DESIGN CATALOGUE FOR RECONSTRUCTION OF EARTHQUAKE RESISTANT HOUSES

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

VOLUME-II

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

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

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

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

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

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

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

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

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

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

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

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

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

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

• Interlocking Brick Masonry
• Confined Hollow Concrete Block Masonry
• Hollow Concrete Block Masonry
• Compressed Stabilized Earth Block Masonry
• Random Rubble Masonry with GI Wire Containment
• Bamboo and Stone Masonry Hybrid Structure

• Rat Trap Bond Masonry
• Earth Bag Masonry
• Light Gauge Steel Structure
• Steel Structure
• Timber Structure
• Debris block Masonry

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

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

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

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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
### MATERIALS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Stone</th>
<th>Interlocking Bricks</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>
</tr>
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<tbody>
<tr>
<td></td>
<td>Cu.m</td>
<td>No.</td>
<td>Cu.m.</td>
<td>Cu.m.</td>
<td>Kg.</td>
<td>Bundle</td>
<td>Sq.m.</td>
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<td>Roofing</td>
<td>-</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.5</td>
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MODEL I.B.-1.1, INTERLOCKING BRICK MASONRY

HOUSING TYPE: I.B.-1.1
DRAWING TITLE: SECTION
SCALE: NONE
DATE: 4/5

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION

ONE STOREY

**SECTION AT A-A**

- **26 GUAGE CGI ROOFING MATERIALS**
- **75MM X 75MM BATTENS @ 300MM C/C**
- **180MM X 90MM RAFTERS @ 600MM C/C**
- **1 LAYERS U-BLOCK WITH 10Φ HORIZONTAL REINFORCEMENT @ ROOF TIE LEVEL**
- **2 LAYERS 10Φ HORIZONTAL REINFORCEMENT @ LINTEL**
- **2 LAYERS U-BLOCK WITH 10Φ HORIZONTAL REINFORCEMENT @ SILL LEVEL**
- **150 MM INTERLOCKING BRICK WALL GROUTED WITH MICRO-CONCRETE OF CEMENT, SAND AND CHIPS (1:2:3).**
- **180MM X 90MM RAFTERS @ 600MM C/C**
- **MORTAR LAYER UNDER 1ST LAYER OF BRICK TO MAKE IT PERFECTLY HORIZONTAL**
- **10Φ VERTICAL REINFORCEMENT ANCHORED AT FOUNDATION WITH 1:4 CEMENT MORTAR WITH MIN. CLEAR COVER 25MM**
- **6 NOS. 10Φ REINFORCEMENT**
- **150MM D.P.C BAND**
- **REFER ROOFING AND BAND DETAILS**
- **REFER FOUNDATION DETAILS**
- **REFER ROOFING AND BAND DETAILS**

**REFERENCES**
- **Foundation Details**
- **Roofing and Band Details**
## 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 1:6 cement sand mortar. Foundation size shall be of width 800mm and depth 800 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. 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 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 150 x 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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<tr>
<td>Sill Band</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>
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<tr>
<td>Lintel Band</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>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>
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</table>
MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY

TWO STOREY

<table>
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<tr>
<th>LEVEL</th>
<th>Stone Cu.m</th>
<th>Interlocking Bricks No.</th>
<th>Cement Bags 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>
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<tr>
<td>Up to Plinth Level</td>
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<td>80.2</td>
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<td>57.1</td>
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<td>6.1</td>
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<td>1.3</td>
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<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<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>
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<td>671.1</td>
<td>4.2</td>
<td>8.7</td>
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MODEL I.B.-1.2, INTERLOCKING BRICK MASONRY

TWO STOREY

HOUSING TYPE: I.B.-1.2
DRAWING TITLE: FLOOR PLANS

GROUND FLOOR PLAN
AREA: 40.36 SQ.M.

FIRST FLOOR PLAN
AREA: 40.36 SQ.M.

I.B.-1.2
2/5
MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

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

SCALE: NONE
DATE: 4/5

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

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

REFER ROOFING AND BAND 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

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

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

WOODEN OR RCC CONCRETE FLOOR

REFER FOUNDATION DETAILS
REFER ROOFING AND BAND DETAILS
## TECHNICAL REQUIREMENTS

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<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>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

FOUNDATION OF STONE MASONRY IN CEMENT MORTAR

3" P.C.C
FLAT BRICK SOLING
COMPACTED EARTH

U-BLOCK WITH 12Φ HORIZONTAL
REINFORCEMENT @ ROOF TIE LEVEL

2 LAYERS 12Φ HORIZONTAL
REINFORCEMENT @ LINTEL

12" P.C.C
450
800
19075 500
500
800MM

150MM STONE 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

FOUNDATION OF STONE MASONRY IN CEMENT MORTAR
ROOF, LINTEL AND SILL LEVEL

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDNG CONSTRUCTION

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

SCALE: NONE
DATE: 1/8
I.B.-1.1/1.2
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 NOS. 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
MODEL I.B.-1.1, INTERLOCKING BRICK MASONRY

FRAMING PLAN (REBAR DETAIL)

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

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

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

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

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

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

NOTE:
GROUTING FOR THE HOLE IS DONE WITH MORTAR

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: I.B.1.1 AND I.B. 1.2
DRAWING TITLE: STRUCTURAL DETAILS
SCALE: NONE
DATE: 4/8

16
MODEL I.B.-1.1 AND I.B.-1.2, INTERLOCKING BRICK MASONRY

1 NO.S OF 12MM Ø VERTICAL REBAR AT 1.2M C/C

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

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

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

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.-1.3, INTERLOCKING BRICK MASONRY

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

SCALE: NONE
DATE: 7/8
MODEL I.B.-1.3, INTERLOCKING BRICK MASONRY

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)

INTERIOR VIEW OF THE FINISHED JOIST AND PAN CAST IN SITU

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

REINFORCEMENT DETAILS IN CONCRETE JOISTS SPAN UPTO 5M

1" x 5" edge mold
Drive nails into horizontal joints

Extended reinforcement of 8φ of 20cm extension @ both ends to tie into wall
3 φ wire @ 12mm oc max.
Top & bottom reinforcement of 8φ

Wood braces formwork for placing of concrete pan
Wood braces
## MODEL I.B.-1.3, INTERLOCKING BRICK MASONRY

### ONE STOREY

#### MATERIALS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Stone</th>
<th>Interlocking Bricks</th>
<th>Cement</th>
<th>Sand</th>
<th>Aggregate</th>
<th>Reinforcing Bar</th>
<th>Clay Tile</th>
<th>Clay Tile Ridge</th>
<th>Wood</th>
<th>No.</th>
<th>No.</th>
<th>Bags</th>
<th>Cu.m.</th>
<th>Cu.m.</th>
<th>Kg.</th>
<th>Nos</th>
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<th>Cu.m.</th>
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<tbody>
<tr>
<td>Up to Plinth Level</td>
<td>No.</td>
<td>No.</td>
<td>Bags</td>
<td>Cu.m.</td>
<td>Cu.m.</td>
<td>Kg.</td>
<td>Nos</td>
<td>Sq.m.</td>
<td>Cu.m.</td>
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</table>
MODEL I.B.-1.3, INTERLOCKING BRICK MASONRY

HOUSING TYPE: I.B.-1.3
DRAWING TITLE: FLOOR PLAN

AREA: 54.26 SQ.M.

GROUND FLOOR PLAN

BEDROOM
3500X3500

KITCHEN
3380X3500

LIVING ROOM
3500X3380

DECK

SCALE: NONE

DATE: 2/6

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION

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

HOUSING TYPE: I.B.-1.3

SCALE: NONE

DATE: 4/6

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION

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).

SECTION AT A-A

REFER ROOFING DETAILS

REFER FOUNDATION DETAILS

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

FOUNDATION DETAIL
PLINTH BAND SECTION
SILL/LINTEL/ROOF BAND SECTION

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

GABLE BAND

GABLE BAND

FOUNDATION DETAIL
PLINTH BAND SECTION
SILL/LINTEL/ROOF BAND SECTION

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

GABLE BAND

FOUNDATION DETAIL
PLINTH BAND SECTION
SILL/LINTEL/ROOF BAND SECTION

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

GABLE BAND

FOUNDATION DETAIL
PLINTH BAND SECTION
SILL/LINTEL/ROOF BAND SECTION

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

GABLE BAND

FOUNDATION DETAIL
PLINTH BAND SECTION
SILL/LINTEL/ROOF BAND SECTION

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

GABLE BAND
### 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 tothing are constructed up to sill level leaving space for columns and then columns and sill are monolithically casted. Same process is applied after constructing hollow concrete block wall up to lintel. Featured Design in C.H.C.-2.1 is a two storied structure with six rooms. Structural system consists of load bearing hollow concrete walls confined with 15 cm x 15 cm R.C.C. Columns. The first floor is of R.C.C. slab and roofing consists of CGI sheet over wooden rafter and purlins.

