



MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
J.L.N. Marg, Jaipur-302017, Tel.: 0141-71335, 2713312, Fax: 0141-2529078

F5 (225) ST/MNIT/Struct./2011

Date: 19/12/2011

TENDER DOCUMENT

EXPERIMENTAL SETUPS FOR EARTHQUAKE ENGINEERING LAB

- 1) Cost of the Tender document: Rs. 500.00
- 2) Last date and time for sale of Tender document: 11/01/2012 (up to 14:00 hrs)
- 3) Last date and time for receipt of bid: 11/01/2012 (up to 14:00 hrs.)
- 4) Time and date of opening of technical bids : 11/01 /2012 (15:00 hrs.)

Assistant Registrar (Stores and Purchase)



CONTENTS OF THE TENDER DOCUMENT

S.N.	DESCRIPTION
1	Notice Inviting Tender
2	General Terms & Conditions
3	Check List
4	Technical Specification (Annexure-T)



F5 (225) ST/MNIT/Struct./2011

Date: 19/12/2011

NOTICE INVITING TENDER

Tenders are invited through Two Bid systems (Part-I:Technical Commercial Bid and Part-II : Financial Bid i.e. Price Bid, from eligible bidders for, **EXPERIMENTAL SETUPS FOR EARTHQUAKE ENGINEERING LAB**, that includes, **SECTION-A**: Electromechanical Shake Tables, **SECTION- B**: Data Acquisition and Control Systems and **SECTION -C**: Experimental Models. The experimental set ups are to be supplied installed and commissioned at MNIT, Jaipur as per the Technical specification. These systems have been developed by Indian Institute of Science, Bangalore, under National Program on Earthquake Engineering Education (NPEEE). The detailed tender document is available on MNIT website: <http://mnit.ac.in/>. The cost of the Tender document has to be enclosed in the form of a Demand Draft in favour of “Registrar MNIT Jaipur”. The Supplier must submit the Techno-commercial and Financial Bid in two separately sealed envelopes; the Financial Bid will be applicable only after the clearance of Techno-commercial Bid. The duly filled Tender document in sealed envelope must be submitted to “**Registrar, Malaviya National Institute of Technology Jaipur, JLN Marg, Jaipur-302017**”.

IMPORTANT: Please note that the bidders shall have to apply for the three sections, namely, SECTION -A, SECTION -B, and SECTION-C, separately, and the same shall be clearly written on the envelope.

Note:

1. Cost of the Tender document: Rs. 500.00
2. Sale of tender document: 19/12/2011 to 11/01/2012 (between 1400 hrs to 1700 hrs on all working days from the Office of Assistant Registrar, Stores and Purchase, MNIT Jaipur)
3. Last date and time for submission of Tender : 11/01/2012 (up to 14: 00 hrs)
4. Date & time of Tender opening (Only Techno-commercial Bid) : 11/01/2012 (15:00 hrs)
5. Earnest Money Deposit (EMD) to be submitted along with the Techno-commercial Bid: Rs.20,000.00 (Twenty Thousand), for each Section.
6. Price Bid: Date and Time will be intimated at later date.
7. Offer by Fax/e-mail will summarily be ignored.



2. GENERAL TERMS & CONDITIONS

2.1 Pre-Qualifying conditions:

- i. The Supplier should be able to produce certificates of having supplied such items in any of the National Institutes of Technology/Indian Institutes of Technologies or other similar institutions in recent time.
- ii. The firm should be registered with Income Tax and Sales Tax Departments (Registration Numbers should be clearly mentioned and valid documentary evidence be attached).

2.2 Two Bid system:

The bid must be submitted in two parts comprising Part-I: Technical Commercial Bid & Part-II: Financial Bid (i.e. Price Bid). The Part-I (Techno-commercial) bid should contain the EMD, detailed technical specifications as per the Tender. The Part-II (Financial Bid) should contain the price offered. Both the parts should be properly marked and enclosed in two separate sealed envelopes for their proper identification. The envelopes superscribed TECHNO-COMMERCIAL BID and FINANCIAL BID should again be sealed in a third bigger envelope super-scribing , “ **BID FOR EXPERIMENTAL SETUPS FOR EARTHQUAKE ENGINEERING LAB, SECTION-A/B or C**”. The Part-I (Techno-commercial bid) will be opened on the date of tender opening and the Part-II (Financial Bid) after evaluation of Part-I. The Part-II of only those bidders shall be opened who are found technically qualified.

2.3 Bid Security, that is, Earnest Money Deposit (EMD):

The EMD of Rs.20,000/- in the form of Demand draft from any scheduled bank drawn in favour of **Registrar, MNIT Jaipur**, must accompany with Part-I (Techno-Commercial Bid). The EMD shall be refunded to unsuccessful bidders, after finalization of the tender. Please note that the bidders shall have to apply for the three Sections , namely, SECTION -A, SECTION -B, and SECTION -C, separately, and the EMD of Rs. 20,000/- is applicable for each Section. The EMD shall be forfeited if any bidder withdraw his offer before finalization of the tender or fails to submit work order acceptance within 15 days from the date of work order.

2.4 Performance Security:

To ensure due performance of the contract, Performance Security of 10% of the total Purchase Order Value (POV) shall have to be furnished by the successful Supplier; this can be in the form of Demand Draft or Fixed Deposit receipt from any scheduled bank. The Performance Security shall remain valid



for a period of sixty days beyond the date of completion of all contractual obligations of the supplier including warranty obligations.

2.5 Other Conditions:

- i) The offers submitted by downloading from the Institute website (<http://mnit.ac.in/>) shall be considered valid only when accompanied by a demand draft for Rs.500.00 drawn in favour of “Registrar, MNIT Jaipur” payable at Jaipur towards the cost of tender documents indicated in the NIT. The draft towards EMD should be enclosed with the Part-I i.e, Techno-commercial bid of tender document. In case of non- submission of tender fee and EMD as detailed above, the tender shall be treated as invalid.
- ii) All the pages of bids including the documents submitted therein must be duly signed and stamped, failing which the offer shall be liable for rejection.
- iii) The Institute reserves the right to cancel the tender without assigning any reason at any stage of the tender process.
- iv) The Institute also reserves the right to alter/modify any or all of the conditions of this tender.
- v) The details of Technical Specification must be clearly mentioned, use of general terms as, “as per specification of tender document”, will make the bid liable for rejection.
- vi) Any deviation in Technical Specification may be clearly mentioned in the Technical Bid (i.e. Part-I).
- vii) The Price quoted must clearly mention, Basic Price, Taxes/Levies, Packaging, Installation Charges etc., and if it is free of cost the same must also be stated. The use of vague terms, such as, as per actual shall not be used.
- viii) The Institute takes no responsibility for delay or non receipt of Tender Document sent by post and also reserves the right to accept; or reject any or all the tenders in part or full without assigning any reason thereof.
- ix) The rates quoted must be inclusive of all charges e.g. packing, forwarding taxes, railway freight, transit insurance and delivery.
- x) Rates of imported goods must be quoted **excluding Custom duty** as the Institute is exempted from payment of custom duty. The rates of indigenous equipments may be quoted without **Excise Duty** as the Institute is exempted from payment of Excise Duty.



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- x) Detailed specifications and "make" of each item should be mandatorily and clearly mentioned by the manufacturer, supported by the illustrated pamphlets wherever possible. Quotations without specifying the make and other particulars may be rejected.
- xi) The accessories included in the equipment should also be clearly mentioned.
- xii) The rates quoted must have the validity of at least for three months from the last date of receipt of quotations.**
- xiii) The Institute is not bound to accept the lowest tender and may reject any tender or any part of the tender giving justification for such an action.
- xiv) The Institute has the right to call a pre bid conference/meeting of all eligible bidders, to acquaint them about the nature/scope of the contracted items. The bidders must provide their contact details for this purpose specifically.
- xv) The bidders may call for any clarification about the bid, however, such clarification shall be at least a week before the bid closing date; the Institute reserves the right to respond to such clarification.
- xvi) The bidder shall examine all instructions, terms & conditions and specification, failure to furnish all information in due format will be at bidders risk, and may result in rejection of the bid.
- xvii) The call of tenders does not bind the Institute to place the order. The bids submitted in response to the invitation may be rejected without assigning any reason. The bidder must be a manufacturer or authorized dealer.
- xviii) The Institute, at its discretion, may extend the last date of submission of tender and opening of the tender.
- xix) The final acceptance of a tender lies with the Institute, and there is no binding on the Institute to accept the lowest bid.
- xx) Any effort by the bidder to canvas/influence the Institute may lead to summary rejection of the bid, without giving any further reason.
- xxi) The document/literature/leaflet submitted with the bid shall be the property of the Institute without any cost.
- xxii) The tender would be regarded as turned down, if no award of contract has been obtained till the expiry of tender validity, and no separate communication will be made in this regard.



2.6 Payment Conditions:

- i) Payment will be made Indian Rupees only, through e- transaction (electronically) or else through account payee cheque. To facilitate electronic payment the supplier must give following information: (a) Title of the Account, (b) Bank name and Branch (c) Account number and (d) IFSC code. The supplier must also attach one cancelled cheque of the firm to facilitate the e-transfer of funds.
- ii) The payment will be made under following two stages:
 - a) Payment after the receipt of goods and found in order by the designated authority of the Institute i.e. Project Coordinator/ HOD: 50 % of the POV
 - b) On satisfactory Installation testing and commissioning: Balance payment.
- iii) The defective, substandard and contrary to the specification items/ instruments supplied have to be replaced by the supplier at its risk and cost within a period of seven days.
- iv) In case of indigenous instrument/ equipment quoted by Indian firms/ representatives/ Indian agents of foreign supplier / manufacturers in rupee terms, the payment will be made in Indian rupees directly after supply and satisfactory commissioning/installation of equipment/instruments.

2.7 Penalty in case of Delay in delivery of Items/Equipments

If the supplier fails to deliver the goods within the period specified in the Purchase Order (PO), the Institute on receipt of request from the supplier may, at its discretion, allow an extension in time. The Institute will be at liberty to impose penalty in case of delay in delivery of items as stipulated as under.

- i) Delay up to one month 1% of the item cost.
- ii) Delay exceeding one month but exceeding two month: 2% of the item cost.
- iii) Delay exceeding two month but exceeding three month: 5% of the item cost.
- iv) Delay exceeding three month: 10% of the item cost.

2.8 Failure of delivery

In case of failure to supply the goods within the prescribed time and in accordance with the specifications given in the tender, the Institute shall be free to cancel the Purchase Order, and will be at liberty to procure the instruments/ equipment from the firm at the cost of the tenderer firm, without prejudice to its general right to effect recovery from the supplier.



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3. CHECK LIST

S.N.	Description	Remarks
i	I have read all the Terms & Conditions of the Tender and acquainted myself with them completely.	
ii	Both the parts of the Bid, namely, Techno-Commercial Bid (Part-I) and Financial Bid (Part-II) have been sealed in two separate envelopes.	
iii	All the proofs/testimonials in support of eligibility have been attached along with Part-I of the Bid; and all such documents have been duly authenticated.	
iv	The Demand Draft in support of Bid Security (i.e. EMD) of each Section has been attached with Part-I of the Bid.	
v	The Part-II of the Bid contains only the Price Quoted in Indian Rupee. The price quoted includes- all Taxes, Levies, Shipping/Transportation, Transit Insurance, Delivery to the Institute, Packaging, Installation and Commissioning charges.	
vi	The items offered are in conformity with the Technical Specification.	
vii	I have mentioned any deviation from Technical Specification, if any.	
vii	I have enclosed the Demand Draft of Rs. 500/- toward Tender fee.	

Place:.....

Date:

Name and Authorized Signature

3. TECHNICAL SPECIFICATIONS

ANNEXURE - T

SECTION A - SHAKE TABLES USED IN CONDUCTING EXPERIMENTS

SHAKE TABLE 1



Fig 1 Electric motor driven shake table



Fig 2. Cam – follower arrangement



Fig 3. Types of cams

The shake table consists of a flywheel, a cam shaft, a vibration table and user designed cams (Fig 2). The cam is connected to a variable speed dc motor with the help of a camshaft. A circular mounting plate is based on the vibrating plate through a T-slot, so that, the test structure can be mounted at any desired angle relative to the angle of incidence of the base motion. The flywheel assembly ensures frequency control with less than 3% accuracy. A set of four cams have been produced to generate harmonic motions of different amplitudes and, also, to provide saw-tooth type of base motions (Fig 3). By varying the speed of the motor, the frequency content of the base motion can be varied.

Table 1 Specification of the electric motor driven shake table

Property	Specifications
Maximum payload	30 kg
Sliding table dimension	400mm * 360 mm
Circular mounting plate dimension	390 mm diameter
Motor	1 HP variable speed dc
Frequency Control	3%

Table 2 Specification of the cam s for the shake table

Wave Form	Frequency	Amplitude
SHM	0-25 Hz	± 0.5 mm
SHM	0-25 Hz	± 1 mm
SHM	0-15 Hz	± 2 mm
Saw Tooth	0-10 Hz	± 10 mm

SHAKE TABLE 2



Fig 4 Electric motor driven shake table

The shake table consists of a connecting rod, a vibration table, linear guide ways and an eccentric cam. The cam is connected to a variable speed dc motor with the help of a gear assembly. Linear guide ways ensure that the motion of the table is linear. A circular mounting plate is based on the vibrating plate through a T-slot, so that, the test structure can be mounted at any desired angle relative to the angle of incidence of the base motion. The table generates harmonic motions of different amplitudes and, the amplitude of base motions can be varied by changing the eccentricity of the cam. By varying the speed of the motor, the frequency content of the base motion can be varied.

Table 3 Specification of the electric motor driven shake table

Property	Specifications
Maximum payload	30 kg
Sliding table dimension	400mm * 300 mm
Circular mounting plate dimension	390 mm diameter
Motor	1 HP variable speed dc
Frequency Control	3%
Amplitude	0 to 8 mm

SHAKE TABLE 3



Fig 5 Electric motor driven shake table (harmonic vertical base motion).

Fig 5 shows an electric motor driven shake table, which produces harmonic vertical base motion. The shake table consists of a connecting rod, a vibration table and a cam. The cam is connected to a variable speed dc motor with the help of a bearing assembly. The vibration table is mounted on springs and the roller supports prevents wobbling. The flywheel assembly ensures frequency control with less than 1% accuracy. A screw mechanism is present to vary the amplitude of base motion. By varying the speed of the motor, the frequency content of the base motion can be varied.

Table 4 Specification of the electric motor driven shake table

Property	Specifications
Maximum payload	60 kg
Sliding table dimension	400mm * 400 mm
Amplitude	0 to 5 mm
Motor	1 HP variable speed dc
Frequency Control	1%

SECTION B -DETAILS OF INSTRUMENTS USED IN EXPERIMENTS



Fig 6 B&K Accelerometer



Fig 7 Signal conditioning Amplifier.



Fig 8 DC Motor control



Fig 9 Oscilloscope

Table 5 Details of instruments used in experiments

Notation	Equipment	Model	Qty.
1	Accelerometers and accessories	B & K 4507 Denmark	2
2	Signal conditioning amplifier	Nexus B&K Denmark	1
3	Oscilloscope	Tektronix, USA	1
4	DC Motor Control	Aplab, Bangalore	1
5	Data acquisition system	DAS1402 Iotech, USA	1

SECTION C -DETAILS OF MODELS USED IN EXPERIMENTS

MODEL 1

The model consists of slabs and columns. Table 6 guides you to the detailed drawing of each part involved in constructing the model. See Fig 21.10 and Fig 21.14 to assemble the model.

Table 6

Sl.no	Parts	Details/ Specification
1	Columns	See Fig 13
2	Slabs	See Fig 11,12
3	Screws	M6 Allen screws, L=25mm, Qty =32 nos.
		M10 Allen screws, L=30mm, Qty =4 nos.



Fig 10 A view of three story frame

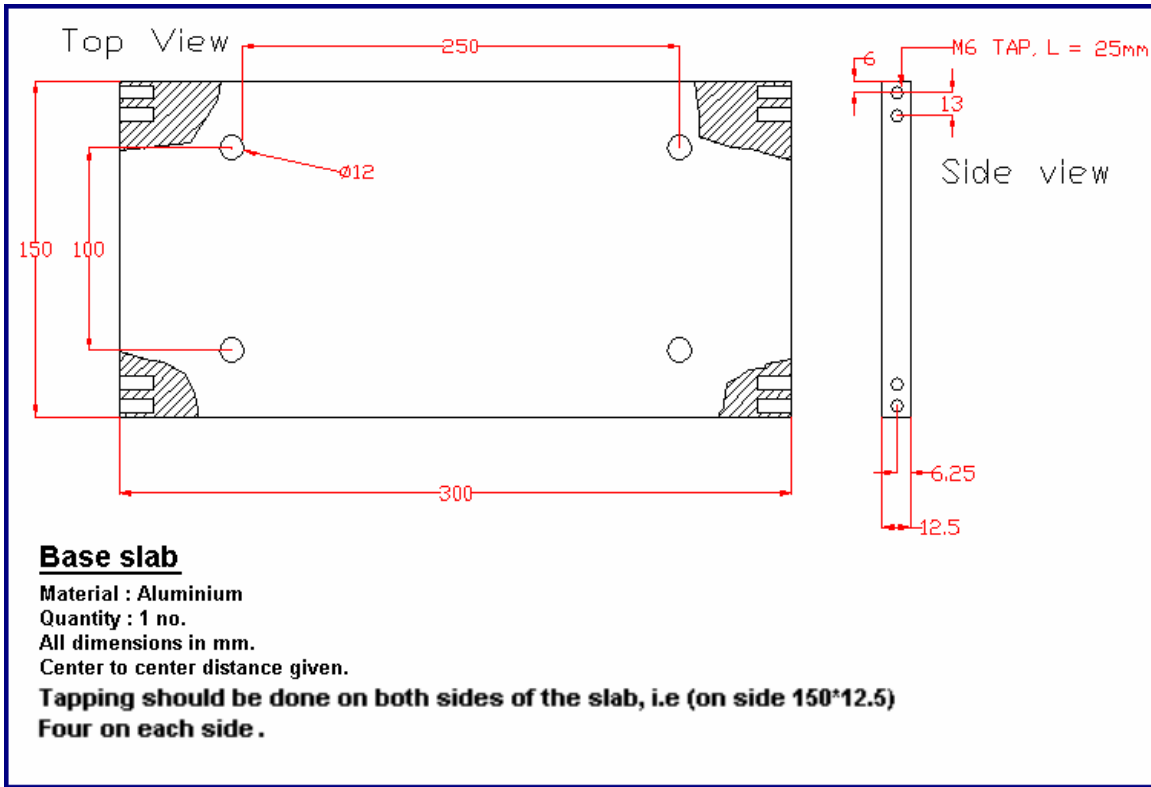


Fig 11 Details of Base slab

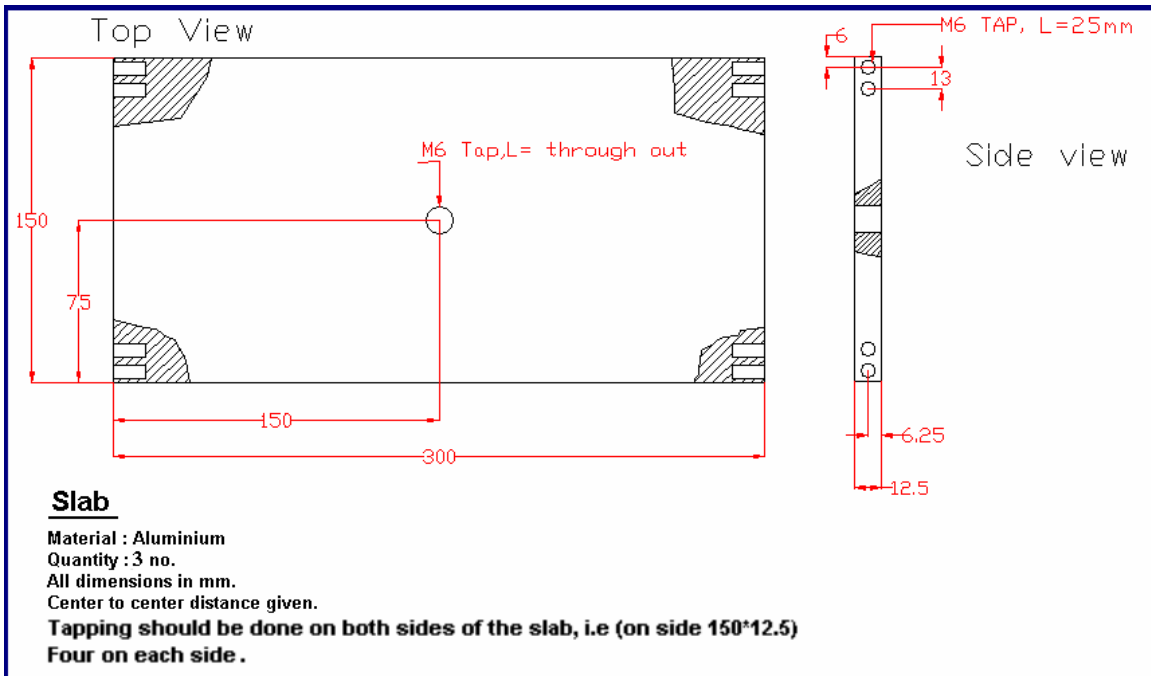


Fig 12 Details of Slab

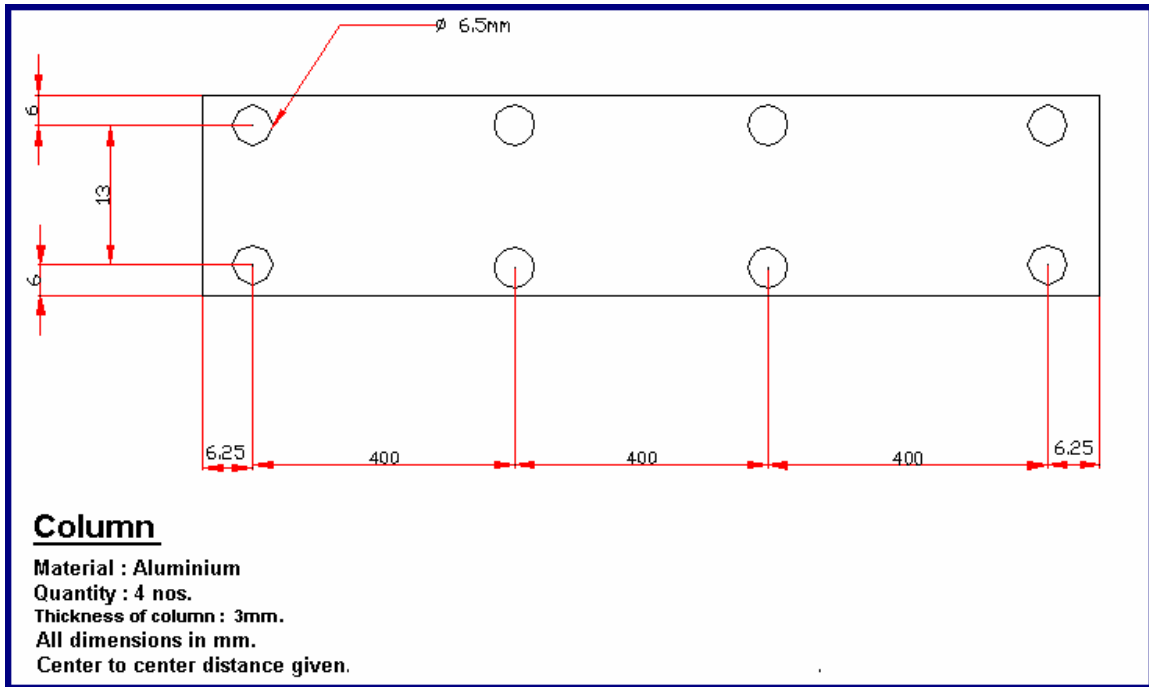


Fig 13 Details of Column

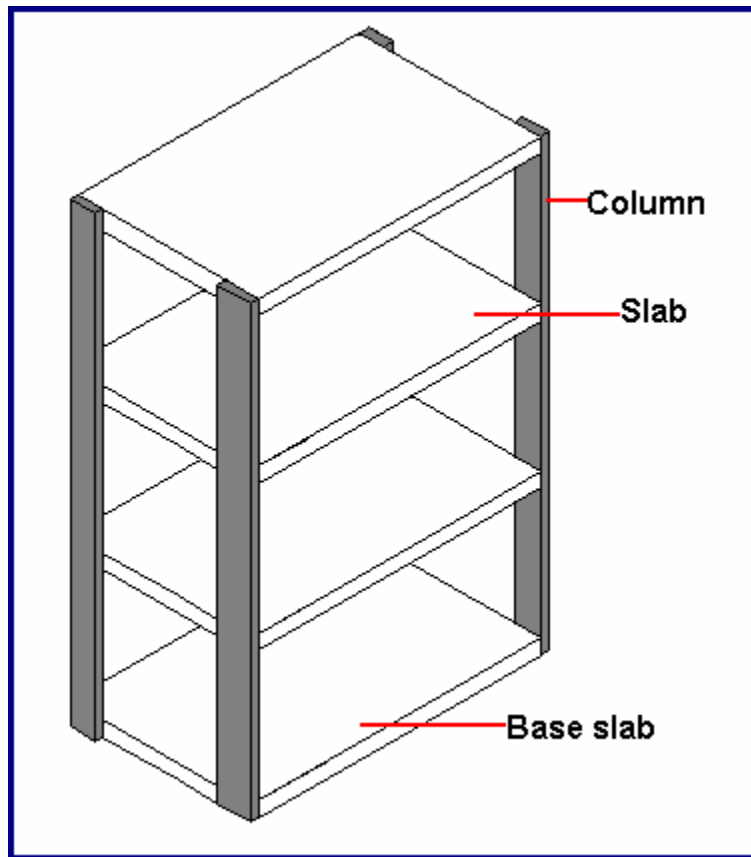


Fig 14 Schematic diagram of three-story frame

MODEL 2

The model consists of main beam, absorber beam, supporting structure, connecting rod, D.C Motor, Flywheel with eccentric mass and Mass on absorber beam . Table 7 guides you to the detailed drawing of each part involved in constructing the model. See Fig 15 and Fig 22 to assemble the model.

