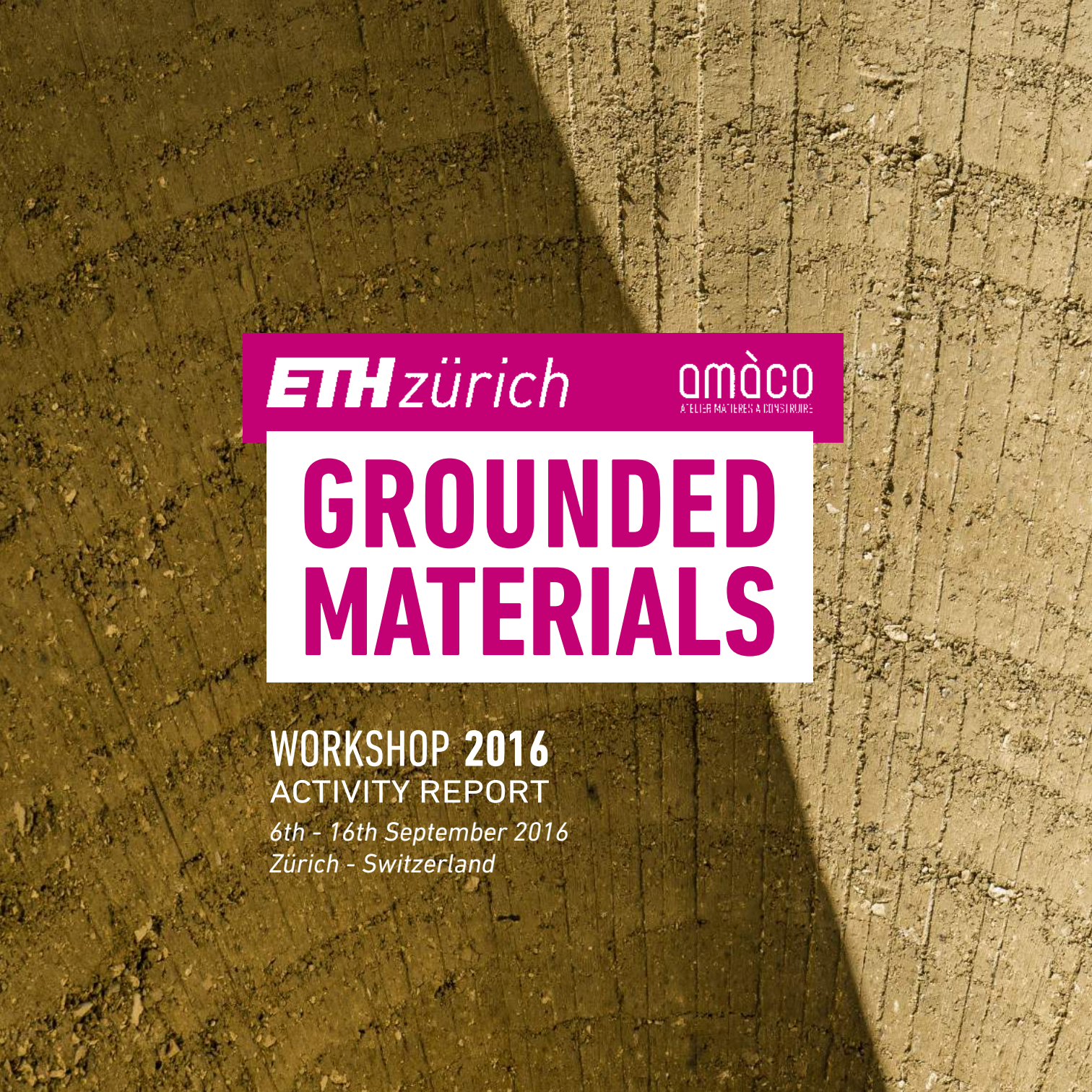

ETH zürich

amàco
ATELIER MATIÈRES À CONSTRUIRE

GROUNDED MATERIALS

WORKSHOP **2016**
ACTIVITY REPORT

6th - 16th September 2016
Zürich - Switzerland

SUMMARY

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ETH zürich

innovedum

D BAUG

Institute of
Construction and Infrastructure
Management

PROF. DR. G. HABERT
CHAIR OF
SUSTAINABLE
CONSTRUCTION

USYS TdLab
Department of Environmental Systems Science
Transdisciplinarity Lab · Science-Society Interface

amàco

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INTRODUCTION

Grounded Materials aims to develop sustainable building materials by disrupting current teaching in two fundamental ways. First, instead of studying each material separately we combine them in creative and unexpected ways – we call this **trans-material**. Secondly, we work with selected stakeholders to ground construction materials in a societal context – we call this **trans-disciplinary**. Grounded Materials means in a specific context, with selected stakeholders and locally available materials.

This course at ETH Zürich aspires to develop grounded materials for the construction sector – materials that are sustainable and innovative whilst still responding to the constraints of those on the ground.

To do so it requires students to work with several materials at the same time (trans-material) and take into account societal constraints in the construction sector (trans-disciplinary). We believe this approach **fosters integrated and socially relevant solutions** in line with current ETH initiative for critical thinking.

I**nterdisciplinary student groups** combine knowledge from material sciences, environmental sciences, engineering and architecture. Transversally, they explore the physical characteristics of various materials whilst taking into consideration production, design and application on the construction site. To develop Grounded Materials students are apply the Design Thinking method to bring together the stakeholder needs and material properties.

The course is hosted by the **Chair of Sustainable Construction** from D-BAUG. The chair seeks to embed sustainability in all aspects of the built environment – whilst transferring integrated knowledge about the characteristics and applications of construction materials. The course is run in close collaboration with the **USYS TdLab** (Transdisciplinarity Lab) that develops new educational and research approaches to solve complex problems at the interface between academia and society. The course is also part of a new partnership with **amàco** (building matter workshop), an innovative teaching centre on construction materials science based in Villefontaine, France. The teaching method entails hands-on experiments, encounters and building. The learning contents draw on aesthetics and aim to stimulate the participant's curiosity.

ETH Zürich, campus Hönggerberg

About the site

Grounded Materials Summer School took place at ETH Zürich Campus Hönggerberg, which is located on a hillside overlooking of the city of Zürich. This campus illustrates the links between science, industry and the general public, and won the European Cultural Award for Science in 2010.

In September, students spent ten days in the Auguste Piccard Hall, performing experiments, participating in lectures and other exercises. They also developed and presented their project for Grounded Materials in this hall.


