WORKSHOP 8

WORKSHOP THEME:

Work in a site about 1.5 klm from the center of Agios Nikolaos with natural materials where the group will engage in actual construction of a small pilot residential structure using ecological materials such as earth tubes (γεώσακους), wood and stone. The outline and footprint of the structure may be partly delineated before the workshop and discussed in detail during the workshop, and part of the foundation built but will be presented and explained to the group. The educational part of the work will be in 3 parts: (a) Presentation and explanation of ecological construction methods and materials (b) Wall contruction, including integration of electromechanical systems, window and door openings, and (c) Plastering of walls. The group will be learning about ecological materials, of techniques and tricks and working out details on one-to-one scale. More details to be announced shortly.

what is an earthbag?

Earthbag technology is an inexpensive, simple and sustainable method for building structures. Having evolved from military bunker construction and flood control methods, Earthbag buildings are notable for their ability to endure fire, flood, wind, earthquake and vermin, and are used in disaster-prone zones all over the world. In Nepal, 55 Earthbag buildings survived a 7.8 magnitude earthquake with no structural damage. Because Earthbag technology makes minimal use of cement, concrete, steel and timber-and the fuel needed to transport them-the technique is easy on the environment, and doesn't deplete scarce natural resources. Earthbag technology also requires less expertise than more traditional building methods, and only the simplest of tools.

Earthbag technology is a wall system, with structures composed primarily of ordinary soil found at the construction site. The soil is stuffed inside polypropylene bags, which are then staggered like masonry and solidly tamped. Earthbag construction minimizes the need for skilled labor, and does not require any special tools or machinery. An Earthbag building can easily be built by a group of unskilled workers, under the supervision of a construction manager. Earthbags are used in retaining walls and for erosion and flood control, as well as under highways.

Earthbag building offers many advantages over existing technologies:
• Safety- Earthbag technology has now been tried and tested in Nepal. More traditional building techniques were also tested, and tragically failed
• Ease of Construction- Earthbag technology is easily learned by rural villagers
• Reduced Use of Materials- Earthbag structures require a minimal amount of cement, concrete, wood and steel
• Reduced Use of Fuel and Transportation- Use of local materials, and fewer materials, means less need for transport and lower fuel costs
• Less Pollution- Building with soil means fewer factories and smoke stacks, fewer pollution-belching trucks for transporting the load, and less depletion of Nepal's forests and natural resources
• Cost-Effective- Building with Earthbags is inexpensive. For example, a typical Earthbag house might cost 900 NPR per square foot, versus 2500 NPR for concrete block construction

The main material of an Earthbag structure is ordinary soil, obtainable at the worksite. Most soils are adequate and precise ratio is not necessary, but there must be enough clay and moisture to bind the aggregate together. The soil can be easily tested without any equipment, using a drop test or a roll test. The most common mix is:
25-%-30% Clay 70%-75% Sandy soil 10% Moisture

After the completion of manufacture is disclosed the compact filler material allows better adhesion of plaster mortar. The soil mixture comes out through the holes of the mesh tube, resulting in a better physical adhesion and monolithic one, between one layer and another, which is difficult to cut, and hard to catch.
The highlight of the wall is constructed of material that allows the plaster mortar adheres on it without any difficulty. The consumption of raw materials, due to the smaller width of the mesh tube is about 20% lower. This impacts in a significant reduction in the physical effort of labor and time saving for the construction, but lose almost nothing in insulation. The wall thickness is about 35 -45 cm after compression, is no longer enough to ensure thermal comfort of people living in the house. After internal and external plaster the final width of the wall is between 45 & 55cm.

Materials for making light pine clay
The tools and experience necessary to build light clay walls are minimal.

Pine needles - Pine needles can be wheat, rye, oats, rice or barley, and should be free of visible decay and insects. Availability of the needles can fluctuate with the season so it is important to have some knowledge of the local agricultural cycles to access the best selection of material. For our constructions we have chosen wheat needles as it was the most locally available type.
Clay soil - Soil should have a minimum clay content of 50% by volume. Making a clay slip is pretty easy: we place soil in the cement mixer (as it's easier for bigger quantities) and by slowly adding water, it reaches the right consistency, which is that of a heavy cream.
Light clay mixture - We place all pine needle stems in a big table and pour evenly of clay slurry onto the straw. Everything needs to be mixed well by hands until they are thoroughly and evenly coated so as to avoid pockets of dry straw.
Pine bricks - Light pine needle clay mixture can be replaced by pine bricks. Our pine bricks are made in a special mold, which allows us to adjust the dimensions by movable partitions.The slip-coated pine is placed into the forms and compacted.

Building the walls
Timber battens - should be fitted horizontally to the structure, in order to "lock in" the pine needle-clay mass. First we nail battens along the one site of a wall. The next step is to fill the wall with light pine clay mixture. Once each layer is complete we nail horizontal batten, to prevent loss of material from the wall, then we tamp next layer of infill until the wall is complete. The material should be pressed good to fill all corners of the wall. Once the wall has dried for a week, we may need to add more mixture in gaps that appear.
Wall drying time depends on the season and climate (wind and relative humidity). Depending on the straw, there are some of missed seeds sprouting, when they shrivel and die, the wall may be dry enough.
The wall can be checked also by moisture meter, the moisture content of the wallsneeds to go below 18%.

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