Table 7

Sl.no	Parts	Details/ Specification
1	Main beam	See Fig 16
2	Absorber beam	See Fig 19
3	Supporting structure	See Fig 17
4	Connecting rod	See Fig 20
5	DC Motor	Specification: 60 Watts, 2400 rpm, 24V
6	Flywheel	See Fig 18
7	Eccentric mass	M3 , L= 15mm ,Qty 2nos. (Mass =Refer experiment Handout)
8	Mass	See Fig 21.
9	Screws	M10 Allen screw, L= 40 mm, Qty = 4 nos. M6 Allen screw, L= 30 mm, Qty = 2 nos. M10 Concrete bolts, L= 60 mm, Qty = 8 nos. M8, L= 20 mm, Qty = 4 nos. M3 grub screw, L= 5 mm, Qty = 4 nos. M3, L= 30 mm, Qty = 2 nos.

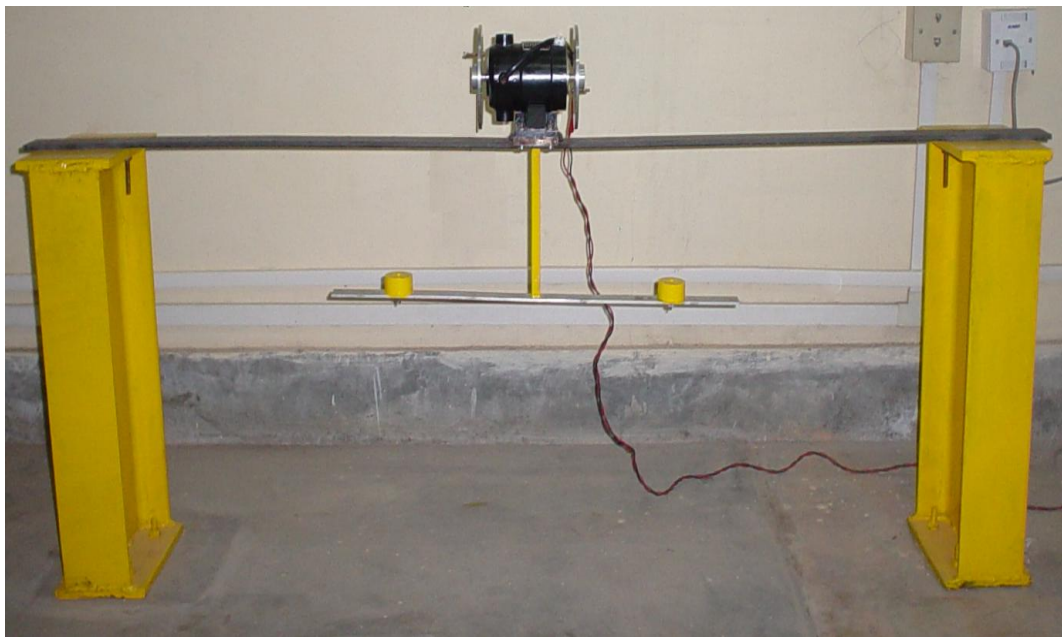


Fig 15 A view of vibration absorber setup.

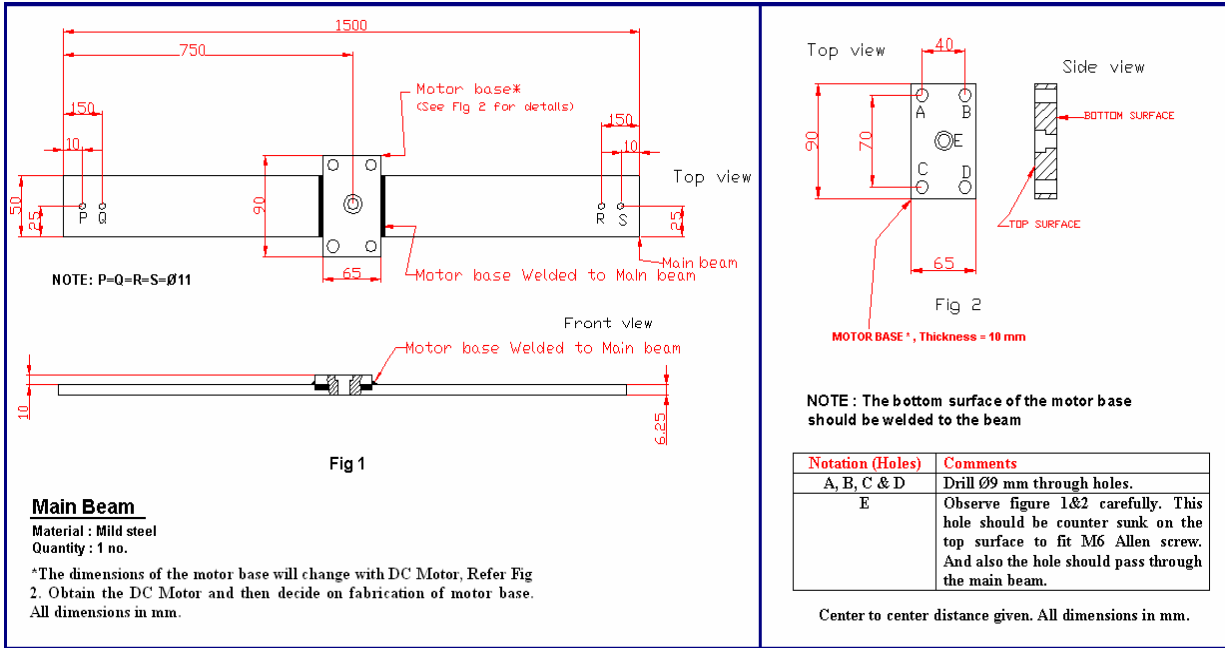


Fig 16 Details of Main beam.

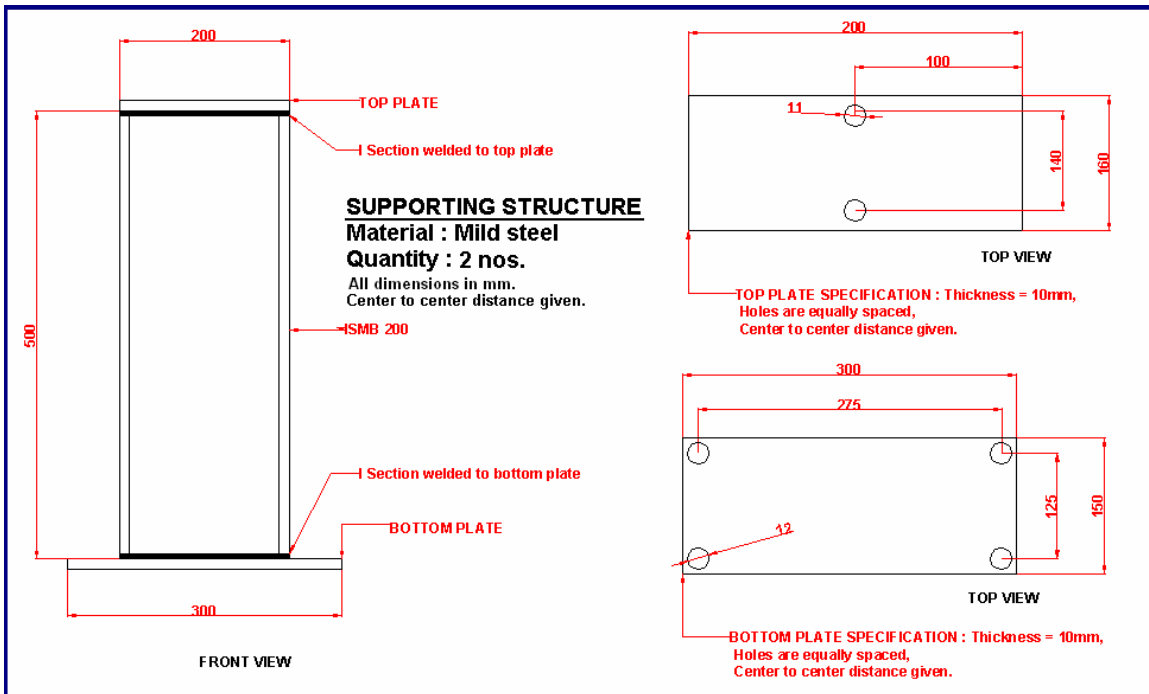


Fig 17 Details of Supporting structure.

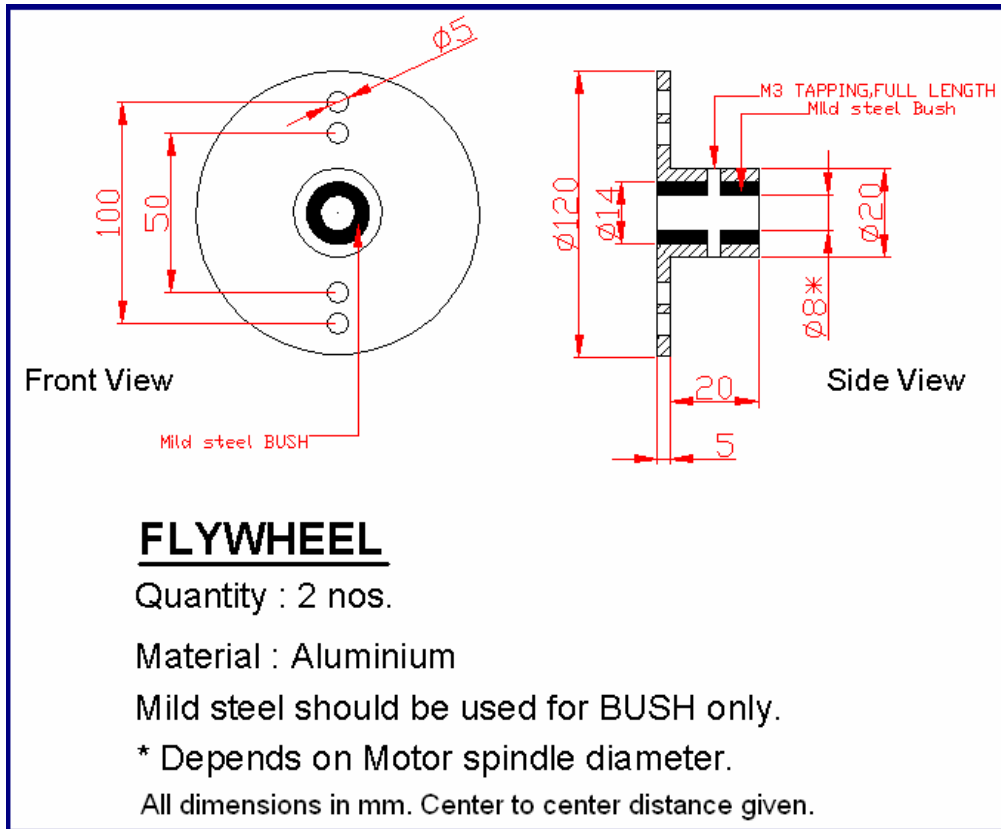


Fig 18 Details of Flywheel.

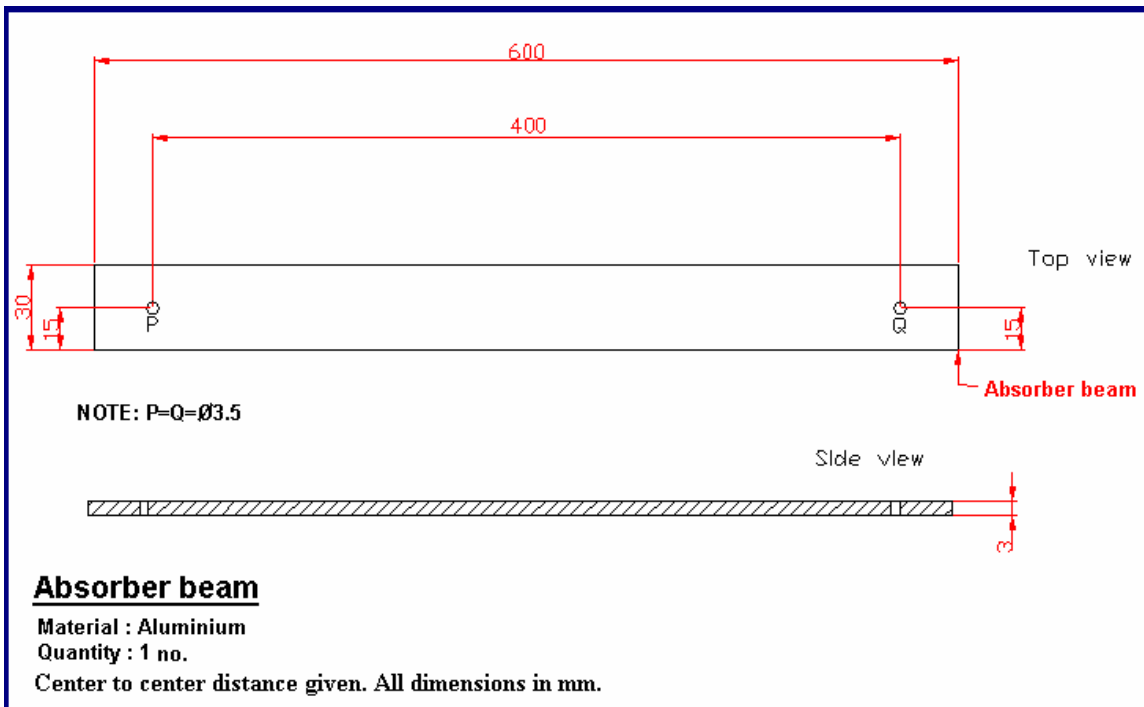


Fig 19 Details of Absorber beam.

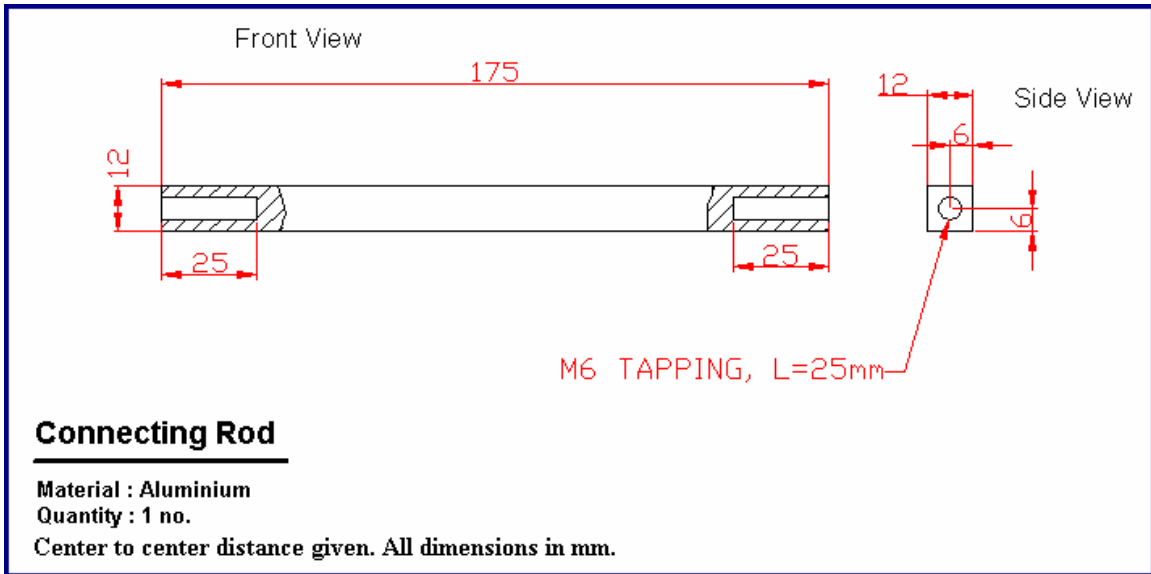


Fig 20 Details of Connecting rod.

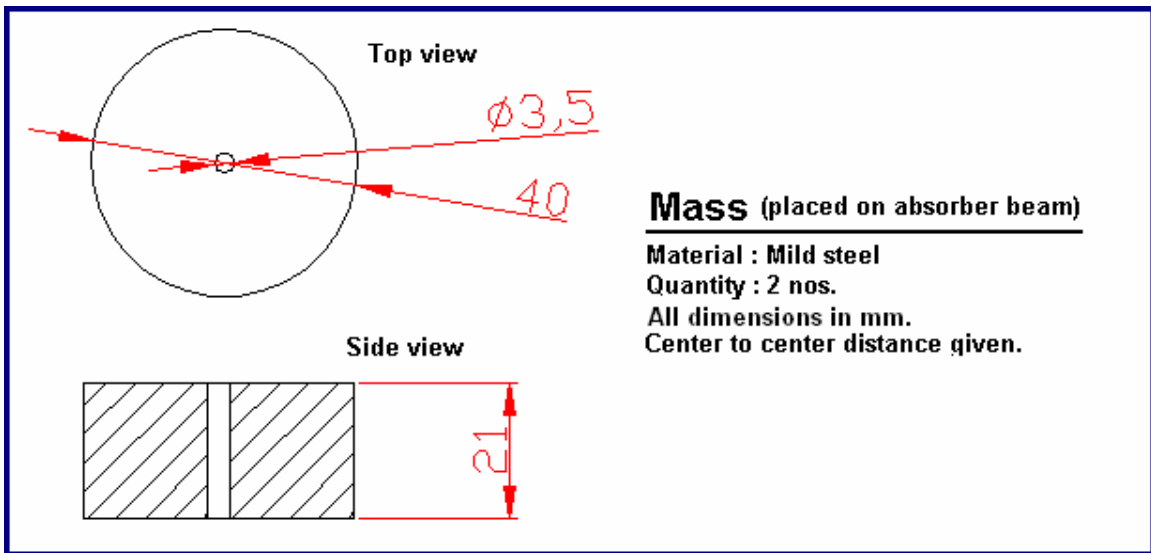
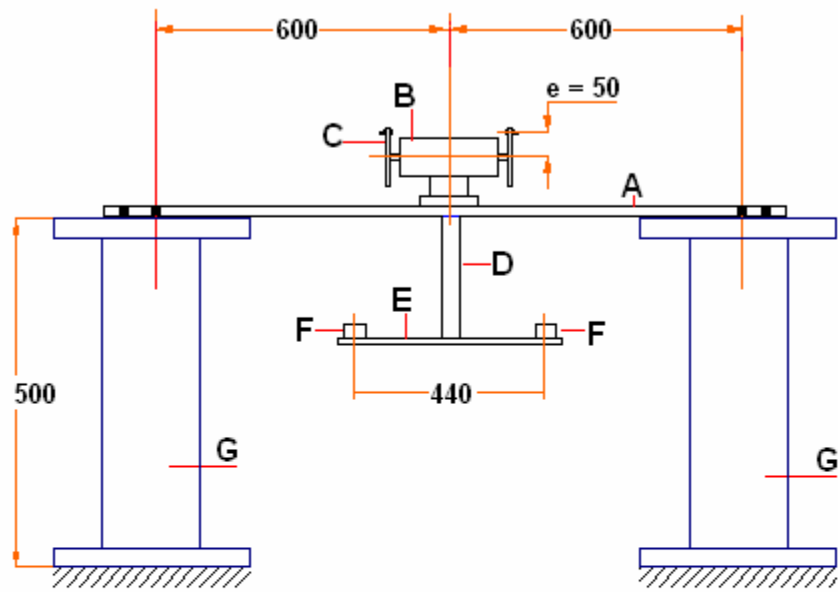


Fig 21. Details of mass placed on absorber beam.



A : MAIN BEAM FIXED TO SUPPORTING STRUCTURE
B : MOTOR
C : FLYWHEEL WITH ECCENTRIC MASS
D : CONNECTING ROD
E : ABSORBER BEAM
F : MASS ATTACHED TO ABSORBER BEAM
G : SUPPORTING STRUCTURE
 Center to center distance given. All dimensions in mm.

Fig 22 Schematic diagram of vibration absorber setup.

MODEL 3

The model consists of an isolator, block and Mass A. Table 8 guides you to the detailed drawing of each part involved in constructing the model. See Fig 23 and Fig 27 to assemble the model.

