Masons Training programme (with house construction)

training in rat trap bond brickwork, selected brick elements, MCR roof and precast RCC Choukhat

Development Alternatives
Description of training package
Masons Training Programme
(along with house construction)
Version FEB07

This document has been prepared as training package for masons based on a 6 day programme based on learning cum simultaneous construction of rural house. The current version of the training package- version FEB07- includes three subject areas- improved brick masonry with emphasis on rat-trap bond, precast RCC choukhats for door/window and Micro Concrete Roofing technology. It has two main parts-

Part A - Programme Description (language English)
This is meant for the trainer/ training organizers and includes the objective, expected outputs, profile of trainees and trainers, logistical and material requirements and the training schedule. The training schedule is provided in terms of independent modules, each with their required time frame, contents, learning objectives, tools and methodology. The current modules pertain to the three subject areas. It is possible to shift the module position or remove/ add new modules at a later stage in response to new/additional requirements.

Part B - Training material (language Hindi)
This includes a series of manuals which are essentially meant for the trainees as reference material for each subject area covered by the training. The manuals have been prepared as precise visual guides with the relevant theory, wherever needed. In the current version, manuals have been prepared for improved brick masonry with emphasis on rat-trap bond, laying MCR roof and Making an Arch. In addition, there are two pocket hand-outs in Hindi about rat-trap bond and conventional English bond masonry.

Additions for next version-
The following are under preparation for the next version of the training package-
1. Reference material (Hindi) for traditional brick elements which can be integrated into modern brick masonry
2. Material for trainers-
   • A presentation (Hindi) as a teaching aid about traditional brick craftsmanship
   • An instruction booklet (Hindi and English) for trainer on rat-trap bond and MCR roofing technology
Objective of training-

To improve skill and craftsmanship of a mason in carrying out brick masonry in rat trap bond and to impart skill required to lay a sloping Micro Concrete Tile roof and to install a precast RCC choukhat for door and window.

Building elements covered in brickwork –

- 9’ thick Rat trap bond brickwork for wall construction (including details for corners, T-junctions and openings)
- A semi-circular 9” thick arch
- Corbelled brickwork
- A built-in storage space 1’ deep
- Brick Jaali in one opening
- Projected shelf in one wall
- 2 aara on the exterior face of entrance wall
- Bracket and canopy over window using bullnose bricks and large chowka
- Parapet on terrace (and its integration with topmost brick layer)
Trainees

The maximum intake of the participants should be 15.
The trainees should preferably satisfy maximum criteria from the following:

- Age- between 20 and 45 years of age,
- At least 2 years of working experience as a mason,
- Educated up to class 8th

Basic understanding of mathematics, specially dimensions

Trainers

There should be a team of resource persons responsible for imparting training-

**Principle trainer**- engineer/ architect or a building professional with prior experience of having implemented construction in rat-trap bond and having basic knowledge and understanding of traditional construction elements of the region

**Associate trainer**- a person with experience in rural housing who will be responsible for additional supervision and specific documentation

**Master mason**- A senior mason, preferably above 40 years of age with considerable experience in brick craftsmanship. The master mason could be involved throughout the training program duration or invited for at least 2 days to interact with masons and inspire them, with focus on special brick elements
Material Requirement

- Bricks of uniform shape and size for brickwork in rat-trap bond - number to be ensured according to requirement for house construction or minimum 5000 in number.

- Special bricks (to be checked once with regard to specific requirement):
  - Bull nose bricks curved along width 30 No.
  - Bull nose bricks curved along height 60 No.
  - Large *Chowka* - 320 x 160 x 25mm, 20 No.
  - Small *Chowka* - 160 x 160 x 25mm, 20 No.
  - Brick tile - 205 x 75 x 50mm, 60 No.

- Grade 43 Ordinary Portland cement - minimum 30

- Coarse sand - minimum 3 trolleys (300 cft).

- Aggregate 10mm, cft

- Precast RCC choukhat - 1 No. each for a door (clear opening 3 feet x 7 feet) and window (2.5 feet x 4 feet)

- Stone slabs 2” thick for roof and storage shelf in kitchen – size to be confirmed before training

- Materials for wooden understructure to demonstrate MCR roof laying – area 4 sq.m – 2 No. bamboo 2 metre long, 4” dia, 5 No. wooden purlin of size 1.5” x 2”, 1 kg iron nails

- MCR tiles (Roman type) - Minimum 50 No. (number to be checked as per specific house design)

- MCR tile making machine (day of usage to be confirmed before training)

- A sieve for coarse sand - opening size 2mm

- 5 pans for transporting mortar/bricks - *tasla/ tagara* – and 2 spades - *phavda*.