ZÜRICH
GROUNDED MATERIALS 2017
SUMMER SCHOOL
ETH Höggenberg Campus, Auguste Piccard Hall

Time schedule

Time	Part 1: Guided Experiments, Workshops, Lectures				
	Tuesday Day 1 6. September	**Wednesday** Day 2 7. September	**Thursday** Day 3 8. September	**Friday** Day 4 9. September	**Saturday** Day 5 10. September
07:00 07:30					
08:00 08:30	*Introduction* *Suprise Exercise*	*Rich picture Stakeholder Analysis SPH*	*Stakeholder Dialog SPH M. Håkanson R. Künzler R. Grimm*	*Lecture: Physics of Clay*	*Synthesis Mission statement*
09:00 09:30	*Sensorial Discov. earth and fibres*			*Fluiding cast earth exercise*	
10:00 10:30	*Earth processing techniques*			*Plasticisers & Cement Cement*	
11:00 11:30	*Arch. earth* *Input SPH F. Rittiner*		*Carzas Exercise earth and fibres*		
12:00 12:30	*SBB*				
13:00 13:30	*Kempthal Stroba D. Baltensperger*	*Site visit 2 SPH ETH Zürich Hönggerberg Innovative Projects*	*Arch. fibres* *Exp. Lecture Physics o fibres*	*Lecture: Physics of grains*	*free*
14:00 14:30				*Synthesis Mix design strategies*	
15:00 15:30	*SBB* *Oberwinterthur R. Künzler S. Weisser*				
16:00 16:30		*Prep. Stakeholder Dialog*	*Lecture: Physics of grains*		
17:00 17:30	*SBB*	*Lecture Sustainability*	*Input Jasmin Packer*		
18:00 18:30					

Part 2: Design Project				
Monday Day 6 12. September	**Tuesday** Day 7 13. September	**Wednesday** Day 8 14. September	**Thursday** Day 9 15. September	**Friday** Day 10 16. September
Project Work	*Project Work*	*Project Work*	*Project Work*	*Wrapping up* *Cleaning* *Exhibition* *Presentation* *Preparation*
				Final *Presentation*
				Apèro

TRANS-MATERIAL

TEACHING

As cities grow and resources become scarce, future engineers and architects have to think and implement sustainable solutions in an increasingly complex context. **Grounded Materials** seeks to suggest thinking materials outside the confines of individual materials like wood, steel and concrete by considering the constituting matter of all materials like fibres, grains and binders across different materials (trans-material). Materials thus can be differently reconstituted, e.g. through a locally specific or available assembly of matter.

Together with experts on material sciences, students experiment with materials and their physical properties to change the attitude towards existing construction materials. Concrete is made of grains and a binder. However, the physical properties that allows to improve strength properties through packing optimization in concrete can also be used to other contexts such as for instance desert sand, earth and all sort of urban waste. Similar attitudes considering fibres or binding agent allows a true trans-material approach.

magic

earth

emotion

wood

straw

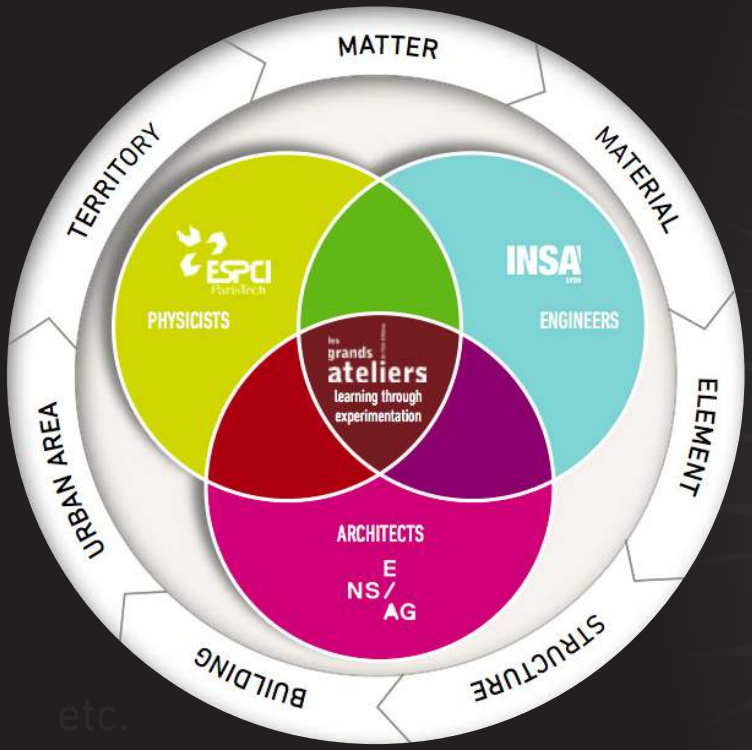
art

sand

etc.

water

creativity



amàco

ATELIER MATIÈRES À CONSTRUIRE

amàco project is an educational resource centre that aims to make visible, in sensory and poetic ways, the physic-chemical behaviour 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.

amàco LECTURES & EXERCISES

amàco conducted material science lectures and practical exercises at the beginning of Grounded Materials.

The lectures were organized around two main subjects :

1.- *Building with Earth :* earthen architecture, traditionnal building techniques, physics of grains and phisics of clay muds ;
2.- *Building with Fibers :* architectures of fibres, physics of fibres.

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

Also, the participants were invited to get involved in hands-on experiments by doing planned exercises with earth and fibres :

1- Sensorial exercice
2- Traditionnal processing earthen techniques
3- Earth exercise (Carazas test) and fibres exercise

SENSORIAL EXERCISE

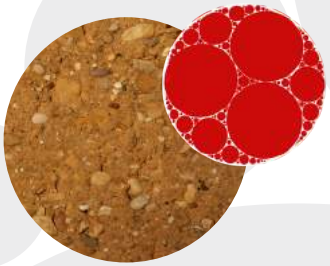
Sensorial discovery of earth
As an introduction to the experiments, the students were invited to discover how their senses allow them to get information on soils.

The view is the dominant sense, to the detriment of other senses. Amàco offers kinesthetic exercises where participants, blindfolded, focus on the sensations given by the touch, the smell, the hearing and the taste.

With this total sensorial experiment, it is possible to identify the mineral composition of a soil, the presence of organic matter, the salinity or the humidity but also and that is the most important it shows what is sensitive only with our own perception: cold, warm, appealing, etc. These exercises link the student with the materials in order to bring a familiarity with what they will work on during the summer school. It also abolish the barriers between the different field of expertise of the students as engineers, architects, environmental or material scientists are all confronted with a new sensations.

Aesthetics of matter
Some raw materials used in construction such as earth, straw or even wood, can be regarded as dirty, fragile and sometimes archaic. Through art, amàco proposes to modify the look on these raw materials highlighting their aesthetic potential.

«BUILDING WITH EARTH» EXPERIMENTAL LECTURE



The lecture «building with earth - from matter to architecture» was divided in two parts.

The first part focused on presenting an overview of earth architecture heritage and contemporary examples. It showed the functions earth material can have in relationship with a building technique (to carry, to insulate, to cover, to fill).
By trying to answer the question: How does it stand? Scientific experiments with grains were presented. They allow to understand the physics of earth as an assemblage of grains, air, water and a binder (clay).

In the second part, we went deeper in the matter and explained the physical-chemistry of interaction between earth components.

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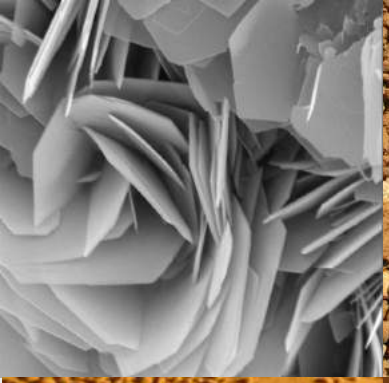
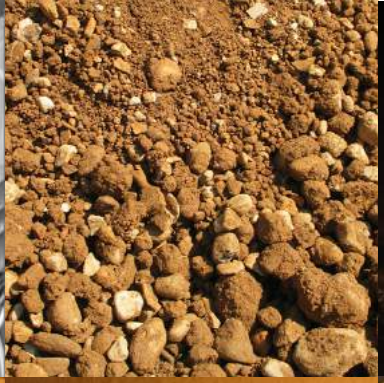
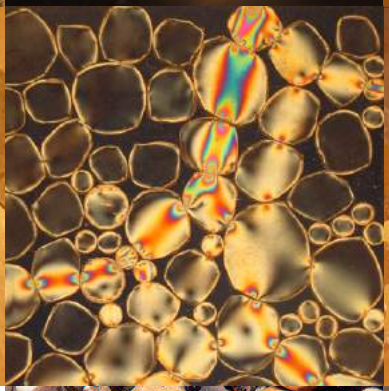
Residence in Schlins – Roger Boltshauser & Martin Rauch, Schlins, Austria © rights reserved










«BUILDING WITH FIBRES» EXPERIMENTAL LECTURE

The lecture «Building with Fibres - 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 fibres in architecture and explore all possibilities and qualities that can be inspiring for architects, engineers, artists, designers, etc. A short overview of the use of fibres in vernacular and contemporary architecture highlighted the different functions fibres can have (filter, insulate, dress, cover, reinforce).

