ATELIER MATIÈRES À CONSTRUIRE WORKSHOP ADOBE ACTIVITIES REPORT

at BASE habitat INTERNATIONAL SUMMER SCHOOL 2014

14th - 28th July 2014 Altmünster - Austria

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architecture for development

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Chaire UNESCO

ATELIER MATIÈRES À CONSTRUIRE

















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INTRODUCTION

The INTERNATIONAL SUMMER SCHOOL ON MODERN EARTHEN ARCHITECTURE AND BAMBOO CONSTRUCTIONS 2014 was organized by BASEhabitat organisation in partnership with the University of Art and Design of Linz, the Research Center, Risc, Infrastructure, Security and Conflict, Bundeswehr Universität Munich, CRATerre-ENSAG, École Nationale Supérieure d'Architecture de Grenoble in France and **amàco** *(«atelier matières à construire»)* which is a project based in France and supported by «Investissements d'Avenir» through the governmental Initiatives for Excellence in Innovative Training programme (IDEFI) for a period of eight years, up until December, 2019.

The aim of the Summer School is to get an intensive Hands-On experience and to gain practical knowledge in building with earth and bamboo, to associate these timeless materials to innovative architecture.

About BASEhabitat

BASEhabitat is a project studio for architecture in developing countries developed in the University of Art and Design of Linz. It stands for basics and beauty, architecture and aesthetics, social and sustainable, energy and education. BASE does not mean specialisation but the development and expansion of the existing classical and comprehensive study of architecture. It represents a step into the reality of life, into the reality of politics and society. Today we can erect buildings in which no outside energy is needed to provide a pleasant internal climate, buildings that use the resources of their location rather than destroying them, that enrich the environment and offer people new challenges and new work. To achieve this we do not need more responsibility, nor must we restrict ourselves or do without something. All that is necessary is additional intelligence, more teamwork, sensuality, joy and beauty.

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ABZ Salzkammergut, Altmünster, Austria

About the site

The Summer School took place in the AB-Z(AgrarBildungsZentrum) Salzkammergut that is an agricultural education center. This place inspires not only because of its situation at the shore of lake Traunsee, but also through the quality of a passive building design that has won several architecture prices.

The main material is untreated wood that comes directly from the region. and it is used in walls, floors, frontages, ceilings and furniture,

All participants were host in the building students rooms.

GMUNDEN

ALTMUNSTER

RA ()

Traunsee lake

BASEHABITAT SUMMER SCHOOL ABZ Salzkammergut,

AUSTRIA

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Four parallel workshops :

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LIGHT EARTH & COB WORKSHOP LEADERS: Stefan Neumann & Jule von Hertell



RAMMED EARTH WORKSHOP LEADERS: Martin Rauch & Dominik Abbrederis



BAMBOO

WORKSHOP- LEADERS: Andrés Bäppler Raminez, Gretta Tresserra & Ruben Calambas Bermudez



ADOBE WORKSHOP LEADERS: Dorian Vauzelle, Lucile Couvreur & Gian Franco Noriega

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Time schedule

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Mon, 21.7.	Tue, 22.7.	Wed, 23.7.	Thu, 24.7.	Fri, 25.7.	Sat, 26.7.	Sun, 27.7.	Mon, 28.7.	
	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	
	8-12 ⁰⁰ Theory Classes	8-12 ⁰⁰ Seismology	8-12 ⁰⁰ Workshop 2	8-12 ⁰⁰ Workshop 2	8-12 ⁰⁰ Workshop 2	8-12 ⁰⁰ Workshop 2	8 ⁰⁰ -11 ³⁰ Check Out Departure	
Excursion	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch		
	13-17 ³⁰ Theory Classes	13-17 ³⁰ Workshop 2	13-17 ³⁰ Workshop 2	13-17 ³⁰ Workshop 2	13-17 ³⁰ Workshop 2	13-17 ³⁰ Closing Session		
	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner		
	19 ³⁰ -20 ³⁰ Th. Classes	19 ³⁰ -20 ³⁰ Peer Lectures	Party					

