DESIGN CATALOGUE FOR

RECONSTRUCTION OF EARTHQUAKE RESISTANT HOUSES

Volume I









October, 2015 (Aswin, 2072)



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RECONSTRUCTION OF EARTHQUAKE RESISTANT HOUSES **DESIGN CATALOGUE FOR**

Volume I

Government of Nepal
Ministry of Urban Development

Department of Urban Development and Building ConstructionBabarmahal, Kathmandu



Foreword



partially damaged 600,000 private homes were fully damaged. In addition, more than 285,000 private homes were Government buildings were damaged. More than 960 health buildings and 8500 schools as well as than 8000 people lost their lives and 22,000 number of people were injured. More than 6,400 It gives me an immense pleasure on the occasion of the publication of Design catalogue for the 2015 earthquakes in Nepal were enormous, both in terms of loss of lives and properties. More reconstruction of Earthquake resistant houses . The impact of the 25 $^{
m th}$ April , 2015 and 12 $^{
m th}$ May

a strong basis for rural households to start the construction of their houses. models and flexible designs. I hope that the information provided in the Design Catalogue will be rural households to apply for, and secure the building permit through various types of design compliance with the National Building Code of Nepal. I expect that the design catalogue supports earthquake resistant construction techniques and to support them to have house designs in The objective of this document is to provide rural households with clear guidance regarding

the personnel and agencies involved in the preparation of the Design Catalogue for continuous involvement during the preparation of this document. My thanks also goes to all of Nilam Kumar Dangol, Senior Divisional Engineer and all the staffs of Housing Division for their valuable suggestions. I am very much thankful to Mr. Ravi Shah, Deputy Director General and Mr. Shambhu K.C. and Mr. Padma Kumar Mainalee of Ministry of Urban Development for their My sincere thanks to the respected Secretary, Mr. Arjun kumar Karki, Joint Secretaries, Mr. preparation of this important document. Reconstruction of Earthquake Resistant Houses for their hard work and concerted efforts on the

Preface



Urban Development and Building Construction (DUDBC) to support rural households in the Reconstruction of Earthquake Resistant Houses, which has been produced by the Department of I would like to congratulate all involved in the development of the Design Catalogue for reconstruction of their houses

reconstruct houses that are safe, adequate, and affordable reconstruction programme is to ensure that earthquake affected households are enabled to impact in affected areas, in particular in relation to housing which suffered severe damage and left thousands of families living in temporary shelters. The primary objective of the housing The impact of the April 25 $^{
m th}$ 2015 and May 12 $^{
m th}$ 2015 earthquakes in Nepal had a significant

of Earthquake Resistant Houses provide a variety of options in terms of cost, size, layout, and resistant construction practices to ensure that households are able to 'Build Back Better'. vernacular architecture and building practices can be maintained with the addition earthquake National Building Code. The house designs have been prepared in such a way as to ensure that free to prepare house designs outside of the catalogue but these designs must comply with the typology. It is not mandatory for households to select a design from this catalogue, and they are The housing prototype and flexible design provided in the Design Catalogue for Reconstruction

I would like to congratulate all the personnel of this department, and all those who have been to the preparation of this catalogue. involved directly or indirectly in the preparation of this catalogue, for their valuable contributions

Rabi Shah

Deputy Director General, DUDBC

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Minimum Requirements, One-story, Technical details, Flexible design	

Background



were fully damaged, and 285,099 houses were partially damaged. districts, as well as loss of life of almost 9,000 people. The Government of Nepal figures indicate that 602,257 houses The April 25th 2015 and May 12th 2015 earthquakes in Nepal caused widespread damage to housing in the affected

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

- 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 include holistic habitat development, with basic services and community infrastructure. The principle of build back better (BBB) should translate into a concept of safer settlements
- 3. Reconstruction should be seen as a vehicle to build long-term community resilience by reducing vulnerabilities for the majority of the building stock in the country. and strengthening community capacities to mitigate future disasters through improved construction practices
- 4. Strengthen the local economy through reconstruction and processes that work to the benefit of the poor and the poor to upgrade their living conditions marginalised sections who are mostly in the informal sector. Reconstruction should provide an opportunity for
- 5. Ensure sustainable and environment-friendly reconstruction processes, taking note of climate change, natural resource management and scientific risk assessments
- 6. Ensure that rehabilitation is equitable and inclusive.

Introduction

commence the reconstruction of their homes from a solid basis, by providing prototype and flexible house designs cover four broad categories of building materials and typology: which can be adopted, and adapted, in all earthquake affected communities. The designs provided in the catalogue The Design Catalogue for Reconstruction of Rural Housing has been developed to support rural households to

- Stone and mud mortar masonry
- Brick and mud mortar masonry
- Stone and cement mortar masonry
- Brick and cement mortar masonry

of Nepal and are approved by the Department of Urban Development and Building Construction (DUDBC) For each design included in the catalogue the following information is provided: The designs provided in this catalogue have all been prepared in compliance with the revised National Building Code

- ■3D view of the design
- Floor plan
- Elevations
- Section
- Technical Details

level, up to ring beam level, and for the construction of the roof construction of the design is also provided and is broken down in terms of requirements to construct up to plinth The number of manpower days for skilled and unskilled labour, as well as the quantity of materials required for the

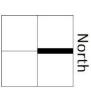
construction techniques application process. The Design Catalogue for Reconstruction of Rural Housing can also provide guidance in terms of budgeting, and estimating the quantity of material required and as a general guide for basic earthquake resistant prototype designs, or can be adapted based on the parameters as defined in the National Building Code of Nepal, the Designs included in the Design Catalogue for Reconstruction of Rural Housing can be selected and used as is, the flexible designs. Once a design has been selected this can be used by the household as part of the building permit

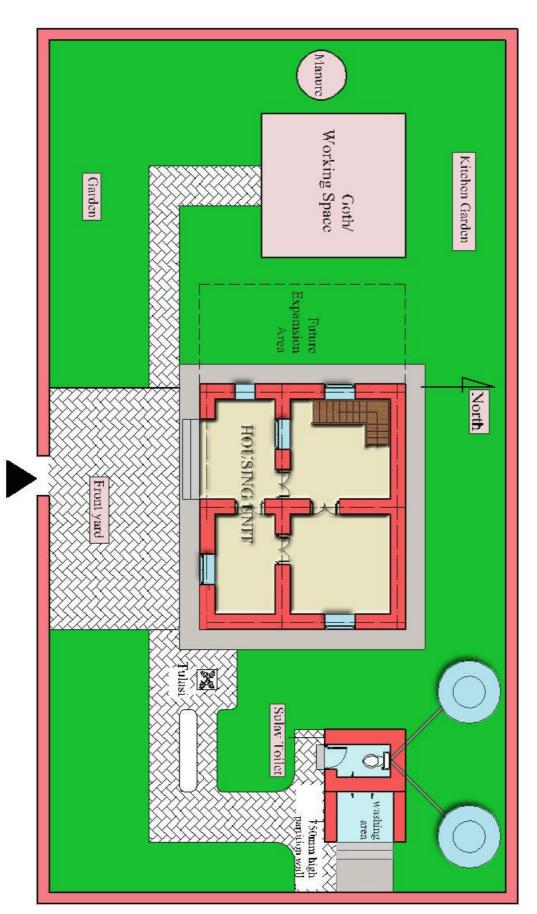
List of Model Houses

housing model Volume I

Structural Type	No. of Floor	Model No.	Designed by	Page
	1	SMC-1.1	JICA	9
Stone masonry in cement mortar, P5-	1	SMC-1.2	JICA	15
	2	SMC-2.1	JICA	21
SMC	2	SMC-2.2	DUDBC	27
	2	SMC-2.3	DUDBC	33
	2	SMC-2.4	DUDBC	39
	2+ATTIC	SMC-2.5	DUDBC	45
	2+TERRACE	SMC-2.6	DUDBC	51
		Technical details		57
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	₽	BMC-1.1	JICA	74
Brick masonry in cement mortar P71-	1	BMC-1.2	JICA	80
	2	BMC-2.1	JICA	86
DIVIC	2	BMC-2.2	DUDBC	92
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SMM		Flexible design		143
	Ľ	BMM-1.1	DUDBC	153
Brick masonry in mud mortar, P147-		Technical details		159
BMM		Flexible design		161

Site Plan





SITE PLAN

STONE MASONRY IN CEMENT MORTAR (SMC)



STONE MASONRY IN CEMENT MORTAR (SMC)

the households' requirements within the parameters as set out in the National Building Code of Nepa included in this category of the catalogue. A flexible design is also included which can be adapted as per masonry construction using cement mortar. Designs for both one-storey and two-storey houses are This section of the Design Catalogue for Reconstruction of Earthquake Resistant houses refers to stone

the 'Minimum Requirements' at the beginning of this section. material required in the construction of the house designs included under this category can be found in The house designs are based on the use of reinforced concrete bands. The technical specifications for the

referred to when constructing any of the designs presented under this category. The key technical details related to this category are included at the end of this section and should be

Minimum Requirements(MRs)

	Minimum Requir	ements (MRs)	for	Stone Masonry in Cement Mortar (NBC202) Page1
No.	Category	,		, , , , , , , , , , , , , , , , , , ,
		A building shall	not	be constructed if site is:
			'	Geological fault or Raptured Area
			~	Areas Susceptible to Landslide
1	Site Selection		~	Steep Slope > 20%
			~	Filled Area
			~	River Bank and Water-logged Area
		No. of story	•	Two storey+ attic, load bearing masonry buildings constructed in cement mortar
		Span of wall	~	The span of wall shall not more than 4.5 meters
2	Shape of House	Size of room	~	The area of individual floor panel not more than 13.5 square metres
		Height of wall	~	The height of wall should not be more than 3.0 meters
		Proportion	•	The house shall be planned in square, rectangular. Avoid long and narrow structure should not be more than 3 times of its width.
		General	~	The foundation trench shall be of uniform width. The foundation bed shall be on the same level throughout the foundation in flat area.
3	900mm for two storey.	The depth of footing should not be less than 800mm for one story, 900mm for two storey.		
		Width	•	The width of footing should not be less than 600mm in medium soil condition. As depend on soil condition. Shown in detail drawings.
		General	~	Provide a reinforced concrete band at plinth level, as shown in detail drawings. The top level of plinth should not be less than 300mm from existing ground level. Recommendation is 450mm.
		Height	~	Minimum height of Plinth band is 150mm.
4	Plinth	Width	•	Minimum thickness of plinth band width should be equal to wall thickness. 350mm for Stone masorny.
		Reinforcement	V	Main reinforcement should be 4-12 dia. bars. Use 6mm diameter rings at 150mm. Hook length should be 500mm. Bars shall have a clear cover of 25mm concrete.
		General	•	Masonry should not be laid staggered or straggled in order to avoid continuous vertical joints. At corners or wall junctions, through vertical joints should be avoided by properly laying the masonry. It should be interlocked.
5	Walls	Joints	•	Mortar joints should not be more than 20mm and less than 10mm in thickness. The ratio recommend 1:4 (Cement: Sand).
		Through Stone	•	Through-stone of a length equal to the full wall thickness should be used in every 600 mm lift at not more than 1.2 m apart horizontally.
		Width	v	The minimum width of wall is 350mm for one-storey and two-storey.

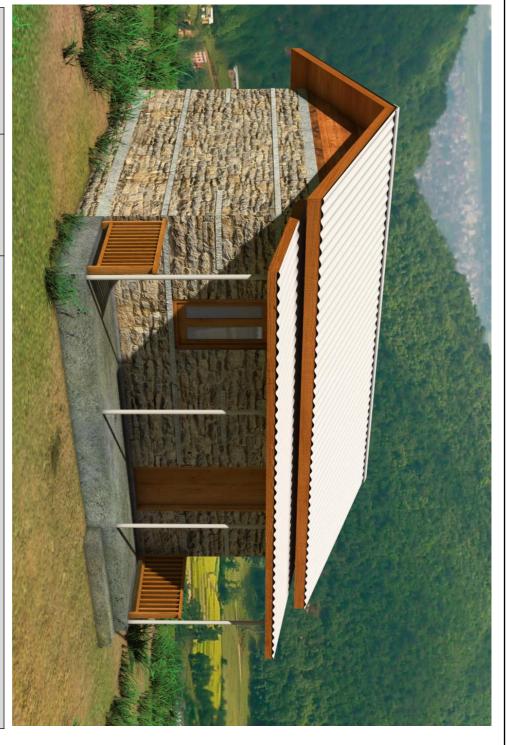
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	Minimum Requir	ements (MRs)	for	Stone Masonry in Cement Mortar (NBC202) Page2
		Location	~	Openings are to be located away from inside corners by a clear distance should not be less than 600 mm.
6	Openings	Total length	•	The total length of openings in a wall is not to exceed half of the length of the wall in single-storey construction.
		Distance	•	The horizontal distance between two openings is to be not less than 600 mm.
		Lintel level	1	Keep lintel level same for doors and windows.
7	Vertical Reinforcement	Location	•	Place vertical steel bars in the wall at all corners, junctions of walls and adjacent to all doors and windows. They shall be covered with cement concrete in cavities made around them during the masonry construction.
	Remoreement	Reinforcement	•	The vertical reinforcing bar for masonry is given in detail drawings. 12mm dia is minimum requirements for masonry houses.
B0000000000000000000000000000000000000			Horizontal bands should be provided throughout the entire wall wit minimum thickness of 75 to 150 mm at following locations:	
	Build band level of opening (sp. Lintel band level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening. The level of opening (sp. A continuous lintel level of opening (sp. A c	A continuous sill band shall be provided through all walls at the bottom level of opening (specially windows). The minimum height is 75mm.		
		•	A continuous lintel band shall be provided through all walls at the top level of opening. The minimum height is 150mm.	
8		This band shall be provided where dowel-bars are required at all corners, junctions of walls. The minimum height is 75mm.		
		Roof band shall be provided at the top-level of walls, so as to integrate them properly at their ends and fix them into the walls. The minimum height is 75mm.		
		Reinforcement	•	Main reinforcement should be 4or 2-12 dia. bars. Use 6mm diameter rings at 150mm. Hook length should be 500mm. Bars shall have a clear cover of 25mm concrete.
		Light roof		Use light roof comprising wooden or steel truss covered with CGI sheets.
		Connection	•	All members of the timber truss or joints should be properly connected as shown in detail drawings.
9	Roof	Cross-tie	~	Trusses should be properly cross-tied with wooden braces as shown in detail drawings.
		Timber	•	Well seasoned hard wood without knots should be used for roofing, timber treatment such as use of coal tar or any other preservative can prevent timber from being decayed and attacked by insects
		Mortar		Cement sand mortar should not be leaner than 1:4 (1 part cement and 4 parts sand) for masonry and 1:6 for plaster
10	Materials	Concrete	•	The concrete mix for seismic bands should not be leaner than 1:1.5:3 (1 part cement, 1.5 parts sand and 3 parts aggregate)
		Reinforcement	•	High Strength Deformed Bars – Fe415: High strength deformed bars with fy = 415 N/

STONE MASONRY IN CEMENT MORTAR, ONE-STOREY

diaphragm effectiveness design focuses on earthquake resistant construction using locally available construction earthquake resistant construction measures are included. This includes the provision of been based on the revised National Building Code of Nepal (NBC) in order to ensure that CGI sheet is used for covering the roof along with wooden rafter and purlin. All design have Model SMC-1.1 is a one-storey house which can accommodate 3-5 people. It consists of two horizontal bands, vertical reinforcement, corner reinforcement, and T-junctions to improve materials. Similarly stone masonry in cement mortar has been used for structural type, where rooms with dimensions of 2650 x 4300, and a verandah with dimensions of 1500 x 6350. The

to improve safety in future earthquakes. The design concept, and the objective of the design is to contribute towards resilient models



	MAN	MAN POWER				MATERIALS			
<u>LEVEL</u>	Skilled	Unskilled	Stone	CEMENT	SAND	AGGREGATE	WOOD	CGI SHEET	Reinforcing bar
	Md	Md	cu.m.	Bags	Cu.m.	Cu.m.	Cu.m.	Bundel	Kg
Up to Plinth Level	57	212	21	82	13	6	0	0	146
SUPERSTRUCTURE	75	129	13	59	8	3	0.79	0	314
ROOFING	17	20	0	0	0	0	1.43	4.71	0
TOTAL	149	361	34	141	21	9	2.22	4.71	460

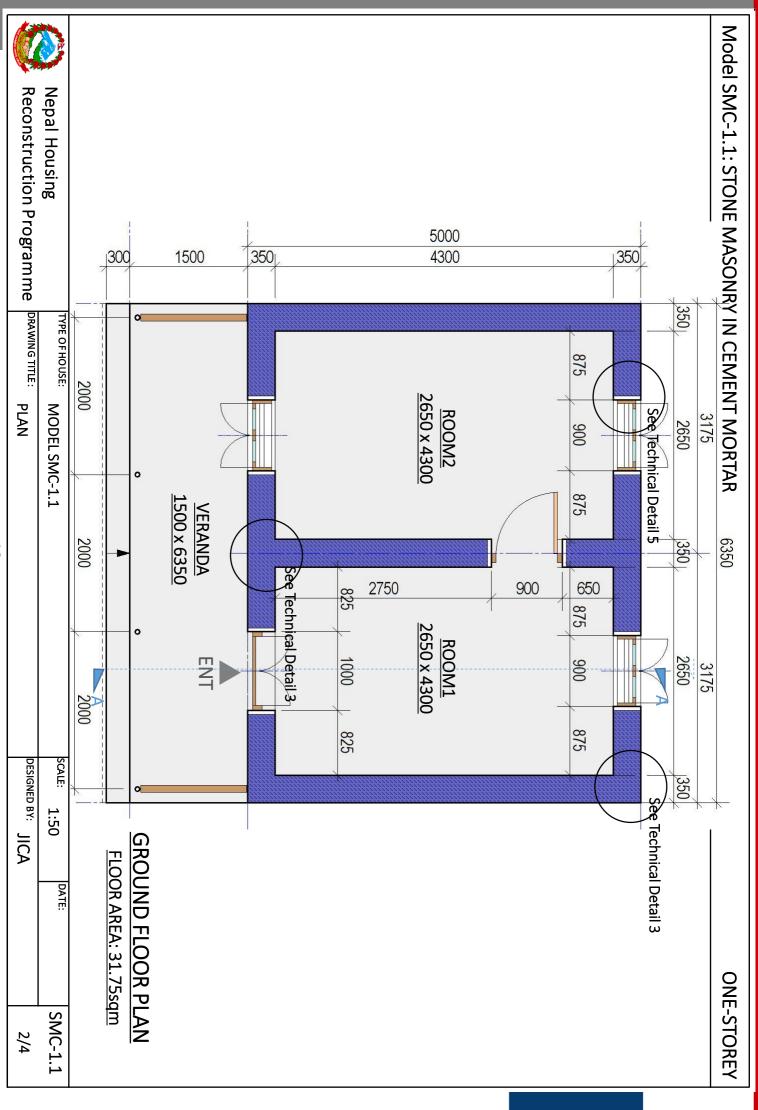
	199
Reconstruction Programme	Nepal Housing
되	₹

DRAWING TITLE:	TYPE OF HOUSE:
PERSPECTIVE AND	MODEL SMC-1.1

	DESIGNED BY: JICA	ESTIMATION
LVO	SCALE: None	

SMC-1.1

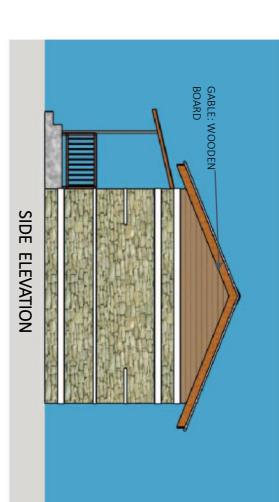
1/4

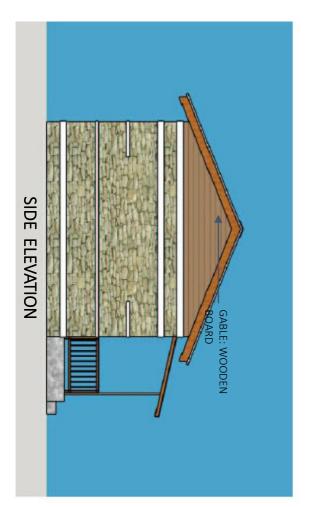


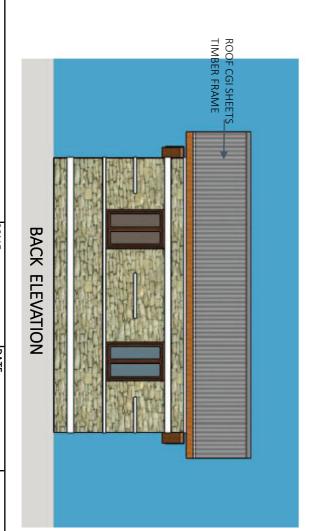
Model SMC-1.1: STONE MASONRY IN CEMENT MORTAR

ONE-STOREY











TYPE OF HOUSE:

ELEVATION MODEL SMC-1.1

SCALE: DESIGNED BY: JICA None

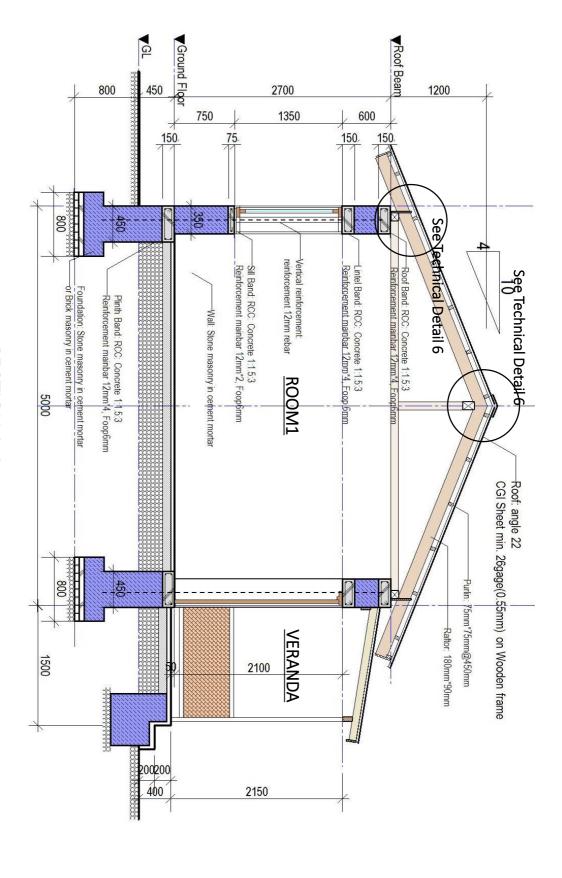
DATE:

SMC-1.1

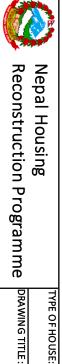
3/4

| Model SMC-1.1: STONE MASONRY IN CEMENT MORTAR

ONE-STOREY







	TYPE OF HOUSE:	MODEL SMC-1.1	SCALE: 1:50
ne	DRAWING TITLE:	SECTION	DESIGNED BY: JICA

STONE MASONRY IN CEMENT MORTAR, ONE-STOREY

effectiveness vertical reinforcement, corner reinforcement, and T-junctions to improve diaphragm been on the revised National Building Code of Nepal (NBC) in order to ensure that earthquake CGI sheet is used for covering the roof along with wooden rafter and purlin. All design have design focuses on earthquake resistant construction using locally available construction resistant construction measures are included. This includes the provision of horizontal bands, materials. Similarly stone masonry in cement mortar has been used for structural type, where room with dimensions of 2650 x 4300, and a verandah with dimensions of 2850 x 4500. The Model SMC-1.2 is a one-storey house which can accommodate 1-3 people. It consists of one

to improve safety in future earthquakes. The design concept, and the objective of the design is to contribute towards resilient models

•



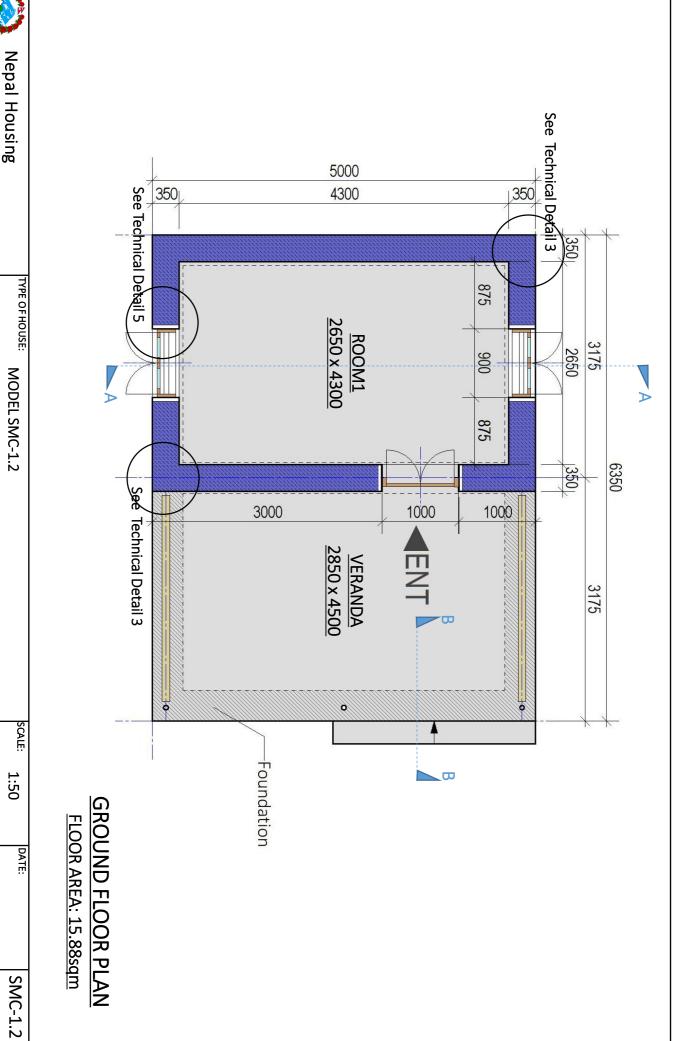
	MAN	POWER				MATERIALS			
<u>LEVEL</u>	Skilled	Unskilled	Stone	CEMENT	DNAS	AGGREGATE	DOOM	CGI SHEET	Reinforcing bar
	Md	Md	cu.m.	Bags	Cu.m.	Cu.m.	Cu.m.	Bundel	Kg
Up to Plinth Level	40	144	15	47	9	3	0	0	87
SUPERSTRUCTURE	49	97	10	45	6	2	0.46	0	165
ROOFING	8	11	0	0	0	0	1.48	3.69	0
TOTAL	97	252	25	92	14	6	1.94	3.69	252

Reconstruction Progr	Nepal Housing

TYPE OF HOUSE: MODEL SMC-1.2

TRAWING TITLE: PERSPECTIVE AND ESTIMATION

ON DESIGNED BY: JICA

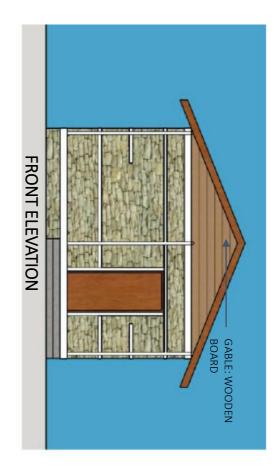


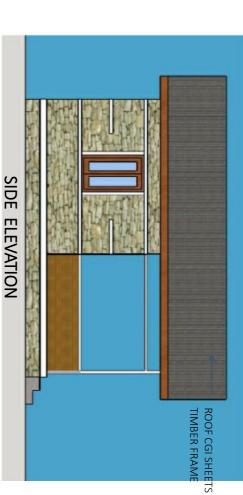
DESIGNED BY: JICA

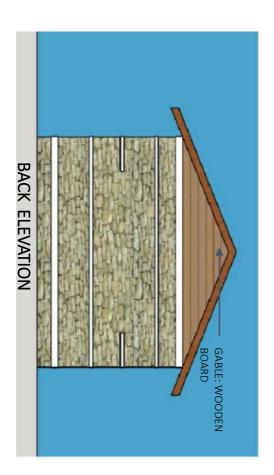
2/4

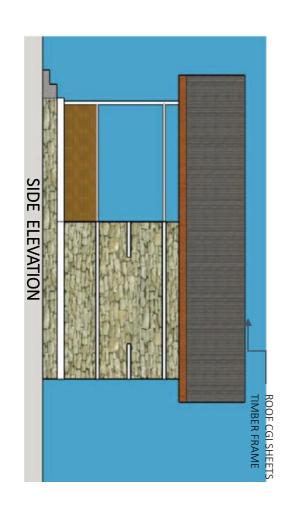
Reconstruction Programme PRAWING TITLE:

PLAN



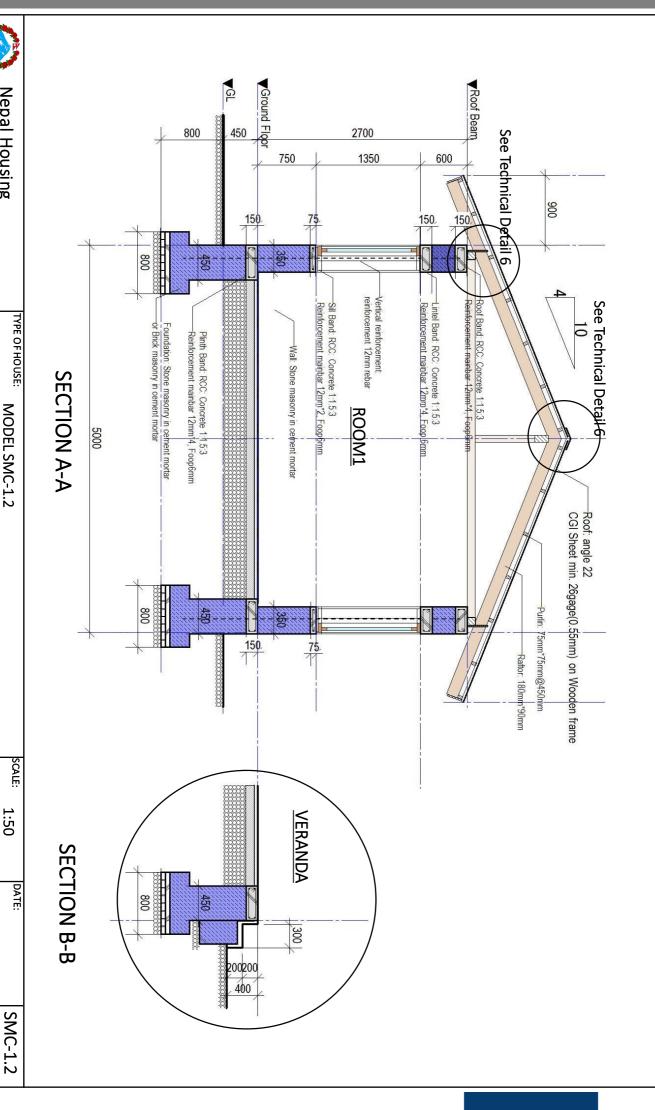








DRAWING TITLE:	TYPE OF HOUSE:
ELEVATION	MODEL SMC-1.2



DESIGNED BY: JICA

4/4

Reconstruction Programme PRAWINGTITE:

SECTION

Nepal Housing

STONE MASONRY IN CEMENT MORTAR, TWO-STOREY

diaphragm effectiveness earthquake resistant construction measures are included. This includes the provision of design have been on the revised National Building Code of Nepal (NBC) in order to ensure that type, where CGI sheet is used for covering the roof along with wooden rafter and purlin. All construction materials. Similarly stone masonry in cement mortar has been used for structural 6350. The design focuses on earthquake resistant construction using locally available of four rooms with dimensions of 2650 x 4300, and a verandah with dimensions of 1500 xModel SMC-2.1 is a two-storey house which can accommodate more than 4 people. It consists horizontal bands, vertical reinforcement, corner reinforcement, and T-junctions to improve

to improve safety in future earthquakes. The design concept, and the objective of the design is to contribute towards resilient models

.



