Hollywood BIM for Infrastructure

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VI6177 This lecture will cover the process of creating striking videos designed to communicate complex infrastructure projects within a Building Information Modeling (BIM) pipeline. You will discover how products from Autodesk, Inc., can enable you to deliver detailed technical information to both engineers and non-technical audiences involved in a project. Helicopter video shooting, tracking, and 3D replacement have become essential exercises for achieving this purpose in transportation infrastructure projects such as airports, freeways, and elevated-train systems. We will follow some of these videos from beginning to end, covering topics that include: preproduction tips for shooting video from a helicopter and tracking with the MatchMover application; integration of tracking points and camera in a 3ds Max software environment; BIM pipeline integration with 3ds Max software and Revit software; rigging and animating transport in 3ds Max software; rendering management in the Backburner application; and optimized compositing. Download videos at:
https://www.dropbox.com/sh/thq3yvdw3119aho/AABlyqsDi9Wz57tZVBIlmfnSa

Learning Objectives

At the end of this class, you will be able to:

- Discover the enormous advantages of using 3D tracking with the MatchMover application for transportation infrastructure projects
- Discover the relevance of rigging and animation in transportation infrastructure projects
- Learn about BIM pipeline integration in 3ds Max software for visualization purposes
- Discover how Autodesk products can allow you to deliver technical information to both engineers and non-technical audiences

About the Speaker

Andrés Lara is an Industrial Designer graduated from Universidad Iberoamericana in 2008. He worked as a designer and visualization 3D artist for SOMA Architects Mexico where he was involved in international projects. His passion for the digital arts took him to study an intensive diploma program at Vancouver Film School in 3D Animation & Visual Effects, graduated with honors in 2009. He went back to Mexico City where he worked for Taboo-Digital as head of the Visual Effects team for the feature "Abel" in 2010. He worked as Set Supervisor for TV Ads production while working in post-production. In 2011 he moved to The FX Shop where he had the chance to get involved in international TV Ads productions. In 2014, he enters as Visualization Manager at ICAbim.

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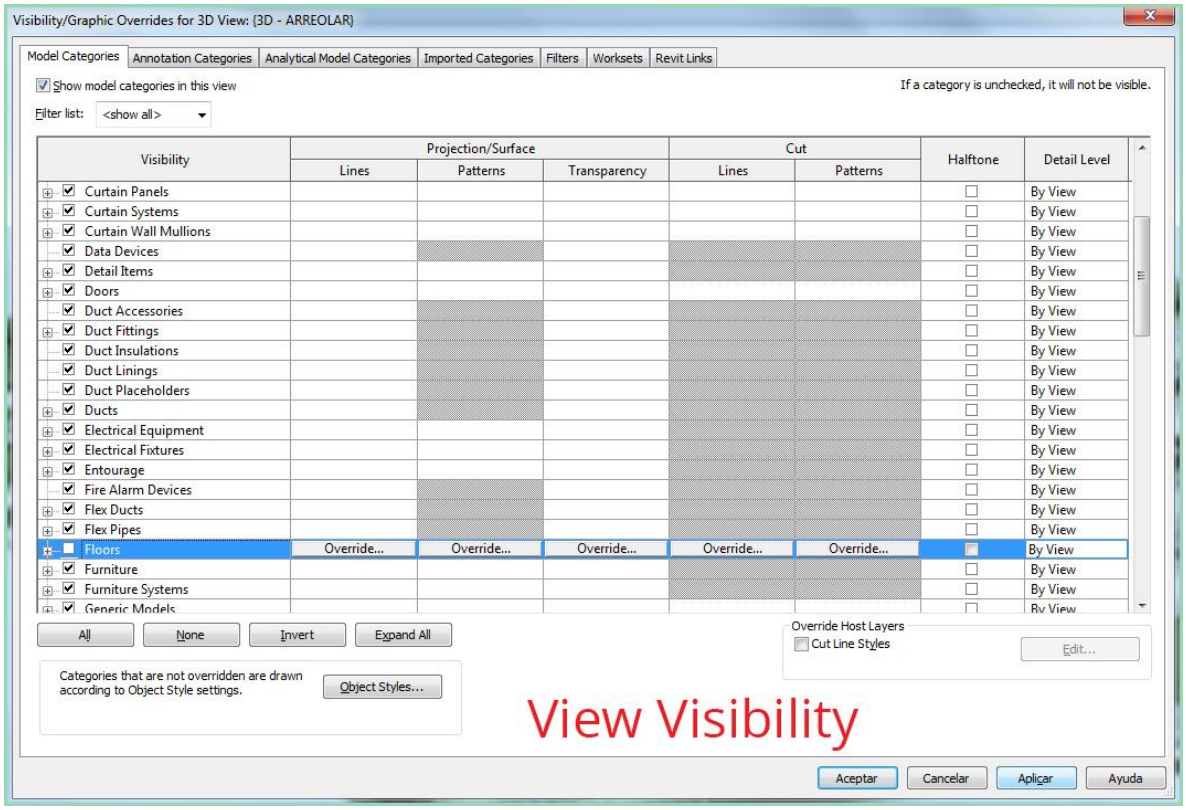
3ds Max integration into BIM pipeline

From Revit to 3ds Max

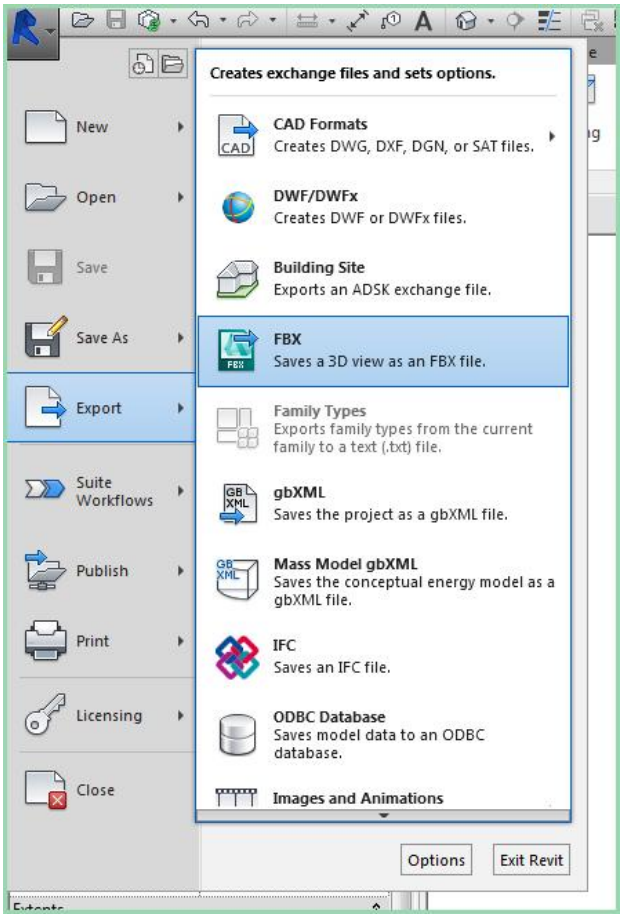
Every model we use in our visualizations comes from a parametric model from Revit. For this matter it is really important to be able to bring that model in an accurate way in order to keep it as real as possible. Once the model is imported into 3ds Max, we can use it for visualization and communication porpoises.

Exporting from Revit

First thing is to export it from Revit. It's really important for us to **detach the model from Central**, so we can work on it as needed, without worrying about the changes we make. Most of the times we don't need the entire model and we can hide some of the geometry in order to make it lighter or even get rid of double walls and repeated geometry.