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≪ amàco project is an educational resource center that aims to make visible, in sensory and poetic ways, the physic-chemical behavior of the most common natural materials, such as sand, water, earth, wood, straw, etc. The project aims to disseminate knowledge regarding their application in construction, so as to promote the emergence of eco-friendly practices. amàco brings together physicists, engineers, artists and architects, under the same roof. Magic, emotion and creativity are the watchwords of the project. ≫

MATERIAL SCIENCE LECTURES

Amàco was invited to be in charge of the material science day lectures at the beginning of Basehabitat summer school. This challenge and responsibility was to think and decide about an adapted theory content and experimental practice for the 80 participants of the workshop.

So this day, after a little presentation of **amàco** project aims, vision and philosophy, the lectures were organized around two main subjects :

1.- «Building with Earth (grains)»
2.- «Building with Fibers».

The «experimental» lectures included some live experiments that were filmed and presented to the participants in order to increase the magic and emotion of the different scientific experiments.

Also, the participants were invited to get involved in the experiments by doing a planned exercise with earth and fibers.

1- Earth exercise (*Carazas test*)
2- Fibers exercise

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«BUILDING WITH EARTH» EXPERIMENTAL LECTURE



Trying to answer the question : How it stands? Scientific experiences with grains were presented to understand the physics of earth that is composed of grains, air, water and a binder (clay).

In the second part, we get more deep in the matter and explain the physic-chemical interaction of this components.





Residence in Schlins – Roger Boltshauser & Martin Rauch, Schlins, Austria © rights reserved



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«BUILDING WITH FIBERS» EXPERIMENTAL LECTURE



The lecture «Building with Fibers - from matter to architecture» was also divided in two parts. The main objective of the first part of the lecture was to show the use of natural fibers in architecture and explore all possibilities and qualities that can inspire as architects, engineers, artists, designers, etc. A short overview of fibers architecture in vernacular and contemporary habitats and some architecture projects linked to the functions that fibers have. (filter, insulate, dress, cover, reinforce, etc.)

In the second part, we get more deep in the matter and explain the origin of fibers, their diversity and their inner physic-chemical properties, for example when there is interaction with other elements. (water, grains, etc)





Architectural installation in Alsace © Jordi Pimas



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EARTH EXERCISE TEST CARAZAS

As explained in th previous lectures, earth is a material composed of three matter states: liquid, solid and gas. A simple gesture in manipulation and a different proportional interaction between this three states will determine the inner properties of the final material.

The aim of this exercise is to observe, by changing the hydric state of the earth (dry, humid, plastic, viscous and liquid) and the manipulation (fill, pressed and compacted), the variations and characteristics that the material can have. It will help us to «understand by doing» the better use and application in different building techniques.

A hole game of actions, techniques and building systems are the result of the change of the hydric state and the mechanic action applied.

In this case, four types of earth where compared by the participants to also make evident that earth soil qualities are not always the same.



FIBERS EXERCISE



Inspired in the previous exercise with earth, different kind of fibers where proposed to observe and compare their behavior changing some parameters.

Fibers were filled dry , pressed with water, pressed with a clay binder and compacted with the same clay binder.

The result were immediately compared.







WORKSHOP ADOBE

The aim of the "Adobe" workshop is to experiment and to explore the aesthetic potential of mud bricks for contemporary design and architecture. Manipulating basic principles of this ancestral building technique the participants will follow a creative process in order to explore the variations and effects of earth matter building expressions.

The participants will design & build an architectural element learning in this practice about different aspects of matter behavior, molding principles and construction parameters of earth-based bricks to stimulate and feed their own design creative process.

Amàco teaching method is based on experimentation and hands-on approach. Our creations appeals to aesthetic and emotion to whet the participant's curiosity. We believe that these methods foster open-mindedness and pleasure of learning. We give a priority to teamwork to encourage knowledge exchange, interdisciplinary and collective intelligence. Moreover, we are specialized in developing building techniques using local materials like earth and natural fibers. Every workshop we take part is the opportunity for us to put into practice our teaching methods and to experiment with other participants.

