

CP500033

Generative Design Visualization: From Fusion 360 to 3ds Max to the Client

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Learning Objectives

- Discover the basics for working with Generative Design in Fusion 360.
- Discover the connection between Fusion 360 and 3ds Max for an optimal design workflow.
- Learn how to import a Fusion 360 model into 3ds Max 2022.
- Learn how to create and render animations of the final design using Arnold.

Description

In the real world, one program just can't do it all. Sketching, massing models, final design, animation, and rendering of engineering models—this class will discuss the workflow for using multiple Autodesk products in a production environment. Discover the ins and outs of this workflow, starting with a simple model, moving to using Generative Design in Fusion 360 software for a final model, then shifting to 3ds Max software and Arnold to render the final animation. Explore how Fusion 360 Team software can help manage the workflow files, review the Fusion 360-to-3ds Max import process, and see how to render photo quality images. Learn how to use Physical Materials, the Physical Camera, and adjust the scene exposure to get a good rendering. Get ahead of the competition by learning to create realistic animations from your Fusion 360 models.

Speaker

Steven Schain, Founder and President of Spectra3D technologies, a design and 3d printing company. There he develops designs using Inventor, Fusion 360 and 3ds Max. In 1998, Autodesk recognized Steven as one of only 16 Autodesk Training specialists worldwide. He has since contributed to Autodesk's certified courseware for 9 releases of 3ds Max, was a co-developer of Autodesk's ACI Program and 3ds Max's fundamental standards and is currently an Autodesk Certified Instructor. As a premier Autodesk trainer, he has continued teaching end users, companies, and many others, including The Walt Disney Company, Guess, and the United States Army. As a 9-year veteran of Autodesk University and a featured speaker, Steven has taught classes ranging from creating particle fountains in 3ds Max, to classes on 3D printing and entrepreneurship.

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Introduction

As a designer or engineer, you can use Autodesk's Fusion 360 software to create buildable designs for anything from simple parts and sculpture all the way to highly complex mechanical assemblies. There are many times when it is helpful to see a design rendered with high quality materials in an environment like where it will be placed.

One of the newer tools available to users of design software is Generative Design. This allows a designer to create multiple variations from a set of design criteria. Fusion 360 incorporates a robust generative design feature set, allowing you to explore multiple options from a single design idea.

Visualization using an animated camera is a tool for showing off a design in a way that still pictures and diagrams cannot convey. 3ds Max is the ideal environment for rendering of Fusion 360 designs. You can import your design into 3ds Max using a two-step process. Once imported, you can place it in a premade environment, apply materials, and render an animation.

Presenting a compelling animation involves being able to coordinate the animation of multiple objects within the same scene. Once the animation is complete, you need to decide what the output will be for the animated sequence.

An animated sequence can be rendered directly to a video file that can be played back at full speed. However, it's often better to render out to a sequence of files that can be turned into a video file later.

The level of quality of final rendering will usually be based on certain requirements. If you're running a test to see if the animation looks the way you want it to, you can save a preview rendering of the viewport. When it comes time to create your final rendering, Arnold can create a high-quality realistic rendered animation.

This class will discuss and outline the steps you would take to go from an Autodesk Inventor design file to a fully rendered animated sequence using 3ds Max 2022 and Arnold.

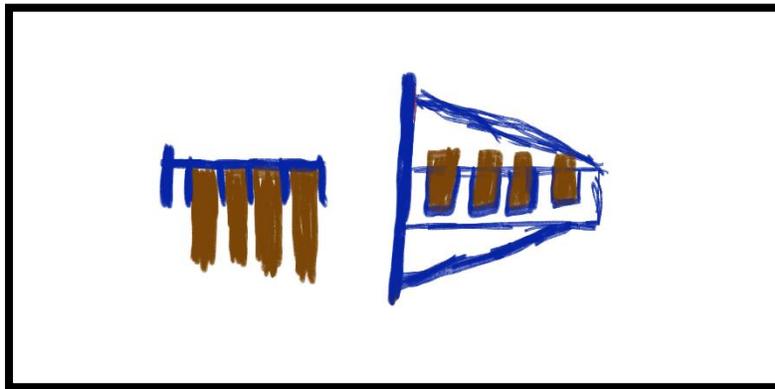
The Project

This project is a simple shelf bracket design for a client who want to use one by two strips of wood instead of a full board for a shelf. While I'd like to say the initial idea is original, it is after all a shelf. However, I did want to use generative design to go beyond the look of a traditional shelf.

