BMTPC
PACS
PERFORMANCE APPRAISAL CERTIFICATION

Formwork For Monolithic Construction

Name and Address of Certificate Holder:	Performance Appraisal Certificate No.
M/s Sintex Industries Ltd. **Kalol (N. Gujarat) – 382721** **Gandhinagar, India**	PAC No **1006-A/2011** Issue No. **01** Date of Issue: **12.09.2011**

User should check the validity of the Certificate by contacting Member Secretary, BMBA at BMTPC or the Holder of this Certificate.

bmtpc

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Government of India
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PERFORMANCE APPRAISAL CERTIFICATE

FOR

FORMWORK FOR MONOLITHIC CONCRETE CONSTRUCTION

ISSUED TO

M/s SINTEX INDUSTRIES LTD

STATUS OF PAC 1006-A/2011

S.No	Issue No.	Date of Issue	Date of renewal	Amendment		Valid up to (Date)	Remark	Authorized Signatory
				No.	Date			
1.	2.	3.	4.	5.	6.	7.	8.	9.
1	01	12-09-2011				13-09-2012		

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PART I CERTIFICATION

I.1 CERTIFICATE HOLDER: M/s **Sintex Industries Ltd.**
Kalol (N. Gujarat) – 382721
Gandhinagar, India
Phone No. 02764-253500
Fax No. 02764-253800

I.2 **DESCRIPTION OF SYSTEM**

I.2.1 **NAME OF THE SYSTEM** – Formwork for Monolithic Concrete Construction.

1.2.1.2 **BRAND NAME - DURACO**

I.2.2 **BRIEF DESCRIPTION**

Hardware used in the Formwork for Monolithic Concrete Construction consists of various Aluminium and PVC sections of consistent dimensions. Majority of the equipment consists of panel sections while the rest includes vertical & horizontal corner sections, bulkheads & special floor, slab & beams that can be dismantled without disturbing the props supporting the slab & beams.

This system is externally adaptable to any building design. Based on the architectural & structural design of the buildings, a process of computer modulation is carried out. It involves iteration and optimization techniques which select the most economical and practical fittings of the standard formwork components. Major differences of Monolithic formwork over conventional formwork system are its (i) modular size, (ii) faster erection, (iii) smooth finish, (iv) light weight and (v) lesser work force.

I.3 **ASSESSMENTS**

I.3.1 **Scope of Assessment**

Suitability of Formwork for Monolithic Concrete Construction for construction of Mass housing wherein large number of units of similar configuration are needed.

I.3.2 **Scope of Inspection**

Scope of inspection included verification of production, performance and testing facilities at the factory including competence of technical personnel and status of quality assurance in the factory.

I.3.3 **Assessment Summary**

I.3.3.1 The assessment was done through inspection and laboratory testing & equipment at the factory and field observations of the formwork in use.

I.3.3.2 **Manufacturing & Test Facilities**

Manufacturing and test facilities available in the factory were found to be suitable & adequate to produce the hardware required for formwork as per the desired design. The PAC holder maintains testing laboratory with necessary equipment for quality assurance.

I.3.3.3 **Competence of Technical Personnel** -- Persons involved in testing were found to be well conversant with testing procedures required for quality control of the product.

I.3.3.4 **Inspection in Actual Use**

A few of the sample units out of about 4000 Affordable Housing Units having plinth areas ranging from 35 to 65 sqm using this Formwork system being constructed at Sulabh Avas Yojna, Lucknow by the manufacturer for Lucknow Development Authority recently inspected by the Panel members have been verified and found to be satisfactory as per specifications.

I.3.3.5 **Quality Assurance Procedure**

The firm follows a Quality Assurance System for production of the formwork as per Annex.-I attached to this Certificate.

I.4 **USES OF THE FORMWORK & ITS LIMITATIONS**

I.4.1 **Design Data** – The data and information provided in Part II of this Certificate shall be used for design of the formwork.

I.4.2 **Storage & Handling Before Erection**

I.4.2.1 **Storage**

The hardware required for the formwork shall be stacked on the hard surface so that they may not break when taken out for assembling.

I.4.2.2 **Receipt & Fixing**

The precautions to be observed while receiving, fixing and de-shuttering the form work materials are given in Appendix I attached with this Certificate.

I.4.3 **Testing of the Formwork**

I.4.3.1 Reports of testing of the various sections forming part of the formwork got done by the manufacturer as per the relevant Indian Standards against Visual, Dimensions, Mechanical & Chemical properties, Flame retardant test, Tensile Stress etc. in accordance with the test reports of CIPET and Divine Laboratories, Ahmedabad have lead to the conclusion that these

meet the requirements of the formwork for buildings provided these are installed in accordance with the manufacturer's instructions & guidelines.

I.5 CONDITIONS OF CERTIFICATION

I.5.1 **Technical Conditions**

Raw materials and the formwork shall conform to the requirements given in Clause II–2.2.

I.5.2 **Quality Assurance**

The Certificate Holder shall implement and maintain a quality assurance system in accordance with Scheme of Quality Assurance (SQA) given in the Annexure attached with this Certificate.

I.5.3 **Handling of User Complaints**

I.5.3.1 The Certificate holder shall provide quick redressal to consumer/user complaints proved reasonable & genuine and within the conditions of warranty provided by him to customer/purchaser

I.5.3.2 The Certificate holder shall implement the procedure included in the SQA. As part of PACS Certification he shall maintain data on such complaints with a view to assess the complaint satisfaction and suitable preventive measures taken.

I.6 CERTIFICATION

I.6.1 On the basis of assessment given in Part III of this Certificate & subject to the conditions of certification, use & limitations set out in this Certificate and if selected, erected & maintained as set out in Part I & II of this Certificate, the Formwork covered by this Certificate conforms to the requirement of the specifications given in Clause II-2.

PART II CERIFICATE HOLDER'S TECHNICAL SPECIFICATIONS

II.1 GENERAL

II.1.1 The PAC holder shall manufacture the Formwork in accordance with the requirements specified in the relevant Indian Standards. In addition it shall follow the Company standards specifying requirements of various materials used in the manufacture of the formwork (see V-2).

II.2 SPECIFICATIONS OF THE SYSTEM & ITS DESIGN INFORMATION

II.2.1 **Specifications**

The specifications for the raw materials, erected formwork and its design shall be as per performance criteria when tested in accordance with the relevant Indian Standards listed in Part V of this Certificate.

II.2.2 **Technical Specifications**

II.2.2.1 *RAW MATERIALS*

(i) ***Aluminium Extruded Sections***

Mechanical & Chemical properties -- Shall conform to IS 733:1983

(ii) ***Hot Dip Galvanizing***

Hot dip galvanized nut, bolts & washers -- Shall conform to IS 4759: 996

(iii) ***Steel Tubes***

Dimensions, Mechanical & Chemical properties – Shall conform to IS 1161:1979 & IS 806:1968

(iv) ***Aluminium Wire***

Dimensions and other properties -- Shall conform to IS 5897:1985

(v) ***PVC Sections***

Chemical and mechanical properties -- Shall conform to IS 10151:1982 and Grade is PVC 67GER01 of RIL.

II.2.2.2 **Construction and Workmanship**

Formwork consists of different sections having different materials namely Hardware, Starter of MS angle & SMC sheet, Top frame of Aluminium channel, Outer side & Inner side wall panels of Aluminium & PVC, Staircase side wall panels, Vertical corners of Aluminium, MS Corner angle, MS Jambs, MS Props & Trusses, MS pipes for drops and slab panels etc. The hardware consists of various standard pieces of formwork equipment manufactured to fine tolerance.

PVC sections used for the formwork shall be thoroughly cleaned on both the sides and then shall be reused / fixed so that the surface may come out smooth.

Only white grease shall be used over the MS flats/ spacers as a releasing agent.

While preparing the Form work, the correct surface alignment of the PVC panel in line with Aluminium angle and the alignment and spacing of the bracing angles shall also be taken into consideration. The straightness and surface alignment shall be checked with precision instruments during preparation of form work.

II.2.2.3 **Design**

Formwork shall be designed to meet the requirement of permanent structures using specified Indian Standard for material used. The design should take into amount the conditions of materials to be actually used for the formwork, environment and site condition loads on formwork and combination of loads shall be taken in accordance with the clause 7.3 of IS 14687:1999.

Design shall be done by qualified structural engineer. The certificate holder shall provide details of design, if required by the client.

II.2.3 Deflection Limit, Stability and Rigidity shall be accordance with the provisions given in IS 14687:1999

II.2.4 **Size**

The formwork may be available in different sizes depending upon the design of the building units as per the requirement.

Typical details of Formwork is given at Annex. II.

II.2.5 **Receipt and Marking/ Painting of Shuttering Material**

(i) The material shall be dispatched after QC check. If any discrepancy in size, dimensions & workmanship etc. is noticed, the same shall not be dispatched

(ii) All the shuttering material received at site shall be checked as per the dispatch list of assembly drawing and any short supply shall be informed

(iii) All the shuttering material received at site shall be entered in register with size description & quantity and updated as per the usage/ new arrival

(iv) All the shuttering material shall be marked/ painted by member no. and set no. or as per the numbering system desired at site and the same shall be entered in the register.

II.2.6 **Information to be Supplied by the Manufacturer**

The requisite information to be supplied by the manufacturer of Formwork System is given in Annex. III.

II.3 **FIXING & ERECTION OF FORMWORK**

II.3.1 Following points shall be observed while fixing/ erecting the formwork:

(i) The marked members shall be fixed at site as per the numbering system and assembly drawings

(ii) Before fixing, the shuttering plates, G corners, top frames and other components shall be properly cleaned

(iii) All the steel components shall be straightened/ aligned as per original shapes if they are damaged during de-shuttering

(iv) The damaged part, if any shall be got repaired before fixing

(v) The shuttering plates and other components shall be applied with oil/ greasing agents

(vi) The sleeves surrounding the flats shall be of proper size

(vii) All the pins & wedges and flats, corner connectors etc. shall be fixed as per the drawings

(viii) All the oblong/ widened holes shall be repaired with washer-pusher

(ix) Leveling and dimensions shall be checked for rooms, corridors stairs etc. before concreting is started. While leveling and adjusting dimensions, extra props/ jacks shall be provided as per requirement

(x) After fixing of shuttering , gap shall be filled with plastic tapes/ metal pieces of appropriate size

II. 4 DE-SHUTTERING OF FORMWORK

II.4.1 (i) Before fixing, the shuttering plates shall be properly cleaned from all the sides

(ii) All the G Corners/ top frames and other components shall be cleaned

(iii) All the steel components shall be straightened, aligned as per original shapes if they are damaged during de-shuttering

(iv) If any damaged part is found, the same shall be repaired at site

(v) All the flats shall be loosened between 6 to 8 hours of concreting

(vi) All the sides of the shuttering plates shall be removed after 16 hours of casting and then cleaned & checked for damage and oil releasing agent shall be applied on it.

(vii) Slab shuttering plates shall be removed after 3 days of concreting by keeping the truss and props intact which shall be removed after 7 days.

(viii) While de-shuttering, lever principal shall be used. No hammering shall be done to loosen the plates/ components.

(ix) The shuttering plates shall not be used for walkway/ staging/ Scaffolding / labour camps/ platforms etc.

