DESIGN CATALOGUE FOR RECONSTRUCTION OF EARTHQUAKE RESISTANT HOUSES

CATALOGUE FOR ALTERNATIVE CONSTRUCTION MATERIALS AND TECHNOLOGIES

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
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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)
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)
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.
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<th>MODEL NO.</th>
<th>PAGE NO.</th>
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<td>RAT TRAP BOND MASONRY</td>
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<td>DEBRIS BLOCK MASONRY</td>
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<td>STEEL STRUCTURE</td>
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<td>162-170</td>
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<td>DEBRIS BLOCK MASONRY</td>
<td>171-180</td>
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</table>
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

I.B.-1.1
I.B.-1.2
I.B.-1.3
### MODEL I.B.-1.1, INTERLOCKING BRICK MASONRY

**HOUSING TYPE:** I.B.-1.1  
**DRAWING TITLE:** ESTIMATE AND 3D-VIEW  
**SCALE:** NONE  
**DATE:** 1/5

#### MATERIALS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Stone Cu.m</th>
<th>Interlocking Bricks No.</th>
<th>Cement Cu.m</th>
<th>Sand Cu.m</th>
<th>Aggregate Cu.m</th>
<th>Reinforcing Bar Kg.</th>
<th>CGI sheet Sq.m</th>
<th>GI Sheet Cu.m</th>
<th>Wood Cu.m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to Plinth Level</td>
<td>8.4</td>
<td></td>
<td>39.9</td>
<td>5.3</td>
<td>3.2</td>
<td>112.1</td>
<td></td>
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<td></td>
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<tr>
<td>Super Structure</td>
<td>-</td>
<td>4,912.0</td>
<td>16.2</td>
<td>0.9</td>
<td>1.7</td>
<td>167.3</td>
<td></td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.5</td>
<td>6.5</td>
<td>0.9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8.4</td>
<td>4,912.3</td>
<td>56.1</td>
<td>6.1</td>
<td>4.9</td>
<td>279.4</td>
<td>3.5</td>
<td>6.5</td>
<td>1.0</td>
</tr>
</tbody>
</table>
GROUND FLOOR PLAN
FLOOR AREA: 20.16 SQ.M.

BEDROOM
2850 X 1950

LIVING ROOM
2250X 2400

KITCHEN
1500 X 2850

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

HOUSING TYPE: I.B.-1.1
DRAWING TITLE: SECTION

SCALE: NONE
DATE: 4/5
### TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Structure System</th>
<th>Reinforced Stabilized Interlocking Brick Masonry Structure with horizontal and vertical reinforcing bars in strategic locations.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foundation</strong></td>
<td>Strip Foundation of Stone Masonry in 1:6 cement sand mortar. Foundation size shall be of width 800mm and depth 800 mm (refer drawing).</td>
</tr>
<tr>
<td><strong>Plinth Band</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Wall</strong></td>
<td>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 &amp; Chips) ratio. Horizontal reinforcement requirement is stated in sill and lintel details below.</td>
</tr>
<tr>
<td><strong>Sill Band</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Lintel Band:</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Roof</strong></td>
<td>Lightweight roof of corrugated Iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing.</td>
</tr>
</tbody>
</table>
### Model I.B.-1.2, Interlocking Brick Masonry

#### Two Storey

![Model Image](image)

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Stone (Cu.m)</th>
<th>Interlocking Bricks (No.)</th>
<th>Cement (Cu.m.)</th>
<th>Sand (Cu.m.)</th>
<th>Aggregate (Cu.m.)</th>
<th>Reinforcing Bar (Kg.)</th>
<th>CGI Sheet (Bundle)</th>
<th>GI Sheet (Sq.m.)</th>
<th>Wood (Cu.m.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to Plinth Level</td>
<td>18.1</td>
<td></td>
<td>80.2</td>
<td>10.9</td>
<td>6.1</td>
<td>177.2</td>
<td></td>
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<tr>
<td>Super Structure</td>
<td>-</td>
<td>6,447.0</td>
<td>57.1</td>
<td>3.0</td>
<td>6.1</td>
<td>493.9</td>
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<td>Roofing</td>
<td>-</td>
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<td></td>
<td></td>
<td></td>
<td>4.2</td>
<td>8.7</td>
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<tr>
<td>TOTAL</td>
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<td>6,447.0</td>
<td>137.3</td>
<td>14.0</td>
<td>12.3</td>
<td>671.1</td>
<td>4.2</td>
<td>8.7</td>
<td>2.8</td>
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</tbody>
</table>

**Materials**
- Stone
- Interlocking Bricks
- Cement
- Sand
- Aggregate
- Reinforcing Bar
- CGI sheet
- GI Sheet
- Wood
MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY
TWO STOREY

GROUND FLOOR PLAN
AREA: 40.36 SQ.M.

FIRST FLOOR PLAN
AREA: 40.36 SQ.M.
MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY

SIDE ELEVATION

FRONT ELEVATION

SIDE ELEVATION

BACK ELEVATION

HOUSING TYPE:  I.B.-1.2

DRAWING TITLE:  ELEVATIONS

I.B.-1.2

DATE:  3/5
MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY

HOUSING TYPE: I.B.-1.2
DRAWING TITLE: SECTION

SCALE: NONE
DATE: 4/5

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

WOODEN OR RCC CONCRETE FLOOR

150 MM INTERLOCKING BRICK WALL GROUTED WITH MICRO-CONCRETE OF CEMENT, SAND AND CHIPS (1:2:3)

26 GAUGE CGI ROOFING MATERIALS
75MM X 75MM BATTENS @ 300MM C/C
180MM X 90MM RAFTERS @ 600MM C/C

REFER ROOFING AND BAND DETAILS

REFER FOUNDATION DETAILS

2 LAYERS U-BLOCK WITH 12Φ HORIZONTAL REINFORCEMENT @ ROOF TIE LEVEL
2 LAYERS 12Φ HORIZONTAL REINFORCEMENT @ LINTEL
2 LAYERS U-BLOCK WITH 12Φ HORIZONTAL REINFORCEMENT @ SILL LEVEL
2 LAYERS U-BLOCK WITH 12Φ HORIZONTAL REINFORCEMENT @ BOTTOM WALL LEVEL

6 NOS. 10Φ REINFORCEMENT

150MM D.P.C BAND 12Φ VERTICAL REINFORCEMENT ANCHORED AT FOUNDATION

GRouted with micro-concrete of cement, sand and chips (1:2:3)
## TECHNICAL REQUIREMENTS

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</tr>
<tr>
<td>Plinth Band</td>
<td>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.</td>
</tr>
<tr>
<td>Wall</td>
<td>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 &amp; Chips) ratio. Horizontal reinforcement requirement is stated in sill and lintel details below.</td>
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<td>Sill Band</td>
<td>2 layers of special U shaped Interlocking bricks shall be used in Sill 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.</td>
</tr>
<tr>
<td>Lintel Band</td>
<td>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.</td>
</tr>
<tr>
<td>Floor</td>
<td>50 mm thick cast in Situ Micro concrete over precast pans and precast concrete joists of 50mm x 200 mm.</td>
</tr>
<tr>
<td>Roof</td>
<td>Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing.</td>
</tr>
</tbody>
</table>
MODEL I.B.-1.1 AND I.B.-1.2, INTERLOCKING BRICK MASONRY

Housing Type: I.B.1.1 and I.B. 1.2

Drawing Title: Structural Details

Foundation of Stone Masonry in Cement Mortar

Roof, Lintel and Sill Level

Foundation of Stone
- 3" P.C.C
- Flat Brick Soling
- Compacted Earth

Mortar Layer under 1st Layer of Brick to Make It Perfectly Horizontal

6 Nos. 10-12Φ Reinforcement

150mm D.P.C Band

12mm Φ Vertical Reinforcement Anchored at Foundation Covered in 1:4 Cement Mortar with Min. 25mm Cover

3" P.C.C

150mm Stone Soling

Compacted Earth

U-Block with 12Φ Horizontal Reinforcement @ Roof Tie Level

2 Layers 12Φ Horizontal Reinforcement @ Lintel

2 Layers 12Φ Horizontal Reinforcement @ Sill
MODEL I.B.-1.1 AND I.B.-1.2 , INTERLOCKING BRICK MASONRY

TYPICAL ELEVATION (REBAR DETAIL IN WALL)

- 2 NO. S OF 12 Ø HORIZONTAL REBAR AT LINTEL LEVEL THROUGH OUT WALL SECTION
- 2 NO. S OF 12 Ø HORIZONTAL REBAR AT SILL LEVEL THROUGH OUT WALL SECTION
- 2 NO. S 12 Ø VERTICAL REBAR AT BOTH SIDES OF OPENING

- REGULAR FULL BRICK
- REGULAR HALF BRICK
- LATERAL FULL LOCK BRICK
- U FULL BRICK
- U HALF BRICK
- LATERAL U FULL LOCK BRICK

HOUSING TYPE: I.B.1.1 AND I.B. 1.2
DRAWING TITLE: STRUCTURAL DETAILS
SCALE: NONE
DATE: 2/8
MODEL I.B.-1.1, INTERLOCKING BRICK MASONRY

2 NO.S OF 12 Ø VERTICAL REBAR AT EACH SIDE OF WINDOW

2 NO.S OF 12 Ø VERTICAL REBAR AT EACH SIDE OF DOOR

4 NO.S OF 12 Ø VERTICAL REBAR AT T-JUNCTION

MIN 3 NO.S OF 12 Ø VERTICAL REBAR AT L-CORNER

2 NO.S OF 12 Ø VERTICAL REBAR AT EACH SIDE OF DOOR

NOTE:
GROUTING FOR THE HOLE IS DONE WITH MORTAR

FRAMING PLAN (REBAR DETAIL)

HOUSING TYPE: I.B.1.1
DRAWING TITLE: STRUCTURAL DETAILS
SCALE: NONE
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

2 NO.S OF 12MM Ø VERTICAL REBAR AT EACH SIDE OF WINDOW

4 NO.S OF 12MM Ø VERTICAL REBAR AT T-JUNCTION

2 NO.S OF 12MM Ø VERTICAL REBAR AT EACH SIDE OF OPENING

12MM Ø VERTICAL REBAR AT > 1.5M C/C

8MM Ø HORIZONTAL REBAR AT PLINTH, SILL, LINTEL & ROOF LVL BANDS

8MM Ø HORIZONTAL REBAR LAPPING

MIN 3 NO.S OF 12MM Ø VERTICAL REBAR AT CORNER

NOTE:
GROUTING FOR THE HOLE IS DONE WITH MORTAR
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)
MODEL I.B.-1.1 AND I.B.-1.2, INTERLOCKING BRICK MASONRY

TYPICAL DETAIL @ WINDOW OPENING

2 NO.S OF 12MM Ø VERTICAL REBAR AT EACH SIDE OF WINDOW

2 NO.S OF 12MM Ø HORIZONTAL REBAR AT LINTEL LVL

TYPICAL DETAIL @ DOOR OPENING

2 NO.S OF 12MM Ø VERTICAL REBAR AT EACH SIDE OF DOOR

2 NO.S OF 12MM Ø HORIZONTAL REBAR AT LINTEL LVL

2 NO.S OF 12MM Ø HORIZONTAL REBAR AT SILL LVL

TYPICAL DETAIL @ WINDOW OPENING

TYPICAL DETAIL @ DOOR OPENING

18
MODEL I.B.-1.1 AND I.B.-1.3, INTERLOCKING BRICK MASONRY

HOUSING TYPE: I.B.1.1 AND I.B. 1.2
DRAWING TITLE: ROOF DETAILS

SCALE: NONE
DATE: 7/8

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: I.B.1.1 AND I.B. 1.2
DRAWING TITLE: ROOF DETAILS

DETAIL AT-X

GABLE BAND

PLAN

DETAIL AT-Y

75X75MM PURLIN @300MM C/C
180X90MM RAFTER @600MM C/C
100X75MM WALL PLATE
J-HOOK
EAVES BOARD

CGI SHEET

ROOF BAND

MASONRY WALL

GABLE BAND

WOODEN NAIL

WOODEN KEY

RAFTER

75X100MM WALL PLATE

CGI RIDGE

75 X 125 RIDGE PIECE
WOODEN POST

RAFTER

NAIL

RIDGE PIECE

RIDGE PIECE
MODEL I.B.-1.3, INTERLOCKING BRICK MASONRY

INTERIOR VIEW OF THE FINISHED JOIST AND PAN CAST IN SITU

25mm x 25mm steel square tube
200mm x 50mm joists @ 600mm c/c
600mm x 600mm pans of 10mm thickness in between joists (micro concrete formwork)

200mm x 50mm joists @ 600mm c/c
600mm x 600mm pans of 10mm thickness in between joists (micro concrete formwork)
25mm x 25mm steel square tube
Placing of Reinforcement mesh of 8φ @ 150mm c/c

1" x 5" edge mold
Drive nails into horizontal joints
U-shaped bricks
Wood braces for placing of concrete pan
Wood braces

REINFORCEMENT DETAILS IN CONCRETE JOISTS SPAN UPTO 5M
**LEVEL** | **Stone** | **Interlocking Bricks** | **Cement** | **Sand** | **Aggregate** | **Reinforcing Bar** | **Clay Tile** | **Clay Tile Ridge** | **Wood** |
---|---|---|---|---|---|---|---|---|---|
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 | - | - | - |
Roofing | - | - | - | - | - | - | - | - | - |
**TOTAL** | 33.5 | 5,756.0 | 142.0 | 19.2 | 9.0 | 1,021.3 | 1,579.3 | 282.0 | 3.1 |
MODEL I.B.-1.3, INTERLOCKING BRICK MASONRY

FRONT ELEVATION

BACK ELEVATION

SIDE ELEVATION

SIDE ELEVATION

HOUSING TYPE: I.B.-1.3
DRAWING TITLE: ELEVATIONS

SCALE: NONE
DATE: 3/6

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION

I.B.-1.3
MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY

Housing Type: I.B.-1.3

Drawing Title: Section

Scale: None

Date: 4/6

Ministry of Urban Development
Department of Urban Development and Building Construction

One Storey

Model I.B.-1.2, Interlocking Brick Masonry

- Drawing Title: Section
- Scale: None
- Date: 4/6

Material Details:
- 26 Gauge CGI Roofing Materials
- 75mm x 75mm Battens @ 300mm C/C
- 180mm x 90mm Rafters @ 600mm C/C
- 150mm Interlocking Brick Wall Grouted with Micro-Concrete of Cement, Sand and Chips (1:2:3).