Autodesk Sketchbook Mobile

Autodesk has some amazing tools in its vast toolbox, and one of them is Autodesk Sketchbook. Sketchbook is been around for a very long time and is available as a mobile app that can be used on a smartphone. My phone is a Samsung Galaxy Note 9 and has a built-in pen that I can use to sketch on the screen. Using my limited sketch abilities, I sketched a rough idea of the design and was able to build the rest of it from memory.

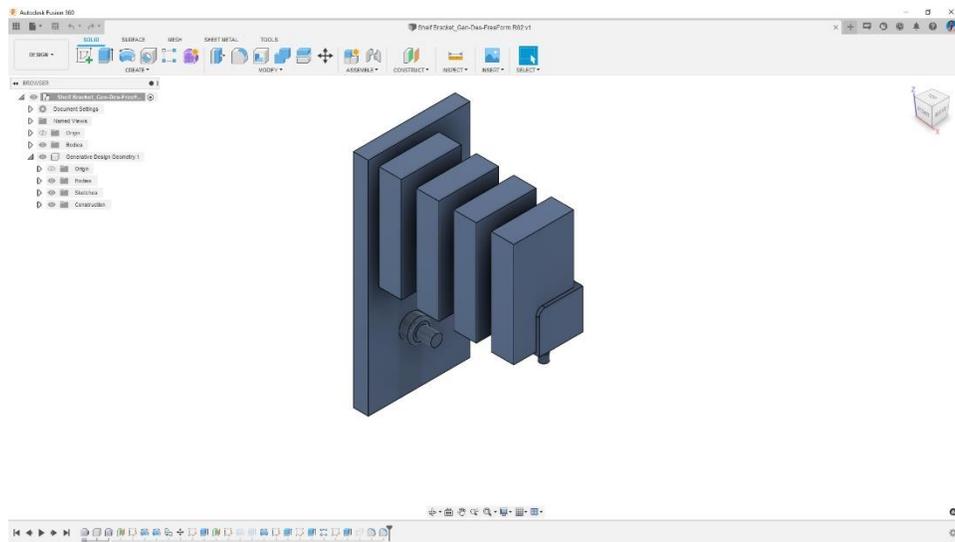
MY ATTEMPT AT SKETCHING THE SHELF DESIGN IN AUTODESK SKETCHBOOK ON MY PHONE.



Designing for Generative Design

The idea behind the design of each shelf bracket is to have them 3D printed using an FDM printer. While this gives me a lot of freedom, there are still some limitations to this method of 3D printing. Things I need to think about our minimum thickness, how much support material I'll need, and what orientation of going to print it in. Thankfully this is something that can be accounted for during the generative design set up.

When setting up a design for generative design, you don't need to design the entire part. While that's helpful in some respects, it is not needed for generative design in fusion 360. You can simply design the components needed that represent the preserve geometry and obstacle geometry.

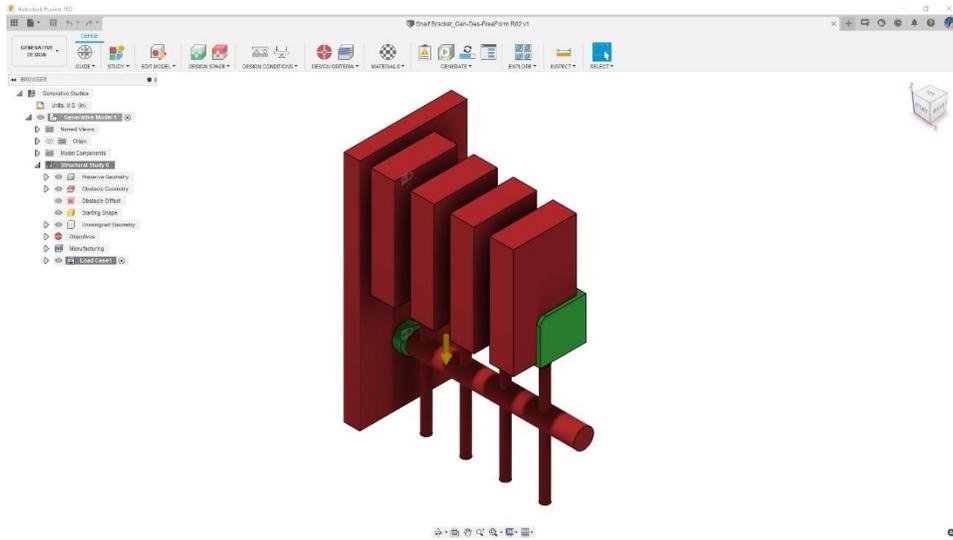


THE SHELF PARTS AS DESIGNED IN FUSION 360.