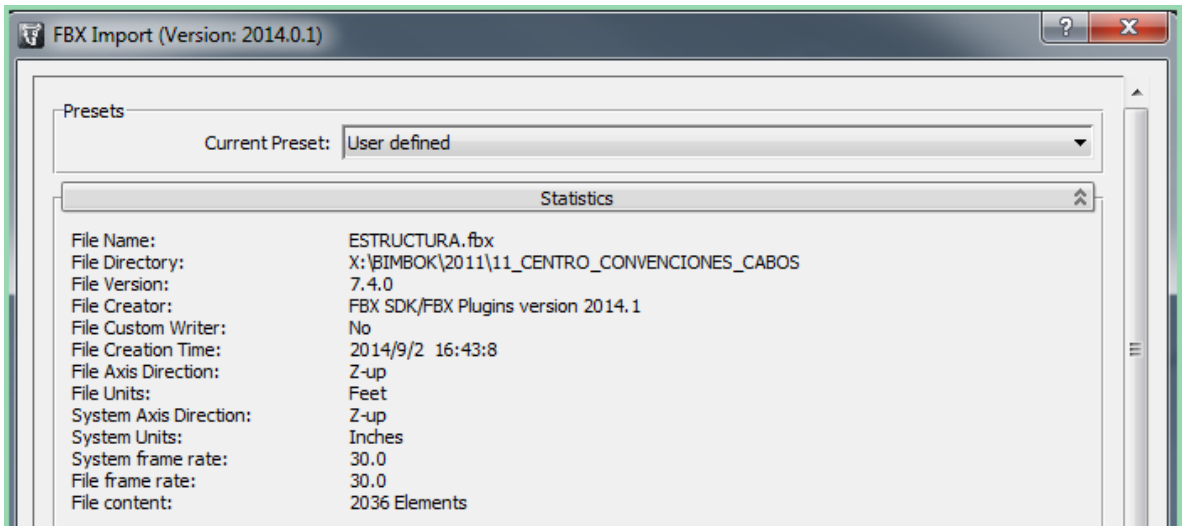


Once we have hid all the geometry we don't need we can proceed to export it. For our porpoises we are going to use FBX export format.



FBX is still the best way to share geometry between Autodesk Software. We can leave all the settings as default, this way we are exporting all the visible geometry including camera and materials, which can be useful for grouping and selecting in 3ds Max.

Once exported as an FBX file, we can easily import it into 3ds Max.



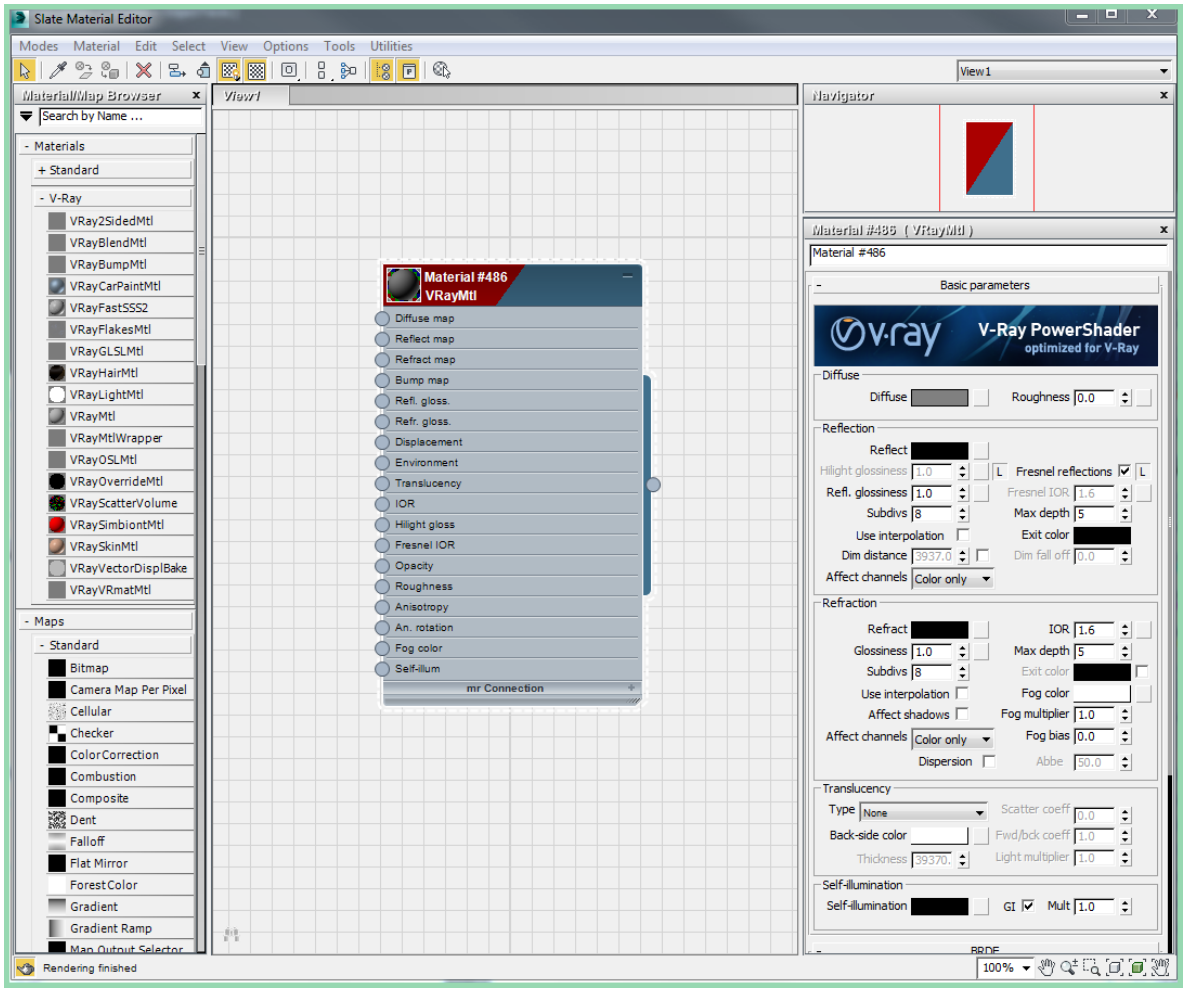
Just make sure to select the Z axis as your Up Axis.

Now that we have it on 3ds Max, we can start playing around with our model. We can rig it, texture it, animate it, and do whatever is needed to fulfill client's requests.

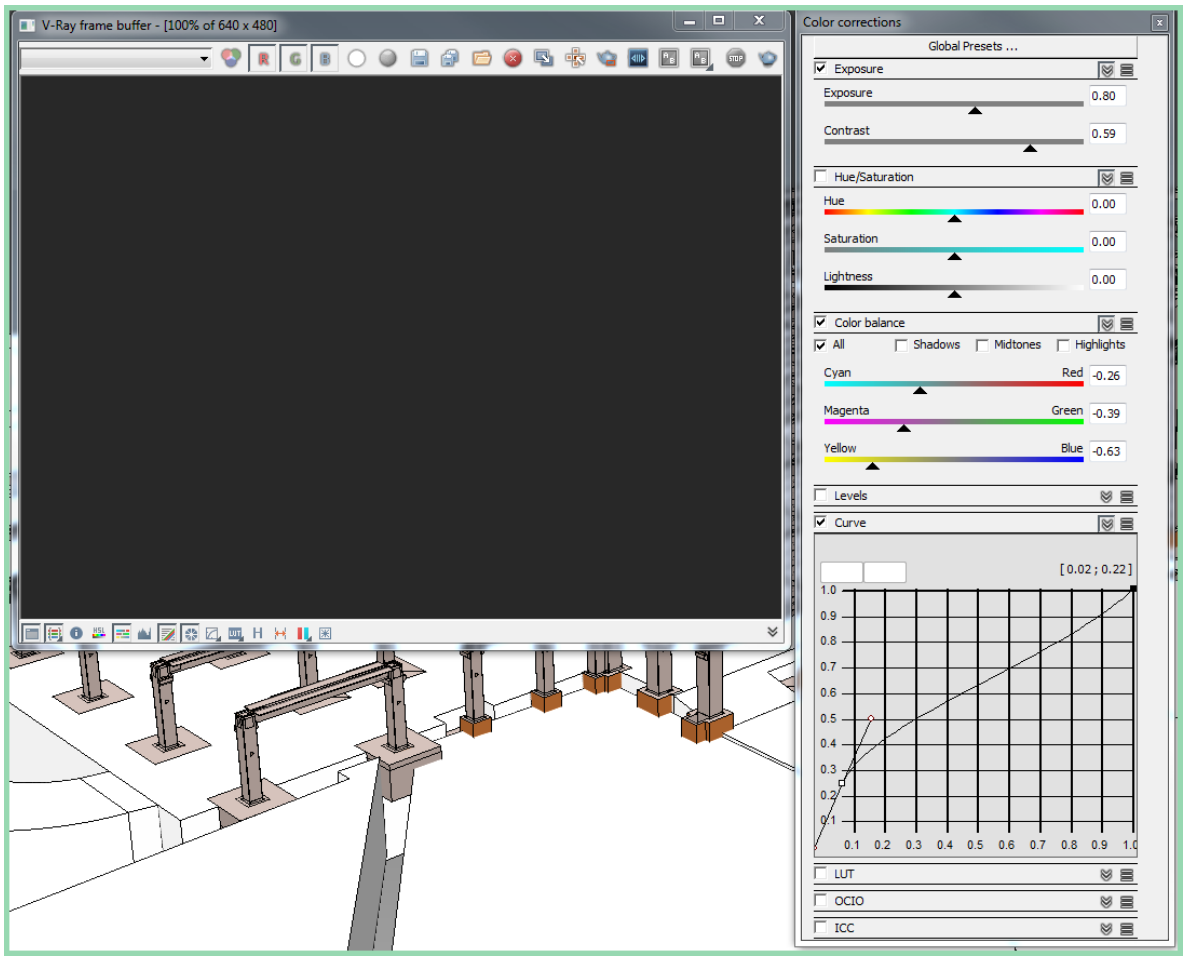
Let's do some simple rendering, and leave rigging and animation for later.

