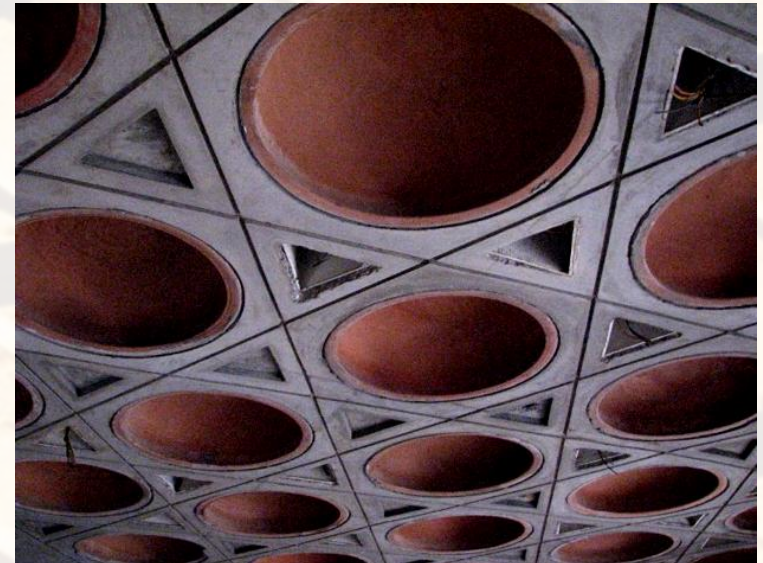
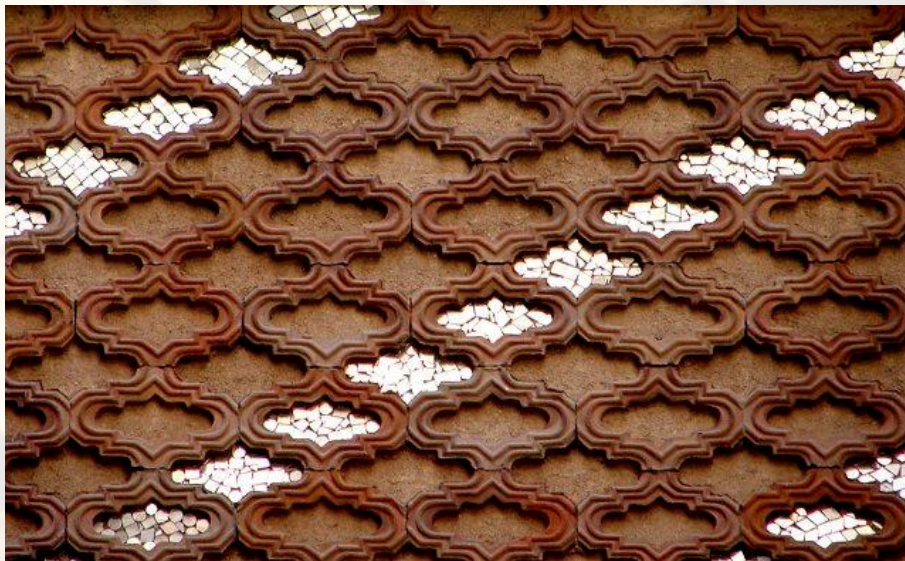


ALTERNATIVE BUILDING TECHNOLOGIES IN MADHYA PRADESH



BENEFITS OF ALTERNATE BUILDING TECHNOLOGIES

- Reduced embodied energy through fuel consumption and less energy intensive material
- Reduced environmental damage through optimal resource use and waste utilization
- Better thermal efficiency and comfort
- Resistant to natural disasters
- Aligned to local production in terms of material and skill availability
- Cost efficiency

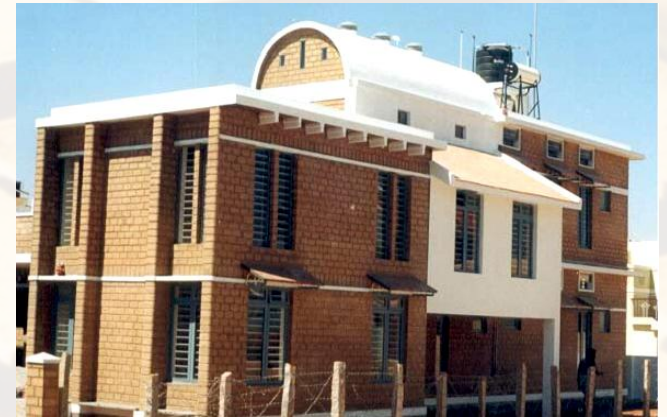


WALLING TECHNOLOGIES: STABILIZED COMPRESSED EARTH BLOCKS

Principle: (CEBs/CSEBs) are mechanically compressed block of local soil. The soil is mixed with a binding material such as cement, lime, rice husks or straw.