	MAN	OWER				MATERIALS			
LEVEL	Skilled	Unskilled	Stone	CEMENT	SAND	AGGREGATE	WOOD	CGI SHEET	Reinforcing bar
	Md	Md	cu.m.	Bags	Cu.m.	Cu.m.	Cu.m.	Bundel	Kg
Up to Plinth Level	86	317	17	76	12	6	0	0	146
SUPERSTRUCTURE	175	290	31	111	17	4	2.95	1.02	631
ROOFING	17	20	0	0	0	0	1.48	3.69	0
TOTAL	279	626	48	187	29	10	4.43	4.71	776

n Programme PRAWING TITLE:

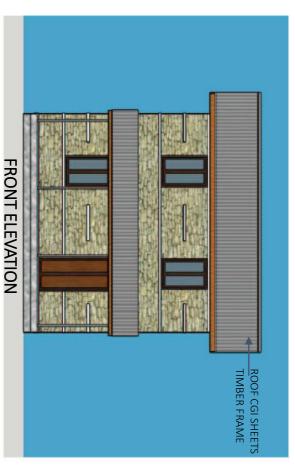
TYPE OF HOUSE:

MODEL SMC-2.1

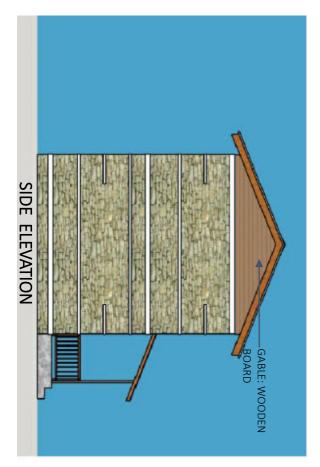
PERSPECTIVE AND ESTIMATION

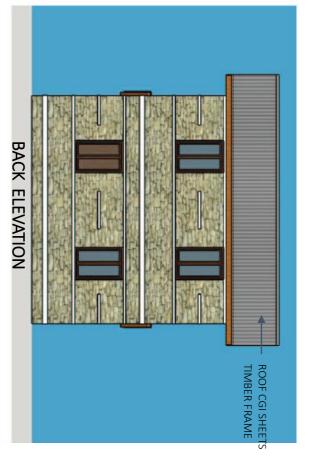
SCALE: DESIGNED BY: JICA None

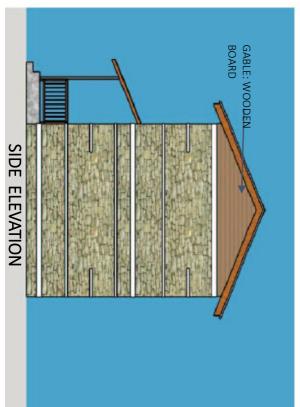
DATE:







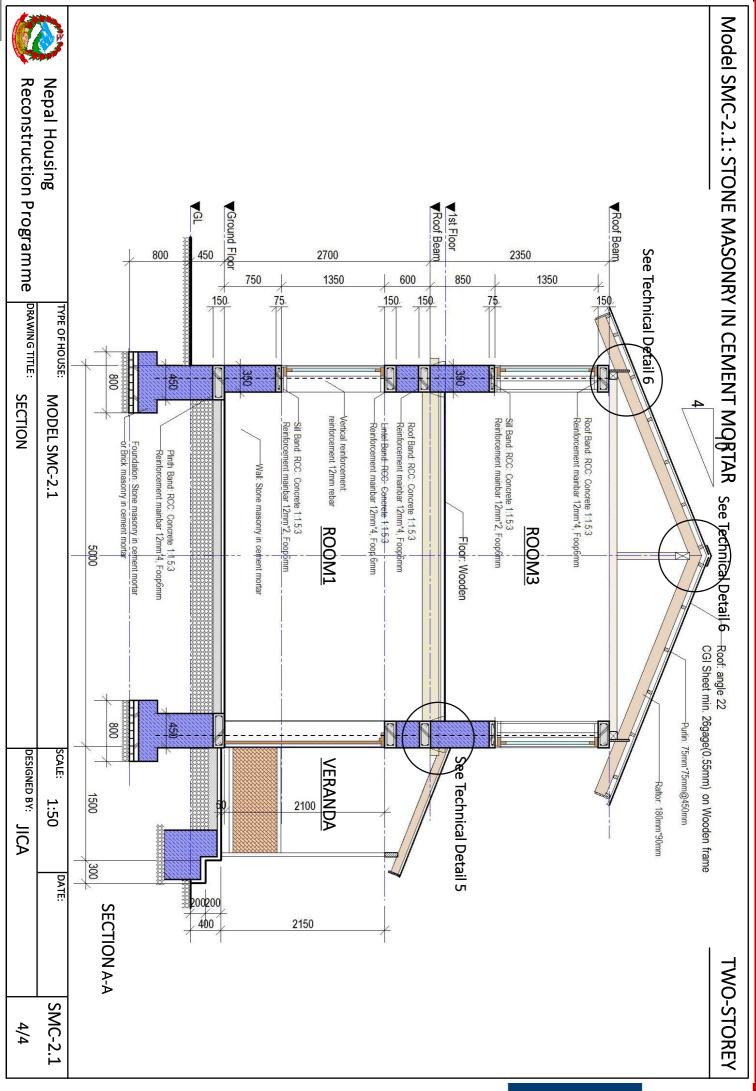






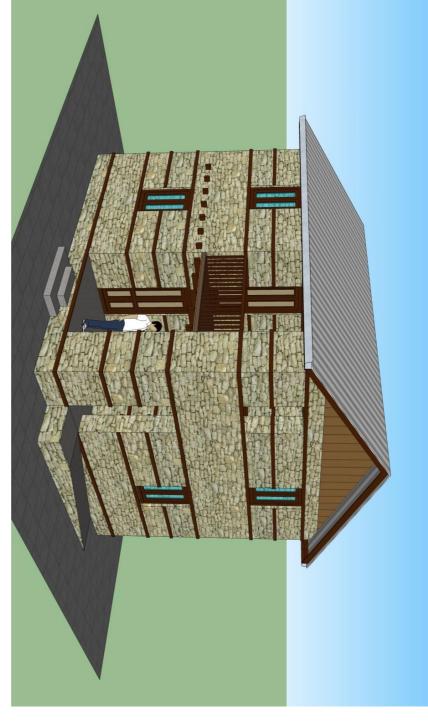
ELEVATION	DRAWING TITLE:
MODEL SMC-2.1	TYPE OF HOUSE:

2.1 SCALE: None	DA I E:	SMC-2.1
DESIGNED BY: JICA	ĈA .	3/4



STONE MASONRY IN CEMENT MORTAR, TWO-STOREY

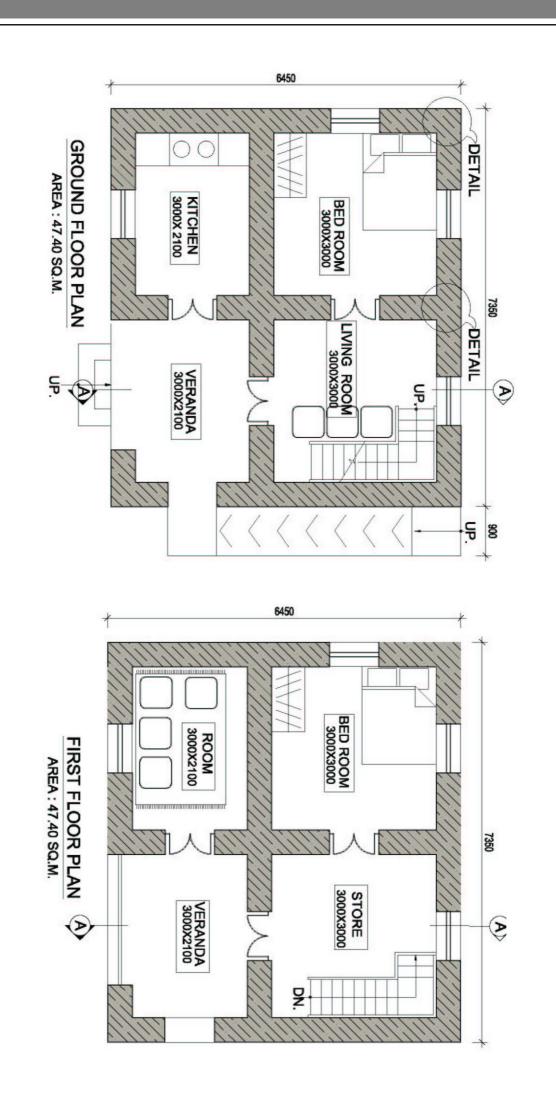
construction using locally available construction materials. Similarly stone masonry in cement safety in future earthquakes concept and the objective of the design is to contribute towards resilient models to improve social and cultural aspects have also been factored into the design of the house. The design reinforcement, and T-junctions to improve diaphragm effectiveness. Climatic conditions and of Nepal (NBC) in order to ensure that earthquake resistant construction measures are wooden rafters and purlins. All designs have been based on the revised National Building Code three rooms and a verandah in the ground floor. The design focuses on earthquake resistant Model SMC- 2.2 is a two storey building which can accommodate 3-7 people. It consists of included. This includes the provision of horizontal bands, vertical reinforcements, corner mortar has been used for structural type, where CGI sheet is used for covering the roof along



CONSTRUCTION MATERIAL AND MANPOWER

	MAN POWER	<u>OWER</u>				<u>MATERIALS</u>				
LEVEL	<u>Skilled</u>	<u>Unskilled</u>	<u>Stone</u>	CEMENT	<u>SAND</u>	<u>AGGREGATE</u>	Rod	CGI SHEET	WOOD	GI SHEET
	Md	Md	Cu.m	Bags	Cu.m	Cu.m	kg	Bundel	Cu.m	Rm.
Up to Plinth Level	54	198	31	82	19	5	265	0	0	0
Ground & First floor	207	246	41	119	20	5	876	0	3.62	0
Roofing work	43	15	0	0	0	0	0	4.69	1.96	10
TOTAL 304	304	458	72	200	40	10	1141	4.69	5.58	10

<i>**</i>	
	P P
Reconstruction Programme	Nepal Housing
DRAWING TITLE:	TYPE OF HOUSE:
PERSPECTIVE AND ESTIMATION	MODEL SMC-2.2
DESIGNED BY: DUDBC	SCALE: NONE
C	DATE:
1/4	SMC-2.2

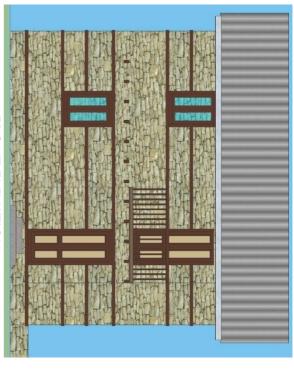


TOTAL AREA: 94.8sqm

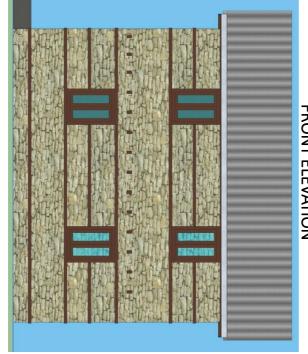
	P
Reconstruction Programme	Nepal Housing
DRAWING TITLE:	TYPE OF HOUSE:
PLAN	MODELSMC-2.2
DESIGNED BY: DUDBC	SCALE: None
С	DATE:
2/4	SMC-2.2

Model SMC-2.2: STONE MASONRY IN CEMENT MORTAR

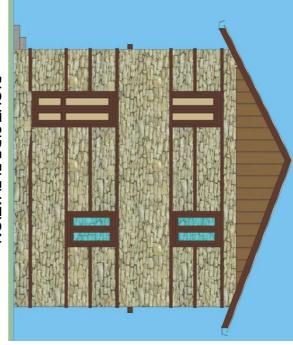
TWO-STOREY



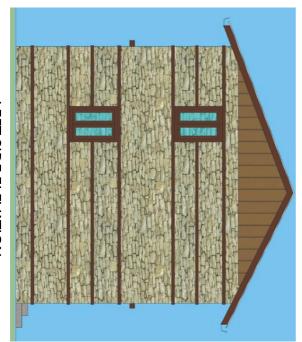
FRONT ELEVATION



BACK ELEVATION



RIGHT SIDE ELEVATION



LEFT SIDE ELEVATION

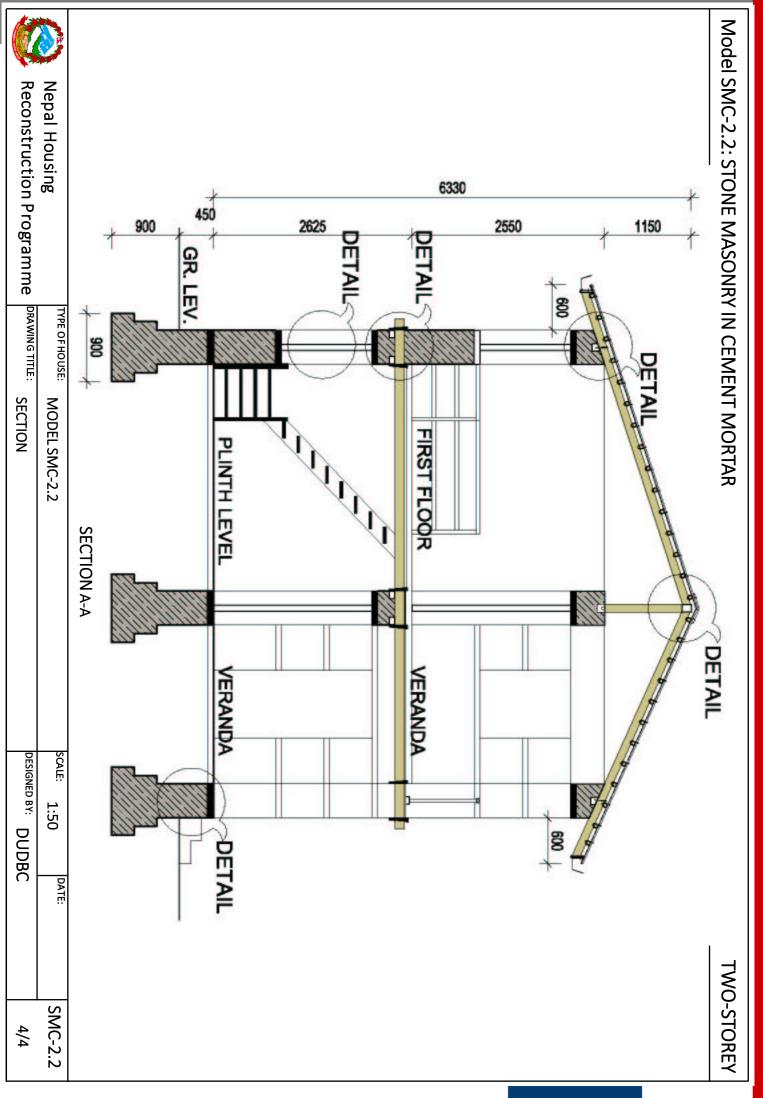
DATE:

SMC-2.2

3/4

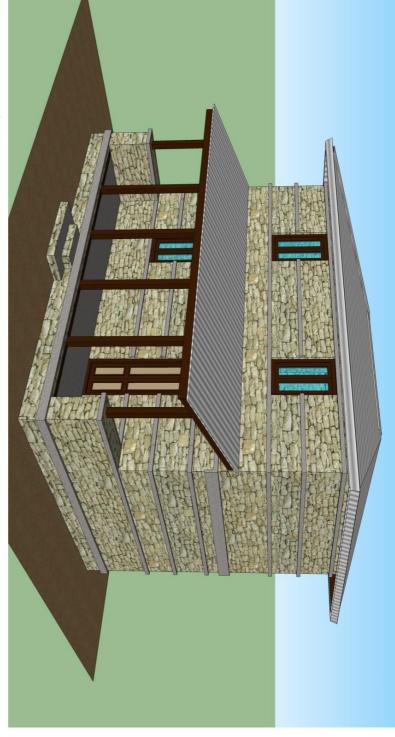


`	DESIGNED BY: DUDBC	: ELEVATION	DRAWING TITLE	mme
D.	SCALE: None	MODEL SMC-2.2	TYPE OF HOUSE:	



STONE MASONRY IN CEMENT MORTAR, TWO-STOREY

earthquake resistant construction using locally available construction materials. Similarly stone construction measures are included. This includes the provision of horizontal bands, vertical covering the roof along with wooden rafters and purlins. All designs have been based on the two rooms with dimension of 3225 x 3150 and a verandah 7800 x 1210. The design focuses on the house. The design concept and the objective of the design is to contribute towards reinforcements, corner reinforcement, and T-junctions to improve diaphragm effectiveness revised National Building Code of Nepal (NBC) in order to ensure that earthquake resistant masonry in cement mortar has been used for structural type, where CGI sheet is used for resilient models to improve satety in future earthquakes Climatic conditions and social and cultural aspects have also been factored into the design of Model SMC-2.3 is a two- storey building which can accommodate 8-10 people. It consists of



CONSTRUCTION MATERIAL AND MANPOWER

	MAN	MAN POWER				MATERIALS	<u> </u>			
<u>LEVEL</u>	<u>Skilled</u>	<u>Unskilled</u>	STONE	CEMENT	<u>SAND</u>	AGGREGATE	WOOD	ROD	CGI SHEET GI SHEET	Ð
	Md	Md	Cu.m	Bags	Cu.m	Cu.m	Cu.m	KG	Bundel	Rm.
Up to Plinth Level	61	220	33	95	17	9	0	305	0	
<u> Ground & First floor</u>	162	357	53	216	32	17	1.02	1487	0	
Roofing work	41	15	0	0	0	0	1.91	0	4.50	11
TOTAL	TOTAL 263	592	86	311	48	26	2.94	1792	4.50	11



Reconstruction Programme PRAWING TITLE: **Nepal Housing**

TYPE OF HOUSE:

MODEL SMC-2.3

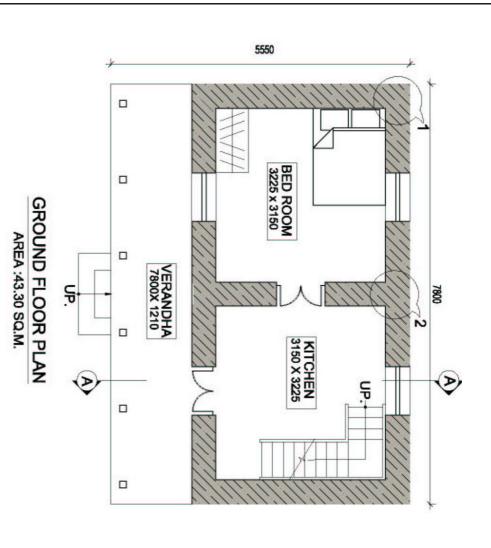
PERSPECTIVE AND ESTIMATION

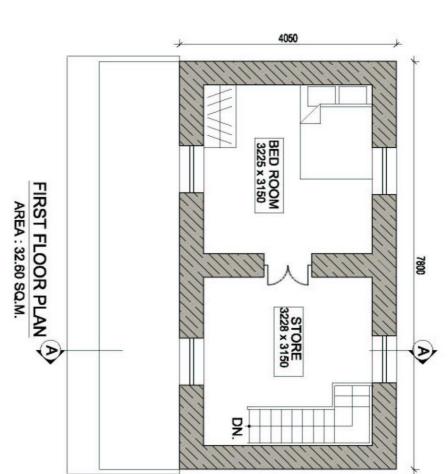
DESIGNED BY: DUDBC NONE

SCALE:

DATE:

SMC-2.3 1/4

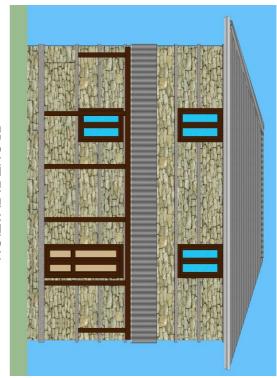




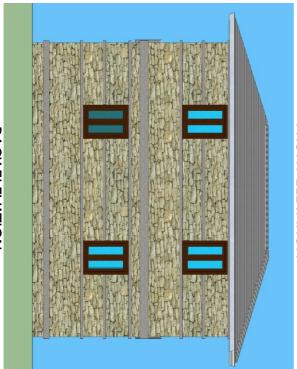
TOTAL AREA: 75.9sqm

PLAN	DRAWING TITLE:	Reconstruction Programme	
MODEL SMC-2.3	TYPE OF HOUSE:	Nepal Housing	P

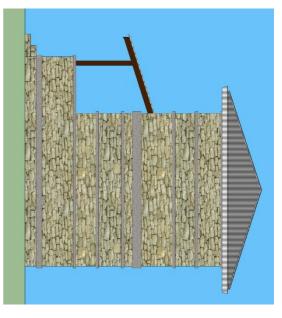
	YPE OF HOUSE:	MODEL SMC-2.3	SCALE: None	DA I E:	SMC-2.3
gramme ^{Di}	gramme DRAWINGTITLE: PL	AN	DESIGNED BY: DUDBC	O	2/4



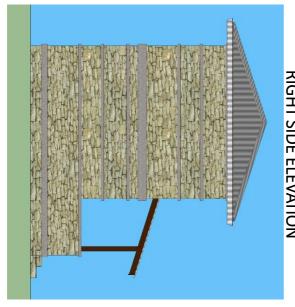
FRONT ELEVATION



BACK ELEVATION

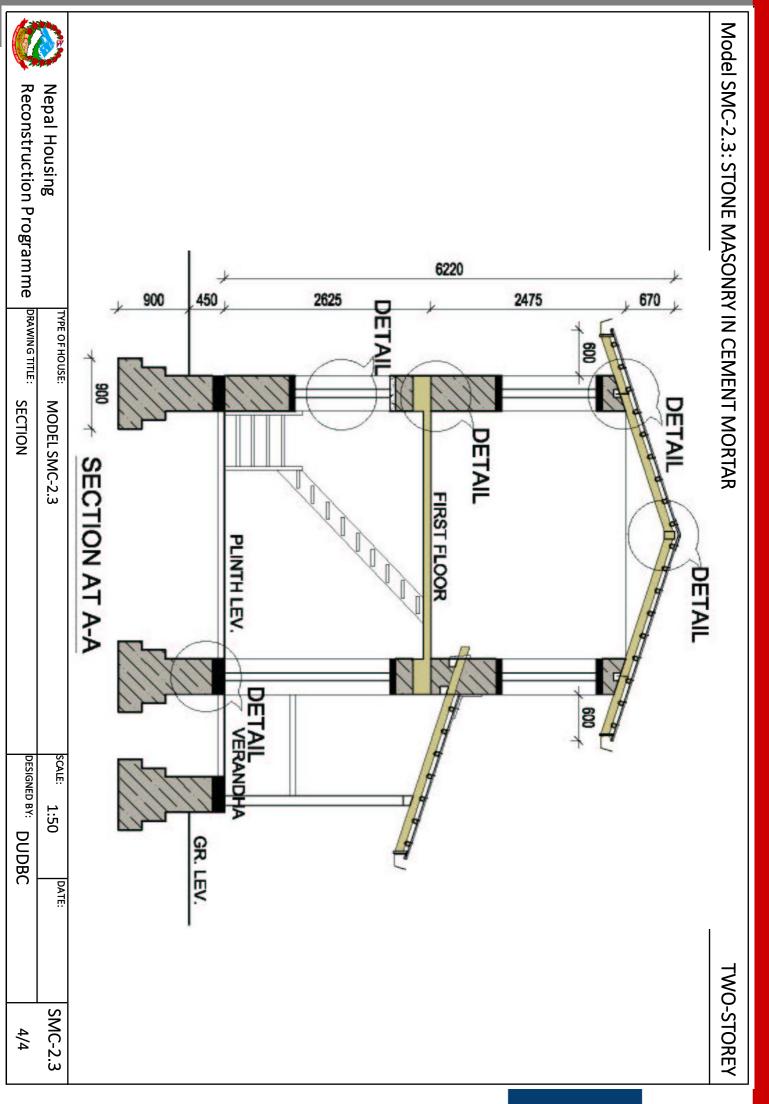


RIGHT SIDE ELEVATION



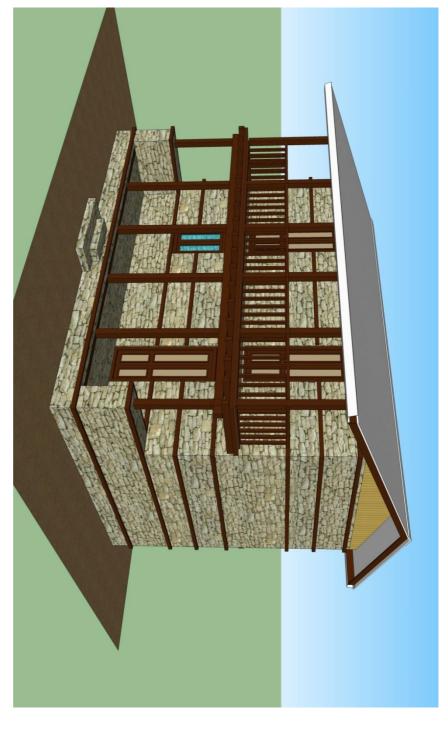
LEFT SIDE ELEVATION

Reconstruction Programme	Nepal Housing
DRAWING TITLE:	TYPE OF HOUSE:
ELEVATION	MODELSMC-2.3
DESIGNED BY: DUDBC	SCALE: None
С	DATE:
3/4	SMC-2.3



STONE MASONRY IN CEMENT MORTAR, TWO-STOREY

earthquakes objective of the design is to contribute towards resilient models to improve safety in future aspects have also been factored into the design of the house. The design concept and the used for structural type, where CGI sheet is used for covering the roof along with wooden includes the provision of horizontal bands, vertical reinforcements, corner reinforcement, and there are two rooms with dimensions 3225x3150 and a covered verandah with dimensions Model SMC-2.4 is a two storey house which can accommodate 8-10 people, On both floors T-junctions to improve diaphragm effectiveness. Climatic conditions and social and cultural (NBC) in order to ensure that earthquake resistant construction measures are included. This rafters and purlins. All designs have been based on the revised National Building Code of Nepa locally available construction materials. Similarly, stone masonry in cement mortar has been 7300X1250 in the first floor. The design focuses on earthquake resistant construction using



CONSTRUCTION MATERIAL AND MANPOWER

	MAN POWER	OWER				MATERIALS	N SI			
<u>LEVEL</u>	Skilled	Unskille d	Stone	CEMEN T	SAND	AGGREGATE	WOOD	CGI SHEET	GI SHEET	Rod (Steel)
	Md	рМ	Cu.m Bags	Bags	Cu.m	Cu.m	Cu.m	Bundel	Rm.	Kg
Up to Plinth Level	50	184	1038	73	15	4	0	0	0	207
SUPERSTRUCTURE 190 381	190	381	2745 180	180	34	4	3.16	0	0	496
ROOFING	46	0	0	0	0	0	2.19	4.36	11	0
TOTAL	. 286	TOTAL 286 565 3783 253	3783	253	49	8	5.37	4.36	11	703

	W.
Rec	Nep

onstruction Programme | PRAWING ТІТІЕ: oal Housing

TYPE OF HOUSE: MODEL SMC-2.4

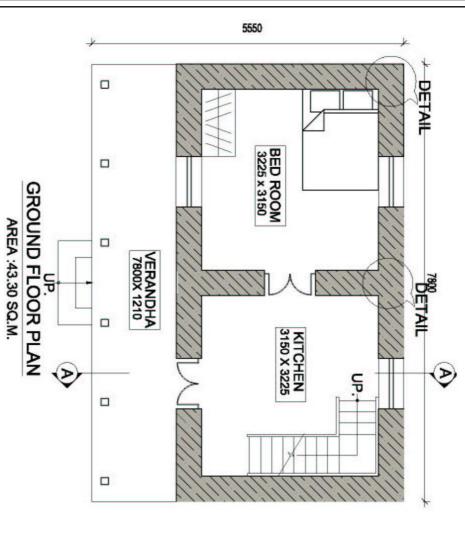
PERSPECTIVE AND ESTIMATION

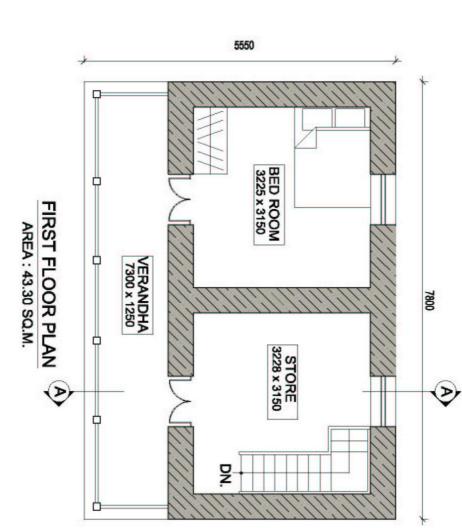
SCALE:

DATE:

DESIGNED BY: DUDBC NONE

SMC-2.4 1/4





TOTAL AREA: 86.6sqm

Programme	Nepal Housing
0	Т

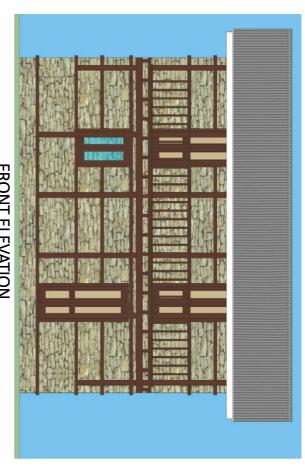
	TYPE OF HOUSE:	MODELSMC-2.4	SCALE: None	DATE:
gramme	DRAWING TITLE:	PLAN	DESIGNED BY: DUDBC	

SMC-2.4

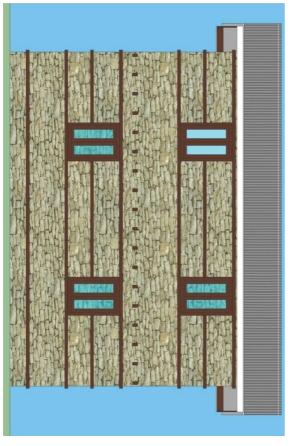
2/4

Model SMC-2.4: STONE MASONRY IN CEMENT MORTAR

TWO-STOREY



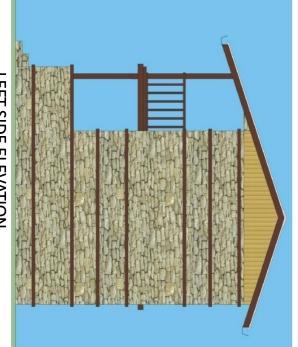
FRONT ELEVATION



BACK ELEVATION



RIGHT SIDE ELEVATION



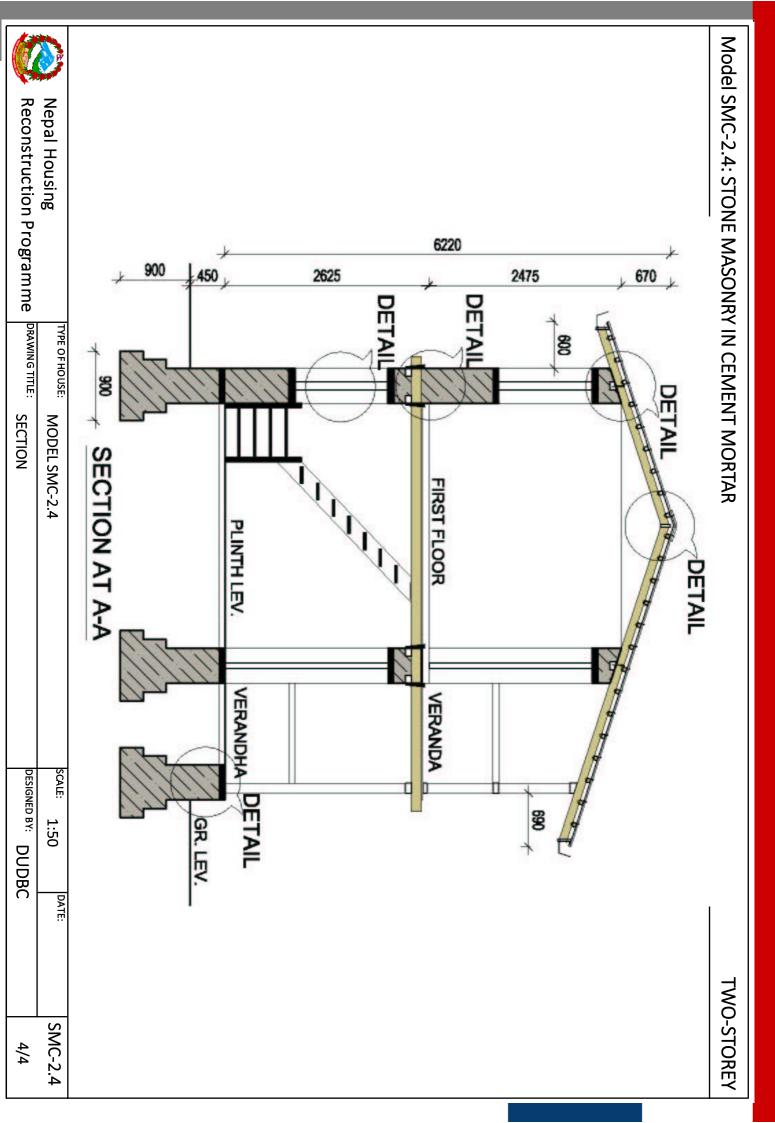
LEFT SIDE ELEVATION

DATE:

SMC-2.4

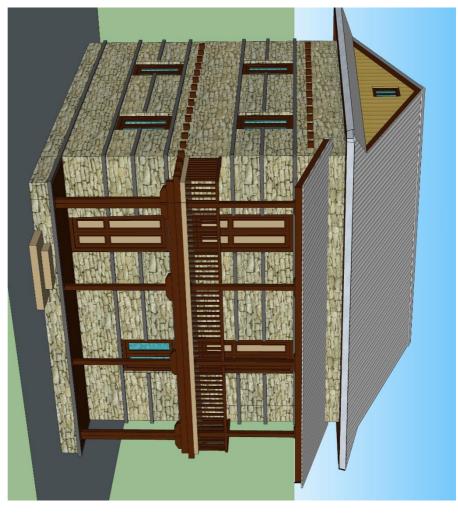
3/4

Reconstruction Programme	Nepal Housing
DRAWING TITLE:	TYPE OF HOUSE:
ELEVATION	MODELSMC-2.4
DESIGNED BY: DUDBC	SCALE: None
	DA:



STONE MASONRY IN CEMENT MORTAR, TWO-STOREY

6550X1100. The design focuses on earthquake resistant construction using locally available are three rooms with dimensions of 2700 X 2700 and a covered verandah with dimensions also been factored into the design of the house. The design concept and the objective of the provision of horizontal bands, vertical reinforcements, corner reinforcement, and T-junctions ensure that earthquake resistant construction measures are included. This includes the designs have been based on the revised National Building Code of Nepal (NBC) in order to type, where CGI sheet is used for covering the roof along wooden rafters and purlins. All construction materials. Similarly stone masonry in cement mortar has been used for structural design is to contribute towards resilient models to improve safety in future earthquakes Model SMC-2.5 is a two and a half storey house, which includes an attic. On both floors there to improve diaphragm effectiveness. Climatic conditions and social and cultural aspects have



CONSTRUCTION MATERIALS AND MANPOWER

	MAN POWER	OWER				MATERI	RIALS			
<u>LEVEL</u>	Skilled	Unskilled	Stone	CEMENT	SAND	AGGREGATE	WOOD	CGI SHEET	GI SHEET	Rod
	Md	Md	Cu.m.	Bags	Cu.m.	Cu.m.	Cu.m.	Bundel	Rm.	Kg
Up to Plinth Level	72	261	48	91	18	5	0.00	0.0	0	282
SUPERSTRUCTURE	294	468	90	215	41	6	3.97	0.0	0	596
ROOFING	52	17	0	0	0	0	2.48	5.22	32	0
TOTAL	418	745	138	306	59	11	6.45	5.22	32	878



Reconstruction Programme PRAWING TITLE: **Nepal Housing**

TYPE OF HOUSE:

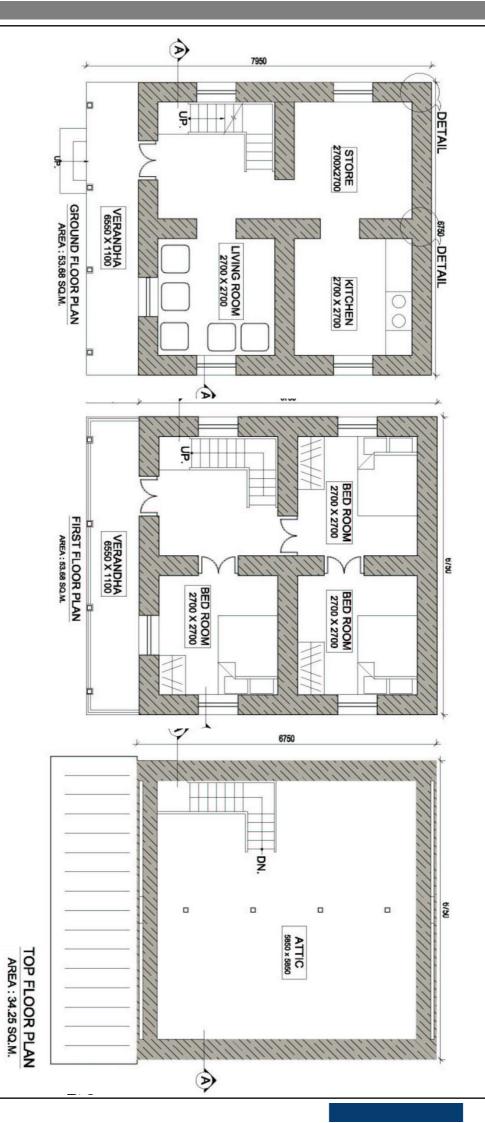
MODEL SMC-2.5

PERSPECTIVE AND ESTIMATION

SCALE: DESIGNED BY: DUDBC NONE DATE:

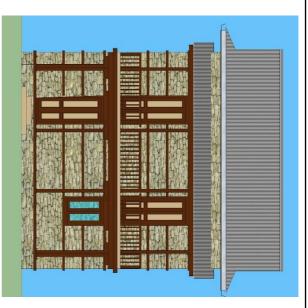
SMC-2.5

1/4

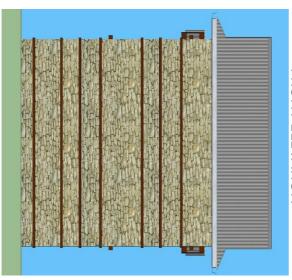


TOTAL AREA: 107.36sqm

	V V
Reconstruction Programme	Nepal Housing
DRAWING TITLE:	TYPE OF HOUSE:
PLAN	MODEL SMC-2.5
DESIGNED BY: DUDBC	SCALE: None
ה	DATE:
2/4	SMC-2.5



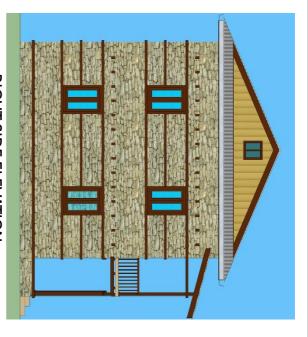
FRONT ELEVATION



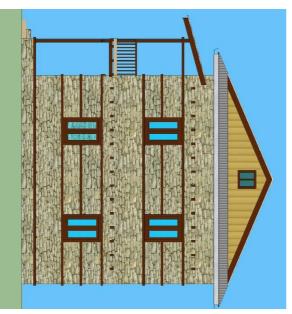
BACK ELEVATION

TYPE OF HOUSE:

MODEL SMC-2.5

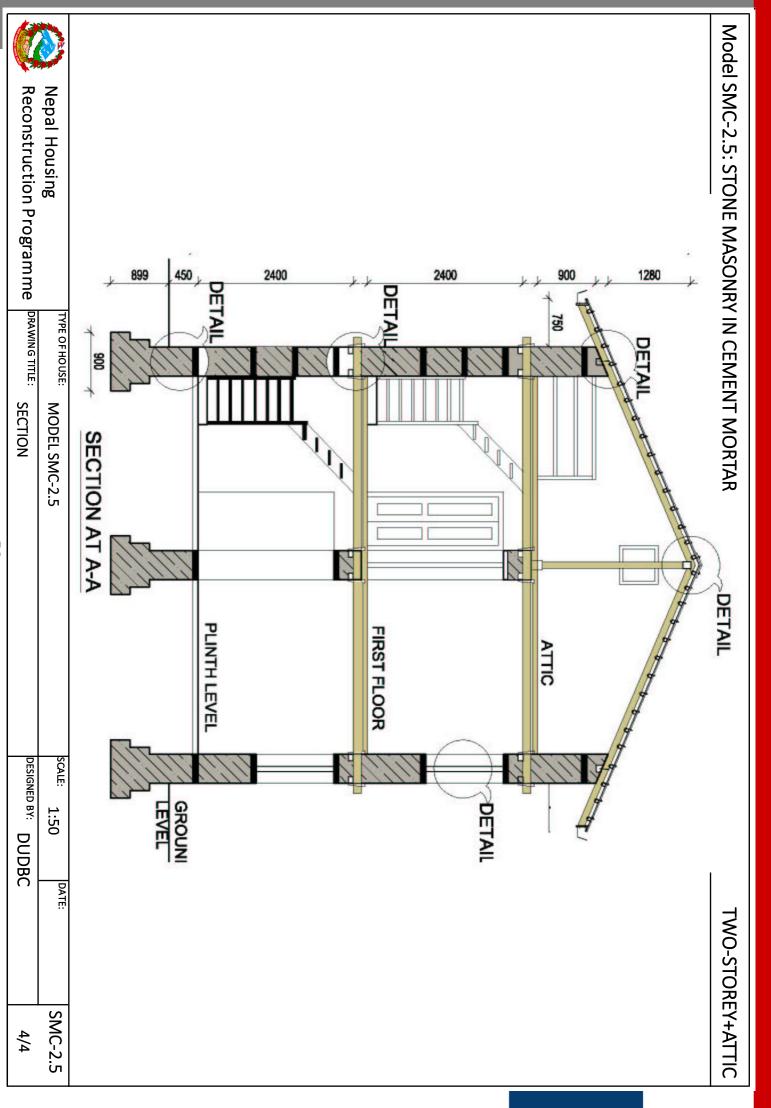


RIGHT SIDE ELEVATION



LEFT SIDE ELEVATION

DESIGNED BY: DUDBC	SCALE: None DATE:
3/	SMC-2.5
4	-2.5



STONE MASONRY IN CEMENT MORTAR, TWO-STOREY

of 3300 X 2700, living room with dimensions of 3300 X 2700 and a veranda with dimensions vertical reinforcements. dimensions 3300 \times 2700 along with verandah dimensions 3300 \times 2100 . All designs have been 3300 x 2100 in the ground floor. Similarly, on the first floor it consists of two bedroom with based on the revised National Building Code of Nepal (NBC) in order to ensure that earthquake flat slab. Covering a plinth area of 48.90 Sq. M., the model consists of kitchen with dimensions Model SMC-2.6 is a two and a half storey building constructed in stone masonry with a RCC resistant construction measures are included. This includes the provision of horizontal bands,



CONSTRUCTION MATERIALS AND MANPOWER

	MAN P	MAN POWER			N	MATERIALS		
<u>LEVEL</u>	<u>Skilled</u>	<u>Unskille</u> <u>d</u>	<u>Stone</u>	Stone CEMENT	SAND	AGGREGATE	WOOD	ROD
	Md	Md	Cu.m.	Bags	Cu.m	Cu.m	Cu.m	ĸ
Up to Plinth Band	65	241	38	103	27	9	0	160
Up to Roof Band	346	721	93	409	54	22	2.09	2654
TOTAL	412	962	132	504	81	31	2.09	2814

10	Nepal Housing

MODEL SMC-2.6	None None	5
DRAWING TITLE: PERSPECTIVE AND ESTIMATION	DESIGNED BY: DUDBC	Ú

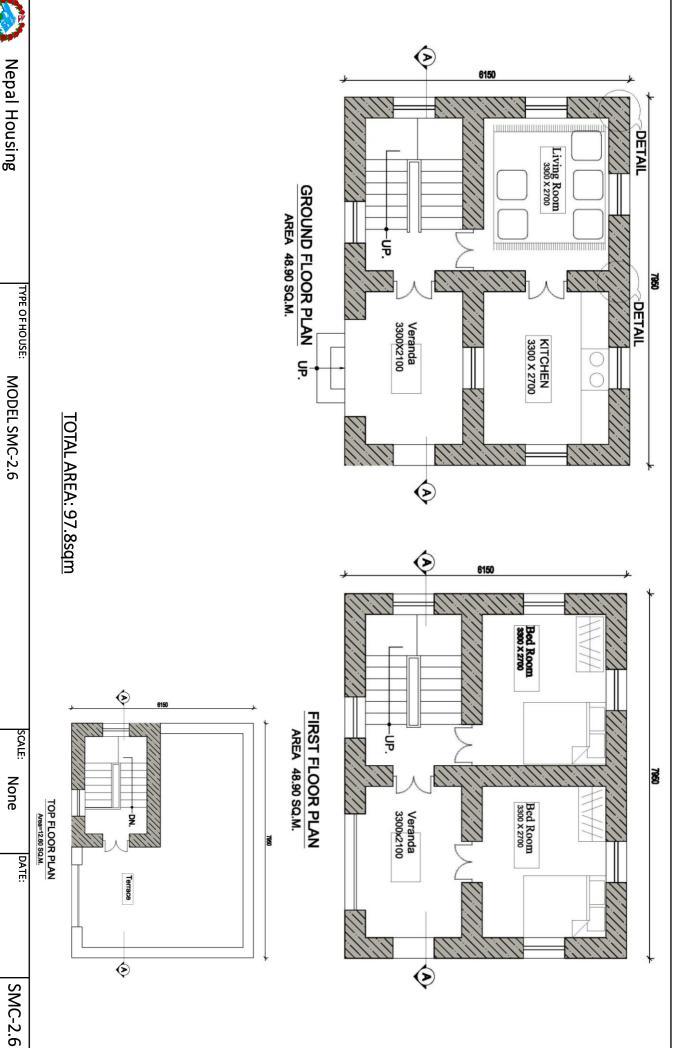
DATE:

SMC-2.6

1/4

| Model SMC-2.6: STONE MASONRY IN CEMENT MORTAR

TWO-STOREY+TERRACE



DESIGNED BY:

DUDBC

2/4

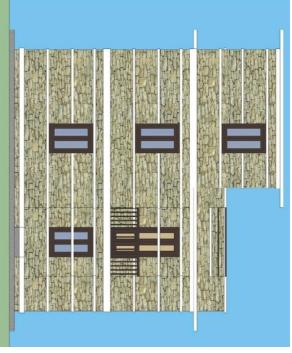
Reconstruction Programme

DRAWING TITLE:

PLAN

Model SMC-2.6: STONE MASONRY IN CEMENT MORTAR

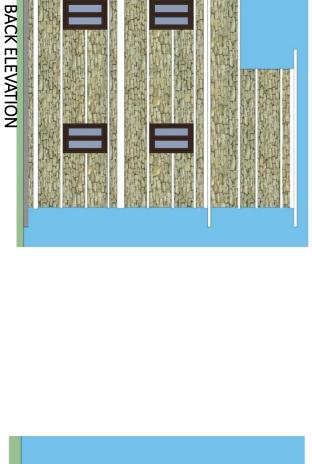
TWO-STOREY+TERRACE



FRONT ELEVATION



RIGHT SIDE ELEVATION





Reconstruction Programme | DRAWING TITLE:

TYPE OF HOUSE: MODEL SMC-2.6

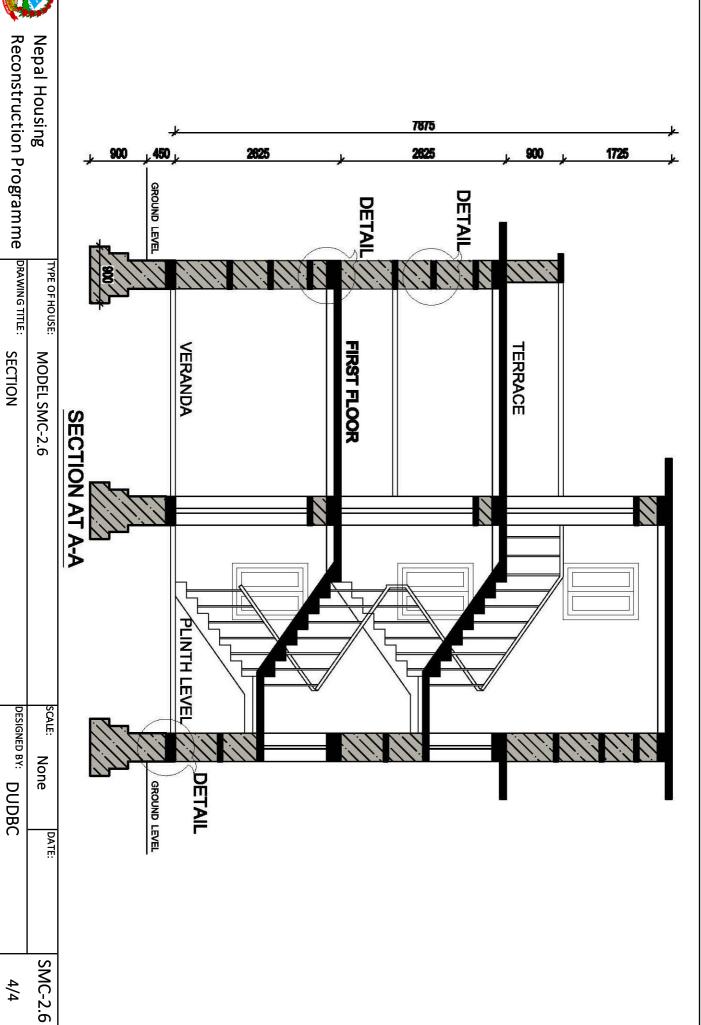
ELEVATION



DESIGNED BY: DUDBC None DATE:

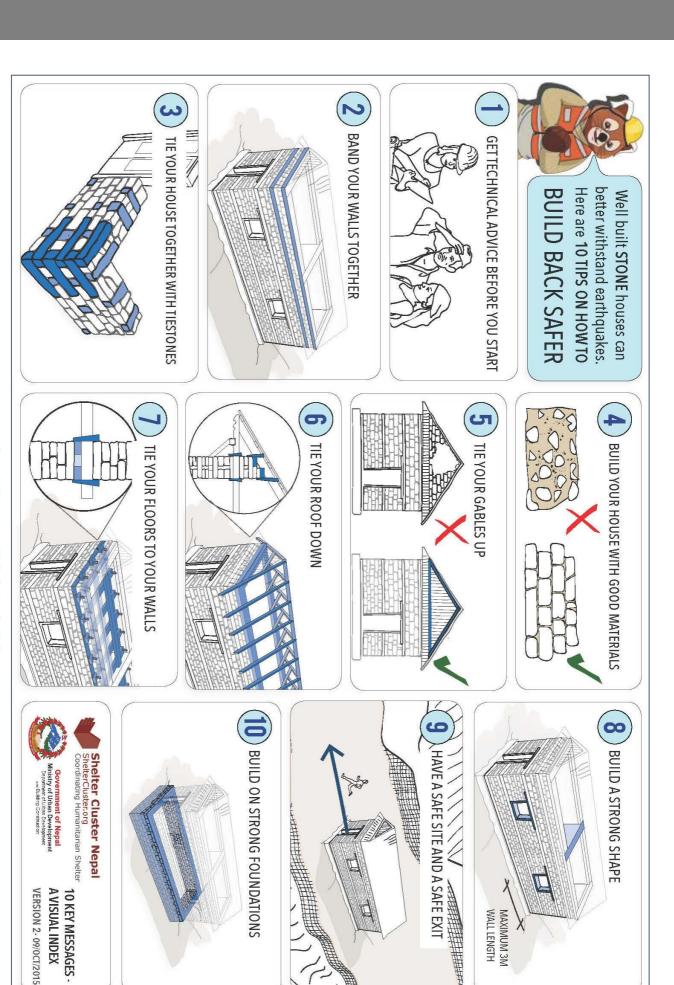
SCALE:

SMC-2.6 3/4

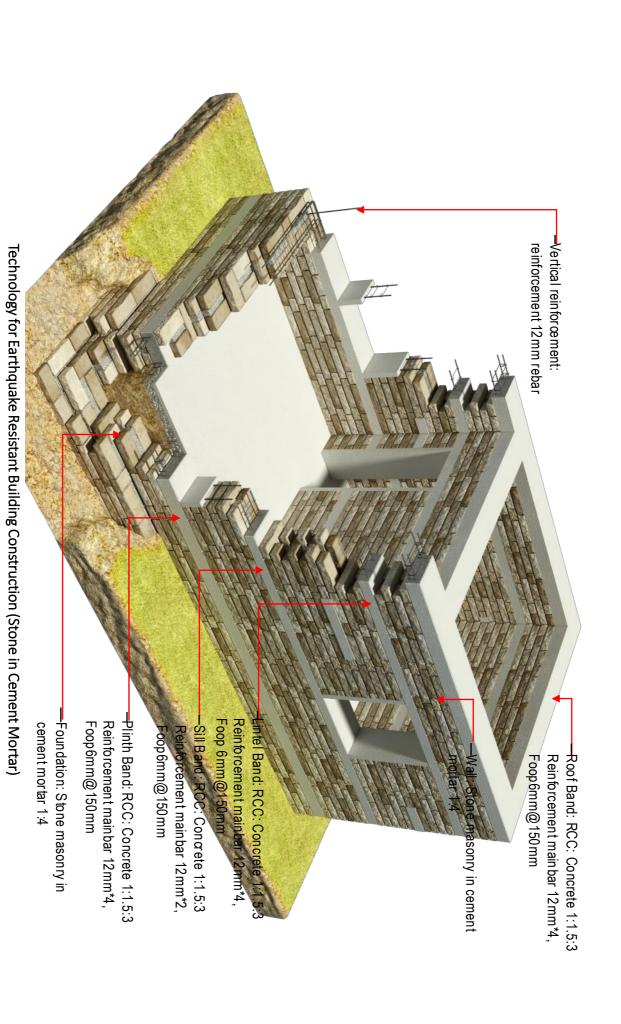


SECTION

Technical Details



10 KEY MESSAGES

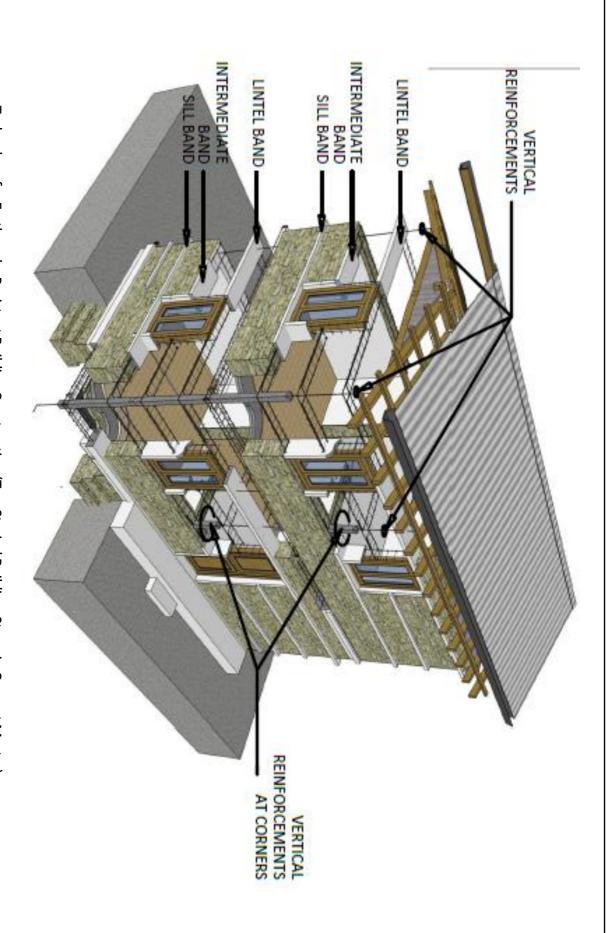


Nepal Housing

Reconstruction Programme | DRAWING TITLE: TYPE OF HOUSE: MODEL SMC TECHNICAL DETAIL 1 (SEISMIC ELEMENTS)

SCALE: DESIGNED BY: JICA None DATE:

SMC

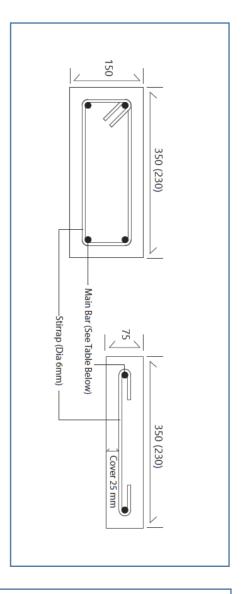


Technology for Earthquake Resistant Building Construction (Two Storied Building, Stone in Cement Mortar)

Reconstruction Programme	Nepal Housing
ramme DRAWING TITLE:	TYPE OF HOUSE:
TECHNI	MODEL

MODEL SMC		SCALE: None	DATE:
DRAWING TITLE: TECHNICAL DETAIL	NIL 2 (SEISMIC ELEMENTS)	DESIGNED BY: DUDBC	

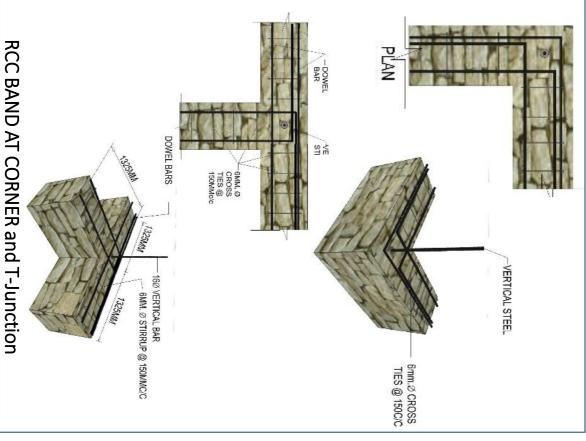
SMC



Cross section of RC bands for two bars and four bars

Requirement of bar for RC bands

		9	
Band/Beam	RC Band Minimum Thickness	Min. No. Of. Bars	Min. Diameter of Bars (mm)
Plinth	150 mm	4	12
Still	75 mm	2	10
	75mm	2	12
Lintel	150mm	2	10 (top)
		2	12 (bottom)
Roof	75mm	2	12
	300mm	4	12
Dowel (Stitch)	75mm	2	8



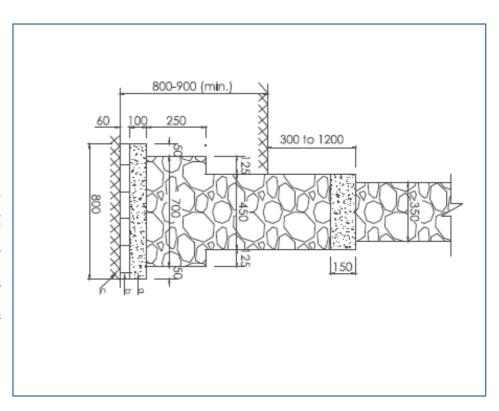


SCALE: None DATE:

BESIGNED BY:

SMC

*Source: NBC202



For two-storey building (in medium soil) (Stone in cement mortar) For one-storey building (in soft soil)

Base width of footing

Masonry Type	No. Of	Minimum base wid	Minimum base width (mm) of wall footing for soil type:	ing for soil type:
	Story	Soft	Medium	Hard
Brick	Two	900	650	550
	One	650	550	550
C+020	Two	*	600	600
Stolle	One	800	600	600

Classification of Foundation Soil and Safe Bearing Capacity

Hard gravel and sand-gravel mixture, dense or loose coarse to medium sand offering high resitance to penetration when excavated by tools;stiff to medium clay which is readily indented with a thumb nail. Medium Find sand and silt (dry lumps easily pulverised by the finger); moist clay and sand-clay mixture which can be indented with strong thumb pressure. Soft Fine sand, loose and dry; soft clay indented with moderate thumb < 150 and >=100 Pressure. Very soft clay which can be penetrated several centimeters with the thumb, wet clays.	Foundation Soil Classification	Types of Foundation Materials	Presumed Safe Bearing Capacity, KN/m ²
Find sand and silt (dry lumps easily pulverised by the finger); moist clay and sand-clay mixture which can be indented with strong thumb pressure. Fine sand, loose and dry; soft clay indented with moderate thumb pressure. Very soft clay which can be penetrated several centimeters with the thumb, wet clays.	Hard	Rocks in different state of wearthing, boulder bed, gravel, sandy gravel and sand-gravel mixture, dense or loose coarse to medium sand offering high resitance to penetration when excavated by tools;stiff to medium clay which is readily indented with a thumb nail.	>=200
Fine sand, loose and dry; soft clay indented with moderate thumb pressure. Very soft clay which can be penetrated several centimeters with the thumb, wet clays.	Medium	Find sand and silt (dry lumps easily pulverised by the finger); moist clay and sand-clay mixture which can be indented with strong thumb pressure.	<200 and >=150
Very soft clay which can be penetrated several centimeters with the thumb, wet clays.	Soft	Fine sand, loose and dry; soft clay indented with moderate thumb pressure.	<150 and >=100
	Weak	Very soft clay which can be penetrated several centimeters with the thumb, wet clays.	<100

*Source: NBC202

SCALE:

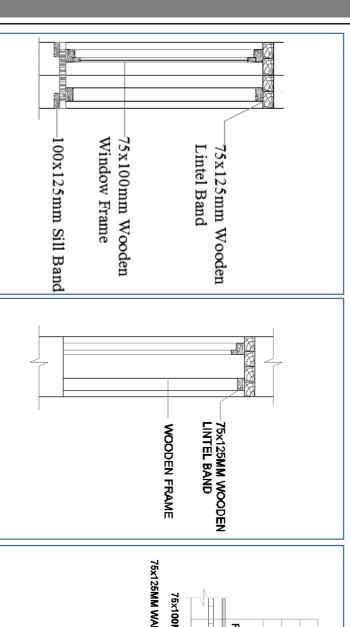
None

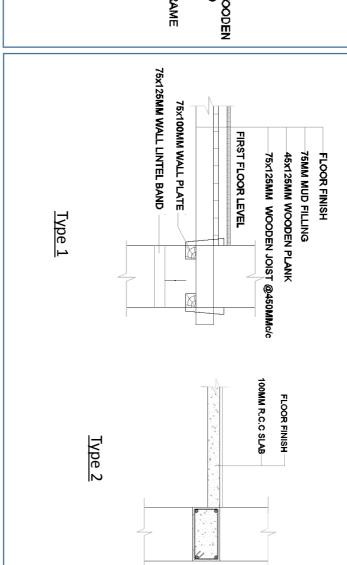
DATE:

DESIGNED BY:

	N. S. W.
Reconstruction Programr	Nepal Housing

	TYPE OF HOUSE:	MODELSMC
Programme	DRAWING TITLE:	TECHNICAL DETAIL 4 (Foundation)





Window Section

Door Section

First Floor Detail

Nepal Housing

Reconstruction Programme PRAWING TITLE:

DRAWING TITLE: TECHNICAL DETAIL 5 (Opening and Floor)

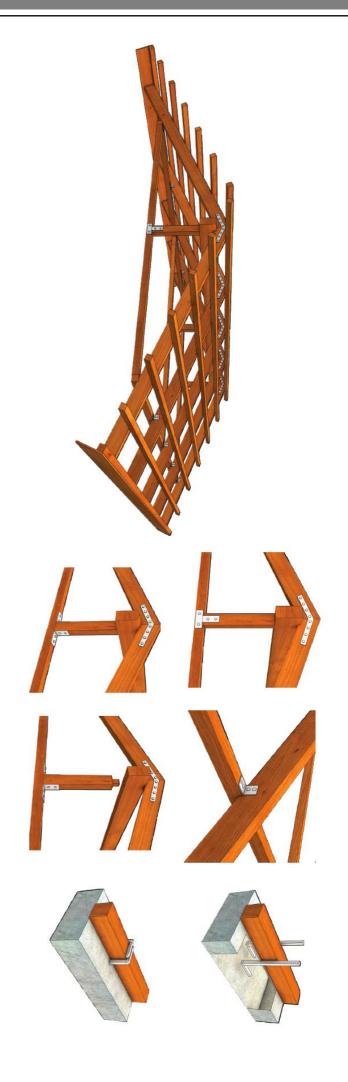
*Source : NBC202

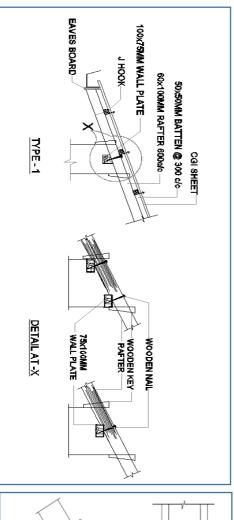
SCALE:

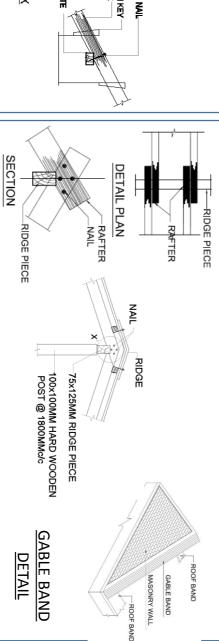
None

DESIGNED BY:

SMC





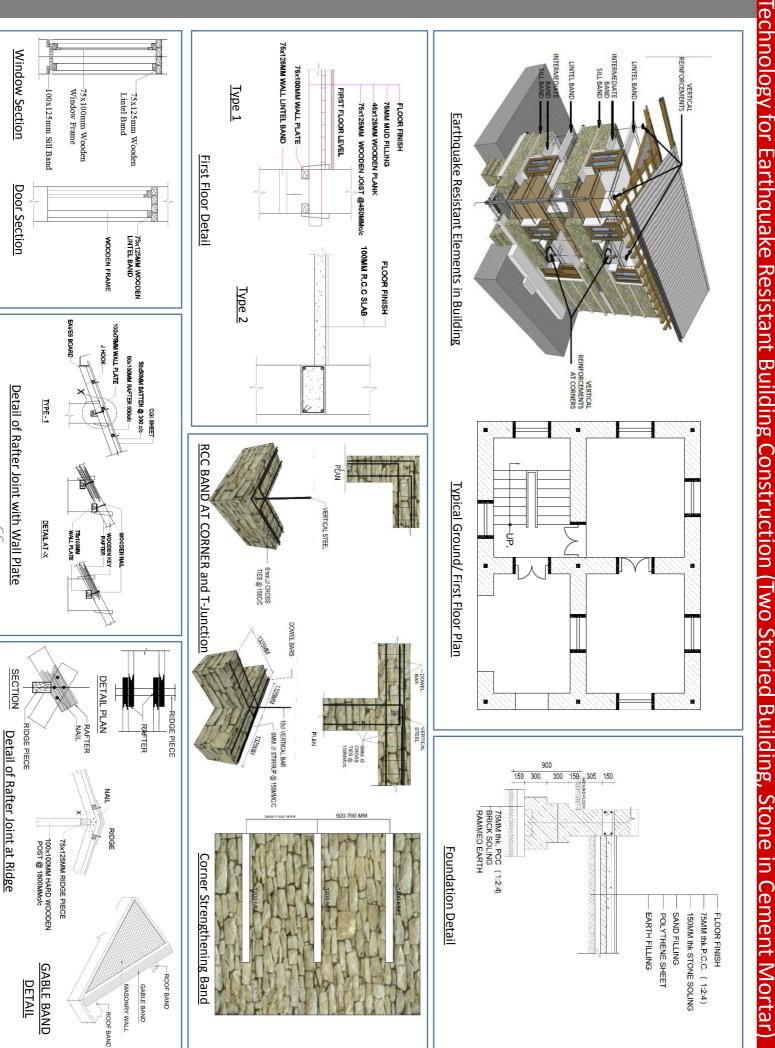


Detail of Rafter Joint with Wall Plate

Detail of Rafter Joint at Ridge

Reconstruction Programme	Nepal Housing
DRAWING TITLE:	TYPE OF HOUSE:
TECHNICAL DETAIL 6 (Roof)	MODELSMC
DESIGNED BY:	SCALE: None
	DATE:
OIVIC	CMC

STONE MASONRY IN CEMENT MORTAR Top (Plan) View Isometric View Side View Ridge (H240xW180) -Reconstruction Programme | DRAWING TITLE: **Nepal Housing** Past (H90xW90) Ridge Cover CGI Sheet -Fascia (H270xW20) Base (H90xW90) TYPE OF HOUSE: MODEL SMC **TECHNICAL DETAIL 7 (Roofing)** Ridge (H240xW180) CGISheet Purtin (H75xW75) Ridge Cover Purtin (H75xW75) Rafter (H180xW90) CGI Sheet Rafter (H180xW90) Purin (H75xW75) Fildge (H75xW75) -CGI Sheet -SCALE: DESIGNED BY: - Rafter (H180xW90) - Purin (H75xW75) - CG Sheet SCIGM Fascia (H270xW20) - Raffor (H180xW90) None DATE: ready to fix roof cover SMC

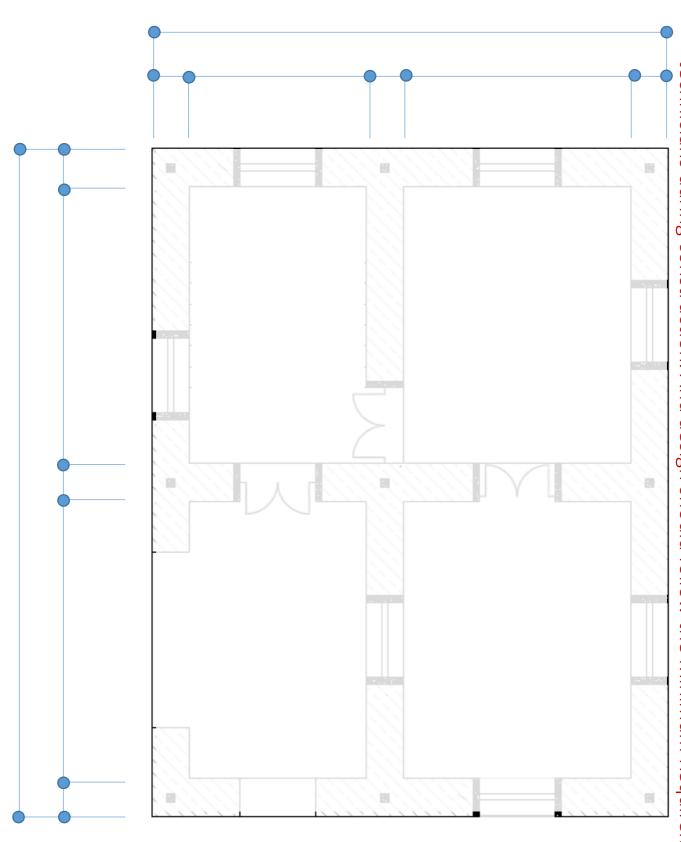


Flexible design

0

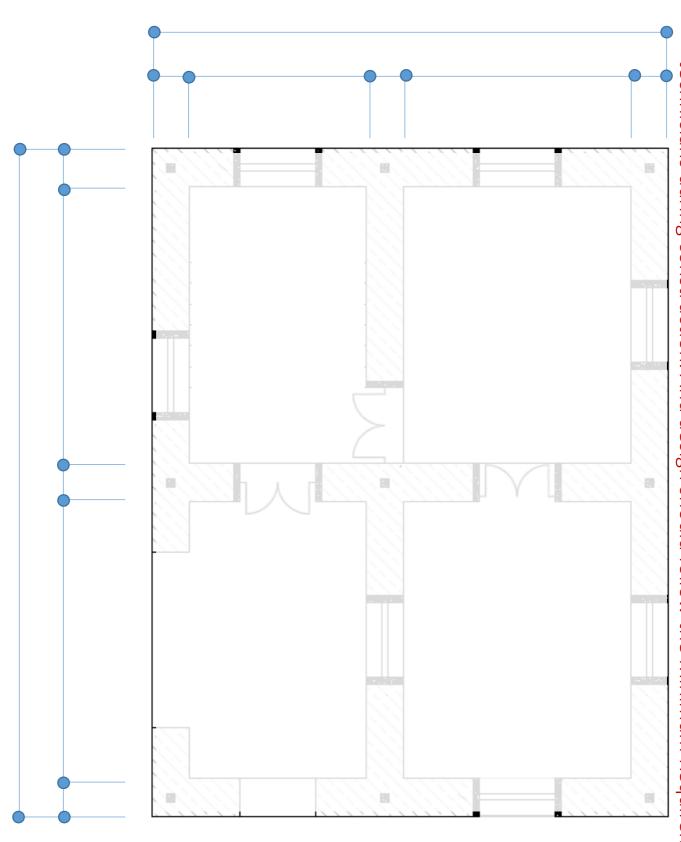
Minimum Requirements for Flexible design

Base drawing for Flexible design



89

Base drawing for Flexible design



69

BRICK MASONRY IN CEMENT MORTAR (BMC)



BRICK MASONRY IN CEMENT MORTAR (BMC)

the households' requirements within the parameters as set out in the National Building Code of Nepa included in this category of the catalogue. A flexible design is also included which can be adapted as per masonry construction using cement mortar. Designs for both one-storey and two-storey houses are This section of the Design Catalogue for Reconstruction of Earthquake Resistant houses refers to brick

the 'Minimum Requirements' at the beginning of this section. material required in the construction of the house designs included under this category can be found in The house designs are based on the use of reinforced concrete bands. The technical specifications for the

referred to when constructing any of the designs presented under this category. The key technical details related to this category are included at the end of this section and should be

Minimum Requirements (MRs)

	Minimum Requi	rements (MRs)	for	Brick Masonry in Cement Mortar (NBC202) Page1
No.	Category			
		A building shall	not	be constructed if site is:
		2000	•	Geological fault or Raptured Area
1	Cita Calaatian	000000000000000000000000000000000000000	~	Areas Susceptible to Landslide
1	Site Selection		1	Steep Slope > 20%
			~	Filled Area
			'	River Bank and Water-logged Area
		No. of story	~	Two storey+ attic, load bearing masonry buildings constructed in cement mortar
		Span of wall	'	The span of wall shall not more than 4.5 meters
2	Shape of House	Size of room	'	The area of individual floor panel not more than 13.5 square metres
		Height of wall	1	The height of wall should not be more than 3.0 meters
		Proportion	~	The house shall be planned in square, rectangular. Avoid long and narrow structure should not be more than 3 times of its width.
		General	V	The foundation trench shall be of uniform width. The foundation bed shall be on the same level throughout the foundation in flat area.
3	Foundation	Depth	•	The depth of footing should not be less than 800mm for one story, 900mm for two storey.
		Width	•	The width of footing should not be less than 600mm in medium soil condition. As depend on soil condition. Shown in detail drawings.
		General	v	Provide a reinforced concrete band at plinth level, as shown in detail drawings. The top level of plinth should not be less than 300mm from existing ground level. Recommendation is 450mm.
		Height	1	Minimum height of Plinth band is 150mm.
4	Plinth	Width	•	Minimum thickness of plinth band width should be equal to wall thickness. 230mm for brick masorny.
		Reinforcement	v	Main reinforcement should be 4-12 dia. bars. Use 6mm diameter rings at 150mm. Hook length should be 500mm. Bars shall have a clear cover of 25mm concrete.
_		General	•	Masonry should not be laid staggered or straggled in order to avoid continuous vertical joints. At corners or wall junctions, through vertical joints should be avoided by properly laying the masonry. It should be interlocked.
5	Walls	Joints	V	Mortar joints should not be more than 20mm and less than 10mm in thickness. The ratio recommend 1:4 (Cement: Sand).
		Width	•	The minimum width of wall is 230mm for one-storey and 350mm for two-storey of ground floor.

	Minimum Requir	rements (MRs)	for	Brick Masonry in Cement Mortar (NBC202) Page2
No.	Category			
		Location	V	Openings are to be located away from inside corners by a clear distance should not be less than 600 mm.
6	Openings	Total length	V	The total length of openings in a wall is not to exceed half of the length of the wall in single-storey construction.
		Distance	V	The horizontal distance between two openings is to be not less than 600 mm.
		Lintel level	1	Keep lintel level same for doors and windows.
7	Vertical Reinforcement	Location	V	Place vertical steel bars in the wall at all corners, junctions of walls and adjacent to all doors and windows. They shall be covered with cement concrete in cavities made around them during the masonry construction.
	Remoreement	Reinforcement	′	The vertical reinforcing bar for masonry is given in detail drawings. 12mm dia is minimum requirements for masonry houses.
				izontal bands should be provided throughout the entire wall with imum thickness of 75 to 150 mm at following locations:
		Sill band	V	A continuous sill band shall be provided through all walls at the bottom level of opening (specially windows). The minimum height is 75mm.
		Lintel band	V	A continuous lintel band shall be provided through all walls at the top level of opening. The minimum height is 150mm.
8	Horizontal Band	Stitch	V	This band shall be provided where dowel-bars are required at all corners, junctions of walls. The minimum height is 75mm.
		Roof band	V	Roof band shall be provided at the top-level of walls, so as to integrate them properly at their ends and fix them into the walls. The minimum height is 75mm.
		Reinforcement	~	Main reinforcement should be 4or 2-12 dia. bars. Use 6mm diameter rings at 150mm. Hook length should be 500mm. Bars shall have a clear cover of 25mm concrete.
		Light roof	~	Use light roof comprising wooden or steel truss covered with CGI sheets
		Connection	′	All members of the timber truss or joints should be properly connected as shown in detail drawings.
9	Roof	Cross-tie	V	Trusses should be properly cross-tied with wooden braces as shown in detail drawings.
		Timber	V	Well seasoned hard wood without knots should be used for roofing, timber treatment such as use of coal tar or any other preservative can prevent timber from being decayed and attacked by insects
		Mortar	V	Cement sand mortar should not be leaner than 1:4 (1 part cement and 4 parts sand) for masonry and 1:6 for plaster
10	Materials	Concrete	•	The concrete mix for seismic bands should not be leaner than 1:1.5:3 (1 part cement, 1.5 parts sand and 3 parts aggregate)
		Reinforcement	v	High Strength Deformed Bars – Fe415: High strength deformed bars with fy = 415 N/

BRICK MASONRY IN CEMENT MORTAR, ONE-STOREY

BMC-1.1

effectiveness vertical reinforcement, corner reinforcement, and T-junctions to improve diaphragm been on the revised National Building Code of Nepal (NBC) in order to ensure that earthquake design focuses on earthquake resistant construction using locally available construction rooms with dimensions of 2830 x 4500, and a verandah with dimensions of 1500 x 6350 The resistant construction measures are included. This includes the provision of horizontal bands, CGI sheet is used for covering the roof along with wooden rafter and purlin. All design have materials. Similarly brick masonry in cement mortar has been used for structural type, where Model BMC- 1.1 a one-storey housing which can accommodate 3-5 people. It consists of two

to improve safety in future earthquakes. The design concept, and the objective of the design is to contribute towards resilient models

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BMC-1.1



		MANE	MAN POWER				MATERIALS			
	<u>LEVEL</u>	Skilled	Unskilled	Brick	CEMENT	SAND	AGGREGATE	WOOD	CGI SHEET	Reinforcing bar
		Md	Md	Nos	Bags	Cu.m	Cu.m	Cu.m	Bundel	Kg
	Up to Plinth Level	45	104	13115	81	11	7	0	0	146
	SUPERSTRUCTURE	67	59	8984	46	5	2	0.79	0	314
	ROOFING	17	20	0	0	0	0	1.48	4.71	0
	TOTAL	129	183	22099	127	15	9	2.27	4.71	460
using		TYPE OF HOUSE:		MODEL BMC-1.1				SCALE:	None	DATE:

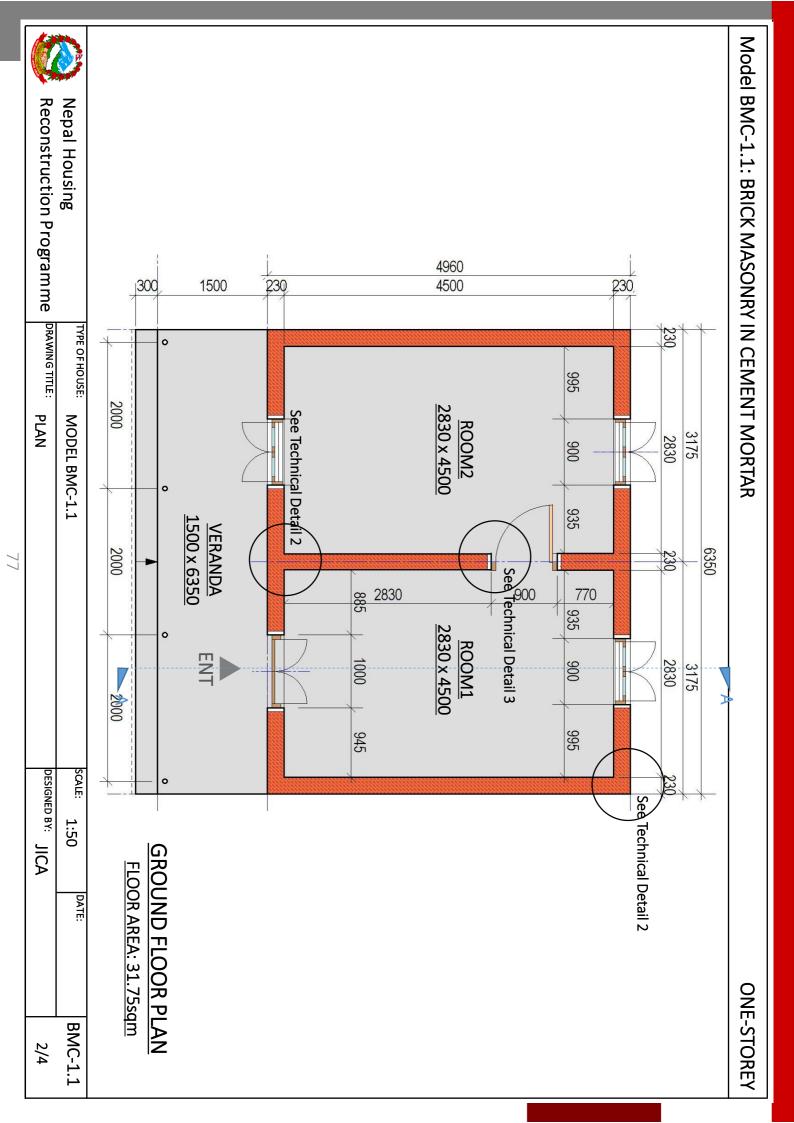
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Reconstruction Programme	Nepal Housing
DRAWING -	TYPE OF HO

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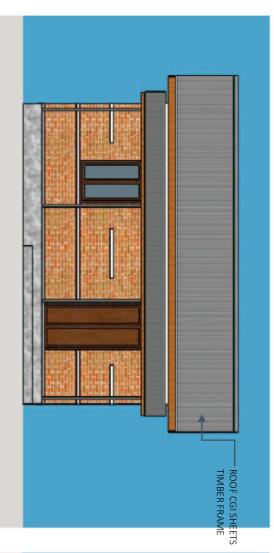
IGNED BY:	
JICA	

76



Model BMC-1.1: BRICK MASONRY IN CEMENT MORTAR

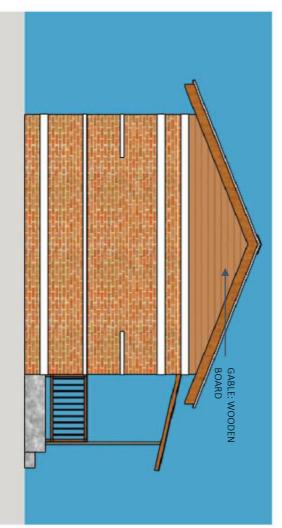
ONE-STOREY



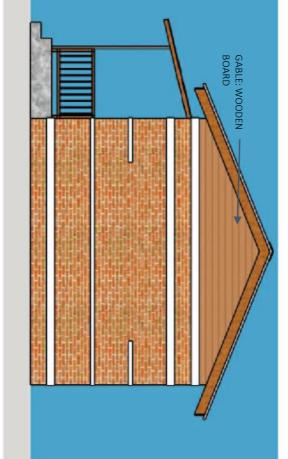
FRONT ELEVATION



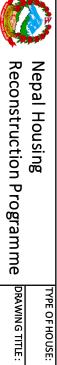
BACK ELEVATION



SIDE ELEVATION



SIDE ELEVATION



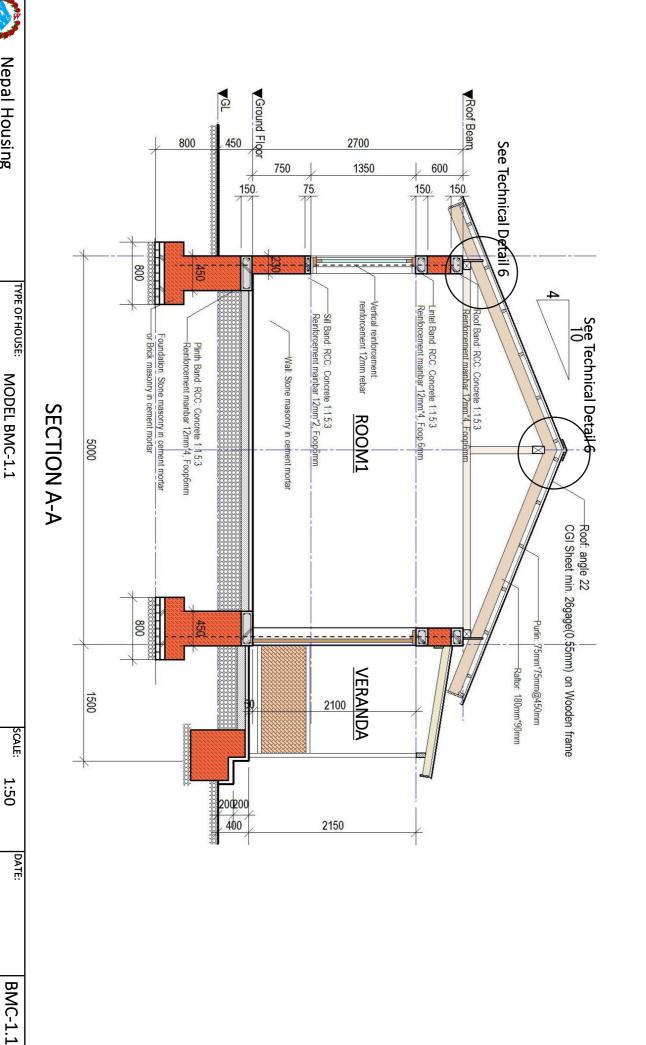
DRAWING TITLE: ELAVATION

DESIGNED BY: JICA

DESIGNED BY: JICA

DATE:

BMC-1.1



DESIGNED BY: JICA

4/4

Reconstruction Programme | DRAWING TITLE:

SECTION

Nepal Housing

BRICK MASONRY IN CEMENT MORTAR, ONE-STOREY

BMC-1.2

effectiveness vertical reinforcement, corner reinforcement, and T-junctions to improve diaphragm been on the revised National Building Code of Nepal (NBC) in order to ensure that earthquake design focuses on earthquake resistant construction using locally available construction resistant construction measures are included. This includes the provision of horizontal bands, CGI sheet is used for covering the roof along with wooden rafter and purlin. All design have materials. Similarly brick masonry in cement mortar has been used tor structural type, where rooms with dimensions of 2830 x 4500, and a verandah with dimensions of 3090 x4960The Model BMC-1.2 is a one-storey house which can accommodate 1-3 people. It consists of one

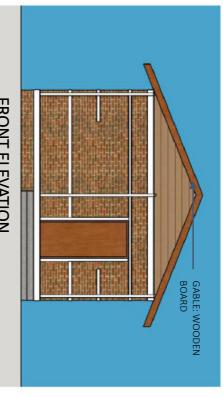
to improve safety in future earthquakes. The design concept, and the objective of the design is to contribute towards resilient models

BMC-1.2

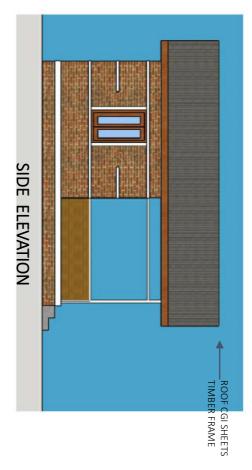


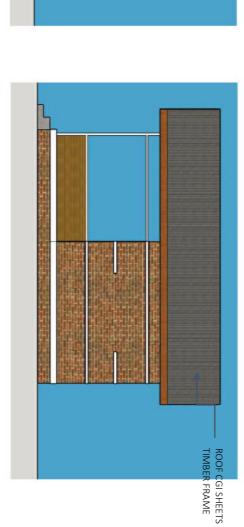
PERSP	DRAWING TITLE:	Reconstruction Programme	
MODE	TYPE OF HOUSE:	Nepal Housing	₩ P

1/4		DESIGNED BY: JICA	PERSPECTIVE AND ESTIMATION	VING TITLE :
BMC-:	DATE:	SCALE: None	MODEL BMC-1.2	OF HOUSE:



FRONT ELEVATION



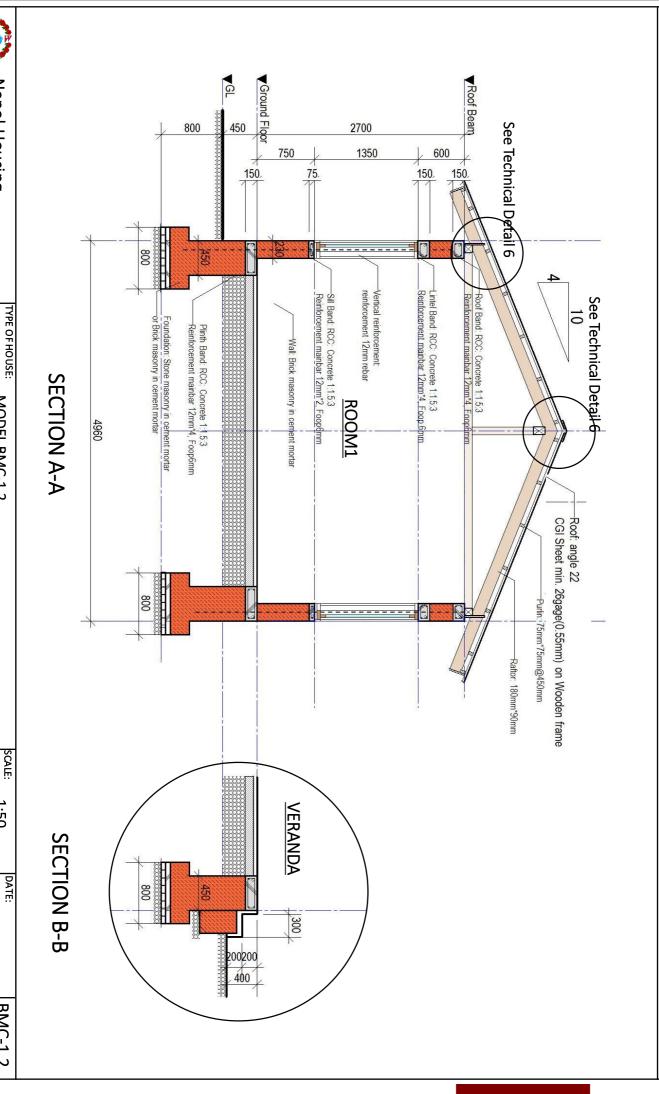


BLE: WOODEN

BACK ELEVATION

SIDE ELEVATION

A .	<u> </u>	
	PV PV	
Reconstruction Programme	Nepal Housing	
DRAWING TITLE:	TYPE OF HOUSE:	
ELAVATION	MODEL BMC-1.2	



MODEL BMC-1.2

Nepal Housing

DESIGNED BY: JICA

1:50

BMC-1.2

4/4

BRICK MASONRY IN CEMENT MORTAR, TWO-STOREY

included. The includes the provision of horizontal bands, vertical reinforcement, corner Code of Nepal (NBC) in order to ensure that earthquake resistant construction measures are with wooden rafter and purlin. All design have been based on the revised National Building mortar has been used for structural type, where CGI sheet is used for covering the roof along construction using locally available construction materials. Similarly brick masonry in cement and a verandah with dimensions of 1500×6350 The design focuses on earthquake resistant of four rooms with dimensions of 2650 x 4260 for ground floor and 2830 x 4500 for first floor, Model BMC-2.1 is a two-storey house which can accommodate more than 4 people. It consists reinforcement, and T-junctions to improve diaphragm effectiveness

to improve safety in future earthquakes. The design concept, and the objective of the design is to contribute towards resilient models



	IVIAN POWER	C WEZ				VIAICKIALS			
<u>LEVEL</u>	Skilled	Unskilled	Brick	CEMENT	SAND	AGGREGATE	WOOD	CGI	Reinforcing bar
	Md	Md	Nos	Bags	cu.m.	cu.m.	cu.m.	Bundel	Kg
Up to Plinth Level	46.93	118.50	13288.00	87.75	11.41	6.71	0.00	0.00	145.85
SUPERSTRUCTURE	81.80	144.21	23648.00	109.12	11.66	4.20	2.95	1.02	630.50
ROOFING	17.32	19.53	0.00	0.00	0.00	0.00	1.48	3.69	0.00
TOTAL	146.05	282.24	36936.00	196.87	23.07	10.91	4.43	4.71	776.35

Reconstruction Progra	Nepal Housing

ramme	
DRAWING TITLE:	TYPE OF HOUSE:
PERSPECTIVE AND ESTIMATION	MODEL BMC-2.1
DESIGNED BY: JICA	SCALE: None
	DATE:

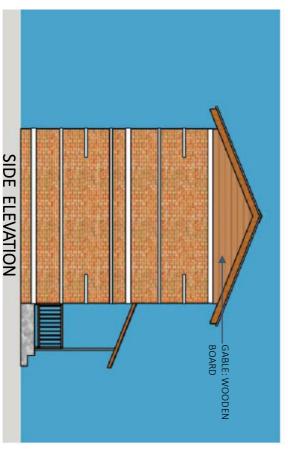
BMC-2.1

1/4

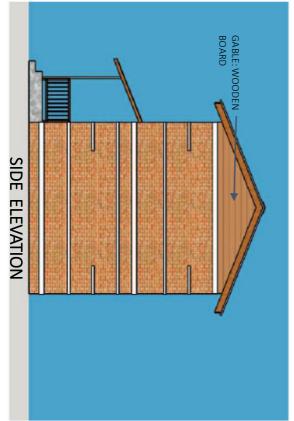
| Model BMC-2.1: BRICK MASONRY IN CEMENT MORTAR

TWO-STOREY





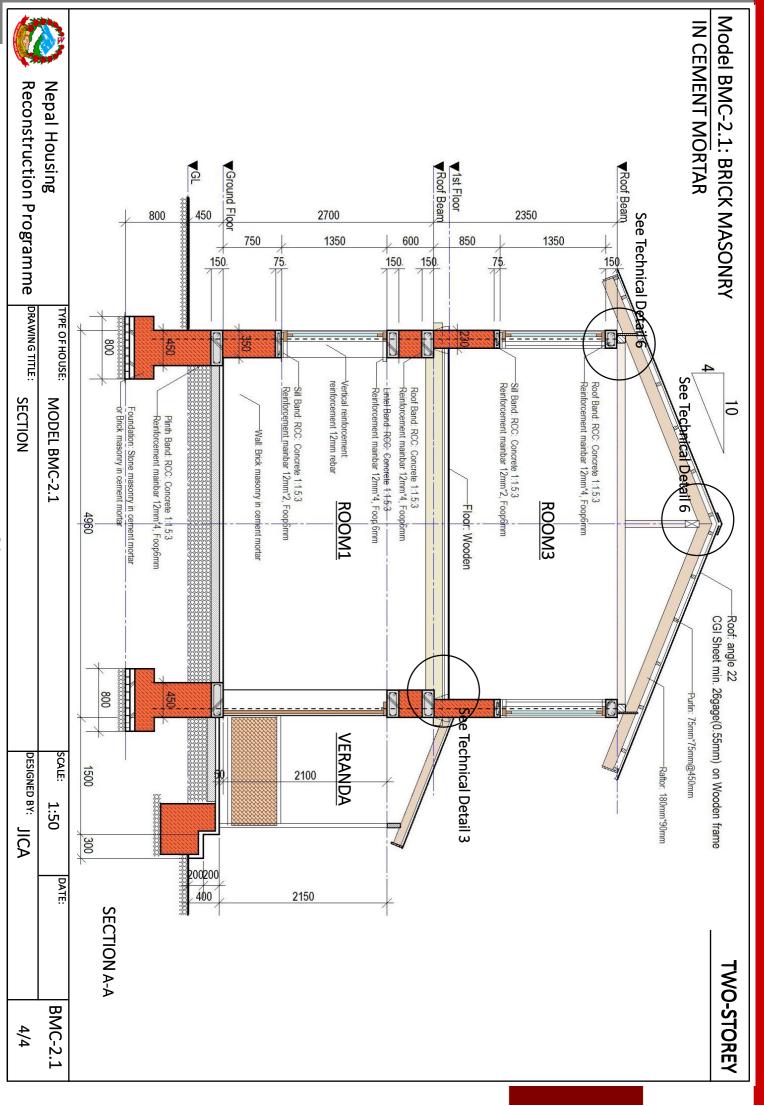






EI EVATION	DRAWING TITLE:
MODEL BMC-2.1	TYPE OF HOUSE:

DESIGNED BY: JICA	SCALE: 1:100
	DATE:
3/4	BMC-2.1



BRICK MASONRY IN CEMENT MORTAR, TWO-STOREY

ensure that earthquake resistant construction measures are included. The includes the veranda with sizes 5475 x 2050 in the ground floor. Similarly, in the first floor it consists of two 37.35 Sq. M., the model consists of kitchen with dimensions 2925X 2925 and a covered provision of horizontal bands, vertical reinforcement, corner reinforcement, and T-junctions. bedrooms, one with dimensions 2925x 2925 and the other with dimensions of 5475 x 2050 Model BMC-2.2 is a two storey building constructed in brick masonry. Covering a plinth area of Nepal, with incorporation of Pidi, Pali and slope roofs The design of this model is influenced by the vernacular architecture of the Hilly region of The model has been based on the revised National Building Code of Nepal (NBC) in order to



CONSTRUCTION MATERIALS AND MANPOWER

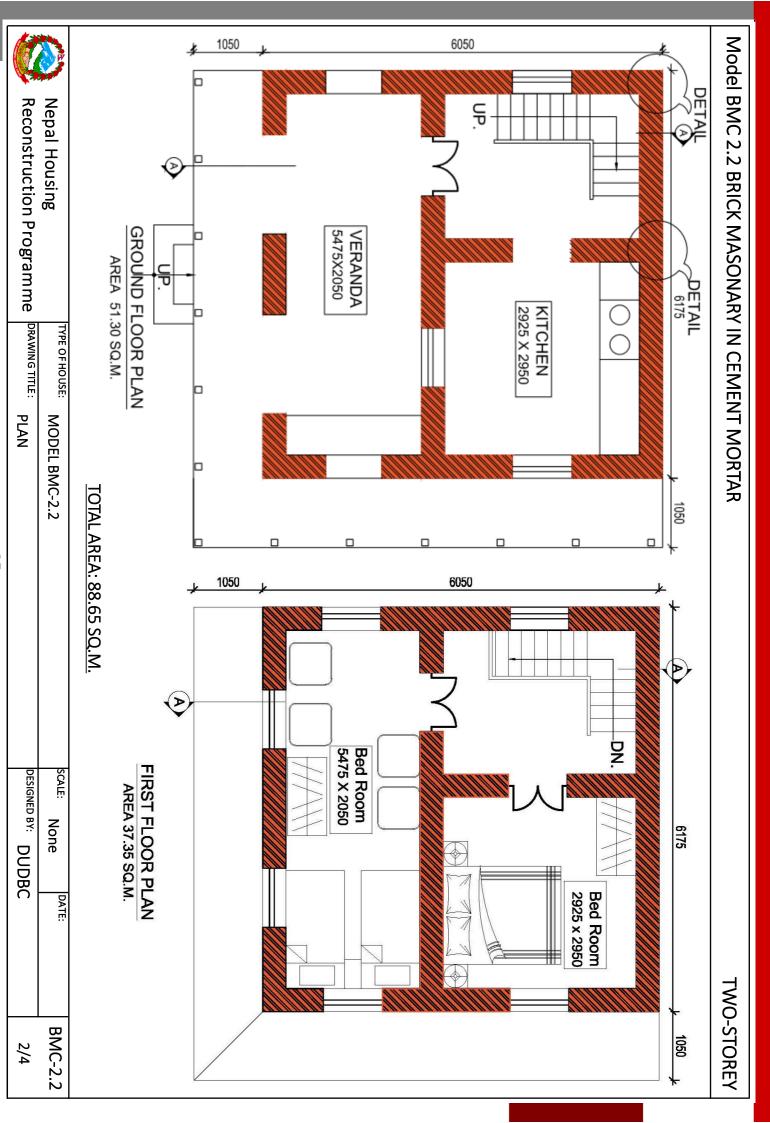
	MAN F	MAN POWER				MATE	<u>ERIALS</u>			
<u>LEVEL</u>	Skilled	Unskilled	Brick	CEMENT	SAND	AGGREGATE	WOOD	CGI SHEET	GI SHEET	Rod
	Md	Md	Nos	Bags	Cu.m.	Cu.m.	Cu.m.	Bundel	Rm.	Kg
Up to Plinth Level	52	113	14296	62	11	3	0	0	0	256
SUPERSTRUCTURE	181	110	23652	121	14	4	3.01	0	0	607
ROOFING	47	18	0	0	0	0	2.13	5.15	9	0
TATOT	280	241	37948	183	25	7	5.14	5.15	26	863

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Reconstruction Programme	Nepal Housing

PERSPECTIVE AND ESTIMATION	DRAWING TITLE:
MODEL BMC-2.2	TYPE OF HOUSE:

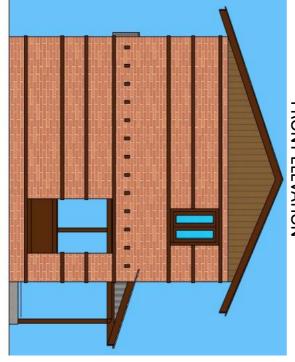
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DBCD SAB DANDISAD	SCALE: NONE

BMC-2.2 1/4

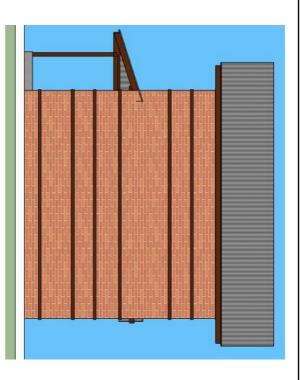




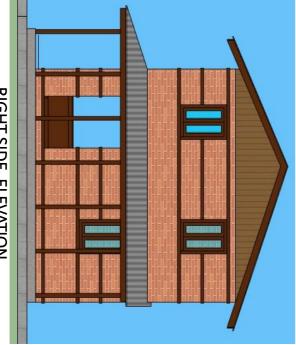
FRONT ELEVATION



LEFT SIDE ELEVATION



BACK ELEVATION



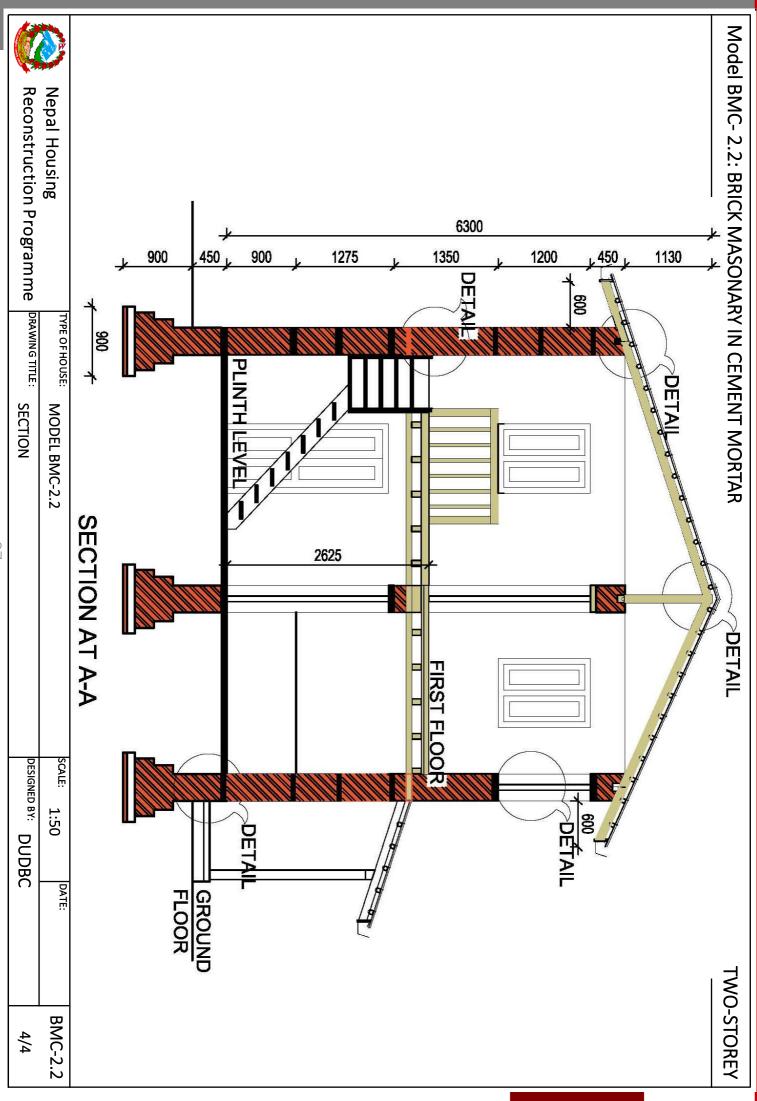
RIGHT SIDE ELEVATION

1:100

DATE:

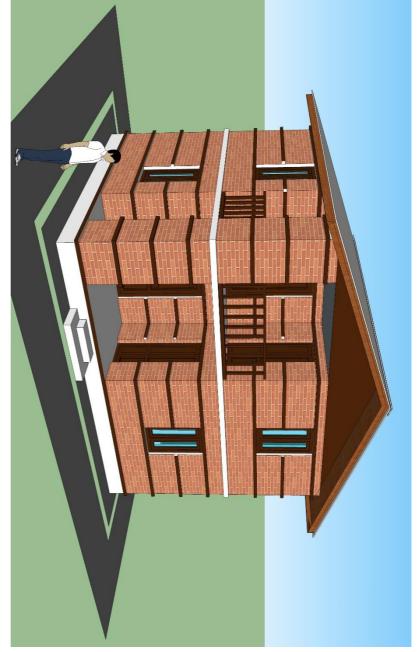


BMC-2.2 3/4



BRICK MASONRY IN CEMENT MORTAR, TWO-STOREY

earthquake resistant construction measures are included. The includes the provision of dimensions of 3100 x 2100 and a living room with dimensions of 3100 x 3100. The model has been based on the revised National Building Code of Nepal (NBC) in order to ensure that dimensions 3100 x 2100 and the other with dimensions 3100x 3100, a covered veranda with 2100 on the ground floor. Similarly, on the first floor it consists of two bedrooms, one with Covering a plinth area of 45.35 Sq. M., the model consists of kitchen with dimensions 3100 X Model BMC-2.3 is a two-storey building constructed of brick masonry using cement mortan horizontal bands, vertical reinforcement, corner reinforcement, and T-junctions 2100, bedroom with dimensions 3100x 3100 and a covered veranda with dimensions 3100x



CONSTRUCTION MATERIALS AND MANPOWER

	MAN F	MAN POWER				<u>MATERIALS</u>				
<u>LEVEL</u>	Skilled	Skilled Unskilled	Brick	CEMENT	SAND	AGGREGATE	WOOD	CGI SHEET	GI SHEET	Rod
	Md	Md	Nos	Bags	Cu.m	Cu.m	Cu.m	Bundel	Rm.	Kg
Up to Plinth Level	59	132	14769	82	14	7	2	0	0	242
SUPERSTRUCTURE	166	127	23537	92	12	0	2	0	0	521
ROOFING	42	14	0	0	0	0	2	4.51	9	0
TOTAL	267	273	273 38306	175	27	7	6	4.51	9	763



Reconstruction Programme PRAWING TITLE: **Nepal Housing**

TYPE OF HOUSE: MODEL BMC-2.3

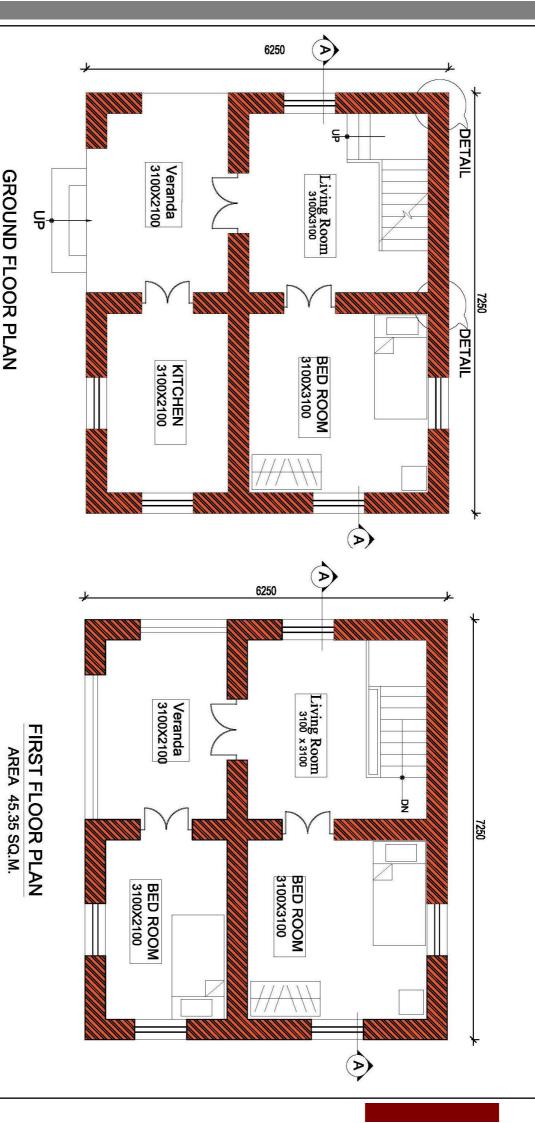
PERSPECTIVE AND ESTIMATION

DESIGNED BY: DUDBC NONE

SCALE:

DATE:

BMC-2.3 1/4



AREA 45.35 SQ.M.

Reconstruction Programme | DRAWING TITLE: PLAN MODEL BMC-2.3

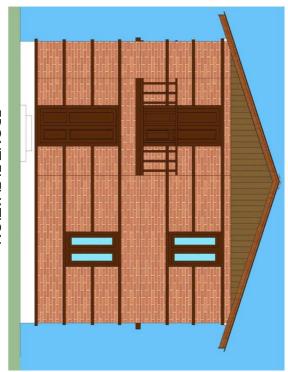
TYPE OF HOUSE:

TOTAL AREA: 90.7sqm

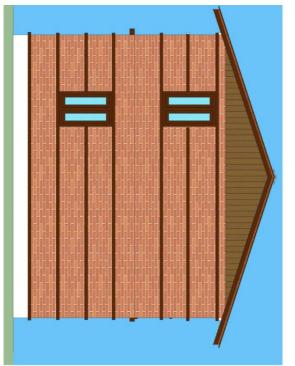
SCALE: DESIGNED BY: DUDBC None DATE:

BMC-2.3

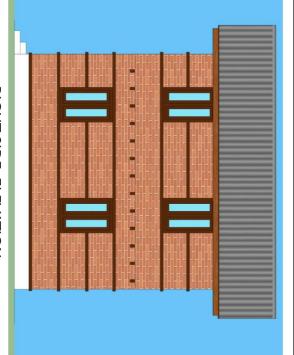
2/4



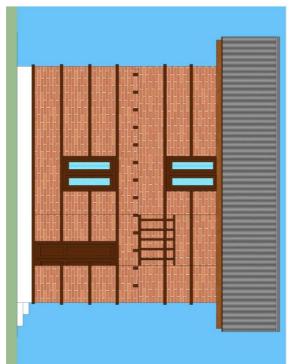
FRONT ELEVATION



LEFT SIDE ELEVATION

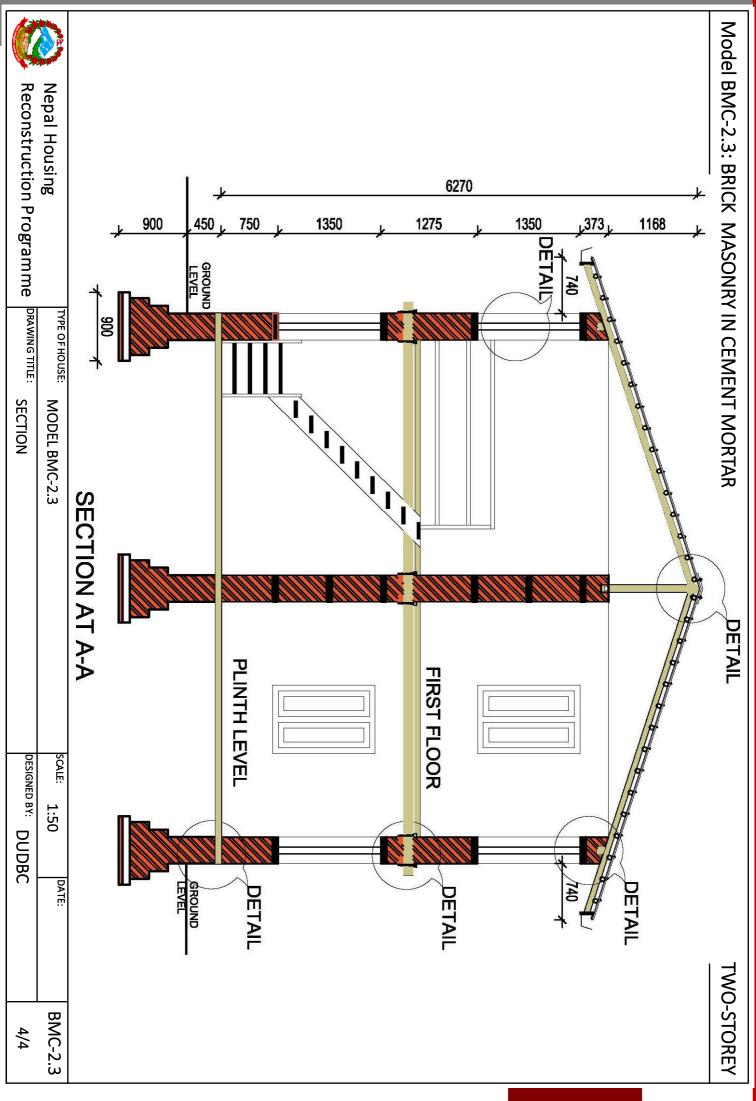


RIGHT SIDE ELEVATION



BACK ELEVATION



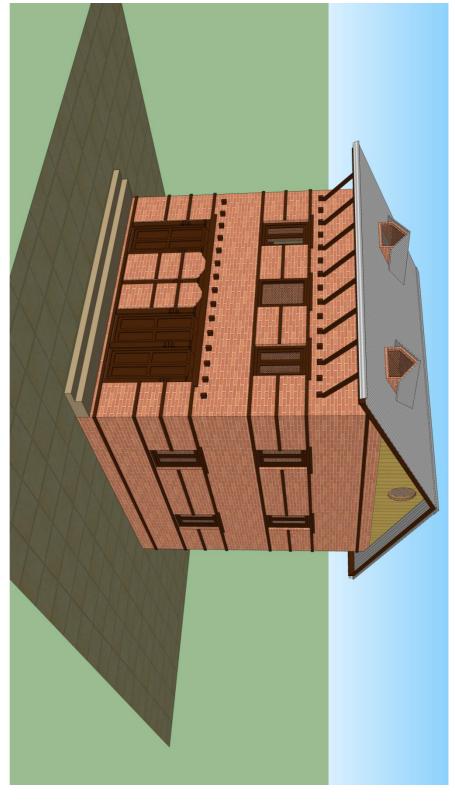


BRICK MASONRY IN CEMENT MORTAR, TWO-STOREY

BMC-2.4

3450 x 3000) and two store rooms (one with dimensions o2700 x 3000 and one with feature of a typical Newari house with a slight variation in its functional characteristics. The dimensions 3450 x 3000) on the ground floor. Similarly, on the first floor it consists of two that earthquake resistant construction measures are included. The includes the provision of model has been based on the revised National Building Code of Nepal (NBC) in order to ensure terrace. The façade has been designed so as to comply with the traditional architectura living room (with dimensions 3450x3000). The attic space includes a kitchen, dining and bedrooms (one with dimensions 2700 x 3000, and one with dimensions 3450x 3000) and a mortar. Covering a plinth area of 50.76 Sq. M., the model consists of a shop (with dimensions Model BMC-2.4 is a two and half storey building constructed of brick masonry with cement horizontal RCC bands and vertical reinforcement

BMC-2.4



CONSTRUCTION MATERIALS AND MANPOWER

	MAN F	MAN POWER				MATERIALS	<u>ALS</u>			
<u>LEVEL</u>	Skilled	Unskilled	Brick	CEMENT	SAND	AGGREGATE	WOOD	CGI SHEET	GI SHEET	Rod
	bМ	Md	Nos	Bags	Cu.m	Cu.m	Cu.m	Bundel	Rm.	Kg
Up to Plinth Level	48	115	14446	77	13	6	0	0	0	271
SUPERSTRUCTURE	319	216	37112	176	21	5	5	0	0	557
ROOFING	41	15	0	0	0	0	2	4.97	32	0
TOTAL	408	345	51559	252	34	11	7	4.97	32	828

Reconstruction Prog	Nepal Housing

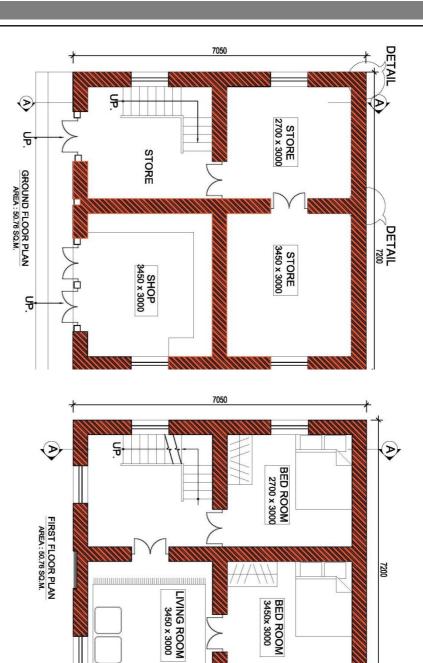
1175 07 110035.	MODEL BMC-2.4	NONE
ogramme PRAWING TITLE:	PERSPECTIVE AND ESTIMATION	DG SA DANSISAD

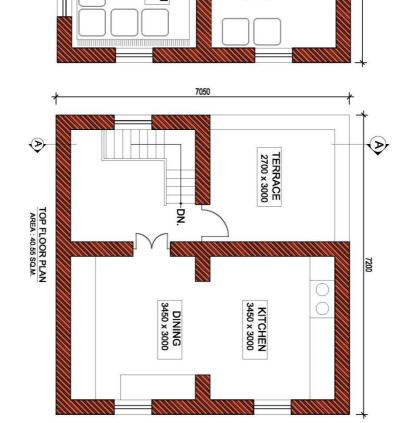
DUDBC

DATE:

BMC-2.4

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Reconstruction Programme	Nepal Housing