Generating Design Options

once an initial design is complete you want to set up a study for generative design. This is done in the generative design workspace within fusion 360. There are several elements that must be taken into consideration. These are Preserve Geometry objects, Obstacle Geometry objects, Loads, Constraints, Materials, Objectives and Manufacturing method. These are set up using the options in the generative design toolbar.

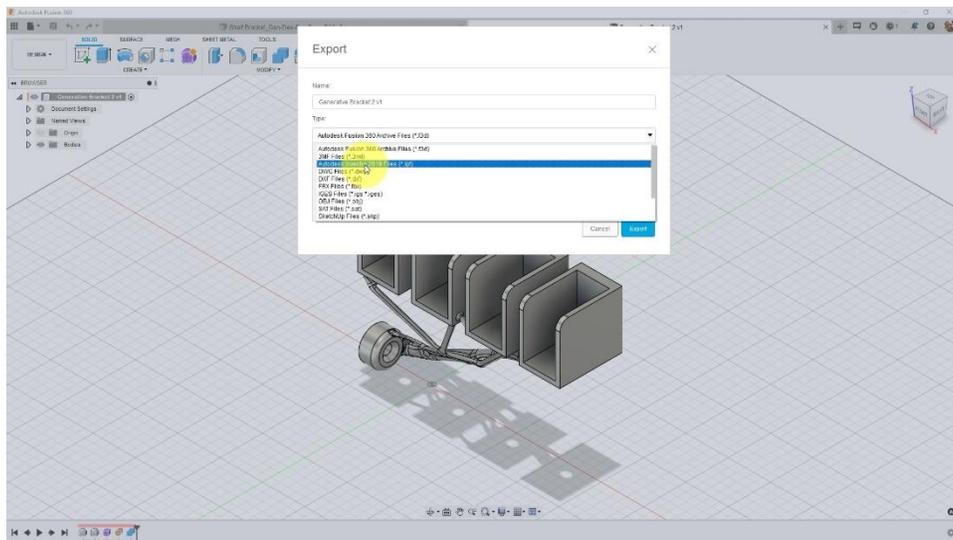
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THE SHELF DESIGN SET UP AND READY TO GENERATE A STUDY.

Exporting the design from fusion 360

once you've chosen the design, you can export the model from fusion 360 in several formats that are compatible with 3ds Max. When bringing files into Autodesk 3ds Max, I like to use the Autodesk Inventor (.IPT) format. This gives me control over the resolution of the geometry when it's imported into 3ds Max.



THE SOLID MODEL VERSION OF THE DESIGN BEING EXPORTED TO AN INVENTOR FILE.

Once the design is complete, a version is selected and exported, it's time to switch over to 3ds Max. Here, I'll set up a project folder and start developing the visualization for the shelf.

Setting the Project Directory

Before doing anything in 3ds Max, it's important to configure a project path. There is a default project directory setup that I'm going to use for this animation. (If you don't work with project directories, I highly recommend using them, as it's a very good way to organize individual projects.)