Refer Roofing Details

Refer Foundation Details

Section at A-A

26 Gauge CGI Roofing Materials
75mm x 75mm Battens @ 300mm C/C
180mm x 90mm Rafters @ 600mm C/C

150mm Interlocking Brick Wall Grouted with Micro-Concrete of Cement, Sand and Chips (1:2:3).

KITCHEN
LIVING ROOM
DECK

G.L.
MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: I.B.-1.3
DRAWING TITLE: DETAILS

SCALE: NONE
DATE: 5/6

PLINTH BAND SECTION

PLINTH BAND (450MMX150MM)
STONE MASONRY IN CEMENT MORTAR (1:4)

SILL/LINTEL/ROOF BAND SECTION

80 LINKS @ 150C/C
80 LINKS @ 6"C/C

GABLE BAND

MASONRY WALL

FOUNDATION DETAIL

ROOFING DETAILS

PLINTH LEVEL

G.L.

GABLE BAND

75X75MM PURLIN @300MM C/C
180X90MM RAFTER @600MM C/C
100X75 MM WALL PLATE

CGI SHEET
75X75MM PURLIN @300MM C/C
180X90MM RAFTER @600MM C/C
100X75 MM WALL PLATE

WOODEN NAIL
WOODEN KEY
RAFTER

EAVES BOARD
X

J-HOOK

ROOFING DETAILS

DETAIL AT-X

3- 100 Hz.
2- 100 Hz.
## TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Structure System</th>
<th>Reinforced Stabilized Interlocking Brick Masonry Structure with horizontal and vertical reinforcing bars in strategic locations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>Strip Foundation of Stone Masonry in 1:4 cement sand mortar. Foundation size is width 900mm and depth 900 mm (refer drawing).</td>
</tr>
<tr>
<td>Plinth Band</td>
<td>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.</td>
</tr>
<tr>
<td>Wall</td>
<td>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 &amp; chips) ratio. Horizontal reinforcement requirement is stated in sill and lintel details below.</td>
</tr>
<tr>
<td>Sill Band</td>
<td>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.</td>
</tr>
<tr>
<td>Lintel Band</td>
<td>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.</td>
</tr>
<tr>
<td>Roof</td>
<td>Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing.</td>
</tr>
</tbody>
</table>
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 X 20cm
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
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY  
TWO STOREY

Housing Type: Model C.H.C.-2.1

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>MATERIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stone</td>
</tr>
<tr>
<td></td>
<td>Hollow Concrete Bricks</td>
</tr>
<tr>
<td></td>
<td>Cement</td>
</tr>
<tr>
<td></td>
<td>Sand</td>
</tr>
<tr>
<td></td>
<td>Aggregate</td>
</tr>
<tr>
<td></td>
<td>Reinforcing Bar</td>
</tr>
<tr>
<td></td>
<td>CGI sheet</td>
</tr>
<tr>
<td></td>
<td>GI Sheet</td>
</tr>
<tr>
<td></td>
<td>Wood</td>
</tr>
<tr>
<td>Cu.m</td>
<td>No.</td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>30.3</td>
</tr>
<tr>
<td>Super Structure</td>
<td>-</td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30.3</td>
</tr>
</tbody>
</table>
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

HOUSING TYPE: MODEL C.H.C.-2.1
DRAWING TITLE: FLOOR PLANS
SCALE: NONE
DATE: 2/11

TWO STOREY

GROUND FLOOR PLAN
FLOOR AREA: 43.71 SQ.M.

FIRST FLOOR PLAN
FLOOR AREA: 43.71 SQ.M.

ROOM 1
3200 X 3020

ROOM 2
3200 X 3020

ROOM 3
3200 X 3020

PORCH
1050 X 9660

100 MM x 100 MM
WOOD POST

150 MM x 150 MM
REINFORCED
CONCRETE TIE COLUMN TYP

150 MM HOLLOW CONCRETE
MASONRY WALL TYP

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C.H.C.-2.1

30
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

FRONT ELEVATION

SIDE ELEVATION

SIDE ELEVATION

BACK ELEVATION

HOUSING TYPE: MODEL C.H.C.-2.1
DRAWING TITLE: ELEVATIONS

SCALE: NONE
DATE:
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

TWO STOREY

MINISTRY OF URBAN DEVELOPMENT

DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: MODEL C.H.C.-2.1

SCALE: NONE

DRAWING TITLE: SECTION

DATE:

C.H.C.-2.1

4/11

REFER FOUNDATION DETAILS

150MM HOLLOW CONCRETE MASONRY WALL IN CEMENT MORTAR (1:5)

WOOD JOIST

WOOD BEAM

CAPITAL

REFER BAND DETAILS

REFER TRUSS DETAIL

REFER ROOF TRUSS DETAIL

SECTION A-A
STONE SOLING WITH SAND

STONE MASONRY FOUNDATION

P.C.C. 1:2:4

STONE MASONRY FOUNDATION

COMPACTED FILL

COMPACTED FILL

SECTION OF INTERIOR FOUNDATION

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

TWO STOREY

HOUSING TYPE: MODEL C.H.C.-2.1

DRAWING TITLE: DETAILS

SCALE: NONE

DATE: C.H.C.-2.1 5/11

FOUNDATION DETAILS

FOUNDATION SECTION OF COLUMN POST

120 MM ROD DOWELED INTO CENTRE OF THE POST

2 LAYERS 26 GAUGE FLATTENED CGI STRAP EMBEDDED IN PLINTH BEAM AND CONNECTED TO TIMBER POST

2 - 75 MM LONG NAILS CONNECTING STRAP AND WOODEN POST (4 TOTAL)

GROUT AROUND THE CONNECTION BETWEEN WOOD POST AND BEAM

MORTAR OR CONCRETE COVER TO PROTECT BAR

12MMØ COLUMN BARS

6MMØ STIRRUPS

8Ø STIRRUP AT 100 MM C/C

PLINTH BEAM 200MM X 150MM

200MM COMPACTED FILL

150MM COMPACTED FILL

350

450

50 200

75

150

200
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

HOUSING TYPE: MODEL C.H.C.-2.1
DRAWING TITLE: DETAILS

TYPICAL COLUMN SECTION: FROM GL TO FIRST FLOOR

- 12MM∅ BARS
- 6MM∅ STIRRUPS
- 100MM X 100MM WOODEN COLUMN POST
- 200 MM X 200 MM FLOOR BEAM

TYPICAL COLUMN SECTION: FROM FIRST FLOOR TO ROOF

- 2 LAYERS OF CGI STRAP
- 37.5MM GUSSET PLATE
- 200 MM X 200 MM ROOF BEAM
- 100MM X 100MM WOODEN COLUMN POST

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

SCALE: NONE
DATE: 6/11

C.H.C.-2.1

6/11
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY
TWO STOREY

Housing Type: MODEL C.H.C.-2.1
Drawing Title: Details
Scale: None
Date: 7/11

Internal Column

External Column

8mm Ø @ 200mm C/C Both Ways

50mm X 50mm Wood Joist at 300mm C/C

100mm Slab Thickness

Slab Detailing for Bars

8mm Ø @ 200mm C/C Both Ways

Hook into Beam
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

SILL/ LINTEL BAND

PLINTH BAND

COLUMN PLAN

SILL/LINTEL BAND

PLINTH BAND

COLUMN PLAN

LONGITUDIONAL SECTION OF SLAB X-X

TRaverse SECTIOn OF SLAB Y-Y
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

TWO STOREY

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: MODEL C.H.C.-2.1
DRAWING TITLE: DETAILS

SCALE: NONE
DATE: 9/11

CGI SHEET
50x50 PURLIN, TYPE

C.1

C.2

C.3

C.4

C.5

C.6

195 MM HOLLOW BLOCK MASONRY WALL

50X100 MM RAFTER

37.5MM GUSSET PLATE

50X100 MM RAFTER

2 LAYERS OF GAUGE FLATTENED CGI STRAP (30 MM LONG)

50X50 PURLIN

32.5MM GUSSET PLATE

75MM LONG NAILS B/W STRAP AND RAFTER ON EACH SIDES (4 TOTAL)

3D VIEW CGI STRAP CONNECTION

2 LAYERS OF 26 GAUGE FLATTENED CGI STRAP

WRAP OVER TRUSS AND DOWN OPPOSITE FACE EACH SIDE

2-75 MM LONG NAILS ON EITHER SIDE CONNECTING THE CGI STRAP AND WOODEN GUSSET PLATE (4 TOTAL)

1-75MM LONG NAILS B/W STRAP AND RAFTER ON EACH SIDES

250X200 CONCRETE BEAM

195 MM HOLLOW BLOCK MASONRY WALL

2 LAYERS OF CGI STRAP

50X100MM RAFTER

2 LAYERS OF 26 GAUGE FLATTENED CGI STRAP

2 50X100MM RAFTER

2 75MM LONG NAILS ON EITHER SIDE CONNECTING THE CGI STRAP AND WOODEN GUSSET PLATE (4 TOTAL)

32.5MM GUSSET PLATE

50X100MM RAFTER

2 LAYERS OF CGI STRAP

32.5MM GUSSET PLATE

2 75MM LONG NAILS ON EITHER SIDE CONNECTING THE CGI STRAP AND WOODEN GUSSET PLATE (4 TOTAL)

CGI SHEET

75MM LONG NAIL B/W STRAPS AND RAFTER

2 75MM LONG NAILS ON EITHER SIDE CONNECTING THE CGI STRAP AND WOODEN GUSSET PLATE (4 TOTAL)

195 MM HOLLOW BLOCK MASONRY WALL

2 75MM LONG NAILS ON EITHER SIDE CONNECTING THE CGI STRAP AND WOODEN GUSSET PLATE (4 TOTAL)

50X100MM RAFTER

PLAN

32.5MM GUSSET PLATE

200X200MM RING BEAM

200X200MM RING BEAM

75MM LONG NAIL B/W STRAPS AND RAFTER

75MM LONG NAIL B/W STRAPS AND RAFTER

ALL DIMENSIONS ARE IN MM
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

HOUSING TYPE: MODEL C.H.C.-2.1

SCALE: NONE

C.H.C.-2.1

10/11

MEMBER 4 (100x50 BOTTOM TIE)

MEMBER 5 (50x50 MM DIAGONAL WEB)

MEMBER 6 (50x50 MM DIAGONAL WEB)

MEMBER 7 (100x50 BOTTOM TIE)

MEMBER 3 (50x50) KING POST

2-75MM LONG NAILS ON EITHER SIDEOf EACH DIAGONAL WEB

2-75 LONG NAILS ON EITHER SIDE OF KING POST

37.5MM THICK GUSSET PLATE ON EITHER SIDE

6-75MM LONG NAILS ON EITHER SIDE OF EACH BOTTOM

37.5 MM THICK GUSSET PLATE (2 NO.S)

50X50 MM KING POST

50X50 MM DIAGONAL WEB

100X50MM BOTTOM TIE

6-75 MM LONG NAILS ON EITHER SIDE OF BOTTOM TIE (12 NO.S)

