

PENS-308

**Argamassa armada**

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Cursus	Sem.	Type
Projeter ensemble ENAC	BA6	Opt.

Language of teaching	English
Credits	4
Withdrawal Session	Unauthorized Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	12
<b>Hours</b>	<b>4 weekly</b>
Lecture	1 weekly
Project	3 weekly

**Number of positions**

**Il n'est pas autorisé de se retirer de cette matière après le délai d'inscription.**

**Summary**

The UE Argamassa Armada will develop prototypes of structural elements in textile reinforced concrete (TRC) for the context of social housing in Nicaragua, based on the knowledge of the TRC Prototype Pavilion at EPFL Fribourg, where the UE will take place.

**Content**

This research through the making is based on the use of innovative Textile Reinforced Concrete (TRC), a material with high mechanical properties where a carbon fabric is embedded in a cementitious matrix cast with low-clinker content binders, like LC3. The use of such binders together with the high efficiency of the reinforcing material allows to dramatically reduce the ecological footprint of construction (use of less material and with lower energy consumption for production). TRC allows thus building very thin and highly durable, and thus very sustainable structures.

The UE aims at further exploring the structural, architectonic, environmental and social dimensions of TRC and its application, especially in the context of social housing in Latin America. Based on the TRC Prototype Pavilion, started in 2019 at EPFL Fribourg and prior research on Brazilian architect Lelé's Argamassa Armada (ferrocement), we will develop TRC elements for social houses in Nicaragua, where the teaching team established a project partnership with *Grupo Sofonias*, an organization working with local communities in the rural area of Jinotepe, Nicaragua. We will also test the use of LC3 cement for TRC, thanks to the collaboration of the LMC lab at the EPFL, a sustainable binder developed at EPFL and already in the way to be implemented in Latin America.

Our working method is a reiterative process of developing through testing at EPFL Fribourg. Architecture, environmental engineering, and civil engineering students will develop a concept of social housing design and build structural elements in textile reinforced concrete, fabricate formwork in folded metal, prepare the textile reinforcement, mix and cast concrete and conceive and test the materials, structural elements and the assembly and behavior of the TRC elements.

**Keywords**

Textile reinforced concrete (TRC), social housing, technological and social innovation, knowledge transfer, interdisciplinarity (architecture and engineering)

**Learning Outcomes**

By the end of the course, the student must be able to:

- Create the conceptual design of social housing
- Assess / Evaluate the needs for housing in developing countries
- Design a structural element / system in textile reinforced concrete for a specific social context

- Construct a formwork system in folded metal
- Dimension a structural element in textile reinforced concrete
- Test structural and material limits
- Assemble the elements to create a shelter

### Teaching methods

Work will take place in an atelier format, through drawing, 1:1 fabrication and collaborative discussions. It will be supported by lectures.

### Expected student activities

Students will need to understand and go through the complete process of analysis, conception, execution and testing:

1. Analysis / understanding of social and technological context
2. Conceptual design of the architectures of social housing
3. Conceptual design of the structure and the structural elements
4. Conception and construction of formwork in folded metal
5. Placement of textile reinforcement in the formwork
6. Casting of concrete, unloading
7. Erection of the elements to create the structure and shelter building
8. Scientific protocol of the technical information and functional layout of the element and casting process

### Assessment methods

Ongoing evaluation: students will be evaluated on the basis of the following criteria:

- ability to work in drawing and 1:1 construction.
- capacity to use testing as a means of advancing an architectural and structural idea.
- collaboration (communication, teamwork, flexibility within different roles);
- Engagement (participation, initiative, responsibility)

### Supervision

Office hours	Yes
Assistants	No
Forum	No
Others	The UE will take place in the Blue Factory in Fribourg. The train tickets will be reimbursed.

### Resources

#### Bibliography

##### *Selected Readings*

Cruz Prieto, Fabio: *De l'observation*. Vina del mar: Inéditos, 1993.

De Oliveira, Olivia: *L'architecture brésilienne sous les projecteurs*. L ARCHITECTURE D AUJOURD HUI 396 72-77.

Ekerman, Sergio Kopinski. *L'œuvre multiforme de Lelé*. L ARCHITECTURE D AUJOURD HUI 396 64-71.

Farias, Bruno Fialho; Netsch, Stefan. *Die Methode Lelé*. BAUWELT 5.14 26-31.

Kaltenbach, Frank. *From tradition to Tourist Attraction - Prefabrication in the Timber Construction of the Dong People*. DETAIL 6/2012 594-598

Kulas, C: *Actual applications and potential textile-reinforced concrete*. Solidian GmbH, Germany, GRC 2015.

Segawa, Hugo; Lima Guimaraes; Ana Gabriela. *Lelé: le créateur, le constructeur, lecontext*. LE VISITEUR 14 / 2009 68-84

Serapião, Fernando: *Fragments of a Lover s Discourse - Brazilian Architecture and Reinforced Concrete*. DETAIL 6/2014 546-554.  
Olmos, Susana Acosta; Cordiviola, Chango; Ekerman, Sergio Kopinski: *Lç humain au cœur de la fabrique architecturale*. L ARCHITECTURE Dç AUJOURDç HUI 396 52-63.  
Schittich, Christian: *Prefabrication- High- Tech and Manual Production*. DETAIL 6/2012 588-598  
Rice, Peter: *An Engineer Imagines*, Artemis 1994

### Ressources en bibliothèque

- [Sobre la observación / Cruz](#)
- [Architecture d'Aujourd'hui, no 396\(2013\): Special Brasil](#)
- [Die Methode Lelé / Farias, Metsch \[online\]](#)
- [From tradition to Tourist Attraction / Kaltenbach \[online in Detail Inspiration\]](#)
- [Fragments of a Lover s Discourse / Serapião \[online in Detail Inspiration\]](#)
- [Prefabrication- High- Tech and Manual Production / Schittich \[online in Detail Inspiration\]](#)
- [Actual applications and potential textile-reinforced concrete / Kulas \[online\]](#)
- [Lelé: le créateur, le constructeur, le context. LE VISITEUR 14 \(2009\), 68-84](#)
- [An Engineer Imagines / Rice](#)

### Websites

- <https://www.epfl.ch/schools/enac/education/design-together-en/enac-summer-workshops/a-prototype-pavillon-in-textile-reinforced-concrete/>
- <https://actu.epfl.ch/news/epfl-students-push-the-boundaries-of-concrete-engi/>