48-749 Special Topics
Parametric Modeling with BIM
Fall Semester 2010 • 6-12 units • 1.30-4.20 • CFA 213

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Lecture 1

- Course introduction
- What is BIM?
- How we use it in this course
- Overview of Revit 2011
Course Introduction

- This course is to prepare students for modeling architectural geometry through development of parametric schemes for architecture applications.

- For students with no programming background, this course is a half-semester course, which supplies the basis of understanding parametric geometric construction mechanisms.

- For all students, the full semester course is regarded as the venue for pursuing individual projects relating to advanced geometric constructions with parametric computation.

- The course will use Revit Architecture 2011, Revit API and .NET framework.
Course credit (6-12)

- All students are initially evaluated for 6 units (half-semester course). Students who score at least B- at mid-semester may proceed to the full semester course for credit.

- The project and any accompanying preparatory assignments will be worth an additional 3 units.

- Students may add to their skill and degree of difficulty by completing a Revit-based advanced parametric modeling assignment for an additional 3 units. This is required of all Computational Design students.
Course Motivation

- BIM tools, such as Revit, offer a parametric 3D model which can generate information early in the design process (quantity take-offs, solar studies, day-lighting simulation, fabrication possibilities)

- With more parametric control over designed components, designers can explore variations, analyze design artifacts, customize components for evaluation and be more efficient.
## Course schedule

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What is BIM?

From Information Science Definition

- As a noun – Building Information Model
  “An instance of a populated data model of buildings that contains multi-disciplinary data specific to a particular building which they describe unambiguously”

- As a verb – Building Information Modeling
  “The act or process of creating a Building Information model”
What is BIM?

- The acronym BIM (Building Information Model(ing)) was coined in the early 2002 (attributed to Phil Bernstein and Jerry Laserin though the concept predates this by at least 15 years)

- BIM relies on the creation and collection of interrelated computable information about a building project
What is BIM?

BIM processes revolve around virtual models that make it possible to share information throughout the building industry.

http://bim.arch.gatech.edu/data/reference/hok.pdf
What is BIM?

- These models are embedded with data, which, when shared among design team members, can reduce errors and facilitate an integrated process.

- The federal government has predicted savings of $15.8 billion annually from an integrated process by using BIM.

(BIG BIM little bim-Finith Jernigan)
What is BIM?

- BIM is an information based system that builds **long term value** and advances innovation
  - It can improve how projects are designed and built
  - It improves the environment and builds economic value
- BIM can be looked at in this course as “**Beyond Information Models**” to understand the nature of the concept
- For clarity we will use **bim** to represent applications—Archicad, Microstation/GC and Revit bim tools
What BIM is not

- BIM is neither a single building model nor a single database
  (series of interconnected models and databases)

- BIM is neither perfect nor a panacea
What BIM is not

- BIM does not have to be only 3D.
  - Example: A spreadsheet can be a BIM

- BIM is not complete

- BIM is not a software application—
  (eg, Revit, ArchiCAD or Microstation/GC etc)
How BIM is used pragmatically

- As a distributed relational parametric database
- So where does the knowledge manifest itself?
How BIM is used in this course

- Focus is on the power of bim tools primarily but not limited to evaluate facets of sustainable building design

- Using information from a BIM we are able to count, sort and calculate different requirements set by sustainable building rating systems
  - Material resources
    - Recycled material content
  - Water resources
    - Water usage and savings
  - Energy use
    - Energy use reduction by optimizing façade/envelope of building
How we have used BIM

- Sustainable building rating systems are defined as tools which examine the performance or expected performance of a ‘whole building’ and translate that examination into an overall assessment that allows for comparison against other buildings.

- LEED (Leadership in Energy and Environmental Design) – USGBC

- BREEAM (Building Research Establishment’s Environmental Assessment Method) – UK

- CASEBEE (Comprehensive Assessment System for Building Environmental Efficiency) – Japan
## Overview of rating systems

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BIM example 1
Structure of our Application
Dot Net Application (Automating LEED Evaluations)
Evaluation example- calculating LEED SS 2 (site density)
Evaluation example - calculating LEED SS 2 (site density)
Ongoing Evaluations- calculating LEED SS 2 (creating mass model for site density)
Revit as a BIM software

- Creates a 3D ‘parametric’ model which produces an abstraction of plans, elevations, sections and schedules using databases.

- Propagates and manages changes throughout these databases so that a change to any part of the database is reflected in all other associated parts of the database.

- Captures and preserves information for collaboration and reuse by additional industry-specific applications.
Revit as a bim software

- Bidirectional Associatively
- All views (e.g., plan, section, schedule) use the same database
- No updates needed (automatic)
- Parametric Relationships
  - Software manages and coordinates changes

Example:
You have equally spaced windows across an elevation. Length of elevation changes. The spacing between the windows changes but the relationship of equal spacing is maintained
Revit vs. AutoCAD

- Revit is a true architectural model (not just geometry)
- Revit is parametric
- Revit uses “families” not blocks (e.g., doors, windows)
- Revit uses alignment instead of osnaps
- Revit has multiple design views (plan, elevation, perspective, section)
Revit vs. AutoCAD

- No command line or layers in Revit
  - Visibility controlled by categories
- Revit uses single file, multiple users projects
- Revit imports/exports AutoCAD file type (.DXF and .DWG)
Revit Fundamentals

- Revit ‘Parametric’ Elements
  - Every Element in Revit is considered a family
  - Each family belongs to a category
Revit Fundamentals- Model

Manage > Object Styles

Model categories include elements like walls, floors, roofs etc.

