Catalogue for Alternative Construction Materials and Technologies

DESIGN CATALOGUE FOR
RECONSTRUCTION OF EARTHQUAKE RESISTANT HOUSES

VOLUME II





MARCH, 2017 (FALGUN,2073)

GOVERNMENT OF NEPAL
MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION
BABARMAHAL, KATHMANDU

DESIGN CATALOGUE FOR RECONSTRUCTION OF EARTHQUAKE RESISTANT HOUSES

Approved by Nepal Government (Minister Level/ Minister of Urban Development)
2073/12/16

VOLUME-II

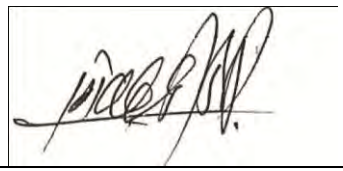
GOVERNMENT OF NEPAL
MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION
BABARMAHAL, KATHMANDU

FOREWORD

It is my immense pleasure that Design Catalogue Volume II comprising of alternative construction materials and technologies is published. The devastating Earthquake of 25th April 2015 and its aftershocks not only resulted in massive loss of life and properties but also raised awareness among development practitioners the need to improve our physical infrastructures to make our communities resilient against these kind of disasters. I see this post-earthquake reconstruction as an opportunity to improve our housing construction technology and practice at grass root level.

The objective of this document is to pave way for use of alternate materials and technologies in the reconstruction process. As per the principles set by Post Disaster Needs Assessment (PDNA) for housing and human settlements recovery and reconstruction, the proposed cost efficient, environment friendly and green technologies are expected to be helpful for sustainable reconstruction of both urban and rural houses.

I would like to sincerely thank Mr. Deependra Nath Sharma, respected Secretary of Ministry of Urban Development for his valuable support and suggestion during the process. I am also thankful to Mr. Ravi Shah, former Deputy Director General, Mr. Ram Chandra Dangal, Deputy Director General (Housing Division) and Mr. Raju Neupane, Senior Divisional Engineer and all the staffs of Housing Division for their continuous involvement during the preparation of this document. I also express my thanks to the team of Central Level Project Implementation Unit (CLPIU) for their support in bringing out this publication. My thanks also goes to all the personnel and agencies for their hard work and concerned efforts on preparation of this important document.



Er. Shiva Hari Sharma
Director General,
Department of Urban Development and Building Construction (DUDBC)

PREFACE

I would like to congratulate all the personnel and agencies involved in the development of Design Catalogue Volume II for reconstruction of Earthquake Resistant Houses. This publication has been developed by the Department of Urban Development and Building Construction to support urban and rural households in the reconstruction of their houses.

The second volume of Design Catalogue consists of seventeen model designs based on twelve alternative materials and technologies not covered by Nepal National Building Code. A wide variety in terms of materials, technology, cost, size and layout are provided to cater the diverse need of both urban and rural households. The proposed designs are ready to use designs and technical details are provided accordingly.

I again express my sincere thanks to members of Technical Working Group, Task Force, Structural experts, UNDP and all personnel of DUDBC and Central Level Project Implementation Unit (CLPIU) involved directly or indirectly in preparation of this publication.

Er. Ram Chandra Dangal
Deputy Director General,
Department of Urban Development and Building Construction (DUDBC)

BACKGROUND

The devastating earthquake of April 25th, 2015 and its aftershocks caused widespread damage to both life and properties. Housing and Human settlement sector was one of the most affected sector. The Government of Nepal figures indicate that around 602,257 houses were fully damaged, 285,099 houses were partially damaged and loss of life was about 9000.

The Post Disaster Needs Assessment (PDNA) report of Government of Nepal, sets out principles for housing and human settlements recovery and reconstruction as follows:

- Encourage the participation of communities by empowering them to take control of reconstruction of their houses and ensuring facilitation of Owner Driven reconstruction
- A comprehensive view of housing reconstruction should indicate holistic habitat development, with basic services and community infrastructure. The principles of Build Back Better (BBB) should translate into a concept of safer settlements.
- Reconstruction should be seen as a vehicle to build long-term community resilience by reducing vulnerabilities and strengthening community capacities to mitigate future disasters through improved construction practices for the majority of building stock in the country.
- Strengthen the local economy through reconstruction and processes that work to the benefit of the poor and marginalised sections who are mostly in the informal sector. Reconstruction should provide an opportunity for the poor to upgrade their living conditions.
- Ensure sustainable and environment-friendly reconstruction processes, taking note of climate change, natural resource management and scientific risk assessments.
- Ensure that rehabilitation is equitable and inclusive.

INTRODUCTION

DUDBC has prepared second volume of Design Catalogue and named it as "**Catalogue for Reconstruction of Earthquake Resistant Houses Volume II".** The Catalogue includes architectural design, structural detailing and material estimate. The main objective is to support urban and rural households in reconstruction of their houses.

The model designs of seventeen houses provided in the catalogue are placed under the following twelve technologies:

- Interlocking Brick Masonry
- Confined Hollow Concrete Block Masonry
- Hollow Concrete Block Masonry
- Compressed Stabilized Earth Block Masonry
- Random Rubble Masonry with GI Wire Containment
- Bamboo and Stone Masonry Hybrid Structure
- Rat Trap Bond Masonry
- Earth Bag Masonry
- Light Gauge Steel Structure
- Steel Structure
- Timber Structure
- Debris block Masonry

The designs provided in this catalogue are based on calculations, model test and analytical tests as these technologies are not covered by Nepal National Building Code, 2060. These designs are approved by Ministry of Urban Development. For each design included in the catalogue, the following information is provided:

- 3D view of the design
- Floor plans
- Elevations
- Section
- Structural Details
- Quantity estimate of major materials

Designs included in this catalogue can be selected and used as they are, for reconstruction of urban and rural housing . For designs, other than those included in this catalogue, detailed engineering design and approval from concerned authorities shall be done.

LIST OF MODELS

TABLE OF CONTENT

INTERLOCKING BRICK MASONRY

I.B.-1.1

I.B.-1.2

I.B.-1.3

Interlock Brick Technology consists of specially designed unburnt bricks with tongue and groove features that allows bricks to interlock each other in masonry and thereby reduces mortar usage. Construction with interlocking brick is economical, quick and environment friendly. Special design of interlocking bricks allows for vertical reinforcement bars in strategic locations of buildings. Three designs are featured under this category. Model I.B 1.1 and I.B 1.3 are single storied one bedroom units. Load bearing walls are of Interlocking Bricks with corrugated galvanized iron sheet roofing. Model I.B. 1.2 is a two storied 3 bedroom housing units. Interlocking bricks are used for wall and precast joist and pan are used for floors. Both vertical and horizontal reinforcement are used and grouted respectively in different part of building

MATERIAL PROPERTIES

Block Size: 30cm X 15cm X10cm of Full Size
15cm X 15cm X10cm of Half Size
Min Compressive Strength of Block : 3.5 MPa
Nominal Mix Ratio: 1:1.5:3 (C:S:A)
Min Yield Strength of Reinforcing Steel :415 MPa

Regular Brick 15 X 30 X 10 cm

Half regular Brick 15 X 15 X 10 cm

U-shaped Brick 15 X 30 X 10 cm

Half U-shaped Brick 15 X 15 X 10 cm

I.B.-1.1

I.B.-1.2

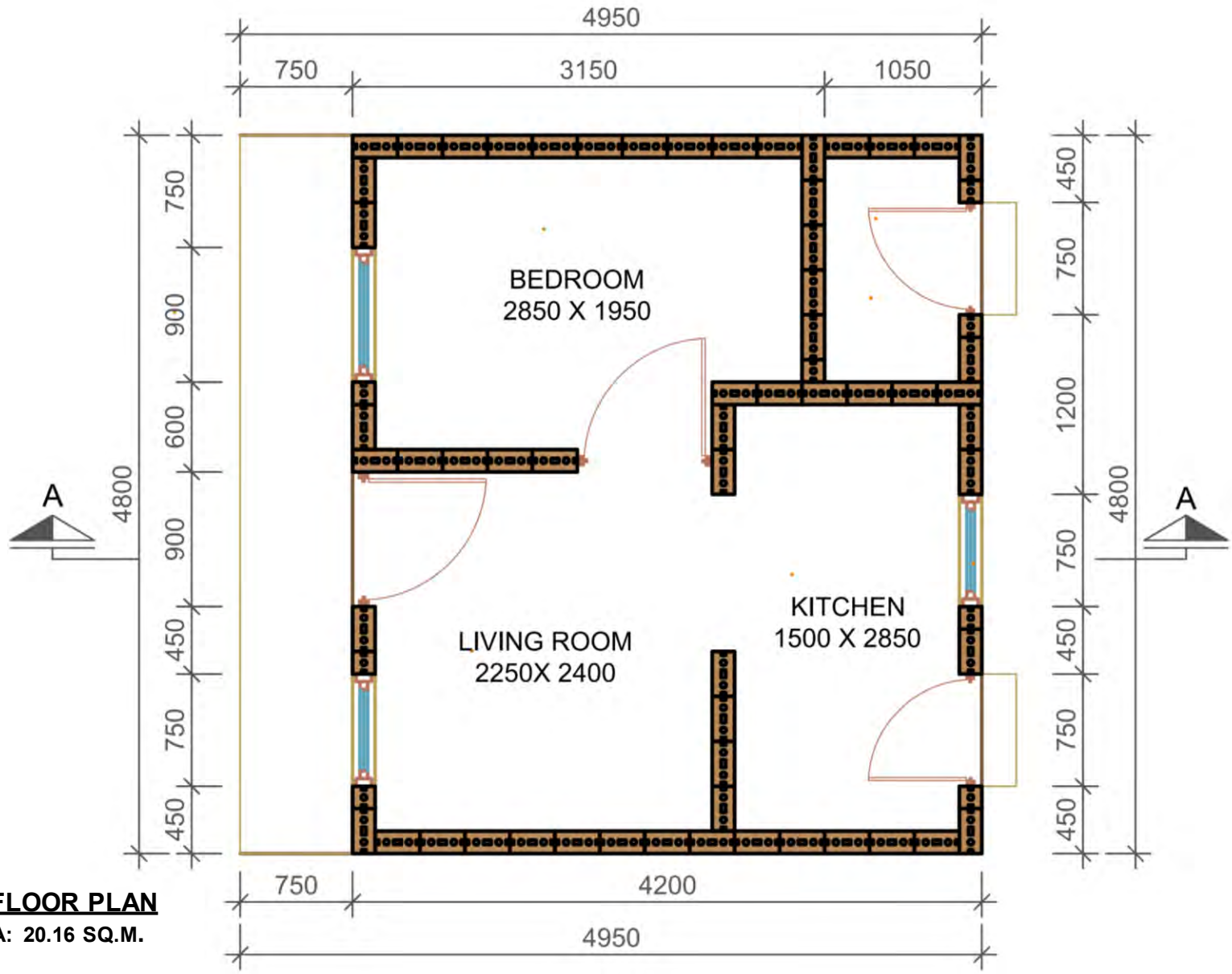
I.B.-1.3

MODEL I.B.-1.1, INTERLOCKING BRICK MASONRY — ONE STOREY

LEVEL	MATERIALS								
	Stone	Interlocking Bricks	Cement	Sand	Aggregate	Reinforcing Bar	CGI sheet	GI Sheet	Wood
	Cu,m	No.	Bags	Cu.m.	Cu.m.	Kg.	Bundle	Sq.m.	Cu.m.
Up to Plinth Level	8.4	-	39.9	5.3	3.2	112.1			-
Super Structure	-	4,912.0	16.2	0.9	1.7	167.3			0.1
Roofing	-	0.3	-	-	-	-	3.5	6.5	0.9
TOTAL	**8.4**	**4,912.3**	**56.1**	**6.1**	**4.9**	**279.4**	**3.5**	**6.5**	**1.0**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.1	SCALE: NONE	I.B.-1.1
	DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	1/5

MODEL I.B.-1.1, INTERLOCKING BRICK MASONRY — ONE STOREY

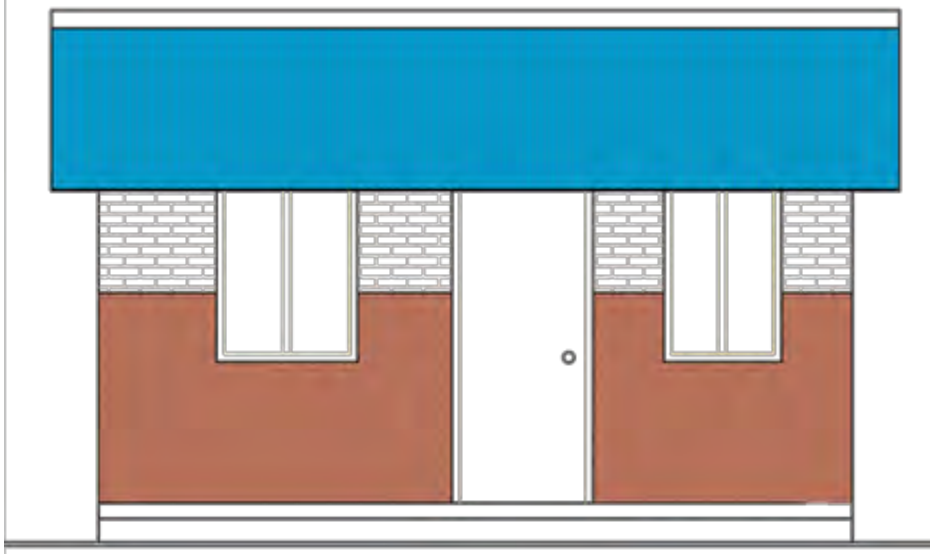


GROUND FLOOR PLAN

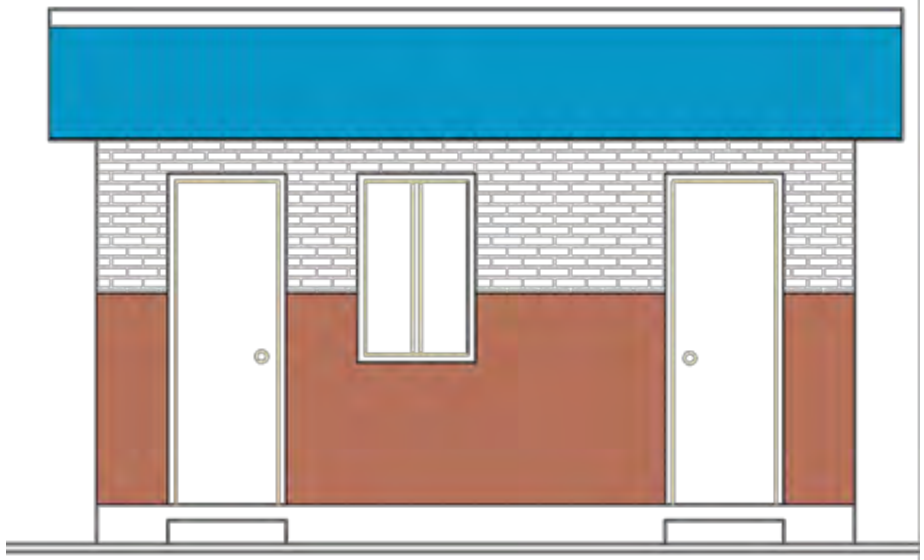
FLOOR AREA: 20.16 SQ.M.

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.1	SCALE: NONE	I.B.-1.1
	DRAWING TITLE: GROUND FLOOR PLAN	DATE:	2/5

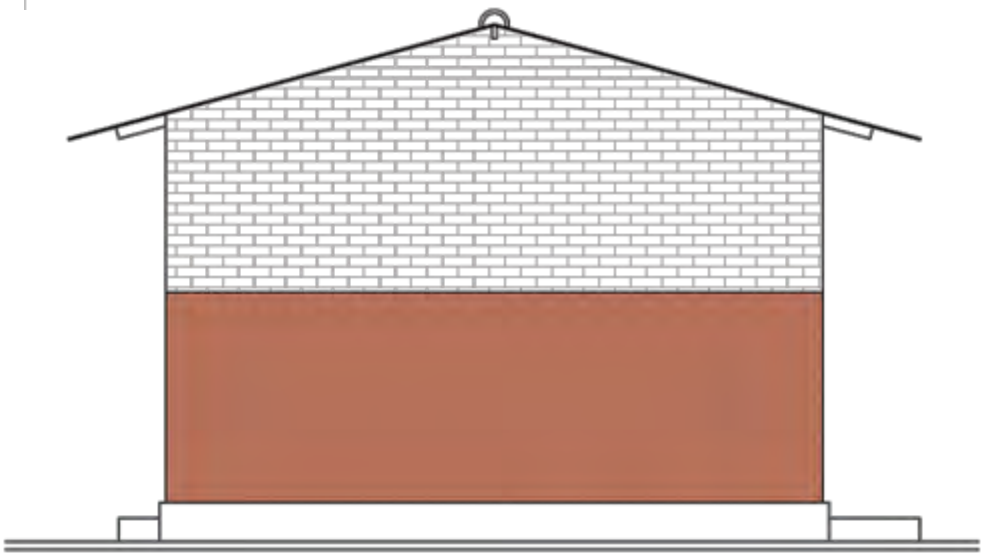
MODEL I.B.-1.1, INTERLOCKING BRICK MASONRY — ONE STOREY



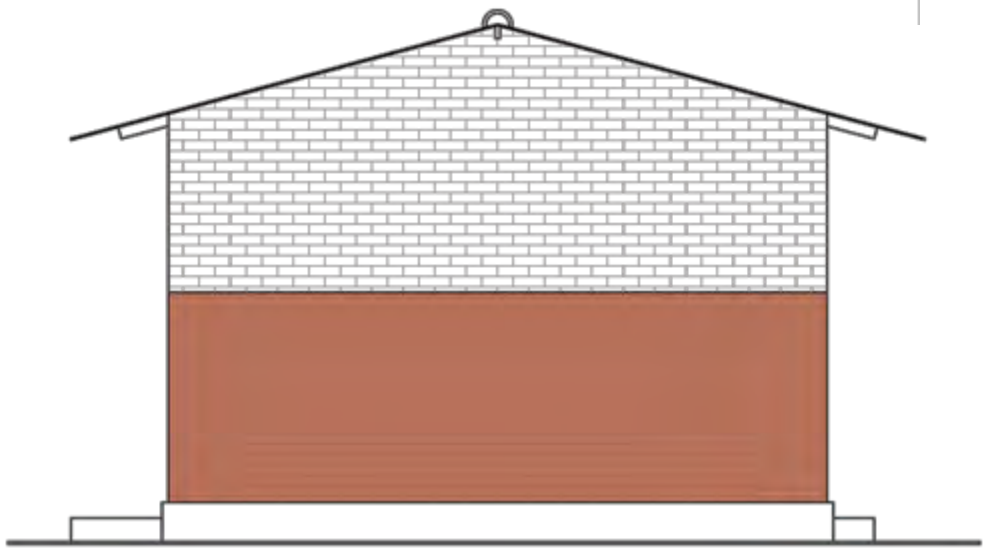
FRONT ELEVATION



BACK ELEVATION



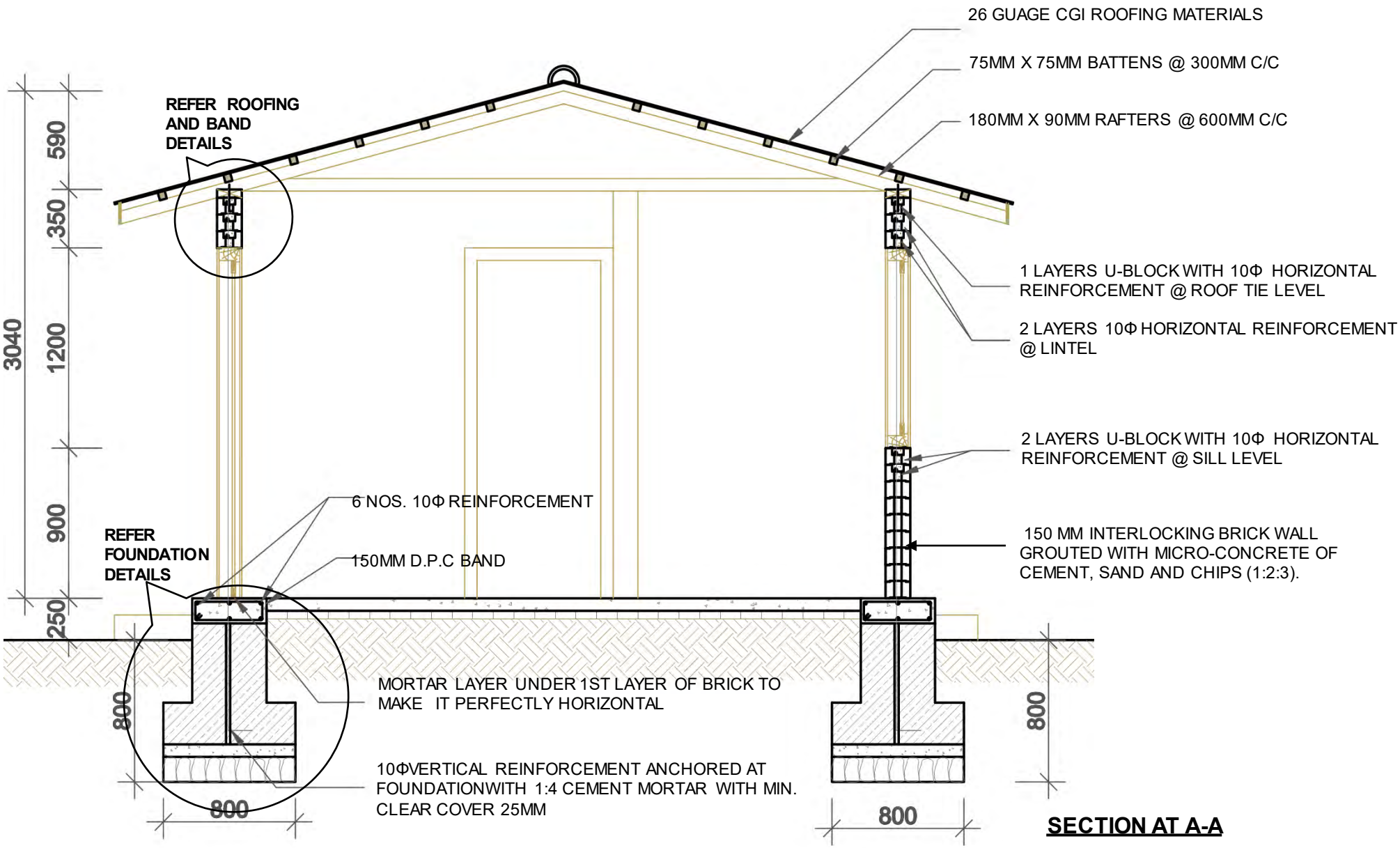
SIDE ELEVATION



SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.1	SCALE: NONE	I.B.-1.1
	DRAWING TITLE: ELEVATIONS	DATE:	3/5

MODEL I.B.-1.1, INTERLOCKING BRICK MASONRY — ONE STOREY



SECTION AT A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.1	SCALE: NONE	I.B.-1.1
	DRAWING TITLE: SECTION	DATE:	4/5

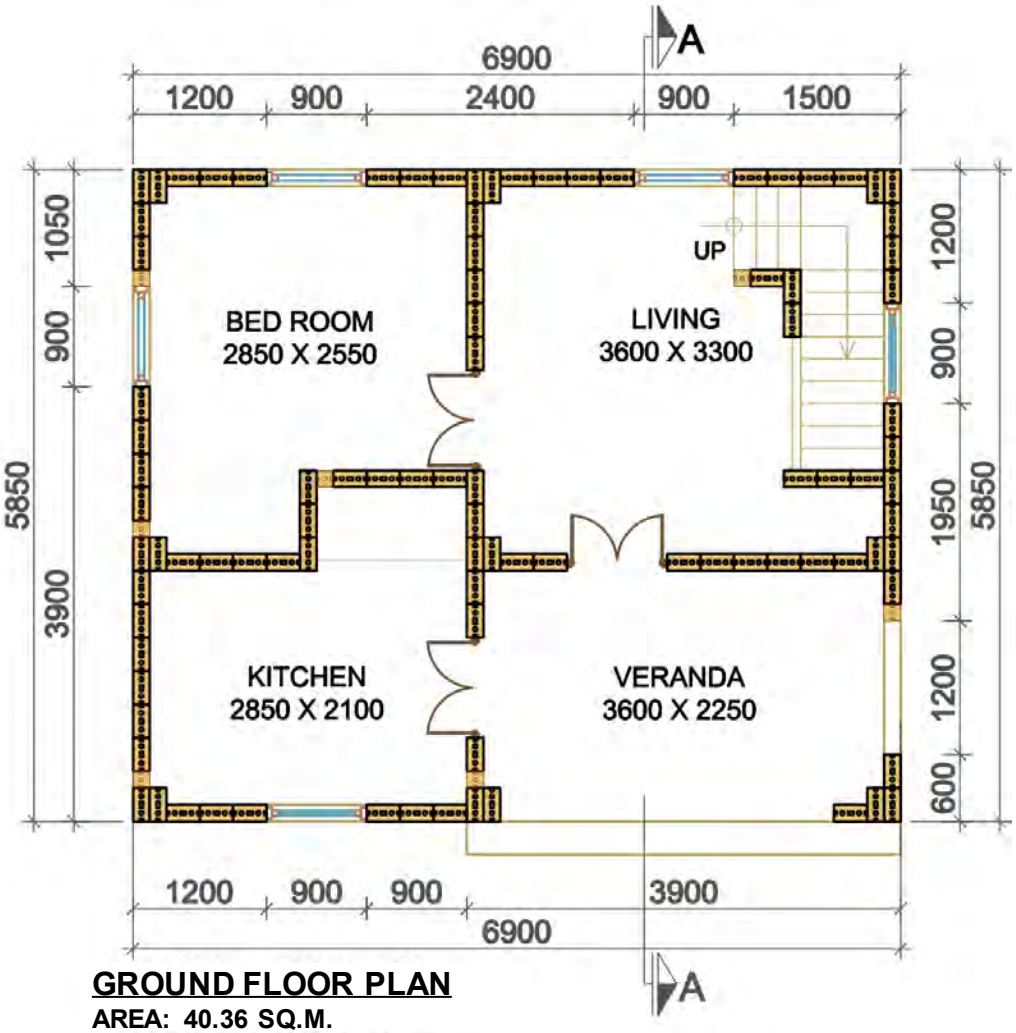
TECHNICAL REQUIREMENTS

Structure System	Reinforced Stabilized Interlocking Brick Masonry Structure with horizontal and vertical reinforcing bars in strategic locations.
Foundation	Strip Foundation of Stone Masonry in1:6 cement sand mortar. Foundation size shall be of width 800mm and depth 800 mm (refer drawing).
Plinth Band	R.C.C (1:1.5:3) band of size 450mm x 150 mm. 6 nos. of 10 mm Ø reinforcement with 8 mm Ø stirrups at 150 mm C/C.
Wall	Load bearing walls of Interlocking bricks. Interlocking bricks shall be made of cement and soil mixed in 1:8 ratio. Two types of Interlocking blocks; normal and U shaped shall be used in full size (300 x 150x 100 mm) and half size (150 x 150 x 100 mm). These blocks shall be air cured for 1 day and water cured for 21 days. Minimum Compressive strength of the block shall be 3.5 Mpa. 12 mm Ø vertical bars shall be provided at corners and joints and grouted with Micro concrete 1:2:3 (Cement, Sand & Chips) ratio. Horizontal reinforcement requirement is stated in sill and lintel details below.
Sill Band	2 layers of special U shaped Interlocking bricks shall be used in Sill level. In the grove of U shaped Bricks, 12 mm Ø reinforcements shall be provided in each layer and grouted with Micro concrete 1:2:3 (Cement, Sand and Chips) ratio.
Lintel Band:	2 layers of special U shaped Interlocking bricks shall be used in Lintel level. In the grove of U shaped Bricks, 12 mm Ø reinforcements shall be provided in each layer and grouted with Micro concrete 1:2:3 (Cement, Sand and Chips) ratio.
Roof:	Lightweight roof of corrugated Iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing.

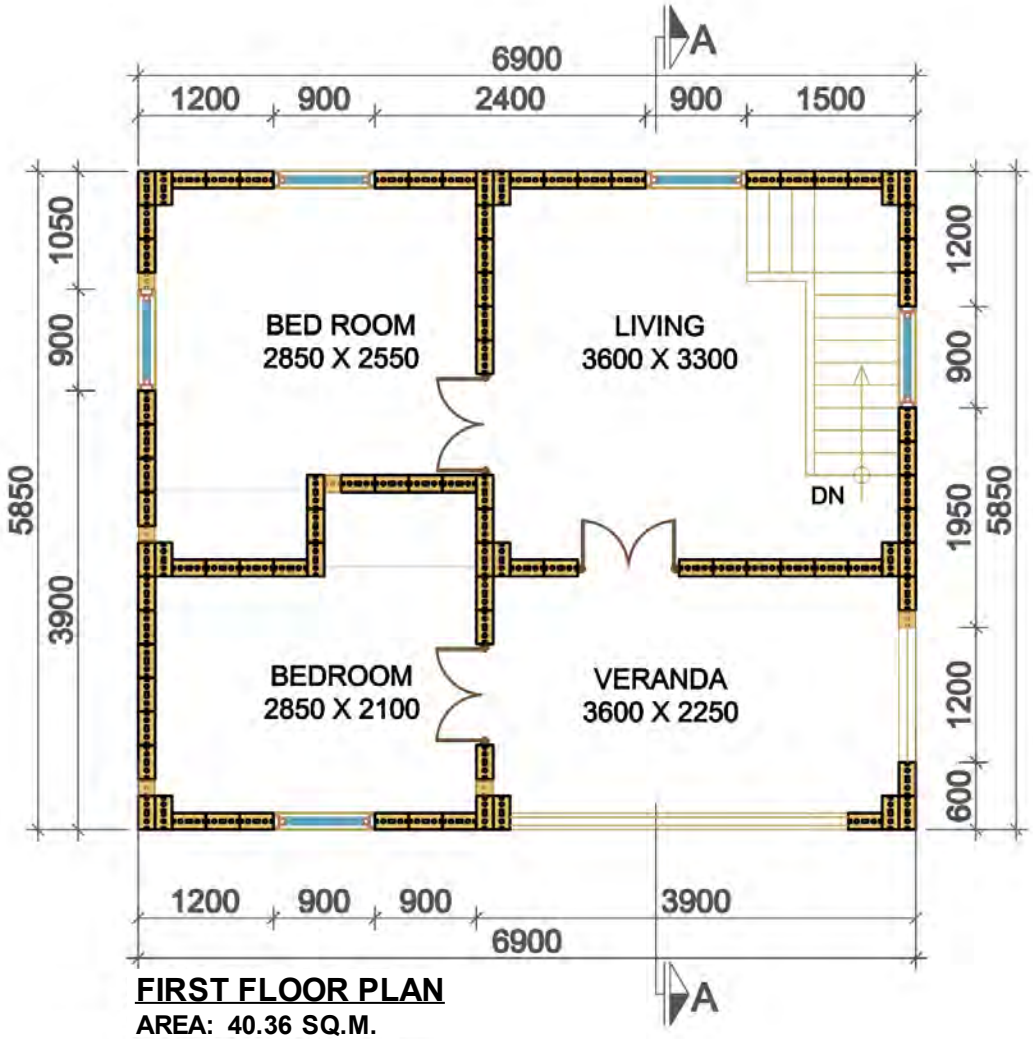
MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY — TWO STOREY

LEVEL	MATERIALS								
	Stone	Interlocking Bricks	Cement	Sand	Aggregate	Reinforcing Bar	CGI sheet	GI Sheet	Wood
	Cu.m	No.	Bags	Cu.m.	Cu.m.	Kg.	Bundle	Sq.m.	Cu.m.
Up to Plinth Level	18.1	-	80.2	10.9	6.1	177.2			-
Super Structure	-	6,447.0	57.1	3.0	6.1	493.9			1.3
Roofing	-	-	-	-	-	-	4.2	8.7	1.5
TOTAL	**18.1**	**6,447.0**	**137.3**	**14.0**	**12.3**	**671.1**	**4.2**	**8.7**	**2.8**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.2	SCALE: NONE	I.B.-1.2
	DRAWING TITLE: ESTIMATE AND 3D VIEW	DATE:	1/5



GROUND FLOOR PLAN
AREA: 40.36 SQ.M.



FIRST FLOOR PLAN
AREA: 40.36 SQ.M.

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.2	SCALE: NONE	I.B.-1.2
	DRAWING TITLE: FLOOR PLANS	DATE:	2/5

MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY — TWO STOREY

SIDE ELEVATION

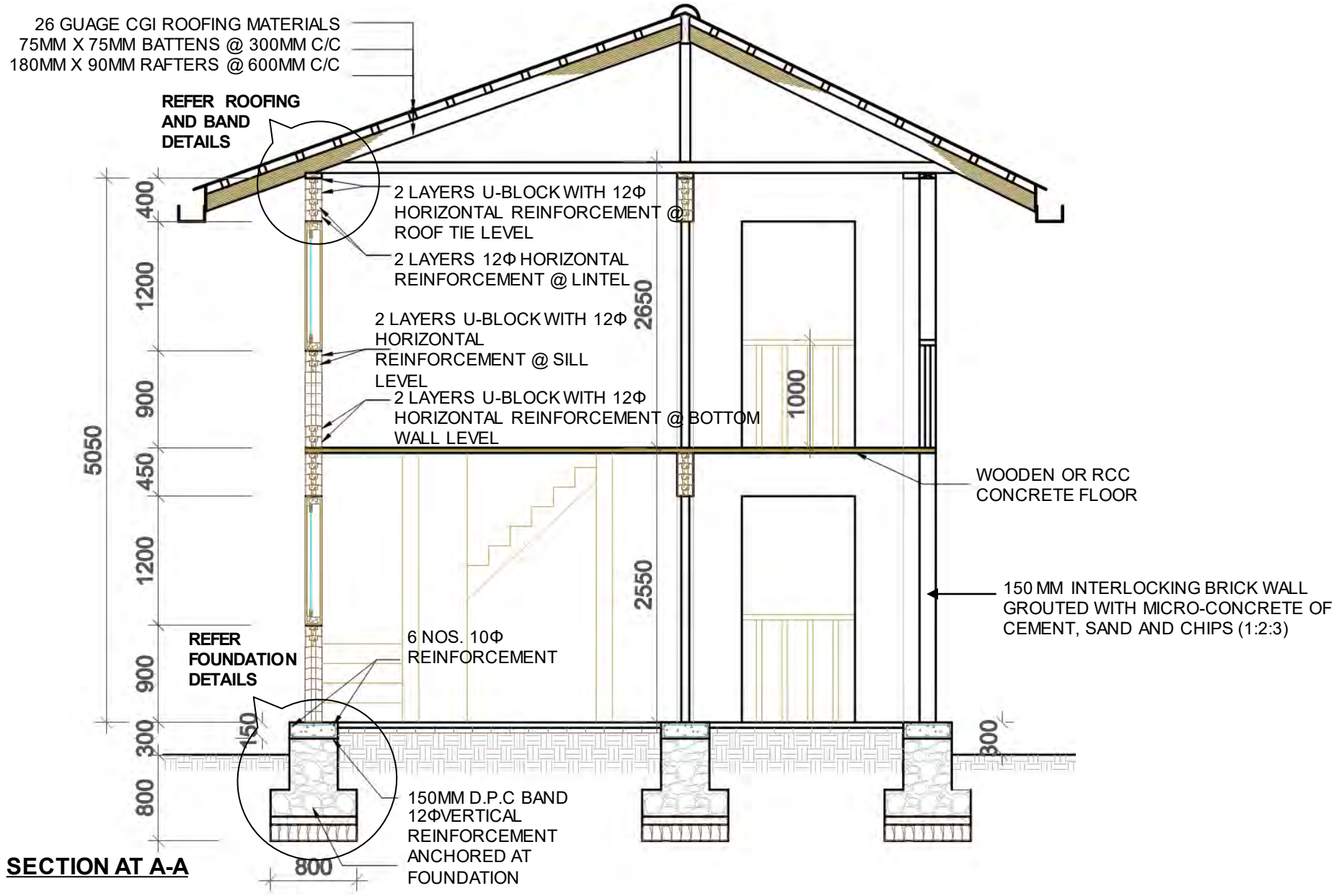
FRONT ELEVATION

SIDE ELEVATION

BACK ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.2	SCALE: NONE	I.B.-1.2
	DRAWING TITLE: ELEVATIONS	DATE:	3/5

MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY — TWO STOREY



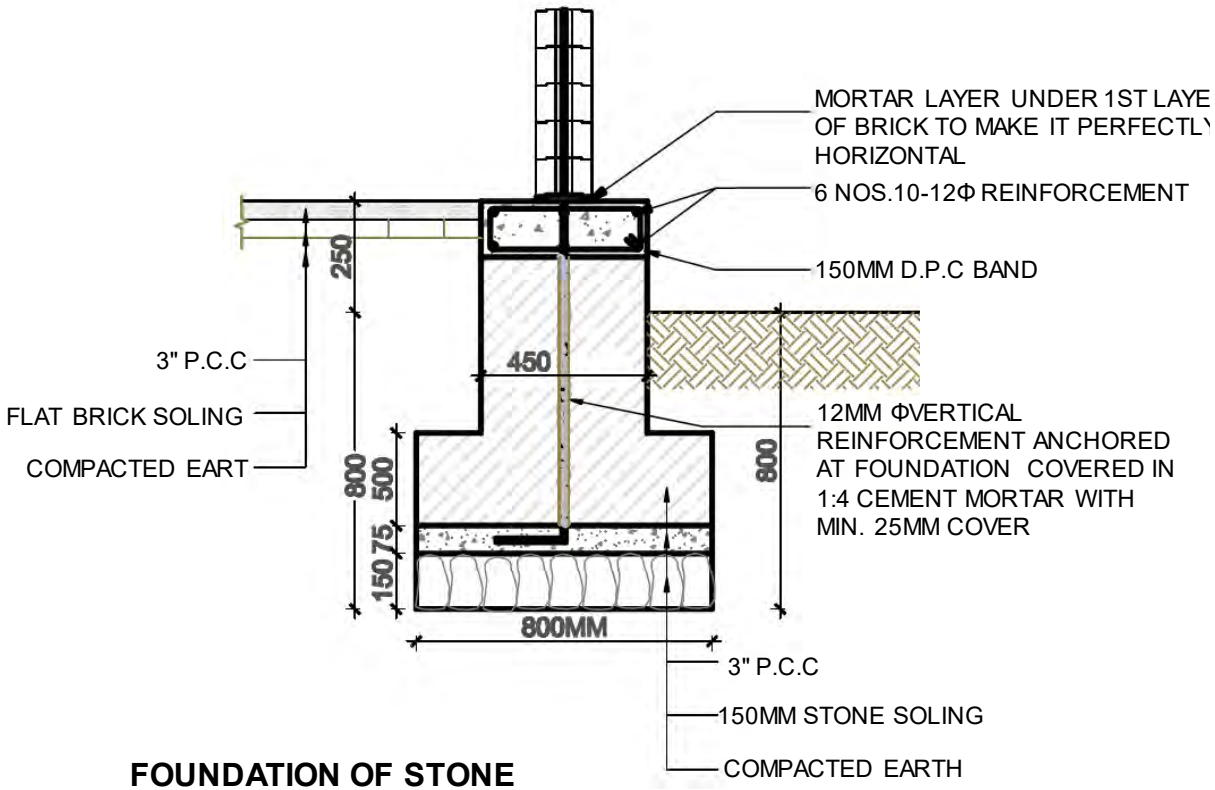
SECTION AT A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.2	SCALE: NONE	I.B.-1.2
	DRAWING TITLE: SECTION	DATE:	4/5

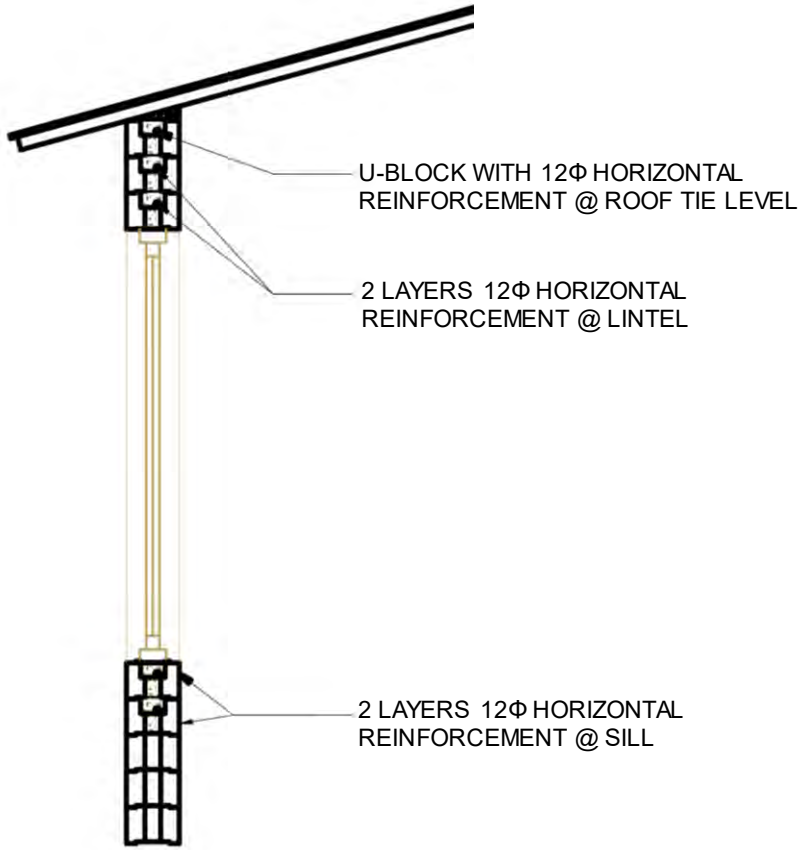
TECHNICAL REQUIREMENTS

Structure System	Reinforced Stabilized Interlocking Brick Masonry Structure with horizontal and vertical reinforcing bars in strategic locations.
Foundation	Strip Foundation of Stone/Brick Masonry in 1:6 cement sand mortar. Foundation size shall be width 800 mm and depth 800 mm (refer drawing).
Plinth Band	R.C.C (1:1.5:3) band of size 450mm x 150 mm. 6 nos. of 10 mm Ø reinforcement with 8 mm Ø stirrups at 150 mm C/C.
Wall	Load bearing walls of Interlocking bricks. Interlocking bricks shall be of cement and soil mixed in 1:8 ratio. Two types of Interlocking blocks; normal and U shaped shall be used in full size (300 x 150x 100 mm) and half size (150 x 150 x 100 mm). These blocks shall be air cured for 1 day and water cured for 21 days. Minimum Compressive strength of the block shall be 3.5 Mpa. 12 mm Ø vertical bars shall be provided at corners and joints and grouted with Micro concrete 1:2:3 (Cement, Sand & Chips) ratio. Horizontal reinforcement requirement is stated in sill and lintel details below.
Sill Band	2 layers of special U shaped Interlocking bricks shall be used in Sill level. In the grove of U shaped Bricks, 12 mm Ø reinforcements shall be provided in each layer and grouted with Micro concrete 1:2:3 (Cement, sand and chips) ratio.
Lintel Band:	2 layers of special U shaped Interlocking bricks shall be used in Lintel level. In the groove of U shaped Bricks, 12 mm Ø reinforcements shall be provided in each layer and grouted with Micro concrete 1:2:3 (Cement, sand and chips) ratio.
Floor:	50 mm thick cast in Situ Micro concrete over precast pans and precast concrete joists of 50mm x 200 mm.
Roof:	Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing.

MODEL I.B.-1.1 AND I.B.-1.2 , INTERLOCKING BRICK MASONRY



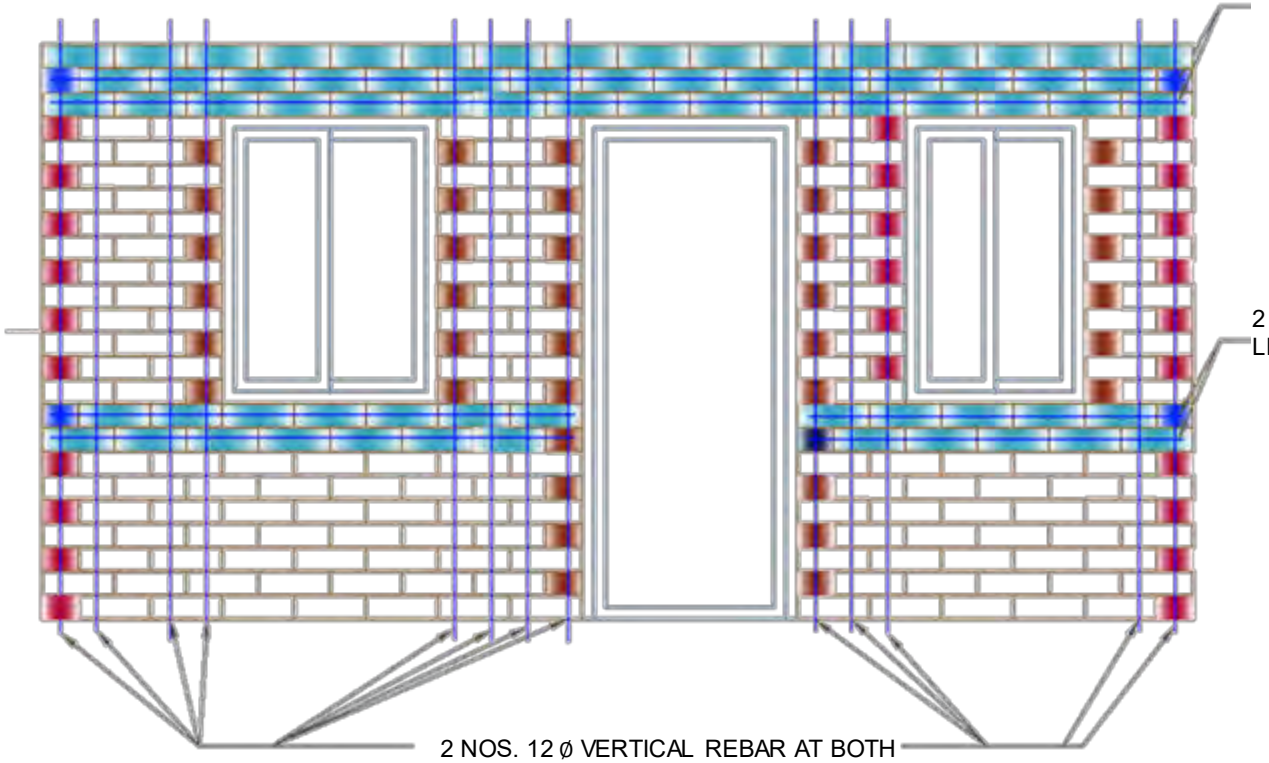
FOUNDATION OF STONE MASONRY IN CEMENT MORTAR



ROOF, LINTEL AND SILL LEVEL

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.1.1 AND 1.B. 1.2	SCALE: NONE	I.B.-1.1/1.2
	DRAWING TITLE:STRUCTURAL DETAILS	DATE:	1/8

MODEL I.B.-1.1 AND I.B.-1.2 , INTERLOCKING BRICK MASONRY



REGULAR FULL BRICK

REGULAR HALF BRICK

LATERAL FULL LOCK BRICK

U FULL BRICK

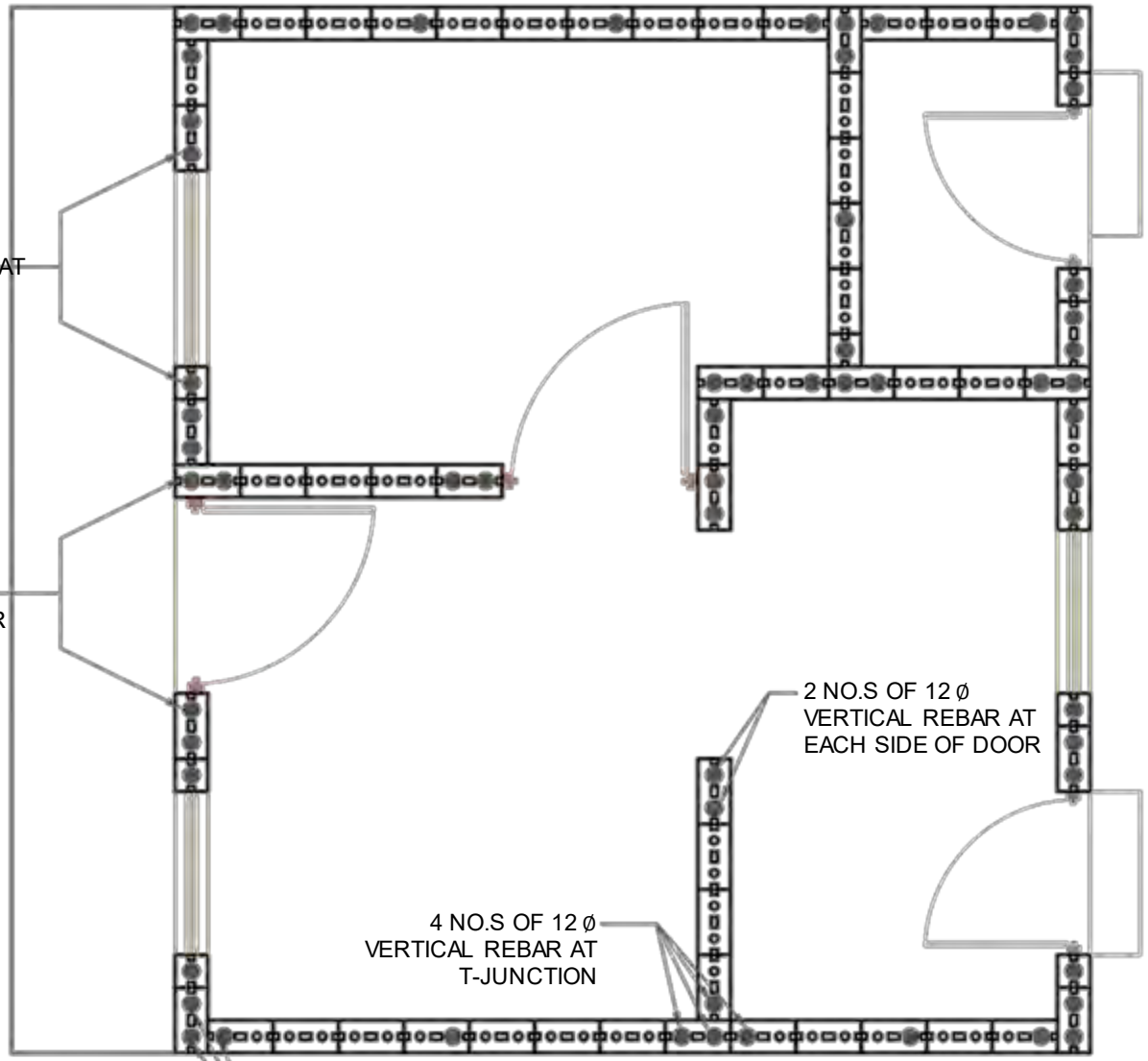
U HALF BRICK

LATERAL U FULL LOCK BRICK

TYPICAL ELEVATION (REBAR DETAIL IN WALL)

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.1.1 AND 1.B. 1.2	SCALE: NONE	I.B.-1.1/1.2
	DRAWING TITLE:STRUCTURAL DETAILS	DATE:	2/8

MODEL I.B.-1.1, INTERLOCKING BRICK MASONRY

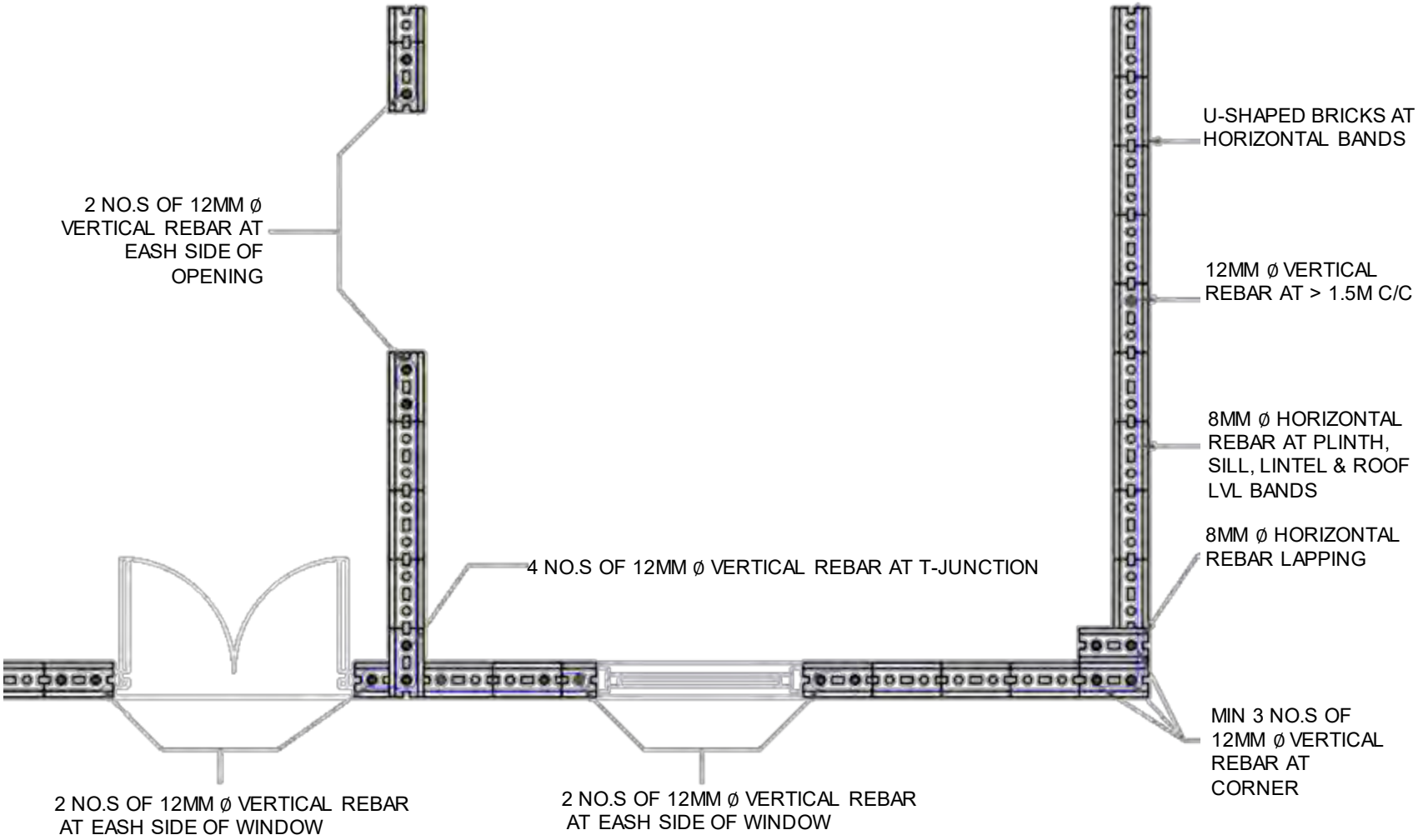


FRAMING PLAN (REBAR DETAIL)

NOTE:
GROUTING FOR THE HOLE IS DONE WITH MORTAR

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.1.1	SCALE: NONE	I.B.-1.1
	DRAWING TITLE:STRUCTURAL DETAILS	DATE:	3/8

MODEL I.B.-1.1 AND I.B.-1.2 , INTERLOCKING BRICK MASONRY

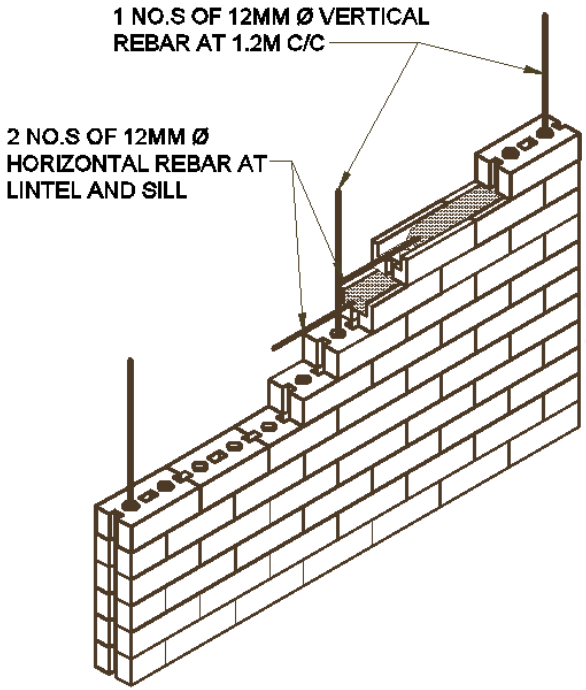


REBAR DETAIL PLAN AT PLINTH, ROOF, SILL & LINTEL BANDS

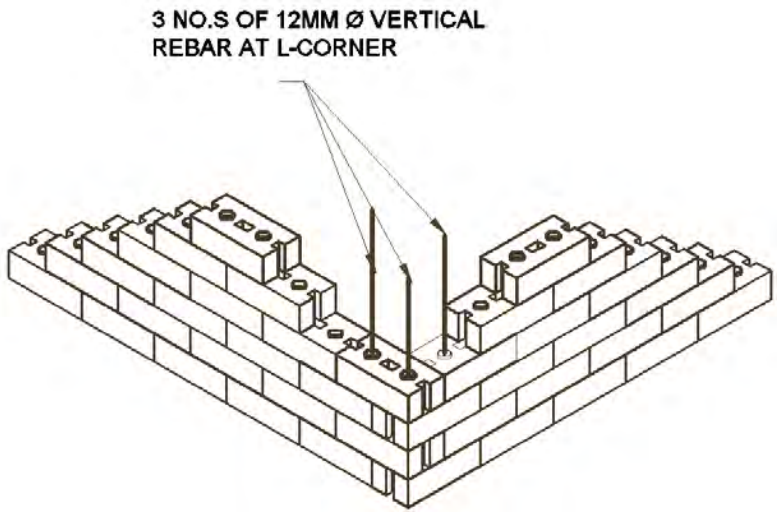
NOTE:
GROUTING FOR THE HOLE IS DONE WITH MORTAR

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.1.1 AND 1.B. 1.2	SCALE: NONE	I.B.-1.1/1.2
	DRAWING TITLE:STRUCTURAL DETAILS	DATE:	4/8

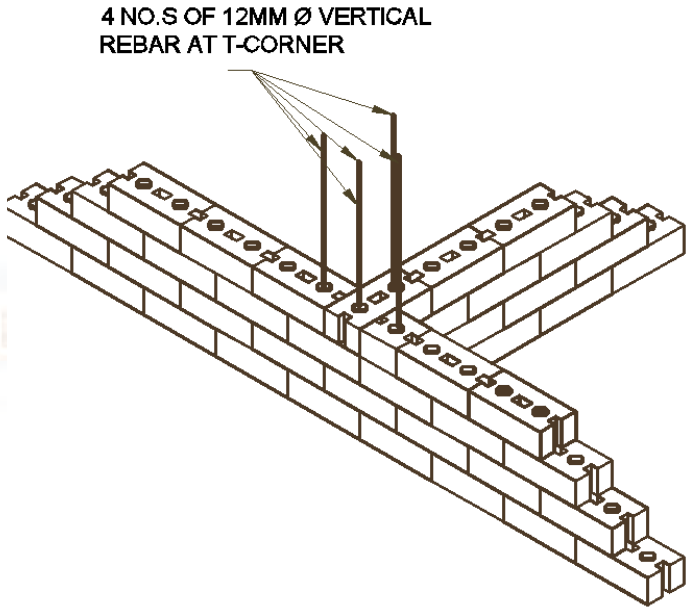
MODEL I.B.-1.1 AND I.B.-1.2 , INTERLOCKING BRICK MASONRY



TYPICAL DETAIL OF WALL



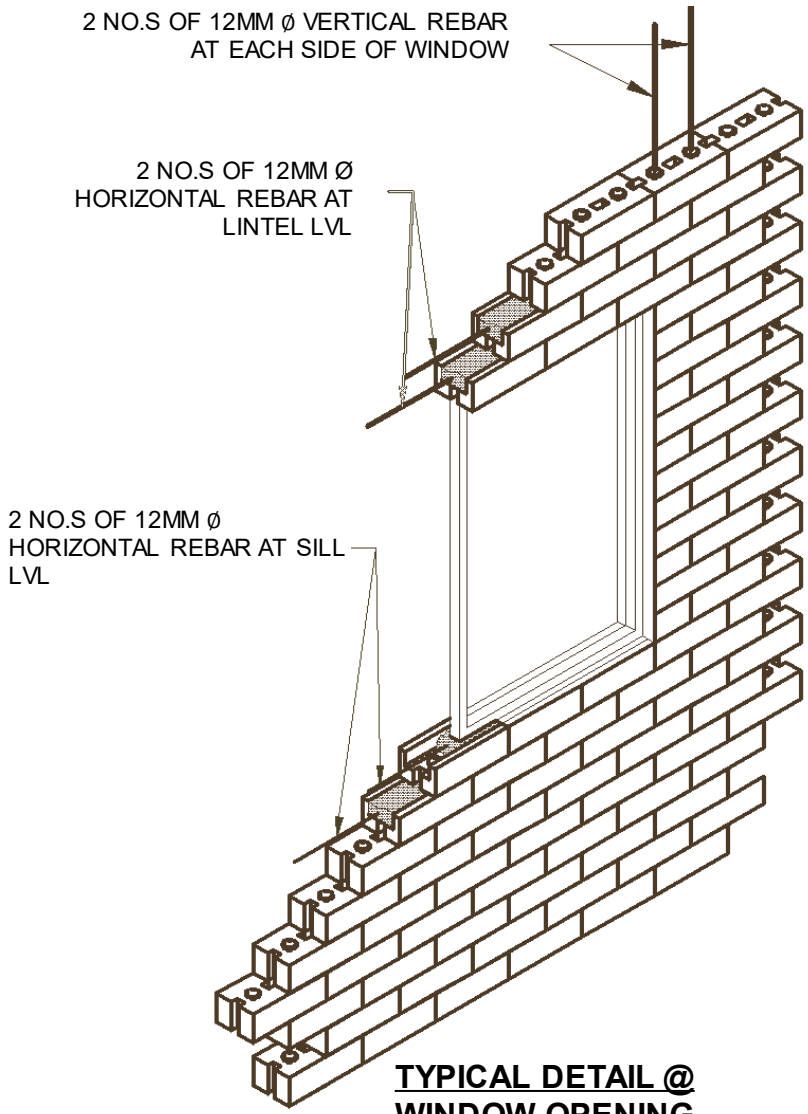
DETAIL A
(TYPICAL DETAIL OF L-CORNER)



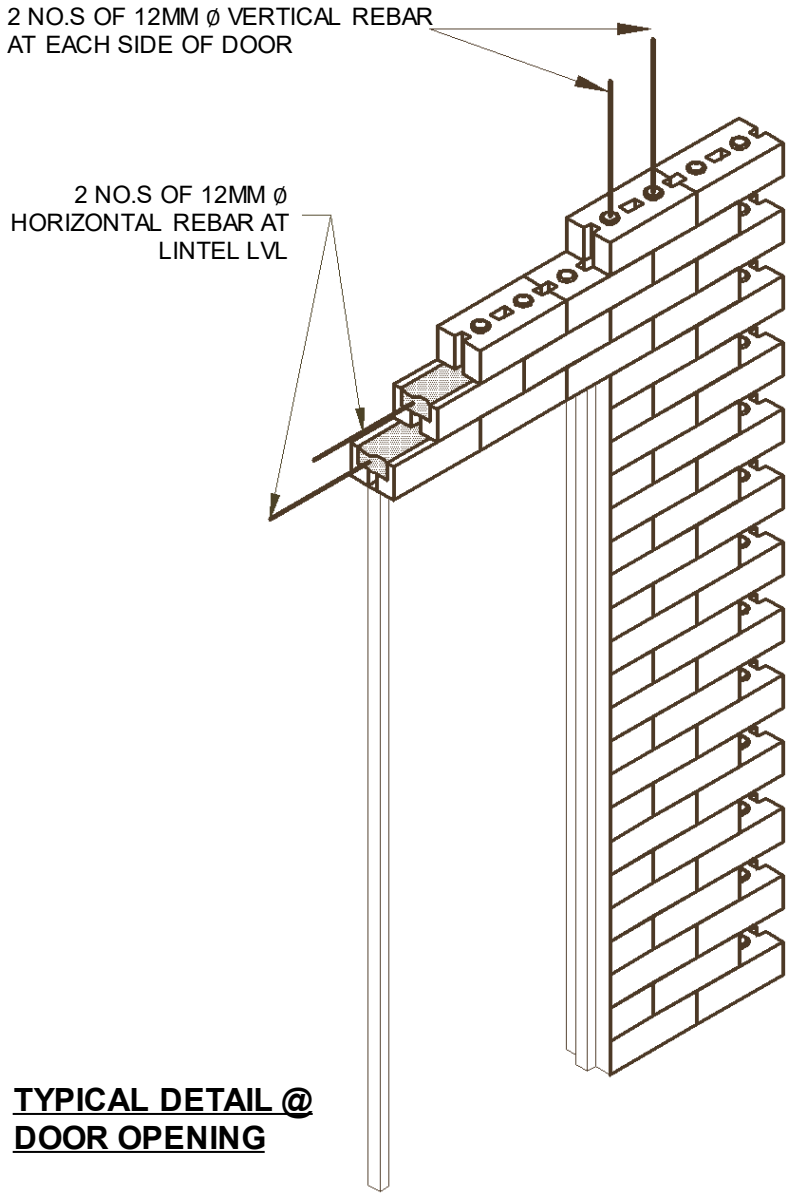
DETAIL B
(TYPICAL DETAIL OF T-CORNER)

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.1.1 AND 1.B. 1.2	SCALE: NONE	I.B.-1.1/1.2
	DRAWING TITLE:STRUCTURAL DETAILS	DATE:	5/8

MODEL I.B.-1.1 AND I.B.-1.2 , INTERLOCKING BRICK MASONRY



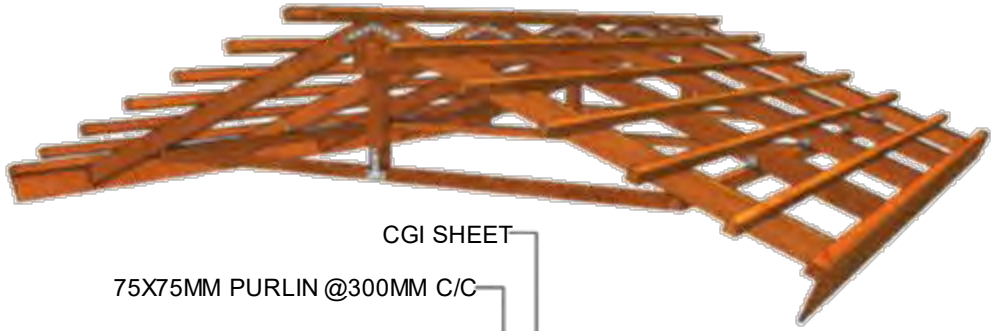
TYPICAL DETAIL @ WINDOW OPENING

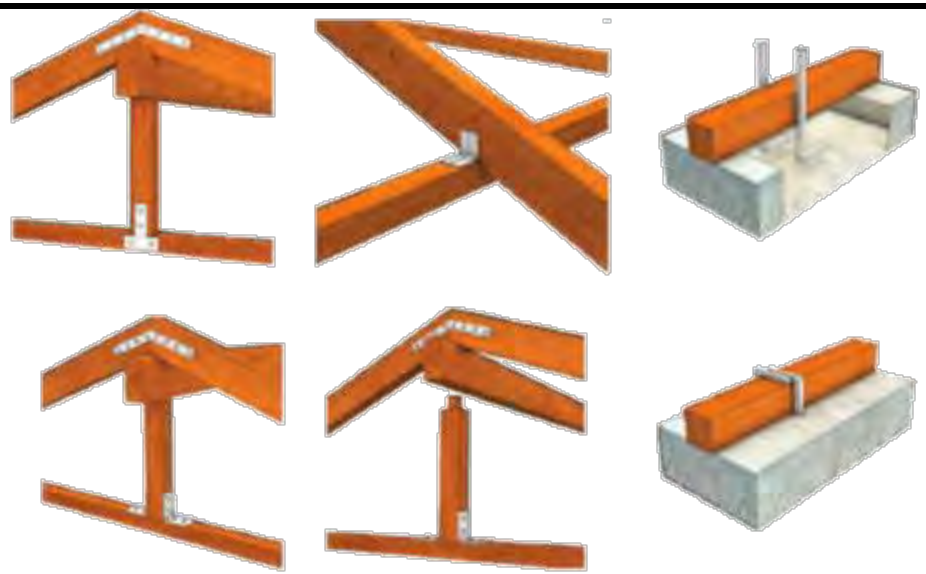


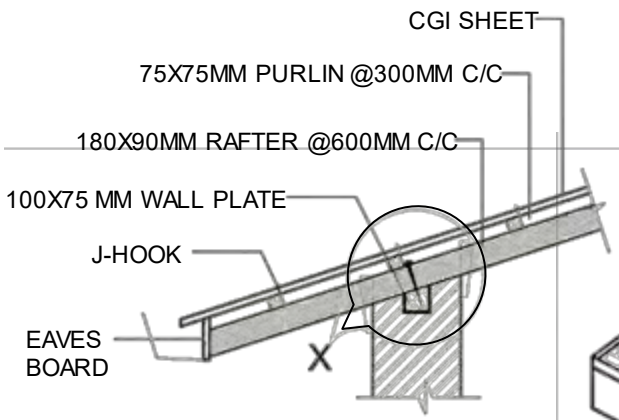
TYPICAL DETAIL @ DOOR OPENING

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.1.1 AND 1.B. 1.2	SCALE: NONE	I.B.-1.1/1.2
	DRAWING TITLE:STRUCTURAL DETAILS	DATE:	6/8

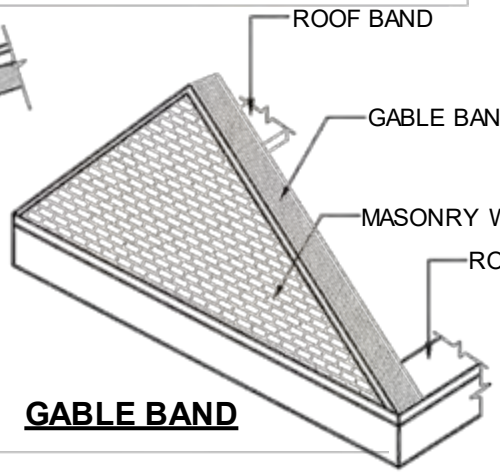
MODEL I.B.-1.1 AND I.B.-1.3 , INTERLOCKING BRICK MASONRY



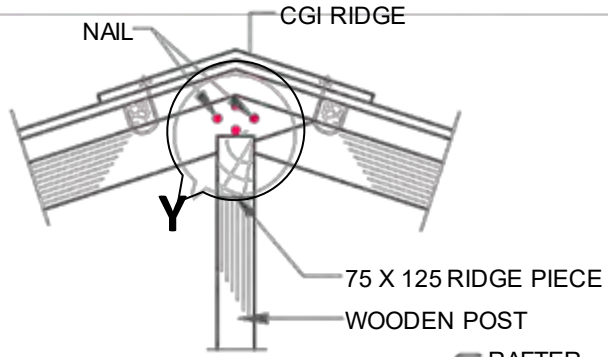


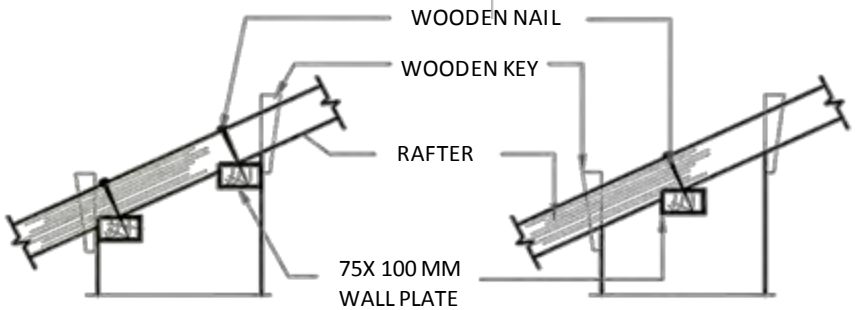


TYPE-1

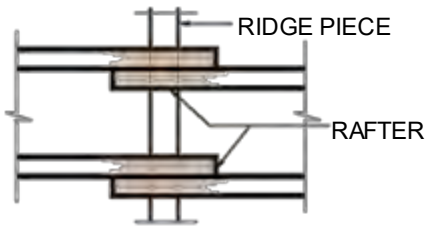


GABLE BAND

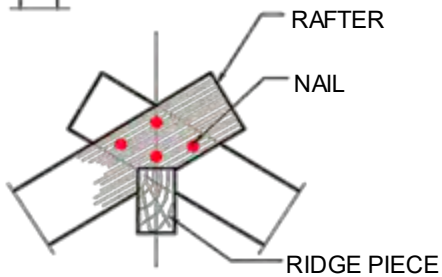




DETAIL AT-X



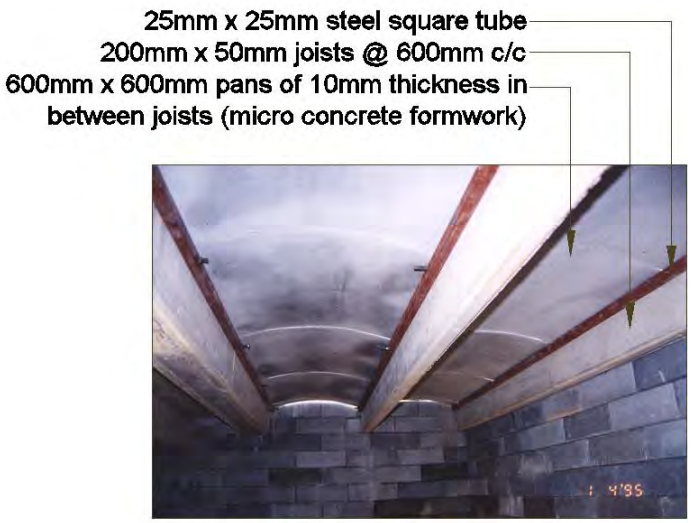
PLAN



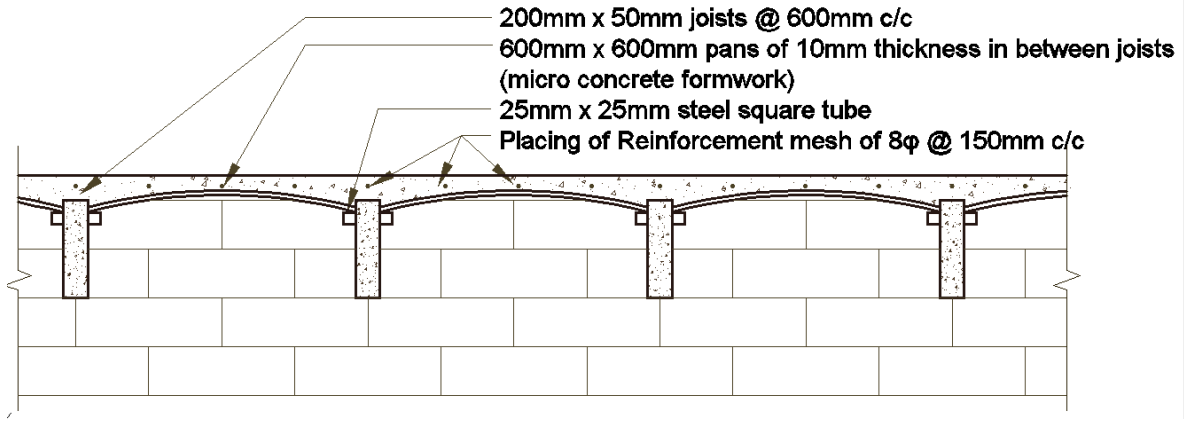
DETAIL AT-Y

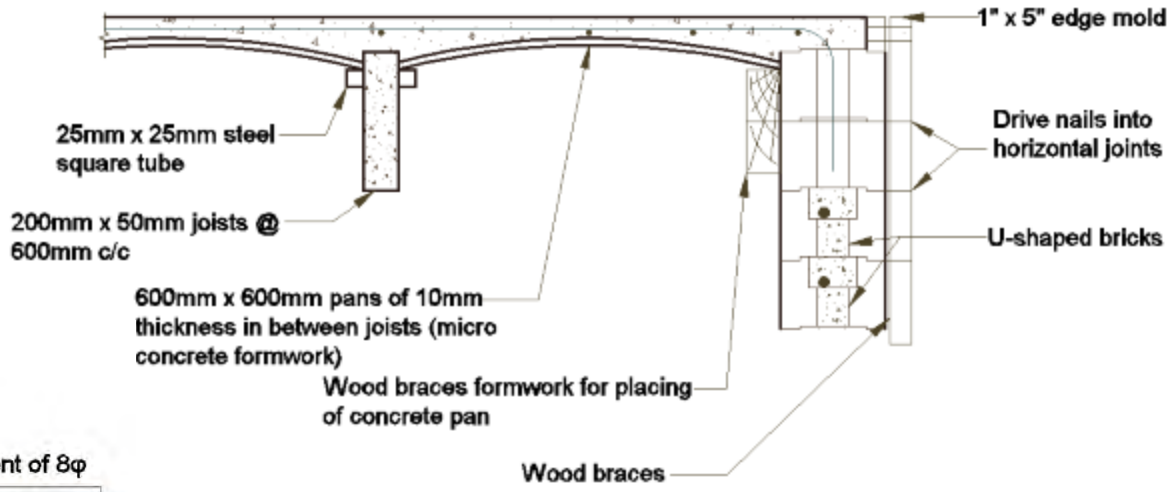
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.1.1 AND 1.B. 1.2	SCALE: NONE	I.B.-1.1/1.2
	DRAWING TITLE:ROOF DETAILS	DATE:	7/8

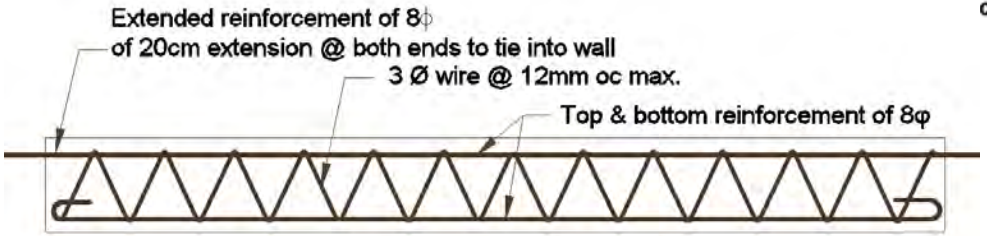
MODEL I.B.-1.3 , INTERLOCKING BRICK MASONRY



INTERIOR VIEW OF THE FINISHED JOIST AND PAN CAST IN SITU



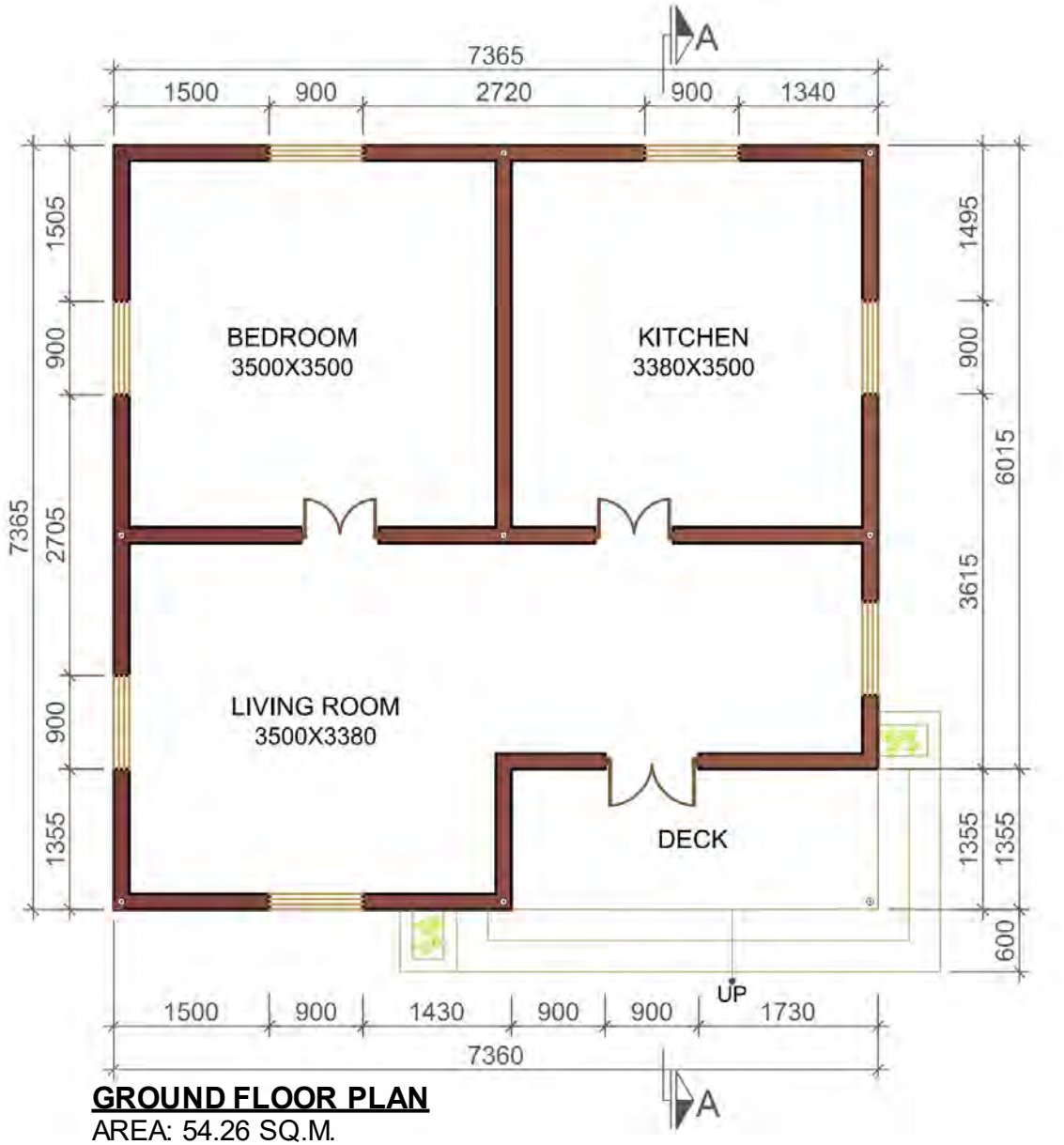




REINFORCEMENT DETAILS IN CONCRETE JOISTS SPAN UPTO 5M

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: 1.B. 1.2	SCALE: NONE	I.B.-1.3
	DRAWING TITLE:STRUCTURAL DETAILS	DATE:	8/8

LEVEL	MATERIALS								
	Stone	Interlocking Bricks	Cement	Sand	Aggregate	Reinforcing Bar	Clay Tile	Clay Tile Ridge	Wood
	No.	No.	Bags	Cu.m.	Cu.m.	Kg.	Nos	Sq.m.	Cu.m.
Up to Plinth Level	33.5	2,406.0	128.1	18.3	7.7	832.5			-
Super Structure	-	3,350.0	13.8	0.9	1.3	188.8			0.3
Roofing	-	-	-	-	-	-	1,579.3	282.0	2.8
TOTAL	**33.5**	**5,756.0**	**142.0**	**19.2**	**9.0**	**1,021.3**	**1,579.3**	**282.0**	**3.1**

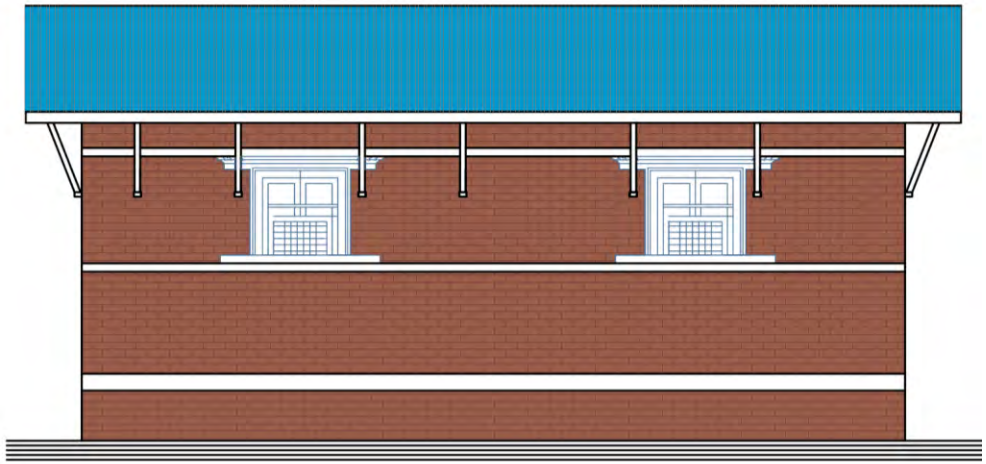


GROUND FLOOR PLAN
AREA: 54.26 SQ.M.

