant and equipment required for each LSB Works.

A) General equipment required for construction Bridge work

1. **For overall bridge length of less than 200m.** – Batch type concrete mixer diesel or electric operated, with a minimum size of 200 liters. automatic water measuring system and integral weigher (hydraulic/pneumatic type). – 1 no.
2. **For overall bridge length of 200 m or more** - Concrete batching and mixing plant fully automatic, with minimum capacity of 15 cum per hour. – 1 no.
3. Transit mixture - 2 No. (**For overall bridge length of 200m. or more**)
4. Steel Shuttering plates of 10 gauge thick or equivalent in mm. Minimum 400Sqm. along with sufficient steel bracings.
5. Vibrator (Needle) -
 - a. 20mm dia. - 4 Nos.,
 - b. 40mm dia. - 4 Nos.
 - c. 60mm dia. - 4 Nos.
6. Plate Vibrator - 4 Nos.
7. Welding plant - 2 Nos.
8. Diesel or Electronic Operated Generator set 100 KvA- 1 No
9. Steel staging arrangements – 2 Sets
10. Water tanker – 1 no.
11. Dewatering Pump -2 nos
12. ETD 200F Hydraulic Breaker – 1 Nos.
13. Tippers/Trucks /Tractors - 6 No.
14. Manual Trolley for Transport of concrete- 4 No.
15. Measuring Boxes of steel -15 Nos.
16. Mechanized Concrete Pump – 2 nos.
17. Semi-automatic batch type mixer with min capacity of 15m³/hr – 2 nos.
18. Excavator - 2nos

B) Additional equipment required in case of construction Bridge with Pile foundation

1. Tripod Winch Set with all accessories such as chisel, tremie pipe with funnel - 2 nos. **(in case of Pile constructed by using tripod winch)**
2. Hydraulic piling rig with all accessories such as cutter, diamond cutter, tremie pipe with funnel - 1 no. **(in case of Pile constructed by using hydraulic piling rig)**

C) Additional equipment required in case of construction Bridge with Well foundation

1. Crane with grab buckets - capacity 0.5 cum to 2.0 cum – 2 nos.
2. Submersible pumps – 2 nos.
3. Air compressors, air locks and other accessories – 2nos.
4. Chisels of appropriate sizes – 4 set.
5. Aqua-header for cutting rocky strata – 2 nos.
6. Diving helmets and accessories – 4 nos.

D) Equipment required For Approach Roads Works

1. Static Roller – 1 Nos.
2. Vibratory Roller - 1 Nos.
3. Excavator cum loader 1.0/0.24 Cum- 1nos
4. Rotavator-1no.
5. Mobile Hot Mix Plant -1 no.
6. Tar Boiler-1no.
7. Bitumen Sprayer- 1no.

Note: All measuring devices of the equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be checked over the range in use, when set up at each site and thereafter, periodically as directed by the Engineer.

Required Field Lab Equipments

Field Lab Equipment's for each Bridges should consist following set up :-

1. Compressive Strength Testing Machine 200MT (With valid Calibration Certificate) - 1 Set.
2. Cube Moulds With tampering rod - 24 nos. of size 15 X 15 X 15 cm.
3. Flexural Test Apparatus.
4. Beam Mould – 3sets of size 10 x 10 x 50 cm
5. Non-Destructive Testing Apparatus. (For Rebound hammer Test)
6. Slump Cone - 3 sets.
7. IS Sieves sets with lid and pan (125mm, 90mm, 75mm, 63mm, 53mm, 50mm, 45mm, 40 mm, 26.5 mm, 25 mm, 22.4 mm, 20 mm, 13.2 mm, 12.5 mm, 11.2 mm, 10 mm, 9.5 mm, 6.3 mm, One Set 5.6 mm, 4.75 mm)

- mm, 3.35 mm, 2.36 mm, 2 mm, 1.18 mm, 600 micron, 425 micron, 300 micron, 180 micron, 150 micron, 90 micron, and 75 micron)
8. Electronic/ Digital Balance Platform Balance 300 Kg Capacity - 1 no.
5 Kg Capacity Accuracy 0.5 gm. - 1 no.
500 gm Capacity Accuracy 0.1 gm - 1 no.
 9. Pan Balance with weight box - 1 no.
 10. Aggregate Impact Test Apparatus - 1 Set
 11. Flakiness Gauge/Elongation Gauge - 1 Set
 12. Digital Thermometers- 3 no.
 13. Ordinary (mercury) thermometer (for room temp.) - 1 no.
 14. Digital Room Temp. - 1 no.
 15. Pocket Type 0°C to 250°C- 1 no.
 16. Digging tools like pick axes, shovels etc. - 1 no.
 17. Core Cutting Machine - 1 Set
 18. Measuring tape, spatula, spirit levels, glassware, porcelain dish pestle mortar. - 1 set
 19. Specific Gravity determination test apparatus with pycnometer/specific gravity bottles, vacuum pump - 1 Set
 20. Water absorption test apparatus- 1 Set
 21. Rapid moisture meter complete with chemicals - 1 Set
 22. Standard Proctor Density Test Apparatus with Rammer- 1 Set
 23. Post Hole Auger with Extensions- 1 Set
 24. Thin-walled sampling tubes- 4 sets (38mm, 50mm, & 100mm dia.)
 25. Oven (200° C), thermostatically controlled - 1 no.
 26. Enamelled tray - 6 nos.
 27. Vicat apparatus for initial and final setting for cement - 1 Set.
 28. Soundness test apparatus for cement - 1 Set.
 29. Mortar cubes mould- 12 sets.
 30. Water Test kit (PH Value, Hardness) - 1 Set
 31. First Aid Box - 1 Nos.

Required Survey Instruments

1. Theodolite - 1 no.
2. Total station- 1 no.
3. Auto level with staff- 2 sets.
4. Ranging Rods- 8 rods
5. Measuring tape 50m, 30m, 10m, 5m, 3m, etc.- 1 Set.
6. Vernier Callipers- 1 no.
7. Screw Gauge- 1 no.

Issued to (Bidder):

Postal Address with Contact No. & e-mail

Price – Free of Cost

West Bengal Form No. 2911

Applicable For Works of value up to Rs 25 (Twenty Five) Crore

Tender No. _____, Sl. No. _____ of _____ (Year)

**TENDER AND CONTRACT FOR WORKS
GENERAL RULES AND DIRECTIONS FOR GUIDANCE OF
BIDDERS/CONTRACTORS**

(A) Applicable for off-line tenders up to Tender Value of Rs. 5.0 lakh

1. All work proposed for execution by contract will be notified in the form of invitation to tender posted in concerned departmental website, e-procurement portal of the Government of West Bengal (<https://wbtenders.gov.in>) and to be published in local news paper for wide circulation also in the notice boards at public places signed by the Tender Inviting Authority.

This form will state the work to be carried out, the date for submitting and opening of tenders as well as the time allowed for carrying out the work; also the amount of earnest money to be deposited with the tender, the amount of security deposit to be deposited by the successful bidder and the percentage, if any, to be deducted from bills. Copies of the specification, design & drawings and other documents required in connection with the work, signed for the purpose of identification by the Authority inviting Tender shall also be open for inspection by the contractor at the office of the Tender Inviting Authority during Office hours.

2. In the event of the tender being submitted by a firm, it must be signed separately by each member thereof, or, in the event of absence of any of the partners, it must be signed on his/her behalf by a person holding a Power-of-Attorney authorizing him/her to do so. Such power-of-attorney is to be produced with the tender, and in the case of a firm carried on by one member of a joint family; it must disclose that the firm is duly registered under the Indian Partnership Act.

3. Acceptance of measurements entered and bills raised on account of a work, when executed by a firm, must also be signed by the several partners, except where the contractors are described in their tender as a firm in which case the receipts must be signed in the name of the firm by one of the partners or by some other person having authority to give effectual receipt for the firm.

4. Any person who submits a tender shall fill up the usual printed form, stating at what rate he or she is willing to undertake the work. Tenders which propose any alteration in the work specified in the said form of invitation to tender, or in the time allowed for carrying out the work, or which contain any other conditions of any sort, will be liable to rejection. No single tender shall include more than one work, but contractors who wish to tender for two or more works shall submit a separate tender for each. Tenders shall have the name and number of the work to which they refer, written outside the sealed envelopes.

5. The Tender Inviting Authority or his/her duly authorized representative will open tenders in presence of intending contractors/bidders who may be present at the time, and

will enter the bid amounts as percentage rates above or below or at par of the tender BOQ of several tenders in a comparative statement in a suitable form. In the event of a tender being accepted, a receipt shall thereupon be given to the contractor/bidder who shall thereupon for the purpose of identification, sign copies of specifications and other documents mentioned in the Rules. In the event of a tender being rejected, the earnest money with such unaccepted tender shall be refunded within 10 days from the date on which the tender is decided, provided the contractor(s) present himself/herself before the Tender Inviting Authority to take the earnest money refund.

6. The accepting authority reserves the right to reject any or all of the tenders without assigning any reasons to the participating bidders and he/she will not be bound to accept either the lowest tender or any of the other tenders.

7. Receipt of an accountant or clerk for any money paid by the contractor/bidder will not be considered as an acknowledgement of payment to the Tender Inviting Authority and the contractor shall be responsible for ensuring that he/she procures a receipt signed by the Tender Inviting Authority, or a duly authorized representative.

8. The Memorandum of work tendered for, and the schedule of materials to be supplied by the executing Department at their supply/issue rates, shall be filled in and completed in the office of the Tender Inviting Authority before the tender form is issued. If a form is issued to an intending bidder/contractor without having been so filled in and completed, he/she shall request the office to have this done before he/she completes and delivers his/her tender.

(B) Applicable for e-tenders of value above Rs. 5.0 Lakh

1. All works of tender value above Rs. 5.00 lakh proposed for execution through this contract document are to be notified and published in the form of notice inviting e-tender (e-NIT) in the designated official tender website of Government of West Bengal having URL <https://wbtenders.gov.in>, and uploaded simultaneously in the URL of concerned Department inviting Tenders. Thus the tender may be seen and downloaded by logging into the “e-procurement” link provided therein, digitally signed by the concerned Tender Inviting Authority and its corresponding abridged notice also published on the same date in the print media.

2. This e-Notice Inviting Tender (e-NIT) will state the work to be carried out, the date for encrypting (submitting) and decrypting (opening) of e-tenders, the time allowed for carrying out the work; amount of earnest money to be deposited with the e-tender; procedure for submission of EMD, amount of security to be furnished by the successful bidder/contractor, security/ performance security to be deducted from running account bills, copies of specifications, Bill of Quantities, design and drawings and any other document required in connection with the work, digitally signed for the purpose of identification by the Tender Inviting Authority.

3. Intending contractors/bidders are required to download the e-tender documents directly from the website stated above. Tender is required to be submitted online by the intending bidders by authorized e-Tokens provided as DSC. This is the only mode of e-submission of tender and document(s). All information posted in the website consisting of e-NIT, WB Form No. 2911, Tender Bill of Quantities (BOQ), corrigenda notices and drawings etc., if any, shall form part of the Contract. Details of procedure of submission have been explained under “General Terms & Conditions” and Annexure attached with the notice of e-tender (e-NIT).

4. All the documents uploaded by the Tender Inviting Authority forms an integral part of the tender contract/agreement. Contractors/bidders are required to upload the entire set of tender documents along with other related documents as asked for in the e-tender through the above website(s) within the stipulated date and time as given in the e-NIT. Tenders are to be submitted in two folders at a time for each work, one being the ‘Technical Bid’ and the other ‘Financial Bid’. The contractor/ bidder shall carefully go through all the documents and prepare to upload the scanned documents in Portable Document Format (PDF) in the designated link in the web portal as their Technical Bid. He/she needs to fill up the rates of items/percentage in the BOQ downloaded for the work in the designated cell and upload the same again in the designated link in the portal as their Financial Bid. Documents uploaded are virus scanned and digitally signed using the Digital Signature Certificate (DSC). Contractors/bidders should especially take note of all

the addenda and corrigenda related to the e-tender and upload all of these documents also as a part of their tender document.