**MATERIAL PROPERTIES**

Block Size: 40cm X 15cm X20cm  
Min Compressive Strength on gross area: 5 Mpa  
Min Compressive Strength on net area: 7.5 Mpa  
Density of the Block: 1600kg/m³  
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**

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Stone</th>
<th>Hollow Concrete Bricks</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>
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<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>77.1</td>
<td>12.3</td>
<td>3.5</td>
<td>252.0</td>
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<tr>
<td>Super Structure</td>
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<td>1,330.0</td>
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<td>7.5</td>
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<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.0</td>
<td>1.7</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>30.3</td>
<td>1,330.0</td>
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<td>1,640.0</td>
<td>5.0</td>
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<td>3.2</td>
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</table>

*ESTIMATE AND 3D VIEW*
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: FLOOR PLANS  
SCALE: NONE  
DATE: 2/11

GROUND FLOOR PLAN
FLOOR AREA: 43.71 SQ.M.

ROOM 1
3200 X 3020

ROOM 2
3200 X 3020

ROOM 3
3200 X 3020

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

UP

100 MM X 100 MM WOOD POST

150 MM X 150 MM REINFORCED CONCRETE TIE COLUMN TYP

150 MM HOLLOW CONCRETE MASONRY WALL TYP

300 MM X 150 MM REINFORCED CONCRETE TIE COLUMN TYP
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

TWO STOREY

FRONT ELEVATION

SIDE ELEVATION

SIDE ELEVATION

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

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

SCALE: NONE
DATE: C.H.C.-2.1
4/11

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDING CONSTRUCTION

WOOD JOIST
WOOD BEAM
CAPITAL

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

REFER FOUNDATION DETAILS

REFER ROOF TRUSS DETAIL

REFER BAND DETAILS

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

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

DRAWING TITLE: DETAILS

FOUNDATION SECTION OF COLUMN POST

SECTION OF INTERIOR FOUNDATION

STONE MASONRY FOUNDATION

STONE SOLING WITH SAND

P.C.C. 1:2:4

STONE MASONRY FOUNDATION

COMPACTED FILL

COMPACTED FILL

PLINTH BEAM
200MM X 150MM

8Ø STIRRUP AT 100 MM C/C

12Ø 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

C.H.C.-2.1 5/11
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

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

SLAB DETAILING FOR BARS

- 8MMØ @ 200MM C/C BOTH WAYS
- 50MM X 50MM WOOD JOIST AT 300MM C/C

*100MM SLAB THICKNESS
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

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

Details:

- **Sill/Lintel Band**: 2-12mm³ BARS, 6mm³ Stirrups
- **Plinth Band**: 4-12mm³ Ribbed Bars, 6mm³ Closed Tie
- **Column Plan**: 4-12mm³ Ribbed Bars, 6mm³ Closed Tie

Dimensions:
- **Longitudinal Section of Slab X-X**: 8mm³ @ 200mm C/C Both Ways
- **Transverse Section of Slab Y-Y**: 8mm³ @ 200mm C/C Both Ways

Scale: None

Date: C.H.C.-2.1

8/11
MODEL C.H.C.-2.1, CONFINED HOLLOW CONCRETE BLOCK MASONRY

HOUSING TYPE: MODEL C.H.C.-2.1
DRAWING TITLE: DETAILS
SCALE: NONE
DATE: 9/11

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION

C.H.C.-2.1

ROOF TRUSS ELEVATION WITH GUSSET PLATE

DETAIL OF CGI STRAP

3D VIEW CGI STRAP CONNECTION

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

TWO STOREY

MEMBER 4 (100x50 BOTTOM TIE)

MEMBER 5 (50x50 MM DIAGONAL WEB)

MEMBER 4 (50x50 MM DIAGONAL WEB)

MEMBER 7 (100x50 BOTTOM TIE)

MEMBER 3 (KING POST)

MEMBER 3 (DIAGONAL WEB)

DIAGONAL WEB

CUT PORTION

CUT PORTION

MEMBER 5 (DIAGONAL WEB)

2-75MM LONG NAILS ON EITHER SIDE OF EACH DIAGONAL WEB

2-75 LONG NAILS ON EITHER SIDE OF KING POST

37.5 MM THICK GUSSET PLATE ON EITHER SIDE

2-75MM LONG NAILS ON EITHER SIDE OF EACH DIAGONAL WEB

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

37.5 MM THICK GUSSET PLATE ON EITHER SIDE

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

ALIGNMENT OF GRAIN

DETAIL AT CONNECTION 2

DETAIL OF GUSSET PLATE

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)

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

TWO STOREY

MEMBER 4 (100x50 BOTTOM TIE)

MEMBER 5 (50x50 MM DIAGONAL WEB)

MEMBER 4 (50x50 MM DIAGONAL WEB)

MEMBER 7 (100x50 BOTTOM TIE)

MEMBER 3 (KING POST)

MEMBER 3 (DIAGONAL WEB)

DIAGONAL WEB

CUT PORTION

CUT PORTION

MEMBER 5 (DIAGONAL WEB)

2-75MM LONG NAILS ON EITHER SIDE OF EACH DIAGONAL WEB

2-75 LONG NAILS ON EITHER SIDE OF KING POST

37.5 MM THICK GUSSET PLATE ON EITHER SIDE

2-75MM LONG NAILS ON EITHER SIDE OF EACH DIAGONAL WEB

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

37.5 MM THICK GUSSET PLATE ON EITHER SIDE

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

ALIGNMENT OF GRAIN

DETAIL AT CONNECTION 2

DETAIL OF GUSSET PLATE

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)

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

TWO STOREY

MEMBER 4 (100x50 BOTTOM TIE)

MEMBER 5 (50x50 MM DIAGONAL WEB)

MEMBER 4 (50x50 MM DIAGONAL WEB)

MEMBER 7 (100x50 BOTTOM TIE)

MEMBER 3 (KING POST)

MEMBER 3 (DIAGONAL WEB)

DIAGONAL WEB

CUT PORTION

CUT PORTION

MEMBER 5 (DIAGONAL WEB)

2-75MM LONG NAILS ON EITHER SIDE OF EACH DIAGONAL WEB

2-75 LONG NAILS ON EITHER SIDE OF KING POST

37.5 MM THICK GUSSET PLATE ON EITHER SIDE

2-75MM LONG NAILS ON EITHER SIDE OF EACH DIAGONAL WEB

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

37.5 MM THICK GUSSET PLATE ON EITHER SIDE

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

ALIGNMENT OF GRAIN

DETAIL AT CONNECTION 2

DETAIL OF GUSSET PLATE

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)
# TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Structure System</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>Foundation</td>
<td>Strip foundation with stone masonry casing the tie column. The depth and width of footing shall be 900mm.</td>
</tr>
<tr>
<td>Plinth Band</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>Wall System</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>Sill Band</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>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 75mm. Main reinforcement shall be 2 nos.12mm dia. bars with 6mm Ø stirrups at 150mm C/C.</td>
</tr>
<tr>
<td>Floor Beam:</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>Floor:</td>
<td>100 mm thick reinforced concrete slab as shown in 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>
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 X 10cm  
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)
<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>
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<td>Cu.m.</td>
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<td>Kg.</td>
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<td></td>
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<td>Up to Plinth Level</td>
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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.

HCB-3.1
2/9
MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY

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

SCALE: NONE

DATE: 3/9

SECTION AT A-A

- **CANTILEVER PANEL**
- **LINTEL BAND**
- **U-SHAPE BLOCK FOR SILL BAND**
- **200 MM HOLLOW CONCRETE BLOCK WALL IN CEMENT CONCRETE (1:5).**
- **REFER FOUNDATION DETAIL**
- **REFER STAIRCASE DETAIL**
- **REFER BEAM DETAIL**
- **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
- **CEMENT PUNNING FINISHING**
  - 38MM THK. CAST IN SITU CONCRETE (M20)
  - 50MM THK. PRECAST PANEL
- **STAIRS**
- **ROOM**
- **TOILET**
- **KITCHEN**
- **GROUND LVL.**
- **WELL COMPACTED EARTH**
- **50MM TK. SCREED/PUNNING**
- **100MM K. CSEB BLOCKS**
- **500 GAUGE PLASTIC LAYERS**

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

DRAWING TITLE: SECTION
MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY

TWO STOREY

FRONT ELEVATION

BACK ELEVATION

SIDE ELEVATION

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

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

HOLEY BLOCK WALL

- 2 - 8 mm Ø M20 CONCRETE
- 6mm Ø STIRRUPS @ 400mm C/C
- HOLLOW BLOCK WALL IN 1:4 C/S MORTAR
- 8 mm Ø @ 200mm C/C
- 4 NO. OF 8 mm Ø

RCC STRIP FOUNDATION

- (M20)
- 25mm TK. SAND FILLING AND COMPACTION
- WELL COMPACTED EARTH

DETAIL AT X

4.75mm Ø TEMPERATURE FLANGE RODS @ 300mm C/C OVER BEAMS
MODEL H.C.B.- 3.1, HOLLOW CONCRETE BLOCK MASONRY

TWO STOREY

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

LONGITUDINAL SECTION OF PRECAST BEAM

- 10 MM Ø REBAR
- 4.75mm Ø STIRRUPS @ 400MM C/C
- 2-10 MM Ø REBAR

LONGITUDINAL SECTION OF LINTEL BEAM

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

PRECAST BEAM CROSS SECTION

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

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: 6/9

HCB-3.1
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
MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

