Subject Number(s)
4.507/4.567

Subject Title and Subtitle
Introduction to Building Information Modeling in Architecture

Term offered
Spring 2022

Instructor(s)
Takehiko Nagkaura

In collaboration with Timo Riekko (Alvar Aalto Foundation, Helsinki)

TA(s)
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Credit Units
3-2-7 U/G / 3-2-4 G

Level
U: 4.507; G: 4.567

Prerequisites
None

Schedule

Lecture/Review	Thursday, 9:00am-10:30am (1-132)
Demo/Lab/workshop	Thursday, 10:30am-Noon (1-132)

Subject Description
This course addresses fundamental methods, theories, and practices that engage contemporary modeling tools in the context of architectural design. It introduces selected academic and professional topics through lectures, demonstrations, and assignments. Topics include component types and assembly, parametric modeling, visualization, simulations, and scripting. Students are expected to initiate intellectual explorations through the use of Building Information Modeling software (Revit) for architectural design projects, and to develop foundations to apply it to their own research projects and design practices later.

For Spring 2022 class, Alva Aalto's design projects are used for analysis. For modeling and simulation, archival resource (drawings and photos) is provided by Aalto Foundation in Helsinki, and outcome of some student projects may be included in their upcoming exhibition in Europe.

List of Subject Objectives
Ability to represent an architectural project through BIM software
Analyze an architectural design through making a BIM model
Learn the theoretical background of BIM software
Learn research opportunities in application or development of BIM software

Evaluation Criteria

Final grade is based on 2 projects and attendance (i.e., class participation). The progress of each project will be reviewed at a constant pace during the regular classes. <u>The class ends with a final review (project 1+2) during the last class, and there is no exam during the exam period.</u> The weight of each portion for grading (9 unit option/12 unit option) is below.

> Project 1: Modeling/Simulation (50%/45%)
> Project 2: Parametric Design and Advanced Visualization (40%/45%)
> Attendance (10%)
> > * Dynamo application is a topic covered at the end of the semester. Students who applies for 9 unit option are not asked to include Dynamo exercise in the Project 2.
>
> > * Each project is evaluated in terms of completion, timeliness, and quality of presentation.

Schedule of Exercises, Projects, Quizzes, Exams or Assignments

class 01
Thursday
2020.02.03

Introduction
History: BIM vs. Geometric Modeling

Project 01 out : Design Analysis/Simulation
Demo: Revit Basic Interface, View/Projection, Grid and Levels
Lab: working session

class 02
Thursday
2020.02.10

Ontology of Architectural Types
Progress check: Resource compilation
Guest: Timo Riekko (Curator, Alvar Aalto Foundation)

Demo: Pre-defined Parametric Types, Constraint Propagation
Lab: working session

class 03
Thursday
2020.02.17

Projection and Perspective
*Progress check:*Design Documents

Demo: Transformation, Group/Link, Area/Rm, Sheet/Schedule
Lab: working session

class 04
Thursday
2020.02.24

Image Processing, Visualization
Progress check: BIM model

Demo: Raytracer, Day-lighting, Photometric Light (IES)
Lab: working session

class 05
Thursday
2020.03.03

Integrated System
Visual Representations

Demo: Material, Walk-through, Topography
Lab: STL/DWG conversion (for 3D printing)

class 06
Thursday
2020.03.10

Analysis and Simulations
Construction, Energy, and Structural

Demo: Green Building Studio, Robot, Navisworks
Lab: working session

class 07
Thursday
2020.03.17

Presentation: Project 01

Thursday
2020.03.24

Spring Vacation ------------------------
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class 08
Thursday
2020.03.31

Revisiting Parametric Types in BIM

Project 02 out : Adaptive Design (Generative/Parametric)
Demo: Custom Types (Family), Progressive Modeling

class 09
Thursday
2020.04.07

AR/VR and BIM
Design and Globalization

Demo:AR/VR/Unity 3D

class 10
Thursday
2020.04.14

Subdivisions and Parametric Types

Demo and Lab: Adaptive Component
Typology BIM (Nagakura and Sung)

class 11
Thursday
2020.04.21

Visual Programming

Demo and Lab: Dynamo, Revit API/SDK

class 12
Thursday   Coding Process and Knowledge   Demo and Lab: Dynamo, Revit API/SDK
2020.04.28   Guest lectures   BIM and practice (Front, Boston)
                    Final presentation. (Students for 9-unit option)

class 13
Thursday   Final presentation. (Students for 12-unit option)
2020.05.05

Tuesday   Last day of MIT class followed by the exam period (May 13-18)
2020.05.10