5. Documents uploaded by the contractors/bidders with all information & rates comprising Technical and Financial bids cannot be changed after last/end date for submission of the e-tender.

6. Deed of Consortium/Partnership Firm, and documents of their registration in the form of certified copy of 'Form No. VIII,' issued under the Indian Partnership Act, 1932 (Act-IX of 1932), GST, & PAN (Permanent Account Number) as per RBI guidelines/above Rs. 50,000/- may be compulsorily furnished for all contracts and all other statutory clearances defined in the e-NIT.

7. The tender evaluation and accepting authorities reserve the right to reject any or all of the tenders without assigning any reasons and he/she will not be bound to accept either the lowest tender or any of the tenders.

8. Withdrawal of e-Tender once the bid has been submitted online and after passing of end date for submission which has been accepted for further processing is not allowed. EMD will be forfeited by the Government and the bidder/contractor penalized in terms of provisions in the notice of the tender.

9. Generally Bids will be valid for 120 days from the date of opening of the financial proposal. However, extension of bid validity may be suitably considered by the Tender Inviting Authority, if required, subject to obtaining a written confirmation of the contractor/bidder(s) to that effect.

TENDER FOR WORKS

I/We on behalf of the Governor hereby tender for the execution of the work specified in the underwritten "Memorandum" within the time specified in such "Memorandum" at the rates specified therein, and in accordance, in all respects within the Rules contained in clauses hereinafter, in all of the annexed General Conditions of Contract (GCC), Special Conditions of Contract (SCC) and with such other materials as are provided for, by and in all other respects in accordance and with such conditions so far as applicable.

MEMORANDUM

(a) If several sub-works are included, they should be detailed in a separate list

- (a) General description of work
- (b) Estimated cost put to Tender ... Rs
- (c) Earnest Money Deposit ... Rs.
- (d) Security Deposit (including earnest money) ... Rs
- (e) Percentage, if any, to be deducted from bill ... Rs
.....
(Rupees.....)
Percentage.....)
- (f) Time allowed for the work from date of written order to Commencecalendar months.

For offline tender during submission of bid and during execution of Agreement for online tender

Name of Work Tendered	Amount Put to Tender	Rate Quoted by the Bidder (% above or less or at par)	Tendered Amount (Contract Price both in words & figures)

Should this Tender be accepted, I/we hereby agree to abide by and fulfill all of the terms and provisions of the said conditions of contract annexed hereto so far as applicable, or in default thereof to forfeit and pay to the Governor or his/her successions in office, the sums of money mentioned in the said conditions.

**Give particulars and numbers*

Strike out (a) or (b) as applicable.

A sum of Rs * has been furnished through online net banking/RTGS/NEFT transfer as earnest money deposit [(a) the full value of which is to be absolutely forfeited to the Governor or his/her successors in office, without prejudice to any other rights or remedies of the said Governor or his successors in office. Should I/we not deposit the full amount of security specified in the above 'Memorandum' in accordance with clause I(A) of the said conditions of contract, the said sum of Rs shall be retained by the Government as on account of such security as aforesaid:(b) the full value of which shall be retained by Government on account of the security deposit specified in clause I (B) of the said conditions of contract].

T Signature of Contractor before submission of tender

Dated the _____ Day of _____ 20____

X
(Witness)

T

X Signature of Witness to Contractor's signature

Address
Occupation

XX Signature of the Executive Engineer/AE on behalf of the Department.

The above tender is here by accepted by me for and on behalf of the Governor of the State of west Bengal

XX

Dated the _____ Day of _____ (Month) _____ (Year)

GENERAL CONDITIONS OF CONTRACT

Clause 1 1.1 Earnest Money - The person/persons who intend to participate in the Tender for an Estimated Amount up to Rs. 25 (Twenty Five) Crore shall have to deposit Earnest Money @ 2% (Two percent) of the Estimated Amount put to Tender or Rs 10 Lakh, whichever is lower.

In case of offline tender earnest money is to be submitted in the form of Bank Draft or Bankers Cheque.

In case of Online Tender (e-Tender) earnest money is to be deposited through e-tender portal (<https://wbttenders.gov.in>) by selecting from either of the following payment modes:

- i) Net banking (any of the banks listed in the ICICI Bank Payment gateway) in case of payment through ICICI Bank Payment Gateway.
- ii) RTGS/NEFT in case of offline payment through bank account in any Bank with his/her tender/quotation as per Memorandum No. 3975-F(Y) dated: - 28.07.2016 of Secretary to the Government of West Bengal, Finance Department. The L1 bidder shall make the Formal Agreement after getting the Letter of Acceptance (LOA) issued by the Tender Accepting Authority. Failure to make the Formal Agreement within the time period as prescribed in the Letter of Acceptance (LOA) for the purpose, may be construed as an attempt to disturb the tendering process and will be dealt with accordingly in a legal manner as deemed fit including blacklisting the bidder.

1.2 Security Deposit - While making any payment to the person(s) whose tender has been accepted (hereinafter shall be called the contractor) for work done under the contract, the authority making payment shall deduct such sum which together with the Earnest Money already deposited and converted into security deposit, shall amount to 10% of the value of works executed at the material point of time and paid during the progressive running accounts bills, so that total deduction together with

Earnest Money constitute 10% of the tendered value of work actually done.

In case of excess/and supplementary work over the tendered amount, additional security @ of 10% of such additional amount is to be deposited for all such excess/ and supplementary works beyond the tendered amount before payment of final bill.

Compensation of all other sums of money payable by the contractor to the Government under the terms of the contract may be deducted from the security deposit.

However, even though the earnest money deposited exceeds the prescribed percentage, due to reduction of tendered amount due to any reason whatsoever, such additional earnest money shall be deemed to have been converted into security and further deductions from progressive bills shall be made, taking into consideration the enhanced component of earnest money so converted into security.

Security deduction will not normally be required for hiring of inspection vehicles and boats etc., supply of tools & plants, furniture and computer peripherals. Separate agreement may be required in those cases, particularly for consultancy and RFP for EPC, which shall be made in standard formats to be approved by the Government.

After completion of the work, the Contractor may opt for refund of the Security Deposit by replacing equal amount of Bank Guarantee of scheduled Bank valid up to 3 months beyond the defect liability period.

Additional Performance Security @ 10% of the tendered amount in the form of Bank Guarantee from a Scheduled Bank, valid up to the date of completion of work, shall be obtained from the successful bidder, if the accepted bid value is 80% or less than the estimated amount put to tender.

If the bidder fails to submit Additional Performance Security within 7 (seven) working days from the date of LoA or the time period as approved by the Tender inviting Authority, his Earnest Money will be forfeited.

If the bidder fails to complete the works successfully, the Additional Performance Security along with Security Deposit lying with the Government shall be forfeited at any time during the pendency of contract period as per relevant Clauses of the Contract.

Necessary provisions regarding deductions of Security Deposit from the progressive bills of the Contractor as per relevant clauses of the contract will in no way be affected/ altered by this Additional Performance Security.

Clause 2. The time allowed for carrying out the work as entered in the tender shall be strictly observed by the contractor and shall be reckoned from the date on which the order to commence work is given to the contractor. The work shall throughout the stipulated period of the contract be proceeded with all due diligence. Time being deemed to be the essence of the contract on the part of the contractor, the contractor shall be bound in all cases, to achieve the 'Milestones' as defined under Clause 5 and specified in the NIT into various 'Identifiable and quantifiable construction related stages' pertaining to the work. In the event of the contractor failing to comply with any of the conditions related to achieving the 'Milestones' within the specified time period prescribed for such 'Milestone' plus one month, he/she shall be liable to pay compensation.

If the contractor fails to commence and/or maintain required progress viz. Milestones defined in the Notice Inviting Tender over the total time allotted for its full completion and in terms of clause 5 or fails to complete the work and clear the site on or before the end of contract period or extended date of completion, he/she shall, without prejudice to any other right or remedy available under the law on account of such breach, pay as agreed compensation to the implementing Department.

This will also apply to items or group of items for which a separate period of completion has been specified.

Compensation for delay of work: @ 2% (Two percent) of the tendered value of work arrived for each month of delay to be computed on per day basis subject to the ceiling limit of security deposit already withheld or due to be withheld during imposition of the said clause and minimum payable compensation equivalent to the Earnest Money deposited (EMD).

*Compensation
for delay*

Provided always, that the total amount of compensation for delay, to be paid under this clause shall not exceed 10% of the tendered value of work or the tendered value of the item or group of items of the work, for which a separate period of completion is originally given.

*Action when whole
of security deposit
is forfeited*

The amount of compensation may be adjusted or set-off against any sum payable to the contractor under this contract, if the contractor catches up with the progress of work subsequently, part or full of the desired progress as per the contract in accordance with the decision of the Tender Accepting Authority, under powers delegated by Government to be communicated by the Engineer-in-Charge, the withheld amount shall be released. However, no interest, whatsoever, shall be payable on such withheld amount.

Force majeure :-If the work(s) be delayed for the following reasons:-

Due to war, internal emergency and other conditions such as abnormally bad weather, flood, cyclone natural calamity or serious loss or damage by fire or civil commotion, the contractor shall immediately give notice thereof in writing to the Engineer-in-charge but shall nevertheless use constantly his/her best endeavors to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the Engineer-in-charge to proceed with the works.

*Contractor
remains liable
to pay
compensation, if
action is not
taken under
Clause 3*

Clause 3. Subject to other provisions contained in this clause, the Engineer-in-charge with the prior approval of Tender Accepting Authority, may, without prejudice to his/her any other rights, remedy against the Contractor in respect of any delay, inferior workmanship, any claims for damages and/or any other provision of the contract or otherwise, and whether the date of completion has or has not been elapsed, by notice in writing, absolutely determine the contract in any of the following cases:

- (i) If the Contractor has been given by the Engineer-in-Charge a notice in writing to rectify, reconstruct or replace any defective work or that work is being performed in an inefficient or otherwise improper or un-workman like manner, shall omit to comply with the requirements of such notice for a period of seven days thereafter;
- (ii) If the Contractor has without reasonable cause suspended the progress of work, or has failed to proceed with the work with due diligence so that, in the opinion of the Engineer-in-Charge he/she will be unable to secure completion of the work by the schedule date for completion, and continues to do so after a notice of seven days in writing from the Engineer-in-charge;
- (iii) If the Contractor fails to complete the work within the stipulated date or the Milestones/items of work within individual dates of completion, if any, stipulated on or before such date(s) of completion and does not complete them or reach the defined Milestones within the period specified in the notice given in writing to that effect by the Engineer-in-charge;
- (iv) If the Contractor persistently neglects to carry out his/her obligations under the contract and/or commits default by not complying with any of the terms & conditions of the contract and does not remedy it, or take effective steps to remedy it, within seven days after a notice in writing is given to him/her to that effect by the Engineer-in-Charge;
- (v) If the Contractor being an individual, or a firm, or any partner thereof, shall at any time be adjudged insolvent or have a 'Receiving Order' or Order for administration of his/her Estate made against him/her, or take any proceedings for liquidation or composition (other than a voluntary liquidation for the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force, or make any conveyance or assignment of his/her effects or composition or arrangement for the benefit of his/her creditor or purport to do so, or if any application be made under Insolvency Act for the time being in force for the sequestration of his/her Estate, or if a trust deed is executed by him/her for benefit of his/her creditors;
- (vi) If the Contractor being a Company pass a resolution or the court delivers an order of judgement that the Company shall be wound up, or if a receiver or a manager on behalf of a creditor be appointed, or if a circumstance arise which entitle the Court or the creditor to appoint a receiver or a manager or which entitle the court to issue a winding up order;
- (vii) If the Contractor shall suffer an execution order being levied on his/her goods and allows it to be continued for a period of 21 days;
- (viii) If the Contractor assigns without prior written approval of the Tender Accepting

Authority, transfers, sublets (engagement of labour on piece work basis or of labour with materials not to be incorporated in the work, shall not be deemed to be subletting) or otherwise parts with or attempts to assign, transfer, sublet or otherwise parts with the entire work or any portion thereof without prior written approval of the Engineer-in-charge;

- (ix) AND THEREFORE, the Contractor has made himself/herself liable for action under any of the cases aforesaid, the Engineer-in-charge on behalf of the Government with the prior approval of Tender Accepting Authority, shall have the powers to adopt any of the following actions, as he/she may deem best suited to the interest of the Government:-
- (a) To determine the contract as aforesaid, of which rescission notice in writing and costs to be recovered for works since executed subject to a minimum of the amount of Earnest Money deposited by the Contractor under the hand of Engineer-in-charge, shall be the conclusive evidence. Upon such determination, the Earnest Money Deposit, Security Deposit already recovered for executed works and performance guarantee, if any under the contract shall be liable to be forfeited and shall be absolutely at the disposal of the Government.
 - (b) After giving notice to the Contractor to measure up the work executed and to take such whole or the balance or part thereof, as shall be un-executed out of his/her hands, and to give it to another Contractor to complete the balance work. The Contractor, whose contract is determined or rescinded as above, shall not be allowed to participate in the tendering process for the balance work.
 - (c) To employ labour paid by the implementing Department, and to supply materials, to carry out the works or any part of the work, debarring the contractor and debiting the cost of labour and price of materials (of the amount of which cost and price determined by certificate of the Engineer-in-Charge shall be final and conclusive against the contractor) and crediting him/her with the value of the work done, in all respects in the same manner and at the same rates as if it had been carried out by the contractor under the terms of his/her contract; the certificate of the Executive Engineer as to the value of the work done shall be final and conclusive against the contractor.