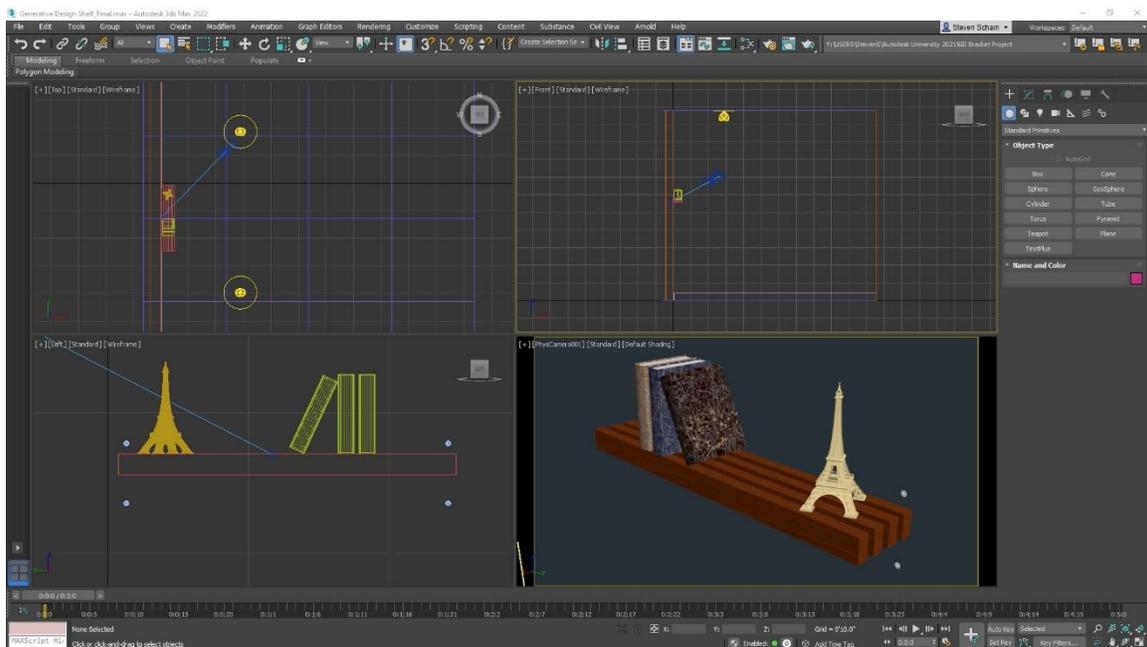
1. In the application menu, choose **Project > Set Active Project**.
2. Navigate to the **CP500033 - Bracket Project** directory and select the folder as the current project directory.

Now, when you load and save files, you can save them to the scenes directory within that project folder.

Loading a Default Scene

Starting with a scene that has lighting and a background already in it saves time when visualizing a design. Furthermore, it is good practice to have several pre-built environments that you can use for rendering product designs. These environments are pre-lit and pre-textured, making it easier to focus on the product you are animating and rendering.

Using preconfigured environments is optional, but if your goal is to render a high-quality animation of an Inventor assembly, it's helpful to use a pre-built file that has many of the settings already configured. That's not to say you won't have to make any changes, but it gives you a good starting point.



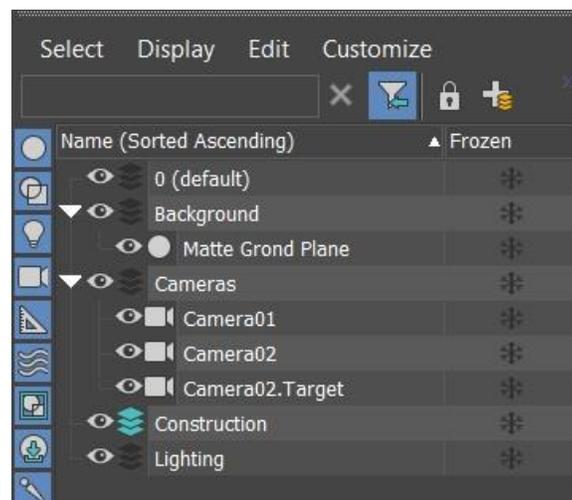
YOU CAN HAVE SEVERAL PRE-BUILT ENVIRONMENTS THAT YOU USE FOR RENDERING DESIGNS. THESE ENVIRONMENTS ARE HELPFUL BECAUSE THEY CAN BE PRE-LIT AND PRE-TEXTURED.

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Layers

Another reason to start with a preconfigured scene is because you can have some layers preset that help to isolate the lighting and cameras, as well as the background and construction objects.

Looking at the Layers dialog for this project's starting file, you'll see that I have a Background layer, a Cameras layer and a Lighting layer. Also notice that those three layers are frozen, which means that I cannot pick them in the viewport.



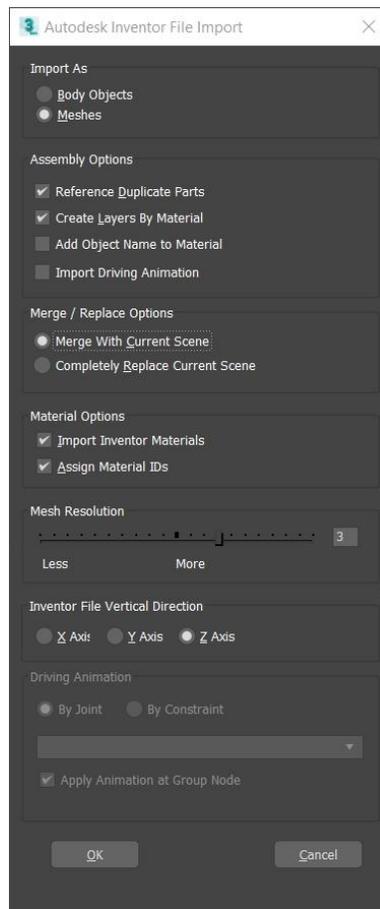
THE SCENE EXPLORER CONFIGURED TO SHOW THE AVAILABLE LAYERS.

