

BLD469141

Shadow Study – Animating the Daylight System in 3DS Max 2021

Renu Muthoo
Ascent – Center for Technical Knowledge

Learning Objectives

- Create a Daylight system using the Sun Positioner daylight system
- Modify the parameters of the sun positioner to get a realistic rendering
- Create renderings at different time of the day during different seasons
- Animate the movement of the daylight to create a shadow study

Description

Creating animations in the 3ds Max software are quick, easy, and fun. In this class, you will learn to animate the movement of daylight throughout a day to create an animated shadow study. This study will provide an accurate representation of how daylight will cast shadows in the scene. You will start by creating a Sun Positioner that provides realistic sunlight with a full sky environment. This system uses a simple and intuitive workflow to create geographically correct positioning and movement of the sun. You will then animate the position of the sun over time for a realistic shadow study.

Speaker(s)

Renu is an Instructional Designer for ASCENT, an Autodesk Authorized Publisher and a leading developer of professional learning materials and knowledge products for engineering software applications. Renu uses her instructional design training to develop courseware for AutoCAD and AutoCAD vertical products, Autodesk 3ds Max, and other Autodesk software products. Renu holds a bachelor's degree in Computer Engineering and has worked with Autodesk products for the past 23 years. She has co-authored a variety of 3ds Max and AutoCAD books and used 3ds Max in real-world scenarios to develop customized 3D web planner solutions.



rmuthoo@rand.com



ASCENTed.com (Blog)

This handout is provided as a supplement to the Autodesk University 2020 class *Shadow Study – Animating the Daylight System in 3DS Max 2021 (BLD469141)*. To get the full benefit out of this handout, consider watching my recorded session on the Autodesk University website. This handout is broken into five main sections four of which align directly with the course objectives with an additional section about compiling the still images to create a movie.

The demo file used in the class has the following setup:

- Appropriate **Materials** have been added to the exterior of the building used.
- A **Physical Camera** has been setup to get the desired exterior view.
- **Arnold Render Production** is used and the rendering options have been setup beforehand.

Pre-requisites: This class assumes a basic understating of setting up a scene in 3ds max software including adding materials to the surfaces in the scene, setting the Physical Camera object to get a camera view in the scene, using the appropriate rendering options, and using the animation controls.

Some information about the above mentioned components can be found at the following locations:

<https://docs.arnoldrenderer.com/display/A5AF3DSUG/Arnold+for+3DS+Max+User+Guide>

<https://knowledge.autodesk.com/support/3ds-max/learn-explore/caas/CloudHelp/cloudhelp/2020/ENU/3DSMax-Rendering/files/GUID-8E6EDF98-8A74-461F-8A0A-09FA772E9748-htm.html>

<https://knowledge.autodesk.com/support/3ds-max/learn-explore/caas/CloudHelp/cloudhelp/2020/ENU/3DSMax-Lighting-Shading/files/GUID-78705B35-7DAF-408F-BB6F-7E69D3A384F2-htm.html>

Shadow Study

Shadow study determines how and where the shadows are cast during different times of the day by a proposed project or existing site. It determines the position of the sun relative to the object throughout the day and then positions the shadow of the object accordingly. Shadow study is a valuable aspect of project planning particularly where projects are sunlight dependant or the position of shadows is critical. For example, Shadow studies are extremely important in the planning of solar projects where following the movement of the sun is critical to the operation. In such projects the movement of the sun needs to be studied in detail as even the slightest of shadows can be detrimental to the project. Shadow study is also necessary when a high rise development is being proposed. They are helpful in determining the impact of shadows cast by or on tall buildings. This helps architects/planners to determine several aspects of the project, such as lighting, natural heating and cooling, planning of outdoor amenity areas, parks, green areas, and boulevards, etc. Shadow studies are also used on existing sites so that the development of the surrounding areas can be planned properly.




Shadow Study in 3DS Max Software

In 3ds max you can perform shadow studies by creating a daylight system and then animating the sun object to simulate the movement of the sun during the day at a given location on earth. The daylight system in 3ds Max is created either by using the **Sun Positioner** system or by using the older **Sunlight and Skylight** system. The legacy Sunlight and Skylight workflow uses five different components to create the daylight system. These components are scattered around in the software making it difficult for the user to locate them and work with them. In comparison, the **Sun Positioner** is a much streamlined process located at a single more intuitive location, in the *Lights* panel, making it user friendly and efficient to create the Daylight system. The **Sun Positioner** is also renderer agnostic, which means that in addition to being used with the Arnold renderer, it can work with any other renderer as well. For this Instructional Demo, you will learn to create the daylight system using the Sun Positioner.

Sun Positioner

A Sun Positioner enables you to create a light system that provides realistic sunlight with a full sky environment. This system uses a simple and intuitive workflow to create a geographically correct positioning and movement of the sun. The following section explains how to create the Sun Positioner.

1. In the Create panel (+), click  (Lights). In the *Object Type* rollout, click **Sun Positioner**, as shown in Figure 1.

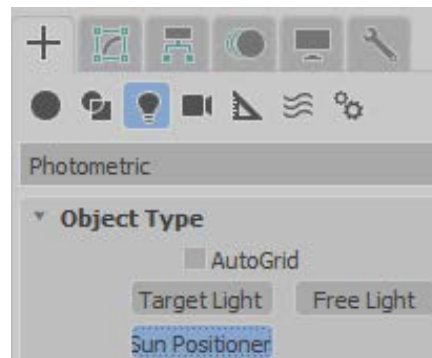


FIGURE 1: Sun Positioner in the Command panel

2. The Sun Positioner enables you to create a compass rose and a light source that mimics the sun. Creating a sun positioner is a three click process:

- The **first click** sets the location and size of the compass rose: Click and drag to set the size of the compass rose in the viewport, as shown in Figure 2.
- The **second click** sets the orientation of the sun by specifying the cardinal directions (N, S, E, W): After the first click, move the cursor to change the position of the cardinal direction as required and click again to set the required direction, as shown in Figure 2. This is the second click and defines on which side the sun will rise.