DIAGONAL WEB

CUT PORTION

CUT PORTION

CUT PORTION

DETAIL AT CONNECTION 2

DETAIL OF GUSSET PLATE

ALIGMENT OF GRAIN

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

DRAWING TITLE: DETAILS

DATE:
**TECHNICAL REQUIREMENTS**

<table>
<thead>
<tr>
<th><strong>Structure System</strong></th>
<th>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. Tooothing shall be ensured for proper connection between wall and tie columns.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foundation</strong></td>
<td>Strip foundation with stone masonry casing the tie column. The depth and width of footing shall be 900mm.</td>
</tr>
<tr>
<td><strong>Plinth Band</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Wall System</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Sill Band</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Lintel Band</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Floor Beam</strong></td>
<td>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</td>
</tr>
<tr>
<td><strong>Floor</strong></td>
<td>100 mm thick reinforced concrete slab as shown in detail drawing.</td>
</tr>
<tr>
<td><strong>Roof</strong></td>
<td>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.</td>
</tr>
</tbody>
</table>
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/mm²
Grade of Steel: Fe 500Mpa
Nominal Mix Ratio: 1:1.5:3 (C:S:A)
**MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY**

**TWO STOREY**

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Hollow Concrete Bricks</th>
<th>Cement</th>
<th>Sand</th>
<th>Aggregate</th>
<th>Reinforcing Bar</th>
<th>Polythene sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Bags</td>
<td>Cu.m.</td>
<td>Cu.m.</td>
<td>Kg.</td>
<td>Sq.m</td>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>447.0</td>
<td>99.3</td>
<td>6.1</td>
<td>12.1</td>
<td>864.6</td>
<td>19.7</td>
</tr>
<tr>
<td>Super Structure</td>
<td>2,398.0</td>
<td>162.8</td>
<td>8.6</td>
<td>17.5</td>
<td>1,677.3</td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td>2,845.0</td>
<td>262.1</td>
<td>14.7</td>
<td>29.6</td>
<td>2,541.9</td>
<td>19.7</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>2,845.0</strong></td>
<td><strong>262.1</strong></td>
<td><strong>14.7</strong></td>
<td><strong>29.6</strong></td>
<td><strong>2,541.9</strong></td>
<td><strong>19.7</strong></td>
</tr>
</tbody>
</table>

**MATERIALS**

- Hollow Concrete Bricks
- Cement
- Sand
- Aggregate
- Reinforcing Bar
- Polythene sheet

**LEVEL**

- Up to Plinth Level
- Super Structure
- Roofing

**ESTIMATE AND 3D VIEW**

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**MINISTRY OF URBAN DEVELOPMENT**

**DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION**

**HOUSING TYPE: MODEL H.C.B.-3.1**

**DRAWING TITLE: ESTIMATE AND 3D-VIEW**

**SCALE: NONE**

**DATE:** HCB-3.1 1/9
MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY

GROUND FLOOR PLAN
AREA: 24.7 SQ.M.

FIRST FLOOR PLAN
AREA: 24.7 SQ.M.

Housing Type: MODEL H.C.B.-3.1
Drawing Title: FLOOR PLANS
Scale: NONE
Date: 2/9

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDING CONSTRUCTION

KITCHEN/DINING
3400x2400

TOILET
900x1100

DRAWING ROOM
2400x3500

CHILDREN’S ROOM
3400 X 2400

PARENT'S ROOM
2400 X 3500
MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY

HOUSING TYPE: MODEL H.C.B.-3.1

DRAWING TITLE: SECTION

SCALE: NONE

DATE: 3/9

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

CANTILEVER PANEL

LINTEL BAND

U-SHAPE BLOCK FOR SILL BAND

LINTEL BAND

200 MM HOLLOW CONCRETE BLOCK WALL IN CEMENT CONCRETE (1:5).

REFER FOUNDATION DETAIL

REFER BEAM DETAIL

REFER STAIRCASE DETAIL

SECTION AT A-A

CEMENT PUNNING FINISHING
38MM THK. CAST IN SITU CONCRETE (M20)
50MM THK. PRECAST PANEL

TERRACE

FLOOR FINISHING
38MM THK. CAST IN SITU CONCRETE (M20)
50MM THK. PRECAST PANEL

ROOM

TOILET

KITCHEN

STAIRS

REFER BEAM DETAIL

50MM TK. SCREED/PUNNING
100MM K. CSEB BLOCKS
500 GAUGE PLASTIC LAY
WELL COMPACTED EARTH

TERRACE

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

Housing Type: MODEL H.C.B.-3.1

Drawing Title: ELEVATIONS

Scale: None

Date: 4/9

Ministry of Urban Development
Department of Urban Development and Building Construction
MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY

TWO STOREY

HOUSING TYPE: MODEL H.C.B.-3.1
DRAWING TITLE: DETAILS

SCALE: NONE
DATE: 5/9

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

FOUNDATION DETAIL

RCC STRIP FOUNDATION
(M20)
25MM TK. SAND FILLING AND COMPACTION
WELL COMPACTED EARTH

PRECAST BEAM
PRECAST SLAB PANEL

BEAM AND SLAB DETAILS

4.75MM Ø TEMPERATURE FLANGE RODS @ 300MM C/C OVER BEAMS

38MM THK. CAST IN SITU (M20) CONCRETE

4.75MM Ø TEMPERATURE FLANGE RODS @ 300MM C/C OVER BEAMS

HOLLOW BLOCK WALL IN 1:4 C/S MORTAR

6MM Ø STIRRUPS @ 400MM C/C

8 MM Ø @ 200MM C/C

4 NO. OF 8 MM Ø

2 - 8 MM Ø
M20 CONCRETE
HOLLOW BLOCK WALL

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

TWO STOREY

PRECAST BEAM CROSS SECTION

LONGITUDINAL SECTION OF LINTEL BEAM

CONCRETE SLAB
HOLLOW BLOCKS FILLED WITH M20 CONCRETE
M20 CONCRETE LINTEL BAND

4.75MM Ø STIRRUP:
3 NO. - 10MM Ø REBARS

7 MM Ø STIRRUPS @ 400MM C/C
1- 8 MM Ø REBAR
3- 8 MM Ø REBAR

4.75mm Ø stirsups@ 4"c/c:
2-10 MM Ø REBAR

1- 10 MM Ø REBAR
2800

600
1600

4.75mm Ø stirsups@ 4"c/c

2-10 MM Ø REBAR

3-10 MM Ø REBAR

LONGITUDINAL SECTION OF PRECAST BEAM
MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY

TWO STOREY

SLAB(S1) DETAILS

SLAB(S2) DETAILS

SLAB(S3) DETAILS

SECTION AT A-A

SECTION AT B-B

SECTION AT A-A

SECTION AT B-B

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: MODEL H.C.B.-3.1
DRAWING TITLE: DETAILS

SCALE: NONE
DATE: 7/9

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

TWO STOREY

REINFORCEMENT DETAIL AT CORNER

- 6mm Ø STIRRUPS @ 200mm C/C
- 3- 12 mm Ø REBAR

COLUMN PROJECTION DETAIL

- 4- 12 mm Ø REBAR
- 6mm Ø STIRRUPS @ 200mm C/C

REINFORCEMENT DETAIL AT T-JUNCTION

- 3- 12 mm Ø REBAR
- M20 CONCRETE FILL

DETAIL AT B SILL BAND

- 2- 8 mm Ø REBARS
- 7 mm Ø STIRRUPS @ 400mm C/C
- M20 CONCRETE

DETAIL AT A LINTEL BEAM

- 1- 8 mm Ø REBAR
- 7 mm Ø STIRRUPS @ 400mm C/C
- 3- 8 mm Ø REBARS
MODEL H.C.B.-3.1, HOLLOW CONCRETE BLOCK MASONRY
TWO STOREY

STAIRCASE DETAIL PLAN

STAIRCASE SLAB UNIT

STAIR SECTION AT B-B

STAIR SECTION AT A-A

M20 CONCRETE SLAB

5 NO - 4.75 MM Ø REBAR

3 NO - 8 MM Ø REBAR

3 NO - 8 MM Ø REBAR

5 NO - 4.75 MM Ø REBAR

800

75

325

288

38

75

50

225

63

158

51

HOUSING TYPE: MODEL H.C.B.-3.1
SCALE: NONE
DATE:
HCB-3.1
8/9
# TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Structure System</th>
<th>Hollow concrete block masonry with precast floor over precast beams. Vertical and Horizontal reinforcements shall be provided in strategic locations as shown in drawings.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>Strip Foundation of width 850 mm and depth 825 mm. Reinforcement 8 mm Ø at 150mm C/C both ways.</td>
</tr>
<tr>
<td>Plinth Band</td>
<td>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.</td>
</tr>
<tr>
<td>Wall System</td>
<td>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.</td>
</tr>
<tr>
<td>Sill Band</td>
<td>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.</td>
</tr>
<tr>
<td>Lintel Band</td>
<td>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.</td>
</tr>
<tr>
<td>Floor Beam</td>
<td>Precast Floor Beam with details as shown in drawing.</td>
</tr>
<tr>
<td>Floor</td>
<td>100 mm thick reinforced concrete slab as shown in detail drawing.</td>
</tr>
<tr>
<td>Roof</td>
<td>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..</td>
</tr>
</tbody>
</table>
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 X 10cm
Min Compressive Strength on gross area CSEB: 3.5 Mpa

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

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

**C.S.E.B.-4.1**
**C.S.E.B.-4.2**
### MODEL C.S.E.B-4.1, COMPRESSED STABILIZED EARTH BLOCK MASONRY

#### ONE STOREY

**Housing Type:** CSEB-4.1

**Drawing Title:** Estimate and 3D-View

**Scale:** None

<table>
<thead>
<tr>
<th>Level</th>
<th>Stabilized block</th>
<th>Cement</th>
<th>Sand</th>
<th>Reinforcing Bar</th>
<th>Wood</th>
<th>Bamboo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Bags</td>
<td>Cu.m.</td>
<td>Kg.</td>
<td>Cu.m.</td>
<td>Nos</td>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>1,758.0</td>
<td>17.0</td>
<td>2.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Super Structure</td>
<td>1,500.0</td>
<td>7.2</td>
<td>1.4</td>
<td>237.3</td>
<td>0.2</td>
<td>25.5</td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.4</td>
<td>31.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3,258.0</td>
<td>24.2</td>
<td>3.7</td>
<td>237.3</td>
<td>2.6</td>
<td>56.5</td>
</tr>
</tbody>
</table>
GROUND FLOOR PLAN
FLOOR AREA: 24.08 SQ.M

ROOM
2400 X 2400

ROOM
2400 X 2400

VERANDAH

FLOOR PLAN
GROUND FLOOR PLAN

ROOM
2400 X 2400

VERANDAH

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDING CONSTRUCTION

HOUSING TYPE: CSEB-4.1
DRAWING TITLE: GROUND FLOOR PLAN

SCALE: NONE
CSEB-4.1
DATE: 2/8

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

ONE STOREY

HOUSING TYPE: CSEB-4.1
DRAWING TITLE: SECTION

SECTION AT X-X

- 5MM CEMENT PUNNING
- ROOF OF C.S.E.B IN STABILIZED SOIL MORTAR WITH CEMENT POINTING OF 1:6 UPTO 2/3 HEIGHT AND 1:1 IN REMAINING UPPER HEIGHT
- 50 MM THK. MUD OVER POLYTHENE SHEET
- 38MM THK. BAMBOO JALI (BHATA OR TATI) @150 MM C/C TO RETAIN SOIL
- 500 GAUGE POLYTHENE SHEET
- 38MM THK. (MINIMUM) BAMBOO STRIPS PLACED TIGHTLY TOGETHER
- FULL SIZE BAMBOO RAFTERS @ 500MM C/C
MODEL C.S.E.B-4.1, COMPRESSED STABILIZED EARTH BLOCK MASONRY

Housing Type: CSEB-4.1

Drawing Title: ELEVATIONS

Scale: None

Date: One Storey

Front Elevation

Back Elevation

Left Elevation

Right Elevation
MODEL C.S.E.B-4.1, COMPRESSED STABILIZED EARTH BLOCK MASONRY

ONE STOREY

Housing Type: CSEB-4.1
Drawing Title: Details

Foundation Section

Foundation of Bamboo Post

Section B-B

Lintel Band

Sill Band

Ministry of Urban Development
Department of Urban Development and Building Construction

Date: 5/8
5MM CEMENT PUNNING
ROOF OF C.S.E.B IN STABILIZED SOIL MORTAR WITH CEMENT POINTING OF 1:6 UPTO 2/3 HEIGHT AND 1:1 IN REMAINING UPPER HEIGHT

50 MM THK. MUD OVER POLYTHENE SHEET
38MM THK. BAMBOO JALI (BHATA OR TATI) @150 MM C/C TO RETAIN SOIL
500 GAUGE POLYTHENE SHEET
38MM THK. (MINIMUM) BAMBOO STRIPS PLACED TIGHTLY TOGETHER
FULL SIZE BAMBOO RAFTERS @ 500MM C/C