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.3	SCALE: NONE	I.B.-1.3
	DRAWING TITLE: FLOOR PLAN	DATE:	2/6

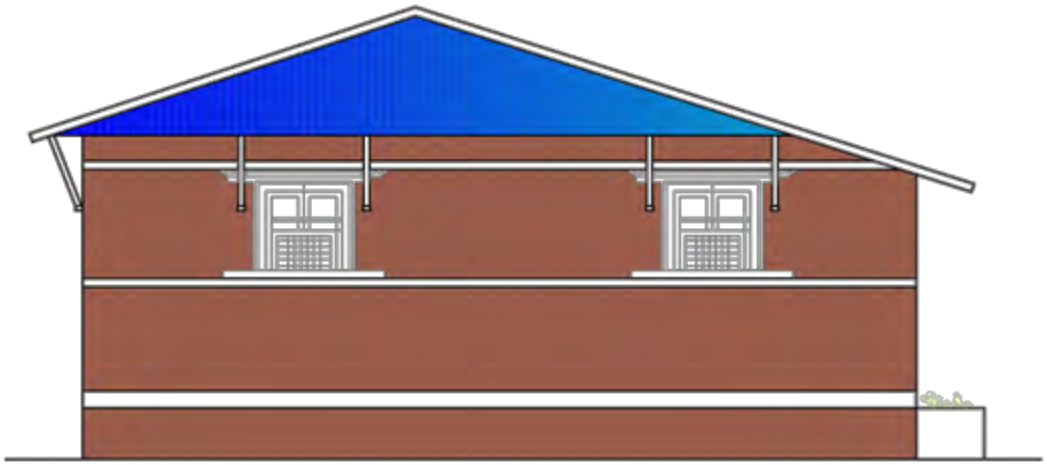
MODEL I.B.-1.3, INTERLOCKING BRICK MASONRY — ONE STOREY

FRONT ELEVATION



BACK ELEVATION

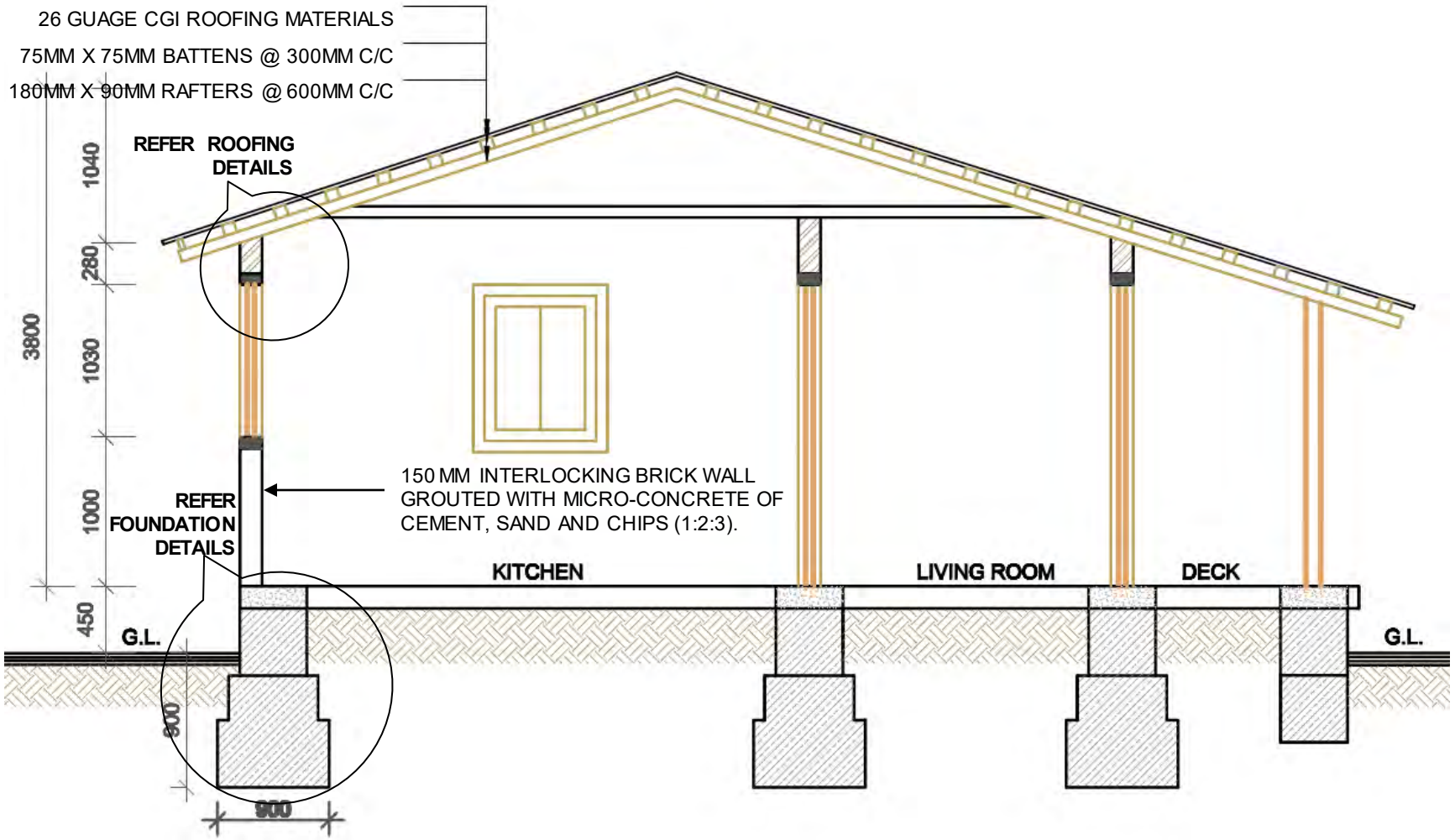
SIDE ELEVATION



SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.3	SCALE: NONE	I.B.-1.3
	DRAWING TITLE: ELEVATIONS	DATE:	3/6

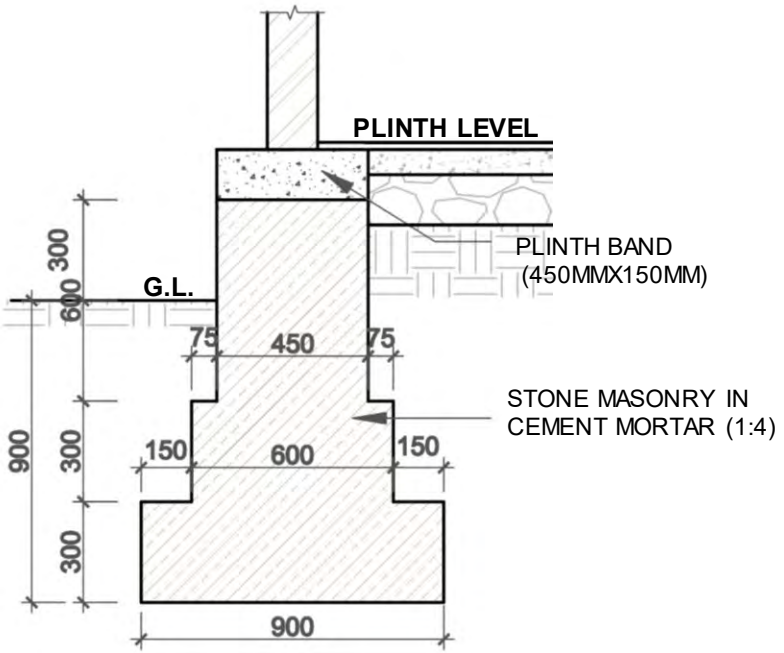
MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY — ONE STOREY



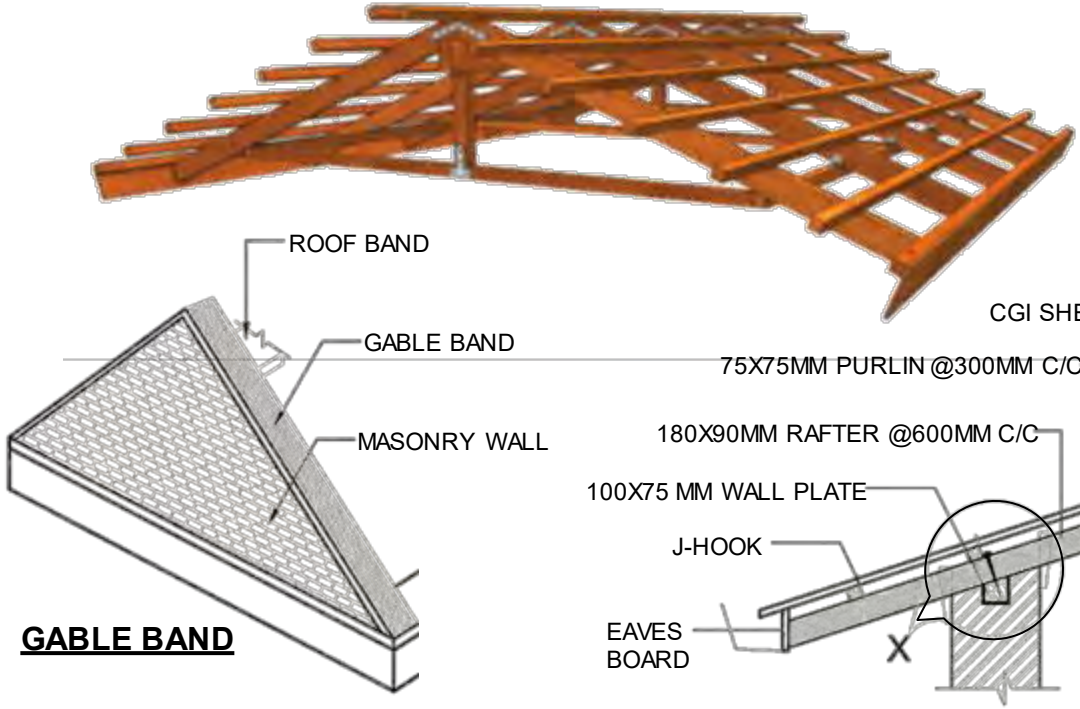
SECTION AT A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.3	SCALE: NONE	I.B.-1.3
	DRAWING TITLE: SECTION	DATE:	4/6

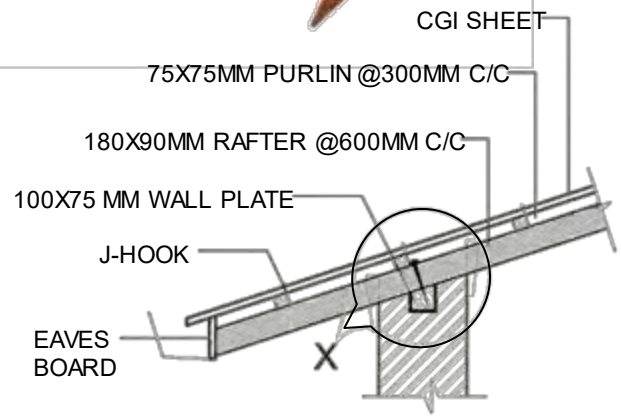
MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY



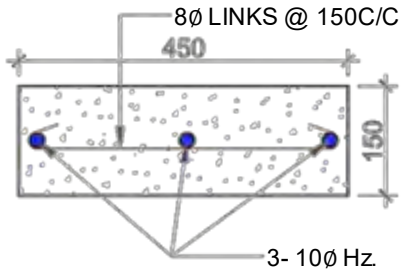
FOUNDATION DETAIL



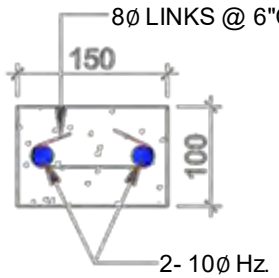
GABLE BAND



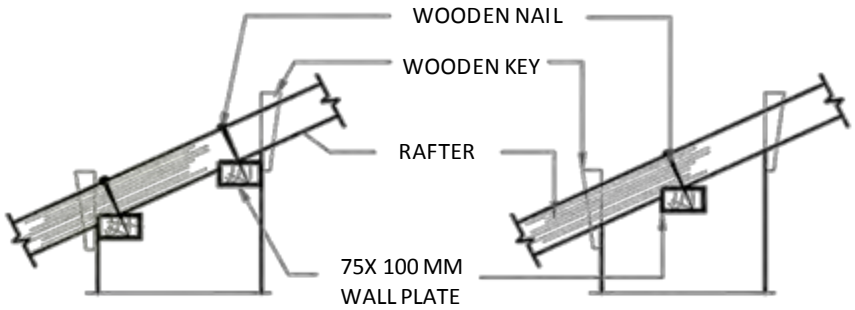
ROOFING DETAILS



PLINTH BAND SECTION



SILL/LINTEL/ROOF BAND SECTION



DETAIL AT-X

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: I.B.-1.3	SCALE: NONE	I.B.-1.3
	DRAWING TITLE: DETAILS	DATE:	5/6

TECHNICAL REQUIREMENTS

Structure System	Reinforced Stabilized Interlocking Brick Masonry Structure with horizontal and vertical reinforcing bars in strategic locations.
Foundation	Strip Foundation of Stone Masonry in 1:4 cement sand mortar. Foundation size is width 900mm and depth 900 mm (refer drawing).
Plinth Band	R.C.C (1:1.5:3) band of size 450mm x 150 mm. with 3 nos. of 10 mm Ø reinforcement and 8 mm Ø stirrups at 150 mm C/C.
Wall	Load bearing walls of Interlocking bricks. Interlocking bricks shall be of cement and soil mixed in 1:8 ratio. Two types of Interlocking blocks; normal and U shaped shall be used in full size (300 x 150x 100 mm) and half size (150 x 150 x 100 mm). These blocks shall be air cured for 1 day and water cured for 21 days. Minimum Compressive strength of the block shall be 3.5 Mpa. 12 mm Ø vertical bars shall be provided at corners and joints and grouted with micro concrete 1:2:3 (Cement, sand & chips) ratio. Horizontal reinforcement requirement is stated in sill and lintel details below.
Sill Band	Reinforced cement concrete sill band of 150x 100 mm size and 1:1.5:3 (1part cement, 1.5 parts sand and 3 parts aggregate). 2 nos. of 10 mm Ø reinforcement and 8 mm Ø stirrups at 150 mm C/C.
Lintel Band:	Reinforced cement concrete lintel band of 150x 100 mm size and 1:1.5:3 (1part cement, 1.5 parts sand and 3 parts aggregate). 2 nos. of 10 mm Ø reinforcement and 8 mm Ø stirrups at 150 mm C/C.
Roof:	Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing.

CONFINED HOLLOW CONCRETE BLOCK MASONRY

C.H.C.-2.1

Construction with Hollow concrete blocks as partition wall is not a new practice. In the technology proposed here, hollow concrete block walls carry the seismic loads and the Reinforced Concrete Columns of minimal size are used to confine the walls. Hollow concrete block walls with toothing are constructed up to sill level leaving space for columns and then columns and sill are monolithically casted. Same process is applied after constructing hollow concrete block wall up to lintel.

Featured Design in C.H.C.-2.1 is a two storied structure with six rooms. Structural system consists of load bearing hollow concrete walls confined with 15 cm x 15 cm R.C.C. Columns. The first floor is of R.C.C. slab and roofing consists of CGI sheet over wooden rafter and purlins.

MATERIAL PROPERTIES

Block Size: 40cm X 15cm X20cm
Min Compressive Strength on gross area : 5 Mpa
Min Compressive Strength on net area : 7.5 Mpa
Density of the Block : 1600kg/m^3
Nominal Mix Ratio: 1:1.5:3 (C:S:A)
Min Yield Strength of Reinforcing Steel: 415 MPa

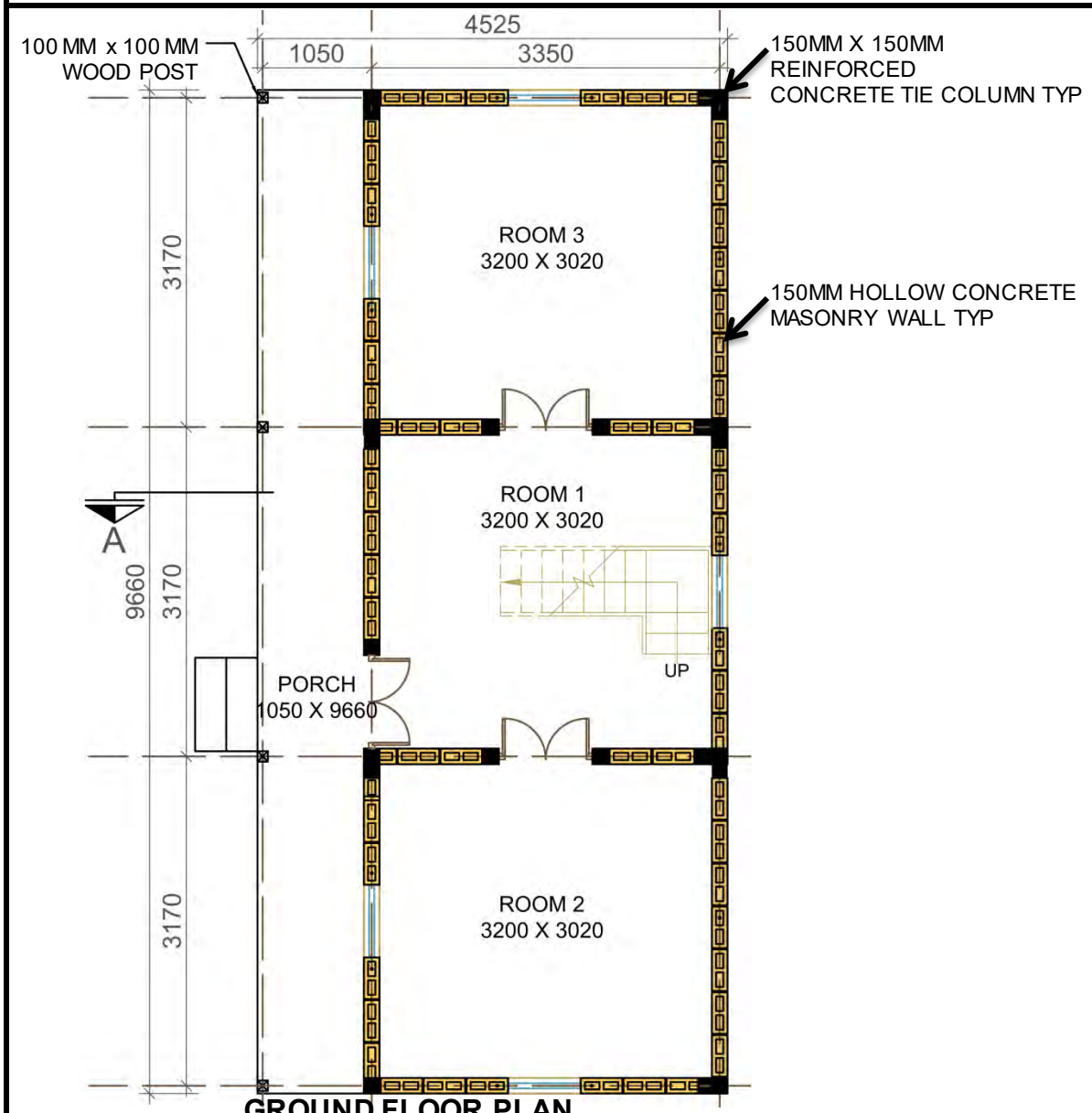
C.H.C.-2.1

MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY — TWO STOREY

LEVEL	MATERIALS								
	Stone	Hollow Concrete Bricks	Cement	Sand	Aggregate	Reinforcing Bar	CGI sheet	GI Sheet	Wood
	Cu.m	No.	Bags	Cu.m.	Cu.m.	Kg.	Bundle	Sq.m.	Cu.m.
Up to Plinth Level	30.3	-	77.1	12.3	3.5	252.0			-
Super Structure	-	1,330.0	101.6	8.7	7.5	1,388.0			1.5
Roofing	-						5.0	6.5	1.7
TOTAL	**30.3**	**1,330.0**	**178.7**	**21.0**	**11.0**	**1,640.0**	**5.0**	**6.5**	**3.2**

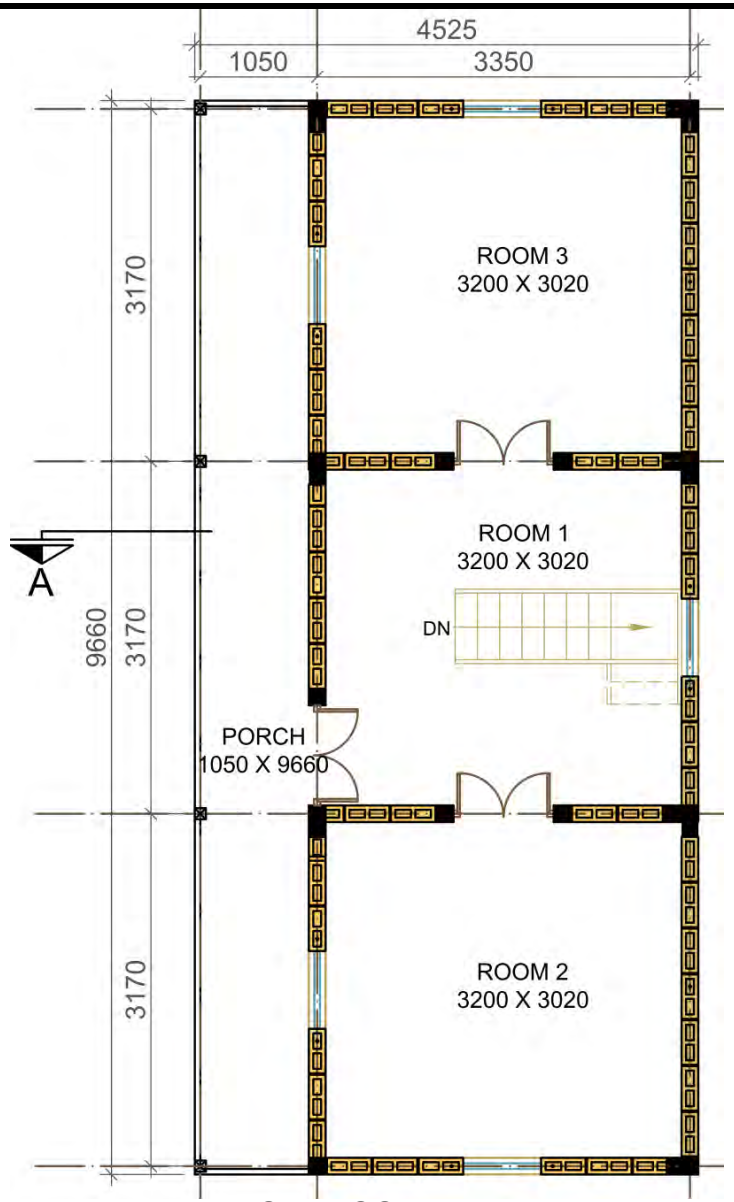
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 1/11
	DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	

MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY — TWO STOREY



GROUND FLOOR PLAN

FLOOR AREA: 43.71 SQ.M.



FIRST FLOOR PLAN

FLOOR AREA: 43.71 SQ.M.

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 2/11
	DRAWING TITLE: FLOOR PLANS	DATE:	

MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY TWO STOREY

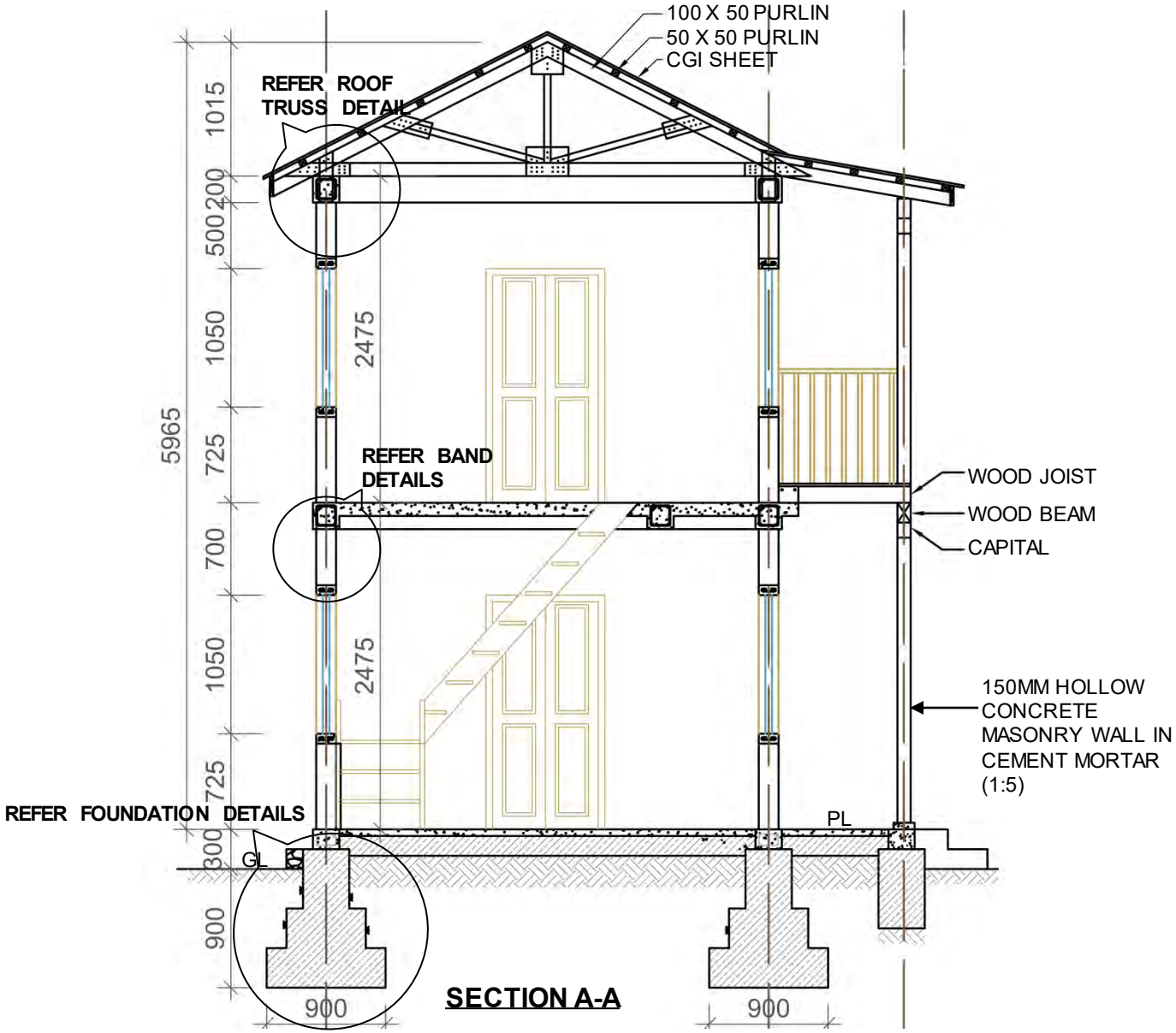
FRONT ELEVATION

SIDE ELEVATION

SIDE ELEVATION

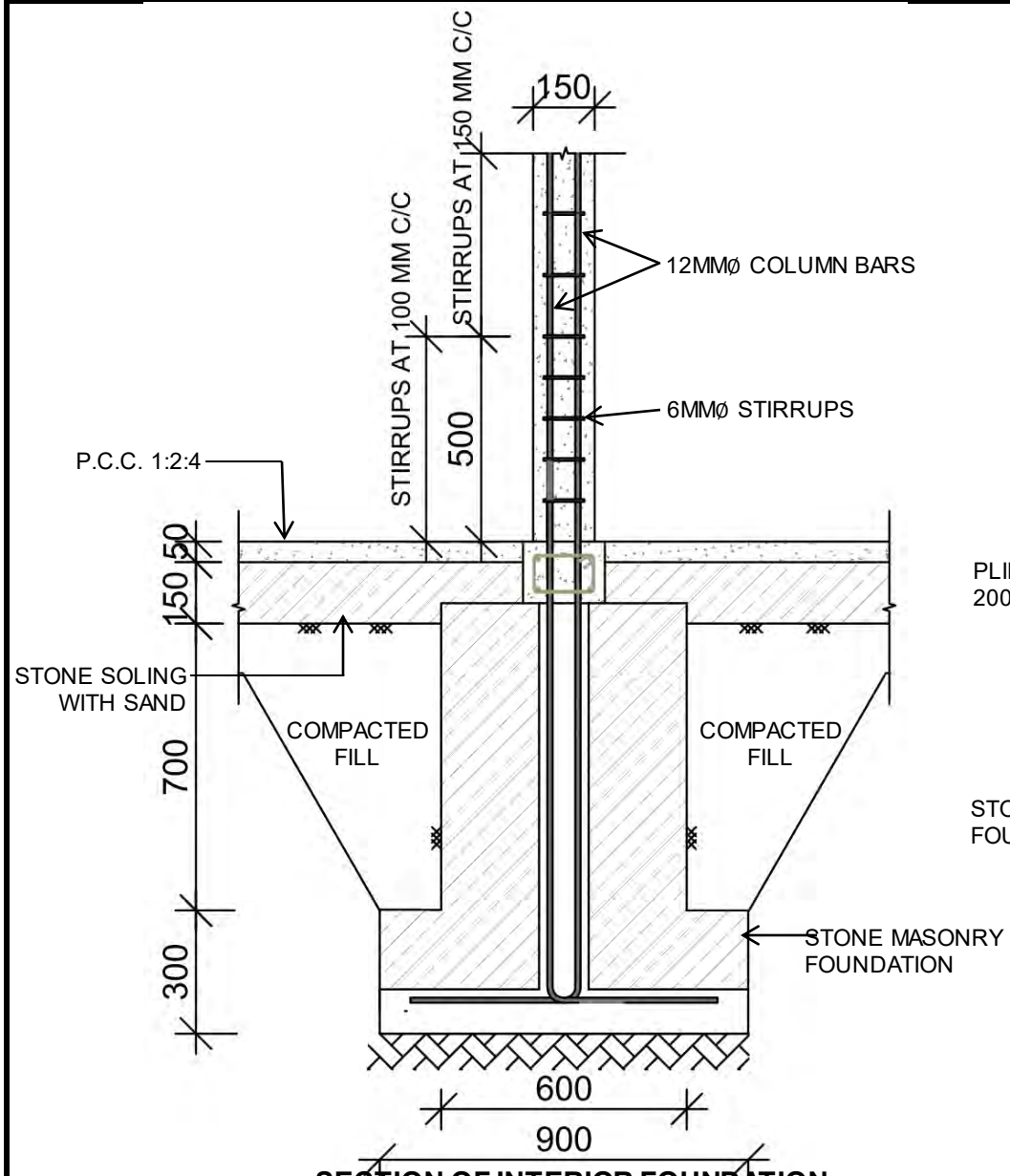
BACK ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 3/11
	DRAWING TITLE: ELEVATIONS	DATE:	

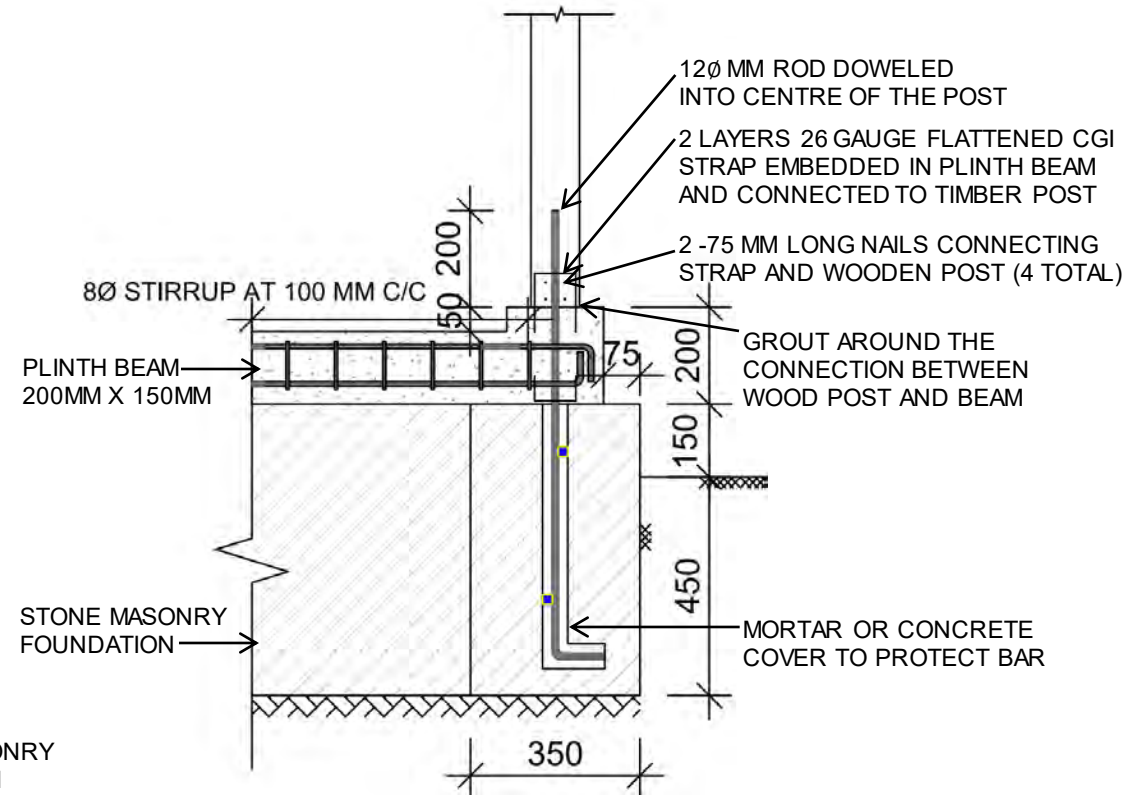


SECTION A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 4/11
	DRAWING TITLE: SECTION	DATE:	



SECTION OF INTERIOR FOUNDATION

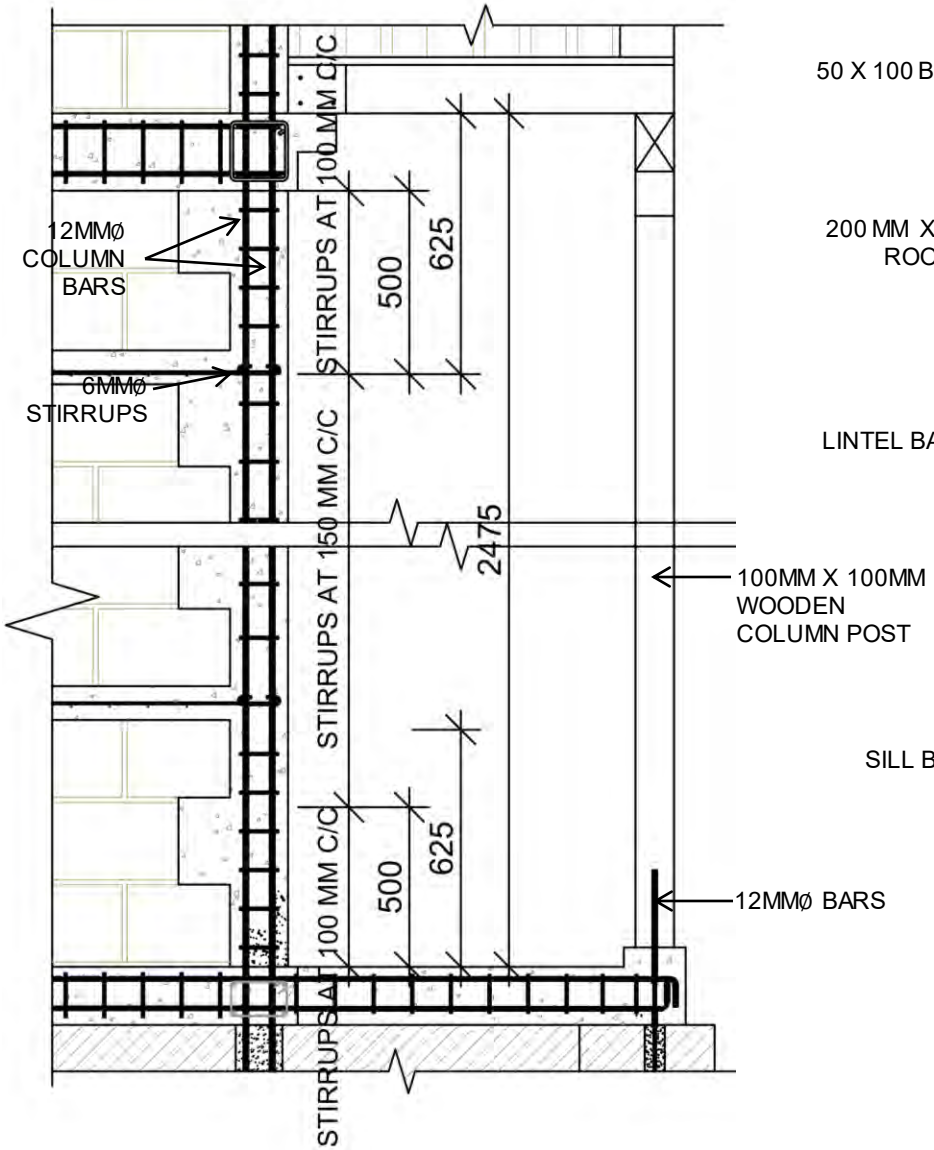


FOUNDATION SECTION OF COLUMN POST

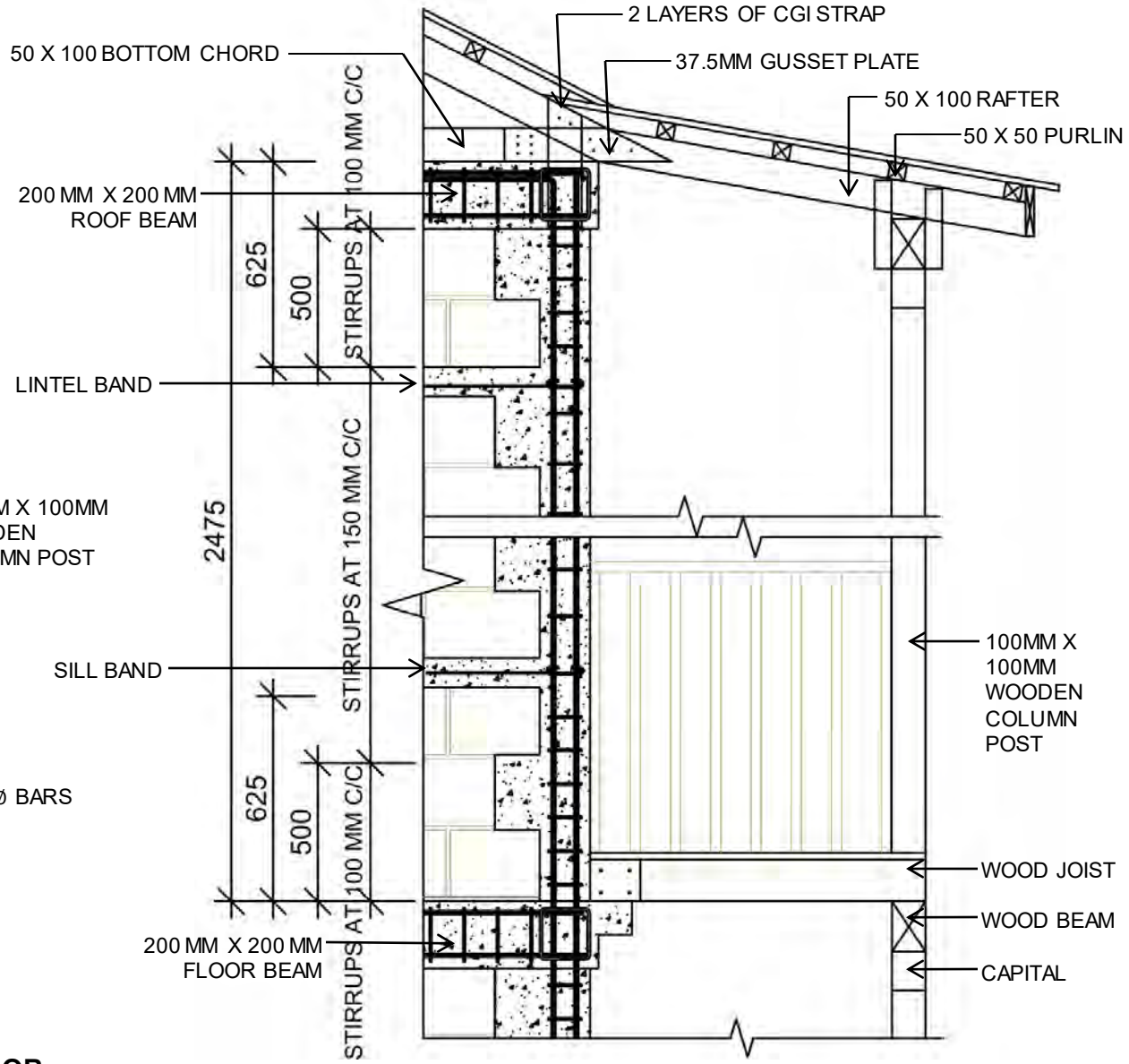
FOUNDATION DETAILS

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 5/11
	DRAWING TITLE: DETAILS	DATE:	

MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY — TWO STOREY

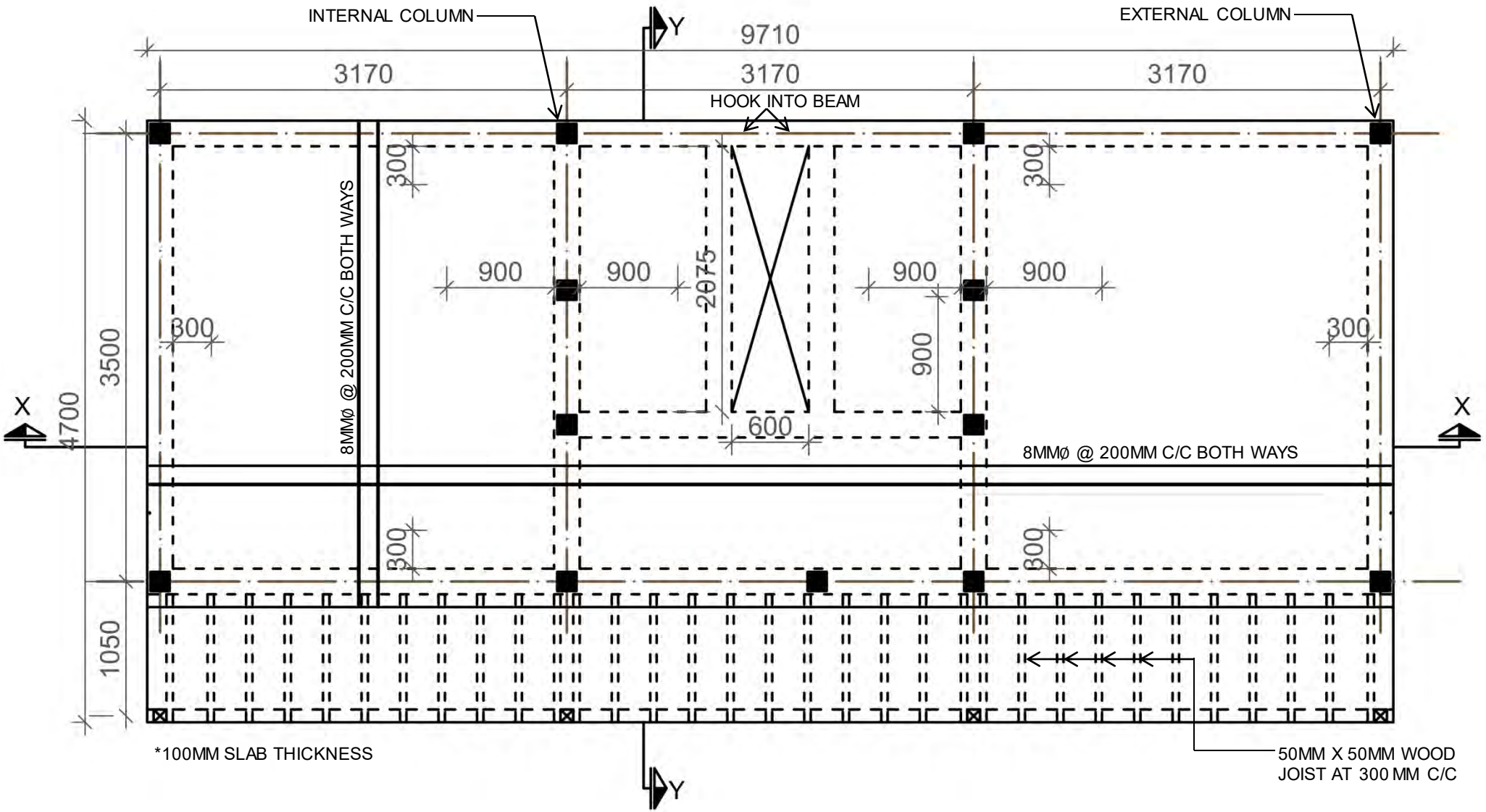


TYPICAL COLUMN SECTION: FROM GL TO FIRST FLOOR



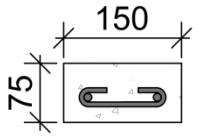
TYPICAL COLUMN SECTION: FROM FIRST FLOOR TO ROOF

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 6/11
	DRAWING TITLE: DETAILS	DATE:	



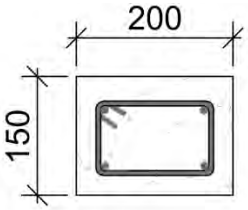
SLAB DETAILING FOR BARS

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 7/11
	DRAWING TITLE: DETAILS	DATE:	



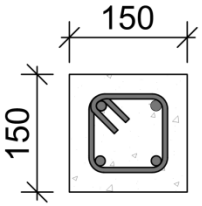
2-12MMØ BARS
6MMØ STIRRUPS

SILL/ LINTEL BAND



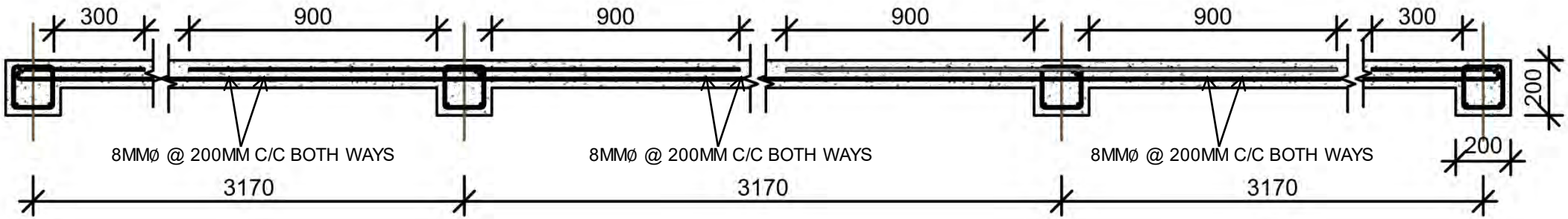
4-12MMØ RIBBED BARS
6MMØ CLOSED TIE

PLINTH BAND

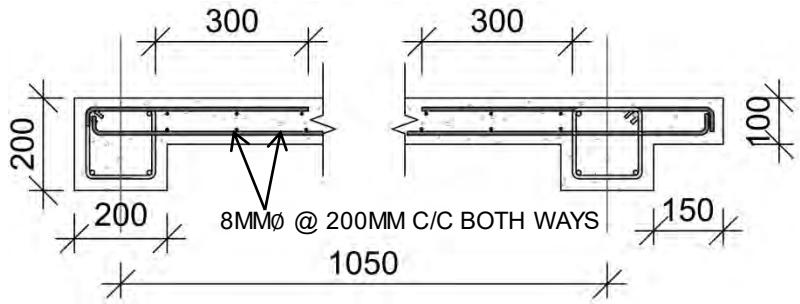


4-12MMØ RIBBED BARS
6MMØ CLOSED TIE

COLUMN PLAN

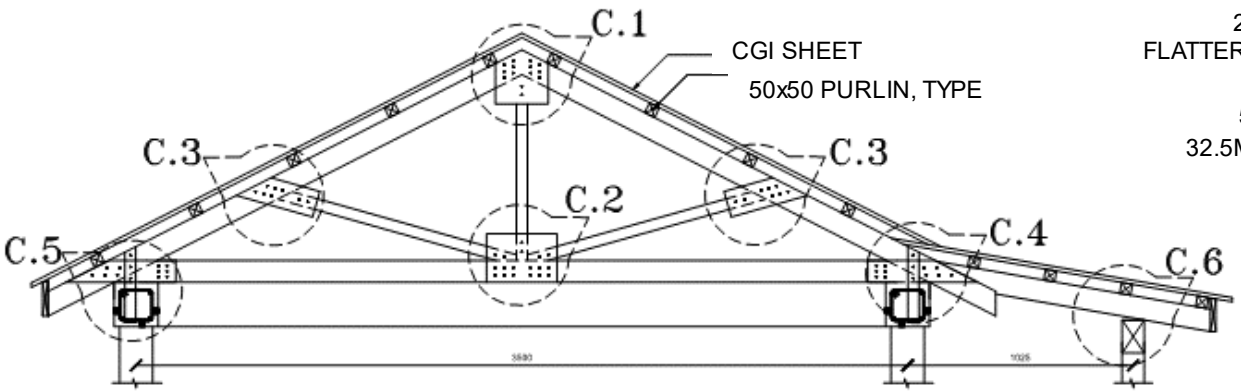


LONGITUDIONAL SECTION OF SLAB X-X

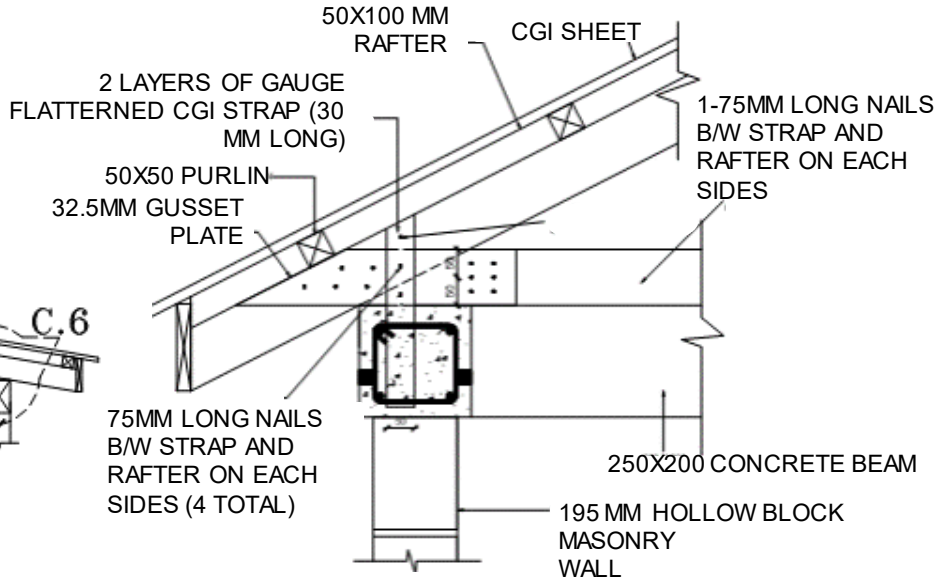


TRAVERSE SECTION OF SLAB Y-Y

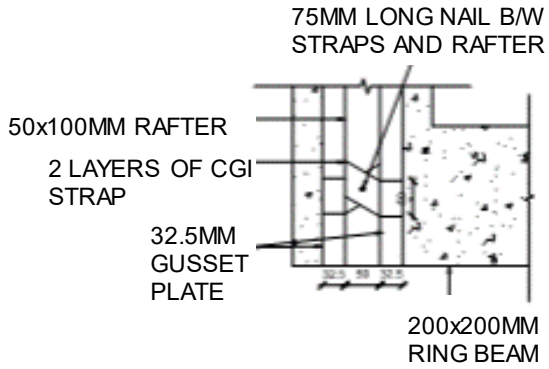
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 8/11
	DRAWING TITLE: DETAILS	DATE:	



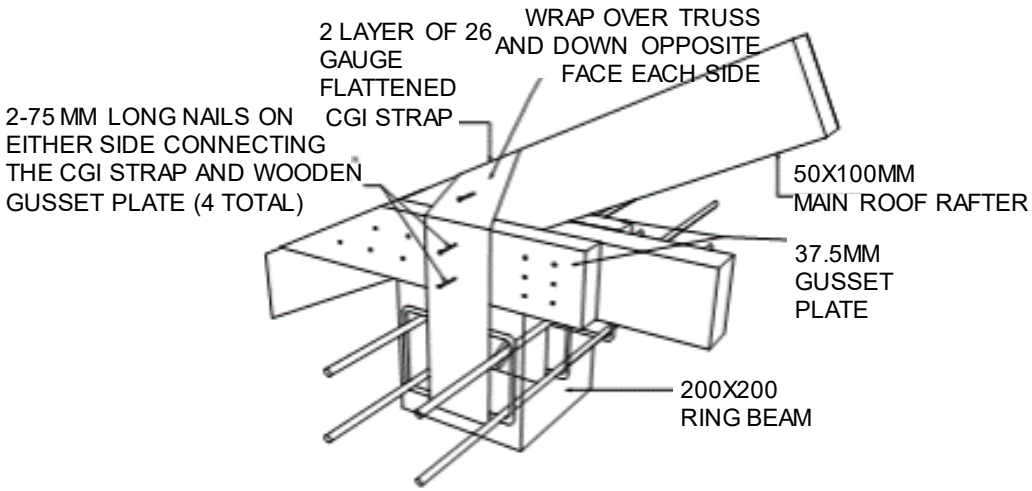
ROOF TRUSS ELEVATION WITH GUSSET PLATE



DETAIL OF CGI STRAP



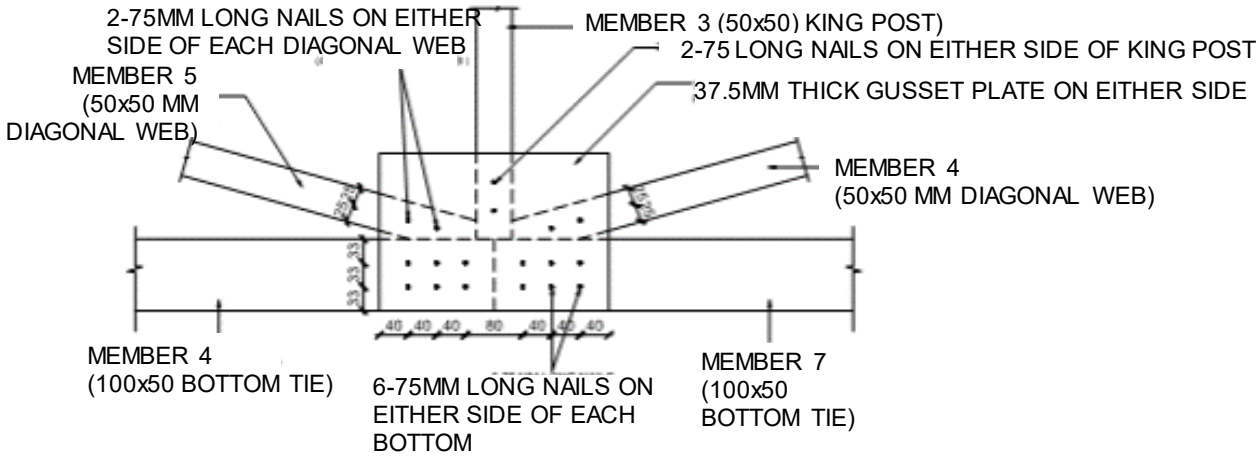
PLAN



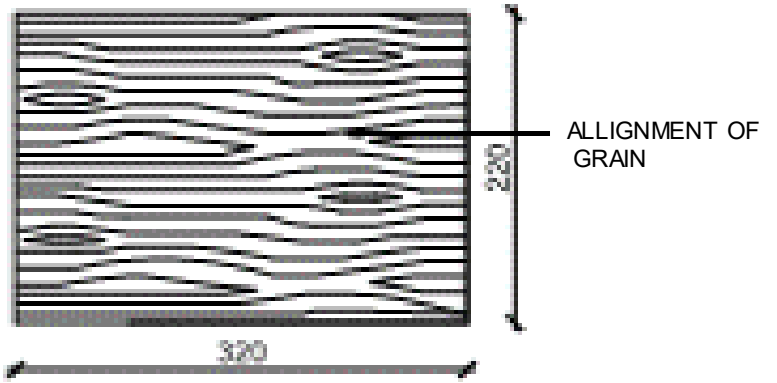
3D VIEW CGI STRAP CONNECTION

ALL DIMENSIONS ARE IN MM

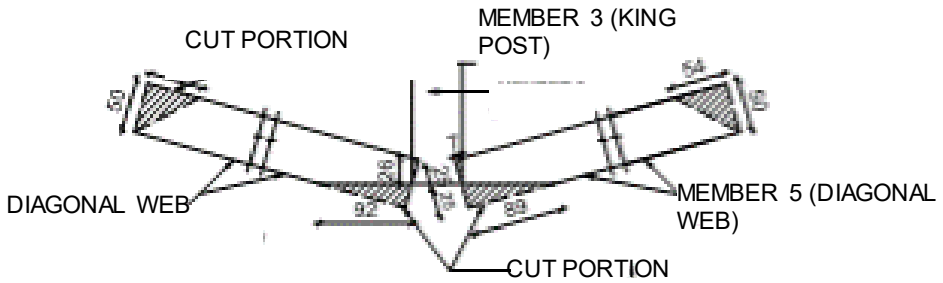
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 9/11
	DRAWING TITLE: DETAILS	DATE:	

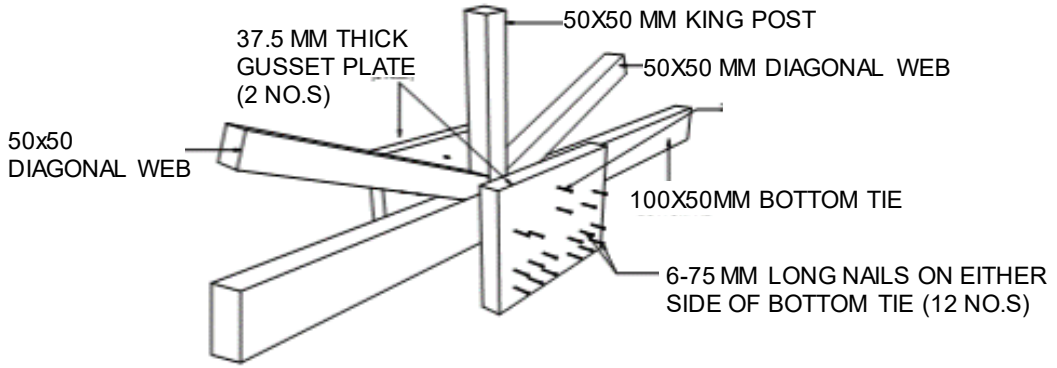


DETAIL AT CONNECTION 2



DETAIL OF GUSSET PLATE





MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL C.H.C.-2.1	SCALE: NONE	C.H.C.-2.1 10/11
	DRAWING TITLE: DETAILS	DATE:	

TECHNICAL REQUIREMENTS

Structure System	Confined Masonry structure. Structural system shall be of hollow concrete block masonry panels and slender cast in situ vertical and horizontal confining Reinforced concrete elements; tie columns and tie beams. Masonry walls shall be constructed first and then tie columns shall be casted in place. Toothing shall be ensured for proper connection between wall and tie columns.
Foundation	Strip foundation with stone masonry casing the tie column. The depth and width of footing shall be 900mm.
Plinth Band	Tie Beam of reinforced concrete of width 200 mm and depth 150mm. Main reinforcement 4 nos.12mm Ø bars with 6mm Ø stirrups at 150mm C/C.
Wall System	The hollow blocks of size 400 x 150 x 200 mm shall be of good quality and shall adhere to the Nepal Standards of block production. The mortar shall be 1: 5 (cement: sand) or richer. The thickness of wall shall be greater than or equal to 150mm.
Sill Band	A continuous reinforced concrete sill band shall be provided throughout the entire wall at the bottom level of openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos.12mm dia. bars with 6mm Ø stirrups at 150mm C/C.
Lintel Band:	A continuous reinforced concrete Lintel band shall be provided throughout the entire wall at the top level of the openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos.12mm dia. bars with 6mm Ø stirrups at 150mm C/C.
Floor Beam:	Floor Beam of reinforced concrete with 200 mm width and 200 mm depth. Main reinforcement shall be 4 nos. 12mm Ø bars with 6mm Ø stirrups at 150mm C/C
Floor:	100 mm thick reinforced concrete slab as shown in detail drawing.
Roof:	Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing. All trusses shall be properly cross tied with wooden braces as shown in the drawing.

HOLLOW CONCRETE BLOCK MASONRY

H.C.B.-3.1

This technology proposes load bearing structure of hollow concrete blocks. Hollow concrete blocks are seen as a good alternative to conventional brick masonry as they can be locally manufactured, cheaper and environment friendly.
Featured Design in H.C.B. 3.1 is a two storied residence with four rooms. Design features are RCC strip foundation, load bearing hollow concrete walls, precast floor and roof, precast stair slabs, horizontal bands and vertical seismic reinforcement at critical sections. The design is of modular type, affordable, structurally sound and environment friendly.

MATERIAL PROPERTIES

Block Size: 40cm X 20cm X10cm
Section of pre- caste Beam : Tapered width (75mmx125mm) x Height 200mm
Min Compressive strength of block : 5 N/mm^2
Grade of Steel : Fe 500Mpa
Nominal Mix Ratio: 1:1.5:3 (C:S:A)

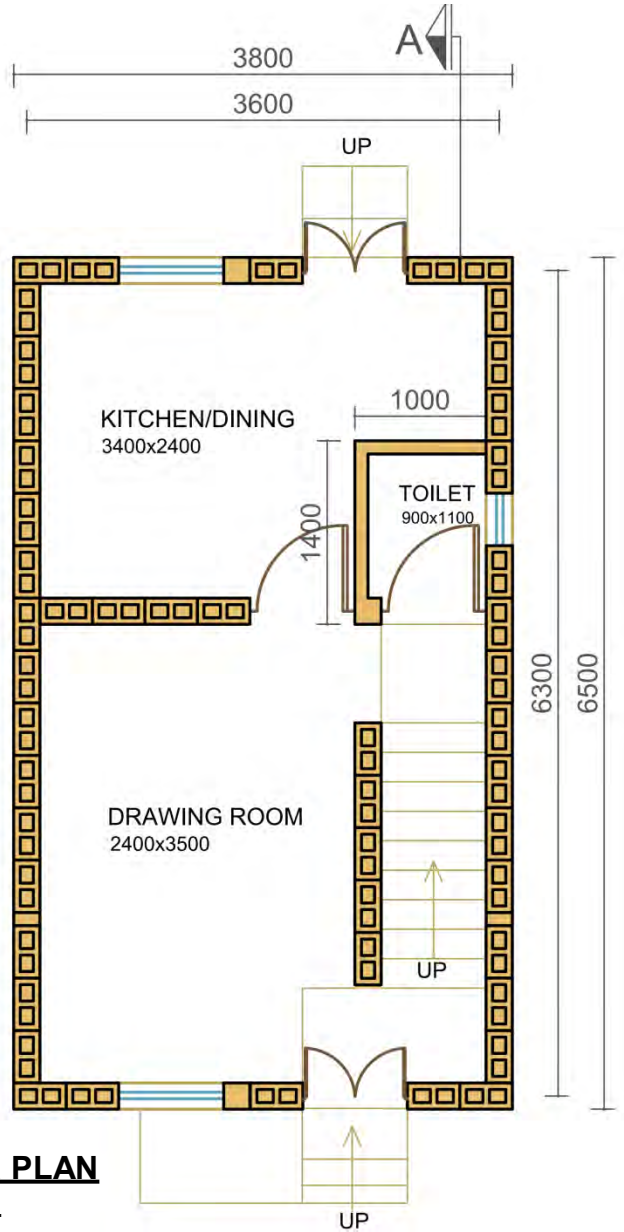
H.C.B.-3.1

MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY — TWO STOREY

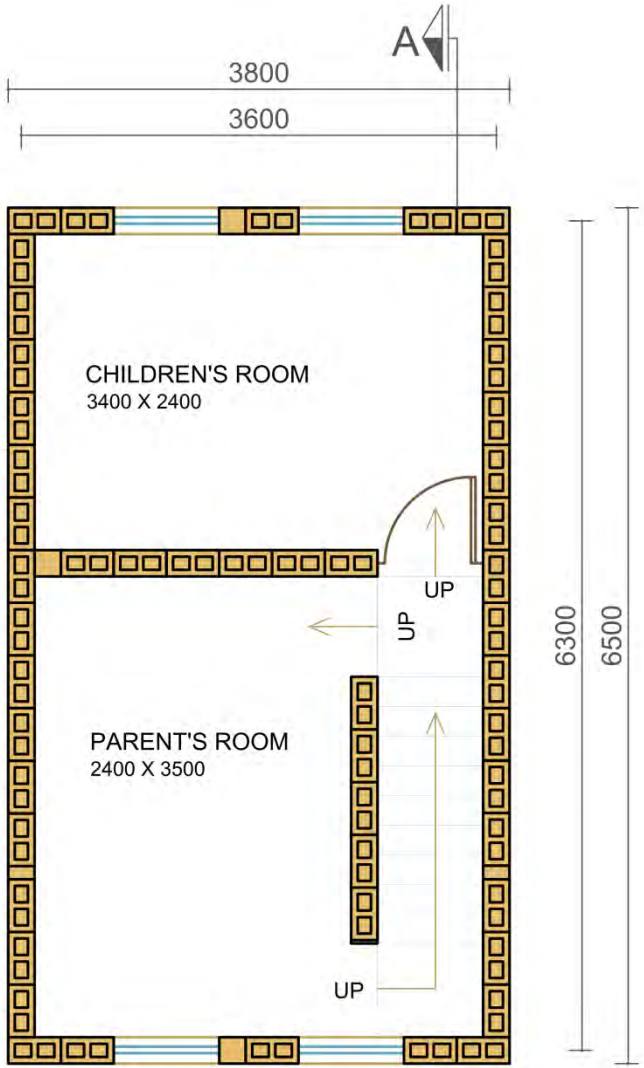
LEVEL	MATERIALS					
	Hollow Concrete Bricks	Cement	Sand	Aggregate	Reinforcing Bar	Polythene sheet
	No.	Bags	Cu.m.	Cu.m.	Kg.	Sq.m
Up to Plinth Level	447.0	99.3	6.1	12.1	864.6	19.7
Super Structure	2,398.0	162.8	8.6	17.5	1,677.3	
Roofing						
TOTAL	**2,845.0**	**262.1**	**14.7**	**29.6**	**2,541.9**	**19.7**

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION

HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	1/9

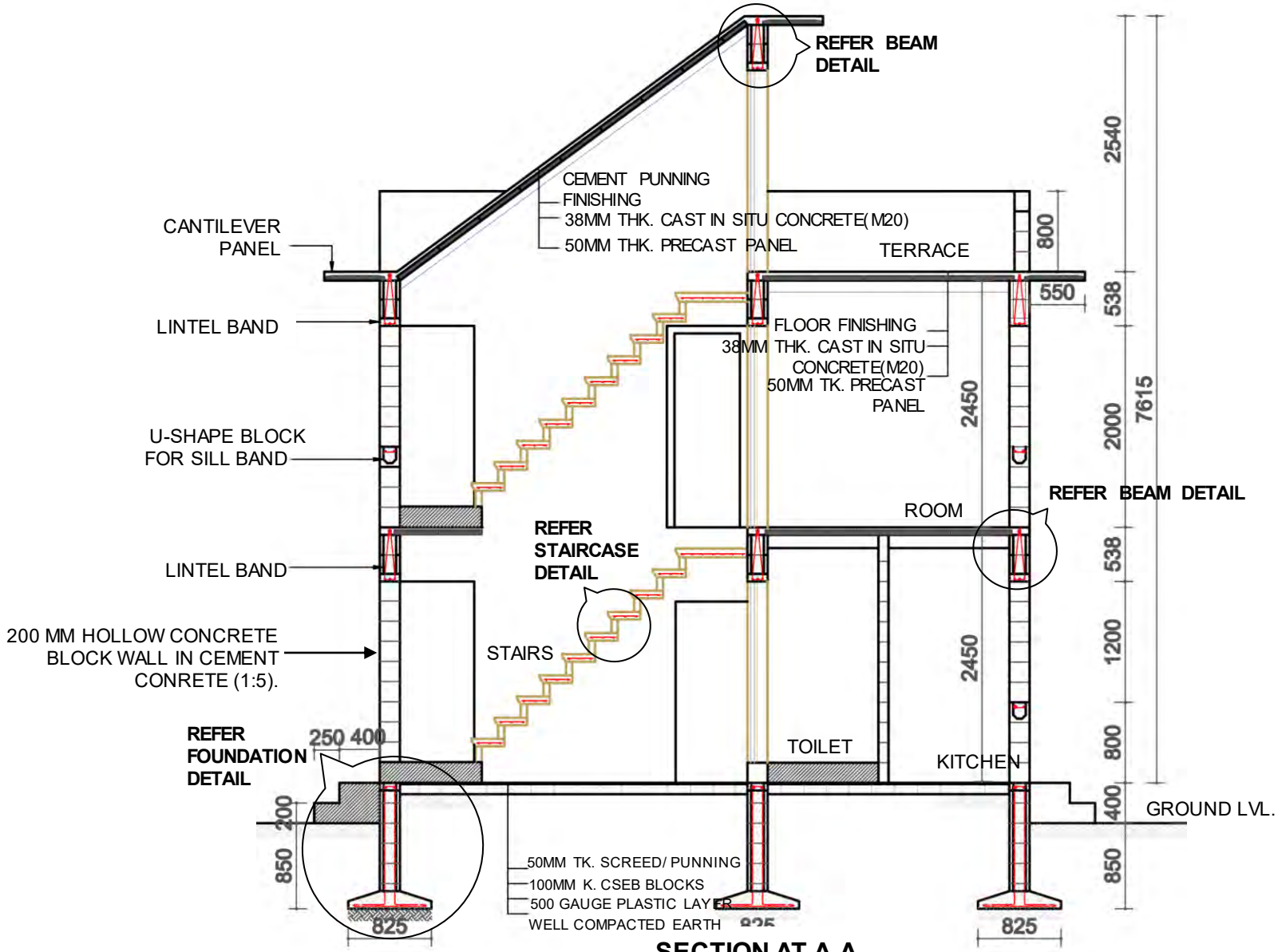


GROUND FLOOR PLAN
AREA: 24.7 SQ.M.