- A Hexa-blade for cutting bricks

- 12 No. bamboo at least 10 feet long, jute rope and working platform for scaffolding required for brick masonry

- An electrically operated brick cutter (preferable)
Logistical requirement

☐ A prepared plinth level according to the house size and layout
☐ A flat area of around 30 sq.ft to be covered with plastic sheet for mortar preparation
☐ Toolkits for all trainees (number to be ensured prior to training) which include-
  o A measuring tape
  o A right angle
  o A plumb bob
  o A piece of string at least 15 feet long
  o A small hammer (1 kg)
  o Three trowels- one regular size, one medium and one small trowel for fine work
  o Wooden tool for Pointing- 2 No.- one for horizontal pointing 3’ long and one for vertical pointing 3” long
  o A wooden mortar saving tool – Rat-trap phanti- of length 2 feet and width 3.5” width
  o A level checking plastic tube 10 feet long
☐ A teaching space for one trainer and arrangement to seat 20 people
☐ One table and, preferably a soft board to display drawings, posters, etc.
☐ 2 big soft cardboard sheets for cut out templates for brick elements
☐ 20 small ruled sheet pads and pens for trainees
☐ A blackboard and a box of colourful chalks or a flipchart and permanent markers/ a white board and markers
☐ Regular supply of water and, when specified, electricity (for instance night time work and MCR machine)
☐ A team of 4 persons dedicated to mortar preparation, transporting bricks and other miscellaneous tasks
☐ A common nearby space for food and lodging and tea at site
Training schedule

The training schedule below provides guidelines for conducting the 6 day training programme. The training objectives listed below should be met even if house construction activity is re-adjusted according to site-specific conditions. The starting time for each day is 9:00 A.M. A 60 minutes break for lunch can be provided in keeping with continuity of on-going work. Tea will be served on site at least thrice during the day.

<table>
<thead>
<tr>
<th>Day One</th>
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</table>
| **Module 1** - Introduction and explaining basic objectives of the programme and its scope  
Time required 30 - 45 minutes |

**Methodology**
- A talk by trainer followed by group discussion.  
**Tools** - A black board / flip chart

<table>
<thead>
<tr>
<th>Contents</th>
<th>Objectives</th>
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</thead>
</table>
| ▪ Introduction  
▪ Need to organize this programme  
▪ What is expected to be achieved with the programme?  
▪ Expectations of the trainees from this programme  
▪ Pointing towards the right attitude for the programme  
▪ Future scope of the training programme | ▪ Understand and interact with one another  
▪ Knowing the background and existing special skills of masons  
▪ Feel free to participate in the process  
▪ Understand the core objectives of the programme  
▪ Establish a spirit of co-operation, pro-activeness and cleanliness |

| Module 2 - The basics of masonry practice and building materials, measurement and units.  
Time required – 45 to 60 minutes |

**Methodology**
- A lecture by trainer  
- A guided discussion about the mason toolkit  
- Field practice – measuring bricks, dry masonry run, observing properties of construction materials  
**Tools** - good quality bricks, cement, sand and special bricks ; Masonry toolkits

<table>
<thead>
<tr>
<th>Contents</th>
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</table>
| ▪ Maintaining verticality and horizontality  
▪ Describing a typical toolkit | ▪ Importance of levelling and verticality  
▪ Understanding use of different tools |
Module 3 – Rat trap bond
Time required – 30 to 45 minutes

Methodology
- A brief lecture by trainer
- Field practice – laying dry-run of rat-trap brickwork on the plinth level

Tools - good quality bricks

<table>
<thead>
<tr>
<th>Contents</th>
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<tbody>
<tr>
<td>Basics of rat-trap bond (module, ends, L and T junctions)</td>
<td>Understand the basics of rat-trap bond masonry practice</td>
</tr>
<tr>
<td>Importance of laying uniform thickness of mortar</td>
<td>Limitations of rat-trap bond</td>
</tr>
<tr>
<td>Correct calculation of length of walls as per rat-trap modules</td>
<td>Locating openings in rat-trap bond</td>
</tr>
<tr>
<td>Different types of pointing</td>
<td>Understand significance of working in modules</td>
</tr>
<tr>
<td>Use of tools in rat-trap bond</td>
<td>Correct use of tools</td>
</tr>
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<td></td>
<td>Importance of pointing</td>
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<td></td>
<td>Possibilities of electrical and water conduit pipes</td>
</tr>
</tbody>
</table>