Rendering with V-Ray

For this render, we are going to use a simple V-Ray Material with default settings.

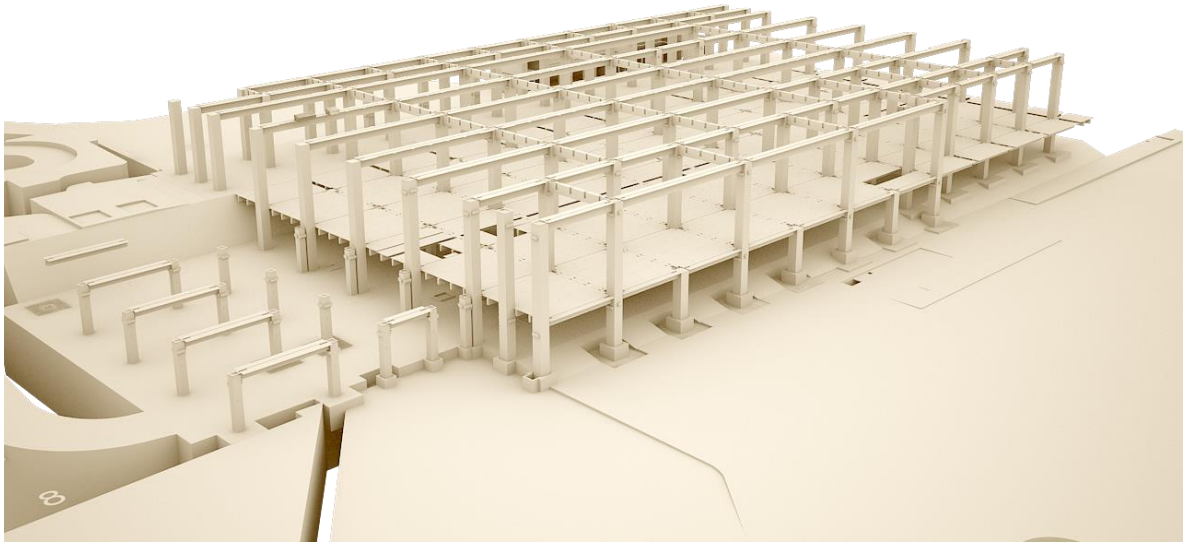


In order to achieve a faster rendering and more control over the color results, we can work with color corrections at the post rendering processing.



For this rendering we were looking for a Mock Up look, so a card board look was used for this delivery.

A simple lighting and material are sometimes the best way to go. We are trying to bring up clear shapes. This way the image will have the right effect and result.



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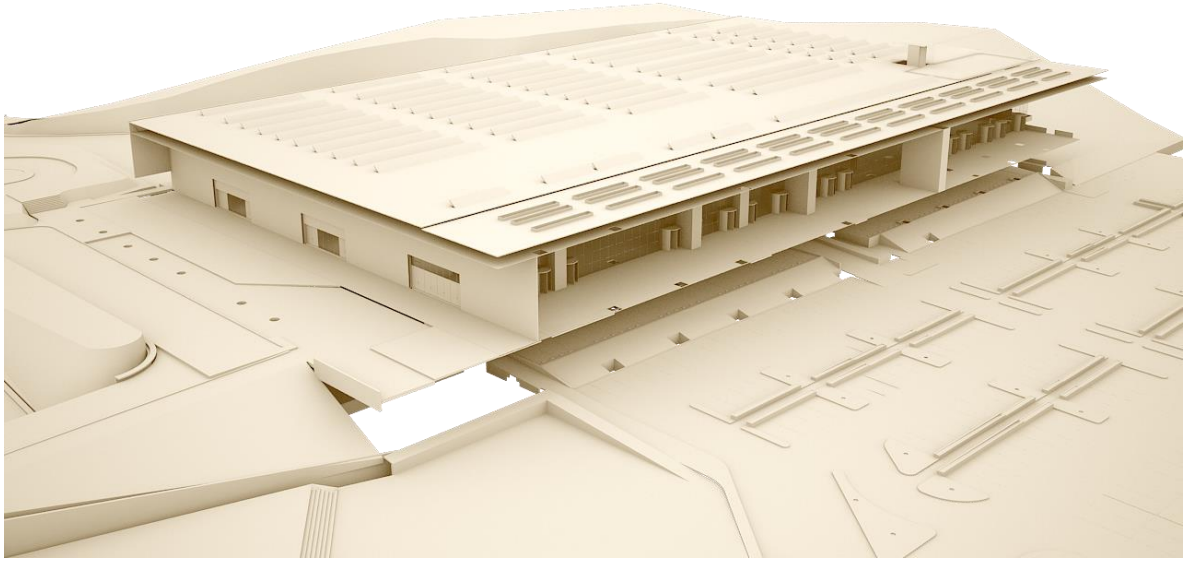

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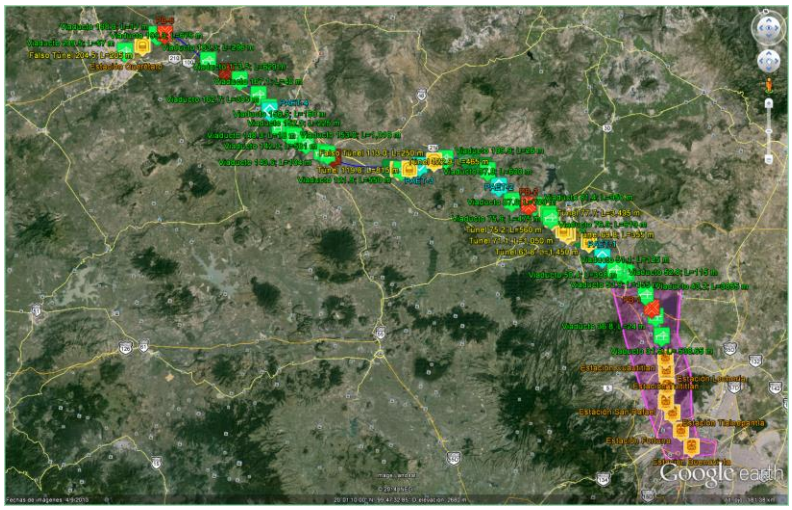
MatchMover for transportation infrastructure projects

Preproduction

Everything starts with a helicopter flight over the area the project is going to run throw. The direction of the shooting is of vital relevance for the success of the project. So it is very important to **Plan Ahead** every meter of the flight plan.

We start by getting the trace as a KMZ file from Google Earth. This way we can get our flight plan and GPS coordinates for the captain to know exactly where we should be flying. On the air we get some freedom to reframe our shooting as needed. Without GPS coordinates is very easy to get lost in the middle of the field.



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1				
2		Plan de vuelo con inf		
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5		Latitude	Longitude	Elevation
6		19.44833168	-99.1517055	2240
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9		19.45138820	-99.1511443	2239
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11		19.45146681	-99.1511343	2239
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24		19.45198037	-99.1511403	2240
25		19.45201961	-99.1511458	2241
26		19.45205875	-99.1511521	2241
27		19.45209778	-99.1511591	2241
28		19.45213669	-99.1511669	2241
29		19.45217546	-99.1511753	2241

Next we prepare a storyboard. In it we plan every shot that we are going to compose, for this we use Google Earth and a simple description of the shot and camera movements.