G.I. WIRE FOR NUTS AND BOLTS
CSEB MASONARY IN STABILIZED MUD MORTAR

BAMBOO
TRUSSED BEAM
TRUSSED BEAM

G.I. WIRE OR 4.75 mm Ø rod

200 mm THK. COMPRESSED STABILIZED SOIL BLOCK WALL

ROOFING DETAILS
MODEL C.S.E.B-4.1, COMPRESSED STABLILIZED EARTH BLOCK MASONRY

ONE STOREY

STRENGTHENING WALL BY BAMBOO AND G.I. WIRE

HALF CUT BAMBOO AS VERTICAL REINFORCEMENT @800mm C/C MINIMUM AND @CORNERS AND OPENINGS

ROUND END 12 GAUGE G.I. WIRE FOR NUT AND BOLT

TYPICAL ELEVATION

CSEB WALL
HALFCUT BAMBOO

CROSS SECTION

PLAN AT B - B

CSEB WALL
HALFCUT BAMBOO
NUT BOLT
12 GAUGE G.I. WIRE @ 600mm C/C

PLAN AT A - A

BITUMEN COATING
BAMBOO SECTION
500 GAUGE POLYTHENE SHEET WRAPPING
WIRE MESH AROUND POLYTHENE WRAPPING
CEMENT CONCRETE (M20) AROUND WIRE MESH

CSEB-4.1

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**TECHNICAL REQUIREMENTS**

<table>
<thead>
<tr>
<th>Structure System</th>
<th>Compressed Stabilized Earth block masonry in mud mortar with stabilized soil roof.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>Strip Foundation of Compressed stabilized Earth Block Masonry of width 400 mm and depth 400 mm over 600 x 75 mm RCC strip foundation.</td>
</tr>
<tr>
<td>Plinth Band</td>
<td>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</td>
</tr>
<tr>
<td>Wall System</td>
<td>Masonry shall be of cement stabilized earth block of size 300x 200 x 100 mm size in mud mortar.</td>
</tr>
<tr>
<td>Sill Band</td>
<td>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.</td>
</tr>
<tr>
<td>Lintel Band</td>
<td>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.</td>
</tr>
<tr>
<td>Roof</td>
<td>5mm cement punning over stabilized soil plaster on 50 mm thick mud roof on bamboo truss.</td>
</tr>
</tbody>
</table>
### MATERIALS

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

**MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY**

**HOUSING TYPE:** CSEB-4.2

**DRAWING TITLE:** ESTIMATE AND 3D-VIEW

**SCALE:** NONE

**DATE:** 1/9
MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY
TWO STOREY

GROUND FLOOR PLAN
FLOOR AREA: 52.02SQ.M

FIRST FLOOR PLAN
FLOOR AREA: 52.02SQ.M

HOUSING TYPE: CSEB-4.2
DRAWING TITLE: FLOOR PLANS
SCALE: NONE
DATE: 2/9

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION
CSEB-4.2

BEDROOM (3520X2780)

KITCHEN/DINING (3520X2780)

LIVING (3530X3270)

LOBBY (3530X3270)

UP

BEDROOM (3520X2780)

ROOM (3520X2780)

DN
MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY

HOUSING TYPE: CSEB-4.2
DRAWING TITLE: SECTION

SECTION AT A-A

REFERENCE ROOF TRUSS DETAIL
REFERENCE SLAB AND BAND DETAIL
REFERENCE FOUNDATION DETAIL

230 MM HOLLOW CONCRETE BLOCK WALL IN CEMENT CONCRETE (1:5).

LIVING ROOM
BEDROOM
LOBBY

G.L.

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

SCALE: NONE
DATE: 3/9
MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY

TWO STOREY

FRONT ELEVATION

BACK ELEVATION

SIDE ELEVATION

SIDE ELEVATION

HOUSING TYPE: CSEB-4.2

SCALE: NONE

DATE: 4/9
MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY TWO STOREY

FOUNDATION SECTION

FOUNDATION DETAIL (FOR VERANDAH)

75MM THICK PCC (1:3:6)
ONE LAYER FLAT BRICK SOLING
COMPACTED EARTH

CEMENT PUNNING OVER 75MM THICK PCC (1:3:6)
ONE LAYER FLAT BRICK SOLING
COMPACTED EARTH

CSEB-4.2

Cement Punning over 75mm thick PCC (1:3:6)
One layer flat brick solving
Compacted earth

75mm thick PCC (1:3:6)
One layer flat brick solving
Compacted earth

CEMENT PUNNING OVER 75MM
THICK PCC (1:3:6)
ONE LAYER FLAT BRICK SOLING
COMPACTED EARTH

75MM THICK PCC (1:3:6)
ONE LAYER FLAT BRICK SOLING
COMPACTED EARTH

DATE:

SCALE: NONE

HAUSING TYPE: CSEB-4.2
DRAWING TITLE: FOUNDATION DETAILS

CSEB-4.2

5/9
MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY
TWO STOREY

FLOOR SLAB

ROOF BAND

SILL BAND

LINTEL BAND

FLOOR BEAM

PLINTH BAND

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: CSEB-4.2
DRAWING TITLE: DETAILS

SCALE: NONE
CSEB-4.2
DATE: 6/9

8φ@150C/C

4-12φ

8φ@150C/C

8φ@150C/C

8φ@150C/C

8φ@150C/C
MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY

TOX STOREY

HOMING TYPE: CSEB-4.2

DRAWING TITLE: REINFORCEMENT DETAILS

SCALE: NONE

CSEB-4.2

DATE:

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MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY

TWO STOREY

Housing Type: CSEB-4.2

Drawing Title: Roof Details

Scale: None

Date: 8/9

Ministry of Urban Development
Department of Urban Development and Building Construction

Joint Plate Details

Runner Cleat Details

Purlin Cleat Details

Base Connection Details

Verandah Post End Plate Details

Roof Truss Details

Joint Plate for 65M pipe (JP1)
PL8 (140x140)
All Holes 14mm Dia

Joint Plate for 40M pipe (JP2)
FL 100 (L=100MM)
All Holes 14mm Dia

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

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

Joint Plate for 65M pipe (JP1)
PL8 (140x140)
All Holes 14mm Dia

Joint Plate for 40M pipe (JP2)
FL 100 (L=100MM)
All Holes 14mm Dia

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

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

Joint Plate for 65M pipe (JP1)
PL8 (140x140)
All Holes 14mm Dia

Joint Plate for 40M pipe (JP2)
FL 100 (L=100MM)
All Holes 14mm Dia

Purlin Cleat for RHS 100x50x3
FL 100x8 / L=150MM
All Holes 18mm Dia
## TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Structure System</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>Chemically compressed stabilized block masonry strip foundation of width 900 mm and depth 900 mm as shown in detail.</td>
</tr>
<tr>
<td>Plinth Band</td>
<td>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.</td>
</tr>
<tr>
<td>Wall System</td>
<td>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.</td>
</tr>
<tr>
<td>Sill Band</td>
<td>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.</td>
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<tr>
<td>Lintel Band</td>
<td>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.</td>
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<tr>
<td>Floor</td>
<td>130 mm thick RCC (1:1.5:3) floor over beam of width 230 mm and depth 300mm (inc. slab thickness).</td>
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<tr>
<td>Roof</td>
<td>CGI sheet roofing over metal truss as shown in the drawing.</td>
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</table>
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.
<table>
<thead>
<tr>
<th>LEVEL</th>
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MODEL R.R.M-5.1, RANDOM RUBBLE MASONARY IN MUD MORTAR

HOUSING TYPE: R.R.M.-5.1
DRAWING TITLE: FLOOR PLAN

FLOOR AREA: 40.365 SQ. M

GROUNDFLOOR PLAN

BED ROOM
2925 X 3000

BED ROOM
2925 X 3000

SCALE: NONE
DATE:

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDNG CONSTRUCTION

R.R.M-5
2/5

ONE STOREY

75
MODEL R.R.M-5.1, RANDOM RUBBLE MASONARY IN MUD MORTAR

HOUSING TYPE: R.R.M.-5.1
DRAWING TITLE:ELEVATIONS

SCALE: NONE

DATE:

ONE STOREY

FRONT SIDE ELEVATION
LEFT SIDE ELEVATION
BACK SIDE ELEVATION
RIGHT SIDE ELEVATION
MODEL R.R.M-5.1, RANDOM RUBBLE MASONARY IN MUD MORTAR
ONE STOREY

HOUING TYPE: R.R.M-5.1
DRAWING TITLE: SECTION

SCALE: NONE
DATE:

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

TIMBER RIDGE BEAM (150 DEEP X 100 WIDE)

CGI ROOFING

PURLINS- 50X50MM (2"X2") @ 300MM (1' 6") C/C

RAFTERS- 50X100MM (2"X4") @ 1200MM (4' 0") C/C

WWM BAND AT TOP OF WALL

SECTION: A-A

TIMBER POST 1100 ABOVE ATTIC WALL.

GABLE WALL TO BE OF GI SHEETS OR TIMBER PLANKS (NO MASONRY)

450MM (18") RR WALL IN MUD MORTAR

WWM BAND TYP.

WWM PLINTH BAND.

TIMBER JOINT

450MM RR WALL IN MUD MORTAR

WWM BAND TYP.

TIES, IF ANY, UNDERGROUND MUST BE ALLUMINIUM WIRES

RANDOM RUBBLE MASONARY IN MUD MORTAR.

REFER WALL PLATE DETAILS

REFER FOUNDATION DETAILS

1100 TIMBER POST

TIMBER FLOOR TYP.

LADDER

MUD FLOOR

TIMBER RIDGE BEAM

W

TIMBER POST 1100 ABOVE ATTIC WALL.

CGI ROOFING

PURLINS- 50X50MM (2"X2") @ 300MM (1' 6") C/C

RAFTERS- 50X100MM (2"X4") @ 1200MM (4' 0") C/C

WWM BAND AT TOP OF WALL

SECTION: A-A

TIMBER POST 1100 ABOVE ATTIC WALL.

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450MM (18") RR WALL IN MUD MORTAR

WWM BAND TYP.

WWM PLINTH BAND.

TIMBER JOINT

450MM RR WALL IN MUD MORTAR

WWM BAND TYP.

TIES, IF ANY, UNDERGROUND MUST BE ALLUMINIUM WIRES

RANDOM RUBBLE MASONARY IN MUD MORTAR.

REFER WALL PLATE DETAILS

REFER FOUNDATION DETAILS

1100 TIMBER POST

TIMBER FLOOR TYP.

LADDER

MUD FLOOR

TIMBER RIDGE BEAM

W

TIMBER POST 1100 ABOVE ATTIC WALL.

CGI ROOFING

PURLINS- 50X50MM (2"X2") @ 300MM (1' 6") C/C

RAFTERS- 50X100MM (2"X4") @ 1200MM (4' 0") C/C

WWM BAND AT TOP OF WALL

SECTION: A-A

TIMBER POST 1100 ABOVE ATTIC WALL.

GABLE WALL TO BE OF GI SHEETS OR TIMBER PLANKS (NO MASONRY)

450MM (18") RR WALL IN MUD MORTAR

WWM BAND TYP.

WWM PLINTH BAND.

TIMBER JOINT

450MM RR WALL IN MUD MORTAR

WWM BAND TYP.

TIES, IF ANY, UNDERGROUND MUST BE ALLUMINIUM WIRES

RANDOM RUBBLE MASONARY IN MUD MORTAR.

REFER WALL PLATE DETAILS

REFER FOUNDATION DETAILS

1100 TIMBER POST

TIMBER FLOOR TYP.

LADDER

MUD FLOOR

TIMBER RIDGE BEAM

W
## Technical Requirements

<table>
<thead>
<tr>
<th>Structure System</th>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>Strip Foundation of stone masonry in mud mortar of size 750 x 750 mm as shown in detail.</td>
</tr>
<tr>
<td>Plinth Band</td>
<td>Red oxide coated or GI Weld Wire mesh (WWM) strap of 350 mm width with wire spacing of 31 x 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.</td>
</tr>
<tr>
<td>Wall System</td>
<td>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.</td>
</tr>
<tr>
<td>Sill Band</td>
<td>Sill band shall be of weld wire mesh or wooden band as shown in detail drawing.</td>
</tr>
<tr>
<td>Lintel Band</td>
<td>Lintel band shall be of weld wire mesh or wooden band as shown in detail drawing.</td>
</tr>
<tr>
<td>Floor</td>
<td>Mud/timber floor over timber joist (Refer drawing).</td>
</tr>
<tr>
<td>Wall Plate</td>
<td>Wall plate shall be timber section of 100mm X 100mm placed above WWM and connected with wall (refer detail drawing)</td>
</tr>
<tr>
<td>Roof</td>
<td>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.</td>
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## Model R.R.M.-5.2, Random Rubble Masonary in Mud Mortar

### Two Storey

#### Materials

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<th>Sand</th>
<th>Mud</th>
<th>CGI Sheet</th>
<th>GI Sheet</th>
<th>Wood</th>
<th>4mm GI wire</th>
<th>2 mm GI Wire</th>
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<td></td>
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<td>Up to Plinth Level</td>
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MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR

GROUNDFLOOR PLAN
FLOOR AREA: 40.365 SQ. M.