Table 8

Sl.no	Parts	Details/Specification
1	Mass A	See Fig 24
2	Isolator	See Fig 25
3	Block	See Fig 26
4	Screws	M6, L=40mm, Qty 1no.
		M3, L=40mm, Qty 5 nos.
		M3, L=10mm, Qty 5nos.



Fig 23 A view of vibration isolator.

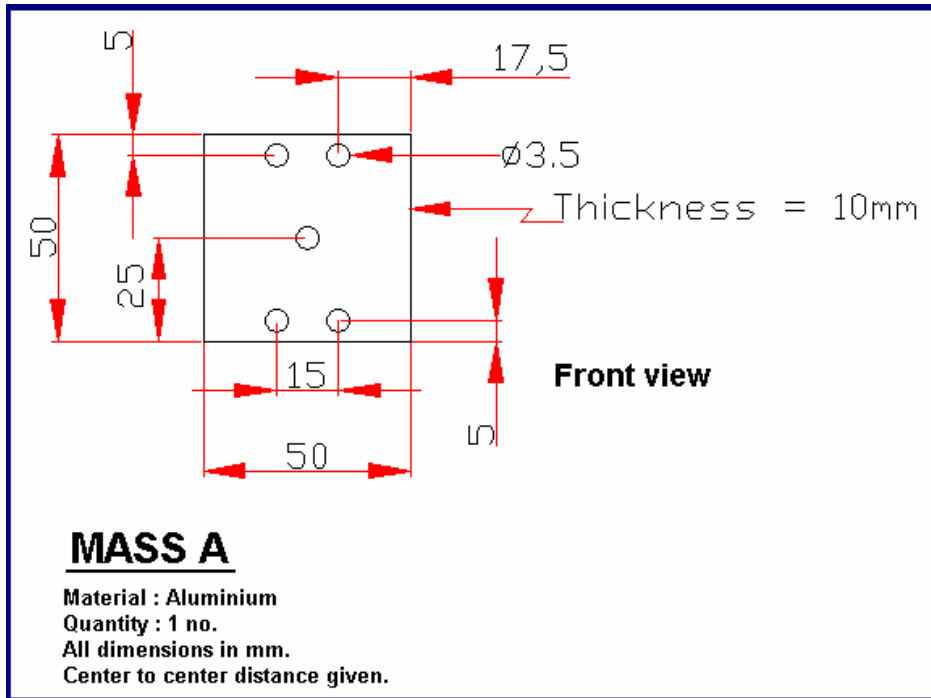


Fig 24 Details of Mass A.

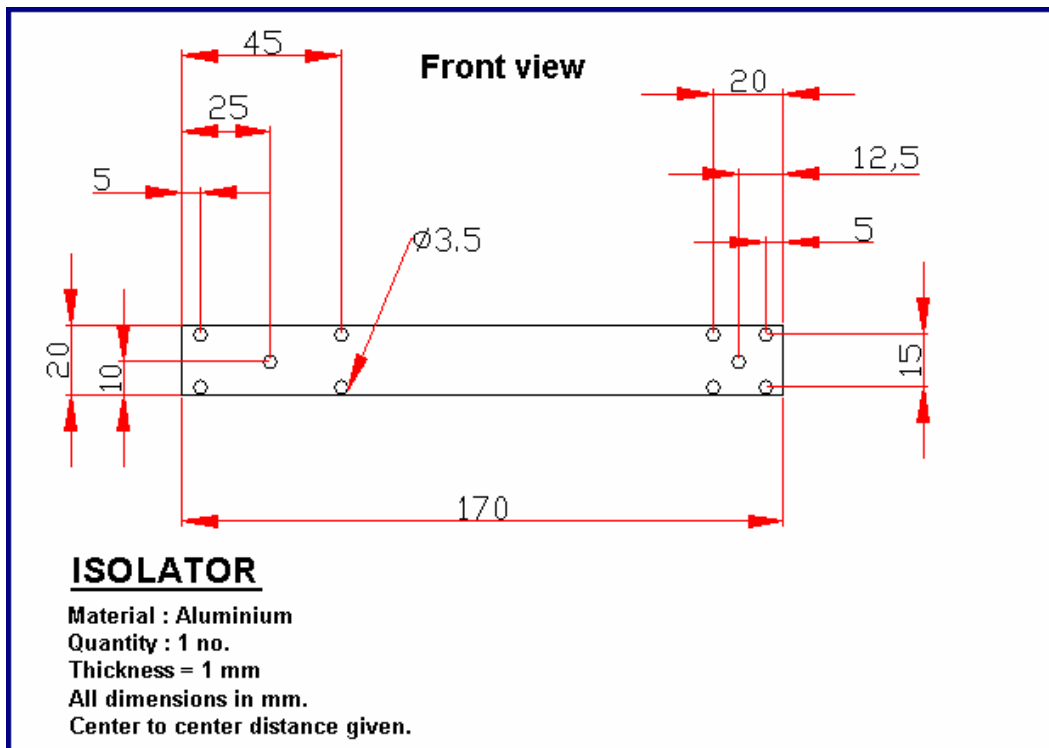


Fig 25 Details of Isolator.

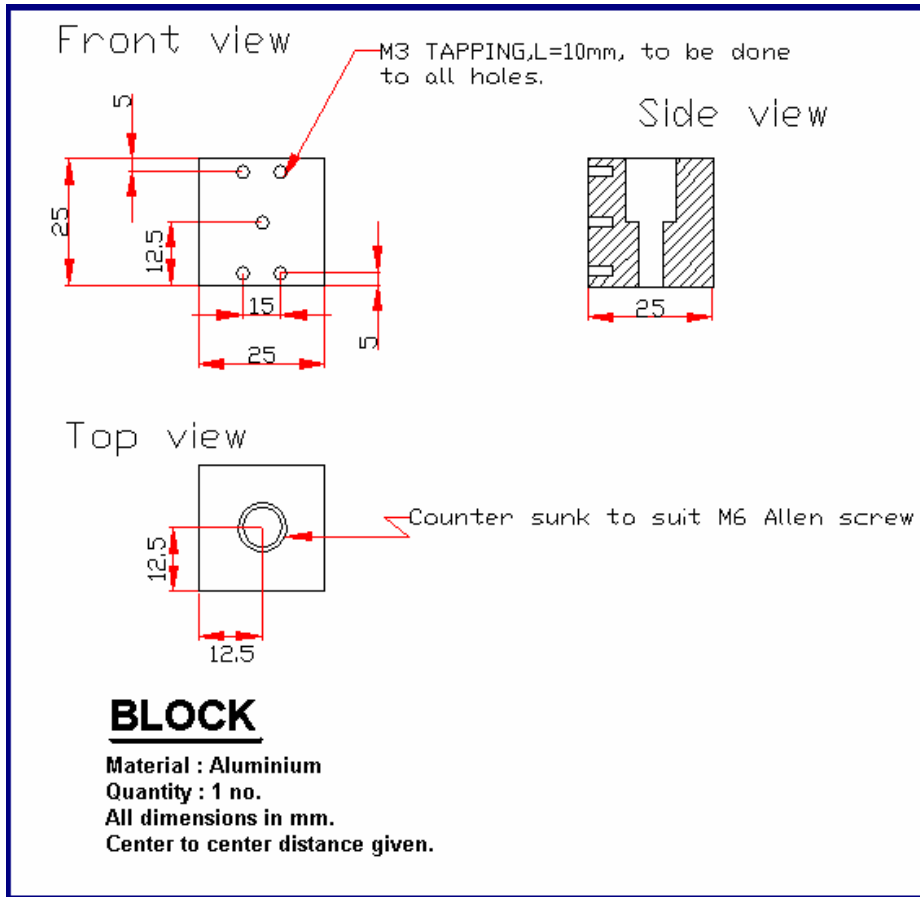


Fig 26 Details of Block.

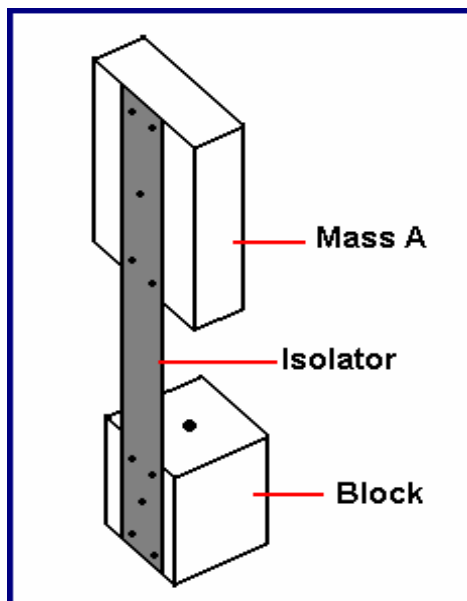


Fig 27 Schematic diagram of vibration isolator.

MODEL 4

The model consists of slabs and columns. Table 9 guides you to the detailed drawing of each part involved in constructing the model. See Fig 28 and Fig 32 to assemble the model.

Table 9

Sl.no	Parts	Details / Specifications
1	Slab	See Fig 29, Fig 30
2	Column	See Fig 31
3	Screws	M6 Allen screw, L= 20 mm, Qty = 8 nos.



Fig 28 A view of one-story frame with planar asymmetry.

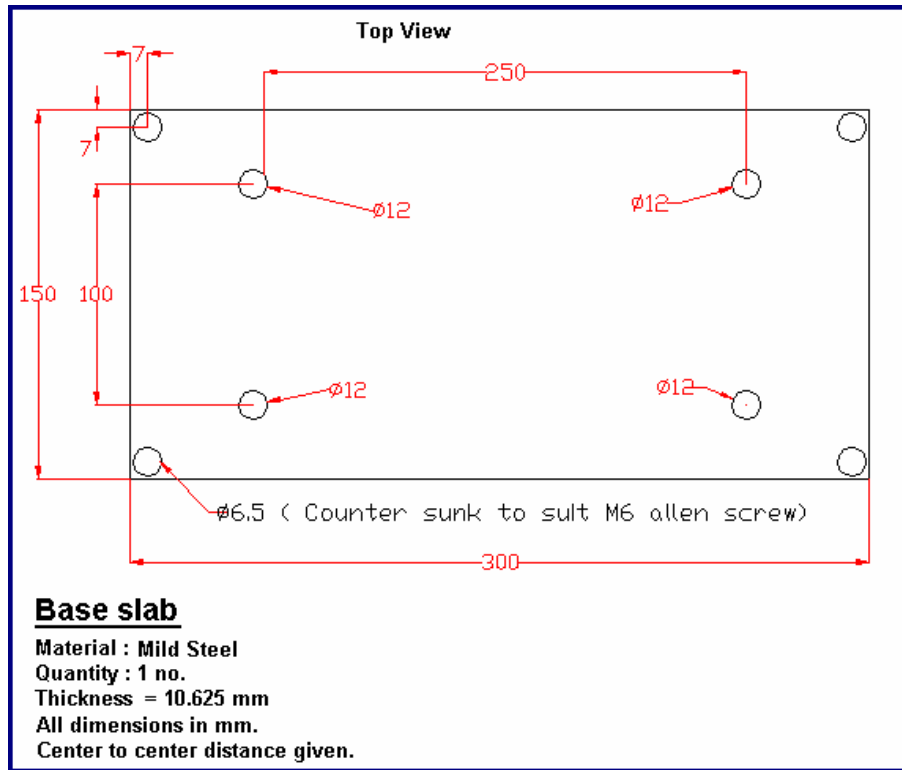


Fig 29 Details of base slab.

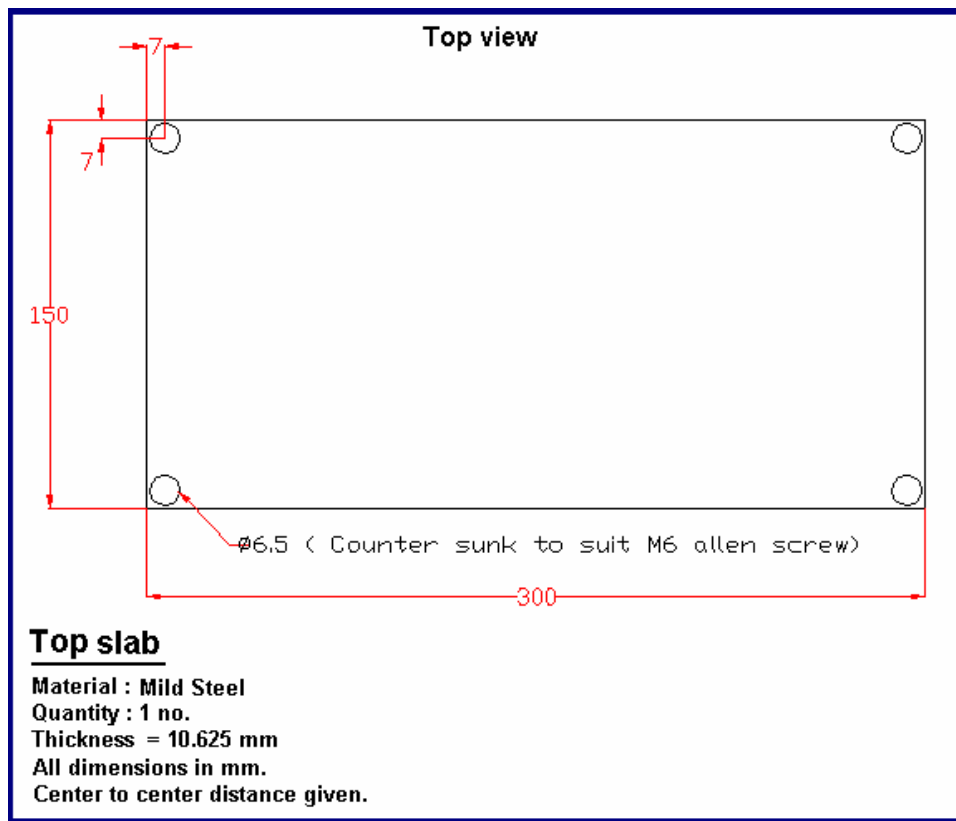


Fig 30 Details of top slab.

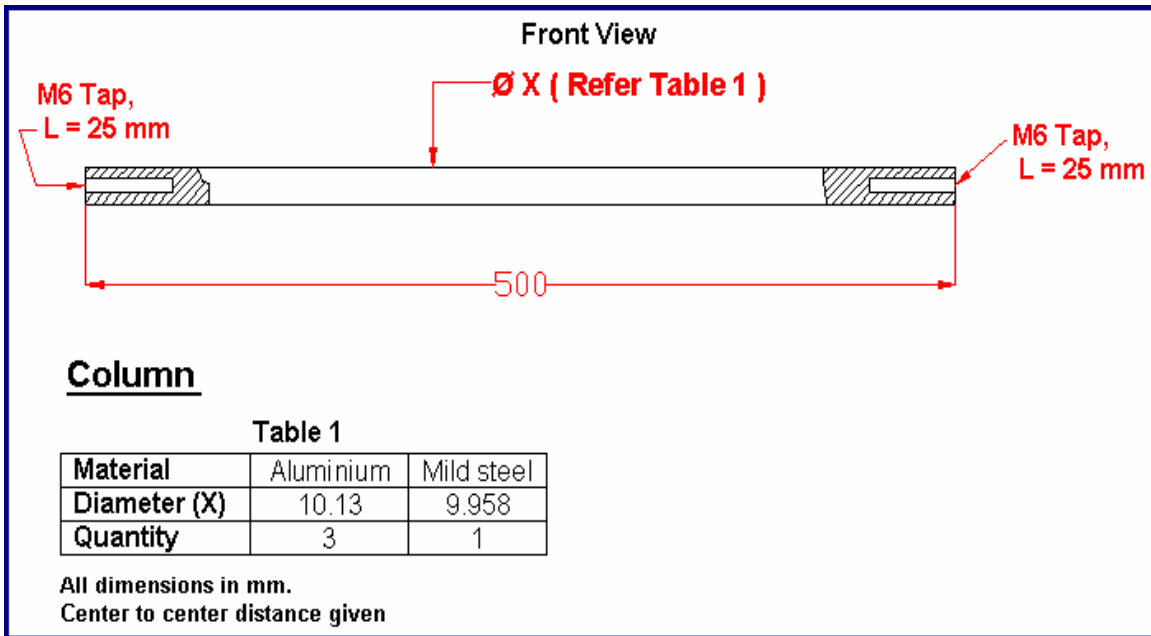


Fig 31 Details of columns.

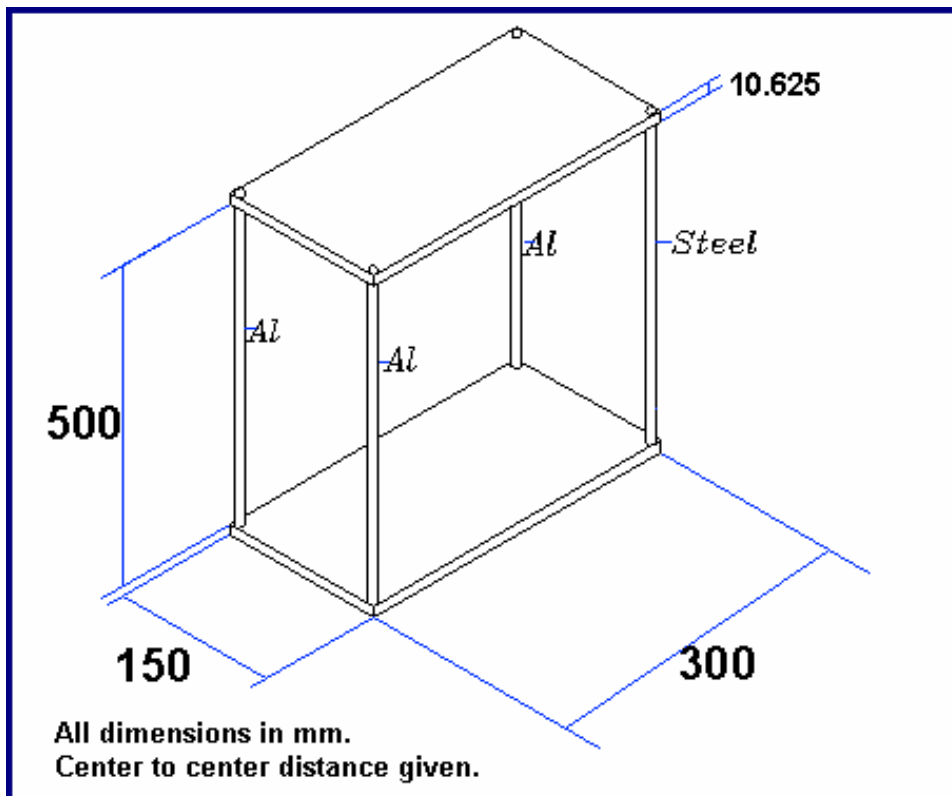


Fig 32 Schematic diagram of one-story frame with planar asymmetry.

MODEL 5

The model consists of main beam, supporting structure, D.C Motor, Flywheel with eccentric mass, knife-edge supports and a lumped mass. Table 10 guides you to the detailed drawing of each part involved in constructing the model. See Fig 33 and Fig 46 to assemble the model. A detailed drawing of parts involved in constructing the knife-edge is given. See Fig 33 and Fig 44 to assemble knife-edge support.

Table 10

Sl.no	Parts	Details/Specification
1	Main beam	See Fig 34
2	Block	See Fig 37
3	Supporting structure	See Fig 36
4	Knife edge supports	See Fig 38,39,40,41,42,43,44
5	DC Motor	60 Watts, 2400 rpm, 24V
6	Flywheel	See Fig 35
7	Eccentric mass	Refer experiment handout
8	Screws	M10 Allen screw, L= 40 mm, Qty = 12 nos.
		M6 Allen screw, L= 20 mm, Qty = 6 nos.
		M10 Concrete bolts, L= 60 mm, Qty = 12 nos.
		M6, L= 20 mm, Qty = 4 nos.
		M6, L= 60 mm, Qty = 4 nos.
		M3 grub screw, L= 5 mm, Qty = 4 nos.
		M10 Allen screw, L= 25 mm, Qty = 12 nos.



Fig 33 A view of two span simply supported beam setup.

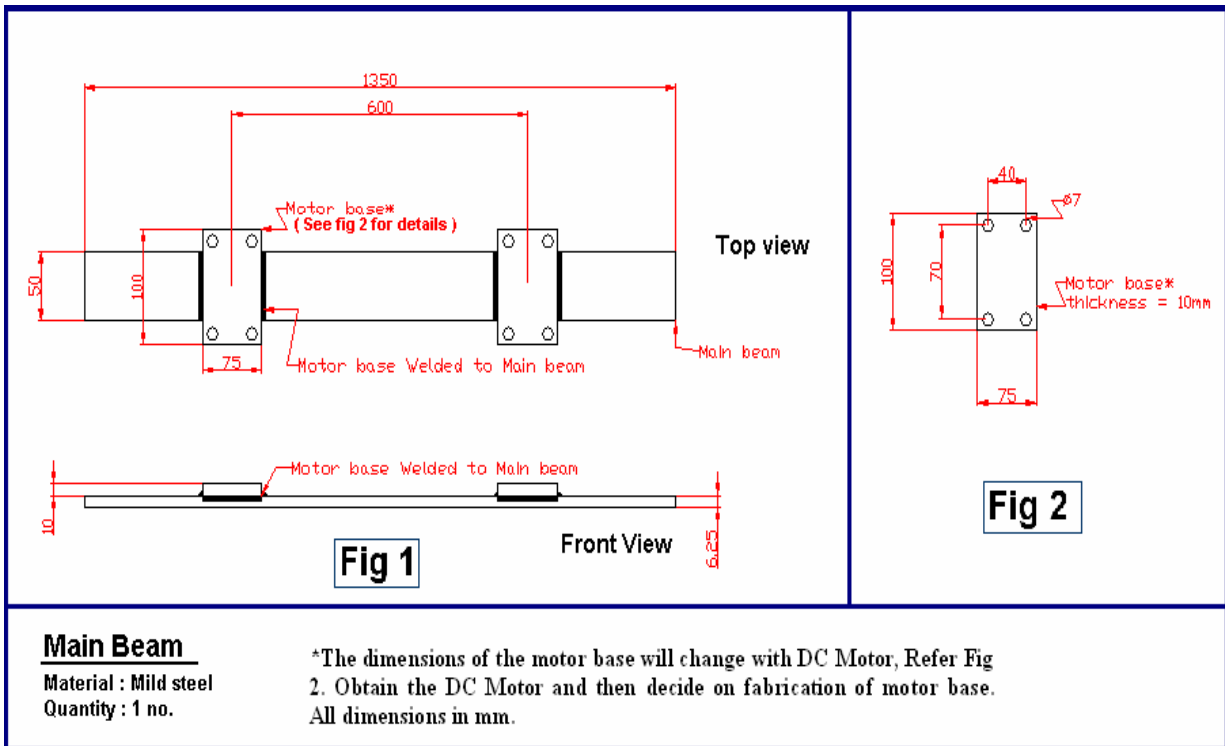


Fig 34 Details of main beam

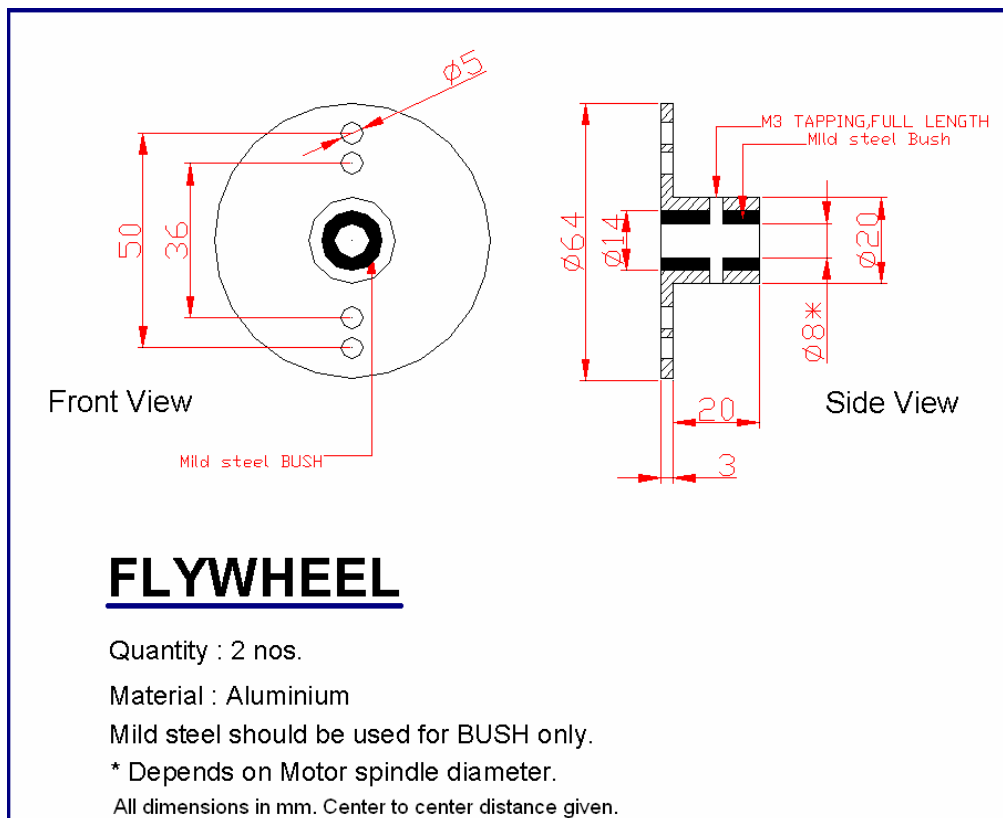


Fig 35 Details of flywheel.