In order to keep everything in time, we work on a schedule and a check list for the whole process. With Microsoft Excel, we manage the progress of each shot; we need to prepare the file for each project. We name, assign and add pictures to every planned shot.

Everything needs to be ready for the flight day. Be careful of what kind of camera are you going to use, and make sure to shot at a high rate frame per second, this way any vibration gets reduced. CMOS sensors could produce Rolling Shutter, and camera tracking will be really painful. Get the best camera possible, you'll save money on tracking time. If possible, don't zoom in, use your lenses as zoomed out as they allow it.

Weather is the only factor you can't plan ahead. Get sure to check on the weather, with some luck you'll fly on a cloudy day. Cloudy days are perfect for the kind of shots we are going to get.

There are less hard shadows and the light is constant. Stay away from fog and rain; they won't make it easy on the camera tracking software.

Once you get all your footage, it's time to do a little editing and color correction in order to prepare it for the 3D tracking.

Camera Tracking

Separate your footage in different shots. Make sure every shot in the storyboard gets its own time and work.

You can find out an example of one of the shots before integration in the dropbox folder.

Next step is to previwe the shot. Look for what kind of movement do the shot has. Is it a Panning or a Dolly In? Does it turns or tilt? This info will be really relevant when getting the camera solve out of MatchMover.

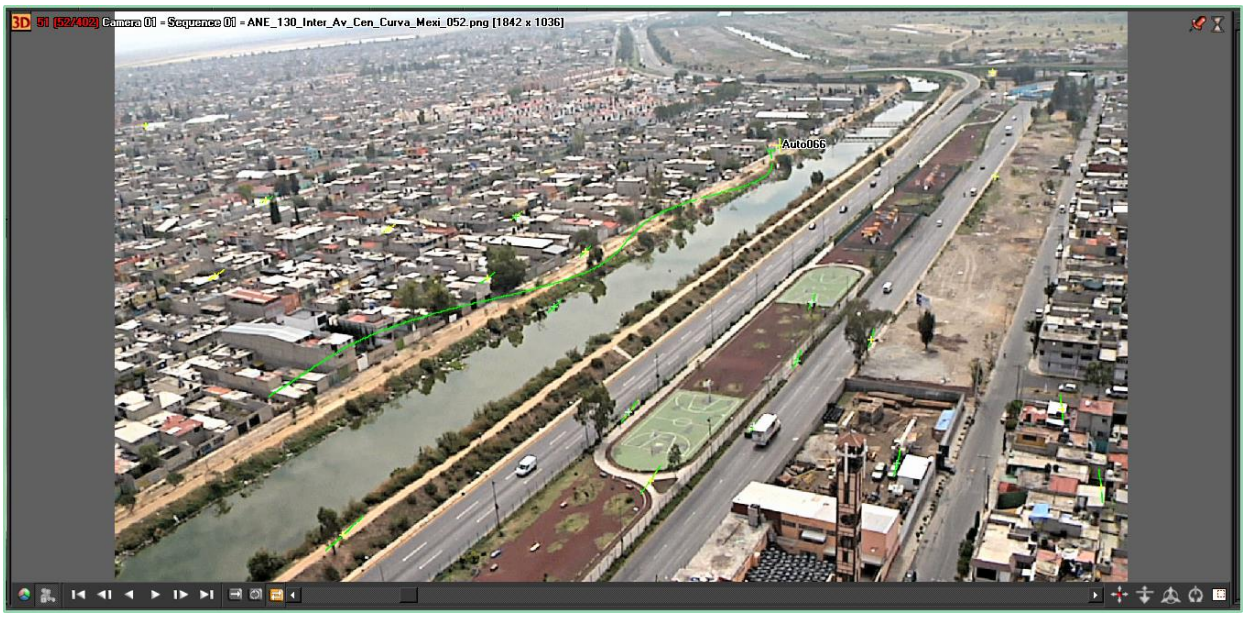
It's time to get into MatchMover. You'll need to convert your video into image sequence, for tracking porpoises I'll recommend turn it into PNG sequence. You are free to convert it into any image format you want to.

Once converted, you can load your image sequence into MatchMover, just go **File – Load Sequence** and select the file. ***Don't forget to set the right FPS***. In this case I'm using 30fps.

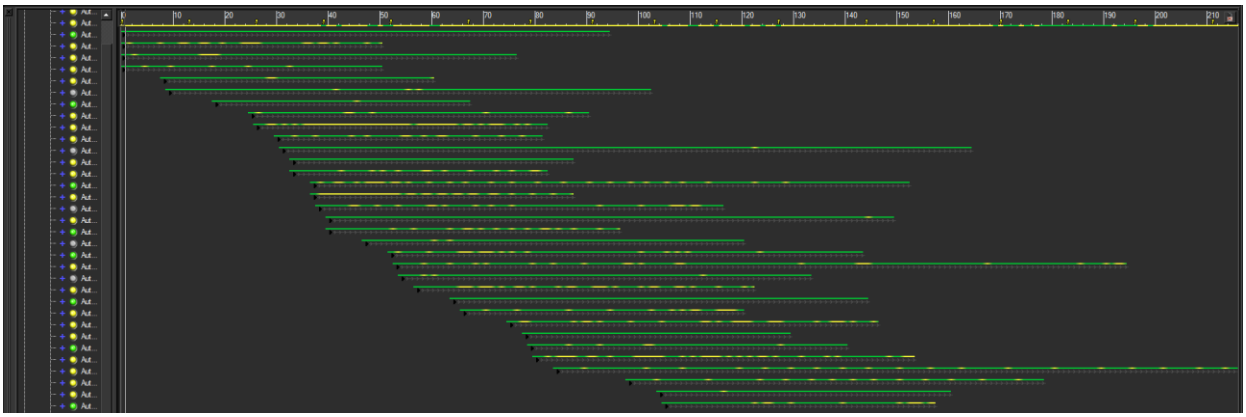
Once loaded, you can preview your shot one more time. Whenever you are ready, go to **2D Tracking – Automatic Tracking** or press F10. This will get MatchMover to calculate automatic tracking points.

MatchMover will set a tracking point from every high contrast point in your shot, including the ones in movement. Because this, it's necessary to clean up the result of the auto tracking. Review your shot frame by frame and get sure to remove every tracking point that grabbed a truck or a car, it will even grab from the helicopter's shadow. Be careful with false points, these are the ones that are created between high points of light posts and low points like road lines or plants. These points represent a wrong parallax point in the scene and they will mess with your camera solve.

Look for long, green-yellow tracks.