BED ROOM
2925 X 3000

BED ROOM
2925 X 3000

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDING CONSTRUCTION

HOUSING TYPE: R.R.M.-5.2
DRAWING TITLE: FLOOR PLAN

SCALE: NONE
DATE: 2/11

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

FIRST FLOOR PLAN
FLOOR AREA: 40.365 SQ. M
MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR  

TWO STOREY

FRONT SIDE ELEVATION

LEFT SIDE ELEVATION

HOUSING TYPE: R.R.M.-5.2
DRAWING TITLE: ELEVATION
SCALE: NONE
DATE: 4/11
MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR  
TWO STOREY

BACK SIDE ELEVATION

RIGHT SIDE ELEVATION

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

RAFTERS- 50X100MM (2"X4") @ 1200MM (4' 0") C/C
PURLINS- 50X50MM (2"X2") @ 450MM (1' 6") C/C
GABLE WALL TO BE OF GI SHEETS OR TIMBER PLANKS
(NO MASONRY)

TIMBER RIDGE BEAM (150 DEEP X 100 WIDE)
TIMBER POST 1100 ABOVE ATTIC WALL.
CGI ROOFING

WWM BAND AT TOP OF WALL

REFER WALL PLATE DETAILS

REFER FOUNDATION DETAILS

WWM BAND TYP.
WWM PLINTH BAND.
TIES, IF ANY, UNDERGROUND MUST BE
ALUMINIUM WIRES

MUD FLOOR

RANDOM RUBBLE MASONRY IN MUD MORTAR.

SECTION : A-A
MODEL R.R.M.-5.1/5.2

TWO STOREY

ECONOMIC OPTION
(Also to be used with existing foundation)

RECOMMENDED OPTION
(Only if aluminum wire are available)

FOUNDATION DETAIL

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

RED-OXIDE COATED OR GI WWM STRAP 350MM WIDE WITH WIRE SPACING OF 31X31MM PLUS 2-4MM GI WIRES LAID IN MUD MORTAR - SEE NOTE 5, SHEET 4.

MASONRY FACE TYP.

WELD WIRE MESH BAND DETAIL.

DIAGONAL WWM STRAP FOR STRONG CORNER CONNECTION SECURELY TIED TO OTHER WWM.

CROSSLINK TIED SECURELY TO WWM WITH GALVANIZED BINDING WIRE.
ATTIC WALL PLATE PLAN.

ENFORCE STRONG CONNECTION WITH METAL STRAPS

WALL PLATE.

ATTIC WALL

SECTION : D-D

TIMBER STUB LOCATIONS TO BE ALIGNED WITH CONTAINMENT WIRES FOR TYING CONTAINMENT REINFORCEMENT.

100X100MM TIMBER WALL PLATE.
ATTIC FLOOR TIMBER FRAMING PLAN

TIMBER PLANKS OR SPLIT BAMBOO WITH MUD FLOORING ON TOP AS PER TRADITIONAL PRACTICE

75X125MM TIMBER JOISTS AT ± 450MM O/C

4-14 GA GI WIRE DIAGONAL BRACING TIES PRE-TENSIONED

50X100MM TIMBER STRUT ON JOIST UNDERSIDE

WALL PLATE

TWO STOREY MODEL R.R.M.-5.1/5.2

SECTION : C-C

Floor Joist

WWM Band
Ensure strong Connection with metal straps Typ.
LOCATION OF CROSS LINKS TO BE PLACED IN ALL STORIES.

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.

DETAIL A
GI WIRE CROSS LINK
LENGTH EQUAL TO WALL THICKNESS.

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

DETAIL A ALT
GI WIRE CROSS LINK
LENGTH EQUAL TO WALL THICKNESS.

TWO 12 GA (2MM DIA) TWISTED GI WIRES WITH LOOSE ENDS EXTENDING OUT 100MM ON BOTH SIDE WALL

TWO 12 GA (2MM DIA) TWISTED GI WIRES WITH LOOSE ENDS EXTENDING OUT 100MM ON BOTH SIDE WALL
## Technical Requirements

<table>
<thead>
<tr>
<th>Structure System</th>
<th>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</th>
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<tr>
<td>Foundation</td>
<td>Strip Foundation of stone masonry in mud mortar of depth 750 mm and width as specified in details for different soil type.</td>
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<tr>
<td>Plinth Band</td>
<td>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.</td>
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<tr>
<td>Wall System</td>
<td>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.</td>
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<tr>
<td>Sill Band</td>
<td>Sill band shall be of weld wire mess or wooden band as shown in detail drawing.</td>
</tr>
<tr>
<td>Lintel Band:</td>
<td>Lintel band shall be of weld wire mess or wooden band as shown in detail drawing.</td>
</tr>
<tr>
<td>Floor:</td>
<td>Mud /timber floor over timber joist (Refer drawing).</td>
</tr>
<tr>
<td>Wall Plate:</td>
<td>Wall plate shall be timber section of 100mm X 100mm placed above WWM and connected with wall (refer detail drawing)</td>
</tr>
<tr>
<td>Roof:</td>
<td>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.</td>
</tr>
</tbody>
</table>
BAMBOO AND STONE MASONRY HYBRID STRUCTURE
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/m³
- Modulus of elasticity: 10.72 x 10³ Mpa
### MATERIALS

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<tr>
<th>LEVEL</th>
<th>Stone</th>
<th>Mud</th>
<th>CGI Sheet</th>
<th>GI Sheet</th>
<th>Wood</th>
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<td>21.1</td>
<td>5.6</td>
<td>9.5</td>
<td>1.3</td>
<td>230.0</td>
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MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

HOUSING TYPE: B.S.M.H.-6.1

DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

MINISTRY OF URBAN DEVELOPMENT

DRAWING TITLE: PLAN

SCALE: NONE

DATE: 4/14

BSMH-6.1

PLAN AT +1575
MIDDLE TIMBER BAND
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

ROOM 2
ROOM 1
KITCHEN
COVERED VERANDAH

12MM DIA BAMBOO PIN
100 X 5 CORNER BRACING MEMBER
50 x 40 TIMBER TIES
SINGLE BAMBOO TIE BEAM FIXED TO POSTS USING BAMBOO PINS AND TIED WITH NYLON STRIPS. TOP AT +2590

460 X 460 BUTRESS
75 X 130 TIMBER BEAMS
MORTISE AND TENON JOINT
75 X 130 TIMBER POSTS

75 X 125 TIMBER RAFTERS FIXED TO LINTEL BAND MEMBER
12MM DIA BAMBOO PINS
50 x 40 TIMBER TIES
SINGLE BAMBOO TIE BEAM FIXED TO POSTS USING BAMBOO PINS AND TIED WITH NYLON STRIPS. TOP AT +2590

130 X 130 TIMBER POSTS
DIAGONAL BAMBOO BRACING TIMBER RAFTERS

75X130 TIMBER BEAM FIXED TO TIMBER POSTS
12MM DIA BAMBOO PIN

PLAN AT +2640 LINTEL BAND

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: B.S.M.H.-6.1
DRAWING TITLE: PLAN

SCALE: NONE
DATE: 5/14
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

TWO STOREY

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION

HOUSING TYPE: B.S.M.H.-6.1
DRAWING TITLE: PLAN

SCALE: NONE
DATE: 6/14

B.S.M.H.-6.1

PLAN AT +2790 (ATTIC FLOOR BEAMS)

BAMBOO POSTS FOR 130 THICK MUD PLASTERED DOUBLE WATTLE WALLS

TWIN BAMBOO BEAMS SUPPORTED ON AND FIXED WITH BAMBOO PINS TO LINTEL BAND

POST TO POST DIAGONAL BRACING BELOW DOUBLE BAMBOO BEAMS

AVG. 75 MM DIA. BAMBOO IN POSTS AND BEAMS TIED WITH LASHING @ 900 C/C POST TO POST

SINGLE BAMBOO TIE BEAM FIXED TO POSTS USING BAMBOO PINS AND TIED WITH NYLON STRIPS. TOP AT +2590

12MM DIA BAMBOO PINS FIXING BAMBOO TO LINTEL TIMBER BAND (TYP)

SPLIT BAMBOO (HALF ROUND) STRIPS PLACED SIDE BY SIDE PERPENDICULAR TO THE BEAMS AS ATTIC UNDER FLOOR

BAMBOO PURLINS

SINGLE BAMBOO TIE BEAMS BELOW. TOP AT +2590

TWIN BAMBOO TIE BEAM.

AVG. 75 MM DIA. BAMBOO IN POSTS AND BEAMS TIED WITH LASHING @ 900 C/C POST TO POST

TWIN BAMBOO BEAMS SUPPORTED ON AND FIXED WITH BAMBOO PINS TO LINTEL BAND

BAMBOO POSTS FOR 130 THICK MUD PLASTERED DOUBLE WATTLE WALLS

BAMBOO PURLINS FIXED TO TIMBER RAFTERS WITH BAMBOO PINS

BAMBOO POSTS FOR 130 THICK MUD PLASTERED DOUBLE WATTLE WALLS SUPPORTED ON ON LINTEL TIMBER BAND

BAMBOO PURLINS

A
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

TWO STOREY

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDING CONSTRUCTION

HOUSING TYPE: B.S.M.H.-6.1
DRAWING TITLE: PLAN

SCALE: NONE
DATE: 7/14

PLAN AT +3350 (ATTIC WINDOW SILL LEVEL)
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

SECTION AT A-A

2 Nos. TRUSS BOTTOM CHORDS ON EITHER SIDE OF TWIN TRUSS MEMBERS

50 MM THICK COMPACTED MUD FLOOR OVER SPLIT BAMBOO BASE OVER POLYTHENE SHEET OVER BAMBOO MAT OVERLAY OVER TWIN BAMBOO BEAMS

100 x 50 TIMBER BANDS AT Lintel LEVEL

400 x 100 x 75 PRECAST CONCRETE 'THROUGH STONES'

100 x 50 TIMBER BANDS AT INTERMEDIATE LEVEL

100 x 50 TIMBER BANDS AT PLINTH LEVEL

75 TH. DAMP PROOF COURSE IN 1:2:4 PCC

ATTIC FLOOR

PRE-COATED C.G.I ROOFING SHEETS AND RIDGE PIECE FIXED USING J-BOLTS

TWIN BAMBOO 'A' FRAME TRUSS SUPPORTED ON MIDDLE BAMBOO OF POSTS

TRUSS BOLTED THROUGH THE OUTER BAMBOO OF THE POSTS

G.I. SHEET GUTTER

75 X 130 TIMBER RAFTER FIXED TO THE LINTEL BAND WITH BAMBOO DOWEL

G.I. SHEET GUTTER

75 X 75 TIMBER DOOR AND WINDOW FRAME (REF DETAIL WW)

75 X 75 X 130 TIMBER BEAM FOR VERANDAH FIXED TO THE POST AND RAFTERS WITH LAP JOINTS

130 X 130 TIMBER POSTS FOR VERANDAH SECURED WITH DOWEL THROUGH M.S. FLAT EMBEDDED IN RC Lintel BAND

REFER DETAIL A

PCC BASE PAD FOR BAMBOO POST

REFER DETAIL "B"

MUD FLOOR OVER COMPACTED CLAY OVER STONE COMPACTED WITH MUD IN LAYERS OF 200MM EACH, TOP AT +460

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

BSMH-6.1
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

Housing Type: B.S.M.H.-6.1

Drawing Title: Section

Section at C-C

Both sides mud plaster on bamboo wattle mounted on bamboo frame.

50 mm thick compacted mud floor over split bamboo base over polythene sheet over bamboo mat overlay over twin bamboo beams.

100 x 50 timber bands at lintel level.

400 x 100 x 75 precast concrete.

75 x 75 timber door and window frame.

Plinth band.

75 thk. DPC.

Knee bracing ref detail P.

Attic floor.

Attic floor.

Bamboo post cluster (type 2) over pcc base block, ref detail B.

Bamboo cross bracing.

G.I. roofing sheet over kitchen fixed using J-bolts.

PRE-COATED C.G.I. ROOFING SHEETS AND RIDGE PIECE FIXED USING J-BOLTS.

TWIN BAMBOO TRUSS.

MUD FLOOR OVER COMPACTED CLAY OVER STONE COMPACTED WITH MUD.

MUD FLOOR OVER COMPACTED CLAY OVER STONE COMPACTED WITH MUD.

PRE-COATED C.G.I. ROOFING SHEETS AND RIDGE PIECE FIXED USING J-BOLTS.

TWIN BAMBOO TRUSS.

G.I. ROOFING SHEET OVER KITCHEN FIXED USING J-BOLTS.

100 x 50 timber bands at intermediate level.

Bamboo rafter.

75 thk. damp proof course in 1:2:4 PCC.

Bamboo rafter.

Mud plaster on bamboo wattle.

100 x 50 timber bands at lintel level.

Mud floor over compacted clay over stone compacted with mud.

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: B.S.M.H.-6.1
DRAWING TITLE: SECTION

Scale: None

BSMH-6.1

Date: 10/14
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 RESISTANT HOUSES FOR THE 2008 KOSI AFFECTED 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’
## 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
# Model RTB-7.1, Rat Trap Bond Masonry

**One Storey**

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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>4.2</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>GI Sheet</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>4.2</td>
<td>10.0</td>
</tr>
</tbody>
</table>
MODEL RTB-7.1, RAT TRAP BOND MASONRY

HOUSING TYPE: R.T.B.-7.1
DRAWING TITLE: GROUND FLOOR PLAN

GROUND FLOOR PLAN
FLOOR AREA: 40.36 SQ.M.