II.5 TOLERANCE IN FORMWORK

Formwork shall be of proper dimensions and shape as per drawings. The tolerances on the shape, lines and dimensions shown in the drawings shall be within the limits specified in Clause 9.6 of IS 14687:1999.

II.6 SKILLS/TRAINING NEEDED FOR ERECTION

Installation guidelines required for the Formwork system shall be supplied to the semiskilled and unskilled workers.

II.7 GUARENTEES/WARRENTIES AND SERVICES PROVIDED BY THE PAC HOLDER

The formwork manufactured by the PAC holder is for its Captive Use only i.e. for construction of Mass housing units and not supplied to any outside agency.

PART III BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

III.1 BASIS OF ASSESSMENT

III.1.1 The technical basis for assessment is as per the Standards listed in Part V of this Certificate

III.1.2 The assessment is based on the results & reports of

(i) Inspection of the factory

(ii) Inspection of the test equipment used, test procedures followed and testing personnel involved in the laboratory of the factory
(iii) Assessment of quality assurance procedures implemented in the factory
(iv) Tests done in the factory on the basis of performance characteristics given by the manufacturer
(v) Tests done in independent laboratories by the manufacturer
(vi) Inspection of the Monolithic Formwork at site

III.2 PRODUCTION PROCESS

III.2.1 **Production Process for Alumunium/ MS items**

• Indent and receipt of Raw materials as per assembly drawings and test certificates
• Cutting, drilling, slotting, assembly & welding of Aluminium Sections/ MS Angle
• Straightening & finishing of Aluminium/ MS frame
• Identification, Marking, Inspection and dispatch of the above components

III.2.2 **Production Process for Assembly of the Final Product**

• Grinding, Length cutting of PVC Sections and Steel tube cutting
• Cutting, gluing & screwing and finishing of End cap
• Hardware and "T" Support fitting for FRP items
• Panel assembly, slotting and finishing
•Identification, Marking, Inspection & dispatch of the above assembly

III.2.3 **Installation & Erection at Site:**

After dispatch of all the components as per Bill of Materials for the site, erection is done as per the relevant drawings.

III.2.4 Inspections & testing is done at appropriate stages of manufacturing process. The inspected parts are stored aside to ensure that no damage occurs during transportation. As part of quality assurance regular in process inspections are carried out by the trained personnel of the PAC holder.

III.2.5 While receiving, fixing and deshuttering the formwork, points given in Annex.-IV should be taken into amount.

III.3 FACTORY INSPECTION

III.3.1 The factory was inspected by the technical representative of the Council. During inspection the entire manufacturing process along with the equipment was inspected. The manufacturing process was found to conform to the process description given by the manufacturer. The in-process inspection and the inspection of the erected formwork were in accordance with the SQA approved as a part of the requirements for grant of this PAC. It is the responsibility of the PAC holder to maintain and

calibrate equipment for manufacturing and testing periodically to manufacture the Formwork in accordance with the specified parameters.

III.4 TEST REPORTS

Reports of the various tests got done by the manufacturer for the raw materials as per Annexure attached from independent laboratories can be obtained by the customers, if required. Further, the manufacturer has submitted design calculations of the performance tests for the erected formwork of the Mass Housing Units for LDA, Lucknow being constructed by them considering vertical and live loads as per IS 875 (Part1-3): 1987, earthquake resistance as per IS 1893: 2002 and deflection etc. as per IS 14687:1999 from Structural engineers duly approved by IIT-Delhi. Further, the performance characteristics indicated in Clause II-2.3 required for the formwork shall be got tested and assessed at required periodicity and with change in materials/their combination and change in design of formwork system.

III.5 USAGE OF FORMWORK

The age of the building units constructed so far by the manufacturer using this Form work is only 4 years.

Details of the Mass Housing Projects using this formwork constructed by the manufacturer are given below:-

S.No.	*Agency*	*Location*	*When completed*
1.	Delhi State Industrial Development Corporation	Bawana, Delhi	2009
2.	Ahmedabad Urban Development Authority	Ahmedabad	2007, March 2010 and Feb. 2011
3.	Ahmedabad Municipal Corporation	Vatva, Ahmedabad	March 2010
4.	Puducherry slum Clearance Board, Tamil Nady	Savanapet, Puducherry (TN)	To be completed by December 2011
5.	Boriavi Nagar Palika	Boriavi, Gujarat	March 2010
6.	Lucknow Development Authority	Gomti Nagar Extn. Lucknow	To be completed by December 2011

PART IV STANDARD CONDITIONS

This certificate holder shall satisfy the following conditions:

IV.1 The certificate holder shall continue to have the product reviewed by BMBA.

IV.2 The product shall be continued to be manufactured according to and in compliance with the manufacturing specifications and quality assurance measures which applied at the time of issue or revalidation of this certificate. The Scheme of Quality Assurance separately approved shall be followed.

IV.3 The quality of the product shall be maintained by the certificate holder.

IV.4 The product user should install, use and maintain the product in accordance with the provisions in this Certificate.

IV.5 This certificate does not cover uses of the product outside the scope of this appraisal.

IV.6 The product is appraised against performance provisions contained in the standards listed in Part-V. Provisions of any subsequent revisions or provisions introduced after the date of the certificate do not apply.

IV.7 Where reference is made in this Certificate to any Act of Parliament of India, Rules and Regulations made there under, statutes, specifications, codes of practice, standards etc. of the Bureau of Indian Standards or any other national standards body and the International Organization for Standardization (ISO), manufacturer's company standards, instruction/manual etc., it shall be construed as reference to such publications in the form in which they were in force on the date of grant of this Certificate (and indicated in Part V to this Certificate)

IV.8 The certificate holder agrees to inform BMBA of their distributors / licensees whenever appointed by him and agrees to provide to BMBA a six monthly updated list thereof.

IV.9 The certificate holder agrees to provide to BMBA feedback on the complaints received, the redressal provided, and the time taken to provide redressal on complaint to complaint basis as soon as redressal is provided. BMBA agrees to provide the certificate holder the user feedback received by it, if any.

IV.10 If at any time during the validity period, PACH is unable to fulfill the conditions in his PAC, he should on his own initiative suspend using the PAC and notify Chairman, TAC the date from which he has suspended its use, the reason for suspension and the period by which he will be able to resume. He shall not resume without the prior permission of BMBA. He shall also inform, simultaneously, his agents, licensees, distributors, institutional, government, public sector buyers, other buyers and all those whom he has informed about his holding the PAC. He shall also inform all those who buy his product(s) during the period of suspension. He shall provide to BMBA at the earliest the list of who have been so informed by him.

IV.11 In granting this Certificate, BMBA takes no position as to:

(a) The presence or absence of patent or similar rights relating to the product;

(b) The legal right of the Certificate holder to market, install or maintain the product;

(c) The nature of individual installations of the product, including methods of workmanship.

IV.12 BMTPC and the Board of Agreement of BMTPC (BMBA) take no position relating to the holder of the Performance Appraisal Certificate (PACH) and the users of the Performance Appraisal Certificate (PAC) respecting the patent rights / copy rights asserted relating to the product / system / design / method of installation etc. covered by this PAC. Considerations relating to patent / copy rights are beyond the scope of the Performance Appraisal Certification Scheme (PACS) under which this PAC has been issued. PACH and users of this PAC are expressly advised that determination of the Claim / validity of any such patent rights / copy rights and the risk of infringement of such rights are entirely the responsibility of PACH on the one hand and that of the users on the other.

IV.13 It should be noted that any recommendations relating to the safe use of the product which are contained or referred to in this Certificate are the minimum standards required to be met with when the product is installed, used and maintained. They do not purport in any way to restate or cover all the requirements of related Acts such as the Factory Act, or of any other statutory or Common Law duties of care, or of any duty of care which exist at the date of this Certificate or in the future, nor is conformity with the provisions of this Certificate to be taken as satisfying the requirements of related Acts.

IV.14 In granting this Certificate, BMTPC and BMBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the use of this product.

IV.15 The certificate holder indemnifies BMBA, its officers and officials involved in this assessment against any consequences of actions taken in good faith including contents of this certificate. The responsibility fully rests with the certificate holder and user of the product.

IV.16 The responsibility for conformity to conditions specified in this PAC lies with the manufacturer who is granted this PAC. The Board (BMBA) will only consider requests for modification or withdrawal of the PAC.

IV.17 The PAC holder shall not use this certificate for legal defense in cases against him or for legal claims he may make from others.

Place: New Delhi
Date of issue_____

Chairman TAC & for and on behalf of
Member Secretary, BMBA

Dr. Shailesh Kr. Agarwal
Chairman, TAC
& Member Secretary, BMBA
Building Materials and Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation, (Govt. of India)
Core 5A, Ist Floor, India Habitat Centre,Lodhi Road,
New Delhi-110 003

Part V LIST OF STANDARDS & CODES USED IN ASSESSMENT

Part V.1	**Standards -**	These Standards are referred for carrying out particular tests only and do not specify the requirement for the whole product as such.
Part V.1.1	**IS 733:1983 –**	Aluminium Extruded Section – Mechanical & Chemical Properties
Part V.1.2	**IS 806:1968 –**	Code of practice for use of steel tubes in general building construction
Part V.1.3	**IS 875(Parts 1-5):1987**	Code of practice for design load for Building & Structures
Part V.1.4	**IS 1161:1979 –**	Steel Tubes for structural purposes – specifications
Part V.1.5	**IS 1608:2005 –**	Mechanical Testing of Metals – Tensile testing
Part V.1.6	**IS 1852:1985 –**	Rolling & Cutting Tolerances for Hot rolled steel Products
Part V.1.7	**IS 1893 (Part 1):2002**	Criteria for earthquake resistant design of structures – General provisions & buildings
Part V.1.8	**IS 2062:1999 –**	Hot Rolled low, medium & high tensile structure's steel
Part V.1.9	**IS 2629:1985 –**	Recommended Practice for Hot Dip Galvanizing of Iron & Steel
Part V.1.10	**IS 4759:1996 –**	Hot Dip zinc coating on structural steel
Part V.1.11	**IS 4826:1979 –**	Specifications for Hot dip galvanized coatings on round steel wires
Part V.1.12	**IS 5897:1985 –**	Aluminium & Aluminium alloy welding rods & wires
Part V.1.13	**IS 10151:1982 -**	Specifications for Polyvinylchloride (PVC) for its contact with Foodstuffs, Pharmaceuticals & Drinking water
Part V.1.14	**IS 13360 –**	Plastics – Method of Testing
Part V.1.14.1	**Part 5, Sec 2:1996 –**	Determination of Tensile Properties
Part V.1.14.2	**Part 5, Sec 4:1996 –**	Determination of Izod Impact Strength
Part V.1.14.3	**Part 5, Sec 7:1996 –**	Determination of Flexural Properties
Part V.1.14.4	**Part 6, Sec 3:1997 –**	Determination of temperature of deflection under load
Part V.1.14.5	**Part 6, Sec 4:1997 –**	Determination of burning behavior of horizontal & vertical specimens in contact with a small flame ignition source
Part V.1.15	**IS 13411:1992 --**	Glass reinforced polyster dough moulding Compounds (DMC)
Part V.1.16	**IS 14687:1999 –**	Falsework for concrete structures
Part V.1.17	**IS 168:1993 –**	Salt spray test of Hot dip galvanized nuts & bolts
Part V.2	**Company Standards of the PAC holder –**	The branded design & specifications of the raw materials and finished product are as submitted by the manufacturer. The PAC holder has to make available the company standards to the consumers according to which testing have been done.

CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA) **Formwork** bearing the mark Manufactured by M/s Sintex Industries Ltd is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No.1006-A /2011** is awarded to **M/s Sintex Industries Ltd.**

The period of validity of this Certificate is as shown on Page 1 of this PAC. This Certificate consists of pages 1 to 28.

Embossing Seal of BMBA

On behalf of BMTPC Board of Agreement

New Delhi, India
Place
Date

Chairman, Technical Assessment Committee (TAC) of BMBA & Member Secretary, BMTPC Board of Agreement (BMBA) Under Ministry of Housing and Urban Poverty Alleviation, Government of India

Dr. Shailesh Kr. Agarwal
Chairman, TAC
& Member Secretary, BMBA
Building Materials and Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation, (Govt. of India)
Core 5A, 1st Floor, India Habitat Centre,Lodhi Road,
New Delhi-110 003

PART VI ABBREVIATIONS

Abbreviations

BMBA	Board of Agreement of BMTPC
BMTPC	Building Materials and Technology Promotion Council
CPWD	Central Public Works Department
ED	Executive Director of BMTPC
IO	Inspecting Officer
MS	Member Secretary of BBA
PAC	Performance Appraisal Certificate
PACH	PAC Holder
PACS	Performance Appraisal Certification Scheme
SQA	Scheme of Quality Assurance
TAC	Technical Assessment Committee (of BMBA)

Performance Appraisal Certification Scheme - A Brief

Building Materials & Technology Promotion Council (BMTPC) was set up by the Government of India as a body under the Ministry of Housing &Urban Poverty Alleviation to serve as an apex body to provide inter-disciplinary platform to promote development and use of innovative building materials and technologies laying special emphasis on sustainable growth, environmental friendliness and protection, use of industrial, agricultural, mining and mineral wastes, cost saving, energy saving etc. without diminishing needs of safety, durability and comfort to the occupants of buildings using newly developed materials and technologies.

During the years government, public and private sector organizations independently or under the aegis of BMTPC have developed several new materials and technologies. With liberalization of the economy several such materials and technologies are being imported.

However, benefits of such developments have not been realized in full measure as understandably the ultimate users are reluctant to put them to full use for want of information and data to enable them to make informed choice.

In order to help the user in this regard and derive the envisaged social and economic benefits the Ministry of Housing &Urban Poverty Alleviation has instituted a scheme called Performance Appraisal Certification Scheme (PACS) under which a Performance Appraisal Certificate (PAC) is issued covering new materials and technologies. PAC provides after due investigation, tests and assessments, amongst other things information to the user to make informed choice.

To make the PACS transparent and authentic it is administered through a Technical Assessment Committee (TAC) and the BMTPC Board of Agreement (BMBA) in which scientific, technological, academic, professional organizations and industry interests are represented.

The Government of India has vested the authority for the operation of the Scheme with BMTPC through Gazette Notification No. 1-16011/5/99 H-II in the Gazette of India No. 49 dated 4th December, 1999.

Builders and construction agencies in the Government, public and private sectors can help serve the economic, development and environmental causes for which the people and Government stand committed by giving preference to materials and technologies which have earned Performance Appraisal Certificates.

Further information on PACS can be obtained from the website: www.bmtpc.org

ANNEX. -I

BUILDING MATERIALS & TECHNOLOGY PROMOTION COUNCIL

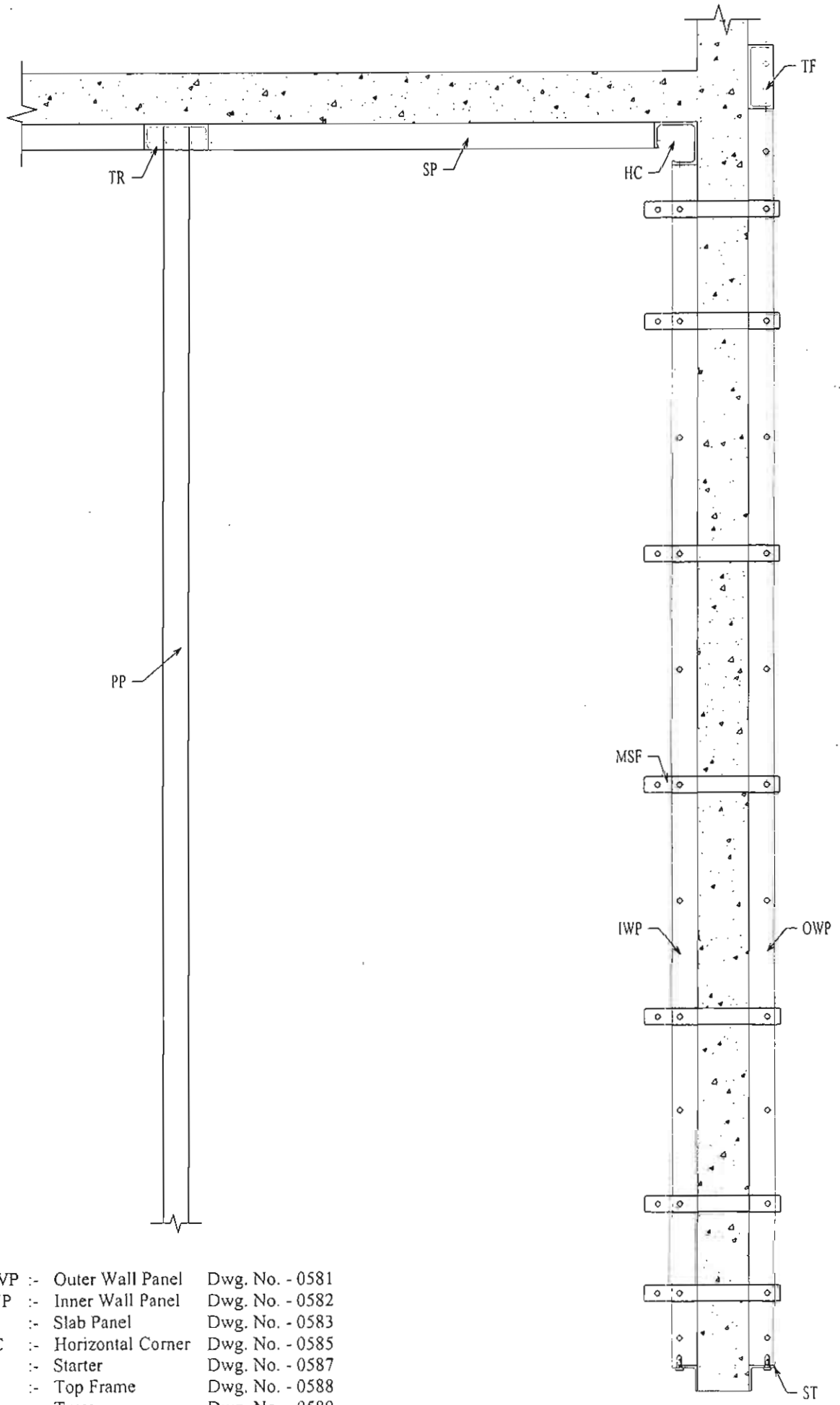
QUALITY ASSURANCE PLAN FOR DURACO FORMWORK

S.No	Parameters to be inspected	Requirement Specified	Test Method	Frequency of Testing
I	**Raw Material – M.S. Pin with Wedges**			
I.1	Visual	Shall be free from any surface defects & as per general notes given in the Drawing	Visual	For Each Lot
I.2	Dimensions	Shall be as per drawings	Measuring tape/ Vernier caliper	For Each lot
I.3	Fitments	Wedges shall be fixed easily in the pin	As per relevant Indian Standards	For each Lot
II	**Raw Material – M.S. Angle/ Steel Tubes Etc.**			
II.1	Visual	Shall be free from any surface defects	visual	For Each Lot
II.2	Dimension	Shall be as per IS 1852:1985	Measuring tape/ Vernier caliper	For each Lot
II.3	Chemical & Mechanical Properties	Shall be as per IS 2062:1999	Shall conform to IS 2062:1999	Verification of Supplier TC
III	**Raw Material – Alumunium Sections**			
III.1	Visual	Shall be free from any surface defects	Visual	For Each Lot
III.2	Dimension	Shall be as per general notes for Tolerances given in drawings	Measuring tape/ Vernier caliper	For Each lot
III.3	Chemical & Mechanical Properties	Shall be as per IS 733:1983	Shall conform to IS 733:1983	Verification of Supplier TC
IV	**Raw Material – PVC Sections**			
IV.1	Visual	Shall be smooth, clean & free from any defects like peeling, war page, burning marks& chipping	Visual	For Each Lot
IV.2	Dimensions	Shall be as per drawings	Measuring tape/ Vernier caliper	For Each Lot
V	**Raw Material – Hot Dip Galvanized Nut & Bolts**			
V.1	Visual	Shall be free from any surface defects like crack, rupture, burrs	Visual	For each Lot

V.2	Dimensions	Shall be as per drawings	Measuring tape/vernier caliper	For Each Lot
V.3	Hot Dip Galvanizing	Coating shall not be less than 85 micron	Shall conform to IS 4759:1996	MTC for each lot & once in 3 months for TTC
V.4	Adhesion of Galvanized Coating	Shall not peel any portion of the coating in Knife Test	Shall conform to IS 2629:1985	---Do ---
V.5	Fitments	Nut shall fit easily on bolt threads without being too loose and washer shall pass the bolt with proper fitments	Shall conform to relevant Indian Standards	For Each lot
V.6	Salt Spray Test	Shall not get corrosion or black spot after 48 hours of salt spray	Shall conform to IS168:1993	For Each Lot
VI	**Aluminium & M.S. Fabriction**			
VI.1	Visual	i)Shall be free from any surface defects ii) All the items shall be straight & grind finished iii)Holes shall be of exact shape & free from blurs & burrs iv)All the Aluminium & M.S. items shall be properly welded	Visual	For Each Lot
VI.2	Dimensions	As per general Tolerances given in the drawings	Measuring tape/ Vernier caliper	For Each Lot
VI.3	Hole Orientation	As per general Tolerances given in the drawings	Shall conform to the drawings	For Each Lot
VI.4	Diagonal	As per general Tolerances given in the drawings	Shall conform to the drawings	For Each Lot
VI.5	Welding	All the Aluminium & M.S. items shall be properly welded	Shall conform to relevant Indian Standards	For Each Lot
VII	**Aluminium + PVC Assembly Work**			
VII.1	Visual	i)Shall be free from any surface defects ii)All the fabricated items shall be smooth, straight & grind finished iii) Holes shall be of exact shape & free from blurs &	Visual	For Each lot

		burrs. iv)Riveting in all the items shall be of exact punch		
VII.2	Dimensions	As per general Tolerances given in the drawings	Shall conform to the drawings	For Each Lot
VII.3	Hole Orientation	As per general Tolerances given in the drawings	Shall conform to the drawings	For Each Lot
VII.4	Diagonal	As per general Tolerances given in the drawings	Shall conform to the drawings	For Each Lot
VIII	**Mass Housing Project Trial Erection**			
VIII.1	Visual	Shall be free from any surface defects and	Shall conform to the drawings	Each Block
VIII.2	Dimensions of each room	Inner and outer dimensions and the opening space for doors, windows & passage shall be as per the drawings	Shall conform to the assembly drawings	Each Block
VIII.3	Fitments	Shuttering members shall be fixed with each other without offset and gap	Shall conform to the assembly drawings	Each Block
VIII.4	Verticality of the wall	Wall shall be vertically erected	Shall conform to the assembly drawings	Each Block
VIII.5	Diagonal	Shall be as per assembly drawings	Shall conform to the assembly drawings	Each Block