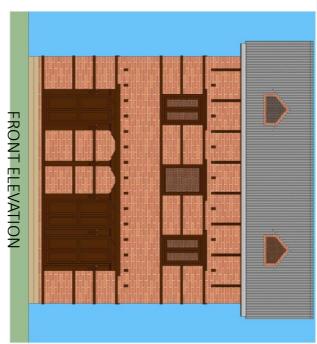
DESIGNED BY: DUDBC	ING TITLE: FLOOR PLAN	DRAWING TI
SCALE: 1:50 DATE:	PFHOUSE: MODEL BMC-2.4	TYPE OF HOUSE:

BMC-2.4

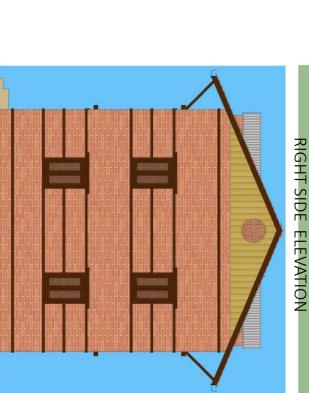
2/4

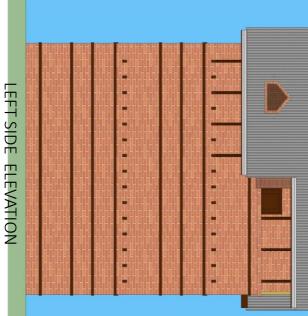
Model BMC-2.4: BRICK MASONRY IN CEMENT MORTAR

TWO-STOREY+ATTIC







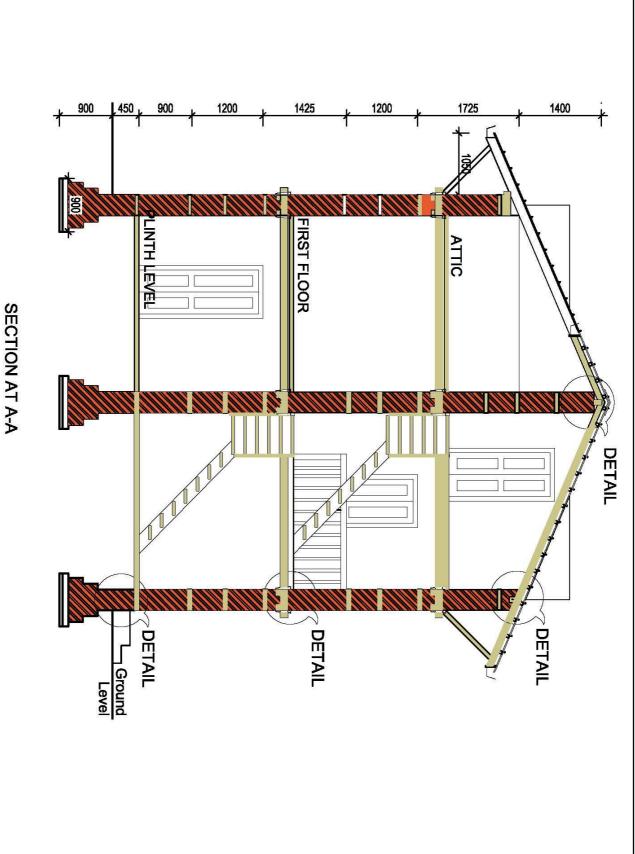




TYPE OF HOUSE: MODEL BMC-2.4

SCALE: 1:100 DESIGNED BY: DUDBC DATE: BMC-2.4 3/4

BACK ELEVATION



TYPE OF HOUSE: SECTION

Nepal Housing

MODEL BMC-2.4

DESIGNED BY: DUDBC None DATE:

SCALE:

BMC-2.4 4/4

BRICK MASONRY IN CEMENT MORTAR, TWO-STOREY

BMC-2.5

construction measures are included. The includes the provision of horizontal RCC bands and on the first floor and a terrace space is include in the roof. The model has been based on the vertical reinforcement dimensions 3000 X 3725, a kitchen with dimensions 3000 x 3075, a bathroom with dimensions brick masonry with cement mortar. On the ground floor, it consists of living room with Model-BMC 2.5 is a typology for row houses design with each unit covering a plinth area of 41 revised National Building Code of Nepal (NBC) in order to ensure that earthquake resistant 1200x 2100 and a store with dimensions 1200 x 1525. Similarly it comprises of two bedrooms 22 Sq. M. This model represents a simple two-storey building with flat roof, constructed in

BMC-2.5



CONSTRUCTION MATERIALS AND MANPOWER

	MAN POWER	<u>OWER</u>				MA-	MATERIALS		
							À		REINFORCEMENT
<u> </u>	SKIIIed	Unskilled	Brick	עטא	CEIVIENT	SAND	AGGKEGATE	WOOD	<u>BAR</u>
	Md	Md	Nos	Cu.m	Bags	Cu.m	Cu.m	Cu.m	KG
Up to Plinth Level	45	109	11012	1136	71	11	5	0	101
Ground FLOOR	127	146	15561	0	116	13	5	0.84	850
FIRST FLOOR	124	141	15156	0	115	13	6	0.81	840
TOTAL	296	396	41730	1136	302	37	16	1.64	1791

Reconstruction Programme	Nepal Housing
DRAWING TITL	TYPE OF HOUS

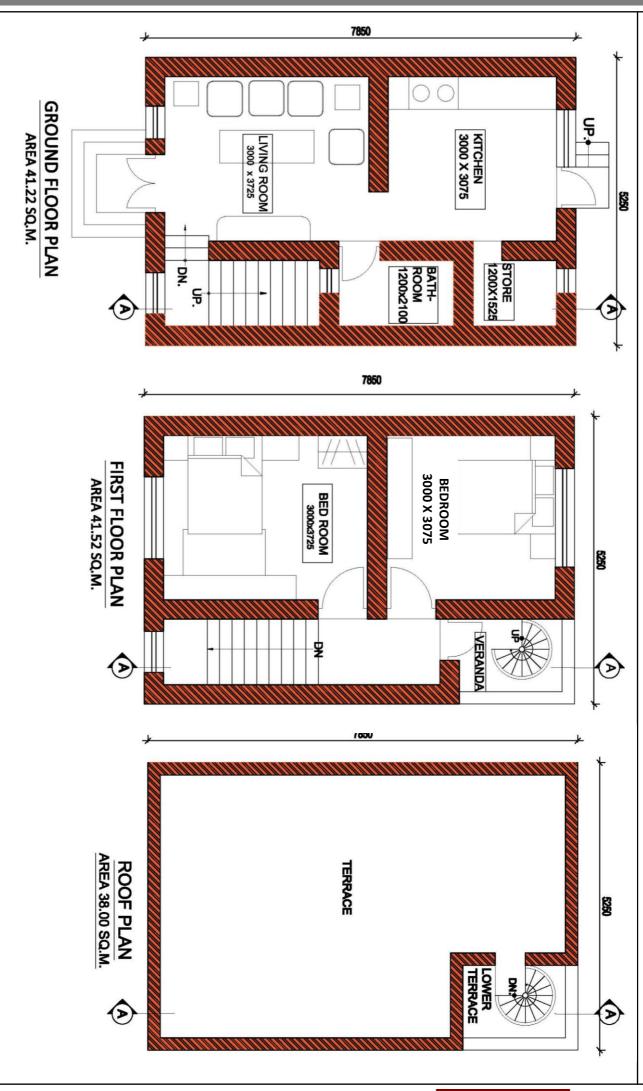
С	DESIGNED BY: DUDBC	PERSPECTIVE AND ESTIMATION	DRAWING TITLE:
DATE:	SCALE: None	MODEL BMC-2.5	TYPE OF HOUSE:

BMC-2.5

1/4

| Model BMC 2.5 BRICK MASONARY IN CEMENT MORTAR

TWO-STOREY+TERRACE



Reconstruction Programme PRAWINGTITE:

PLAN

Nepal Housing

TYPE OF HOUSE:

MODEL BMC-2.5

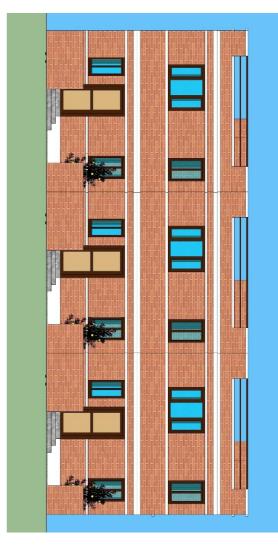
SCALE:

DATE:

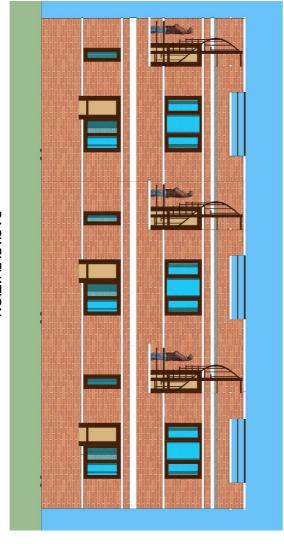
BMC-2.5

2/4

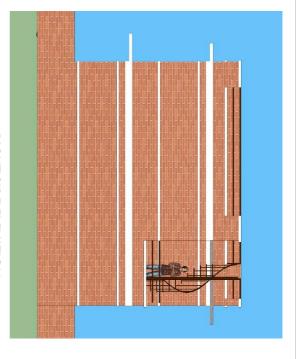
DESIGNED BY: DUDBC



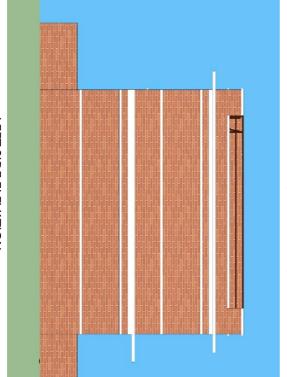
FRONT ELEVATION



BACK ELEVATION



RIGHT SIDE ELEVATION

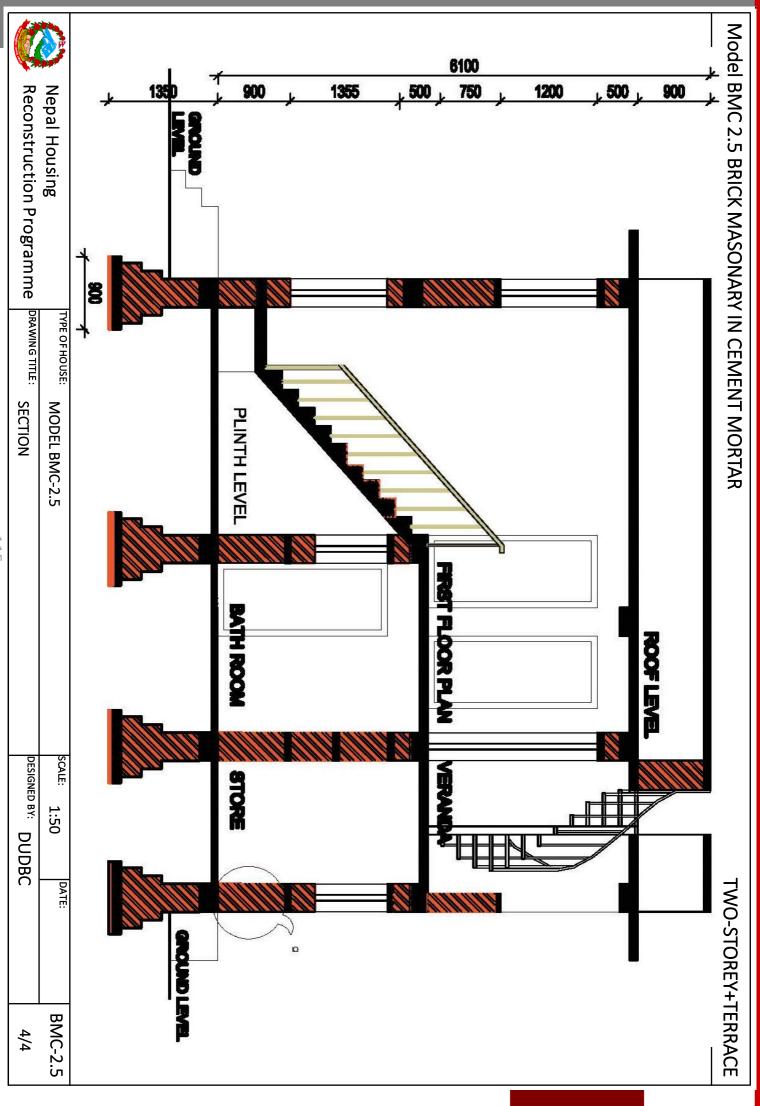


LEFT SIDE ELEVATION

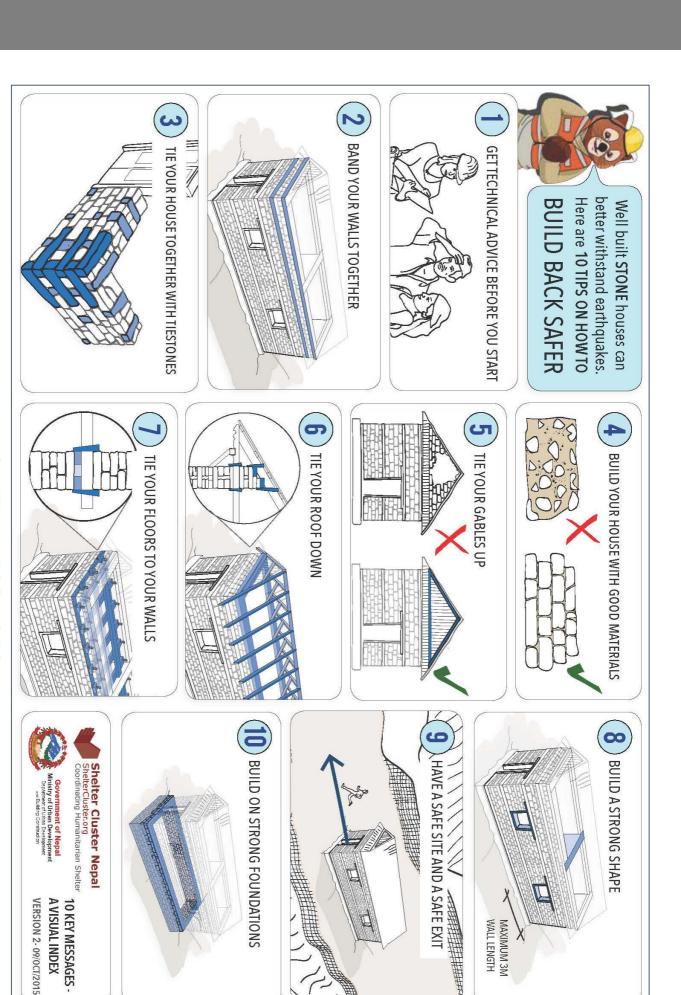
Reconstruction Programme	Nepal Housing

amme	
DRAWING TITLE:	TYPE OF HOUSE:
ELEVATION	MODEL BMC-2.5

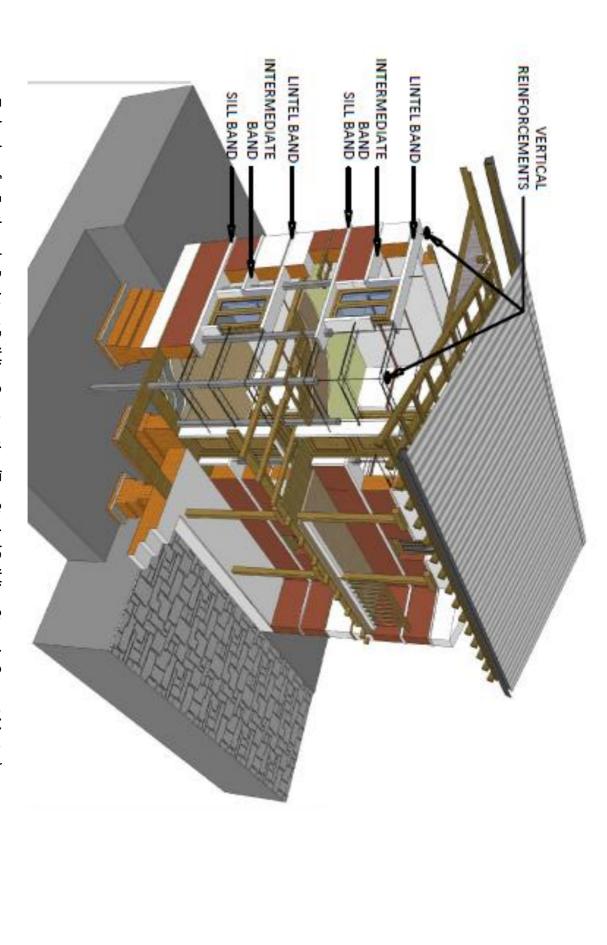
DES	SC
DESIGNED BY: DUDBC	SCALE: None
	DATE:
3/4	BMC-2.5



Technical Details



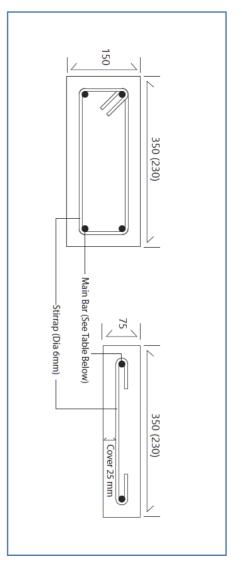
10 KEY MESSAGES



Technology for Earthquake Resistant Building Construction (Two Storied Building, Stone in Cement Mortar)



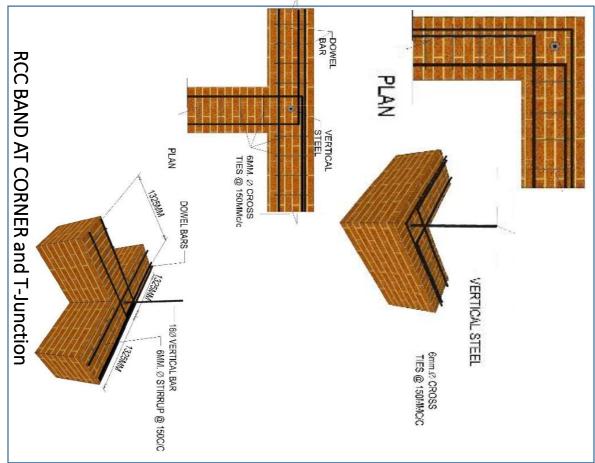
E OF HOUSE:	MODELBMC	SCALE: None	DATE:
WING TITLE:	TECHNICAL DETAIL 1 (SEISMIC ELEMENTS)	DESIGNED BY: DUDBC	



Cross section of RC bands for two bars and four bars

Requirement of bar for RC bands

L CHAILCI	ויכלמון כוווכוור טו ממו וטו ויכ ממוומי		
Band/Beam	RC Band Minimum Thickness	Min. No. Of. Bars	Min. Diameter of Bars (mm)
Plinth	150 mm	4	12
Still	75 mm	2	10
	75mm	2	12
Lintel	150mm	2	10 (top)
		2	12 (bottom)
Roof	75mm	2	12
	300mm	4	12
Dowel (Stitch)	75mm	2	8



*Source: NBC202

Nepal Housing

Reconstruction Programme | DRAWING TITLE:

TYPE OF HOUSE: MODEL SMC

TECHNICAL DETAIL 2 (Reinforcing bar arrangement)

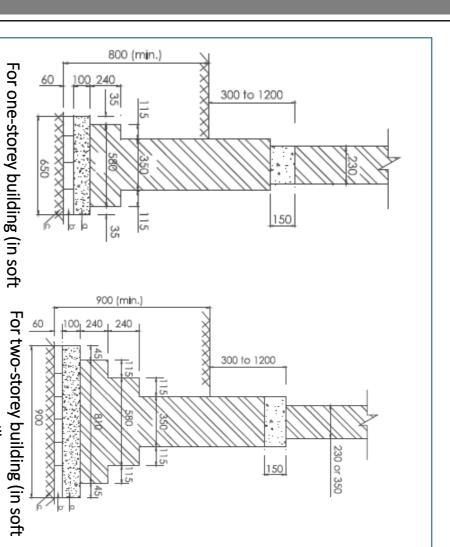
DESIGNED BY:

SCALE:

None

DATE:

SMC



Base width of footing

Masonry Type	No. Of	Minimum base wid	Minimum base width (mm) of wall footing for soil type:	ing for soil type:
	3101 y	Soft	Medium	Hard
Brick	Two	900	650	550
	One	650	550	550
C+opo	Two	*	600	600
Stolle	One	800	600	600

Classification of Foundation Soil and Safe Bearing Capacity

Foundation Soil	Types of Foundation Materials	Presumed Safe Bearing Capacity, KN/m ²
Hard	Rocks in different state of wearthing, boulder bed, gravel, sandy gravel and sand-gravel mixture, dense or loose coarse to medium sand offering high resitance to penetration when excavated by tools;stiff to medium clay which is readily indented with a thumb nail.	>=200
Medium	Find sand and silt (dry lumps easily pulverised by the finger); moist clay and sand-clay mixture which can be indented with strong thumb pressure.	<200 and >=150
Soft	Fine sand, loose and dry; soft clay indented with moderate thumb pressure.	<150 and >=100
Weak	Very soft clay which can be penetrated several centimeters with the thumb, wet clays.	<100

*Source: NBC202

SCALE:

None

DATE:

BMC

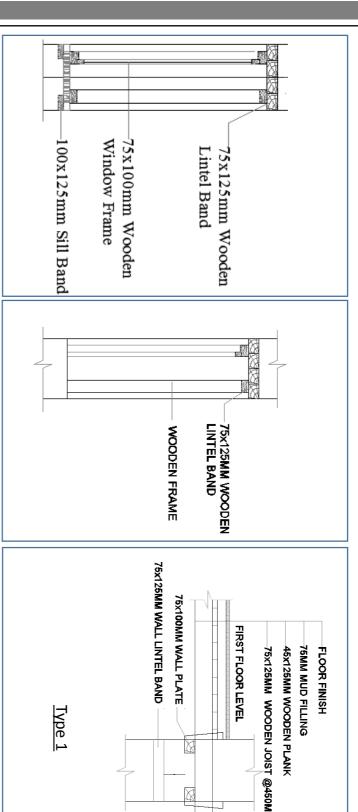
DESIGNED BY:

1	
Reconstruction Program	Nepal Housing

(Brick in cement mortar)

(Brick in cement mortar)

mme	
DRAWING TITLE:	TYPE OF HOUSE:
TECHNICAL DETAIL 3 (Foundation)	MODEL BMC



75x125MM WOODEN JOIST @450MMc/c 100MM R.C.C SLAB FLOOR FINISH Type 2

Window Section

Door Section

First Floor Detail

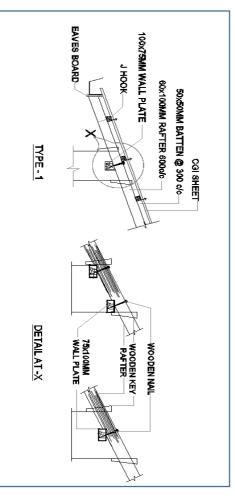
Reconstruction Programme PRAWING TITLE: **Nepal Housing**

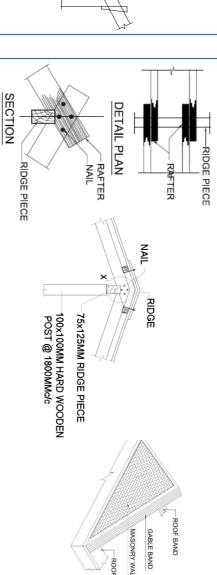
TYPE OF HOUSE: MODEL BMC TECHNICAL DETAIL 4 (Opening and Floor)

SCALE: DESIGNED BY: None DATE: **BMC**

*Source: NBC202







ROOF BAND

Detail of Rafter Joint with Wall Plate

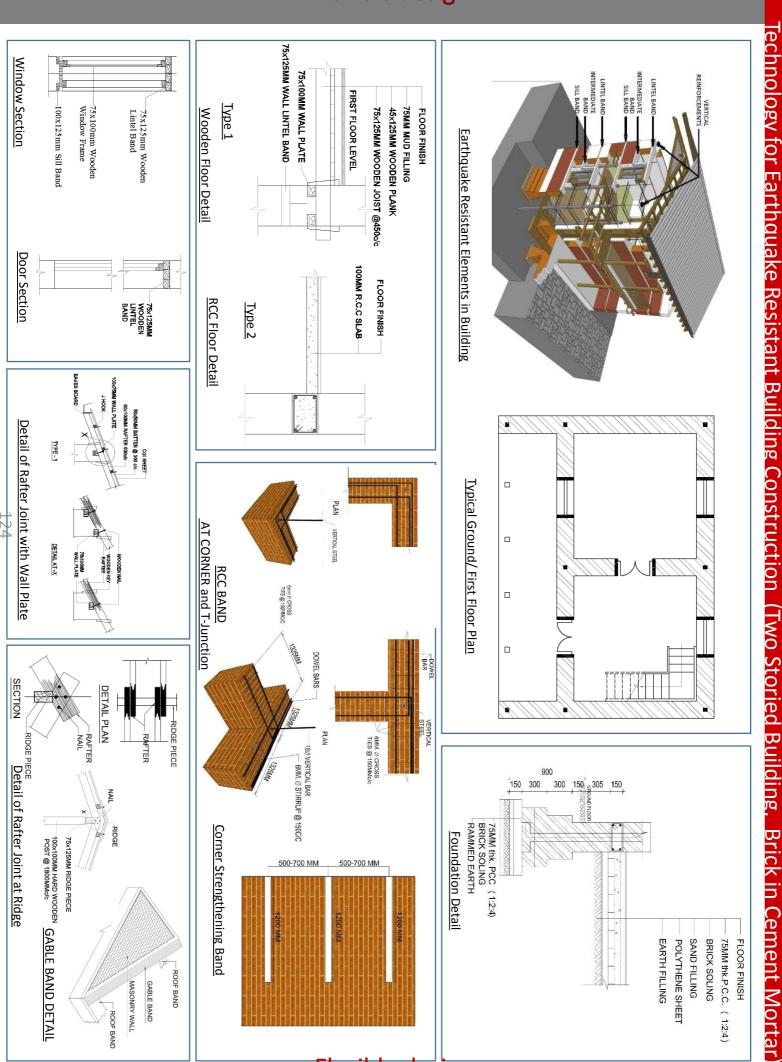
Detail of Rafter Joint at Ridge

DIVIC		DESIGNED BY:	TECHNICAL DETAIL 5 (Roof)	DRAWING TITLE:
	DATE:	SCALE: None	MODELBMC	TYPE OF HOUSE:

Reconstruction Programme PRAWING TO **Nepal Housing**

BRICK MASONRY IN CEMENT MORTAR Top (Plan) View Isometric View Side View Ridge (H240xW180) -Reconstruction Programme | DRAWING TITLE: **Nepal Housing** Past (H90xW90) Ridge Cover CGI Sheet -Fascia (H270xW20) Base (H90xW90) TYPE OF HOUSE: MODEL BMC **TECHNICAL DETAIL 6 (Roofing)** Ridge (H240xW180) CGISheet Purtin (H75xW75) Ridge Cover Purtin (H75xW75) Rafter (H180xW90) CGI Sheet Rafter (H180xW90) Purin (H75xW75) Fildge (H75xW75) -CGI Sheet -SCALE: DESIGNED BY: - Rafter (H180xW90) - Purin (H75xW75) - CG Sheet SCIGM Fascia (H270xW20) - Raffor (H180xW90) None DATE: ready to fix roof cover BMC

Flexible design



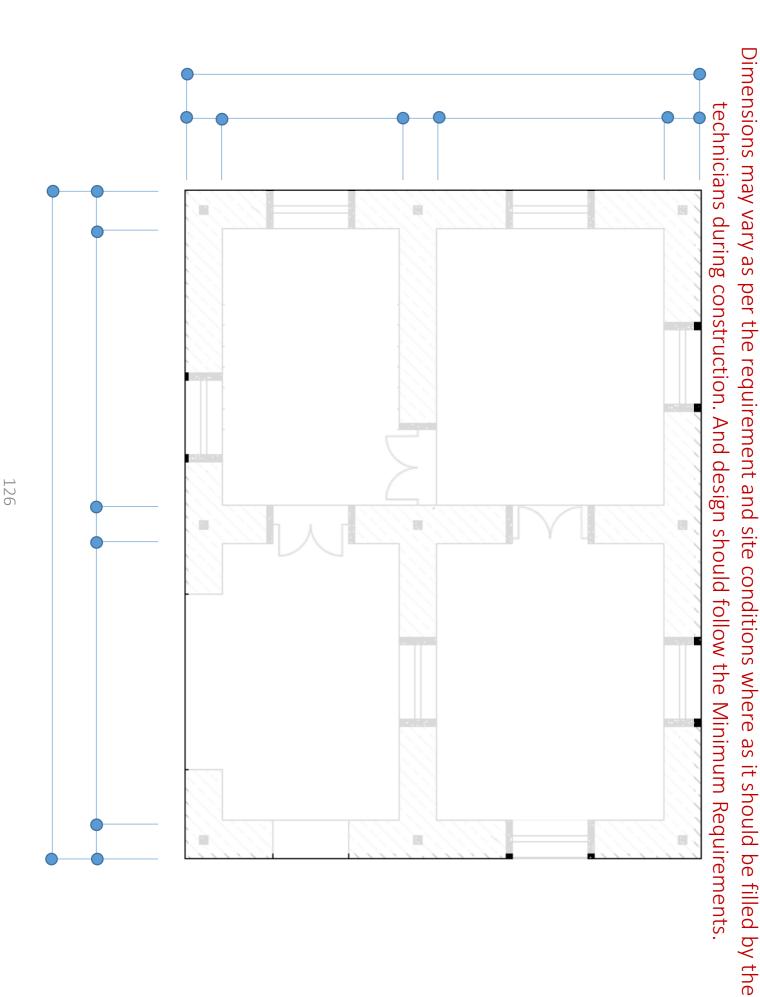
Flexible design

Minimum	Requirements	for F	lexible	e design
				3.33.8.