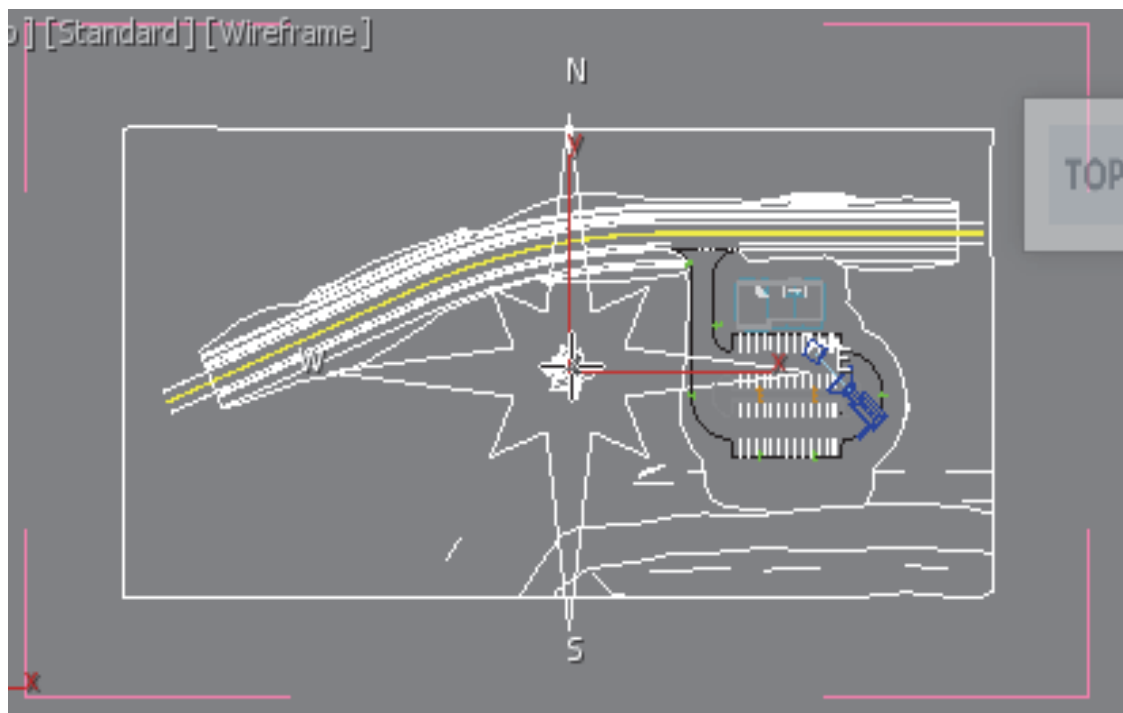
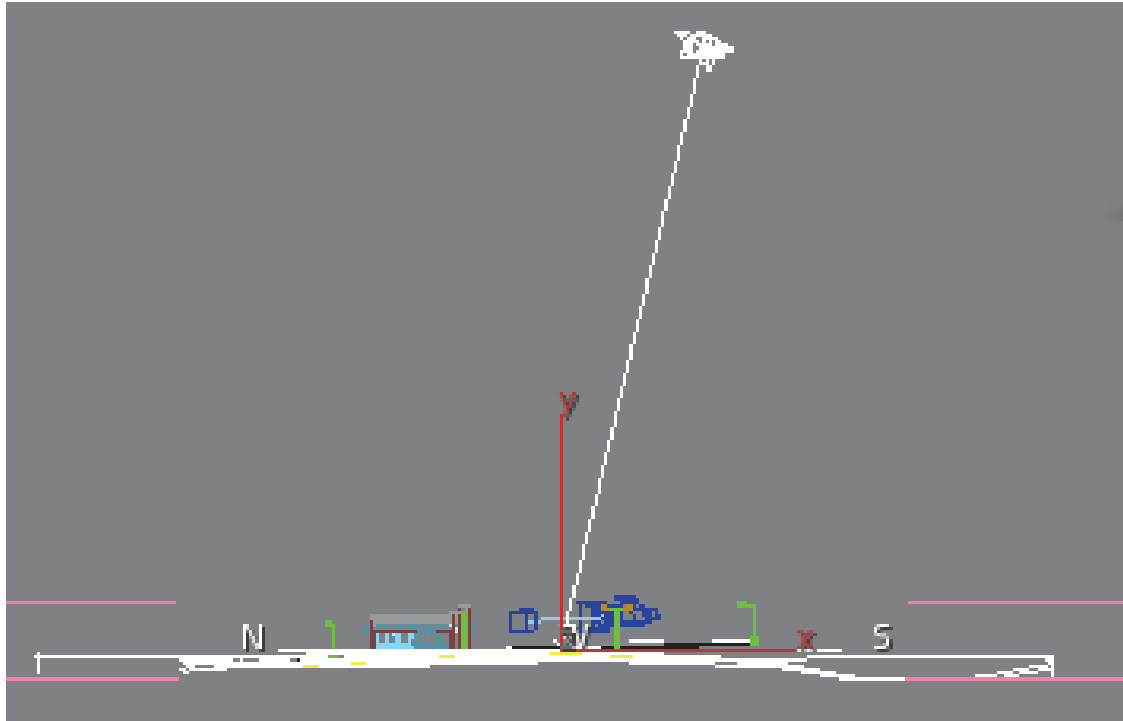


FIGURE 2: SETTING THE COMPASS ROSE AND THE CARDINAL DIRECTIONS

TIP: The compass rose is a helper object and is meant for display purposes only. It identifies the direction in which your sun is going to rise.

- The **third click** sets the distance of the sun: After your second click note that your sun is attached to the cursor and starts from the center of the compass rose. Move the cursor up or down in one of the side views and click to place the sun, as shown in Figure 3.



. FIGURE 3: SETTING THE DISTANCE OF THE SUN OBJECT

TIP: It is easier to create the compass rose and set the cardinal directions in the Top view. It is recommended to maximize the Top view, zoom to its extents, click and drag to place the compass rose, and then click again to set the direction. For the third click which sets the distance of the sun object, change to the Left/ Right view and move the cursor up or down for appropriate distance of the sun from the earth and then click to place the sun object.

NOTE: You can set the exact parameters later in the Sun Positioner Parameters area of the Command Panel.

Modifying the Parameters of the Sun Positioner

Once you have created the daylight system, you can modify all the settings in the Sun Positioner parameters.

Display rollout

The *Display* rollout, as shown in Figure 4, enables you to control the display of the *Compass Rose* and set its radius. This is meant for visual purposes only and the size of the compass rose has no effect on the actual visualization.

- Use the **Show** button to toggle the display of compass rose in the viewports.
- Use the **Radius** option to set the display radius of the compass rose in the viewport.
- Using the **North Offset** option, you can set the cardinal direction and place the sun based on the date and time.
- In the *Sun* area, in the **Distance** edit box, you can set the distance of the sun from the compass rose in the viewport.

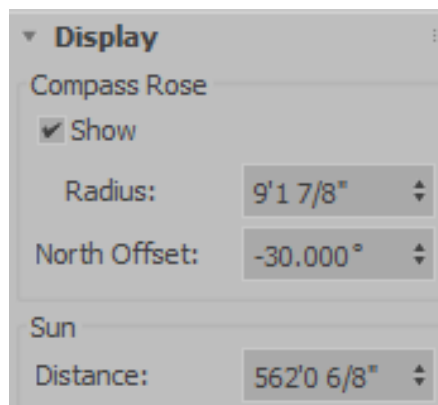


FIGURE 4: DISPLAY ROLLOUT

Sun Position rollout

The *Sun Position* rollout, as shown in Figure 5, enables you to customize the settings of the daylight system.

- When you create the daylight system using the Sun Positioner the **Physical Sun & Sky Environment** is automatically set. This is indicated by the **Install Sun & Sky Environment** button being grayed out once the Sun Positioner is created in the scene.
- The *Date & Time Mode* area enables you to set the **time, date, and location** information and based on that the position of the sun is modified. You can also use a **Weather Data File** based on which the sun position and the sky illumination is set.
- The *Date & Time* area enables you to set the date in hours and minutes. For example, if you want to set the time to 7 p. m., you have set it as 19 h. You then set the day, month, and year. You also have the option of using daylight savings time and setting the range of consecutive days to be used. This can be done by entering the start and end dates.