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

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

REINFORCEMENT DETAIL AT CORNER

COLUMNS PROJECTION DETAIL

DETAIL AT B SILL BAND

DETAIL AT A LINTEL BEAM

REINFORCEMENT DETAIL AT T-JUNCTION

SCALE: NONE
DATE: 7/9

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

STAIRCASE DETAIL PLAN

STAIRCASE SLAB UNIT

STAIR SECTION AT B-B

STAIR SECTION AT A-A

5 NO - 4.75 MM Ø REBAR
3 NO - 8 MM Ø REBAR
M20 CONCRETE SLAB

3 NO - 8 MM Ø REBAR
5 NO - 4.75 MM Ø REBAR

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. 10 mm Ø bars with 6 mm Ø stirrups at 150 mm C/C.</td>
</tr>
<tr>
<td>Wall System</td>
<td>The hollow blocks shall be of size 400 x 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 75 mm. Main reinforcement shall be 2 nos. 8 mm dia. bars with 6 mm Ø stirrups at 150 mm 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 600 mm 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 10 mm dia. bars with 7 mm Ø triangular stirrups at 150 mm.</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 X10cm
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>
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<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</td>
<td>3 - 4 MPa</td>
</tr>
<tr>
<td>(after 24 hours immersion)</td>
<td></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>
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</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>MATERIALS</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Stabilized block</td>
</tr>
<tr>
<td></td>
<td>No.</td>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>1,758.0</td>
</tr>
<tr>
<td>Super Structure</td>
<td>1,500.0</td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3,258.0</td>
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</tbody>
</table>
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

REFER ROOFING DETAIL

REFER FOUNDATION DETAIL

CEMENT PLASTERED EAVES WITH WIRE MESH

BAMBOO POST
MODEL C.S.E.B-4.1, COMPRESSED STABLILIZED EARTH BLOCK MASONRY

Housing Type: CSEB-4.1

Drawing Title: Elevations

Scale: None

One Storey

Front Elevation

Back Elevation

Left Elevation

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

HOUSING TYPE: CSEB-4.1
DRAWING TITLE: DETAILS

FOUNDATION SECTION

200MM THK. CSEB Masonry

8MM ø REBARS @ 200 C/C
4 NO. 6MM ø REBARS
RCC STRIP FOUNDATION

LINTEL BAND

4 NO. 10MM ø REBARS
6MM ø @150MM C/C

SECTION B-B

BAMBOO POST
BITUMEN COATING
500 GAUGE POLYTHENE SHEET
WIRE MESH
C. CONCRETE (M20)

HOLLOW C. BLOCK

FOUNDATION OF BAMBOO POST

300 200

425

500

600

FOUNDATION OF BAMBOO POST

2 NO. 10MM ø REBARS
6MM ø @150MM C/C

SILL BAND

100 200

75 400

600

200MM THK. CSEB Masonry

100
MODEL C.S.E.B-4.1, COMPRESSED STABILIZED EARTH BLOCK MASONRY

ROOFING DETAILS

- 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

SECTION A’ - A’

- 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
- TIMBER TRUSSED BEAM

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

- TRUSSED BEAM
- G.I. WIRE OR 4.75 mm Ø rod

- 200mm THK. COMPRESSED STABILIZED SOIL BLOCK WALL
MODEL C.S.E.B-4.1, COMPRESSED STABILIZED EARTH BLOCK MASONRY

ONE STOREY

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

STRENGTHENING WALL BY BAMBOO AND G.I. WIRE

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

HALFCUT
BAMBOO
CSEB WALL

CROSS SECTION

PLAN AT B - B

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

PLAN AT A - A

BAMBOO SECTION
500 GAUGE POLYTHENE
SHEET WRAPPING
WIRE MESH AROUND
POLYTHENE WRAPPING
CEMENT CONCRETE (M20)
AROUND WIRE MESH
### 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>
**MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY**  
**TWO STOREY**

### 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>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>
<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>-</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>1,410.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.2</td>
<td>9.8</td>
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<td>1,408.3</td>
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<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>

**LEVEL**

- **Up to Plinth Level**
- **Super Structure**
- **Roofing**

**TOTAL**

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<tr>
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<td>1,408.3</td>
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</tbody>
</table>

- CS Blocks
- Cement
- Sand
- Aggregate
- Reinforcing Bar
- CGI Sheet
- GI Sheet
- Wood
- MS Black Pipe

**HOUSETYPE:** CSEB-4.2

**DATE:**

---

**MINISTRY OF URBAN DEVELOPMENT**
**DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION**

**HOUSING TYPE:** CSEB-4.2
**DRAWING TITLE:** ESTIMATE AND 3D-VIEW
**SCALE:** NONE

---

**TWO STOREY**

---

**LEVEL**

- **Up to Plinth Level**
- **Super Structure**
- **Roofing**

**TOTAL**

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>No.</th>
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<td>10.0</td>
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<td>8.2</td>
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---

**CSEB-4.2**

---

**DATE:**

---

**63**
MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY

TWO STOREY

GROUND FLOOR PLAN
FLOOR AREA: 52.02SQ.M

KITCHEN/DINING
(3520x2780)

LIVING
(3530x3270)

LOBBY
(3530x3270)

BEDROOM
(3520x2780)

FIRST FLOOR PLAN
FLOOR AREA: 52.02SQ.M

BEDROOM
(3520x2780)

ROOM
(3520x2780)

CSEB

FLOOR PLANS

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: CSEB-4.2

SCALE: NONE

DRAWING TITLE: FLOOR PLANS

DATE:

CSEB-4.2

2/9
MODEL C.S.E.B-4.2, COMPRESSED STABILIZED EARTH BLOCK MASONRY  TWO STOREY

REFERENCES:
- ROOF TRUSS DETAIL
- SLAB AND BAND DETAIL
- FOUNDATION DETAIL

SECTION AT A-A

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

HOUSING TYPE: CSEB-4.2

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

FRONT ELEVATION

BACK ELEVATION

SIDE ELEVATION

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

TWO STOREY

FOUNDATION SECTION

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

FOUNDATION DETAIL
(FOR VERANDAH)

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

DRAWING TITLE: FOUNDATION DETAILS

HOUSING TYPE: CSEB-4.2

SCALE: NONE

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

LAYOUT OF HORIZONTAL AND VERTICAL REINFORCEMENT

LOCATION OF VERTICAL REINFORCEMENT

- 12φ VERTICAL REBAR
- 16φ VERTICAL REBAR
- ROOF BAND
- LINTEL BAND
- SILL BAND
- FLOOR BEAM
- LINTEL BAND
- PLINTH BAND

12φ

VERTICAL
REBAR

16φ

VERTICAL
REBAR

4-10φ VERTICAL BAR AT EACH CORNER

2-10φ VERTICAL BAR AT EVERY 1.2M IN WALL

4-10φ VERTICAL BAR AT JAMBS OF OPENINGS

2-10φ VERTICAL BAR AT EVERY JUNCTION

HOUSING TYPE: CSEB-4.2
DRAWING TITLE: REINFORCEMENT DETAILS
SCALE: NONE
DATE: 7/9
MODEL C.S.E.B-4.2, COMPRESSED STABLILIZED EARTH BLOCK MASONRY

TWO STOREY

ROOF TRUSS DETAILS

VERANDAH POST END PLATE DETAILS

BASE CONNECTION DETAILS

JOINT PLATE DETAILS

PURLIN CLEAT DETAILS

RUNNER CLEAT DETAILS

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: CSEB-4.2
DRAWING TITLE: ROOF DETAILS
SCALE: NONE
DATE: 8/9

CSEB-4.2
## 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>
</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 150mm. Main reinforcement shall be 4 nos. 12mm dia. bars with 8mm Ø stirrups at 150mm C/C.</td>
</tr>
<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>
</tr>
<tr>
<td>Roof:</td>
<td>CGI sheet roofing over metal truss as shown in the drawing.</td>
</tr>
</tbody>
</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.
**Model R.R.M-5.1, Random Rubble Masonary in Mud Mortar**

**One Storey**

### Materials

<table>
<thead>
<tr>
<th>Level</th>
<th>Stone</th>
<th>Weld Wire Mesh</th>
<th>Sand</th>
<th>Mud</th>
<th>CGI Sheet</th>
<th>GI Sheet</th>
<th>Wood</th>
<th>4mm GI Wire</th>
<th>2mm GI Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Sq.m</td>
<td>Cu.m.</td>
<td>Cu.m.</td>
<td>Sq.m.</td>
<td>Cu.m.</td>
<td>Kg</td>
<td>Kg</td>
<td>Kg</td>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>16.1</td>
<td>10.4</td>
<td>1.3</td>
<td>7.4</td>
<td></td>
<td></td>
<td>-</td>
<td>6.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Super Structure</td>
<td>28.8</td>
<td>40.7</td>
<td>-</td>
<td>11.0</td>
<td></td>
<td></td>
<td>0.5</td>
<td>19.0</td>
<td>44.0</td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.1</td>
<td>9.1</td>
<td>5.6</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>44.9</td>
<td>51.1</td>
<td>1.3</td>
<td>18.4</td>
<td>4.1</td>
<td>9.1</td>
<td>6.1</td>
<td>25.0</td>
<td>62.0</td>
</tr>
</tbody>
</table>
MODEL R.R.M-5.1, RANDOM RUBBLE MASONARY IN MUD MORTAR

GROUND FLOOR PLAN
FLOOR AREA: 40.365 SQ. M

BED ROOM 2925 X 3000
BED ROOM 2925 X 3000

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

SCALE: NONE
DATE: 2/5
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

Housing Type: R.R.M-5.1

Department of Urban Development and Building Construction

Gable Wall to be of GI sheets or timber planks (no masonry)

Timber post 1100 above attic wall.