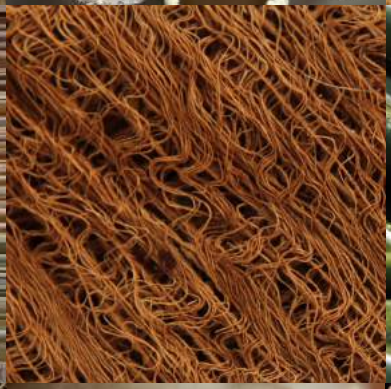
In the second part, we deepen our understanding of fibres and explained their origins, their diversities and their inner physical and chemical properties, especially when there are interactions with other elements (water, grains, etc.).

cane structure © Canya viva

Architectural installation in Alsace © Jordi Pimas

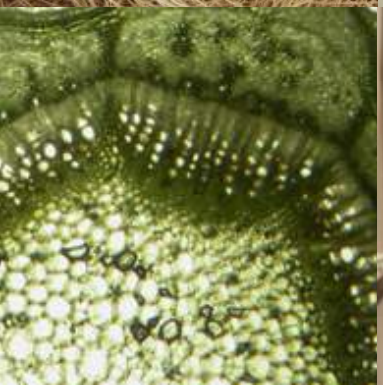




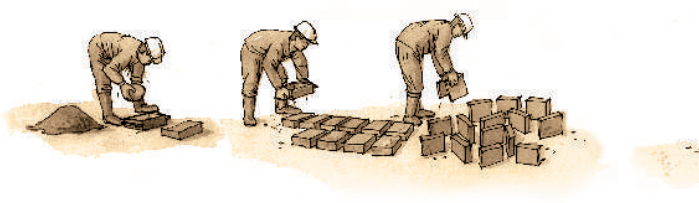








TRADITIONNAL PROCESSING TECHNIQUE EXERCISE

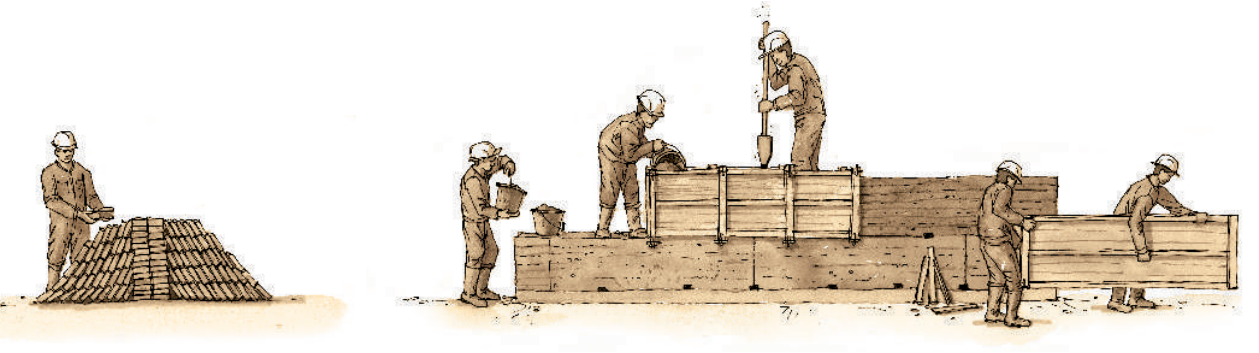


These exercises propose to discover some processing techniques used in traditional earth construction. By manipulating specific tools for each technique, participants collectively understand the differences between rammed earth (a monolithic technique), adobes (a masonry technique), compressed earth-straw or earth-hemp (insulation technique).

Furthermore, by changing various parameters, like the type of earth, the tools, the hydric state of the earth, the proportions of earth/fibres, the compaction forces, the accuracy of their practice, they can see the differences in the final building material they are producing. This «understanding by doing» gives them the appropriate know-how to use the matter around them.

ADOBE

Mud bricks or "adobe" is a very ancient and intuitive building technique used since the rise of human sedentary societies.
It consists of transforming a mix of earth and straw in a plastic matter by the addition of water so that the mix can be molded. The fresh bricks are then sun dried.



RAMMED EARTH

Rammed earth is also vernacular technique requiring slightly more tools than adobe.
Wooden or steal tools are actually used to compact, layer by layer, earth into a formwork. The result is a monolithic bearing wall.

COMPRESSED EARTH-BRICKS

Similar to rammed earth, compressed earth-bricks are a based on earthen materials. However, they are briefly assembled through a brick-press that compacts the earth into an always same shaped brick and hence can accelerate the process of building with earth.

EARTH EXERCISE TEST CARAZAS

As explained in the experimental lecture, earth is a material composed of three element : a liquid (water), a solid (sand/clay) and a gas (air). By modifying the hydric state of the earth, the interactions between these three elements can be drastically changed.

The aim of this exercise is to observe the variations in material aspect, by changing the hydric state of the earth (dry, humid, plastic, viscous or liquid) and the processing technique (poured, pressed or compacted). This exercise allows to teach by doing, the possible existing choices and variability in order to achieve a desired property.

During the exercise, four types of earth where tested and compared by the participants in order to show explicitly that different earth soil qualities provides very different results.

FIBRES EXERCISE

Inspired by the previous exercise with earth material, different kind of fibres were also tested with similar experimental set up.
The fibres were used at different hydric state (dry, mixed with water or with liquid mud) and similarly as the earth exercise they were either poured, pressed or compacted.

The results were immediately compared.


TUESDAY
WEDNESDAY
AM

TRANS-DISCIPLINARY TEACHING

In addition to the environmental considerations, future engineers and architects will have to take into account an increasingly complex societal context. Grounded Materials considers construction materials, and potential future materials in relation to their societal impact and in negotiation with selected stakeholders in this field (producers, users, developers, owners, etc.).

Together with experts, Grounded Materials provides a forum for students to adopt the perspective of various stakeholders from the construction sector in order to consider social and environmental constraints. This is because we believe that sustainable construction materials should be grounded in discussion between students, scientists, builders and producers in order to address emergent issues.

USYS TdLab

Department of Environmental Systems Science

Transdisciplinarity Lab · Science-Society Interface

The TdLab from the Department of Environmental System Science at ETH Zurich develops new educational and research approaches to solve complex problems at the interface between academia and society. Through its teaching programmes, the TdLab trains students to apply their scientific expertise to tackle complex societal problems that advance sustainable development.

USYS TdLAB EXERCISES & SITE VISITS

USYS TdLab led a series of activities that introduced students to the method of design thinking to identify the problem they want to solve through their design of a grounded material. The TdLab proposed a series of interactive exercises that led them to adopt a stakeholder's perspective when designing their solution. The context of this Grounded Materials 2016 is the ETH Zürich Student Project House (SPH), a potential project at the Hönggerberg Campus to facilitate project based work by students.

