

Avoiding rain damage

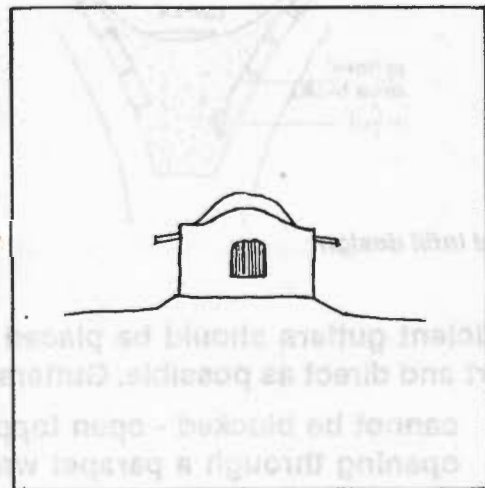
A critical factor in the construction of a building with unstabilized and hand moulded earth bricks is to protect it from rain and moisture damage. In this respect, buildings with domes and vaults have their own particular needs. In addition to basic structural requirements, a combination of measures specifically addressing the water problem are necessary. The following points must be considered:

1. Choice of site.
2. Evacuation of water away from the building.
3. Assuring controlled but rapid runoff of water from the roof.
4. Using a good "appropriate" exterior render.
5. Regular inspection and maintenance.

Above all, one should always bear in mind that vaults and domes built with earth bricks do not suit all sites - and thus one should be very careful when thinking of building in a new area.

1. Choice of site

Sites where rainwater is likely to collect round the building should be avoided. Buildings should not be placed too close to large trees, in order to avoid leaves and debris collecting on the roof and risking blocking the gutters.

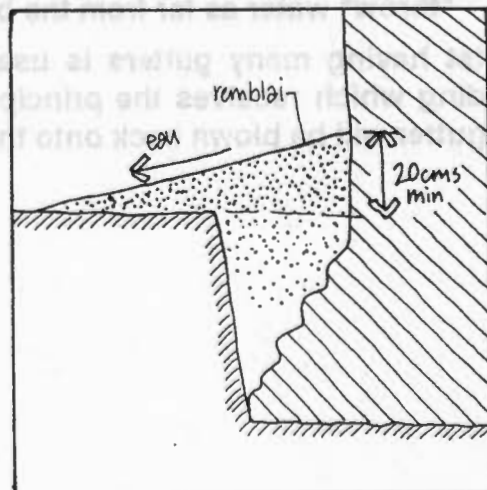


Keep the floor level well above the level of the site

Bank up round the building to ensure run-off

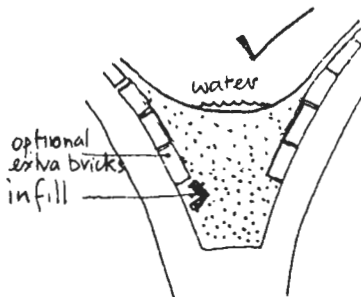
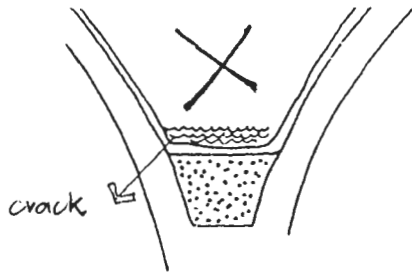
2. Evacuation of water from around the building.

The threshold or door step should be at least 20cm above the level of the surrounding site. Earth should be built up and compacted around the building in a slope away from it, thus ensuring no standing water next to the walls. (Fig 1.)



3. Water runoff from the roofs.

Bad Infill design....



Good Infill design

A smooth and gradual transition from massive to thin parts of the building, such as between the shell of a dome and the thicker infill between the walls, domes and parapets, helps to reduce the abrupt change in thermal mass. Abrupt changes provoke cracking and may be avoided by careful design and implementation. Levels between adjoining roofs should not be too different. Parapets should be high enough to allow sufficient infill to ensure a gradual change in roof thickness as it approaches the walls.

