Instructor: Simone Giostra
Mentors: Olga Carcassi, Kunaljit Chadha, Giulia Grassi, Selenia Marinelli, Giulia Pelliccia, Pierpaolo Ruttico

COURSE DESCRIPTION

Over the past 25 years, digital design and manufacturing tools promised to radically transform architecture. Many of these promises, however, remained unfulfilled: if we visit a construction site today, we will hardly find any evidence of living in the 21st century. The same digital manufacturing technologies (3D printing, CNC milling, laser cutting) that transformed many a domain, such as the medical or the military complex, and indeed created entirely new fields of knowledge, have not yet made a real contribution to— let alone disrupt— the design and construction industries.

SCALE-UP! bridges the gap between digital fabrication and architectural scale.

SCALE-UP! brings relevant science to bear on the design practice.

SCALE-UP! connects different areas of knowledge within schools.

SCALE-UP! promotes cutting edge investigation with real-world applications.

Material exploration: work in the course is driven by material practice. The starting point for every investigation is the manipulation of a particular *material* by a specific *technique*. Analogue systems are often used as models for material exploration of physical properties that can be later simulated in a digital environment with the use of algorithms. Each material domain requires critical evaluation in applying a particular set of rules, with practice at its base.

Mentorship: given the wide range of topics offered to students, no single course or consultant could possibly provide specific knowledge and guidance to every student. Instead, the class will work with 'mentors' from other disciplines and areas of knowledge within the Politecnico, including PhD candidates and researchers, as well as with a range of 'experts' from industry partners and engineering companies associated with the program.

Digital tools: Each student will have to learn software that is specific to the topic at hand; working knowledge of Rhinoceros and Grasshopper is highly recommended, but not mandatory. While digital consultants might be available as required, students are expected to be independent thinkers and self-sufficient in finding on-line resources and learning the ropes.

Course Structure: The first part of the semester is dedicated to gathering resources and setting up research projects that are tailored to individual students. State-of-the-art is the first step in the semester, when students become experts in the chosen area of research; this is also the time to acquire digital tools. The second part of the semester is devoted to conducting experiments with both physical analogues and digital models. At the end of the semester each student will have completed the exploration and experimentation of a given technique/material assembly.

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Long-term goal: the course is an entry point for every student with a strong interest in the use of computational tools and strategies in pursue of innovative design solutions with real world applications. It's an incubator to grow research ideas into a workable thesis project, where a selected number of students will be able to extend their research into a thesis with the associated Scale-Up Thesis Lab.

Areas of research: Students will choose from a list of investigations provided by the instructors and supported by mentors or industry partners, collaborating in competence-based 'clusters', yet conducting the work individually.

Topics currently supported by a mentor are as follow:

- Topic 01: Mycelium-based bio-composites — Olga Carcassi
- Topic 02: Tension Active Textiles — Giulia Grassi
- Topic 06: Robotic Fabrication — Pierpaolo Ruttico
- Topic 08: Biodegradable plastic — Selena Marinelli
- Topic 09: Robotic Compressed Earth — Kunaljit Chadha
- Topic 10: Wooden-based Composite — Giulia Pelliccia

If you have your own area of interest or specialty, or you have already chosen a supervisor outside the course or the school, you may choose to work on a topic for which we do not provide a mentor. Below are a few examples:

- Pneumatic and inflatable structures: Inflatable formwork for pre-cast concrete; self-contained pillow structures;
- Cold bending: Cold-bent glass for warped facades; cold-bent concrete formwork;
- Origami and 3-D tiling: Folding geometry for solar capture; active and responsive shading;
- Structural systems: Minimum surface and shell structures; topological optimization;
- Surface geometry: Geometrically actuated thermal flows;
- Organic materials: Seeded 3D printed concrete armatures;
- Biodegradable plastic: Construction materials for degradable construction;
- Lightweight construction: Fabric materials for temporary structures;

The course is in collaboration with Prof. Ingrid Paoletti and the Material Balance Lab.