Module 4 – Layout for masonry
Time required – 75 to 90 minutes

Methodology
- A brief lecture by trainer
- Field practice – laying base course in rat-trap brickwork on the plinth level

Tools - A black board / flip chart, good quality bricks, precast choukhat for door and window

<table>
<thead>
<tr>
<th>Contents</th>
<th>Objectives</th>
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<tbody>
<tr>
<td>Methodology for layout of base course</td>
<td>Understand the importance of accurately laying the base course</td>
</tr>
<tr>
<td>Ensuring perpendicular corners with a right-angle and by Pythagoras theorem</td>
<td>Understanding modular nature of rat-trap masonry</td>
</tr>
<tr>
<td>Complete rat-trap modules in a wall</td>
<td>Locating openings in rat-trap bond</td>
</tr>
<tr>
<td>Leaving door opening in the base course</td>
<td>Learning traditional methods of ensuring a right angle</td>
</tr>
</tbody>
</table>
Module 5 – Rat-trap masonry
Time required – remaining time in the day.

Methodology
- Brick Masonry for house construction supervised by trainer

Tools – Good quality bricks, cement mortar, masonry toolkits

<table>
<thead>
<tr>
<th>Contents</th>
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<tbody>
<tr>
<td>Laying base course</td>
<td>Establish comfort of working in rat-trap bond</td>
</tr>
<tr>
<td>Verticality and horizontality of brickwork</td>
<td>Correct use of tools</td>
</tr>
<tr>
<td>Laying mortar of uniform thickness</td>
<td>Practice basics of rat –trap bond as learnt</td>
</tr>
<tr>
<td>Neatness of work and finish</td>
<td>in module 3</td>
</tr>
</tbody>
</table>

Target for construction on the first day-
At least the first two courses of brickwork in rat-trap bond including the door opening

End of day One
From the second day onwards, the training is mostly at the construction site. Firstly by way of following guidelines for best masonry practice and secondly by on-site discussions about integrating brick elements into rat-trap masonry and finding solutions.

### Day Two

**Module 6 - The significance of traditional brickwork and its use in modern context.**

Introduction of a master craftsman.

Time required – 60 to 75 minutes

#### Methodology

- A talk by a master mason about craftsmanship in traditional brickwork practices and its relevance in current practices
- A talk and presentation by trainer on brick elements and their integration in rat-trap brickwork followed by experience sharing
- The master mason will continue to demonstrate and interact with the trainees on at least the second and the third day

**Tools** - A black board / flip chart ; A laptop computer / video-Television, posters and visuals about brick elements

<table>
<thead>
<tr>
<th>Contents</th>
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<tbody>
<tr>
<td>Prevailing brickwork practices in the region</td>
<td>Distinguish old and new construction practices</td>
</tr>
<tr>
<td>Traditional brick elements and craftsmanship</td>
<td>Identify traditional brick elements</td>
</tr>
<tr>
<td>Naming different traditional bricks used in</td>
<td>Relate traditional brickwork in modern context</td>
</tr>
<tr>
<td>the training and their intended use</td>
<td>Feeling pride in the craft of brickwork</td>
</tr>
</tbody>
</table>

**Module 7 – Precast RCC Choukhat- the product and its installation**

Time required – 90 to 105 minutes

#### Methodology

- A lecture by trainer about precast RCC choukhat and its installation
- Installation of choukhat

**Tools** - A black board / flip chart ; precast RCC choukhat for door, 2-4 local bamboo-10 feet long, jute rope, cement concrete for grouting holdfast joint

<table>
<thead>
<tr>
<th>Contents</th>
<th>Objectives</th>
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</thead>
<tbody>
<tr>
<td>Specifications of precast RCC choukhat for</td>
<td>Understanding the precast RCC choukhat</td>
</tr>
<tr>
<td>door and window-advantages and limitations</td>
<td>Understanding implications of precast RCC choukhat on rat-</td>
</tr>
<tr>
<td>Integration with rat-trap masonry</td>
<td>trap masonry</td>
</tr>
<tr>
<td>Installation stage and procedure</td>
<td></td>
</tr>
</tbody>
</table>
Module 8 – Built-in storage space
Time required – 30 to 45 minutes of discussion

Methodology
- A discussion on integrating a storage space and resolving the brick detail
- Construction of storage space