Textbooks and Reading Sources

None. All custom resource (digital files for tutorials and demonstrations, links to examples) are online. The followings include the snapshot of the resource page.

http://cat2.mit.edu/4.567/2020s/samples.html

Tutorial 00
   Install Revit 2019/2020 (Use free educational version: Make sure to register as student)
   Autodesk Revit Videos and Tutorials (Revit 2019/2020)
   Linkedin Learning (Formerly Lynda.com) for MIT: This is a commercial site providing on-line software
      tutorials on video. Via the above link, MIT community members get free access if you use it on MIT
      network or with MIT certificate on your machine. Once you get into the home page, pull-down
      Browse the Library menu and click CAD. Revit appears under CAD Software category on the left
      column of the page. My suggestion for a new learner is to use the one for Version 2017 (choose it
      from the left column) such as Revit Architecture 2015 Essential Training with Paul F. Aubin.

Tutorial 01
   Demo file: Revit 3D model modified from AutoDesk tu torial site (.rvt, 7MB)
                        Revit 2017 version, Revit 2020 version
   4.560 Analytique
   Photoshop Channel and Mask Demo
   Demo file: images for photoshop demo (zipped jpg files, 1Mb)

Tutorial 02
   Demo file: Citrohan House - Grid and Levels (.rvt, 2.5MB) Revit 2017 version
                        Revit 2019 version   Revit 2020 version
   Renaissance Revit by Paul F. Aubin: Interesting book on modeling classic elements in Revit
   Autodesk A360 for sharing a project on cloud

Tutorial 03
   D'Espouy Analytique
   QuickTime example
   Demo file: Citrohan House - Stairs, Curtain Wall, Link and Sheet (.zip, 2.7MB)
                        Revit 2017 version   Revit 2019 version
Tutorial 04
   Demo file: Citrohan House - Rendering, Photometric Lights and Textures (.rvt, 7MB)
   Lighting fixture catalogue with photometrics

Illumination Transformation Example with IES Lights

Tutorial 05
  Demo file: Citrohan House for site modeling (.rvt, 5MB)
                                 Revit 2017 version   Revit 2019 version
  Sample Revit animations
  Sample animations from 4.562
  Demo file: Sample model for animation (.rvt 5.4Mb)
                                 Revit 2017 version   Revit 2019 version

Tutorial 06
  Demo file: In-Place Element, In-Place Mass (.rvt, 5MB)
                                 Revit 2017 version   Revit 2019 version

Tutorial 07
  Demo file: Custom Family part 1 and 2 (.rvt, 3MB)
                                 Revit 2017 version   Revit 2019 version

Tutorial 08
  Demo file: Curtain Wall and Surface Division (included in the zip for of Tutorial 09)

Tutorial 09
  Demo file: Conceptual Mass and Adaptive Placement Points (.zip, 2MB)
                                 Revit 2017 version   **Revit 2019 version**
  On-line tutorials/samples

Tutorial 10
  Shape Grammar examples
  Demo file: NITROS plug-in for Autocad (.vlx 100k)
  Demo file: Sample model for addendum (.rvt 7Mb)
  Demo file: Adaptive Placement Point with XYZ axis arrow (.rfa 7Mb)
  Demo file: VSTA example files (.rvt 6Mb) demo-09_VSTA_sample.zip

Tutorial 11
  Dynamo: Dynamo script examples (The files to go with the class note handout.)
  Dynamo: Revit project that works with the Dynamo script examples
  Site of Ian Keough, who initially created Dynamo and his original Dynamo download site

Lab Fees (if any)
No cost for MIT architecture students. Students from other school may need to pay for the cost of 3D printing a small model.