UNIVERSITÀ DEGLI STUDI FIRENZE
SCUOLA DI ARCHITETTURA

CORSO DI LAUREA MAGISTRALE ARCHITETTURA
CURRRICULUM ARCHITECTURAL DESIGN]

iCAD

International Course on Architectural Design

MASTER PROGRAM

COURSE:	CLASS:
ARCHITECTURE STRUCTURAL DESIGN LAB	SYSTEMS AND COMPONENTS DESIGN

DIGITAL TECHNOLOGY FOR ARCHITECTURAL FABRICATION

FORM MANUFACTURING

prof. Giuseppe Ridolfi, PhD

SYLLABUS

FALL 2014

Architecture structural design lab [cod. D59] **SYSTEMS AND COMPONENTS DESIGN**	**FALL 2014 / 6 CFU**
prof. arch. Giuseppe Ridolfi Phd Email giusepperidolfi@gmail.com Phone: 3357066597	Class Location: room 06, S. Teresa, via della mattonaia 14 Class Hours: Fri 14:00-16:00 Office Location: room 27, Palazzo Vegni, via s.Niccolò 89/a Office Hours: Tu 10:30-12:30

Digital technology for architectural fabrication. Form manufacturing

CLASS OUTLINE

Class description. «Systems and components design» (first year) and «Environmental systems design» (second year) represent the disciplinary contribution of «Technology of architecture» to the two integrated laboratories «Architecture structural design lab» (1st year) and «Building and environmental design lab» (2nd year).
The aim of these two classes is to explore new technologies and related opportunities derived from digital computation and industrial automatic production in conceiving, designing and producing architecture. In this semester, the **«**Systems and components design» class begins with a preliminary introduction to industrial design in architecture and an overview about processes involving generation and management of digital information to support decision-making in constructions known as Building Information Modeling (Revit/Autodesk, 2003), Building Design Advisor (Lawrence Berkeley National Lab, 1993), Building Information Model (G.A. van Nederveen, F.P. Tolman, 1992), Integrated Project Models (Microstation/Bentley Systems, 1984) Virtual Building (Archicad, Gábor Bojár, 1982) and Building Description System (Charles Eastman, 1974). The class then covers a preliminary understanding about the workflow between computational design, building modeling and computer programmable devices for architectural constructions.

More in detail, the class of the first year covers methodologies and skills about the use of software and automatic manufacturing technologies for the production/control of structures, components and elements of buildings. The topic is «Form manufacturing» in which students are asked to study forms and model materials to feed automatic manufacturing in order to fabricate a **«Structural and/or Envelope System Prototype»** to apply in the «Architectural Design» class and to verify in the «Structural Design» class.

For these reasons, the class of this semester is not approaching the building shaping as a mere invention of free-form and software is not intended and used as a tools for rendering, but as a coherent and interoperative process to address the real manufacture of buildings: a new modus operandi for architectural designers. Emphasis is upon the use of 3D Computer Aided Design (CAD), and Computer Aided Manufacturing (CAM) related to the technologies of laser cutting. According to the characteristics of this technology, the class promotes the study of structural plane plates and their generation/assembly criteria. Students' proposals involving different manufacturing systems such as CNC Contouring, CNC Additing, etc. are strongly discouraged although some small parts of the whole system could be fabricated using such a kind of techs.

The class is organized in different stages:

- introduction: from the industrial production as a «zero tolerance» manufacturing to Building Information Modeling;
- shape investigation: intuitive shape research and optimization processes through the observation of natural morphogenesis, architectural case-study analysis and experiments based on transformational methods entailing manipulation of surfaces or objects through procedures such as cutting/stretching, morphing/warping, folding/unfolding, origami/kirigami, waffling techniques and patterning strategies;
- digital shaping and project proposal developing: use of 3d modeling software and other digital tools and plugins for paneling, tessellation and surfaces developing to integrate the previous shape investigation and to support the automatic fabrication of the projects in relationship with the «Architectural Design» class;
- numerical controlled production: study of CAM with specific insights on laser cutting technology and its application in architectural constructions;
- production preparation: data preparation for production addressing specific attention to tolerance, scale and material characteristics.
- production: elements manufacturing and assembling to realize a scaled **«Structural and/or Envelope System Prototype»** as the Final Project Proposal.

Methodology and activity specifications. The class is a fab-lab conceived as an hybrid computer based hands off/hands on activity, supported by the Department's laser cutter Architectural Models Laboratory (LMA), reinforced by theoretical dissertations and intermediate/final Students' Presentation.

Theoretical activities are carried out through teacher's slide presentations integrated by guest lectures on parametric/generative modeling and CAD/CAM data translation; selected readings on digital architecture, new construction technologies and advanced materials; desk-crits; pin-up discussions; poster presentations; individual and collective reviews.
Practical activities are developed through home and in-class assignments concerning case-study analysis on meaningful examples of architectures involving use of digital design and computer manufacturing technologies; natural morphogenesis observations; physical/digital shape manipulations and generations; model making and final manufacturing concerning files preparation to support laser cutting processes and assembling the resulting elements and parts.

Teaching methods include knowledge database online sharing (via Dropbox, Issuu and mainly Mindmup) produced by the concurrent cooperation of teacher and students; managing a personal scrapbook (Taccuino) to gather ideas, suggestions, copies of sketches, assumptions and verifications carried out during the design process. The Taccuino it's also to collect the documentation of the fabrication phase and to show the learning process of each student.