Tools - A black board / flip chart; good quality bricks and toolkits

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<tbody>
<tr>
<td>Maintaining a single face of rat-trap bond</td>
<td>Design considerations for a built-in storage space</td>
</tr>
<tr>
<td>Corbelling of bricks for depth of storage space</td>
<td>Understanding implications of a built-in storage space on masonry’s strength</td>
</tr>
<tr>
<td>Integrating the storage space into rat-trap masonry</td>
<td>Thumb rules to follow about corbelling</td>
</tr>
<tr>
<td>End details of built-in storage and limitations of size and shape</td>
<td></td>
</tr>
</tbody>
</table>

Target for construction on the second day-
- Brick masonry upto at least the 7th course, including the construction of the built-in storage space
- Installation of precast RCC choukhat for door

End of day Two
## Day Three

### Module 9 – Integrating brick elements at the sill level.
**Bull Nose corbelling, sill level detail, shelf/ wall projections, beginning arch, aara frameless windows**  
Time required – 75 to 90 minutes

#### Methodology
- A guided discussion led by the master mason about possibilities of brick elements at sill level  
- A discussion led by the trainer and preparation of drawings, sketches of brick elements to be integrated integrated at sill level  
**Tools** - A black board / flip chart ; Good quality bricks, special bricks-large chowka, small chowka

#### Contents | Objectives
--- | ---
- Possibilities of brick elements at the sill level  
- Designs for aara on the exterior face and their integration in rat trap bond  
- Cutting and shaping of bricks  
- Providing a built in shelf in the interior  
- Understand the design and construction of brick elements at the sill level  
- Understand proportions of all elements to fit in with rat trap modules  
- Choosing good quality appropriate bricks for different brick elements

### Module 10 – Construction of Arch  
Time required – 45 to 60 minutes

#### Methodology
- A lecture by trainer about construction of arch  
- A talk by master mason on Ghoonghat wali mehrab  
- Construction of arch  
**Tools** - A black board / flip chart ; Good quality bricks ; soil ; bull-nose bricks

#### Contents | Objectives
--- | ---
- What is arch and types of arches.  
- Important structural considerations and thumb rules for arch construction  
- Construction procedure of arch  
- Understand the arch as a building system  
- Understand the Do’s and Don’t’s of arch construction
Target for construction on the third day-

- Brick masonry upto at least the 13th course
- Construction of arch for a window opening
- Construction of brick elements at sill level- at least a sill level detail worked out at site and a shelf in the interior
- Construction of aara on the exterior face
- Installation of precast RCC choukhat for window
- Construction of frameless openings
- At least one third height of the 9" x 9" brick masonry column to support MCR understructure

End of day Three
## Day Four

**Module 11 – Basic estimation of productivity and consumption of raw materials in Rat-trap bond masonry**  
Time required – 45 to 60 minutes

**Methodology**  
- A lecture by trainer on productivity and material estimation  
**Tools** - A black board / flip chart

<table>
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<th>Contents</th>
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<tbody>
<tr>
<td>Planning for materials and manpower required for a day’s work</td>
<td>Understand how to calculate volume of brickwork, raw material consumption and output for a given team of mason(s) and labourers</td>
</tr>
<tr>
<td>Thumb rules to estimate raw material requirement for rat-trap masonry</td>
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</tbody>
</table>

**Target for construction on the fourth day-**

- Construction of various brick elements started on the third day will continue on the fourth day till completion.  
- Completion of 9” x 9” brick masonry column to support MCR understructure  
- Brick masonry till at least the 21st course

*End of day Four*
### Day Five

**Module 12 – Integration of brick elements at lintel level**  
Time required – 45 to 60 minutes

**Methodology**  
- A lecture by trainer on considerations at lintel level  
- A guided discussion for design of lintel and canopy by trainees  
- Construction of canopy at the lintel level

**Tools** - A black board / flip chart ; bull nose bricks ; special brick- large *chowka*

<table>
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<tbody>
<tr>
<td>Design of canopy using special bricks and integration with rat-trap masonry</td>
<td>Understand the proportions of canopy and its potential in shading from sun</td>
</tr>
</tbody>
</table>

**Module 13 – MCR tile production**  
Time required – 60 to 75 minutes

**Methodology**  
- A lecture by trainer on MCR tile and production method  
- Demonstration of MCR tile production by a trained mason