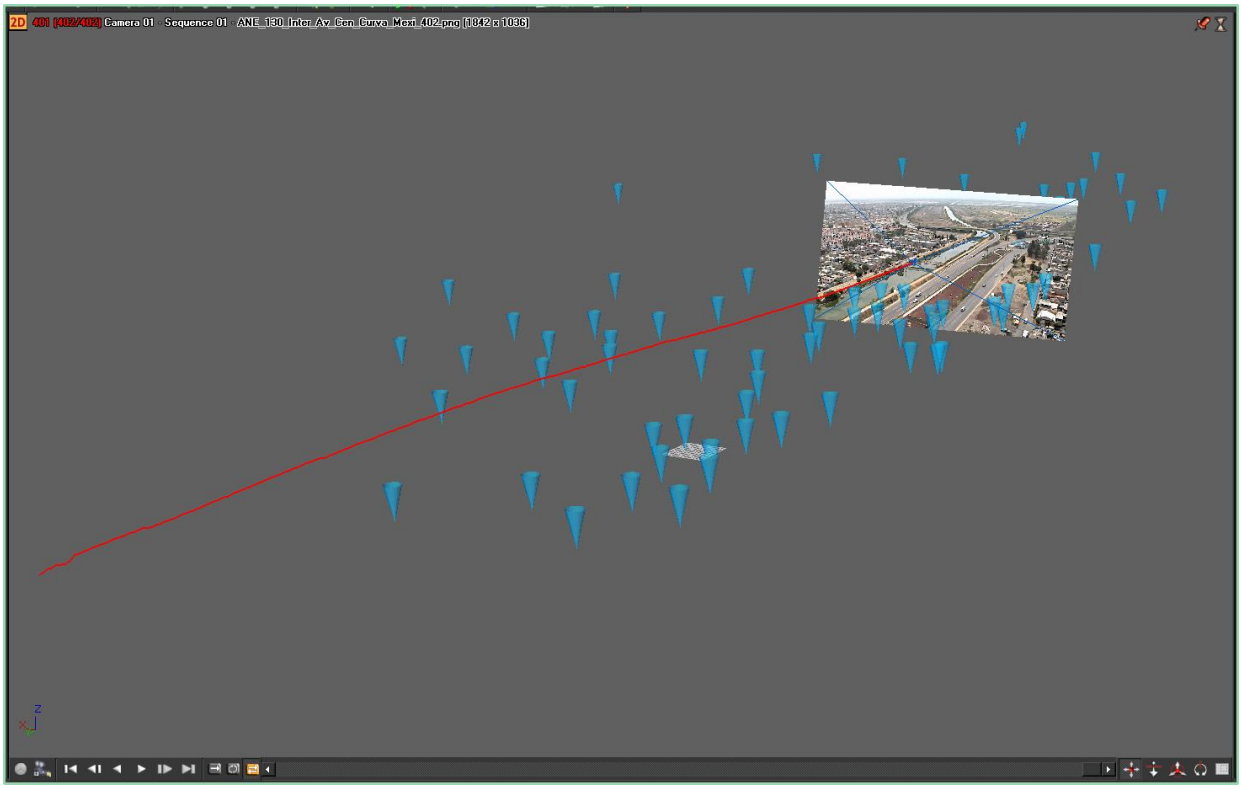


Also you are trying to get at least four green tracks by every single frame on your shot. You can look at this on the track view.



Once you are done cleaning your shot, it's time to get a Camera Solve. Go to **3D Tracking – Solve for Camera** or press F9. MatchMover will solve the camera movement and present a 3D version of the track.

It does a pretty good job. Check for the camera path on the 3D view, it has to make sense with the movement of the helicopter. The camera path is represented by a red line in the screen.



Now that the camera solve makes sense with the real camera movement is time to export our camera and get it into 3ds Max and add our geometry.

Select, **File – Export**. Export the camera as .MS for 3D Studio Max. Select only the Good and Fair tracks, export the camera and 3D points.

Inside 3ds Max, you need to run the .MS file as a script. Go to **MAXScript – Run Script** and select the file you just exported. 3ds Max imports the camera and tracking points from MatchMover into a new scene.

Select the newly imported camera. In its properties, get the image sequence that you use in MatchMover as the Background's File, don't forget to check Sequence in the Select Background Image window.

You should see all the tracking points matching the scene. **Now you're ready to import all the Revit models needed for the project.** Be careful with the space positioning of all the geometry you add to the scene. If necessary, you can use the tracking points as reference for the new objects.

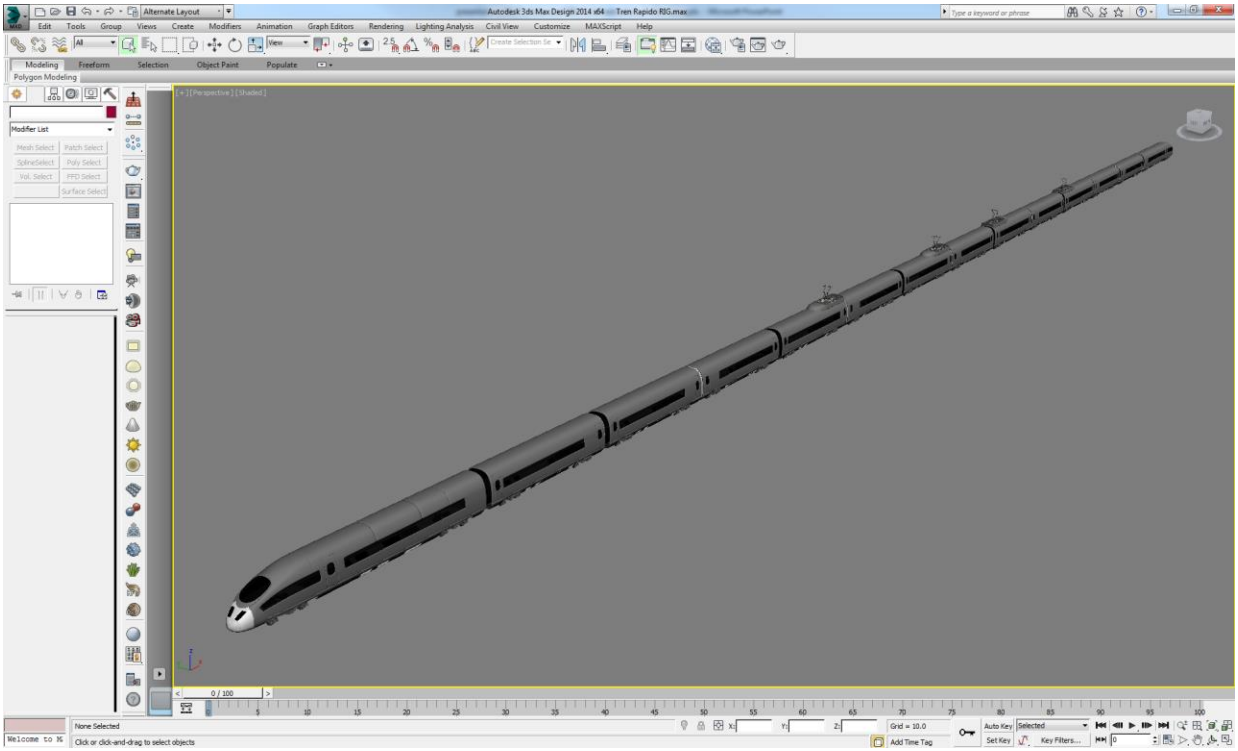
In dropbox, you can find an example of the final result.

Rigging and Animation in transportation infrastructure projects

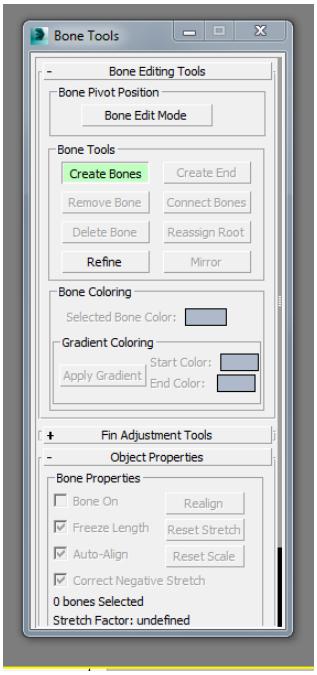
Basic Rigging and Animation

Now that we have our scene tracked and the models in place, we can add a real scale train to the shot. But a static train looks a bit dull. Let's do some basic rigging and path animation for it.

Let's import the parametric train model from Revit or a FBX model into our scene.

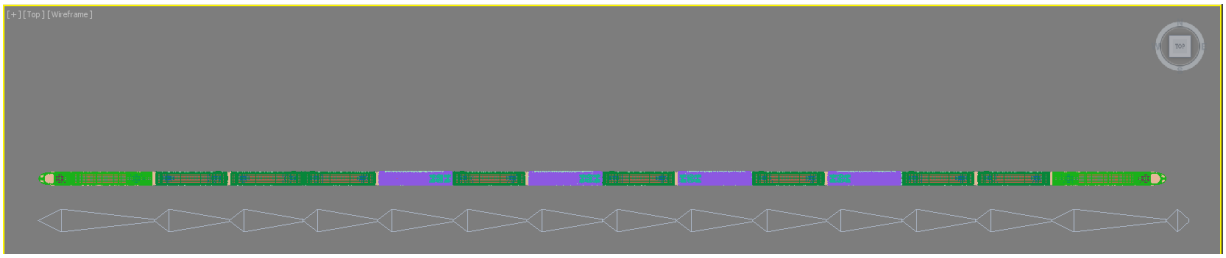


Once the train model is imported we can start rigging it for animation. For this example will be using Bones, a SplineIK Solver, Link, Position and Path Constraints.