WWM Band at top of wall

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

Timber Floor TYP.

Timber Ridge Beam

Timber Joint

450mm (18") RR Wall in Mud Mortar

450mm RR Wall in Mud Mortar

WWM Band TYP.

WWM Plinth Band.

Ties, if any, underground must be aluminium wires

Random Rubble Masonary in Mud Mortar

Refer Wall Plate Details

Refer Foundation Details

Section: A-A

Ministry of Urban Development

Scale: None

Drawing Title: Section

Date:

R.R.M-5
## 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 31x 31 mm plus 2 nos. 4 mm GI wires laid in mud mortar. Diagonal WWM strap shall be provided for stronger corner connection securely tied to other WWM.</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 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 as shown in the drawing.</td>
</tr>
</tbody>
</table>
## Model R.R.M.-5.2, Random Rubble Masonry in Mud Mortar

### Two Storey

**Materials**

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Stone</th>
<th>Weld wire mesh</th>
<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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Sq.m</td>
<td>Cu.m.</td>
<td>Cu.m.</td>
<td>Sq.m.</td>
<td>Cu.m.</td>
<td>Kg</td>
<td>Kg</td>
<td>Kg</td>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>16.1</td>
<td>10.4</td>
<td>1.3</td>
<td>7.4</td>
<td>-</td>
<td>-</td>
<td>6.0</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td>Super Structure</td>
<td>49.3</td>
<td>71.9</td>
<td>-</td>
<td>18.8</td>
<td>0.9</td>
<td>28.0</td>
<td>66.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.1</td>
<td>9.1</td>
<td>6.6</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>65.4</td>
<td>82.3</td>
<td>1.3</td>
<td>26.3</td>
<td>4.1</td>
<td>9.1</td>
<td>7.4</td>
<td>34.0</td>
<td>84.0</td>
</tr>
</tbody>
</table>

### Diagram

- **Housing Type:** R.R.M.-5.2
- **Drawing Title:** Estimate and 3D-View
- **Scale:** None
- **Date:** 1/11

---

*MINISTRY OF URBAN DEVELOPMENT*

*DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION*

*HOUSING TYPE: R.R.M.-5.2*

*DRAWING TITLE: ESTIMATE AND 3D-VIEW*

*SCALE: NONE*

*R.R.M-5.2*

*DATE: 1/11*
MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR

TWO STOREY

GROUND FLOOR PLAN
FLOOR AREA: 40.365 SQ. M.

BED ROOM
2925 X 3000

BED ROOM
2925 X 3000

FLOOR PLAN

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

SCALE: NONE
DATE: 2/11
MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR  
TWO STOREY

FLOOR PLAN
FLOOR AREA: 40.365 SQ. M

BED ROOM
2925 X 3000

ROOM
2925 X 3000

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

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

HOUSING TYPE: R.R.M.-5.2
DRAWING TITLE: ELEVATION
SCALE: NONE
DATE: 5/11
MODEL R.R.M.-5.2, RANDOM RUBBLE MASONARY IN MUD MORTAR

Housing Type: R.R.M.-5.2

Drawing Title: Section

Section: A-A

Scale: None

Date: 6/11

Ministry of Urban Development
Department of Urban Development and Building Construction

Timber Ridge Beam (150 deep x 100 wide)

Timber Post 1100 above attic wall.

CGI Roofing

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)

WWM Band

At top of wall

Random rubble masonry in mud mortar

Random rubble masonry in mud mortar

Timber Joint

Timber Ridge Beam

450mm RR Wall in mud mortar

WWM Band Typ.

WWM Plinth Band

Ties, if any, under ground must be aluminium wires

Mud Floor

B buttress

Refer Wall Plate Details

Foundation Details

Refer Wall Plate Details

Random rubble masonry in mud mortar.
ECONOMIC OPTION
(Also to be used with existing foundation)

RECOMMENDED OPTION
(Only if aluminum wire are available)

FOUNDATION DETAIL

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>No. of storey</th>
<th>Width</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One</td>
<td>Two</td>
<td>Two plus attic</td>
</tr>
<tr>
<td>Hard</td>
<td>Width</td>
<td>Depth</td>
<td>Width</td>
</tr>
<tr>
<td>Medium</td>
<td>750</td>
<td>750</td>
<td>750</td>
</tr>
<tr>
<td>Soft</td>
<td>750</td>
<td>750</td>
<td>900</td>
</tr>
</tbody>
</table>

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.
- 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.

100X100MM TIMBER WALL PLATE.

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

ENSURE STRONG CONNECTION WITH METAL STRAPS

ATTIC WALL

WALL PLATE.

SECTION : D-D
ATTIC FLOOR TIMBER FRAMING PLAN

50X100MM TIMBER STRUT ON JOIST UNDERSIDE

75X125MM TIMBER JOISTS AT ± 450MM O/C

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

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

TIMBER FLOOR BEAM

WALL PLATE

Floor Joist

WWM Band
Ensure strong Connection with metal straps Typ.

SECTION : C-C

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: R.R.M.-5.1/5.2
DRAWING TITLE: DETAIL

SCALE: NONE
DATE: 9/11

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

LOCATION OF CROSS LINKS TO BE PLACED IN ALL STORIES.
## 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>
</tr>
</thead>
<tbody>
<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>
</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 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>
</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.</td>
</tr>
<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>
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
## MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

### TWO STOREY

![Model B.S.M.H.-6.1](image)

### LEVEL MATERIALS

<table>
<thead>
<tr>
<th>Level</th>
<th>Stone Cu.m.</th>
<th>Mud Cu.m.</th>
<th>CGI Sheet Bundle</th>
<th>GI Sheet Sq.m.</th>
<th>Wood Cu.m.</th>
<th>Bamboo Nos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to Plinth Level</td>
<td>11.6</td>
<td>13.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super Structure</td>
<td>21.3</td>
<td>8.1</td>
<td></td>
<td></td>
<td>0.6</td>
<td>230.0</td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>5.6</td>
<td>9.5</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>32.9</strong></td>
<td><strong>21.1</strong></td>
<td><strong>5.6</strong></td>
<td><strong>9.5</strong></td>
<td><strong>1.3</strong></td>
<td><strong>230.0</strong></td>
</tr>
</tbody>
</table>
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

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

Drawing Title: Plan

Date:

Scale: None

B.S.M.H.-6.1

Ground Floor

2500

7700

2200

75 x 75 timber door and window frame fixed to plinth band to lintel band

100 x 50 timber bands at plinth, sill and lintel levels

50mm gap between the bamboo posts and stone wall

2 nos. 75 x 75 vertical timber members joining the plinth, intermediate and lintel bands

100 x 50 timber bands at plinth, sill and lintel levels

50mm deep lap joints using bamboo pins

50 x 40 timber ties fixed with 12mm dia bamboo pins @ 500mm c/c

8mm dia threaded m.s. long bolt with 25mm washers and nuts through bamboo posts and plinth band timbers typ. ref. detail xx

7700

2200

AVG. 75 mm dia. bamboo

Bamboo post cluster (type 1)

Bamboo post cluster (type 2)

8mm dia threaded m.s. long bolt with 25mm washers and nuts. Ref. detail b

75 x 75 timber door and window frame

460 x 460 butress in long wall

460 x 460 butress in long wall

460 x 460 butress in long wall

460 x 460 butress in long wall

RCC plinth beam

130 x 130 timber post

130 x 130 timber post

8mm till +1070

3350

3350

6170

6170

2060

2060

2500

7700

2200

2200

1930

1930

Open Verandah

To perimeter drain outside

Covered Verandah

Kitchen

Smm till +1070

Plan at +460

Plinth band in local treated timber

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:

BSMH-6.1

2/14

93
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

TWO STOREY

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

DRAWING TITLE: PLAN

SCALE: NONE

DATE: 3/14

BSMH-6.1

PLAN AT +1000

WINDOW SILL LEVEL

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDNG CONSTRUCTION
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

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

Drawing Title: Plan

Middle Timber Band

Plan at +1575

MINISTRY OF URBAN DEVELOPMENT

DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDING CONSTRUCTION

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

SCALE: NONE

DRAWING TITLE: PLAN

DATE:

BSMH-6.1

4/14

95
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: 6/14

BSMH-6.1

PLAN AT +2790 (ATTIC FLOOR BEAMS)
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