Model elements appear by default in all view-plan, elevations, section and 3D views

Detailed components only appear in views that they are placed.

Projection view shows elements where they have not been cut
Revit Fundamentals - Model

Detailed components only appear in views that they are placed.

Projection view shows elements where they have not been cut

cut lines

projection lines
Revit Fundamentals- Annotation

Annotation categories include annotations, symbols and descriptive data.

Examples - dimensions, tags, callouts

Annotations such as grids, sections, levels are 2D graphics but have 3D characteristics as they appear in other views.
A parametric element is something which can change size, material and graphic look but is still the same fundamental element.

Most elements in Revit allow for the creation of variations of a base type.

- Example each type of door typically represents a variation in size, material, color, but is derived from the same family.

- Type parameters affect all instances in the same family.

- Instant parameters affect only the selected instance.
Revit Families

- System Families
- Component Families
- In-Place Families

Difference lies in their creation methods, in what context they are created and the types of parameters available.
Revit Families- System Families

- They are made of limited categories—walls, roofs, floors, ceilings, stairs, railings, mechanical equipments and topo surfaces

- They have different creation methods:
  - Walls – draw/place a wall
  - Floor/Roof – has to be in Sketch Mode then it generates a 3D model
  - Floors and railings more detail in Sketch Mode that has additional features that floors do not have
Revit Families- Component Families

- Components or standard families are created outside the project environment using the family editor. These are stored in an external library which can be loaded into the project.
- Each component belongs to a specific Revit category.
- They have their own extension .rfa
Revit Families- Component Families

- Go to insert tab > Choose Load Family
Revit Families- In Place Families

- In place families are custom elements that are specific to a project and the conditions of the project.

- The model grays out and becomes in-selectable when such families are made.
  - Example, a non vertical wall shape or skewed mullion

- These can be copied from project to project

- These do not interface well with energy modeling, day lighting tools or direct-to-fabrication.
Family Creations & Manipulations- component

Wall Family _ Comer

Image by Taihung Chen & Chingyi Chou, GSAPP, presented at NYV Revit User Group Meeting (designReform.com)
Introduction to Revit 2011

Cluster: Baker 140C

OR

Download from:
http://students.autodesk.com/
Revit 2011 Interface Overview
Revit 2011 Interface, Application menu

- The big purple R on top left
- It allows to open and create new-existing projects/families
- Allows to save and export in various formats
  - RVT = Revit Projects
  - RTE = Revit Templates
  - RFA = RevitFamily
Revit 2011 Interface, Application menu

Option allows the following settings:

- File location
- Settings relevant to steering wheels
- The view cube
- Spelling
- Macro
- General settings—such as saving time intervals
The ribbon is organized in tabs and panels

Nine Tabs
- Home
- Insert
- Annotate
- Structure (this is new in 2011)
- Massing and Site
- Collaborate
- View
- Manage
- Modify
Revit 2011 Interface, Ribbon

Home - contains all tools to create 3D elements

Insert – imports and manages CAD files and Raster images

Annotate – Contains all tools for adding 2D elements to describe building model in a project
Revit 2011 Interface, Ribbon

Structure – Tools that deal with structural elements and their details

Massing and Site – creating and modifying conceptual mass models

Collaborate – Tools that aid in collaboration on the same project
Revit 2010 Interface, Ribbon

View – Many views are different queries into the Revit database

Manage – Design options as well as project related settings are located here

Modify – Once elements are created they have to be changed or edited
Revit 2011 Interface, View window

Steering wheel and View Cube

View Controls

1/8" = 1'-0"
Revit 2011 Interface, View window

- **View Controls**
  - Scale
  - Temporary/hide
  - Crop view
  - Model graphic style
  - Detail level
  - Graphics display option
  - Show crop region
  - Reveal hidden elements
  - View Controls
  - Steering wheel
    - Allows 2D zoom, pan and rewind

1/8" = 1'-0"
Revit 2011 Interface, View window

Navigation Wheel (F8)

Right click and choose Options… to set the Steering Wheel parameters
Revit 2011 Interface, View window
Revit 2011 Interface, View window

Graphic display options
Revit 2011 Interface- Units and settings

- Units for the following can be set for a project by going to the Manage Tab > select Project Units
Revit 2011 Units and settings

- For Snaps go to Manage Tab > snap; The Dimension Snap is the increment, in which the cursor moves while creating components.
Revit 2011 Project browser
Revit 2011 Elevation markers

For Elevation markers View>Elevation
Revit 2011 Lesson 1

Exercise 1-3
- Open, Save, and Close an Existing Project

Exercise 4
- Creating a New Project
  - Set units
  - Set project information

Exercise 5
- Using Zoom & Pan to View Drawings

Exercise 6
- Using Revit’s Help System
Exercise 1-3

Open Project Basic Sample Project
Exercise 1-3

Open Another Project: Advanced Sample Project
Exercise 1-3

And another project
Exercise 1-3

Toggle between projects
Exercise 4

- Create a new Revit project

- Template Files
  - Units set (e.g. Imperial or Metric)
  - Wall, door, and window family styles defined
  - Title blocks inserted
Exercise 5

Using Zoom and Pan to View a Drawing
Exercise 6

Use Revit’s Help System