FIRST FLOOR PLAN
AREA: 24.7 SQ.M.

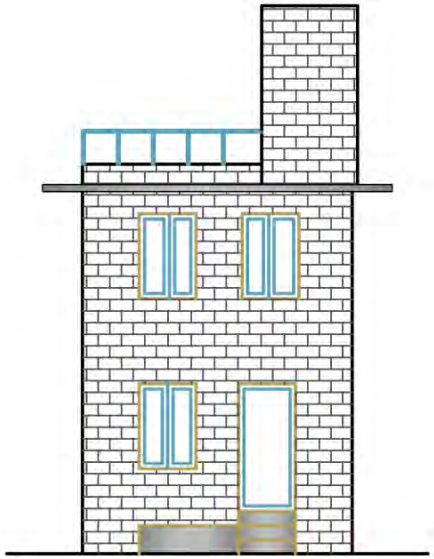
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
	DRAWING TITLE: FLOOR PLANS	DATE:	2/9



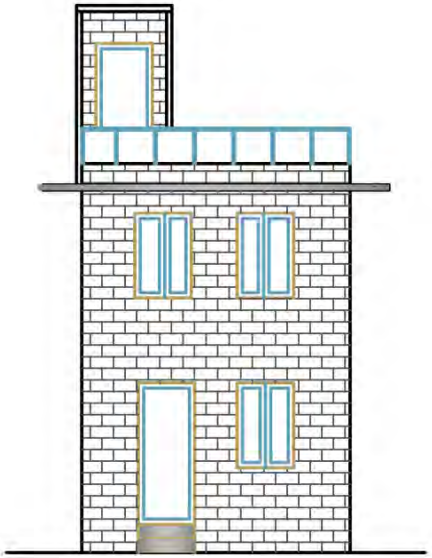
SECTION AT A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
	DRAWING TITLE: SECTION	DATE:	3/9

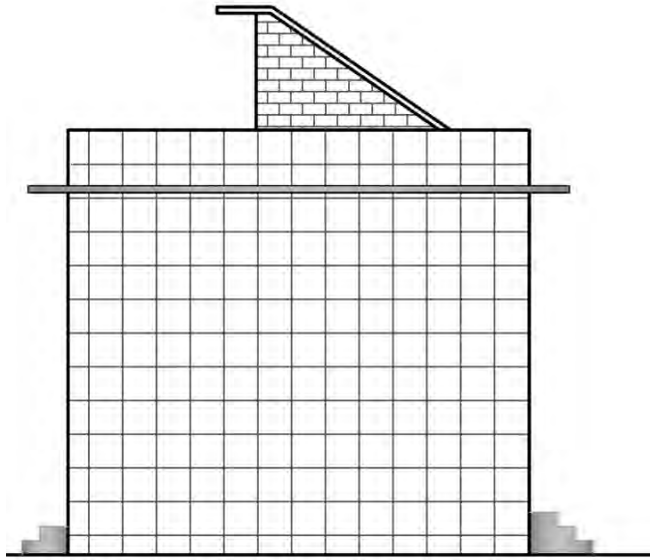
MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY — TWO STOREY



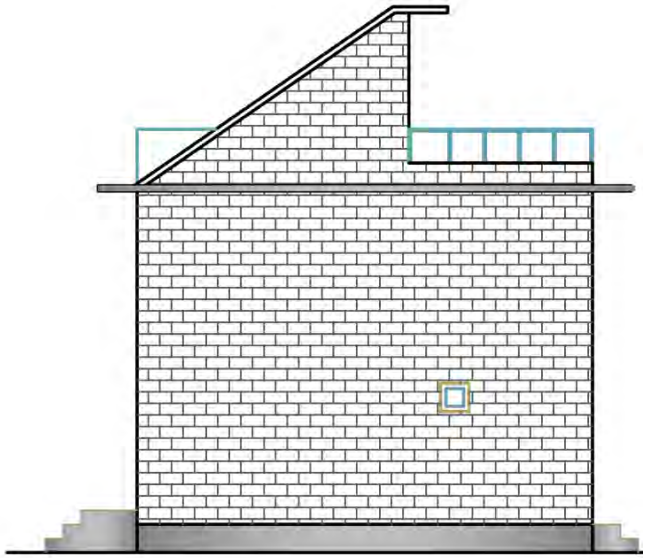
FRONT ELEVATION



BACK ELEVATION

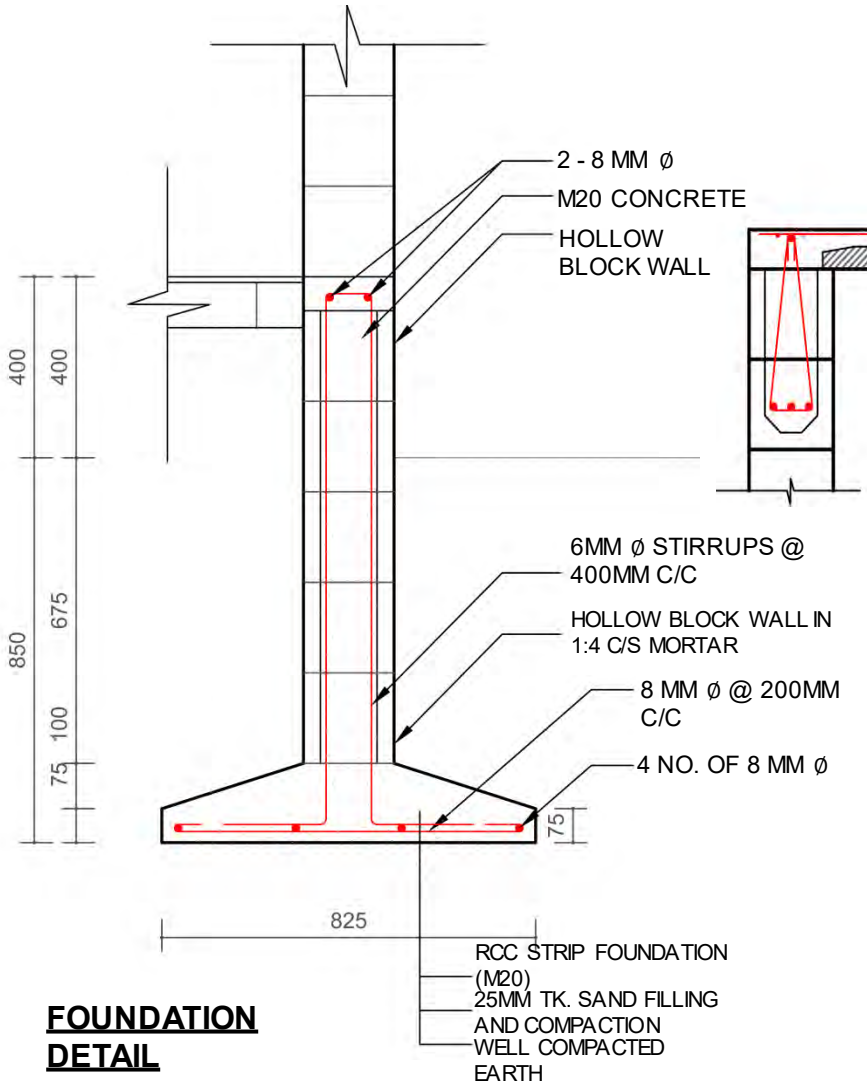


SIDE ELEVATION

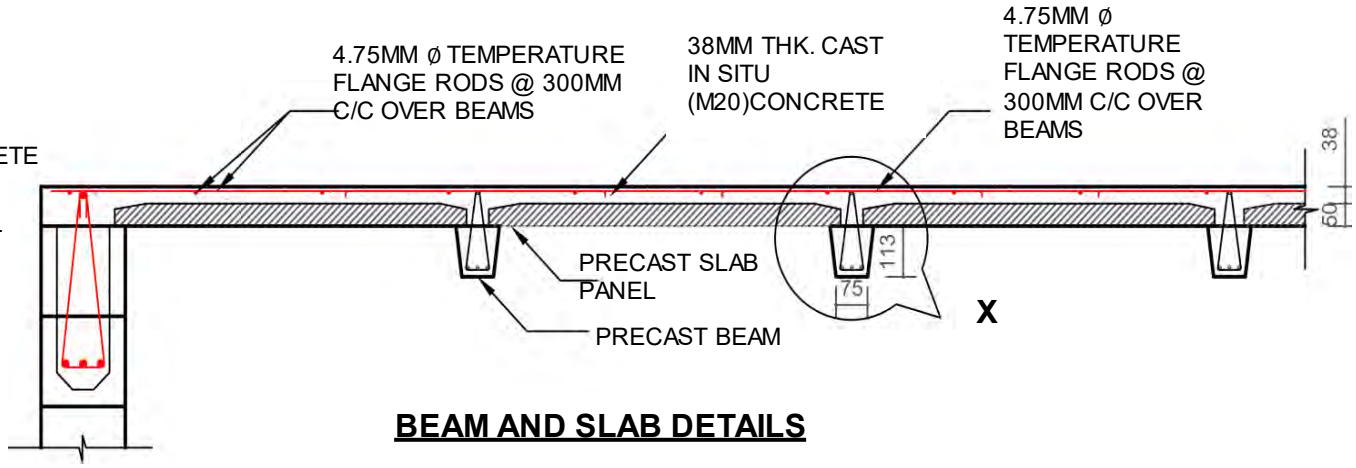


SIDE ELEVATION

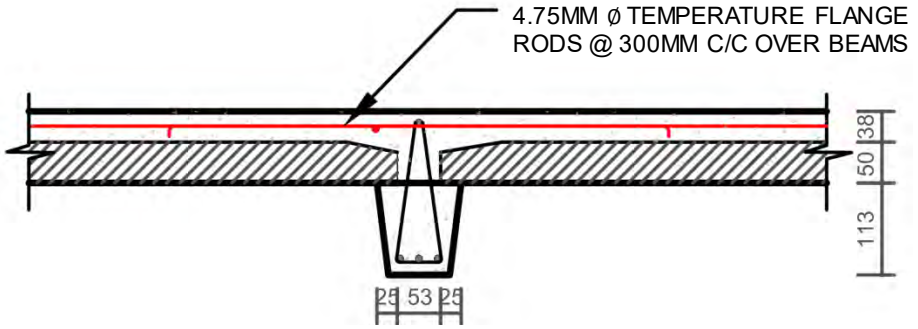
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
	DRAWING TITLE: ELEVATIONS	DATE:	4/9



FOUNDATION DETAIL

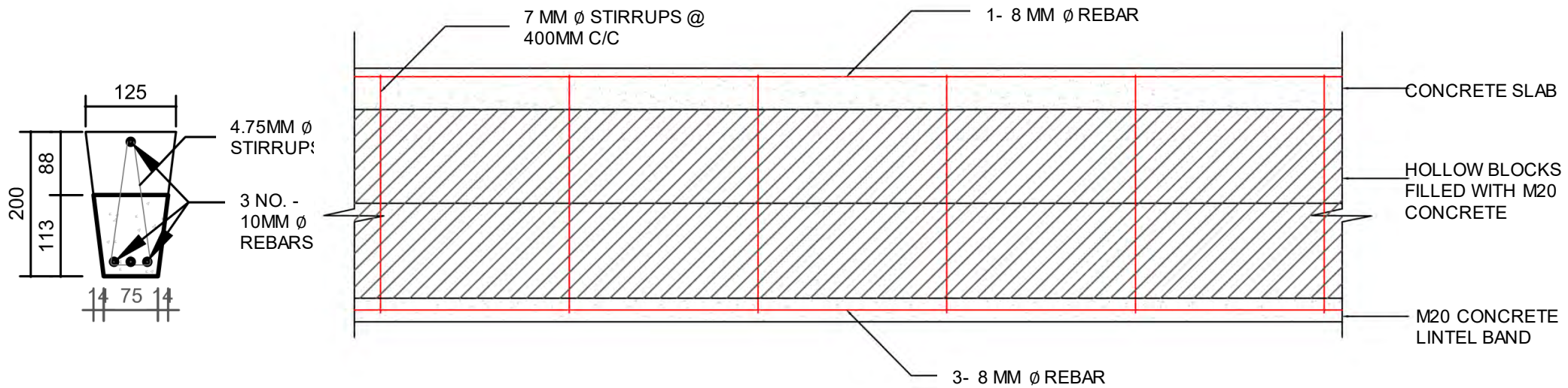


BEAM AND SLAB DETAILS



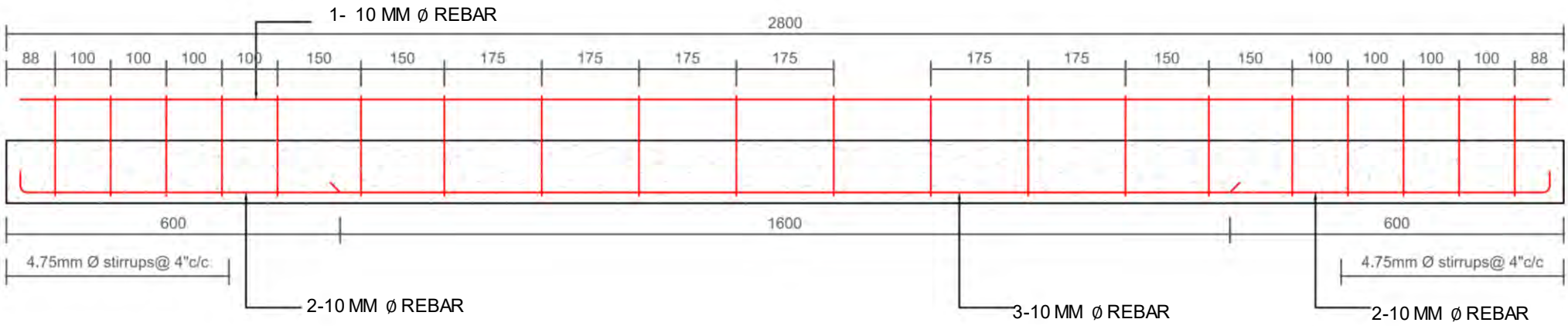
DETAIL AT X

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
	DRAWING TITLE: DETAILS	DATE:	5/9



PRECAST BEAM CROSS SECTION

LONGITUDINAL SECTION OF LINTEL BEAM



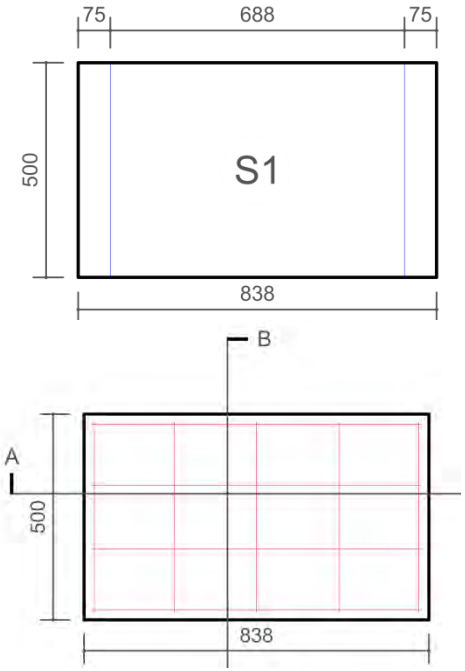
LONGITUDINAL SECTION OF PRECAST BEAM

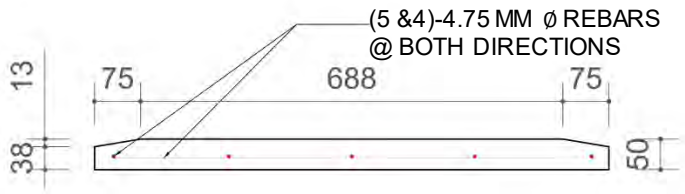
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
	DRAWING TITLE: DETAILS	DATE:	6/9

MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY

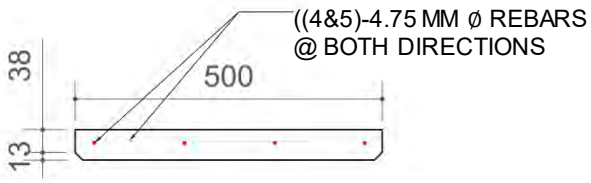
TWO STOREY

SLAB(S1) DETAILS



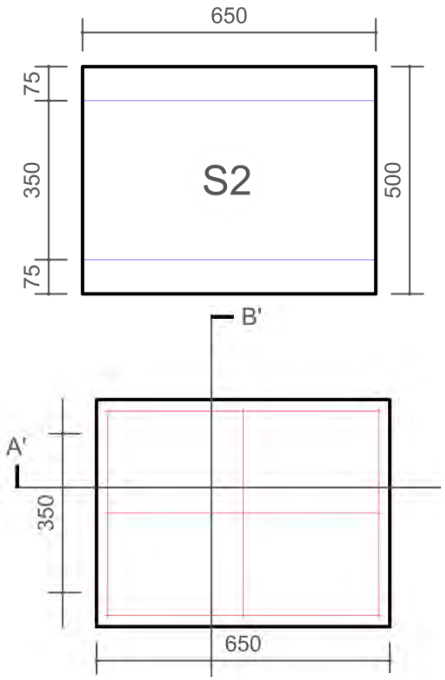


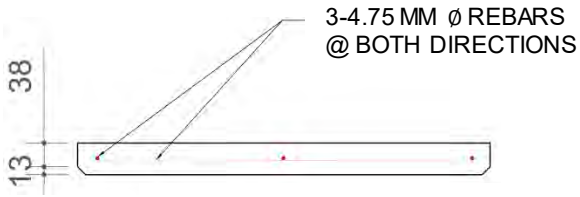
SECTION AT A-A



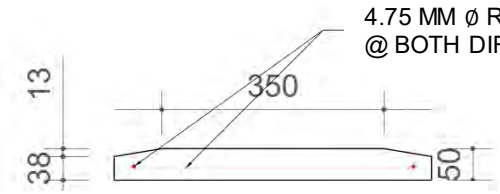
SECTION AT B-B

SLAB(S2) DETAILS



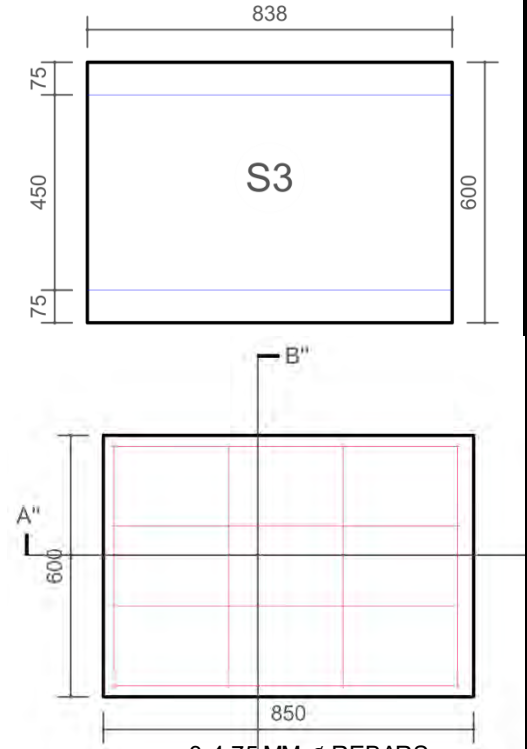


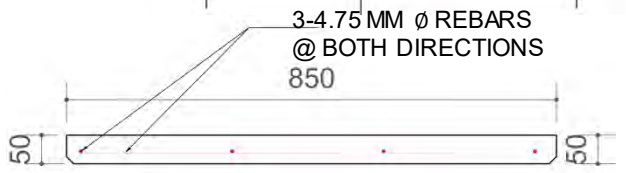
SECTION AT A-A

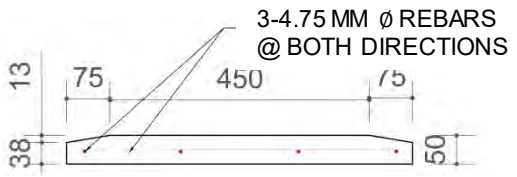


SECTION AT B-B

SLAB(S3) DETAILS





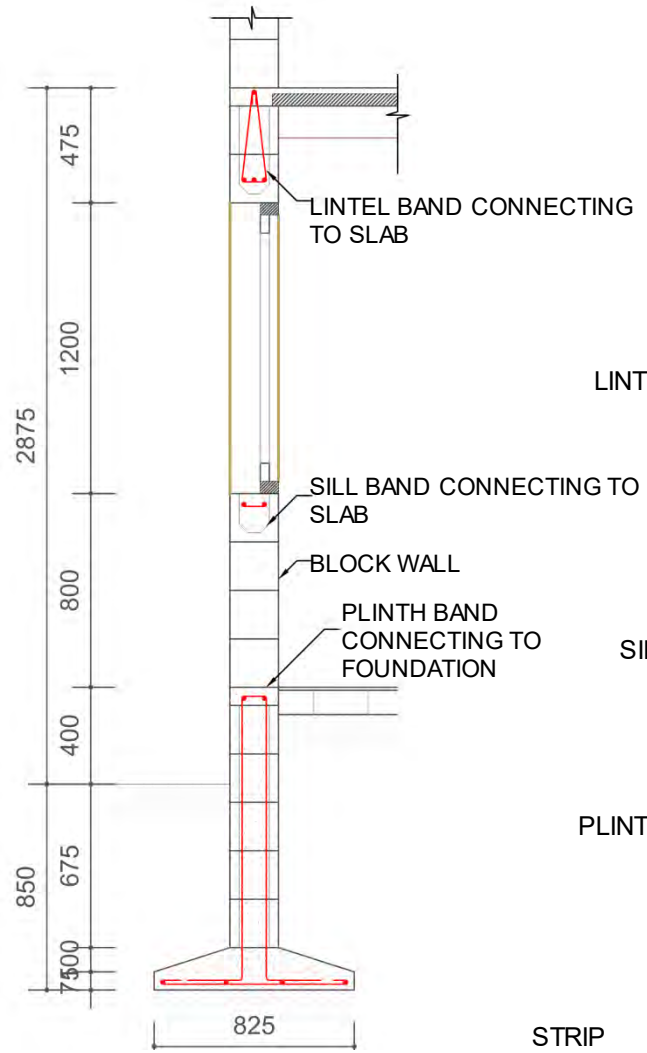


SECTION AT B-B

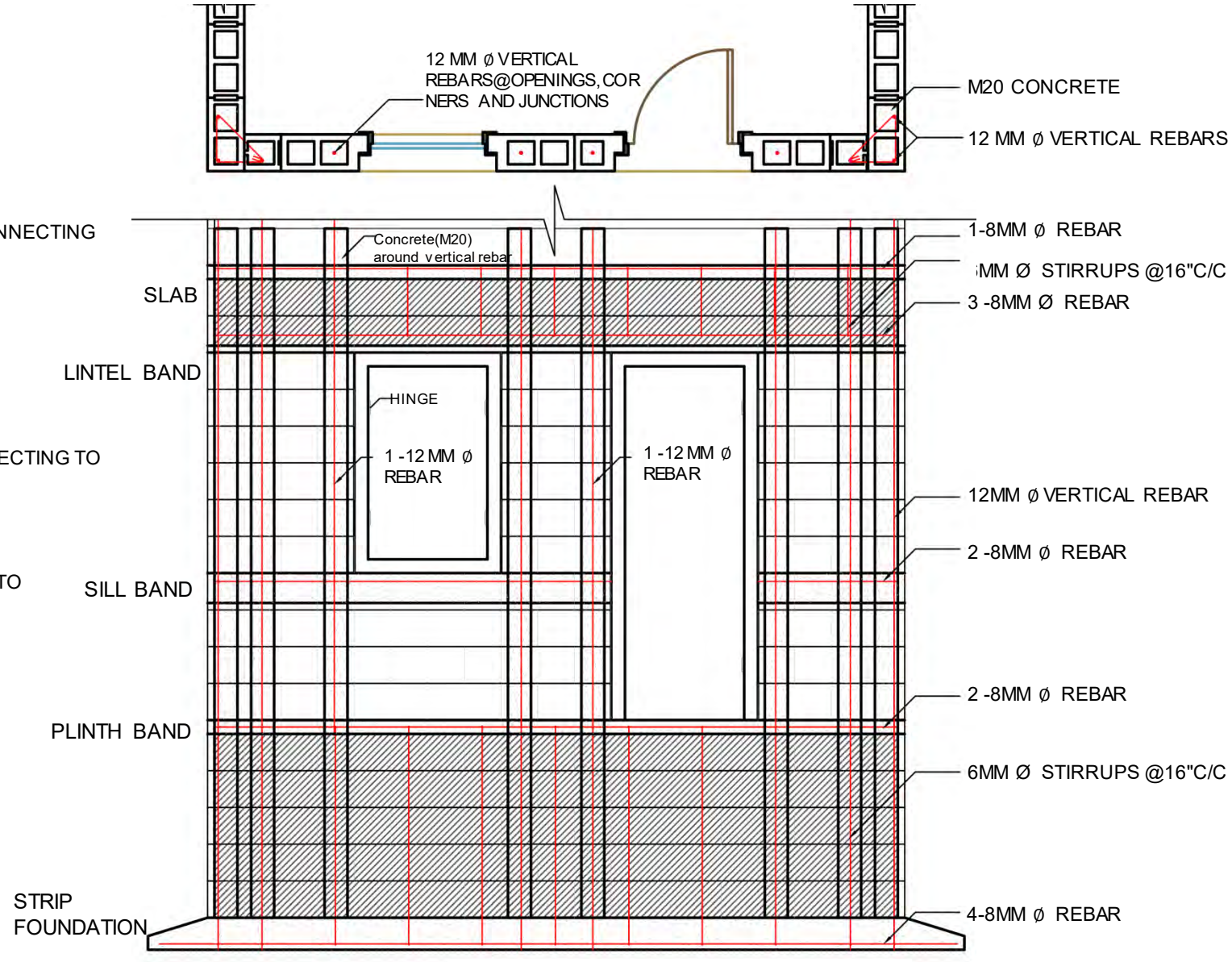
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
	DRAWING TITLE: DETAILS	DATE:	7/9

MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY

TWO STOREY

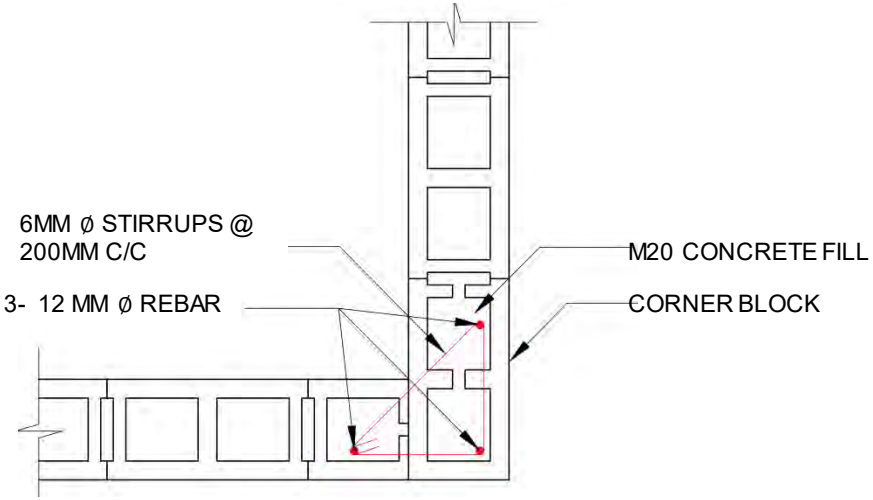


WALL SECTION AT OPENING

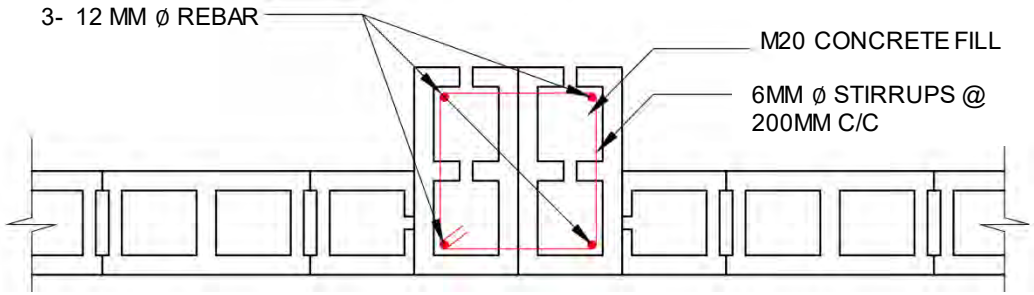


SECTIONAL ELEVATION

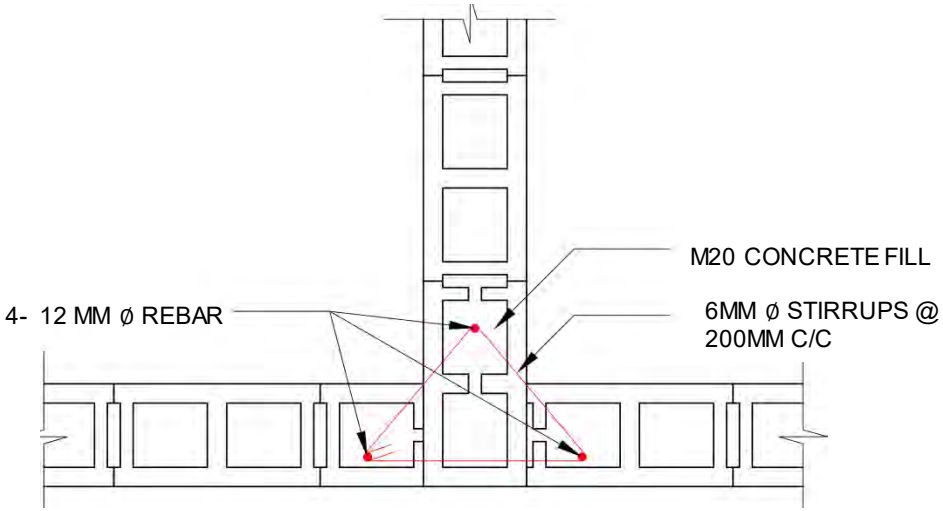
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
	DRAWING TITLE: DETAILS	DATE:	8/9



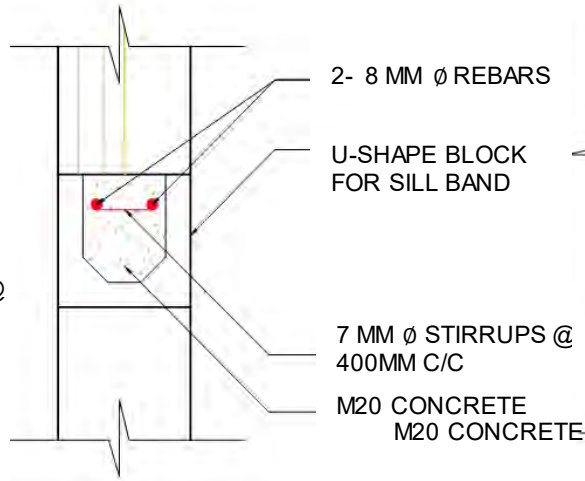
REINFORCEMENT DETAIL AT CORNER



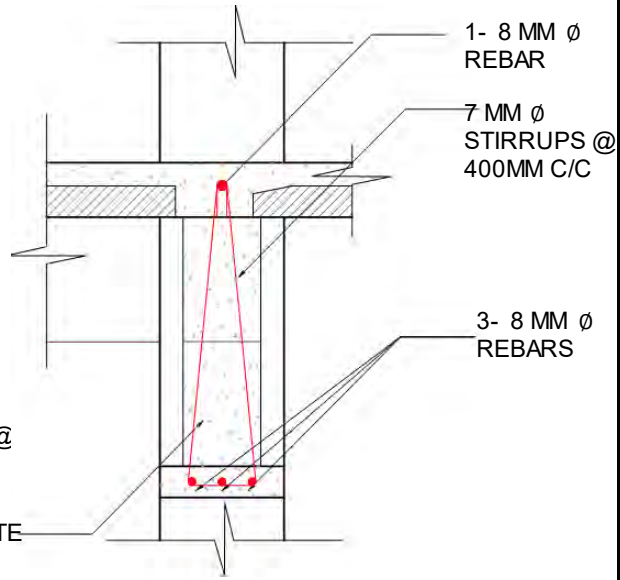
REINFORCEMENT DETAIL A T T-JUNCTION



COLUMN PROJECTION DETAIL

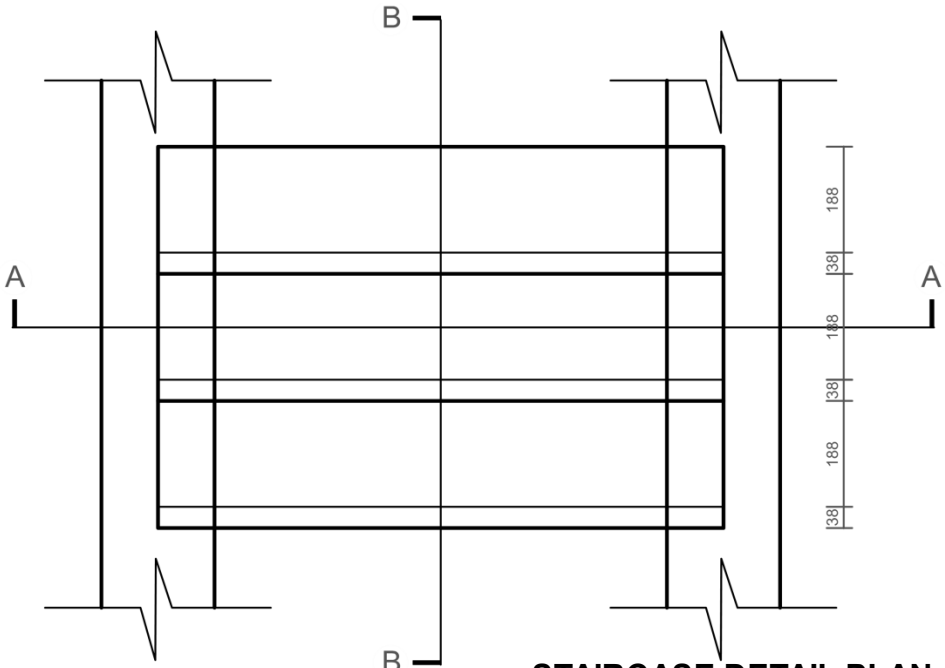


DETAIL AT B SILL BAND

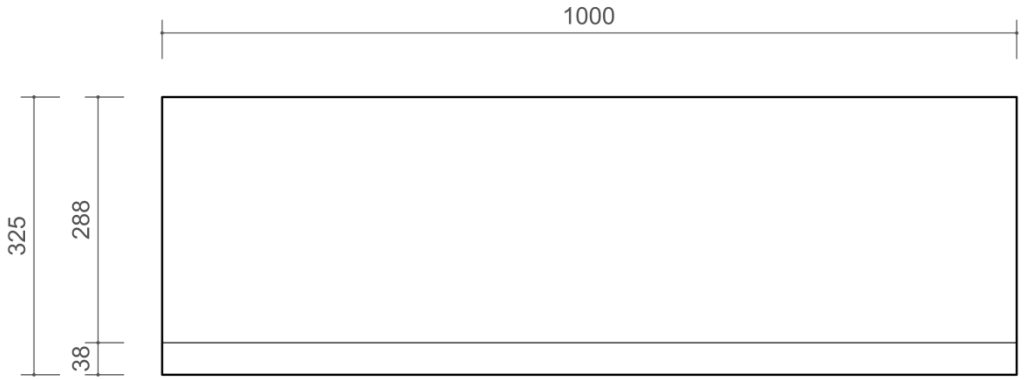


DETAIL AT A LINTEL BEAM

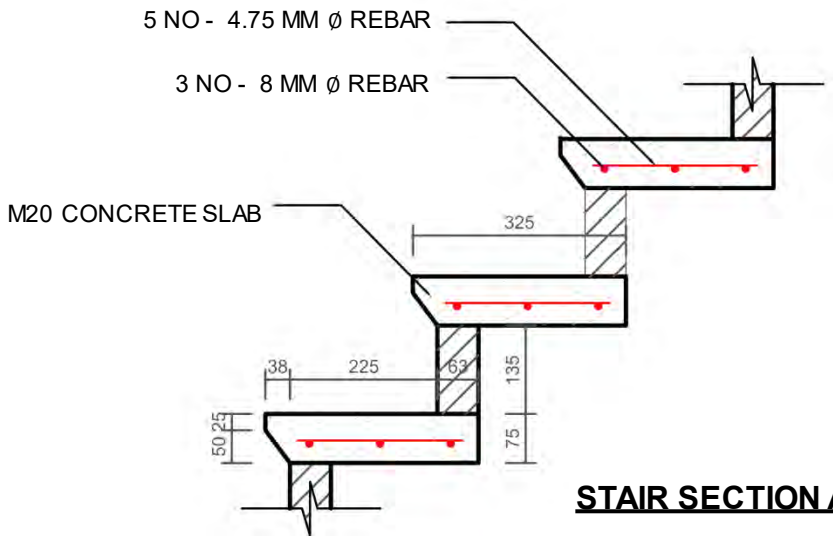
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
	DRAWING TITLE: DETAILS	DATE:	7/9



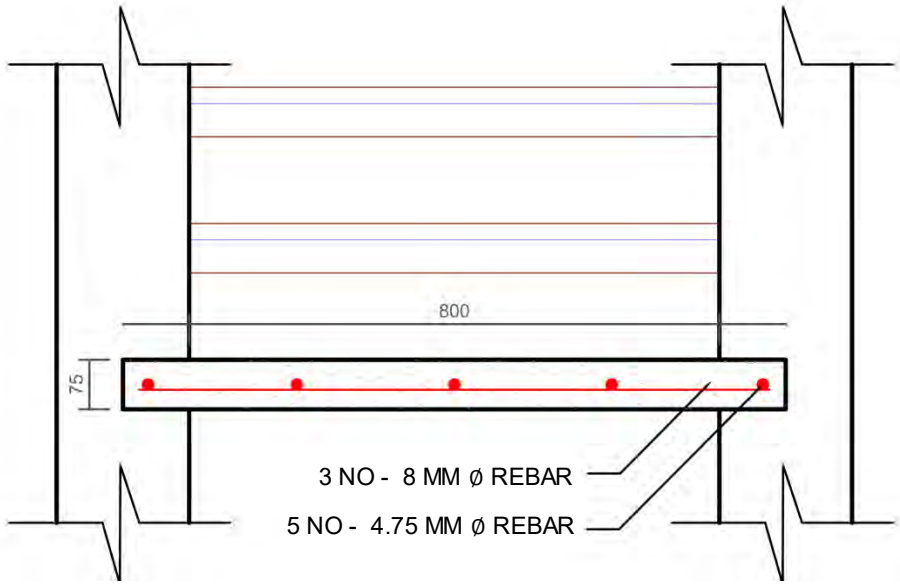
STAIRCASE DETAIL PLAN



STAIRCASE SLAB UNIT



STAIR SECTION AT B-B



STAIR SECTION AT A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL H.C.B.-3.1	SCALE: NONE	HCB-3.1
	DRAWING TITLE: DETAILS	DATE:	8/9

TECHNICAL REQUIREMENTS

Structure System	Hollow concrete block masonry with precast floor over precast beams. Vertical and Horizontal reinforcements shall be provided in strategic locations as shown in drawings.
Foundation	Strip Foundation of width 850 mm and depth 825 mm. Reinforcement 8 mm Ø at 150mm C/C both ways.
Plinth Band	Plinth beam of reinforced concrete of width 200 mm and depth 150 mm shall be provided. Main reinforcement shall be of 4 nos.10mm Ø bars with 6mm Ø stirrups at 150mm C/C.
Wall System	The hollow blocks shall be of size of 400x 200 x 100 mm and be of good quality and shall adhere to the Nepal Standards of block production. The mortar shall be 1: 4 (cement: sand) or richer.
Sill Band	A continuous reinforced concrete sill band shall be provided throughout the entire wall at the bottom level of the openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos.8mm dia. bars with 6mm Ø stirrups at 150mm C/C.
Lintel Band:	A continuous lintel band shall be provided throughout the entire wall at the top level of the openings. The depth of the band shall be 600mm and triangular stirrups shall connect lintel and slab. Hollow concrete blocks between lintel and slab shall be filled with 1:1.5:3 concrete.. Main reinforcement shall be 3 nos. of 10mm dia. bars with 7mm Ø triangular stirrups at 150mm.
Floor Beam:	Precast Floor Beam with details as shown in drawing.
Floor:	100 mm thick reinforced concrete slab as shown in detail drawing.
Roof:	38 mm cast in situ concrete (1:1.5:3) over 50 mm precast slab panels and precast beam of size 125 x 200 mm..

COMPRESSED STABILIZED EARTH BLOCK MASONRY

C.S.E.B.-4.1

C.S.E.B.-4.2

Compressed Stabilized Earth Block **(CSEB)** Technology makes use of mud as a predominant building material. The properties of soil used are improved by using stabilizers like cement. The proposed technology is very suitable for rural areas where local materials are used and their quality improved by adding small quantities of non local materials. Featured design C.S.E.B.-4.1 is a low cost, single storied two room residential units of load bearing stabilized earthen block walls with mud stabilized soil roof over bamboo rafter and purlins. Design Model C.S.E.B.-4.2 is a two storied residential units with eight rooms. Load bearing walls are made of Earthen block stabilized with chemicals.

MATERIAL PROPERTIES(C.S.E.B 4.1)

Block Size: 30cm X 20cm X10cm

Min Compressive Strength on gross area CSEB: 3.5 Mpa

MATERIAL PROPERTIES(C.S.E.B 4.2)

Properties	**Solid Brick**
Size	230*110*55 mm
28 days dry compressive strength	7.5 - 10 MPa
28 days wet compressive strength (after 24 hours immersion)	3 - 4 MPa
Apparent bulk density	2100 - 2350 kg/m3
Total Water absorption	5 - 10 %
Moisture content	< 0.03%
Dry Shrinkage	< 0.04%
Shell thickness	-

C.S.E.B.-4.1

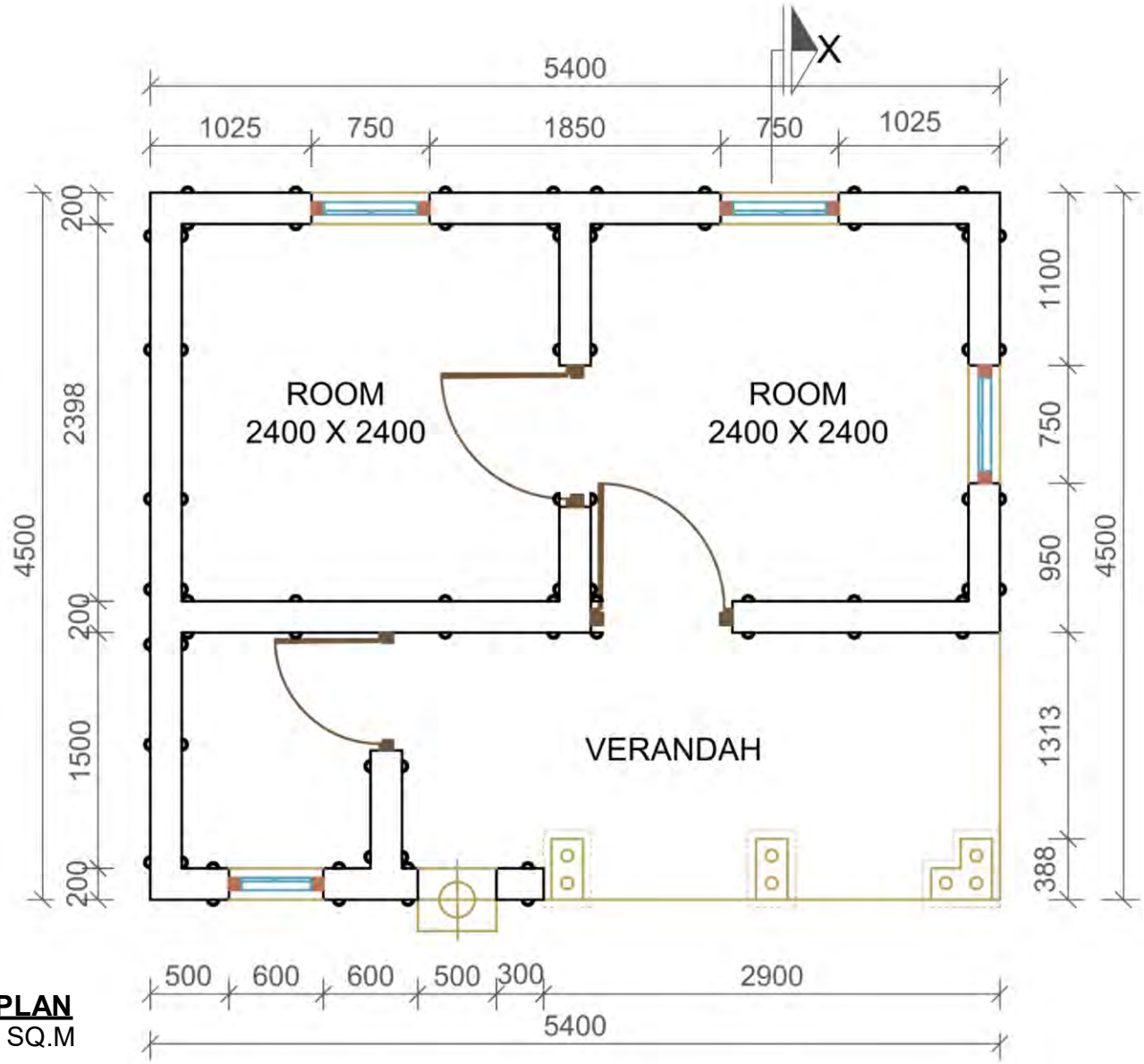
C.S.E.B.-4.2

MODEL C.S.E.B-4.1, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — ONE STOREY

LEVEL	MATERIALS					
	Stabilized block	Cement	Sand	Reinforcing Bar	Wood	Bamboo
	No.	Bags	Cu.m.	Kg.	Cu.m.	Nos
Up to Plinth Level	1,758.0	17.0	2.3	-	-	-
Super Structure	1,500.0	7.2	1.4	237.3	0.2	25.5
Roofing	-	-	-	-	2.4	31.0
TOTAL	**3,258.0**	**24.2**	**3.7**	**237.3**	**2.6**	**56.5**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.1	SCALE: NONE	CSEB-4.1
	DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	1/8

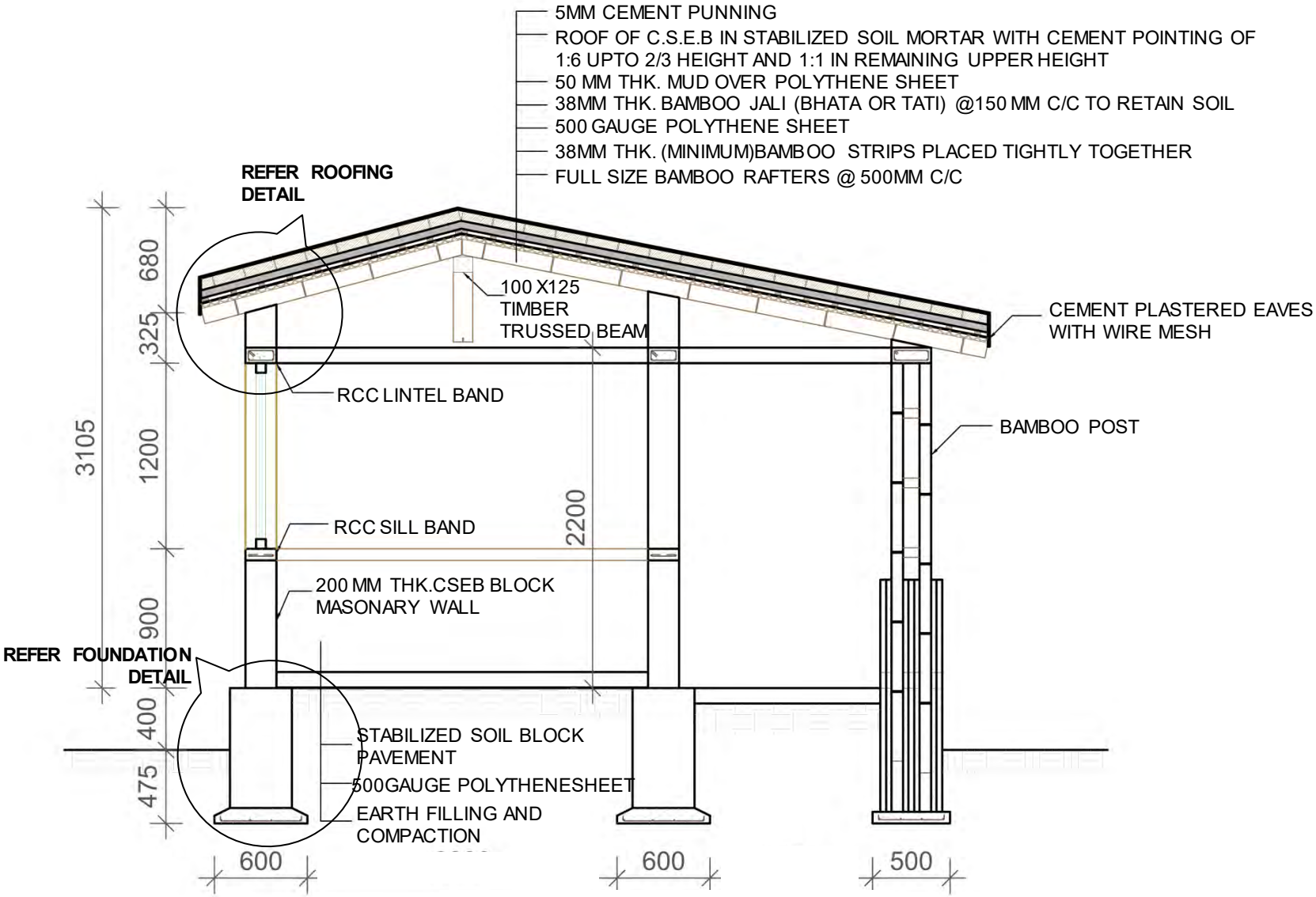
MODEL C.S.E.B-4.1, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — ONE STOREY



GROUND FLOOR PLAN
FLOOR AREA: 24.08 SQ.M

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.1	SCALE: NONE	CSEB-4.1
	DRAWING TITLE: GROUND FLOOR PLAN	DATE:	2/8

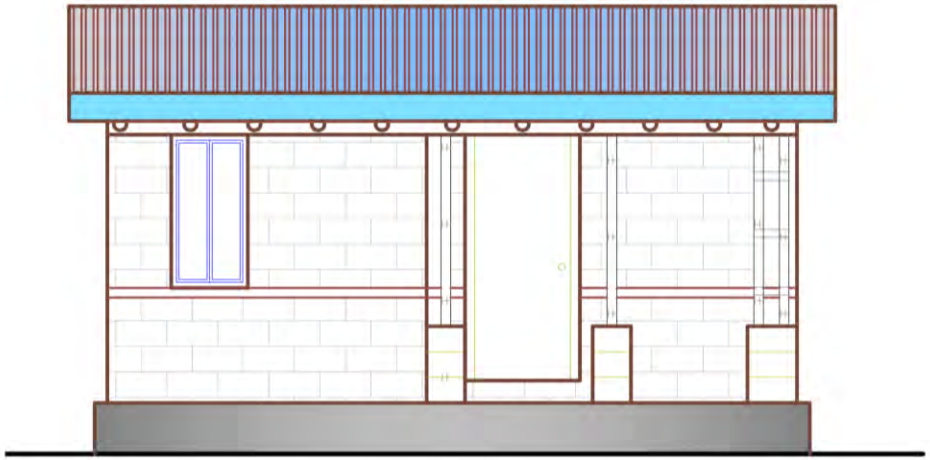
MODEL C.S.E.B-4.1, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — ONE STOREY



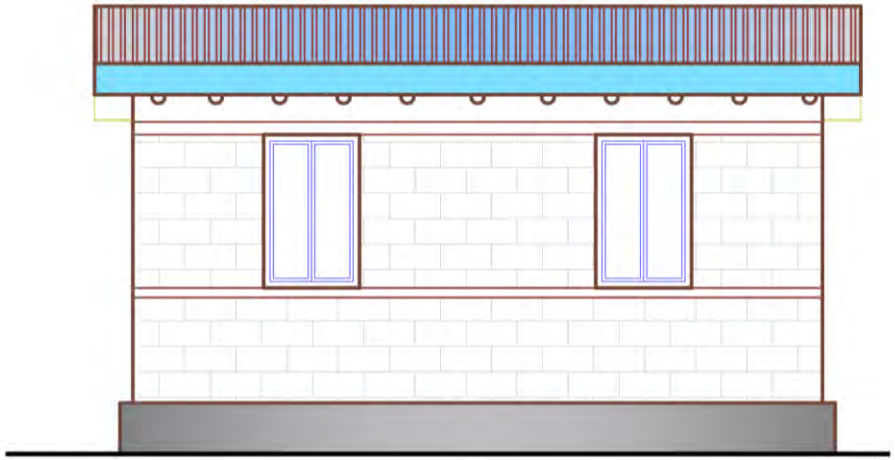
SECTION AT X-X

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.1	SCALE: NONE	CSEB-4.1
	DRAWING TITLE: SECTION	DATE:	3/8

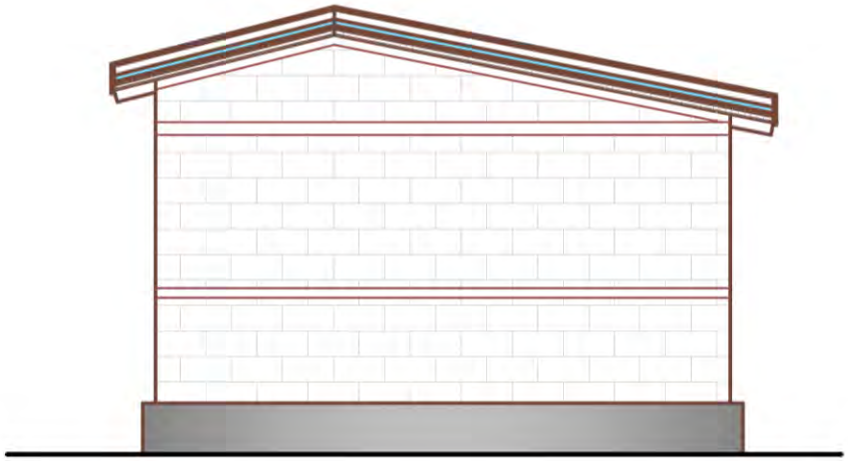
MODEL C.S.E.B-4.1, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — ONE STOREY



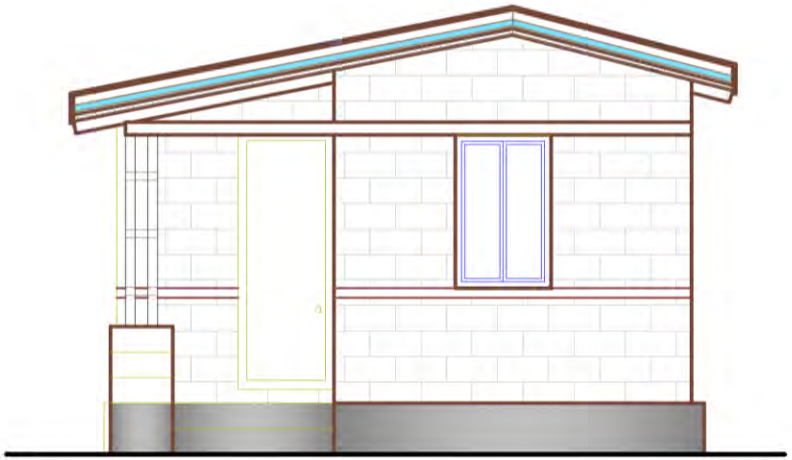
FRONT ELEVATION



BACK ELEVATION



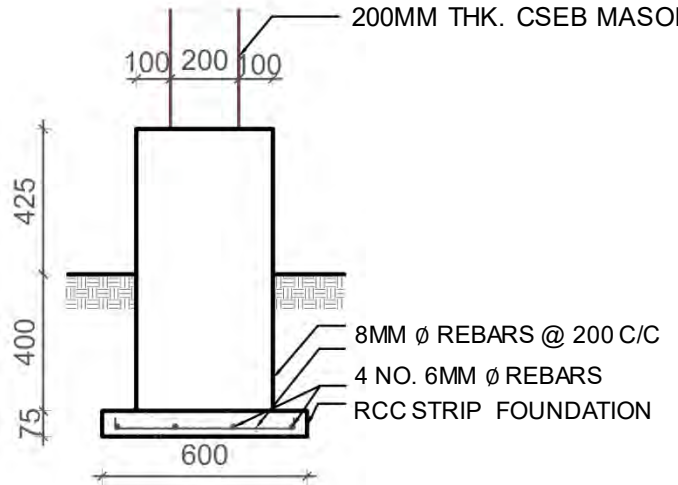
LEFT ELEVATION



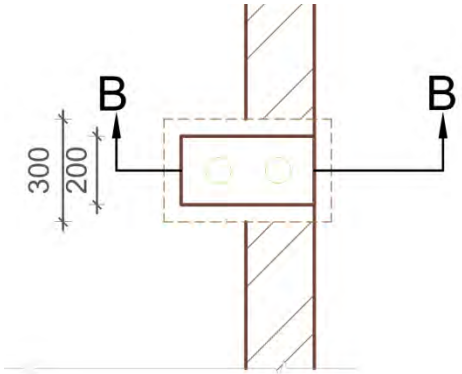
RIGHT ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.1	SCALE: NONE	CSEB-4.1
	DRAWING TITLE: ELEVATIONS	DATE:	4/8

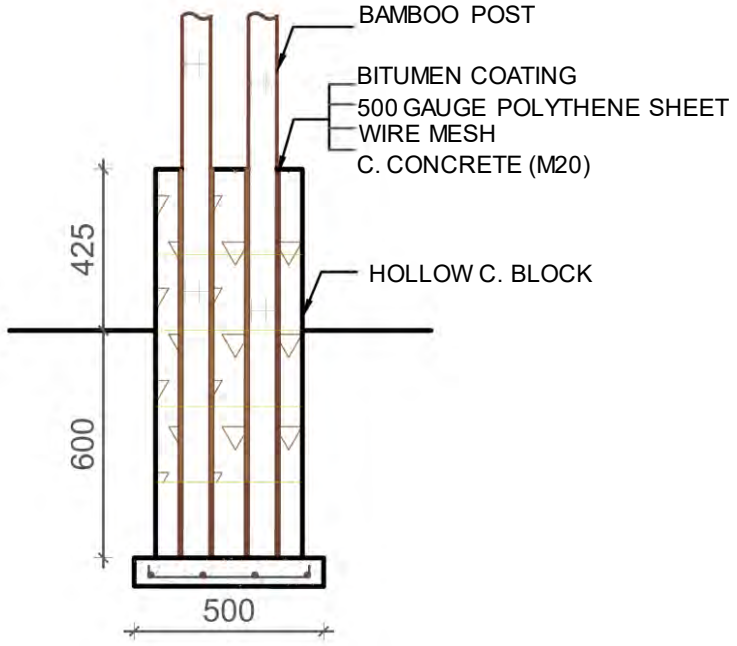
MODEL C.S.E.B-4.1, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — ONE STOREY



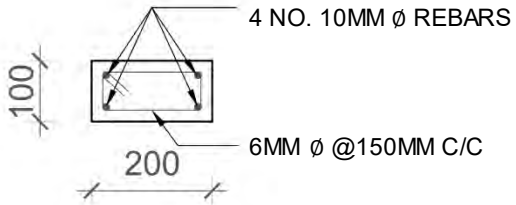
FOUNDATION SECTION



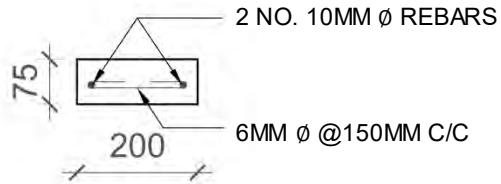
FOUNDATION OF BAMBOO POST



SECTION B-B



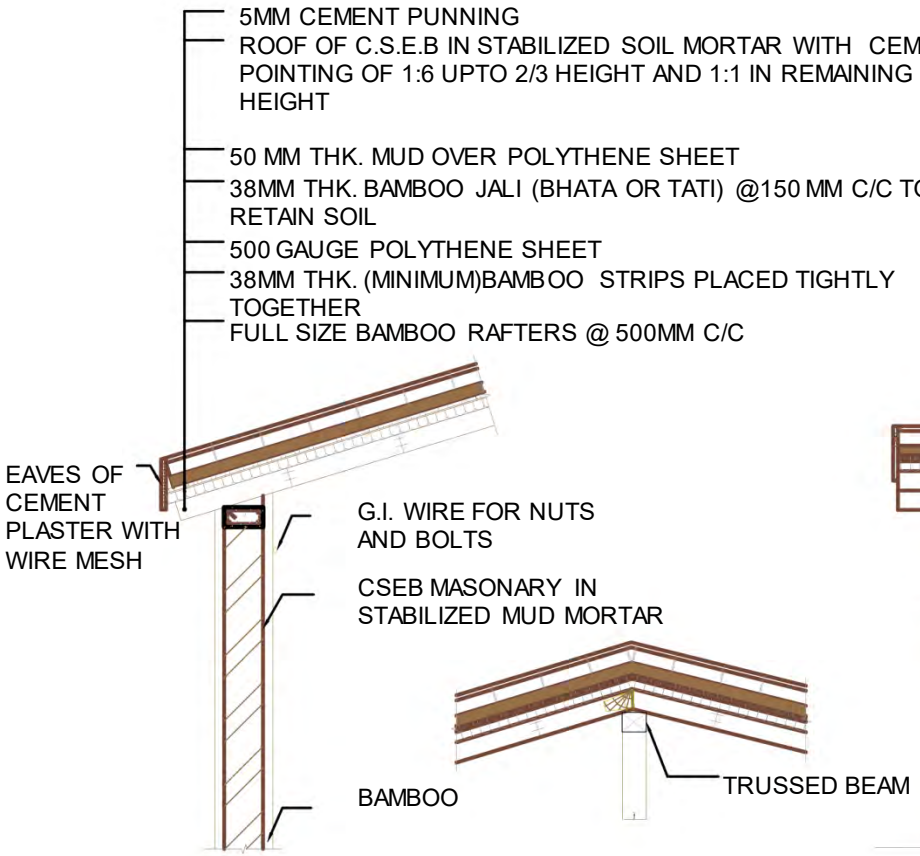
LINTEL BAND



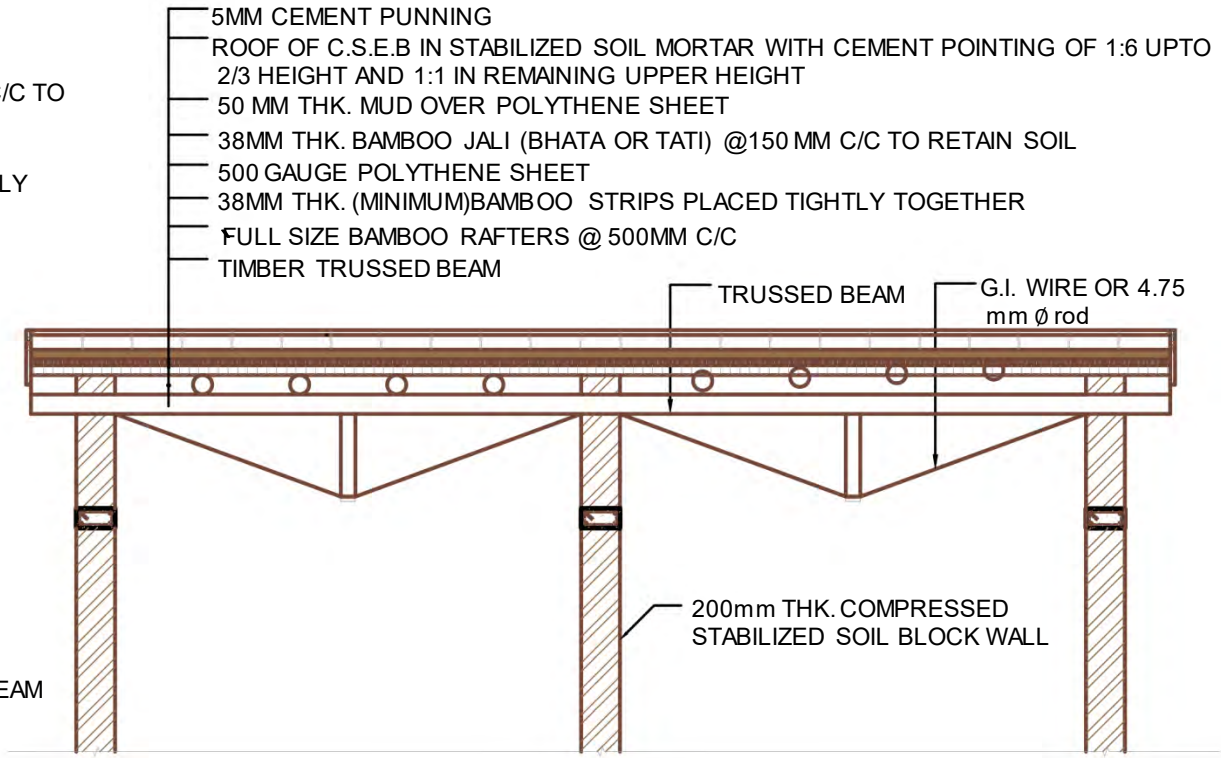
SILL BAND

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.1	SCALE: NONE	CSEB-4.1
	DRAWING TITLE: DETAILS	DATE:	5/8

MODEL C.S.E.B-4.1, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — ONE STOREY



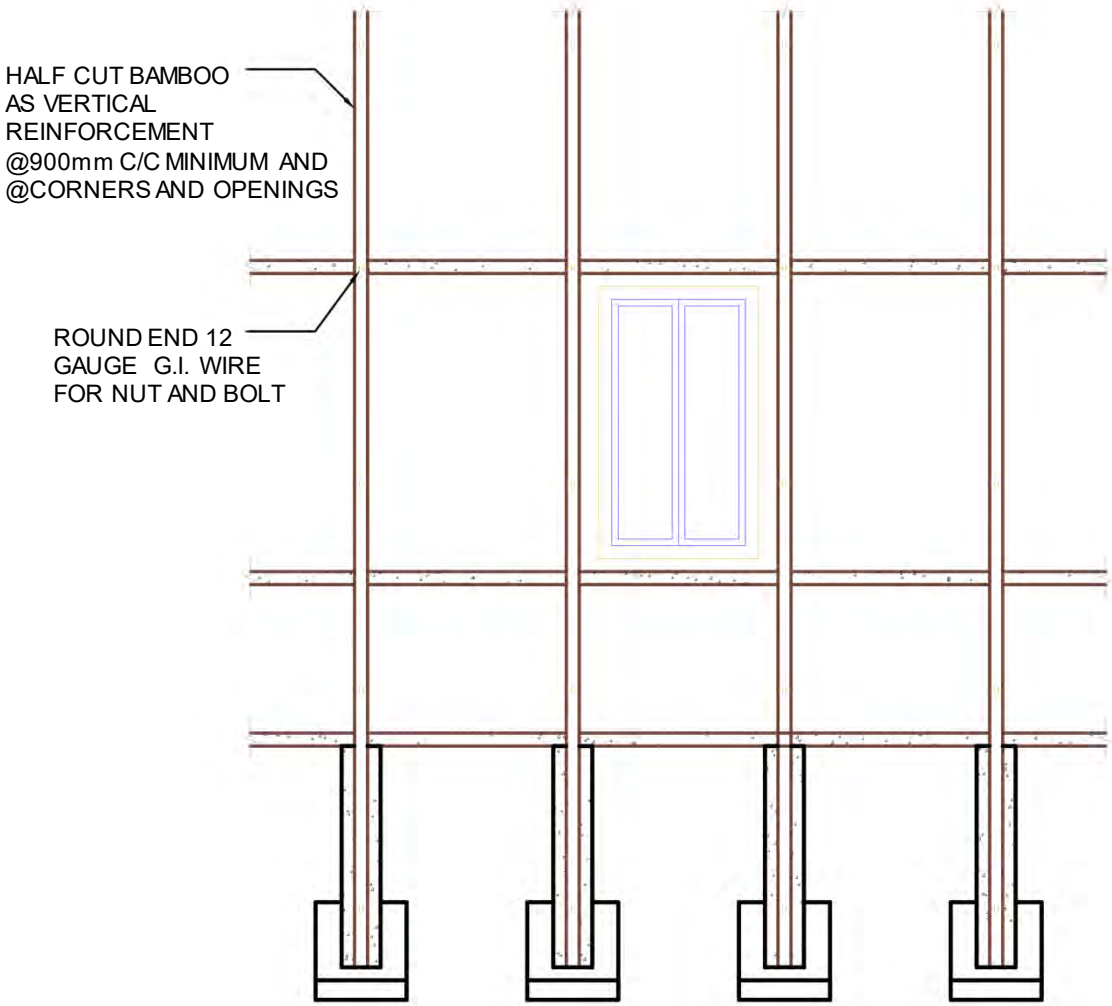
ROOFING DETAILS



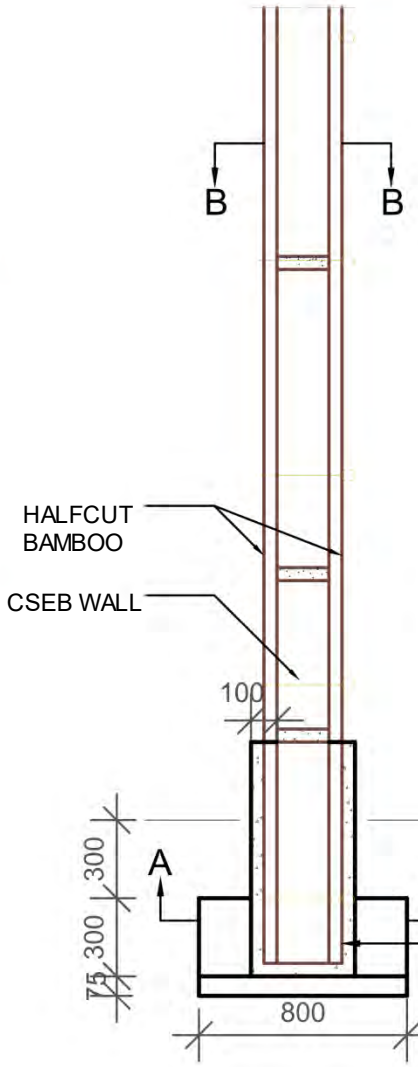
SECTION A' - A'

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.1	SCALE: NONE	CSEB-4.1
	DRAWING TITLE: DETAILS	DATE:	6/8

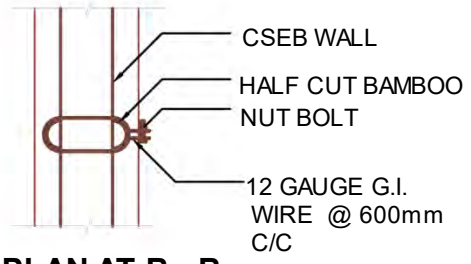
MODEL C.S.E.B-4.1, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — ONE STOREY



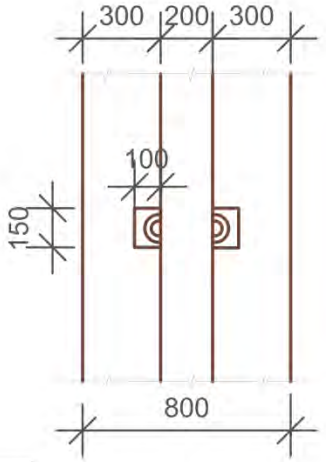
TYPICAL ELEVATION



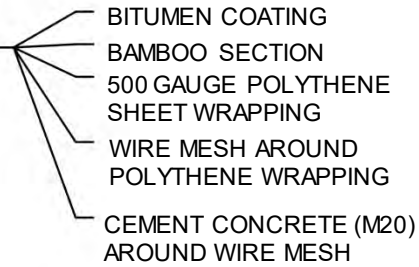
CROSS SECTION



PLAN AT B - B



PLAN AT A - A



STRENGTHENING WALL BY BAMBOO AND G.I. WIRE

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.1	SCALE: NONE	CSEB-4.1
	DRAWING TITLE: DETAILS	DATE:	7/8

TECHNICAL REQUIREMENTS

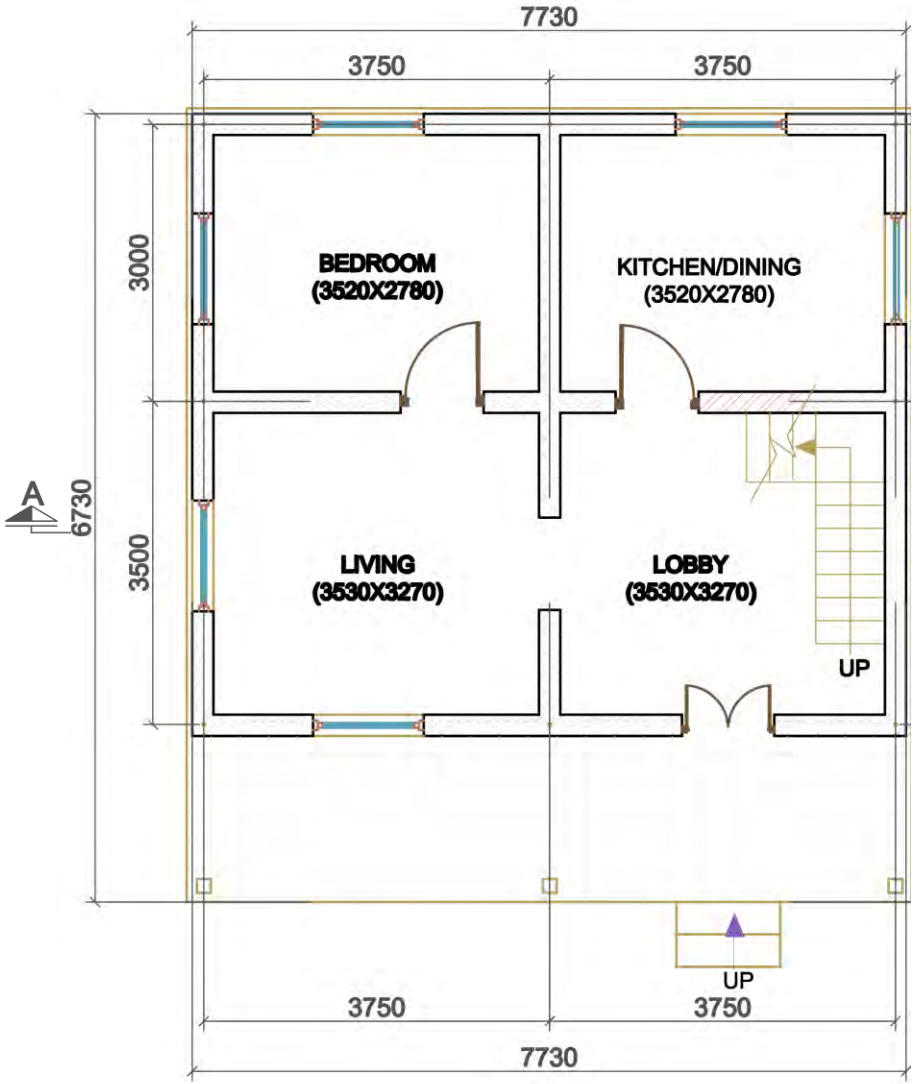
Structure System	Compressed Stabilized Earth block masonry in mud mortar with stabilized soil roof.
Foundation	Strip Foundation of Compressed stabilized Earth Block Masonry of width 400 mm and depth 400 mm over 600 x 75 mm RCC strip foundation.
Plinth Band	Plinth Beam of reinforced concrete of width 200 mm and depth 100mm shall be provided. Main reinforcement 4 nos.10mm Ø bars with 6mm Ø stirrups at 150mm C/C
Wall System	Masonry shall be of cement stabilized earth block of size 300x 200 x 100 mm size in mud mortar.
Sill Band	A continuous reinforced concrete sill band shall be provided throughout the entire wall at the bottom level of the openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos.10mm dia. bars with 6mm Ø stirrups at 150mm C/C.
Lintel Band:	A continuous reinforced concrete Lintel band shall be provided throughout the entire wall at the top level of the openings. The minimum depth of the band shall be 100 mm. Main reinforcement shall be 4 nos.10mm dia. bars with 6mm Ø stirrups at 150mm C/C.
Roof:	5mm cement punning over stabilized soil plaster on 50 mm thick mud roof on bamboo truss.