The main exercises were:
1- The Marshmallow challenge
2- Rich Picture Activity
3- Stakeholder Analysis

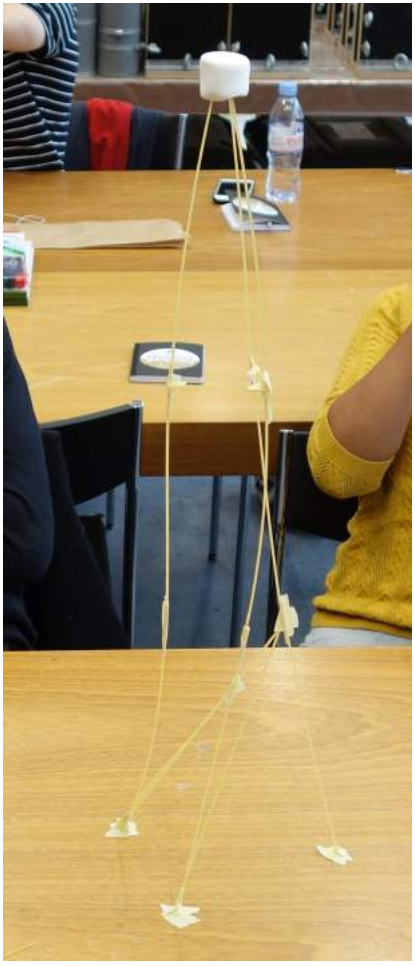
In addition to these exercises, the students visited two sites were they engaged with specific stakeholders. Debriefing allowed us to consolidate the information gathered and the challenges this raised for the design of new sustainable materials.

1- An alternative material retailer (Stroba)
2- A construction site using earth material (IG-Lehm)
3- The ETH Zürich Campus with various multi-purpose buildings

MARSHMALLOW CHALLENGE

This short and fun exercise is a perfect ice-breaker, and quickly builds a team spirit within interdisciplinary student group. Each group is given 20 sticks of spaghetti, a metre of tape and string and a marshmallow, and has to build the highest tower with the marshmallow at the very top.

This exercise leads the students to negotiate, exchange and decide on how to build the tower in a limited amount of time, most important here is not so much the preconceived knowledge of each person, but the group's ability to try and test solutions as they move forward. It is then not surprising that elementary school children regularly perform better at this challenge than senior executive managers.



RICH PICTURE ACTIVITY

This enables students to apprehend the complexity of a system, in this case, the value chain of sustainable construction materials. The learning objective of this activity was for students to realize how a building materials are grounded within a local context and selected stakeholders. The context was a planned Student Project House (SPH) at the ETH Zürich Campus Hönggerberg planned by the ETH rectorate.

Given the interdisciplinary background of the course, the goal of this exercise was also to assess the knowledge of sustainable materials and their potential application at the SPH of each student. In order to do this, each student had to first to think about a Grounded Material that could be implemented at the SPH.

The students were then asked to draw a Rich Picture of the SPH and how it incorporates their Grounded Material. In groups students discussed and reflected the definition and content of the value chains that each of them drew. Each group chose to develop one Rich Picture and the implementation strategies further. The refined Rich Pictures, were openly presented and discussed. This enabled to broaden the understanding of sustainable materials and take a wider view of possible applications. Students then had to consider stakeholders involved in SPH in development, production, implementation and use of the Grounded Materials. Another discussion helped categorize stakeholders and enable their consideration of the entire life cycle of the SPH. To conclude students had to consider incentives and constraints for selected stakeholders using Grunded Materials for the SPH. The resulting Rich Pictures were presented in plenum and discussed.

Throughout this process, the teaching team provided only guidance regarding instructions for what and for how long the activities were to be. All the knowledge and content specific to the topic of sustainable materials came from the students themselves. This is an important aspect of problem-based learning, upon which the design of this activity is based.


FLEXICO - THE CORK HOUSE


FLEXICO - THE CORK HOUSE

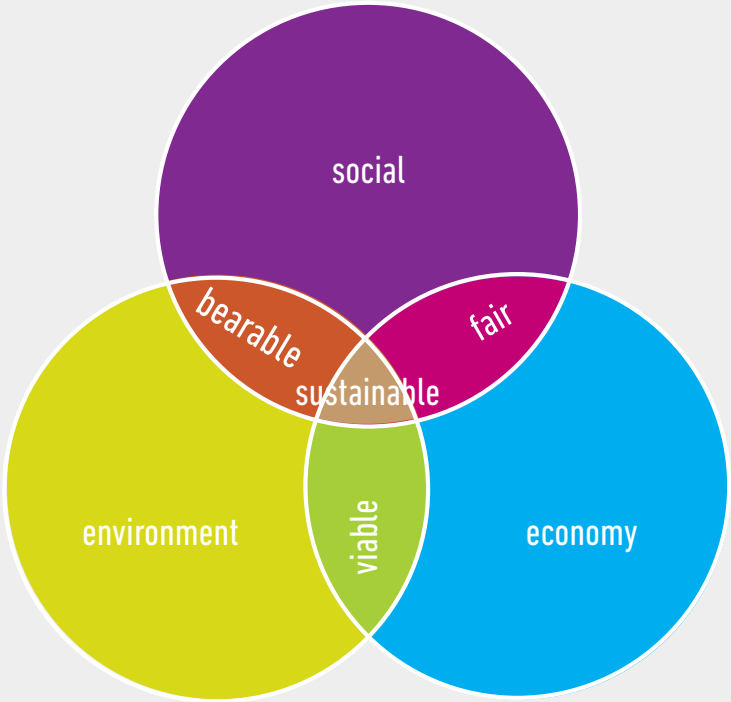
SUSTAINABILITY LECTURE

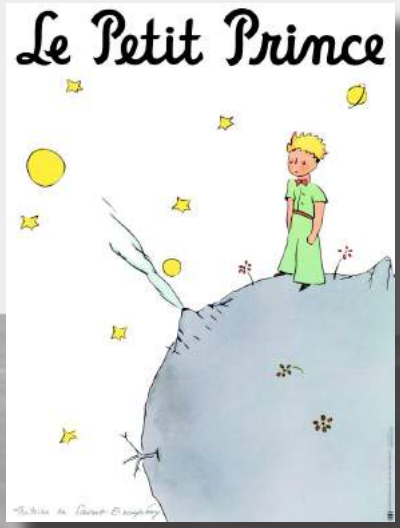
In the evening, after the rich picture analysis, Prof. Guillaume Habert of the Chair for Sustainable Construction, provided the students with a theoretical introduction to sustainability and how it is currently defined.

The history of sustainability was given from the Limits of growth (Meadows 1972) to the Brundtland-report (Brundtland 1987). The environmental impact of the building sector was also demonstrated, along with the importance of reducing energy use within this sector.

An initial definition of a Grounded Material was proposed. A Grounded Material is sustainable in terms of its ecological footprint, appropriate and socio-economically relevant and finally regenerative within its socio-technical system. As such, Grounded Materials promote a built environment that actively transforms both nature and society.

URBAN MINING





"One sees clearly only with the heart.
Anything essential is invisible to the eyes"
Antoine de Saint-Exupery

"What is important in building materials is not what they are,
but what you do with them"
John Turner

STAKEHOLDER ANALYSIS

This exercise aimed at clarifying why it is important to understand the roles and needs of stakeholders in the construction sector in addition to the technical constraints that exist for the development of alternative building materials.

