

AVEI NEWSLETTER



The Earth Institute team in action on the PEC Road at the Visitors' Centre

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The weather may be heating up, but the Auroville Earth Institute has still had time in the past two months to push forward its research projects, with exciting developments for poured earth concrete roads and the Auram Crusher.

It has been a time for professional exchange as well with Lara taking part in the Expert Group Meeting in Pondicherry and Satprem giving the inaugural speech at a conference at Anna University, Trichy.

Training activities are at the forefront with three weeks of courses in February, new trainees in the office and on the construction site, and new developments in the courses offered at the Earth Institute.

Please feel free to share this newsletter with your friends and colleagues as we spread the knowledge of earth architecture to the world!

Earthily yours,
The AVEI Team

Expert Group Meeting in Pondicherry

From the 2nd to the 3rd of February 2015, Lara took part in an “Expert Group Meeting on Economy & Energy Efficiency of Buildings in the Tropics” in Pondicherry, India. This expert workshop was organized by Brahmanand Mohanty (faculty of the Asian Institute of Technology, School of Environment), facilitated by Auroville Green Practices, and sponsored by the French Environment and Energy Management Agency (ADEME).

Nineteen experts, including scientists, architects, building engineers and industry representatives, gathered from 4 countries (India, Reunion/France, Sri Lanka and Thailand), to share experiences, identify challenges and

discuss possible approaches to solutions for cost-effective and energy-efficient housing in the tropical region. A wide range of target contexts were addressed in these 4 countries, including urban, peri-urban, and rural contexts. Both active and passive technologies were discussed to reduce the operating energy of buildings. Yet, despite the numerous variables such as target context, technology, geography and social economy of the host countries, the group found common ground on a core set of technical and policy issues applicable to housing in this climate.

In the coming decades, the tropical zone at large is facing unprecedented population density increases, rapid economic growth and lifestyle changes, and alarming levels of emissions from the building sector. Yet, there is comparatively little



research available in building science in this climate to suggest a comprehensive way forward for “no-regret” sustainable growth strategies in the region; strategies that combine climate-sensitive design, appropriate building science, use of technological innovation as well as local design and construction practices.

Accordingly, the group resolved to establish a broad collaborative platform for sustainable housing in the tropics, with the aims to integrate the fundamentals of building science with informed policy making, to promote knowledge sharing and wide-scale dissemination of best practices for the design of low-energy buildings in tropical climates.

Written on the basis of the group's “Declaration on economic and energy efficient housing in the tropics”:

<http://www.agpworkshops.com/blog-detail?blogid=26> ■



International experts who attended the workshop

Soil Crushing with the Auram Crusher

In addition to the Auramix 5000 and Auram 4000 and 6000 presses that are under development (see **Issues 6** and **18** for the full articles), the Earth Institute has also been collaborating with metal workshop Aureka to produce a mechanized soil crusher to further automate the block production process.

The Auram Crusher requires 7 to 8 workers for operation. Six to seven workers fill 50-liter wheelbarrows with dry soil. One worker operates the machine and controls the soil fed into the hopper. The soil travels on a 3 m conveyor belt. This conveyor belt pours the raw soil into the crusher, where a rotor hits the soil and pushes it through an outlet grill. A 5 m conveyor belt takes the soil away to the storage site.



Filling the Auram Crusher's hopper with wheel barrows

The Earth Institute conducted two series of field trials on the crusher in December and January 2014. These trials allowed the Earth Institute to assess the required number and distribution of workers to operate the crusher. It was then sent back to Aureka for minor adjustments.

The Auram Crusher has a theo-

retical output of 12 m³/h, if the machine is constantly loaded to its maximum capacity. However the practical output is 5 to 7 m³/h, depending on the speed of loading and the soil type. By using the Crusher in tandem with the Auramix 5000 and Auram 4000 or 6000, the soil preparation can match the CSEB production speed.

During the Poured Earth Concrete road at the Visitors' Centre (see article "PEC Road at the Auroville Visitors' Centre", **pg. 4** of this issue), the crusher was used to prepare the soil for the poured earth concrete. Soil delivered from the Matrimandir soil quarry was piled close to the crusher and eight workers with wheelbarrows brought it to the feeder.

To see the Crusher in action, go to:

<https://youtu.be/-6DCMx7QEXg>



Filling the hopper and breaking up very large clumps



Tamping the raw red earth slopes up to the roadway



Filling the cement mixer with the PEC

PEC Road at the Auroville Visitors' Centre

In March, the Earth Institute was asked to make a 44 m long stretch of Poured Earth Concrete (PEC) road at the entrance to the Visitors' Centre parking. The goal was to reduce the dust kicked up by regular traffic into the unpaved parking area and to reduce road surface maintenance requirements.

