Lesson 5 – Basic Rendering

Rendering - Process of turning geometry into pixels

"Render Setup" (F10) – Main rendering settings.

“Target:” – Various rendering mechanisms
Production – For creating final output. Saves file(s), etc…
Iterative – For testing. Suspends save commands
Activeshade (Arnold, ART) – Real-time updating. For testing.

“A360 Cloud Rendering…” – Login with Autodesk account.
Network Rendering – “Backburner”. Revisit for animation.

“Preset:” – Save/recall rendering settings.

“Renderer:” – Choose from internal and any plug-in rendering engines

NOTE: Specific tools may depend on "Rendering Engine"

Arnold – Default in MAX 2021+
Allows creation of complex materials and rendering effects
CPU (default) and GPU options
Revit materials will NOT render. Must reassign or use ART renderer

Tools for the Arnold Renderer:
1. Cameras – Physical Camera
2. Exposure Control – Physical Camera Exposure Control (default)
3. Lighting – “Arnold Light”, “Photometric Light” &/or “Sun Positioner”
4. Materials – Arnold “Standard Surface” &/or “Physical Material”

V-Ray – Plug-in. Also available for Rhino, Revit, Sketchup, etc…
Versions for CPU (accurate) and for GPU (quick) rendering
Available materials and lights may differ between versions

Tools for the V-Ray Renderer:
1. Cameras – “VRayPhysicalCamera” &/or “Physical Camera”
2. Exposure Control – Physical Camera Exposure Control (default)
3. Lighting – “V-Ray” lights
4. Materials – “Physical Material” &/or “V-Ray” materials

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ART (Autodesk Raytracer) – Default in MAX <2021 & Revit.
Built for architecture/design – Revit materials render
Physically based (rules of physics)
Minimal controls/tweaks

Tools for the ART Renderer:

1. Cameras – Physical Camera
2. Exposure Control – Physical Camera Exposure Control (default)
3. Lighting – "Photometric Light" &/or "Sun Positioner"
4. Materials – "Physical Material" &/or "Autodesk" material

"Common" Tab – Settings used in all rendering engines

Time Output
Single - Current frame. Typically frame 0. Use for still images
Multiple Frames (Active Time Segment, etc…) - revisit for animation

Area to Render - View, Region, Selected, etc...

Output Size - Width vs Height
Pixels vs Resolution (dpi) - screen 72dpi - print 100dpi+

HDTV (default) – 1280x720
Custom (print or custom video sizes) or presets (defined video formats)

Image Aspect - proportion of image. Use Lock
Pixel Aspect Ratio - Computer/Print = 1.0, otherwise device dependent.

Render Output – Three Things:

1. "Save in:" – Location of file(s) on hard drive or server
2. "File name" – Name of the file(s)
3. "Save as type" - Format & compression

   Single images - TIFF, JPG, PNG (transparency/alpha)

   Motion (animation) - Single file (AVI) Sequence of Stills (TIFF, JPG)

   Compression – File size vs quality. Uncompressed best, but big.

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Renderer-specific Tabs – Settings depend on selected rendering engine

Arnold

- "Arnold Renderer" tab
  - Compatibility Mode
    - 3ds Max Maps Support – Allows the use of 3ds Max maps
    - Arnold – Must use "Arnold" maps
  - Sampling and Ray Depth – Increases quality & render times
    - Preview (AA) – First pass. Very low quality for initial, quick view
    - Camera (AA) – Overall Quality for "rays of light" reaching the camera
    - Diffuse, Specular, etc… - For more detailed quality settings
  - Filtering – Anti-aliasing type and settings
  - Environment, Background & Atmosphere
    - Environment Lighting & Reflections (IBL) – Increases quality
    - Backplate - Override scenes' background. Color or Image
- "System" tab
  - General – Basic settings
  - Device – "Render Device" = CPU (quality) or GPU (speed)
- "Arbitrary Output Variables (AOV)" tab – Breaks rendering into "passes"

Misc

- Safe Frame
  - Viewport option (under viewport name, i.e. "Perspective")
  - Shows proportion of rendering in viewport. Very useful.
- "Print Size Assistant"
  - "Rendering" pull-down.
  - Sets "Production" rendering parameters for print. Need to watch dpi

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Cameras – Physical. Behaves like a real camera

Two objects - Camera and Target.
Use “Move” transform (Gizmo, Type-in, Snap, Clone) to position
Also can use “Align”

Camera Viewport
Dolly – Moves camera toward/away from target along axis

Orbit - Moves camera in sphere around target. Distance fixed.

Truck – Pan command or click and drag mouse wheel. Moves camera.

Field-of-View – Disabled for Physical Cameras

Parameters
“Show Horizon Line” – Draws a non-renderable line across the horizon.