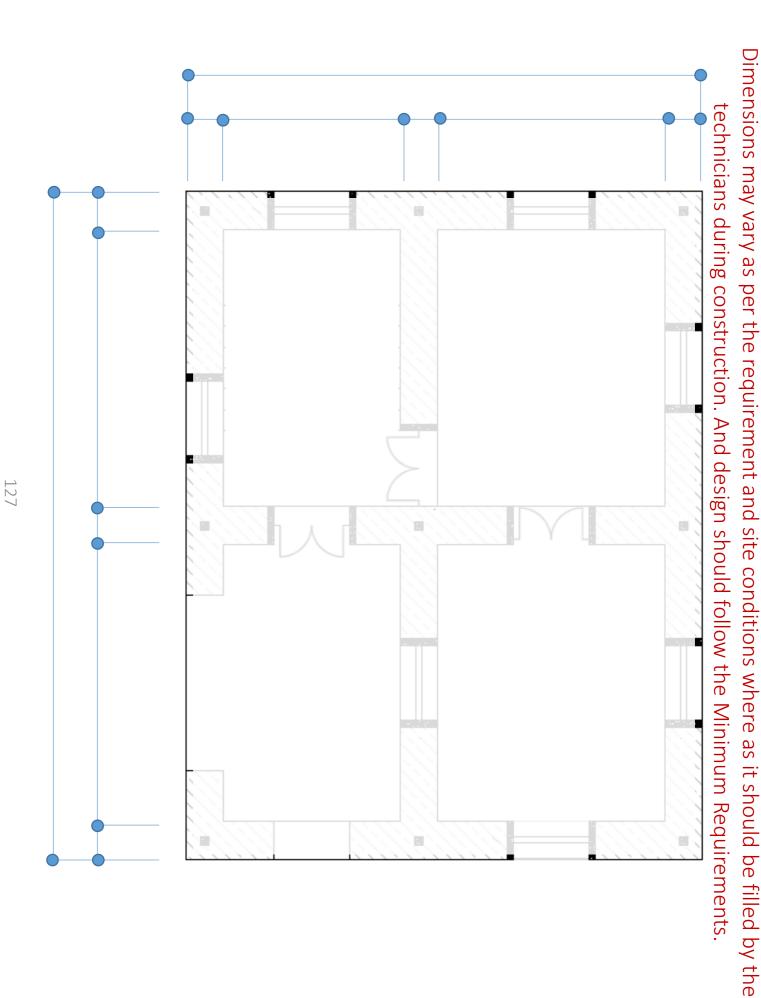
- 5		4																
_						ω				2					_			
Walls		Plinth				Foundation				Shape of House					olle belection	0:100		
General Joints	Reinforcement	Width	Height	General	Width	Depth	General	Proportion	Height of wall	Size of room	Span of wall	No. of story						A building shall
ः र र	۲	5	5	<	5	5	5	5	5	5	۲	5	5	5	۲	<	5	not l
continuous vertical joints. At corners or wall junctions, through vertical joints should be avoided by properly laying the masonry. It should be interlocked. Mortar joints should not be more than 20mm and less than 10mm in thickness. The ratio recommend 1:4 (Cement: Sand). The minimum width of wall is 230mm for one-storey and 350mm for	Main reinforcement should be 4-12 dia. bars. Use 6mm diameter rings at 150mm. Hook length should be 500mm. Bars shall have a clear cover of 25mm concrete.	Minimum thickness of plinth band width should be equal to wall thickness. 230mm for brick masorny.	Minimum height of Plinth band is 150mm.	Provide a reinforced concrete band at plinth level, as shown in detail drawings. The top level of plinth should not be less than 300mm from existing ground level. Recommendation is 450mm.	The width of footing should not be less than 600mm in medium soil condition. As depend on soil condition. Shown in detail drawings.	The depth of footing should not be less than 800mm for one story, 900mm for two storey.	The foundation trench shall be of uniform width. The foundation bed shall be on the same level throughout the foundation in flat area.	The house shall be planned in square, rectangular. Avoid long and narrow structure should not be more than 3 times of its width.	The height of wall should not be more than 3.0 meters	The area of individual floor panel not more than 13.5 square metres	The span of wall shall not more than 4.5 meters	Two storey+ attic, load bearing masonry buildings constructed in cement mortar	River Bank and Water-logged Area	Filled Area	Steep Slope > 20%	Areas Susceptible to Landslide	Geological fault or Raptured Area	A building shall not be constructed if site is:

The total length of openings in a wall is not to exceed half of the length of the wall in single-storey construction. The horizontal distance between two openings is to be not less than because we will be provided through and length of length of place vertical steel bars in the wall at all corners, junctions of walls and adjacent to all doors and windows. They shall be covered with cement concrete in cavities made around them during the masonry houses. Keep lintel level same for doors and windows. They shall be covered with cement concrete in cavities made around them during the masonry houses. It was not the concrete will with minimum thickness of 75 to 150 mm at following locations: A continuous lintel band shall be provided through all walls at the bottom level of opening (specially windows). The minimum height is 75mm. A continuous lintel band shall be provided through all walls at the bottom level of opening. The minimum height is 150mm. A continuous lintel band shall be provided through all walls at the top level of opening sylunctions of walls. The minimum height is 55mm. A continuous lintel band shall be provided where dowel-bars are required at all corners, junctions of walls. The minimum height is 75mm. Main reinforcement should be 4 or 2-12 dia. bars. Use 6 mm diameter rings at 150mm. Hook length should be 500mm. Bars shall have a clear cover of 25mm concrete. Use light roof comprising wooden or steel truss covered with CGI sheets and walls are required at all as shown in detail drawings. Well seasoned hard wood without knots should be used for roofing, timber treatment such as use of coaltar or any other preservative can prevent timber from being decayed and attacked by insects Well seasoned hard wood without should not be leaner than 1.1.1.5.3 (1 part cement and and 3 parts aggregate)					
Total length Distance Lintel level Lintel level Hori mini Sill band Lintel band Lintel band Lintel band Connection Co	crete mix for seismic bands should not be leaner than 1:1.5:3 (: nent, 1.5 parts sand and 3 parts aggregate)			Materials	10
Total length Distance United level Coation Reinforcement Still band Unitel band Unitel band Connection Connection Cross-tie Cross-tie Composition Cross-tie Connection Cross-tie Cross-tie Connection Cross-tie	sand mortar should not be leaner than 1:4 (1 part cement and and 1:6 for plaster				
Total length Distance Lintel level Location Reinforcement Sill band Lintel band Lintel band Cross-tie Connection Cross-tie	soned hard wood without knots should be used for roofing, reatment such as use of coal tar or any other preservative can timber from being decayed and attacked by insects				
Total length Distance Lintel level Lintel level Location Reinforcement Sill band Sill band V Stitch V Reinforcement Connection V	should be properly cross-tied with wooden braces as shown in awings.			Roof	9
Total length Distance Unitel level Location Reinforcement Sill band Siltch Stitch Reinforcement Freinforcement Cuther Sill band	bers of the timber truss or joints should be properly connected n in detail drawings.				
Total length Distance Lintel level Location Reinforcement Sill band Uintel band Sitich Stitch Reinforcement	t roof comprising wooden or steel truss covered with CGI sheet	L			
Total length Distance Uintel level Location Reinforcement Mori mini Sill band V Stitch Stitch	inforcement should be 4 or 2-12 dia. bars. Use 6mm diameter 150mm. Hook length should be 500mm. Bars shall have a clear 25mm concrete.				
Total length Distance Uintel level Cocation Reinforcement Horri mini Sill band V Stitch	nd shall be provided at the top-level of walls, so as to integrate operly at their ends and fix them into the walls. The minimum 75mm.				
Total length Distance Lintel level Reinforcement Hori mini Sill band	id shall be provided where dowel-bars are required at all junctions of walls. The minimum height is 75mm.			Horizontal Band	∞
Total length Distance Lintel level Cation Reinforcement Hori mini Sill band	uous lintel band shall be provided through all walls at the top pening. The minimum height is 150mm.				
Total length Distance Lintel level Location Reinforcement Hori	uous sill band shall be provided through all walls at the bottom pening (specially windows). The minimum height is 75mm.	<u>!</u>			
Distance Lintel level Cartion	ands should be provided throughout the entire wall with ickness of 75 to 150 mm at following locations:	Horizontal I ninimum t			
Total length Distance Lintel level Location	ical reinforcing bar for masonry is given in detail drawings. dia is minimum requirements for masonry houses.				
Total length Distance Lintel level	rtical steel bars in the wall at all corners, Junctions of walls and to all doors and windows. They shall be covered with cement in cavities made around them during the masonry	1		Vertical Reinforcement	7
Total length	tel level same for doors and windows.	1			
Total length	izontal distance between two openings is to be not less than				
	Il length of openings in a wall is not to exceed half of the length all in single-storey construction.			Openings	6
Openings are to be located away from inside corners by a clear distance should not be less than 600 mm.	gs are to be located away from inside corners by a clear distanc not be less than 600 mm.		_		

Base drawing for Flexible design



Base drawing for Flexible design



STONE MASONRY IN MUD MORTAR (SMM)



STONE MASONRY IN MUD MORTAR (SMM)

requirements within the parameters as set out in the National Building Code of Nepal 203 category of the catalogue. A flexible design is also included which can be adapted as per the households' masonry construction using cement mortar. Designs for both one-storey houses are included in this This section of the Design Catalogue for Reconstruction of Earthquake Resistant houses refers to stone

the 'Minimum Requirements' at the beginning of this section. material required in the construction of the house designs included under this category can be found in The house designs are based on the use of reinforced concrete bands. The technical specifications for the

referred to when constructing any of the designs presented under this category. The key technical details related to this category are included at the end of this section and should be

Minimum Requirements (MRs)

Minimum Requirements (MRs) for Stone Masonry in Mud Mortar (NBC203) Page1 No. Category A building shall not be constructed if site is: ✓ Prone to geological fault or raptured area Susceptible to landslide Site Selection 1 ✓ Steep slope > 20% Filled area River bank and water-logged area No. of storeys Two storey+ attic 2 The house shall be planned square, rectangular. House should not Shape of House Proportion 1 more than 3 times its width. The foundation trench shall be of uniform width. The foundation bed General V shall be on the same level throughout the foundation in flat area. Depth ✓ The depth of footing should be at least 750mm. Foundation 3 The width of footing should not be less than 750mm and 800mm Width ✓ respectively for one and two-storeyed houses in medium soil condition. Width depends on soil type. Refer to technical drawings. The top level of plinth should be at least 300mm above existing 4 Plinth General 1 ground level. Recommended plinth height from the ground is 450mm. Masonry should be laid staggered to avoid formation of continuous vertical joint. At corners or wall junctions, continuous vertical joints General should be avoided by properly laying large stones. The walls should be interlocked. Mortar joints should not be more than 20mm and less than 10mm in Joints thickness. Spacing of through stone shall not be more than 1200mm in the horizontal direction and 600mm in the vertical direction. Seasoned Though Stone timber, precast or cast insitu concrete can be used instead of through 5 Walls stone. Maximum length of unsupported wall shall not exceed 12 times its Length of wall thickness. If unsupported length of wall is more than this, buttress shall be provided at an interval not exceeding 12 times wall thickness. The wall thickness should not be less than 350-450mm, 450mm Wall thickness respectively for one and two-storey houses. The height of wall between floors should not be more than 8 times Height of wall wall thickness.

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Ξ,

	Minimum Requ	uirements (MRs) fo	or St	tone Masonry in Mud Mortar (NBC2O3) Page2				
No.	Category							
		Location	~	Openings are to be located away from inside corners by 1/4 of the height of the adjoining opening, but not less than 600 mm.				
6	Openings	Total length of openings	′	Total length of opening should be less than 0.3 and 0.25 of individual wall length respectively for one and two-storey house.				
		Distance between opening	~	Distance between two openings shall be larger of half the height of shorter opening or 600mm.				
		Lintel level	1	Keep lintel level same for doors and windows				
	Place vertical steel bars in the wall at all corners, wall ju adjacent to all doors and windows. They shall be cover concrete in cavities made around them.							
7	Reinforcement	Reinforcement	′	At corners and junctions vertical reinforcing bar should be 12mm for one storey, and 16 mm in the ground floor and 12mm in the upper storey in case of two storey house. At jambs, the reinforcing bars should be 12mm.				
		General	•	Horizontal reinforced concrete bands should be provided throughout the entire wall with minimum thickness of 75 to 150 mm at following locations. Minimum width of bands should be equal to the wall thickness. Where reinforcing bars have been used, these shall have a clear cover of 25mm. Where reinforced concrete is not available, timber bands and stitches could be used.				
		Plinth band	•	A continuous plinth band shall be provided through all walls at the plinth level. The minimum height is 75mm with 2-12 reinforcing bars for hard soil. In case of soft soil, band should be 150mm high with 4-12 reinforcement. Use 6mm dia. stirrups at 150mm centres.				
	Horizontal Band	Sill band	V	A continuous sill band shall be provided through all walls at the bottom level of opening (specially windows). The minimum height is 75mm with 2-10 reinforcing bars. Use 6mm diameter stirrups at 150mm centres.				
8		Lintel band	•	A continuous lintel band shall be provided through all walls at the top level of opening. The minimum height is 75mm with 2-12mm bars. Use 6mm stirrups at 150mm centres. Extra thickening should be provided where openings are more than 1m wide.				
		Roof band	′	Roof band shall be provided at the top of walls, so as to tie the walls at their top and tie the roof to the walls. The minimum height is 75mm with 2-12mm diameter bars. Use 6mm dia. Stirrups at 150mm centres.				
		Gable band	•	Masonry gable wall must have the triangular portion of masonry enclosed in a reinforced concrete band. The minimum height of band is 75mm with 2-12mm bars. Use 6mm dia. Stirrups at 150mm centres. It is recommended to replace gable masonry wall with lightweight materials such as metal sheet or timber.				
		Stitch	′	The stitches shall be provided at all corners, junctions of walls to strengthen connections. The min. height is 75mm with 2-8mm bars. Use 6mm dia. Stirrups at 150mm centres.				

Minimum Requirements for Stone Masonry in Mud Mortar (NBC203)

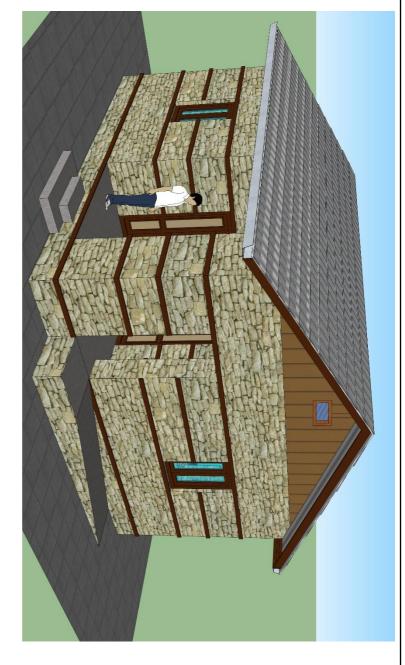
	Minimum Requ	irements (MRs) fo	or St	tone Masonry in Mud Mortar (NBC203) Page3
No.	Category			
				Use light roof comprising of wooden or steel structure covered with
		Light roof	✓	light roofing materials. Heavy roofing materials such as stone slabs or
				mud should be avoided.
9	Roof	Connection	,	All members of the timber truss or joints should be properly
		Connection	٧	connected as shown in technical details.
		Cross tip	J	Trusses should be properly cross-tied with wooden braces as shown in
		Cross-tie •	٧	technical details.
		Timber		Well seasoned hard wood / local wood without knots should be used
				for structural purpose. Timber treatment such as use of coal tar or any
			V	other preservative can prevent timber from being decayed and
				attacked by insects.
		Mortar	1	Mud should be free from organic material and pebbles, etc.
10	Materials			Brick should be class A1 or A2 with compressive strength not less than
				3.5N/sqmm.
		Concrete	v	The concrete mix for seismic bands should not be leaner than 1:2:4 (1
		Concrete	•	part cement, 2 parts sand and 4 parts aggregate)
		Reinforcement	V	High Strength Deformed Bars – Fe415 or Fe500 respectively with fy =
		remiorcement	•	415 N/sqmm or 550N/sqmm could be used for reinforcements.

STONE MASONRY IN MUD MORTAR, TWO-STOREY

SMM-1.1

covered verandah of dimensions 3000x2100. An attic space is also included. The design effectiveness. Climatic conditions and social and cultural aspects have also been factored into vertical reinforcements, corner reinforcement and T-junctions to improve the diaphragm on the revised National Building Code of Nepal (NBC) in order to ensure that earthquake used for covering the roof along with wooden rafters and purlins. The model has been based 3000x3000, a kitchen of dimensions 3000x2100, a living room of dimensions 3000x3000 and a towards resilient models to improve safety in future earthquakes. the design of the house, The design concept and the objective of the design is to contribute resistant construction measures are included. The includes the provision of horizontal bands Similarly, stone masonry in mud mortar has been used for structural type, where CGI sheet is focuses on earthquake resistant construction using locally available construction materials Model SMM-1.1 is a single storey building which consists of a bedroom of dimensions

SMM-1.1



CONSTRUCTION MATERIALS AND MANPOWER

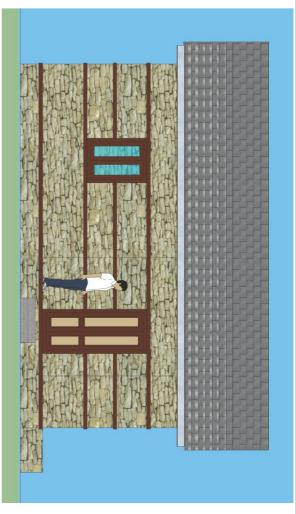
	MAN POWER	<u>OWER</u>			MATERIALS	
LEVEL	<u>Skilled</u>	<u>Unskilled</u>	<u>Stone</u>	MUD	WOOD	SLATE
	Md	Мд	Cu.m	Cu.m	Cu.m	Sq.m
Up to Plinth Level	52	92	28	30	1.54	0
Ground floor	119	65	27	10	3.78	0
Roofing work	68	40	0	0	2.34	161
TOTAL	TOTAL 238	197	56	41	7.66	161

Nepal Housing Reconstruction Program	

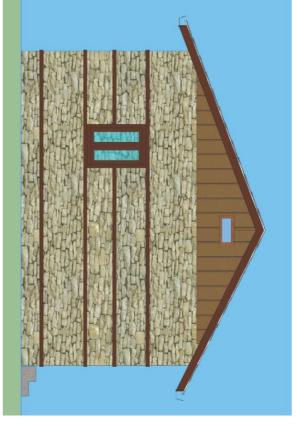
DESIGNED BY: DUDBC	PERSPECTIVE AND ESTIMATION	mme DRAWING TITLE:	nme
NONE	MODELSMM-1.1	TIPE OF HOOSE.	

SMM-1.1

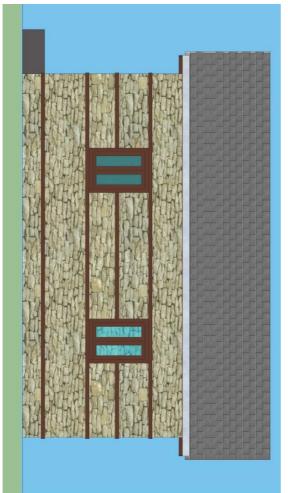
1/4



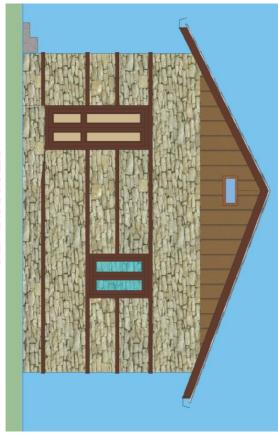
FRONT ELEVATION



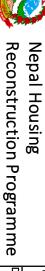
RIGHT SIDE ELEVATION



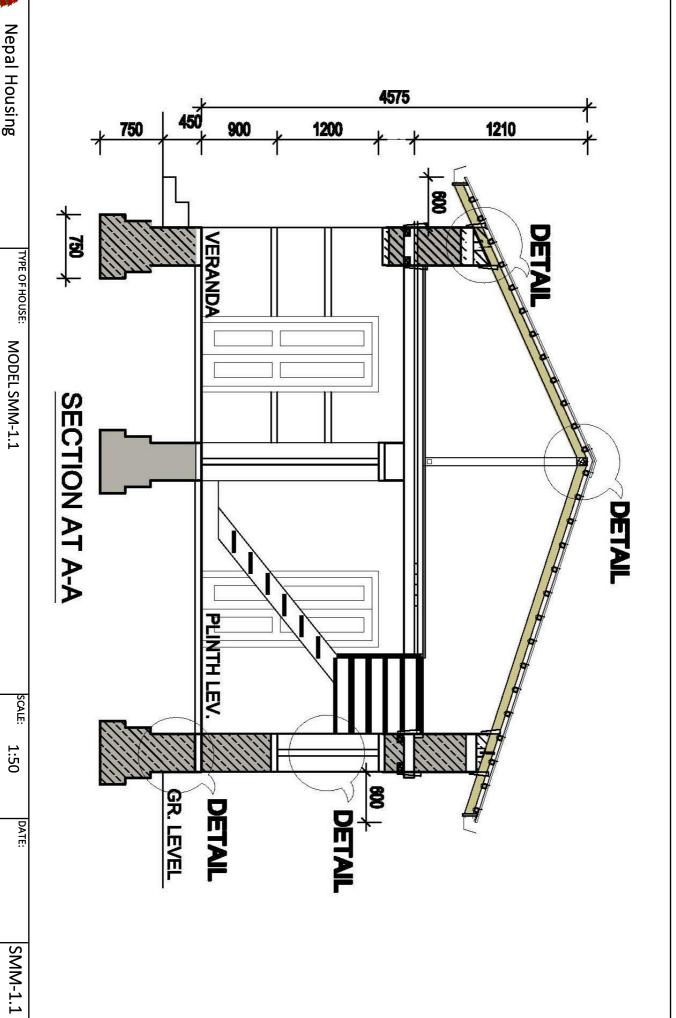
BACK ELEVATION



LEFT SIDE ELEVATION



3/4	(C) -	DESIGNED BY: DUDBC	ELAVATION	DRAWING TITLE:	amme
SMM-1.1	DATE:	SCALE: None	MODELSMM-1.1	TYPE OF HOUSE:	



Reconstruction Programme | DRAWING TITLE:

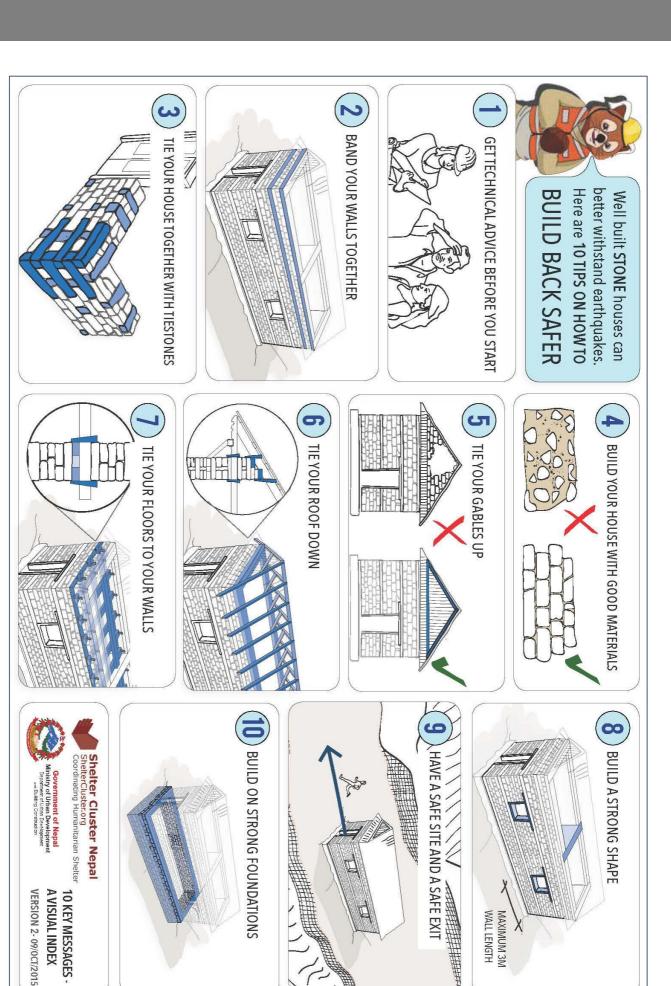
SECTION

DESIGNED BY: DUDBC

4/4

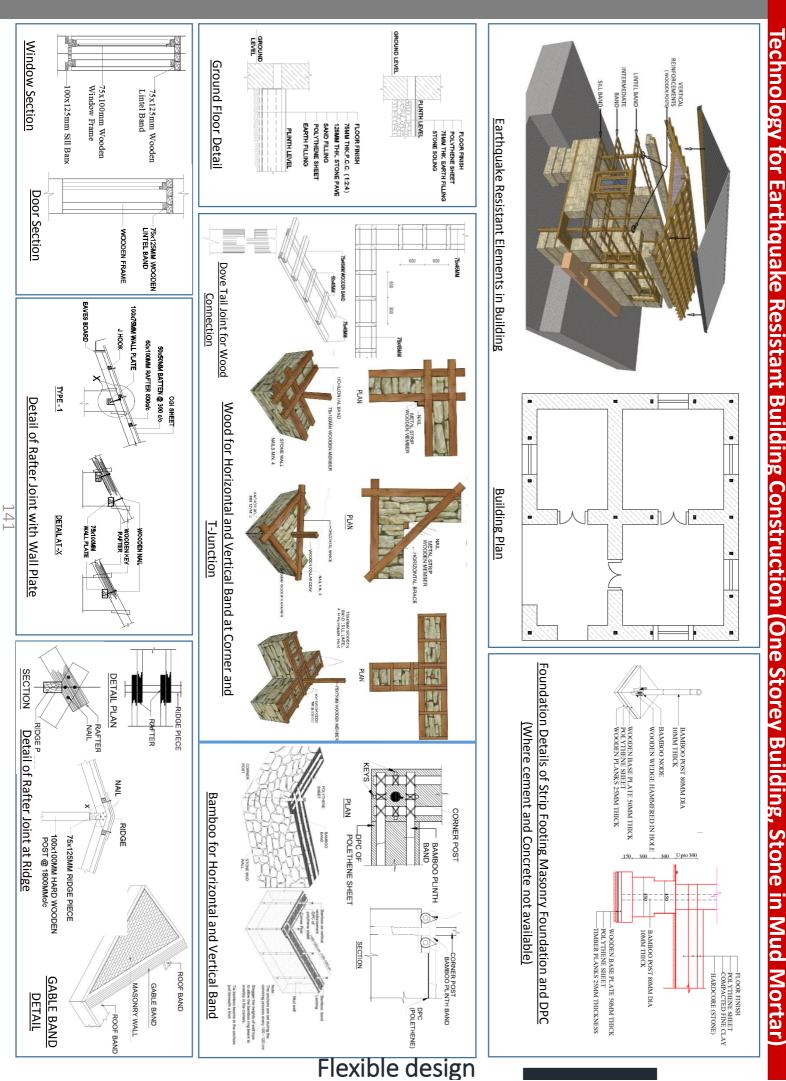
STONE MASONRY IN MUD MORTAR (SMM)

Technical Details

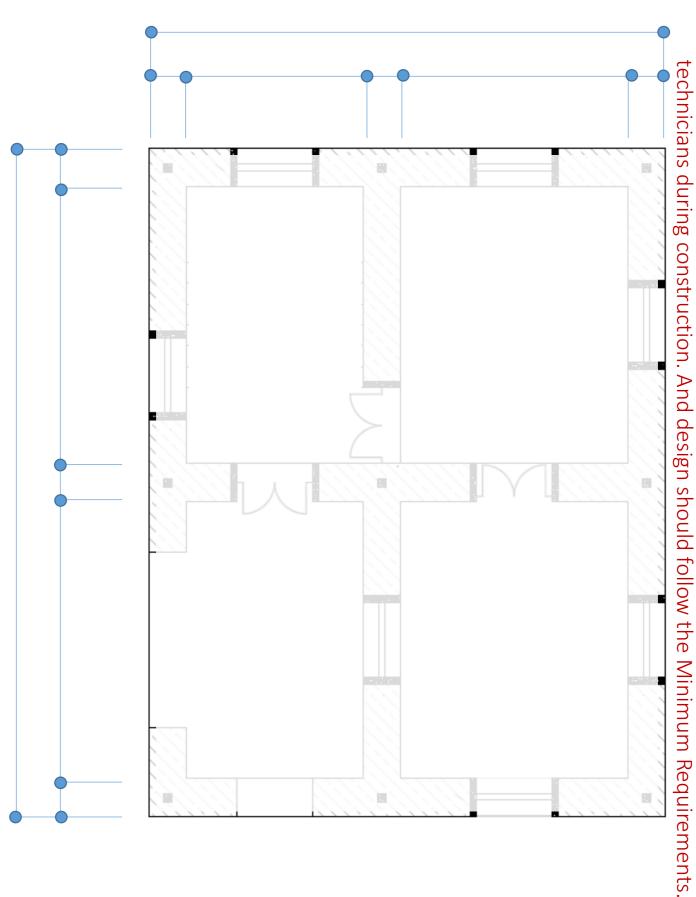


10 KEY MESSAGES

Flexible design



Base drawing for Flexible design



142

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in	in	nur	n I	Rec	σ	rer	ne	nts fo	4	ex.	ib	ω		les	Sig	2				1 Site S			
o con	Height of wall	Wall thickness	ı	Length of wall	Walls	Though Stone	Joints	General	Plinth General		Width	Foundation	Depth	General		Shape of House Proportion	No. of storeys			Site Selection	<u></u>		
WAAAU CIICAIICOO.	The height of w	ς	,	ς	J	Spacing of throws horizontal directions and the second sec	Mortar joints sh thickness.	Masonry shoul vertical joint. At should be avoic interlocked.	The top level of ground level. Re		respectively for	The width of for	The depth of fo	shall be on the		The house shall	ς.	River bank and water-logged		- 1		Prone to geolog	A building shall not
	The height of wall between floors should not be more than 8 times wall thickness	The wall thickness should not be less than 350-450mm, 450mm respectively for one and two-storey houses.	shall be provided at an interval not exceeding 12 times wall thickness	Maximum length of unsupported wall shall not exceed 12 times its thickness. If unsupported length of wall is more than this, buttress	timber, precast or cast insitu concrete can be used instead of through stone.	Spacing of through stone shall not be more than 1200mm in the horizontal direction and 600mm in the vertical direction. Seasoned	Mortar joints should not be more than 20mm and less than 10mm in thickness.	Masonry should be laid staggered to avoid formation of continuous vertical joint. At corners or wall junctions, continuous vertical joints should be avoided by properly laying large stones. The walls should be interlocked.	The top level of plinth should be at least 300mm above existing ground level. Recommended plinth height from the ground is 450mm.	Contained a service achemical on your special per never to economical analysis	respectively for one and two-storeyed houses in medium soil	The width of footing should not be less than 750mm and 800mm	The depth of footing should be at least 750mm.	shall be on the same level throughout the foundation in flat area.	more than 3 times its width. The foundation trench shall be of uniform width. The foundation bed	The house shall be planned square, rectangular. House should not	ic	water-logged area		0%	andslide	Prone to geological fault or raptured area	A building shall not be constructed if site is:
			, y					be	. 3				7	3)			
			Horizontal Band										Reinforcement	Vertical					Openings				
		Lintel band		מוני	S. I		Plinth band		General			Reinforcement			OCCUPATION OF THE PROPERTY OF	Lintel level	opening	Distance between	CO CO	Total length of		LOCATION	+
their top and tie the		Use 6mm stirrups a	A continuous lintel	75 mm with 2-10 re 150mm centres.	A continuous sill bar bottom level of ope	12 reinforcement.	plinth level. The min	clear cover of 25 mn timber bands and s	the entire wall with locations. Minimun	Horizontal reinforce	should be 12mm.	one storey, and 16 storey in case of two	At corners and junc	1	Place vertical steel b	✓ Keep lintel level sam	shorter opening or	Distance between to	Wall length respecti	lotal length of oper	T-+-	height of the adjoin	Openings are to be