Building on the experiences of two other PEC road experiments at the Earth Institute premises (see **Issues 18** and **20**), the Earth Institute devised a new mix ratio for the PEC wearing course. For 75 liters of red soil, 25 liters of sand were added, along with 210 liters of various sizes of aggregates. The PEC was stabilized with ~8% cement and ~3.3% of lime.

The construction phase began on the 5th of March, with site prepa-

ration and the marking of the levels. Eighty-eight PEC curbs that had been precast at the Earth Institute in the prior weeks were laid along the border of the road and set in place. The sides were filled in with raw red soil, which was compacted to create a slope up to the road surface.

A team of 9 workers used the Auram Crusher to prepare 22 m³ of red soil from the Matriman-

dir soil quarry for the PEC while another team laid down the 10 cm subcourse of varyingly-sized aggregates. The subcourse was leveled with a bobcat and then compressed using a roller.

The PEC wearing course was then cast over two and a half days. A concrete mixer was used to mix the soil, sand, cement, lime, and aggregates and the mix was then carried with wheel barrows to



Casting the wearing course

the sections of the road to be vibrated and leveled. All gaps and cracks were filled in using a trowel. This road experiment provided the opportunity to implement a special system to make split joints every 9 m, with continuous casting. It worked perfectly and made split joints of 2 mm thick, which was the thickness of the metal sheet. The wearing course was completed on the 13th of March. The surface was then raked with a special custom-made scraper mounted with wire brushes to create an abrasive finish and covered with jute cloth for curing. The road has been cured 1 week with jute cloth protecting it and then 3 days exposed to sun, to let it harden before opening the road. The road was opened to traffic on the 23rd of March and curing will go on until the 10th of April so that it may be cured for a total of 4 weeks.

The Earth Institute benefited greatly from this opportunity to



Filling gaps in the wearing course

further fine tune the production and application process for PEC. We look forward to seeing how this revised mix ratio will perform and how the regular vehicular passage will affect the road surface.

To watch a short video summary, see:

https://youtu.be/HrDJVhI_KIs ■

BMTPC Conference at Anna University

Satprem was invited to Anna University in Trichy, Tamil Nadu on the 26th of February for their two-day training program on "Cost-Effective and Disaster-Resistant Technologies". Sponsored by the Building Materials & Technology Promotion Council (BMTPC) and held at Anna University's Bharathidasan Institute of Technology campus, the conference was composed of lectures from professors and professional experts from the area on topics ranging from building materials to disaster preparedness and disaster-resistant building.

Satprem was asked to give the inaugural speech and he lectured on the subject of "Disaster Resistance with Hollow Interlocking Compressed Stabilized Earth Blocks (CSEB)". ■



Raking the wearing course to create an abrasive finish

Recent Visitors to the Earth Institute

Solène Delahousse

The renowned lime specialist Solène Delahousse visited the Auroville Earth Institute on the 24th of February to meet with Satprem and Lara. Solène's decades of experience in the field began when she first studied stucco techniques in Italy back in the nineties. She has gone on to study in detail the intricacies of lime fresco, the Spanish technique of sgraffito, and the Moroccan technique of tadelakt. During her graduate studies, she examined the parallels of modern trends in earthen architecture in France and Mali. Today, she shares this wealth of knowledge through training courses offered in France and abroad.

During her visit, she donated two of her publications, *La fresque, un décor à la chaux* and *Le tadelakt, un décor à la chaux*, to the Earth Institute library.



<http://www.solenedelahousse.com/>

Meskerem Assegued

On the 26th of February, artist, curator, anthropologist and writer Meskerem Assegued visited Auroville and the Earth Institute. She was invited to India on behalf of the Indian Council for Cultural Relations (ICCR), and traveled extensively to learn about Indian arts and culture. Meskerem is the founding director of the Zoma Contemporary Art Center (ZCAC), an artist residency center located in Addis Ababa and Harla (a small village south of Dire Dawa), Ethiopia. She has curated exhibitions in Ethiopia and abroad.

Meskerem and fellow artist collaborator Elias Sime have undertaken a number of projects using raw earth as a material for buildings, sculpture and projects that challenge the limits of each (see photo). They have experimented widely with several vernacular earth construction techniques, in particular, the Ethiopian 'chikka' technique and stabilized adobe and plaster with the traditional Mayan technique of fermented cactus juice.

In 2010, Lara and Meskerem met while Lara was supervising the construction of the Catalan floor system for the Sustainable Urban Dwelling Unit (SUDU) at The Ethiopian Institute of Architecture, Building Construction and City



Development (EiABC). Meskerem later invited Lara to teach a village workshop on Catalan vaulting at ZCAC, with Olivier Moles of CRAterre teaching Nubian vault construction. The Auroville Earth Institute then became involved in extensive testing of the fermented cactus technique, on the basis of the recipe given by Meskerem.