The advantage to working with frozen layers is that you don't have to worry about accidentally selecting the lights or moving cameras. And notice there is also a construction layer that's the current layer, so anything you build will be created on that layer. If I want to animate one of the cameras that are in the scene, I can unfreeze the layer and animate it.

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Importing the Design

3ds Max allows you to import Autodesk Inventor files, whether they are parts (IPT) or assemblies (IAM). These objects keep the naming they have been given in Fusion 360 and are imported as one of two types of objects: a Body Object, or an editable mesh. Once the file(s) have been imported, they can be edited, just like any other model in 3ds Max.



THE AUTODESK INVENTOR FILE IMPORT DIALOG BOX.

Import Settings

The first thing to choose when importing is to decide whether you're going to work with Body Objects or Meshes in 3ds Max. These objects work in completely different ways.

A *body object* is an ACIS solid model that maintains the solid features from Autodesk Inventor. Body objects are unique in that the render resolution and the viewport resolution can be adjusted to fit your needs. It is completely possible to use a body object for both a very high-resolution, rendered animation, and low-resolution, real-time simulation geometry.

A *mesh object* is a polygon mesh surface that's generated from the imported data. The quality of the mesh is determined by the mesh resolution option towards the bottom of the dialog. Once

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you import an Inventor file as a mesh, you don't have the ability to change the resolution of the geometry.

After that come the Assembly options. These three possible selections allow you to reference duplicate parts, create layers based on the material, and add an object name to the material. When the **Create Layers By Material** option is enabled, layer names are generated by material, and all objects with that particular material are placed on that layer. This can be helpful for organizing your scene.

Depending on how you want to organize your scene will depend on whether or not you enable **Add Object Name to Material**. This option will use the imported material name in the name of the object. Be aware that when importing Autodesk Inventor files, some of the object names may be very long. While most will be based on the object name, keep in mind that some of the standard hardware can have very long names. But overall, naming shouldn't be too much of an issue, as long as your Inventor file is logically named.

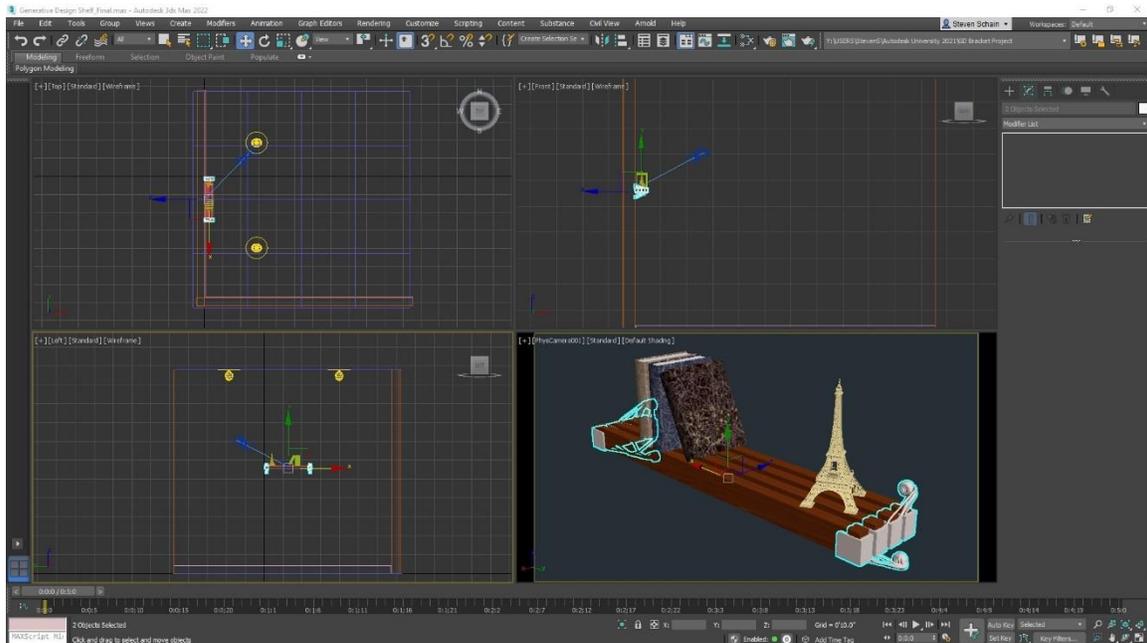
The **Merge and Replace** option is, simply put, whether you want to merge the objects together in the current scene or replace the scene with the imported file.