«ADOBE BUILDING TECHNIQUE» LECTURE



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A basic principle

Mud bricks or "adobe" is a material based in an very ancient and intuitive technique used since the beginning of civilizations.

It consist in transforming raw earth in a plastic matter by the use of water so the mix can be molded, and after that, dried under the sun to produce a "handleable" construction material.

As experienced, the evolution of this technique is based in a very basic construction principle : molding a handleable material that can be stacked together later in a way to compose an intelligent construction technique.

1. left : bricks production in «Huaca de l sol», Lambayeque, Peru. © Nathan Benn/CORBIS 2. rigth : Petite structure faite par des enfants lors du «Festival Grains s'Isère» © Craterre





one of the most ancient building techniques

The most ancient mud brick formed by hand was found at Jericho, Palestine in the VIII millennium B.C. And the oldest molded brick was found in Catal Höyuk, Anatolia, Turkey. VI century B.C.

As we can see, there was a long process in which the form of earth bricks evolve from hand-made forms (ball of earth, cone, hemisphere, piriform, etc) to the molding of parallelepipeds of square or rectangular plan as we commonly use today.

Depending on the region of the world, not only the forms but also the dimensions of the bricks are very different from each other. Also because their wher adjusted to the function of the element or the building to construct.

Right: City of Çatal Höyük, Turkey. (VI century B.C.) © reserved rights
Right: Morphologie de briques de terre crue. © reserved rights
Right: Typical Çatal Höyük house © Estudio Marcel Socias, Franck Lechenet / DoubleVue.fr









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In our heritage architecture

Even if this technique is universal and based in the same principles, we can find different expressions an morphology of adobe-based architectures around the world. This a good example of it's versatility and an infinite source of inspiration for now a days practices and designs.

^{1.} Left : La ville de Shibam, YEMEN, «le manhattan du désert» © Yann Arthus Bertrand

^{2.} Above : Ancien city of ChanChan, Trujillo, Peru © Dave G. Houser / CORBIS

^{3.} Above: Cité de Merv, Turkménistan © Peretz Partensky

^{4.} Above: Tower of narin castle at Maybod, Iran © movahedi, www.panoramio.com



for contemporary architecture

Architects an constructors still experiment and try to develop this technique exploring their potentialities as a natural and accessible material. We also believe in their architectural qualities and the particularities of its architectural language.



1. Left : Cassia Co-op Training Centre, TYIN Architectes, Indonésie © Pasi Aalto / www.archidialy.com 2. Right : «Los Robles» cellar, Chile. Architectes: José Cruz + Hernán Cruz + Ana Turell © www.eartharchitecture.com 3-4. Below: Primary school, Maosi village, Xiansheng Town, Qingyang City, Gansu Province, China. Architectes : Edward NG, Jun MU © Jun Mu - Department of Architecture, The Chinese University of Hong Kong



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Adobe production techniques

If we see the wheel of earth building techniques we are referring as adobe for a technique that is placed next to other masonry techniques.

Depending of the production process adobe technique can be differentiated in three categories :

- 1. Hand-made formed adobes
- 2. Manual molded adobes
- 3. Mechanized adobes.

 Above: Production debriques coniques, Tubali, NIGERIA, musée de MATNA; ville de jos, état du plateau © CRAterre
Above : Manual molded bricks © reserved rights
S. Right : mechanized production of bricks, Fresno California USA, 1992 ©
Christine Bastin & Jacques Evrard
K. Right : In Germany an industrilized production of bricks is used to dry the
bricks in ovens. This helps to reduce drving area costs © CRATerre-ENSA6







1. Above: Cycle de production de la brick de terre crue © CRAterre - ENSAG 2. Left : Drawings from the book «Batir en Terre» © CRAterre - ENSAG

2.4

Adobe production line



The chose of the raw earth matter should fit the technique requirements. Fields test can be made to determine the cohesion properties of clay before extracting the soil and transporting it to the material production site.

After extraction, raw earth can be stabilized by some aggregates if needed (ex. Sand) to optimize the quality of the final brick. Then water is added to let the mix «rest» to activate clay properties. Mix can be made manually or with the help of animals or mixing machines.