*Contractors
remains liable to
pay compensation
if action not taken
under Clause 3*

In the event of above course being adopted by the Engineer-in-charge, the Contractor shall have no claim of compensation for any loss sustained by him/her by reason of his/her having purchased or procured any material or entered into any engagement or made any advances on any account or with a view to execute the work or the performance of the contract. In case, action is taken under any of the provisions aforesaid, the contractor shall not be entitled to recover or be paid any sum for any work thereof actually performed under this contract, unless and until the Engineer-in-charge has certified in writing that the performance of such work and value payable in respect thereof, and he/she shall only be entitled to be paid the value so certified.

Clause 3A. In case, the work cannot be started due to reasons not within the control of the Contractor within 1/4th (one fourth) of the stipulated time for completion of the work or 45 days whichever is less, which is accepted as a valid & justified reason by the Tender Accepting Authority, either party viz. Contractor & the Engineer-in-Charge may close the contract with the approval of Tender Accepting Authority. In such an eventuality, the earnest money deposited and the security of the contractor shall be refunded, but no payment on account of interests, loss of profit or damages etc. shall be payable at all.

Clause 3B. In case a continuing work cannot be completed due to reasons beyond the control of the contractor, like Force Majeure enumerated later under Clause 5, the contract may be terminated as stated in clause 3A above by the Engineer-in-Charge with the consent of the contractor and approval of the Tender Accepting Authority.

Clause 4. In cases in which any of the powers conferred upon the Engineer-in-Charge under Clause 3 hereof shall have become exercisable and the same had not

*Power to take
possession of or
require removal
of or sell
Contractor's
plant*

been previously exercised, non-exercising thereof shall not constitute as a waiver of any of the conditions hereto, and such powers shall, notwithstanding be exercisable in the event of any future case of default by the contractor, for which by any clause or clauses hereof, he/she is declared liable to pay compensation amounting to whole of his/her security deposit, and the liability of the contractor for past and future compensation shall remain unaffected. In the event of the Engineer-in-Charge putting in force either of the powers under ix (a) or (c) vested with him/her under the preceding clause, he/she may if he/she so desires, take possession of all or any tools & plant, materials and stores, in or upon the work, or the site thereof, or belonging to the contractor, or procured by him/her and intended to be used for execution of the work, or any part thereof, paying or allowing for the same in account at the contract rates or in case of these not being applicable, at current market rates to be certified by the Engineer-in-Charge whose certificate thereof, shall be final and binding. Otherwise, the Engineer-in-Charge may deliver notice in writing to the contractor or his/her clerk, foreman or other authorized agent, requiring him/her to remove such tools & plant, materials or stores from the premises within a time to be specified in such notice; and in the event of the contractor failing to comply with any such requisition, the Engineer-in-Charge may remove them at the contractor's expense or sale them by public auction or private sale on account of the contractor and at his/her risk, in all respects, and the certificate of the Engineer-in-Charge as to the expense of any such removal, and the amount of the proceeds and expense of any such sale shall be final and conclusive against the contractor.

Clause 5. The time allowed for execution of a work as specified in the 'Schedule of Work' or in the extended time in accordance with the terms and conditions shall be the essence of the contract. Execution of work shall commence from such time period as mentioned in the said schedule, or from the date of handing over of the site to the contractor whichever is later. If the contractor commits default in commencing execution of the work as aforesaid within thirty days, without justifiable reasons included under Force Majeure or other such reasons beyond the control of the contractor, in which case to be reported within seven days by the contractor, considered valid and cogent by the Engineer-in-Charge, the Engineer-in-Charge shall after passing of thirty days from the date of scheduled commencement of work as per work order, with the prior approval of the Tender Accepting Authority, without prejudice to any other right to remedy available in law, be at liberty to apply clause 2 and subsequently clause 3 of the tender document.

5.1 As soon as possible after the contract is executed, signed and agreed, the contractor shall submit a 'Time and Progress Chart' for each broad activity (Milestone) and get it approved by the Engineer-in-Charge. The chart shall be prepared in direct relation to the time slated in the Notice Inviting Tender (NIT) document, for completion of items or group of items of the work. It shall indicate the forecast of the dates of commencement and completion of various trades of sections of the work. This may be amended, as necessary, by an agreement between the Engineer-in-Charge and the contractor within the limitations of time imposed in the NIT document. Further, to ensure good progress during execution of work, the contractor shall in all cases, in which the time allowed for any work exceeds one month (save and except for special jobs for which a separate programme has been agreed upon) to complete the work as per defined 'Milestones' given in such 'Schedule of Work' defined clearly in the NIT itself into various 'Identifiable and quantifiable construction related stages' related with the type and nature of work, and that the 'total time allowed for completion of work' is to be broken up against achievement of those stages during the construction / progress of work to ensure a periodic monitoring of progress and enable the contractor and the Engineer-in-Charge to take corrective measures from time to time.

5.2 If the work(s) be delayed by:

Force majeure, due to war, internal emergency and other conditions such as abnormally bad weather, flood, cyclone natural calamity or serious loss or damage by fire or civil commotion, strike or lockout affecting procurement of construction materials or any of the trades employed in the work, or any other cause which in the absolute discretion of the Engineer-in-Charge is beyond the contractor's control, then upon happening of any such event causing delay, the

contractor shall immediately give notice in writing to the Engineer-in-Charge but shall nevertheless use constantly his/her best endeavors to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the Engineer-in-Charge to proceed with the works.

- 5.3** Request for rescheduling of 'Milestones' of various activities and extension of time, to be eligible for consideration, shall be made by the contractor in writing within fourteen days of the happening of the event causing delay in the prescribed form. The contractor may also, if practicable, indicate in such a request the period for which extension is desired.
- 5.4** If any such case the Engineer-in-Charge, with the approval of Tender Accepting Authority, may give a fair and reasonable extension of time and reschedule the activity wise 'Milestones' for completion of the work. Such extension shall be communicated to the contractor by the Engineer-in-Charge with the approval of Tender Accepting Authority in writing within maximum 1 (one) month of the date of receipt of such request.

Final Certificate

Clause 6. On completion of work, the contractor shall be furnished with a certificate by the Engineer-in-Charge of such completion, but no such certificate shall be given, nor shall the work be considered to be completed until and unless the contractor shall have removed from the work premises on which the work is executed, all scaffolding, surplus materials and rubbish, and cleaned off the dirt from wood works, doors, windows, floors, or other parts of any building, upon or about which the work is executed, or of which he may have had possession for the purpose of the execution thereof, nor until the work shall have been measured by the Engineer-in-charge whose measurements shall be binding and conclusive against the contractor. If the contractor shall fail to comply with the requirements of this clause as to removal of scaffolding, surplus materials and rubbish and cleaning off dirt on or before the date fixed for completion of the work, the Engineer-in-charge may at the expense of the contractor remove such scaffolding, surplus materials and rubbish, and dispose of the same as he/she thinks fit, and clean off such dirt as aforesaid; and the contractor shall forthwith be bound to pay the amount of all expense so incurred, and shall have no claim in respect of any such scaffolding or surplus materials as aforesaid, except for any sum actually realized by the sale thereof.

*Payment on
inter- mediate
certificates to
be regarded
as advances*

Clause 7. No running account bill payment shall be normally made for works less than 30 (Thirty) percent of Tendered Value or up to Rs 25.00 lakh, whichever is less, till after the whole of the work shall have been completed and certificate of completion given. For works of tendered value above Rs 25.00 lakh, for running account bill payment, the contractor shall on submitting a bill of at least Rs 25.00 lakh there for, be entitled to receive a payment proportionate to the part thereof, approved and passed by the Engineer-in-charge, whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the contractor. But all such intermediate payments shall be regarded as payments by way of advance against the final measured bill payment only and not as payments for work actually done and completed, and shall not preclude the bad, unsound, and imperfect or unskillful work which is to be removed and taken away and reconstructed, or re-erected or to be considered as an admission of the due performance of the contract, or any part thereof, in any respect, or the accruing of any claim, nor shall it conclude, determine or affect in any way the powers of the Engineer-in-charge under these conditions or any of them as to the final settlement and adjustment of the accounts or otherwise or in any other way vary or affect the contract. The final bill shall be submitted by the contractor within one month of the date fixed for completion of the work, otherwise the Engineer-in-charge's certificate of the measurement and of the total amount payable for the work accordingly shall be final and binding on all parties.

*Bills to be
submitted
monthly*

Clause 8. Works bill shall be submitted by the contractor each month, after fulfilling above clause, on or before the date fixed by the Engineer-in-charge, for all works executed during the previous month, and the Engineer-in-charge shall take or cause to take the requisite measurement for the purpose of having the same verified, and the claim as far as admissible adjusted, if possible, before the expiry of fourteen days from the presentation of the bill. If the contractor does not submit the bill within the time fixed as aforesaid, the Engineer-in-charge may depute a Junior Engineer to measure up the said

work in presence of the contractor, whose countersignature in the measurement book will be sufficient warrant; and the Engineer-in-charge may prepare a bill from such list which shall be binding on the contractor in all respects.

Within 10 (Ten) days of completion of work, the contractor shall give notice of such completion to the Engineer-in-charge and within 14 (Fourteen) days of receipt of such notice, the Engineer-in-charge shall inspect the work, and if there is no defect in the work, he/she shall furnish to the contractor a final certificate of completion. Otherwise, a provisional certificate of physical completion indicating defects (a) to be rectified by the Contractor and/or (b) for which payment will be made at reduced rates, shall be issued. Such reduced rate is to be imposed with the approval of Superintending Engineer concerned.

Clause 8A. When annual repair and maintenance work is carried out, the splashes and droppings from white washing, colour washing, painting etc., on walls, floors, windows shall be removed and the surface cleaned simultaneously with the completion of these items of work in the individual rooms, quarters or premises etc. where the work is done without waiting for the actual completion of all the other items of work in the contract. In case, the contractor fails to comply with the requirements of this clause, the Engineer-in-Charge shall have the right to get this work done at the cost of the contractor either Departmentally or through any other contractor. Before taking such action, the Engineer-in-Charge shall give ten days notice in writing to the contractor.

Clause 8B. The Contractor shall submit completion Plan/Drawing as required in the 'General Specification' for Civil as well as Electrical Works as applicable within 30 days of completion of the work.

Clause 9. The Contractor shall submit all bills in printed forms, as per format prescribed by Government of West Bengal, in the office of the Engineer-in-Charge, and the charges in the bills shall always be entered at the rates specified in tender or in case of any extra work ordered in pursuance of these conditions, and not mentioned or provided for in the tender at rates thereafter provided for such work.