To do so, we organised a stakeholder dialog inviting selected stakeholder with different roles associated to ETH Zürich and the Student Project House (SPH). They included the client, an architect, the developer and a stakeholder who is acquainted with the application with sustainable materials.

The Students conducted the dialog by asking predefined questions to receive valuable information about the SPH, the roles of the stakeholders and their positions on the development, production, implementation and use of sustainable building materials at the SPH. The stakeholder should provide the students insights in their personal incentives and constraints to use the selected sustainable construction materials. These different positions were then discussed in a plenary; where we identified and discussed the conflicting interests, learning that one man's incentive can be another man's constraint.

All the constraints and incentives were gathered on a wall as a reminder during the further process of Grounded Materials. At the end of the exercise, the position of the different stakeholders enabled the students to understand the positions of stakeholder's also related to the site visits, and help frame their questions.


GROUNDED:
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
AM
PM


MARIA
FLORIAN
RETO
JASMIN
RALPH
DIETER
SAMMI
KATHARINA

SITE VISIT : Stroba

Stakeholder : Alternative material distributor

Near Winterthur the students met a small family-owned retailer of environmentally-friendly materials. The retailer showed mineral plasters that are ecologically friendly produced and insulation materials based on plants or animal hair and thus based mostly on renewable resources or products that have little environmental impact.

Students learned which materials would be useful in which part of the house materials and asked who are the clients. The owner of the company explained that these ecologically-friendly products are mainly used by small companies or individual builders. The question of cost competitiveness was raised and the importance of a holistic understanding of what a cost is was discussed. Finally, the students had the perception that a lack of knowledge for the potential users of these materials were a critical barrier for their further implementation.


THERMO
HANF
...dämmen
und wohlfühlen...


strobaustoffe ag


STROCO
strobaustoffe ag
strobaustoffe ag
Dämmzopf 50/25 mm

SITE VISIT : Construction Site

Stakeholder : Builders

In Winterthur the students met with two builders of two nearby residential houses that were mostly renovated by using earthen materials. Walls were built with rammed earth, where wooden construction was necessary it was plastered with earth. One house was recently finished the other is still work in progress. Both were examples of in-situ construction process, where the builders built on site. This allowed much flexibility to tailor building elements to the very old building structure but it meant a slow building progress. The builders displayed different earths and applications of construction processes and shared their experience on building with earth. The projects were special because the builders were essentially their own clients and resident of the same houses.

SITE VISIT : Student Project House

Stakeholder : ETH Rectorate

The Student Project House (SPH) is a project led by the ETH Zürich rectorate. It is a platform that offers a framework with inspirational events, skill and technical courses and support students in their extracurricular projects. The SPH support therefor consists of coaching, tools and infrastructure for students. It is brought together in a house, one in the main campus and a second one at the Campus Hönggerberg. The latter is currently planned and was focused upon by Grounded Materials 2016 as the context. Until either of the SPH in the two campuses are realised, the ETH Zürich has implemented a temporary pilot station that is placed in an existing building and was inaugurated just after Grounded Materials. Conversations with the selected stakeholder running the SPH offered students insights in what the needs were from the perspective of the user and client alike. Furthermore, it showed the students what the novel concept of SPH potentially could look like. The aim of Grounded Materials however was not to design the envisioned SPH for the Campus Hönggerberg, but to find pathways to consider and implement sustainable or Grounded Materials.

SITE VISIT : ETH Zürich

Stakeholder : Engineer, architect

At the ETH Zürich Campus Hönggerberg the students visited two new buildings for student housing, where the ETH served as client. The architect of one of the project gave insights on the planning and construction process, the use of materials and their application. Students living in this housing explained their perspective and needs living on the campus. In addition, students visited the new underground grid providing renewable energy for heating and cooling from a geothermal source to all new buildings on this campus. The energy engineer explained challenges in implementing the sustainability goals of ETH in part with this renewable energy grid.

ADDITIONAL INPUT

Prof. Dr. Andrea Frangi

Prof. Dr. Andrea Frangi of the Timber Engineering Group at ETH Zürich gave students insight to the built research project of the House of Natural Ressources, a building with a structural system Prof. Dr. Andrea Frangi of the Timber Engineering Group at ETH Zürich (D-BAUG) gave students a presentation at and insight on the built research project of the House of Natural Resources (HoNR). Part of the ETH Zürich Hönggerberg Campus, the HoNR is a building constructed almost entirely of wood. A structural system of beach wood beams and columns is combined with a hybrid wood-concrete floor and a glass façade. Each was a component of the research project that would find an application in the building. For Prof. Frangi a unique moment to research new construction materials and immediately test them in the building. The HoNR a very modular building offering the possibility to add an additional floor if needed in the future. While in use now, the building is constantly monitored towards the structural behaviour of the construction materials. A very interesting project for the students learn from as a sustainable solution for buildings. of wood beams and columns and a hybrid wood-concrete floor.

Dr. Jasmin Packer

The environmental scientist Dr. Jasmin Packer conducted a hands-on exercise with the students on material and habitats. Each group was provided with a set of materials (mud, wood, branches) and a habitat description. The students had to guess which animal habitat this corresponded to and make it in a short amount of time.

This was an entry for students to the topic of ecology, or the relations of organisms to one another and their physical surroundings. It also raised questions on how animals modify their surrounding by using local materials.She also discussed with students the meaning of resilience, and the importance of habitats that can absorb shocks and changes.

SYNTHESIS

TRANS-MATERIAL SYNTHESIS : Mix design options

After focusing on individual material components students learned about ways to combine them. The students explored the consequences of optimising (or not) the ratio of different grain in an assemblage. First they quantified the grain optimization by comparing final height of column filled with always the same mass but different ratio of sand and gravel. They did the same exercise by mixing fibres and sand. In a second step they observed the effect of the ratio between the solid volume and the liquid volume in a suspension. To do so, they mixed different ratio of grain (either pure sand or sand and straw fibres) and a liquid paste (composed of clay and water). The mixes were examined through slump tests to define maniability of the final product. The last experiment combining different approach and entitled the Habert Test is a matrix with different water and clay ratio in the paste and different paste/grain ratio. The discussion after these experiments summarized the different key points to consider for the mix-design of materials and their relation with the final function of the material (insulation or structure) and its processing technique (pressed, poured).



TRANS-DISCIPLINARY SYNTHESIS : Mission Statement

To conclude the first part of Grounded Materials students were asked to define a mission statement that would serve as a starting point for the design of a sustainable material. The learning objective was for the students to practice being specific about what problem for which they were designing a solution. The assumption was that the materials designed should solve specific problems for a specific group of people in order for it to be of use in the real world. The mission statement or problem definition required to answer three questions:
1) Who are affected by the problem or observation you have identified?
2) What is the unmet demand or need of these people?
3) What is/are the specific insight(s) upon which you have based the answers to questions 1 and 2?
In order to find the three elements of the problem statement, students first collected and summarized the insights of the first week. Second the students identified needs based on site visits and hands-on experiments. Third they associated the selected needs and discussed how different stakeholders could be affected. Finally, they selected from the list of stakeholders and needs the most striking combination that should be solved by the group. In short presentations the groups presented then their mission statements and reasoning as to why they chose it. While the statements could be amended and improved during the second part based on an iterative process of designing a project, this problem definition provided the initial focus for their experimental efforts. This process of problem definition is adapted from the Design Thinking methodology used at the design schools of Stanford University, Potsdam University and variations of the method in corporate settings.