Design:

It can be used in the construction of various structures like wall masonry with arched openings, jack arches and domes for roofing. The component made of these blocks needs protection from water and tensile forces; hence walls made of these blocks should have appropriate overhangs from chajja or roof.



Low Carbon Climate Resilient Features

- Lower embodied energy material due to minimal use of high energy material.
- Low environmental impact as there is no burning involved.
- Thermally efficient nature imparted by soil which is a main constituent.

WALLING TECHNOLOGIES: CAVITY WALL CONSTRUCTION

Principle:

- A cavity wall consists of two layers of masonry, separated by a cavity (of 50-100 mm) that has better insulation properties than a regular masonry wall .
- The isolation of the exterior and interior layers by the air space allows heat to be significantly absorbed and dissipated in the outer layer and cavity before reaching the inner layer and building interior.

Design:

- It has good potential for use in public buildings, where significant savings in operational energy can be realized.



Low Carbon Climate Resilient Features

- Significantly improved thermal performance reducing need for mechanical cooling or heating.

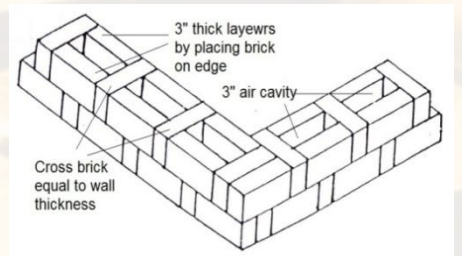
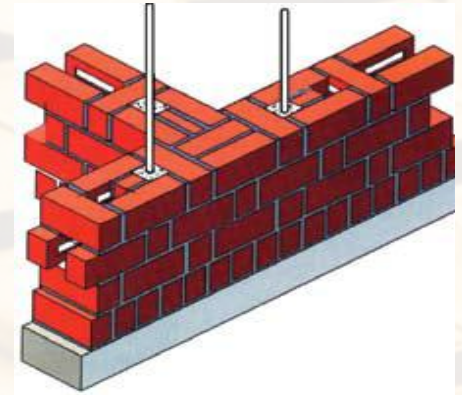
WALLING TECHNOLOGIES: RAT TRAP BOND

Principle:

• Rat-trap bond is a masonry technique in which the bricks are laid in such a manner that a cavity is formed between two faces of the wall. Typically, a 75mm cavity is formed in a 230mm thick wall by placing the bricks on edge in a modular fashion .

•Design:

- Usable up to 2 storeys of load bearing masonry, wherever burnt clay brickwork is used.
- As infill walls, usable in multi-storeyed buildings.
- Well-suited to exposed brickwork because of its neat appearance.



Low Carbon Climate Resilient Features

- **This technique reduces the number of bricks by at least 20%. and saves at least 30% mortar. It reduces the overall cost of wall by at least 25%.**
- Improves insulating capacity of brickwork.
- **30% less emissions from brickwork as compared to a conventional English bond brick wall.**

WALLING TECHNOLOGIES: HOLLOW CONCRETE BLOCKS

Principle: Hollow concrete block masonry that uses lesser concrete as compared to solid concrete blocks and provides better thermal insulation due to cavity.

Design:

- Usable in wall masonry and as roofing blocks along with precast inverted T- beams.
- Hollow Concrete blocks incorporate at least 40% air cavity in gross volume and masonry can be strengthened with steel reinforcement (typically corners, openings), which makes them well-suited for low-rise load bearing construction instead of the RCC frame which is conventionally adopted.



Low Carbon Climate Resilient Features

- Solid and Hollow concrete blocks may be particularly useful in places where there is scarcity of good quality clay required for burnt clay brick manufacture.
- The aggregate can be resourced locally.

ROOFING TECHNOLOGIES: MCR ROOFING

Principle:

- Micro concrete is a type of cement concrete which uses fine aggregate – typically less than 6mm size, which is then moulded as a roofing tile which can be used as a cladding material for sloping roofs.

Design:

- With an appropriately designed understructure, MCR roofs can be used for a variety of applications in low cost housing, institutional buildings, factories and parking areas.



Low Carbon Climate Resilient Features

- Low environmental degradation during extraction and production.
- Utilises waste such as filtered extracts from sand, waste from stone quarry etc.
- Low embodied energy due to less use of cement.
- Low scale production requirement.