*Payments of
contractor's
bills to Banks*

Clause 9A (1) Payments due to the contractor may, if so desired by him/her be made to his bank through e-Pradan, details of which has to be directly furnished to the Engineer-in-charge.

While the online receipt given by such Banks shall constitute a full and sufficient discharge/acquittance for the payment, the contractor should wherever possible present his/her bills duly receipted and discharged through his/her Banker/s.

(2) In the case of bills, which the contractor presents for payment direct, and which are not endorsed in favour of the Bank, while efforts will be made to secure payment to the financing Bank, payments made to the contractor should be accepted as full acquittance so far as the Government is concerned. As a part of the arrangement, the financing Bank should give the Government a letter to this effect.

Note 1. The procedure will not affect the usual rights of the Government to deduct from contractor's bill, (whether endorsed in favour of a Bank or not) any sum due to Government of account of penalties, over-payments etc., on this or any other contract with the Governor of the State of West Bengal.

Note 2. Nothing contained herein shall operate to create in favour of the Bank any rights, claims or equities vis-à-vis the Governor.

*Stores supplied
by Government*

Clause 10. If the specification or estimate of the work provides for use of any special description of material to be supplied by the Engineer-in-Charge, (such materials & stores and the prices to be charged there for as hereinafter mentioned being so far as practicable for the convenience of the contractor, but not so as in any way to control the meaning or effect of this contract specified in the schedule or 'Memorandum' hereto annexed), the contractor shall be supplied with such materials and stores as is required from time to time to be used by him/her for the purpose of the contract only, and the value of the full quantity of materials and stores so supplied at the rates specified in the said schedule or Memorandum may be set off or deducted from any sums then due, or thereafter to become due to the contractor under the contract, or otherwise or against or from the security deposit, or the proceeds of sale thereof; if the same is held in Government securities, the same or a sufficient portion thereof being in this case sold for

the purpose. All materials supplied to the contractor shall remain the absolute property of Government, and shall not on any account be removed from the site of the work, and shall at all times be open for inspection by the Engineer-in-charge. Any such material unused and in perfectly good condition at the time of the completion or determination of the contract shall be returned to the Engineer-in-charge's store, if by a notice in writing under his/her hand, he/she shall so require; but the contractor shall not be entitled to return any such material unless with such consent, and shall have no claim for compensation on account of any such material so supplied to him/her as aforesaid being unused by him, or for any wastage or damage to any such material.

Work to be executed in accordance with specifications, drawings, orders, etc.

Clause 11. The Contractor shall execute the whole and every part of work in the most substantial and workman like manner, and both, as regards to materials and otherwise, in every respect, in strict accordance with the specifications. The contractor shall also conform exactly, fully and faithfully to the design and drawings, and instructions in writing relating to the work signed by the Engineer-in-Charge and lodged in his/her office, to which the contractor shall be entitled to have access at such office, or on the site of the work for the purpose of inspection during office hours, and the contractor shall, if he/she so require, be entitled at his/her own expense to make or cause to be made copies of the specifications, and of all such design, drawings and instructions as aforesaid.

Alteration in specification and designs do not invalidate contract

Clause 12. The Engineer-in-Charge shall have powers to make any alteration in, omission from, addition to, or substitution for, the original specifications, drawings, designs and instructions, that may appear to him/her to be necessary or recommended by Superintending Engineer or the Chief Engineer during the progress of work, and the contractor shall be at all times be bound to carry out these works, in accordance to any instructions which may be given to him/her in writing, signed by the Engineer-in-charge, and such alterations, omissions, additions or substitutions, shall not invalidate the contract but shall be deemed to have formed a part of the work included in the original tender and any altered, additional or substituted work which the contractor may be directed to do in the manner specified above as a part of the work shall be carried out by the contractor on the same conditions in all respects on which he/she agreed to do the main work, and at the same rates, if any, may be specified in the tender for the main work. Time for the completion of the work shall be extended in the proportion that the altered, additional or substituted work bears to the original work contract, and the certificate of the Engineer-in-charge shall be conclusive as to such proportion. And, if the altered, additional or substituted work includes any class of work, for which no rate is specified in the contract, then such class of work shall be carried out at the rates entered in the schedule of rates of concerned Works Department applicable in the district, which was in force at the time of acceptance of the contract, minus/plus the percentage which the total tendered amount bears to the estimated cost of the entire work put to tender; and if the altered, additional or substituted work is not entered in the said schedule of rates, payment thereof shall be made by the Engineer-in-charge by determining the rates on analysis worked out from (a) the basic rates of materials and labour provided in the aforesaid schedule of rates, or (b) the current market rates of materials and labour when even basic rates for the work are not available in the schedule. In cases when such rates are determined on analysis by the Engineer-in-charge under (a) above, the stipulated percentage above or below schedule of rates as provided in the contract shall also apply, and in case of rates worked out on analysis under (b) above, payment shall be made at the rates so determined without application of the said stipulated percentage. In the event of any dispute regarding rates determined on analysis for any altered, additional or substituted work under this clause, the decision of the Superintending Engineer shall be final and binding.

Rates for works not in tender BOQ/SoR

No compensation for alternation in or restriction of work to be carried out.

Clause 13. If at any time after the commencement of the work the Governor shall for any reason whatsoever not require the whole thereof as specified in the tender to be carried out, the Engineer-in-charge shall give notice in writing of the fact to the contractor, who shall have no claim to any payment or compensation whatsoever on account of any profit or advantage which he might have derived from execution of the work in full, but which he/she did not derive in consequence of the full amount of the work not having been carried out; neither shall he/she have any claim for compensation by reason of any alterations having been made in the original specifications, drawings, designs and instructions which shall involve any curtailment of the work as originally contemplated.

*Action and
compensation
payable in case
of bad work*

Clause 14. If it shall appear to the Engineer-in-charge or his/her subordinate engineer in-charge of the work, that any work has been executed with unsound, imperfect, or unskillful workmanship, or with materials of any inferior description, or that any materials or articles provided by the Contractor, for the execution of the work are unsound, or of a quality inferior to that contracted for, or otherwise not in accordance with the contract, the contractor shall on demand in writing from the Engineer-in-charge specifying the work, materials or articles complained of notwithstanding that the same may have been inadvertently passed, certified and paid for, forthwith rectify or remove and re-construct the work so specified in whole or in part, as the case may require, or as the case may be remove the materials or articles so specified and provide other proper and suitable materials or articles at his/her own proper charge and cost; and in the event of his failing to do so within a period to be specified by the Engineer-in-charge in his/her demand aforesaid, then the contractor shall be liable to pay compensation at the rate of one percent on the amount of the estimate put to tender / on up to date executed work value for every day not exceeding ten days, while his/her failure to do so shall continue and in the case of any such failure, the Engineer-in-charge may rectify or remove, and re-execute the work or remove and replace with others, the materials or articles complained of as the case may be at the risk and expense in all respects of the contractor.

*Work to
be open to
inspection*

Clause 15. All work under or in course of execution or executed in pursuance of the contract shall at all times be open to inspection and supervision of the Engineer-in-Charge and all his/her subordinates and also higher Officers / Authority of the Government and the contractor shall at all times during the normal working hours, and at all other times at which reasonable notice of the intention of the Engineer-in-charge or his/her subordinates to visit the work site shall have been given to the contractor, either himself/herself be present to receive orders and instructions, or have a responsible agent duly accredited in writing present for that purpose. Orders given to the contractor's agent shall be considered to have the same force as if it had been given to the contractor himself/herself.

*Contractor
or his/her
responsible
agent to be
present*

*Notice to be
given before
work is
covered up*

Clause 16. The Contractor shall give, not less than five days notice in writing to the Engineer-in-charge or his/her subordinate in-charge of the work, before covering up or otherwise placing beyond the reach of measurement any work, in order that the same is so covered up or placed beyond the reach of measurement, and shall not cover up or place beyond the reach of measurement any work without the consent in writing of the Engineer-in-charge or his/her subordinate, in-charge of the work; and if any work shall be covered up or placed beyond the reach of measurement without such notice having been given or consent obtained, the same shall be uncovered at the contractor's expense, or, in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

*Contractor
liable for
damage done
and for
imperfections for
180 days after
certificate*

Clause 17. If the Contractor or his/her workers or authorized representatives shall break, deface, injure or destroy any part of the structure in which they may be working or any building, road, road curbs, fence, canals, water pipes, cables, drains, electric or telephone posts or wires, trees, grass or grassland or cultivated ground contiguous to the premises on which the work or any part of it is being executed, or if any damage shall happen to the work from any cause whatever or any imperfections become apparent in it at any time, whether during its execution or within a period of six months after issuance of a certificate of its completion by the Engineer-in-Charge, the contractor shall make the same good at his/her own expense, or in default, the Engineer-in-Charge may cause the same to be made good by other workers, and deduct the expenses (of which the certificate of the Engineer-in-Charge shall be final and binding) from any sums, whether under the contract or otherwise, that may be then, or at any time thereafter become due to the contractor by the Government or from his/her security deposit, or the proceeds of sale thereof, or of a sufficient portion thereof, and if the cost in the opinion of the Engineer-in-Charge whose opinion shall be final and conclusive against the contractor, making such damage or imperfections good shall exceed the amount of such security deposit and/or such sums, it shall be lawful for the Government to recover the excess costs from the contractor in accordance with the procedure prescribed by any law for the time being in force.

Clause 17A. The Contractor shall also supply without charge the requisite number of persons with the means and materials necessary for the purpose of setting out works, and counting, weighing, assisting in the joint measurement or examination at any time and from time to time of the work or materials. Failing his/her so doing the same may be

provided by the Engineer-in-Charge at the expense of the Contractor and the expenses may be deducted from any money due to the contractor under the contract or from his/her Security Deposit or the proceeds of sales thereof or of a sufficient portion thereof. The Contractor shall also provide all necessary fencing / barricading / providing caution boards etc. and light required to protect the public from accident, and shall be bound to bear the expenses of defence of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damage and costs which may be awarded in such suit, actions or proceedings to any such persons or which may with the consent of the Contractor be paid to compromise any claim by any such persons.

Clause 18A. In every case in which by virtue of the provisions under sub-section (1) of Section 12, of the Workmen's Compensation Act, 1923, the implementing Department is obliged to pay compensation to a workman employed by the contractor, in execution of the works. The implementing Department will recover from the Contractor the amount of compensation so paid; and without prejudice to the rights of the Department under sub-section (2) of section 12, of the said Act, implementing Department shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by implementing Department to the Contractor whether under this contract or otherwise. The implementing Department shall not be bound to contest any claim made against it under sub-section (1) Section 12, of the said Act, except on the written request of the contractor and upon his/her giving to the implementing Department full security for all costs for which the Department might become liable in consequence of contesting such claims.

Clause 18B. In every case in which by virtue of the provisions under 'The Contract Labour (Regulation & Abolition) Act 1970', and its amendments and rules, the implementing Department is obliged to pay amount of wages to a workman employed by the Contractor in execution of the works, or to incur any expenditure in providing welfare and health amenities required to be provided under the above said Act and the rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by Contractors, executing Department will recover from the Contractor, the amount of wages so paid or the amount of expenditure so incurred; and without prejudice to the rights of the executing Department under sub-section(2) of Section 20, and sub-section (4) of Section 21, of the Contract Labour (Regulation and Abolition) Act, 1970, executing Department shall be at liberty to recover such amount or any part thereof by deducting it form the security deposit or from any sum due by Executing Department to the Contractor whether under this contract or otherwise and the executing Department shall not be bound to contest any claim made against it under sub-section (1) of Section 20, sub-section (4) of section 21, of the said Act, except on the written request of the Contactor and upon his/her giving to the implementing Department full security for all costs for which the Department might become liable in contesting such claim.

Clause 19. The Contractor shall obtain a valid license under the Contract Labour (Regulation and Abolition) Act, 1970, before the commencement of the work, and continue to have valid licenses until the completion of the work. The contractor shall also abide by the provisions of the Child Labour (Prohibition and Regulation) Act, 1986, Fatal Accident Act, 1855, Personal Injuries (Compensation Insurance) Act, 1970.