TWO STOREY

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

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

SCALE: NONE
DATE: 7/14

PRE-COATED GALVANIZED IRON ROOFING SHEETS PROTECTION OVER SMM WALL FIXED WITH J-BOLTS

130 MM THICK MUD PLASTERED DOUBLE WATTLE WALLS ON BAMBOO FRAME

HOT

PLAN AT +3350 (ATTIC WINDOW SILL LEVEL)

ATTIC FLOOR LVL +2850

CROSS BRACING

SPLIT BAMBOO (HALF ROUND)

WOVEN BAMBOO MAT UNDERLAY

ATTIC FLOOR LVL +2850

CROSS BRACING IN TRUSS PLANE BELOW THE PURLINS

TWIN BAMBOO TRUSS ABOVE SUPPORTED ON MIDDLE BAMBOO POSTS AND BOLTED

BAMBOO POSTS IN A CLUSTER OF 3 FROM GROUND FLOOR LEVEL BOLTED TO EACH OTHER AND TO THE DOUBLE BAMBOO ROOF TRUSS

PRE-COATED GALVANIZED IRON ROOFING SHEETS TO SLOPE DOWNTAKE FOR RAINWATER HARVESTING

J BOLTS WITH WATER-TIGHT WASHERS FOR FIXING GI SHEETS TO BAMBOO PURLINS

PRE-COATED GALVANIZED IRON ROOFING SHEETS PROTECTION OVER SMM WALL FIXED WITH J-BOLTS

2500

2200

9910

SLOPE

9910

2200

2200

SLOPE

3350

6930

2060

J BOLTS WITH WATER-TIGHT WASHERS FOR FIXING GI SHEETS TO BAMBOO PURLINS

PRE-COATED GALVANIZED IRON ROOFING SHEETS PROTECTION OVER SMM WALL FIXED WITH J-BOLTS

2500

2200

9910

SLOPE

9910

2200

2200

SLOPE

3350

6930

2060

C

Pre-coated galvanized iron roofing sheets protection over SMM wall fixed with J-bolts.

130 mm thick mud plastered double wattle walls on bamboo frame.

Cross bracing in truss plane below the purlins.

Twin bamboo truss above supported on middle bamboo posts and bolted.

Bamboo posts in a cluster of 3 from ground floor level bolted to each other and to the double bamboo roof truss.

Pre-coated galvanized iron roofing sheets to slope downtake for rainwater harvesting.

J bolts with water-tight washers for fixing GI sheets to bamboo purlins.

Plan at +3350 (attic window sill level).
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: SECTION

SCALE: NONE

BSMH-6.1

DATE:

100

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

1060

ATTIC FLOOR

1750

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

G.I. SHEET GUTTER

100

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

1750

100 x 50 TIMBER BANDS AT INTERMEDIATE LEVEL

5170

100 x 50 TIMBER BANDS AT PLINTH LEVEL

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

2360

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

100

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

100 x 50 TIMBER RAFTER FIXED TO THE LINTEL BAND WITH BAMBOO DOWEL

100

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

100 x 50 TIMBER RAFTER FIXED TO THE LINTEL BAND WITH BAMBOO DOWEL

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

2360

500 x 100 x 75 PRECAST CONCRETE ‘THROUGH STONES’

2360

100

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

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

100

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

100

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

G.I. SHEET GUTTER

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

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

130 X 130 TIMBER POSTS FOR VERANDAH SECURED WITH DOWEL THROUGH M.S. FLAT EMBEDDED IN RC LINTEL BAND REFER DETAIL A
MODEL B.S.M.H.-6.1, BAMBOO AND STONE MASONRY HYBRID STRUCTURE

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

SCALE: NONE
DATE: 10/14

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

ATTIC FLOOR

- 1675
- 1110
- 395
- 860
- G.I. ROOFING SHEET OVER KITCHEN FIXED USING J-BOLTS
- G.I. ROOFING SHEETS AND RIDGE PIECE FIXED USING J-BOLTS
- TWIN BAMBOO TRUSS
- BAMBOO CROSS BRACING
- PRE-COATED C.G.I ROOFING SHEETS AND RIDGE PIECE FIXED USING J-BOLTS

GROUND FLOOR

- 460
- 2165
- 100 x 50 TIMBER BANDS AT LINTEL LEVEL
- 50 MM THICK DPC PLINTH BAND
- 75 THK. DPC

KNEE BRACING REF DETAIL P

BAMBOO POST CLUSTER (TYPE 2) OVER PCC BASE BLOCK. REF DETAIL B

MUD FLOOR OVER COMPACTED CLAY OVER STONE COMPACTED WITH MUD

- 75 THK. DAMP PROOF COURSE IN 1:2:4 PCC
- MUD PLASTER ON BAMBOO WATTLE
- 100 x 50 TIMBER BANDS AT INTERMEDIATE LEVEL

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

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

DRAWING TITLE: DETAILS

SCALE: NONE

DATE: 12/14
DETAIL B (SECTION): BASE PAD FOR BAMBOO CLUSTER POSTS ‘TYPE 1’ AND ‘TYPE 2’

AVG. 76 MM DIA. BAMBOO POSTS TIED WITH LASHING @ 900 C/C AND PAINTED WITH CREOSOTE TILL 300 MM FROM BASE

10 MM DIA. NUTS AND BOLTS

50 MM WIDE 6 MM TH. M.S. FLAT PLATE EMBEDDED IN 305 TH P.C.C BASE PAD

PLINTH LEVEL +457

305 MM TH. PRE-CAST P.C.C. BASE PAD

12 MM BOLT THROUGH BAMBOO POST AND TIMBER BAND AT PLINOTH LEVEL

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’

12 MM BOLT THROUGH BAMBOO POST AND TIMBER BAND AT PLINOTH LEVEL

102 X 51 MM TIMBER BAND AT PLINOTH LEVEL

75 MM DEEP TWO BAR R.C.C. PLINOTH BEAM
### TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Structure System</th>
<th>Two independent structural system; bamboo structure and stone masonry in mud mortar with 150 mm gap between them as shown in the drawings.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>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.</td>
</tr>
<tr>
<td>Bands:</td>
<td>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 x 50 mm size covering entire thickness of wall. These timber shall be laterally tied with timber sections of size 38*50 mm</td>
</tr>
<tr>
<td>Wall System</td>
<td>Random rubble masonry in mud mortar. Wall thickness 450 mm</td>
</tr>
<tr>
<td>Floor:</td>
<td>50 mm thick mud flooring over split bamboos laid over joists of bamboo twins (double section) @ 400 mm c/c (Refer drawing)</td>
</tr>
<tr>
<td>Roof:</td>
<td>Lightweight roof of Corrugated Iron sheet over bamboo truss. All joints in the truss shall be properly connected as shown in the drawing.</td>
</tr>
</tbody>
</table>
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
### MATERIALS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Stone</th>
<th>Brick</th>
<th>Cement</th>
<th>Sand</th>
<th>Aggregate</th>
<th>Wood</th>
<th>Reinforcing Bar</th>
<th>CGI Sheet</th>
<th>GI Sheet</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>Cu.m.</td>
<td>Kg.</td>
<td>Bundle</td>
<td>Rm.</td>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>19.5</td>
<td>2,225.0</td>
<td>59.0</td>
<td>10.3</td>
<td>2.5</td>
<td></td>
<td>280.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super Structure</td>
<td>5,125.0</td>
<td>32.0</td>
<td>3.1</td>
<td>2.5</td>
<td>0.6</td>
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<td>297.8</td>
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</tr>
<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.0</td>
<td></td>
<td>-</td>
<td>4.2</td>
<td>10.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>19.5</td>
<td>7,350.0</td>
<td>91.0</td>
<td>13.4</td>
<td>4.9</td>
<td>4.6</td>
<td>578.2</td>
<td>4.2</td>
<td>10.0</td>
</tr>
</tbody>
</table>

**LEVEL:** ONE STOREY

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

GROUNDFLOOR PLAN
FLOOR AREA: 40.36 SQ.M.