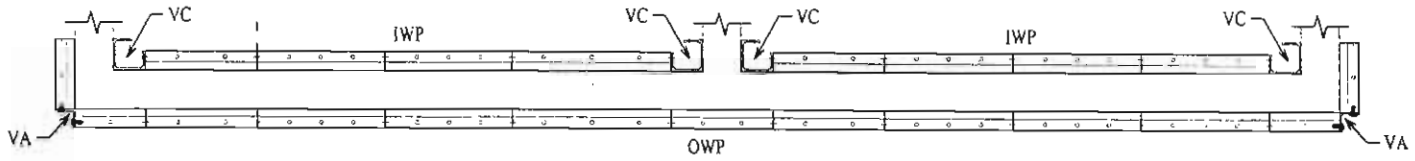
ANNEXURE- II



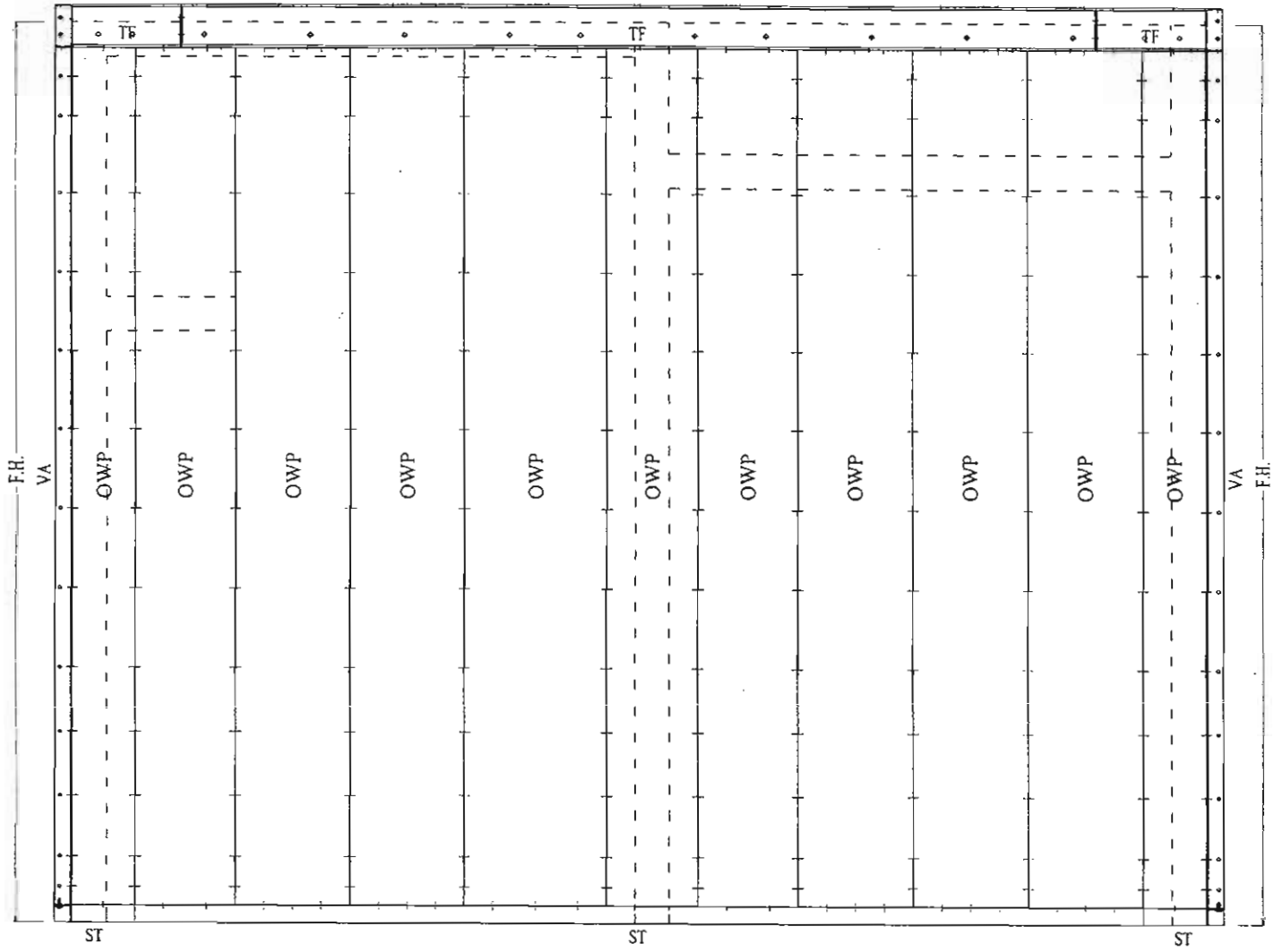
1.	OWP	:- Outer Wall Panel	Dwg. No. - 0581
2.	IWP	:- Inner Wall Panel	Dwg. No. - 0582
3.	SP	:- Slab Panel	Dwg. No. - 0583
4.	HC	:- Horizontal Corner	Dwg. No. - 0585
5.	ST	:- Starter	Dwg. No. - 0587
6.	TF	:- Top Frame	Dwg. No. - 0588
7.	TR	:- Truss	Dwg. No. - 0589
8.	PP	:- M.S. Pipe	Dwg. No. - 0590
9.	MSF	:- M.S. Flate	Dwg. No. - 0591

ASSEMBLY FOR CROSS SECTION VIEW

APPD BY
CHKD BY
DRN BY
DWG NO:- MHP/STD/SEP-11/1200-0578
DRAWING TITLE:- TYPICAL CROSS SECTION FOR WALL & SLAB
CUSTOMER NAME:- TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY



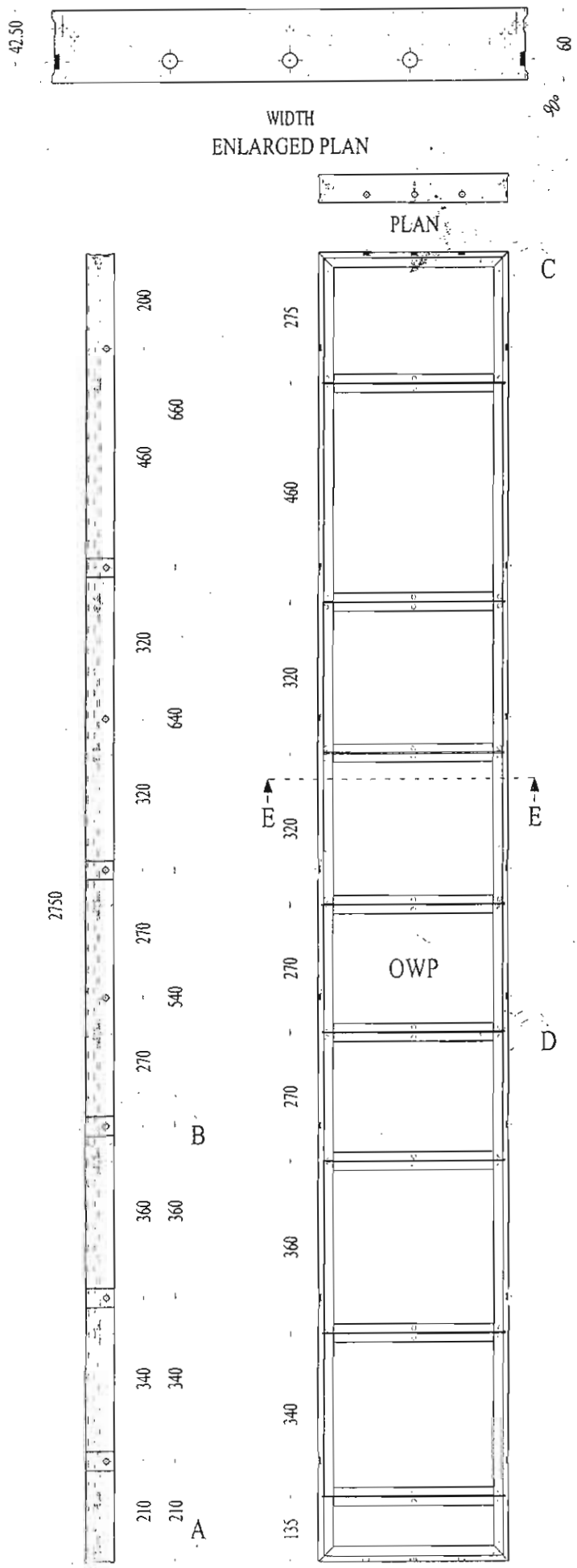
PLAN



ASSEMBLY FOR OUTER SIDE VIEW

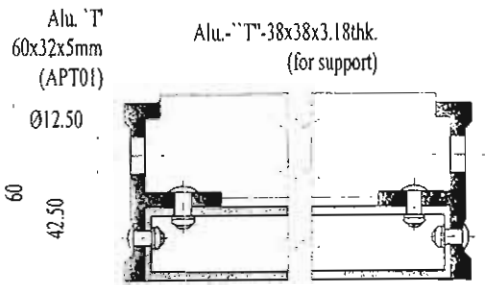
1. OWP :- Outer Wall Panel Dwg. No. - 0581
2. VA :- Vertical ASngle Dwg. No. - 0586
3. ST :- Starter Dwg. No. - 0587
4. TF :- Top Frame Dwg. No. - 0588

CUSTOMER NAME:-	DRAWING TITLE:-	DRN BY	CHKD BY	APPD BY
TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY	OUTSIDE ARRANGEMENT WALL PANELS			
		DWG NO.:- MHP/STD/SEP-11/1200-0579		

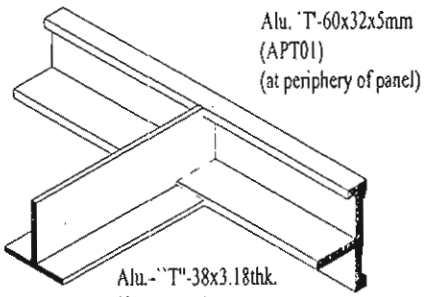


SIDE VIEW ELEVATION

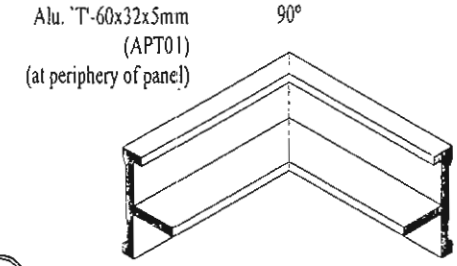
OUTER WALL PANEL (OWP)