The Contractor shall also comply with the provisions of the 'Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996' and 'The Building and Other Construction Workers Welfare Cess Act, 1996'. Failure to fulfill these requirements shall attract penal provisions of the contract, arising out of the resultant non-implementation of such provisions.

Labour

Clause 19A. No labour/s below the age of eighteen years shall be employed in the work and the contractor shall abide by the provisions of the Child Labour (Prohibition & Regulation) Act, 1986. Employment of female labour/s in works in the neighborhoods of sensitive barracks should be avoided as far as possible.

*Payment of
minimum
Wages to
Labour*

Clause 19B. The Contractor shall pay to labours employed by him/her either directly or through Sub-Contractors, wages not less than fair wages as defined by the Labour Commissioner of the State Government under 'Minimum Wages Act, 1948', Contractor's Labour Regulations or as per the provisions of the Contract Labour (Regulation and

Abolition) Act, 1970, wherever applicable.

The contractor shall, notwithstanding the provisions of any contract to the contrary, cause to be paid fair wage to labour indirectly engaged on the work, including any labour engaged by his sub-contractors in connection with the said work, as if the labour had been immediately employed by him/her.

In respect of all labourers directly or indirectly employed in the works for performance of the Contractor's part of the contract, the contractor shall comply with or cause to be complied with the contractor's Labour Regulations made by the State Government/ Government of India, from time to time in regard to payment of wages, wage period, deductions from wages, recovery of wages not paid and deductions made without authority, maintenance of wage books or wage slips, publication of scale of wage and other terms of employment, inspection and submission of periodical returns and all other matters likewise in nature or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979, Minimum Wages Act, 1948, wherever applicable.

- a) The Engineer-in-Charge concerned shall have the right to deduct from the money due to the contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfillment of the conditions of the contract for the benefit of the workers, non-payment of wages or of deductions made from his/her/their wages which are not justified by their terms of the contract or non-observance of the regulations.
- b) Under the provision of Weekly Holidays Act, 1986, the contractor is bound to allow to the labours, directly or indirectly employed in the work, one day rest for 6 days of continuous work, and pay wages at the same rate as for duty. In the event of default, the Engineer-in-charge shall have the right to deduct the sum or sums not paid on account of wages for weekly holidays to any labour and pay the same to the persons entitled thereto from any money due to the contractor by the Engineer-in-charge concerned.

The contractor shall also comply with the provisions of the 'Employees Liability Act, 2008', Workmen's Compensation Act and 'Maternity Benefits Act' or the amendments thereof or any other law relating thereto, and the rules made there under from time to time.

The Contractor shall indemnify and keep indemnified the implementing Department against payments to be made under and for the observance of the laws aforesaid and PW Contractor's Labour Regulations without prejudice to this right to claim indemnity from his/her sub-contractors.

The laws aforesaid shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this contract.

Whatever is the minimum wage for the time being, or if the wage payable is higher than minimum wage, such wage shall be paid by the contractor to the workers directly without the intervention of any Dafadar, and that Dafadar shall not be entitled to deduct or recover any amount from the minimum wage payable to the workers as and by way of commission or otherwise.

The contractor shall ensure that no amount by way of commission or otherwise is deducted or recovered by the Dafadar from the wage of workers.

Clause 19C. In respect of all labours directly or indirectly employed in the work for the performance of the contractor's part of this contract, the contractor shall at his/her own expenses, arrange for the safety provisions as framed from time to time by the competent authority, and shall at his/her own expense provide all facilities in connection therewith. In case the contractor fails to make arrangement, and fail to provide necessary facilities as aforesaid, he/she shall be liable to pay a penalty of Rs. 2000/- for each default, and in addition the Engineer-in-Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in their behalf, from the contractor.

Clause 19D. For the works above Rs. 2.0 crore, the Contractor shall submit by the 4th and 19th of every month to the Engineer-in-charge, a true statement showing in respect of the second half of the preceding month and the first half of the current month respectively-

The number of labourers employed by him/her on the work, their working hours, and the

wages paid to them;

Accidents that had occurred during the said fortnight showing the circumstances under which it had happened, and the extent of damage and injury caused by them, and the number of female workers who have been allowed maternity benefits according to Clause 19F of the contract and the amount paid to them;

Failing which the contractor shall be liable to pay to the Department, a sum not exceeding Rs. 2000/- for each default or materially incorrect statement. The decision of the Engineer-in-charge shall be final in deducting from any bill due to the contractor; the amount levied as fine and would be binding on the contractor.

Clause 19E. In respect of all labours directly or indirectly employed in the work for the performance of the contractor's part of this contract, the contractor shall comply with or cause to be complied with all the rules framed by the Government from time to time for the protection of health and sanitary arrangements of workers employed by the contractor.

Clause 19F. In the event of the contractor(s) committing a default or breach of any of the provisions of the Contractor's Labour Regulations and Rules for the protection of health and sanitary arrangement for the workers as amended from time to time or furnishing any information or submitting or filing any statement under the provisions of the above Regulations and Rules which is materially incorrect, he/she shall, without prejudice to any other liability, pay to the Department a sum not exceeding Rs. 2000/- for every default, breach or furnishing, making, submitting, filing such materially incorrect statements and in the event of the contractors defaulting continuously in this respect, the penalty may be enhanced to Rs. 200/- per day for each day of default subject to a maximum of five per cent of the tendered value. The decision of the Engineer-in-charge shall be final and binding on the parties.

Should it appear to the Engineer-in-charge that the contractor(s) is/are not properly observing and complying to the provisions of the Contractor's Labour Regulations and Rules, The Minimum Wages Act, 1948 and Contract Labour (Regulation and Abolition) Act 1970, for the protection of health and sanitary arrangements for work-people employed by the contractor(s) (hereinafter referred as 'the said Rules') the Engineer-in-charge shall have the power to give notice in writing to the contractor(s) requiring that the said Rules be complied with and the amenities prescribed therein be provided to the work-people within a reasonable time to be specified in the notice. If the contractor(s) shall fail within the period specified in the notice to comply with and/or observe the said Rules and to provide the amenities to the work-people as aforesaid, the Engineer-in-charge shall have the power to provide the amenities herein before mentioned at the cost of the contractor(s). The contractor(s) shall erect, make and maintain at his/her own expense and to approved standards all necessary hutments and sanitary arrangements required for his/her/their work-people on the site in connection with the execution of the works, and if the same shall not have been erected or constructed, according to approved standards, the Engineer-in-charge shall have power to give notice in writing to the contractor(s) requiring that the said hutments and sanitary arrangements be remodeled and/or reconstruct such hutments and sanitary arrangements according to approved standards, and if the contractor(s) shall fail to remodel or reconstruct such hutments and sanitary arrangements according to approved standards within the period specified in the notice, the Engineer-in-charge shall have the power to remodel or reconstruct such hutments and sanitary arrangements according to approved standards at the cost of the contractor(s).

Clause 19G. The contractor shall comply with all the provisions of The Minimum Wages Act, 1948, Contract Labour (Regulation and Abolition) Act, 1970, Employees Liability Act, Industrial Dispute Act and Maternity Benefit Act, 1961, as amended from time to time and rules framed thereunder and other labour laws affecting contract labour that may be brought into force by the appropriate authority from time to time.

Clause 19H. The Engineer-in-charge may require the contractor to remove from the site of work, any person or persons engaged/assigned or employed by the contractors upon the work who may be determined as insane or incompetent or misconducts himself/herself, and the contractor shall forthwith comply with such requirements.

Clause 19I. It shall be the responsibility of the contractor to see that the

building/structure under construction is not occupied by anybody unauthorized during construction, and is handed over to the Engineer-in-charge with vacant possession free from encumbrances in entirety, If such buildings/structures through completed is occupied illegally, then the Engineer-in-Charge shall have the option to refuse to accept the said building/structure in that position. Any delay in acceptance on this account will be treated as the delay in completion and for such delay a levy up to 5% of tendered value of work may be imposed by the Engineer-in-charge whose decision shall be final both with regard to the justification and quantum and shall be binding on the contractor.

However, the Engineer-in-charge, through a notice, may require the contractor to remove the illegal occupations, any time on or before construction and delivery.

Work on Sundays

Clause 20. No work shall be done on Sundays without the prior sanction of the Engineer-in-charge.

Work not to be sublet. Contract may be rescinded and security deposit forfeited for subletting, bribing, or if contractor becomes insolvent

Clause 21. The contract shall not be assigned or sublet without specific orders from Government in respect of a specified sub-contractor. And if the contractor shall assign or sublet his contract, or attempt so to do, or become insolvent or commence any insolvency proceedings or make any composition with his creditor, or attempt to do so, or if any bribe, gratuity, gift, loan, perquisite, reward or advantage, pecuniary or otherwise, shall either directly or indirectly be given, promised, or offered by the contractor, or any of his servants or agents to any public officer or person in the employ of Government in any way relating to his office of employment, or if any such officer or person shall become in any way directly or indirectly interested in the contract, the Divisional Officer may thereupon by notice in writing rescind the contract, and the security deposit of the contractor shall thereupon stand forfeited and be absolutely at the disposal of Government and the same consequences shall ensure as if the contract had been rescinded under the Clause 3 hereof, and in addition the contractor shall not be entitled to recover or be paid for any work there for actually performed under the contract.

Sum payable as compensation to be considered as reasonable without reference to actual loss

Clause 22. All sums payable by way of compensation under any of these conditions shall be considered as reasonable compensation to be applied to the use of Government without reference to the actual loss or damage sustained and whether or not any damage shall have been sustained.

Changes in constitution of firm

Clause 23. Where the contractor is a partnership firm or a consortium, prior approval in writing of the Engineer-in-Charge shall be obtained for any change made in the constitution of the firm/consortium. Where the contractor is an individual or a Hindu Undivided Family (HUF) business concern, such approval as aforesaid shall likewise be obtained, before the contractor enters into any partnership agreement/Memorandum of Articles whereunder the partnership firm/ consortium would have the right to carry out the works hereby undertaken by the contractor. If previous approval as aforesaid is not obtained, the contract is liable to be rescinded.

Works to be under direction of Engineer-in-Charge

Clause 24. All works to be executed under the contract shall be executed under the direction of Engineer-in-Charge. Further instructions/advice, if felt necessary by Superintending Engineer/ Chief Engineer, shall also be binding to be communicated by the Engineer-in-Charge.

Settlement of disputes - Dispute Redressal Committee'

Clause 25. Settlement of Disputes and Arbitration:

Except where otherwise provided in the contract, all questions and disputes relating to the meaning of the specifications, designs, drawings and instructions hereinbefore mentioned and as to the quality of workmanship or materials used on the work or as to any other question, claim, right, matter or thing whatsoever, in any way arising out of or relating to the contracts, designs, drawings, specifications, estimates, instructions, orders or these conditions or otherwise concerning the works, or the executions or failure to execute the same, whether arising during the progress of the work, or after the completion or abandonment thereof shall be dealt with as mentioned hereinafter:

If the contractor considers any work demanded of him/her to be outside the requirements of the contract, or disputes any drawings, record or decision given in writing by the Engineer-in-Charge or any matter in connection with or arising out of the contract or carrying out of the work to be unacceptable, he/she shall promptly within 15 days request the Chairman of the Departmental Dispute Redressal Committee, in writing, for

written instruction or decision. Thereupon, the Dispute Redressal Committee shall give its written instruction or decision within a period of three months from the date of receipt of the Contractor's letter.

The Dispute Redressal Committee in each of the Works Departments shall be constituted with the following officials as Members:

1	Secretary / Engineer-in-Chief of the Department concerned	Chairman
2	Joint Secretary / Deputy Secretary / any Officer of equivalent rank of the Department	Member
3	One Designated Chief Engineer / Engineer of the Department to be nominated by the Department concerned.	Member Secretary and Convenor
4	One representative of Finance Department of the Government not below the rank of Joint Secretary or Financial Advisor in case of the Works Department where FA system has been introduced.	Member

This provisions will be applicable irrespective of the value of the works to which the dispute may relate.