Earth mix is transported to the molding area. The mix is directly placed beside molding area. Molding process is made in a flat compact surface. The mold is filled by the prepared mix and unmolded immediately after.

After sufficient drying that means that they can be manipulated. Bricks are turned to dry efficiently. Dried bricks are stocked together.



EARTH CARACTERISATION





Field tests

Some fields tests were applied in order to understand raw earth and to decide the «right» mix for making our bricks with the local soil. Four different kinds of soil have been used for pedagogic reasons. Compare to understand. There was not so much clay in the local soil. We conclude it was a «silty soil». If sand was used it should be only to stabilize the mix for having a relative comfort molding the bricks.


BOTTLE TEST

Measure the proportion of the inert grains and the fine grains

Procedure :

In a transparent bottle, fill with 1⁄4 soil and 3⁄4 water. Agitate vigorously and leave

to settle down till the water on top is clear.

Results :

Note the proportions of the different constituents:

- Gravel and sand at the bottom
- silt and clay at the top.



CIGAR TEST

To determine the cohesive properties of the soil. To verify if the quantity of clay in the soil is suitable for the production of bricks.

Procedure :

Eliminate the particles larger than 5mm

Prepare the sample to a plastic state

Fabricate a cigar of 3 cm thickness and push it gently off the hand.

Results :

Measure the length L :

- If the length is less than 5cm is a SANDY SOIL

- If the cigar is more than 20 cm is a CLAYEY SOIL

(*) between 5cm et 20cm is good for mud bricks

PILL TEST

To test the resistance when dry. Determine the percentage of shrinkage.

Procedure :

Remove the gravel in the soil sample and prepare the soil to a plastic state. Cast 2 discs in a piece of PVC tube or similar.

After drying :

- Observe the eventual shrinkage behavior.
- Evaluate the resistance of the soil to cracking and crushing by testing between

the thumb and the index finger *Results* :

- No shrinkage, easily crushed to powder : SANDY SOIL
- Shrinkage, easily reduced to powder: SILTY SOIL
- High shrinkage, difficult to reduce to powder : CLAYEY SOIL



FROM MATTER TO MATERIAL – ADOBES







About matter formulations

The material came from local environment. We had at our disposal raw earth soil and sand that was directly delivered when needed. We had also 2 big straw bales of straw already cut between 5 to 10cm.

The earth used was "tricky" because it has a very sticky behavior when putted in a plastic consistence. That make us think about stabilizing it with the addition of sand. Not too much because of a high percentage of silt inside and maybe no too much clay. It was a matter of testing to find the right proportion of the mix that was comfortable enough to mold and resistant enough after drying.

First we only had sand 0/4 that was considered too big to achieve quality results. The hypothesis was that there was a big granulometry gap that didn't help to find a balanced mix. Anyway we use this sand the first round of bricks. Later we've got fine sand 0/1 that we think helped for the second round of production.









Mix preparation

After deciding the proportions of the mix, a short explanation of the line of production help to organize the group in teams to get a continuous flow of the production.

The mix was prepared following low technology methods (by feet) but some times with the help of a planetary mixing machine to have a preliminary mix of earth soil and sand. The straw was always added and mixed by feet on the floor.

The prepared mix was transported to the production site under the tent when ready.

Touching and feeling the earth texture and plasticity always captures the attention and fascinate the students. The motivation of the group who waited impatiently for that moment was clear.

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Brick molding

A big challenge was made for each group in the first day of adobe workshop : to produce as much as possible of adobe bricks.

The teams get a technical explanation before starting the work. Only with little supervision the participant handle to produce around 400 bricks in a few hours.

 The main idea of this part of the workshop is to introduce some "classical" production knowledge and to have enough bricks to play with later.















Drying & stocking

Summer time in Altmünster was very hot, almost ideal to dry adobe bricks. But as usual in summer time, rain can happen and weather forecast can't be 100% trustful around the mountains. For this reason, adobe molding took place under a tent trying to prevent an eventual rain.