MODEL C.S.E.B-4.2, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — TWO STOREY

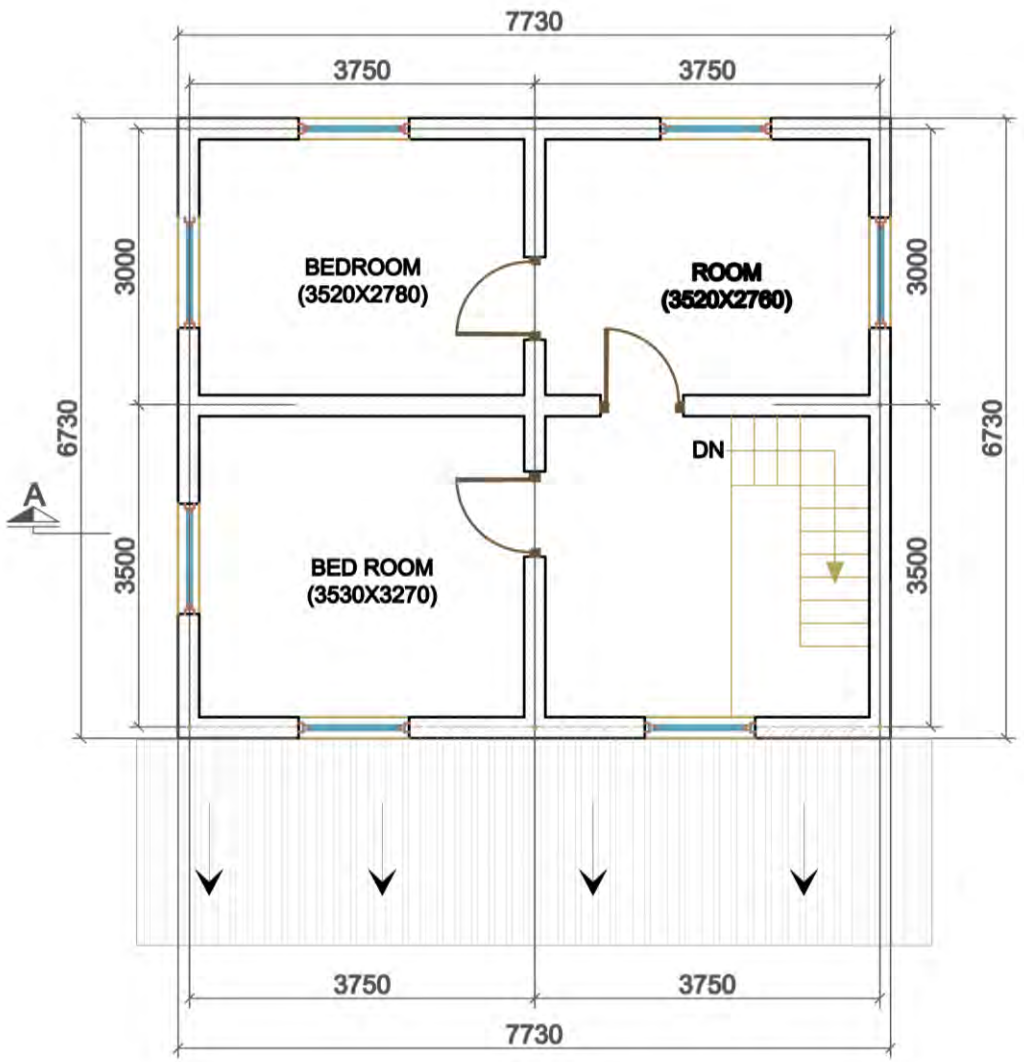
LEVEL	MATERIALS								
	CS Blocks	Cement	Sand	Aggregate	Reinforcing Bar	CGI Sheet	GI Sheet	Wood	MS Black Pipe
	No.	Bags	Cu.m.	Cu.m.	Kg.	Bundle	Sq.m.	Cu.m.	Kg.
Up to Plinth Level	4,040.0	42.7	3.9	7.4	1,410.1			-	-
Super Structure	6,651.0	115.0	6.1	12.4				1.7	
Roofing	-	-	-	-	-	8.2	9.8	-	1,408.3
TOTAL	**10,691.1**	**157.6**	**10.0**	**19.8**	**1,410.1**	**8.2**	**9.8**	**1.7**	**1,408.3**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.2	SCALE: NONE	CSEB-4.2
	DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	1/9

MODEL C.S.E.B-4.2, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — TWO STOREY



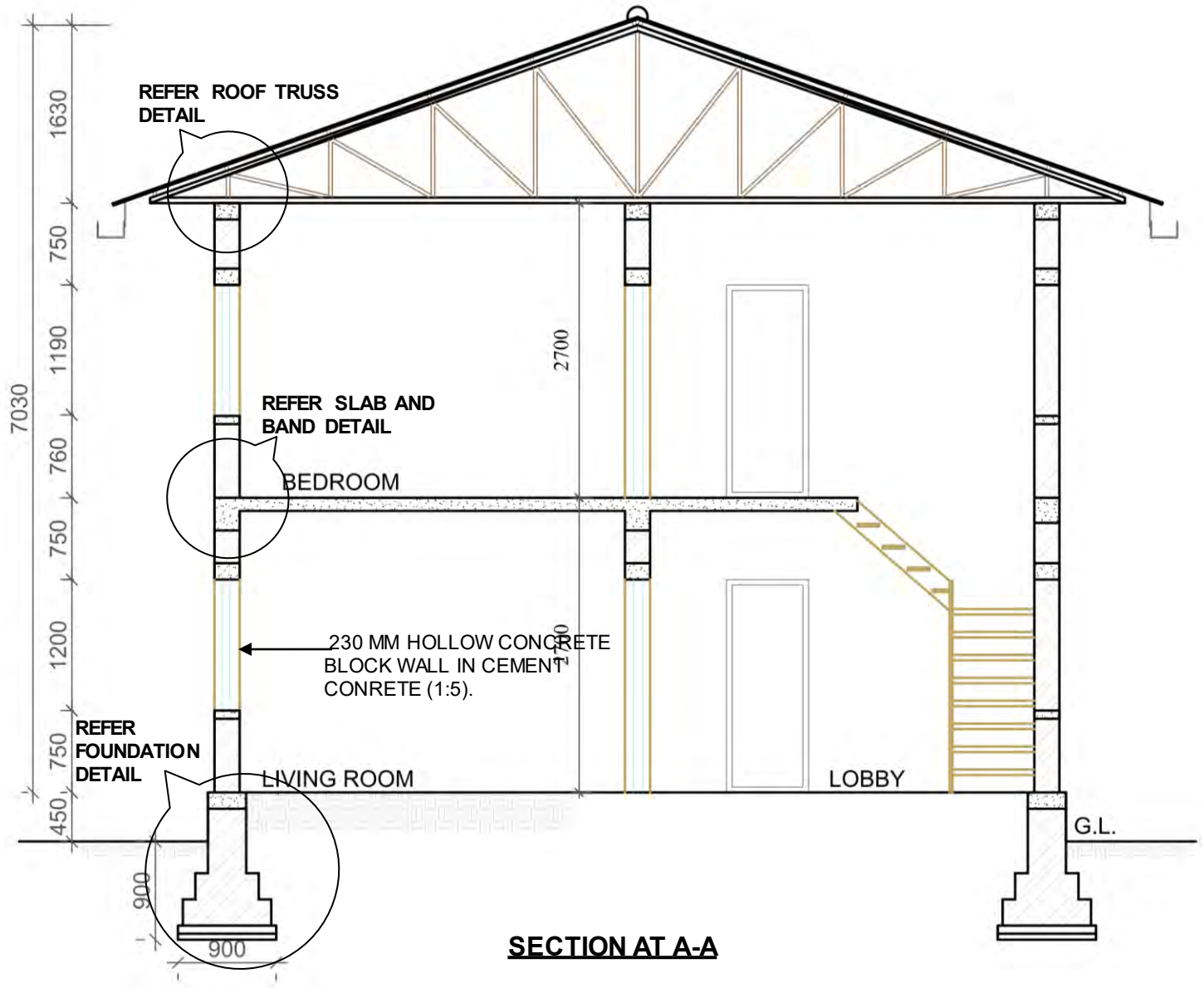
GROUND FLOOR PLAN
FLOOR AREA: 52.02SQ.M



FIRST FLOOR PLAN
FLOOR AREA: 52.02SQ.M

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.2	SCALE: NONE	CSEB-4.2
	DRAWING TITLE:FLOOR PLANS	DATE:	2/9

MODEL C.S.E.B-4.2, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — TWO STOREY



SECTION AT A-A

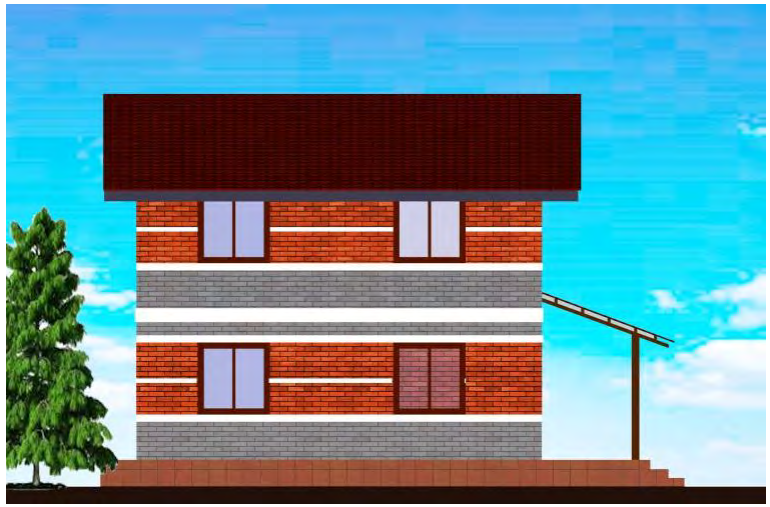
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.2	SCALE: NONE	CSEB-4.2
	DRAWING TITLE:SECTION	DATE:	3/9

MODEL C.S.E.B-4.2, COMPRESSED STABLILIZED EARTH BLOCK MASONRY TWO STOREY

FRONT ELEVATION

BACK ELEVATION

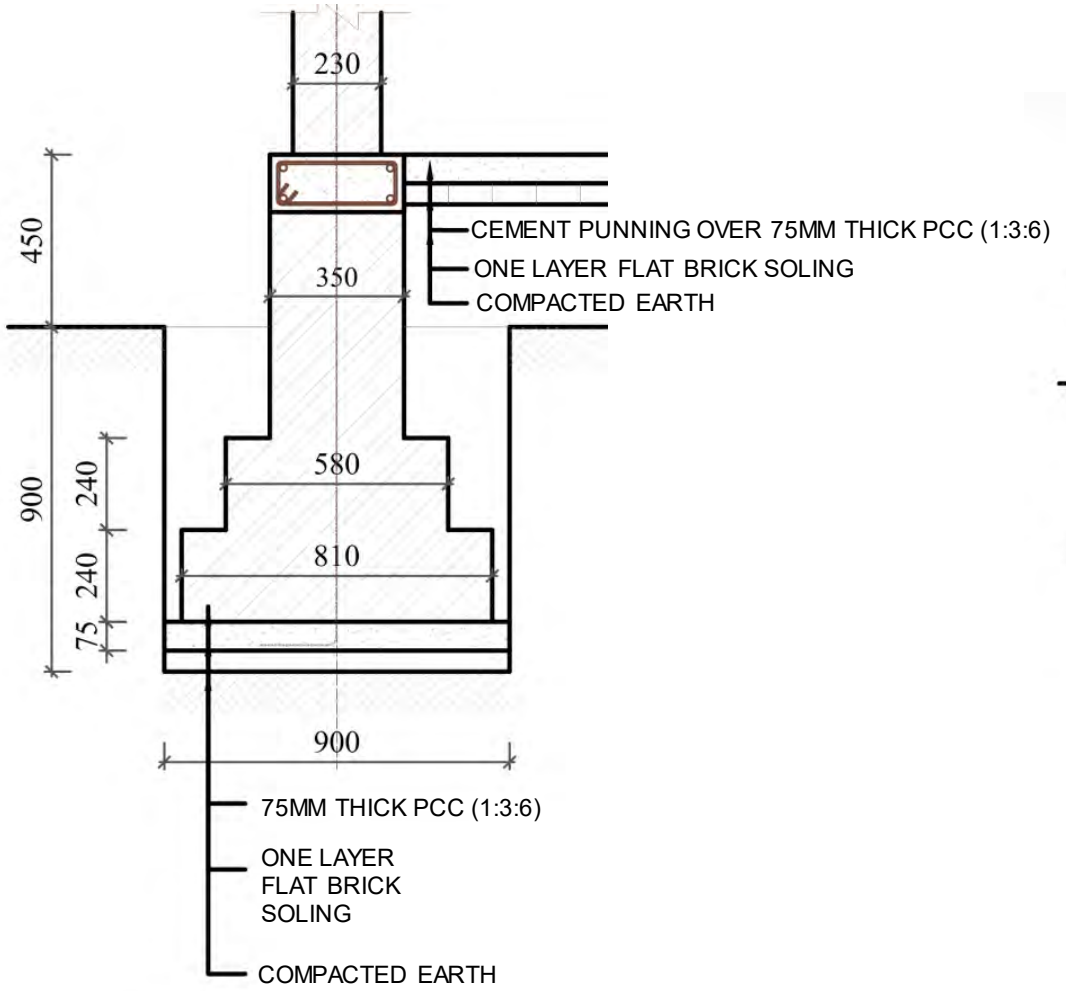
SIDE ELEVATION



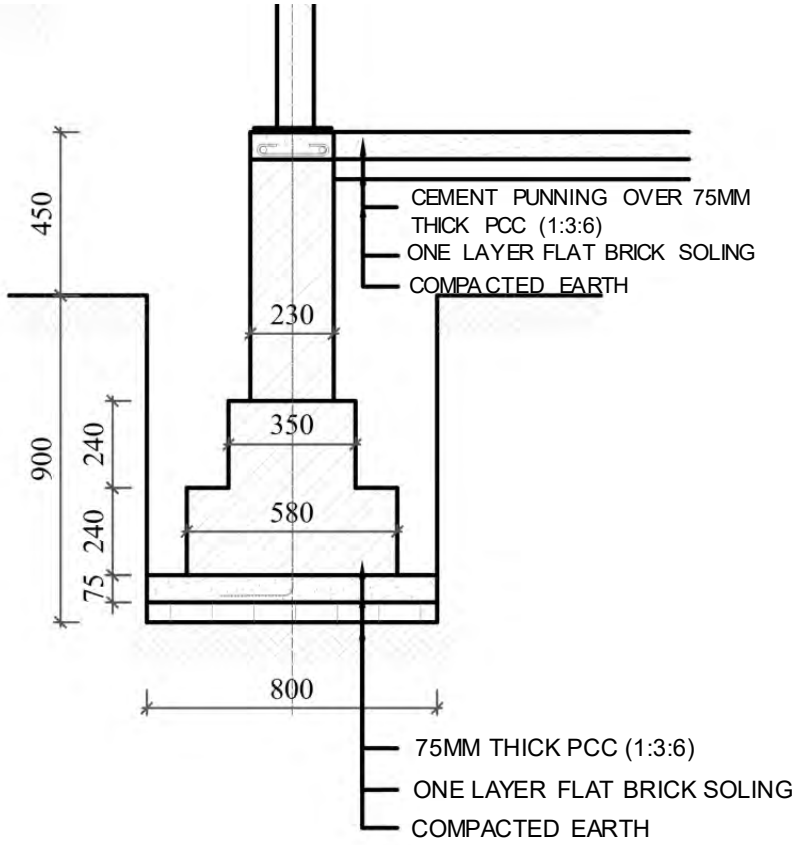
SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.2	SCALE: NONE	CSEB-4.2
	DRAWING TITLE:ELEVATION	DATE:	4/9

MODEL C.S.E.B-4.2, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — TWO STOREY

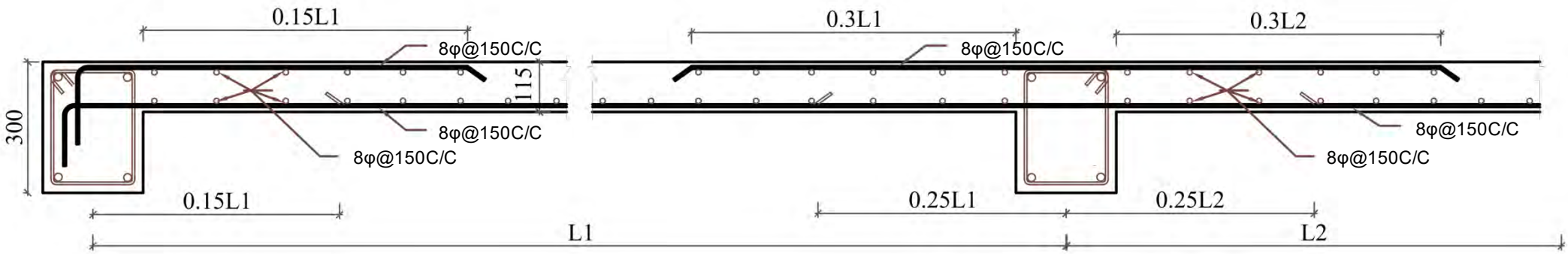


FOUNDATION SECTION

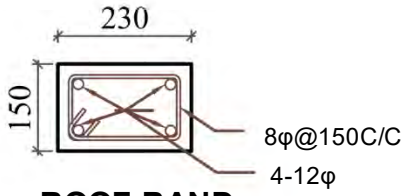


FOUNDATION DETAIL (FOR VERANDAH)

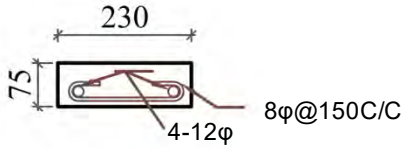
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.2	SCALE: NONE	CSEB-4.2
	DRAWING TITLE:FOUNDATIONDETAILS	DATE:	5/9



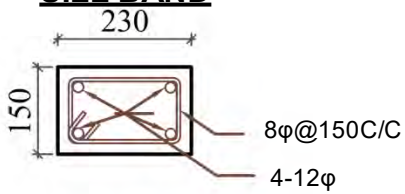
FLOOR SLAB



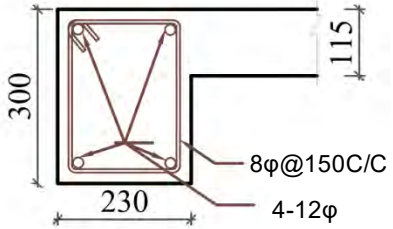
ROOF BAND



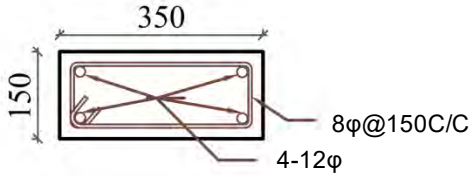
SILL BAND



LINTEL BAND

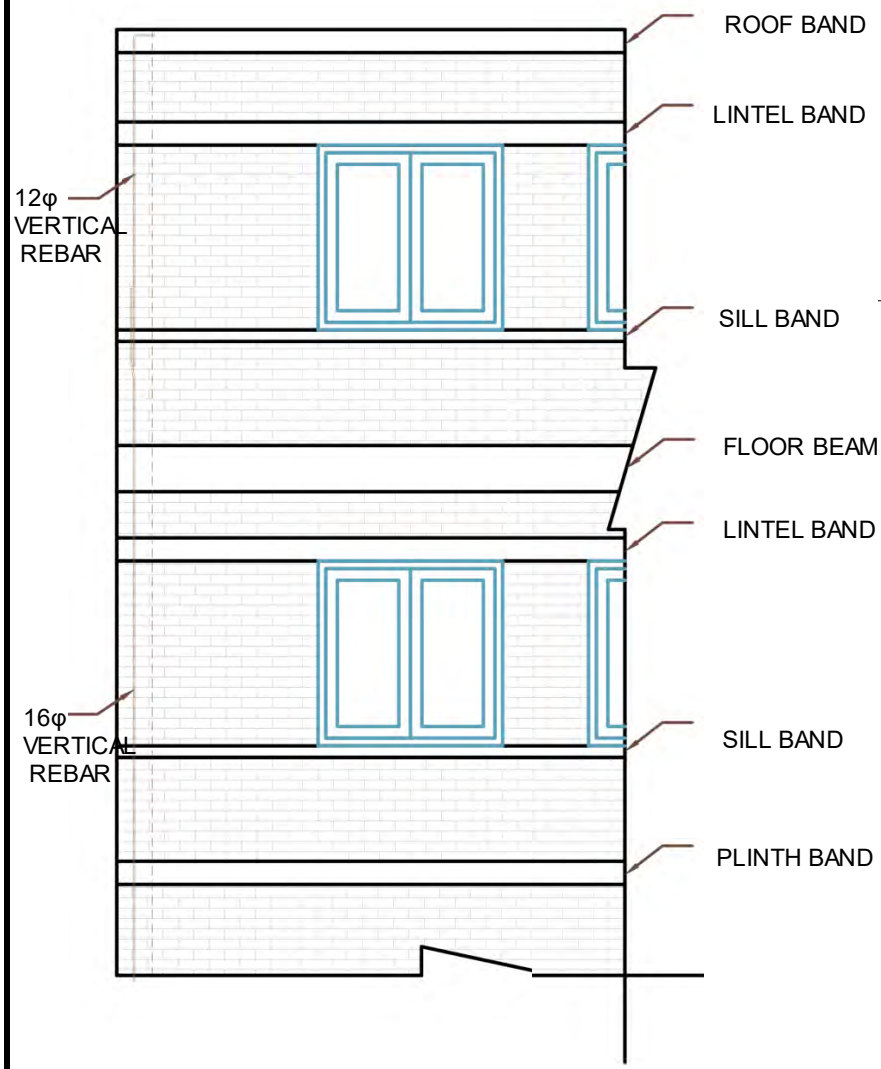


FLOOR BEAM

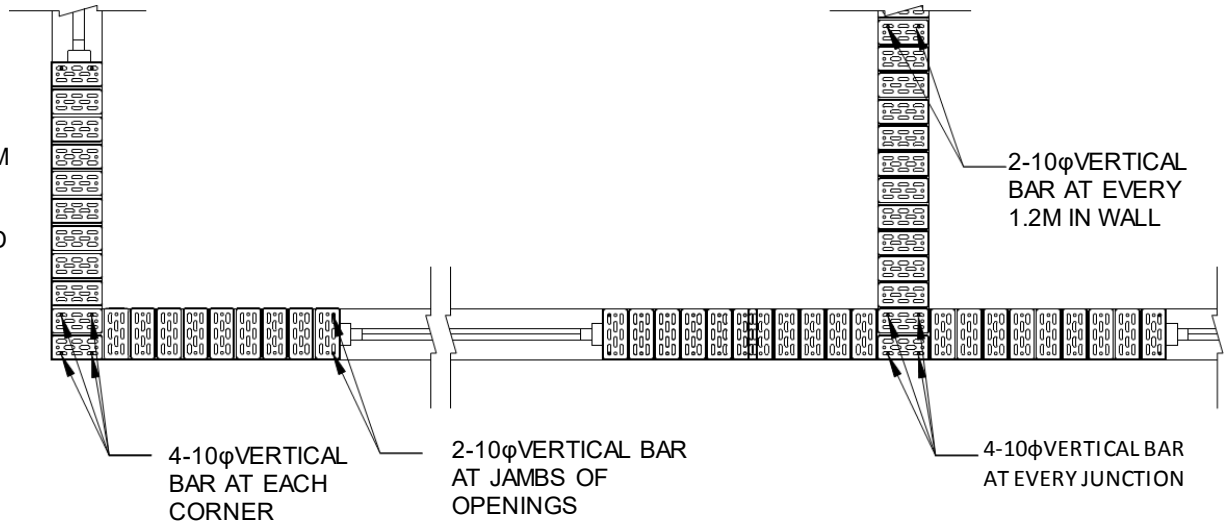


PLINTH BAND

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.2	SCALE: NONE	CSEB-4.2
	DRAWING TITLE:DETAILS	DATE:	6/9



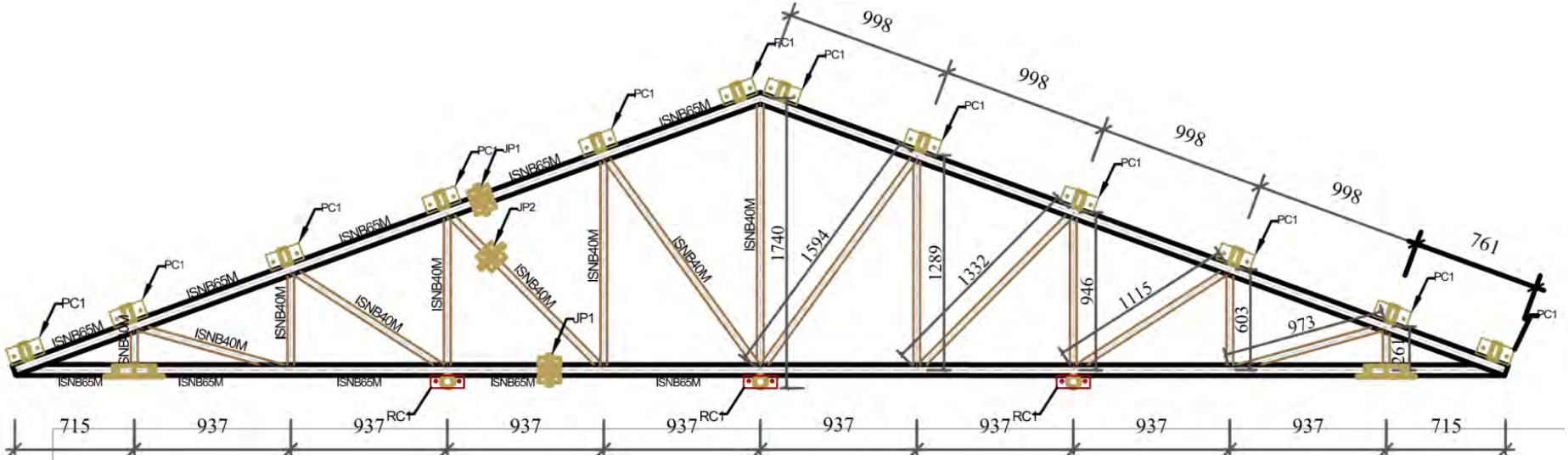
LAYOUT OF HORIZONTAL AND VERTICAL REINFORCEMENT



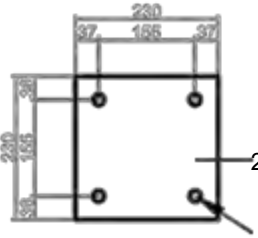
LOCATION OF VERTICAL REINFORCEMENT

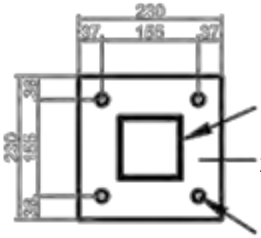
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.2	SCALE: NONE	CSEB-4.2
	DRAWING TITLE:REINFORCEMENT DETAILS	DATE:	7/9

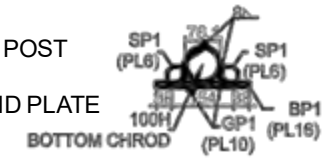
MODEL C.S.E.B-4.2, COMPRESSED STABLILIZED EARTH BLOCK MASONRY — TWO STOREY



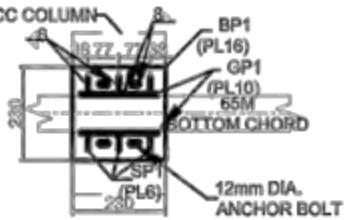
ROOF TRUSS DETAILS





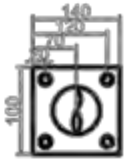


VIEW A



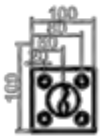
VIEW B

VERANDAH POST END PLATE DETAILS



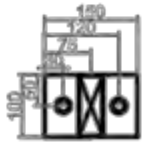
JOINT PLATE FOR
65M PIPE (JP1)
PL8 (140X140)
ALL HOLES 14MM DIA

VERANDAH POST END PLATE DETAILS

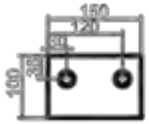


JOINT PLATE FOR
40M PIPE (JP2)
FL 100 (L=100MM)
ALL HOLES 14MM DIA

JOINT PLATE DETAILS



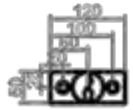
PURLIN CLEAT FOR
RHS 100X50X3
FL 100X8 / L=150MM
ALL HOLES 18MM DIA



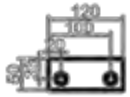
TRUSS CLEAT FOR
RHS 100X50X3
FL 100X8 / L=150MM
ALL HOLES 18MM DIA

PURLIN CLEAT DETAILS

BASE CONNECTION DETAILS



RUNNER CLEAT FOR
40M PIPE
FL 50X6 / L=120MM
ALL HOLES 14MM DIA



TRUSS CLEAT FOR
40M PIPE
FL 50X6 / L=120MM
ALL HOLES 14MM DIA

RUNNER CLEAT DETAILS

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: CSEB-4.2	SCALE: NONE	CSEB-4.2
	DRAWING TITLE: ROOF DETAILS	DATE:	8/9

TECHNICAL REQUIREMENTS

Structure System	Chemically stabilized earth block (solid/hollow) masonry in cement sand mortar with CGI sheet roof over metal truss. Vertical and Horizontal reinforcements shall be provided in strategic locations as shown in the drawing.
Foundation	Chemically compressed stabilized block masonry strip foundation of width 900 mm and depth 900 mm as shown in detail.
Plinth Band	Plinth Beam of reinforced cement concrete (1:1.5:3) of width 300 mm and depth 150mm shall be provided. Main reinforcement 4 nos.12mm Ø bars with 8mm Ø stirrups at 150mm C/C.
Wall System	The chemically compressed stabilized Earth block shall be of size of 230x 100 x 55mm size and stabilized with flat plug resin chemical. Mortar shall be cement sand in 1:5 ratio or richer.
Sill Band	A continuous reinforced concrete sill band shall be provided throughout the entire wall at the bottom level of the openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos.12mm dia. bars with 8mm Ø stirrups at 150mm C/C.
Lintel Band:	A continuous reinforced concrete lintel band shall be provided throughout the entire wall at the top level of the openings. The minimum depth of the band shall be 150mm. Main reinforcement shall be 4 nos.12mm dia. bars with 8mm Ø stirrups at 150mm C/C.
Floor:	130 mm thick RCC (1:1.5:3) floor over beam of width 230 mm and depth 300mm (inc. slab thickness).
Roof:	CGI sheet roofing over metal truss as shown in the drawing.

RANDOM RUBBLE MASONRY IN MUD MORTAR WITH GI WIRE CONTAINMENT

R.R.M-5.1
R.R.M-5.2

This technology is an improvement on random rubble masonry structure by introduction of GI containment wires. Vertical GI Containment wires are provided on two faces of a masonry wall to prevent flexural failure. The reinforcement on the two faces are connected by ties going through walls to prevent delamination of the walls. The proposed design makes minimal changes in local construction system.

Featured design R.R.M. 5.1 is a one storied two room unit with CGI sheet roofing. Featured design R.R.M. 5.2 is a two storied four room unit with CGI sheet roofing. Basic materials like stone and mud for walls, corrugated galvanized iron sheets on timber rafter/purlins for roof and mud flooring on timber deck for intermediate floors are proposed similar to common houses in the hills of Nepal. The basic shape and size of the building comply Nepal National Building Code, NBC 203 : 1994, Guidelines for earthquake resistant building construction: low strength masonry.

R.R.M-5.1

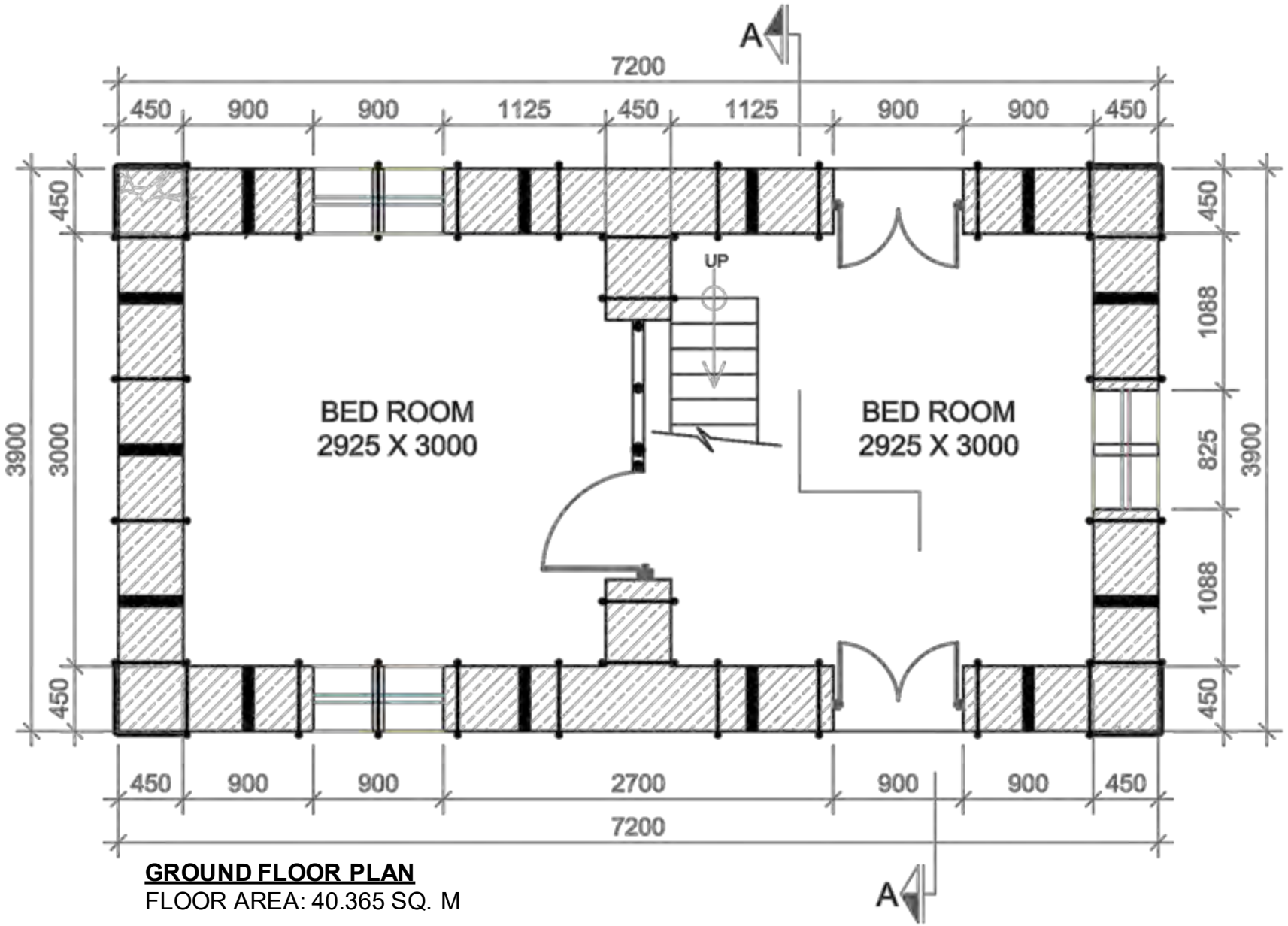
R.R.M-5.2

MODEL R.R.M-5.1, RANDOM RUBBLE MASONARY IN MUD MORTAR — ONE STOREY

LEVEL	MATERIALS								
	Stone	Weld wire mesh	Sand	Mud	CGI Sheet	GI Sheet	Wood	4mm GI wire	2 mm GI Wire
	No.	Sq.m	Cu.m.	Cu.m.	Bundle	Sq.m.	Cu.m.	Kg	Kg
Up to Plinth Level	16.1	10.4	1.3	7.4			-	6.0	14.0
Super Structure	28.8	40.7	-	11.0			0.5	19.0	44.0
Roofing	-	-	-	-	4.1	9.1	5.6	-	4.0
TOTAL	**44.9**	**51.1**	**1.3**	**18.4**	**4.1**	**9.1**	**6.1**	**25.0**	**62.0**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.1	SCALE: NONE	R.R.M-5.1
	DRAWING TITLE:ESTIMATE AND 3D-VIEW	DATE:	1/5

MODEL R.R.M-5.1, RANDOM RUBBLE MASONARY IN MUD MORTAR — ONE STOREY

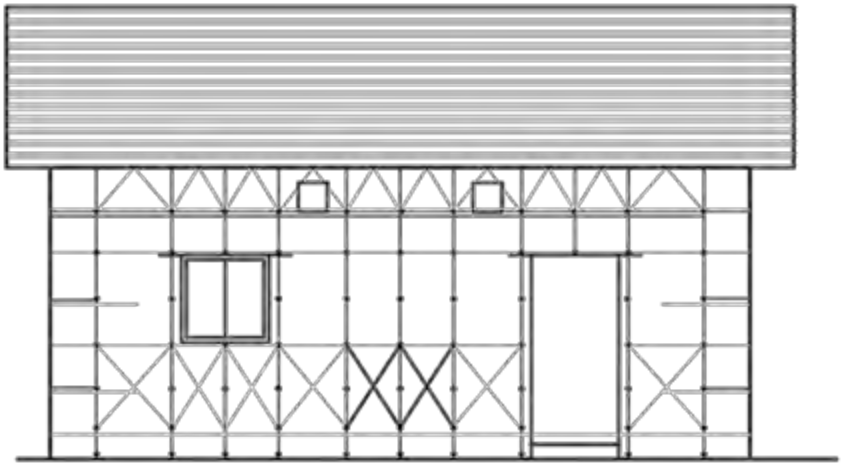


GROUND FLOOR PLAN

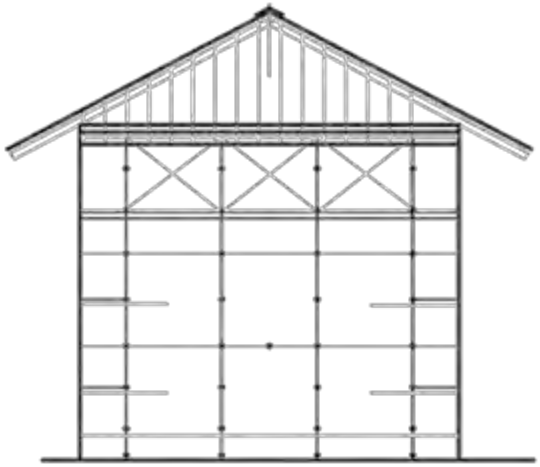
FLOOR AREA: 40.365 SQ. M

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.1	SCALE: NONE	R.R.M-5
	DRAWING TITLE:FLOOR PLAN	DATE:	2/5

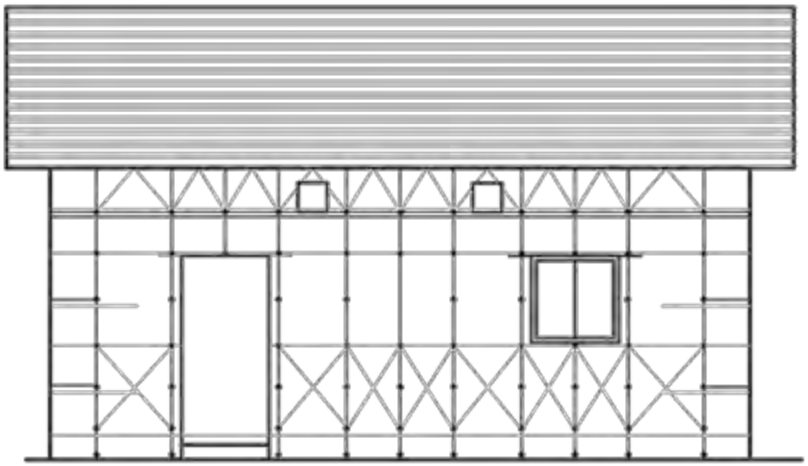
MODEL R.R.M-5.1, RANDOM RUBBLE MASONARY IN MUD MORTAR — ONE STOREY



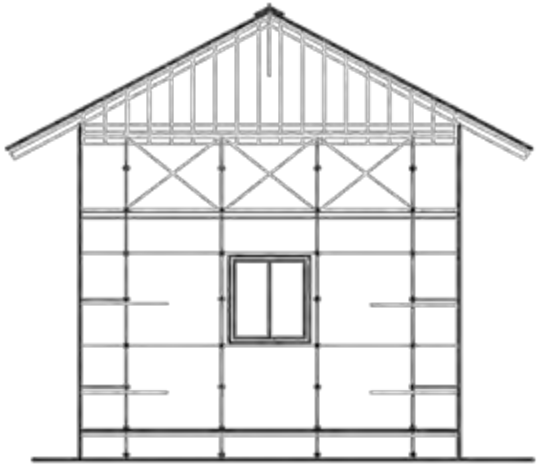
FRONT SIDE ELEVATION



LEFT SIDE ELEVATION



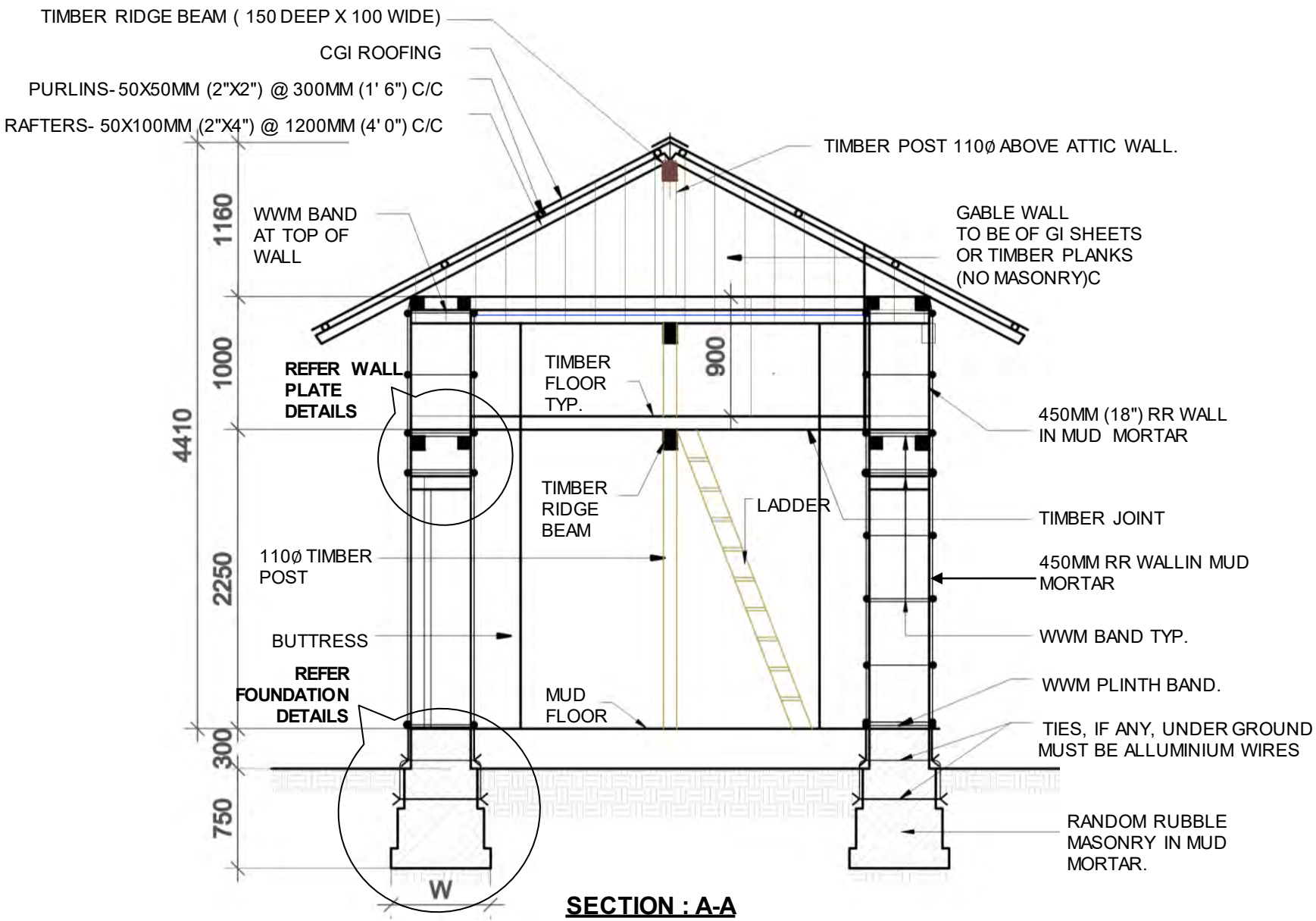
BACK SIDE ELEVATION



RIGHT SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.1	SCALE: NONE	R.R.M-5
	DRAWING TITLE:ELEVATIONS	DATE:	3/5

MODEL R.R.M-5.1, RANDOM RUBBLE MASONARY IN MUD MORTAR — ONE STOREY



SECTION : A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.1	SCALE: NONE	R.R.M-5
	DRAWING TITLE:SECTION	DATE:	4/5

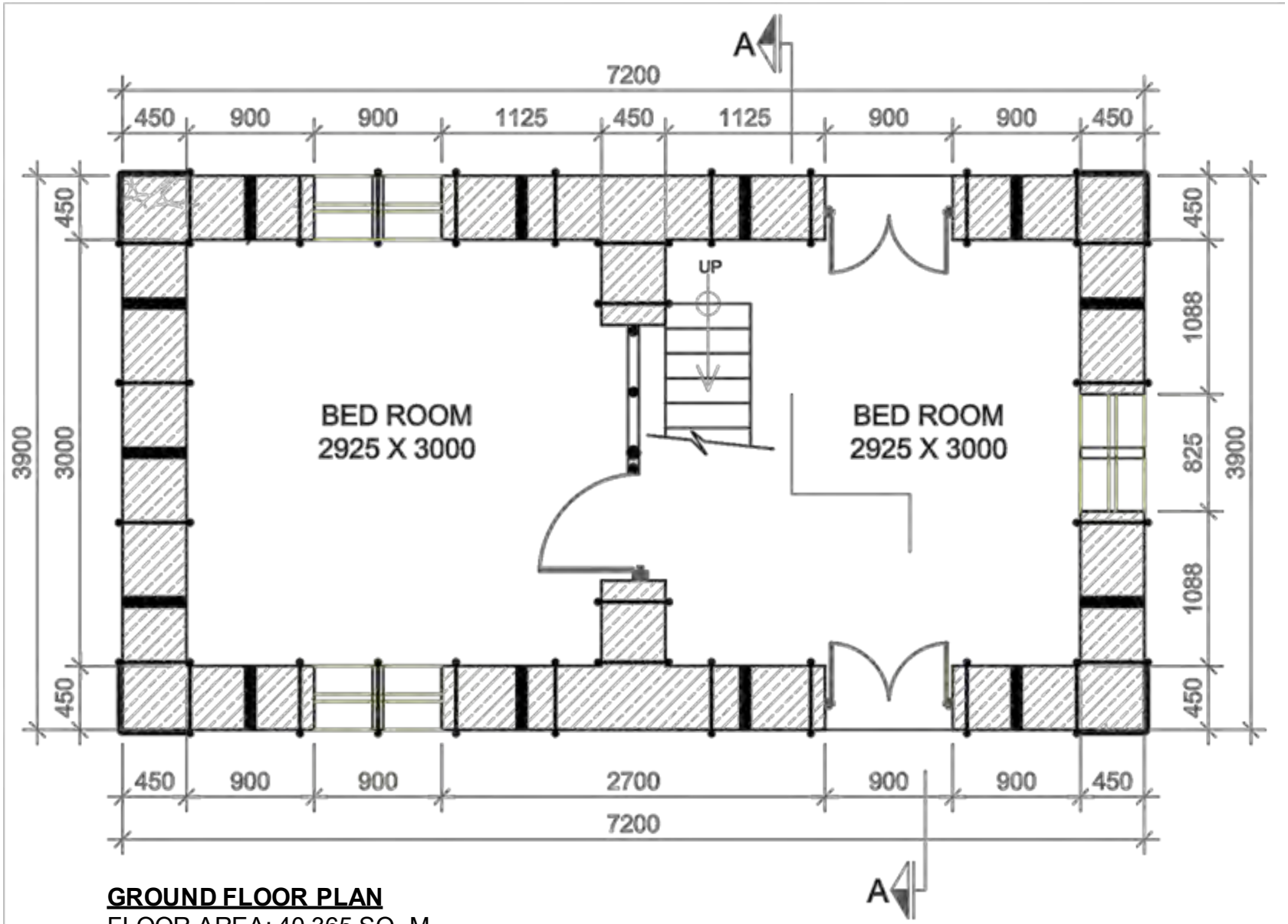
TECHNICAL REQUIREMENTS

Structure System	Stone Masonry wall in mud mortar with Vertical GI Containment wires shall be provided on two faces of a masonry wall. The GI containment wires on the two faces shall be connected by ties going through walls
Foundation	Strip Foundation of stone masonry in mud mortar of size 750 x 750 mm as shown in detail.
Plinth Band	Red oxide coated or GI Weld Wire mesh (WWM) strap of 350 mm width with wire spacing of 31x 31 mm plus 2 nos. 4 mm GI wires laid in mud mortar. Diagonal WWM strap shall be provided for stronger corner connection securely tied to other WWM.
Wall System	Random rubble masonry in mud mortar with 4 mm vertical GI wire cross linked with 2 nos. 14 gauge (2mm) galvanized iron wires placed at 450mm C/C.
Sill Band	Sill band shall be of weld wire mess or wooden band as shown in detail drawing.
Lintel Band:	Lintel band shall be of weld wire mess or wooden band as shown in detail drawing.
Floor:	Mud/timber floor over timber joist (Refer drawing).
Wall Plate:	Wall plate shall be timber section of 100mm X 100mm placed above WWM and connected with wall (refer detail drawing)
Roof:	Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing. All trusses shall be properly cross tied as shown in the drawing.

MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR — TWO STOREY

LEVEL	MATERIALS								
	Stone	Weld wire mesh	Sand	Mud	CGI Sheet	GI Sheet	Wood	4mm GI wire	2 mm GI Wire
	No.	Sq.m	Cu.m.	Cu.m.	Bundle	Sq.m.	Cu.m.	Kg	Kg
Up to Plinth Level	16.1	10.4	1.3	7.4			-	6.0	14.0
Super Structure	49.3	71.9	-	18.8			0.9	28.0	66.0
Roofing	-	-	-	-	4.1	9.1	6.6	-	4.0
TOTAL	**65.4**	**82.3**	**1.3**	**26.3**	**4.1**	**9.1**	**7.4**	**34.0**	**84.0**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.2	SCALE: NONE	R.R.M-5.2
	DRAWING TITLE:ESTIMATE AND 3D-VIEW	DATE:	1/11

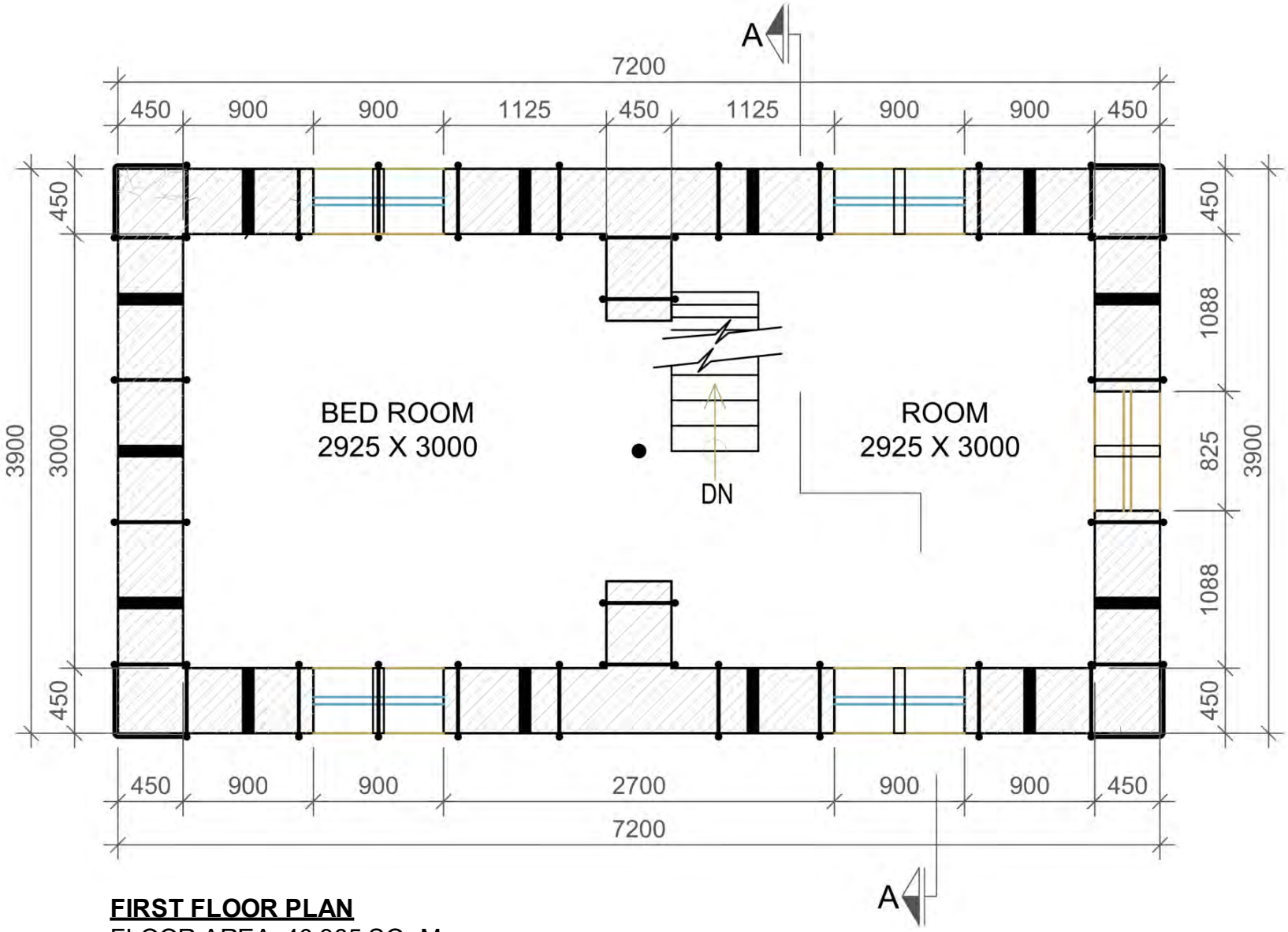


GROUND FLOOR PLAN

FLOOR AREA: 40.365 SQ. M.

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.2	SCALE: NONE	R.R.M-5.2
	DRAWING TITLE:FLOOR PLAN	DATE:	2/11

MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR — TWO STOREY

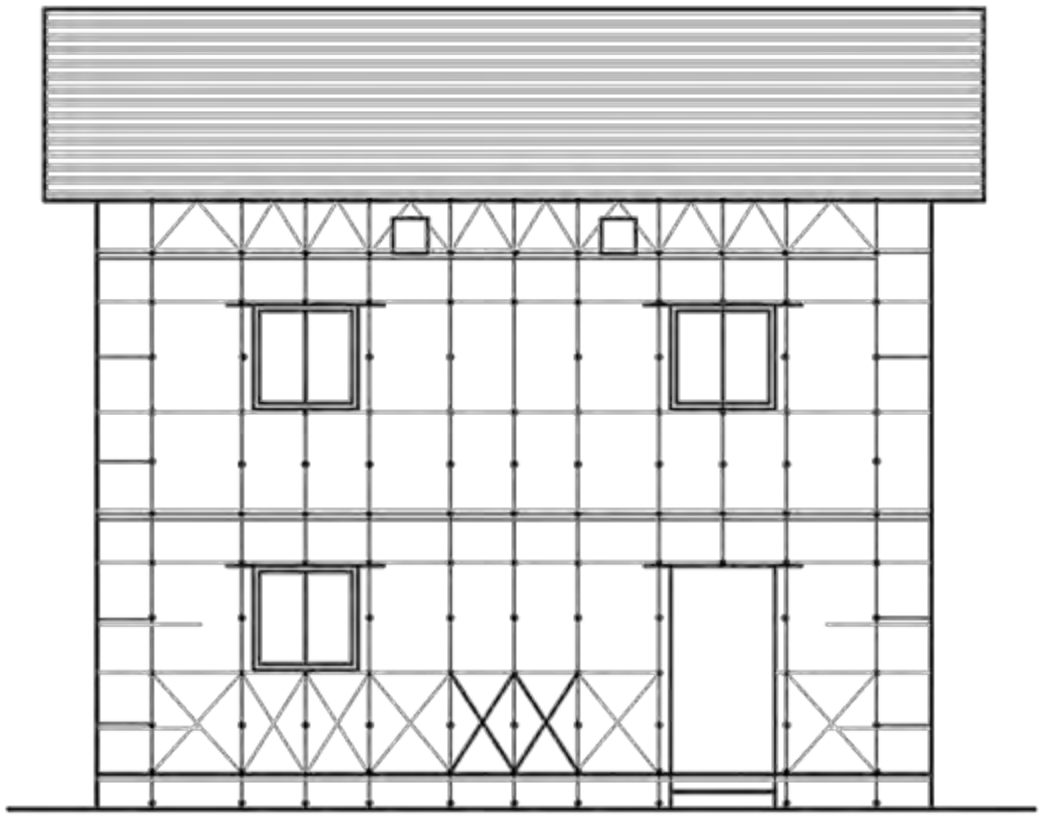


FIRST FLOOR PLAN

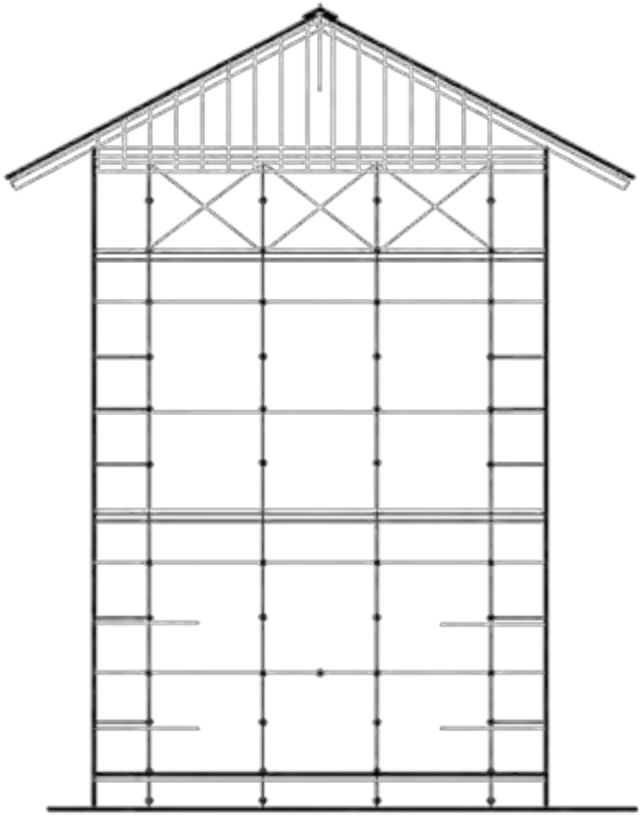
FLOOR AREA: 40.365 SQ. M

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.2	SCALE: NONE	R.R.M-5.2
	DRAWING TITLE:FLOOR PLAN	DATE:	3/11

MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR — TWO STOREY



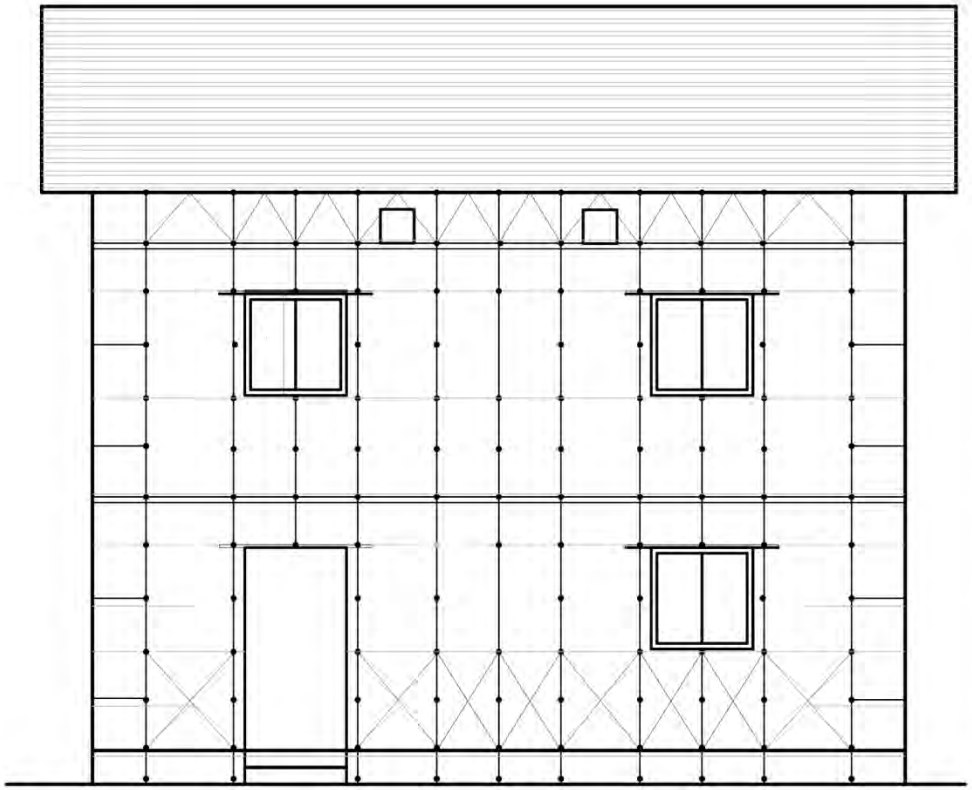
FRONT SIDE ELEVATION



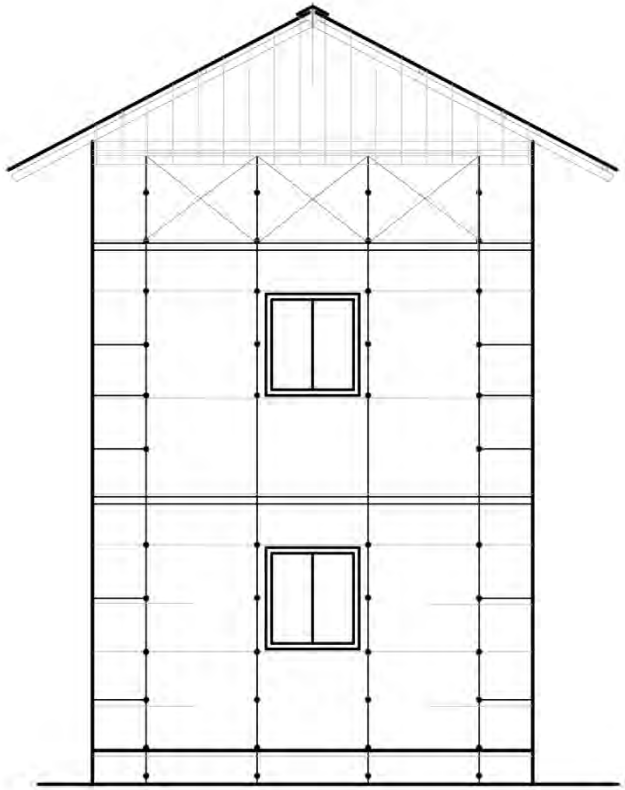
LEFT SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.2	SCALE: NONE	R.R.M-5.2
	DRAWING TITLE:ELEVATION	DATE:	4/11

MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR — TWO STOREY



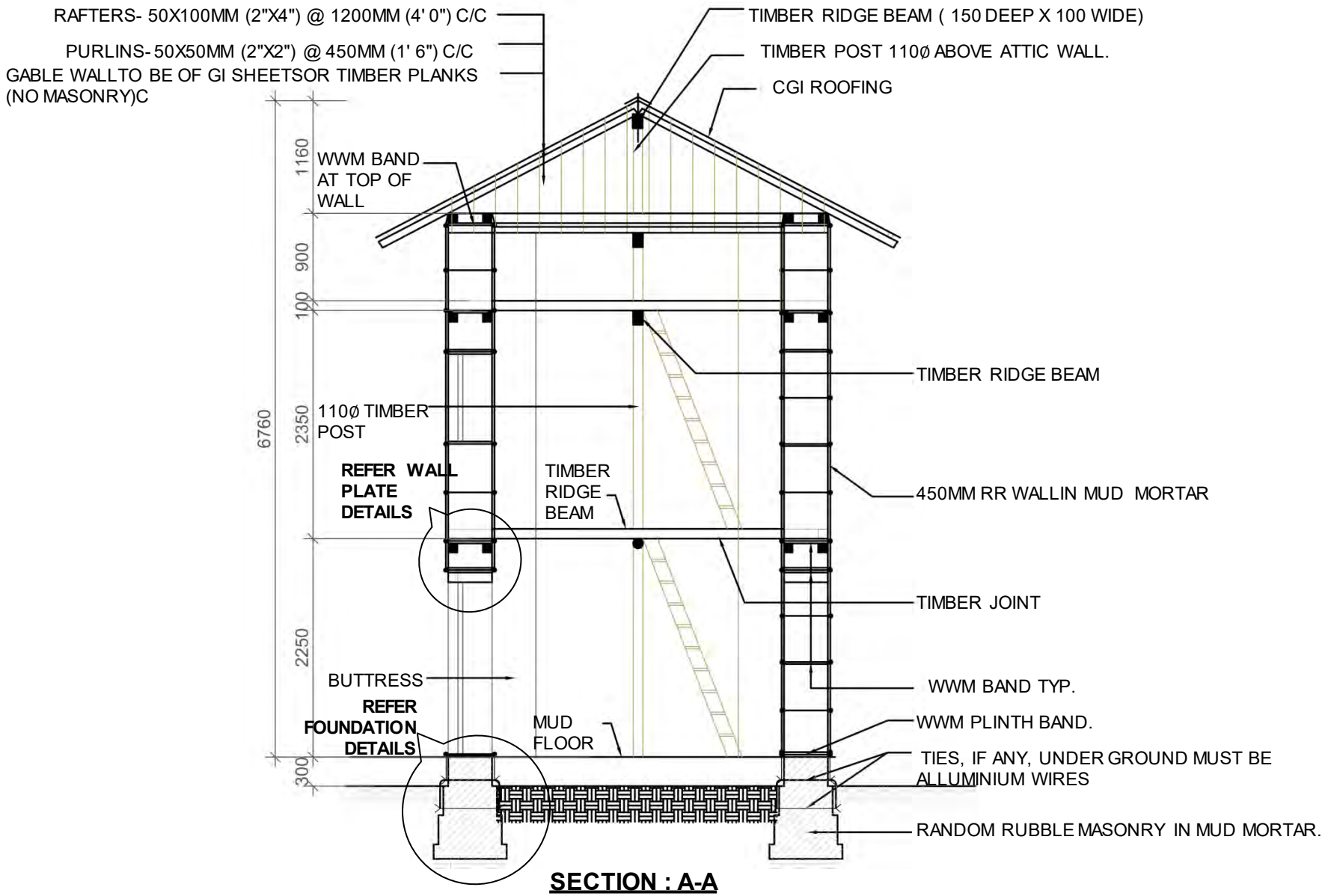
BACK SIDE ELEVATION



RIGHT SIDE ELEVATION

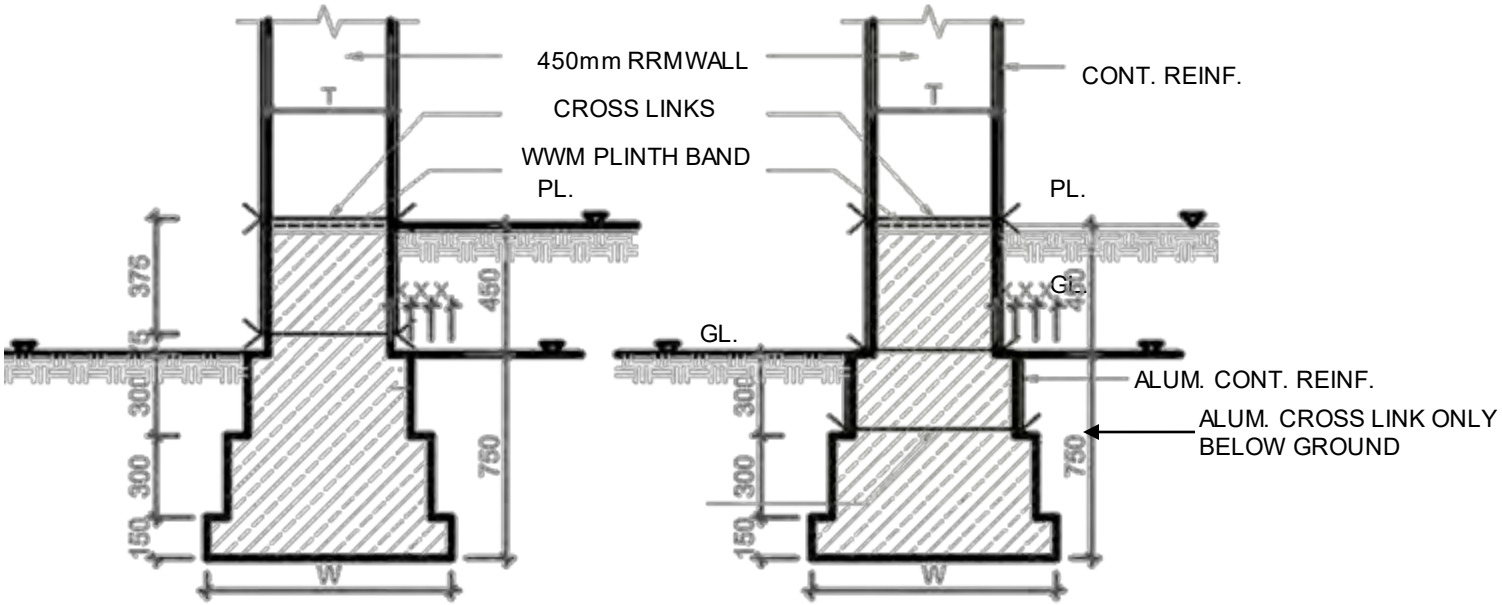
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.2	SCALE: NONE	R.R.M-5.2
	DRAWING TITLE:ELEVATION	DATE:	5/11

MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR — TWO STOREY



SECTION : A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.2	SCALE: NONE	R.R.M-5.2
	DRAWING TITLE:SECTION	DATE:	6/11



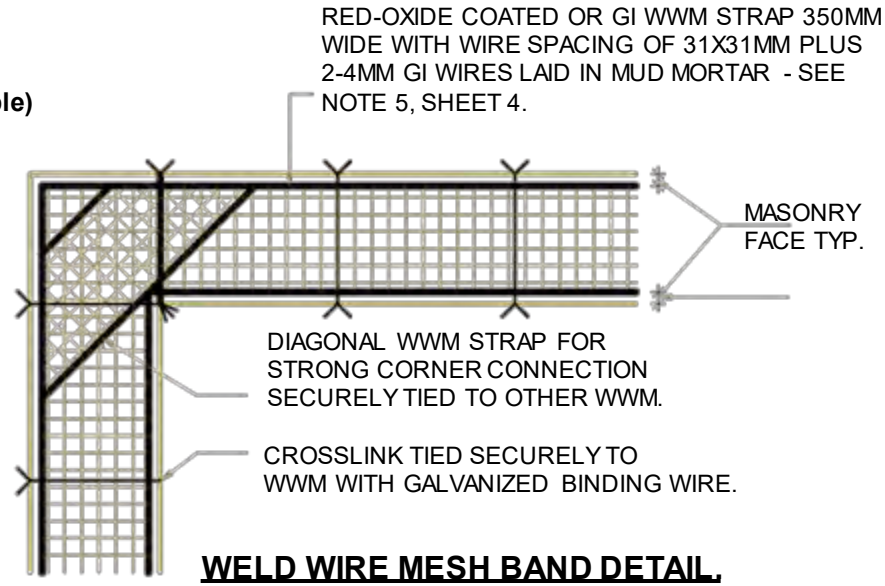
ECONOMIC OPTION
(Also to be used with existing foundation)

RECOMMENDED OPTION
(Only if aluminum wire are available)

FOUNDATION DETAIL

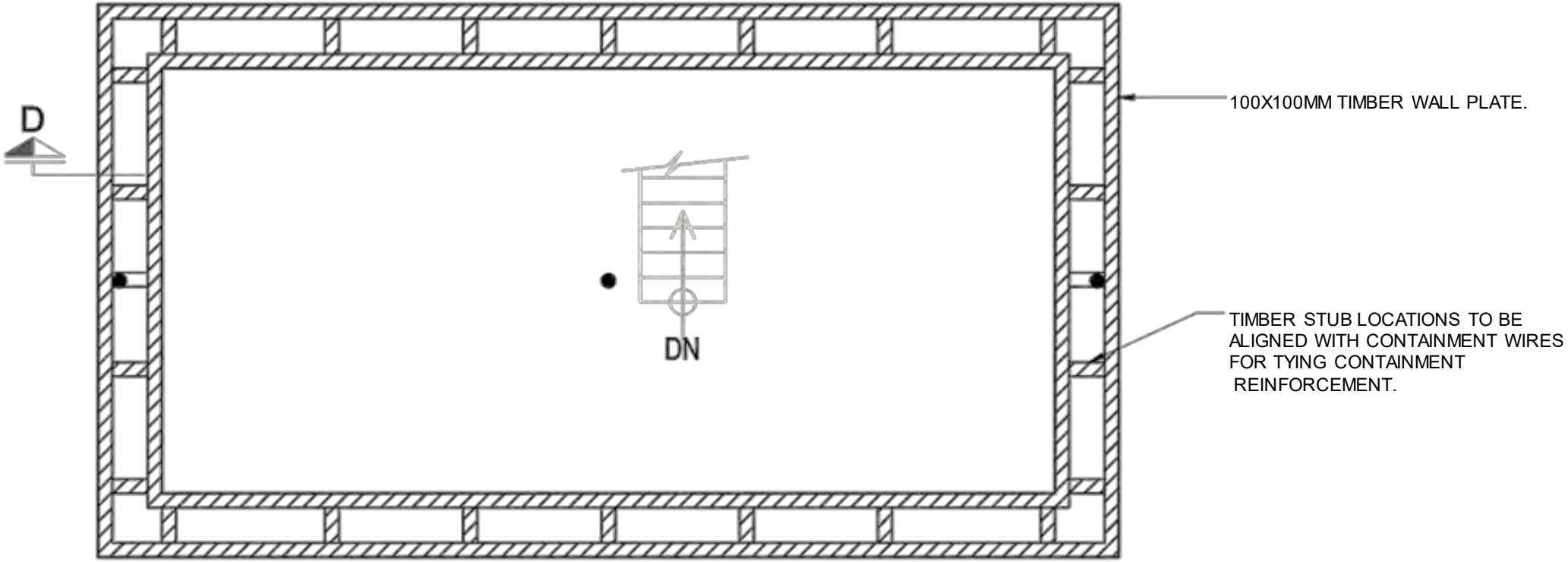
Soil Type	No. of storey					
	One		Two		Two plus attic	
	Width	Depth	Width	Depth	Width	Depth
Hard	750	750	750	750	750	750
Medium	750	750	750	750	750	750
Soft	750	750	900	750	900	750

SIZE OF STRIP FOOTING FOR DIFFERENT SOIL TYPES AS PER NBC 203

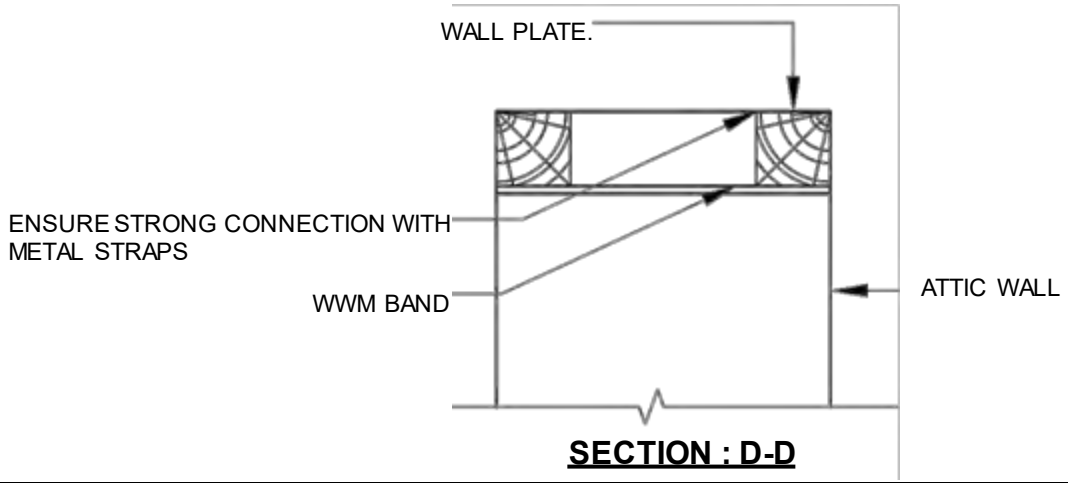


WELD WIRE MESH BAND DETAIL.