BED ROOM
3430X3585

KITCHEN
3585X3585

VERANDAH

HOUSING TYPE: R.T.B.-7.1
DRAWING TITLE: GROUND FLOOR PLAN
DATE: 2/10

SCALE: NONE

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

HOUSING TYPE: R.T.B.-7.1

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

ROOF: ANGLE 21 CGI SHEET MIN. 28 GAUGE ON WOODEN FRAME

PURLING: 75MMX75MM @450MMC/C

RAFTER: 180MMX90MM@610MMC/C

RAFTER: 125MMX75MM@450MMC/C

PURLING: 75MMX75MM @450MMC/C

RIDGE COVER

RIDGE PIECE: 125MMX75MM

RTB-7.1

3/10
MODEL RTB-7.1, RAT TRAP BOND MASONRY
ONE STOREY

FRONT ELEVATION

SIDE ELEVATION

SIDE ELEVATION

BACK ELEVATION

HOUSING TYPE: R.T.B.-7.1
DRAWING TITLE: ELEVATIONS
SCALE: NONE
DATE: 4/10
RTB-7.1
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

LINTEL 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

FOUNDATION: STONE MASONRY IN CEMENT MORTAR 1:4

VERTICAL REINFORCEMENT: REINFORCEMENT 12MM REBAR

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: R.T.B.-7.1
DRAWING TITLE: SECTIONAL PERSPECTIVE

SCALE: NONE
DATE:

RTB-7.1
5/10
MODEL RTB-7.1, RAT TRAP BOND MASONRY

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

TOP (PLAN) VIEW

ISOMETRIC VIEW

SIDE VIEW

DETAILS

HAIRLINE'

CGI SHEET MIN. 26GAGE

RAFTER (H180 X W90)

PURLIN (H75 X W75)

RIDGE COVER

Post (D100 X W100)

RAFTER (H180 X W90)

PURLIN (H75 X W75)

RIDGE COVER

CGI SHEET MIN. 26GAGE

PREPARED FOR: 

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: R.T.B.-7.1
DRAWING TITLE: ROOF DETAILS

SCALE: NONE
RTB-7.1

DATE: 8/10
MODEL RTB-7.1, RAT TRAP BOND MASONRY

ONE STOREY

HOUSING TYPE: R.T.B.-7.1
DRAWING TITLE: ROOF DETAILS

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

SCALE: NONE
DATE: 9/10

CGI SHEET
75X75MM PURLIN @300MM C/C

ROOF BAND

180X90MM RAFTER @600MM C/C

100X75 MM WALL PLATE

J-HOOK

EAVES BOARD

X

TYPE-1

GABLE BAND

MASONRY WALL

ROOF BAND

CGI RIDGE

75 X 125 RIDGE PIECE

WOODEN POST

RAFTER

NAIL

Y

DETAIL AT-X

WOODEN NAIL

WOODEN KEY

RAFTER

75X 100 MM WALL PLATE

RIDGE PIECE

DETAIL AT-Y

RIDGE PIECE

RAFTER

NAIL
## Technical Requirements

<table>
<thead>
<tr>
<th>Structure System</th>
<th>Load bearing Rat Trap Bond (RTB) masonry structure.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foundation</strong></td>
<td>Stone masonry strip footing of width 800 mm and depth 800 mm in cement sand mortar 1:4.</td>
</tr>
<tr>
<td><strong>Plinth Band</strong></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><strong>Wall System</strong></td>
<td>Rat trap bond brick masonry in 1:4 cement sand mortar.</td>
</tr>
<tr>
<td><strong>Sill Band</strong></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>
</tr>
<tr>
<td><strong>Lintel Band:</strong></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><strong>Roof Band:</strong></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><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>
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)
### MODEL E.B.-8.1, EARTHBAG MASONRY

**ONE STORY**

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>Materials</th>
<th>Cu.m.</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>
<th>Cu.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to Plinth Level</td>
<td>Stone</td>
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</tr>
<tr>
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<td>Cement</td>
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<tr>
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<td>Sand</td>
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<td>-</td>
<td>-</td>
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</tr>
<tr>
<td></td>
<td>Aggregate</td>
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<td>-</td>
<td>-</td>
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</tr>
<tr>
<td></td>
<td>Reinforcing Bar</td>
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<tr>
<td></td>
<td>CGI Sheet</td>
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</tr>
<tr>
<td></td>
<td>Wood</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td></td>
<td>Earth</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>Stone</td>
<td>12.3</td>
<td>18.4</td>
<td>1.0</td>
<td>2.0</td>
<td>237.3</td>
<td>4.2</td>
<td>8.0</td>
<td>2.9</td>
<td>25.5</td>
</tr>
</tbody>
</table>
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, EARTH BAG MASONRY

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

SECTION A-A

REFER FOUNDATION DETAIL

450 MM THK. EARTH BAG MASONRY IN BARBED WIRE

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

25MM CEMENT / EARTHEN PLASTER
GALVANIZED CHICKEN WIRE MESH
380MM EARTH BAG
12MM REBAR WITH 300MM OVERLAP
3 LAYERS OF 150MM GRAVEL BAGS
DRY STONE MASONRY

REFER ROOF BAND CONNECTION DETAIL

RIDGE H240XW180
POST H90XW90
RAFTER H180XW90
PURLIN H75XW75
BASE H90XW90

SCALE: NONE
DATE: 4/11
MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

MODEL E.B.-8.1, EARTHBAG MASONRY

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

SCALE: NONE
DATE:

RIDGE H240XW180
POST H90XW90
RAFTER H180XW90
PURLIN H75XW75

REFER ROOF BAND CONNECTION DETAIL

BASE H90XW90

100X100 WOODEN DOOR FRAME

100X100 WOODEN WINDOW FRAME

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

1960

SECTION B-B

300

450 MM THK. EARTHBAG MASONRY IN BARBED WIRE

REFER FOUNDATION DETAIL

450

2895

335

1205

600

905

600

150

150

150

150

124

E.B.-8.1

5/11
MODEL E.B.-8.1, EARTHBAG MASONRY

ROOF PLAN

ROOF BAND CONNECTION WITH TRUSS

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

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

E.B.-8.1
6/11

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

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

SCALE: NONE
DATE: 7/11

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

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

ONE STOREY
MODEL E.B.-8.1, EARTHBAG MASONRY

HOUSING TYPE: MODEL E.B.-8.1

FOUNDATION SECTION

EARTHBAGS
GRAVEL FILLED BAGS
MUD FLOORING
RUBBLE SOLING
FILTER GEO-FABRIC ENVELOPES RUBBLE TRENCH

150MM
150MM

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

BASE WIDTH OF FOOTING = 200 + 1 BAG WIDTH

PERFORATED PIPE

100MM

RUBBLE TRENCH

TOP SOIL

SUB SOIL

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

E.B.-8.1
8/11

DATE:

127
**CONSTRUCTION SEQUENCE**

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

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

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

4. **BUILD RUBBLE TRENCH FOUNDATION INSTALL FRENCH DRAIN & PLUMBING**

5. **FILL AND PLACE FIRST COURSE OF GRAVEL BAGS**

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

7. **LAY SECOND OR THIRD GRAVEL BAG LAYER ABOVE FLOOR LEVEL**

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

9. **MAKE DOOR_THRESHOLDS, INSTALL DOOR FRAMES AND OPTIONAL DOOR BUCKS**
CONSTRUCTION SEQUENCE

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

11 FILL BAGS WITH EARTH, PLACE FIRST COURSE AND TAM

12 REPEAT STEP 6 AFTER EACH COURSE

13 PREVENT CORNER DROP

14 TAM, 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
**TECHNICAL REQUIREMENTS**

<table>
<thead>
<tr>
<th>Structure System</th>
<th>Load bearing Earthbag masonry structure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>Strip Foundation of dry stone masonry of width 600 mm and depth 900 mm.</td>
</tr>
<tr>
<td>Plinth</td>
<td>Three polypropylene bags filled with gravel shall be placed up to plinth level.</td>
</tr>
<tr>
<td>Wall System</td>
<td>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.</td>
</tr>
<tr>
<td>Roof Band:</td>
<td>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.</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>
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

### 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>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>42.1</td>
<td>15,702.0</td>
<td>115.1</td>
<td>13.0</td>
<td>11.1</td>
<td>468.5</td>
<td>-</td>
<td>-</td>
<td>-</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>1,753.2</td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8.8</td>
<td>32.9</td>
<td>5,938.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>42.1</td>
<td>15,702.0</td>
<td>117.2</td>
<td>13.3</td>
<td>11.1</td>
<td>468.5</td>
<td>8.8</td>
<td>32.9</td>
<td>5,938.0</td>
</tr>
</tbody>
</table>
MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE

GROUND FLOOR PLAN
AREA: 65.63 SQ. M
HOUSING TYPE: MODEL L.G.S.-9.1
DRAWING TITLE: SECTION

SCALE: NONE
DATE:
L.G.S 9.1
4/9
MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE

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

Drawing Title: Details

Scale: None

Date: 5/9

Ministry of Urban Development
Department of Urban Development and Building Construction

Foundation Section

Typical Strap Bracing in Wall

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

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

Drawing Title: Details

Structural Elevation 1

Structural Elevation 2

Typical Elevation Detail at Opening

Ministry of Urban Development
Department of Urban Development and Building Construction

Housing Type: Model L.G.S.-9.1
Drawing Title: Details

Scale: None

Date: 6/9

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

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

PLANT VIEW AT CORNER

10MM THICK CLADDING BOARD
160MM LX12MM DIA ANCHOR BOLT
10X16-16 HEX TEK SCREW
160MM LX12MM DIA ANCHOR BOLT

160MM LX12MM DIA ANCHOR BOLT
C90X37X0.75MM STUD
3MM THICK 75X75MM MS L BRACKET HOLD DOWN
3MM THICK 75X75MM CONNECTION PLATE
3-4.8MMØ SCREW @ 15MM OC
C90X37X0.75MM NUG

PLANT VIEW AT WALL STUD

160MM LX12MM DIA ANCHOR BOLT
3MM THICK 75X75 SQUARE WASHER PLATE
3MM THICK 75X75MM STUD

PLANT VIEW AT INTERSECTION

10MM THICK CLADDING BOARD
160MM LX12MM DIA ANCHOR BOLT
160MM LX12MM DIA ANCHOR BOLT

C90X37X0.75MM STUD
4MM THICK CONNECTION PLATE
3-4.8MMØ SCREW @ 15MM OC
2-4.8MMØ SCREW ON BOTH SIDE OF STUDS
C90X37X0.75MM NUG

TYPICAL CONNECTION DETAILS OF STUD AND NUG.