BED ROOM
3430X3585

KITCHEN
3585X3585

VERANDAH

UP
970
1422
7700
2713

7700

1295
1300
2435
1300
1370

1200
1000

3584
4040

3584
4040

109
MODEL RTB-7.1, RAT TRAP BOND MASONRY

HOUSING TYPE: R.T.B.-7.1
DRAWING TITLE: SECTION
DATE:

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

RIDGE COVER
RIDGE PIECE: 125MMX75MM

ROOF: ANGLE 21 CGI SHEET
MIN. 26 GAUGE ON WOODEN FRAME

PURLING: 75MMX75MM @450MMC/C

RAFTER: 180MMX90MM@610MMC/C

RAFTER: 125MMX75MM@450MMC/C

PURLING: 75MMX75MM @450MMC/C

SECTION AT A-A

REFER ROOF DETAIL

REFER FOUNDATION DETAIL

230 MM RAT TRAP BOND MASONRY WALL IN CEMENT MORTAR (1:4)

ROOF BAND RCC CONCRETE: 1:1.5:3 REINFORCEMENT MAIN BAR 12MM*4

LINTEL BAND RCC CONCRETE: 1:1.5:3 REINFORCEMENT MAIN BAR 4-12MM DIA.

SILL BAND RCC CONCRETE: 1:1.5:3 REINFORCEMENT MAIN BAR 12MM*2

PLASTER PUNNING 3MM
PCC 1:2.4 5CM THK.

BRICK SOLING COMPACTED 110MM

SOIL FILLING COMPACTED

COMPACT EARTH

STRAP BEAM 150MM THK.
MODEL RTB-7.1, RAT TRAP BOND MASONRY

FRONT ELEVATION

SIDE ELEVATION

SIDE ELEVATION

BACK ELEVATION

HOUSING TYPE: R.T.B.-7.1
DRAWING TITLE: ELEVATIONS

RTB-7.1
4/10
MODEL RTB-7.1, RAT TRAP BOND MASONRY

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

WALL: RTB BRICK MASONRY IN CEMENT MORTAR 1:4

CORNER STITCH: RCC: CONCRETE 1:1.5:3 REINFORCEMENT MAIN BAR 2-12MMØ, STIRRUP 7MM@150MM

ROOF BAND: RCC: CONCRETE 1:1.5:3 REINFORCEMENT MAIN BAR 4-12MMØ STIRRUP 7MM@150MM

SECTIONAL PERSPECTIVE

PLINTH BAND: RCC: CONCRETE 1:1.5:3 REINFORCEMENT MAIN BAR 4-12MMØ STIRRUP 7MM@150MM

SILL BAND: RCC: CONCRETE 1:1.5:3 REINFORCEMENT MAIN BAR 2-12MMØ STIRRUP 7MM@150MM

LINTEL BAND: RCC: CONCRETE 1:1.5:3 REINFORCEMENT MAIN BAR 4-12MMØ STIRRUP 7MM@150MM

FOUNDATION: STONE MASONRY IN CEMENT MORTAR 1:4

VERTICAL REINFORCEMENT: REINFORCEMENT 12MM REBAR

HOUSING TYPE: R.T.B.-7.1

DRAWING TITLE: SECTIONAL PERSPECTIVE

SCALE: NONE

DATE: 5/10

RTB-7.1
MODEL RTB-7.1, RAT TRAP BOND MASONRY

HOUSING TYPE: R.T.B.-7.1
DRAWING TITLE: DETAILS
DATE: 6/10

RAT-TRAP BOND IN T-JUNCTION

RAT-TRAP BOND IN CORNER JUNCTION

DETAIL C
FOUNDATION SECTION

RAT-TRAP LAYER 1

RAT-TRAP LAYER 2

12 Ø VERTICAL BAR GROUTED WITH 1:1.5:3 CONCRETE

12 Ø VERTICAL BAR GROUTED WITH 1:1.5:3 CONCRETE
### CROSS SECTION OF RC BANDS FOR TWO BARS AND FOUR BARS

### REQUIREMENT OF BAR FOR RC BANDS

<table>
<thead>
<tr>
<th>BAND/BEAM</th>
<th>RC BAND MINIMUM THICKNESS</th>
<th>MIN. NO. OF BARS</th>
<th>MIN. DIAMETER OF BARS (MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLINTH</td>
<td>150MM</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>SILL</td>
<td>75MM</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>LINTEL</td>
<td>150MM</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>ROOF</td>
<td>150MM</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>CORNER STITCH</td>
<td>75MM</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

### RCC BAND AT CORNER AND T-JUNCTION

- 7MM DIA. CROSS TIES @150MM C/C
- 12mm Ø VERTICAL BAR
- 7MM DIA. CROSS TIES @150MM C/C
MODEL RTB-7.1, RAT TRAP BOND MASONRY

ONE STOREY

HOUSING TYPE: R.T.B.-7.1

DRAWING TITLE: ROOF DETAILS

SCALE: NONE

DATE: 8/10

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

RAFTER (H180 X W90)
PURLIN (H75 X W75)

RIDGE COVER

CGI SHEET MIN. 26GAGE

Top (plan) View

Isometric View

Side View

Details

Post (D100 X W100)

RIDGE COVER

CGI SHEET

PURLIN (H75 X W75)

RAFTER (H180 X W90)
MODEL RTB-7.1, RAT TRAP BOND MASONRY

**ONE STOREY**

**DRAWING TITLE:** ROOF DETAILS

- **CGI SHEET**
- **75X75MM PURLIN @300MM C/C**
- **180X90MM RAFTER @600MM C/C**
- **100X75 MM WALL PLATE**
- **J-HOOK**
- **EAVES BOARD**
- **ROOF BAND**
- **GABLE BAND**
- **MASSONRY WALL**
- **CGI RIDGE**
- **75 X 125 RIDGE PIECE**
- **WOODEN POST**
- **RAFTER NAIL**
- **RIDGE PIECE**

**DETAIL AT-X**

- **75X 100 MM WALL PLATE**
- **WOODEN NAIL**
- **WOODEN KEY**

**DETIAL AT-Y**

- **75X 100 MM WALL PLATE**
- **RAFTER**
- **WOODEN NAIL**
- **RIDGE PIECE**

**PLAN**

**TYPE-1**

- **GABLE BAND**

**HOUSING TYPE:** R.T.B.-7.1

**SCALE:** NONE

**DATE:** 9/10
## TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Structure System</th>
<th>Load bearing Rat Trap Bond (RTB) masonry structure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>Stone masonry strip footing of width 800 mm and depth 800 mm in cement sand mortar 1:4.</td>
</tr>
<tr>
<td>Plinth Band</td>
<td>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.</td>
</tr>
<tr>
<td>Wall System</td>
<td>Rat trap bond brick masonry in 1:4 cement sand mortar.</td>
</tr>
<tr>
<td>Sill Band</td>
<td>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.</td>
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<tr>
<td>Lintel Band:</td>
<td>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.</td>
</tr>
<tr>
<td>Roof Band:</td>
<td>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.</td>
</tr>
<tr>
<td>Roof:</td>
<td>Lightweight roof of corrugated iron sheet over wooden truss. All joints in the truss shall be properly connected as shown in the drawing.</td>
</tr>
</tbody>
</table>
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)
<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Material</th>
<th>Quantity 1</th>
<th>Quantity 2</th>
<th>Quantity 3</th>
<th>Quantity 4</th>
<th>Quantity 5</th>
<th>Quantity 6</th>
<th>Quantity 7</th>
<th>Quantity 8</th>
<th>Quantity 9</th>
<th>Quantity 10</th>
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<tr>
<td></td>
<td>Cement</td>
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<td>2.0</td>
<td>237.3</td>
<td>4.2</td>
<td>8.0</td>
<td>2.9</td>
<td>25.5</td>
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<td>Sand</td>
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<tr>
<td></td>
<td>CGI Sheet</td>
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</table>

MODEL E.B.-8.1, EARTH BAG MASONRY

ONE STOREY

Housing Type: Model E.B.-8.1

Drawing Title: Estimate and 3D-View

Scale: None

Date: E.B.-8.1

1/11
MODEL E.B.-8.1, EARTHBAG MASONRY

GROUND FLOOR PLAN
FLOOR AREA: 31.95 SQ.M.

Room 1
3035 X 3045

Room 2
3035 X 3045

Wooden Partition
MODEL E.B.-8.1, EARTHBAG MASONRY

HOUSING TYPE: MODEL E.B.-8.1
DRAWING TITLE: SECTION

SECTION A-A

REFER FOUNDATION DETAIL

REFER ROOF BAND CONNECTION DETAIL

RIDGE H240XW180
POST H90XW90
RAFTER H180XW90
PURLIN H75XW75

BASE H90XW90

25MM CEMENT/EARTHEEN PLASTER
GALVANIZED CHICKEN WIRE MESH
380MM EARTH BAG
12MM REBAR WITH 300MM OVERLAP

3 LAYERS OF 150MM GRAVEL BAGS

DRO STONE MASONRY

50MM MUD FLOORING
5OOGAUGE POLYTHENE SHEET
100MM STONE SOLING
450 MM THK. EARTHBAG MASONRY IN BARBED WIRE

2895 150 600 1205
150 600 1205

4/11
MODEL E.B.-8.1, EARTHBAG MASONRY

HOUSING TYPE: MODEL E.B.-8.1
DRAWING TITLE: SECTION

SCALE: NONE
DATE: 5/11

EARTHBAG MASONRY IN BARBED WIRE

50MM MUD FLOORING
500GAUGE POLYTHENE SHEET
100MM STONE SOLING

REFER FOUNDATION DETAIL
REFER ROOF BAND CONNECTION DETAIL

100X100 WOODEN DOOR FRAME
100X100 WOODEN WINDOW FRAME

450 MM THK.
300
1960
905
600

335
150
2895
150 600
1205

RIDGE H240XW180
POST H90XW90
RAFTER H180XW90
PURLIN H75XW75
BASE H90XW90

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MODEL E.B.-8.1, EARTHBAG MASONRY

ONE STOREY

ROOF PLAN

ROOF BAND CONNECTION WITH TRUSS

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HOUSING TYPE: MODEL E.B.-8.1
DRAWING TITLE: ROOF DETAILS

SCALE: NONE
DATE: 6/11
MODEL E.B.-8.1, EARTHBAG MASONRY

HOUSING TYPE: MODEL E.B.-8.1
DRAWING TITLE: SECTIONAL PERSPECTIVE

RUBBLE TRENCH FOUNDATION
BARBED WIRE
ROOF BAND
VERTICAL REBAR
HORIZONTAL REBAR
METAL ANCHOR
STIRRUPS
WOODEN TRUSS
EARTH BAG WALL

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SCALE: NONE
DATE: 7/11

E.B.-8.1

126
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.
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.


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.

**Construction Sequence**

**Model E.B.-8.1, Earthbag Masonry**

**Housing Type:** Model E.B.-8.1

**Drawing Title:** Construction Sequence

**Scale:** None

**Date:** 9/11

**Department of Urban Development and Building Construction**

**Ministry of Urban Development**
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  TAMPER, 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 GALVANIZED/PLASTIC MESH FOR PLASTERING

19  INSTALL BOND BEAM, LIGHTWEIGHT ROOF AND ELECTRICAL WIRING

20  PLASTER AND PAINT
### 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/mm² for LGS 9.1
- Min. 350 N/mm² for LGS-9.2

Galvanized zinc coated: Min. 275gsm
**MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE**

**ONE STOREY**

![Image of one-storey model](image)

### MATERIALS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Stone</th>
<th>Brick</th>
<th>Cement</th>
<th>Sand</th>
<th>Aggregate</th>
<th>Reinforcing Bar</th>
<th>CGI Sheet</th>
<th>GI Sheet</th>
<th>MS angles &amp; Plates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cu.m.</td>
<td>No.</td>
<td>Bags</td>
<td>Cu.m.</td>
<td>Cu.m.</td>
<td>Kg.</td>
<td>Bundle</td>
<td>Sq.m.</td>
<td>Cu.m.</td>
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<tr>
<td>Up to Plinth Level</td>
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<td>TOTAL</td>
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<td>468.5</td>
<td>8.8</td>
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</tr>
</tbody>
</table>
GROUND FLOOR PLAN
AREA: 65.63 SQ. M
MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE

HOUSING TYPE: MODEL L.G.S.-9.1
DRAWING TITLE: ELEVATIONS

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SCALE: NONE
DATE: L.G.S. 9.1 3/9
MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE

ROOM

VERANDAH

SECTION ALONG A-A

REFER FOUNDATION DETAIL

REFER ROOF TRUSS DETAIL

C90x37x0.75MM BMT BRACE

C90x37x0.75MM BMT STUD

C90x37x0.75MM BMT RAFTER

2C90x37x0.75MM BMT SUPPORT TOP CHORD

3C90x37x0.75MM BMT SUPPORT BOTTOM CHORD

C90x37x0.75MM RAFTER

C90x37x0.75MM SQUARE SECTION

RIDGE

SCALE: NONE

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

Housing Type: Model L.G.S.-9.1

Foundation Section

- Tie Beam
- 450mm Thick P.C.C (1:3:6)
- Stone Soling
- Well Compacted Earth

Connection Details at DPC Level

- Strap Brace
- Hex Tek
- Hold Down Bracket
- Wafer Tek

Foundation Section Details

- 75mm Thick P.C.C (1:3:6)
- One Layer Flat Brick Soling
- Well Compacted Earth

Typical Strap Bracing in Wall

- 2-10x16x16 Hex Tek Screw
- 4mm Dia Rivet
- Strap Tensioner
- C90x37x0.75mm Stud
- 1 Rivet/10-16 16 Hex Tex Screw
- 0.75x50mm Strap Bracing

- 2-10x16-16 Hex Tek Screw
- C90x37x0.75mm Horizontal Nug
MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE

HOUSING TYPE: MODEL L.G.S.-9.1
DRAWING TITLE: DETAILS

SCALE: NONE
DATE:
L.G.S. 9.1
6/9

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

ONE STOREY

structural elevation 1

structural elevation 2

Typical elevation detail at opening
MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE

**Housing Type:** MODEL L.G.S.-9.1

**Drawing Title:** DETAILS

**Scale:** NONE

**Date:** 7/9

---

**Plan View at Corner:**
- 10MM Thick Cladding Board
- 160MM Lx12MM DIA Anchor Bolt
- 160MM Lx12MM DIA Anchor Bolt
- 10X16-16 Hex Tek Screw
- 160MM Lx12MM DIA Anchor Bolt
- Holes for Concrete Nail

**Plan View at Wall Stud:**
- 160MM Lx12M M Dia Anchor Bolt
- 3MM Thick 75X75 Square Washer Plate
- 160MM Lx12MM Dia Anchor Bolt
- 10MM Thick Cladding Board
- 3MM Thick 75X75 M Stud

**Plan View at Intersection:**
- 160MM Lx12MM Dia Anchor Bolt
- 10X16-16 Hex Tek Screw
- 3MM Thick 75X75M Stud
- 3MM Thick Connection Plate
- 3-4.8MMØ Screw @ 15MM OC
- 2-4.8MMØ Screw on both side of studs
- C90X37X0.95MM BMT Section Stud
- C90X37X0.95MM BMT Stud

**Typical Connection Details of Stud and Nug.:**
- C90X37X0.75M M Stud
- 4MM Thick Connection Plate
- 3-4.8MMØ Screw @ 15MM OC
- 2-4.8MMØ Screw on both side of studs
- C90X37X0.75MM Nug

---

**MINISTRY OF URBAN DEVELOPMENT**
**DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION**
## TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Structure System</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>Strip footing of Random rubble masonry in cement sand mortar with width 900 mm and depth 850 mm.</td>
</tr>
<tr>
<td>Plinth Band</td>
<td>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</td>
</tr>
<tr>
<td>Wall System</td>
<td>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.</td>
</tr>
<tr>
<td>Bracing:</td>
<td>K Bracing and X Bracing made up of cold formed steel channel sections of minimum thickness 0.75mm as mentioned in drawing</td>
</tr>
<tr>
<td>Roof System:</td>
<td>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.</td>
</tr>
</tbody>
</table>
## MODEL L.G.S.-9.2, LIGHT GAUGE SHEET STRUCTURE

### TWO STOREY

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

**LEVEL**

- **Brick**
- **Cement**
- **Sand**
- **Aggregate**
- **Reinforcing Bar**
- **CGI Sheet**
- **GI Sheet**
- **MS angles & Plates**
- **Wall Board**

**MATERIALS**

- **No.**: Number of items
- **Bags**: Bags of each material
- **Cu.m.**: Cubic meters of each material
- **Kg.**: Kilograms of each material
- **Bundle**: Bundles of each material
- **Sq.m.**: Square meters of each material
- **Cu.m.**: Cubic meters of each material
- **Sq.m.**: Square meters of each material

**Dimensions**

- **L.G.S.**: Light Gauge Structure
- **9.2**: Model Number

**DATE**: None

**Drawing Title**: Estimation and 3D-View

**Housing Type**: Model L.G.S.-9.2

**Scale**: None
MODEL L.G.S.-9.2, LIGHT GAUGE SHEET STRUCTURE

TWO STOREY

Housing Type: Model L.G.S.-9.2
Drawing Title: Floor Plans

Scale: None

Date: 2/7

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

L.G.S.-9.2

Ground Floor Plan
Floor Area: 36.19 sq. m.

First Floor Plan
Floor Area: 36.19 sq. m.
MODEL L.G.S.-9.2, LIGHT GAUGE SHEET STRUCTURE

HOUSING TYPE: MODEL L.G.S.-9.2
DRAWING TITLE: SECTION

REFER TYPICAL ROOF TRUSS DETAIL

REFER TYPICAL FLOOR SECTION

REFER FOUNDATION DETAIL

SECTION AT X-X

CGI SHEET

PUNNING
20 MM SCREEDING
50 MM RCC, 8MM DIA.
REINFORCEMENT B/W
25 MM CONCRETE
TILES
250MMX50 MMX15 MM FLOOR JOIST

L.G.S.-9.2
DATE: 4/7
MODEL L.G.S.-9.2, LIGHT GAUGE SHEET STRUCTURE

HOUSING TYPE: MODEL L.G.S.-9.2

DETAILS
FOUNDATION AND WALL SECTION

FRAME CONNECTION TO WALL L BRACKET HOLD DOWN

U-TRACK OVER CONCRETE SLAB

NO 8 SCREWS THROUGH THE CEILING BOARDS TO THE BOTTOM CHORD OF THE JOIST

GROUND LEVEL
PLINTH LEVEL

REGULAR CONCRETE INFILL (2400 KG/M³)
SIZE 10 MM BARS @ 100 MM C/C
SIZE 10 MM BARS @ 224 MM C/C LAID PERPENDICULAR TO THE PRIMARY REINFORCEMENT
SIZE 12 MM BARS LAID @ 250 MM C/C HORIZONTALLY AS PRIMARY REINFORCEMENT

CELLULAR LIGHT WEIGHT CONCRETE INFILL (600 KG/M³)

50 MM CONCRETE TOP
6 MM REBAR @ 200 MM SPACING
25 MM THICK CONCRETE TILES
250 MM DEEP LATTICE FLOOR JOIST
5 MM THICK CEILING BOARDS

89X50X15 STUD
8.8 GRADE WAFER HEAD SCREWS

U-TRACK

89X50X15 U-TRACK
8.8 GRADE WAFER HEAD SCREWS
M12 ANCHOR BOLT WITH INBUILT WASHER

DETAIL AT C

FRAME CONNECTION TO WALL L BRACKET HOLD DOWN

5/7
### TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure System</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Foundation</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Wall System</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Flooring System</strong></td>
<td>The flooring System shall be of 50 mm RCC on 25 mm concrete tiles on 250 x 50 x 15 mm floor joists</td>
</tr>
<tr>
<td><strong>Roof System</strong></td>
<td>Light roof steel truss covered with CGI sheets. All members of the truss or joints shall be properly connected as shown in detail drawings.</td>
</tr>
</tbody>
</table>
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/m³.

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
### MODEL S.S.-10.1, STEEL STRUCTURE

**TWO STOREY**

![Two Storey Model S.S.-10.1](image)

#### LEVELS

<table>
<thead>
<tr>
<th>Level</th>
<th>Brick</th>
<th>Cement</th>
<th>Sand</th>
<th>Aggregate</th>
<th>Reinforcing Bar</th>
<th>MS pipe</th>
<th>Steel sections</th>
<th>CGI Sheet</th>
<th>GI Plain sheet</th>
<th>Aluminium Door</th>
<th>Aluminium Window</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Up to Plinth Level</strong></td>
<td>3,384.0</td>
<td>130.0</td>
<td>11.0</td>
<td>13.0</td>
<td>974.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Super Structure</strong></td>
<td>-</td>
<td>111.0</td>
<td>5.0</td>
<td>10.0</td>
<td>582.0</td>
<td>-</td>
<td>3,930.1</td>
<td>-</td>
<td>10.3</td>
<td>845.4</td>
<td>22.6</td>
</tr>
<tr>
<td><strong>Roofing</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>845.4</td>
<td>6.3</td>
<td>11.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>3,384.0</td>
<td>241.0</td>
<td>16.0</td>
<td>23.0</td>
<td>1,556.0</td>
<td>845.4</td>
<td>3,930.1</td>
<td>6.3</td>
<td>11.1</td>
<td>10.3</td>
<td>22.6</td>
</tr>
</tbody>
</table>
MODEL S.S.-10.1, STEEL STRUCTURE

HOUSING TYPE: MODEL S.S-10.1
DRAWING TITLE: ELEVATIONS
SCALE: NONE
DATE: 

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION

TWO STOREY

FRONT ELEVATION

RIGHT SIDE ELEVATION

BACK ELEVATION

LEFT SIDE ELEVATION
MODEL S.S.-10.1, STEEL STRUCTURE

HOUSING TYPE: MODEL S.S-10.1
DRAWING TITLE: SECTION
DATE: 4/11

SCALE: NONE

CGI SHEET
50.8x50.8x3 MM PURLIN
50.8x50.8x3 MM TOP CHORD
38.1x38.1x2 MM TOP CHORD
50.8x50.8x3MM BOTTOM CHORD
PRE-CAST RCC SLAB

REFER TRUSS DETAIL
REFER BEAM DETAIL
REFER FOUNDATION

INFILL WITH DENSITY MORE THAN 1000 KG/M³
MODEL S.S.-10.1, STEEL STRUCTURE

FOUNDATION DETAIL

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Foundation Type</th>
<th>Foundation Size (LxB)</th>
<th>Footing sizes and reinforcement details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1</td>
<td>1200x1200</td>
<td>T10@150mm c\c-bothway</td>
</tr>
<tr>
<td>2</td>
<td>F2</td>
<td>900x900</td>
<td>T10@150mm c\c-bothway</td>
</tr>
<tr>
<td>3</td>
<td>F3</td>
<td>750x750</td>
<td>T10@150mm c\c-bothway</td>
</tr>
</tbody>
</table>

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

MODEL S.S.-10.1, STEEL STRUCTURE

TWO STOREY

FOUNDATION PLAN

FOUNDATION SECTION AT A-A

PEDESTAL COLUMN

TOE WALL

REBAR B/W 10s 150C/C

REBAR B/W 10s 150C/C

8-12s REBAR.

100

75mm P.C.C (1:3:6)
SINGLE LAYER BRICK SOLING
RAMMED EARTH

460

75mm P.C.C (1:3:6)
SINGLE LAYER BRICK SOLING
RAMMED EARTH
MODEL S.S.-10.1, STEEL STRUCTURE

BEAM-COLUMN PLAN

ISMC150
(SECONDARY BEAM)

ISMB150
(PRIMARY BEAM)

FULL PENETRATION GROOVE WELD

HOUSING TYPE: MODEL S.S.-10.1
SCALE: NONE
DATE: 7/11

S.S.-10.1
MODEL S.S.-10.1, STEEL STRUCTURE

HOUSING TYPE: MODEL S.S-10.1
DRAWING TITLE: STRUCTURE DETAILS

BASE PLATE CONNECTION PLAN

BASE PLATE CONNECTION SECTION

PLINTH LEVEL

COLUMN

BASE PLATE

150

300

4NOS. M20 BOLT OF CLASS 4.6 WITH LENGTH 425mm

2-ISMC150

2-ISMC150 COLUMN

FULL PENETRATION GROOVE WELD

2-M16 BOLTS OF CLASS 4.6

ISMB150 BEAM

ISA 65x65x8

FULL PENETRATION GROOVE WELD

3.2mm FILLET WELD

ISA 65x65x8

BEAM AND COLUMN CONNECTION

BASE PLATE CONNECTION SECTION

BASE PLATE

4NOS. M20 BOLT OF CLASS 4.6 WITH LENGTH 425mm

2-ISMC150

FULL PENETRATION GROOVE WELD

250x250mm BASE PLATE OF THICKNESS 12mm

BEAM AND COLUMN CONNECTION

FULL PENETRATION GROOVE WELD

2-ISMС150 COLUMN

BEAM AND COLUMN CONNECTION
MODEL S.S.-10.1, STEEL STRUCTURE

TWO STOREY

COMPOSITE FLOOR PLAN

SECTION AT X-X

SECTION AT Y-Y

LAP DETAIL

END ANGLE DETAIL

HOUSING TYPE: MODEL S.S-10.1
DRAWING TITLE: STRUCTURE DETAILS

SCALE: NONE
DATE: 9/11

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION
MODEL S.S.-10.1, STEEL STRUCTURE