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.1/5.2	SCALE: NONE	R.R.M.
	DRAWING TITLE:DETAIL	DATE:	7/11

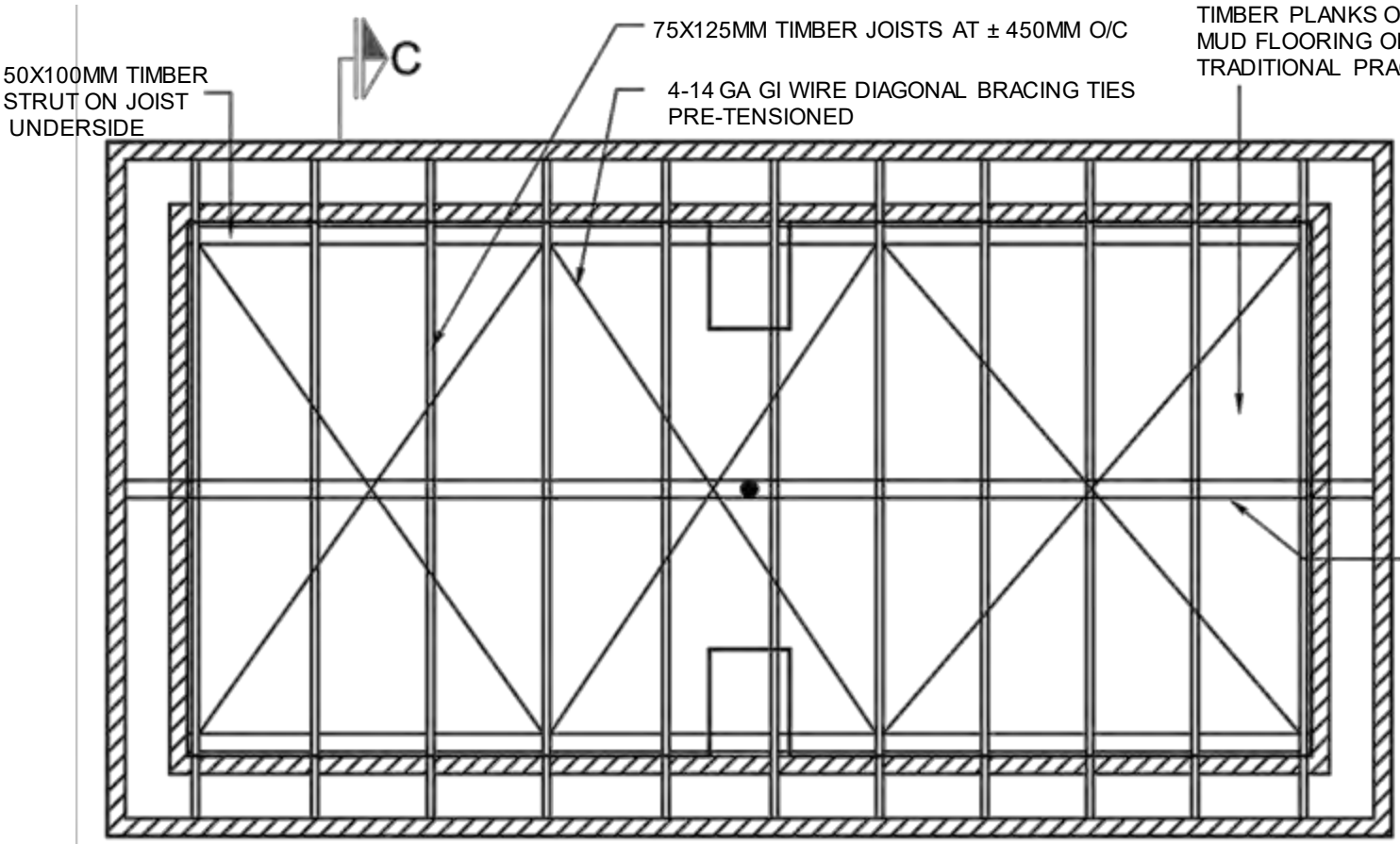


ATTIC WALL PLATE PLAN.

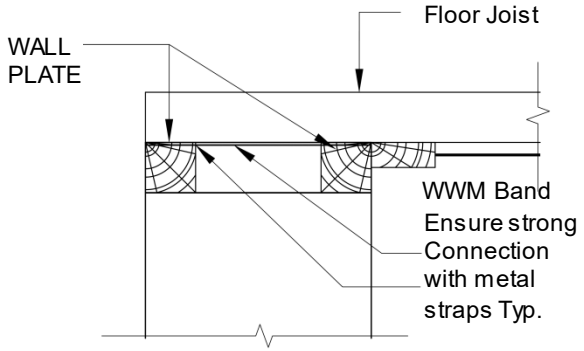


SECTION : D-D

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.1/5.2	SCALE: NONE	R.R.M.
	DRAWING TITLE:DETAIL	DATE:	8/11



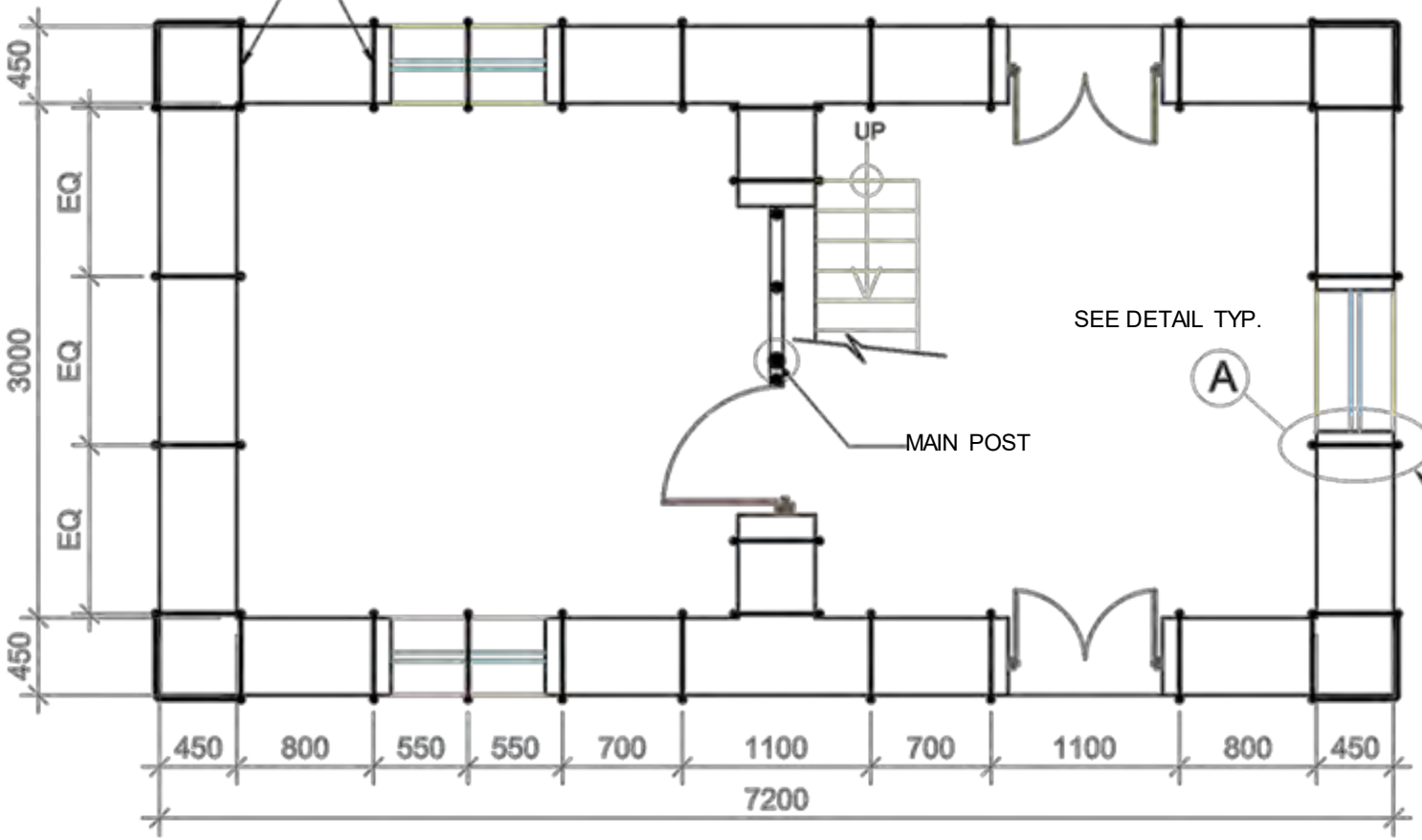
ATTIC FLOOR TIMBER FRAMING PLAN



SECTION : C-C

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.1/5.2	SCALE: NONE	R.R.M.
	DRAWING TITLE:DETAIL	DATE:	9/11

ALL CROSS-LINKS TO BE PLACED AT PLINTH AND LOWER LEVELS AS SHOWN IN FOUNDATION DETAILS, AND ABOVE PLINTH LEVEL AT APPROXIMATELY 450MM VERTICAL SPACING DURING THE CONSTRUCTION OF WALL.

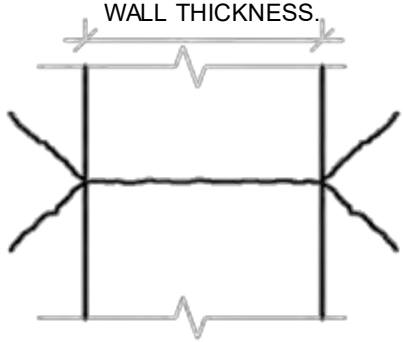


LOCATION OF CROSS LINKS TO BE PLACED IN ALL STORIES.

DETAIL A

GI WIRE CROSS LINK

LENGTH EQUAL TO WALL THICKNESS.



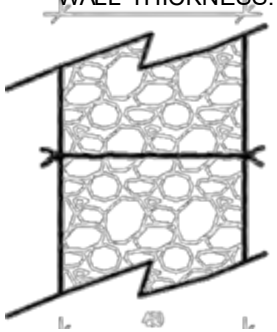
TWO 14 GA (2MM DIA) TWISTED GI WIRES WITH LOOSE ENDS EXTENDING OUT100MM ON BOTH SIDE WALL

CROSS LINKS APPROX.100MM AWAY FORM JAMB (TYP.)

DETAIL A ALT

GI WIRE CROSS LINK

LENGTH EQUAL TO WALL THICKNESS.



TWO 14 GA (2MM DIA) TWISTED GI WIRES WITH LOOSE ENDS EXTENDING OUT100MM ON BOTH SIDE WALL

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.R.M.-5.1/5.2	SCALE: NONE	R.R.M.
	DRAWING TITLE:DETAIL	DATE:	10/11

TECHNICAL REQUIREMENTS

Structure System	Stone Masonry wall in mud mortar with Vertical GI Containment wires shall be provided on two faces of a masonry wall. The GI containment wires on the two faces are connected by ties going through walls
Foundation	Strip Foundation of stone masonry in mud mortar of depth 750 mm and width as specified in details for different soil type.
Plinth Band	Red oxide coated or GI Weld Wire mesh (WWM) strap of 350 mm width with wire spacing of 31x 31 mm plus 2 nos. 4 mm GI wires laid in mud mortar. Diagonal WWM strap need to be provided for stronger corner connection securely tied to other WWM.
Wall System	Random rubble masonry in mud mortar with 4 mm vertical GI wire cross linked with 2 nos. 14 gauge (2mm) galvanized iron wires placed at 450mm.
Sill Band	Sill band shall be of weld wire mess or wooden band as shown in detail drawing.
Lintel Band:	Lintel band shall be of weld wire mess or wooden band as shown in detail drawing.
Floor:	Mud /timber floor over timber joist (Refer drawing).
Wall Plate:	Wall plate shall be timber section of 100mm X 100mm placed above WWM and connected with wall (refer detail drawing)
Roof:	Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing. All trusses shall be properly cross tied with wooden braces as shown in the drawing.

BAMBOO AND STONE MASONRY HYBRID STRUCTURE

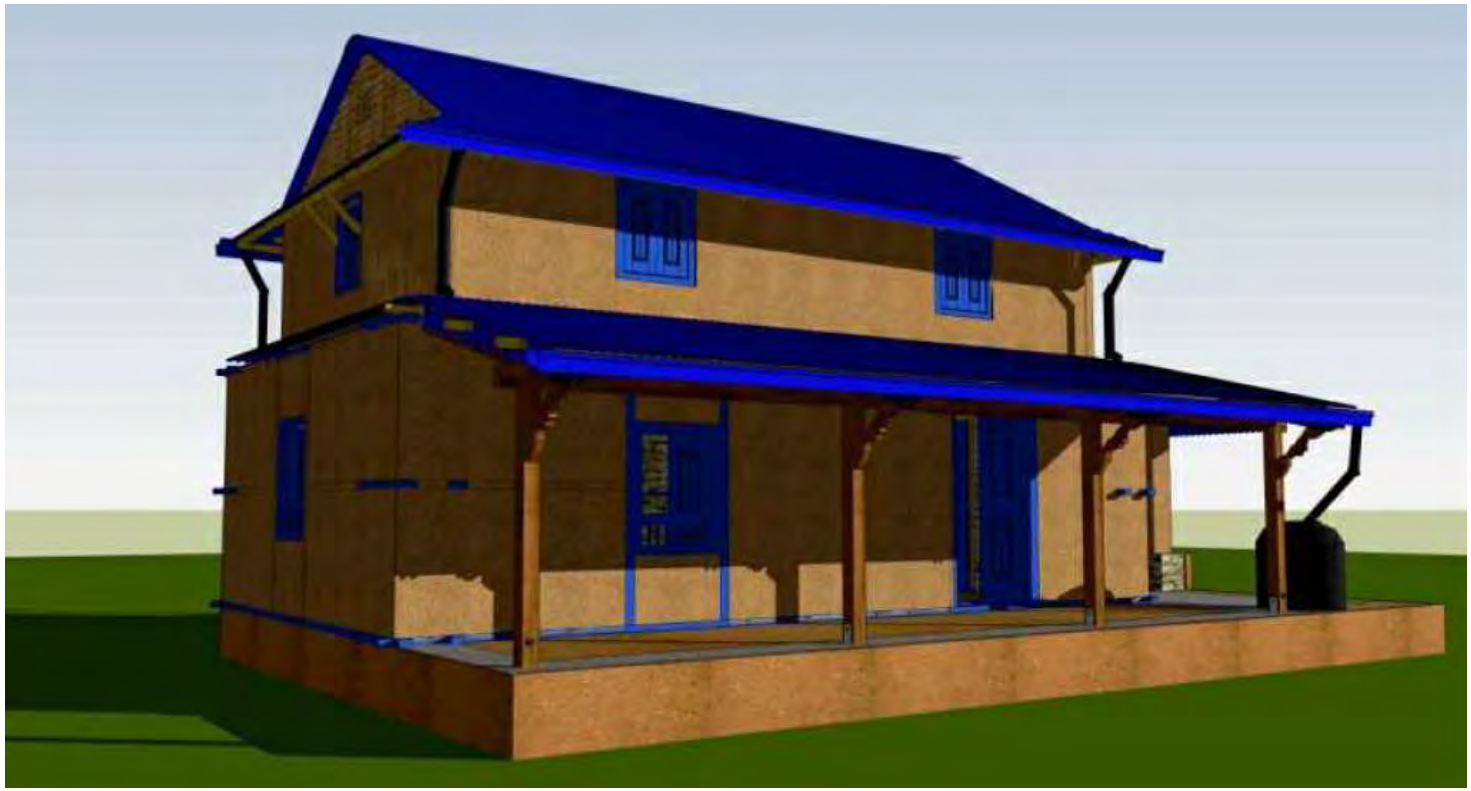
B.S.M.H.-6.1

The proposed technology uses traditional, yet earthquake resistant construction using materials and skills that are indigenous and locally available. Local bamboo ***(Banbusa Nutans), seasoned and treated, is used in a structural*** frame with bamboo wattle and daub panels as walls on the upper floor. The frame is surrounded with a wall in Stone Masonry with Mud Mortar on the ground floor of the house.
Featured design in H.B.S.M.-5.1 consists of a Ground Floor space that can be converted into two rooms using a lightweight Wattle and Daub partition. A Kitchen and a Covered Verandah flank the room on the short and the long side respectively.

MATERIAL PROPERTIES
Bamboo Properties
Min Compressive Strength of bamboo: 45.6 Mpa
Density of bamboo : 673 Kg/m^3
Modulus of elasticity: 10.72 x 103 Mpa

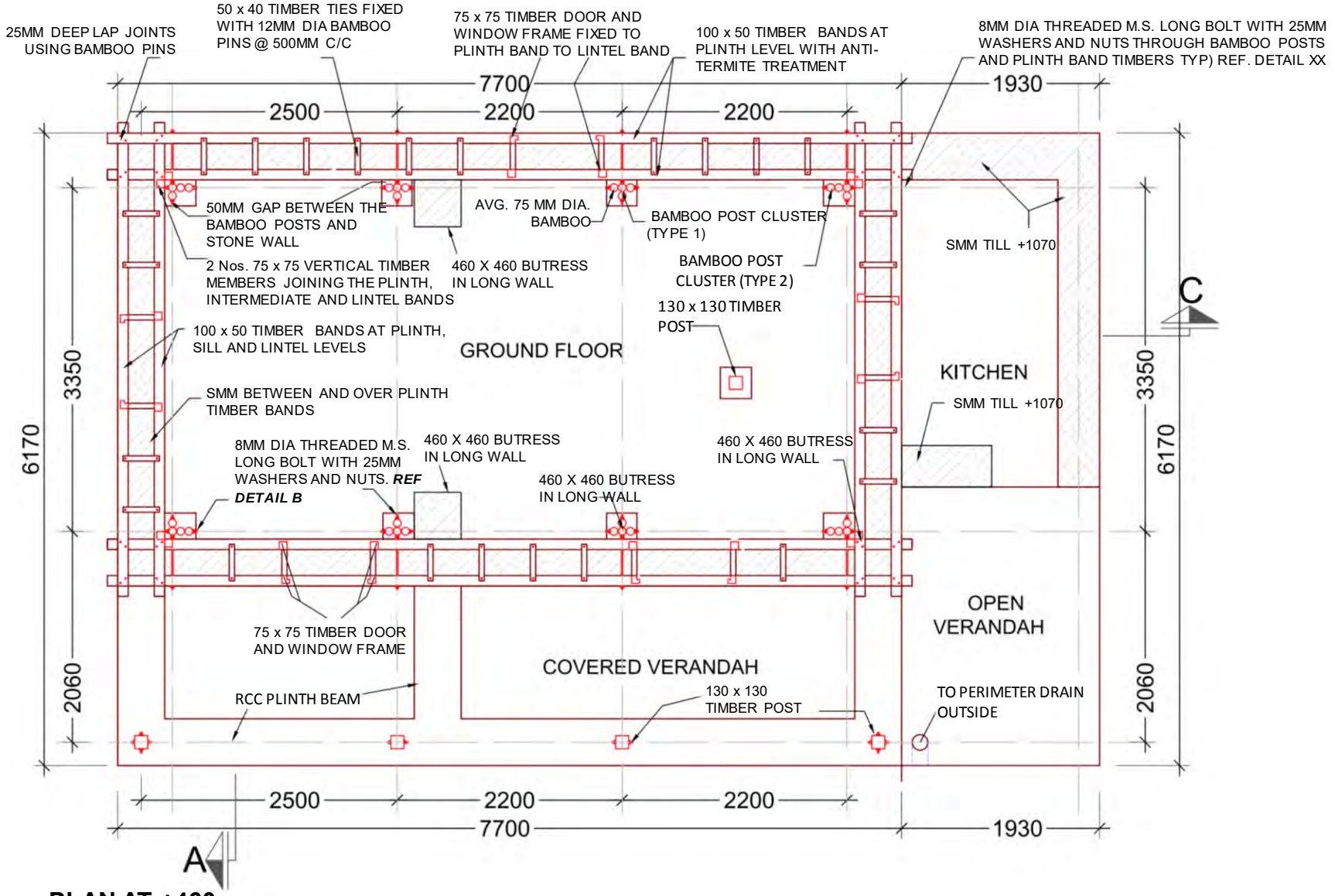
B.S.M.H.-6.1

MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE — TWO STOREY



LEVEL	MATERIALS					
	Stone	Mud	CGI Sheet	GI Sheet	Wood	Bamboo
	Cu.m.	Cu.m.	Bundle	Sq.m.	Cu.m.	Nos
Up to Plinth Level	11.6	13.0			-	
Super Structure	21.3	8.1			0.6	230.0
Roofing	-	-	5.6	9.5	0.7	
TOTAL	**32.9**	**21.1**	**5.6**	**9.5**	**1.3**	**230.0**

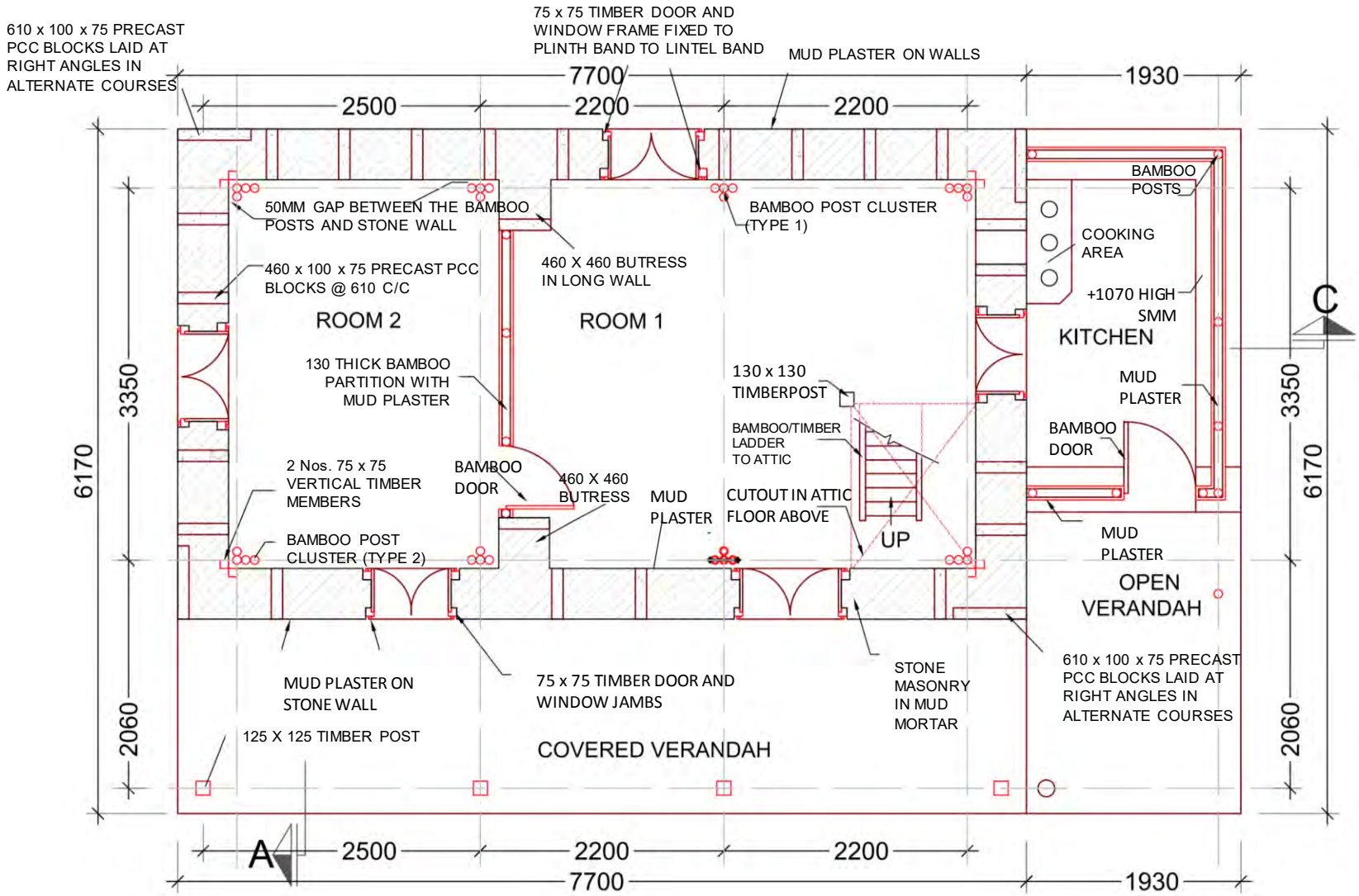
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	1/14



PLAN AT +460

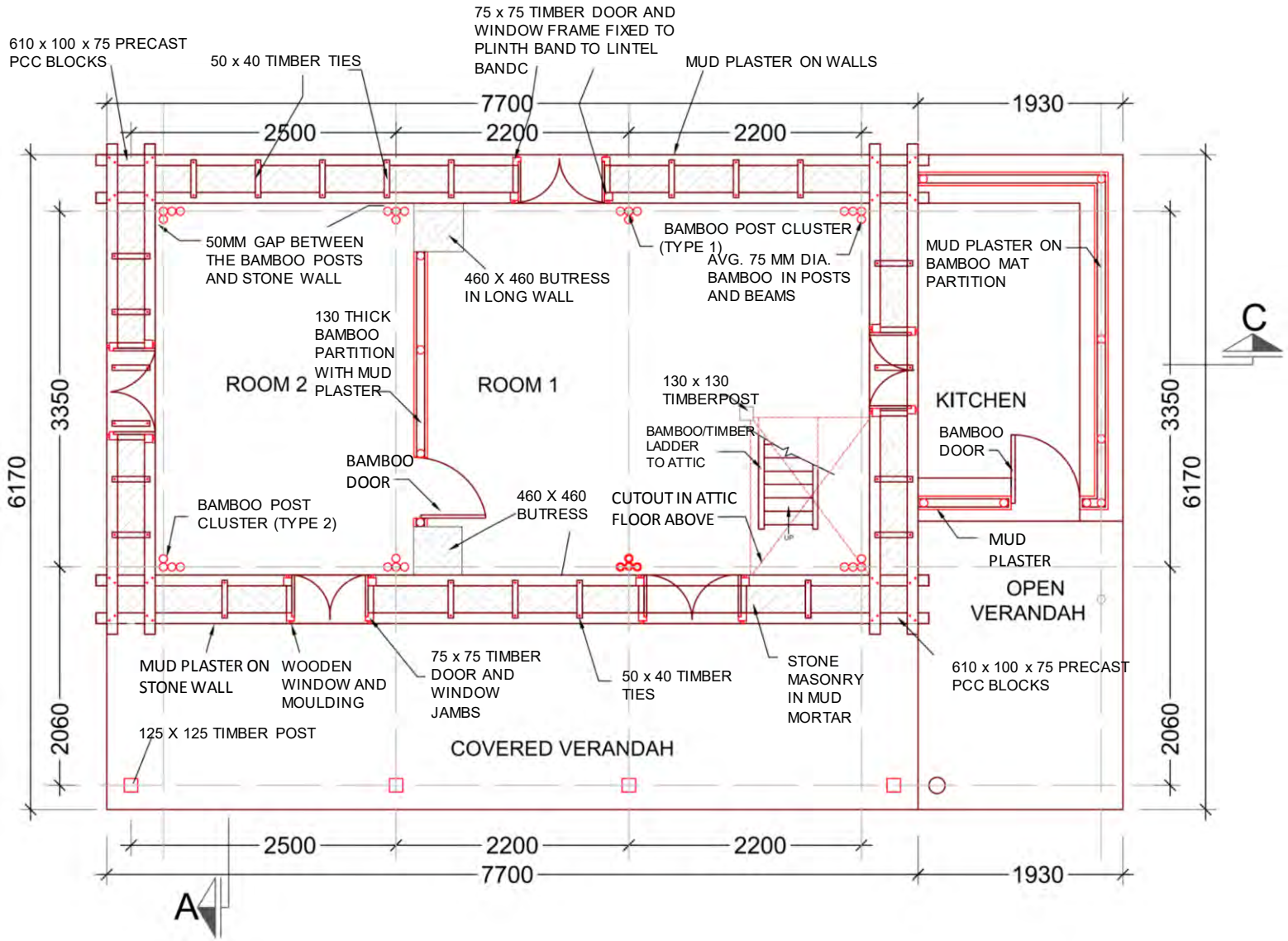
PLINTH BAND IN LOCAL TREATED TIMBER

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: PLAN	DATE:	2/14



PLAN AT +1000
WINDOW SILL LEVEL

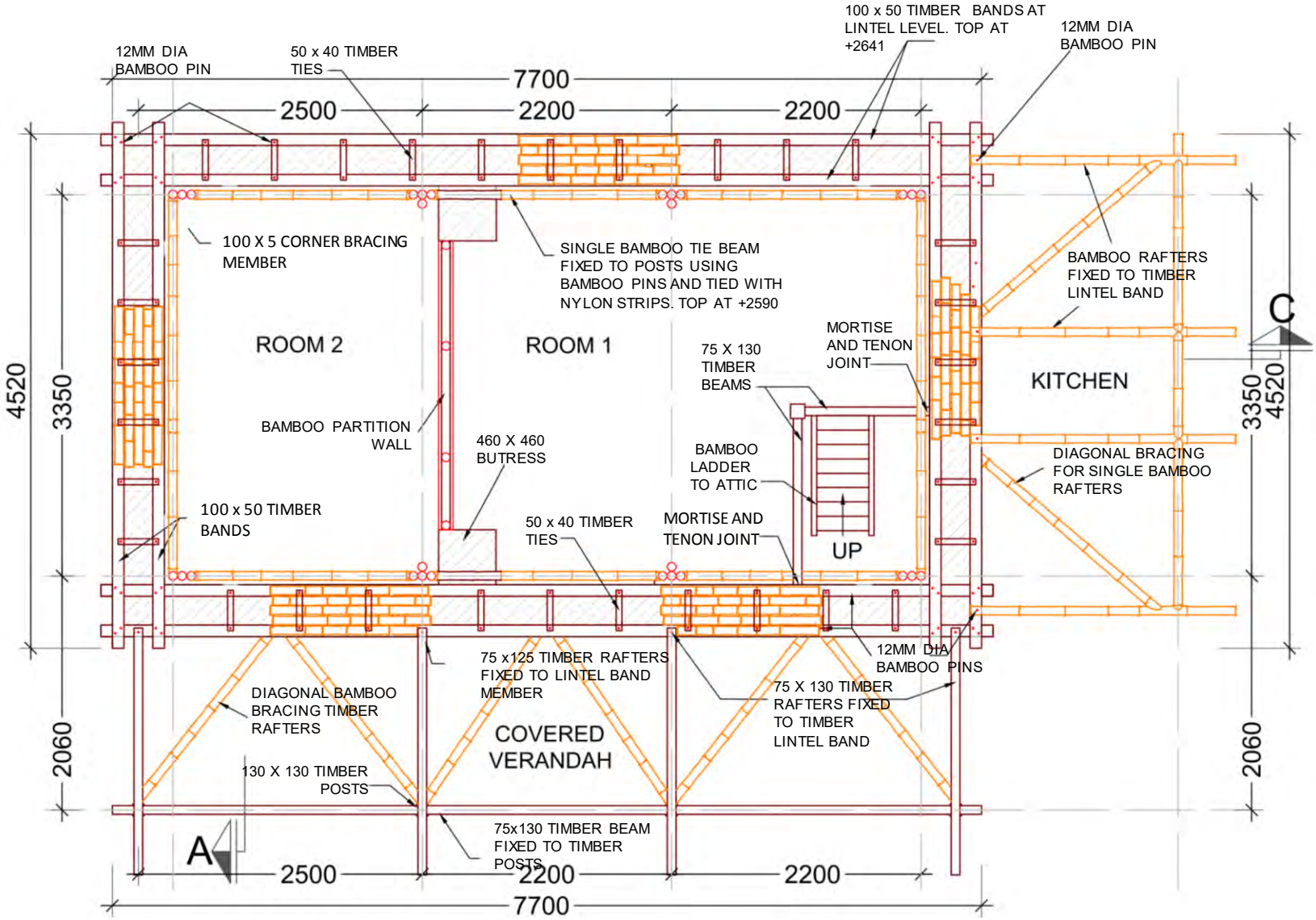
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: PLAN	DATE:	3/14



PLAN AT +1575
MIDDLE TIMBER BAND

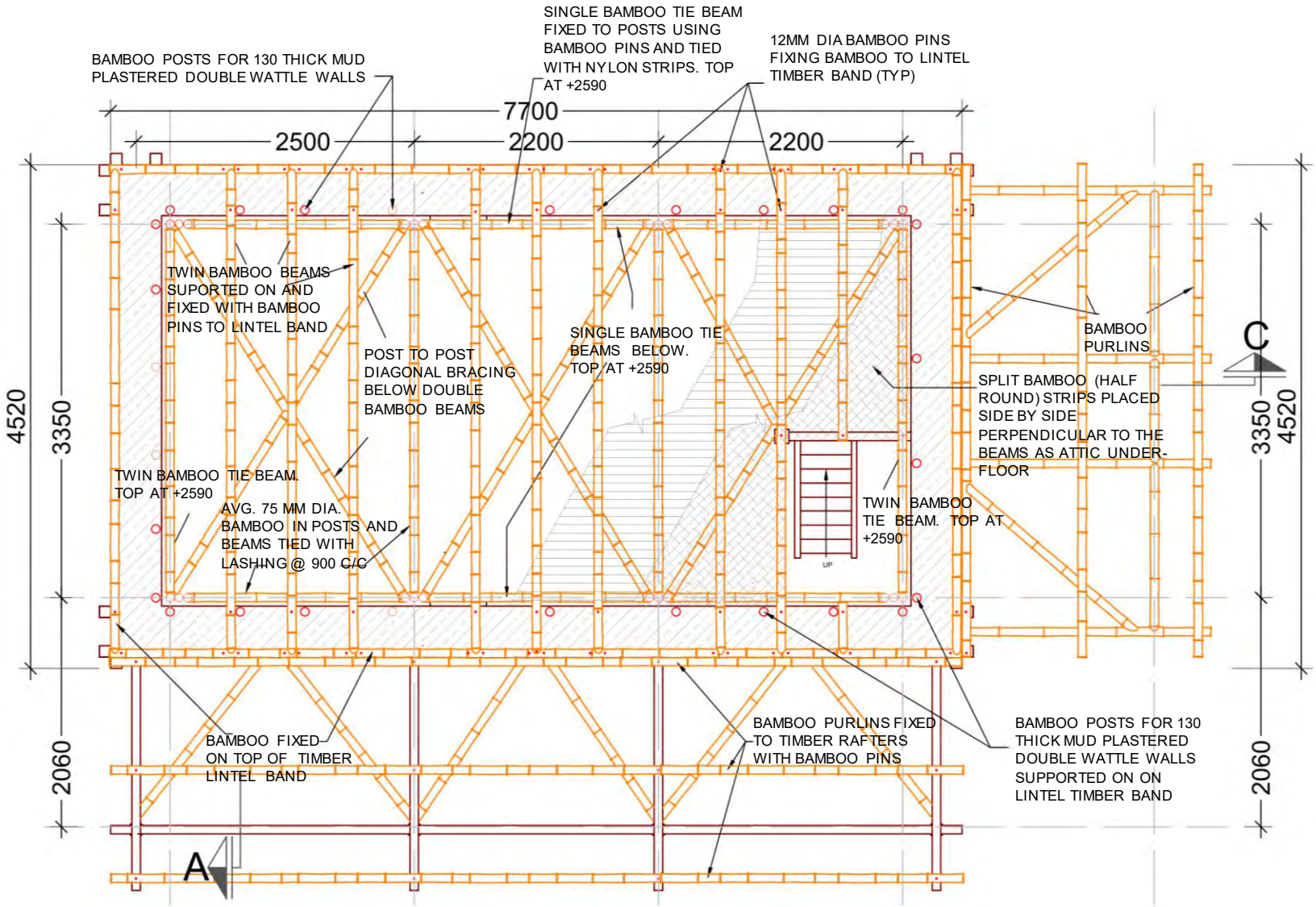
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: PLAN	DATE:	4/14

MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE — TWO STOREY



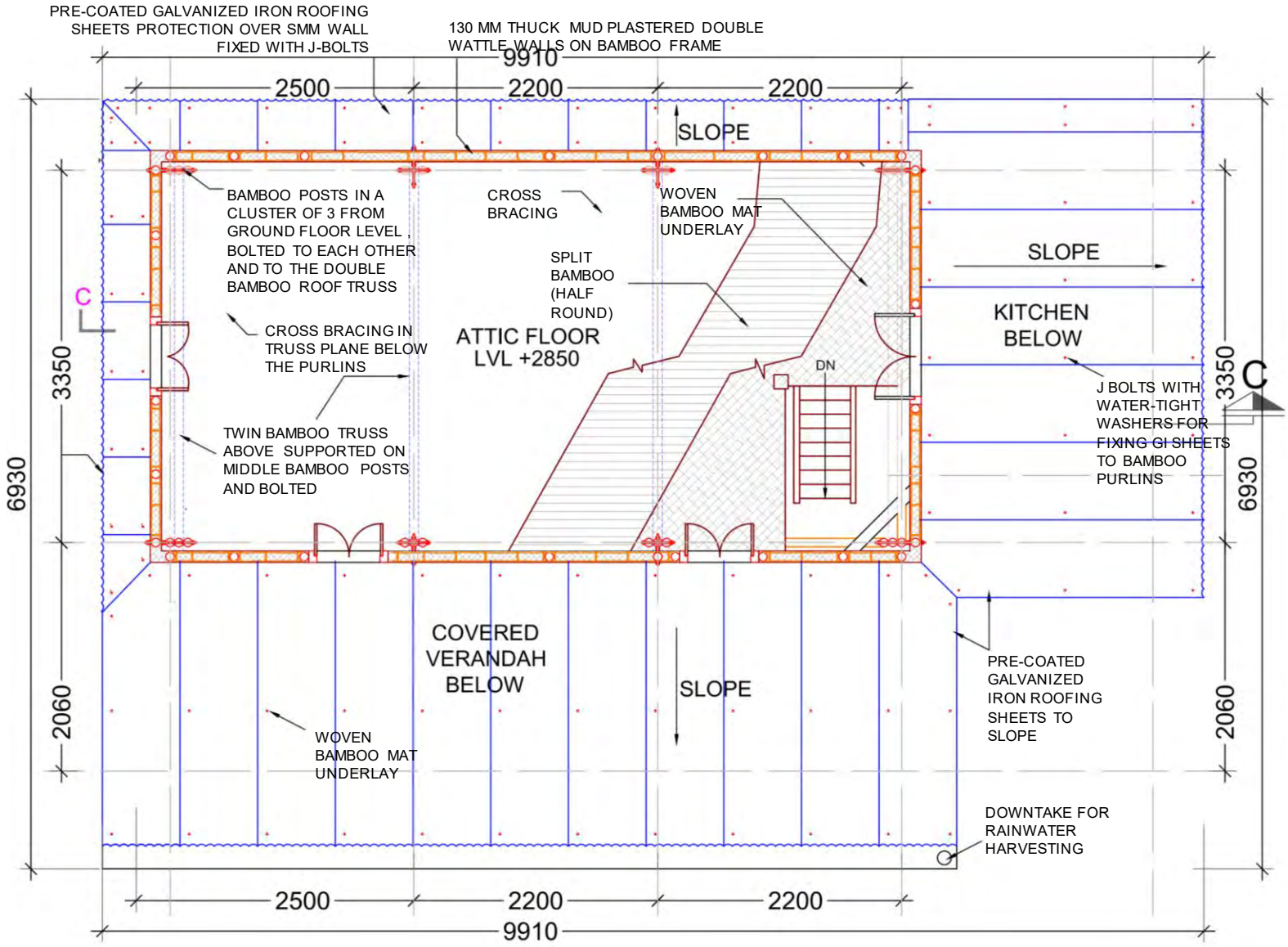
PLAN AT +2640
LINTEL BAND

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: PLAN	DATE:	5/14



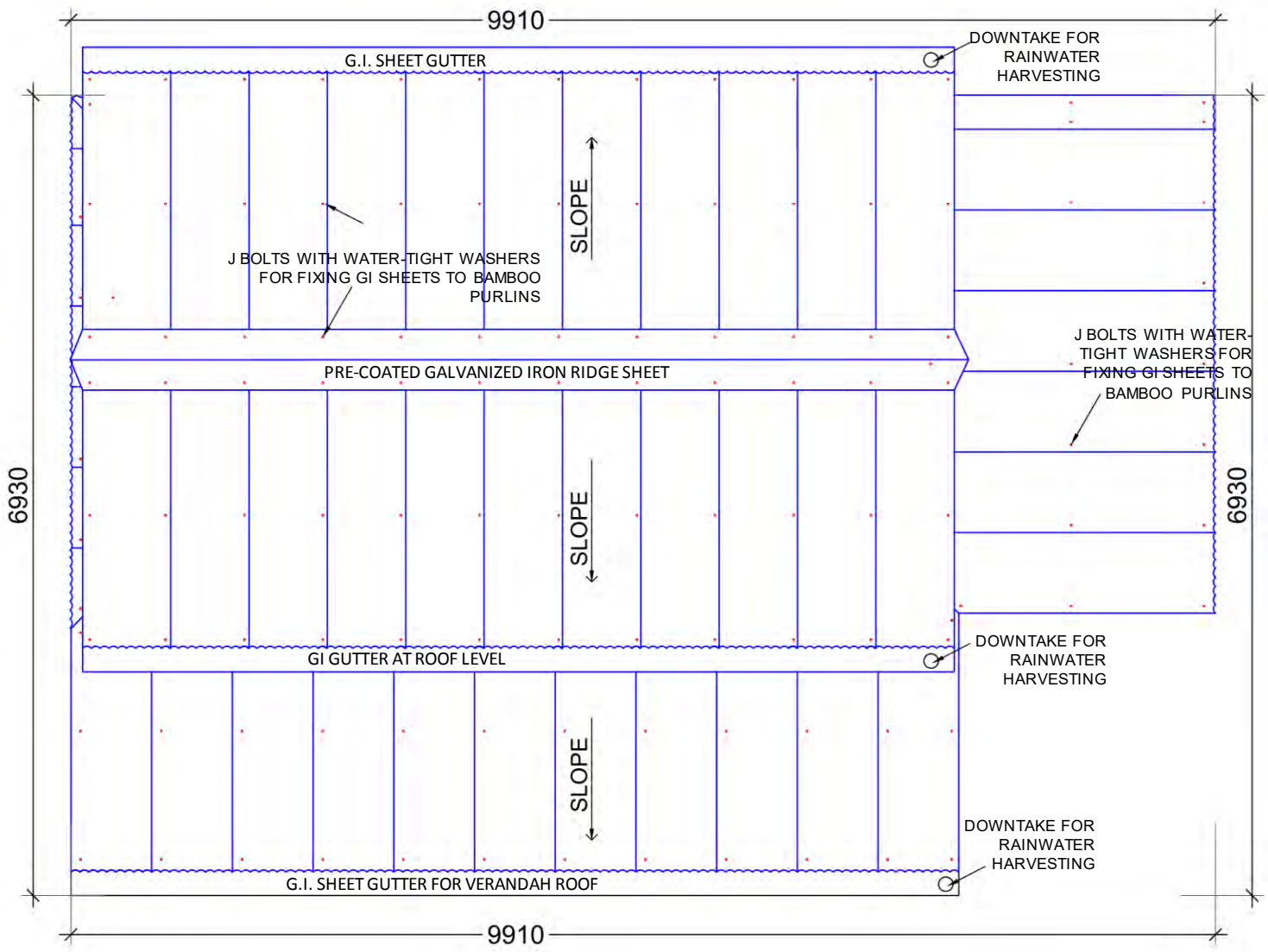
PLAN AT +2790 (ATTIC FLOOR BEAMS)

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: PLAN	DATE:	6/14



PLAN AT +3350(ATTIC WINDOW SILL LEVEL)

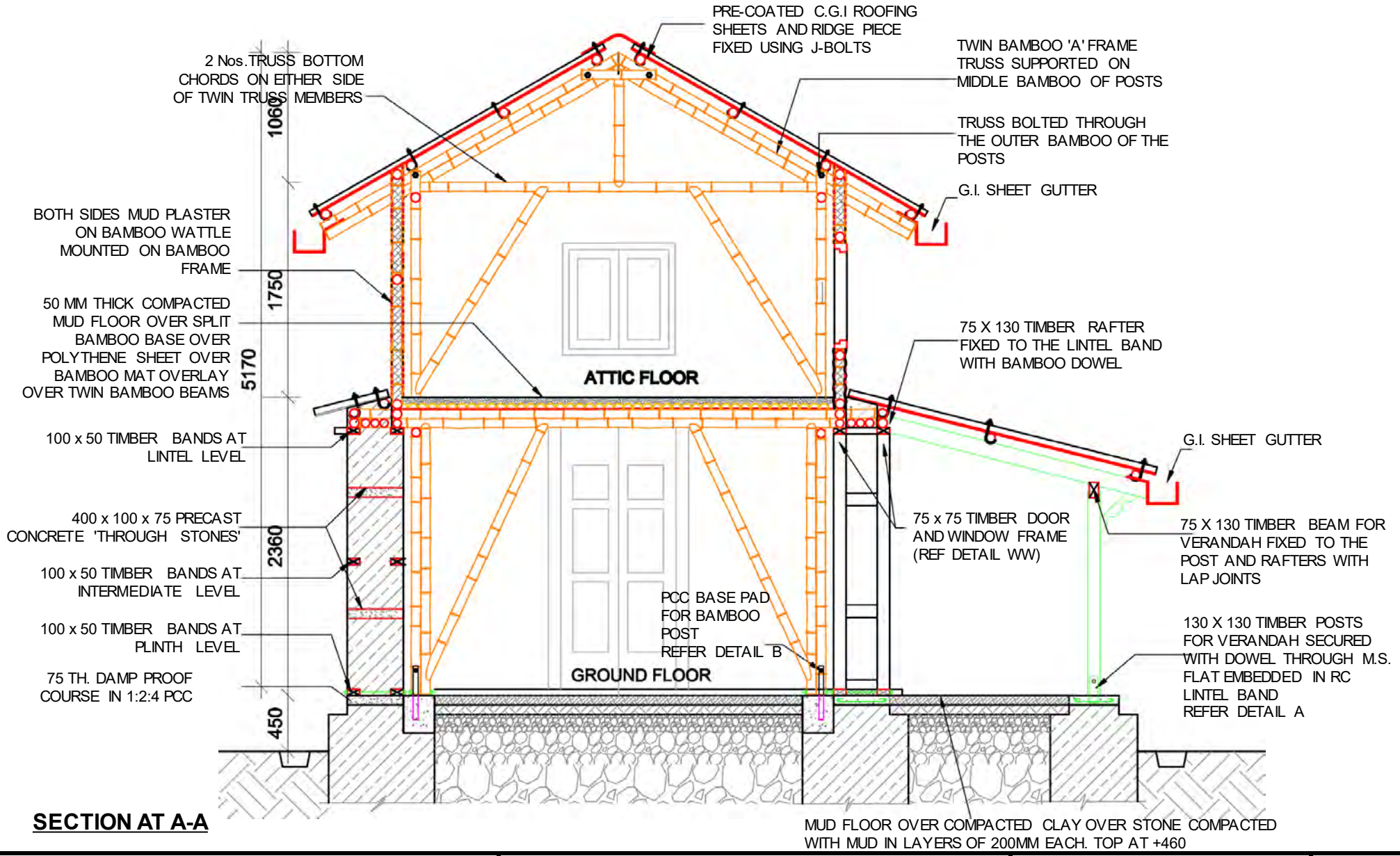
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: PLAN	DATE:	7/14



ROOF PLAN

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: PLAN	DATE:	8/14

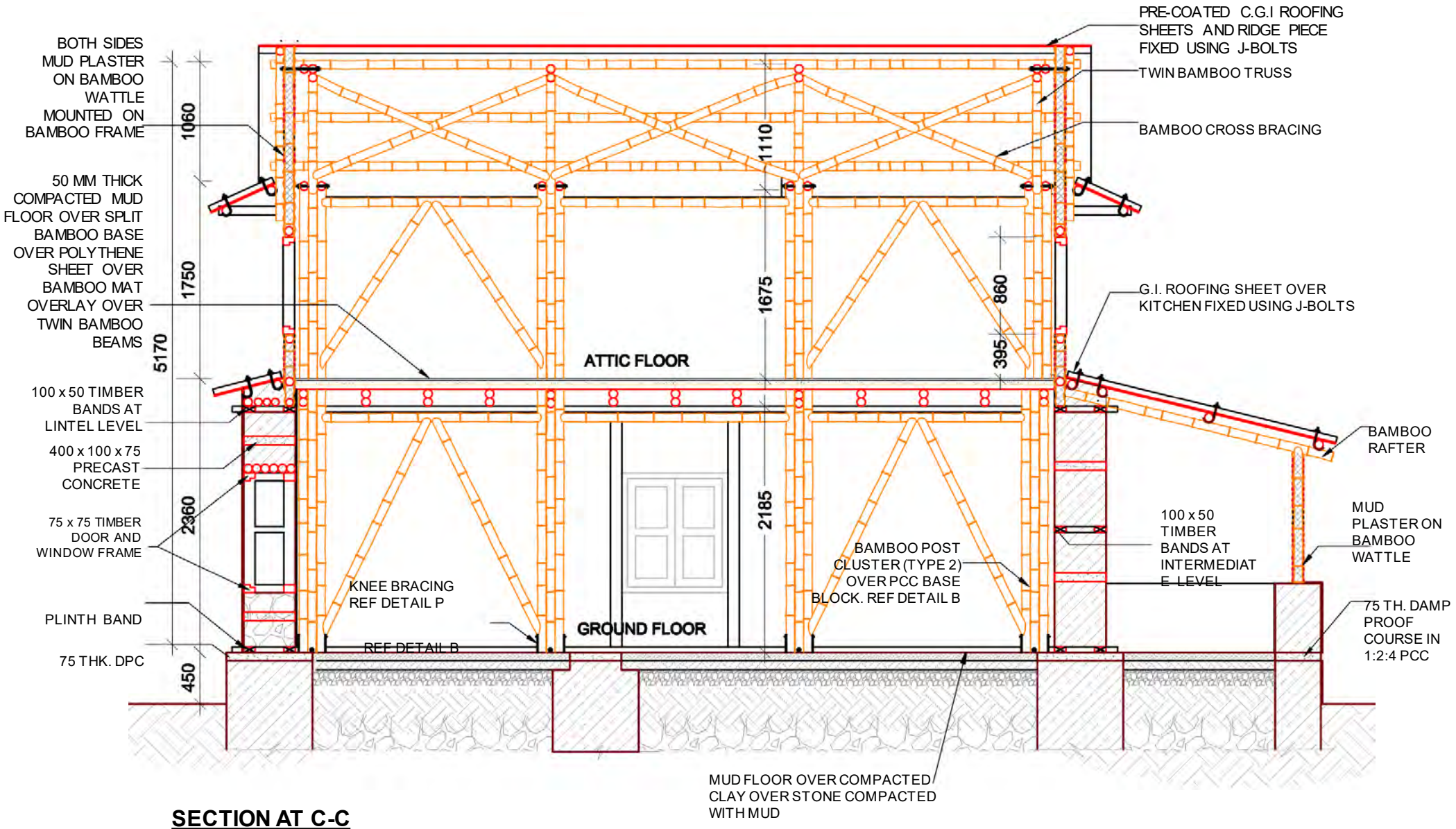
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE — TWO STOREY



SECTION AT A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: SECTION	DATE:	9/14

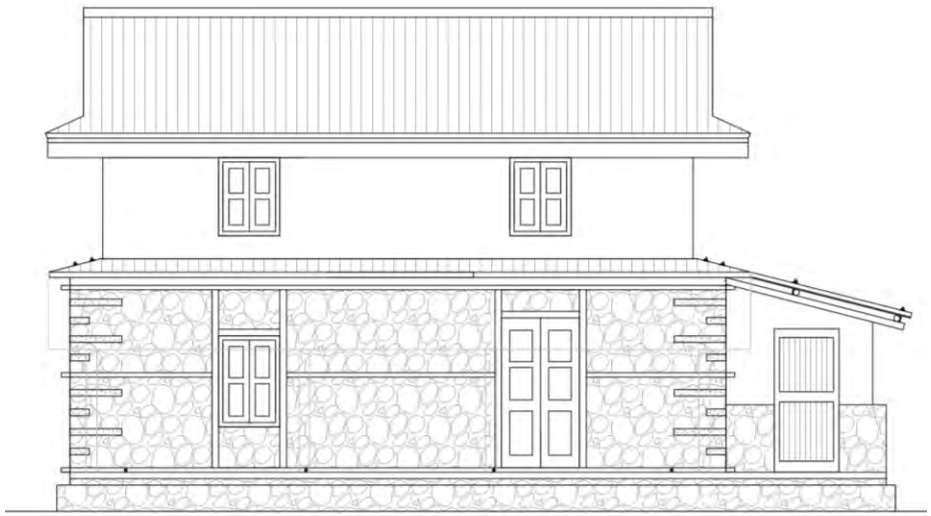
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE — TWO STOREY



SECTION AT C-C

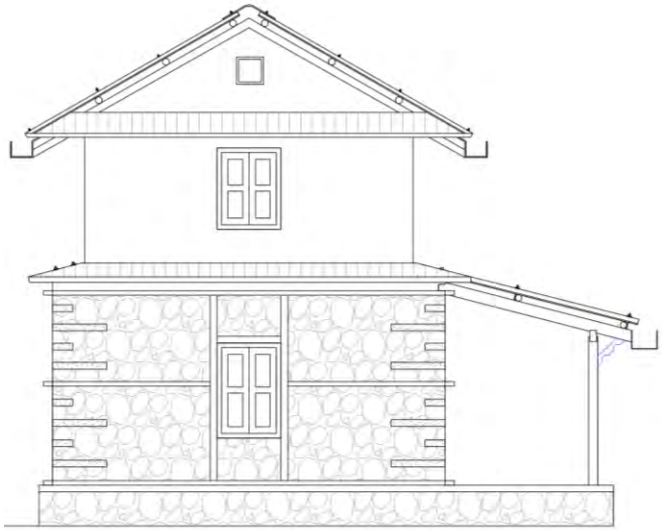
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: SECTION	DATE:	10/14

MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE — TWO STOREY

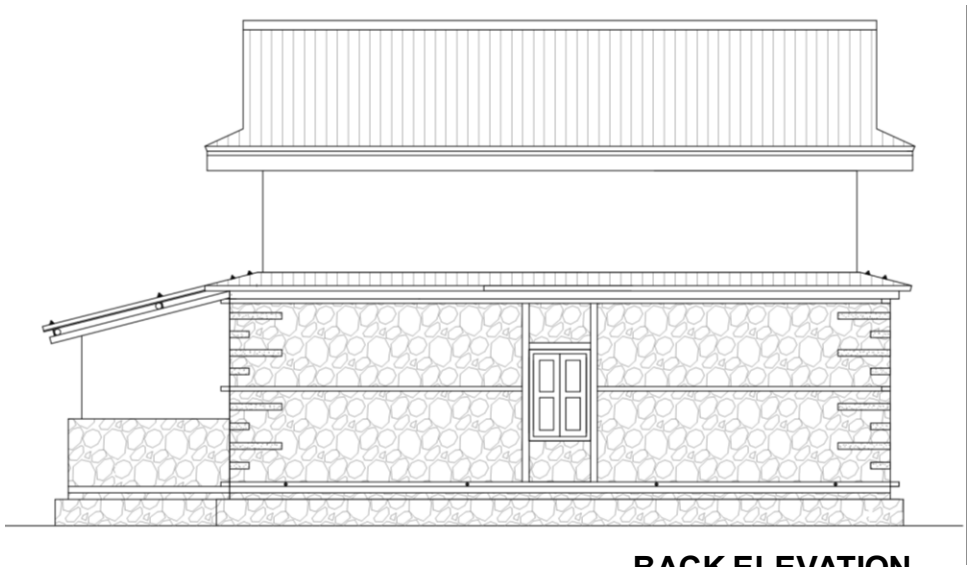


FRONT ELEVATION

SIDE ELEVATION

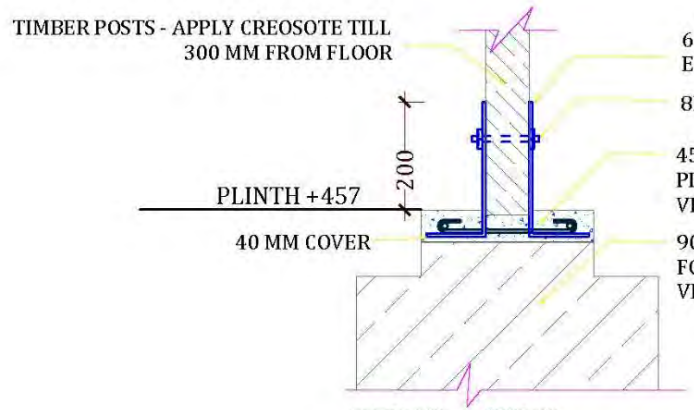


SIDE ELEVATION

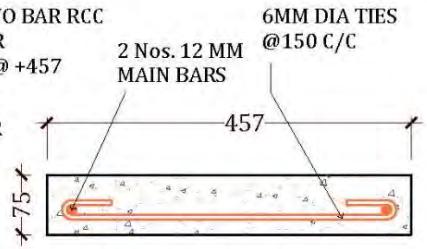


BACK ELEVATION

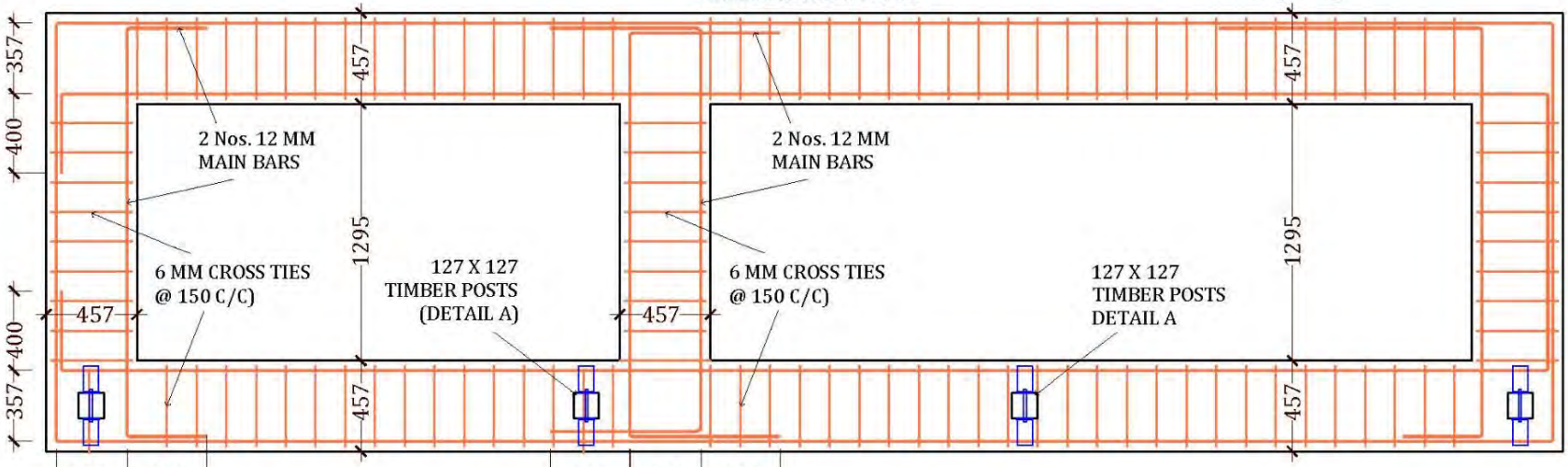
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: ELEVATIONS	DATE:	11/14



DETAIL A (NTS)
BASE PAD FOR
VERANDAH POSTS



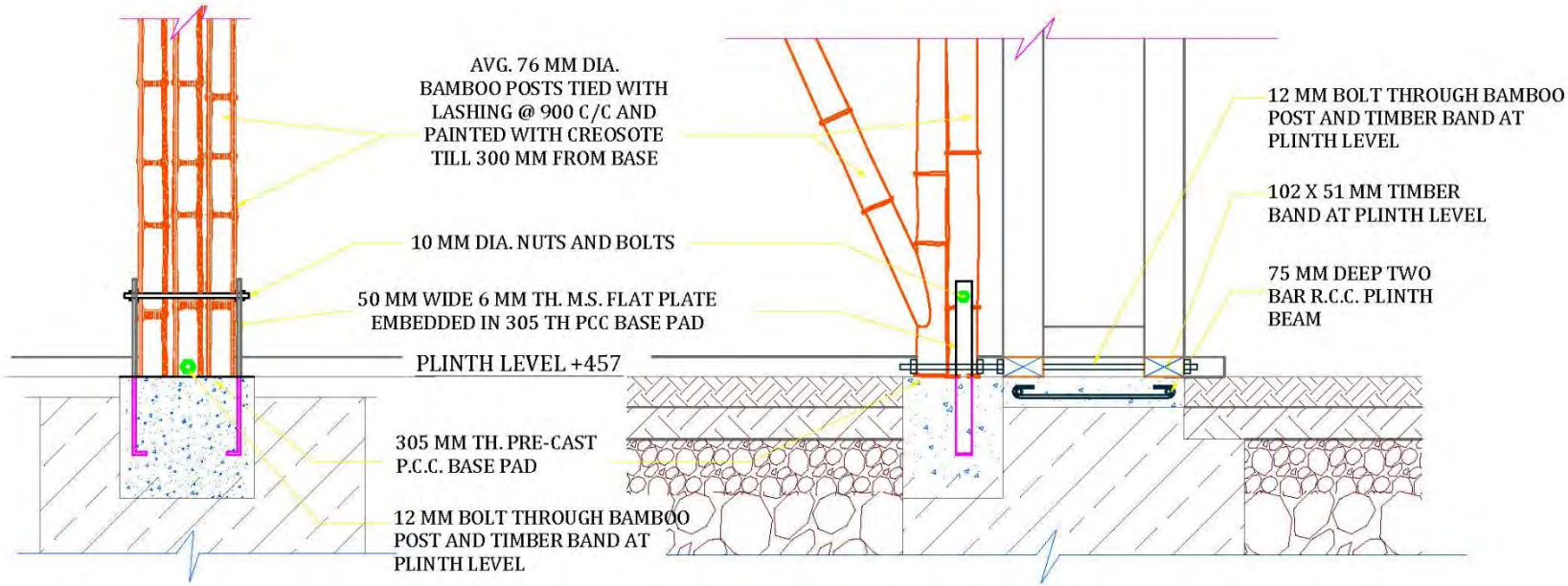
DETAIL A - CROSS SECTION
OF VERANADAH RC
BAND(NTS)



DETAIL A - REINFORCEMENT - CORNER

DETAIL A - REINFORCEMENT - 'T' JUNCTION

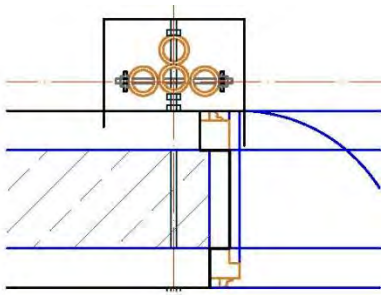
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: DETAILS	DATE:	12/14



DETAIL B (SECTION): BASE PAD FOR BAMBOO CLUSTER POSTS 'TYPE 1' AND TYPE 2'

DETAIL B (SIDE ELEVATION): BASE PAD FOR BAMBOO CLUSTER POSTS 'TYPE 1' AND TYPE 2'

ADAPTED FROM: RE-CONSTRUCTION OF MULTI-HAZARD RSISTANT HOUSES FOR THE 2008 KOSI AFECTED DISTRICTS IN WEST BIHAR. PART - II: TECHNICAL GUIDELINES FOR BAMBOO BASED CONSTRUCTION



DETAIL B (PLAN): BASE PAD FOR BAMBOO CLUSTER POSTS 'TYPE 1' AND TYPE 2'

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: B.S.M.H.-6.1	SCALE: NONE	BSMH-6.1
	DRAWING TITLE: DETAILS	DATE:	13/14

TECHNICAL REQUIREMENTS

Structure System	Two independent structural system; bamboo structure and stone masonry in mud mortar with 150 mm gap between them as shown in the drawings.
Foundation	Strip Foundation of stone masonry in mud mortar of width 850 mm and depth 750 mm. For bamboo posts, 150 x 150 mm thick PCC base pad over polythene sheet.
Bands:	Timber bands shall be provided at plinth, lintel and intermediate level as shown in the drawing. Band consists of two parallel timber sections of 100 x50 mm size covering entire thickness of wall. These timber shall be laterally tied with timber sections of size 38*50 mm
Wall System	Random rubble masonry in mud mortar. Wall thickness 450 mm
Floor:	50 mm thick mud flooring over split bamboos laid over joists of bamboo twins (double section) @ 400 mm c/c (Refer drawing)
Roof:	Lightweight roof of Corrugated Iron sheet over bamboo truss. All joints in the truss shall be properly connected as shown in the drawing.

RAT-TRAP BOND MASONRY

R.T.B.-7.1

Rat-Trap Bond is a modular type of masonry construction in which bricks are laid on edge, thereby creating an internal cavity within the wall. The cavity improves the thermal behavior of the wall and significantly reduces the quantity of brick and mortar in the masonry. It is a Green Building technology and an appropriate option against conventional solid brick wall masonry from sustainable point of view. Rat trap bond masonry can be used both for partition wall or as a load bearing structures. As Rat trap bond construction is a modular type of masonry construction, due care must be taken while designing the wall length and height.
The design featured in Model RTB-2.1 is a two roomed single storied load bearing structure of Rat Trap bond masonry. Horizontal bands, vertical reinforcements, corner reinforcement and reinforcement in T- junctions are provided.

MATERIAL PROPERTIES
Min Compressive Strength of Rat Trap Bond : 1.3 Mpa
Unit weight of RTB masonry: 15KN/m3
Young's Modulus: 715 Mpa

R.T.B.-7.1

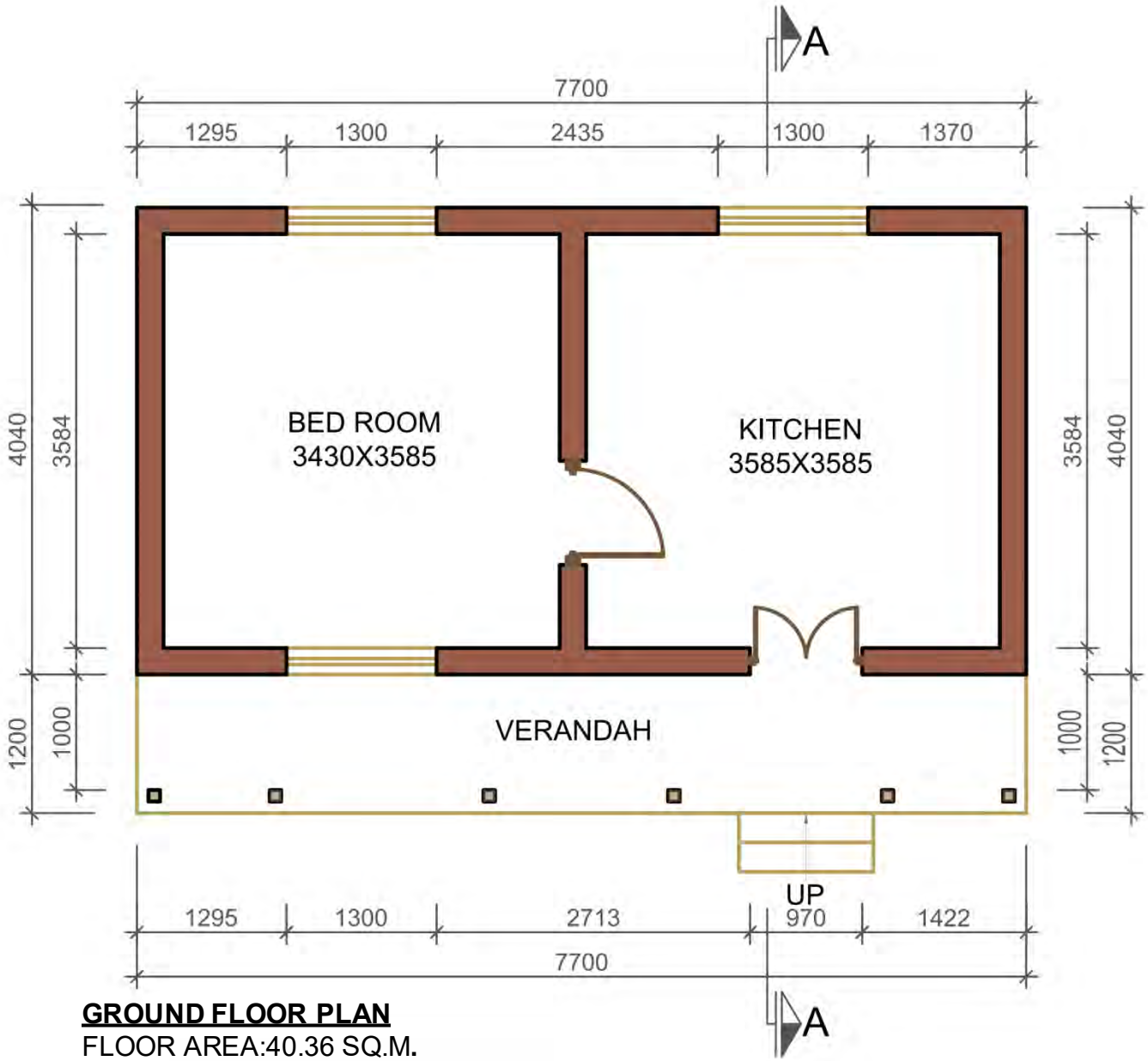
MODEL RTB-7.1, RAT TRAP BOND MASONRY — ONE STOREY

LEVEL	MATERIALS								
	Stone	Brick	Cement	Sand	Aggregate	Wood	Reinforcing Bar	CGI Sheet	GI Sheet
	Cu.m.	No.	Bags	Cu.m.	Cu.m.	Cu.m.	Kg.	Bundle	Rm.
Up to Plinth Level	19.5	2,225.0	59.0	10.3	2.5		280.4		
Super Structure		5,125.0	32.0	3.1	2.5	0.6	297.8		
Roofing		-	-	-	-	4.0	-	4.2	10.0
TOTAL	**19.5**	**7,350.0**	**91.0**	**13.4**	**4.9**	**4.6**	**578.2**	**4.2**	**10.0**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE R.T.B.-7.1	SCALE: NONE	RTB-7.1
	DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	1/10

MODEL RTB-7.1, RAT TRAP BOND MASONRY

ONE STOREY



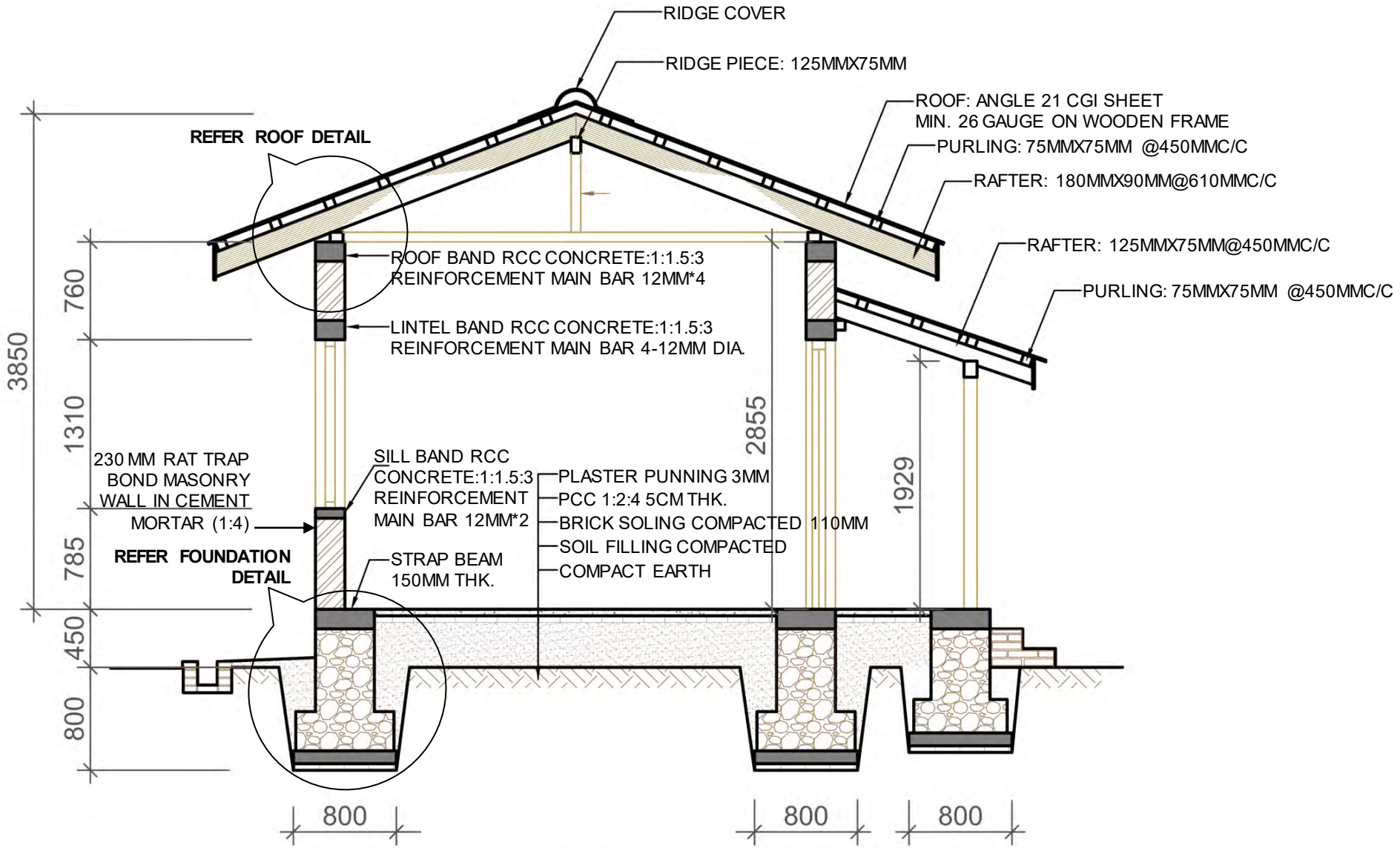
GROUND FLOOR PLAN

FLOOR AREA:40.36 SQ.M.