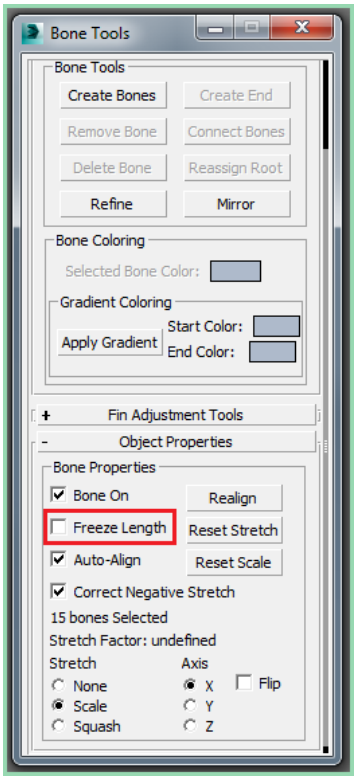


First let's get the Bones in place. From the Top view and snapping to the grid, let set the number of bones according to the number of cars in our train plus a knob. Meaning, if the train has 14 cars, we need to lay 14 bones plus the knob (the little bone at the end of the chain).

From the Bone Tools, select **Create Bones**. Turn on Snap, set it to Grid Points.



We need the bone's chain to be as straight as possible for it to work the right way.



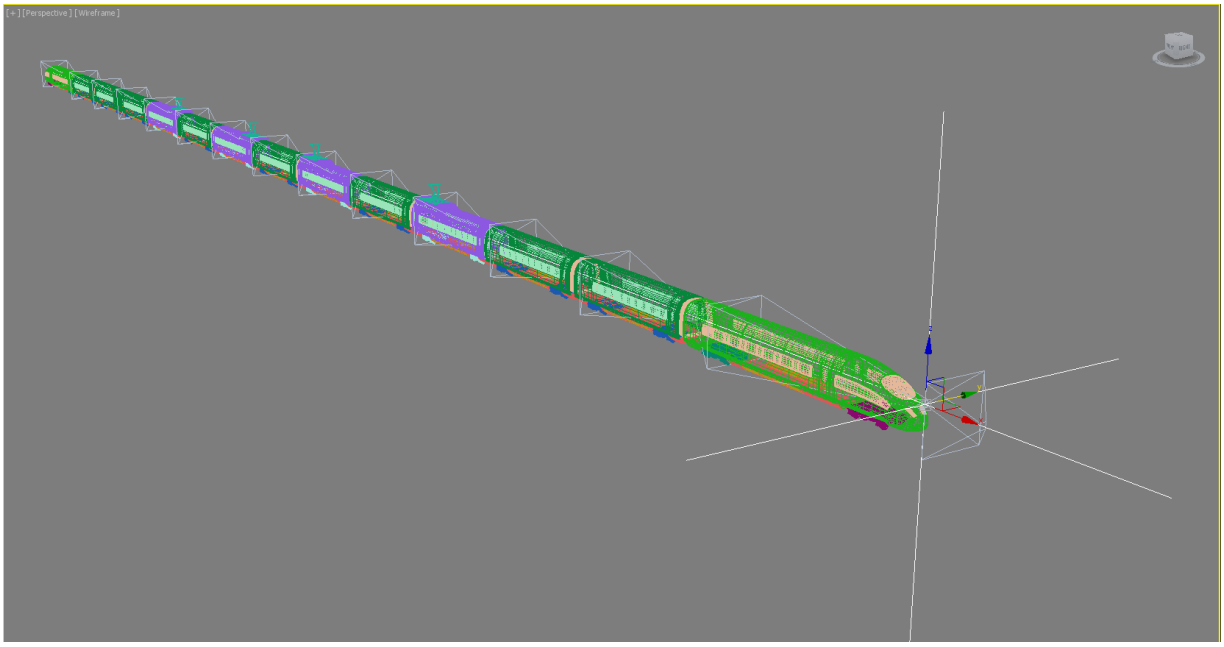
Now let's stretch each bone to match the length of every car. In order to do this, we need to turn of Freeze Length in the Bone Tools window.

Once we adjusted the length of the bones, we turn Freeze Length back on. This will prevent us from having an elastic train.

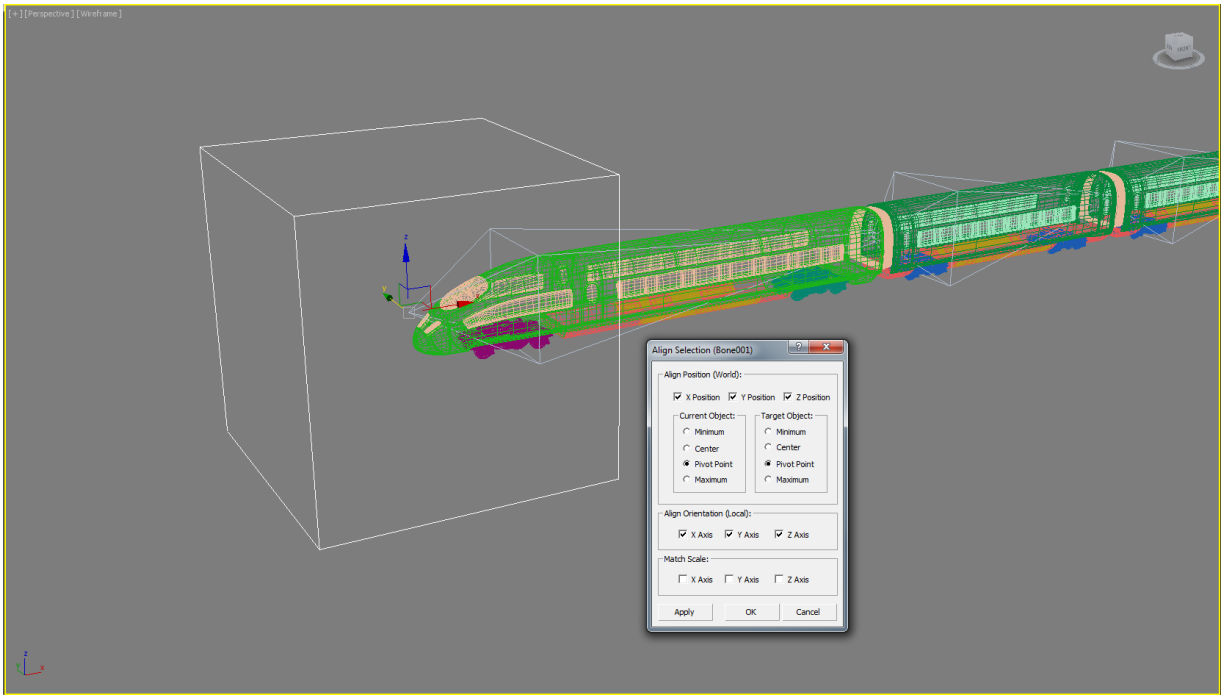
The next step is to move the chain inside the train's geometry. Check every viewport to make sure the chain is in the right place. We need to be aware that with this rig, the knob is going to be the front car, and the base the end car. So if you have a one direction train, be sure to set your chain for the knob to end in the front engine.

For the train to be able to follow a curve path we are going to add an IK Solver. Select the base bone of the chain. Go to **Animation – IK Solvers – SplineIK Solver**. Select the knob.

A helper set's itself at the knob. We'll setup it later, for now just let it rest there.