ROOFING TECHNOLOGIES: PLANK AND JOIST ROOFING

Principle: This is a system which uses precast concrete elements to construct a roof. The planks are supported over partially precast RC joists side by side and then joined together with in-situ concrete poured over the entire roofing area. Both elements of the roof – planks and joists can be manually produced at site using a wooden moulds. Alternatively, given the context of a large scale use such as housing project, they can be produced in a small enterprise mode using steel moulds mounted on vibrating tables.

Design:

- The roof can also be used as an intermediate floor.
- The building should be designed keeping in mind the modular size of the planks.



Low Carbon Climate Resilient Features

- Simple technology for a flat roof which is not vulnerable to damage by cyclones.
- Reduces at least 25% low embodied energy as compared to a conventional RCC roof.

ROOFING TECHNOLOGIES: PRECAST ARCH PANEL ROOFING

Principle: The roof is constructed with pre-cast panels made with burnt clay tiles placed on pre-cast reinforced concrete beams. The arch profile imparts lateral or transverse strength to the panels for distributing the roof load through compressive forces. The panels serve as a lost formwork for the finished roof, after topping concrete has been laid over the pre-cast components.

Design:

- Usable economically till a span of 5 metres.
- Recommended for areas where burnt clay products are commonly used and produced in good quality – both the semi arid and coastal study area.



Low Carbon Climate Resilient Features

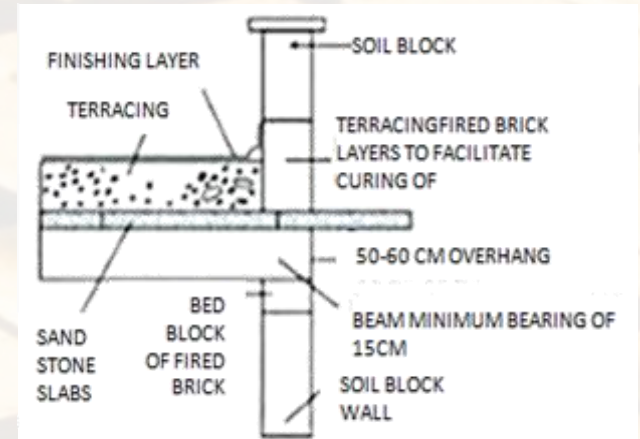
- Simple technology to replace conventional RCC roof for moderate spans
- 40% less steel used - however, the energy content is ultimately determined by the embodied energy of the brick tiles.
- Finishes like plaster and paint are not needed

ROOFING TECHNOLOGIES: STONE *PATTI*

Principle: It is a flat roofing system with sandstone slabs resting over steel or slender RCC section beams. The slabs are laid over with terracing for insulation and to provide a slope for rainwater drainage.

Design:

- It is appropriate where sandstone slabs are available and is more economical than RCC slabs.
- Where larger granite stone pattis are available like in Madhya Pradesh, the beams are not needed and can rest on walls.



Low Carbon Climate Resilient Features

- Simple technology to replace conventional RCC roof for moderate spans.
- The use of locally available stone reduces the embodied energy.

ROOFING TECHNOLOGIES: FERRO CEMENT CHANNEL ROOFING

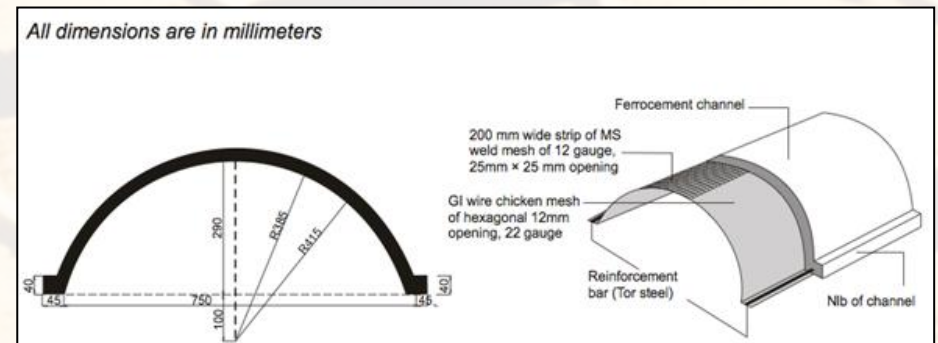
Principle:

The building system uses pre-cast ferrocement roofing channels of a segmental arch profile which are placed adjacent to each other and spanning over two supports. After partly filling the valley between channels with concrete, the channels form an idealized T-beam and are able to carry the load of a roof / floor.



Low Carbon Climate Resilient Features

- Re-utilises waste like flyash.
- Reduced use of steel.
- Pre-casting of roof leads to much reduction in construction time.



ROOFING TECHNOLOGIES: FILLER SLABS

Principle:

- It is a roofing system which is based on replacing the concrete portions of a roof slab with filler materials like tiles or earthen pots.