TRUSS DETAIL

VERTICAL CHORD

DIAGONAL CHORD

38.1x38.1x2mm DIAGONAL CHORD

3mm FILLET WELD ALL AROUND THE PIPE

6mm PLATE

2-8e BOLTS OF CLASS 4.6

DETAIL AT A

SECTION AT 1-1

TRUSS COLUMN CONNECTION DETAIL

BOTTOM CHORD OF TRUSS 50.8x50.8mm WITH 3mm THICK

2ISA 50x50x6

200x200mm BEARING PLATE WITH 6mm THICK

2-ISMC150

PLAN

CGI SHEET

50.8x50.8x3mm PURLIN

50.8x50.8x3mm TOP CHORD

38.1x38.1x2mm VERTICAL CHORD

50.8x50.8x3mm BOTTOM CHORD

50.8x50.8x3mm THICK MIDDLE VERTICAL CHORD

TRUSS DETAIL

VERTICAL CHORD
## TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Structure System</th>
<th>Moment resisting steel frame system.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>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.</td>
</tr>
<tr>
<td>Tie beam:</td>
<td>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</td>
</tr>
<tr>
<td>Wall System</td>
<td>Infill walls with density more than 1000 kg/m³ on moment resisting steel frame.</td>
</tr>
<tr>
<td>Column:</td>
<td>Two ISMC150 column with full penetration groove weld in factory is used in structure.</td>
</tr>
<tr>
<td>Beam:</td>
<td>ISMB 150 shall be used as primary beam. ISMC 150 shall be used for Secondary Beam.</td>
</tr>
<tr>
<td>Flooring System:</td>
<td>The flooring System shall be made of profile metal decking system. Thin layer of RC concrete shall be laid as shown in detail drawing.</td>
</tr>
<tr>
<td>Roof System:</td>
<td>Light roof steel truss covered with CGI sheets. All members of the truss or joints shall be properly connected as shown in detail drawings.</td>
</tr>
</tbody>
</table>
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/m²
- Modulus of Elasticity: $9.4 \times 10^3$ N/mm²
- Binding & tension along Grains, Extreme Fiber Stress, inside location: 13.7 N/mm²
- Binding & tension along Grains, Extreme Fiber Stress, outside location: 11.4 N/mm²
- Shear Stress, Horizontal in Beams all locations: 1 N/mm²
- Shear Stress, along grains all locations: 1.4 N/mm²
- Compressive Stress, inside location (parallel to grains): 8.6 N/mm²
- Compressive Stress, outside location (parallel to grains): 7.7 N/mm²
**MODEL T.S.-11.1, TIMBER STRUCTURE**

**TWO STOREY**

---

**MATERIALS**

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Brick</th>
<th>Cement</th>
<th>Sand</th>
<th>Aggregate</th>
<th>Reinforcing Bar</th>
<th>MS Angle &amp; Plates</th>
<th>Wood</th>
<th>CGI Sheet</th>
<th>GI Plain sheet</th>
<th>Aluminium Door</th>
<th>Aluminium Window</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Bags</td>
<td>Cu.m.</td>
<td>Cu.m.</td>
<td>Kg.</td>
<td>Cu.m.</td>
<td>Kg.</td>
<td>Cu.m.</td>
<td>Bundle</td>
<td>Sq.m.</td>
<td>Sq.m.</td>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>3,652.7</td>
<td>112.9</td>
<td>16.7</td>
<td>8.7</td>
<td>630.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Super Structure</td>
<td>-</td>
<td>17.5</td>
<td>1.2</td>
<td>2.2</td>
<td>-</td>
<td>526.3</td>
<td>16.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.3</td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.2</td>
<td>6.7</td>
<td>11.4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3,652.7</td>
<td>130.4</td>
<td>17.9</td>
<td>10.9</td>
<td>630.0</td>
<td>526.3</td>
<td>16.5</td>
<td>6.7</td>
<td>11.4</td>
<td>10.3</td>
<td>22.6</td>
</tr>
</tbody>
</table>
MODEL T.S.-11.1, TIMBER STRUCTURE

GROUND FLOOR PLAN
AREA: 61.64 SQ.M.

ROOM 1
4975x2950

ROOM 2
4975x2950

ROOM 3
4975x2950

FIRST FLOOR PLAN
AREA: 61.64 SQ.M.

ROOM 4
4975x2950

ROOM 5
4975x2950

ROOM 6
4975x2950

Housing Type: Model T.S.-11.1
Drawing Title: Floor Plans
Scale: None
Date: 2/7
MODEL T.S.-11.1, TIMBER STRUCTURE

HOUSING TYPE: MODEL T.S.-11.1
DRAWING TITLE: SECTION

SCALE: NONE
DATE: 4/7

TWO STOREY

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: MODEL T.S.-11.1
DRAWING TITLE: SECTION

SCALE: NONE
DATE: 4/7
MODEL T.S.-11.1, TIMBER STRUCTURE

STUD CONNECTION TO FOUNDATION AT BRACING

STUD CONNECTION TO FOUNDATION OTHER THAN BRACING

STUD CONNECTION TO FOUNDATION AT BRACING

PLINTH LEVEL

GROUND LEVEL

FOUNDATION

PLINTH BAND
MODEL T.S.-11.1, TIMBER STRUCTURE

Housing Type: Model T.S.-11.1
Drawing Title: Joist and Joint Detail

Ministry of Urban Development
Department of Urban Development and Building Construction

Corner Post Connection

Floor Joist Plan

Corner Bracing Position

Floor Joist (75x135)

Floor Joist (37x100mm)

Corner Bracing (37x100mm)

Bracing (37x100mm)

75x75 Vertical Stud (Upper Floor Stud)

3-M20 Bolt of Grade 4.6

Floor Joist (75x135)

75x75 Vertical Stud (Lower Floor Stud)

M10 Bolt

M20 Bolt of Grade 4.6

POST

BRACING (37x100mm)

8mm Thick Metal Plate

Floor Joist (37x100mm)

Corner Bracing Connection

Stud Connection at Floor

M12 Bolt of Class 4.6

8mm thick metal plate

Floor Joist (37x100mm)

Model TS-11.1 - Timber Structure

Scale: None

Date:
**TECHNICAL REQUIREMENTS**

<table>
<thead>
<tr>
<th>Structure System</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>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.</td>
</tr>
<tr>
<td>Plinth Band</td>
<td>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.</td>
</tr>
<tr>
<td>Wall System</td>
<td>Local soft wood timber planks on timber structure system.</td>
</tr>
<tr>
<td>Stud</td>
<td>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.</td>
</tr>
<tr>
<td>Bracing</td>
<td>Diagonal bracing of local hard wood of size 37mm X 100mm. Connection details shown in detail drawing.</td>
</tr>
<tr>
<td>Joist</td>
<td>Timber joist of size 75mm X 75mm with spacing of 425mm.</td>
</tr>
<tr>
<td>Flooring system</td>
<td>Flooring shall be of mud under timber planks supported on timber joists.</td>
</tr>
<tr>
<td>Roof System</td>
<td>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.</td>
</tr>
</tbody>
</table>
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

## Drawings Title

- **Housing Type:** D.B.-12.1
- **Estimate and 3D View**

## Level 1: Up to Plinth Level

<table>
<thead>
<tr>
<th>Material</th>
<th>No.</th>
<th>Bags</th>
<th>Cu.m.</th>
<th>Cu.m.</th>
<th>Kg.</th>
<th>Bundle</th>
<th>Sq.m.</th>
<th>Cu.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debris Block</td>
<td>1,762.0</td>
<td>34.2</td>
<td>2.4</td>
<td>4.7</td>
<td>273.5</td>
<td>-</td>
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<tr>
<td>Cement</td>
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<td>Sand</td>
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<td>Aggregate</td>
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<tr>
<td>Reinforcing Bar</td>
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<tr>
<td>CGI Sheet</td>
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<td>GI Sheet</td>
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</tbody>
</table>

## Level 2: Super Structure

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<th>Cu.m.</th>
<th>Kg.</th>
<th>Bundle</th>
<th>Sq.m.</th>
<th>Cu.m.</th>
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<tbody>
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<td>21.8</td>
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<td>2.3</td>
<td>307.1</td>
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</table>

## Level 3: Roofing

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<th>Cu.m.</th>
<th>Kg.</th>
<th>Bundle</th>
<th>Sq.m.</th>
<th>Cu.m.</th>
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## Total

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<tr>
<th>Material</th>
<th>No.</th>
<th>Bags</th>
<th>Cu.m.</th>
<th>Cu.m.</th>
<th>Kg.</th>
<th>Bundle</th>
<th>Sq.m.</th>
<th>Cu.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debris Block</td>
<td>3,685.0</td>
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<td>3.6</td>
<td>7.0</td>
<td>580.6</td>
<td>5.2</td>
<td>8.3</td>
<td>3.1</td>
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</tbody>
</table>

## Scale

- **None**

## Date

- 1/8
FLOOR PLAN
AREA: 31.75 SQ. M.
MODEL 12.1, DEBRIS BLOCK MASONRY

HOUSING TYPE: D.B.-12.1

DRAWING TITLE: ELEVATIONS

SCALE: NONE

DATE: 3/8

FRONT ELEVATION

SIDE ELEVATION

SIDE ELEVATION

BACK ELEVATION
MODEL 12.1, DEBRIS BLOCK MASONRY

ROOM 1

VERANDAH

SECTION AT A-A

SEE ROOFING DETAILS

PURLIN: 75MMX 75 MM @450 MM
RAFTER: 180 MM X 180 MM

ROOF BAND: RCC: CONCRETE 1:1.5:3
REINFORCEMENT MAIN BAR 12 MM X4

LINTEL BAND: RCC: CONCRETE 1:1.5:3
REINFORCEMENT MAIN BAR 12 MM X4

VERTICAL REINFORCEMENT:
REINFORCEMENT MAIN BAR 12 MM REBAR

SILL BAND: CONCRETE 1:1.5:3
(REINFORCEMENT MAIN BAR 12 MM X 2)

WALL: 300 MM THICKNESS, UPCYCLED
BLOCK IN MUD MORTAR

PLINTH BAND: RCC CONCRETE 1:1.5:3 REINFORCEMENT
MAIN BAR 12 MM X4

FOUNDATION: UPCYCLED BLOCK IN CEMENT MORTAR
OR BRICK MASONRY WITH CEMENT MORTAR

SEE ROOFING DETAILS

SCALE: NONE
DATE:

HOUSING TYPE: D.B.-12.1
DRAWING TITLE: SECTION
**Model 12.1, Debris Block Masonry**

- **Foundation:** Upcycled block in cement mortar or brick masonry with cement mortar.
- **Wall:** 300 mm thickness.
- **Plinth Band:** RCC concrete 1:1.5:3 reinforced with main bar 12 mm x 4.

### Band/Beam

<table>
<thead>
<tr>
<th>Band/Beam</th>
<th>RC Band Min. Thickness</th>
<th>Min. No. of Bar</th>
<th>Min. Dia of Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plinth</td>
<td>150 mm</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Sill</td>
<td>75 mm</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Lintel</td>
<td>75 mm</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>150 mm</td>
<td>2 (top)</td>
<td>12 (bottom)</td>
</tr>
<tr>
<td>Roof</td>
<td>75 mm</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>300 mm</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Dowel (Stitch)</td>
<td>75 mm</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

**Diagram Details**

- **Plinth Band**
  - 300 mm
  - 150 mm
  - Main bar (see given table)
  - Stirrup (Dia 6 mm)
MODEL 12.1, DEBRIS BLOCK MASONRY

VERTICAL REINFORCEMENT ON CORNERS & JOINTS

PLAN

RCC BAND AT CORNER

RCC BAND AT T-JUNCTION

DOWEL BAR

VERTICAL STEEL

VERTICAL STEEL

BAND AT CORNER

BAND AT T-JUNCTION

DOWEL BAR

VERTICAL STEEL

6 MM DIA CROSS TIE @150 MM C/C

180 MMM VERTICAL STEEL

6 MM DIA STIRRUP @150 C/C

D.B.-12.1

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### 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 2 nos. 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

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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. PREMNATH MASKEY
DR. PURUSHOTTAM DONGOL

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S.D.E. MANOJ NAKARMI
S.D.E. GANESH KARMACHARYA
ER. SURENDRA VAIDYA
ER. DEVENDRADEV KHANAL
ER. PRATIK PRADHAN

CLPIU
S.D.E. PARIKSHIT KADARIYA (DEPUTY PROJECT DIRECTOR)
ER. BIPIN KUMAR GAUTAM (STRUCTURAL ENGINEER)
ER. DIPENDRA AARYAL (CIVIL ENGINEER)
AR. KRISHNA LAXMI MAHARJAN
AR. KOPILA WAGLE
AR. POOJA SHAH
AR. PRABINA POKHAREL
AR. SMRITI UPADHYAY
AR. SHAMI ADHIKARI
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AR. ASHISH SHARAN LAL
NATIONAL CENTRE FOR PEOPLE'S ACTION IN DISASTER PREPAREDNESS (NCPDP-INDIA) / UNITED NATION DEVELOPMENT PROGRAM (UNDP-NEPAL)
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ABARI NEPAL
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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