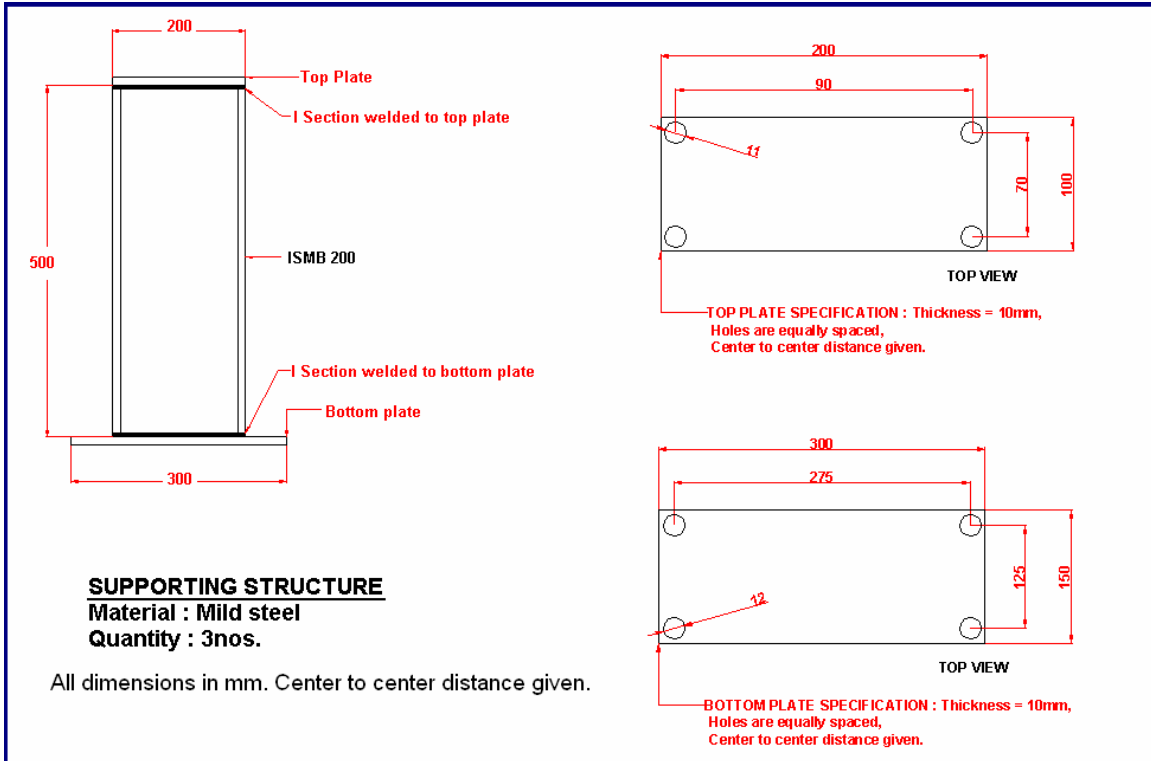


Fig 36 Details of supporting structure.

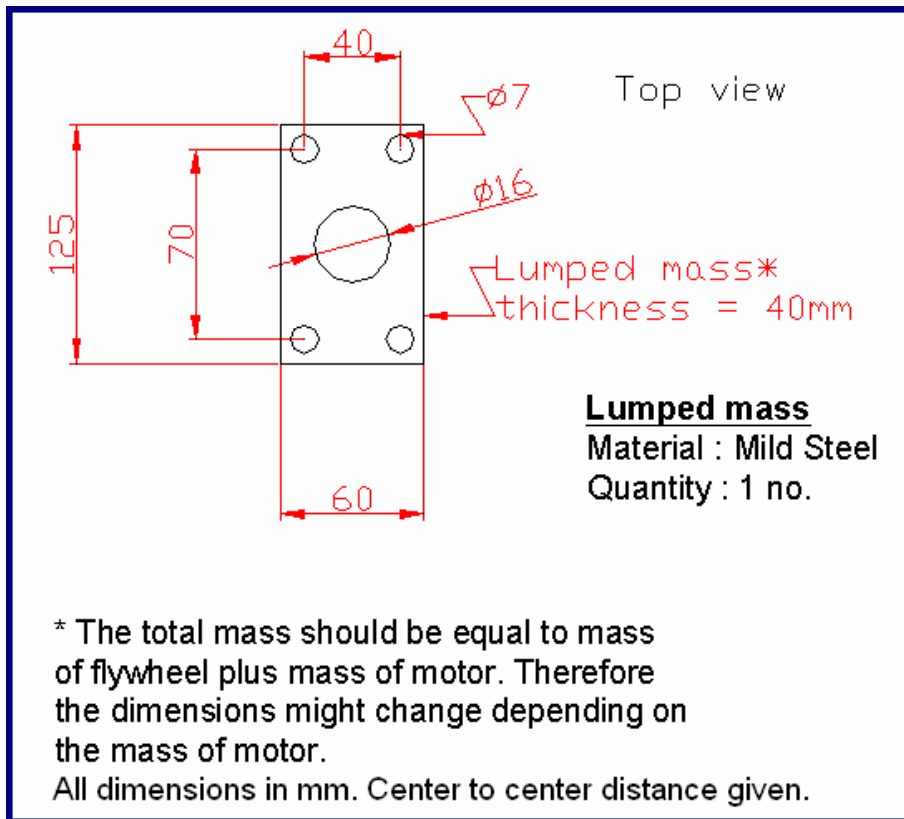


Fig 37 Details of lumped mass.

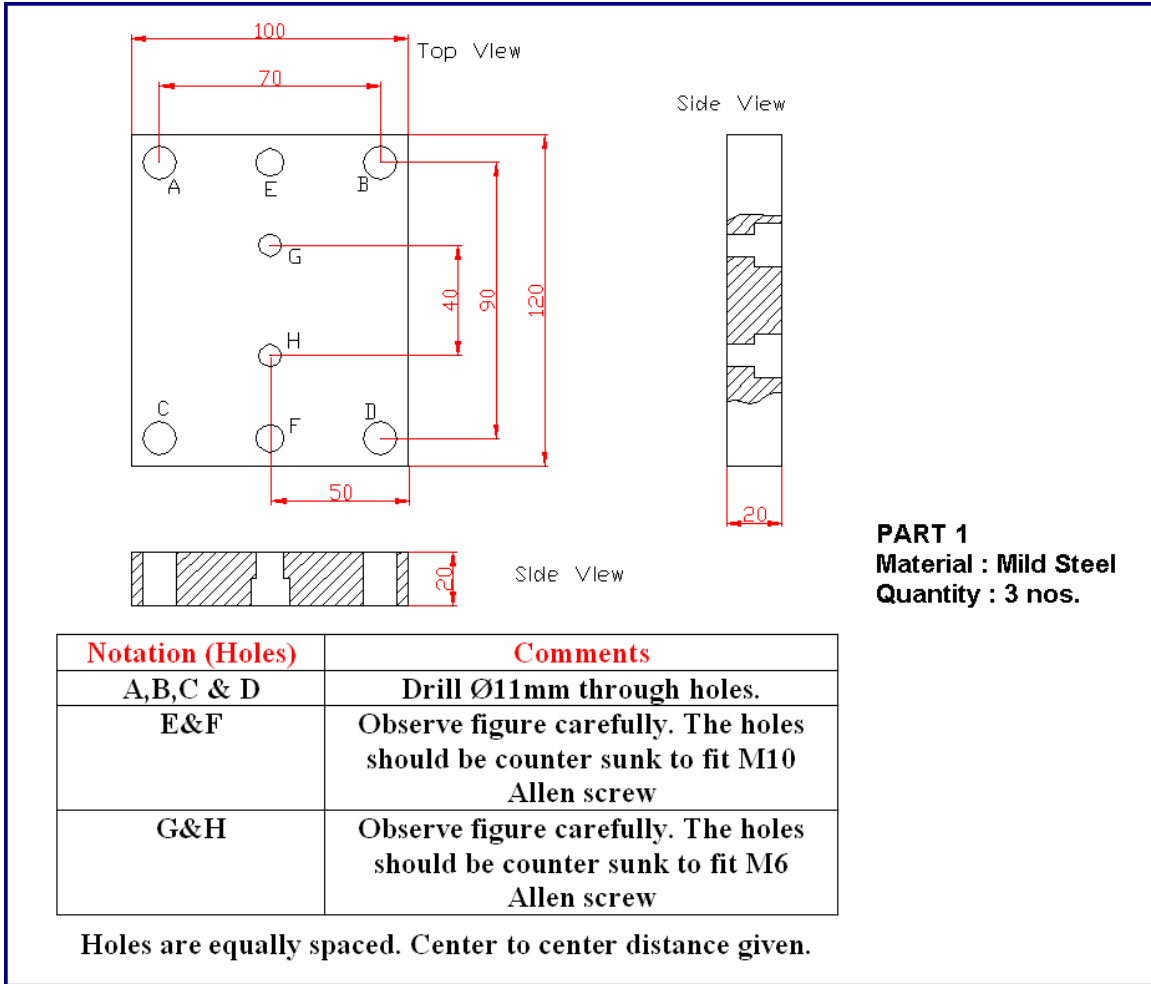


Fig 38 Details of knife-edge support part1.

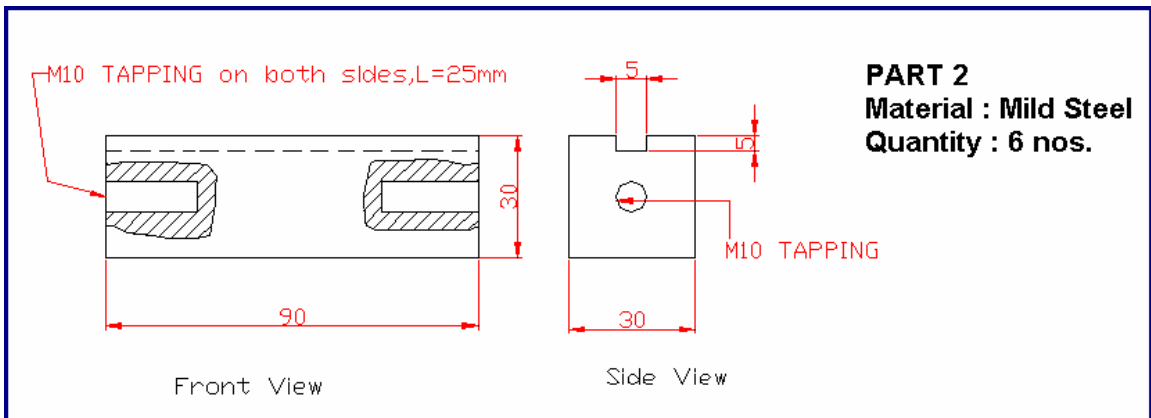


Fig 39 Details of knife-edge support part2.

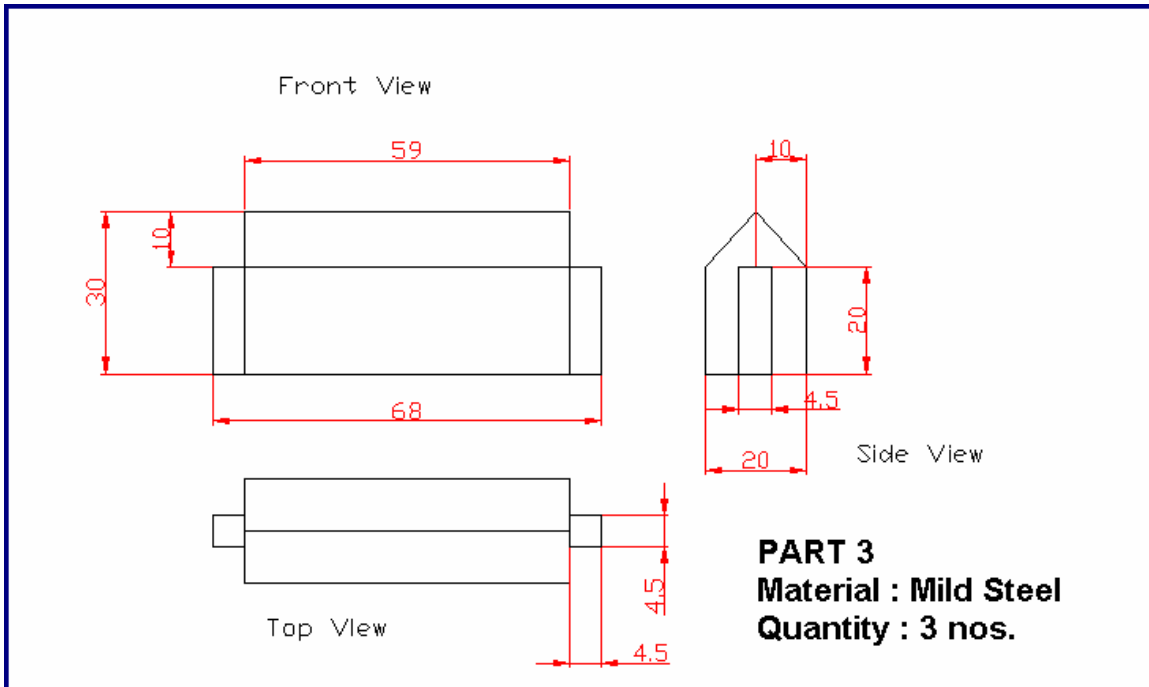


Fig 40 Details of knife-edge support part3.

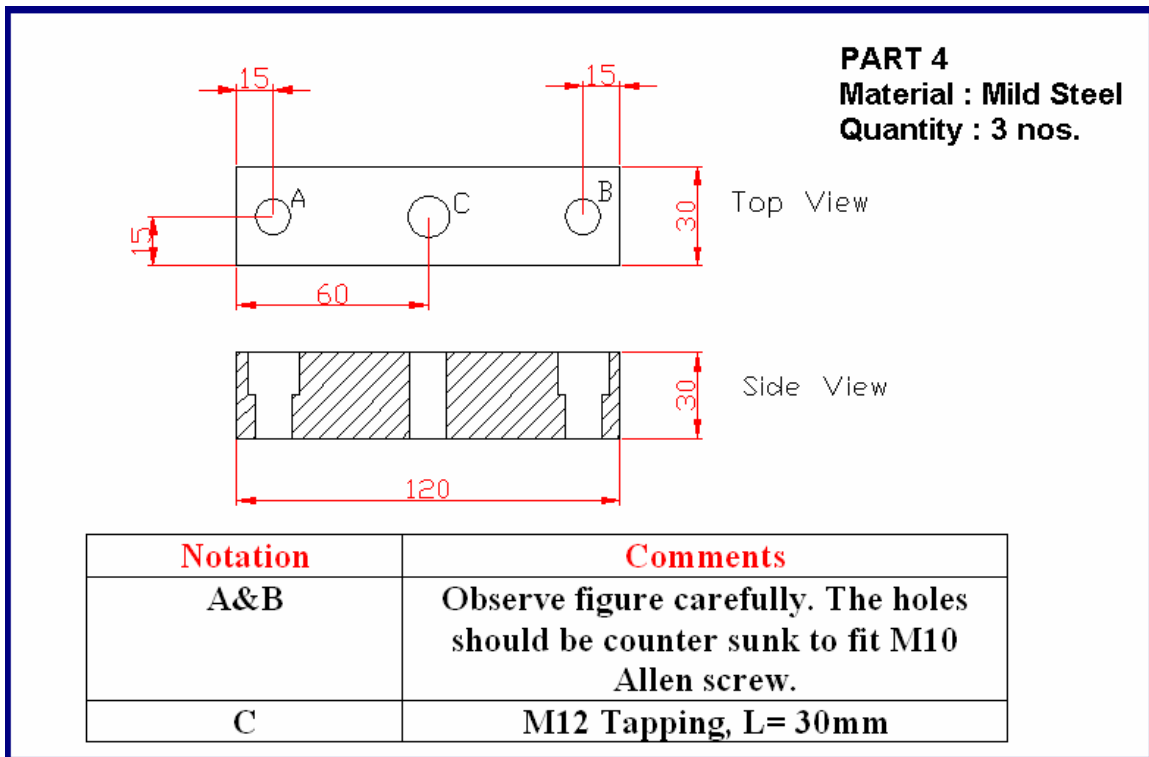


Fig 41 Details of knife-edge support part4.

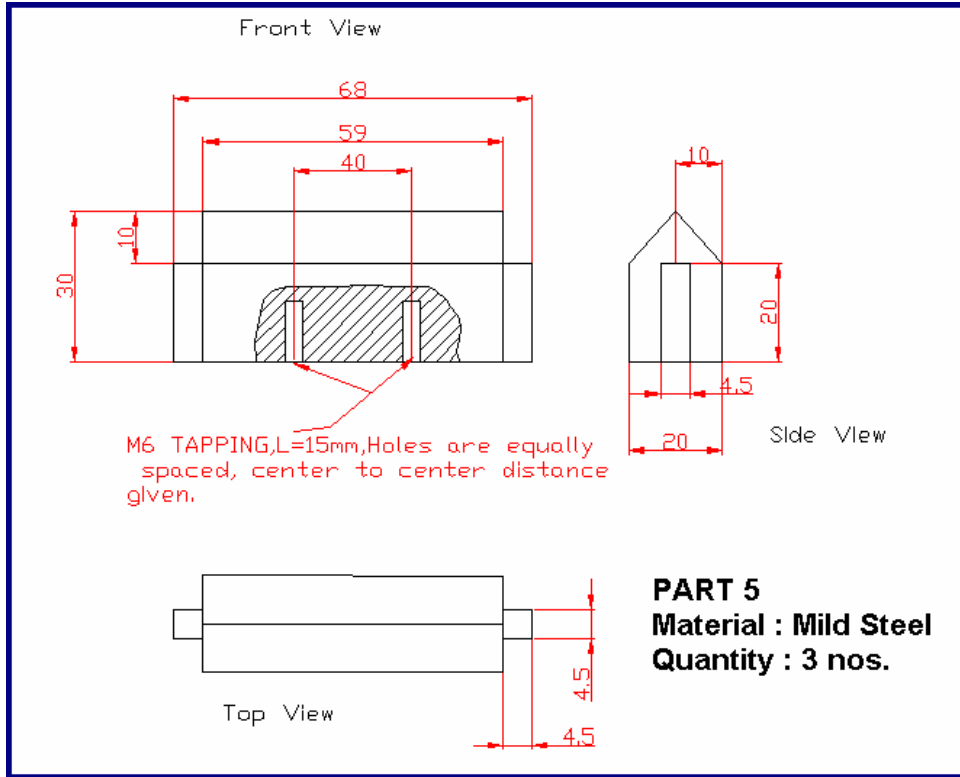


Fig 42 Details of knife-edge support part5.

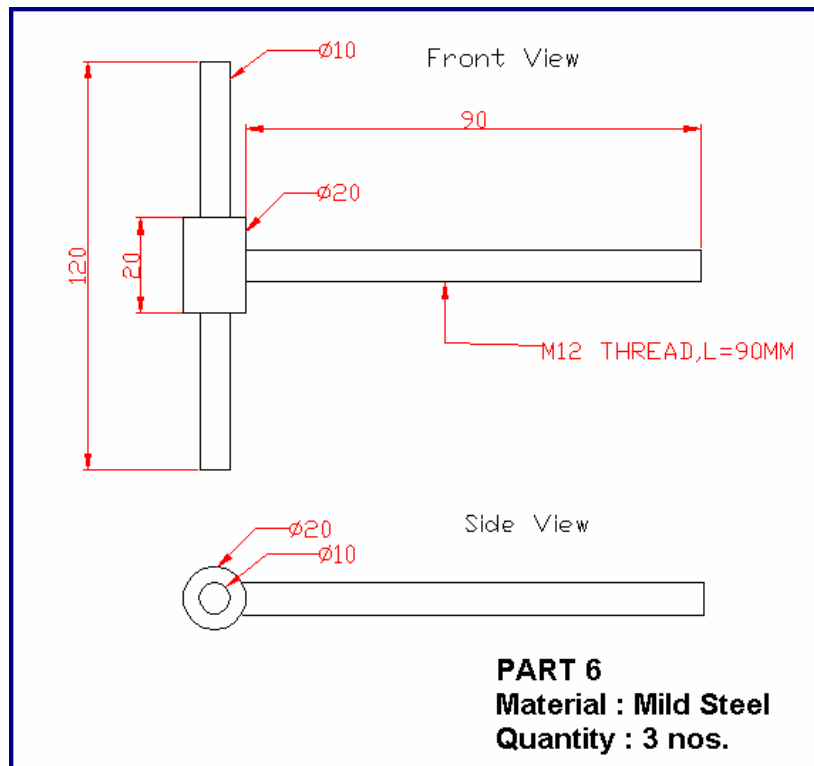


Fig 43 Details of knife-edge support part6.