**Tools** - A black board / flip chart ; cement, 6mm aggregate, MCR machine

<table>
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<tbody>
<tr>
<td>MCR Tile- the product and specifications</td>
<td>Understand the product before roof laying</td>
</tr>
<tr>
<td>Mix design and Production methodology</td>
<td>Understand benefits of decentralized production</td>
</tr>
<tr>
<td>Applications</td>
<td></td>
</tr>
<tr>
<td>Enterprise creation potential</td>
<td></td>
</tr>
</tbody>
</table>

**Module 14 – Exposure visit for traditional brick craftsmanship**  
Time required – 3 Hours

**Methodology**  
- A visit to a nearby site-for instance, a historical monument- where traditional brick elements and craftsmanship can be observed

**Objectives**  
- A feeling of pride in a brick mason’s work  
- Establishing a connection between the training programme and the achievements in brick masonry in the past  
- Re-inforcing the need to revive craftsmanship in brick masonry in the modern context
<table>
<thead>
<tr>
<th>Target for construction on the fifth day-</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Completion of lintel and canopy on a window using special bricks</td>
</tr>
<tr>
<td>▪ Brick masonry till at least the 24\textsuperscript{th} course</td>
</tr>
<tr>
<td>▪ Brick masonry should be complete till roof level for at least two walls for laying stone slab the next day</td>
</tr>
</tbody>
</table>

*End of day Five*
### Module 15 – MCR roof laying

**Time required** – 2.5 hours

**Methodology**
- A lecture by trainer on laying MCR roof
- Practice of MCR roof laying on a 2sq.m wooden understructure

**Tools** - A black board / flip chart ; 2 No. bamboo 2 metre long, 4” dia, 5 No. wooden purlin of size 1.5” x 2”, 1 kg iron nails, MCR tiles

<table>
<thead>
<tr>
<th>Contents</th>
<th>Objectives</th>
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<tbody>
<tr>
<td>MCR roofs- type designs</td>
<td>Understand the benefits of MCR tile as compared to conventional burnt clay tiles</td>
</tr>
<tr>
<td>MCR understructure requirements and possibilities</td>
<td>Estimating raw material requirements - understructure and MCR tiles- for roof laying</td>
</tr>
<tr>
<td>MCR tile laying procedure</td>
<td>Understand the correct procedure for laying MCR roof</td>
</tr>
<tr>
<td>Quality control for a durable, safe and leak-proof roof</td>
<td></td>
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</tbody>
</table>

### Module 16 – Laying stone slab roof and roof level brick detail

**Time required** – 2 hours

**Methodology**
- A guided discussion about stone slab roof and the finishing detail of roof edge
- Preparation of sketches for roof detail
- Laying a single stone slab and implementing the detail

**Tools** - A black board / flip chart ; A 2” stone slab cut to size, good quality bricks

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<tr>
<td>Roofing options</td>
<td>Understand the roofing system of stone slab</td>
</tr>
<tr>
<td>Structural considerations for stone slab</td>
<td>Understand the procedure for laying stone slab</td>
</tr>
<tr>
<td>Finishing required over stone slab and water-proofing</td>
<td>Realize the importance of an appropriate edge detail in rat-trap brickwork</td>
</tr>
</tbody>
</table>
Module 17 – Evaluation of trainees
Time required – 90 minutes

Methodology
- An exercise given by the trainer to 3-4 groups of trainees
- Presentation of solutions by the trainee groups
- Discussion of solutions and their approach
Tools - A black board / flip chart ; good quality bricks

<table>
<thead>
<tr>
<th>Contents</th>
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</thead>
</table>
| The exercise should cover the following-  
- Calculation of wall lengths and openings according to rat-trap modules  
- Estimation of raw material quantities for a given volume of rat-trap brickwork | To assess independent ability of mason trainees to plan an appropriate house design in keeping with rat-trap module  
To highlight the correct approach in implementing rat-trap brick masonry |

Module 18 – Closure of training and feedback
Time required – 45 minutes

Methodology
- A talk by trainer
- Feedback from trainees
- Possibilities of future association between DA and trained personnel
Tools - A black board / flip chart

<table>
<thead>
<tr>
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</table>
| A review of work carried out during the training programme  
Possibilities of higher-level training  
Feedback from trainees and suggestions about improvement | Assess the overall experience of trainees during the programme  
Re-inforcing the need to revive craftsmanship and pride in brick masonry  
Ideas on how the trainees plan to take the work forward |

Target for construction on the six day-
- Brick masonry till the roof level
- Laying at least 1 stone slab on finished masonry
- Lying a portion of the roof edge brickwork

End of day Six