The **Material Options** allow you to import the materials straight from Inventor; this does, however, come with its issues, as not all Inventor materials have a direct correlation to materials in 3ds Max.

The last options are whether you want higher or lower mesh resolution (if you imported Inventor files as Mesh objects), and a choice of the vertical direction to be on the X, Y, or Z axes (typically left on the Z axis).

Once the import process is complete, the shelf will be placed where it was built. In this case, it will have to be moved to the correct location on the right side of the wood slats and up against the wall.

Note: One additional—and important—thing to understand is that you can build multiple assembly files, and if you place them all relative to each other, they will import into 3ds Max in the proper location.



THE SHELF BRACKETS SHOWN AFTER THEY ARE IMPORTED, MOVED, AND A MIRROR CREATED.

Working with the Camera

one thing that's good about using pre-populated scenes is that you can have cameras set up and ready for easy animation.

When setting up the animation, the first thing to do is to set up your frame rate. For example, if the animation is going to be for film, it will need to be set at 24 frames per second. However, if it is for video, then it will need to be set at 30 frames per second. After that, the length of the animation, as well as the start and end times, will be needed to be set.

This animation is a simple animation where the camera goes from above the shelf to below it, so I want to make sure I have enough time to see it. Remember—this is going to be shown to a client, so you don't want it to go by too quickly. Will 10 seconds be enough time, or will I need to make the length 30 seconds? Determining this ahead of time will avoid issues that can occur if you must retime an animation later.

To animate a camera, I can either use keyframes or place the camera along a path, if I need a more complex camera animation. Here, I'm simply going to move the camera from above the shelf to below it in five seconds.

The idea here is not to create the final version of the animation; rather, it's to rough it in. Later, I can edit it using the Curve Editor and the Dope Sheet if I so choose.

Working with Materials

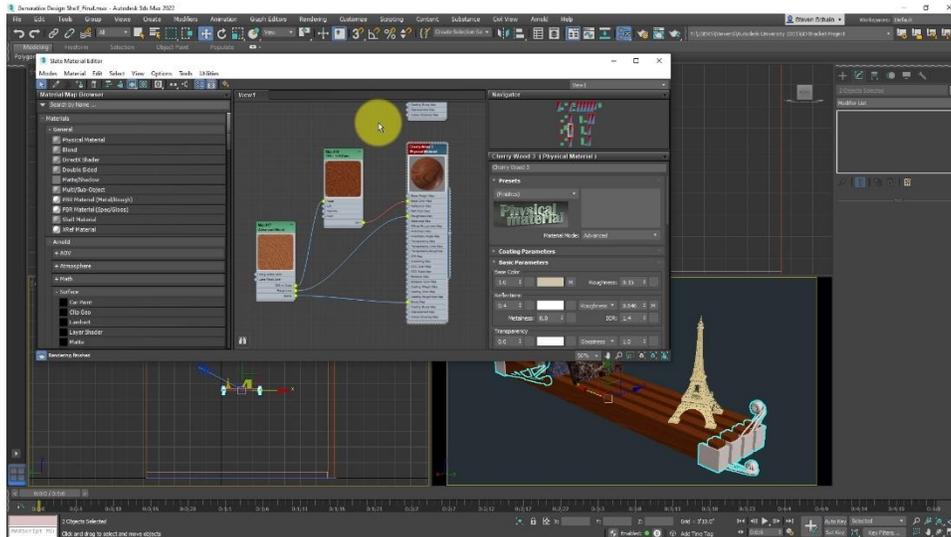
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Editing Material Properties

When working with textures in 3ds Max and rendering with Arnold, my preference is to work with the physical material instead of the Arnold standard surface shader. The only reason for this is that the physical material has fewer parameters and is quicker to work with.

When setting up a material like the cherry wood for the one by two's, I only worry about a few parameters. Those are the base color, reflections, and any bump map. For this wood the base color is coming from the advanced wood shader, so is the reflection roughness and the bump map.

