02. 3D Visualization of Design

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CAD & Graphics II | HOM2027 | Fall 2014 | Every Friday 2:00 pm – 6:00 pm

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What to do today

1. Lecture: 3d Visualization of Design

2. Technical Note & Setup: Accessing local area network in Rm #504

3. Lab exercise: Rendering scenes in SketchUP + Vray
   - Setting up your Lab Exercise environment
   - SketchUP + Vray: Recall your skill
   - Installing 3ds Max Design and first run

4. Requirements: All lab exercises outcome files should be submitted in “Shared Folder”
   \textbf{\large At least 4 images in JPG format (Max 8 JPGs).} Try to get your best render shots!
What is the essence of design?
Architectural Design “versus” Construction

- **2000 years ago** Marcus Vitruvius Pollio (born c. 80–70 BC, died after c. 15 BC) - the author of De architectura, (The Ten Books on Architecture) → discussed the value inherent in using plans, elevations, and perspectives to convey design intent.

- **Renaissance** Leon Battista Alberti (February 14, 1404 – April 20, 1472) - the author of De Re Aedificatoria (1452, On the Art of Building) → distinguished architectural “design” from “construction” by proposing that the essence of design lay in the thought processes associated with conveying lines on paper. His goal was to differentiate the intellectual task of design from the craft of construction.

- **Modern Architecture** Form follows function - coined by Louis Sullivan, in his article “The Tall Office Building Artistically Considered” in 1896. referring to Vitruvius.

- **Contemporary** 2D CAD (AKA CAAD, CADD…), 3D Graphics
- **Cutting-edge** BIM – the most advanced CAD system so far

[Image of Vitruvian Man by Leonardo da Vinci, an illustration of the human body inscribed in the circle and the square derived from a passage about geometry and human proportions in Vitruvius’ writings]

[Image of English title page of the first edition of Giacomo Leoni’s translation of Alberti’s De Re Aedificatoria (1452). The book is bilingual, with the Italian version being printed on the left and the English version printed on the right.]

[Image of Architectural Design “versus” Construction slide]

[Image of Architectural Design “versus” Construction slide]
What is Design?

- “structured arrangement of design units (elements)”

   design units are:
   1) a physical element that forms a design
   2) an element of design that a designer can cognitively deal with


What is “Designing”?

“Designing is an act of creating and elaborating a design.”
Geometry-oriented approach to the design

- Conventionally CAD systems only deal with "geometry"
- Because people believed that geometric shape is all about design, at that time.
- Geometry is important, but it is a subset of a design.
Conceptual modeling of a building – for both human and computer

Information is important. Geometry is one part of information.
Building Data Model: a bit more elaborated model

- Building
  - Site
  - Structure
    - Floor
    - Site
  - Space
    - SpaceGroup
    - Interior Facilities
    - Door
    - Window
  - Opening
  - Wall
  - Column
  - Beam
  - Roof
  - Ceiling
  - Slab
  - Foundation
  - Other Structural Element

- Geometry
  - Surface
  - Material...

- Relationship:
  - One
  - One or more
  - Zero or more
  - B contains A / A is super class of B
  - B is made up of A (composition)

- Major building elements for interior design
- Dynamically Instantiatable Objects
CAD evolves into 3d BIM → Not just evolving from 2d to 3d

“Rectangular Shape” in a CAD model

“Space Object” in a BIM model

“Office” Labeled Polygon

Label Text: “Office”
Layer Label Text: “Level 1”
2D or 3D Dummy Geometry

Space Object Instance contains “information”

GUID (Globally Unique ID)
Name: “Office”
Zone Name: “Leasing Spaces”
Space Number: 250
Floor, Spatial Topology
NET Area, Height, Volume...
Relations, Topology Data
3D Geometry Data
Standard Names, Standard Area, Required Area
Basic Rentable Area
ANSI/BOMA Category
Occupants Code
Energy Zone Type
Cost Estimate Data
Security Information
......
Why CAD & Graphics?

Especially, why 3D Computer Graphics?

- For enhancing your design visualization skills
- For moving forward to advanced design computing issues such as BIM
History of computer-aided design is a history of understanding what is design

- The design is a drawing of the product
  → e.g. Geometric drafting in 2D

- The design is a surface model of the product
  → e.g. Geometric surface modeling in 3D

- The design is a 3D model of the product
  → e.g. Solid modeling

- The design is an editable 3D model of the product
  → e.g. Parametric modeling

- The design is the integrated representation of all the compositional, analytical and fabrication representations of the product
  (Geometry is just one part of the model)
  → e.g. Product Data Modeling, Building Information Modeling

This semester
Example: Hotel Expo
Example: Jewish Museum
Example: Sleepbox
You’re already well-known to design visualization especially using AutoCAD and SketchUP + Vray.