Class goals. Upon completion the class, the student is expected to acquire:

- awareness about the nature, efficiency and constraints of automated production systems;
- capacity to understand contemporary digital architecture;
- knowledge and skills to conceive and manage construction operational workflows and architectural artifacts under the digital technologies of industrial manufacturing;
- geometrical knowledge and skills to operate in form generation and modeling software;
- confidence with spatial aggregations at different scales of plane elements in order to realize structural systems and architectural envelopes;
- abilities to manage the designing process combining architectural design, structural engineering, construction technologies, materials and computer fabrication techniques;
- basic understanding of the computer-numerically assisted fabrication process and, more specifically, laser cutter machines and software to feed them;
- capacity to produce physical models and to test precision and feasibility of architectural ideas;
- awareness on advanced technologies and new materials suitable for digital architecture;
- abilities to conceive communication strategies and to realize effective public presentations through consistent digital instruments.

Assignments and Grade. Student work evaluation is based on the following assignments, relative credits and weights:

1	Individual Taccuino «On form investigation» - Vol. 1 | Diagrams and Realizations > A4 Brochure to submit via Dropbox & Poster Presentation	10%
2	Schematic Proposal > Poster presentation and validation	10%
3	Individual Taccuino «On form investigation» - Vol. 2 | Assembly & Joining Technology >A4 Brochure to submit via Dropbox & Poster Presentation	15%
4	Individual Paper on «Digital Technology and Architectural Fabrication»	15%
5	Final Proposal > Poster and Model presentation for Approval	15%
6	Final Exam > Final Presentation	35%

The Final Exam (credit #06) is focused on the assessment of the Final Project Proposal concerning a **«Structural and/or Envelope System Prototype»** to be applied in whole or in parts of the architectural building developed in the Design Class and to be schematically verified in the Structure Class. The Student has to communicate succinctly her/his results through the Final Presentation showing:

- concept, compositing diagrams and project references as an excerpt of the Taccuino researches
- renderings of the proposal in relationship with the architectural building developed in Design Class
- general and detailed drawings
- graphic and schematic report of the structural verification
- numerical controlled model prototype
- documentation of the conceiving and manufacturing process

Materials to submit for the Final Exam are:

- Taccuino «On form investigation» - Vol. 1 | Diagrams and Realizations (format: UNI DIN A4 / horizontal)
- Taccuino «On form investigation» - Vol. 2 | Research on «Assembly and Joining Technology» (format: UNI DIN A4 / horizontal)
- Final Project Proposal (1 poster format: UNI DIN A1 / vertical)
- Scaled Prototype of the Final Project Proposal with photo/video documentation
- Slide presentation
- CD/DVD collecting all the files produced by the student

Grades are expressed in thirty taking in consideration originality, creativity, refinement, dedication, attention, completeness, correctness:

- 30L- 29 exceptional evaluation, awarded to students whose work is outstanding
- 28-27 distinguished evaluation, awarded to students whose work is good
- 26-24 average evaluation, awarded to students whose work is adequate
- 23-18 low evaluation, awarded to students whose work is sufficient but not completely satisfactory in all the aspects
- <18 insufficient, awarded to students whose work failed in several aspects

- NC «not classified», awarded to students whose work is missing or presents severe lacks.

Attendance. This is an occupational class, and attendance is important. Class policy establishes that if the student is not attending compulsory classes (see the Class schedule) or has collects more than three absences in normal class fails the exam. In any case, the professor is not responsible for students who are not receiving information due to their truancy although most of the information is accessible on line.

Academic integrity and honesty. The class is against plagiarism and dishonesty. Cheating, appropriation of materials from other authors without crediting them and re-using researches or projects done in previous course without appropriate authorization is a violation of the University's code of academic integrity. Penalties for such violations can result in loss of credits, to fail the course and, in severe cases, to incur legal actions. Students are invited to place clearly source references and credits in appropriate way using standard conventions.

Class requirements. The student attending the class is required to have her/his laptop with preinstalled 3D CAD software, raster/vector graphic programs and any other digital tools for visual communication and public presentations. Plugins and other specific software useful to support the activities of the class will be available for free downloading during the semester.
Although the class is an introductory teaching on BIM and 3D CAD/CAM, each student is expected to have confidence in CAD with a basic understanding of solid modeling and to be skilled in graphic design for final and intermediate presentations.
Because the class is not providing any teaching about the use of CAD and graphic software and considering that the class proceeds from scratch to advanced modeling techniques and to the parametric/generative design of the second year, the student is strongly recommended to enter the short course provided by the «Laboratorio Informatico del Dipartimento di Architettura (LIA)» in order to reinforce their skills and abilities. Date of submission and topic of the short courses will be given during the class.

In addition, the student is required to have completed studies on traditional materials and technologies for architectural constructions.

Bibliography and Resources. Bibliography, reading materials, lectures integrations, tutorials to assist assignments and other resources including the Syllabus, the Class Schedule are available online at the **Course Map**. The student is required to access regularly the Course Map to check news and resources update.

Major topics and Tags. Architectural industrial design, digital design, automated fabrication, BIM, CAD/CAM, digital modeling, folding, interoperability, kirigami, laser cutting, morphogenesis, origami, structural plane plates, tessellation, waffling, zero defects manufacturing.