PROF. DR. G. HABERT CHAIR OF SUSTAINABLE CONSTRUCTION

Led by Prof. Dr. Guillaume Habert, the Chair for Sustainable Construction from the Department of Civil, Environmental and Geomatic engineering at the ETH Zürich intends to ground sustainability in all disciplines involved in the built environment. More specifically, the chair seeks to develop research on the following points :

- The identification of the relevant parameters that influence the environmental impacts of buildings at the international, national and regional levels.

- The quantification of the improvement potential for each specific materials during the various stages of its life cycle.

- The implementation of these sustainable practices throughout the proposition of innovative constructive techniques based on a detailed analysis of the technical, economic and socio-cultural situations

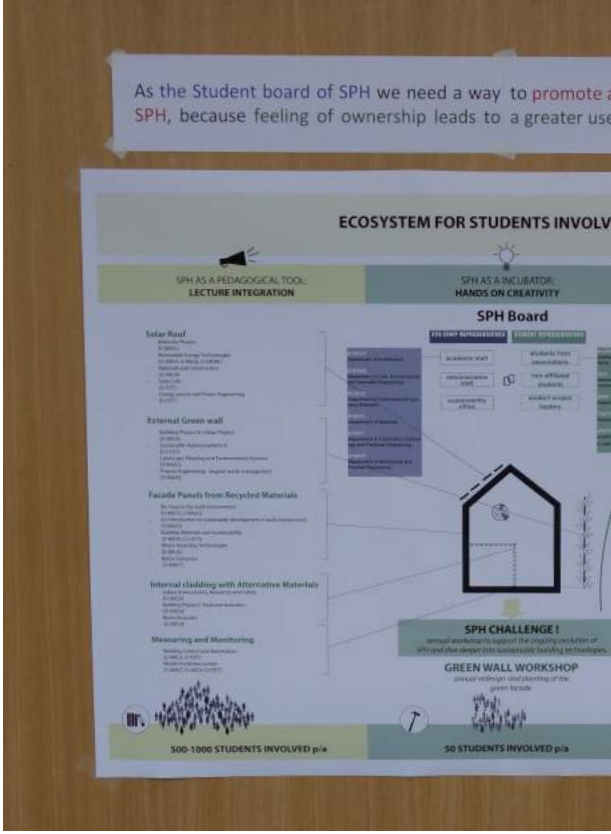
GROUNDED MATERIAL PROJECTS

In the second part of course, the students worked collaboratively on the challenge of developing a Grounded Material in response to their mission statement. They were expected to adopt the perspective of the stakeholder they had decided to represent. Throughout the second week students were tutored by the teaching team, and had the opportunity to go back to stakeholders to discuss their progress. At the end of Grounded Materials, the students presented their project to invited guests. The guests were made up of selected experts and stakeholders and enabled a rich dialogue and feedback on the quality of the material, and its applicability on site. Each group had the opportunity to present in character, representing the stakeholder they had selected. They defended their mission statement, and explained the particular needs their solution sought to address. During the final presentation, we had some rich discussions between students, and invited guests on the design process itself, the viability of their solution and the potential it unlocked. The variety of solutions among the groups highlighted that there are many different pathways to sustainability in the construction sector.

The following learning-evaluation criteria provided a framework to assess the student's performance:

- Relevance of the mission statement compared to socio-cultural and economic constraints discussed with the stakeholders.
- The proposed solution to tackle the identified needs.
- The technical constraints are understood and relevant characterisation tests are used to optimise the product.
- The material optimisation process is clearly explained, and the analysis is based on scientific concepts and guided by a rational approach.
- The strong points are highlighted and potential sources of improvement have been identified.
- The oral expression and the information presented is clear and relevant.


TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
AM
PM

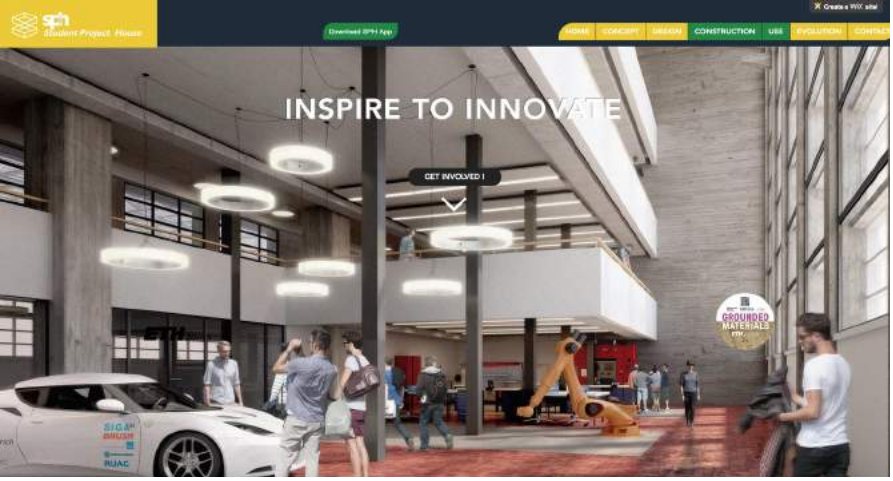

As the Student board of SPH we need a way to promote
SPH, because feeling of ownership leads to a greater use
ECOSYSTEM FOR STUDENTS INVOLV
SPH AS A PEDAGOGICAL TOOL:
LECTURE INTEGRATION
SPH AS A INCUBATOR:
HANDS ON CREATIVITY
SPH Board
Solar Roof
External Green wall
Facade Panels from Recycled Materials
Internal cladding with Alternative Materials
Measuring and Monitoring
SPH CHALLENGE !
GREEN WALL WORKSHOP
500-1000 STUDENTS INVOLVED p/a
50 STUDENTS INVOLVED p/a