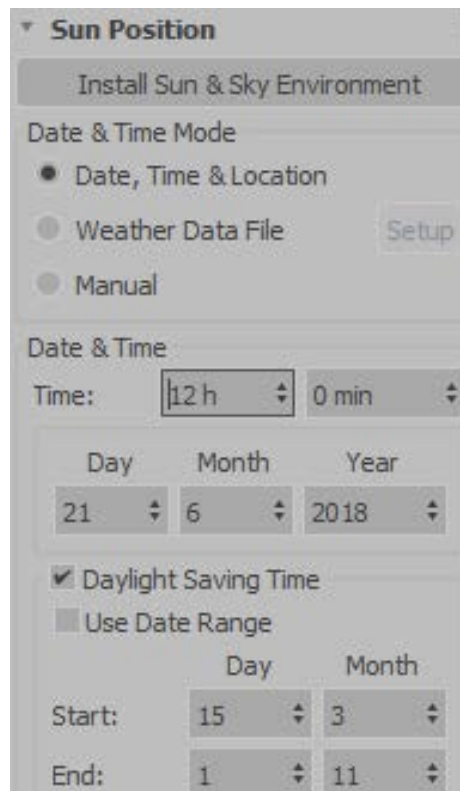


FIGURE 5: SUN POSITION ROLLOUT

- The *Location on Earth* area, as shown in Figure 6, enables you to set the location using a database file. If you know the exact Latitude and Longitude coordinates, you can enter those as well. The Time Zone allows you to set an offset from GMT.
- In the *Horizontal Coordinates* area, you set the **Azimuth** and **Altitude** values of the sun. These values are calculated automatically when you set the date and time in the Sun Position rollout.

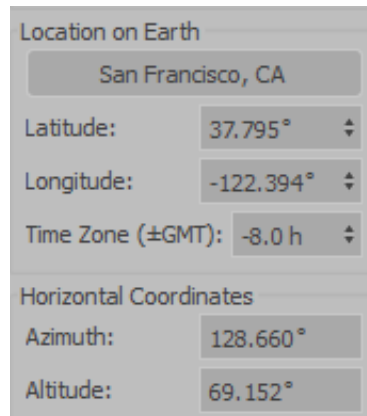


FIGURE 6: LOCATION ON EARTH

- Clicking on the location button in the *Sun Position* rollout, opens the Geographical Location dialog box, as shown in Figure 7. Here you can select the location from the list which is also displayed in the map.

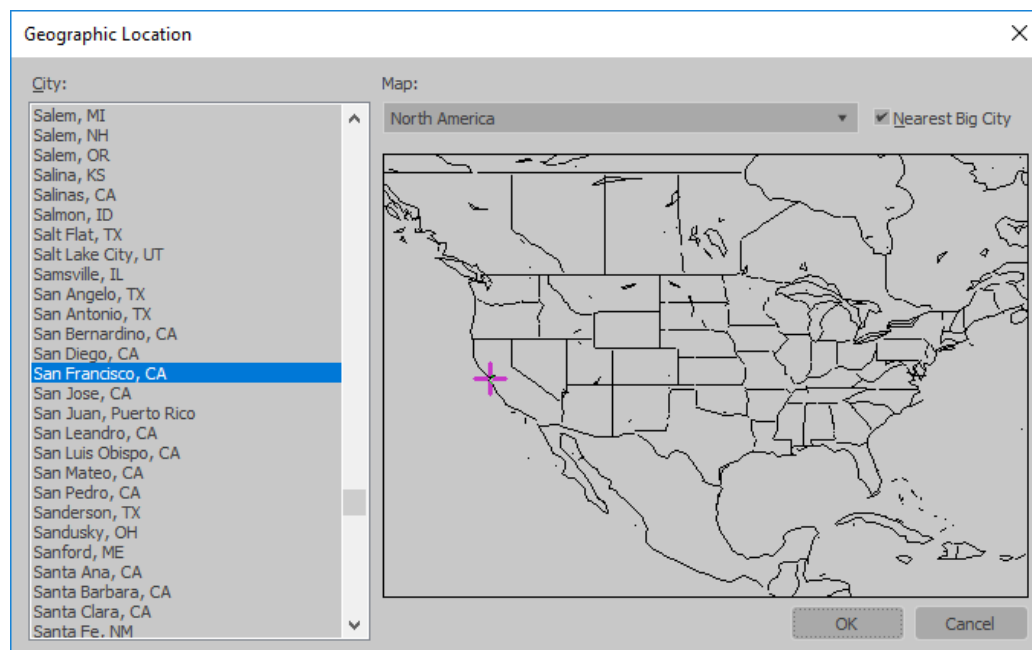


FIGURE 7: GEOGRAPHIC LOCATION

BONUS INFO: The Latitude and Longitude values are indicated in degrees and identifies the location on earth. The latitude value is calculated with respect to the Equator and ranges between -90 to +90. The places in northern hemisphere have a positive latitude values whereas the locations in the southern hemisphere have a negative value. Similarly the Longitude values are calculated east or west of Prime Meridian and the range is between -180 to +180. Any location west of Prime Meridian will have a negative longitude value whereas any place located east of Prime Meridian will have a positive longitude value.

*BONUS INFO: Note that in the Environment and Effects dialog box, the **Sun & Sky environment** has been automatically set when you create the daylight system using the Sun Positioner. Before rendering one of the viewports, you should also check if the lighting and exposure control are as per your requirements by clicking **Render Preview**. Here, you can tweak the **EV Compensation** values as per your requirements, as shown in Figure 8.*

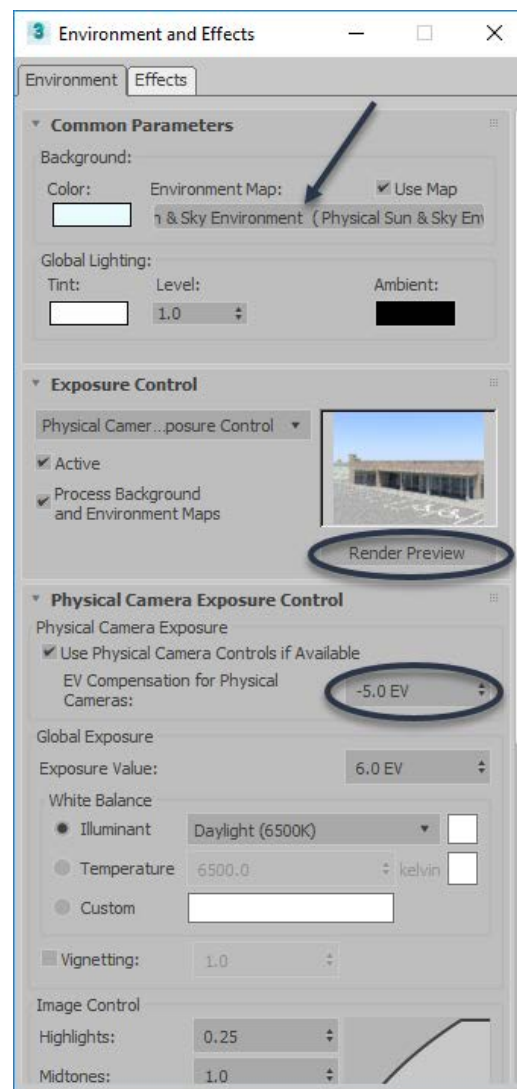



FIGURE 8: EXPOSURE CONTROL

Rendering the Still Images

Before animating the Sun Positioner, you should check that the render of the design at a certain time and day is as per your expectations. Although the default lighting produced with the Sun positioner is quite good, there might be times when you might be required to tweak the exposure control values to get the render as per your expectations. You are also required to set up the common parameters for the render, such as the size of the image, and the viewport required to be rendered.

Render Setup

1. In the Main Toolbar, click  (Render Setup) or select Rendering>Render Setup to open the Render Setup dialog box, as shown in Figure 9.