Nevertheless, during the day, and after the bricks where dry enough to move around, the adobes where transported outside the tent in human chain. The adobes were turned to dry more homogeneous and quicker, so we can use them to build little architectural elements (arch, vault, dome) at the third day of the workshop.

STACKING EXPERIMENTS - «ELADIO DIESTE» EXERCISE

«A building con not be profound as a work of art unless it has an earnest and subtle fidelity to the laws of matter. Only the reverence that this fidelity requires can make our building serious, lasting and worthy partners in our contemplative journey.» Eladio Dieste 1924-1995



STACKING EXPERIMENTS - «TOWERS» EXERCISE

A geometrical game

Inspired in the teaching methods of the architect Patrice Doat with the first year students in the school of architecture in Grenoble, the participants organized in three groups explore the nature of the brick experimenting different stacking compositions.

The aim of this exercise is to stimulate creativity introducing some structural principles. A play of lights and shadows, texture and shapes start to reveal the aesthetic potential of the brick to create spatial qualities and formal expression with a simple geometrical shape.





JEUX D'ADOBES DESIGN YOUR OWN MUD BRICK

DESIGN STUDIO – BUILDING WITH ADOBE

Aims of the exercise

The workshop studio entitled *"Jeux d'adobes"* or "Adobe's game" in english, is an artistic exercise of free creation to freely explore the aesthetic qualities possibilities of the material.

This exercise is about studying, working and playing with the material (earth). More specifically thinking about the shape, texture and qualities of dry earth modules, assembled with a mortar to constitute an architectural element.

A creative approach implies not necessary working with the traditional sizes or formats already existing for a brick of raw earth, and also not an obligation to follow the rules of classic masonry for assembling them.

Following an open design process, the participant develop a sensitive approach of the material exploring creatively and intuitively using the knowledge acquired and their own imaginary, the aesthetic potential of adobe bricks building techniques in contemporary architecture.

This exercise offers the learner the possibility of question and explore different ways to express a concept by simple transformation and manipulation of material, the earth. To develop his concept the participant will have to formalize his idea and he will be confronted with the realities of gestures and physical constraints of a construction adobes.





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« Only people who understand the nature of materials can make art using them » Wang SHU - architecte

1. Left : mains de potiers à l'ouvrage, © https://onepassiononedevotion.wordpress.com 2. Left : terre à pisé © AMACO





Design in progress

The students have to produce one or several ideas to produce a 1m² wall element. They have at their disposal a wooden base of 1m long by 30cm thick. They have the possibility of creating their own mold and the tools necessary for the production (shovel, trowel, etc).

They had to use earth material but they had also th possibility to add fibers (straw) and sand to create their own material formulation according to their idea. The prototype principle is to be composed by bricks (modules) that when assembled reveals th composition idea.

The preliminary ideas elaborate by the participants in a brainstorming were explained to the group and then associated in general research subjects to create the working teams (stacking, pattern & texture). The teams worked their projects according to this themes chosen by the teachers in a second phase of design to decide the final prototype.

The production phase was done by each team in complete autonomy putting in practice all the knowledge learned in the previous part of the workshop.























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ONE SIDE IS RATIONALLY DESIGNED REGULAR PATIERN, THE OTHER IDE EXPRESS THE CONSEQUENCE OF THE ASSEMPLY OF THE FIRST SIDE.

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ADOBE BUILDING ELEMENTS – ARCH & VAULT



learning from tradition

The arch, the vault and the dome are all applications of the same concept. The vault, or open-ended tunnel, is only an exceptionally deep arch. The dome is in effect a collection of arches all sharing the same center. In each case the pressure of gravity on the material forming the arch will hold it together as long as the outward thrust is contained by buttresses.

Participants get to explore building methods of this bricks traditional architectural elements.







ADOBE BUILDING ELEMENTS – DOME

A dome is a rounded vault made of either curved segments or a shell of revolution, meaning an arch rotated around its central vertical axis.

Unlike arches, which require support for each element until the keystone is in place, domes are stable during construction as each level is made a complete and self-supporting ring.



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ARRA