Welsh School of Architecture

Really really Sustainable Building: hemp/lime construction and design

Proposed brief for the vertical studio beginning 28 April 2009

1) Aims

1.1 To investigate a method of construction using one material for structure, containment and insulation.
To design a small building to demonstrate this method.

1.2

Learning objectives

2) To understand how to design and make a structure, mainly in compression, consisting of walls and vault in hemp/lime (See drawing below). This is a live project which will be of general importance in the development of sustainable building, and it links to research within and without the Welsh School of Architecture.

Advantages of hemp/lime

Sustainability and Supply:

3) Lime is virtually inexhaustible. Hemp is relatively easy to grow and to process in most agricultural areas of Britain.

3.1 Energy:
Materials have low embodied energy and good thermal performance, and it is easy to achieve airtightness.
Simplicity of construction:

3.2 Reduction in number of materials, and simplification of activities on site.

Construction

There are 3 basic operations:
Shuttering for walls and vault 1.2 metre wide spanning 2.6 metres
Casting hemp/lime

4) Finishing: roof cladding and rendering/plastering

Organization of group of 10 students over three weeks

The students will divide into two self-elected groups consisting of members of both Year 1 and Year 2.
The groups will work in shifts on construction and recording, and research.

5) Week 1

The prototype will be erected in the first week to allow maximum time for construction and drying of the material so that the shuttering can be removed as soon as possible.

10.00 am 28 April 09: Introduction by Ian Pritchett of Limetec and by the architect, David Lea.

5.1 The students will then form into two groups. One group will build in the morning and research in the afternoon, and vice versa.
Group 1:
Prepare the materials and equipment.
Construct and erect the shuttering which will be left in place until week 2.
Mix, place and tamp the hemplime for the walls.
Fabricate and position the timber wallplate.
Mix, place and tamp the hemplime for the vault.

Keep records of the process, for example volume of materials, time taken for each operation.

Group 2:

Start research, for example, analysis of different vault constructions and their characteristics in order to define alternative forms. Criteria: economy and availability of material, simplicity and ease of construction, thermal performance, structural strength, etc.

Students may investigate historic examples such as catenary, round and pointed vaults, vaults made of small units such as fired and unfired clay bricks and stone; and vaults made of a homogeneous material such as concrete or catalan types which use small units (tiles) in rapid setting mortar to achieve a homogeneous result.

Analysis of thrust lines will be important.

Week 2

Students will write a report on the experience of construction and prepare a presentation for week 3.

The shuttering will be struck as soon as possible to allow tests to determine strength, moisture content, speed and depth of drying out, thermal insulation. (Note: It is always possible that the vault will fail.)

If there is any further time available a sample area of roof finish, for example timber shingles, can be fixed, and a sample of render aplled to the walls or vault. (However it may be necessary to leave the material for 28 days before rendering).

Week 3

5.2 A simple design project, for example a small house, using the techniques explored during the first two weeks. Students can work alone or in groups for this part of the vertical studio. Students should present this work on one side of A1 or the equivalent and a model at 1:50 scale.

Bibliography

Bevan, Rachel and Woolley, Tom 'Hemp Lime Construction'. bre press. 2008

Houben, Hugo and Guillard, Hubert 'Earth Construction', IT Publications 1994. (See pages 270, 271 and 288 – 295 in paticular for compression structures).

Fathy, Hassan 'Architecture for the Poor', University of Chicago Press. 1973

Richards, J. M. et al 'Hassan Fathy'. Concept Media. 1985

5.3 Both these books illustrate structures in compression using unfired earth, which has a similar compressive strength to hemp lime.

Contacts

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