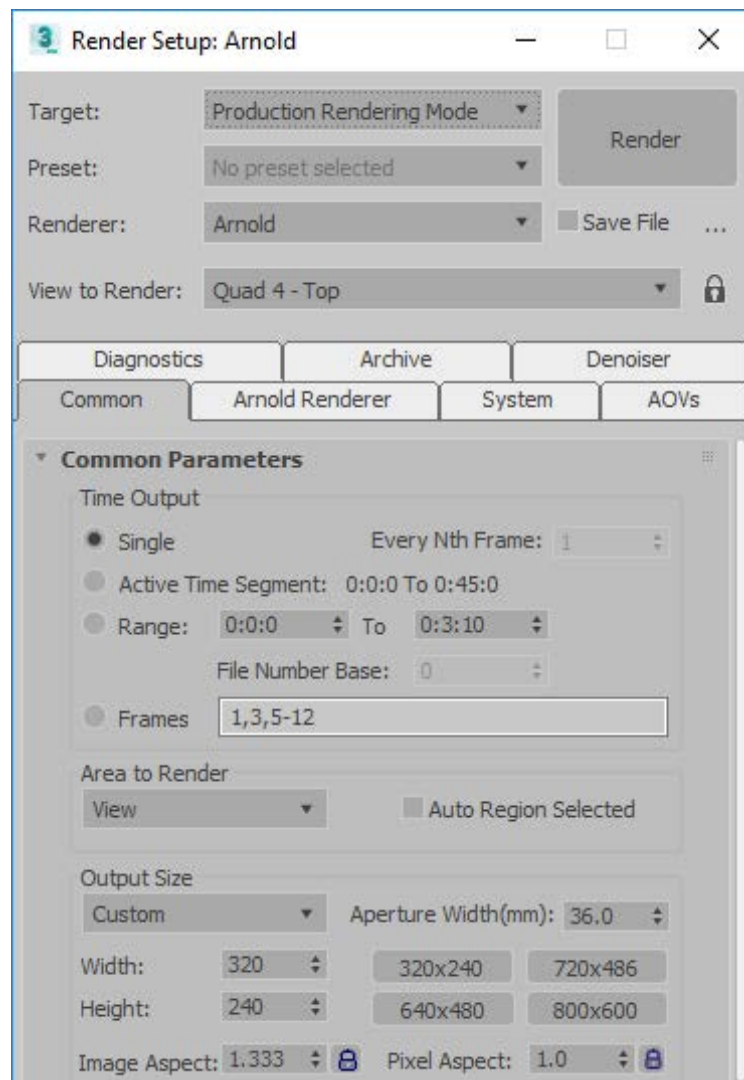


FIGURE 9: RENDER SETUP DIALOG BOX

2. Near the top of the dialog box, in the common options, set the **Renderer** that you will be using. As the Sun positioner is render agnostic, you can use the renderer of your choice and set the render parameters as per your requirements.
3. In the **View to Render**, select the viewport that you want to render. It can be the view where you have set the camera as per your requirements.
4. In the **Common Parameters**, set the *Time Output* to **Single** to check if the rendered image looks OK before you will animate the Sun Positioner.
5. In the **Output Size**, set the required size of the rendered image.
6. Click **Render** to render the image of the selected viewport.

Figure 10 and Figure 11 displays the renderings at 7 a.m. and 7 p.m. on 21st of June respectively. The Renderer used is Arnold and the viewport for rendering is set to camera view where a Physical camera has been set.



FIGURE 10: 7 A.M. IN JUNE



FIGURE 11: 7 P.M. IN JUNE

TIP: If there is no specific month provided for conducting a shadow study, it is a good practice to start with two dates of 21st of June and 21st of December (the summer and winter solstices). This way you will be covering the maximum and minimum sun exposure on a given site.

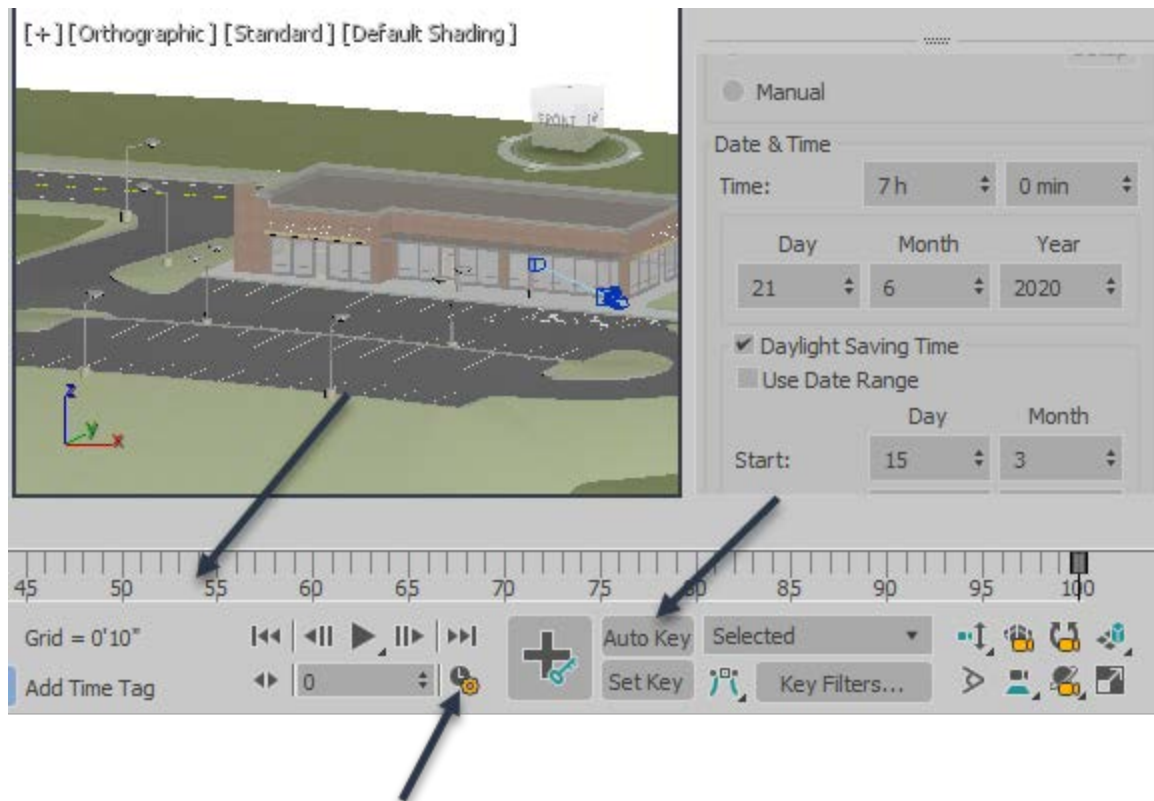
TIP: It is also recommended that you find out the sunrise and the sunset schedule of a given location on a particular date such that you can animate your sun between those times. This way you will eliminate creating renderings for the times when there is no sunlight.

Animating the movement of the sun

Animations in the Autodesk 3ds Max software are created by playing back a number of still frames in rapid succession. To create a shadow study you will animate the movement of the daylight throughout a day.

Animation and Time Controls


The Animation and Time Controls (as shown in Figure 12) are located at the bottom of the 3ds Max screen. You are going to use the **Auto Key** and the **Time Configuration** for animating the sun.



. FIGURE 12: TIME CONTROLS

*NOTE: In the Animation Controls, when the **Auto Key** button is active, it is highlighted in red. The Time slider bar area is also highlighted in red and the current viewport is enclosed in a red border, indicating that the scene is in animation mode.*

Time Configuration

Clicking  (Time Configuration) opens the Time Configuration dialog box (as shown in Figure 13) where you assign the length, playback rate, and other critical parameters to an animation. It is recommended to adjust these parameters before you start configuring an animation.