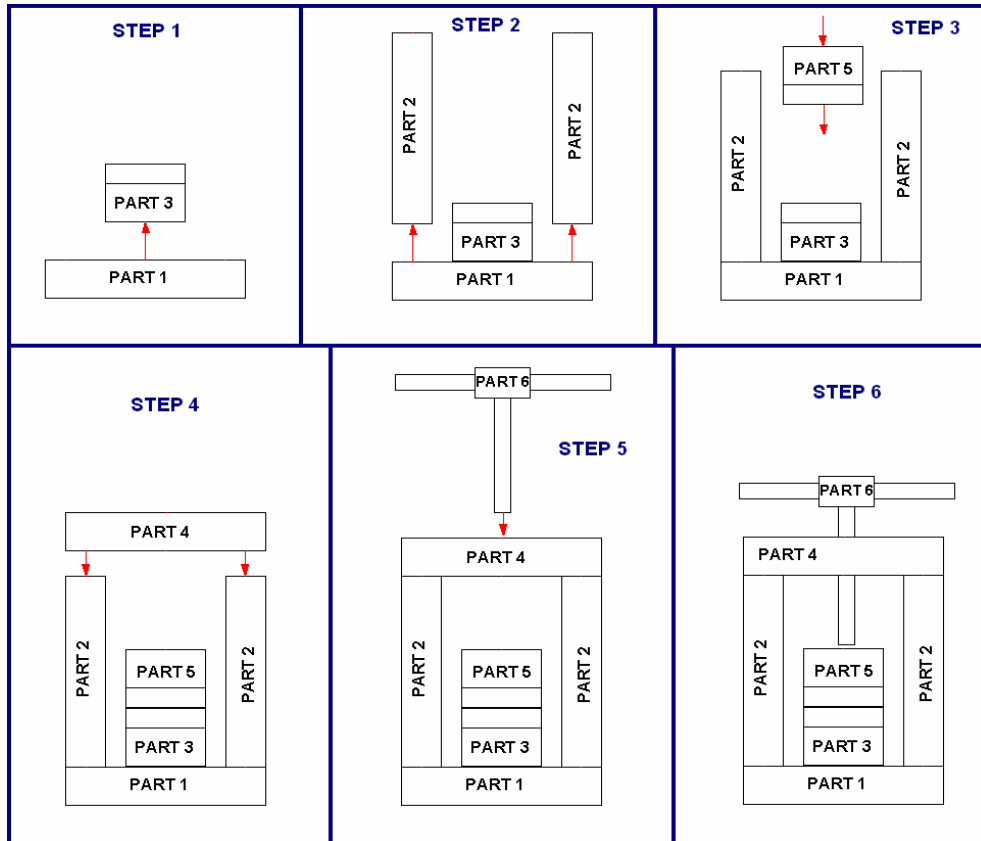


Fig 44 Assembling knife-edge support.

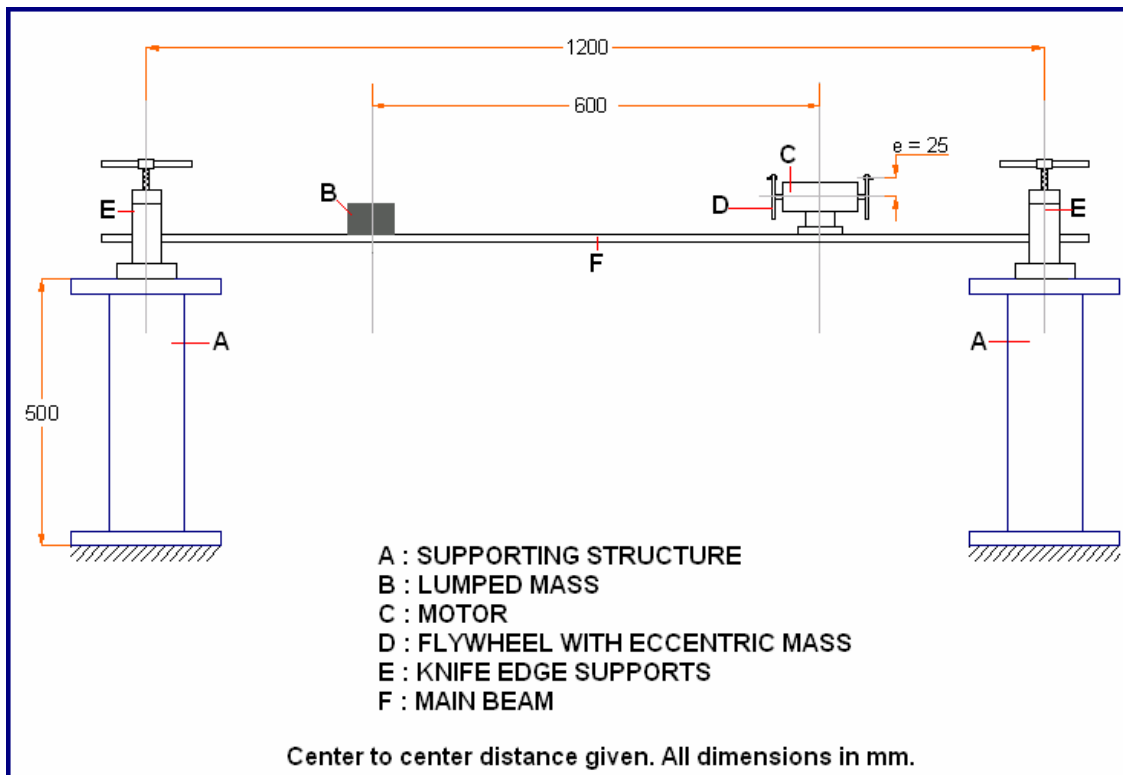


Fig 45 Schematic diagram of one span simply supported beam.

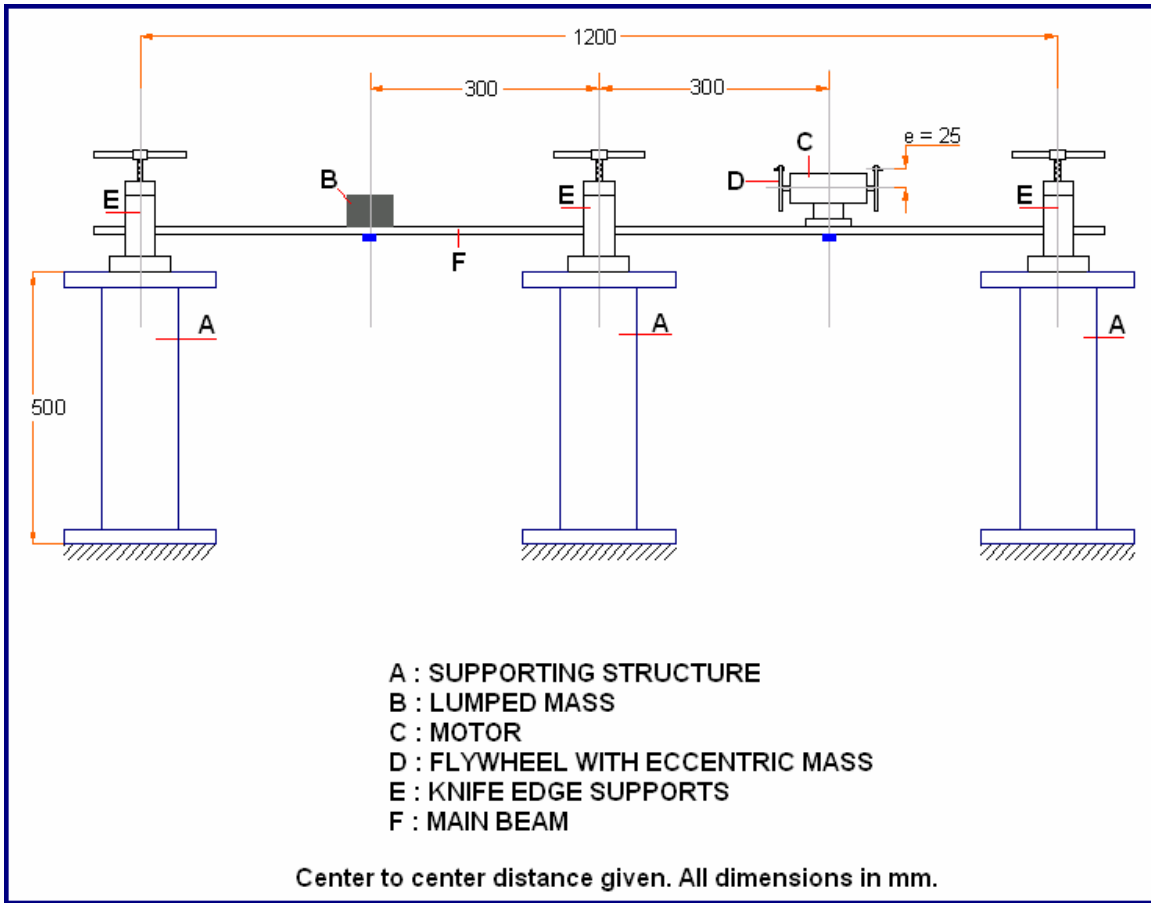


Fig 46 Schematic diagram of two span simply supported beam.

MODEL 6

The model consists of foam , hinges and an outer layer. Table 12 guides you to the detailed drawing of each part involved in constructing the model. Foam must be pre stressed to avoid slippage. See Fig 49 and Fig 52 to assemble the model.

Table 12

Sl.no	Parts	Details /Specifications
1	Soil model	630*325*100 , Qty = 2nos.
2	Outer layer for soil model	See Fig 50 and Fig 51
3	Hinges	50mm
4	Screws + Nuts	M10 Allen screw, L= 30 mm, Qty = 4 nos. M4, L= 20 mm, Qty = 32 nos.



Fig 49 A view of soil model.

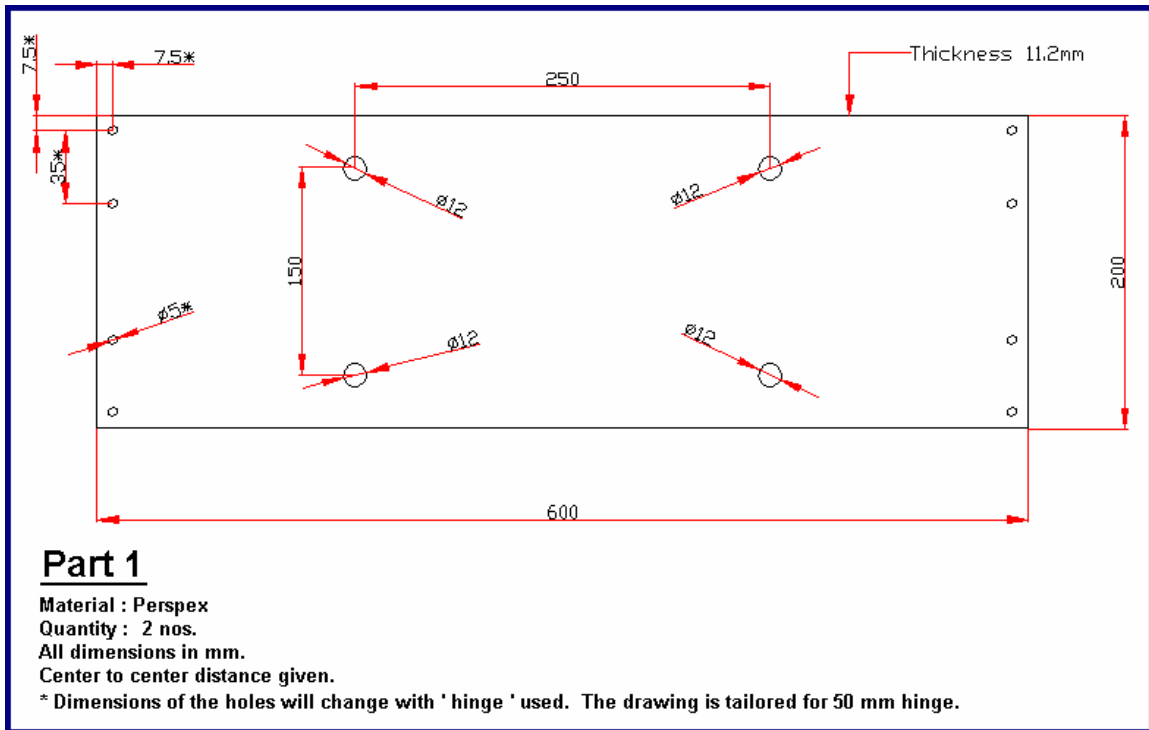


Fig 50 Details of parts involved in soil model.

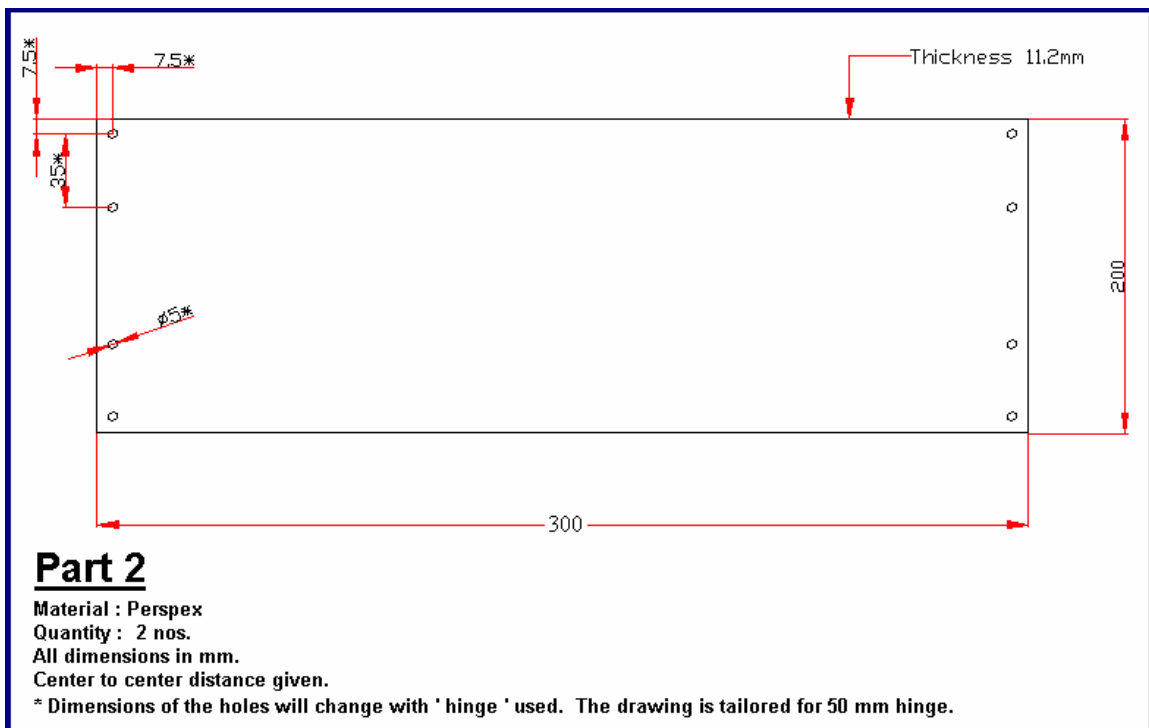


Fig 51 Details of parts involved in soil model.

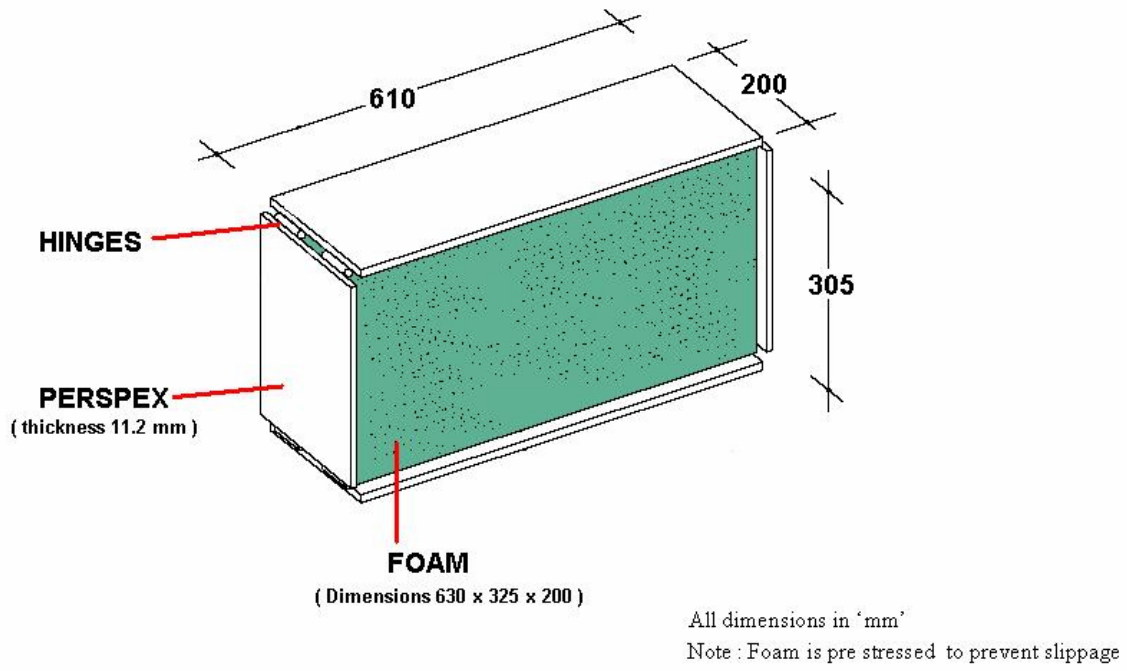


Fig 52 Schematic diagram of soil model.

Model 9

The model consists of slabs and columns. Table 13 guides you to the detailed drawing of each part involved in constructing the model. See Fig 53 and Fig 57 to assemble the model.

Table 13

Sl.no	Parts	Details/ Specification
1	Columns	See Fig 56
2	Slabs	See Fig 54,55
3	Screws	M6 Allen screws, L=25mm, Qty =16 nos.
		M10 Allen screws, L=30mm, Qty =4 nos.



Fig 53 A view of one story frame.

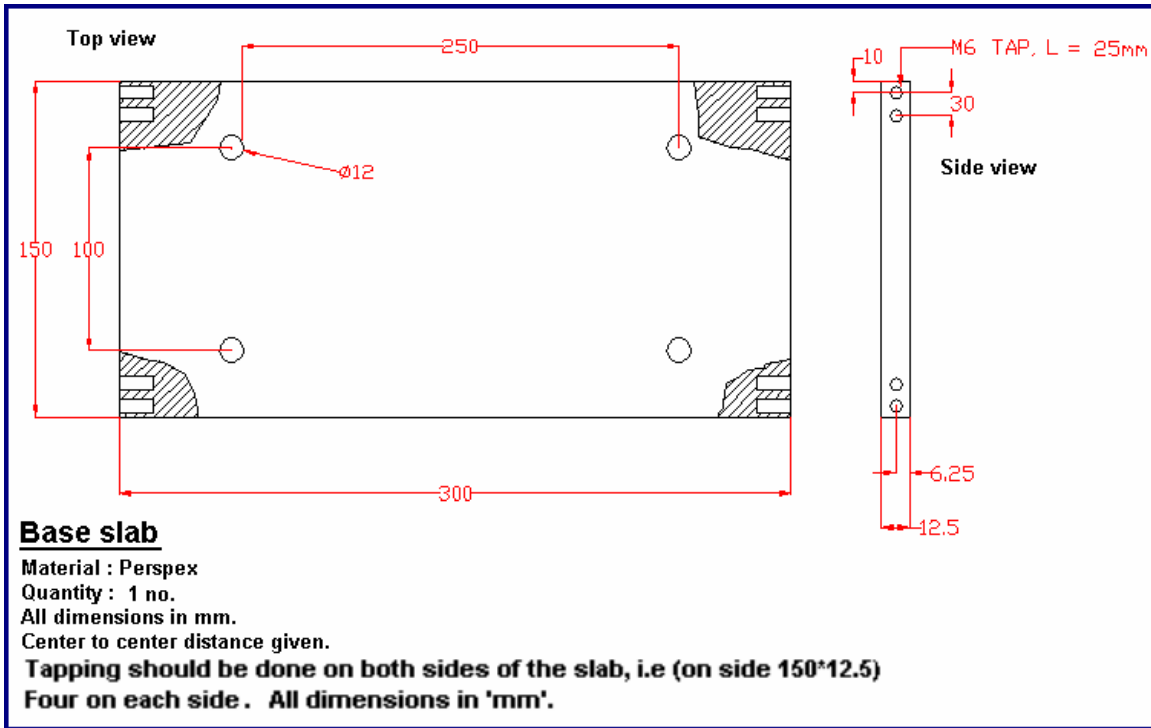


Fig 54 Details of base slab.

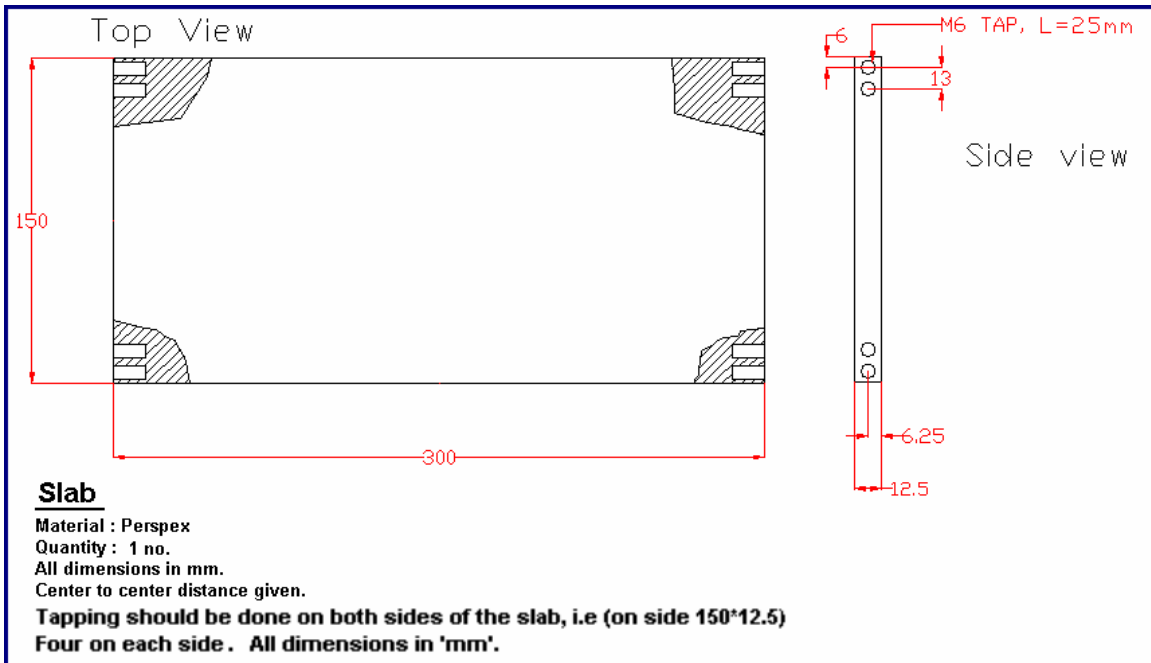


Fig 55 Details of slab.