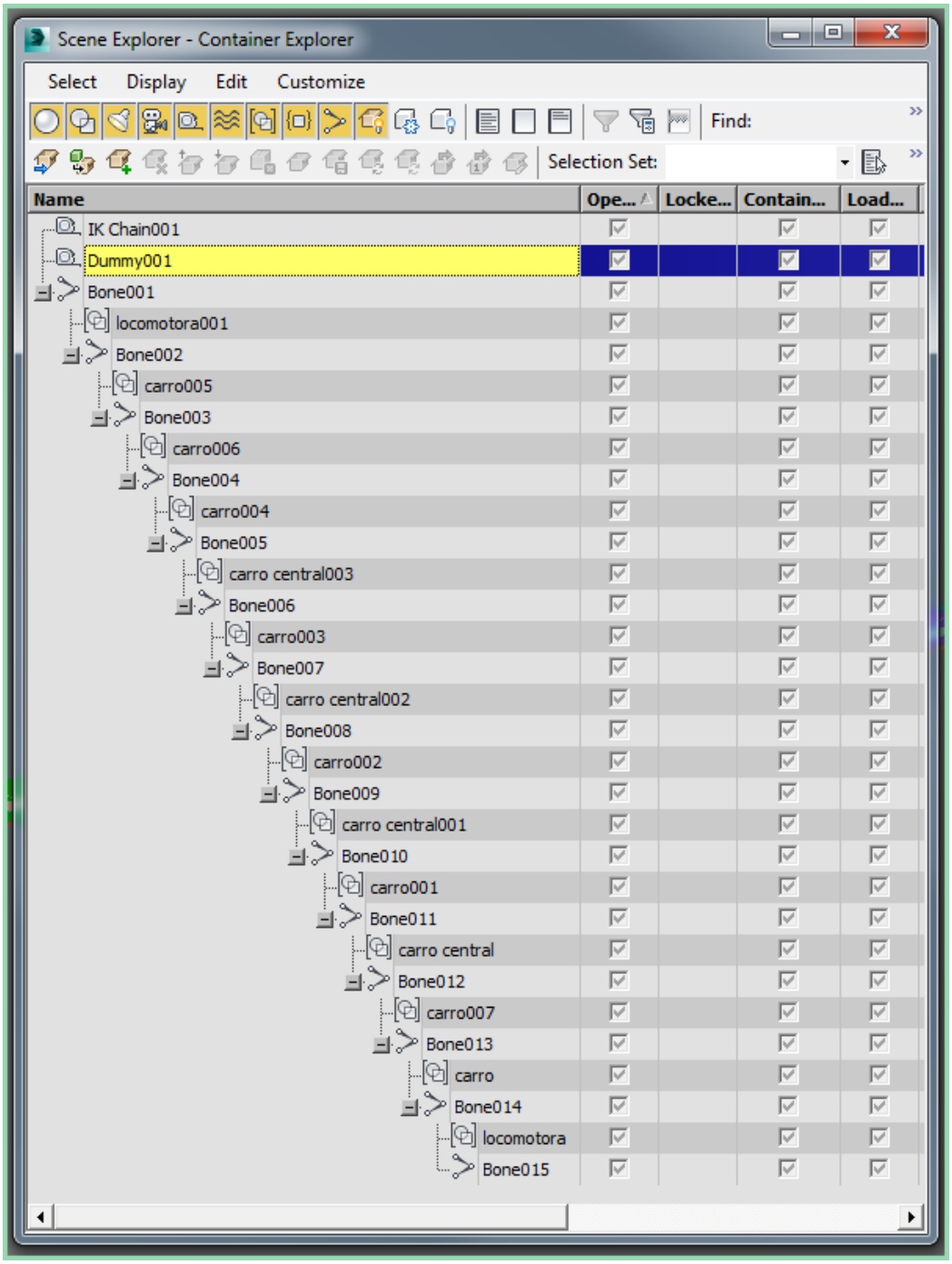


Once we have our IK Solver in place, let's bring a dummy. Align the dummy's position and rotation to the base bone. This will be our path constraint's controller; this is why we need it to be totally aligned to our chain.

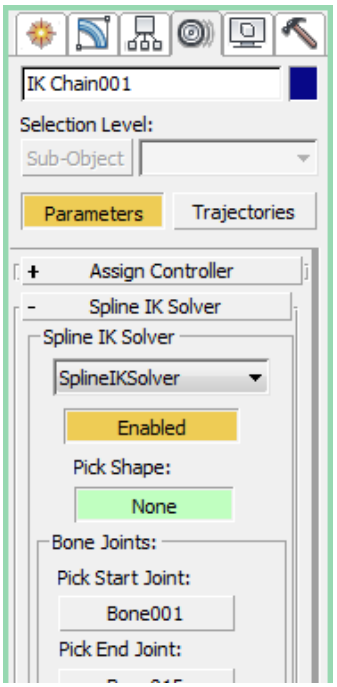


With the dummy aligned to the base bone, Position Constraint the base bone to the dummy. Now, if you change the dummy's position, the entire bone chain shall follow.

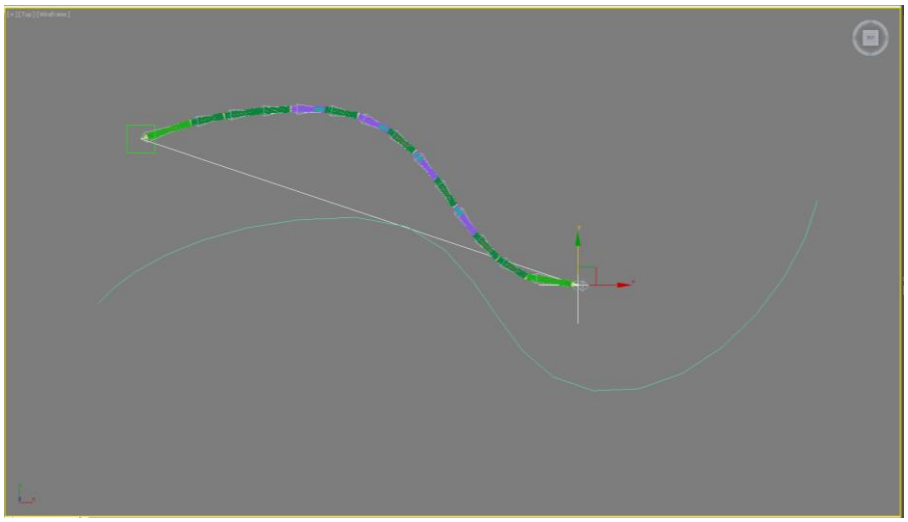
We need to link the rest of the train to the chain. Select the first engine, and link it to the base bone. When you move the base bone, the engine will follow. Link every bone to its corresponding car. At the end the relationship between bones and geometry shall look like this.



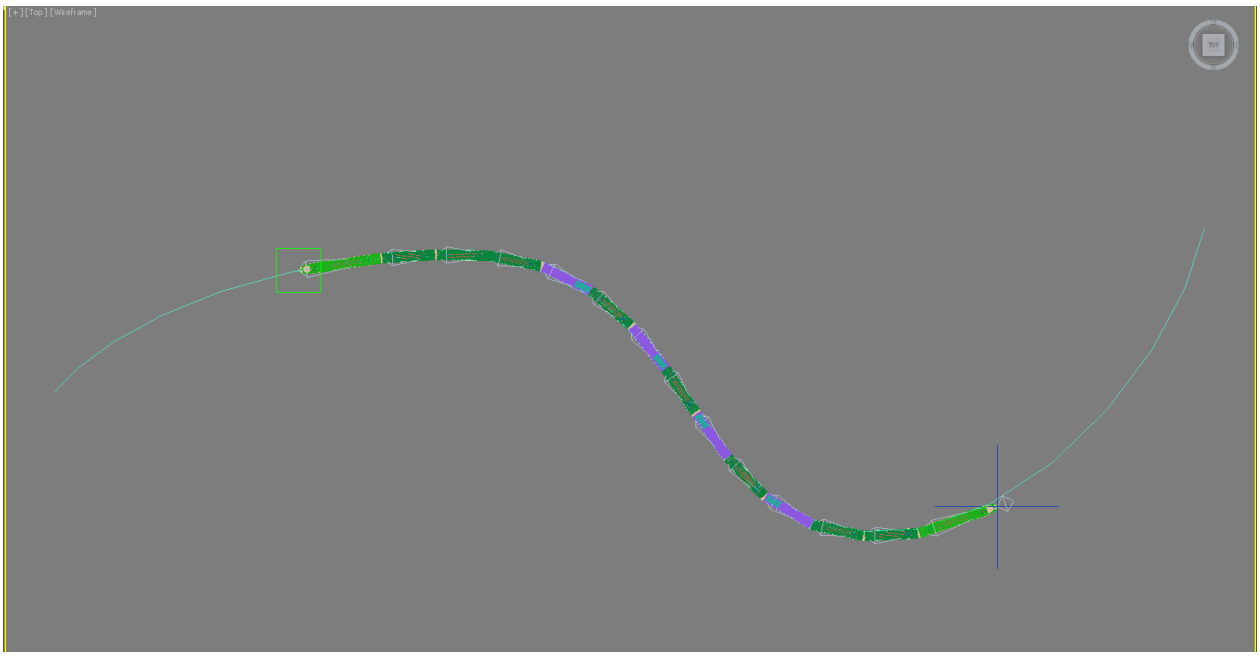
To get the train on track we need to add a line into the scene. In order to get some nice curves I use Bezier as the Drag Type. We usually use curves from the tracks that engineer designed so we don't get impossible curves. But for now, I'm taking a creative license.