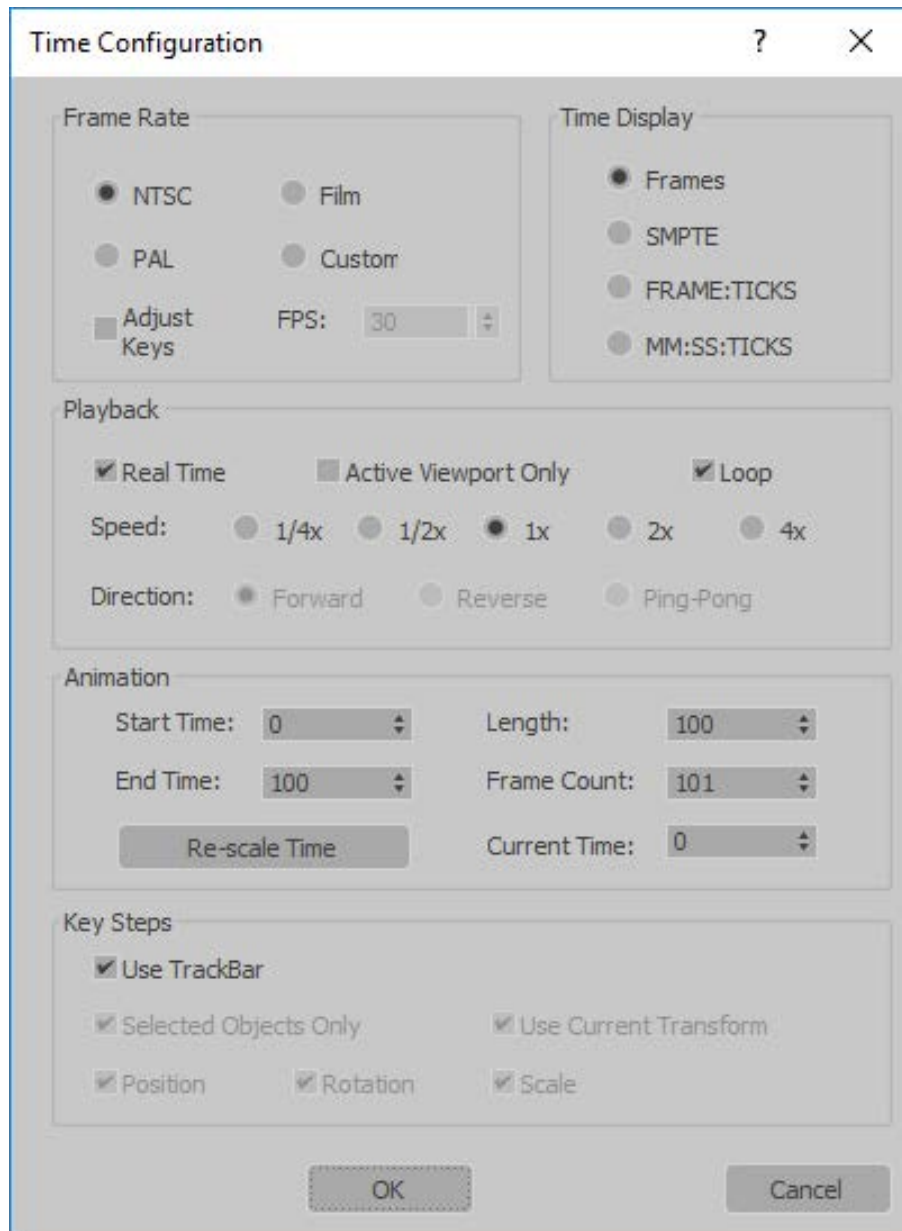
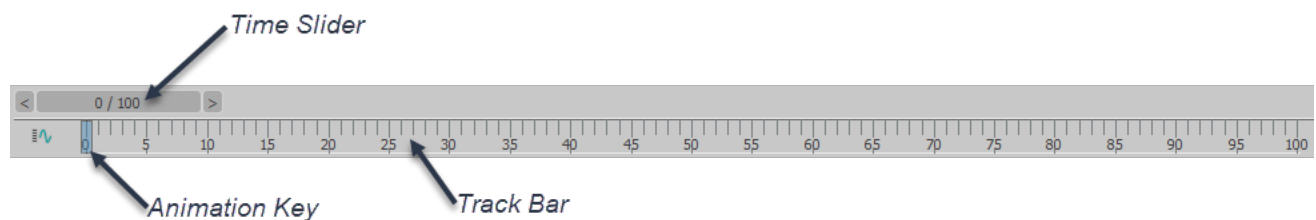


FIGURE 13: TIME CONFIGURATION DIALOG BOX

- The *Frame Rate* area provides options to define how many still frames to show per second (FPS). When setting a frame rate, the goal is to create an animation that flows smoothly without rendering additional frames. The best choice for frame rate depends on the medium where you intend to play your animation.
 - **NTSC: National Television Standards Committee:** the standard television frame rate used across most of the Americas and Japan: 30 FPS.
 - **PAL: Phase Alternate Line:** the standard used across Europe: 25 FPS.
 - **Film:** Assigns the frame rate used in film production: 24 FPS.
 - **Custom:** Enables you to select a specific frame rate. Animations created for desktop and web-based presentations are often set 12-25 FPS.
- The *Time Display* area provides options to select how you want to measure time during your animation. You can select Frames, SMPTE, FRAMES:TICKS, or MM:SS:TICKS.
- The options in the *Animation* area define the active time segment (the current animation length) between the starting and ending time.


Time Slider and Track Bar

The Time slider and the Track bar (shown in Figure 14) are found below the viewports and enable you to advance and reverse along an animation forward or backwards in time by holding the Time slider.



. FIGURE 14: TIME SLIDER

Animating the Sun Positioner

1. Activate the Camera view for which you want to create a shadow study.
2. In the Animation controls, click  (Time Configuration) to open the Time Configuration dialog box.
3. In the Time Configuration dialog box, set the settings in the *Frame Rate*, *Time Display*, and the *Animation* areas. Click **OK**.
4. Verify that the Animation Time slider is located at the beginning position (0 location) in the Time slider bar.
5. Select the Sun Positioner object in the viewport.
6. In the Modify panel of the Sun Positioner, set the starting time of the day to begin the shadow study on.
7. In the Animation Controls, click **Auto Key** to start the animation. Note that the Auto Key is highlighted in red along with the slider bar being highlighted in red and a red border enclosing the active viewport, as shown in Figure 15.