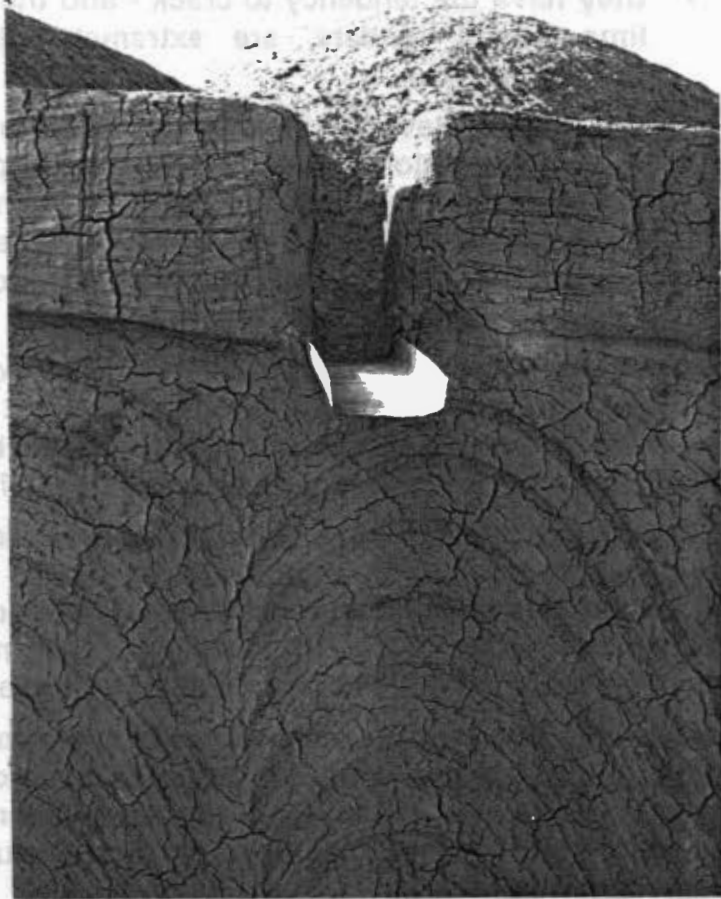
Well designed roofs ensure that when water running off the roof has collected in a gully, that it is flowing in the centre of the gully on infilled material, and not on the thinner main roof structure of the dome or vault. (Fig 2).

Sufficient gutters should be placed to ensure that the route to each gutter is as short and direct as possible. Gutters should be designed so that they:

- cannot be blocked - open topped gutters are better than tubular gutters; the opening through a parapet wall is better left open at the top, instead of the more common use of a capped opening through the parapet, which can be blocked by leaves and debris;
- do not slow down the water flow
- "throw" water as far from the building as possible

Whilst having many gutters is useful, avoid placing gutters on the side of the building which receives the principal rain bearing winds, since water flowing off the gutter will be blown back onto the wall and damage it.

Good gutter design:



and unimportant cracking in the earth plaster, which in this building has already lasted through several years of heavy rains

4. External renders

The external render protects the structure from erosion, particularly water erosion. The choice of render is critical to the durability of the structure.

Traditional earth renders with organic additives vary from location to location in their ability to reduce water erosion and infiltration; the local traditional earth render currently used by builders may not be the best available locally (quite often bad contemporary practice may have resulted in poorer quality renders than those of say 20 years ago).

An unstabilized earth render will be water-resistant but not water-proof. One of the earth render's most important characteristics is that although during a rain storm some water is absorbed by the roof, when the rain stops this water evaporates and the roof is left in good condition. This wetting and drying is normal. Cracks in unstabilized earth renders (as opposed to structural cracks) are not in themselves important, and damage to earth renders is very easy though labour intensive to repair efficiently.

Stabilized renders can be virtually waterproof, but:

- they have the tendency to crack - and these cracks, especially in cement or lime based renders, are extremely difficult to repair efficiently and economically;
- they do not have the characteristic of allowing the structure to dry out after water penetration through a crack, water passing through the cracks, soaks the brick work and is then trapped beneath the render. This build-up of damp leads first to damaged finishes and eventually to damaged structures. If cracks occur where collected water is flowing the situation is particularly serious.

Control joints can be very effective in reducing cracking, but require experience in their design and execution, add to the cost of the building and are poorly understood. Cement stabilized external renders have the added drawback that they separate from unstabilized surfaces, and this in itself can contribute to cracking.

In the case of a waste oil or bitumen based render, cracks can often be repaired by reworking the damaged section. The degree to which an oil based render can be re-worked depends on the mix, but in some cases reworking can be done by wetting the render to make it soften, but this must be determined for each case. Repairs should be done at the first signs of a problem.

Stabilized/water-proof renders work better on walls than they do on roofs. There is less tendency to cracking, and where there are cracks, there is less concentration of water flow over them. Thus although water seeping through cracks in wall render causes damage, the rate of damage is much slower, and in the short term it is rarely serious.

In the case of domed or vaulted roofs however water penetration through cracks in stabilized renders can lead to major structural damage, and for this reason, very great care should be paid in choosing their use.

In making a choice the following points are pertinent:

- In areas where traditional earth renders can be seen to last well on existing buildings, particularly on roofs as in some types of granary, an unstabilized earth render may be the best solution, but provided that regular and sufficient maintenance is carried out. These renders have the advantage of being easy to repair cheaply.
- b. A stabilized render can allow one to build vault and dome roofs with unstabilized bricks in areas with quite high rainfall, but this is only viable if cracking can be prevented or repaired easily. Testing on an inexpensive prototype is advisable if at all possible.