Course Guide to CEE 135a

Parametrics: Applications in Architecture and Product Design

Introduction

This course has been developed collaboratively by the Architecture / Civil Engineering and Product Design Programs. It explores the process of designing both architecture and products using a common approach known as Parametrics – a methodology for design exploration and customization. A parameter in this context is a variable, which the designer can manipulate to rapidly generate many unique design configurations that follow a specified logic. For example, Figure 1 shows four designs for a high-rise tower generated from the variation of a single parameter in a digital model. This course will use parametric software in conjunction with Computer-Aided Manufacturing (CAM) technology to quickly create physical prototypes of digital models.

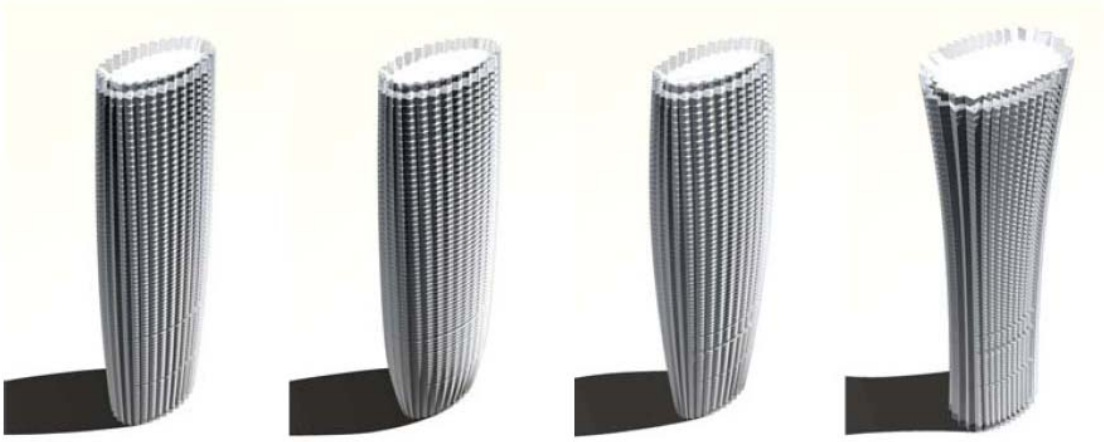

Figure 1: *Four high-rise designs generated from the same parametric model*

Parametric design and rapid prototyping have been utilized for many years in product design and are becoming increasingly popular in the Architecture, Engineering and Construction (AEC) industry. However, the use of these technologies differs in each case. In general, the product design process is closely informed by how a product is to be made in volume, and product designers often have an intimate understanding of materials and manufacturing methods used. Product designers are typically able to build prototypes at a scale that closely approximates the final product and, in some cases, using similar fabrication techniques. Architectural projects, by contrast, are almost always unique – tailored to a particular site and client– although often using standardized set of building components. In

addition, architects often must prototype at a scale and using technology which is far removed from how a project will actually be constructed.

This course will include design projects at the scale of both architect and product. Students will learn to build parametric models which are responsive to customer needs, environmental factors, fabrication and/or other concerns to rapidly explore design ideas. These assignments are designed to provide a fresh perspective and a basis for comparison of the creative process as viewed by architects and product designers.

Objectives

- Provide methods for and experience in defining and systematically exploring design ideas and communicating this process to others
- Achieve proficiency with parametric modeling software and creating physical prototypes from digital models using CNC machinery (laser cutter and 3D printer)
- Develop the ability to critically assess a given design logic / process and its impact on the range of possible solutions

Course Structure

Classes

Meet every Monday and Wednesday from 10am to noon in room 292A of the Y2E2 building. Time will be divided equally between lecture and studio / workshop components.

Lectures

The lectures are structured to give students a background in parametric design and physical prototyping. Topics include design theory, precedents in architecture and product design, as well as methods for modeling, prototyping and fabrication.

Workshops

Workshops are designed to familiarize students with parametric modeling software and rapid prototyping methods. The workshop time will also be used to mentor individuals and teams on their design projects.

The Teaching Team

The instructors for the course are Forest, Scott and Thomas. We each come from different industries (engineering, product design and architecture, respectively) and have applied parametric methods on a variety of projects ranging from prosthetics and furniture to sports stadia. For more information on our qualifications and expereince, please see the course Wiki (address below).

Name	Contact	Office Hours
Forest Flager	forest@stanford.edu	Fri 10am – 1pm or by appointment
Scott Summit	summitid@pacbell.net	Mon/Wed noon-1pm or by appointment
Thomas Wingate	twingate@stanford.edu	By appointment

In addition to our experience, we will bring in practicioners from ***Frank Gehry and Associates*****, Arup, Apple** and other companies who will explain how they use parametric design and rapid prototyping in their respective practices and will provide you with feedback on your work.

Assignments

The primary assignments for the course will be completion of three design projects:

- Project 1: Eyewear
- Project 2: Beverage Container
- Final Project: Bus Station OR Straw Bale Home

The projects will be done individually or in small teams. The deliverables will vary by project but will generally involve a presentation describing the design process and final result as well as a 3d parametric model file and, in some cases, a physical prototype.

In addition to the three projects, there will a couple of short assignments based on class excercises and/or discussion.

Grading Policy

Parametric design requires a different approach to the design process and a different way of working than what you may be familiar with. Students will be evaluated based on their demonstrated understanding and originality in applying parametric methods as evidenced in the three design projects. The teaching team understands that students taking the course will have varied 3d and parametric modeling experience and will take this into account when grading assigments.

Student participation in class discussion as well as reviewing and discussing your peer's work on the course Wiki is a key component in the learning process as reflected in the grading breakdown below:

Item	% of total grade
Project 1	15%
Project 2	25%
Final Project	50%
Participation / Class Excercises	10%

The Wiki

All materials, announcements, assigments and grading will be posted on the class Wiki:

http://php.twofourfour.org/dokuwiki/start

Each student will have a private area where they can upload assignments and review grading. Once class assignments have been turned in and reviewed by the teaching team they will be posted in the public area on the Wiki so that you can view and comment on each other's work.

Software / Technology

Most of the design projects will require a 3d parametric digital model as a deliverable. Students can work in whatever software they are most comfortable with to produce the models. No previous modeling experience is required for the course. We will provide formal instruction in Digital Project (DP) software which is based on CATIA, a comprehensive design and manufacturing platform commonly used in the Aerospace industry:

http://www.gehrytechnologies.com/index.php?option=com_content&task=view&id=97&Itemid=211

DP will be installed on the cluster machines in the room where the course is held (Y2E2, rm 292A) and can be installed on student machines if so desired.

Part of the course will also involve creating phyical prototypes of your designs using a laser cutter and FDM (3d printing) technologies. We will use the Product Realization Laboratory (prl.stanford.edu) on campus for this purpose. To use the lab you are required to pay a fee (which will be covered by the course budget) and attend a short safety briefing.