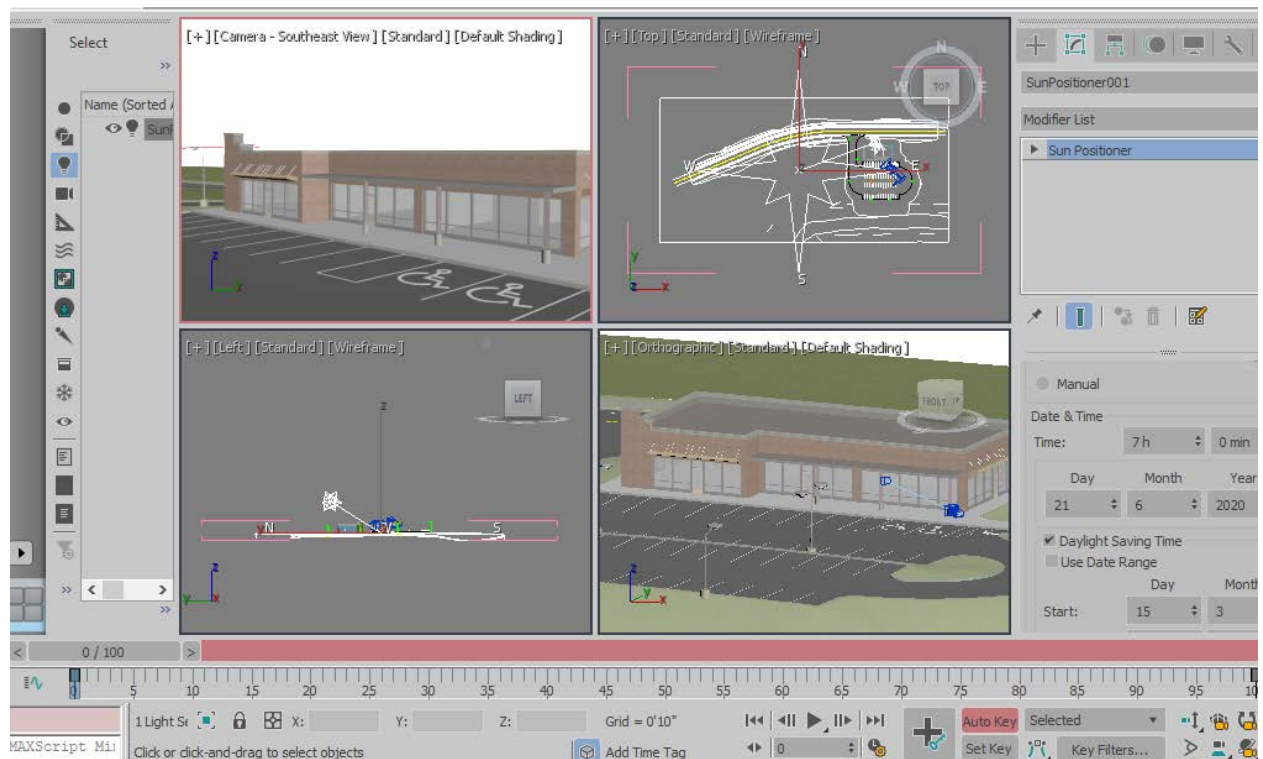


FIGURE 15: ANIMATION MODE

*NOTE: In the Animation Controls, when the **Auto Key** button is active, it is highlighted in red. The Time slider bar area is also highlighted in red and the current viewport is enclosed in a red border, indicating that the scene is in animation mode.*

8. Drag the Time slider to the ending position.
9. In the Modify panel of the Sun Positioner, set the ending time of the day, as shown in Figure 16. Note that two keys are added at the start and end position in the Slider bar.

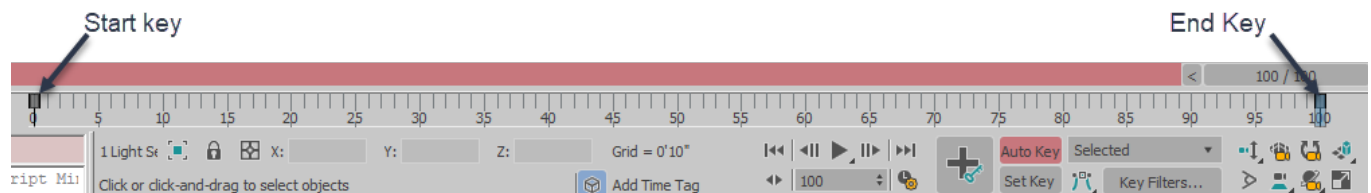


FIGURE 16: START AND END KEYS

10. In the Animation Controls, click **Auto Key** to clear it. **It ends and saves the animation.** Verify it is not highlighted in red anymore.

TIP: You can click and drag the Time slider left and right (scrub) and note how the position and elevation of the Sun Positioner object changes in the viewport, as shown in Figure 17 and Figure 18

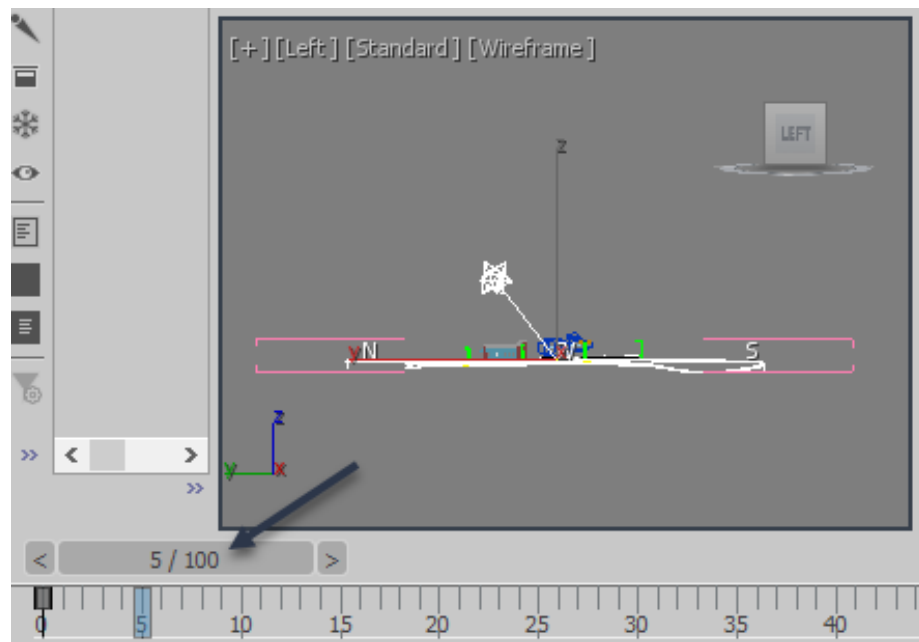


FIGURE 17: SUN POSITION AT FRAME 5

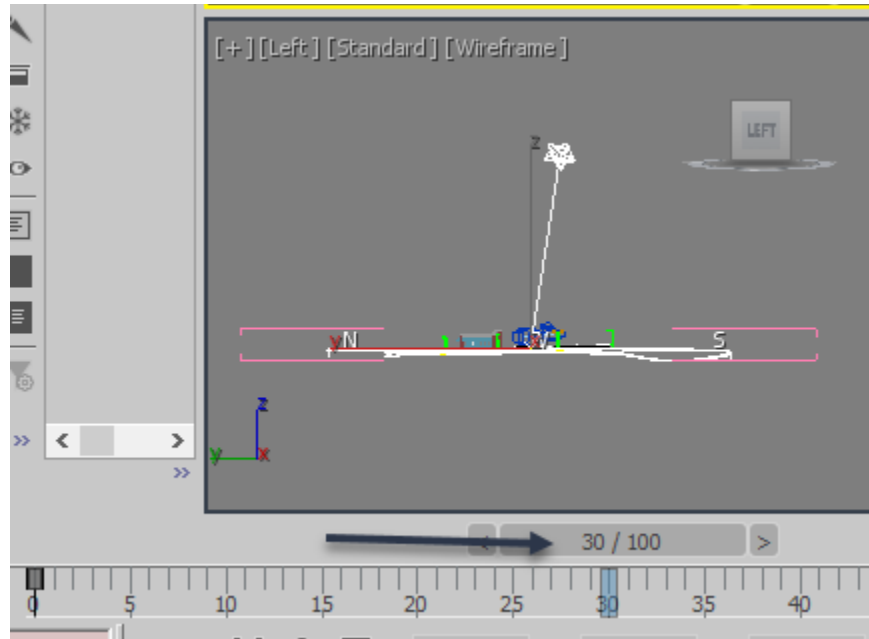




FIGURE 18: SUN POSITION AT FRAME 30

11. Open the Render Setup dialog box by clicking ( (Render Setup)) and set the following:
 - a. In the **Renderer** list, select the active renderer of your choice , as shown in Figure 19.
 - b. In the **View to Render**, set the current viewport to the camera view and lock it  , as shown in Figure 19.
 - c. In the *Time Output* area, select **Active Time Segment** (as shown in Figure 19) to indicate that you are rendering an animation.
 - d. In the *Time Output* area, set **Every Nth Frame** (as shown in Figure 19) to render only the specific frames and not the entire animation.
 - e. In the *Output Size* area set the required render size, as shown in Figure 19.