After several years of discussions, it was a very pleasant surprise to have a visit from Meskie, and we look very much forward to future exchange and collaboration.

<http://zcac.weebly.com/> ■

Remembering Frei Otto

Written by Lara

Recently, the renowned architect, engineer and structural artist Frei Otto passed away at the age of 89, soon before he was to receive the Pritzker Prize to honor his lifetime achievements. I wanted to write something personal, to share the enormous influence that Otto's work has had on me as an artist and architect. I was first exposed to his work as a young artist fascinated by the confluence of art and science. The IL publications opened a whole world of knowledge for me in minimum material structures and structural art... Form-finding with nature's rules of economy, the idea of using the least possible material to express beauty in form, e.g. with soap bubbles, tree structures, hanging nets and shells.

Nearly 10 years later, I attended a lecture by structural engineer Werner Sobek at Harvard on the work being done in his office and at the Institute for Lightweight Structures and Conceptual Design (ILEK) at the University of Stuttgart. Impressive, inspiring, future-oriented, technologically sophisticated, I realized that Sobek was the inheritor of the institute begun by Otto in the 1960's. So I requested to be a research intern at the institute.

Working at ILEK under the light-



ILEK tent structure, originally erected as a prototype to test the construction and assembly of the German Pavilion for the World Expo 1967 in Montreal. (photos: ILEK)

weight canopy designed by Frei Otto was a singularly unique experience in my career. Taking the form of a taut soap bubble, the space itself was a 360-degree surround in nature... a tensile membrane structure with a wooden deck and a continuous, tilted glass façade with backstays at human scale. In this space, one's eyes are always turned *upwards* to the cable structure, with its pri-

mary and secondary cables and clamps, and the floating, doubly-curved wooden deck suspended above... or *outwards* to the green gardens around the institute.

I spent that summer combing through the immense archives of the institute, the library at the peak of the soap bubble. In this awesome repository, everything can be found related to natural



structures and constructions, efficient form and lightweight principles ... including minimal cable net structures, tree branch structures, grid-shells, compression structures and shells, bubbles, pneus, bone, forminifera, deployable forms and adaptable architecture. From the biological scale, to the material scale, the architectural scale, and even the scale of human settlements, extensive experiments were performed here to extract the ephemeral design methods and rules of nature's architecture, linking form, force, construction, structure and aesthetics.

The institute has changed a great deal from the time of Otto, with the merged chairs of lightweight and concrete structures (or "massivbau"), and the wider range of modern industrial building materials, steel and glass façade systems, pre-stressed concrete design and ultra-lightweight adaptive structures. Yet the institute has still the same spirit, inspiring study of natural forms and structures, with the indexes of its history in every corner... the soap bubble testing machine and an endless array of models and empirical experiments (e.g. dynamic loading tests of cable nets, tree structures and masonry arches). I admit to representing more of the "old guard" in my short time at the institute... not as a modern engineer, but as a craftsman awed by the beauty and sophistication of structure and material science in simple things like crack patterns in clay.



Empirical testing models displayed at ILEK

I spent the rest of my time at ILEK assisting with research on glass-bending tests to replace the glass façade of the "eye" at the peak of the institute, observing beam bending tests, and contributing to various research papers. For my own work, I wrote a paper on "Lightweight Principles in Masonry Design & Construction". I tried to travel as much as possible to see the most amazing structures of the region, in particular the work of Otto, Isler, Schleich and Sobek; alas I had no money, and mostly confined myself to the library and my imagination.

But the last travel I will never forget. With a deep hope to meet Frei Otto, I took the advice of my friend the slide librarian and sent Otto a letter. I was invited to visit him on the last day before my departure. For four hours, Otto spoke to me with high energy and keen visual memory, asking questions, telling stories about his recent work with Shigeru Ban,

about his experience teaching at MIT in the early 60's, about the places he remembered so vividly from that time. The two most important messages that Otto shared with me: 1. That the weakest materials, like soap, were the key to understanding the best structural form. 2. He told me to look around me always and pay careful attention to my surroundings, to learn from and remember what I see. Perhaps this statement made the greatest impression upon me, because he expressed this with the most urgency. At 83, Otto was already almost fully blind, though still designing. Yet in his lifetime, it was his attention to hidden things of great beauty, form and engineering in nature that left the greatest mark on the world.

<http://www.pritzkerprize.com/2015/jury-citation>

<http://www.uni-stuttgart.de/ilek/1/homepage/> ■

Three New Team Members

The Earth Institute has welcomed three new members to the team.