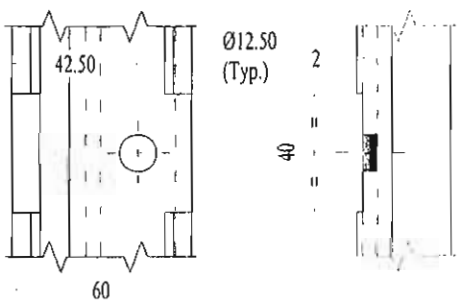
(E) DETAIL - EE



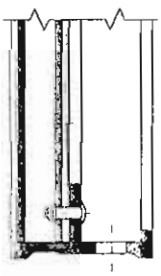
(D) WELDING JOINT OF 'T' SUPPORT & PERIPHERY ANGLE



(C) WELDING JOINT AT CORNER (INSIDE)



(B) TYP. SLOT DETAIL AT SIDE FACE OF Alu. T (APT01)

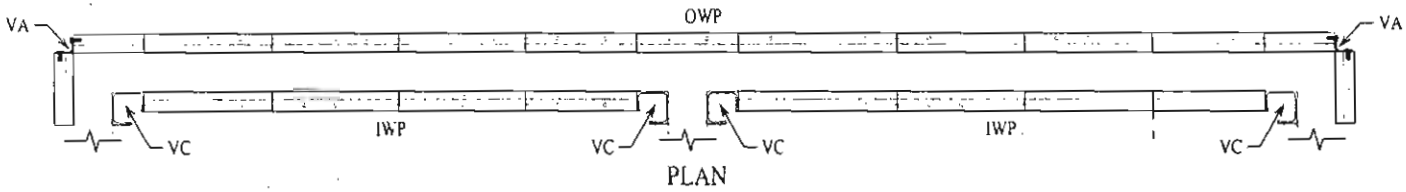


(A) DETAIL - AA

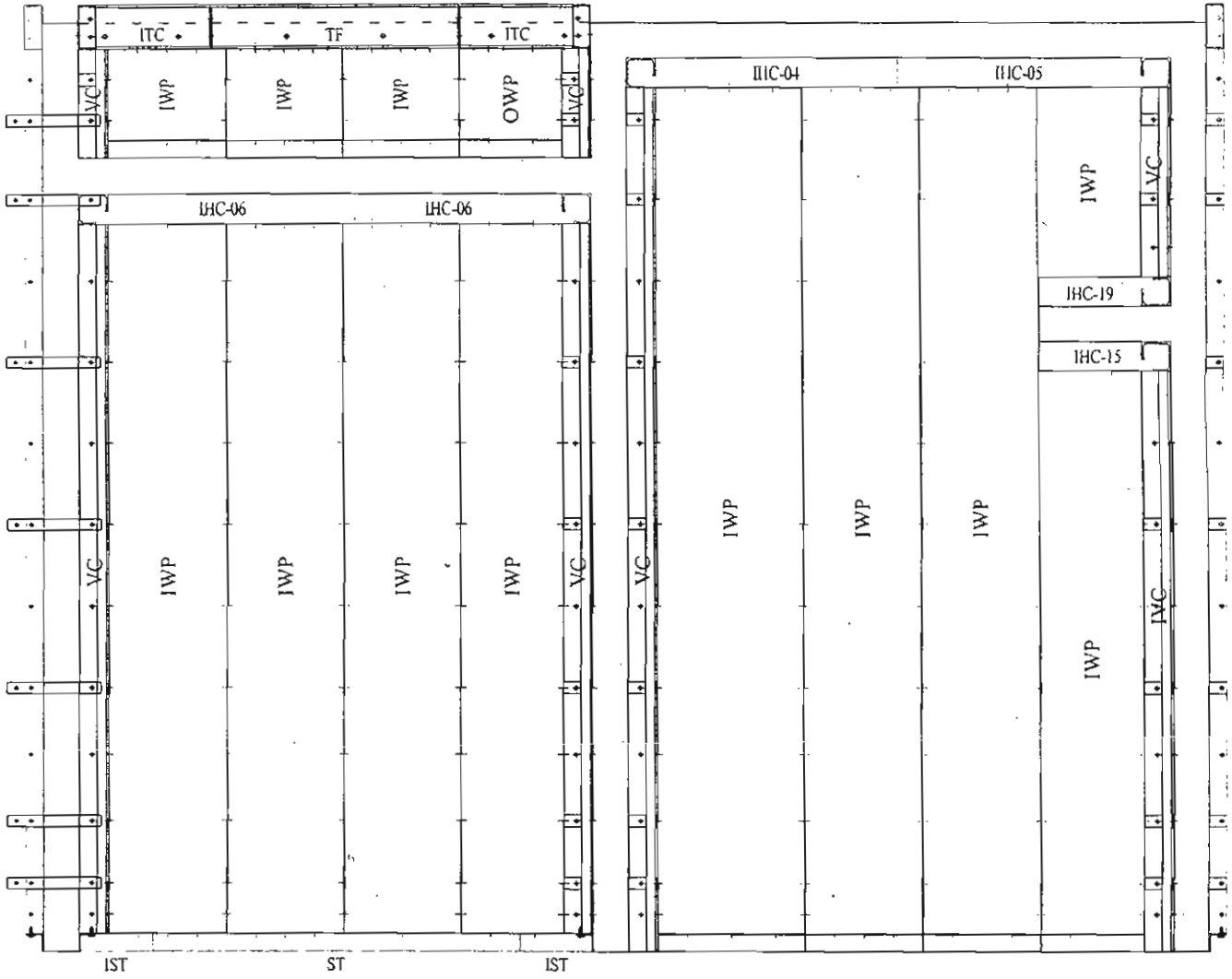
DRN BY | CHKD BY | APPD BY | DWG NO.:- M/HP/STD/SEP-11/1200-0581

DRAWING TITLE:- TYPICAL DETAILS OF OUTER WALL PANEL

CUSTOMER NAME:- TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY



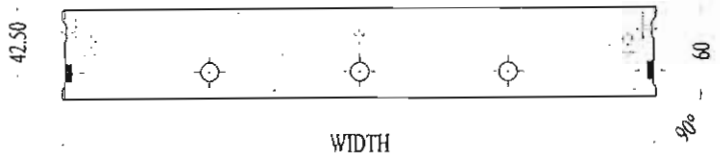
PLAN



ASSEMBLY FOR INNER SIDE VIEW

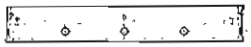
1. IWP :- Inner Wall Panel Dwg. No. - 0582
2. VC :- Vertical Corner Dwg. No. - 0554
3. HC :- Horizontal Corner Dwg. No. - 0585
4. ST :- Starter Dwg. No. - 0587
5. TF :- Top Frame Dwg. No. - 0588
6. MSF :- M.S. Flate Dwg. No. - 0591

CUSTOMER NAME:-	DRAWING TITLE:-	DRN BY	CHKD BY	APPD BY
TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY	INSIDE ARRANGEMENT WALL PANELS			
		DWG NO.:- MHP/STD/SEP-11/1200-0580		

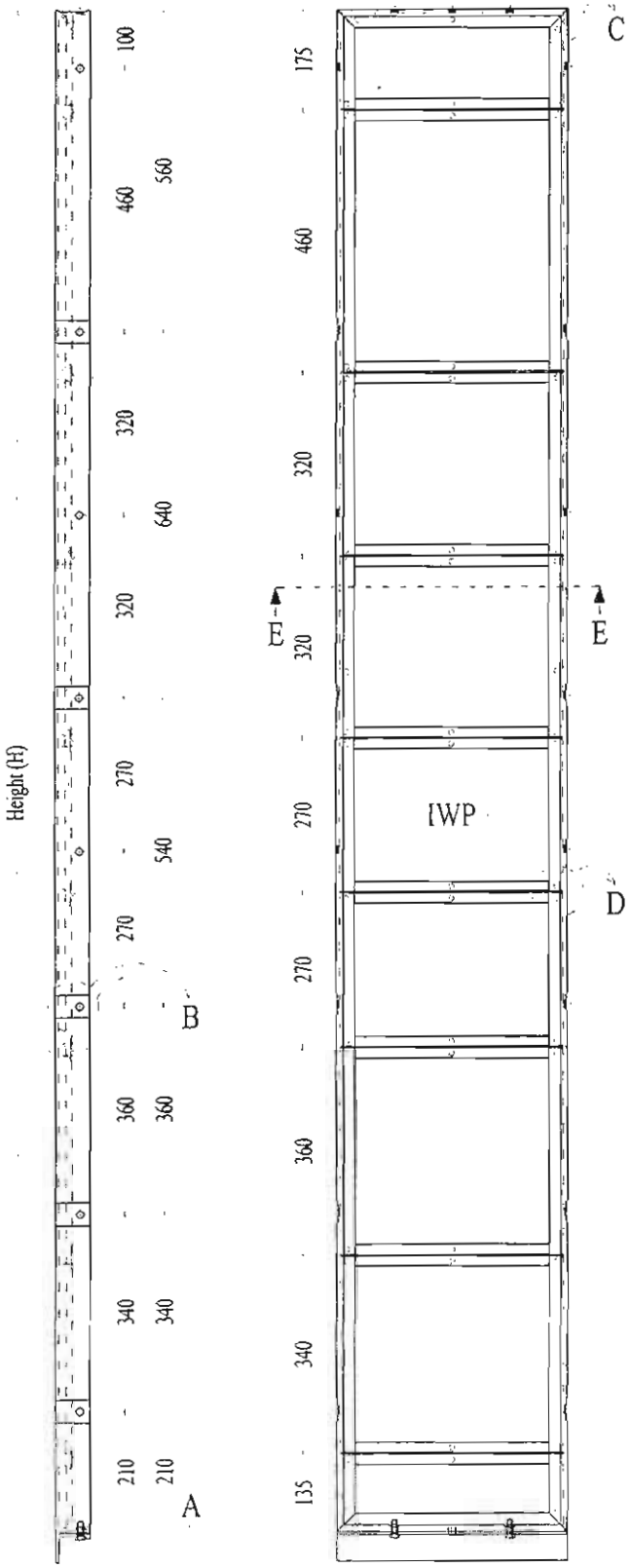


WIDTH

ENLARGED PLAN



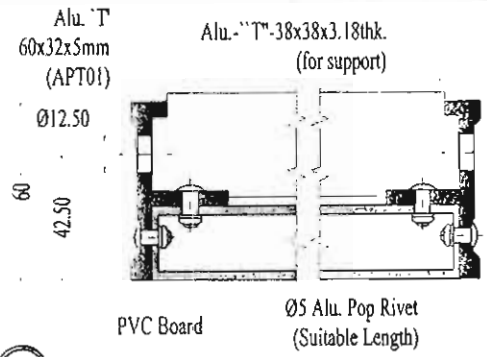
PLAN



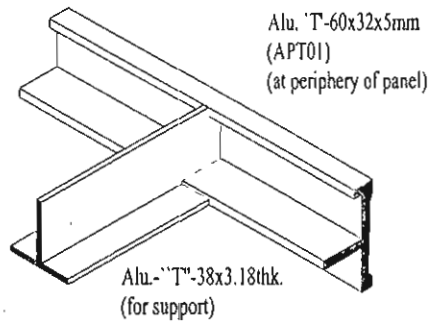
SIDE VIEW

ELEVATION

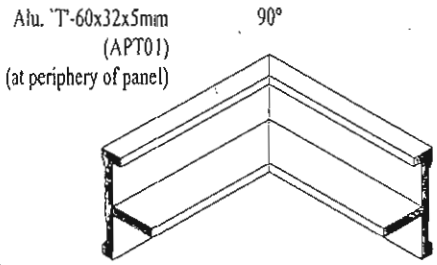
INNER WALL PANEL (IWP)