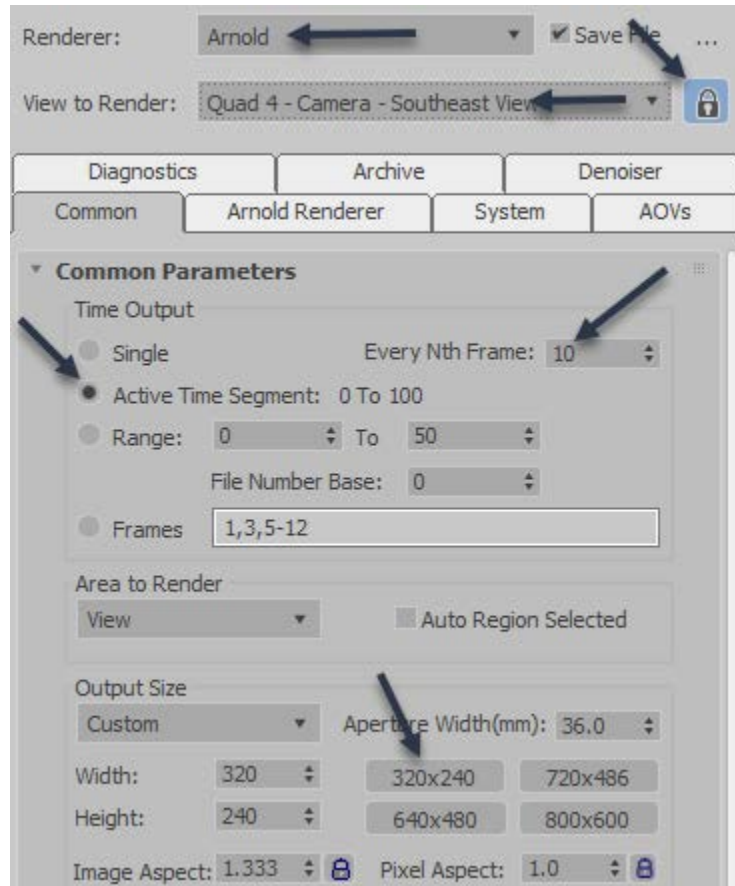


FIGURE 19: RENDER SETUP OPTIONS

- f. In the *Render Output* area, click **Files**, as shown in Figure 20.

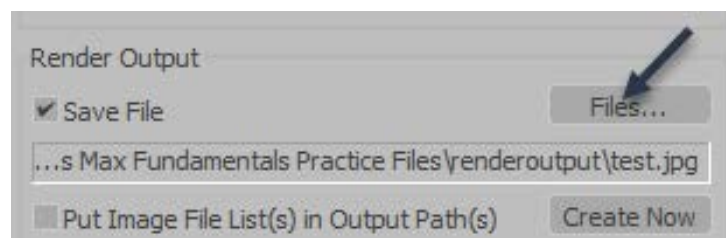


FIGURE 20: SAVE TO FILES IN RENDER OUTPUT

- g. Render the animation to still frames and enter a name. Select the type of file you want to save the rendered images as. For example, select **JPEG File** from the *Save as type* drop-down list, as shown in Figure 21. Save the images and in the JPEG Image Control, set Quality to Best, and then click **OK**.

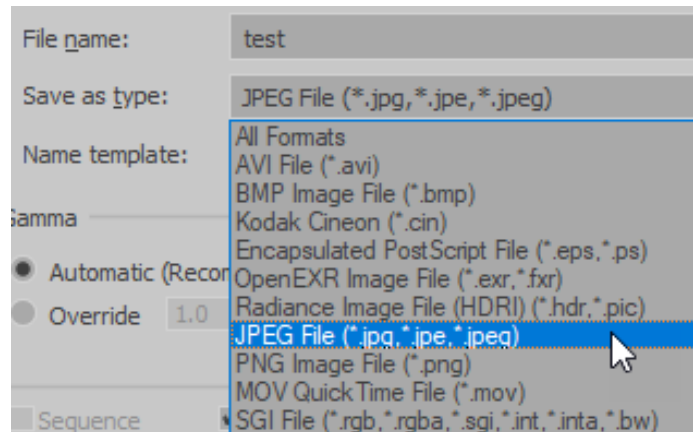


FIGURE 21: FILE TYPE

- h. Click **Render** to begin animating the individual frames of the animation through the course of a day from starting time to ending time. Note the change in brightness of the daylight and the movement of the shadows from one frame to another.

NOTE: It might take a few minutes to render all the frames. You can check the current frame being rendered out of the total number of frames, in the Rendering dialog box, as shown in Figure 22.

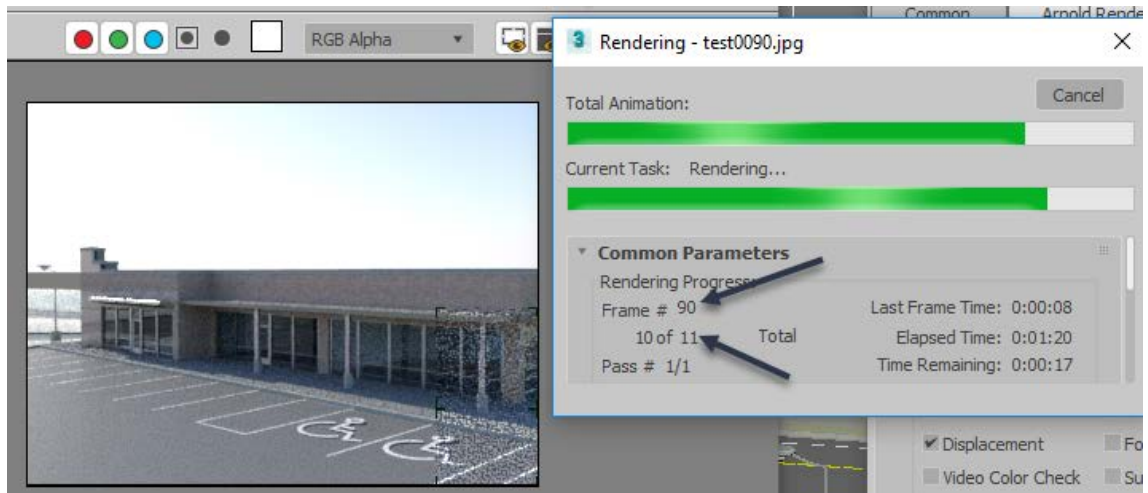


FIGURE 22: RENDERING IN PROGRESS


12. In the Windows Explorer, in the folder where you saved the files, note the rendered images at different frames, as shown for frame 1, frame 6, and frame 11 (out of a total of 11 frames rendered) in Figure 23.



FIGURE 23: RENDERED FRAME IMAGES

ADDITIONAL SECTION:

Assembling the Animation

1. In the menu bar, select **Rendering>Compare Media in RAM Player** to open the RAM player. The RAM player is a utility used for compiling animations.
2. In the Channel A area, click  (Open Channel A), as shown in Figure 24.