DETAIL AT A

C90X37X0.95MM BMT SECTION STUD
HOLES FOR CONCRETE NAIL

160MM LX12MM DIA ANCHOR BOLT
3MM THICK 75X75MM MS L BRACKET HOLD DOWN
C90X37X0.95MM BMT SECTION STUD

HOLES FOR CONCRETE NAIL
MODEL L.G.S.-9.1, LIGHT GAUGE STEEL STRUCTURE

ROOF LAYOUT

SUPPORT DETAIL

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDING CONSTRUCTION

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

L.G.S 9.1
8/9

SCALE: NONE
DATE:
### TECHNICAL REQUIREMENTS

<table>
<thead>
<tr>
<th><strong>Structure System</strong></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><strong>Foundation</strong></td>
<td>Strip footing of Random rubble masonry in cement sand mortar with width 900 mm and depth 850 mm.</td>
</tr>
<tr>
<td><strong>Plinth Band</strong></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><strong>Wall System</strong></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><strong>Bracing:</strong></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><strong>Roof System:</strong></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>
### MATERIALS

<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>
<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>
<th>Sq.m.</th>
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<tbody>
<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></td>
<td></td>
<td></td>
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<td></td>
<td>2.5</td>
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<tr>
<td>Super Structure</td>
<td>-</td>
<td>2.2</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>4,184.8</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>244.3</td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>5.4</td>
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</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>2,973.0</td>
<td>89.8</td>
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<td>9.5</td>
<td>594.5</td>
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<td></td>
<td></td>
<td>246.8</td>
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</tbody>
</table>
MODEL L.G.S.-9.2, LIGHT GAUGE SHEET STRUCTURE

TWO STOREY

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

L.G.S.-9.2

143

DATE: 2/7
MODEL L.G.S.-9.2, LIGHT GAUGE SHEET STRUCTURE

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

CGI SHEET

REFER TYPICAL ROOF TRUSS DETAIL

REFER TYPICAL FLOOR SECTION

REFER FOUNDATION DETAIL

SECTION AT X-X

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

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

SCALE: NONE
L.G.S.-9.2

DATE:
4/7
MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

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

SCALE: NONE
DATE: 5/7

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

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

Details at C
Foundation and Wall Section

- 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
- No 8 Screws Through the Ceiling Boards to the Bottom Chord of the Joist

Materials:
- 10 mm Starter Bar @ 400 mm Spacing
- 25 mm Thick Concrete Boards
- Cellular Light Weight Concrete Infill (600 KG/M3)
- 600 mm High Density Concrete Infill Between Walls Studs

Reinforcement:
- 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
- Regular Concrete Infill (2400 KG/M3)

Frame Connection to Wall L Bracket Hold Down

- 89x50x15 Stud
- 8.8 Grade Wafer Head Screws
- M12 Anchor Bolt with Inbuilt Washer

U-Track Over Concrete Slab

- 89x50x15 U-Track
- 8.8 Grade Wafer Head Screws

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

TWO STOREY

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: MODEL L.G.S.-9.2
DRAWING TITLE: DETAILS
SCALE: NONE
DATE: 6/7

TYPICAL FLOOR SECTIONS

ISOMETRIC VIEW OF STUDS ARRANGEMENT

TYPICAL WALL SECTION

TYPICAL ROOF TRUSS TO STUD CONNECTIONS

TYPICAL NOGGING SECTION
**TECHNICAL REQUIREMENTS**

<table>
<thead>
<tr>
<th>Structure System</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</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>Wall System</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>Flooring System</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>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>
STEEL STRUCTURE

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

---

### 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 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>Up to Plinth Level</td>
<td>3,384.0</td>
<td>130.0</td>
<td>11.0</td>
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<tr>
<td>Super Structure</td>
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<td>10.0</td>
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<td>3,930.1</td>
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<td>-</td>
<td>10.3</td>
<td>22.6</td>
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<tr>
<td>Roofing</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>845.4</td>
<td>6.3</td>
<td>11.1</td>
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<tr>
<td>TOTAL</td>
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<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

GROUND FLOOR PLAN
AREA: 60.85 SQ.M

ROOM 4950x2950
ROOM 4950x2950
ROOM 4950x2950

FIRST FLOOR PLAN
AREA: 60.85 SQ.M

ROOM 4950x2950
ROOM 4950x2950
ROOM 4950x2950

HOUSING TYPE: MODEL S.S-10.1
DRAWING TITLE: FLOOR PLANS
 SCALE: NONE

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND
BUILDING CONSTRUCTION

S.S.-10.1

DATE: 2/11
MODEL S.S.-10.1, STEEL STRUCTURE

TWO STOREY

FOUNDATION TRENCH PLAN

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>
MODEL S.S.-10.1, STEEL STRUCTURE

FOUNDATION PLAN

PEDESTAL COLUMN

FOUNDATION SECTION AT A-A

TOE WALL

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDNG CONSTRUCTION

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

SCALE: NONE
DATE: 6/11

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

BEAM-COLUMN PLAN

ISMC150 (SECONDARY BEAM)
ISMB150 (PRIMARY BEAM)

FULL PENETRATION GROOVE WELD

2-ISMC150(COLUMN)
MODEL S.S.-10.1, STEEL STRUCTURE

BASE PLATE CONNECTION PLAN

BASE PLATE CONNECTION SECTION

BEAM AND COLUMN CONNECTION

2-ISM150 COLUMN

FULL PENETRATION GROOVE WELD

ISMB150 BEAM

ISA 65x65x8

2-M16 BOLTS OF CLASS 4.6

FULL PENETRATION GROOVE WELD

3.2mm FILLET WELD

ISA 65x65x8

BEAM AND COLUMN CONNECTION

FULL PENETRATION GROOVE WELD

2-ISM150 COLUMN

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

250x250mm BASE PLATE OF THICKNESS 12mm

BASE PLATE CONNECTION PLAN

BASE PLATE CONNECTION SECTION

PLINTH LEVEL

COLUMN

COLUMNS

HOUSING TYPE: MODEL S.S-10.1

DRAWING TITLE: STRUCTURE DETAILS

SCALE: NONE

DATE: 8/11

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

TWO STOREY

TRUSS DETAIL

VERTICAL CHORD

DIAGONAL CHORD

3mm FILLET WELD ALL AROUND THE PIPE

BOTTOM CHORD

6mm PLATE

2.8s BOLTS OF CLASS 4.6

DETAIL AT A

PLAN

TRUSS COLUMN CONNECTION DETAIL

SECTION AT 1-1

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

2ISA 50x50x6

200x200mm BEARING PLATE WITH 8mm THICK

2-ISMC150

CGI SHEET

50.8x50.8x3mm TOP CHORD

38.1x38.1x2mm VERTICAL CHORD

50.8x50.8x3mm BOTTOM CHORD

50.8x50.8x3mm PURLIN

50.8x50.8x3mm THICK MIDDLE VERTICAL CHORD

38.1x38.1x2mm DIAGONAL CHORD

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: MODEL S.S-10.1
DRAWING TITLE: STRUCTURE DETAILS
DATE: 10/11
SCALe: NONE

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

## TWO STOREY

### 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 12 mm dia. Bars with 8 mm Ø rings at 150 mm 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 ISMC 150 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>
TIMBER STRUCTURE

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

**PROPERTIES OF TIMBER**

- Density: 640 kg/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**

<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>Kg.</td>
<td>Cu.m.</td>
<td>Bundle</td>
<td>Sq.m.</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>10.3</td>
<td>22.6</td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td>-</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>
</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

Housing Type: Model T.S.-11.1
Drawing Title: Floor Plans

Ground Floor Plan
Area: 61.64 sq.m.

First Floor Plan
Area: 61.64 sq.m.