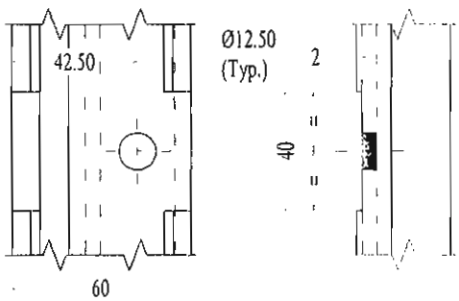
(E) DETAIL - EE



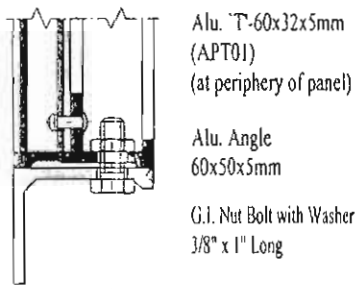
(D) WELDING JOINT OF 'T' SUPPORT & PERIPHERY ANGLE



(C) WELDING JOINT AT CORNER (INSIDE)



(B) TYP. SLOT DETAIL AT SIDE FACE OF Alu. T (APT01)



(A) DETAIL - AA

APPD BY

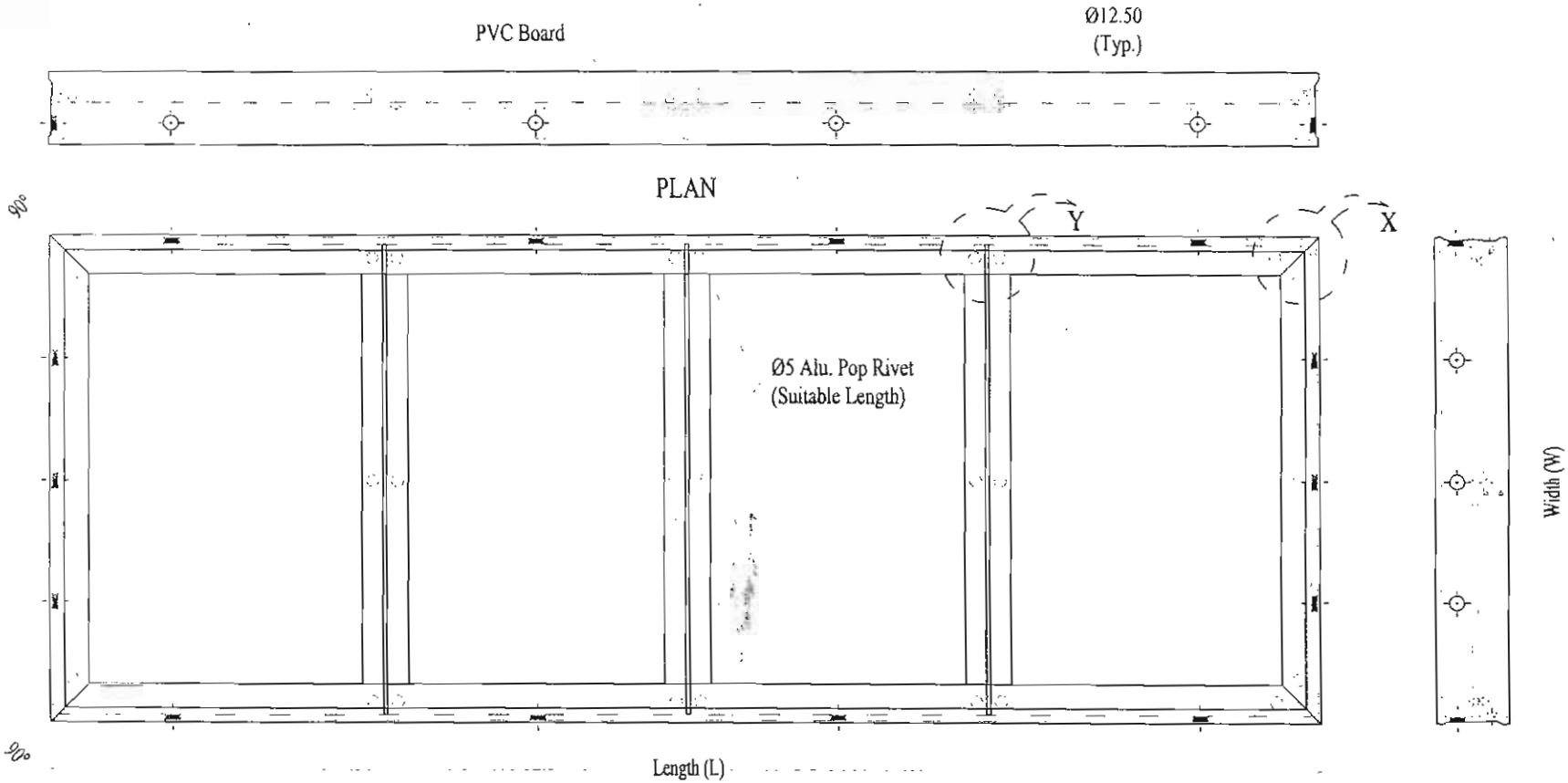
CHKD BY

DRN BY

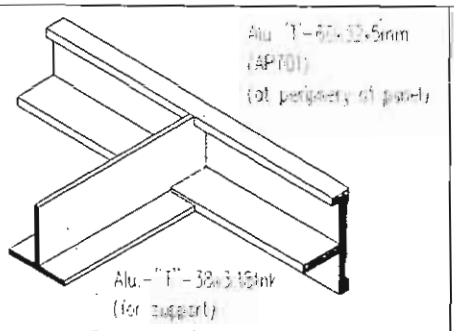
DWG NO.:- MHP/STD/SEP-11/1200-0582

DRAWING TITLE:- TYPICAL DETAILS OF INNER WALL PANEL

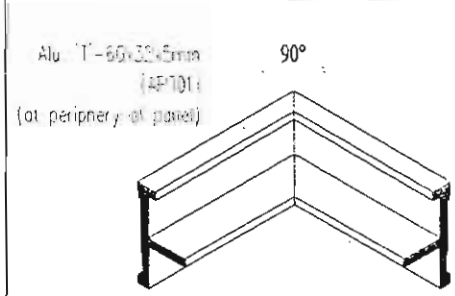
CUSTOMER NAME:- TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY



SLAB PANEL (SP)



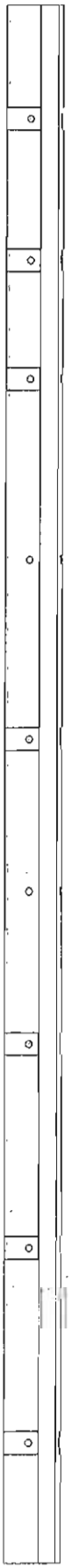
(Y) WELDING JOINT OF 'T' SUPPORT & PERIPHERY ANGLE



(X) WELDING JOINT AT CORNER (INSIDE)

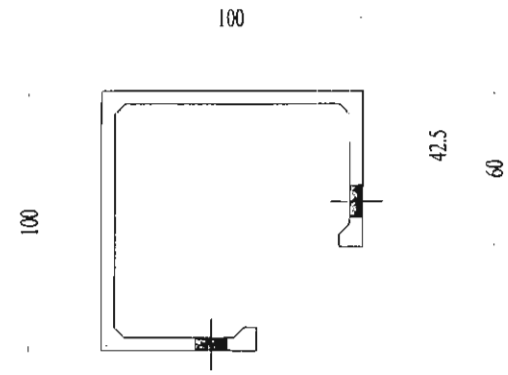
CUSTOMER NAME:- TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY	DRAWING TITLE:- TYPICAL DETAILS OF SLAB PANEL	DRN BY	CHKD BY	APPD BY
		DWG NO.:- MHP/STD/SEP-11/1200-0583		

PLAN

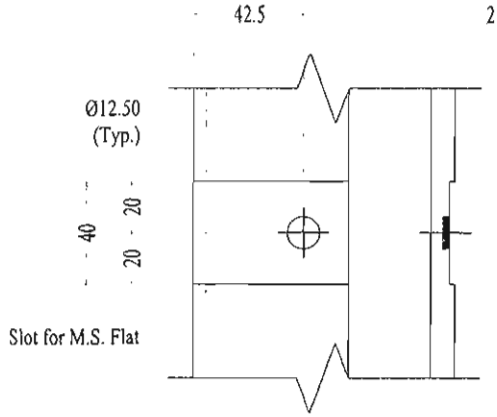


ELEVATION

VERTICAL CORNER (VC)



ENLARGED PLAN



DETAIL - A

CUSTOMER NAME:- TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY

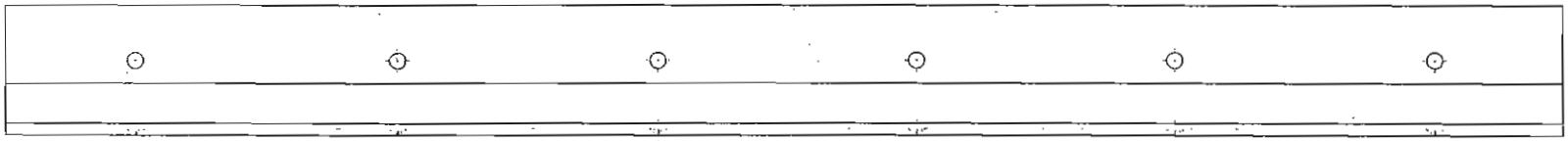
DRAWING TITLE:- TYPICAL DETAILS OF VERTICAL CORNERS

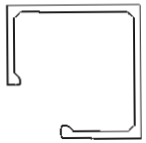
DRN BY | CHKD BY | APPD BY

DWG NO.:- MHP/STD/SEP-11/1200-0584

Ø12.50mm (Typ.)
(for Pin Wedge)

Alu. 'G' Corner
100x100x5mm Thk.