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.T.B.-7.1	SCALE: NONE	RTB-7.1
	DRAWING TITLE: GROUND FLOOR PLAN	DATE:	2/10

MODEL RTB-7.1, RAT TRAP BOND MASONRY

ONE STOREY



SECTION AT A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.T.B.-7.1	SCALE: NONE	RTB-7.1
	DRAWING TITLE: SECTION	DATE:	3/10

MODEL RTB-7.1, RAT TRAP BOND MASONRY

ONE STOREY

FRONT ELEVATION

SIDE ELEVATION

SIDE ELEVATION

BACK ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.T.B.-7.1	SCALE: NONE	RTB-7.1
	DRAWING TITLE: ELEVATIONS	DATE:	4/10

MODEL RTB-7.1, RAT TRAP BOND MASONRY

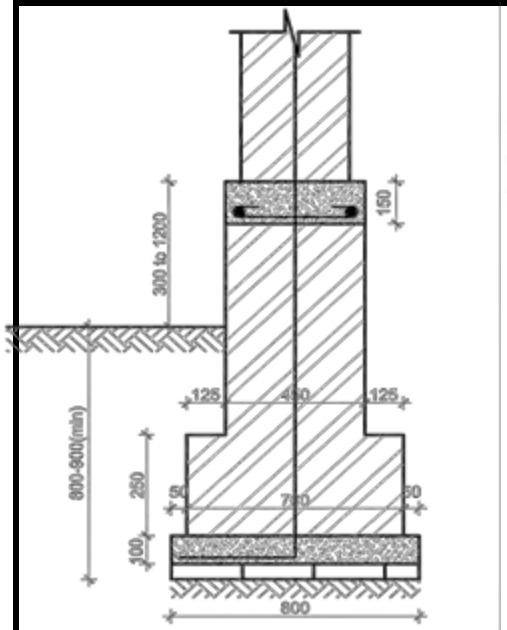
ONE STOREY

TECHNOLOGY FOR EARTHQUAKE RESISTANT BUILDING CONSTRUCTION (RAT-TRAP BOND BRICK MASONRY IN CEMENT MORTAR)

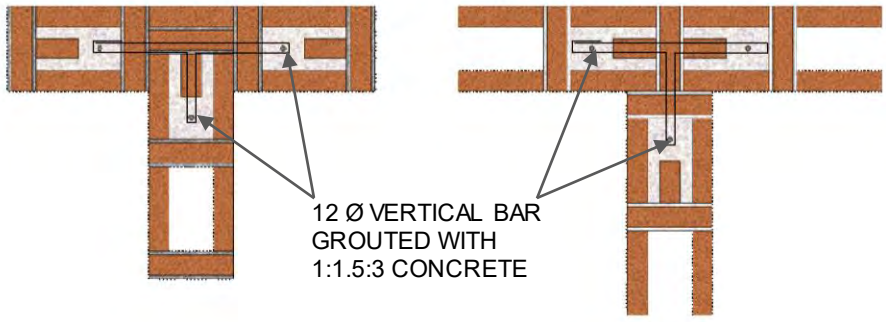
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.T.B.-7.1	SCALE: NONE	RTB-7.1
	DRAWING TITLE:SECTIONAL PERSPECTIVE	DATE:	5/10

MODEL RTB-7.1, RAT TRAP BOND MASONRY

ONE STOREY

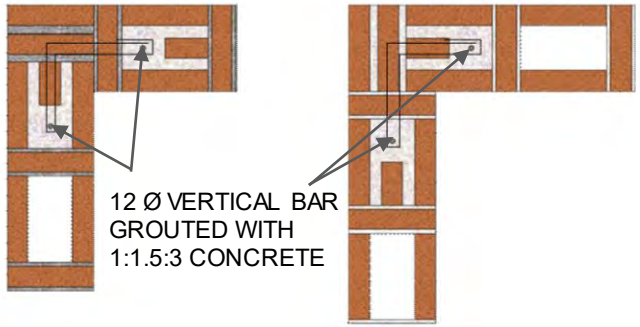


DETAIL C
FOUNDATION SECTION



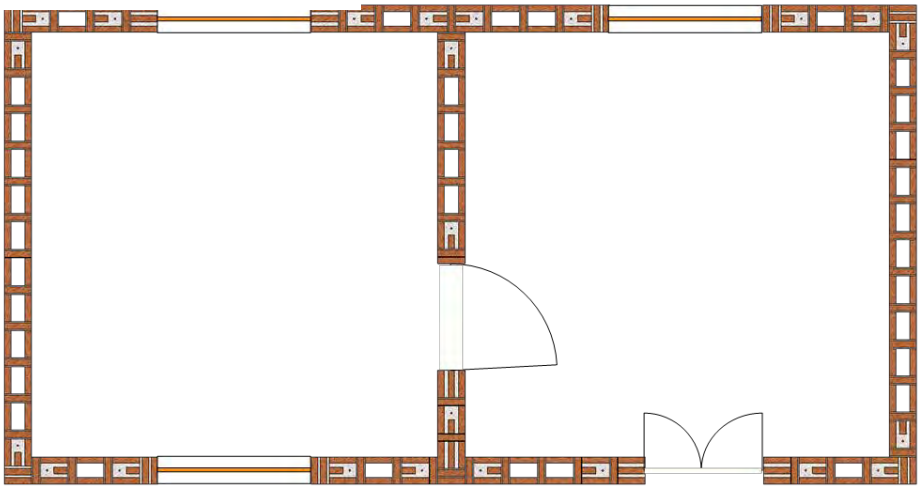
LAYER 1 LAYER 2

RAT-TRAP BOND IN T-JUNCTION

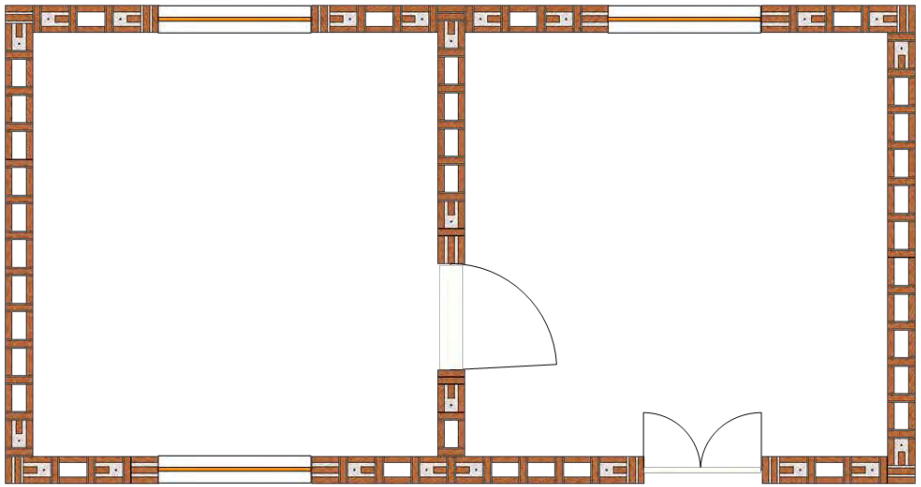


LAYER 1 LAYER 2

RAT-TRAP BOND IN CORNER JUNCTION



RAT-TRAP LAYER 1

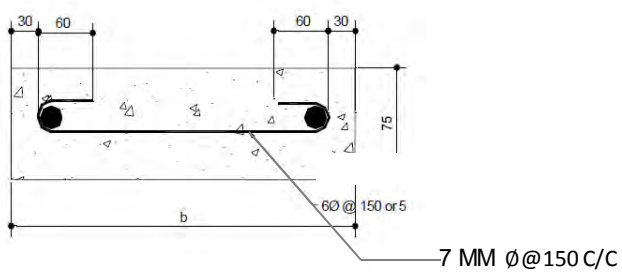


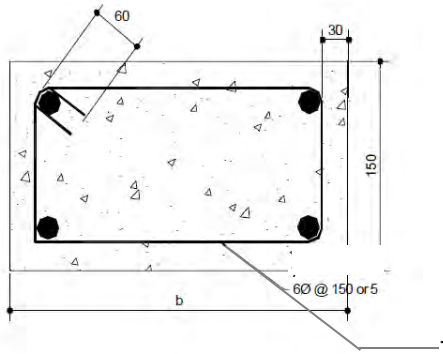
RAT-TRAP LAYER 2

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.T.B.-7.1	SCALE: NONE	RTB-7.1
	DRAWING TITLE: DETAILS	DATE:	6/10

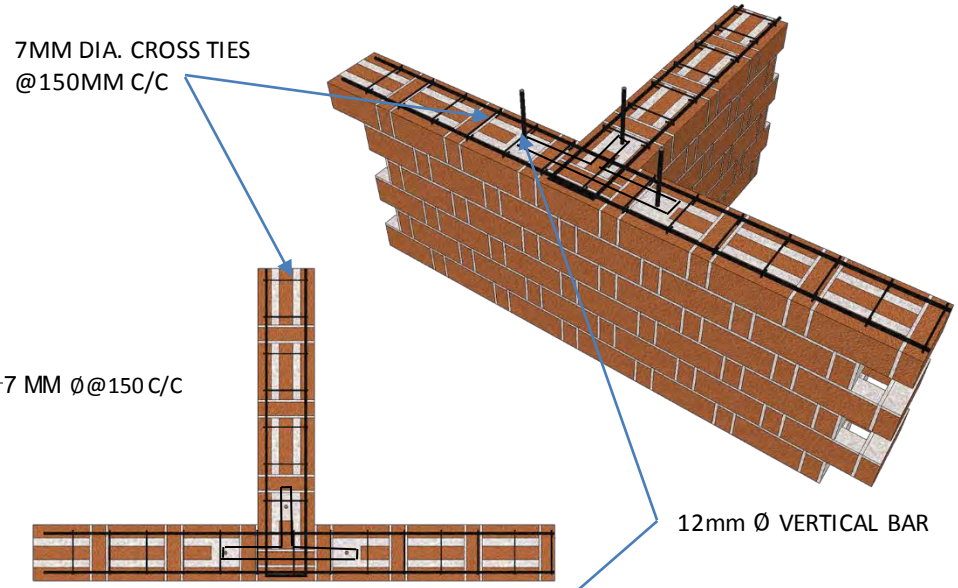
MODEL RTB-7.1, RAT TRAP BOND MASONRY

ONE STOREY



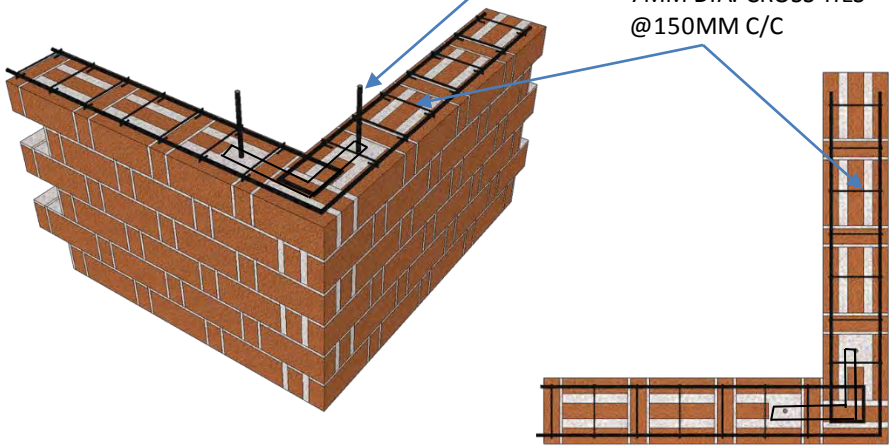


CROSS SECTION OF RC BANDS FOR TWO BARS AND FOUR BARS



REQUIREMENT OF BAR FOR RC BANDS

BAND/BEAM	RC BAND MINIMUM THICKNESS	MIN. NO. OF BARS	MIN. DIAMETER OF BARS (MM)
PLINTH	150MM	4	12
SILL	75MM	2	12
LINTEL	150MM	4	12
ROOF	150MM	4	12
CORNER STITCH	75MM	2	12

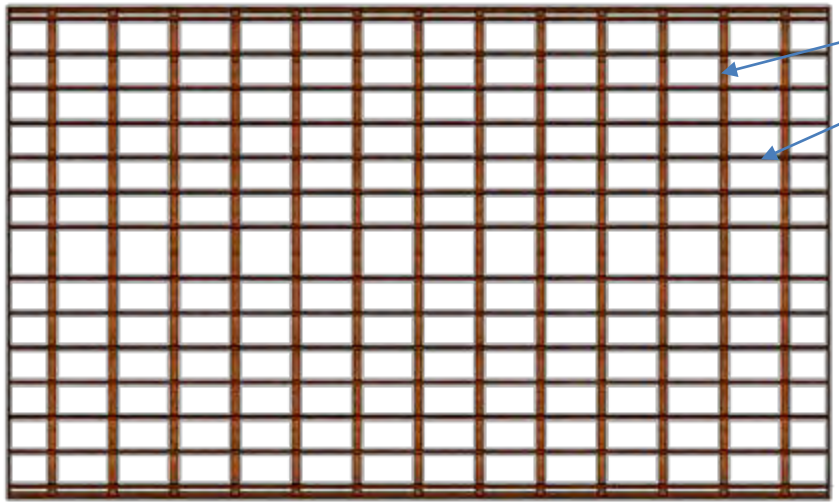


RCC BAND AT CORNER AND T-JUNCTION

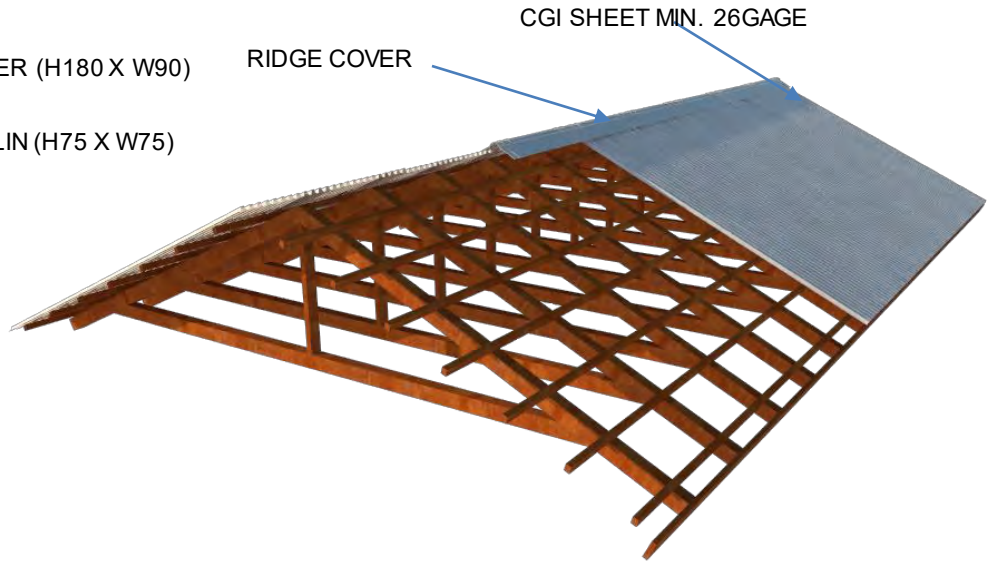
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.T.B.-7.1	SCALE: NONE	RTB-7.1
	DRAWING TITLE: DETAILS	DATE:	7/10

MODEL RTB-7.1, RAT TRAP BOND MASONRY

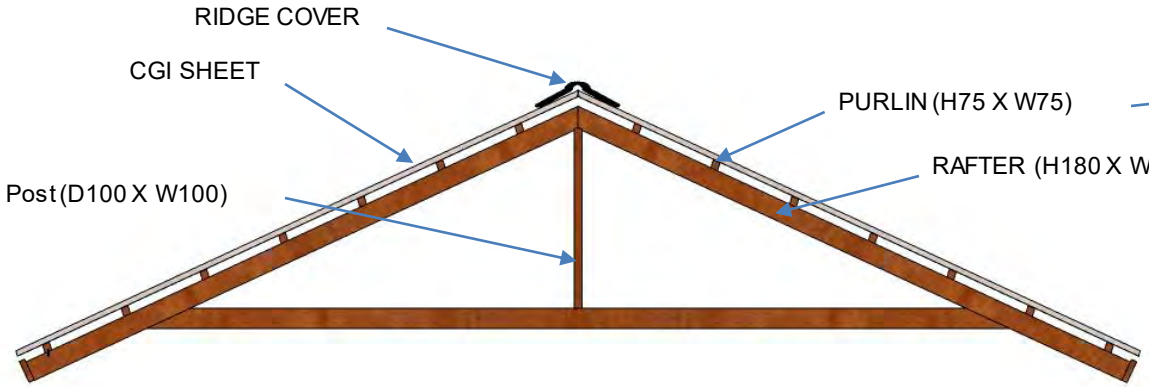
ONE STOREY



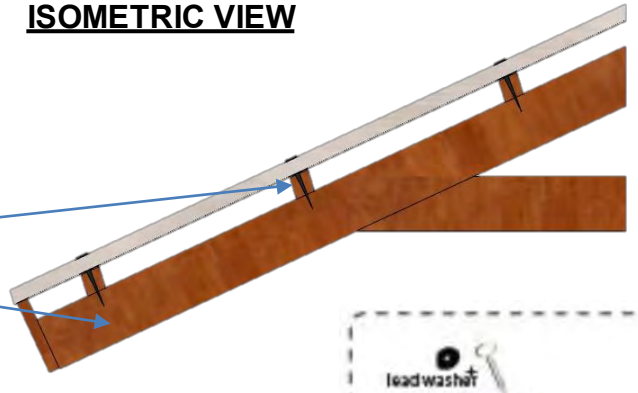
TOP (PLAN) VIEW



ISOMETRIC VIEW



SIDE VIEW

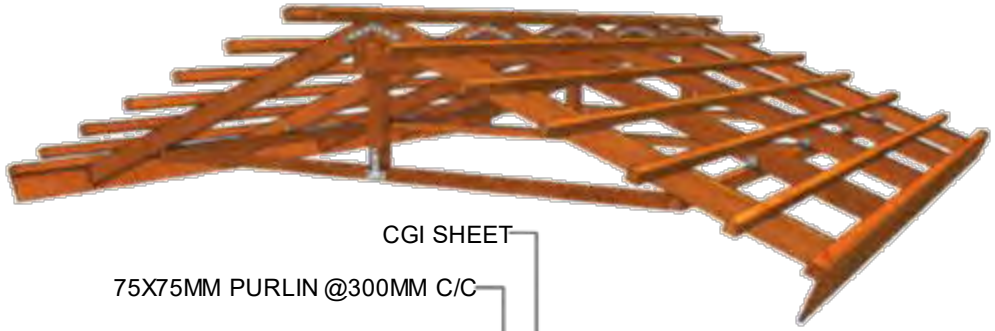


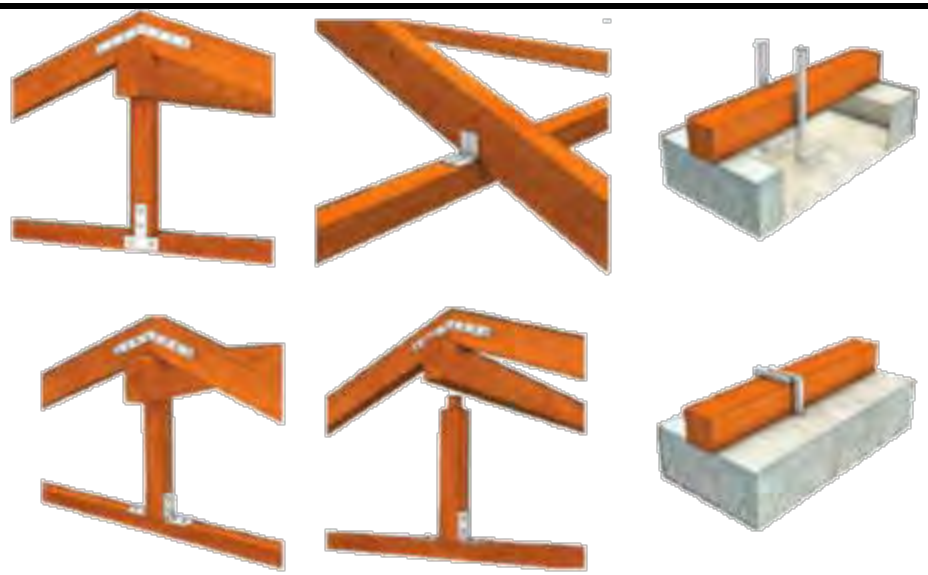
DETAILS

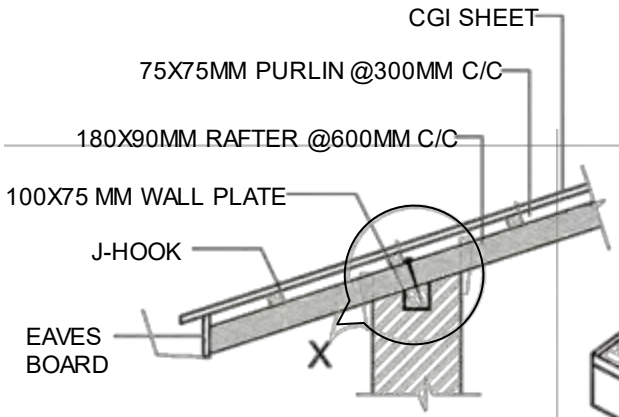
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.T.B.-7.1	SCALE: NONE	RTB-7.1
	DRAWING TITLE: ROOF DETAILS	DATE:	8/10

MODEL RTB-7.1, RAT TRAP BOND MASONRY

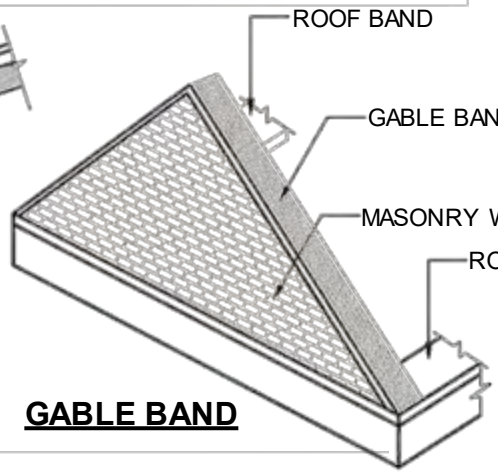
ONE STOREY



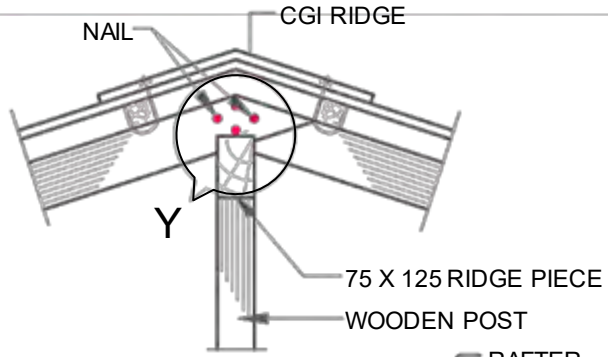


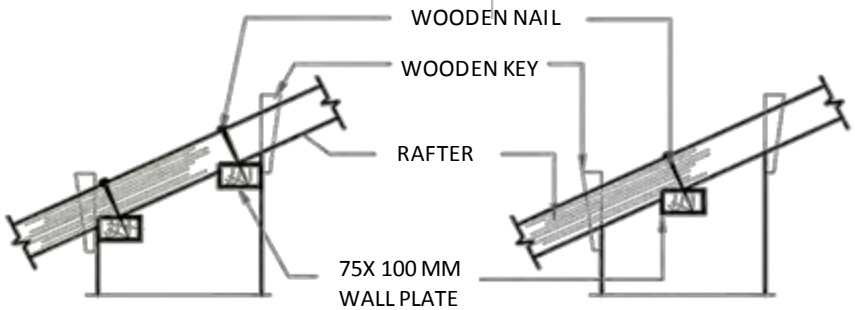


TYPE-1

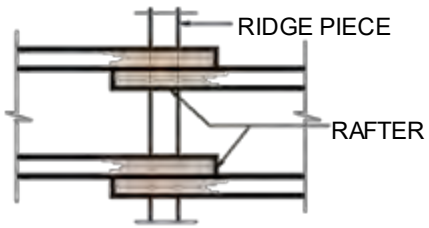


GABLE BAND

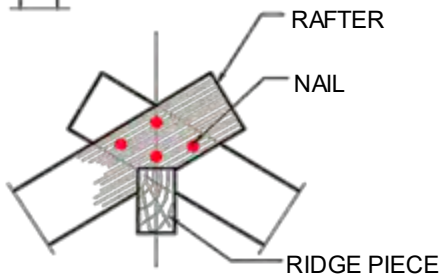




DETAIL AT-X



PLAN



DETAIL AT-Y

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: R.T.B.-7.1	SCALE: NONE	RTB-7.1
	DRAWING TITLE: ROOF DETAILS	DATE:	9/10

TECHNICAL REQUIREMENTS

Structure System	Load bearing Rat Trap Bond (RTB) masonry structure.
Foundation	Stone masonry strip footing of width 800 mm and depth 800 mm in cement sand mortar 1:4.
Plinth Band	RCC (1:1.5:3) plinth band shall be provided throughout the entire wall at plinth level. The minimum depth of the band shall be 150mm. Main reinforcement shall be 4 nos.12mm dia. bars with 7mm Ø stirrups at 150mm C/C.
Wall System	Rat trap bond brick masonry in 1:4 cement sand mortar.
Sill Band	RCC (1:1.5:3) sill band shall be provided throughout the entire wall at the bottom level of the openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos.12mm dia. bars with 7mm Ø stirrups at 150mm C/C.
Lintel Band:	RCC (1:1.5:3) lintel band shall be provided throughout the entire wall at the bottom level of the openings. The minimum depth of the band shall be 150mm. Main reinforcement shall be 4 nos.12mm dia. bars with 7mm Ø stirrups at 150mm C/C.
Roof Band:	RCC (1:1.5:3) roof band shall be provided throughout the entire wall at roof level. The minimum depth of the band shall be 150mm. Main reinforcement shall be 4 nos.12mm dia. bars with 7mm Ø stirrups at 150mm C/C.
Roof:	Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing.

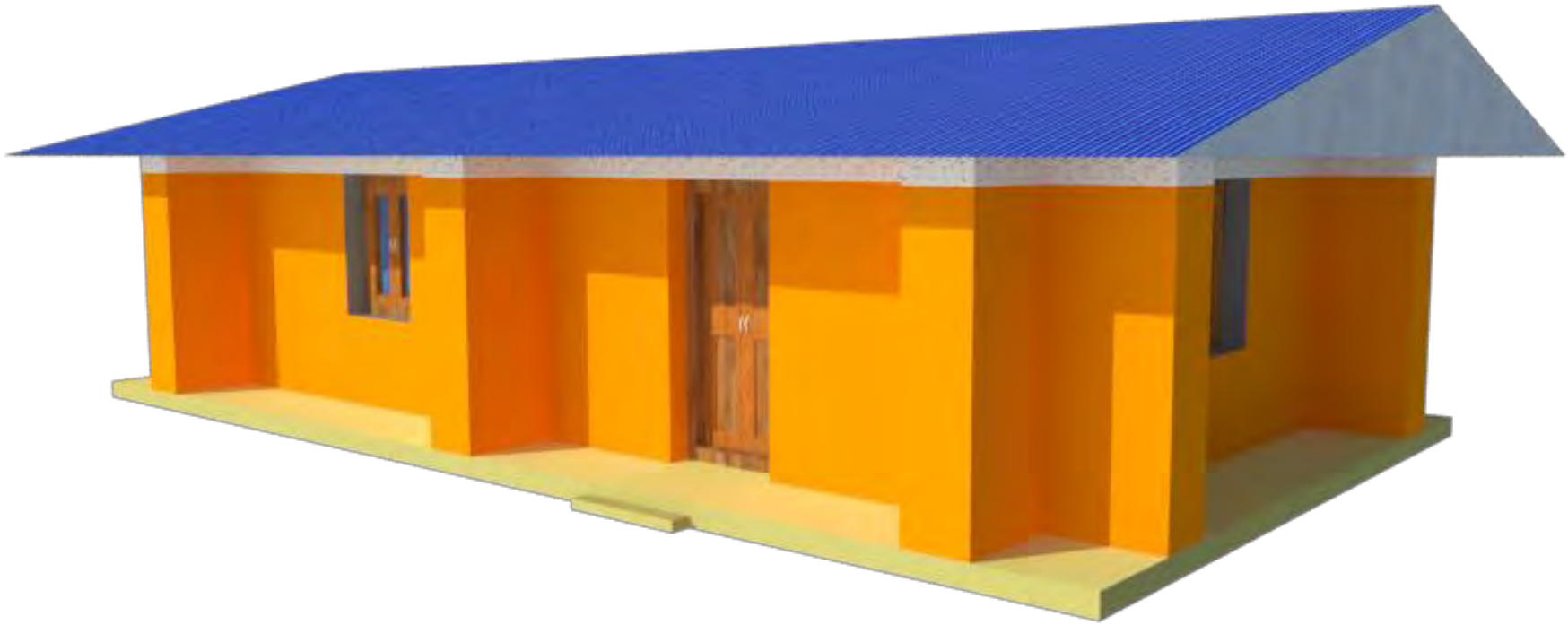
EARTHBAG MASONRY

E.B.-8.1

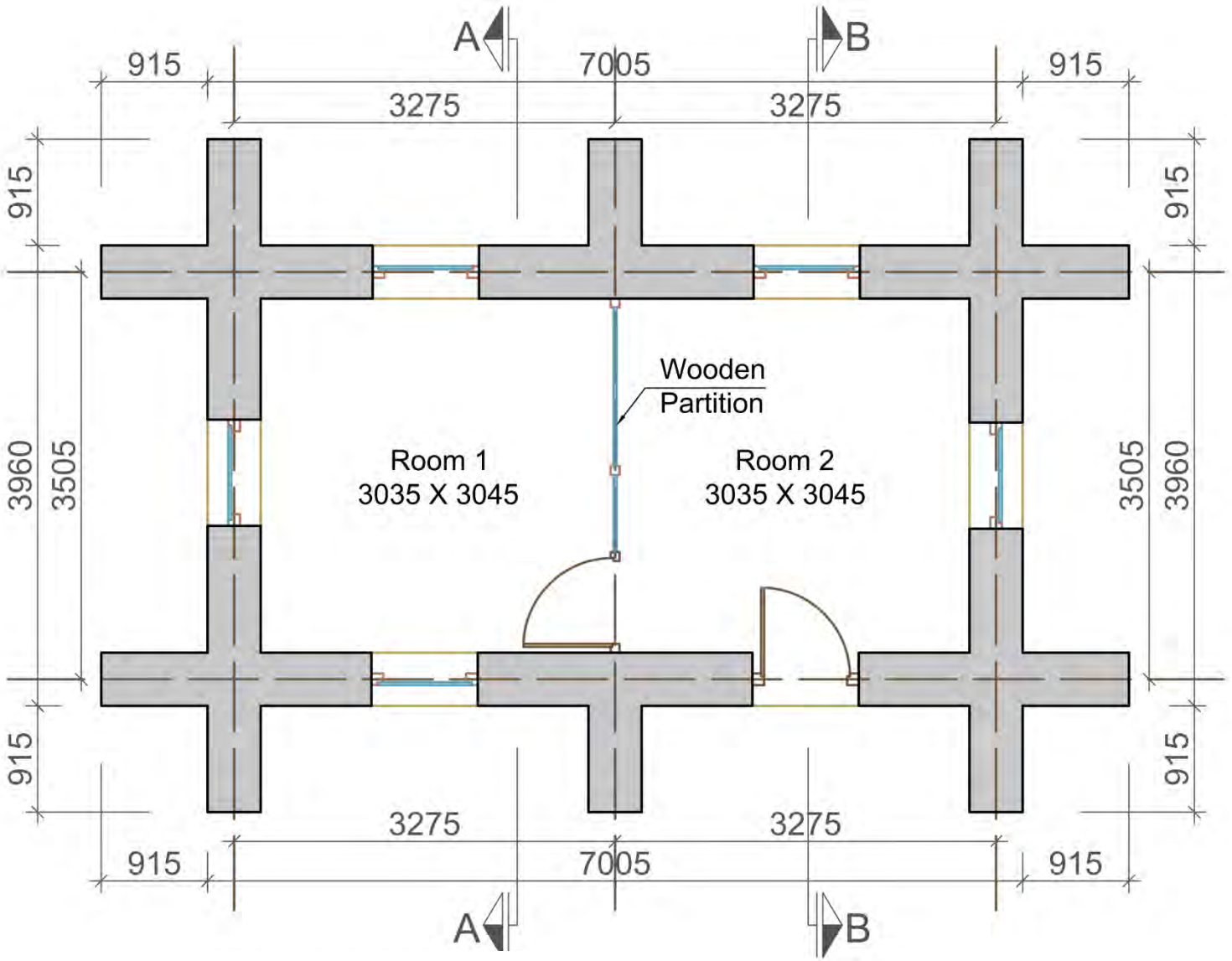
Earthbag technology is a simple, inexpensive and sustainable method for building structures using ordinary soil found at construction site. The technology consists of Polypropylene bags filled with locally available soil, laid similarly to masonry with barbed wire serving as a mortar and provides tensile as well as shear strength.
The featured design of Earthbag technology EB 8.1 consists of single storied structure with two rooms. The wall system uses Polypropylene bags filled with soil whereas CGI sheet is used for covering the roof along with wooden rafters and purlins.

MATERIAL PROPERTIES
Soil for Earthing: 25% - 30% clay & 70% - 75% Sandy soil
Bags: Polypropylene bags
Barbed wire: 14guage, 4 pointed
Rebar: Mild steel bar of Grade Fe 250
Nominal Mix Ratio : 1:1.5:3 (C:S:A)

E.B.-8.1



LEVEL	MATERIALS								
	Stone	Cement	Sand	Aggregate	Reinforcing Bar	CGI Sheet	GI Sheet	Wood	Earth
	Cu.m.	Bags	Cu.m.	Cu.m.	Kg.	Bundle	Sq.m.	Cu.m.	Cu.m.
Up to Plinth Level	12.3	-	-	-	-			-	-
Super Structure	-	18.4	1.0	2.0	237.3			0.5	25.5
Roofing	-	-	-	-	-	4.2	8.0	2.4	
TOTAL	**12.3**	**18.4**	**1.0**	**2.0**	**237.3**	**4.2**	**8.0**	**2.9**	**25.5**



GROUND FLOOR PLAN

FLOOR AREA: 31.95 SQ.M.

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL E.B.-8.1	SCALE: NONE	E.B.-8.1 2/11
	DRAWING TITLE: FLOOR PLAN	DATE:	

FRONT ELEVATION

SIDE ELEVATION

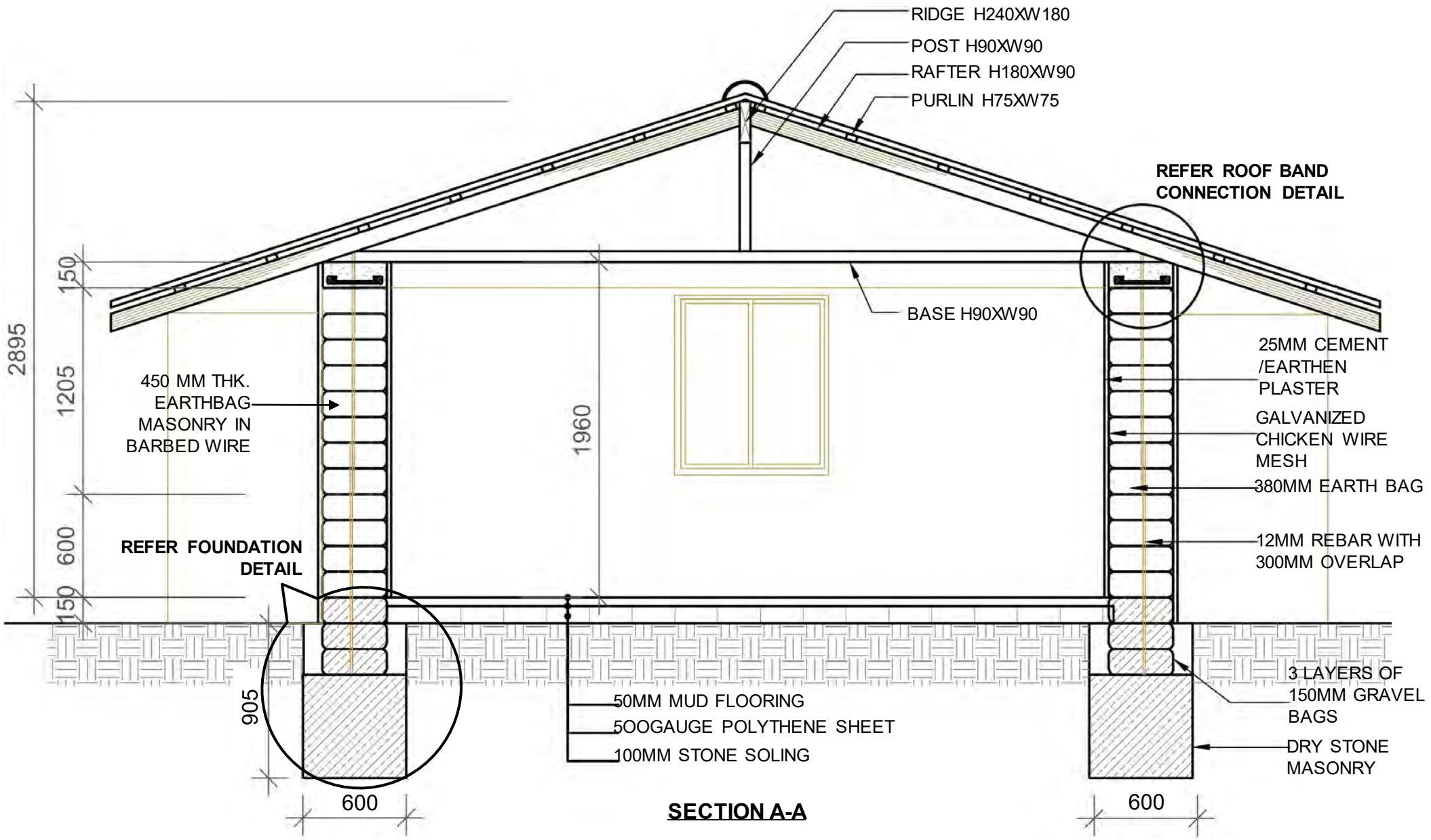
BACK ELEVATION

SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL E.B.-8.1	SCALE: NONE	E.B.-8.1 3/11
	DRAWING TITLE: ELEVATIONS	DATE:	

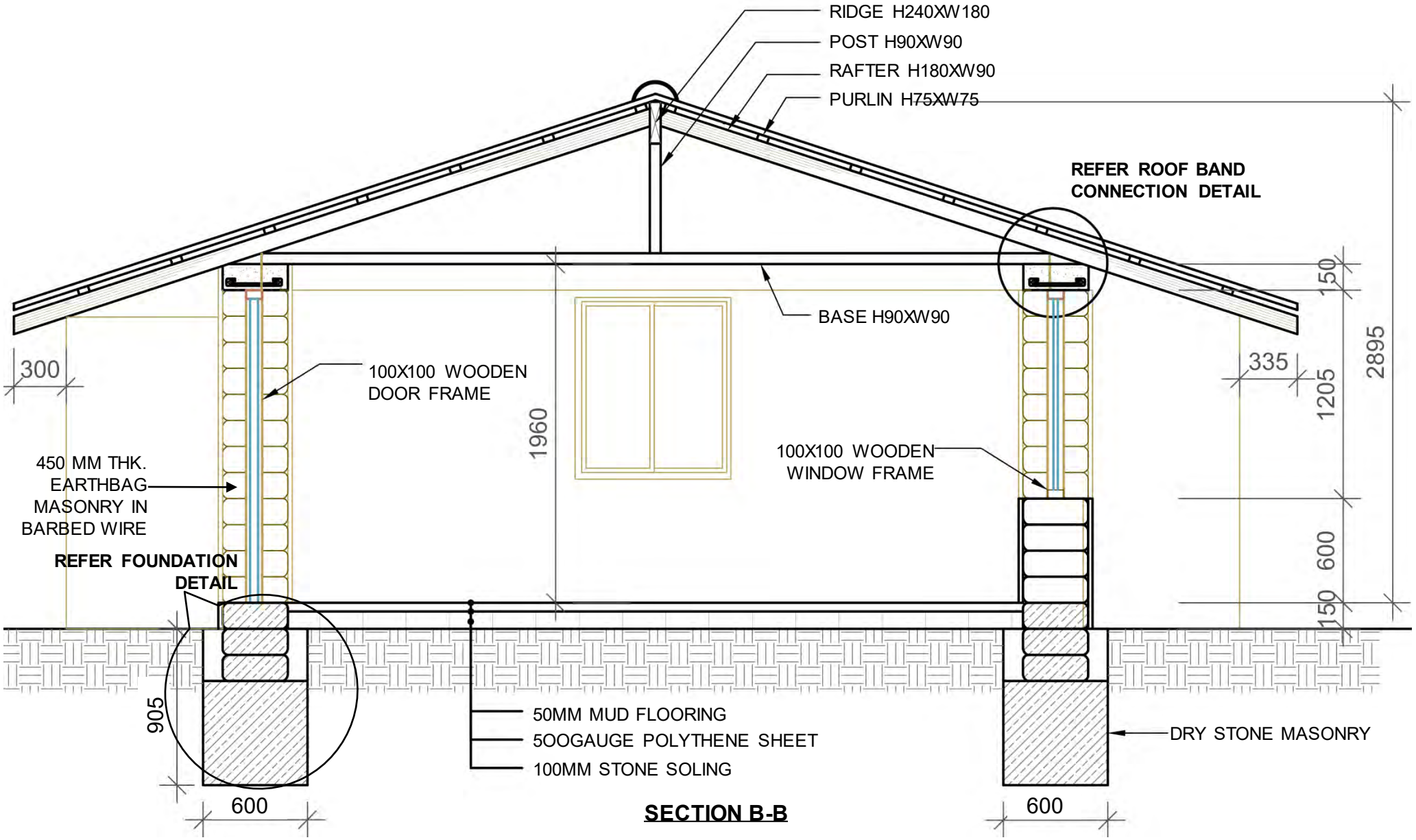
MODEL E.B.-8.1, EARTHBAG MASONRY

ONE STOREY



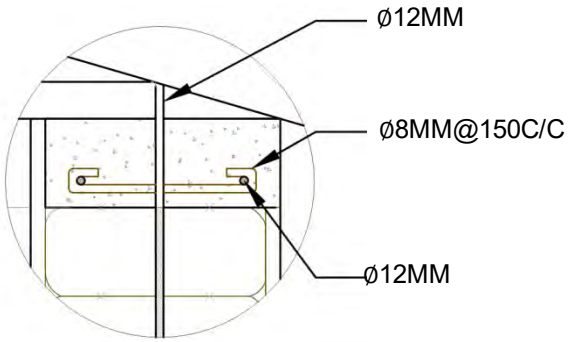
SECTION A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL E.B.-8.1	SCALE: NONE	E.B.-8.1 4/11
	DRAWING TITLE: SECTION	DATE:	

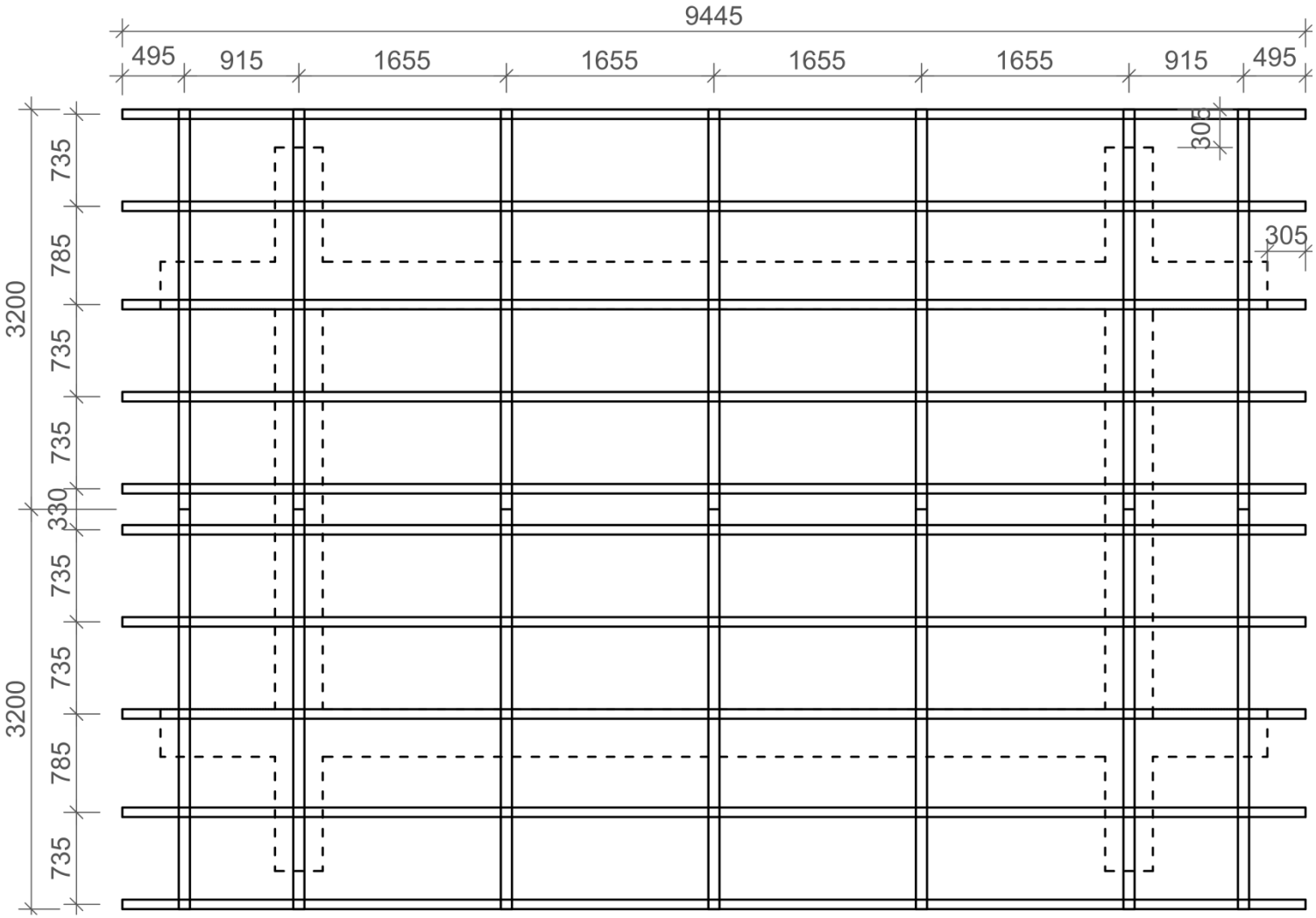


SECTION B-B

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL E.B.-8.1	SCALE: NONE	E.B.-8.1 5/11
	DRAWING TITLE: SECTION	DATE:	

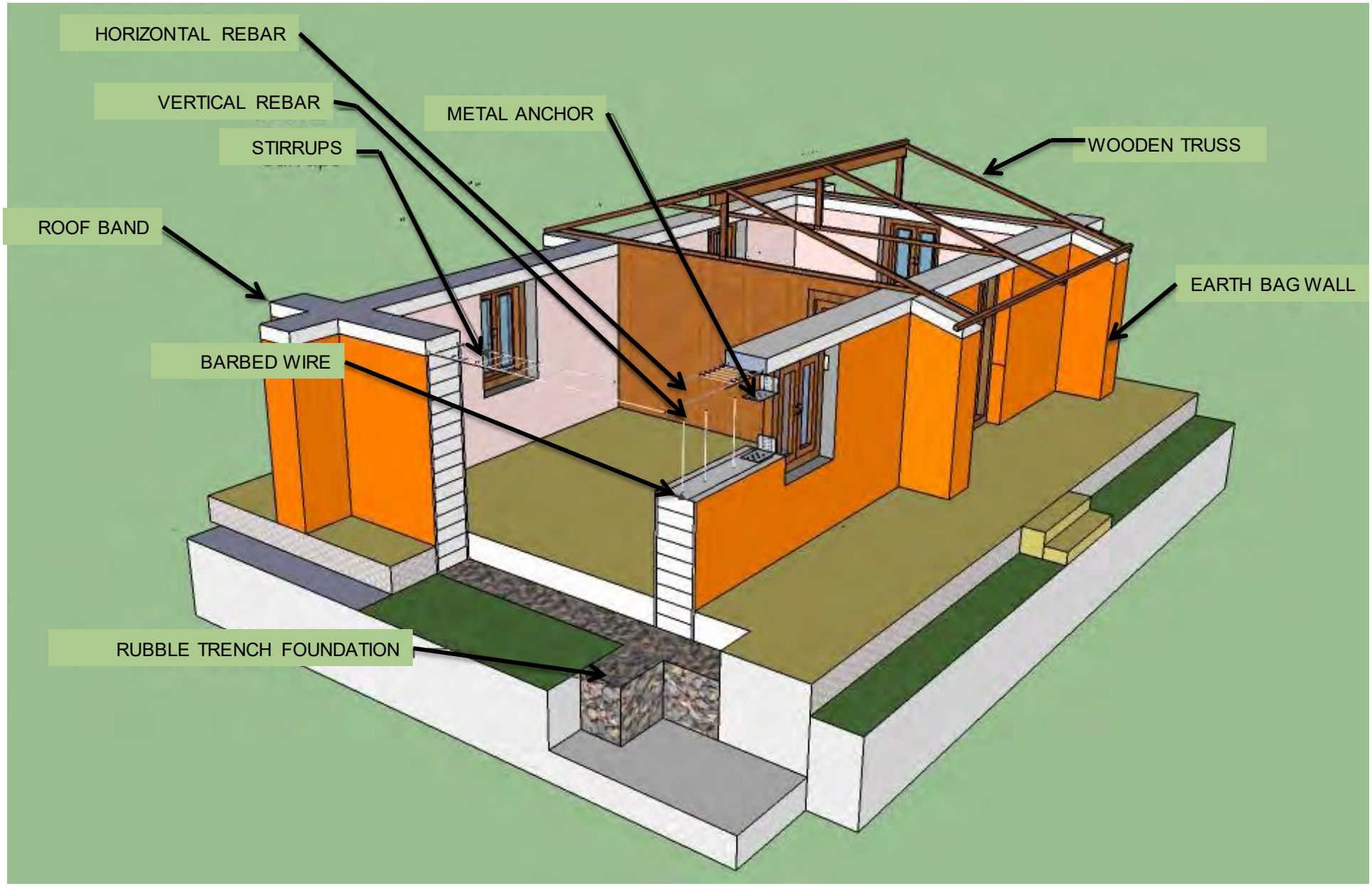


ROOF BAND CONNECTION WITH TRUSS

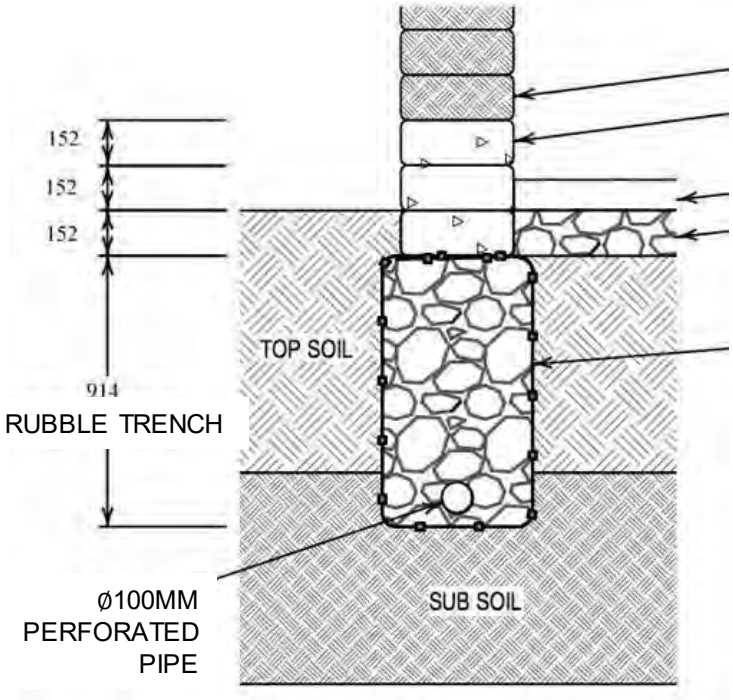


ROOF PLAN

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL E.B.-8.1	SCALE: NONE	E.B.-8.1 6/11
	DRAWING TITLE: ROOF DETAILS	DATE:	

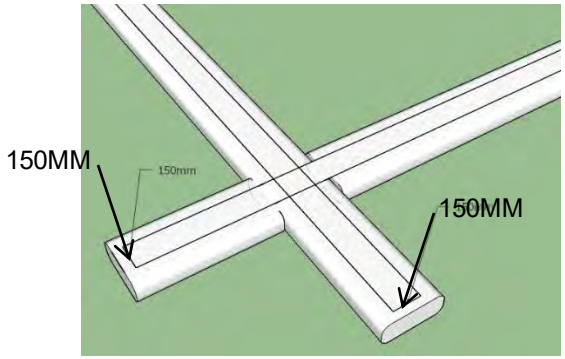


MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL E.B.-8.1	SCALE: NONE	E.B.-8.1 7/11
	DRAWING TITLE: SECTIONAL PERSPECTIVE	DATE:	



BASE WIDTH OF FOOTING = 200 + 1 BAG WIDTH

FOUNDATION SECTION

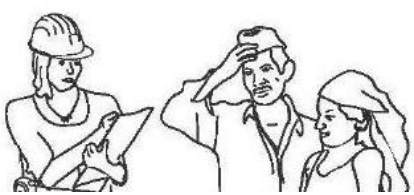


BARBED WIRE SHOULD BE LAID CENTRALLY WITH A MINIMUM GAP OF 150MM AS SHOWN IN THE FIGURE ABOVE

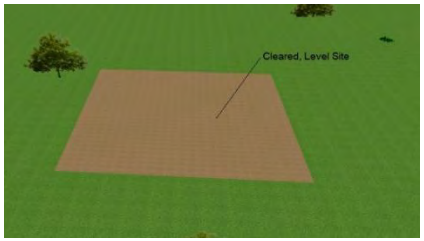
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL E.B.-8.1	SCALE: NONE	E.B.-8.1 8/11
	DRAWING TITLE: DETAILS	DATE:	

CONSTRUCTION SEQUENCE

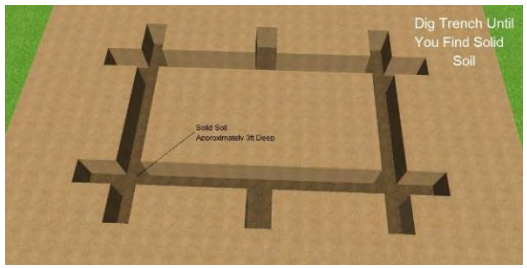
1 SURVEY THE SITE AND SAMPLE THE SOIL. GET ADVICE FROM AN ENGINEER



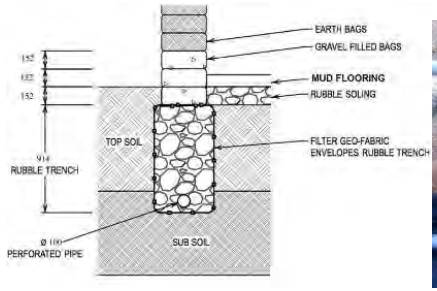
2 LEVEL THE BUILDING SITE AND COVER WITH TARP TO PROTECT BAGS FROM RAIN & SUN



3 MARK THE FOOTPRINT, INCLUDING CORNER & WALL BUTTRESSES, EXCAVATE TRENCH 3FT DEEP, 2FT WIDE



4 BUILD RUBBLE TRENCH FOUNDATION INSTALL FRENCH DRAIN & PLUMBING

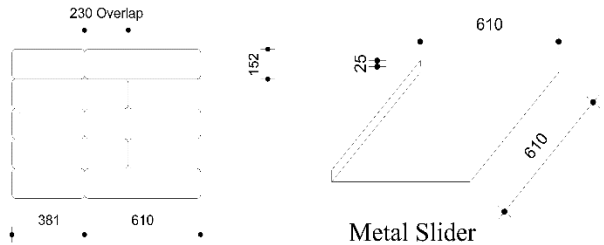


5 FILL AND PLACE FIRST COURSE OF GRAVEL BAGS

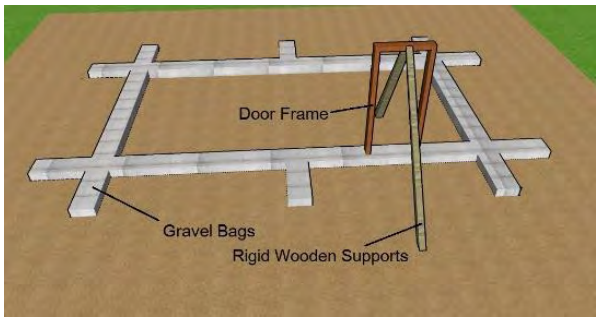
6 LAY TWO STRANDS OF 4-POINT BARBED WIRE ON TOP OF EACH COURSE AND ADD WALL TIES

7 LAY SECOND OR THIRD GRAVEL BAG LAYER ABOVE FLOOR LEVEL

8 USE SLIDERS AND ALWAYS OVERLAP THE BAGS WHILE BUILDING THE WALL



9 MAKE DOOR THRESHOLDS, INSTALL DOOR FRAMES AND OPTIONAL DOOR BUCKS

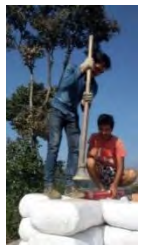


MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL E.B.-8.1	SCALE: NONE	E.B.-8.1 9/11
	DRAWING TITLE:CONSTRUCTION SEQUENCE	DATE:	

CONSTRUCTION SEQUENCE

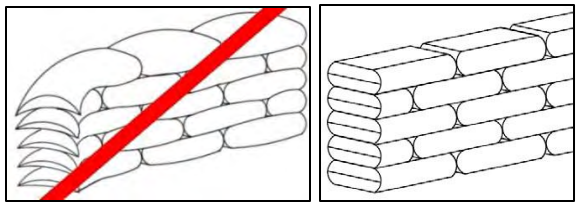
10 PREPARE SOIL FOR EARTHBAGS: SIEVE AND MAINTAIN 10% MOISTURE


11 FILL BAGS WITH EARTH, PLACE FIRST COURSE AND TAMP

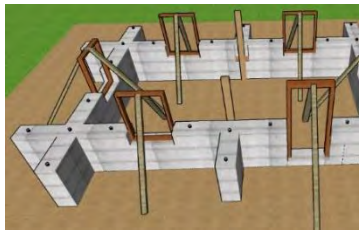
12 REPEAT STEP 6 AFTER EACH COURSE

13 PREVENT CORNER DROP

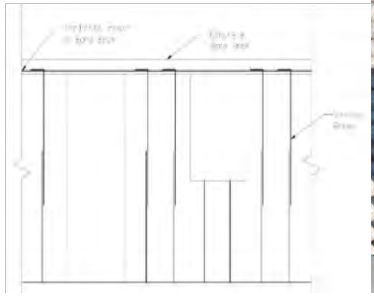


14 TAMP, LEVEL AND FLATTEN WALLS AFTER EACH COURSE

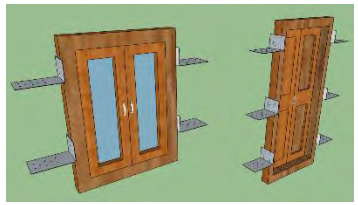
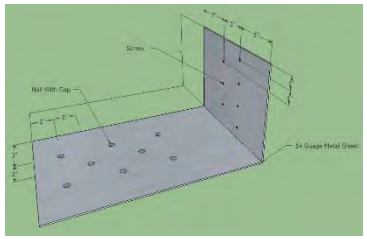
15 PLACE THE WINDOW FRAME SO THE LINTEL LEVEL COINCIDES WITH THE BOND BEAM LEVEL



16 INSTALL VERTICAL REBARS AT SILL AND LINTEL LEVEL




17 USE ANCHOR PLATES TO ATTACH DOORS AND WINDOWS

18 INSTALL GALVINIZED/PLASTIC MESH FOR PLASTERING

19 INSTALL BOND BEAM, LIGHTWEIGHT ROOF AND ELECTRICAL WIRING


20 PLASTER AND PAINT

TECHNICAL REQUIREMENTS

Structure System	Load bearing Earthbag masonry structure.
Foundation	Strip Foundation of dry stone masonry of width 600 mm and depth 900 mm.
Plinth	Three polypropylene bags filled with gravel shall be placed up to plinth level.
Wall System	450 mm thick Earthbag masonry shall be interconnected in each layers with barbed wire. Buttress shall be provided along the unsupported length of wall as shown in drawing.
Roof Band:	RCC (1:1.5:3) roof band shall be provided throughout the wall at roof level. The minimum depth of the band shall be 150mm. Main reinforcement shall be 2 nos.12mm dia. bars with 8mm Ø stirrups at 150mm C/C.
Roof:	Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing.

LIGHT GAUGE STEEL STRUCTURE

L.G.S.-9.1
L.G.S.-9.2

Cold Form Light gauge steel construction is a structural system consisting of thin steel sections cladded with light gauge steel panel, Cellular light weight concrete, Cement fiber board, gypsum board or calcium silicate board. The steel sections used here are called *cold formed* sections, meaning that the sections are formed, or given shape at room temperature. This kind of technology requires high level of planning and precision as cold formed sections are fabricated at factory. Similarly skilled manpower are required in site for precise execution of designs.
Featured design L.G.S 9.1 is a single storied residential unit with 2 bedrooms. Model L.G.S 9.2 is a two storied residential units with 4 bedrooms.

MATERIAL PROPERTIES

The raw materials used for the LGS steel frame is Galvanized cold form steel stripe
Yield strength:
Min. 450 N/mm^2 for LGS 9.1
Min. 350 N/mm^2 for LGS-9.2
Galvanized zinc coated: Min. 275gsm

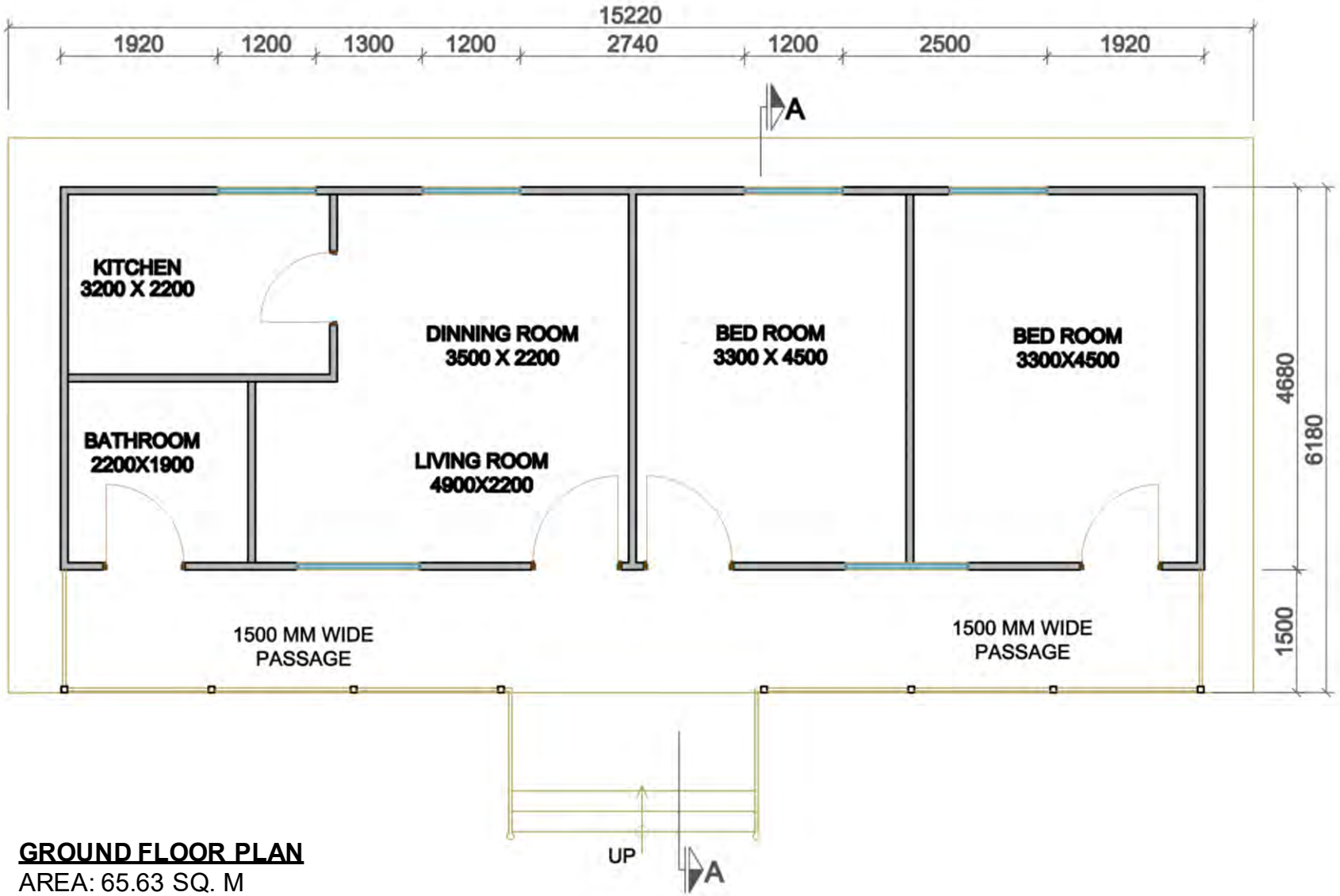
L.G.S.-9.1
L.G.S.-9.2

MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE — ONE STOREY

LEVEL	MATERIALS								
	Stone	Brick	Cement	Sand	Aggregate	Reinforcing Bar	CGI Sheet	GI Sheet	MS angles & Plates
	Cu.m.	No.	Bags	Cu.m.	Cu.m.	Kg.	Bundle	Sq.m.	Cu.m.
Up to Plinth Level	42.1	15,702.0	115.1	13.0	11.1	468.5			-
Super Structure		-	2.2	0.3	-	-			4,184.8
Roofing		-	-	-	-	-	8.8	32.9	1,753.2
TOTAL	**42.1**	**15,702.0**	**117.2**	**13.3**	**11.1**	**468.5**	**8.8**	**32.9**	**5,938.0**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.1	SCALE: NONE	L.G.S 9.1 1/9
	DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	

MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE — ONE STOREY

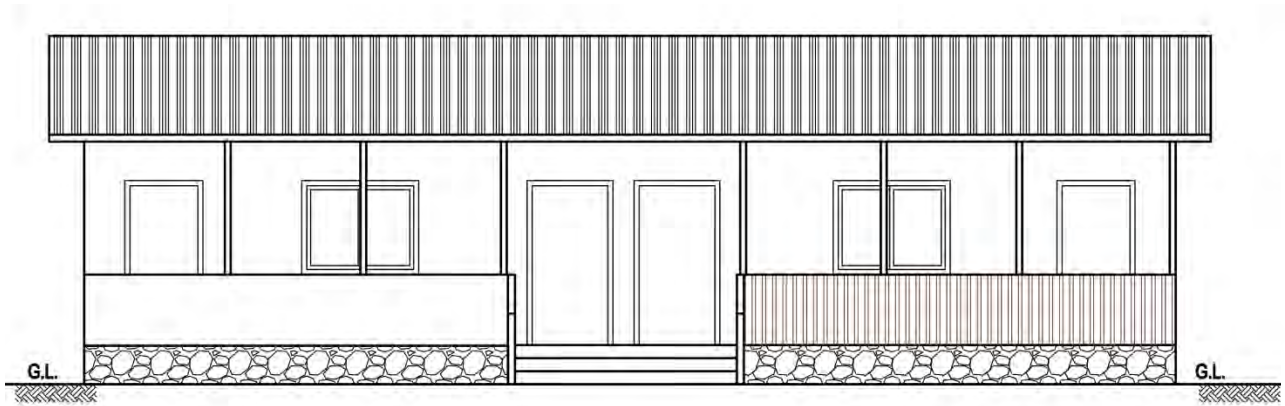


GROUND FLOOR PLAN
AREA: 65.63 SQ. M

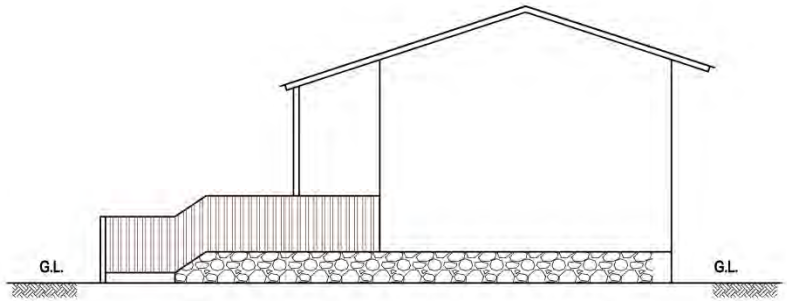
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.1	SCALE: NONE	L.G.S 9.1 2/9
	DRAWING TITLE: FLOOR PLAN	DATE:	

MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE

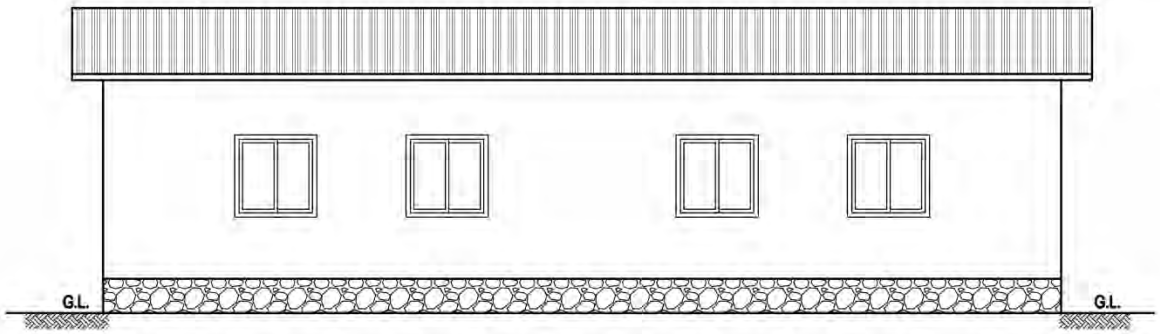
ONE STOREY



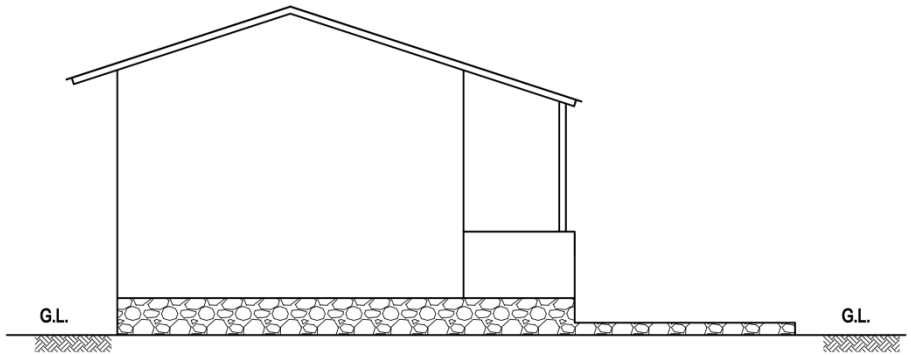
FRONT ELEVATION



SIDE ELEVATION



BACK ELEVATION

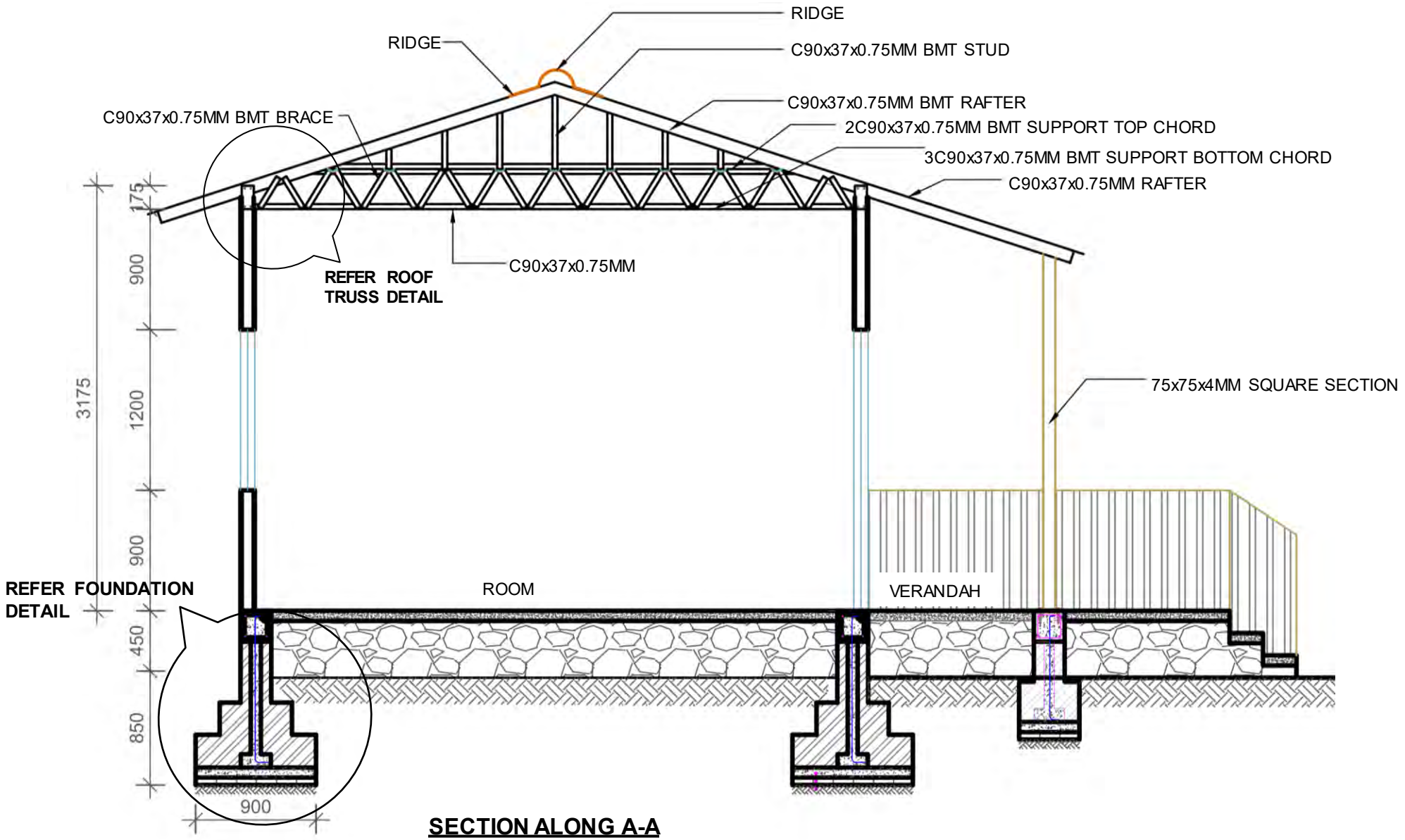


SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.1	SCALE: NONE	L.G.S 9.1 3/9
	DRAWING TITLE: ELEVATIONS	DATE:	

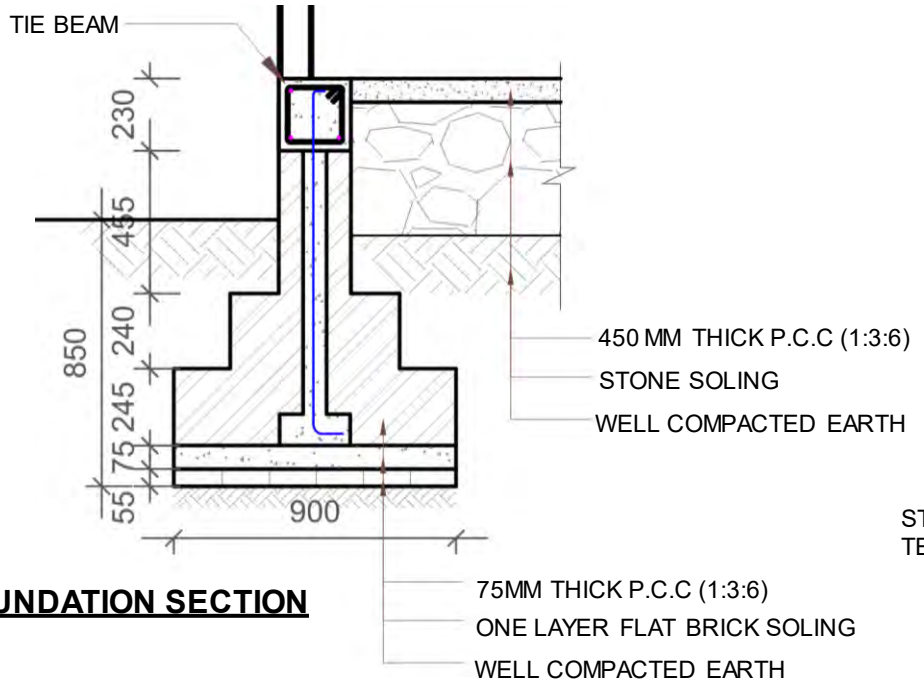
MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE

ONE STOREY

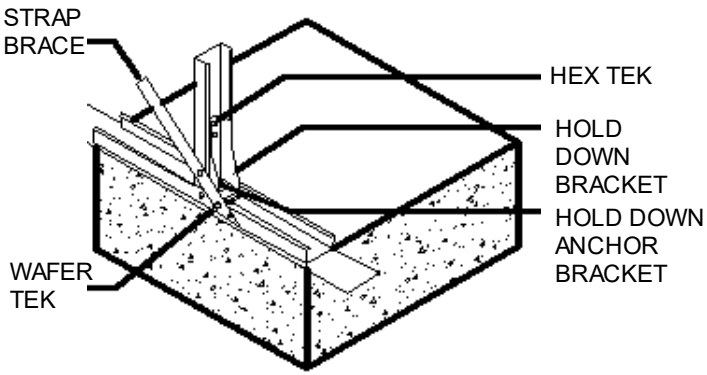


SECTION ALONG A-A

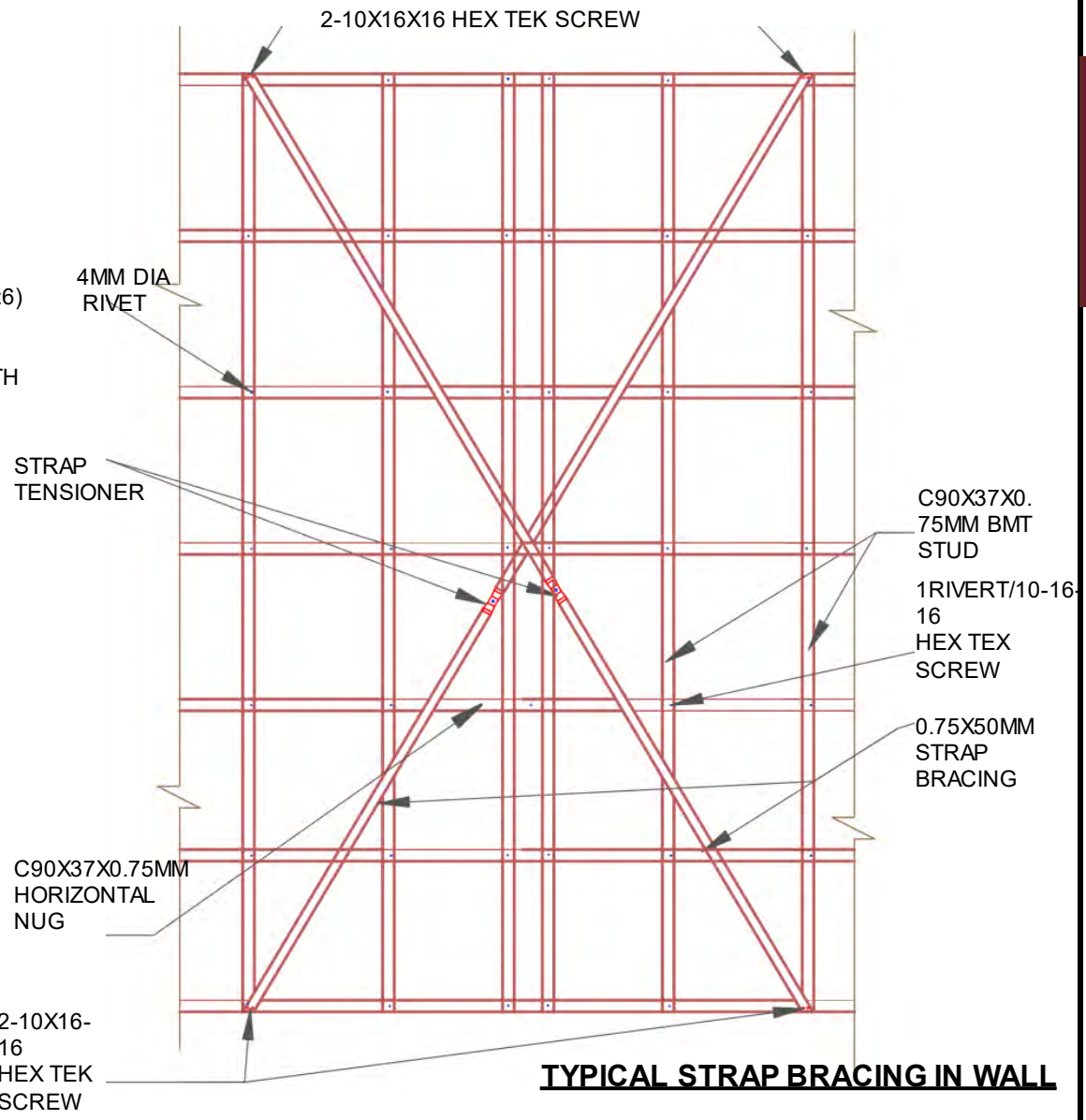
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.1	SCALE: NONE	L.G.S 9.1 4/9
	DRAWING TITLE: SECTION	DATE:	



FOUNDATION SECTION



CONNECTION DETAILS AT DPC LEVEL

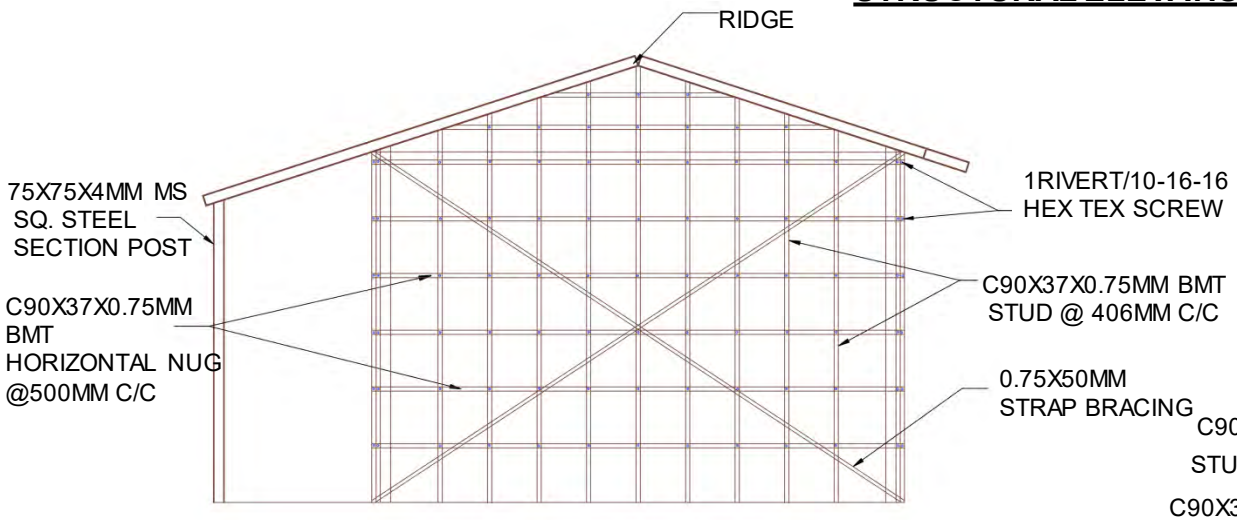


TYPICAL STRAP BRACING IN WALL

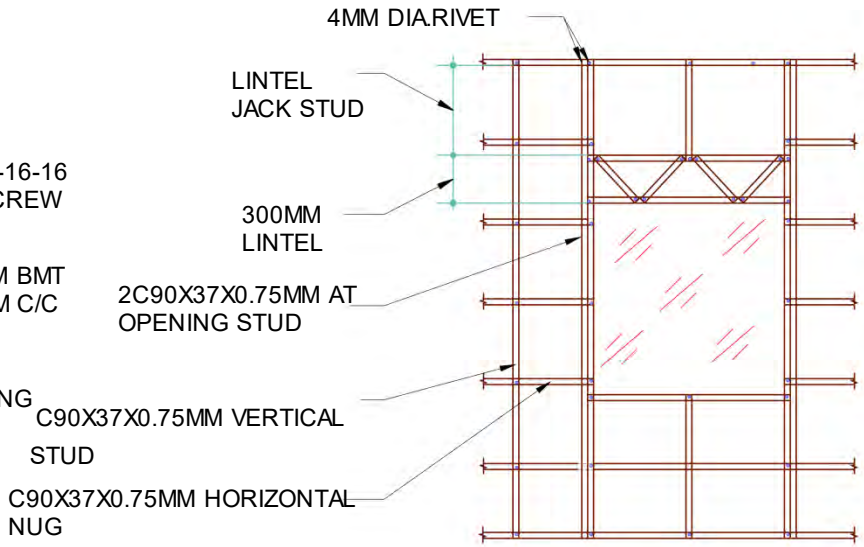
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.1	SCALE: NONE	L.G.S 9.1 5/9
	DRAWING TITLE: DETAILS	DATE:	

MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE — ONE STOREY

STRUCTURAL ELEVATION 1



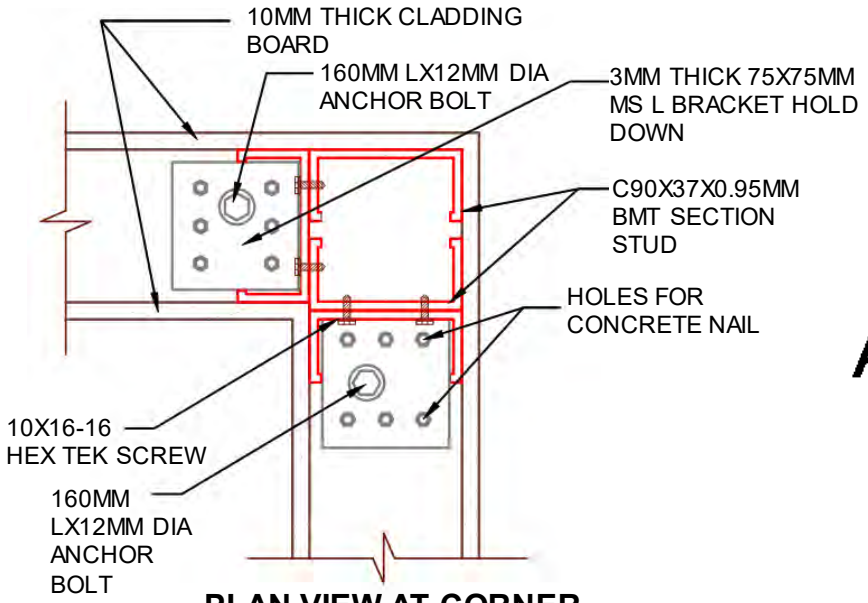
STRUCTURAL ELEVATION 2



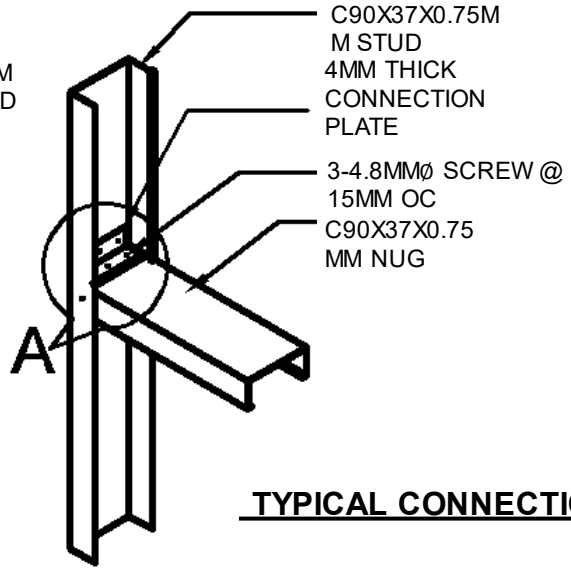
TYPICAL ELEVATION DETAIL AT OPENING

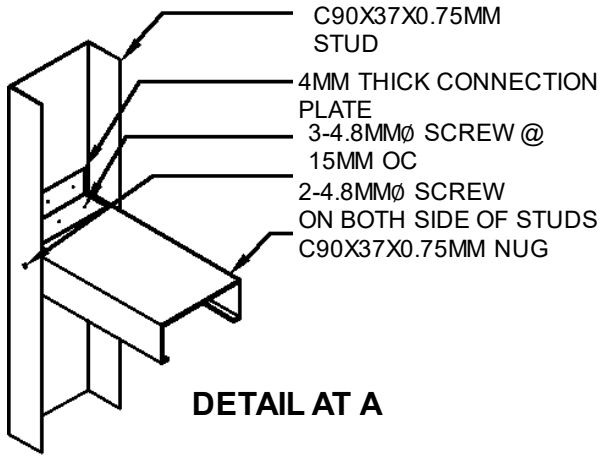
ALL SECTIONS C90X37X0.95MM BMT

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.1	SCALE: NONE	L.G.S 9.1 6/9
	DRAWING TITLE: DETAILS	DATE:	



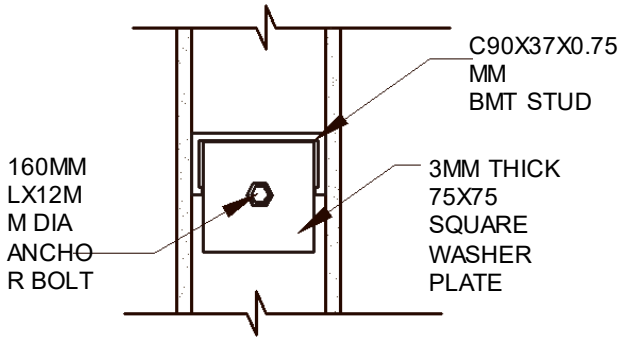
PLAN VIEW AT CORNER



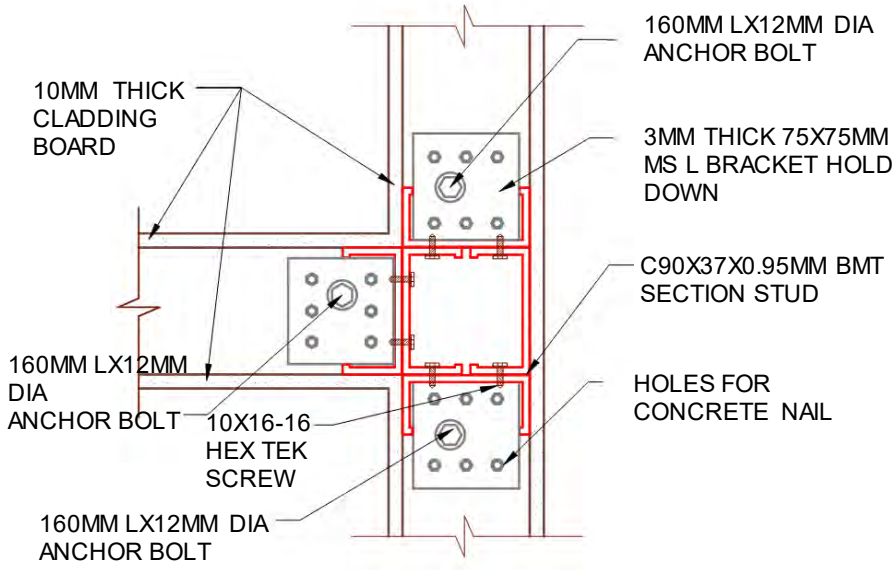


DETAIL AT A

TYPICAL CONNECTION DETAILS OF STUD AND NUG.

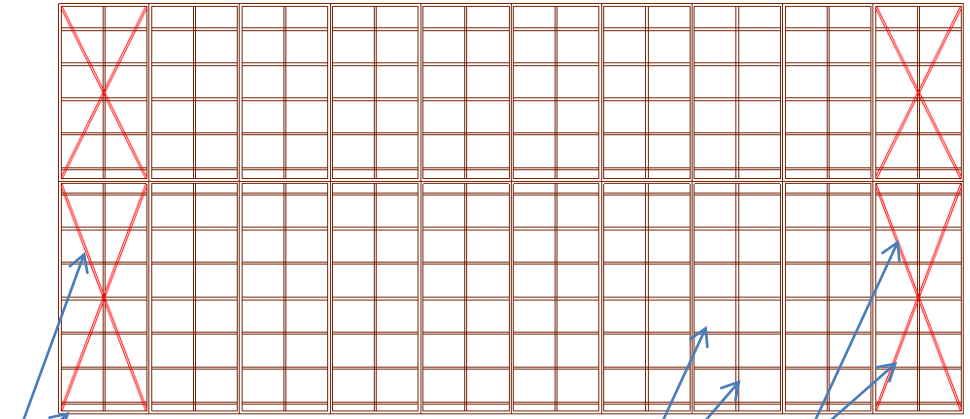


PLAN VIEW AT WALL STUD

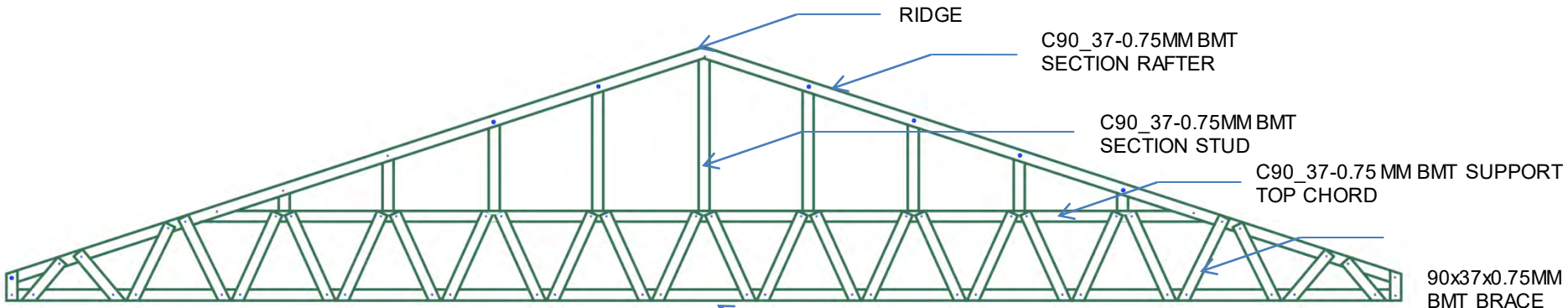


PLAN VIEW AT INTERSECTION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.1	SCALE: NONE	L.G.S 9.1 7/9
	DRAWING TITLE: DETAILS	DATE:	



ROOF LAYOUT



SUPPORT DETAIL

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.1	SCALE: NONE	L.G.S 9.1 8/9
	DRAWING TITLE: DETAILS	DATE:	

TECHNICAL REQUIREMENTS

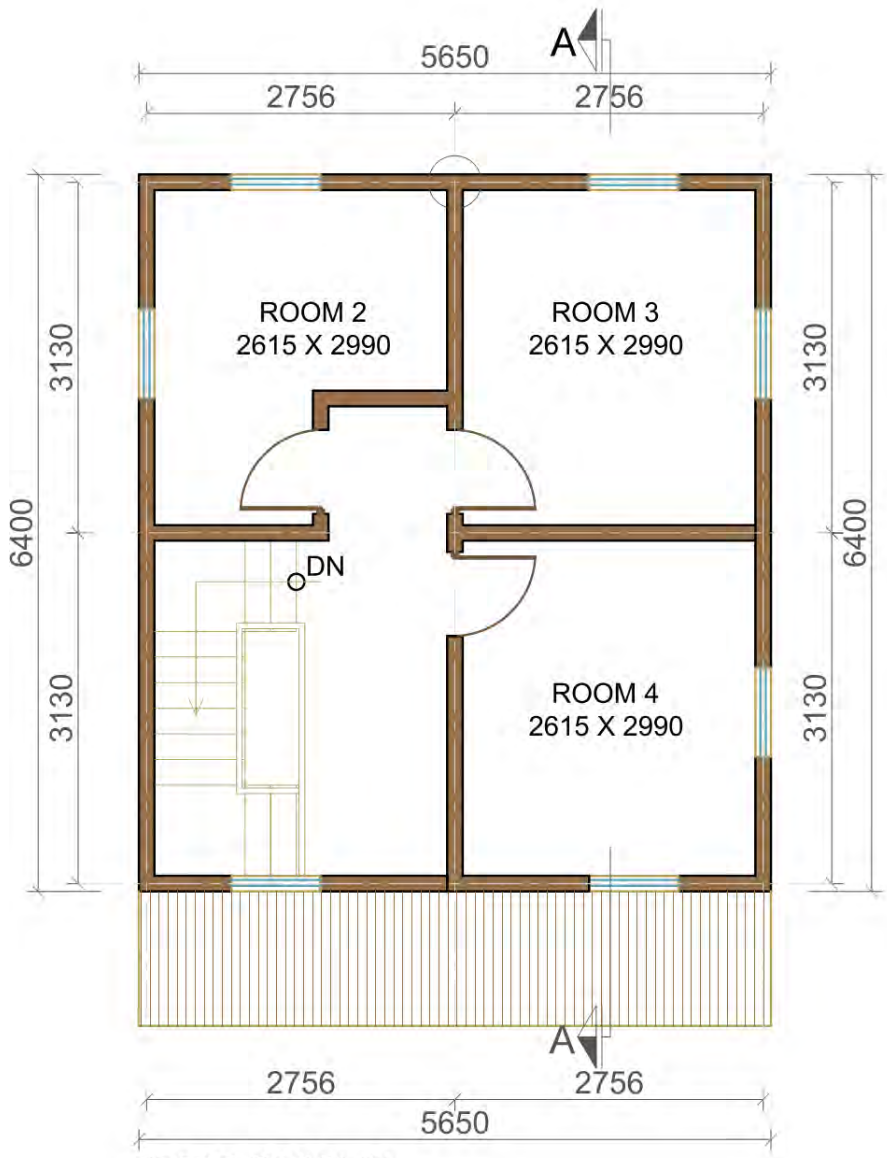
Structure System	Structural system consisting of thin steel sections cladded with materials like light gauge steel panel, Cellular light weight concrete, Cement fiber board, gypsum board, calcium silicate board etc.
Foundation	Strip footing of Random rubble masonry in cement sand mortar with width 900 mm and depth 850 mm.
Plinth Band	R.C.C (1:1.5:3) plinth band of size 230x 230 mm. Main reinforcement shall be 4 nos. of 12mm dia. Bars with 8mm Ø rings at 150mm C/C
Wall System	Wall frames shall be of cold formed steel channel sections of minimum thickness 0.75mm. All the vertical studs and horizontal nog of the wall frames shall be at the spacing mentioned in the drawings.
Bracing:	K Bracing and X Bracing made up of cold formed steel channel sections of minimum thickness 0.75mm as mentioned in drawing
Roof System:	Truss shall be of Cold formed steel channel section of minimum thickness 0.55mm and depth of web 90 mm covered with light roofing materials.

MODEL L.G.S.-9.2, LIGHT GAUGE SHEET STRUCTURE — TWO STOREY

LEVEL	MATERIALS								
	Brick	Cement	Sand	Aggregate	Reinforcing Bar	CGI Sheet	GI Sheet	MS angles & Plates	Wall Board
	No.	Bags	Cu.m.	Cu.m.	Kg.	Bundle	Sq.m.	Cu.m.	Sq.m.
Up to Plinth Level	2,973.0	87.6	6.4	9.5	594.5			-	2.5
Super Structure	-	2.2	0.3	-	-			4,184.8	244.3
Roofing	-	-	-	-	-	5.4	14.8	2,629.8	
TOTAL	**2,973.0**	**89.8**	**6.7**	**9.5**	**594.5**	**5.4**	**14.8**	**6,814.6**	**246.8**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.2	SCALE: NONE	L.G.S.-9.2
	DRAWING TITLE: ESTIMATION AND 3D-VIEW	DATE:	1/7

GROUND FLOOR PLAN
FLOOR AREA: 36.19 SQ. M.

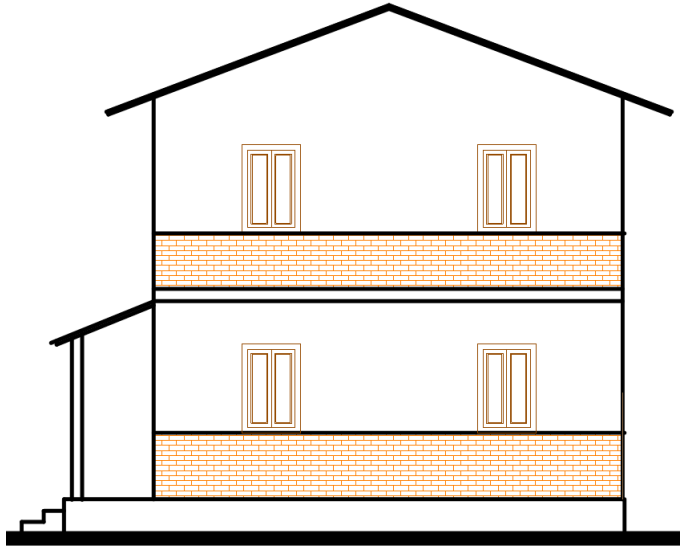


FIRST FLOOR PLAN
FLOOR AREA: 36.19 SQ. M.

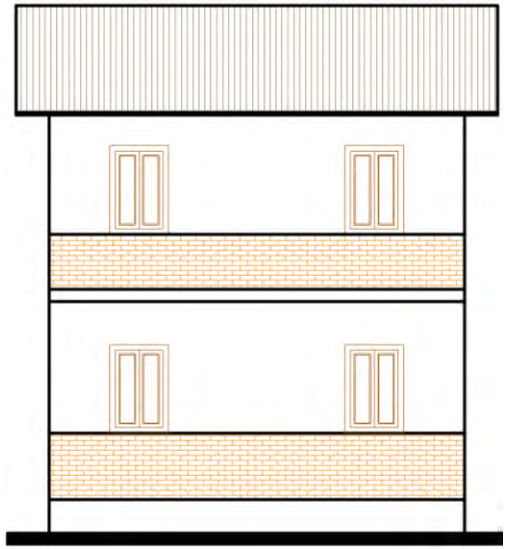
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.2	SCALE: NONE	L.G.S.-9.2
	DRAWING TITLE: FLOOR PLANS	DATE:	2/7

MODEL L.G.S.-9.2, LIGHT GAUGE SHEET STRUCTURE — TWO STOREY

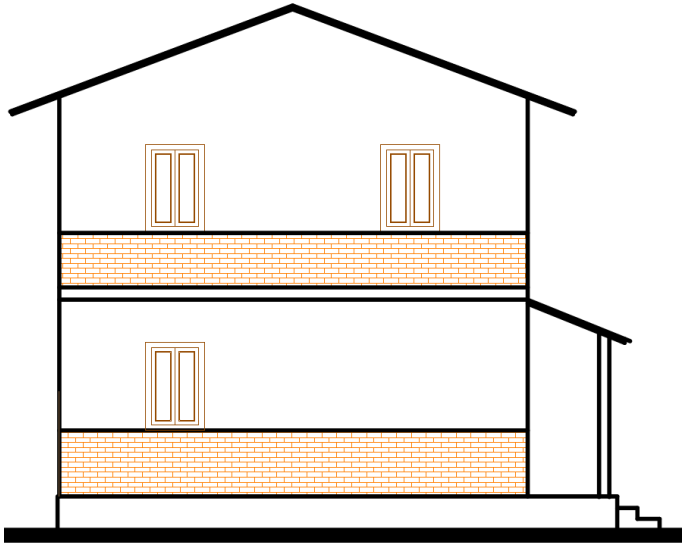
FRONT ELEVATION



SIDE ELEVATION



BACK ELEVATION

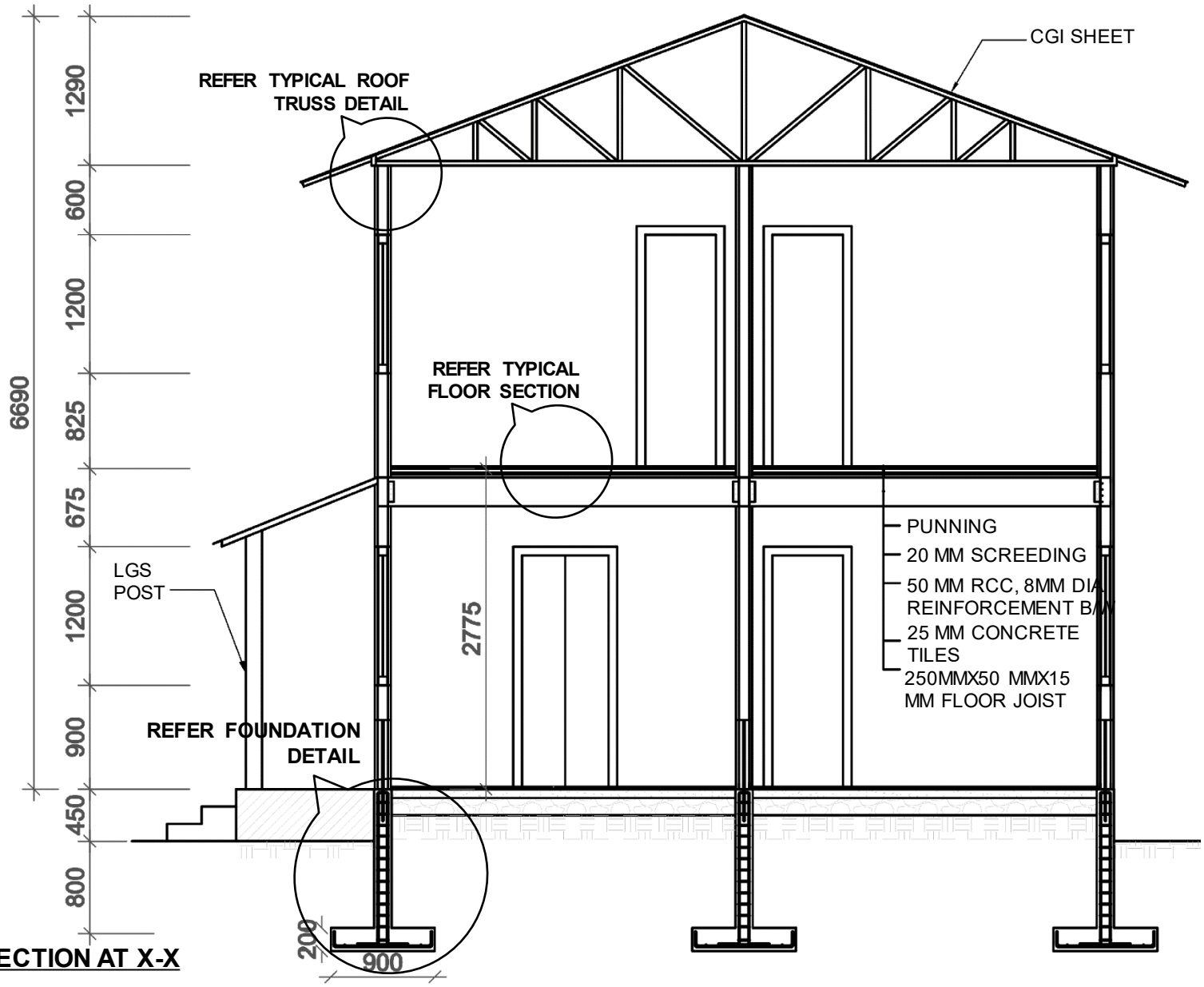


SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.2	SCALE: NONE	L.G.S.-9.2
	DRAWING TITLE: ELEVATIONS	DATE:	3/7

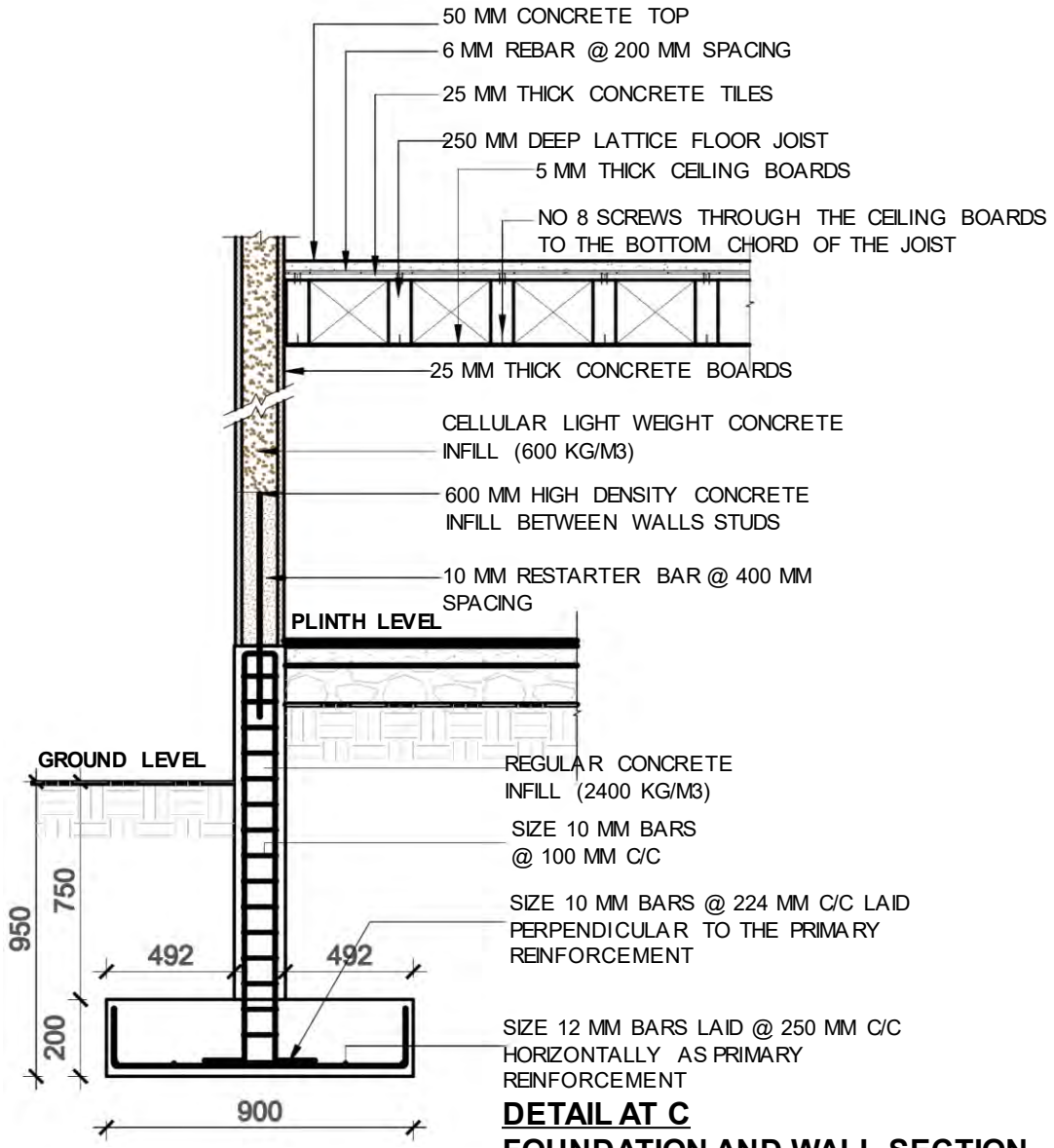
MODEL L.G.S.-9.2, LIGHT GAUGE SHEET STRUCTURE

TWO STOREY

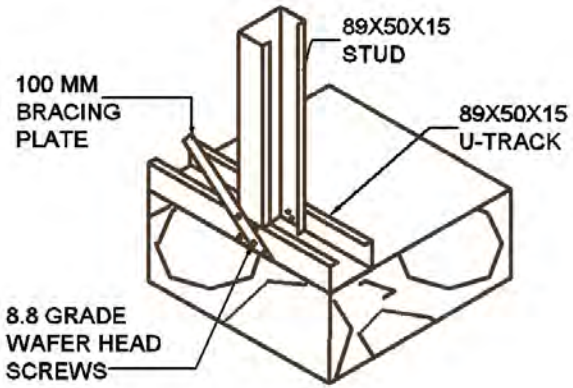


SECTION AT X-X

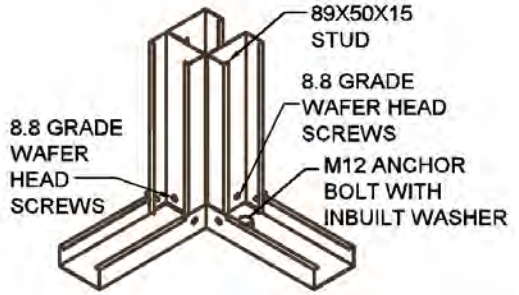
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.2	SCALE: NONE	L.G.S.-9.2
	DRAWING TITLE: SECTION	DATE:	4/7



DETAIL AT C
FOUNDATION AND WALL SECTION

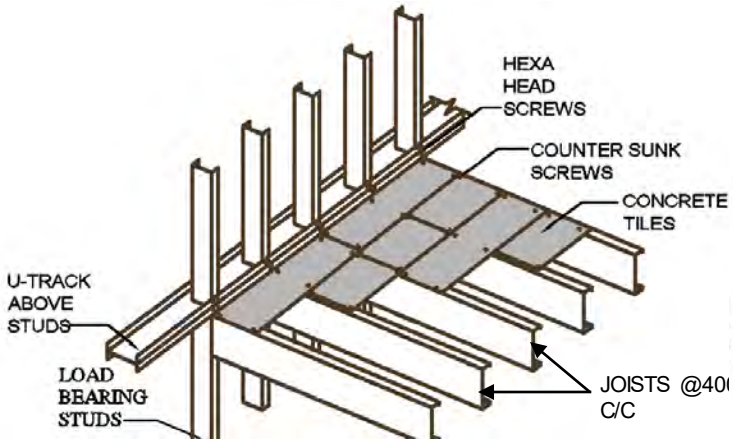


U-TRACK OVER CONCRETE SLAB

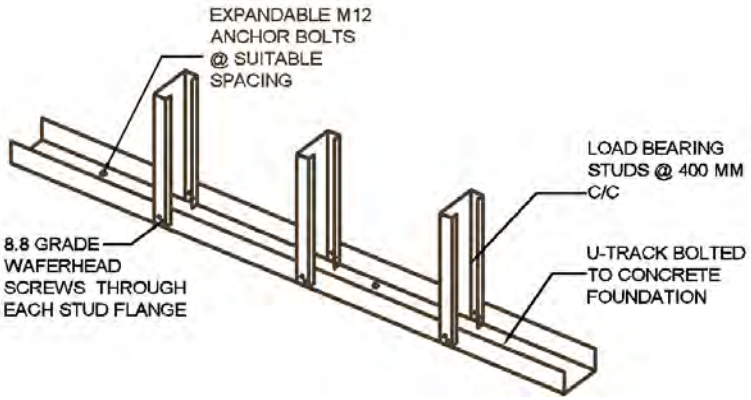


FRAME CONNECTION TO WALL L BRACKET HOLD DOWN

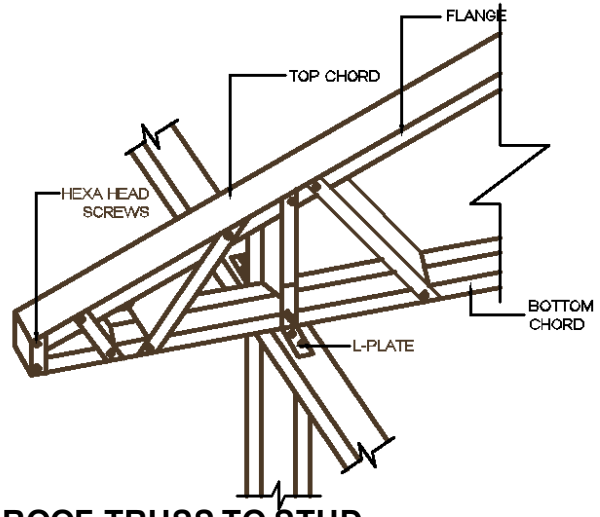
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.2	SCALE: NONE	L.G.S.-9.2
	DRAWING TITLE: DETAILS	DATE:	5/7



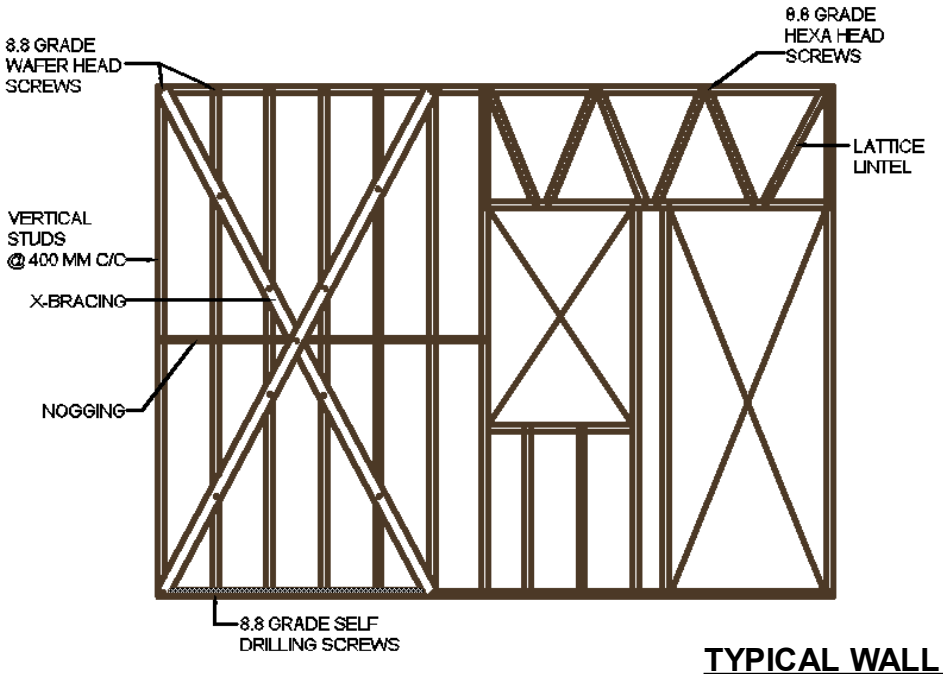
TYPICAL FLOOR SECTIONS



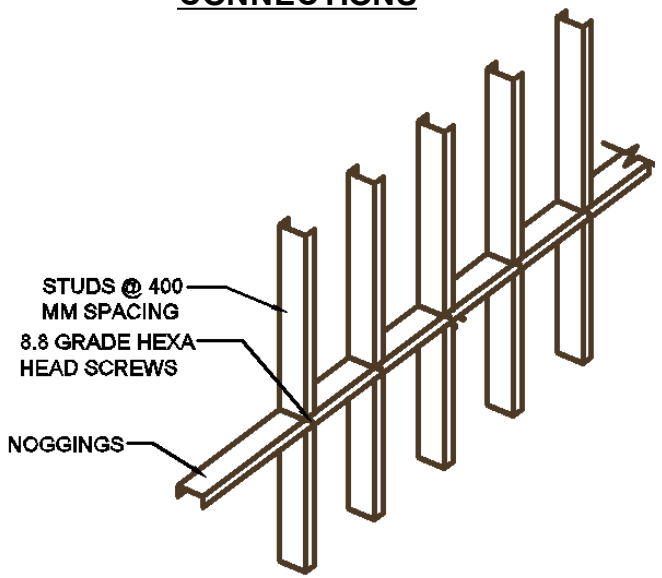
ISOMETRIC VIEW OF STUDS ARRANGEMENT



TYPICAL ROOF TRUSS TO STUD CONNECTIONS



TYPICAL WALL SECTION



TYPICAL NOGGING SECTION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL L.G.S.-9.2	SCALE: NONE	L.G.S.-9.2
	DRAWING TITLE: DETAILS	DATE:	6/7

TECHNICAL REQUIREMENTS

Structure System	Structural system consisting of thin steel sections cladded with Cellular light weight concrete tiles. Minimum tensile strength and yield strength of Light gauge steel to be 350 Mpa and 450 Mpa respectively.
Foundation	Reinforced Concrete strip footing of size as specified in detail drawing on foundation of width 900mm and depth 950mm.LGS tracks shall be bolted to the foundation using M12 expandable bolts at an interval of 1.2m-1.8m.
Wall System	Wall frames shall be of cold formed steel channel sections. All the vertical studs and horizontal joists of the wall frames shall be at the spacing mentioned in the drawings.
Flooring System	The flooring System shall be of 50 mm RCC on 25 mm concrete tiles on 250 x 50 x 15 mm floor joists
Roof System	Light roof steel truss covered with CGI sheets. All members of the truss or joints shall be properly connected as shown in detail drawings.

STEEL STRUCTURE

S.S.-10.1

S.S 10.1 is a structural system consisting of mild steel columns and beams to make steel moment resisting frame system. Both the gravity and lateral load is resisted by moment resisting frame. The floor system is made of profile metal decking system over which the thin layer of RCC is laid. The roofing system consists of MS Steel tubes truss with CGI Sheet. The infill wall consists of light weight partition wall made of light weight material having density less than 1000Kg/m^3
The featured design consists of two storey residential building consisting of 6 nos. of room.

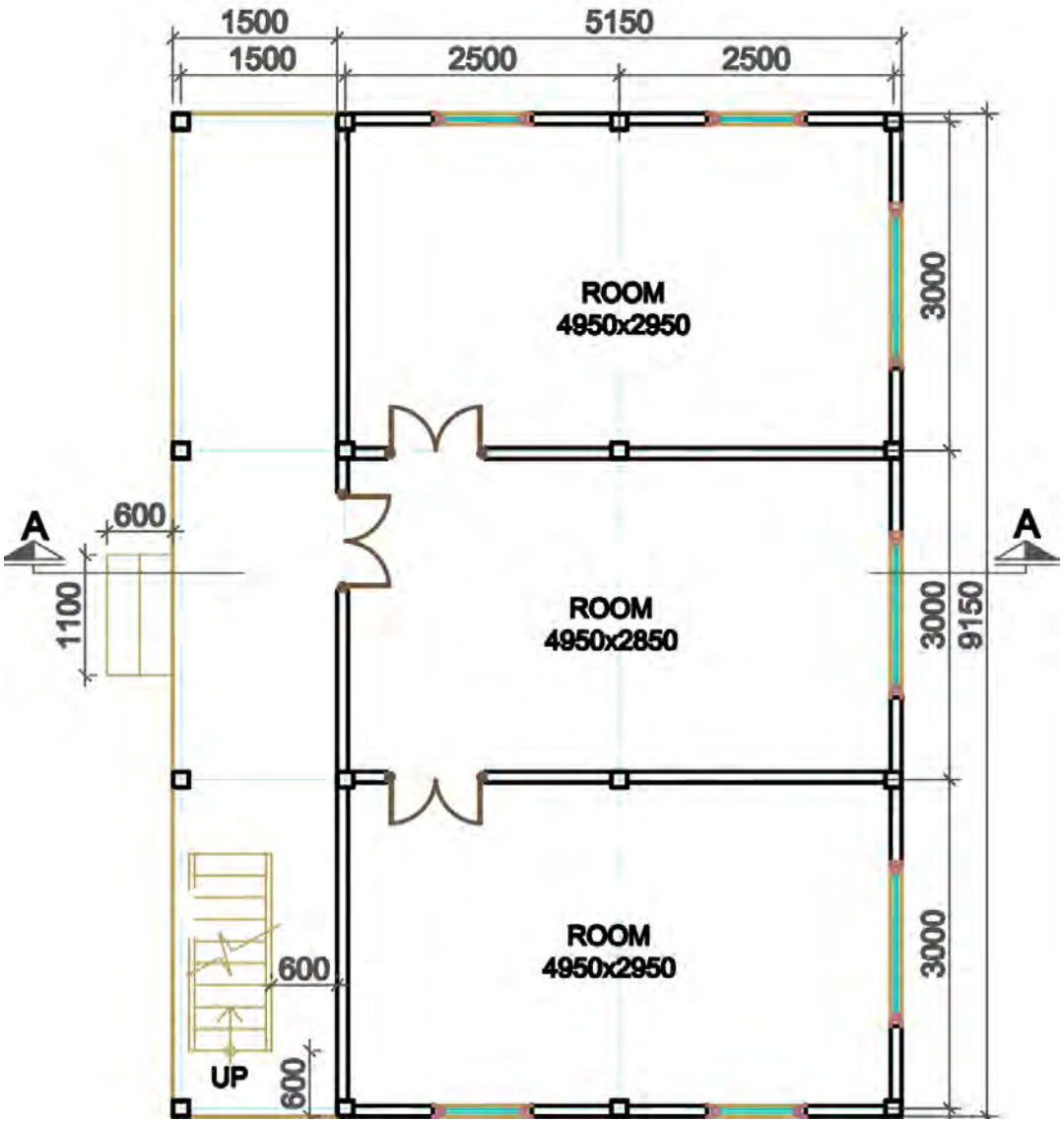
MATERIAL PROPERTIES AND SPECIFICATION
Structural Steel Yield Strength: Fe250
CGI Sheet: min 53 gauge
Infill material density ≥ 1000kg/m3
Mix ratio grade: 1:1.5:3
Tensile Strength of rebar: Fe 500

S.S.-10.1

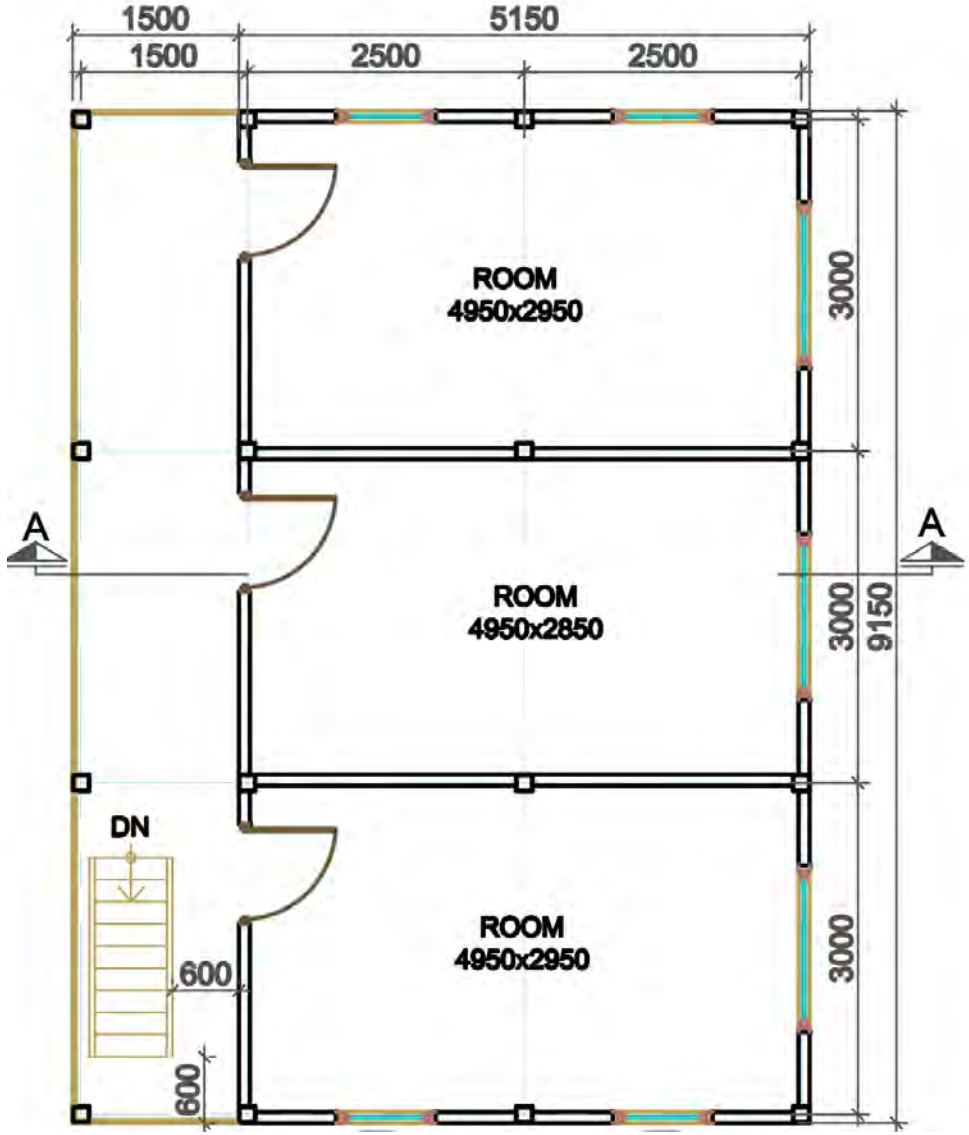
MODEL S.S.-10.1, STEEL STRUCTURE — TWO STOREY

LEVEL	MATERIALS										
	Brick	Cement	Sand	Aggregate	Reinforcing Bar	MS pipe	Steel sections	CGI Sheet	GI Plain sheet	Aluminium Door	Aluminium Window
	No.	Bags	Cu.m.	Cu.m.	Kg.	Kg.	Kg.	Bundle	Sq.m.	Sq.m.	Sq.m.
Up to Plinth Level	3,384.0	130.0	11.0	13.0	974.0	-	-			-	-
Super Structure	-	111.0	5.0	10.0	582.0	-	3,930.1			10.3	22.6
Roofing	-	-	-	-	-	845.4	-	6.3	11.1	-	-
TOTAL	**3,384.0**	**241.0**	**16.0**	**23.0**	**1,556.0**	**845.4**	**3,930.1**	**6.3**	**11.1**	**10.3**	**22.6**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL S.S-10.1	SCALE: NONE	S.S.-10.1
	DRAWING TITLE: ESTIMATION AND 3D-VIEW	DATE:	1/11



GROUND FLOOR PLAN
AREA: 60.85 SQ.M

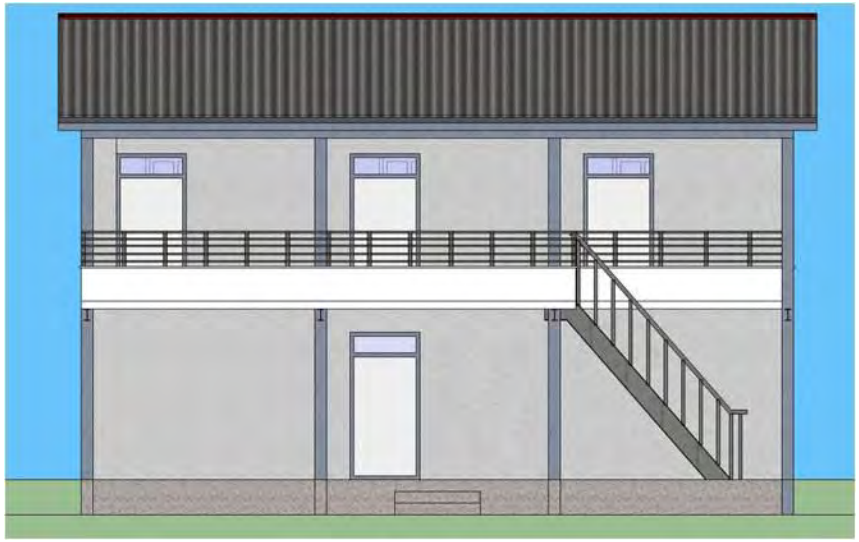


FIRST FLOOR PLAN
AREA: 60.85 SQ.M

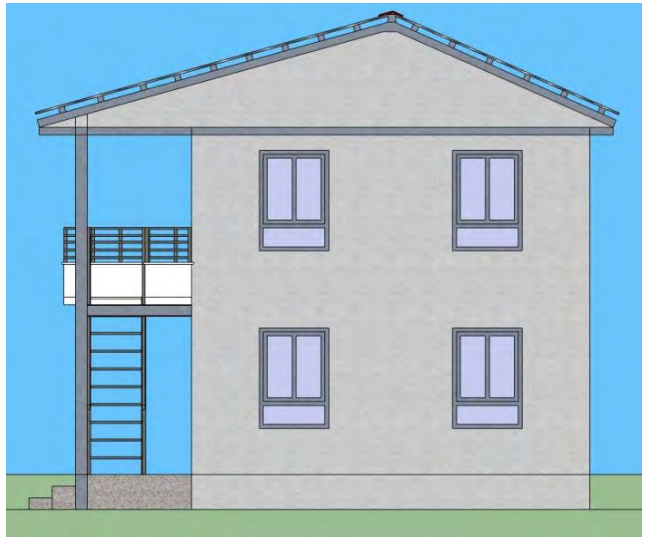
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL S.S-10.1	SCALE: NONE	S.S.-10.1
	DRAWING TITLE: FLOOR PLANS	DATE:	2/11

MODEL S.S.-10.1, STEEL STRUCTURE

TWO STOREY

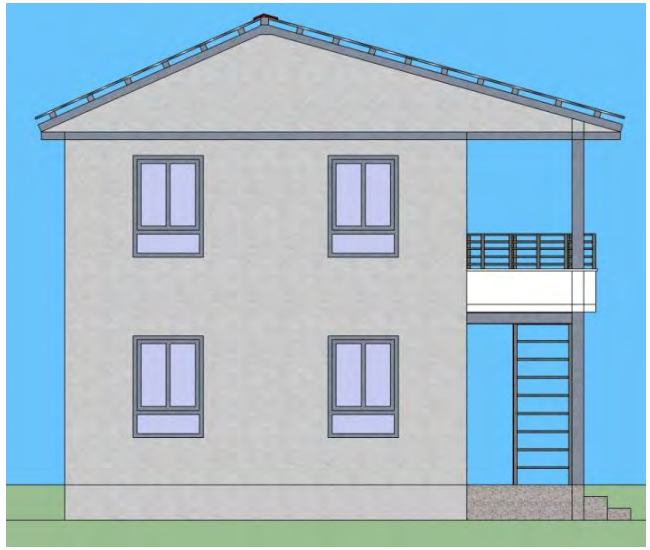


FRONT ELEVATION



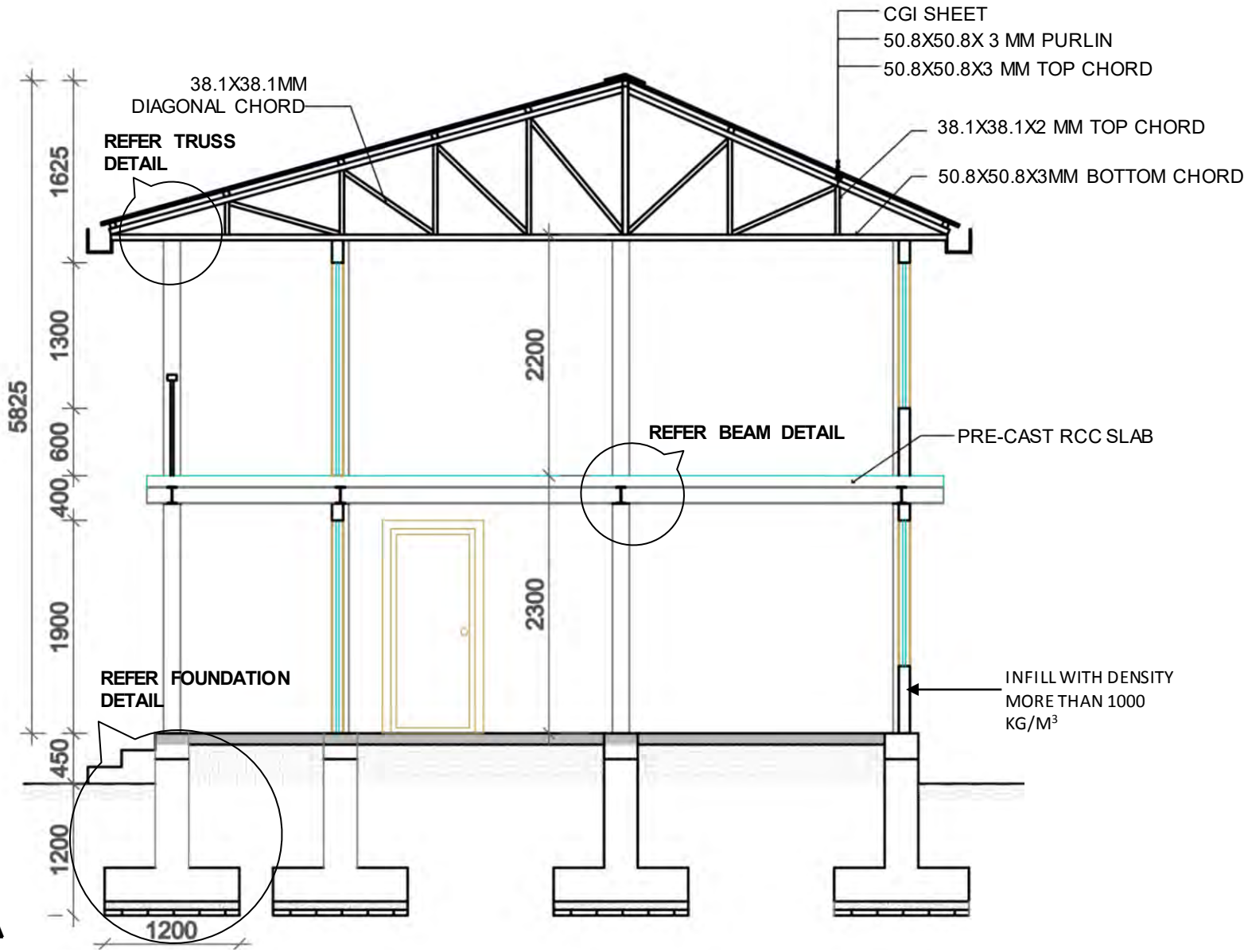
RIGHT SIDE ELEVATION

BACK ELEVATION



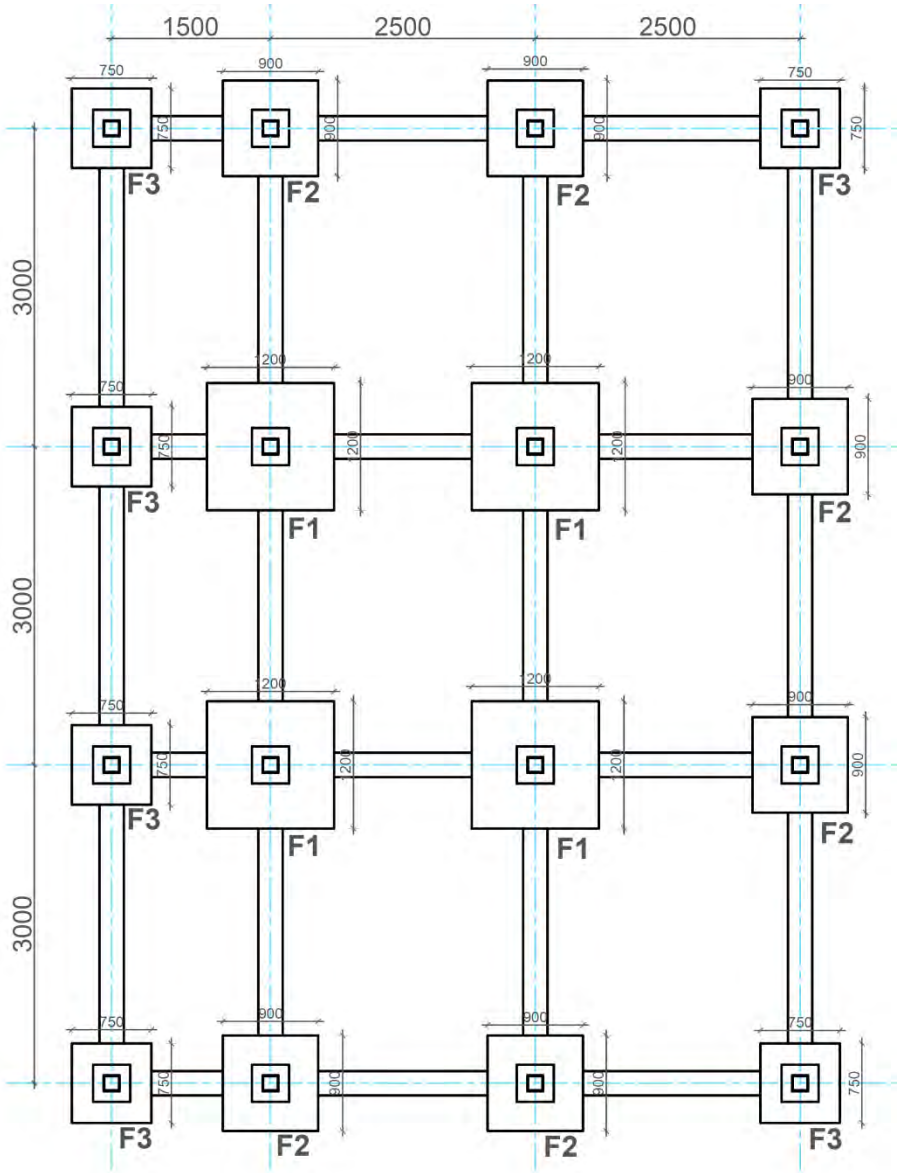
LEFT SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL S.S-10.1	SCALE: NONE	S.S.-10.1
	DRAWING TITLE: ELEVATIONS	DATE:	3/11



SECTION AT A-A

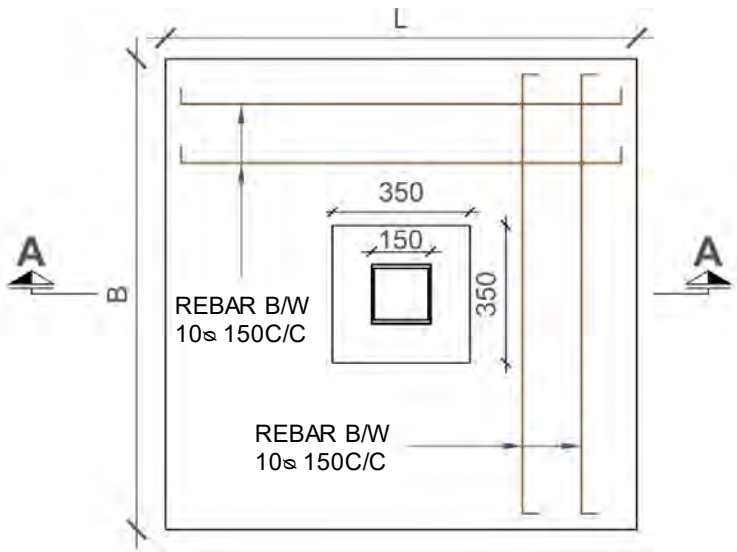
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL S.S-10.1	SCALE: NONE	S.S.-10.1
	DRAWING TITLE: SECTION	DATE:	4/11



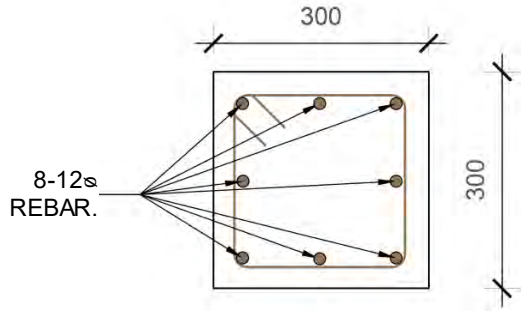
FOUNDATION TRENCH PLAN

FOUNDATION DETAIL

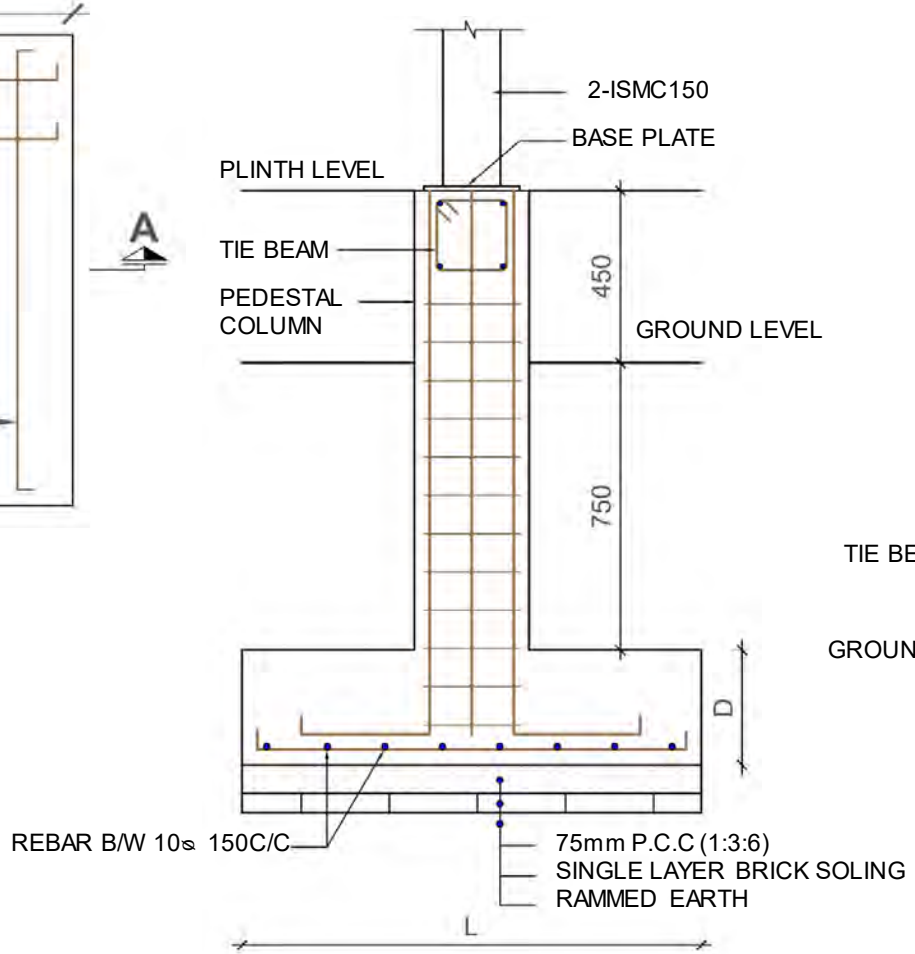
Serial No.	Foundation. Type	Foundation Size (LxB)	Footing sizes and reinforcementdetails	
			Depth (D)	Rebar
1	F1	1200x1200	300	T10@150mm c\c-bothway
2	F2	900x900	300	T10@150mm c\c-bothway
3	F3	750x750	300	T10@150mm c\c-bothway



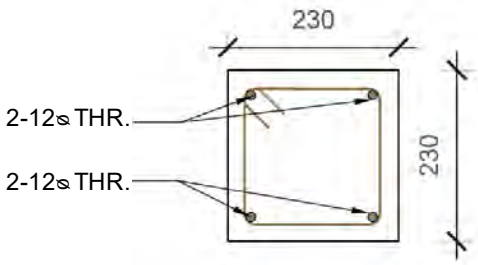
FOUNDATION PLAN



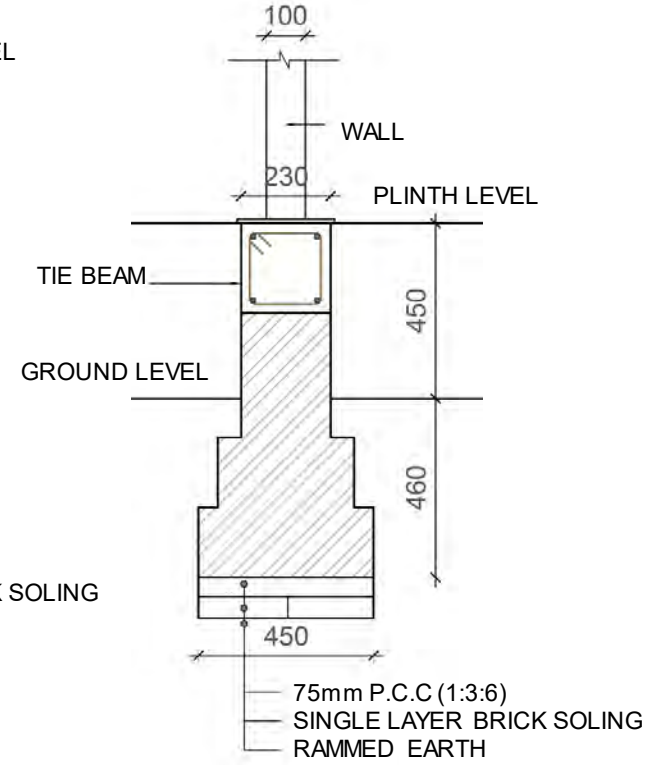
PEDESTAL COLUMN



FOUNDATION SECTION AT A-A

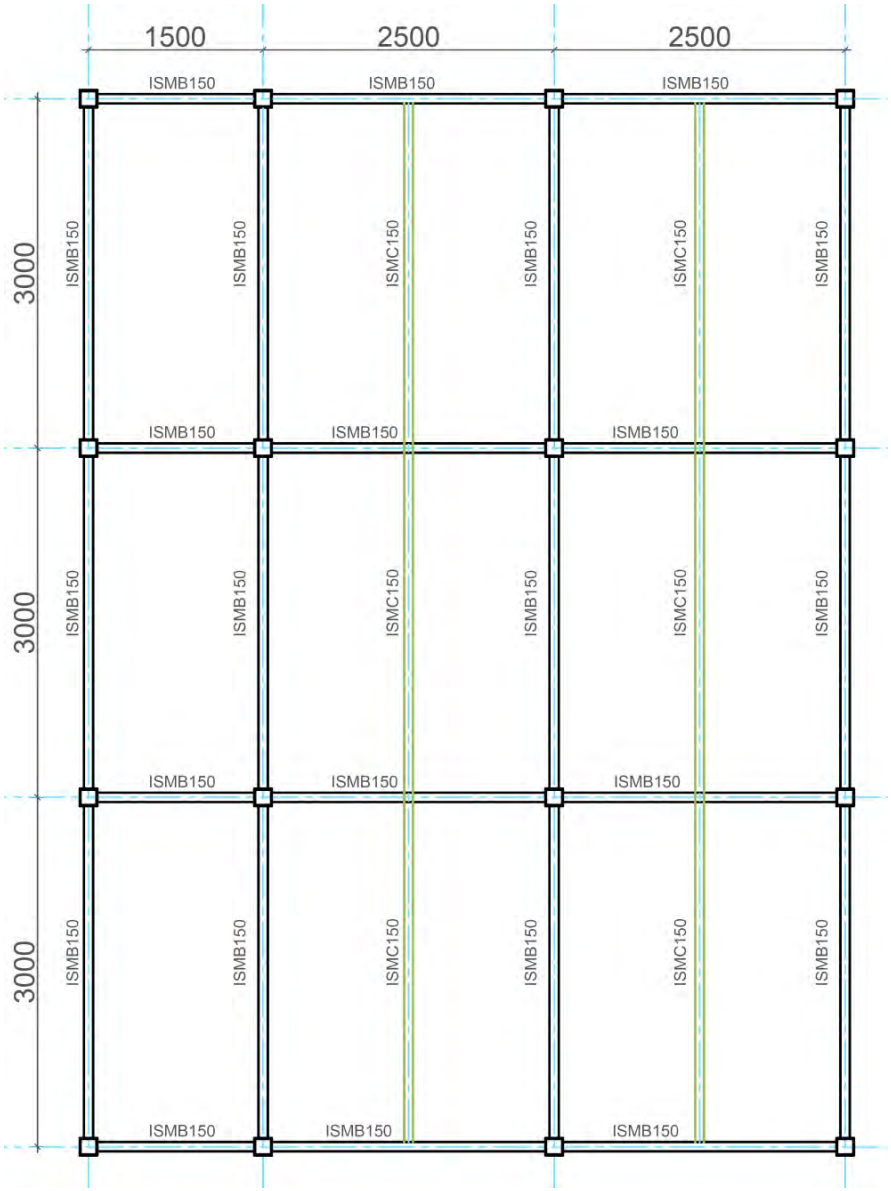


TIE BEAM

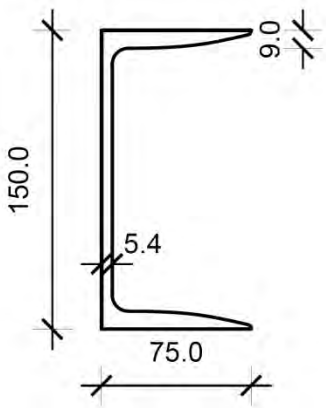


TOE WALL

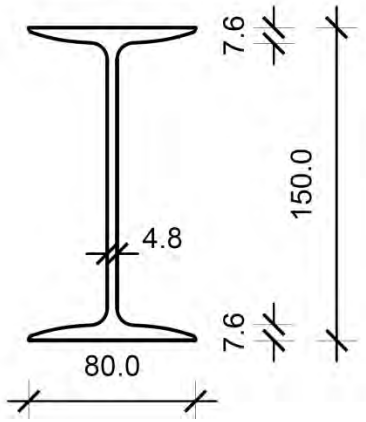
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL S.S-10.1	SCALE: NONE	S.S.-10.1
	DRAWING TITLE: STRUCTURE DETAILS	DATE:	6/11



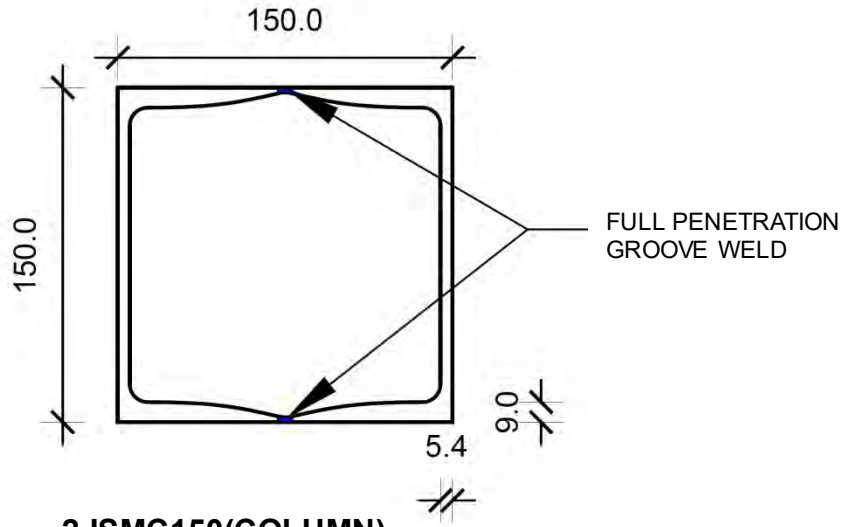
BEAM-COLUMN PLAN



ISMC150
(SECONDARY BEAM)

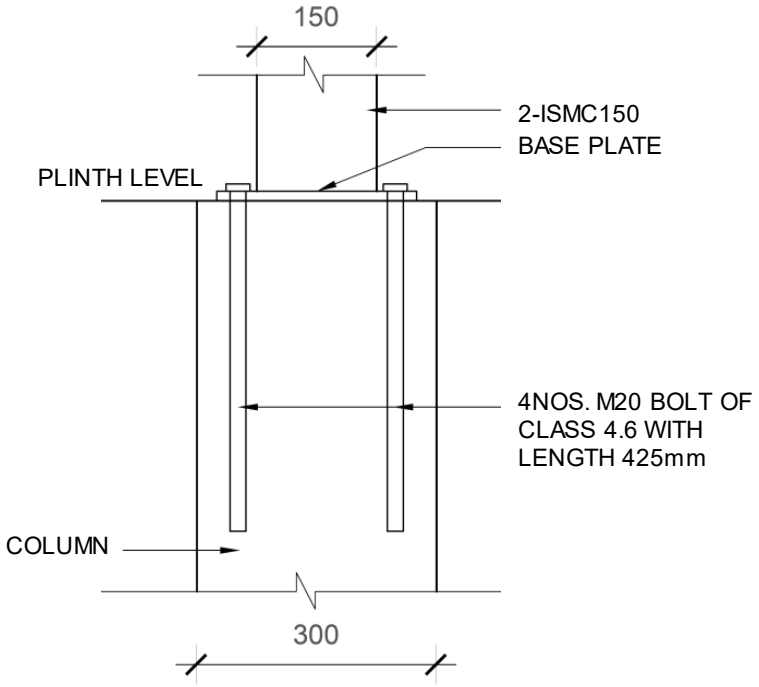


ISMB150
(PRIMARY BEAM)