Clause 26. The contractor shall fully indemnify and keep indemnified the implementing Department against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any article or part thereof included in the contract. In the event of any claims made under or action brought against implementing Department in respect of any such matter as aforesaid, the contractor shall be immediately notified thereof by the implementing Department and the contractor shall be at liberty, at his/ her own expense, to settle any dispute or to conduct any litigation that may arise therefrom, provided that the contractor shall not be liable to indemnify the implementing Department if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Engineer-in-Charge this behalf.

Lump sum as in estimates

Clause 27. When the estimate on which the tender is made includes lump sums in respect of parts of the work, the contractor shall be entitled to payment in respect of the items of works involved or the part of the work in question at the same rates as are payable under this contract for such items, or if the part of the work in question is not, in the opinion of the Engineer-in-charge, capable of measurement, certificate in writing of the Engineer-in-charge shall be final and conclusive against the contractor with regard to any sum or sums payable to him under the provisions of this clause.

Action where no specification

Clause 28. In the case of any class of work for which there is no such specifications as referred to under Clause 11, such work shall be carried out in accordance with the latest Bureau of Indian Standards (BIS) specifications. In case there are no such specifications in Bureau of Indian Standards, the work shall be carried out as per reputed manufacturer's specifications if accepted by the Engineer-in-Charge. If not available, then as per State Government / Union Government accepted and approved specifications. In case there are no such specifications as required above, the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-Charge which is approved by the Tender Accepting Authority.

Definition of works

Clause 29. The expression "works" or "work" where used in these conditions shall, unless there be something either in the subject or context repugnant to such construction, be constructed and taken to mean the works by or by virtue of the contract constructed to be executed, whether temporary or permanent and whether original, altered, substituted or additional.

Clause 30. The Contractor(s) shall at his/their own cost provide his/their labour with hutting on an approved site, and shall make arrangements for conservancy and sanitation in the labour camp to the satisfaction of the local Public Health and Medical Authorities. He/they shall also at his/their own cost make arrangements for the laying

of pipe lines for water supply to his/their labour camp from the existing mains wherever available, and shall pay all fees, charges and expenses in connection with there and incidental thereto.

Clause 31. The contractor(s) shall make his/their own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following conditions:-

- i) That the water used by the contractor(s) shall be fit for construction purposes to the satisfaction of the Engineer-in-charge;
- ii) The Engineer-in-Charge shall make alternative arrangements for supply of water at the risk and cost of contractor(s) if the arrangements made by the contractor(s) for procurement of water are, in the opinion of the Engineer-in-Charge, unsatisfactory.

Clause 32. The contractor undertakes to make arrangement for the supervision of the work by the firm supplying the construction materials. The Contractor shall collect the total quantity of materials as per approved programme required for the work as per approved programme, before the work is started and shall hypothecate it to the Engineer-in-Charge. If any material remains unused on completion of the work on account of lesser use of materials in actual execution for reasons other than authorized changes of specifications and abandonment of portion of work, a corresponding deduction equivalent to the cost of unused materials as determined by the Engineer-in-Charge shall be made and the material returned to the contractor. Although the materials are hypothecated to Institute, the contractor undertakes the responsibility for their proper watch, safe custody and protection against all risks. The materials shall not be removed from site of work without the consent of the Engineer-in-Charge in writing.

The contractor shall be responsible for rectifying defects noticed within Defect Liability Period from the date of completion of the work and the portion of the security deposit relating to work shall be refunded after the expiry of Defect Liability Period.

Clause 33. The contractor shall provide all necessary superintendence during execution of the work and as long thereafter as may be necessary for proper fulfilling of the obligations under the contract.

*Contractors
Superintendence,
Supervision,
Technical Staff &
Employees*

The contractor shall immediately after receiving letter of acceptance of the tender and before commencement of the work, intimate in writing to the Engineer-in-Charge, the name(s), qualifications, experience, age, address(es) and other particulars along with certificates, of the principal technical representative to be in charge of the work and other technical representative(s) who will be supervising the work. The Engineer-in-Charge shall within 3 days of receipt of such communication intimate in writing his/her approval or otherwise of such representative(s) to the contractor. Any such approval may at any time be withdrawn and in case of such withdrawal, the contractor shall appoint another such representative according to the provisions of this clause. Decision of the tender accepting authority shall be final and binding on the contractor in this respect. Such a principal technical representative shall be appointed by the contractor soon after receipt of the approval from the Engineer-in-Charge and shall be available at site before start of work.

If the contractor (or any partner in case of firm/company) himself/herself has such qualifications, it will not be necessary for the said contractor to appoint such a principal technical representative but the contractor shall designate and appoint a responsible agent to represent him and to be present at the work whenever the contractor is not in a position to be so present. All the provisions applicable to the principal technical representative under the clause will also be applicable in such a case to the contractor or his responsible agent. The principal technical representative and/or the contractor shall on receiving reasonable notice from the Engineer-in-Charge or his designated representative(s) in charge of the work in writing or in person or otherwise, present himself/herself to the Engineer-in-Charge and/or at the site of work, as required, to take instructions. Instructions given to the principal technical representative or the responsible agent shall be deemed to have the same force as if these have been given to the contractor. The principal technical representative and/or the contractor or his/her responsible authorized agent shall be actually available at site especially during important stages of execution of work, during recording of measurement of works and whenever so required by the Engineer-in-Charge by a notice as aforesaid and shall also note down instructions conveyed by the Engineer-in-Charge or his/her designated representative in the site order

book and shall affix his signature in token of noting down the instructions and in token of acceptance of measurements.

If the Engineer-in-Charge, whose decision in this respect is final and binding on the contractor, is convinced that no such technical representative(s) is/are effectively appointed or is/are effectively attending or fulfilling the provision of this clause, a recovery (non-refundable) shall be effected from the contractor as specified in Schedule and the decision of the Engineer-in-Charge as recorded in the site order book and measurement recorded checked / test checked in Measurement Books shall be final and binding on the contractor. Further if the contractor fails to appoint a suitable technical representative and/or other technical representative(s) and if such appointed persons are not effectively present or are absent by more than two days without duly approved substitute or do not discharge their responsibilities satisfactorily, the Engineer-in-Charge shall have full powers to suspend the execution of the work until such date as suitable other technical representative(s) is/are appointed and the contractor shall be held responsible for the delay so caused to the work. The contractor shall submit a certificate of employment of the technical representative(s) along with every running account bill / final bill and shall produce evidence if at any time so required by the Engineer-in-Charge.

The contractor shall provide and employ on the site only such technical assistants as are skilled and experienced in their respective fields and such foremen and supervisory staff as are competent to give proper supervision to the work.

The contractor shall provide and employ skilled, semi-skilled and unskilled labour as is necessary for proper and timely execution of the work.

The Engineer-in-Charge shall be at liberty to object to and require the contractor to remove from the works any person who, in his opinion, misconducts himself, or is incompetent or negligent in the performance of his duties or whose employment is otherwise considered by the Engineer-in-Charge to be undesirable. Such person shall not be employed again at works site without the written permission of the Engineer-in-Charge and the persons so removed shall be replaced as soon as possible by competent substitutes.

Clause 34. "Levy / Taxes Payable by Contractor"

- (i) GST, Building and other Construction Workers' Welfare Cess or any other tax or Cess in respect of this contract shall be payable by the Contractor and Engineer-in-Charge shall not entertain any claim whatsoever in this respect.
- (ii) The contractor shall deposit Government Royalty and obtain necessary permit for supply of the sand, stone chips, red bajri, sand stone, river bed materials etc. from local authorities, if those are directly procured from quarry sites.

In case materials are procured from secondary sources, certificates of quarry owners to the effect of payment of royalties and Cess would have to be furnished. In absence of such certificates towards payment of Royalties and Cess such components shall be deducted from the contractor's bills at prescribed rates and deposited through 'GRIPS' portal or otherwise, in the designated Government Treasuries/PAO.

If pursuant to or under any law, notification or order, any Royalty, Cess or the like becomes payable by the implementing Department and does not at any time become payable by the contractor to the State Government/Local appropriate authorities in respect of any material used by the contractor in the works then in such a case, it shall be lawful to the Department and it will have the right and be entitled to recover the amount paid in the circumstances as aforesaid from dues of the contractor.

Clause 35.

- (i) All tendered rates shall be inclusive of statutory taxes and levies payable under respective statutes. However, if any further tax or cess is imposed by Statute, after the last stipulated date for the receipt of tender including extensions if any and the contractor thereupon necessarily and properly pays such taxes/levies/cess, the contractor shall be reimbursed the amount so paid. Provided such payments, if any, is not, in the opinion of the Engineer-in-charge (whose decision shall be final and binding on the contractor) attributable to delay in execution of work within the control of the contractor.
- (ii) The contractor shall keep necessary books of accounts and other documents for the purpose of this condition as may be necessary and shall allow inspection of the same by a duly authorized representative of the Department and/or the Engineer-in-Charge

and further shall furnish such other information/document as the Engineer-in-Charge may require from time to time.

- (iii) The contractor shall, within a period of 30 days of the imposition of any such further tax or levy or cess, give a written notice thereof to the Engineer-in-Charge that the same is given pursuant to this condition, together with all necessary information relating thereto.

Clause 36. Without prejudice to any of the rights or remedies under this contract, if the contractor dies, the Engineer-in-charge shall have the option of terminating the contract without compensation to the contractor, but would be liable to clear full dues and claims on work done to his/her legal successor/s.

Clause 37. The contractor shall not be permitted to tender for works in which his near relative is posted as in any capacity between the grades of the Executive Engineer and Junior Engineer (both inclusive). He shall also intimate the names of persons who are working with him/her in any capacity or are subsequently employed by him/her and who are near relatives to any Official in the Institute. Any breach of this condition by the contractor would render him/her liable to be removed from the approved list of contractors of the Department. If however the contractor is registered in any other Department, he/she shall be debarred from tendering in the Department for any breach of this condition.

NOTE: By the term "near relatives" is meant wife, husband, own parents and grandparents, own children and grandchildren, own brothers and sisters, own uncles, aunts and first cousins and their corresponding in-laws.

Clause 38. No engineer of Gazetted Rank or other Gazetted Officer employed in engineering or administrative duties in the Government shall work as a contractor or employee of a contractor for a period of one year after his/her retirement from Government service without the previous permission of Government in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found at any time to be such a person who had not obtained the permission of Government as aforesaid, before submission of the tender or engagement in the contractor's service, as the case may be.

Clause 39. The work (whether fully constructed or not) and all materials, machines, tools and plants, scaffolding, temporary buildings and other things connected therewith shall be at the risk of the contractor until the work has been delivered to the Engineer-in-Charge and a certificate from him/her to that effect obtained. In the event of the work or any materials properly brought to the site for incorporation in the work being damaged or destroyed in consequence of hostilities or warlike operation, the contractor shall when ordered (in writing) by the Engineer-in-Charge to remove any debris from the site, collect and properly stack or remove in store all serviceable materials salvaged from the damaged work and shall be paid at the contract rates in accordance with the provision of this agreement for the work of clearing the site of debris, stacking or removal of serviceable material and for reconstruction of all works ordered by the Engineer-in-Charge, such payments being in addition to compensation up to the value of the work originally executed before being damaged or destroyed and not paid for. In case of works damaged or destroyed but not already measured and paid for, the compensation shall be assessed by the Engineer-in-Charge concerned. The contractor shall be paid for the damages/destruction suffered and for the restoring the material at the rate based on analysis of rates tendered for in accordance with the provision of the contract. The certificate of the Engineer-in-Charge regarding the quality and quantity of materials and the purpose for which they were collected shall be final and binding on all parties to this contract.

Provided always that no compensation shall be payable for any loss in consequence of hostilities or warlike operations (a) unless the contractor had taken all such precautions against air raid as are deemed necessary by the Air Force Officers or the Engineer-in-Charge (b) for any material etc. not on the site of the work or for any tools, plant, machinery, scaffolding, temporary building and other things not intended for the work.

In the event of the contractor having to carry out reconstruction as aforesaid, he/she shall be allowed such extension of time for its completion as is considered reasonable by the Engineer-in-charge.