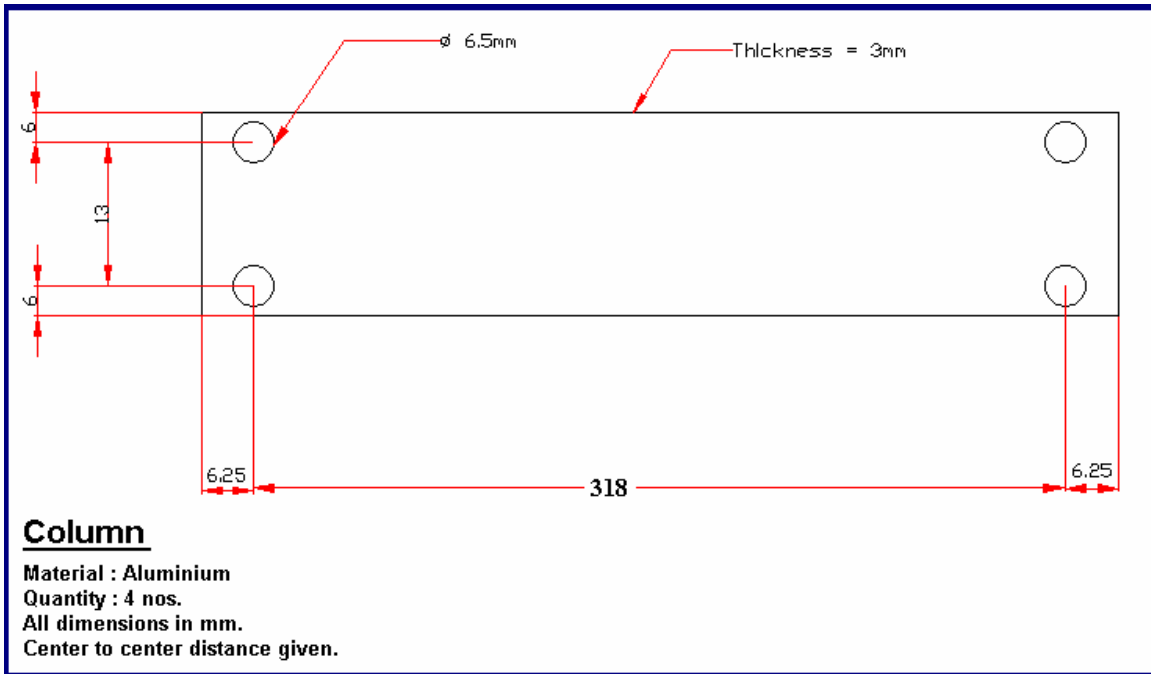


Fig 56 Details of columns

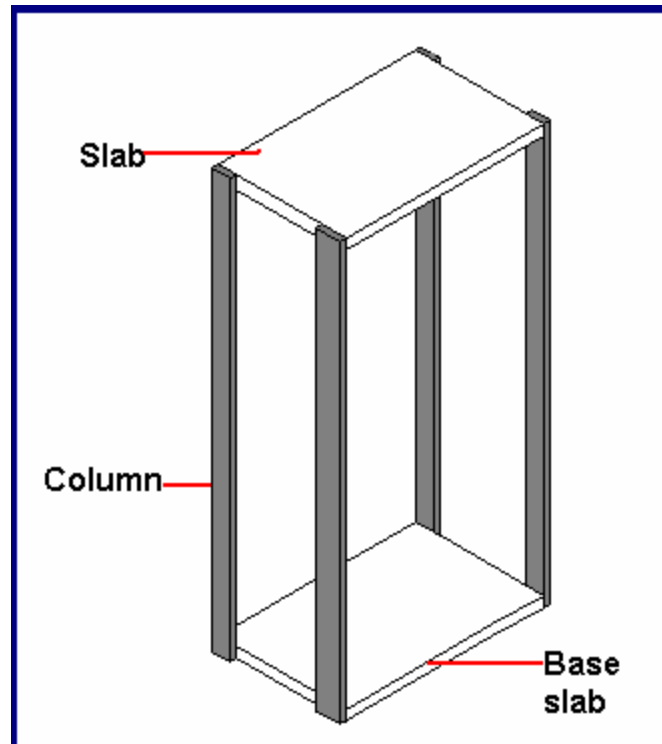


Fig 57 Schematic diagram of one story frame.

Model :

The model consists of slabs and columns. Table 14 guides you to the detailed drawing of each part involved in constructing the model. See Fig 58 and Fig 62 to assemble the model.

Table 14

Sl .no	Parts	Details/ Specification
1	Columns	See Fig 61
2	Slabs	See Fig 59,60
3	Screws	M6 Allen screws, L=25mm, Qty =16 nos.
		M10 Allen screws, L=30mm, Qty =4 nos.



Fig 58 A view of one story frame.

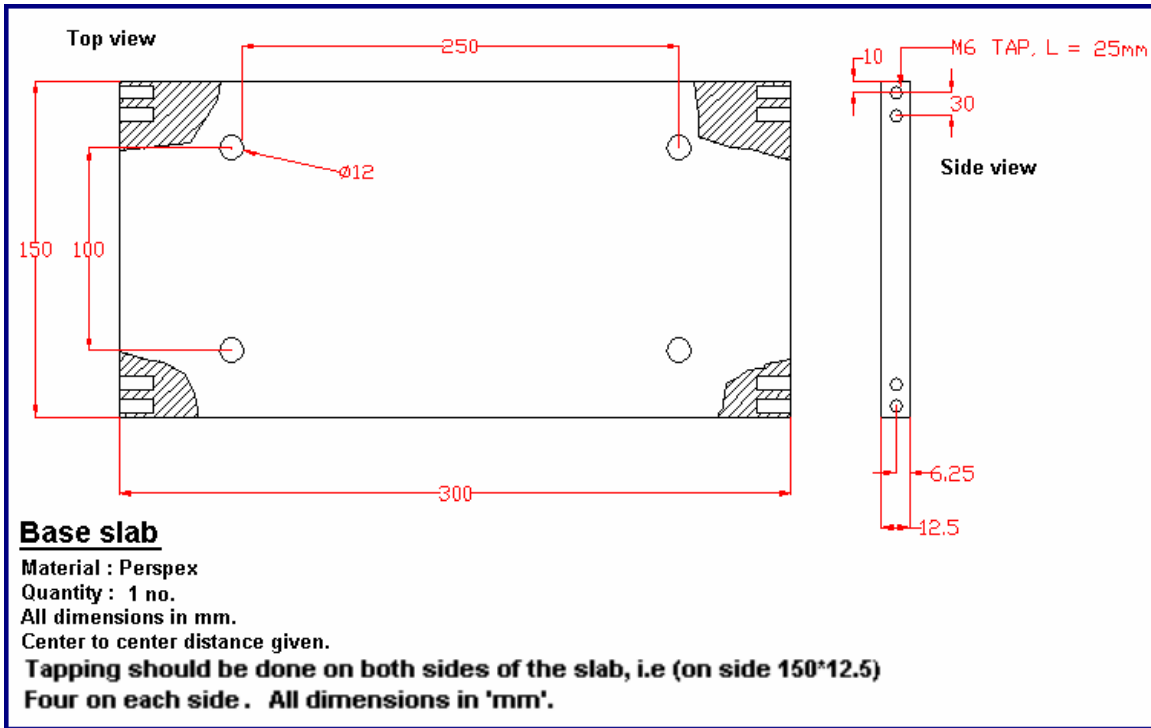


Fig 59 Details of base slab.

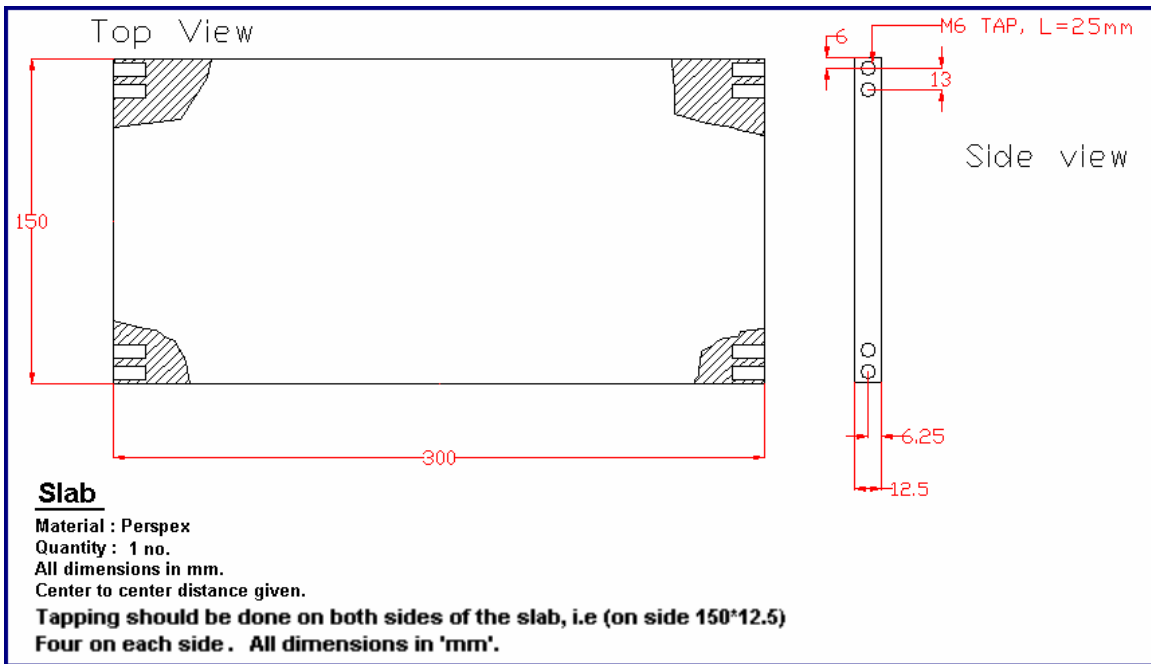


Fig 60 Details of slab.

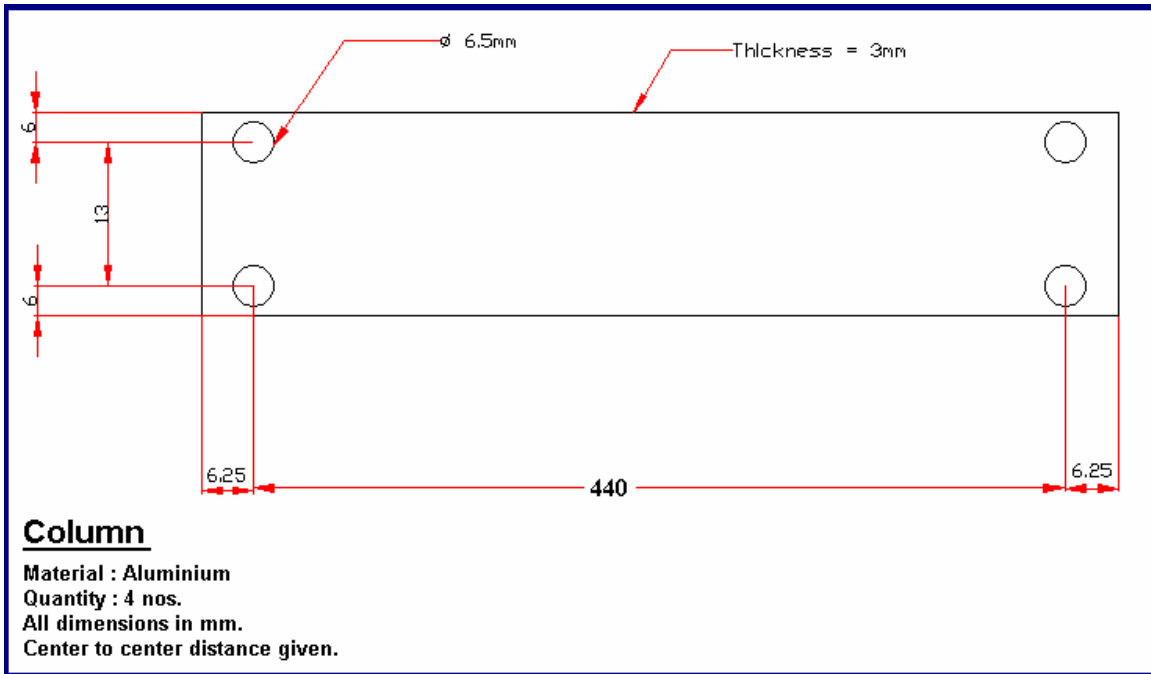


Fig 61 Details of column.

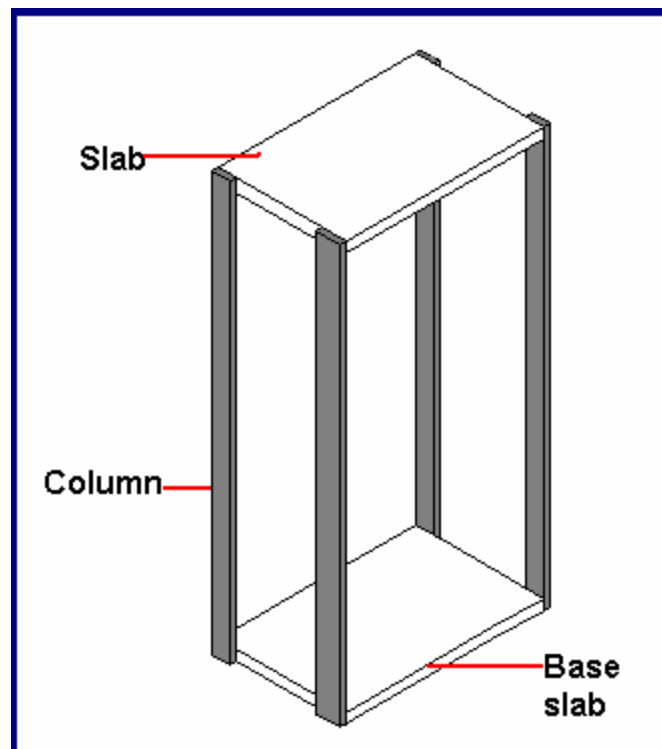


Fig 62 Schematic diagram of one story frame.

Model ;

The model consists of two boxes, made of plywood. The inner dimensions of the boxes are given in Fig 63a. Box 1 is used for conducting the experiment, while box2 is used for seating box 1 on the shake table. It must be ensured that boxes are leak proof.

Table 15

Sl.no	Parts	Material	Quantity	Dimensions
1	Box1	Plywood (t=18.75mm)	1	350*450*140
2	Box2	Plywood (t=18.75mm)	1	400*500*150
3	Soil	-	17.41 kg	-
4	Brick	Clay + sand	1	235*115*75

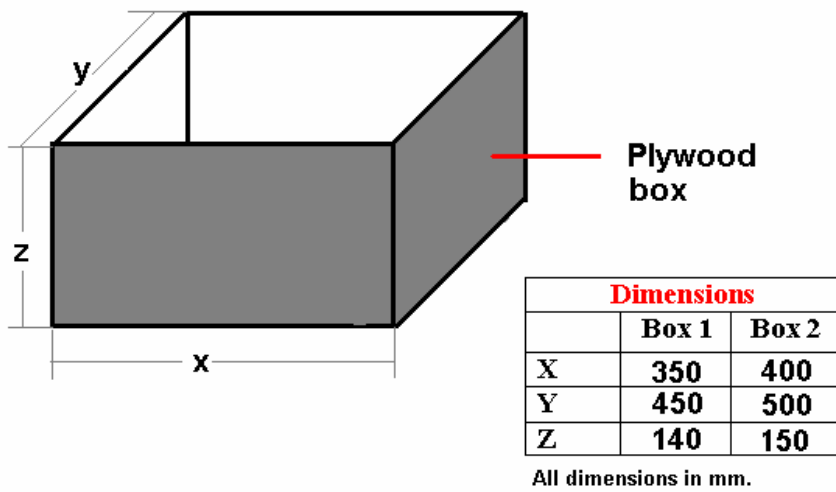


Fig 63a Details of plywood box.



Fig 63b A view of liquefaction model setup.

Model 12

The model consists of slabs, stiffeners and columns. Table 16 guides you to the detailed drawing of each part involved in constructing the model. See Fig 64 and Fig 70 to assemble the model.

Table 16

Sl.no	Parts	Details/Specifications
1	Slab	See Fig 65,66
2	Column	See Fig 67
3	Stiffener A	See Fig 68
4	Stiffener B	See Fig 69
5	Screws	M6 Allen screws, L=20mm Qty = 60 nos. M3, L=10mm , Qty = 140 nos.



Fig 64 A view of four story model with stiffeners.

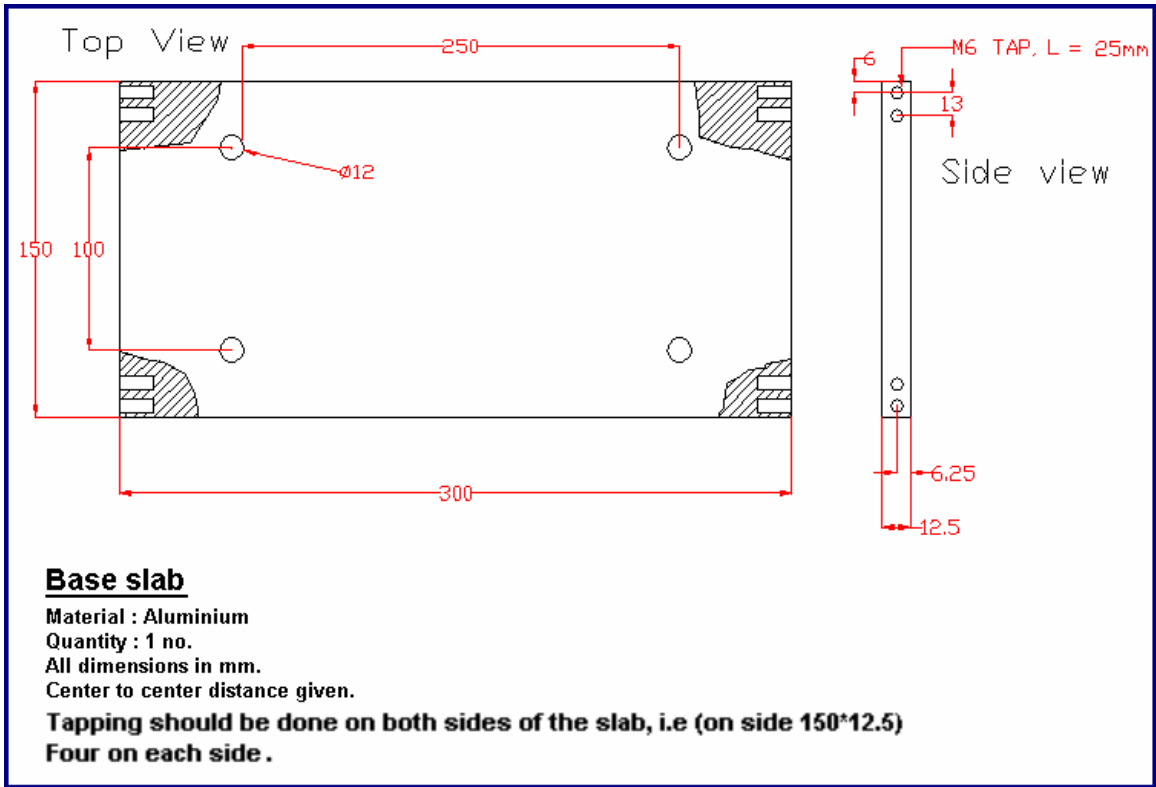


Fig 65 Details of base slab.

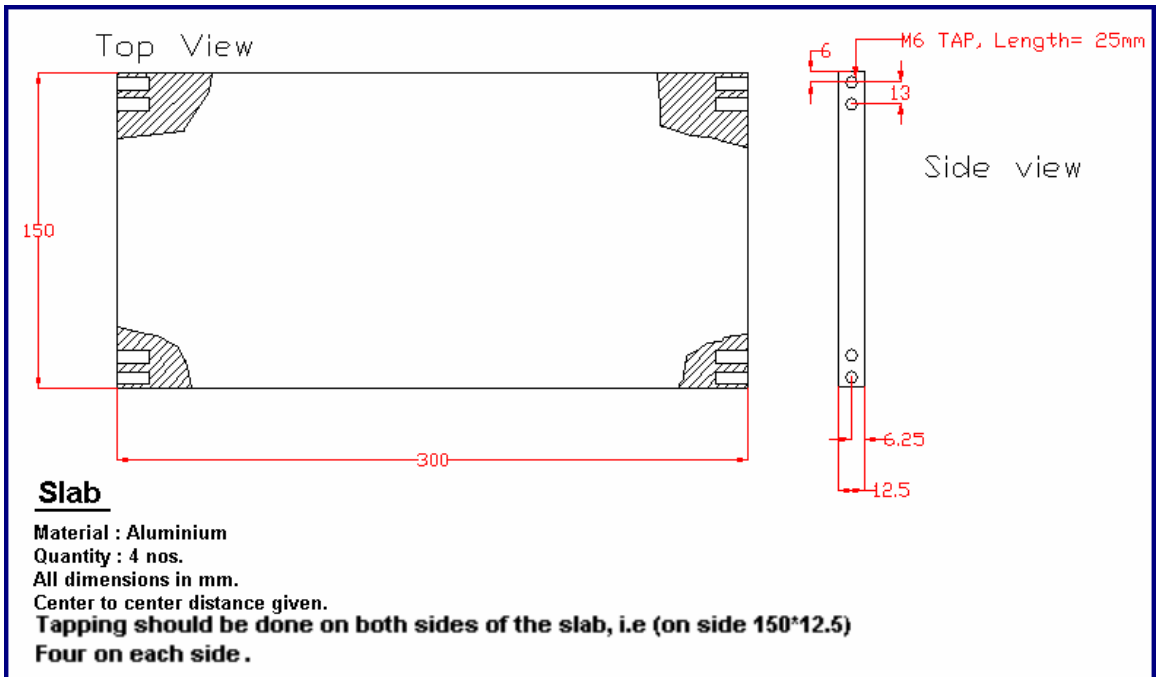


Fig 66 Details of slab.