In this semester, it’s 3ds Max Design-based class for advanced visualization and representation of your design.
What you have to learn are:

- Fundamentals of Computer Science & Engineering Theory
- Computer Hardware
- Network & Internet
- Computer Software – OS: Windows

- Fundamentals of Design Computing theories

- Computer Software – Specific Applications: CAD & Graphics tool: “3ds Max Design” for this semester + Mental Ray, Vray, Photoshop, etc.

- Even more things about Design Computing!
Design Computing
Conventional Architectural 3D Computer Graphics: CAD, CADD, CAAD...

Your Design & idea

Real World Object
Only in your head

(Digital) Design Presentation
- Plan, Elevation, Section...
- Axonometric, Isometric...
- Sketch, Diagram...
- Slides, Pictures...
- Animation...
- Design Panel, printed media...

Repetitive task: geometric drawing, drafting...
Modeling: Geometric shape is just one part of the model

Your Design & idea → Computational Model + More Information → BIM → Digital Design Presentation

- Plan, exported by model
- 3D, exported by model
- Sketch, exported by model
- Pictures from model
- Animation from model
- Anything from model

One source, multi use
Semantic Integrity

Your Design & idea → Computational Model → Your mini world (UoD) (Universe of Discourse) → Real Object → Real World

Are they semantically same?
Semantics

- Is your CAD model photo-realistic?
- Does it have Semantic Integrity?

→ Photo-realistic visualization is NOT always the solution.
→ Architecturally “effective” visualization which has semantic integrity is of importance.
Photo-realistic visualizations using current/common CG tools

SketchUP + Vray (download a model from Google 3d warehouse and edit lights, in 5 min)
Photo-realistic visualizations using current/common CG tools

SketchUP + Vray
Photo-realistic visualizations using current/common CG tools

SketchUP + Vray
Photo-realistic visualizations using current/common CG tools

3ds Max + Mental Ray, in 3 minutes from nothing
Photo-realistic visualizations using current/common CG tools
Photo-realistic visualizations using current/common CG tools
5-min render in 3ds Max Design
Design Computing

Means: Computing Technology

Goal: Design

Computational Processing

Development

Visualization

Analysis

...
Lab Exercises
Setting up LE environment

- Network to access “504-main” PC
- Log-on “Autodesk Student Community” to download Autodesk products for students
- Installing “3ds Max Design 2014 (2015)”
- Installing “Vray” plugin
- Others
Digital Design Media & Computing
Design Modes

Mode of thought

Design is a plan or framework of linking ideas together into a system of meaning. It can also be an end in itself, an abstraction which generates ideas and concepts.

Mode of expression

Design is also a way of taking thought systems and applying them to visual equivalents — usually defined by exploiting a medium’s unique qualities to maximize meaning.

Mode of production

Design is finally a way of making artifacts — limited by the way media is structured and exploiting its inherent qualities — by what is expected, or by the unexpected.

(Digital) Design Media

Design by hand. Design by computing.

- Design by pencil to computing (computer hardware + software)
- The pencil is one of the most basic media of design (graphic design tool).
- Proliferation of IT → What’s new media for design? → Digital Design Media
Review: 3d Visualization by Computers:
Rendering
Rendering basics – all about lights

- Lighting Source
  - Direct Illumination (e.g. Sunlight)
  - Indirect Illumination
  - Environment

- Target Objects
  - Diffuse
    - Intensity
    - Texture Map
  - Reflection
    - Refraction
    - Caustics

- Camera
  - Source, Target
  - Field of View
Photo-realistic Rendering: Global illumination, Ray tracing...

- To “compute” the interactions between light rays and all target objects in the given environment
- “Rendering” usually refers to the “control” such interactions with amount of options
Lab Exercises

Recall: SketchUP + Vray

Recall your render skill!
Lab Exercise 1. Panton Chairs

Vray Setup Roll-outs

Environment
- Brightness
- GI, BG
- Background, HDRI

Output
- rendering image size
Vray Setup Roll-outs

Change Environment from “TexSky” to “TexBitmap” or “None”
- Choose TexBitmap, UVW Type is UVWGenEnvironment
- Load the HDR image
Vray Material Editor

Create Layers: Emissive, Reflection, Refraction
Lab Exercise 2. Vray Lighting
2. Various Primitive Objects and Vray Materials

- Control Vray sunlight and sky
- Rectangular shape lighting
- Omni (free) light, spotlight
- Emissive lighting
- Refraction & IOR: Glass object
- 3d Text with emissive lighting background
- Make some lightings and render the scene
Lab Exercise 3. Vray Lightings and Texture Mapping
Lab Exercise 4. Installing 3ds Max Design 2015
Next Class

- 3ds Max Design + Mental Ray