I'm also a big fan of Autodesk's advanced wood material. Clicking on it, you can see it has an extraordinary amount of detail and contains several presets that make life easier when creating wood textures. I also can make use of the three outputs for diffuse color, roughness, and bump to plug directly into the material. Or, in this case, I'm using an OSL shader to adjust the gamma a little and give the color a richer look.



THE SLATE MATERIAL EDITOR SHOWING THE WOOD MATERIAL ASSIGNED TO THE 1 X 2'S.

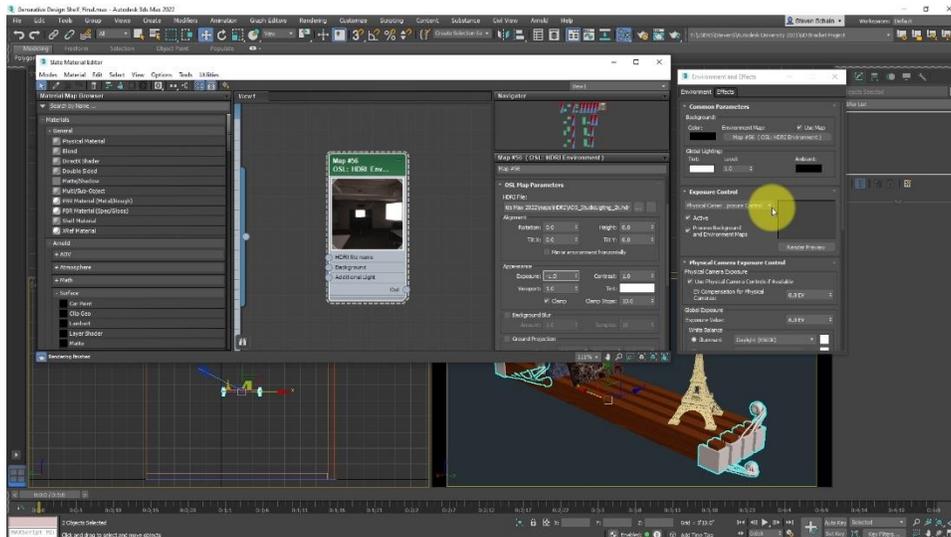
HDRI Environment

I want to elaborate briefly about the environment shader. In this scene I'm using the OSL HDRI environment material and select it. Aside from the two photometric lights that are in the scene, I'm using this studio lighting HDR image to add additional light coming from a background image.

Opening the environment and effects dialog, I can use the environment shader in the environment map slot. Dragging from the output of the environment shader to the map slot in the common parameters, I'll instance the shader, so I can control it from the material editor. The only change I made in the OSL environment shader is to bring the exposure down to -1. This reduces the amount of light contributed by this environment.

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Before I close the environment and effects dialog, I want to point out that this scene uses the physical camera exposure control. This allows me to set the exposure value differently for each camera in the scene. But here, I only have one camera.

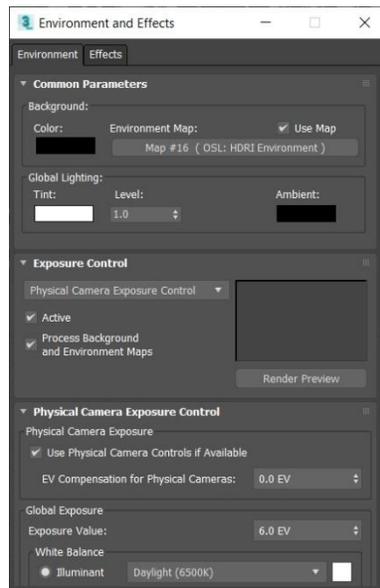


Rendering with Arnold

Now that I've animated the camera and edited the materials, I'm ready to set up and render the scene. When rendering a final sequence, there are certain things that are important keep in mind.

Since this is a simple visualization, I'm not worried about the composition. I want the client to be able to see the shelf design and what it will look like from different angles, so I'm less concerned about following strict compositional rules.

Next, the scene exposure must be set properly. If the exposure is not set correctly, you could overexpose or under expose the scene. One of the added benefits of using a predefined stage to import the assembly into is that the exposure can be preset to match the lighting in the scene. The scene uses the Physical Camera Exposure Control, and the exposure value is set in the camera's Exposure rollout.