Lens - Focal Length:
Wide - <50mm
Telephoto - >50mm

Exposure - Adjusts amount of light to enter “lens”
Target - Exposure Value (EV)
More intense light needs a larger EV (Large EV=Squint)

Exterior = 14-15, Interior = 9-10.

Adjust ±1 EV's at a time

Global – Non-Physical cameras or other viewports
“Rendering/Exposure Control” pull-down/“Global Exposure”

Uses same settings as Physical Camera (EV, etc…)

Camera’s exposure settings override global settings (default)

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Exterior Lighting

Sun Positioner (Arnold, ART. **Not** V-Ray) - Compass + Light (direct+indirect).

Compass Rose – Non-renderable "helper" object. Defines North

1. **Click** to place center of compass rose.
2. Rotate to orient north and **Click** to set.
3. Move mouse up (or down) for distance and **Click** to set.

All three can be adjusted

Light (sun) - Parameters (modify panel)

Display
- Radius – Size of compass
- North Offset – Rotates compass
- Sun Distance – Distance from model (compass)

Sun Position
- Date & Time
  - Time (daylight savings or not)
  - Day/Month/Year
  - Location on Earth
    1. Map - Click on City Name to access map
    2. Latitude/Longitude
- Weather Data File (EPW – **E**nergy**P**lus **W**eather) – External file
- Manual – Use "Move" transform to position sun (sub-object)

Physical Sun & Sky Environment.
- Automatically assigned when "Sun Positioner" placed
- **Must** be active for "Sun Positioner" to work
- Use Arnold's "Backplate" for background images

Instance into Material Editor to modify settings
- Intensity
- Sun's disc and glow sizes
- Night sky illumination – Light levels and color
- Horizon and Ground – Position of horizon in degrees. Color.

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Material Editor (M) - 2 Modes:

1. Slate – Best for creating, single, complex materials (typically lots of mapping).
   One material at a time. Graphical interface

2. Compact ("Artist Palette") – Best creating and managing multiple materials
   Sample Slots (24), each with a Name, Type and Parameters
   Can have multiple, identically named slots (materials), only one in scene.

General Materials – Work in all rendering engines. Choices may vary by engine

Physical Material – All purpose "real" material. Found under "General" rollout

Main Settings:

1. Preset (template) – Lays out preset parameters

2. Material Mode
   Autodesk Std Surface Compliant – For "Maya" compatibility

   Classic Simple – Base color with white reflections (non-metals)
   Classis Advanced - Base & Reflection colors separated (Metals, Glass)
   Advanced Reflectance Parameters = Angle vs Reflection

3. Base Color and Reflections
   Color of material/reflections and Amount
   Metalness - Quick metal. 0 = all Base color, 1 = all Reflection color
   Roughness – How shiny (mirror = 0 to matte=1)
   IOR – Index of Refraction ("intensity" of any reflections). Air = 1.0

Type of Material	IOR Range
Glass	1.2 ~ 1.8
Metals	4 ~ 50 (with adjustments from "Metalness" value)
Wood	1.5 ~ 2.2
Ceramics/Stone/Concrete	1.6 ~ 2.8
Fabric/Rubber/Leather	1.5 ~ 2.0
Wall Paint	1.4 ~ 1.9
Plastic	1.6 ~ 2.2

4. Transparency
   Color of transmitted light and Amount.
   Depth (0-? units) – Physical depth of transparency (density)
   Thin-walled – For single faced surfaces

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Basic "Physical" Materials:

Solid – Use Simple mode (or Adv for more control over reflection)
Base color - Amount = **1** + Swatch color
Roughness – Shiny = 0, Matte = 1
IOR = 1.5 – 2.0

Transparency = **0** (color swatch doesn't matter)

Transparent (non-glass) – Use Simple mode
Base color - Amount = **1** + Swatch color
Reflections - Roughness (Shiny = 0, Frosted = 1)
IOR = 1.5 – 2.0

Transparency = **1 (or less)**, Swatch = Base color (plus tweaks)

Glass – Use Advanced
Base color amount = **0** (color swatch doesn't matter)
Reflections = **1** + Roughness (Shiny = 0, Frosted = 1)

IOR = 1.2 – 1.8

Transparency = **1**, Swatch = White (or color)
Depth = Density of transparency (Deeper = more transparent)
Thin-walled – No refraction

Metal – Use Advanced or Simple + metalness
Base color amount = **0** (color swatch doesn't matter)
Reflection amount = **1** + Swatch color (color of metal) + Roughness
Mirror = 0, "Brushed" = 0.5, Dull = 1

IOR = 4 – 50 (Highly reflective, i.e. chrome)

Transparency = **0** (color swatch doesn't matter)

<u>Multi/Sub-Object</u>

Render engine neutral, can mix and match materials

(Material) ID - Corresponds to ID assigned to geometry (faces)
Name – Can tag sub-material