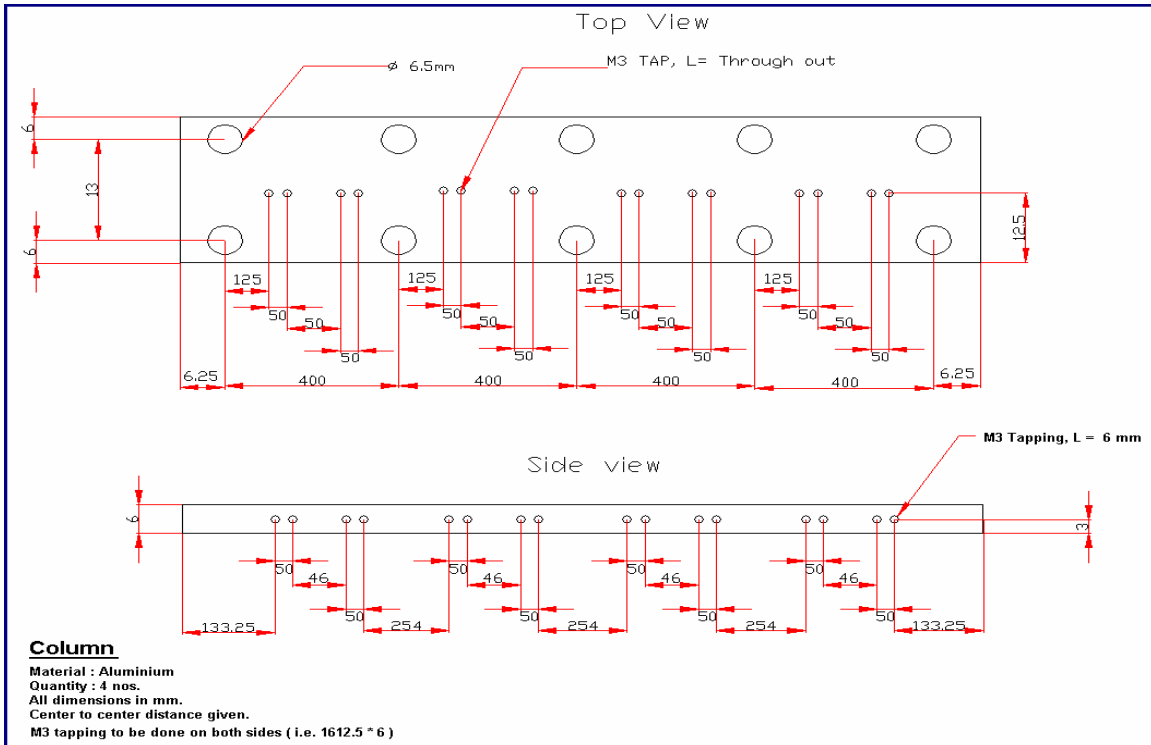


Fig 67 Details of column.

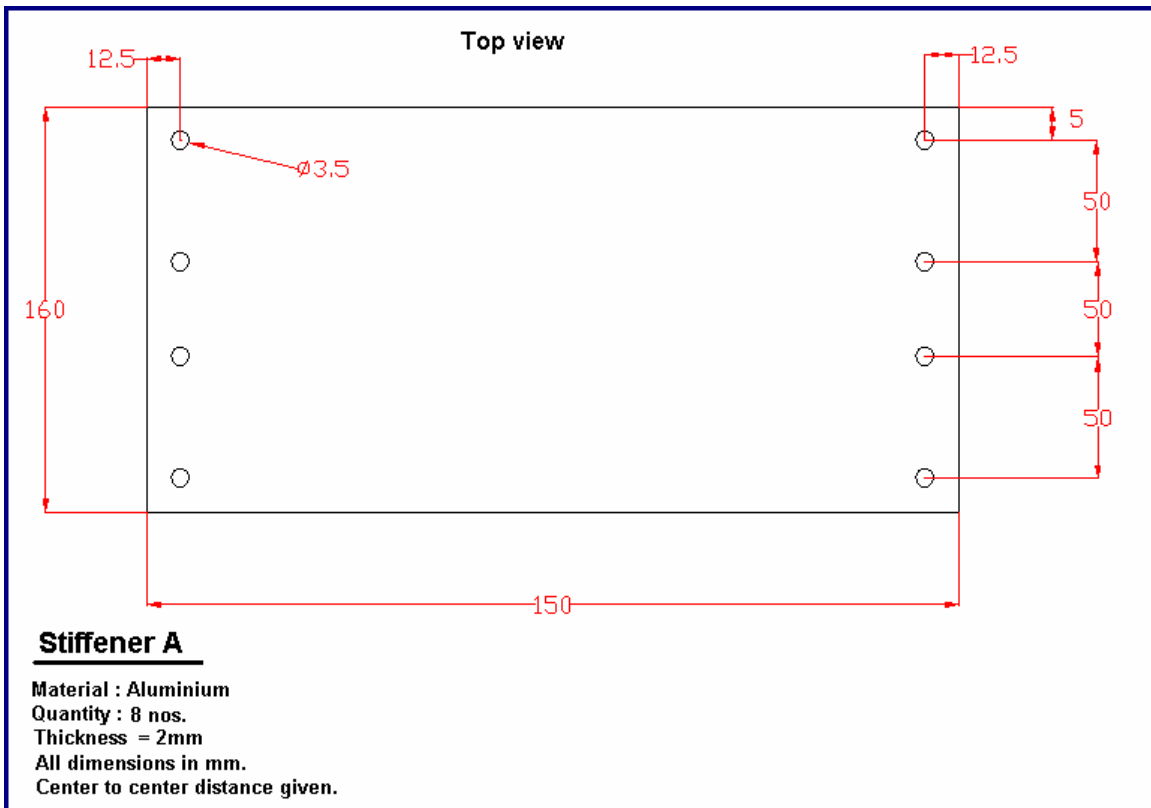


Fig 68 Details of stiffener A.

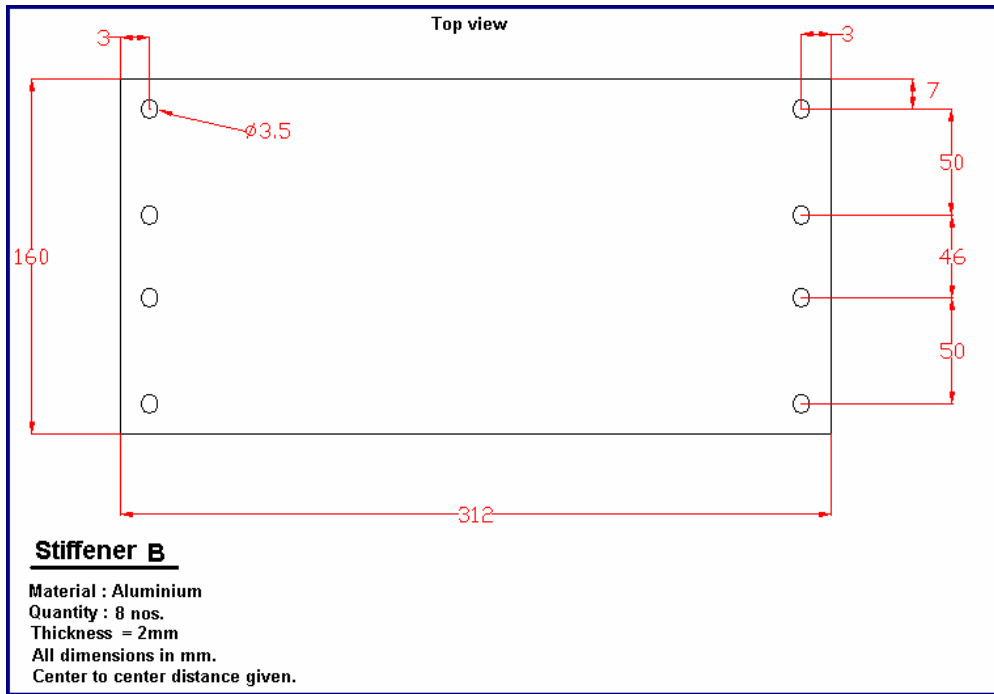


Fig 69 Details of stiffener B.

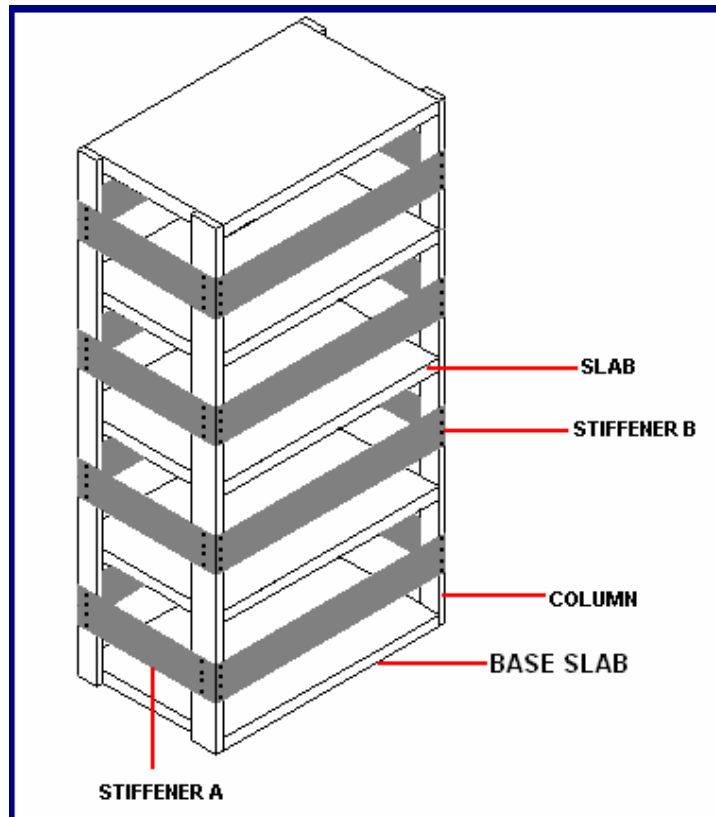


Fig 70 Schematic diagram of four story frame with stiffeners.

Model 13

The model consists of slabs, stiffeners and columns. Table 17 guides you to the detailed drawing of each part involved in constructing the model. See Fig 76 to assemble the model.

Table 17

Sl.no	Parts	Details/Specifications
1	Slab	See Fig 71,72
2	Column	See Fig 73
3	Stiffener A	See Fig 74
4	Stiffener B	See Fig 75
5	Screws	M6 Allen screws, L=20mm, Qty = 16 nos.
		M3, L=10mm, Qty = 32 nos.

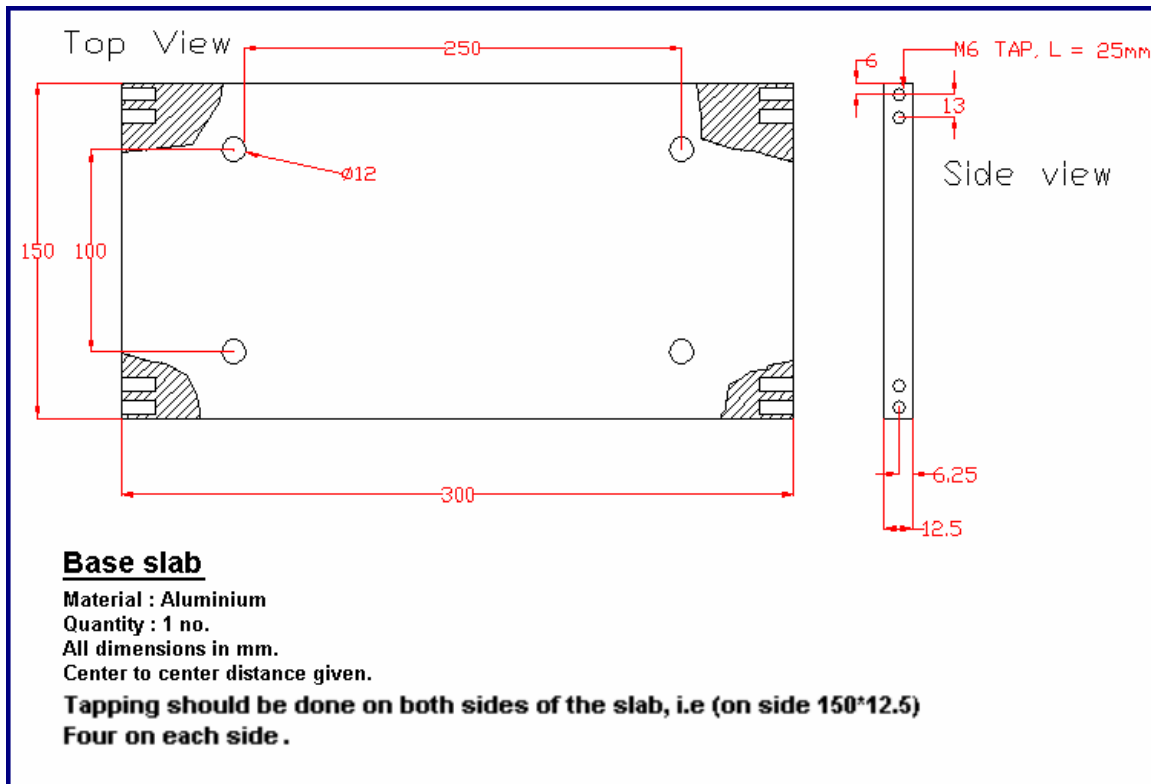


Fig 71 Details of base slab.

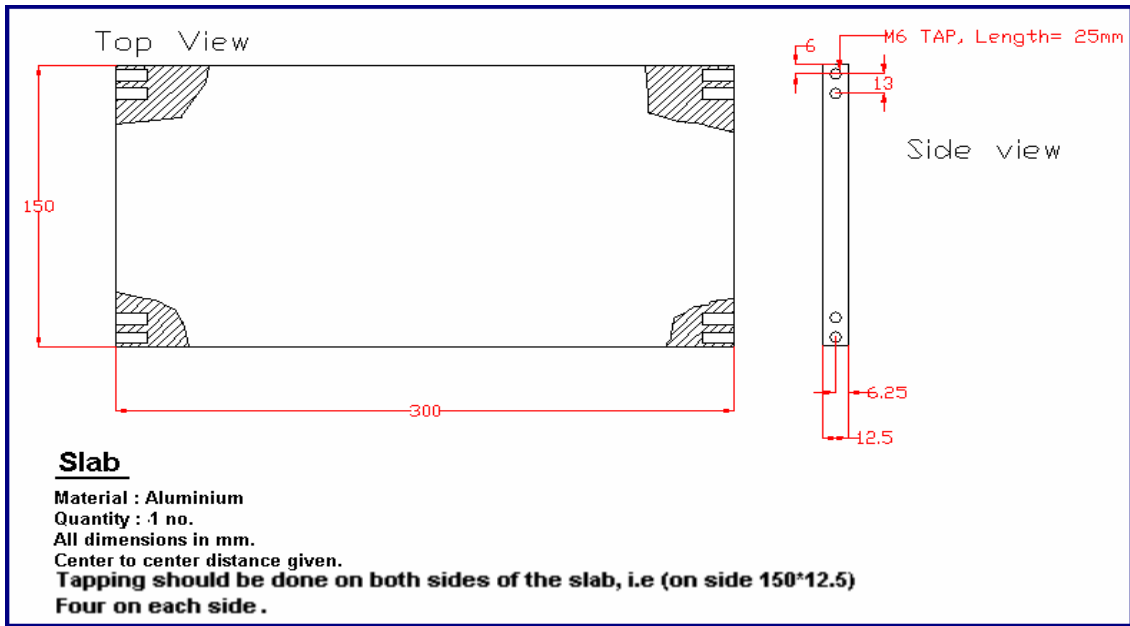


Fig 72 Details of slab.

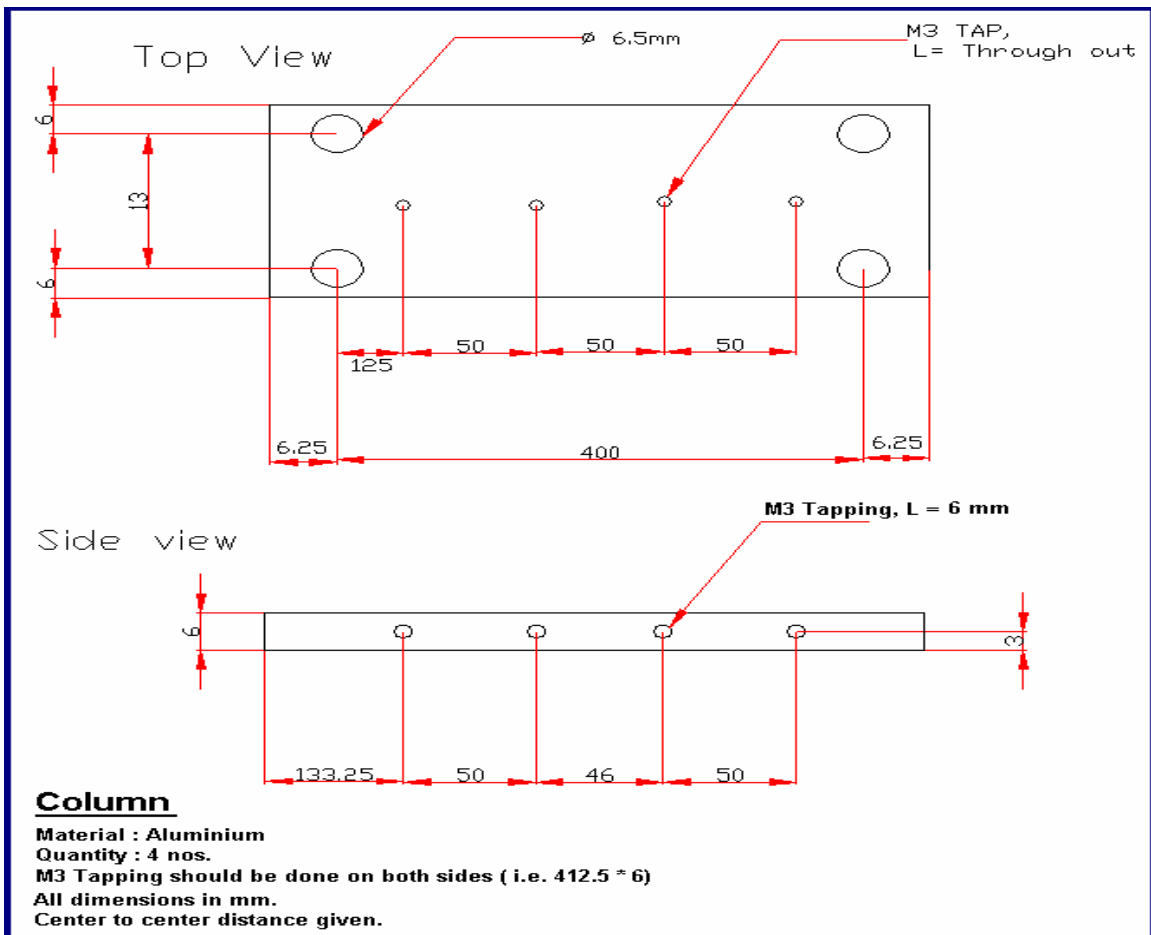


Fig 73 Details of column.

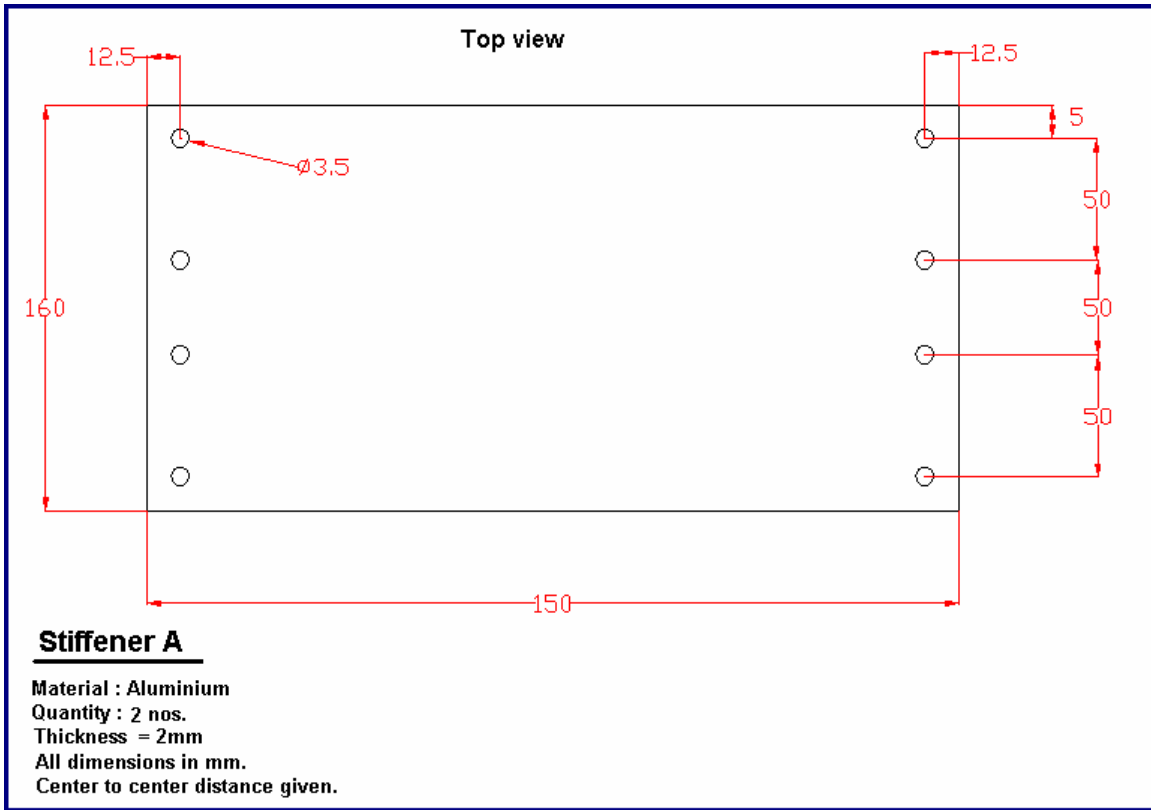


Fig 74 Details of Stiffener A.

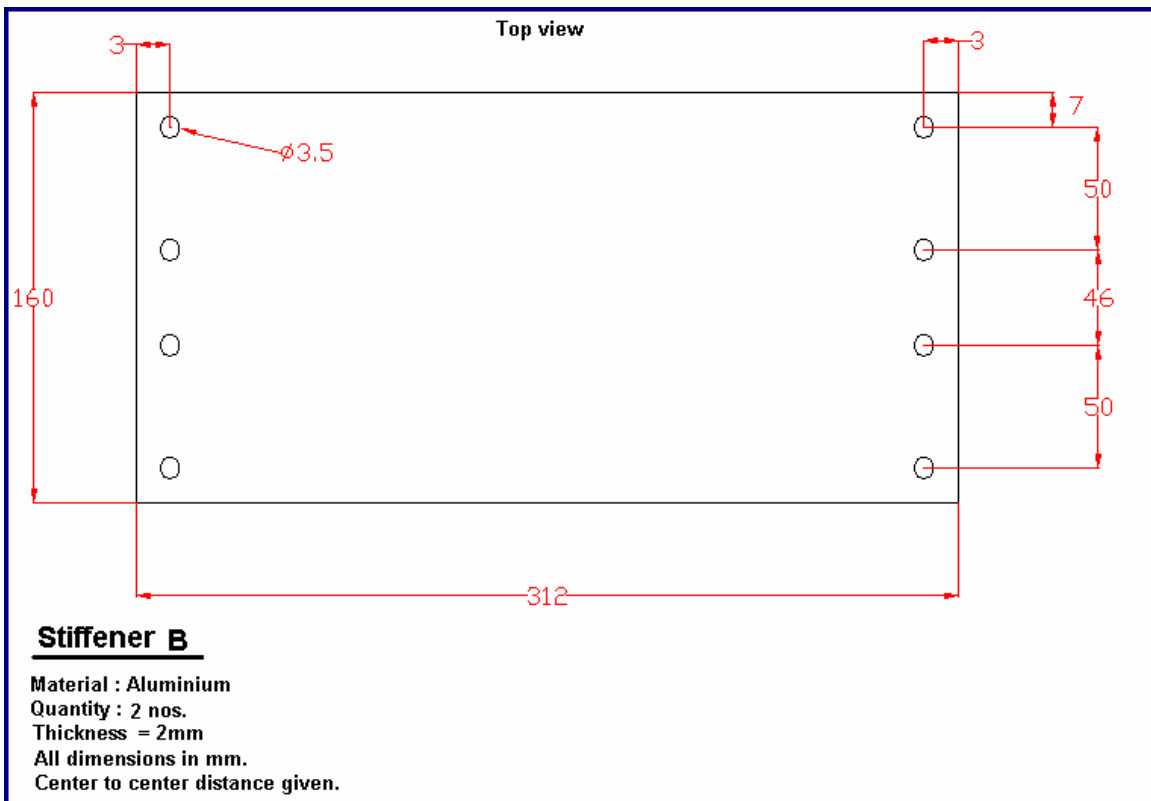


Fig 75 Details of stiffener B.