IRs) to	Rs) for Stone Masonry in Mud Mortar (NBC203) Page 1)	equirements (MRs) fo	or St	Minimum Requirements (MRs) for Stone Masonry in Mud Mortar (NBC203) Page2
	A building shall not be constructed if site is:	No. Category			Openings are to be located away from inside corners by 1/4 of the
	✓ Prone to geological fault or raptured area		Location	5	height of the adjoining opening, but not less than 600 mm.
	Steep slope > 20%		Total length of	<	Total length of opening should be less than 0.3 and 0.25 of individual
		6 Openings	openings		wall length respectively for one and two-storey house.
			Distance between		Distance between two openings shall be larger of half the height of
	✓ Two storey+ attic		opening	7	shorter opening or 600mm.
			Lintel level	5	Keep lintel level same for doors and windows
amoomoon.	more than 3 times its width.				Place vertical steel bars in the wall at all corners, wall junctions and
	The foundation trench shall be of uniform width. The foundation bed		Location	5	adjacent to all doors and windows. They shall be covered with cement
	shall be on the same level throughout the foundation in flat area.	Vertical			concrete in cavities made around them.
	✓ The depth of footing should be at least 750mm.	7 Reinforcement	+		At corners and junctions vertical reinforcing bar should be 12mm for
	The width of footing should not be less than 750mm and 800mm		Reinforcement	<	one storey, and 16 mm in the ground floor and 12mm in the upper
	respectively for one and two-storeyed houses in medium soil				storey in case of two storey nouse. At Jamps, the reinforcing bars
	condition. Width depends on soil type. Refer to technical drawings.				should be 12hilli.
	The ten level of plinth should be at least 200mm above existing				Horizontal reinforced concrete bands should be provided throughout
	ground level. Recommended plinth height from the ground is 450mm.		General	ζ	locations. Minimum width of bands should be equal to the wall
	Masonry should be laid staggered to avoid formation of continuous				thickness. Where reinforcing bars have been used, these shall have a
	vertical joint. At corners or wall junctions, continuous vertical joints				timber bands and stitches could be used.
	interlocked.				
	Mortar joints should not be more than 20mm and less than 10mm in thickness.		Plinth band	<	A continuous pinnin band shall be provided through all walls at the plinth level. The minimum height is 75mm with 2-12 reinforcing bars
	Spacing of through stone shall not be more than 1200mm in the horizontal direction and 600mm in the vertical direction. Seasoned				tor nard soil. In case of soft soil, band should be 150mm high with 4-12 reinforcement. Use 6mm dia. stirrups at 150mm centres.
	timber, precast or cast insitu concrete can be used instead of through				A continuous sill band shall be provided through all walls at the
	stone. Maximum length of unsupported wall shall not exceed 12 times its		Sill band	<	bottom level of opening (specially windows). The minimum height 75mm with 2-10 reinforcing bars. Use 6mm diameter stirrups at
	thickness. If unsupported length of wall is more than this, buttress shall be provided at an interval not exceeding 12 times wall thickness.	8 Horizontal Band	ā.		A continuous lintel band shall be provided through all walls at the top
	The wall thickness should not be less than 350-450mm, 450mm respectively for one and two-storey houses.		Lintel band	ς	level of opening. The minimum height is 75mm with 2-12mm bars. Use 6mm stirrups at 150mm centres. Extra thickening should be
	The height of wall between floors should not be more than 8 times wall thickness.				provided where openings are more than 1m wide. Roof hand shall he provided at the top of walls so as to tie the walls at
			Roof band	ς	their top and tie the roof to the walls. The minimum height is 75mm with 2-12mm diameter bars. Use 6mm dia. Stirrups at 150mm centres.
			G D D D D D D D D D D D D D D D D D	ς	Masonry gable wall must have the triangular portion of masonry enclosed in a reinforced concrete band. The minimum height of band is 75mm with 3-12mm hars. Use 6mm dia Stirruns at 150mm
					centres. It is recommended to replace gable masonry wall with lightweight materials such as metal sheet or timber.
			Stitch	ς	The stitches shall be provided at all corners, junctions of walls to strengthen connections. The min. height is 75mm with 2-8mm bars Use 6mm dia. Stirrups at 150mm centres.

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Minimum Requirements for Flexible design

No.	Category			
				Use light roof comprising of wooden or steel structure covered with
		Light roof	<	\checkmark light roofing materials. Heavy roofing materials such as stone slabs or
				mud should be avoided.
9	Roof	Opposition		All members of the timber truss or joints should be properly
		Colliection	<	connected as shown in technical details.
		++	`	Trusses should be properly cross-tied with wooden braces as shown in
		CIOSS-LIE	<	technical details.
				Well seasoned hard wood / local wood without knots should be used
		T.	`	for structural purpose. Timber treatment such as use of coal tar or any
		Ö	•	other preservative can prevent timber from being decayed and
				attacked by insects.
		Mortar	<	Mud should be free from organic material and pebbles, etc.
10	Materials	B		Brick should be class A1 or A2 with compressive strength not less than
		2		3.5N/sqmm.
			`	The concrete mix for seismic bands should not be leaner than 1:2:4 (1
		COLICIENT	<	part cement, 2 parts sand and 4 parts aggregate)
		Reinforcement		High Strength Deformed Bars – Fe415 or Fe500 respectively with fy =
		Kelliotecillette	•	415 N/sqmm or 550N/sqmm could be used for reinforcements.

Minimum Requirements (MRs) for Stone Masonry in Mud Mortar (NBC203)

BRICK MASONRY IN MUD MORTAR (BMM)



BRICK MASONRY IN MUD MORTAR (BMM)

requirements within the parameters as set out in the National Building Code of Nepal 203 category of the catalogue. A flexible design is also included which can be adapted as per the households' masonry construction using cement mortar. Designs for both one-storey houses are included in this This section of the Design Catalogue for Reconstruction of Earthquake Resistant houses refers to brick

the 'Minimum Requirements' at the beginning of this section. material required in the construction of the house designs included under this category can be found in The house designs are based on the use of reinforced concrete bands. The technical specifications for the

referred to when constructing any of the designs presented under this category. The key technical details related to this category are included at the end of this section and should be

Minimum Requirements (MRs)

Mi	nimum Require	ements (MRs) fo	r Bri	ck Masonry house in Mud Mortar (NBC203) Page1
No.	Category			
		00000000	A ho	ouse shall not be constructed if site is:
			1	Prone to geological fault or raptured area
1	C:+- C- +:		1	Susceptible to landslide
1	Site Selection		1	Steep slope > 20%
			1	Filled area
		000000000000000000000000000000000000000	1	River bank and water-logged area
	Shape of	No. of story	1	Two storey +attic
2	'	D		The house shall be planned square, rectangular. Avoid long and
	House	Proportion	1	narrow house. The house should not be more than 3 times its
				The foundation trench shall be of uniform width. The foundation bed
		General	1	shall be on the same level throughout the foundation in flat area.
	Farm dation	Depth	1	The depth of footing should be at least 750mm.
3	Foundation			The width of footing should not be less than 650mm and 750mm
		Width	1	respectively for one and two-storey houses in medium soil
				condition. Width depends on soil type. Refer to technical drawings.
				The top level of plinth should be at least 300mm above existing
4	Plinth	General	1	ground level. Recommended plinth height from the ground is
				450mm.
				Masonry should be laid staggered to avoid formation of continuous
				vertical joint. At corners or wall junctions, continuous vertical joints
		General	1	should be avoided by properly laying the masonry. The walls should
				be interlocked.
				Mortar joints should not be more than 20mm and less than 10mm
		Joints	1	in thickness.
_) A / - I I -			Maximum length of unsupported wall shall not exceed 12 times its
5	Walls			thickness. If unsupported length of wall is more than this, buttress
		Length of wall		shall be provided at an interval not exceeding 12 times wall
				thickness.
) A /		The thickness of the wall should not be less than 230mm, 350mm
		Wall thickness	~	respectively for one-storey and two-storey plus attic house.
				The height of wall between floors should not be more than 12 times
		Height of wall	1	wall thickness.
		Location		Openings are to be located away from inside corners by 1/4 of the
		Location	~	height of the adjoining opening, but not less than 600 mm.
		Total longth	V	Total length of opening should be less than 0.3 and 0.25 of
6	Openings	Total length	V	individual wall length respectively for one and two-storey house.
		Distance between	V	Distance between two openings shall be larger of half the height of
		openings	V	shorter opening or 600mm.
		Lintel level	1	Keep lintel level same for doors and windows

	Minimum Requ	uirements (MRs) for	Brick Masonry in Mud Mortar (NBC203) Page2
No.	Category			
	Vertical	Location	'	Place vertical steel bars in the wall at all corners, wall junctions and adjacent to all doors and windows. They shall be covered with cement concrete in cavities made around them.
7	Reinforcemen t	Reinforcement	v	At corners and junctions vertical reinforcing bar should be 12mm for one storey, and 16 mm in the ground floor and 12mm in the upper storey in case of two storey house. At jambs, the reinforcing bars should be 12mm.
		General	v	Horizontal reinforced concrete bands should be provided throughout the entire wall with minimum thickness of 75 to 150 mm at following locations. Minimum width of bands should be equal to the wall thickness. Where reinforcing bars have been used, these shall have a clear cover of 25mm concrete. Where reinforced concrete is not available, timber bands and stitches could be used.
		Plinth band	•	A continuous plinth band shall be provided through all walls at the plinth level. The minimum height is 75mm with 2-12 reinforcing bars for hard soil. In case of soft soil, band should be 150mm high with 4-12 reinforcement. Use 6mm dia. stirrups at 150mm centers.
		Sill band	V	A continuous sill band shall be provided through all walls at the bottom level of opening (specially windows). The minimum height is 75mm with 2-10 reinforcing bars. Use 6mm diameter stirrups at 150mm centres.
8	Horizontal Band	Lintel band	V	A continuous lintel band shall be provided through all walls at the top level of opening. The minimum height is 75mm with 2-12mm bars. Use 6mm stirrups at 150mm centres. Extra thickening should be provided where openings are more than 1m wide.
		Roof band	V	Roof band shall be provided at the top of walls, so as to tie the walls at their top and fix the roof to the walls. The minimum height is 75mm with 2-12mm diameter bars. Use 6mm dia. Stirrups at 150mm centres.
		Gable band		Masonry gable wall must have the triangular portion of masonry enclosed in a reinforced concrete band. The minimum height of band is 75mm with 2-12mm bars. Use 6mm dia. Stirrups at 150mm centres. It is recommended to replace gable masonry wall with light-weight materials such as metal sheet or timber.
		Stitch	V	The stitches shall be provided at all corners, junctions of walls to strengthen connections. The min. height is 75mm with 2-8mm bars. Use 6mm dia. Stirrups at 150mm centres.

Minimum Requirements for Brick Masonry in Mud Mortar (NBC203)

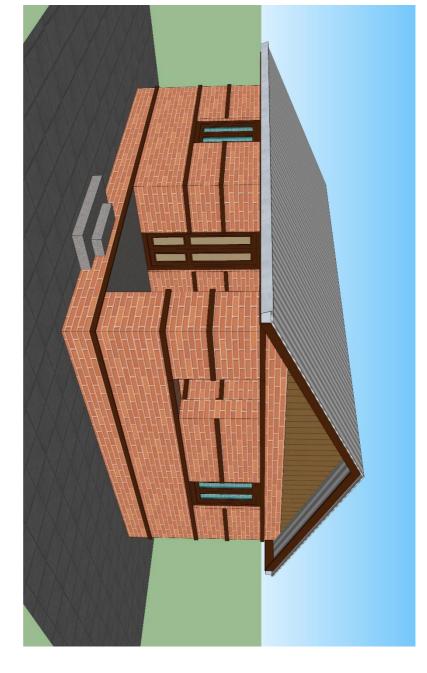
	Minimum Requ	uirements (MRs)	for	Brick Masonry in Mud Mortar (NBC203) Page3
No.	Category			
		Light roof	/	Use light roof comprising of wooden or steel structure covered with light roofing materials. Heavy roofing materials such as stone slabs or mud should be avoided.
9	Roof	Connection	~	All members of the timber truss or joints should be properly connected as shown in technical details.
		Cross-tie	~	Trusses should be properly cross-tied with wooden braces as shown in technical details.
		Timber	•	Well seasoned hard wood / local wood without knots should be used for strctural purpose. Timber treatment such as use of coal tar or any other preservative can prevent timber from being decayed and attacked by insects.
		Mortar	/	Mud should be free from organic material and pebbles, etc.
10	Materials	Brick		Brick should be class A1 or A2 with compressive strength not less than 3.5N/sqmm.
		Concrete	•	The concrete mix for seismic bands should not be leaner than 1:2:4 (1 part cement, 2 parts sand and 4 parts aggregate)
		Reinforcement	~	High Strength Deformed Bars – Fe415 or Fe500 respectively with fy = 415 N/sqmm or 550N/sqmm could be used for reinforcements.

BRICK MASONRY IN MUD MORTAR, ONE-STOREY

BMM-1.1

effectiveness. Climatic conditions and social and cultural aspects have also been factored into vertical reinforcements, corner reinforcements and T-junctions to improve diaphragm on the revised National Building Code of Nepal (NBC) in order to ensure that earthquake covered verandah of dimensions 3000x2100. An attic space is also included. The design 3000x300, a kitchen of dimensions 3000x2100, a living room of dimensions 3000x 3000 and a towards resilient models to improve safety in future earthquakes. the design of the house, The design concept and the objective of the design is to contribute resistant construction measures are included. The includes the provision of horizontal bands Similarly brick masonry in mud mortar has been used for the structure type, where CGI sheet Model BMM-1.1 is a single storey house which consists of a bedroom of dimensions is used for covering the roof along with wooden rafters and purlins. The model has been based focuses on earthquake resistant construction using locally available construction materials

BMM-1.1

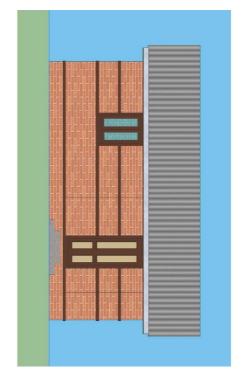


CONSTRUCTION MATERIAL AND MANPOWER

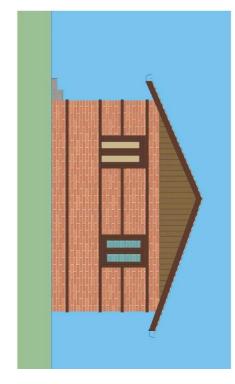
	MAN POWER	<u>OWER</u>		I ∨	<u>MATERIALS</u>		
<u>LEVEL</u>	Skilled	Unskilled	Brick	Mud	WOOD	CGI SHEET	GI SHEET
	Md	Md	Nos	Cu.m.	Cu.m.	Bundel	Rm
Up to Plinth Level	38	57	9876	25	1.11	0	0
Ground Floor	66	46	13642	10	1.14	0	0
ROOFING	35	13	0	0	1.62	4	10
TOTAL	139	115	23518	35	3.87	4	10

	N. W.	
Reconstruction Programme	Nepal Housing	
amme 🏻		
RAWING TITLE :	YPE OF HOUSE:	

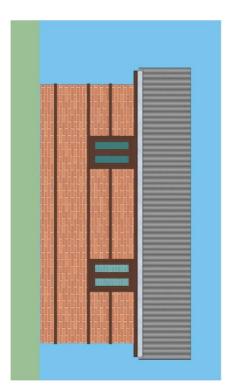
1/4	,	DESIGNED BY: DUDBC	PERSPECTIVE AND ESTIMATION	RAWING TITLE:
BMM-1.1	DATE:	SCALE: NONE	MODEL BMM-1.1	YPE OF HOUSE:



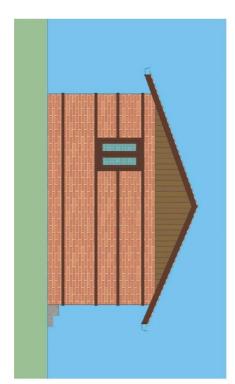
FRONT ELEVATION



RIGHT SIDE ELEVATION



BACK ELEVATION



LEFT SIDE ELEVATION



Reconstruction Programme PRAWING TITLE: **Nepal Housing**

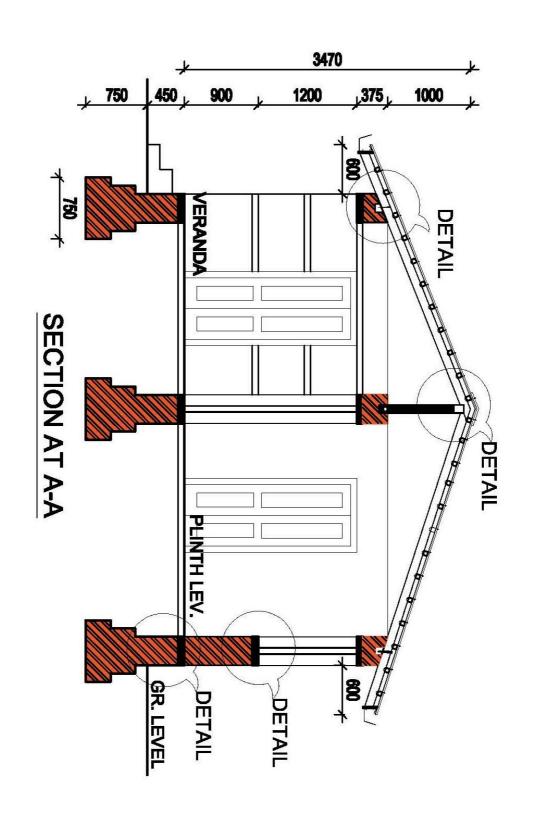
TYPE OF HOUSE: **ELAVATION**

MODEL BMM-1.1

SCALE:

DESIGNED BY: DUDBC 1:100 DATE:

BMM-1.1 3/4





SECTION MODEL BMM-1.1 DESIGNED BY: DUDBC SCALE:

1:50

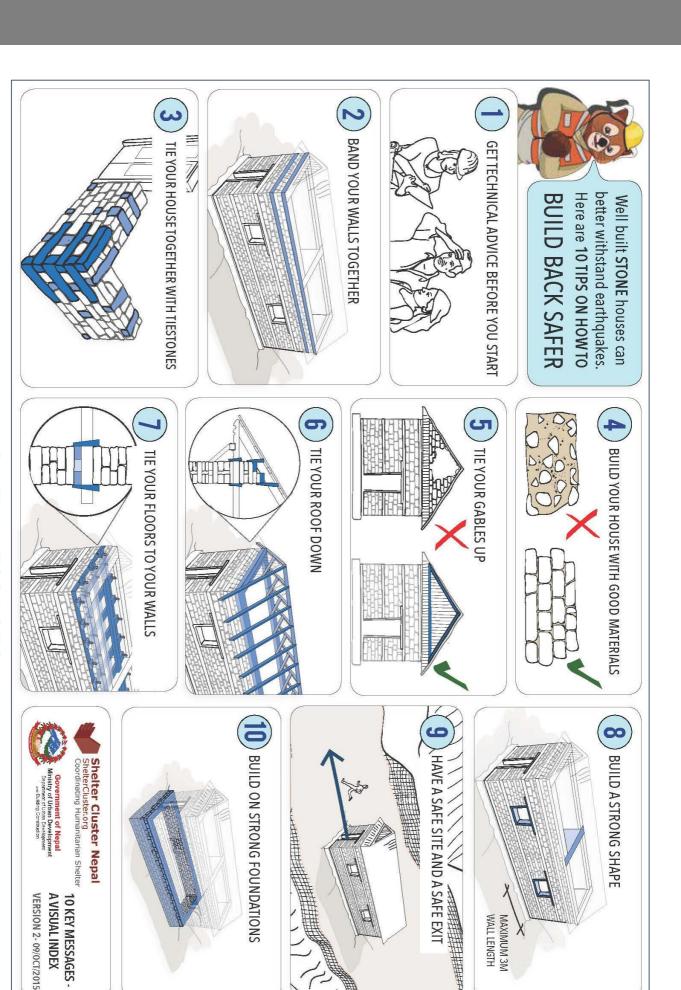
DATE:

BMM-1.1

4/4

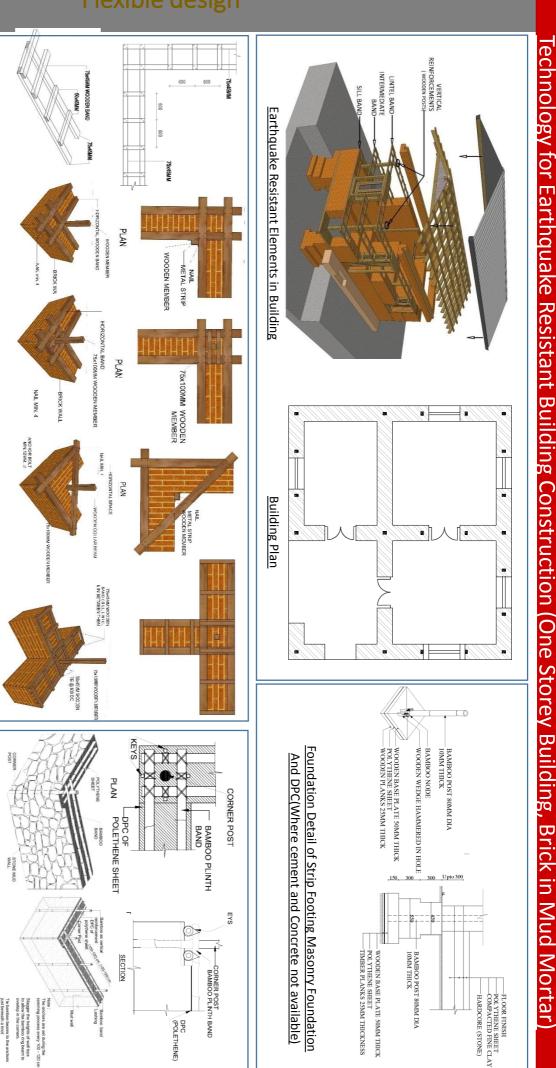
BRICK MASONRY IN MUD MORTAR (BMM)

Technical Details



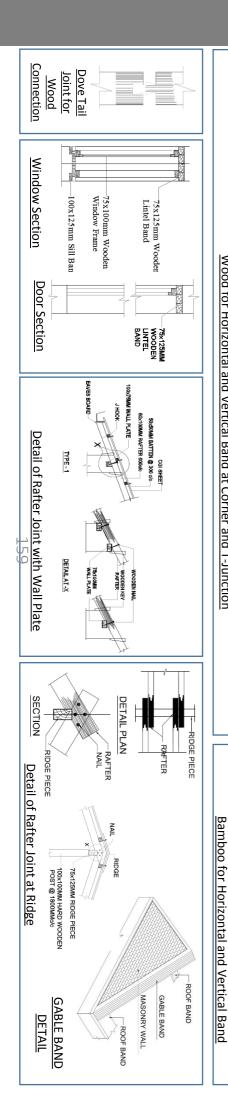
10 KEY MESSAGES

Flexible design



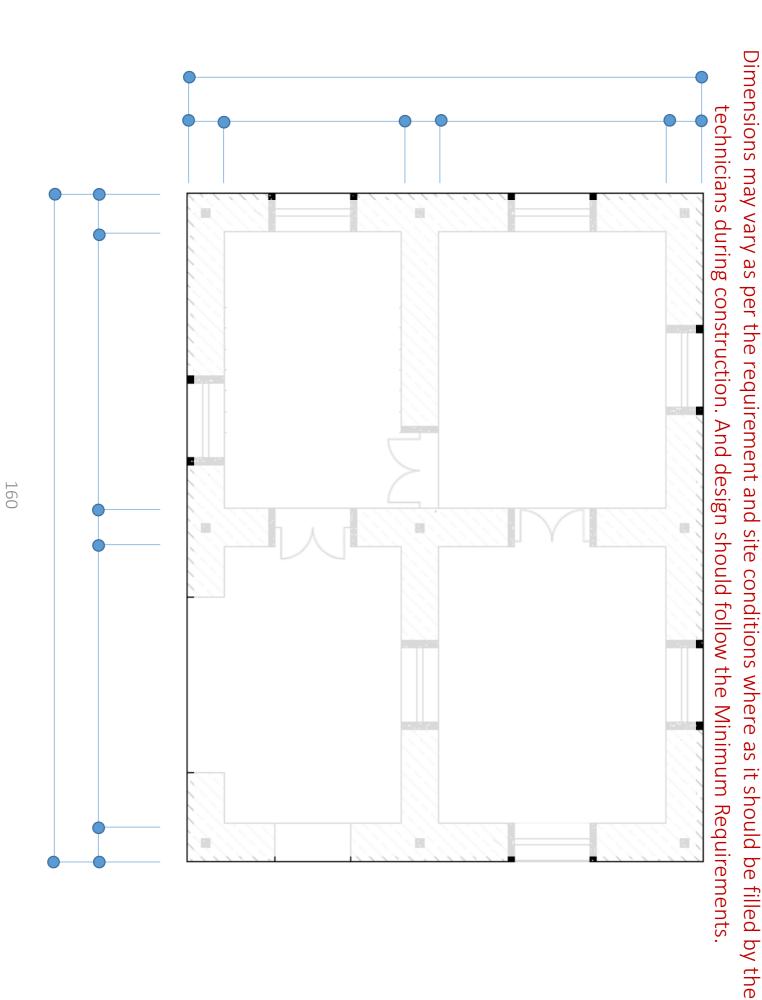
design

Flexible



Wood for Horizontal and Vertical Band at Corner and T-Junction

Base drawing for Flexible design



Minimum Requirements for Flexible design

No. Category A house shall not be constructed if site is: Prone to geological fault or raptured area

2203) Page1	No.	Minimum Requestion	Requirements (MRs)	for	for Brick Masonry in Mud Mortar (NBC203) Page2 Place vertical steel bars in the wall at all corners, wall junctions and
	7 F	Vertical Reinforcemen t	Location	<i>S S</i>	At corners and junctions vertical reinforcing bars storey, and 16 mm in the ground floor and 27 mm for one storey, and 16 mm in the ground floor and 12mm in the upper storey in case of two storey house. At jambs, the reinforcing bars should be 12mm.
ngular. Avoid long and more than 3 times its width. The foundation bed foundation in flat area. Omm. an 650mm and 750mm			General	,	Horizontal reinforced concrete bands should be provided throughout the entire wall with minimum thickness of 75 to 150 mm at following locations. Minimum width of bands should be equal to the wall thickness. Where reinforcing bars have been used, these shall have a clear cover of 25mm concrete. Where reinforced concrete is not available, timber bands and stitches could be used.
es in medium soil efer to technical drawings. OOmm above existing t from the ground is			Plinth band	,	A continuous plinth band shall be provided through all walls at the plinth level. The minimum height is 75mm with 2-12 reinforcing bars for hard soil. In case of soft soil, band should be 150mm high with 4-12 reinforcement. Use 6mm dia. stirrups at 150mm centers.
d formation of continuous continuous vertical joints masonry. The walls should			Sill band	'	A continuous sill band shall be provided through all walls at the bottom level of opening (specially windows). The minimum height is 75mm with 2-10 reinforcing bars. Use 6mm diameter stirrups at 150mm centres.
Ill not exceed 12 times its	00	Horizontal Band	Lintel band	,	A continuous lintel band shall be provided through all walls at the top level of opening. The minimum height is 75mm with 2-12mm bars. Use 6mm stirrups at 150mm centres. Extra thickening should be provided where openings are more than 1m wide.
s more than this, buttress ling 12 times wall stranged than 230mm, 350mm			Roof band	7	Roof band shall be provided at the top of walls, so as to tie the walls at their top and fix the roof to the walls. The minimum height is 75mm with 2-12mm diameter bars. Use 6mm dia. Stirrups at 150mm centres.
y plus attic house. not be more than 12 times ide corners by 1/4 of the ass than 600 mm.			Gable band	(Masonry gable wall must have the triangular portion of masonry enclosed in a reinforced concrete band. The minimum height of band is 75mm with 2-12mm bars. Use 6mm dia. Stirrups at 150mm centres. It is recommended to replace gable masonry wall with lightweight materials such as metal sheet or timber.
n 0.3 and 0.25 of and two-storey house. arger of half the height of			Stitch	९	The stitches shall be provided at all corners, junctions of walls to strengthen connections. The min. height is 75mm with 2-8mm bars Use 6mm dia. Stirrups at 150mm centres.

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Minimum Requirements for Flexible design

No.	Category			
				Use light roof comprising of wooden or steel structure covered with
		Light roof	<	🗸 light roofing materials. Heavy roofing materials such as stone slabs or
		000000000		mud should be avoided.
9	Roof	1		All members of the timber truss or joints should be properly
		colliection	<	connected as shown in technical details.
		+:	`	Trusses should be properly cross-tied with wooden braces as shown
		CLOSS-ILE	7	in technical details.
				Well seasoned hard wood / local wood without knots should be used
		H		for strctural purpose. Timber treatment such as use of coal tar or any
		1	<	other preservative can prevent timber from being decayed and
		00000000		attacked by insects.
		Mortar	<	Mud should be free from organic material and pebbles, etc.
10	Materials			Brick should be class A1 or A2 with compressive strength not less
		S		than 3.5N/sqmm.
			`	The concrete mix for seismic bands should not be leaner than 1:2:4
		COIICIETE	7	(1 part cement, 2 parts sand and 4 parts aggregate)
		D		High Strength Deformed Bars – Fe415 or Fe500 respectively with fy =
		ספוווסוכמוומונ	۲	415 N/samm or 550N/samm could be used for reinforcements.

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