Clause 40. The contractor shall comply with the provisions of the Apprentices Act, 1961 and the Apprenticeship Rules, 1992 and orders issued thereunder from time to time. If

he/she fails to do so, his/her failure will be a breach of the contract and the Engineer-in-Charge may, in his/her discretion, cancel the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him/her of the provisions of the said Act.

Clause 41. Procedure For Suspension and Debarment of Supplier, Contractors and Consultants

The procedure as laid down below shall govern the suspension/debarment of Suppliers/Contractors/Consultants (Contractors for brevity) involved in Government procurement for offences or violations committed during competitive bidding and contract implementation, for the works under different Departments of Government of West Bengal.

Grounds for Suspension and Debarment:-

- (1) Submission of eligibility requirements containing false information or falsified documents.
- (2) Submission of Bids that contain false information or falsified documents, or the concealment of such information in the Bids in order to influence the outcome of eligibility screening or any other stage of the bidding process.
- (3) Unauthorized use of one's name/digital signature certificate for the purpose of bidding process.
- (4) Any documented unsolicited attempt by a bidder (**A Person/Contractor/Agency /Joint Venture/Consortium/Corporation participating in the procurement process and/or a person / Contractor / Agency / Joint Venture / Consortium / Corporation having an agreement/contract for any procurement with the department shall be referred as Bidder**) unduly influencing the outcome of the bidding in his favour.
- (5) Refusal or failure to post a self-declaration to the effect of any previous debarment imposed by any other department of State Government and/or Central Government.
- (6) All other acts that tend to defeat the purpose of the competitive bidding such as lodging false complain about any Bidder, lodging false complain about any Officer duly authorized by the Department, restraining any interested bidder to participate in the bidding process, etc.
- (7) Assignment and subcontracting of the contract or any part thereof without prior written approval of the procuring entity.
- (8) Whenever adverse reports related to adverse performance, misbehaviour, direct or indirect involvement in threatening, making false complaints etc. damaging the reputation of the department or any other type complaint considered fit by the competent authority of the department, are received from more than one Officer or on more than one occasion from individual Officer.
- (9) Refusal or failure to post the required performance security / earnest money within the prescribed time without justifiable cause.
- (10) Failure in deployment of Technical Personnel, Engineers and/or Work Supervisor having requisite license / supervisor certificate of competency as specified in the contract.
- (11) Refusal to accept an award after issuance of "Letter of Acceptance" or enter into contract with the Government without justifiable cause.
- (12) Failure of the Contractor, due solely to his fault or negligence, to mobilize and start work or performance within the specified period as mentioned in the "Letter of Acceptance", "Letter of Acceptance cum Work Order", "Work Order", "Notice to Proceed", "Award of Contract", etc.
- (13) Failure by the Contractor to fully and faithfully comply with its contractual obligations without valid cause, or failure by the Contractor to comply with any written lawful instruction of the Procuring Entity/Authority (the Officer authorized by the Administrative Department, Government of West Bengal for procurement) or its representative(s) pursuant to the implementation of the Contract.
- (14) For the procurement of Consultancy Service/Contracts, poor performance by the Consultant of his services arising from his fault or negligence. Any of the following acts by the Consultant shall be construed as poor performance.
 - (i) Non deployment of competent technical personnel, competent Engineers and/or work supervisors;
 - (ii) Non-deployment of committed equipment, facilities, support staff and manpower;
 - (iii) Defective design resulting in substantial corrective works in design and/or construction;

- (iv) Failure to deliver critical outputs due to consultant's fault or negligence;
 - (v) Specifying materials which are inappropriate and substandard or way above acceptable standards leading to high procurement cost;
 - (vi) Allowing defective workmanship or works by the Contractor being supervised by the Consultant.
- (15) For the procurement of goods, unsatisfactory progress in the delivery of the goods by the manufacturer, supplier, or distributor arising from his fault or negligence and/or unsatisfactory or inferior quality of goods, vis-à-vis as laid down in the contract.
- (16) Willful or deliberate abandonment or non-performance of the project or Contract by the Contractor resulting in substantial breach thereof without lawful and/or just cause.

CATEGORY OF OFFENCE :-

- (A) First degree of offence: 1 to 16 of the above Clause-41 to be considered as First degree of offence.
- (B) Second degree of offence: Any one of the offences as mentioned under 'A' above, committed by a particular Bidder/Contractor/Supplier on more than one occasion, be considered as Second degree of offence.

In addition to the penalty of suspension/debarment, the bid security / earnest money posted by the concerned Bidder or prospective Bidder shall also be forfeited.

PENALTY FOR OFFENCE :-

- (I) For committing First degree of offence: Disqualifying a Bidder from participating in any procurement process under the Administrative Department of Government of West Bengal up to 2 (two) years.
- (II) For committing Second degree of offence: Disqualifying a Bidder from participating in any procurement process under the Administrative Department of Government of West Bengal up to 3 (three) years.

PROCEDURE OF SUSPENSION AND DEBARMENT DURING THE PROCUREMENT PROCESS

- (1) Initiation of Action, Notification and Hearings:
Any Bidder or procurement authority on his own or based on any other information made available to him may invite the process of suspension/debarment proceedings by filing a written application with the **Bid Evaluation Committee** and such filing of written application has to be done within forty eight hours from the date and time of publication of the result of technical evaluation of any bid.
 - (a) Upon verification of the existence of grounds for suspension/debarment, the Chairperson of **Bid Evaluation Committee** shall immediately notify the bidder concerned either electronically through his registered e-mail or in writing to his postal address, advising him that:
 - i) A complaint has been filed against him and prima facie material has been found, which may lead to suspension/debarment.
 - ii) He has been recommended to be placed under suspension/debarment by the suspension committee (as constituted by the respective Administrative Department) stating the ground for such.
 - iii) The said bidder, within three days from the date of issue of such notification by the Bid Evaluation Committee, may approach the Chairperson of Suspension Committee by submitting all required documents in his favour for hearing. Any application made thereafter would not be entertained.

Such notice should contain the e-mail id and the postal address of the Chairperson of the Suspension Committee.
 - (b) After receiving the recommendation for suspension from Bid Evaluation Committee, Suspension Committee shall issue a notice to the alleged bidder electronically through his registered e-mail id, to submit all relevant documents in support of his defense within three working days after issuance of the notice of the Suspension Committee. The Suspension Committee will conduct the hearing within seven working days from the date of receipt of the documents from the alleged bidder. If no appeal has been received from the alleged bidder or if after hearing sufficient ground for suspension is found, the Suspension Committee, will suspend the alleged bidder from participating in the procurement process under the Administrative Department for a period of six months from the date of issuance of suspension order. The Chairperson of the

Suspension Committee shall issue the suspension order within seven days from the last date of hearing and shall notify the bidder concerned either electronically through his registered e-mail id or in writing to his postal address. The Chairperson of Suspension Committee shall also inform the decision to all concerned.

If sufficient reason for suspension is not found, the Suspension Committee would reject the recommendation of Bid Evaluation Committee and would allow the bidder to take part in the tendering process.

If the bidder is suspended, the Suspension Committee would recommend debarment of the bidder and forward the case with all documents to the Debarment Committee for further action.

- (c) The Debarment Committee upon receipt of the recommendation of the Suspension Committee shall scrutinize the documents. The Debarment Committee will hold a hearing of the alleged bidder and issue necessary order within ten working days from the last date of hearing. The Debarment Committee, if satisfied after hearing, shall forward the case to the Department for orders of Debarment. The Department in due course will issue Debarment Order disqualifying/prohibiting the erring bidder from participating in the bidding/procurement of all projects under the Administrative Department for a specified period. The alleged bidder shall be intimated accordingly either electronically through his registered e-mail id or in writing to his postal address. Otherwise the Debarment Committee may reject the recommendation of the Suspension Committee. The Chairperson of Debarment Committee shall also inform the decision to all concerned.

PROCEDURE FOR DEBARMENT DURING THE CONTRACT IMPLEMENTATION STAGE:-

- (A) Upon termination of contract due to default of the Bidder, the Engineer-in-Charge shall recommend for debarment to the Bid Evaluation Committee. The Bid Evaluation Committee shall submit his recommendation of debarment of the alleged Bidder along with a detailed report stating clearly the reasons for debarment to the Debarment Committee within 30 (thirty) days from the date of termination of contract. The alleged Bidder shall be intimated accordingly either electronically to his registered e-mail id or in writing to his postal address. The Chairperson of Bid Evaluation Committee shall also inform the decision to all concerned.
- (B) The Debarment Committee upon receipt of the recommendation of Bid Evaluation Committee shall scrutinize the documents. The Debarment Committee will hold a hearing about the matter from the Bidder and issue necessary order within 10 (ten) working days from the last date of hearing. The Debarment Committee, if satisfied after hearing, shall forward the case to the Department for the order of debarment. The Department in due course will issue debarment order disqualifying/prohibiting the erring Bidder from participating in the bidding/procurement of all projects under the Administrative Department, Government of West Bengal for a specified period. The alleged Bidder shall be intimated accordingly either electronically to his registered e-mail id or in writing to his postal address. Otherwise the Debarment Committee may reject the recommendation of the Bid Evaluation Committee. The Chairperson of Debarment Committee shall also inform the decision to all concerned.

STATUS OF SUSPENDED / DEBARRED BIDDER :-

- (a) Bidder placed under Suspension/Debarment by the competent authority will not be allowed to participate in any procurement process under the Administrative Department within the period of suspension/debarment. The earnest money of the suspended Bidder shall stand forfeited to the Government.
- (b) If the Suspension/Debarment Order is issued prior to the date of issue of "Letter of Acceptance", "Letter of Acceptance cum Work Order", "Work Order", "Notice to Proceed", "Award of Contract" etc. for any Bid, the Suspended/Debarred Bidder shall not be qualified for Award for the said Bid and such Procurement Process will be dealt with as per existing norms by simply excluding the erring Bidder.
- (c) If the Suspension/Debarment Order is issued after award of a Government Project/Contract to the Debarred Bidder, the awarded Project/Contract shall not be prejudiced by the said Order provided that the said offence(s) committed by the Debarred Bidder is not connected with the awarded project/contract.

Clause 42. Executive Engineer of the concerned Division will be the Engineer-in-Charge in respect of the Tender contract and all correspondences concerning rates, claims, change

in specifications and/or design and similar important matters will be valid only if accepted/recommended by the Engineer-in-Charge. If any correspondence of above tender is made with Officers other than the Engineer-in-charge for speedy execution of works, the same will not be valid unless copies are sent to the Engineer-in-Charge and also approved by him. Instructions given by the Assistant Engineer and the Junior Engineer on behalf of the Engineer-in-Charge (who have been authorized to carry out the work on behalf of the Engineer-in-Charge) regarding specification, supervision, approval of materials and workmanship shall also be valid. In case of dispute relating to specification and work, the decision of Engineer-in-Charge shall be final and binding. The Engineer-in-Charge will however invariably take decisions relating to tender contract or as mentioned in the relevant rules and clauses of the contract document with the approval of the Tender Accepting Authority.

Clause 43. Acceptance of the Tender will rest with the Tender Accepting Authority without assigning reason thereof to the bidder. The accepting authority reserves the right to reject any or all of the tenders without assigning any reason thereof to the bidder/contractor.

Clause 44. In the event of acceptance of Lowest Rate, no multiple Lowest Rates will be considered for acceptance by the Department. In such cases, the Tender will be cancelled.

Clause 45. In the event of conflicting different clauses, the clauses in the e-NIT will prevail.

Clause 46. Engineer-in-Charge shall not entertain any claim whatsoever from the Contractor for payment of compensation on account of idle labour on such grounds including non-possession of encumbrance free land.

Clause 47. Engineer-in-Charge shall not be held liable for any compensation due to machines becoming idle or any circumstances including untimely rains, other natural calamities, like strikes etc.

Clause 48. Imposition of any Duty/Tax/Octroi/Royalty etc. whatsoever of its nature (after work order / commencement and before final completion of the work) is to be borne by the contractor/bidder. Original challan of those materials, which are procured by the bidder, may be asked to be submitted for verification.