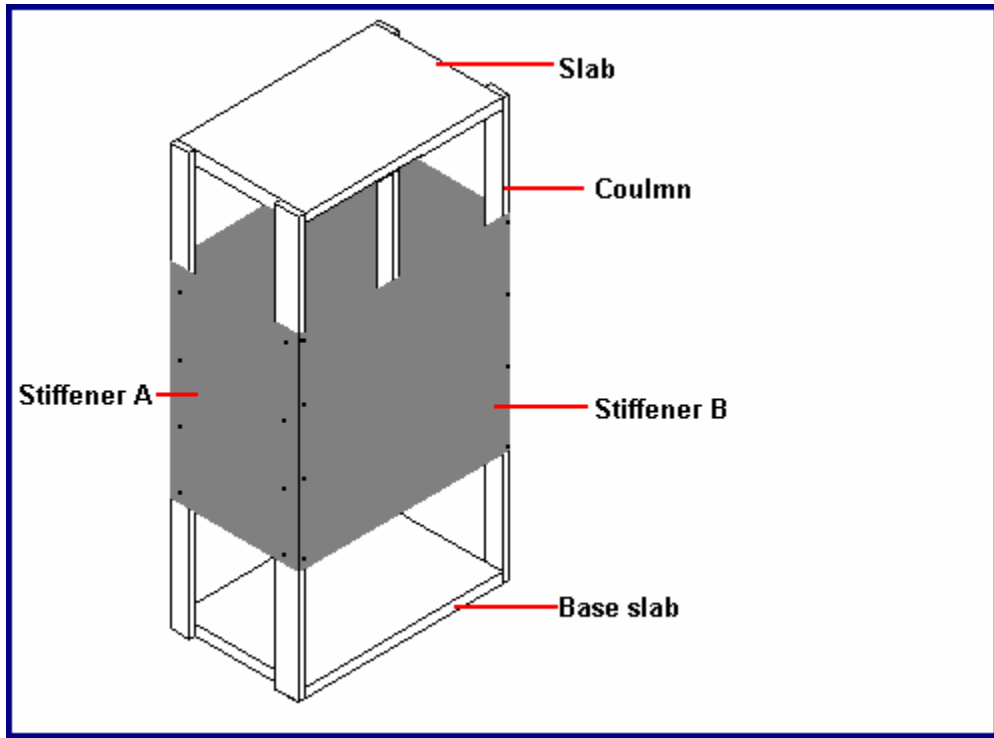


Fig 76 Schematic diagram of one story frame with stiffeners

Model 14

The model consists of slabs, Rebars and sleeves. Table 18 guides you to the detailed drawing of each part involved in constructing the model. See Fig 77 and Fig 83 to assemble the model.

Table 18

Sl.no	Parts	Details/Specification
1	Slab	See Fig 78, 79
2	Rebars1	See Fig 80
3	Rebars2	See Fig 81
4	Sleeve	See Fig 82
5	Screws	M6 Allen screws, L=25mm, Qty = 40 nos.



Fig 77 A view of 4 story frame.

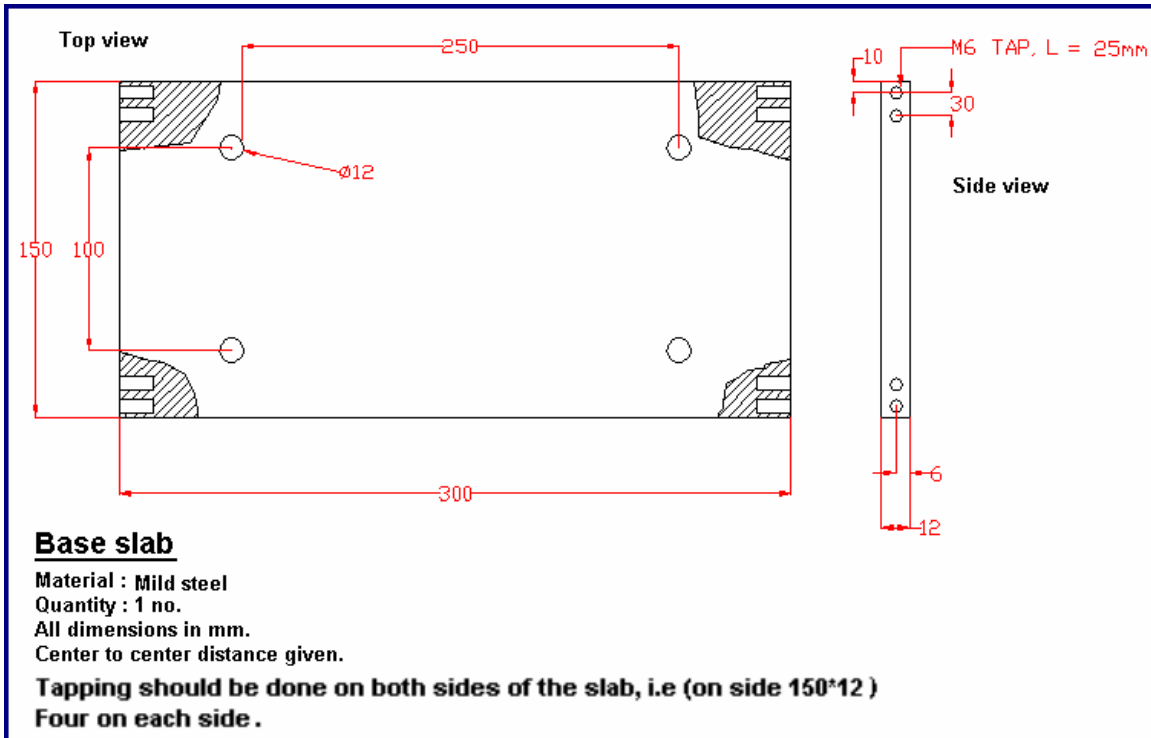


Fig 78 Details of base slab.

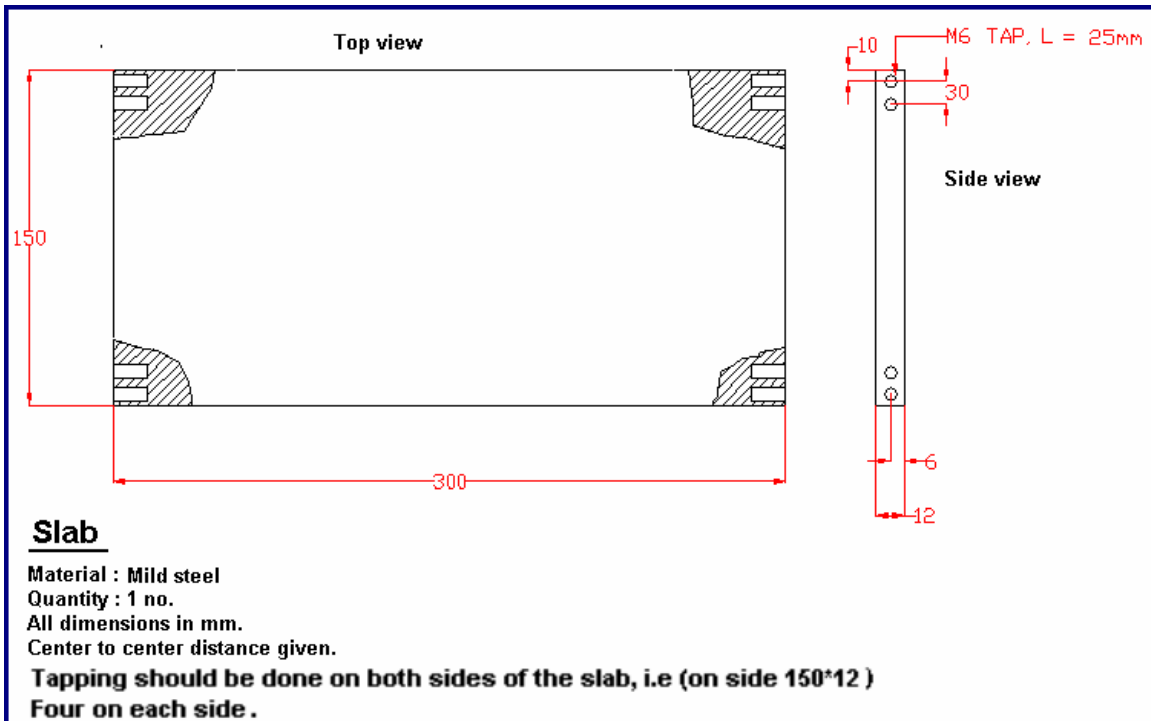


Fig 79 Details of slab.

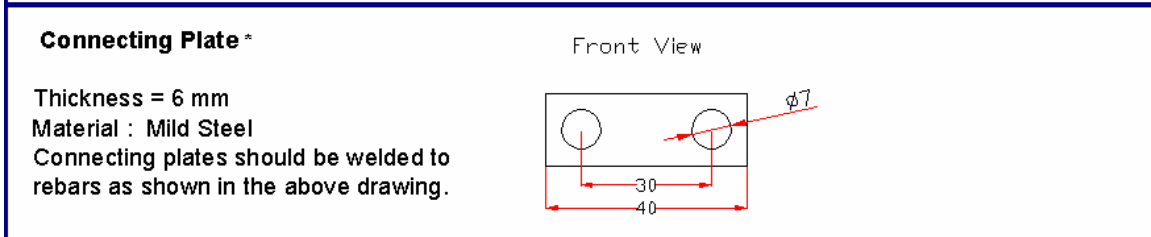
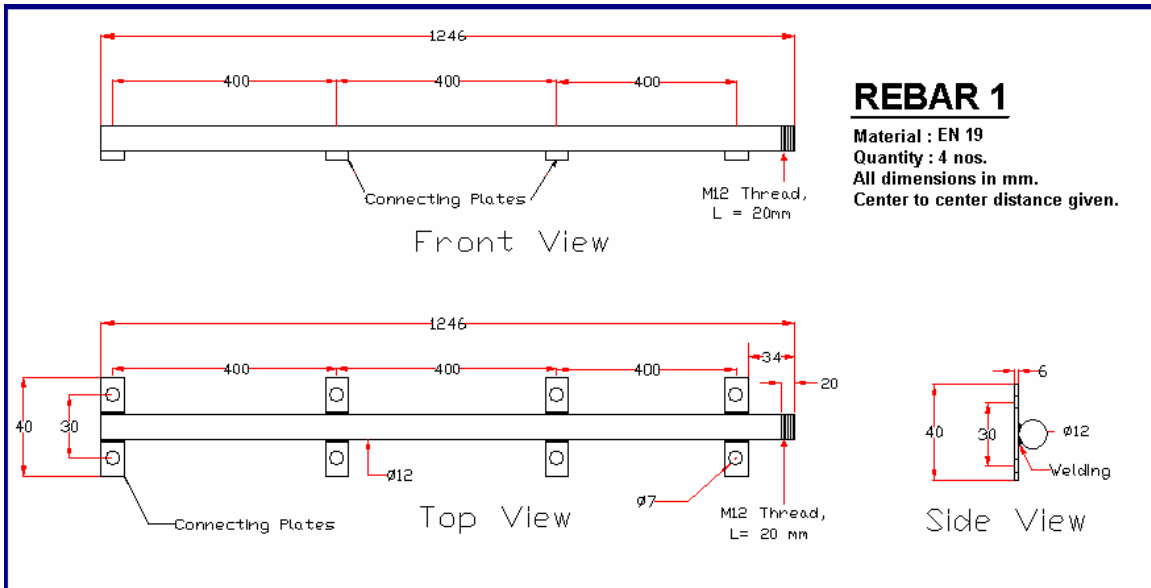
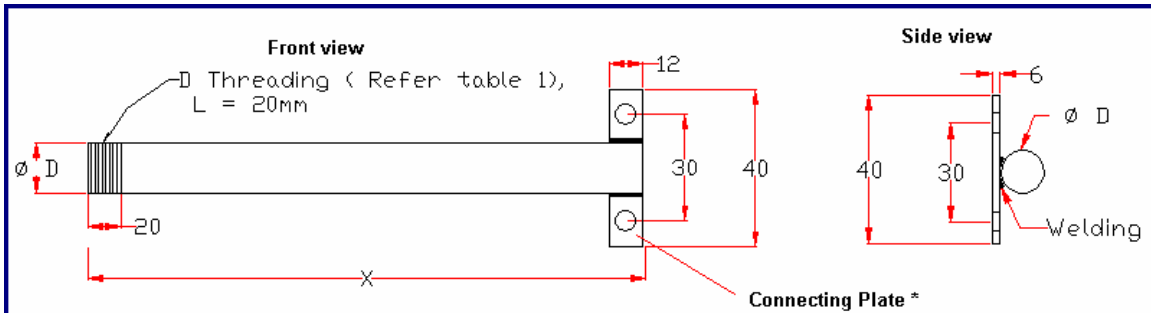


Fig 80 Details of Rebar1.



Rebar2

Table 1

Quantity	4	4	4
Length (X mm)	361	281	411
Diameter (D mm)	12	10	10
Material	EN 19	Mild steel	Mild steel

All dimensions in mm. Center to center distance given.

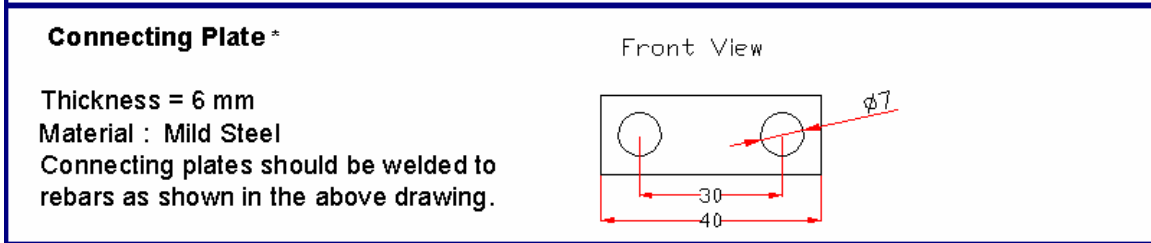


Fig 81 Details of Rebar2.

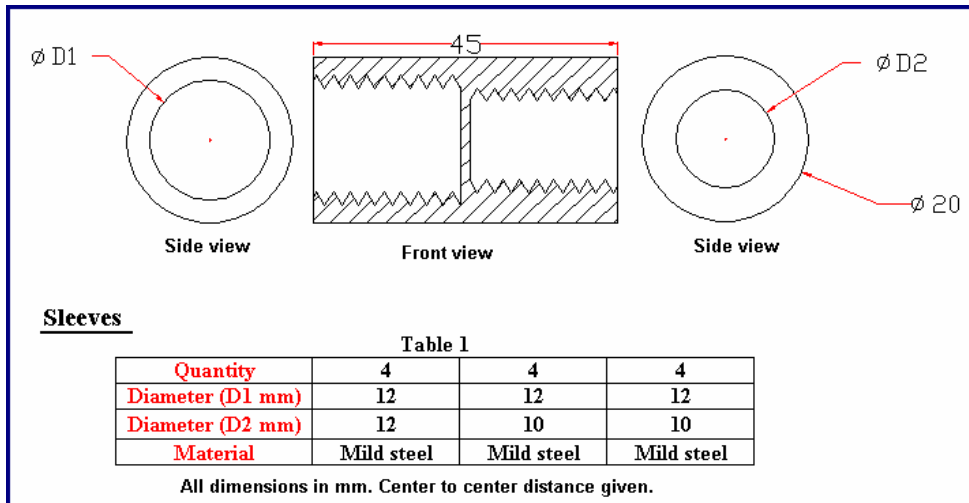


Fig 82 Details of sleeves.

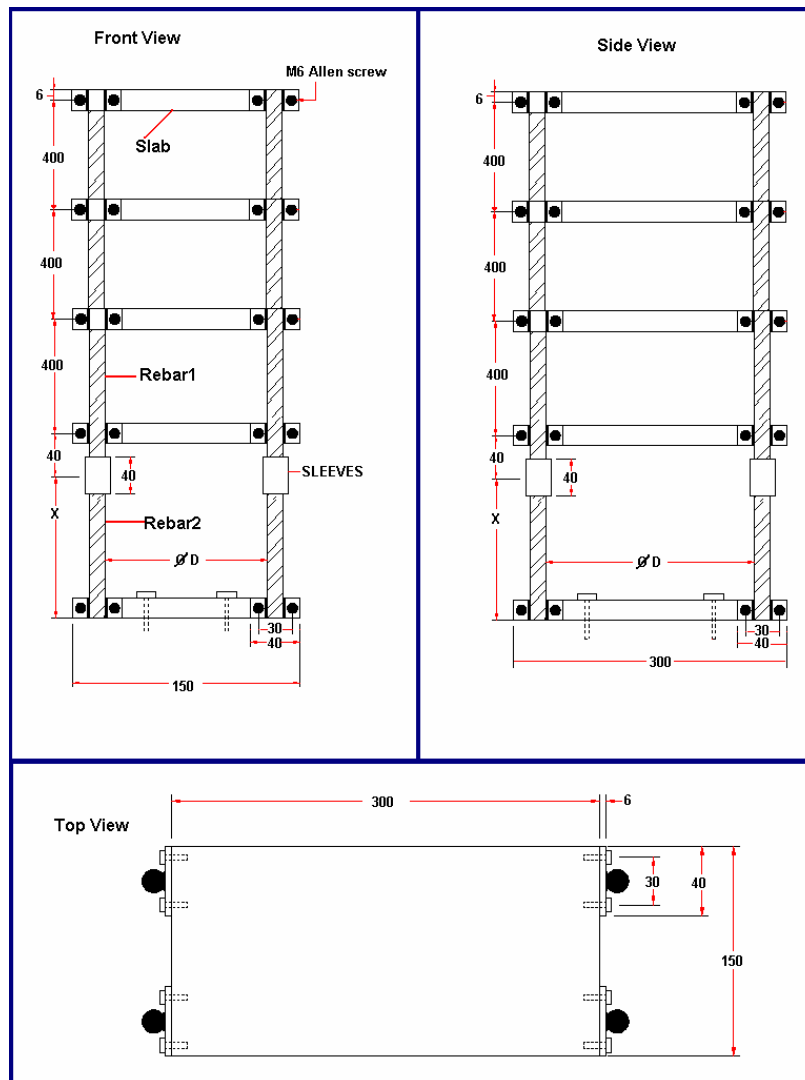


Fig 83 Schematic diagram of four story frame.

Model 15

Table 19

Sl.no	Parts	Material	Details
1	Water tank wall	Perspex	See Fig 84
2	Exterior Frame (Angles)	Mild steel	

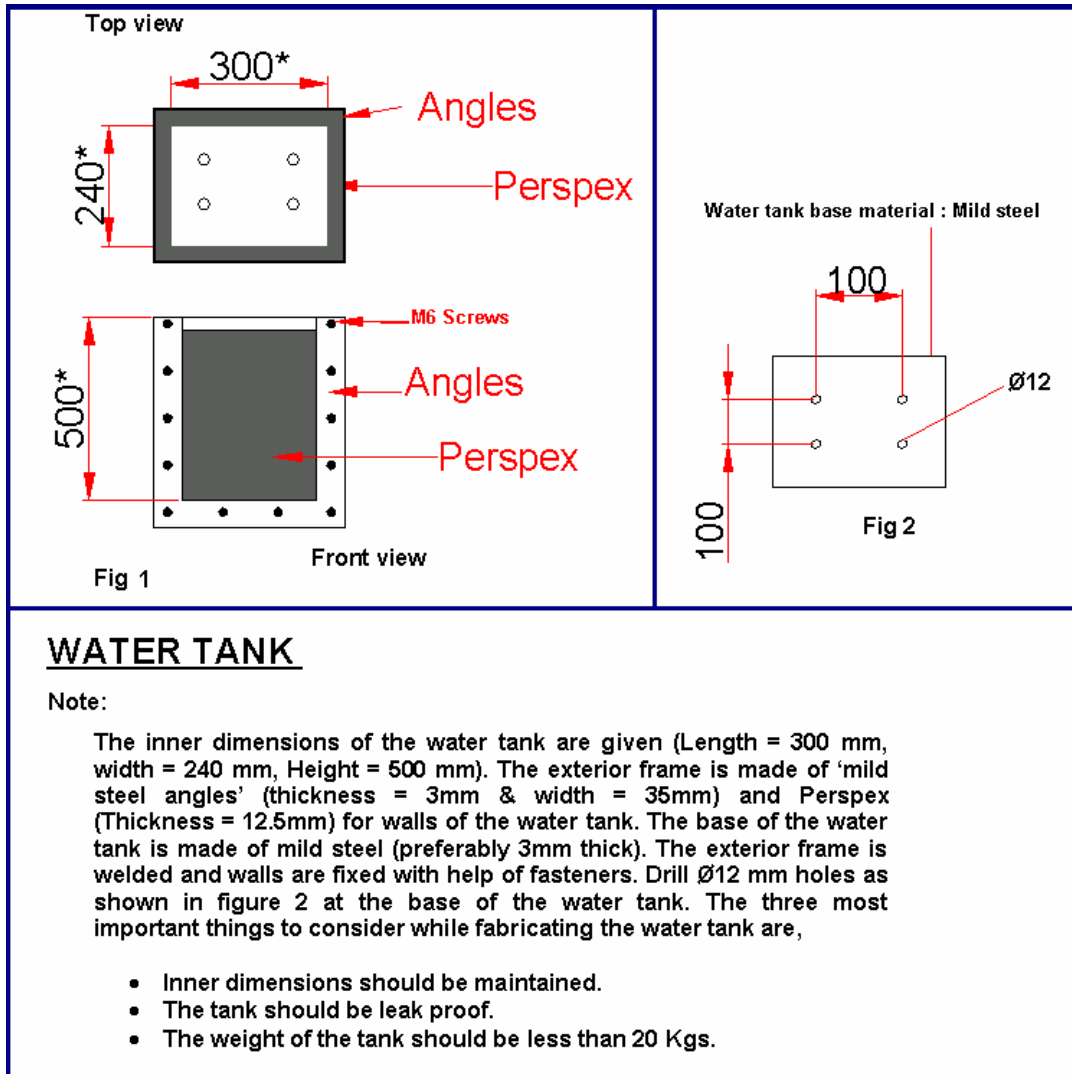


Fig 84 Details of water tank



Fig 85 A view of water tank