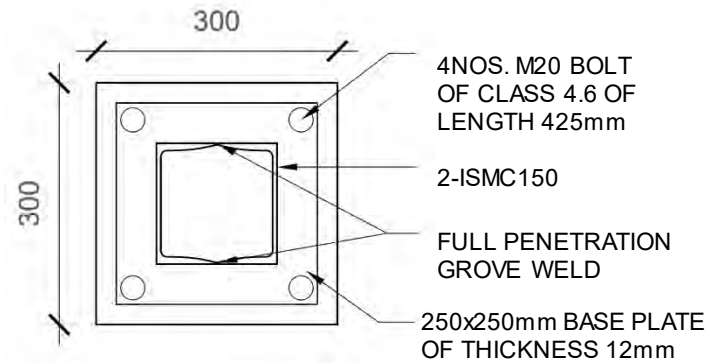


2-ISMC150(COLUMN)

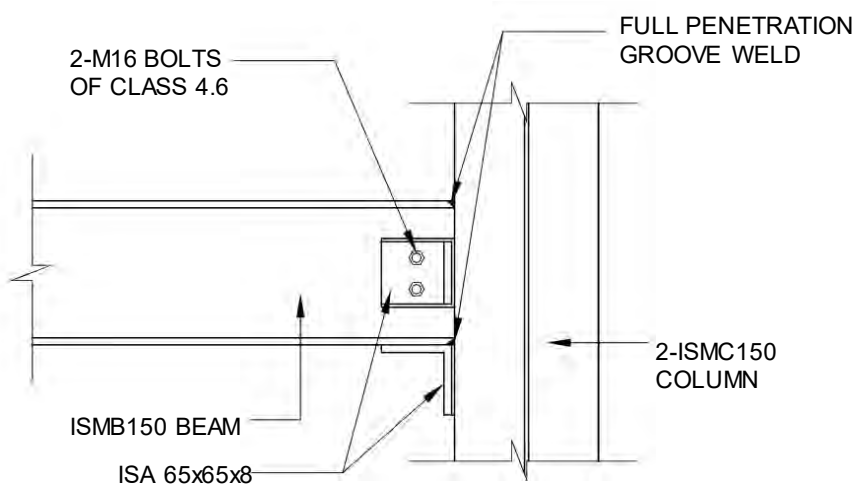
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL S.S-10.1	SCALE: NONE	S.S.-10.1
	DRAWING TITLE: STRUCTURE DETAILS	DATE:	7/11



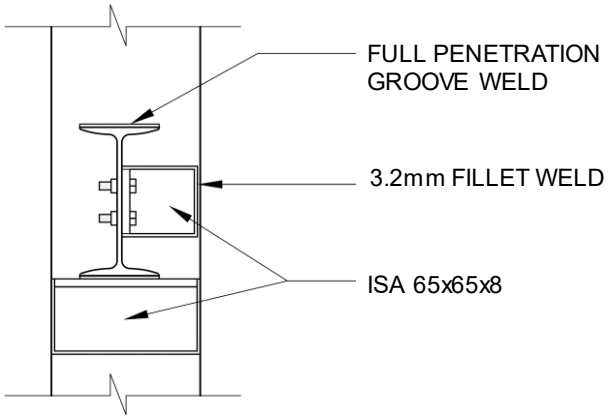
BASE PLATE CONNECTION SECTION



BASE PLATE CONNECTION PLAN

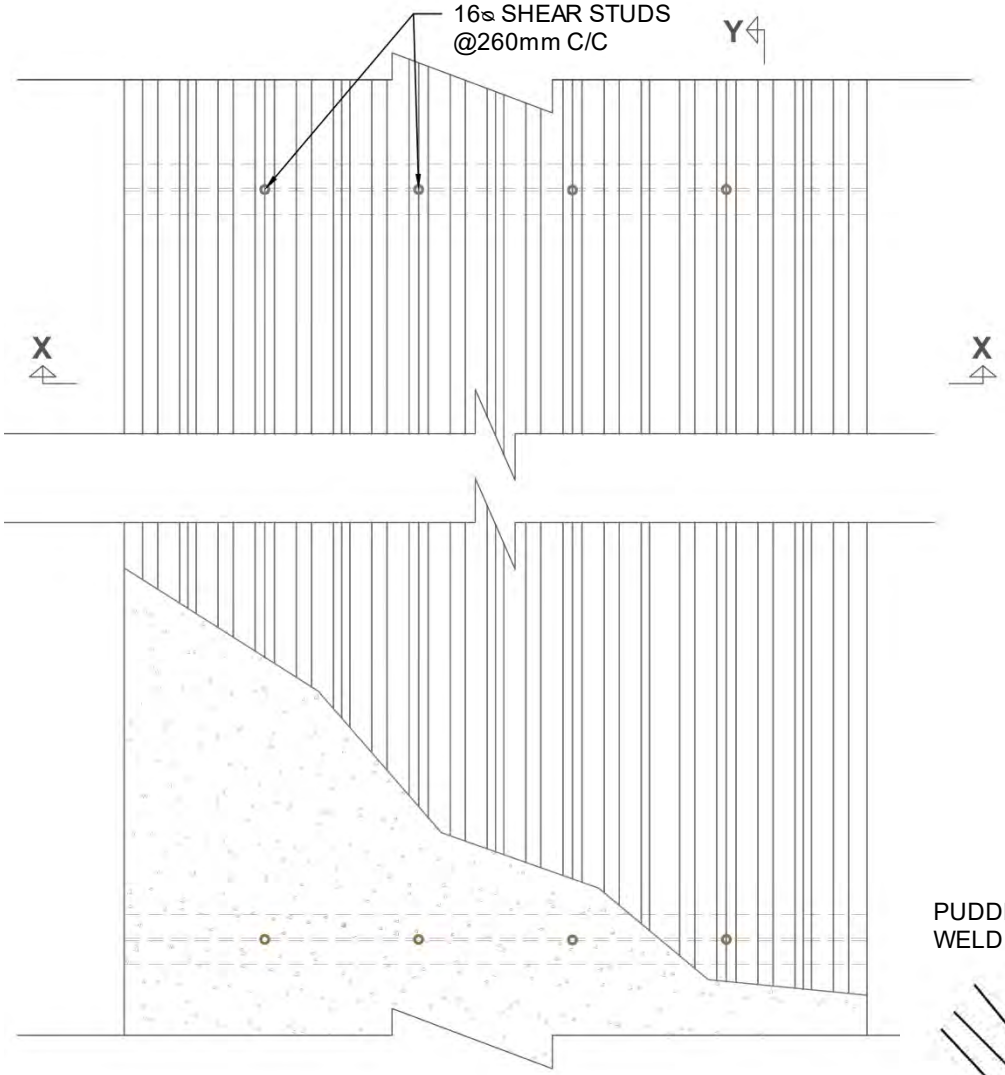


BEAM AND COLUMN CONNECTION

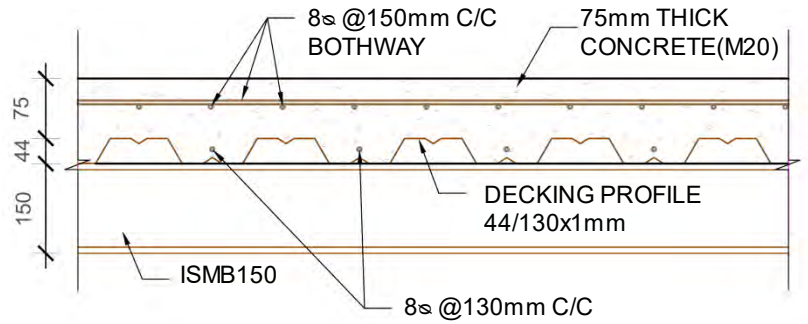


BEAM AND COLUMN CONNECTION

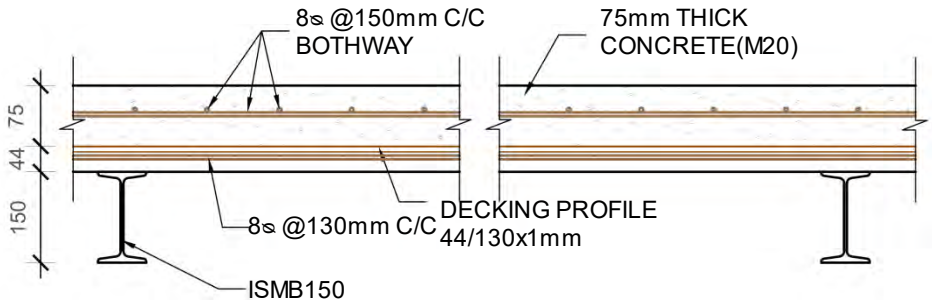
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL S.S-10.1	SCALE: NONE	S.S.-10.1
	DRAWING TITLE: STRUCTURE DETAILS	DATE:	8/11



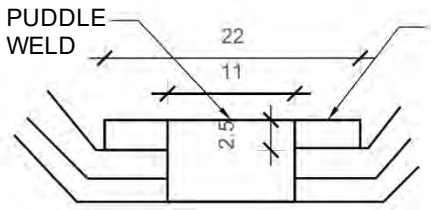
COMPOSITE FLOOR PLAN



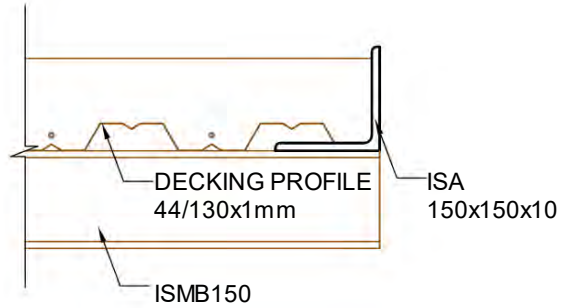
SECTION AT X-X



SECTION AT Y-Y

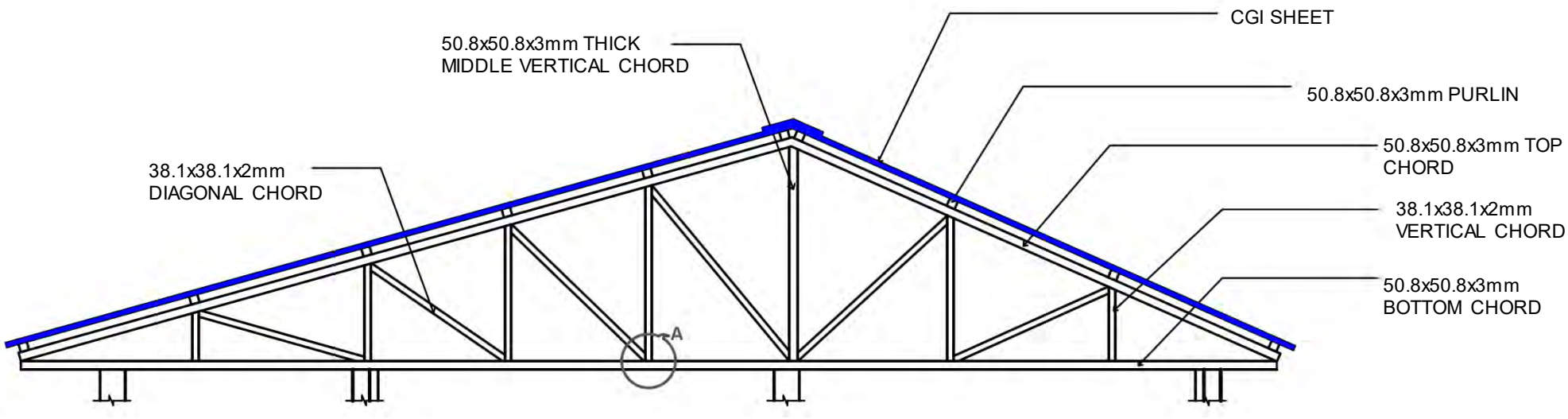


LAP DETAIL

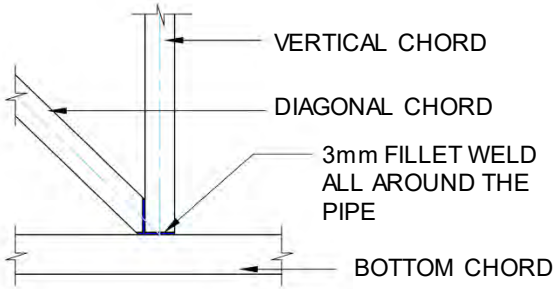


END ANGLE DETAIL

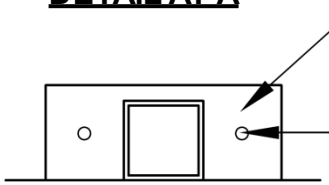
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL S.S-10.1	SCALE: NONE	S.S.-10.1
	DRAWING TITLE: STRUCTURE DETAILS	DATE:	9/11



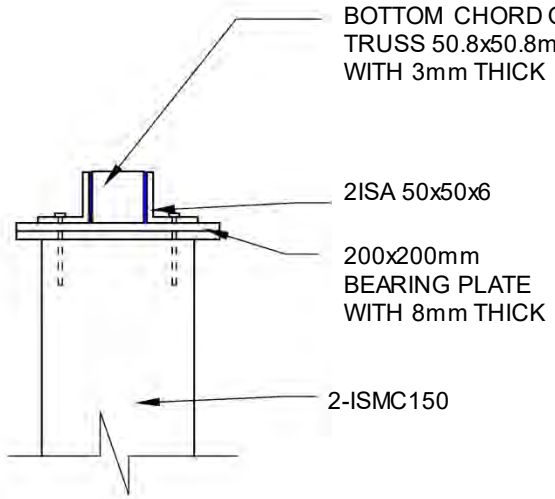
TRUSS DETAIL



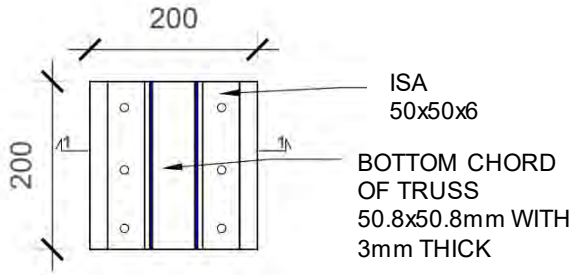
DETAIL AT A



CLEAT DETAIL



SECTION AT 1-1



PLAN

TRUSS COLUMN CONNECTION DETAIL

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL S.S-10.1	SCALE: NONE	S.S.-10.1
	DRAWING TITLE: STRUCTURE DETAILS	DATE:	10/11

TECHNICAL REQUIREMENTS

Structure System	Moment resisting steel frame system.
Foundation	Isolated footing shown in detail drawing. Depth of Pedestal Column of 1.05 meters from ground level and width shown as per design in table.
Tie beam:	R.C.C (1:1.5:3) tie beam of size 230x 230 mm. Main reinforcement shall be 4 nos. of 12mm dia. Bars with 8mm Ø rings at 150mm C/C
Wall System	Infill walls with density more than 1000 kg/m^3 on moment resisting steel frame.
Column:	Two ISMC150 column with full penetration groove weld in factory is used in structure.
Beam:	ISMB 150 shall be used as primary beam. ISMC 150 shall be used for Secondary Beam.
Flooring System:	The flooring System shall be made of profile metal decking system. Thin layer of RC concrete shall be laid as shown in detail drawing.
Roof System:	Light roof steel truss covered with CGI sheets. All members of the truss or joints shall be properly connected as shown in detail drawings.

TIMBER STRUCTURE

T.S.-11.1

T.S 11.1 is a structural system consisting of timber studs (vertical members) and horizontal member load bearing system. The gravity load is resisted by the studs and lateral load is resisted by the timber bracing located at strategic positions. The floor system consists of wooden joist over which the wooden planks are laid. The roofing system consists of wooden truss system with CGI sheet. The timber planks are used as light weight partition walls The featured design consists of two storied resident having 6 number of rooms.

PROPERTIES OF TIMBER

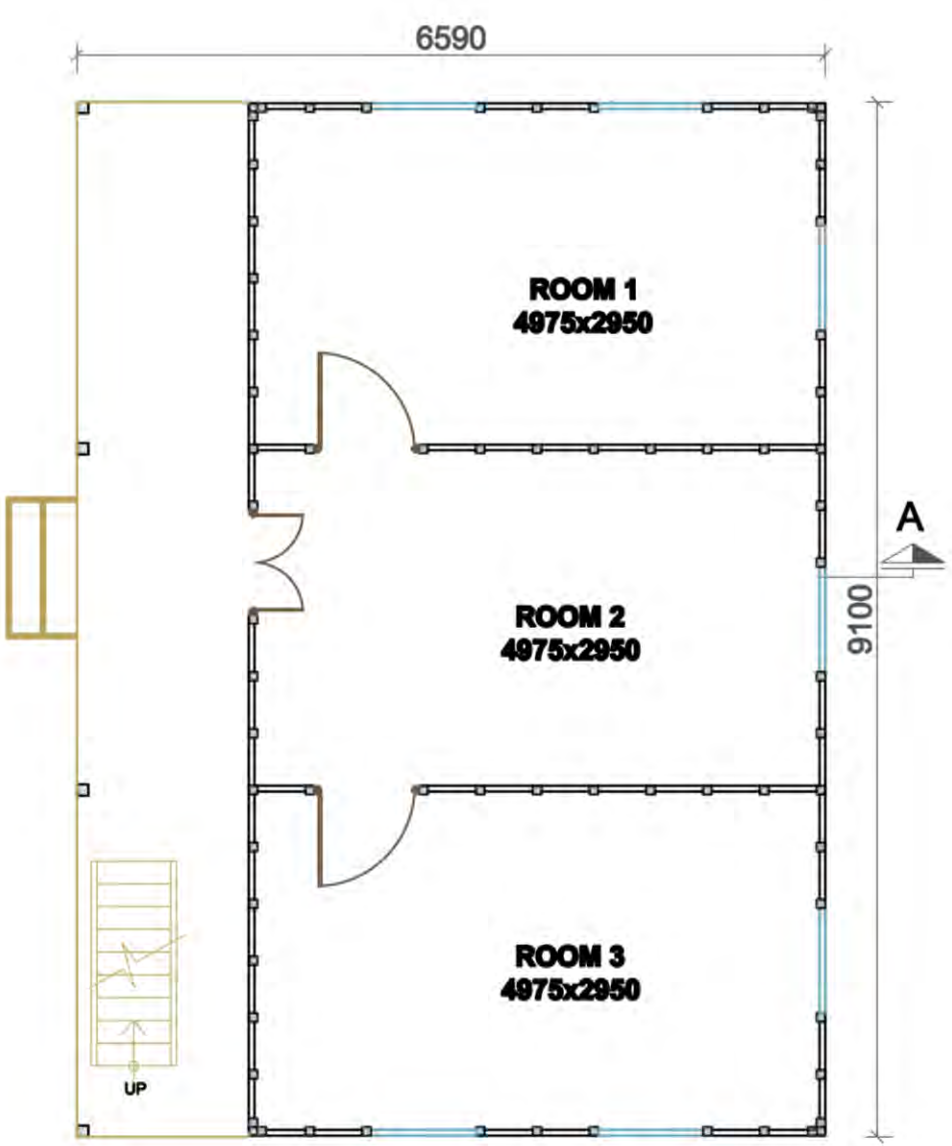
Density: 640 kg/m^2
Modulus of Elasticity: 9.4 x10^3 N/mm^2
Binding & tension along Grains, Extreme Fiber Stress, inside location: 13.7 N/mm^2
Binding & tension along Grains, Extreme Fiber Stress, outside location: 11.4 N/mm^2
Shear Stress, Horizontal in Beams all locations: 1 N/mm^2
Shear Stress, along grains all locations: 1.4 N/mm^2
Compressive Stress, inside location (parallel to grains): 8.6 N/mm^2
Compressive Stress, outside location (parallel to grains): 7.7 N/mm^2

T.S.-11.1

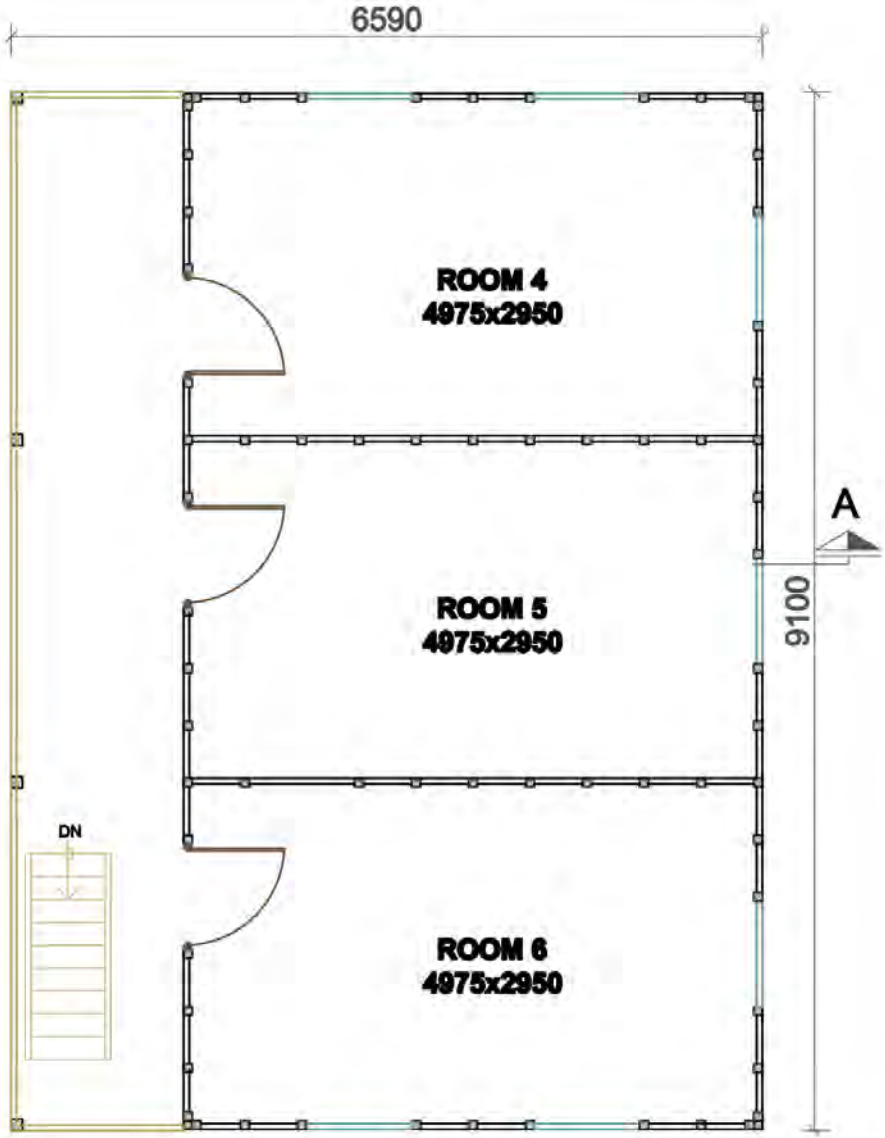
MODEL T.S.-11.1, TIMBER STRUCTURE — TWO STOREY

LEVEL	MATERIALS										
	Brick	Cement	Sand	Aggregate	Reinforcing Bar	MS Angle & Plates	Wood	CGI Sheet	GI Plain sheet	Aluminium Door	Aluminium Window
	No.	Bags	Cu.m.	Cu.m.	Kg.	Kg.	Cu.m.	Bundle	Sq.m.	Sq.m.	Sq.m.
Up to Plinth Level	3,652.7	112.9	16.7	8.7	630.0	-	-			-	-
Super Structure	-	17.5	1.2	2.2	-	526.3	16.3			10.3	22.6
Roofing	-	-	-	-	-	-	0.2	6.7	11.4	-	-
TOTAL	**3,652.7**	**130.4**	**17.9**	**10.9**	**630.0**	**526.3**	**16.5**	**6.7**	**11.4**	**10.3**	**22.6**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL T.S-11.1	SCALE: NONE	T.S.-11.1
	DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	1/7



GROUND FLOOR PLAN
AREA: 61.64 SQ.M.

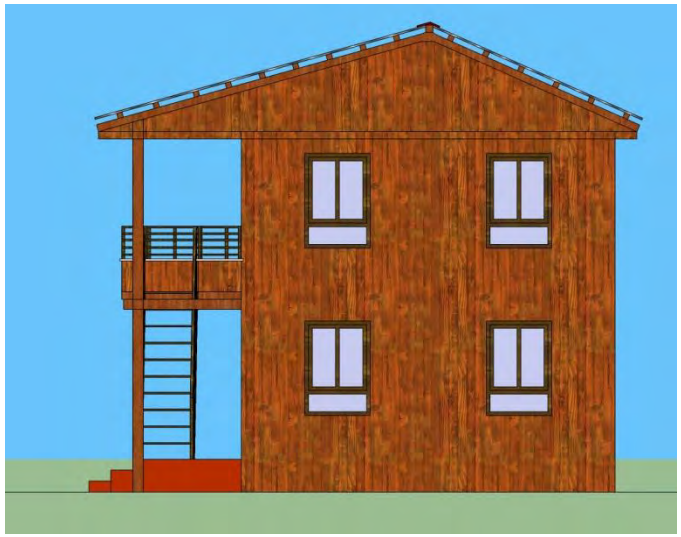


FIRST FLOOR PLAN
AREA: 61.64 SQ.M.

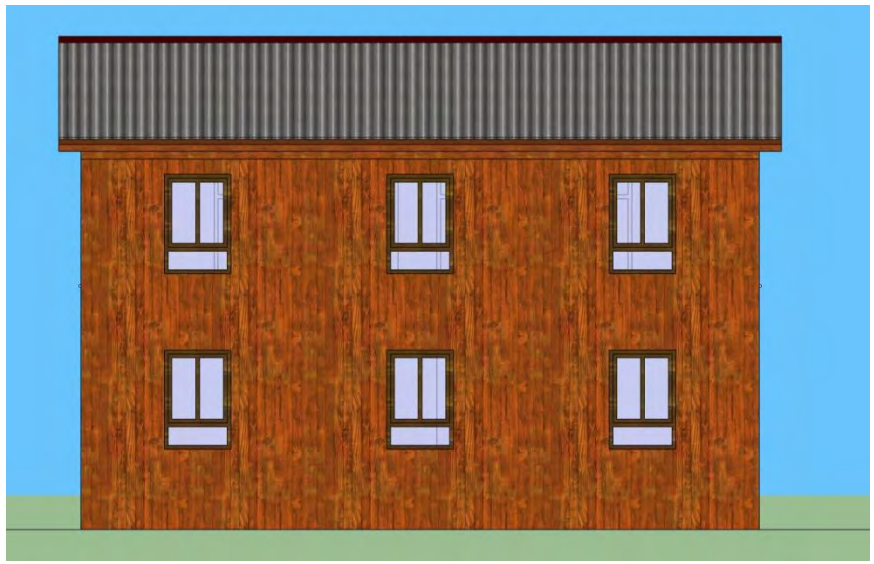
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL T.S-11.1	SCALE: NONE	T.S.-11.1
	DRAWING TITLE: FLOOR PLANS	DATE:	2/7

MODEL T.S.-11.1, TIMBER STRUCTURE — TWO STOREY

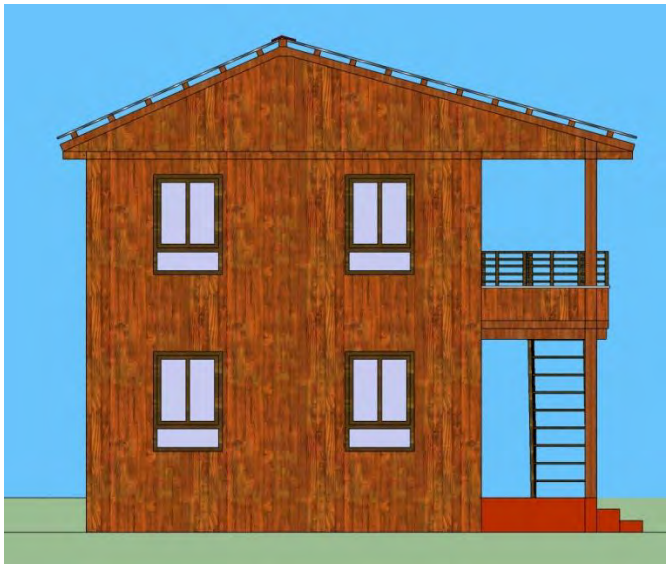
FRONT ELEVATION



RIGHT SIDE ELEVATION



BACK ELEVATION

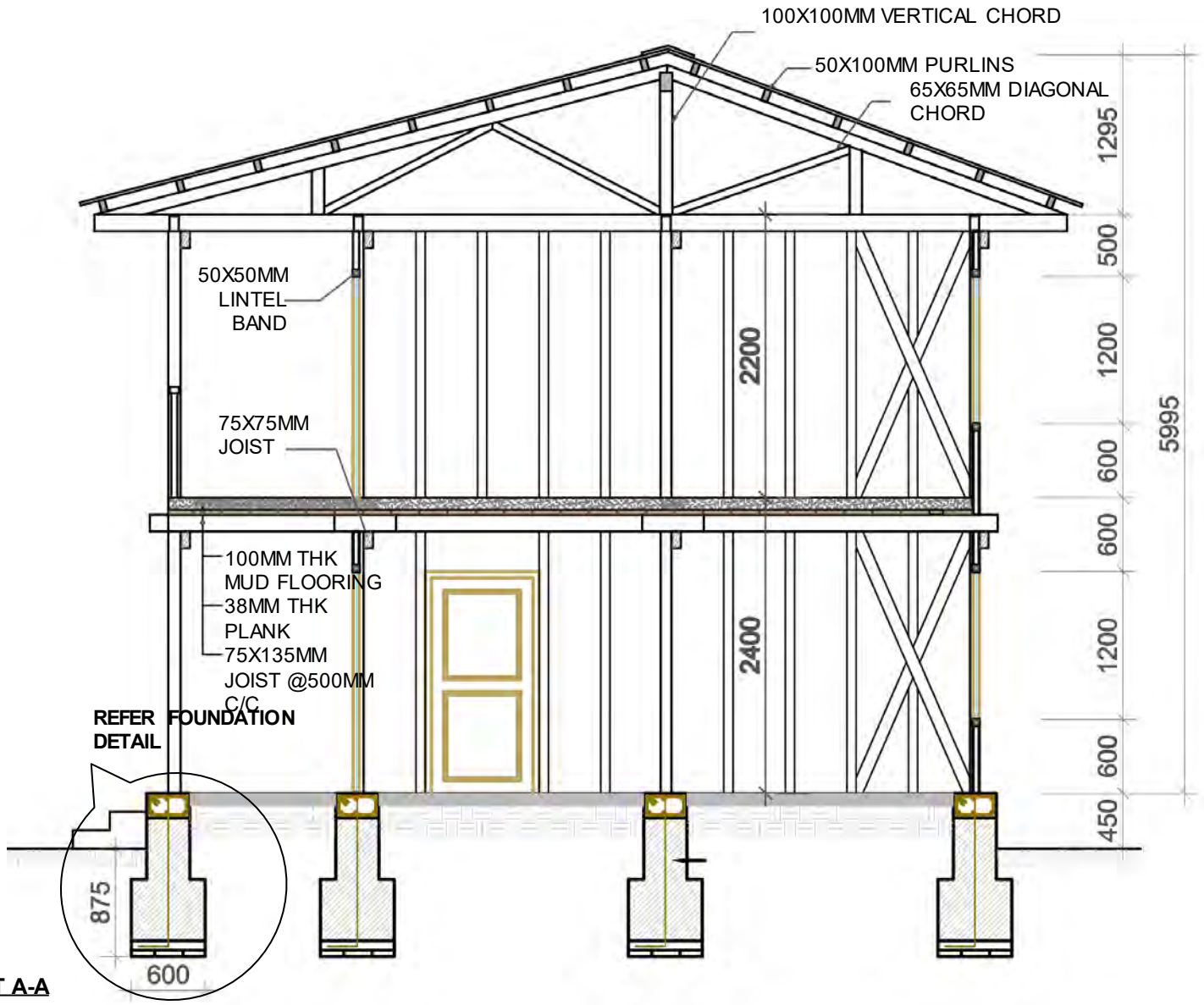


LEFT SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL T.S-11.1	SCALE: NONE	T.S.-11.1
	DRAWING TITLE: ELEVATIONS	DATE:	3/7

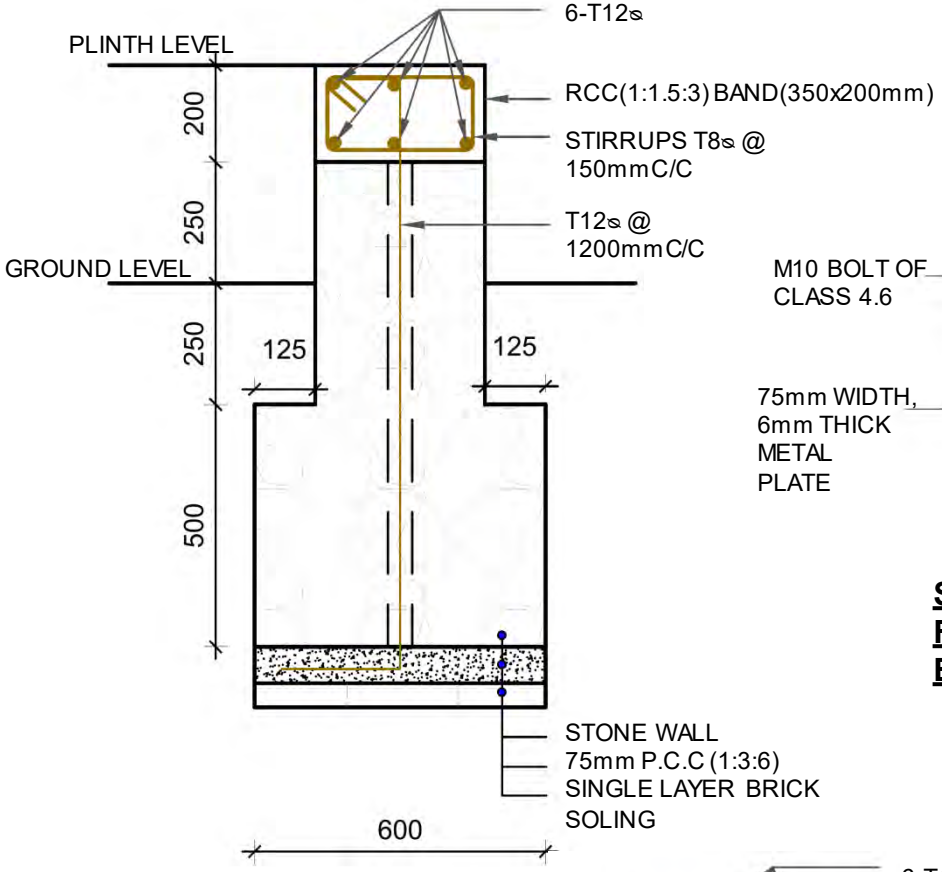
MODEL T.S.-11.1, TIMBER STRUCTURE

TWO STOREY

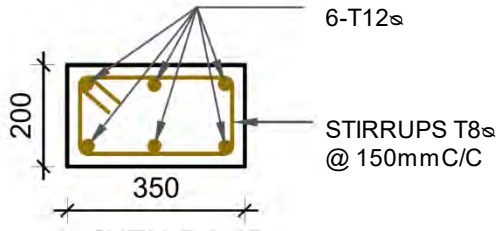


SECTION AT A-A

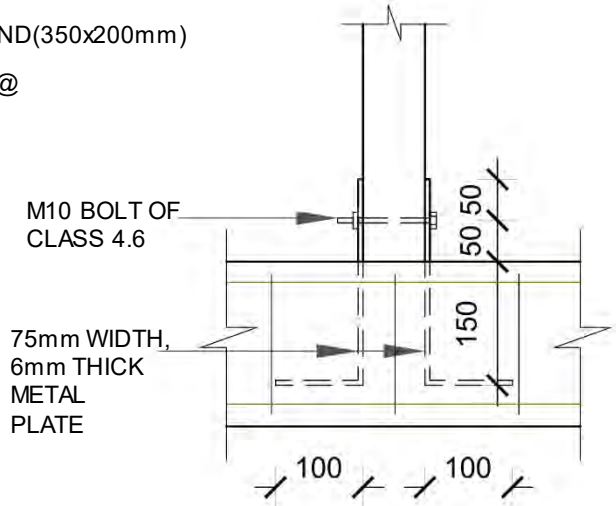
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL T.S-11.1	SCALE: NONE	T.S.-11.1
	DRAWING TITLE: SECTION	DATE:	4/7



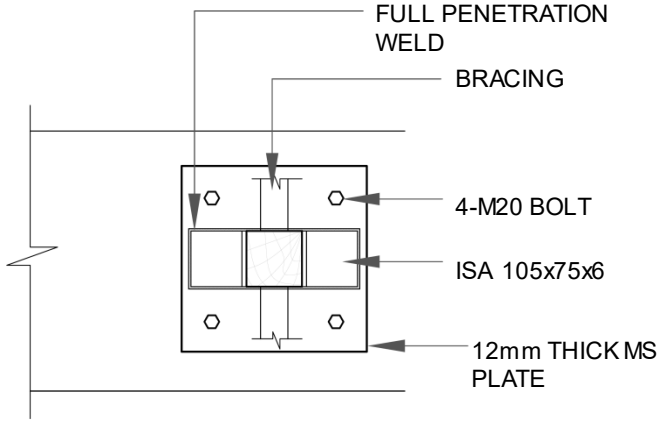
FOUNDATION



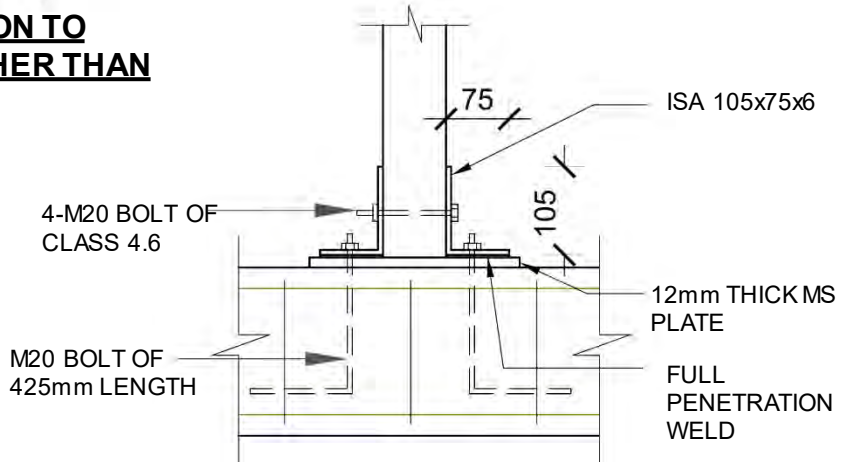
PLINTH BAND



STUD CONNECTION TO FOUNDATION OTHER THAN BRACING

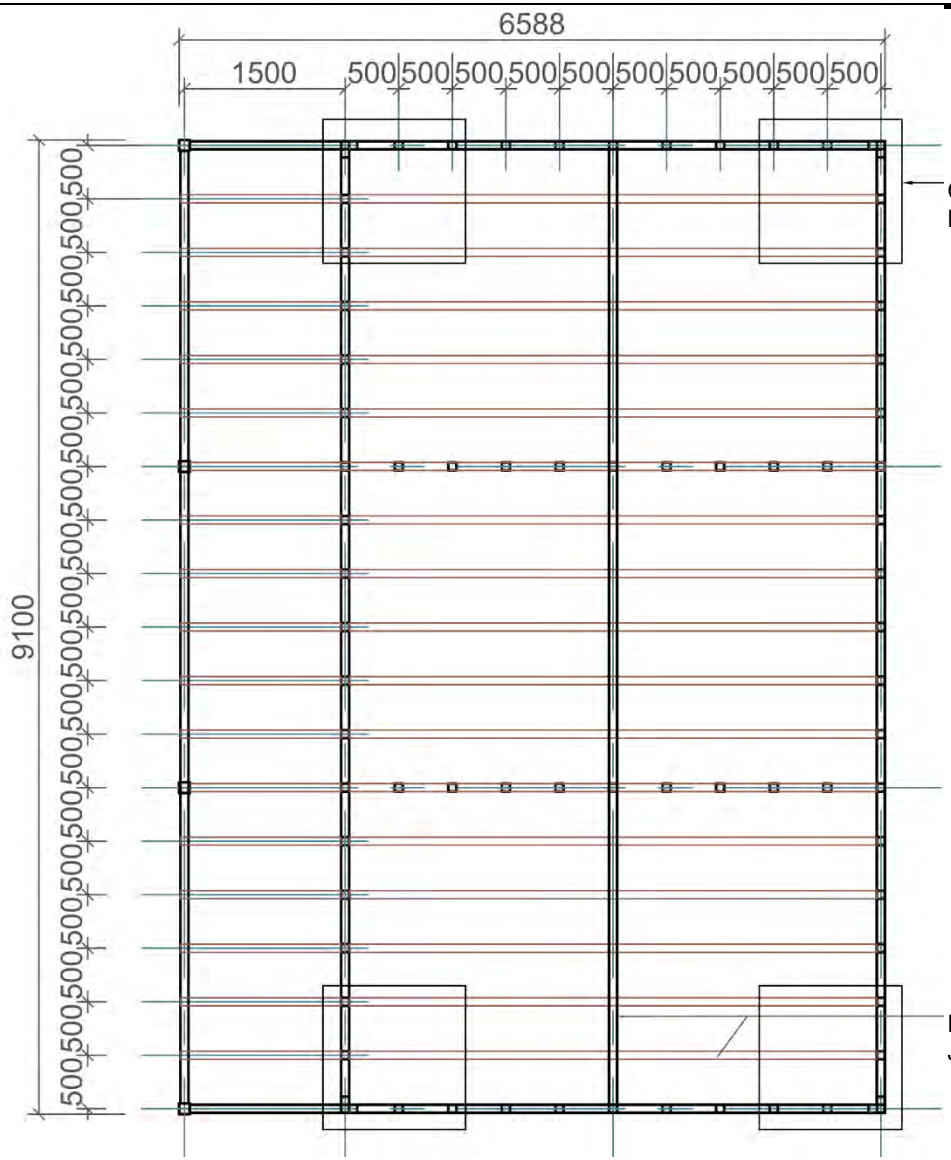


STUD CONNECTION TO FOUNDATION AT BRACING

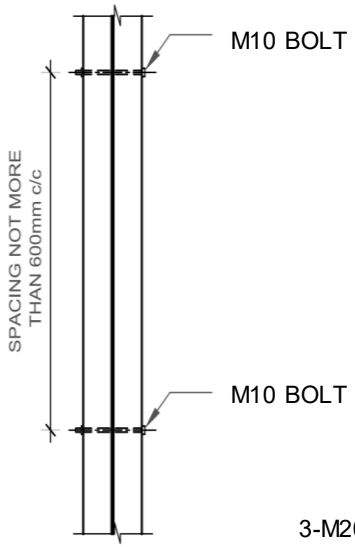


STUD CONNECTION TO FOUNDATION AT BRACING

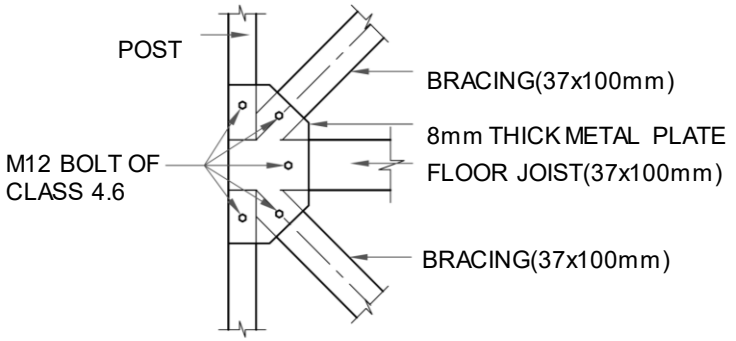
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL T.S-11.1	SCALE: NONE	T.S.-11.1
	DRAWING TITLE: FOUNDATION DETAIL	DATE:	5/7



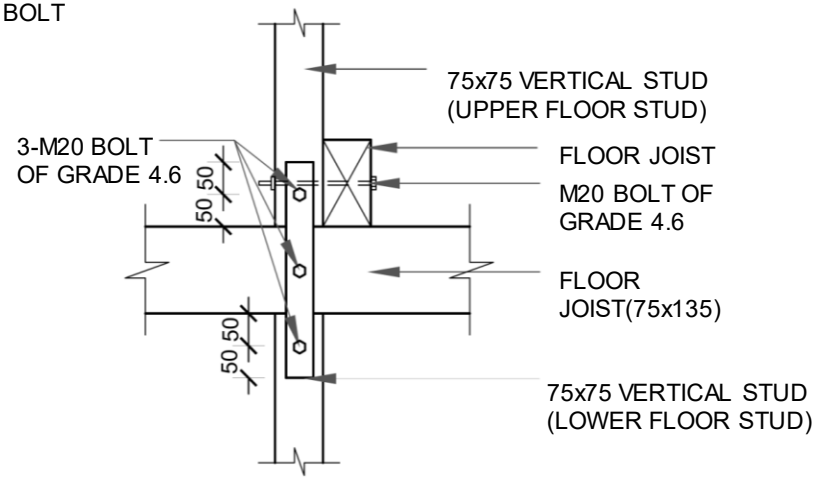
FLOOR JOIST PLAN



CORNER POST CONNECTION



BRACING CONNECTION



STUD CONNECTION AT FLOOR

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: MODEL T.S-11.1	SCALE: NONE	T.S.-11.1
	DRAWING TITLE: JOIST AND JOINT DETAIL	DATE:	6/7

TECHNICAL REQUIREMENTS

Structure System	Structural system consisting of timber studs (vertical members) and horizontal member load bearing System. Timber shall be hard wood like sal, khote salla or equivalent.
Foundation	Strip Foundation of stone masonry in 1:6 cement sand mortar and of width 600 mm width and depth 750 mm as shown in detail drawing.
Plinth Band	R.C.C (1:1.5:3) plinth band of size 350 x 200 mm. Main reinforcement shall be 6 nos. of 12mm dia. Bars with 8mm Ø rings at 150mm C/C.
Wall System	Local soft wood timber planks on timber structure system.
Stud:	Studs of local hard wood of size 75mm X 75 mm @500 mm C/C spacing shall be used. Connection with plinth band is shown detail drawing.
Bracing:	Diagonal bracing of local hard wood of size 37mm X 100mm. Connection details shown in detail drawing.
Joist:	Timber joist of size 75mm X 75mm with spacing of 425mm.
Flooring system:	Flooring shall be of mud under timber planks supported on timber joists.
Roof System:	Light roof steel truss covered with corrugated galvanized iron sheets. All members of the truss or joints shall be properly connected as shown in detail drawings.

DEBRIS BLOCK MASONRY

D.B.-12.1

The technology proposes residence construction with block made from stone or brick debris stabilized with cement. The objective of the design is to contribute towards resilient models that helps in debris management as well as improves safety in future earthquakes.
Featured design D.B 12 is a single storied model house with 2 rooms. Bands are provided at plinth level, sill level, corner, lintel level and roof level. Roofing is of corrugated Galvanized Iron sheets under wooden rafters

MATERIAL PROPERTIES

For mud mortar stone masonry

Size: 300 mm length × 150 mm width × 200 mm height
Color: light grey
Density: 2000 Kg/cm3 to 2300 Kg/cm3

For mud mortar brick masonry

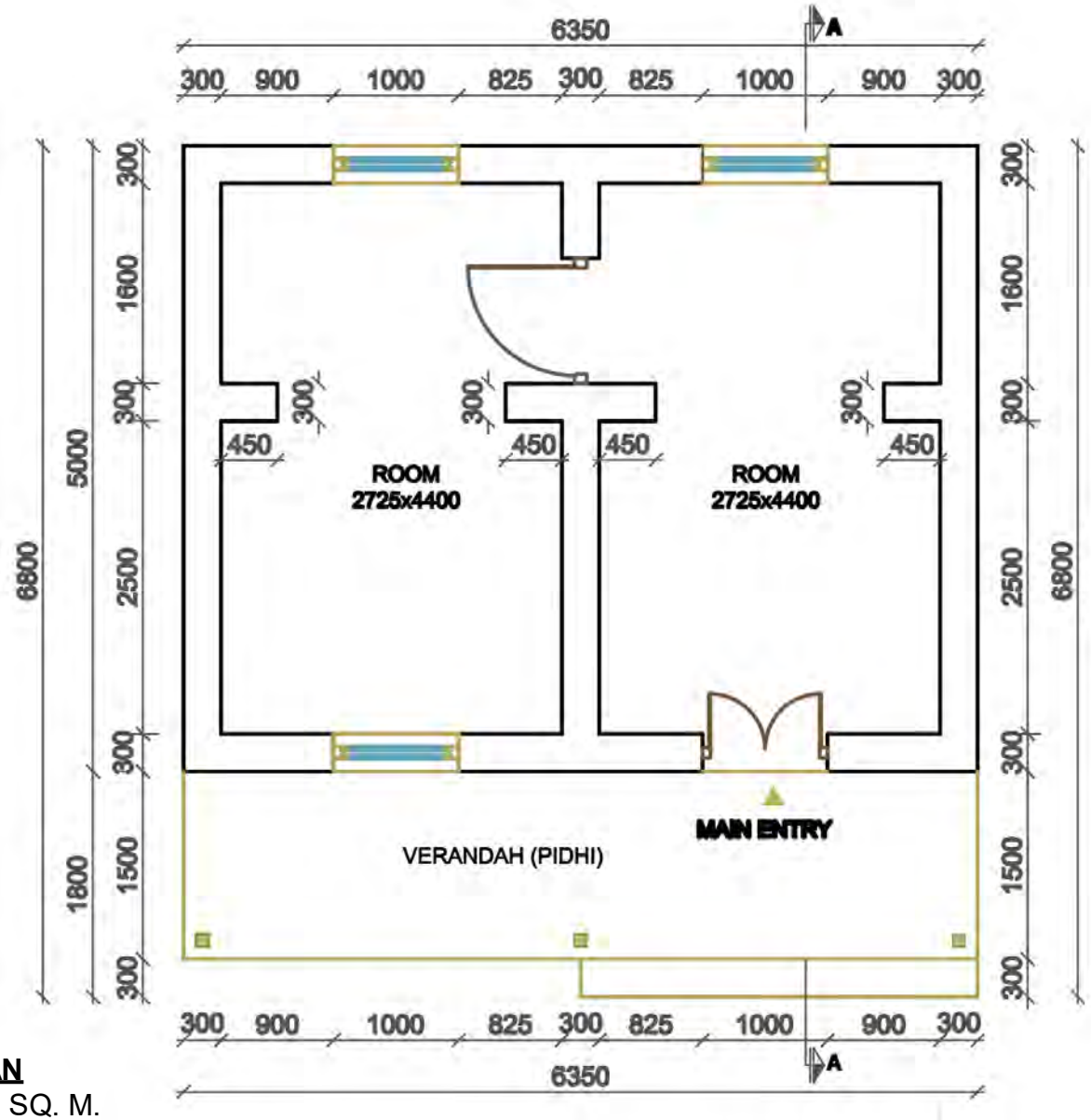
Size: 300 mm length × 150 mm width × 200 mm height
Color: light grey
Density: 1700 Kg/cm3 to 2200 Kg/cm3

D.B.-12.1

MODEL 12.1, DEBRIS BLOCK MASONRY — ONE STOREY

LEVEL	Debris Block	Cement	Sand	Aggregate	Reinforcing Bar	CGI Sheet	GI Sheet	Wood
	No.	Bags	Cu.m.	Cu.m.	Kg.	Bundle	Sq.m.	Cu.m.
Up to Plinth Level	1,762.0	34.2	2.4	4.7	273.5			-
Super Structure	1,923.0	21.8	1.2	2.3	307.1			0.3
Roofing	-	-	-	-	-	5.2	8.3	2.8
TOTAL	**3,685.0**	**55.9**	**3.6**	**7.0**	**580.6**	**5.2**	**8.3**	**3.1**

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: D.B.-12.1	SCALE: NONE	D.B.-12.1
	DRAWING TITLE: ESTIMATE AND 3D-VIEW	DATE:	1/8

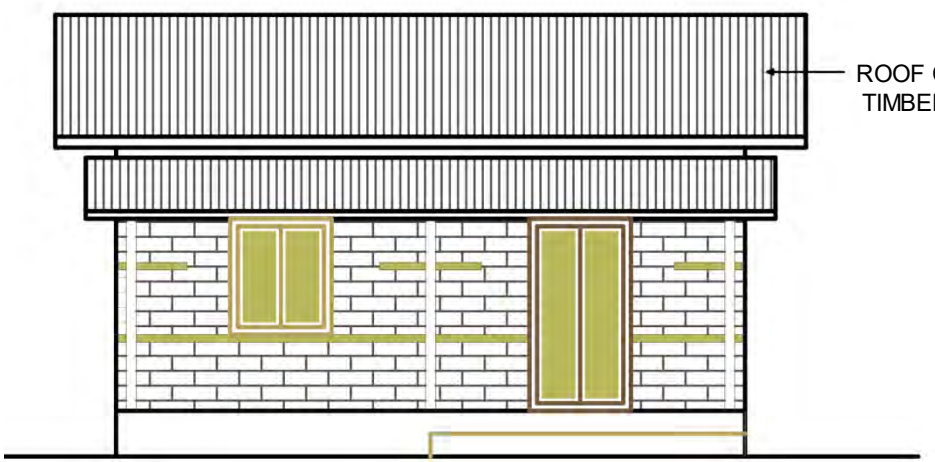


FLOOR PLAN
AREA: 31.75 SQ. M.

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: D.B.-12.1	SCALE: NONE	D.B.-12.1
	DRAWING TITLE: FLOOR PLAN	DATE:	2/8

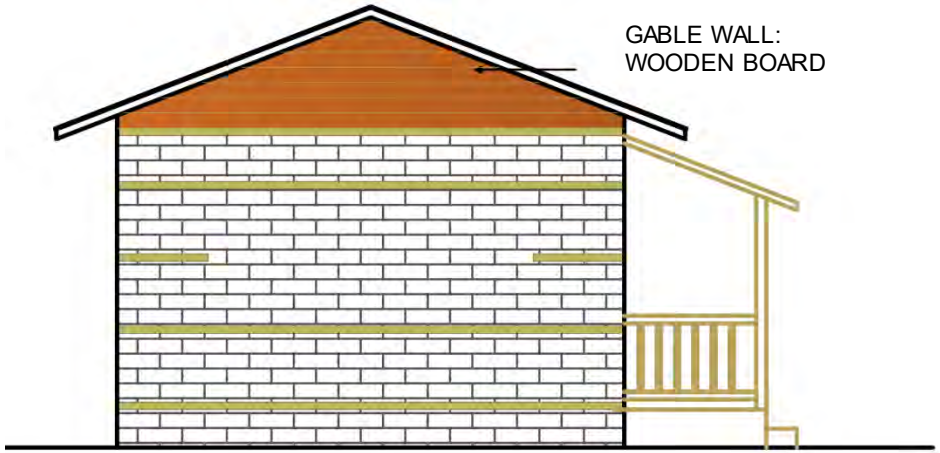
MODEL 12.1, DEBRIS BLOCK MASONRY

ONE STOREY

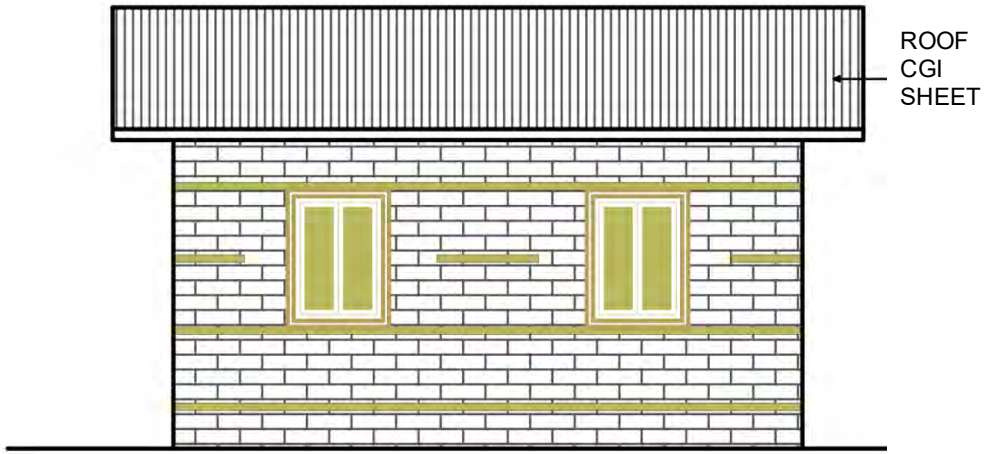


FRONT ELEVATION

SIDE ELEVATION



SIDE ELEVATION

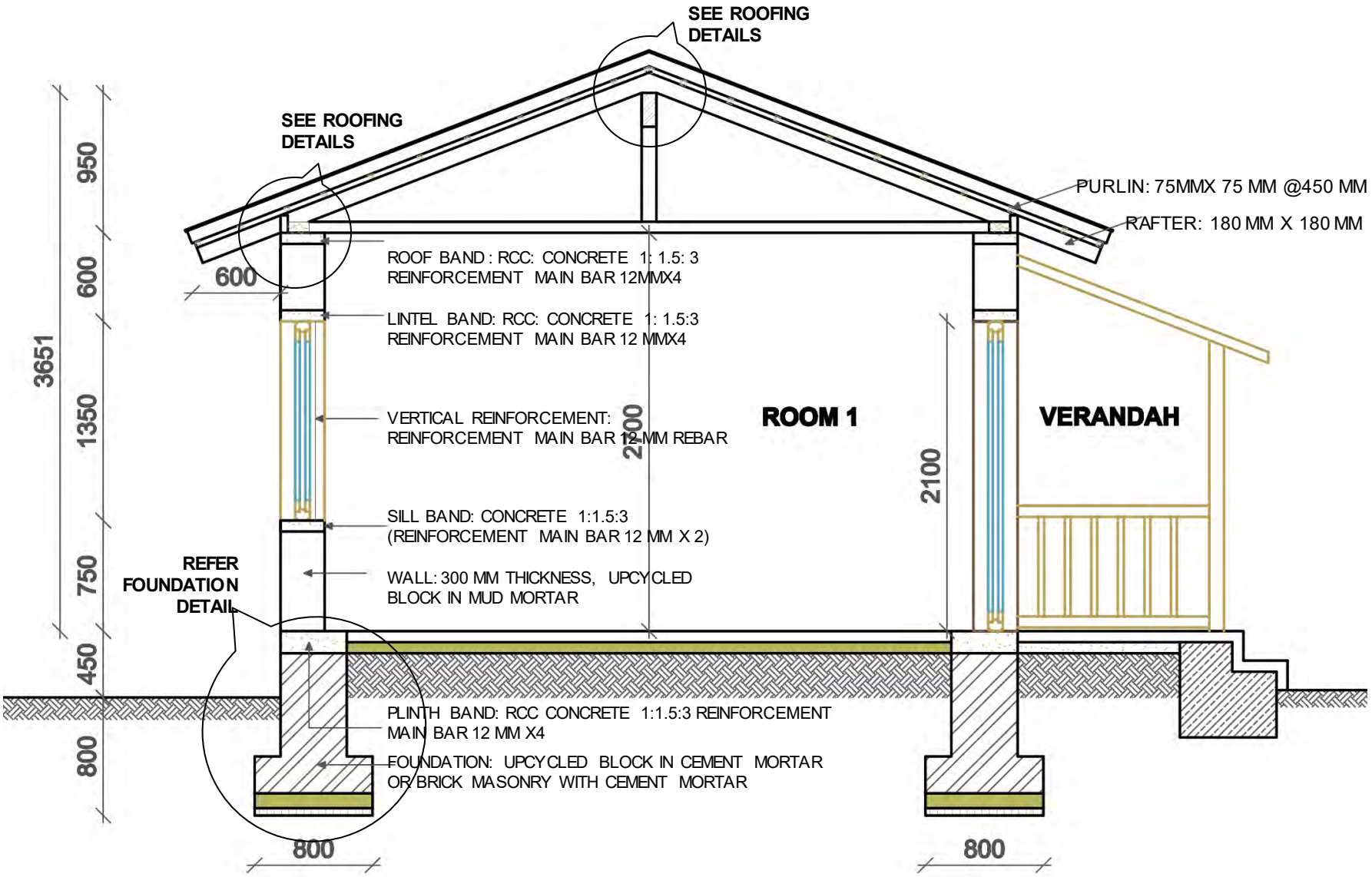


BACK ELEVATION

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: D.B.-12.1	SCALE: NONE	D.B.-12.1
	DRAWING TITLE: ELEVATIONS	DATE:	3/8

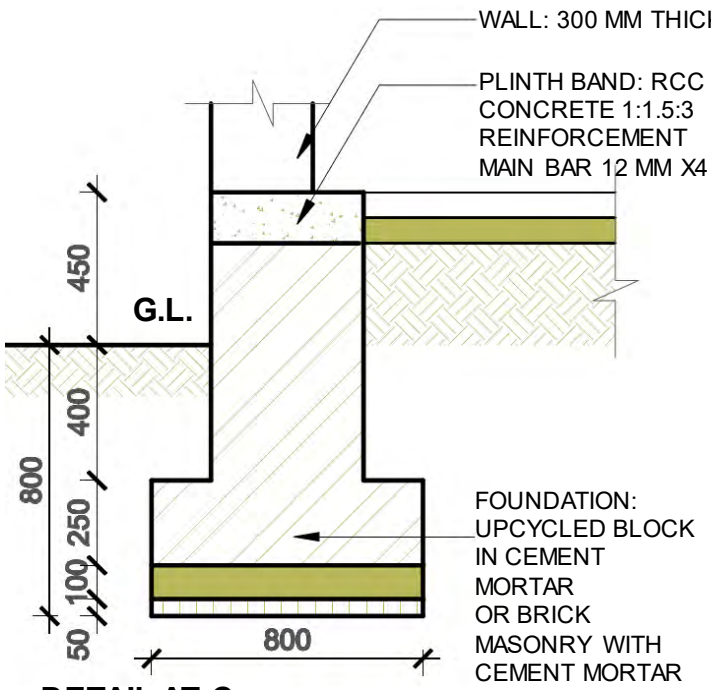
MODEL 12.1, DEBRIS BLOCK MASONRY

ONE STOREY



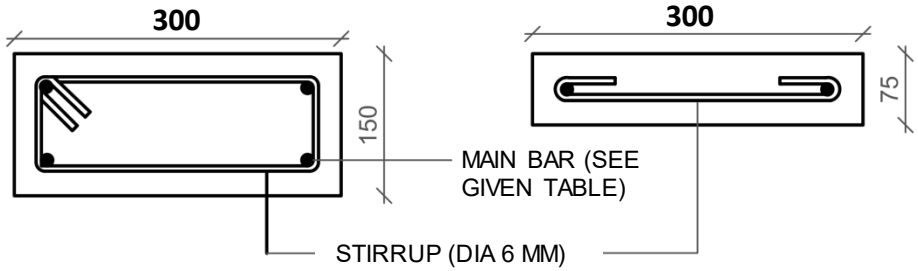
SECTION AT A-A

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: D.B.-12.1	SCALE: NONE	D.B.-12.1
	DRAWING TITLE: SECTION	DATE:	4/8

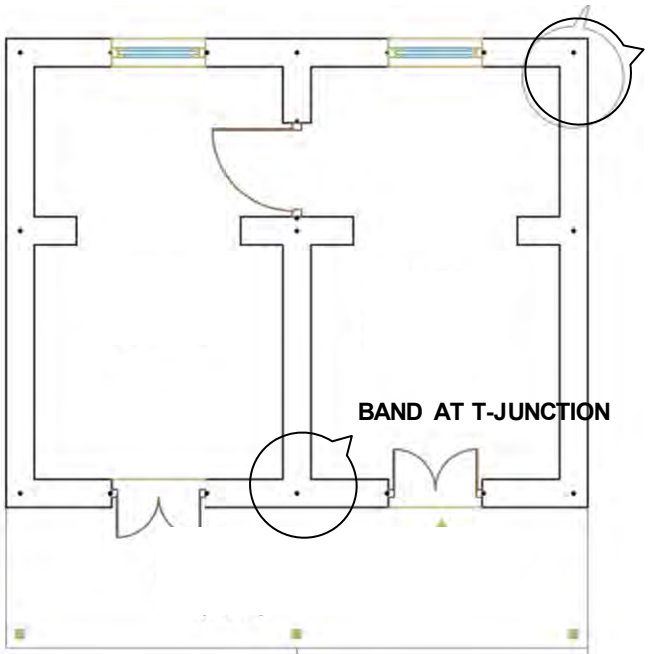


DETAIL AT C
FOUNDATION SECTION

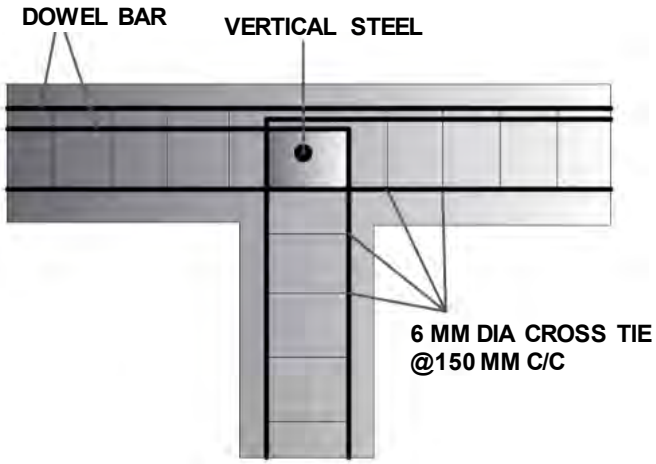
BAND/BEAM	RC BAND MIN. THICKNESS	MIN. NO. OF BAR	MIN. DIA OF BAR
PLINTH	150 MM	2	12
SILL	75 MM	2	10
LINTEL	75 MM	2	12
	150 MM	2	10 (top)
		2	12 (bottom)
ROOF	75 MM	2	12
	300 MM	4	12
DOWEL (STITCH)	75 MM	2	8



PLINTH BAND

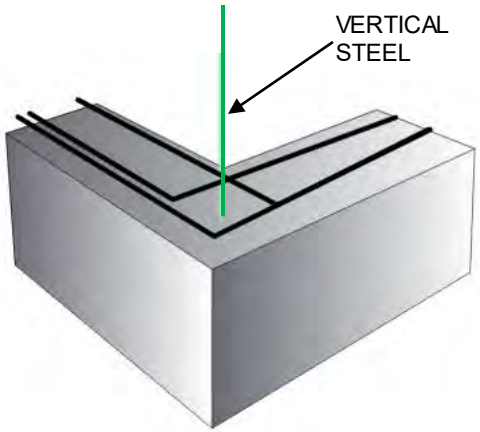


VERTICAL REINFORCEMENT ON CORNERS & JOINTS

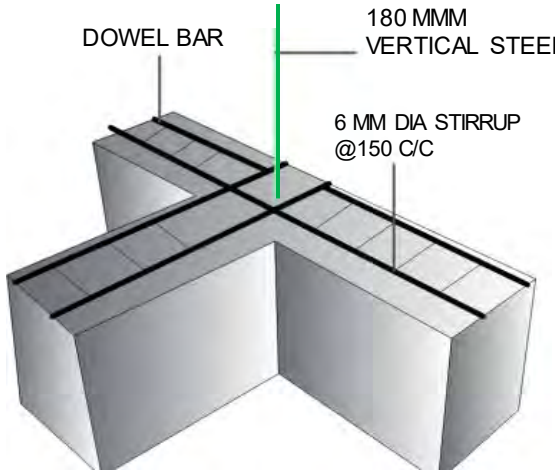


PLAN

PLAN

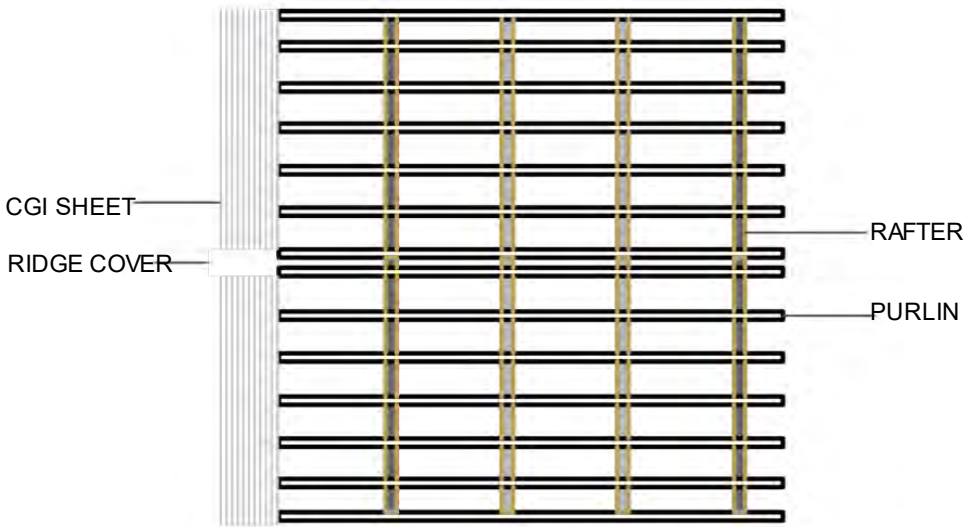


RCC BAND AT CORNER

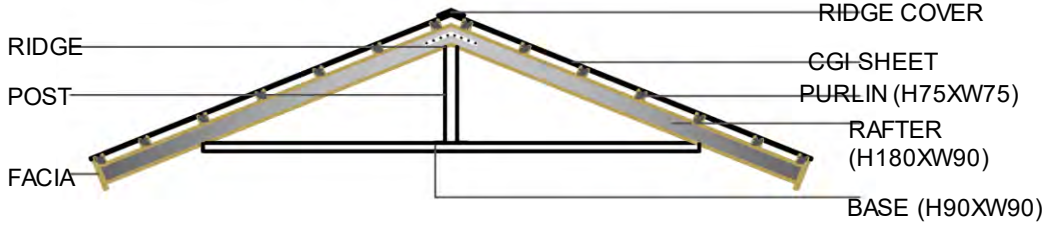


RCC BAND AT T-JUNCTION

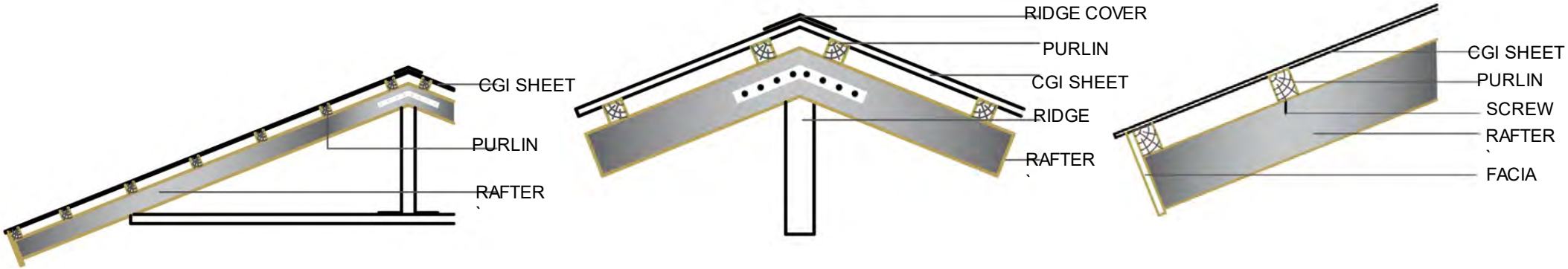
MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: D.B.-12.1	SCALE: NONE	D.B.-12.1
	DRAWING TITLE: STRUCTRAL DETAILS	DATE:	6/8



PLAN VIEW



SIDE VIEW



ROOFING DETAIL

MINISTRY OF URBAN DEVELOPMENT DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION	HOUSING TYPE: D.B.-12.1	SCALE: NONE	D.B.-12.1
	DRAWING TITLE: ROOFING DETAILS	DATE:	7/8

MODEL 12.1, DEBRIS BLOCK MASONRY — ONE STOREY

Structure System	Load bearing stone/brick debris block masonry in mud mortar
Foundation	Strip Foundation with brick/ debris block masonry in mud mortar. The depth and width of foundation shall be 800mm.
Plinth Band	R.C.C (1:1.5:3) plinth band of size 350 x 150 mm. Main reinforcement shall be 4 nos. of 12mm dia. bars with 6mm Ø stirrups at 150mm C/C.
Wall System	The debris blocks used shall be of good quality and have strength as mentioned in material properties. The thickness of wall shall be greater than or equal to 300mm.
Sill Band	RCC (1:1.5:3) sill band shall be provided throughout the entire wall at the bottom level of the openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos.12mm dia. bars with 6 mm Ø stirrups at 150mm C/C.
Lintel Band:	RCC (1:1.5:3) lintel band shall be provided throughout the entire wall at the top level of the openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2nos.12mm dia. bars with 6mm Ø stirrups at 150mm C/C or as specified in the details.
Roof Band:	RCC (1:1.5:3) roof band shall be provided throughout the entire wall at roof level. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos. 12mm dia. bars with 6mm Ø stirrups at 150mm C/C.
Roof System:	Light roof timber truss with CGI sheet roofing. All members of the truss or joints shall be properly connected as shown in detail drawings.

PERSONNEL INVOLVED IN PREPARATION OF THIS CATALOGUE

DUDBC (HOUSING DIVISION)

D.D.G. RAM CHANDRA DANGAL
ER. RABI SHAH (FORMER D.D.G.)
S.D.E. HIMAL K.C
S.D.E. PRATIGYA MANANDAR
S.D.E. RAJU NEUPANE
AR. JEETA GURUNG
SUB-ER. PURNA RAJTHALA
COM. OP. RAM KRISHNA KHATRI

STRUCTURAL EXPERT

PROF. DR. PREM NATH MASKEY
DR. PURUSHOTTAM DONGOL

TECHNICAL WORKING GROUPS

S.D.E. MACHAKAJI MAHARJAN
S.D.E. MANOJ NAKARMI
S.D.E. GANESH KARMACHARYA
ER. SURENDRA VAIDYA
ER. DEVENDRA DEV KHANAL
ER. PRATIK PRADHAN

CLPIU

S.D.E. PARIKSHIT KADARIYA (DEPUTY PROJECT DIRECTOR)
ER. BIPIN KUMAR GAUTAM (STRUCTURAL ENGINEER)
ER. DIPENDRA ARYAL (CIVIL ENGINEER)
AR. KRISHNA LAXMI MAHARJAN
AR. KOPILA WAGLE
AR. POOJA SHAH
AR. PRABINA POKHAREL
AR. SMRITI UPADHYAY
AR. SHAMI ADHIKARI

AGENCIES/ PERSONNEL SUBMITTING PROPOSAL

AR. ASHISH SHARAN LAL
NATIONAL CENTRE FOR PEOPLE'S ACTION IN DISASTER PREPAREDNESS (NCPDP-INDIA) / UNITED NATION DEVELOPMENT PROGRAM (UNDP-NEPAL)
ASIAN INSTITUTE OF TECHNOLOGY (AIT)
BUILDCHANGE/ MERCYCORPS
ABARI NEPAL
MINERGY INITIATIVES
RANDOLPH LANGENBACH
SAMARACHANA NEPAL
ER. SHANKAR DHAKAL
CENTRAL OFFICE RE-ARCHITECTED AS A DATACENTER (CORD)
GOOD EARTH NEPAL
HABITAT FOR HUMANITY
PORTAL PREFAB
PI ENGINEERING
PANCHAKANYA GROUP
GO GREEN ENGINEERING
BUILDERS WITHOUT BORDERS
SHELTER AND LOCAL TECHNOLOGY DEVELOPMENT CENTER (SLTDC)
AAC ITTA UDHYOG PVT. LTD.
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
INTERNATIONAL GREEN DEVELOPERS
FUTURE WORKS
SEISMIC NEPAL
ARCHITECTURE AND DEVELOPMENT
BUILT UP NEPAL
UNITED NATION DEVELOPMENT PROGRAM (UNDP)
THE FAMILY OF MARTYRS SOCIETY
CREATIVE SERVICES PRIVATE LTD.
SUPER ECO-BRICK INNOVATIONS
INNO-TECH NEPAL PVT LTD.
STEADFAST COMPANIES