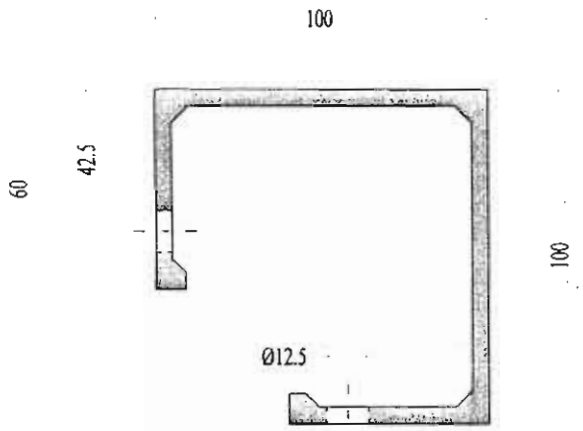


Length (L)

ELEVATION

SIDE VIEW

HORIZONTAL CORNER (HC)



SECTION - AA

	CUSTOMER NAME:-	DRAWING TITLE:-	DRN BY	CHKD BY	APPD BY
	TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY	TYPICAL DETAILS OF HORIZONTAL CORNER	DWG NO.:-	MHP/STD/SEP-11/1200-0585	

PLAN

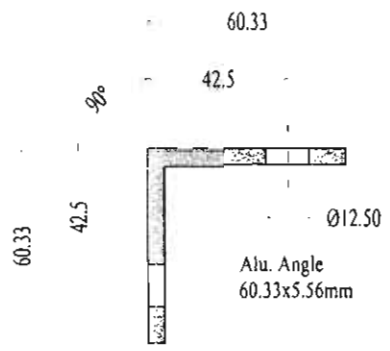
Ø12.50mm Typ.
(for Pin Wedge)

A A

Height (H)

ELEVATION

VERTICAL ANGLE (VA)

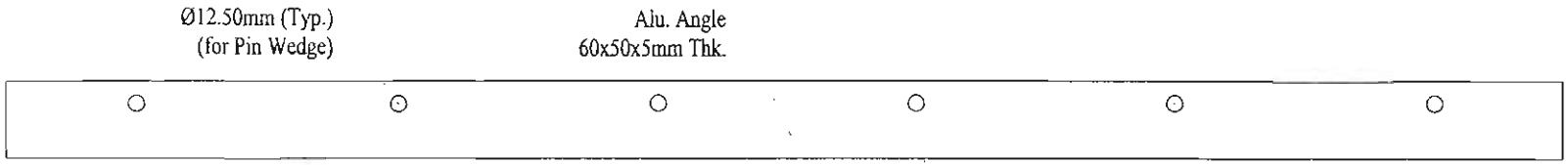


ENLARGED PLAN

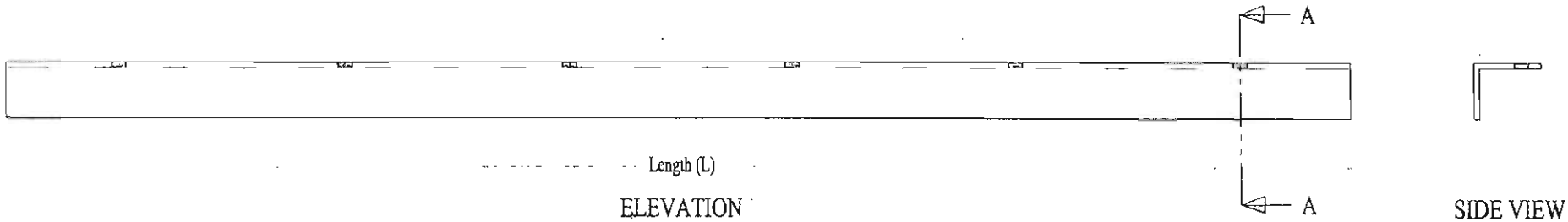
APPD BY
CHKD BY
DRN BY
DWG NO.:- MHP/STD/SEP-11/1200-0586

DRAWING TITLE:- TYPICAL DETAILS OF VERTICAL ANGLE

CUSTOMER NAME:- TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY



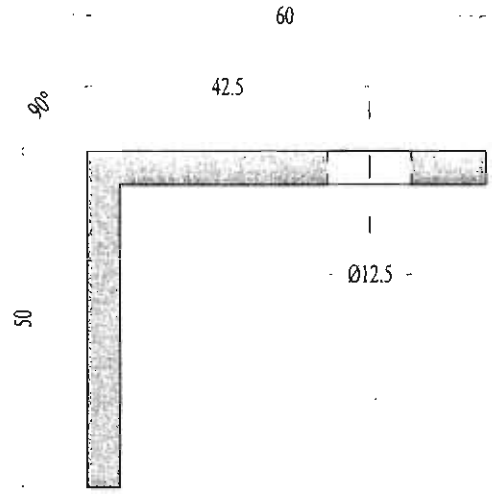
PLAN



ELEVATION

SIDE VIEW

STARTER (ST)



SECTION - AA

	CUSTOMER NAME:- TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY	DRAWING TITLE:- TYPICAL DETAILS OF STARTER	DRN BY / CHKD BY / APPD BY DWG NO.:- MHP/STD/SEP-11/1200-0587

Ø12.50mm (Typ.)
(for Pin Wedge)

Alu. 'C' Channel
150x60x5mm Thk.

PLAN

Length (L)

ELEVATION

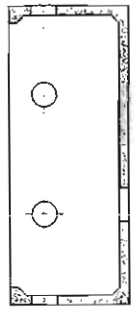
SIDE VIEW

TOP FRAME (TF)

Alu. Sheet
4mm Thk.
(Both End)

Ø12.50
(Typ.)

Alu. Channel
150x60x5mm Thk.

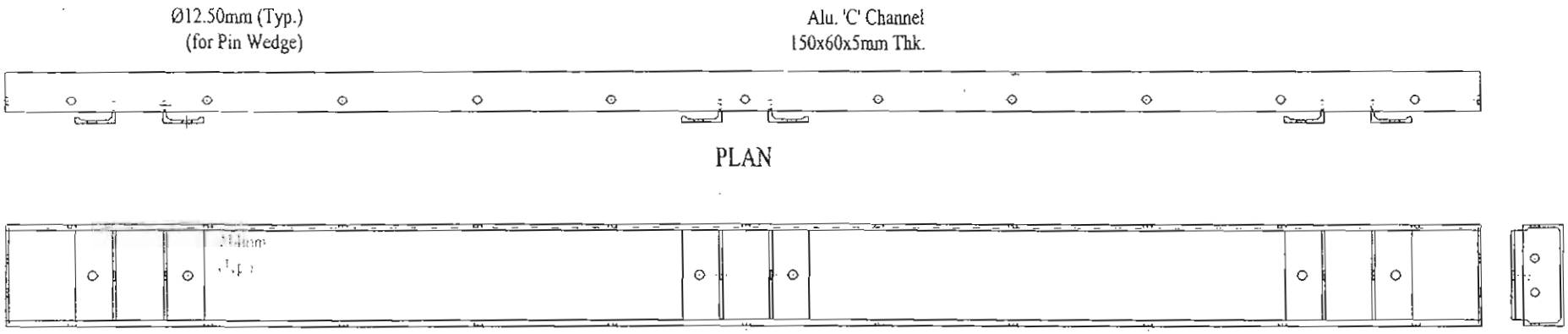


42.5

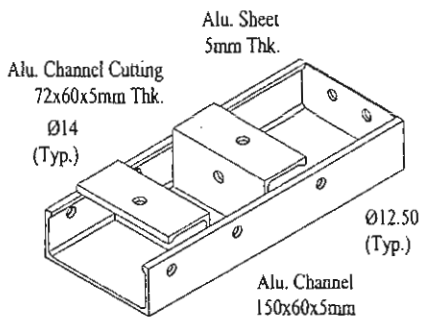
60

ENLARGED SIDE VIEW

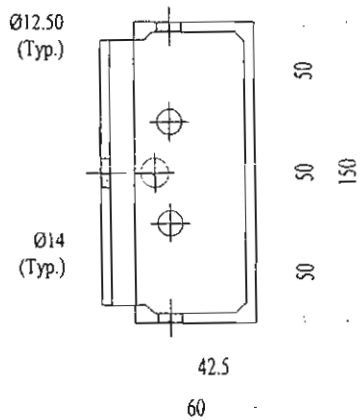
	CUSTOMER NAME:-	DRAWING TITLE:-	DRN BY	CHKD BY	APPD BY
	TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY	TYPICAL DETAILS OF TOP FRAME			
			DWG NO.:- MHP/STD/SEP-11/1200-0588		



TOP FRAME (TF)

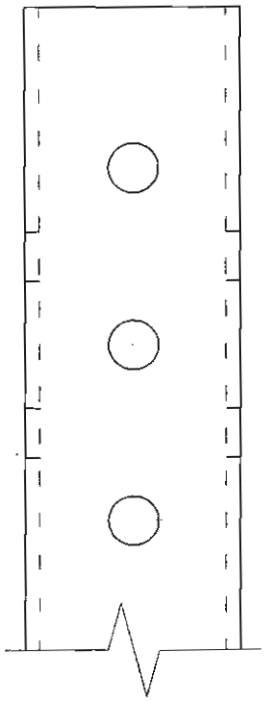


ISOMETRIC VIEW



ENLARGED ELEVATION

CUSTOMER NAME:-	DRAWING TITLE:-	DRN BY	CHKD BY / APPD BY
TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY	TYPICAL DETAILS OF TRUSS		DWG NO:- MHP/STD/SEP-11/1200-0589



DETAIL - A

A

M.S. PIPE-OD 60mm
'B' GRADE

MARKED

L1 = (L-8)

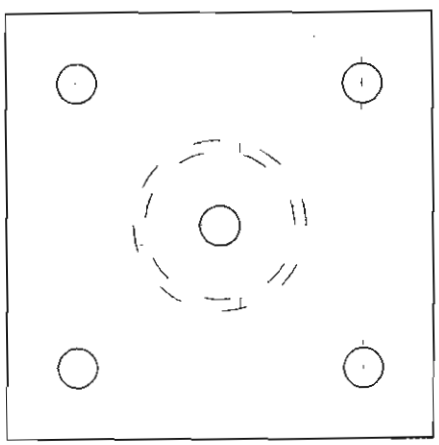
LENGTH (L)

WELDING
JOINT

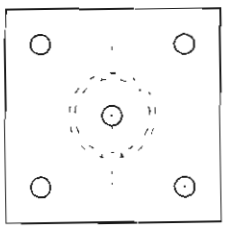
8

ELEVATION

M.S. PLATE
8mm Thk.



ENLARGE
BOTTOM VIEW



BOTTOM VIEW

M.S. PIPE (PP)

CUSTOMER NAME:- TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY

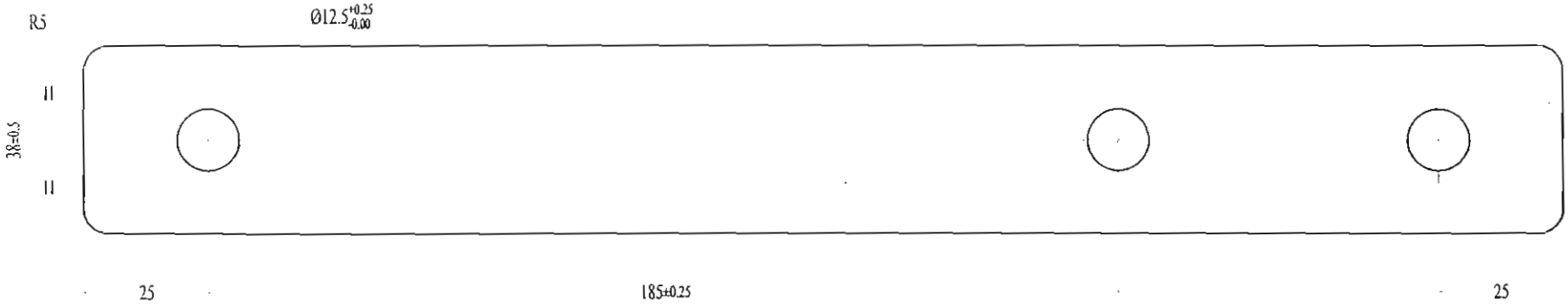
DRAWING TITLE:- TYPICAL DETAILS OF M.S. PIPE

DRN BY | CHKD BY | APPD BY

DWG NO.:- MHP/STD/SEP-11/1200-0590

3±0.2 Thk.