Clause 49. Cess @ 1% or as amended time to time of the cost of construction works shall be deducted from the Gross value of all Works Bill in terms of Finance Department order. Also it is instructed to register his/her establishment under the Act, with the competent registering Authority, i.e. Assistant Labour Commissioner / Deputy Labour Commissioner of the region.

Clause 50. No Mobilization/Secured Advance will be allowed unless specified otherwise in the contract.

Clause 51. Valid PAN issued by the Income Tax Department, Government of India, valid 15 digit Goods and Services Tax Payer Identification Number (GSTIN) under GST Act 2017, Cess, Royalty of Sand, Stone Chips, Stone Metal Gravel, Boulders, Forest product etc., Toll Tax, Income Tax, Ferry Charges and other Local Taxes, if any, are to be paid by the Contractor/Bidder. No extra payment will be made as a reimbursement or as compensation for these. The rates of supply and finished work items are inclusive of these taxes and charges.

Clause 52. All working Tools & Plants, Scaffolding, Construction of Vats & Platforms and arrangement of Labour Camps will have to be arranged by the Contractor at his/her own cost.

Clause 53. The Contractor shall supply Mazdoors, Bamboos, Ropes, Pegs, Flags etc. for laying out the work and for taking and checking measurements for which no extra payment will be made.

Clause 54. The Contractor/Bidder should see the site of works and Tender Documents, Drawings etc. before submitting e-Tender and satisfy himself/herself regarding the condition and nature of works and ascertain difficulties that might be encountered in executing the work, carrying materials to the site of work, availability of drinking water and

other human requirements & security etc. Work on river banks may be interrupted due to a number of unforeseen reasons e.g. sudden rises in water levels, inundation during flood, inaccessibility of working site for carriage of materials. Engineer-in Charge may order the contractor to suspend work that may be subjected to damage by climate conditions. No claim will be entertained on this account. There may be variation in alignment, height of embankment or depth of cutting, location of revetment, structures etc. due to change of topography, river condition and local requirements etc. between the preparation and execution of the scheme for which the tendered rate and contract will not stand invalid. The Contractor will not be entitled to any claim or extra rate on any of these accounts.

Clause 55. A machine page numbered Site Order Book (with triplicate copy) will have to be maintained at site by the Contractor and the same has got to be issued from the Engineer-in-Charge before commencement of work. Instructions given by inspecting officers not below the rank of Assistant Engineer will be recorded in this book and the contractor must note down the action to be taken by him in this connection as quickly as possible.

Clause 56. The work will have to be completed within the time mentioned in the e-NIT. A suitable Work Programme based on time allowed for completion of work as per e-NIT is to be submitted by the contractor within 7 (seven) days from the date of receipt of work order which should satisfy the time limit of completion. The contractor should inform in writing, within 7 (seven) days from the date of receipt of work order, the names of his authorized representatives who are to remain present at site daily during work execution who will receive instructions of the work, sign measurement book, bills and other Government papers etc.

Clause 57. No compensation for idle labour, establishment charge or on other reasons such as variation of price indices etc. will be entertained.

Clause 58. All possible precautions should be taken for the safety of the people and work force deployed at worksite as per safety rule in force. Contractor will remain responsible for his labour in respect of his liabilities under the Workmen's Compensation Act etc. He must deal with such cases as promptly as possible. Proper road signs as per PWD practice or any other sign board for safety purpose as per requirement by the concerned Administrative Department will have to be erected by the Contractor at his own cost while operating in public thoroughfares.

Clause 59. The Contractor will have to maintain qualified technical employees and/or Apprentices at site as per prevailing Apprentice Act or as stipulated in the contract.

Clause 60. The Contractor will have to accept the Work Programme as per modifications and priority of work fixed by the Engineer-in-Charge so that most vulnerable reach and/or vulnerable items are completed before impending monsoon or rise in river flood water level or for other suitable reasons.

Clause 61. Quantities of different items of work mentioned in the tender schedule or in work order are only tentative. In actual work, these may vary considerably. Payment will be made on the basis of works actually done in different items and no claim will be entertained for reduction of quantities in some items or for omission of some items. For execution of quantitative excess in any item or supplementary new items of work as decided by the Department, approval of the Superintending Engineer / Chief Engineer / Government would be required, depending on whosoever be the Tender Accepting Authority, before making such payment.

Clause 62. In order to cope up with the present system of e-billing, supply of departmental materials is generally not allowed. However, if in special circumstances, Departmental materials may be issued to the Contractor/Bidder to the extent of requirements as assessed, those may be recovered from the Running Account Bill and/or Final Bill, as applicable.

Clause 63. Any material brought to site by the contractor is subject to approval of the Engineer-in-Charge. The rejected materials must be removed by the contractor from the site at his own cost within 24 hours of issue of the order to that effect. The rates in the schedule are inclusive of cost and carriage of all materials to worksite. The materials will have to be supplied in phase with due intimation to the Assistant Engineer concerned in

conformity with the progress of the work. For special type of materials, i.e. Geo Synthetic Bags, HDPE Bags, Geo Textile Filter, Geo Jute Filter etc., if any, relevant Data Sheet containing the name of the Manufacturers, Test Report etc. will also be submitted on each occasion. Engineer-in-Charge may conduct independent test on the samples drawn randomly before according approval for using the materials at site. In this regard decision of Engineer-in-Charge shall be final and binding.

Clause 64. For all items of contract jobs requiring skilled labour, the contractor shall have to employ 70% (Seventy Percent) of skilled labour locally. In case the Contractor fails to recruit skilled local labour, the Contractor shall employ skilled labour locally secured by Government in the manner indicated above. For bridge works, highly technical works of labour, the contractor may, with the prior permission in writing of the Engineer-in-charge to whom full facts must be placed for such permission, import and employ skilled labour up to 30% (Thirty Percent) of the total requirement. In this case the expression “Imported labour” shall mean “labour imported primarily from other States and secondarily, from the distant districts of the State of West Bengal.” In case where the contractor fails to secure unskilled local labour or to engage imported labour, the contractor shall employ labour locally recruited by Government or labour imported by Government at the rate to be decided by the Superintending Engineer of the works concerned, whose decision as to the circumstances in which employment of such labour is of mutual advantage to Government and the contractor, will be final and binding on the parties.

Clause 65. All queries and disputes arising out of the works tender contract is to be brought to the notice of the Chairman of the ‘Department Dispute Redressal Committee’ in writing for decision within 15 days.

Clause 66. The contractor shall have to make his own arrangements for water, both for the work and use by his workers, etc., for road rollers and for all tools and plant, etc., required on the work.

Clause 67. Contractor will be responsible for the payments of all water charges payable to the Corporation Municipality / Panchayat or any other water works authority including a Government Department concerned.

Clause 68. If the contractors shall desire an extension of the time for completion of the work under clause 5 of the contract, no application for such extension will be entertained if it is not received in sufficient time to allow the Executive Engineer to consider it and the Contractor will be responsible for the consequences arising out of his negligence in this respect.

Clause 69. The Contractor will have to leave ducts in walls and floors to run conduit or cables, where necessary, and he will not be entitled to any extra payment on this account.

Clause 70. Contractors in the course of their work should understand that all materials obtained in the work of Dismantling, Excavation, etc., will be considered Government property and will be disposed of to the best advantage of Government.

Clause 71. In case of very special case of circumstances, if any Departmental materials are issued, there may be delay in obtaining the materials by the Department and the Contractor is, therefore, required to keep himself/herself in touch with the day to day position regarding the supply of materials from the Engineer-in-charge and to so adjust the progress of the work that his labour may not remain idle nor may there be any other claim due to or arising from delay in obtaining the materials. It should be clearly understood that no claim whatsoever shall be entertained by the Department on account of delay in supplying materials.

Clause 72. No compensation for any damage done by rain or traffic during the execution of the work will be made.

Clause 73. Whenever a work is carried out in municipal area, electric lights or electric danger signals whenever available shall be provided by the contractors on the barriers as well as paraffin lights. Facilities for the electric connection will be made by this Department but the Contractor will bear all the expenses.

Clause 74. The Contractor should quote through rate inclusive of cost of materials and carriage to place of working.

Clause 75. The Contractors should give complete specifications showing the method of execution and the quantity and quality of materials they intend to use per hundred square metre area.

Clause 76. In cases where water is used by the Contractor he will be required to deposit in advance with the Executive Engineer the charges for water which are to be calculated in accordance with the schedule of miscellaneous rates in the Canal Act.

Clause 77. It must be clearly understood by the Contractor that no claim on account of enhanced rates on those already accepted, due to fluctuations arising out of any situation will be entertained during the currency of this contract for the work as per schedule attached to the agreement and the additional work, if any, under Clause 12 of the contract.

Clause 78. In the event of emergency the Contractor will be required to pay his labour everyday and if this is not done, Government shall make the requisite payments as would have been paid by the contractor and recover the cost from the contractors.

INCONVENIENCE OF THE PUBLIC

Clause 79. The Contractor(s) shall not deposit material on any site which will seriously inconvenience the public. The Engineer-in-charge may require the Contractor(s) to remove any materials, which are considered by him to be a danger or inconvenience to the public or cause them to be removed at the contractor's cost.

Clause 80. The Contractor undertakes to have the site clean, free from rubbish to the satisfaction of the Engineer-in-charge. All surplus materials, rubbish etc. will be removed to the places fixed by the Engineer-in-charge and nothing extra will be paid.

Clause 81. The Contractor shall not allow any rubbish or debris to remain on the premises during or after repairs, but shall remove the same and keep the place neat and tidy during the progress of the work. The Engineer-in-charge may get the site premises cleared of debris etc. And recover the cost from the bill of the contractor, if the latter shows slackness in observing this clause.

Clause-82. Construction materials brought at site shall not be stacked at random. The contractor shall stack all these materials as directed by the Engineer-in-charge.

INTERPRETATION OF CLAUSES

Governor means the Governor of the State of West Bengal and his/her successors.

The Government means Government in the concerned Works Department.

The Department means the Secretary of the concerned Department or his/her authorized representative.

The Divisional Officer means the Executive Engineer of the concerned Works Department for the time being of the Division concerned, also identified as the Engineer-in-Charge.

The Sub-divisional Officer means the Assistant Engineer of the concerned Works Department for the time being of the Sub-division concerned. Junior Engineer equivalent to Section Officer of the Section concerned.

Superintending Engineer in the concerned works Department is the final Authority regarding Schedule of Rates and also the acceptance of Non-scheduled item rates arrived on the basis of market rate analysis for supplementary items, and the authority for approval of Reduced Rates and Part Rates. He is also the Tender Accepting Authority for works of value above Rs. 45.00 lakh and up to Rs. 2.00 crore under existing delegated power.

Chief Engineer in the concerned Works Department is the technical head of the Directorate and is also the Tender Accepting Authority for all works of value above Rs.

2.00 crore. Excess work over individual items comprising the original tender may be exceeded beyond 10% with the approval of concerned tender accepting authority and verified by the Superintending Engineer / Chief Engineer subject to the total value of work upon completion is within the technically sanctioned cost and that there is no major deviation from original scope of work in the tender. **Any supplementary tender/item/work in connection with the main tender is to be taken up with the approval of the Tender Accepting Authority not below the rank of Executive Engineer.** Such supplementary tenders above 10% of BOQ are to be executed only with the approval of appropriate Government irrespective of the value of tender.

Words importing the singular number only include the plural number and vice versa.

Irrespective of the accepting authority, Divisional officer shall be the authority signing agreement for all tenders of value more than Rs. 3.00 lakh up to any amount on behalf of the State.

Schedule showing (approximately) materials to be supplied by the Engineer-in-Charge under clause 10:

Particulars	Rates at which the materials will be charged to the contractor			Place of delivery
	Unit	Rs.	P.	

Note 1- The person or firm submitting the tender should see that the rates in the above schedule are filled up by the Engineer-in-charge on the issue of the form prior to the submission of the tender.

(Name in full)
 *Signature of Contractor/Agency
 with official seal containing
 Principal office address

(Name in full)
 *Signature of Executive Engineer/
Assistant Engineer
 on behalf of the Governor of the
 State of West Bengal with official seal
 containing designation & address

* To be authenticated on each and every page of the contract document by all parties.