Beatrice

I'm an architecture student and a Watson Fellow, traveling on a one-year grant to study earth building techniques. My interest in earth building grew out of love of ceramics and an undergrad degree in architectural history. This year I've sought an education in material, a tactile knowledge of earth as a building material on building sites of adobe, rammed earth, cob and CSEB. Ever since my first experiences with pottery I've had an interest in spaces and communities of making – the building site, the workshop, the artist's studio. My project focuses on how vernacular techniques can be adapted to a changing climate and economy. This year as I've made adobes, pressed blocks, and built formwork, I've studied how traditional ways of teaching endure (or don't) and the shifting but persistent importance of working with your hands.

At the Earth Institute I participated in CSEB and AVD workshops, getting an overview of CSEB production and my first taste of structural engineering. For the past five weeks I've been volunteering at Sri Vast Ashram, learning from the masons as they finish the reception building – a

deep dive into earth plasters, pointing and not falling off scaffolding. I'm grateful for the generosity and skill of all my teachers here at Auroville.

Taru

As an electrical engineer currently pursuing my Master's in Ceramic and Glass Design at the National Institute of Design, India, I appreciate the way India has grown in terms of infrastructure, especially in the last two decades, but also feel concerned when I see the disconnect amongst various elements, such as available resources, planning, design details, environmental impact and most importantly, the increase in construction waste.

I was granted the Schmidt MacArthur Fellowship-for 2014 and I looked at it, not just as my duty, but also the greatest opportunity to develop a 'circular economy' model, in the construction sector, relevant to the context of India and other similar countries.

I always looked at Auroville as a system conducive to experimentation and development of concepts. The Auroville Earth Institute facilitated the realization of my idea of incorporating various construction wastes into new construction materials, using the technique of 'Poured Earth Concrete' as the base of this research. The Institute intrigued me, for it celebrates the idea of using earth and earth technology in a way that not only provides sustain-

able solutions for the desperate present day, but also carves a path for a better tomorrow.

Martin

I was first interested in joining Earth Institute last year, to volunteer on the construction site of the AVEI school. It finally didn't happen, as I had already been studying in India for one year and my visa was expiring. Instead, I worked with a carpenter for about three months in the south of France. Taking part in an actual construction process made me understand the importance of materials in architecture in a very practical way, the need to experiment building with more sustainable materials, and also showed me the communication issues that can exist between architects and craftsmen, whereas both have a lot to learn from each other.

So in a way, it made sense to come to Auroville to intern at the Earth Institute to complete my architecture course, to learn how to design and build with earth in a place that links design, construction, research and teaching. ■



Recent AVEI Courses

The Earth Institute's 2015 training courses began in February with three weeks of back-to-back training courses. From the 2nd to the 7th of February, Satprem taught the one-week CSEB Design course to a group of twenty-three trainees, coming from India, the United States, and Germany. The following week, training on CSEB construction continued with the CSEB Intensive course taught by Satprem and Ayyappan, which combines CSEB Production and CSEB Masonry into one week. This course had 38 trainees in attendance, including three Americans, one Spanish, two Italians, and one German. Finally, from the 10th to the 21st of February, 30 trainees attended the AVD (Arches, Vaults, & Domes) Intensive course taught by Lara, which is a combination of AVD Theory and AVD Masonry in one week. The trainees were primarily Indian, but also included one American and one Spanish, as well as two Ivorians, making Côte d'Ivoire the 80th country to be added to the list of nationalities of the Earth Institute's trainees. ■

Earth & Bamboo Workshops 2015



EARTH & BAMBOO 5-day Workshop
 18-22 May, 24-28 Aug,
 12-16 Oct, or 16-20 Nov 2015
 AVEI & Auroville Bamboo Centre

Earth and bamboo are two materials which have been used together for a wide range of traditional construction techniques in Southeast Asia. Both materials are locally abundant and affordable materials with a very low carbon footprint. Both are known to be materials of the people. And both are materials which can be used for crude self-construction or with highly engineered precision. Are earth and bamboo only materials of the past, or are they also materials for the construction of a sustainable future? Please come to discover yourself in this 5-day hands-on workshop at Auroville.

<http://www.agpworkshops.com/> ■

AVEI Training Course Schedule for Mid 2015

April

13th to 18th: CSEB Production
 20th to 25th: CSEB Masonry

June

1st to 6th: Ferrocement
 8th to 13th: AVD Theory
 15th to 20th: AVD Masonry

July

6th to 11th: CSEB Design
 13th to 18th: CSEB Intensive
 20th to 25th: AVD Intensive

September

08/31st to 5th: CSEB Production
 7th to 12th: CSEB Masonry
 14th to 19th: AVD Theory
 21st to 26th: AVD Masonry

AVEI Newsletter

Issue 21 - March 2015
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