Room 1: 4975x2950
Room 2: 4975x2950
Room 3: 4975x2950
Room 4: 4975x2950
Room 5: 4975x2950
Room 6: 4975x2950
MODEL T.S.-11.1, TIMBER STRUCTURE

TWO STOREY

FRONT ELEVATION

RIGHT SIDE ELEVATION

BACK ELEVATION

LEFT SIDE ELEVATION

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

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

SCALE: NONE
DATE:

T.S.-11.1
3/7
MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

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

MODEL T.S.-11.1, TIMBER STRUCTURE

TWO STOREY

SCALE: NONE
DATE: 4/7

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

50X50MM LINTEL BAND
75X75MM JOIST
100MM THK MUD FLOORING
38MM THK PLANK
75X135MM JOIST @500MM C/C
50X50MM LINTEL BAND
875 600
SECTION AT A-A

REFER FOUNDATION DETAIL
MODEL T.S.-11.1, TIMBER STRUCTURE

STUD CONNECTION TO FOUNDATION OTHER THAN BRACING

STUD CONNECTION TO FOUNDATION AT BRACING

STUD CONNECTION TO FOUNDATION AT BRACING

STUD CONNECTION TO FOUNDATION AT BRACING

GROUND LEVEL

PLINTH LEVEL

FOUNDATION

PLINTH BAND

STONE WALL
75mm P.C.C (1:3:6)
SINGLE LAYER BRICK SOLING

RCC(1:1.5:3) BAND(350x200mm)

STIRRUPS T8s @ 150mm C/C

T12s @ 1200mm C/C

6-T12s

M10 BOLT OF CLASS 4.6

75mm WIDTH,
6mm THICK
METAL PLATE

4-M20 BOLT

4-M20 BOLT OF 425mm LENGTH

M20 BOLT OF CLASS 4.6

FULL PENETRATION WELD

BRACING

4-M20 BOLT

ISA 105x75x6

12mm THICK MS PLATE

FULL PENETRATION WELD

ISA 105x75x6

12mm THICK MS PLATE

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: MODEL T.S-11.1
DRAWING TITLE: FOUNDATION DETAIL

SCALE: NONE
DATE: 5/7

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

TWO STOREY

FLOOR JOIST PLAN

CORNER BRACING POSITION

CORNER POST CONNECTION

BRACING CONNECTION

STUD CONNECTION AT FLOOR

FLOOR JOIST PLAN

POST

BRACING (37x100mm)

8mm THICK METAL PLATE

FLOOR JOIST (37x100mm)

BRACING (37x100mm)

M12 BOLT OF CLASS 4.6

M10 BOLT

8mm THICK METAL PLATE

FLOOR JOIST (37x100mm)

POST

BRACING CONNECTION

3-M20 BOLT OF GRADE 4.6

M20 BOLT OF GRADE 4.6

FLOOR JOIST (75x135)

75x75 VERTICAL STUD (UPPER FLOOR STUD)

75x75 VERTICAL STUD (LOWER FLOOR STUD)

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: MODEL T.S-11.1
DRAWING TITLE: JOIST AND JOINT DETAIL
SCALE: NONE
DATE: 6/7

T.S.-11.1
## TECHNICAL REQUIREMENTS

### Structure System
Structural system consisting of timber studs (vertical members) and horizontal member load bearing System. Timber shall be hard wood like sal, khote salla or equivalent.

### Foundation
Strip Foundation of stone masonry in 1:6 cement sand mortar and of width 600 mm width and depth 750 mm as shown in detail drawing.

### Plinth Band
R.C.C (1:1.5:3) plinth band of size 350 x 200 mm. Main reinforcement shall be 6 nos. of 12mm dia. Bars with 8mm Ø rings at 150mm C/C.

### Wall System
Local soft wood timber planks on timber structure system.

### Stud:
Studs of local hard wood of size 75mm X 75 mm @500 mm C/C spacing shall be used. Connection with plinth band is shown detail drawing.

### Bracing:
Diagonal bracing of local hard wood of size 37mm X 100mm. Connection details shown in detail drawing.

### Joist:
Timber joist of size 75mm X 75mm with spacing of 425mm.

### Flooring system:
Flooring shall be of mud under timber planks supported on timber joists.

### Roof System:
Light roof steel truss covered with corrugated galvanized iron sheets. All members of the truss or joints shall be properly connected as shown in detail drawings.
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

**Housing Type:** D.B.-12.1

**Drawing Title:** ESTIMATE AND 3D-VIEW

#### Level

<table>
<thead>
<tr>
<th>Level</th>
<th>Debris Block</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>
</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>
</tr>
<tr>
<td>Up to Plinth Level</td>
<td>1,762.0</td>
<td>34.2</td>
<td>2.4</td>
<td>4.7</td>
<td>273.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super Structure</td>
<td>1,923.0</td>
<td>21.8</td>
<td>1.2</td>
<td>2.3</td>
<td>307.1</td>
<td></td>
<td></td>
<td>0.3</td>
</tr>
<tr>
<td>Roofing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.2</td>
<td>8.3</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>3,685.0</td>
<td>55.9</td>
<td>3.6</td>
<td>7.0</td>
<td>580.6</td>
<td>5.2</td>
<td>8.3</td>
<td>3.1</td>
</tr>
</tbody>
</table>

#### Notes
- **Scale:** NONE
- **Date:**

---

**MINISTRY OF URBAN DEVELOPMENT**

**DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION**

**HOUSING TYPE:** D.B.-12.1

**Drawing Title:** ESTIMATE AND 3D-VIEW

**Scale:** NONE

**Date:** 1/8
MODEL 12.1, DEBRIS BLOCK MASONRY

HOUING TYPE: D.B.-12.1
DRAWING TITLE: ELEVATIONS

ONE STOREY

FRONT ELEVATION

SIDE ELEVATION

SIDE ELEVATION

BACK ELEVATION

ROOF CGI SHEETS
TIMBER FRAME

GABLE WALL:
WOODEN BOARD

GABLE WALL:
WOODEN BOARD

ROOF CGI SHEET
MODEL 12.1, DEBRIS BLOCK MASONRY

HOUSING TYPE: D.B.-12.1

DRAWING TITLE: SECTION

SECTION AT A-A

ROOM 1

VERANDAH

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 MMX4

LINTEL BAND: RCC: CONCRETE 1:1.5:3
REINFORCEMENT MAIN BAR 12 MMX4

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

REFERENCES:

- 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
- WALL: 300 MM THICKNESS, UPCYCLED BLOCK IN MUD MORTAR
- PURLIN: 75MMX 75 MM @450 MM
- RAFTER: 180 MM X 180 MM
- ROOF BAND: RCC: CONCRETE 1:1.5:3
- LINTEL BAND: RCC: CONCRETE 1:1.5:3
- VERTICAL REINFORCEMENT:
  REINFORCEMENT MAIN BAR 12 MM REBAR
- SILL BAND: CONCRETE 1:1.5:3
  (REINFORCEMENT MAIN BAR 12 MM X 2)
MODEL 12.1, DEBRIS BLOCK MASONRY

HOUSING TYPE: D.B.-12.1

DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

MINISTRY OF URBAN DEVELOPMENT

ONE STOREY

WALL: 300 MM THICKNESS

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

DETAIL AT C

FOUNDATION SECTION

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

PLINTH BAND

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

6 MM DIA CROSS TIE @150 MM C/C

180 MM VERTICAL STEEL

6 MM DIA STIRRUP @150 C/C

PLAN

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

HOUSING TYPE: D.B.-12.1
DRAWING TITLE: STRUCTURAL DETAILS

SCALE: NONE

DATE:

D.B.-12.1

6/8

178
MODEL 12.1, DEBRIS BLOCK MASONRY

HOUSING TYPE: D.B.-12.1
DRAWING TITLE: ROOFING DETAILS

MINISTRY OF URBAN DEVELOPMENT
DEPARTMENT OF URBAN DEVELOPMENT AND BUILDING CONSTRUCTION

D.B.-12.1
7/8
### Structure System
Load bearing stone/brick debris block masonry in mud mortar

### Foundation
Strip Foundation with brick/ debris block masonry in mud mortar. The depth and width of foundation shall be 800mm.

### Plinth Band
R.C.C (1:1.5:3) plinth band of size 350 x 150 mm. Main reinforcement shall be 4 nos. of 12mm dia. bars with 6mm Ø stirrups at 150mm C/C.

### Wall System
The debris blocks used shall be of good quality and have strength as mentioned in material properties. The thickness of wall shall be greater than or equal to 300mm.

### Sill Band
RCC (1:1.5:3) sill band shall be provided throughout the entire wall at the bottom level of the openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos.12mm dia. bars with 6 mm Ø stirrups at 150mm C/C.

### Lintel Band:
RCC (1:1.5:3) lintel band shall be provided throughout the entire wall at the top level of the openings. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2nos.12mm dia. bars with 6mm Ø stirrups at 150mm C/C or as specified in the details.

### Roof Band:
RCC (1:1.5:3) roof band shall be provided throughout the entire wall at roof level. The minimum depth of the band shall be 75mm. Main reinforcement shall be 2 nos. 12mm dia. bars with 6mm Ø stirrups at 150mm C/C.

### Roof System:
Light roof timber truss with CGI sheet roofing. All members of the truss or joints shall be properly connected as shown in detail drawings.
PERSONNEL INVOLVED IN PREPARATION OF THIS CATALOGUE

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

STRUCTURAL EXPERT
PROF. DR. PREMNATH MASKEY
DR. PURUSHOTTAM DONGOL

TECHNICAL WORKING GROUPS
S.D.E. MACHAKAJI MAHARJAN
S.D.E. MANOJ NAKARMI
S.D.E. GANESH KARMACHARYA
ER. SUREN德拉VAIDYA
ER. DEVENDRADEV KHANAL
ER. PRATIK PRADHAN

CLPIU
S.D.E. PARIKSHIT KADARIYA (DEPUTY PROJECT DIRECTOR)
ER. BIPIN KUMAR GAUTAM (STRUCTURAL ENGINEER)
ER. DIPENDRRAARYAL (CIVIL ENGINEER)
AR. KRISHNA LAXMI MAHARJAN
AR. KOPILA WAGLE
AR. Pooja Shah
AR. PRABINA POKHAREL
AR. SMRITI UPADHYAY
AR. SHAMI ADHIKARI
AGENCIES/ PERSONNEL SUBMITTING PROPOSAL

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