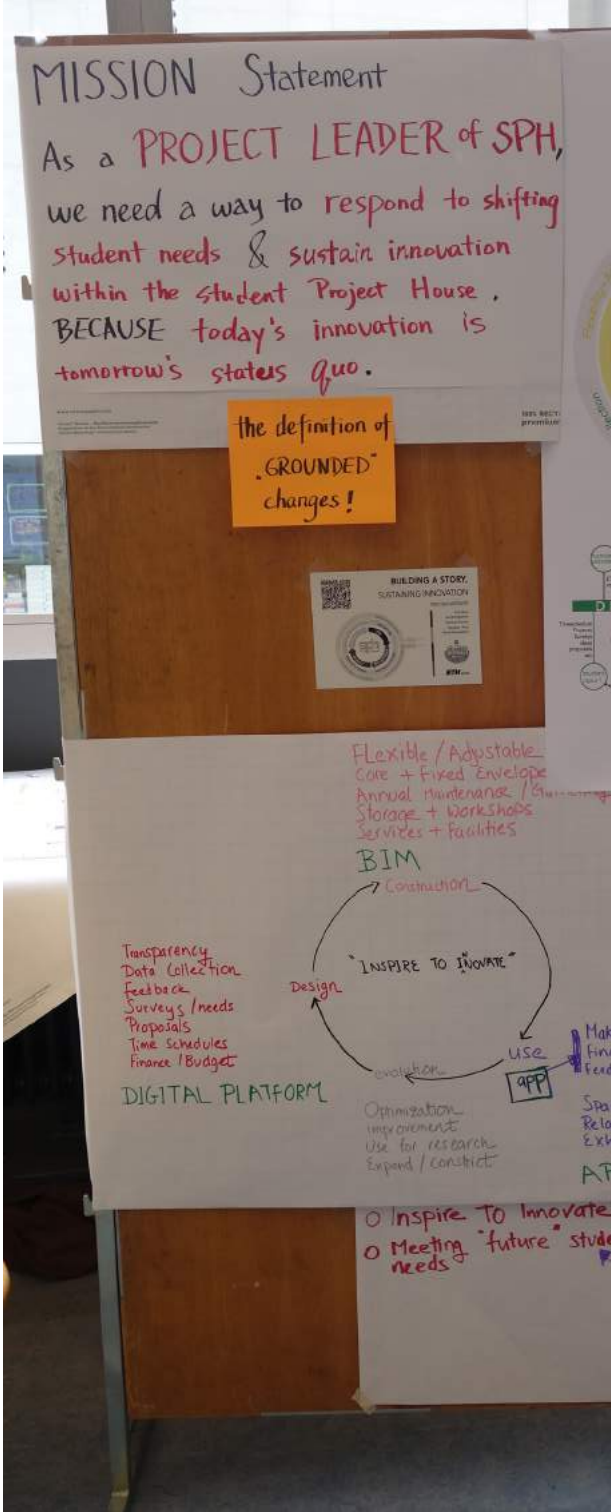

SOUTH FACING SPH
FACADE with WINDOWS
Shading and cooling, reduced sensible heat through evaporation.
Removal in winter to allow for sunlight.
Student design and build of external structure, balcony for green wall access.

PROJECT : GROUP 1

Mission Statement : As the student board of SPH we need a way to promote a greater student involvement in SPH, because feeling of ownership leads to a greater use of the building.

The student group identified different strategies. Firstly, on the organisation level, a SPH board involving students and ETH staff could be responsible of the building and what is happening inside. Secondly, the building itself can be used as a pedagogical test field where students and professors from all departments can perform tests and measures. Finally, the building can also be used as a gathering point for students and friend community. To achieve these different functions, the group proposed removable façade systems and a visible (pedagogical) photovoltaic system where new PV could be installed and tested. The group also proposed a green wall, detached from the building, which will act as a passive shading, but could also be used for urban farming. This will engage students in the maintenance of the wall, create connections between departments and plant the seeds for a community Involvement around this building. It is actually important to think of the involvement of the students once the building is built and not only during its construction. This green façade allows a constant re-appropriation of the building by the new student generation. This can be connected to existing initiatives such as Seed City.


INSPIRE TO INNOVATE
GET INVOLVED !

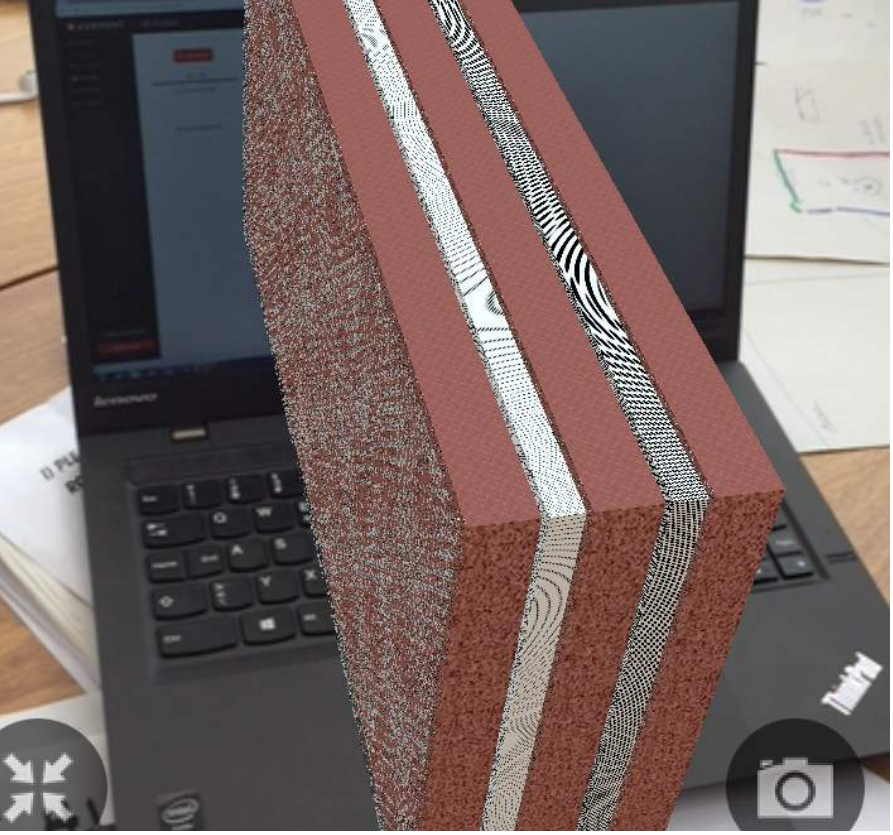

MISSION Statement
As a PROJECT LEADER of SPH,
we need a way to respond to shifting student needs & sustain innovation within the student Project House.
BECAUSE today's innovation is tomorrow's status quo.
the definition of "GROUNDED" changes!
BUILDING A STORY,
SUSTAINING INNOVATION
FLexible / Adjustable
Core + Fixed Envelope
Annual maintenance
Storage + Workshops
Services + Facilities
BIM
Construction
"INSPIRE TO INNOVATE"
Design
use
evolution
app
Transparency
Data Collection
Feedback
Surveys / needs
Proposals
Time Schedules
Finance / Budget
DIGITAL PLATFORM
Optimization
improvement
Use for research
Expand / constrict
Inspire To Innovate
Meeting "future" stude
needs


BUILDING A STOR
SUSTAINING INNOVATIO
https://goo.gl/SOq
Tian
Lea Baumga
Gianluca Ge
Georgios
Randi Nanaya
SPH APP+AR
USE
EVOLUTION
DESIGN
CONSTRUCTION
APP+PLATFORM+BIM
DIGITAL PLATFORM + Data collection
Transparency + Data collection
Optimization + Generation
Make invisible visible
sph
inspire to innovate
WHY?
HOW?
ETH

PROJECT : Group 2

Mission Statement : As a project leader of SPH, we need a way to respond to shifting student's needs and sustain innovation within the Student Project House, because today's innovation is tomorrow's status quo.

The student group 2 identified the project leader of the SPH as their stakeholder. They proposed a digital platform (BIM+) that wouldboth help to plan and maintain the SPH. During the planning phase, the digital platform would enable the discussion between students (future users), ETH (client) and the architect office. It will allow to better identify the needs and constraints of the different stakeholders. The platform would become a digital repository of all documents during planning phase and changes during the use phase that were implemented. Similar to the SPH the platform therefore should drive and sustain continuous innovation not only in planning or construction but also during the maintenance of a building, through the entire life cycle. The platform can help stakeholders interact, communicate and collect their needs related to the SPH. The platform would enable the project leader to react accordingly, involve other stakeholder critical to specific needs or help to solve an issue. The platform would become a digital extension of the SPH and also help garner interest for other students working at the SPH.



Mission Statement

'As the **ETH board** we need an **attra**
appealing way to **showcase researc**
in sustainable construction,

BUT these are often **invisible** or **vis**
uninspiring parts of buildings.'