Design:

- Suitable for large spans flat, sloping or domed roofs.
- The aesthetic and acoustic properties of using various materials as fillers must be utilized.

Low Carbon Climate Resilient Features

- Consumes 30% less concrete and 40% less steel due to reduced weight of slab by the introduction of a less heavy, low cost filler material like two layers of burnt clay tiles.
- Enhances thermal comfort inside the building due to insulating properties
- 23% saving on cost of this slab compared to the traditional slab.

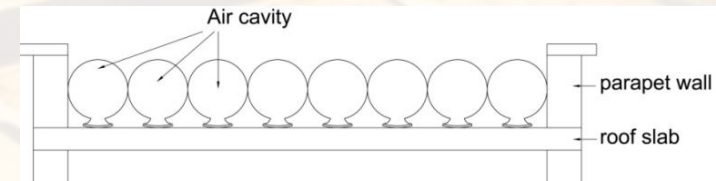


ROOFING TECHNOLOGIES: INVERTED EARTHEN POT INSULATION

Principle: Insulating the roof top with inverted earthen pot is an easy and cost effective method to reduce solar gain. In this method roof is covered by inverted earthen pots, the top of earthen pot can be covered with a layer of earth or lime mortar finish or can be left uncovered also. Earthen pots painted with white paints further reduce the heat load.

Design:

- As covering of pots made roof unusable, this type of system can be applied at non accessible flat roof or solid pitched roof.



Low Carbon Climate Resilient Features

- Utilises waste as pots which are non usable, partially broken on opening can be used and has low embodied energy due to properties of soil and less amount of soil required.
- Thermal efficiency of this system is very high as thin layer of terracotta covers much volume and trap much air.

ROOFING TECHNOLOGIES: FUNICULAR SHELLS

Principle: A Funicular Shell is a 3 dimensional catenary on a rectilinear base. The roofing system consists of doubly curved shells made with materials of good compressive strength such as waste stone pieces and brick tiles, supported on reinforced concrete edge beams.



Design:

- A series of these shells in variable geometric configurations supported on a grid of concrete beams, identical to a coffer slab, provides an attractive roof for small to medium span
- It does not need plastering/ painting.
- It is particularly well suited for large spans, eg. community buildings/ halls where a grid of beams can support a variety of funicular shells.

Low Carbon Climate Resilient Features

- Utilises waste stone to provide a roof which can be very well adapted to structural requirements.
- Low embodied energy due to virtual elimination of steel in the slab portion.

SANITATION: ECOSAN TOILET

Principle:

The basic principle of the Ecosan toilet is separation of faeces and urine and separate storage of the two wastes and then application of the nutrients contained in human waste as manure and fertilizer in agriculture.

The toilet has a special pan to separate the solid and liquid waste.

The faeces are stored and decomposed for a period of around 6 months and urine is diluted with water before use.



Low Carbon Climate Resilient Features

- Promotion of recycling by safe, hygienic recovery and use of nutrients, organics, trace elements, water and energy.
- Appropriate sanitation solution for areas of high water table or soil types where leaching of waste is not feasible.

Thank you

Disclaimer

This document is an output from a project funded by the UK Department for International Development (DFID) and the Netherlands Directorate-General for International Cooperation (DGIS) for the benefit of developing countries. However, the views expressed and information contained in it are not necessarily those of or endorsed by DFID or DGIS, who can accept no responsibility for such views or information or for any reliance placed on them. This publication has been prepared for general guidance on matters of interest only, and does not constitute professional advice. You should not act upon the information contained in this publication without obtaining specific professional advice. No representation or warranty (express or implied) is given as to the accuracy or completeness of the information contained in this publication, and, to the extent permitted by law, the entities managing the delivery of the Climate and Development Knowledge Network do not accept or assume any liability, responsibility or duty of care for any consequences of you or anyone else acting, or refraining to act, in reliance on the information contained in this publication or for any decision based on it.

© Copyright Climate and Development Knowledge Network 2013.

All content / information present here is the exclusive property of Development Alternatives (DA). The content / information contained here is correct at the time of publishing. The views expressed in this document do not necessarily reflect the views of any organization(s) associated with DA. This document contains details of a number of organizations, events, publications, projects and individuals. However, this does not imply that these entities are either endorsed or recommended by DA in preference to others of a similar nature. These entities shall not be liable for any damages incidental to the use of the information contained in this document. No material from here may be copied, modified, reproduced, republished, uploaded, transmitted, posted or distributed in any form without prior written permission from DA. Unauthorized use of the content / information appearing here may violate copyright, trademark and other applicable laws, and could result in criminal or civil penalties.

© Development Alternatives 2013