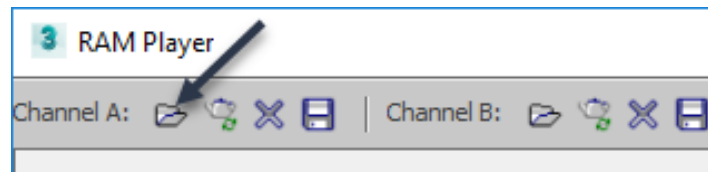


FIGURE 24: OPEN CHANNEL A

3. In the Open File, Channel A dialog box, navigate to the folder where you saved the rendered images. Note the number of images, in this case there are 11 still images, starting at test0000.jpg, and then every 10th frame (i.e., test0010. jpg, test0020. jpg etc.). This is dependant on the **Every Nth Frame** in the Render Setup dialog box. Select the first rendered image and verify that **Sequence** is enabled, as shown in Figure 25. Click **Open**

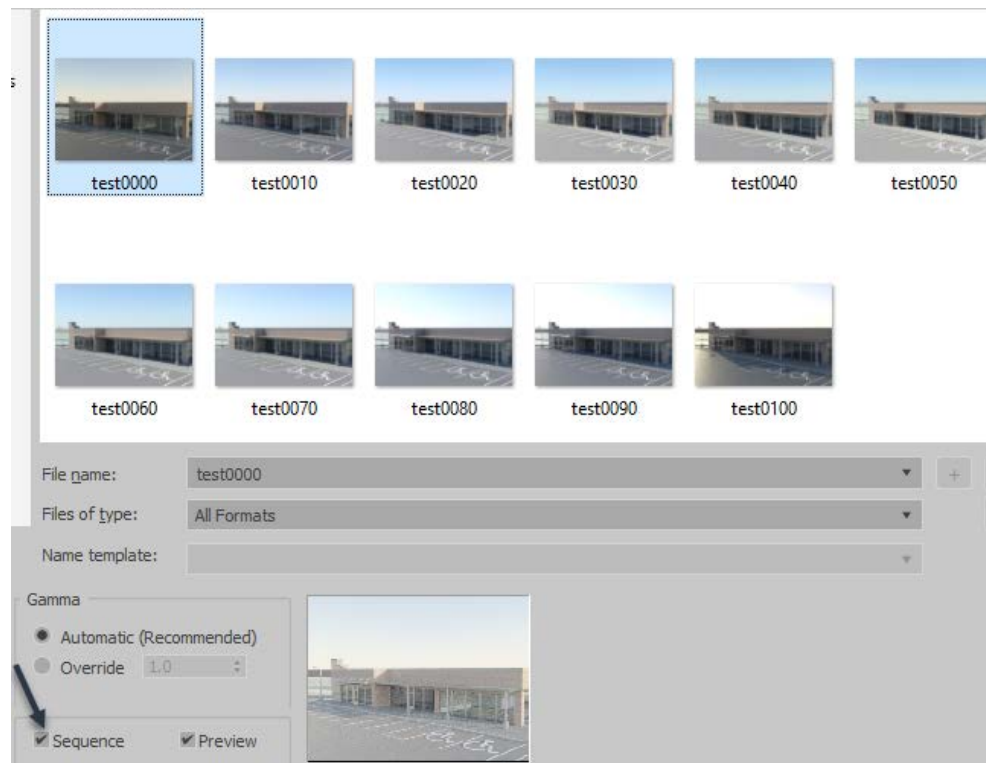


FIGURE 25: FILE CHANNEL A DIALOG BOX

4. The Image File List Control dialog box opens, as shown in Figure 26. It displays the folder where the image file list (.IFL) is being created. Click **OK**.

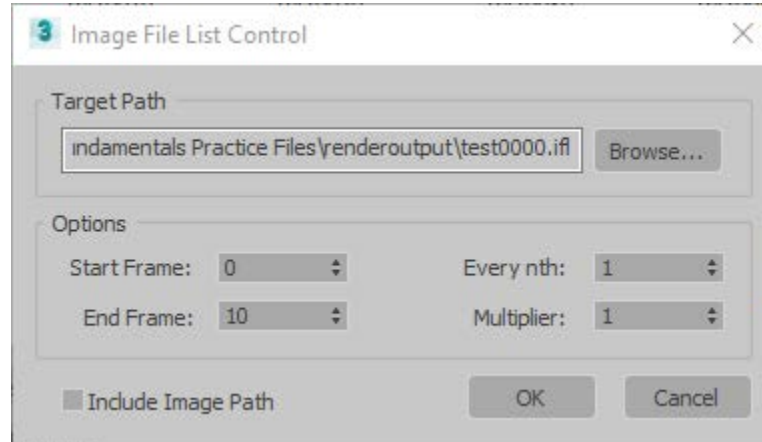



FIGURE 26: IMAGE FILE LIST DIALOG BOX

5. The RAM Player Configuration dialog box opens. Click **OK**.
6. After the animation has loaded into the RAM player you can play back the animation at different frame rates by selecting a number in the drop-down list, as shown in Figure 27. Click  (Playback Forward) to play the animation and check the shadow study. Stop the animation.

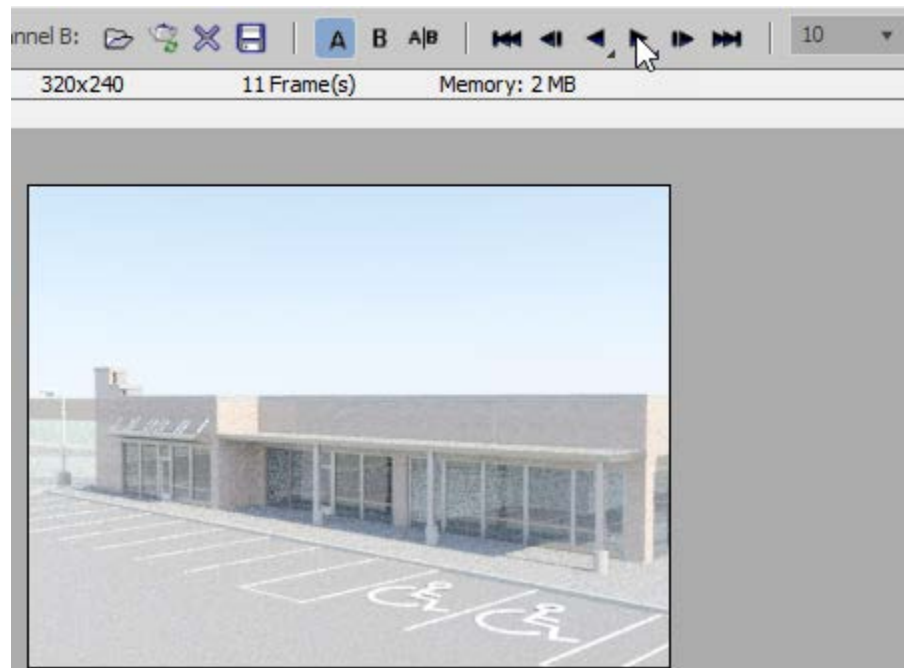



FIGURE 27: PLAYBACK SHADOW STUDY ANIMATION

7. To save a desktop animation file, click  (Save Channel A).
8. In the Save File, Channel A dialog box, browse to the folder where you saved animation file. Set *Save as type* to a file type of your choice, e.g. **AVI File (*.avi)**. Save the animation.
9. In the AVI File Compression Setup dialog box, for the Compressor, select **MJPEG Compressor**, set the *Quality* to your preferred choice, and click **OK**.
10. Exit the RAM Player.
11. In your Windows Explorer, navigate to folder where you saved the AVI file and play the file to watch the animation.