③ SHOWCASE

- **DESIGN**
  - ➡ Modern appearance
- **MEASUREMENT**
  - ➡ Temp., Humid., Strength to compare with conventional material
- **MODERN TECHNIQUES**
  - ➡ Robotics, BIM, Dyn. El. 4D-Modelling

④ PROMOTION

- **SHOWROOM**
  - ➡ Grounded materials in hands-on experiments
- **WORKSHOPS**
  - ➡ Suppliers, Engineers, Students, Contractors
- **VIRTUAL REALITY TOOL**
  - ➡ Show construction process, structure and building layers, measurements
- **WEBSITE**

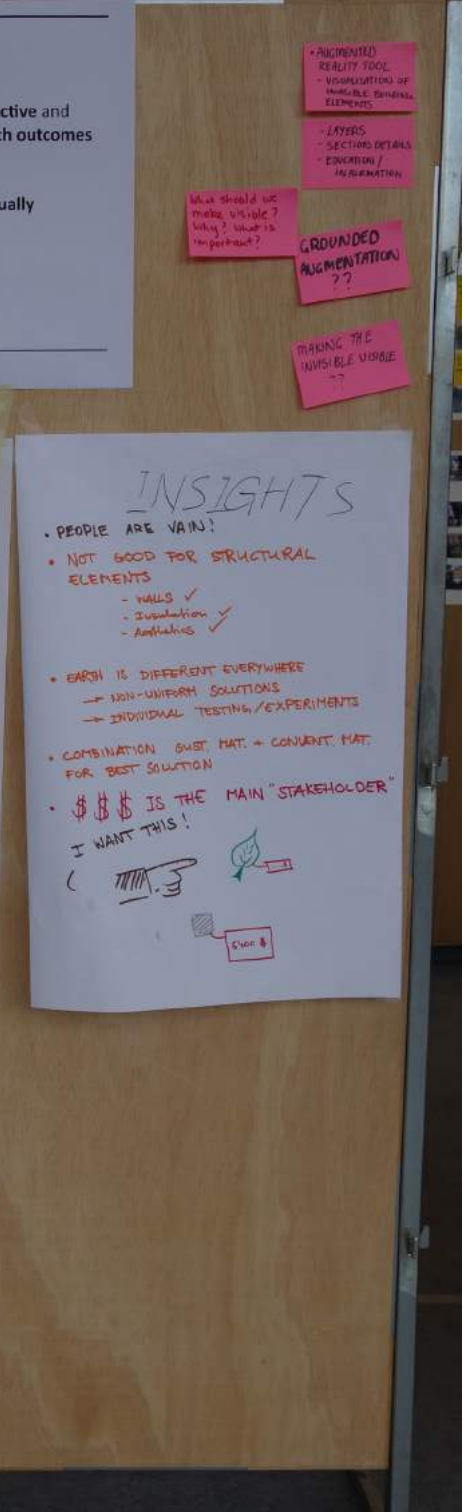
① DESIGN MATERIAL

- **CANTON ZH**
- **GROUNDED MAT.**
  - ➡ local wood, wool, earth, gravel, etc.
  - ➡ Competition with restrictions
  - ➡ upcycled/old mat. from Hönggerberg

② DESIGN STRUCTURE

- **DIFFERENT MAT. + CONSTRUCTIONS**
  - ➡ Different atmosphere to meet the specific needs of each space
  - ➡ Reveal hidden structure by separating spaces with glass sections, draws people to further investigate

GROUNDED COMPETITION!



PROJECT : Group 3

Mission Statement : As the ETH Board we need an attractive and appealing way to showcase research outcomes in sustainable construction, but these are often invisible or visually uninspiring parts of buildings.

The student group 3 defined the ETH Board as their stakeholder and sought ways with modern technology to showcase and promote alternative and sustainable materials. Considering generally finished construction projects, the materials used are often hidden behind a layer of plaster and not visible. The positive aspects of ecological materials and their performance or comfort is also not visible. The students attempted to find ways to make the invisible visible. Using Augmented Reality (AR), the students used an existing App to display a three dimensional model of a building element with all its components and properties. Sustainable materials could be exposed through AR merely by walking through a building even long after it was finished. The group therefore makes use of high-end technology to access and make visible sustainable materials to communicate their strengths compared to conventional materials.


ETH zürich
SEE TO BELIEVE
GROUNDED MATERIALS
PROMOTE
UNUSED RESOURCES
STUDENT INVOLVEMENT
GROUNDED MATERIALS
ETH zürich
PAPER BRICKS
PAPER WALLS

PROJECT : Group 4

Mission Statement : We are an interdisciplinary student group of the Grounded Materials course. We need a way to promote Grounded Materials and influence the Student Project House, because no one's doing it!

The student group 4 identified themselves – students of Grounded Materials – as the stakeholder. They would attempt to promote sustainable and alternative – or Grounded Materials – through the aspect of waste. They researched the amount of material waste at the ETH Zürich Hönggerberg Campus, e.g. how much paper or cardboard was used on a daily basis. Rather than continuing the value chain of recycling these materials they would include an additional use phase as construction materials. For different uses, from internal separation walls to insulating paper bricks and rammed earth walls with built-in passive ventilation. The different construction materials could find different application throughout the SPH and then be recycled. Since a continuous resource was activated they would have continuous supply to renew the materials if necessary. They also attempted to find application outside the SPH due to the abundance of such consumption materials. Finally showing these materials In the SPH would raise the awareness of students on the amount of waste generated on the campus. For instance the amount of waste paper would allow to build 52m2 wall per day with the compressed bricks developed by the students.


GROUNDED
MATERIALS
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY

Video Grounded Materials 2016

In addition to this report, a video documentation of Grounded Materials 2016 was created and can be accessed it via this QR-code. It showcases the different aspects of the summer school and the work of the students.

Teaching of the block course Grounded Materials brought together the knowledge of the chair of Sustainable Construction (SC), the Transdisciplinarity Lab (TdLab) and Atelier Matières à Construire (Amàco) through trans-material and trans-disciplinary approaches. Students received input, did experiments and workshops to develop skills in materials, creating materials, construction with materials and the relationship of materials to stakeholders and their role in the construction industry. The aim is to convey a holistic approach to materials teaching and their role for sustainable development.

PROF. DR. G. HABERT
CHAIR FOR
SUSTAINABLE
CONSTRUCTION

USYS TdLab
Department of Environmental Systems Science
Transdisciplinarity Lab · Science-Society Interface

amàco
ATELIER MATIÈRES À CONSTRUIRE

GROUNDED MATERIALS

ETH zürich

GROUNDED MATERIALS

was hosted by the Chair of Sustainable Construction
and developed in collaboration with the TdLab and amàco.

Chair of Sustainable Construction,
Institute of Construction and Infrastructure Management, ETH Zürich :
Prof. Dr. Guillaume Habert (development, teaching), Sasha Cisar (development, coordination), Gnanli Landrou (teaching), Giulia Celentano (teaching and video), Annette Walzer (support).

USYS TdLab (Transdisciplinarity Lab), ETH Zürich :
Dr. Pius Krüttli (development),
Alice Hertzog (development, teaching), Dr. Bin Bin Pearce (consultancy).

amàco (atelier matières à construire),
ENSAG, INSA de Lyon, ESPCI, Les Grands Ateliers, Villefontaine :
Gian Franco Noriega (development, teaching).

Selected guests and stakeholders :
Ralph Kuenzler (IG Lehm), Sami Weisser, Dieter Baltensberger (Stroba), Dr. Florian Rittiner (ETH D-MTEC), Dr. Maria Håkanson (ETH Student Project House), Reto Grimm (ETH Immobilien), Katharina Keckeis (architect), Dr. Jasmin Packer (Adelaide University), Annette Aumann (Nachhaltiges Bauen Stadt Zürich), Prof. Dr. Alexander Passer (TU Graz), Dr. Sebastien Lasvaux (HESSO)

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Participants (students) :
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