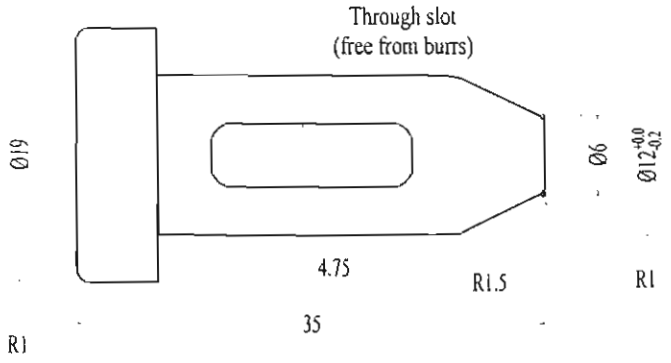
PLAN



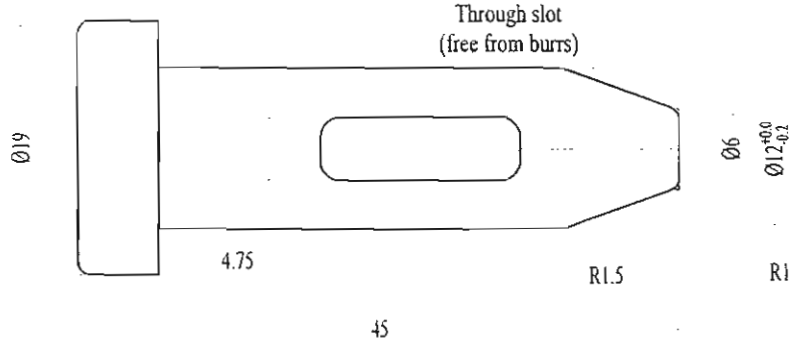
ELEVATION

M.S. FLAT

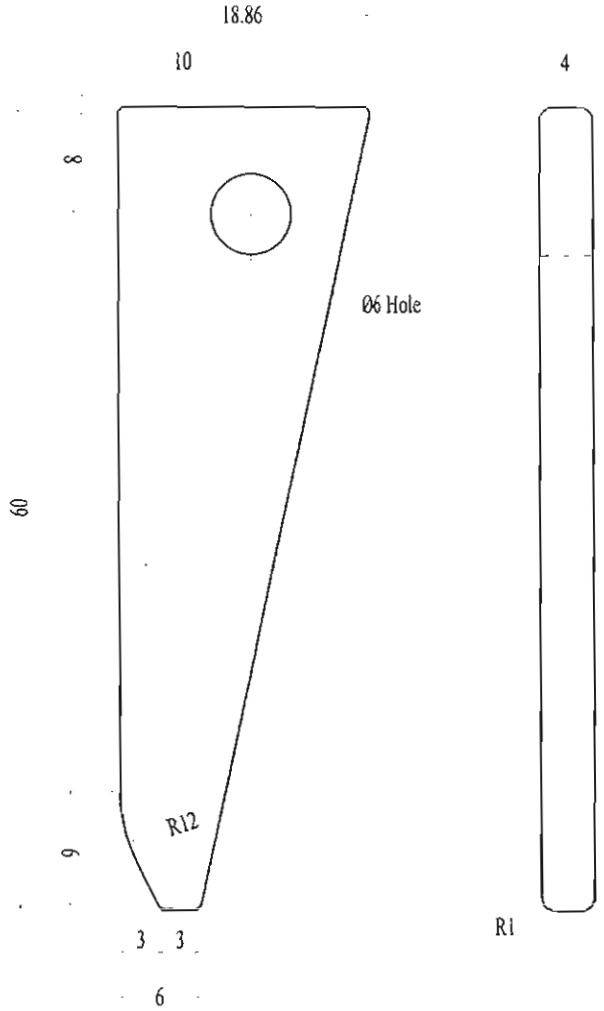
CUSTOMER NAME:-	DRAWING TITLE:-	DRN BY	CHKD BY	APPD BY
TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY	TYPICAL DETAILS OF M.S. FLAT	DWG NO.:- MHP/STD/SEP-11/1200-0591		



M.S. PIN - 35mm Long



M.S. PIN - 45mm Long



M.S. WEDGE

PIN & WEDGE

	CUSTOMER NAME:-	DRAWING TITLE:-	DRN BY	CHKD BY	APPD BY
	TYPICAL DETAILS FOR MONOLITHIC CONCRETE CONSTRUCTION TECHNOLOGY	TYPICAL DETAILS OF PIN - WEDGE	DWG NO.:-	MHP/STD/SEP-11/1200-0592	

ANNEX.-III

INFORMATION TO BE SUPPLIED BY THE MANUFACTURE FORMWORK SYSTEMS

1 INFORMATION TO BE SUPPLIED

1.1 The manufacturer shall give the information in such details so as to assist the user and to obviate use of the material due to absence of information or due to wrong assumptions made on the part of the user.

The user may refer unusual problems of erection or assembly which the manufacturer shall clarify with all technical details.

1.2 The manufacturer of formwork systems or its parts shall supply the information necessary for the design, erection, use, dismantling and maintenance of the components.

The information shall relate to the properties of ht individual components, their use in expected assemblies, any specific requirements for inspection and maintenance; and should include the following:

a) Identification, description and the intended use of the components, their dimension and weights.

b) Drawings of major components giving dimensions, extensibility, weight. Locating and fixing arrangements, Locations of holes and cleats, etc, and other details of interest of use to designer or site engineers.

c) Details and specifications of the materials used and reference to relevant standards.

- Aluminum as per IS 733
- HD Galvanized Iron Parts as per IS 4759
- MS Tubes as per IS 1161 and 806
- PVC sections as per IS 10151: 1982

d) Modifications for extended or additional uses and limitations for every use should be given.

e) Strength details of the component and assemblies as given below:

1. Maximum working loads for different conditions of use and extensions
   - For foundations walls 150mm thickness of wet concrete pressure
   - For walls 100mm thickness of wet concrete pressure
   - For Slabs maximum 125mm thickness
2. Maximum eccentricities related to above conditions;
   - Variation from the plum for wall – 3 mm
   - For exposed 90° corners and other conspicuous lines – Nil
   - Variation in the plane of the wall surface in a length of 2.0 Meter. – 3 mm
   - Variation in the thickness in the wall. +2mm
   - For supporting Props. 1.5° for 1.0 m ht. with maximum 25 mm.
3. Deflections and cambers are maximum working loads;
   - Maximum deflection of 1.50mm for slabs spanning up 3.20m. No reverse camber is required.
4. Conditions of limiting deflection;
   - Not Applicable
5. Assumed working stresses and material properties, for example, yield stresses

Material	YS in Kg/mm^2	WS in Kg/ mm^2
Aluminum	25.0	18.0
Mild Steel	25.0	16.5

6. Section properties

Item	Size in Cm
G-Corner	100x100x5mm
C-Section	150x60x5mm
T-Section	60x32x5mm
t-Section	38x38x3.18mm
Angle	60x60x5mm

f) Maximum allowable wear and tear defects due to long usage and life of the components where applicable and number of uses.

g) Erection methods, erection stages, erection tools, precautions and tests on the complete structure.

h) Method of stripping or releasing the system. Suggested method of stacking and maintenance of the system.

i) Detailed instructions on special or uncommon uses of the equipment.

ANNEX.- IV

Following points shall be observed while receiving, fixing and deshuttering the formwork materials. It is very important that all those points are invariably checked and fulfilled for better performance of formworks:

1. POINTS TO BE OBSERVED WHILE RECEIPT OF SHUTTERING MATERIALS

1.1 All the shuttering material received at site shall be checked as per the dispatch list/ BOQ of assembly drawing and any short supply shall be informed immediately to the concern department.

1.2 The material shall be dispatched after QC check, still any discrepancy in size, dimensions, workmanship if observed shall be immediately informed to design, production department.

1.3 All the shuttering material received at site shall be documented in register with size description and quantity and updated as per the usage/ new arrival. (This is to keep track of the material supplied at site/ damage occurred to material and replacement required).

1.4 All the shuttering material shall be marked / painted by member no. and set no. or as the numbering system desired at site and same shall be documented in register. (This is to avoid usage of member of one set being used in another set)

2. POINTS TO BE OBSERVED WHILE FIXING OF SHUTTERING MATERIAL

2.1 The marked members shall be fixed at the site as per numbering system and assembly drawing then be checked by site supervisor/ application engineer and randomly checked by project manager and then only concreting be carried out.

2.2 Before fixing, the shuttering plates shall be properly cleaned from all the sides and then fixed to correct position.

2.3 All the G Corners / top frames and other components shall be cleaned if they are filled with concrete / cement position.

2.4 All the steel components shall be straightened /aligned as per original shaped if they are damaged during deshuttering, and then only shall be fixed.

2.5 If any damaged part is found, that shall be immediately got repaired at site and then fixed.

2.6 The shuttering plates and parts shall be properly applied with oil / releasing agents.

2.7 The sleeves surrounding the flat shall be of proper size (it is observed that lager sleeves are used that gives very bad look and creates big holes)

2.8 All the pins & wedges, flats, corner connectors etc. shall be fixed as per holes and drawings.

2.9 Leveling and dimensions checking for rooms, corridors and stairs shall be carried out and then only concreting shall be carried out.

2.10 While leveling and adjusting dimensions, if required extra props / jacks shall be supported as per the site requirement.

2.11 After fixing of the shuttering, if any gap found shall be filled / covered with plastic tapes / metal pieces of appropriate size.

2.12 The site engineer/ application engineer shall sign about proper fixity of the shuttering material and shall also take sign of third party / consultant as the case may be.

3. POINTS TO BE OBSERVED WHILE CONCRETING

3.1. The concrete shall be poured in layers of app. ¼ to 1/3 height of the wall. In any case it shall not increase by 1/3 height of the wall in a single stretch.

3.2. Proper workability of the concrete shall be ensured as per design mix and site conditions.

3.3. The pouring of the concrete shall be carried in such manner that no accumulation of the concrete occurs at one place.

4. POINTS TO BE OBSERVED AFTER CONCRETING

4.1 All the flats shall be loosened between 6 to 8 hours of concreting.

4.2 All the sides of the shuttering plates shall be removed after 16 hours of casting and then it be cleaned checked for damage and oil releasing agent be applied on it.

4.3 The slab shuttering plates shall be removed after 3 days of concreting keeping the truss and props intact and the truss and propose be removed after 7 days.

4.4 While deshuttering lever principle shall be sued. No hammering shall be done to loosen the plates/ components.

5. GENERAL POINTS

5.1 The shuttering plates shall not be used for walk way / staging / scaffolding / labour camps / platforms etc.

5.2 All the oblong / widened holes shall be repaired with washer-pusher.

5.3 A routine checking of stocks and assessment of damaged components repair / replacement needed shall be done at least once in three months and design changes shall be informed to design department.

5.4 Fitters / Carpenters shall be trained to carry out minor repairs.