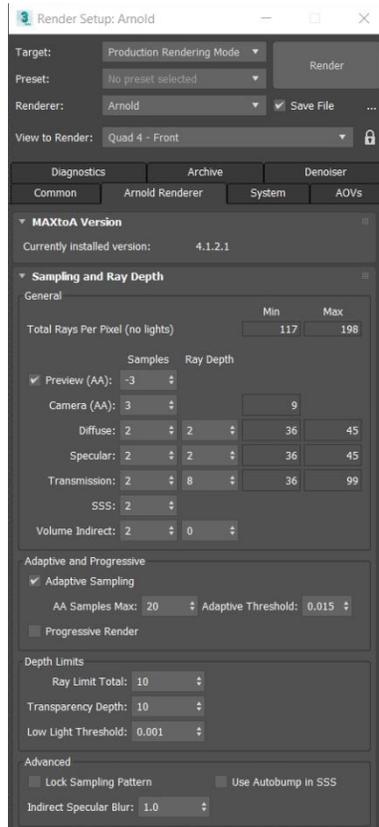


THE ENVIRONMENT AND EFFECTS DIALOG WITH THE EXPOSURE CONTROL SET TO PHYSICAL CAMERA EXPOSURE CONTROL.

Configuring Arnold

Once everything is set properly, it's time to configure the rendering parameters. Part of setting up the rendering parameters is configuring Arnold. Thankfully, Arnold is an easy renderer to configure. Depending on the level of output quality you need, you can adjust the **Samples** and **Ray Depth** in the **General** group box. The higher the values, the higher the quality and the longer it will take to render. I generally start out with low settings to make sure that everything is going to work, then I increase settings based on the type of lighting in the scene.

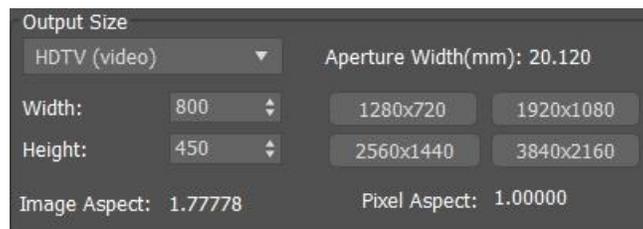
For a scene like this where there are not many specular reflections or transparent objects, I'll adjust the **Diffuse** Samples and Ray Depth, along with the **Camera Antialiasing**. To help speed things up a little bit, I also turn ON **Adaptive Sampling**. This uses a threshold value to determine what parts of the scene get more sampling than others.



THE RENDER SETUP DIALOG WITH MY STARTING ARNOLD CONFIGURATION.

Output Size and File Type

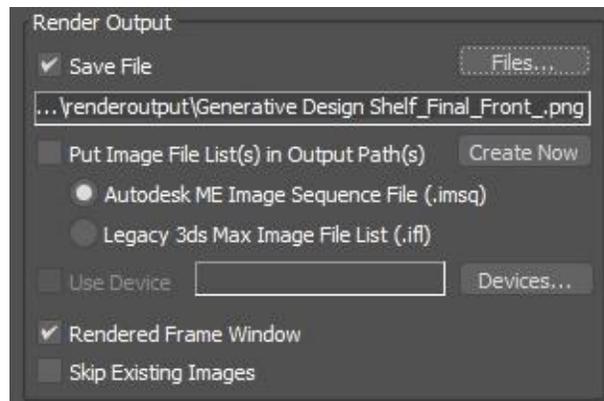
Determining the size of the rendered image should be done ahead of time. This is because the aspect ratio of the final rendered image will change what you see through the camera lens. So, you want to set that up as soon as you can. For this scene, I'm using the **HDTV** formatted **Output Size** and rendering to **800 x 450** image resolution. This will be a low-resolution first pass to make sure everything looks good. If I like the way this renders, then I'll increase the output size for a final render.



THE OUTPUT SIZE OPTIONS CONFIGURED FOR HDTV.

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Finally, what image format will you need to use? Are you going to convert the sequence directly into an animation video file, or will the sequence be edited later? If the sequence is going to be taken into a compositing program, like Autodesk Composite, what image components do you need for compositing? Once you have determined the image format, you are ready to render the animation. For this animation, I'll use PNG files to maintain quality, and I'll open the sequence in 3ds Max's ram player to save it to an AVI file.



THE RENDER OUTPUT SETTINGS CONFIGURED TO RENDER A SEQUENCE OF PNG FILES.

Once I click **Render**, the animation will begin rendering, starting with the first frame in the current frame range. The speed of the rendering depends entirely on the speed of the computer and whether you can distribute the rendering of each frame.



Once the rendering is complete, you will have a sequence of PNG file that you can convert to an AVI file or import into a video editing or compositing program for further work.