Select the Helper at one end of the train; this is the IK Solver. In its Motion Properties, go to the **Spline IK Solver** dropdown and select the **Pick Shape** button. Then select the line you just drew. The train twists taking the shape of the line.



Finally, we need to Path Constraint the dummy to the line. Select the dummy and go **Animation – Constraints – Path Constraint**, then select the line. The train shall position itself over the line and use it as a track.



To animate the train you just need to move across the timeline. It will run along the active time segment as set on the Render Setup. If it needs to go faster just move the last key frame to the left.

You can find the result of this exercise in the dropbox folder for this lecture.

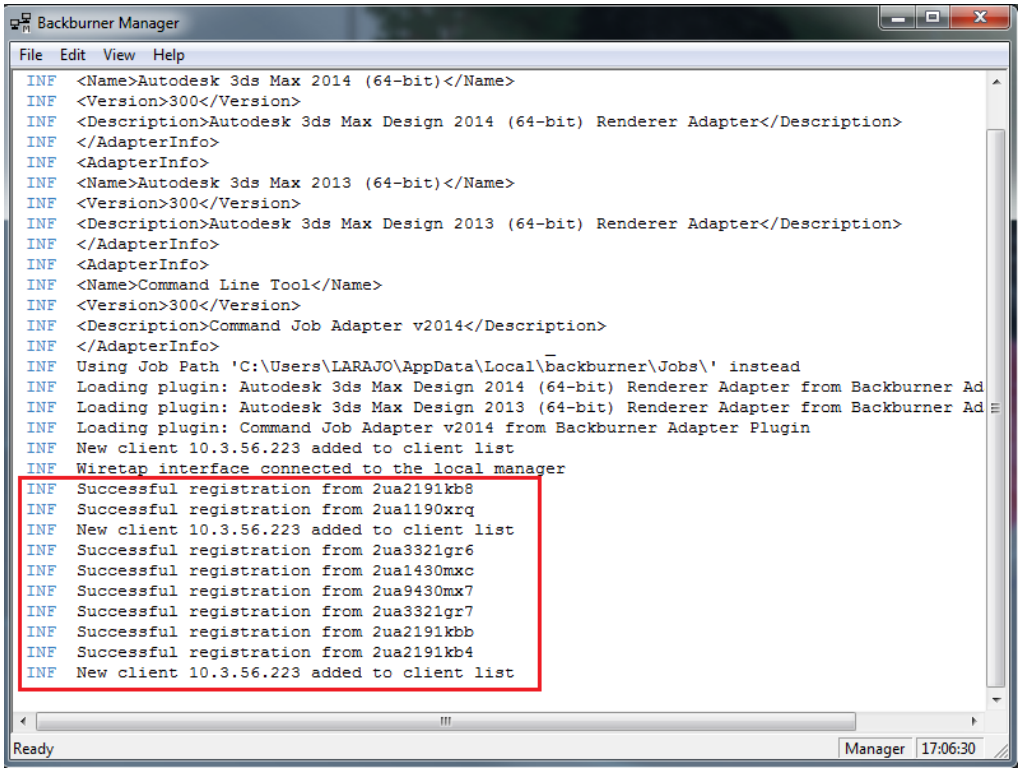
Rendering with Backburner

The IT settings may be the hardest part. Once you get throw the entire network-sharing, access-granting process, you are ready to go. It's very important that every computer has 3ds Max and all used plugins installed.

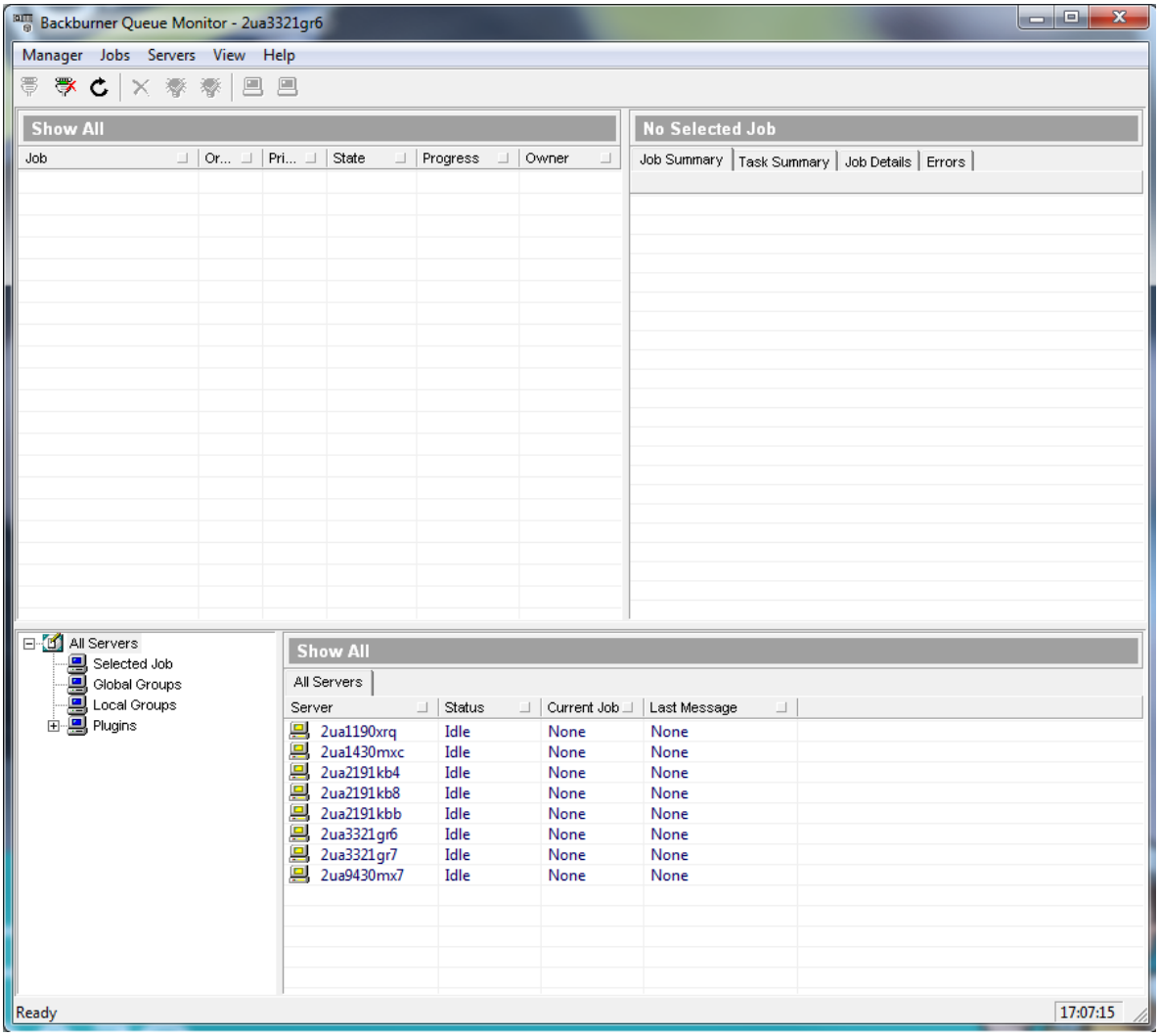
Backburner is simple to setup, and you can have it running in no-time. It is composed by three parts: Manager, Monitor and Server.

The math is really simple, take the rendering time that is taking one computer to render a sequence and divide it by the number of setup servers in your farm. For this example we are using only 8 computers.

Turn on your Manager, Monitor and Server in the main computer (the one from which you're sending the render), and just the Server in every other slave computer. To connect each Server to the Manager, you can do it by the main computer's IP Address or by its Full Network Name. I like to use the Network Name because some of our computers have a dynamic IP Address.



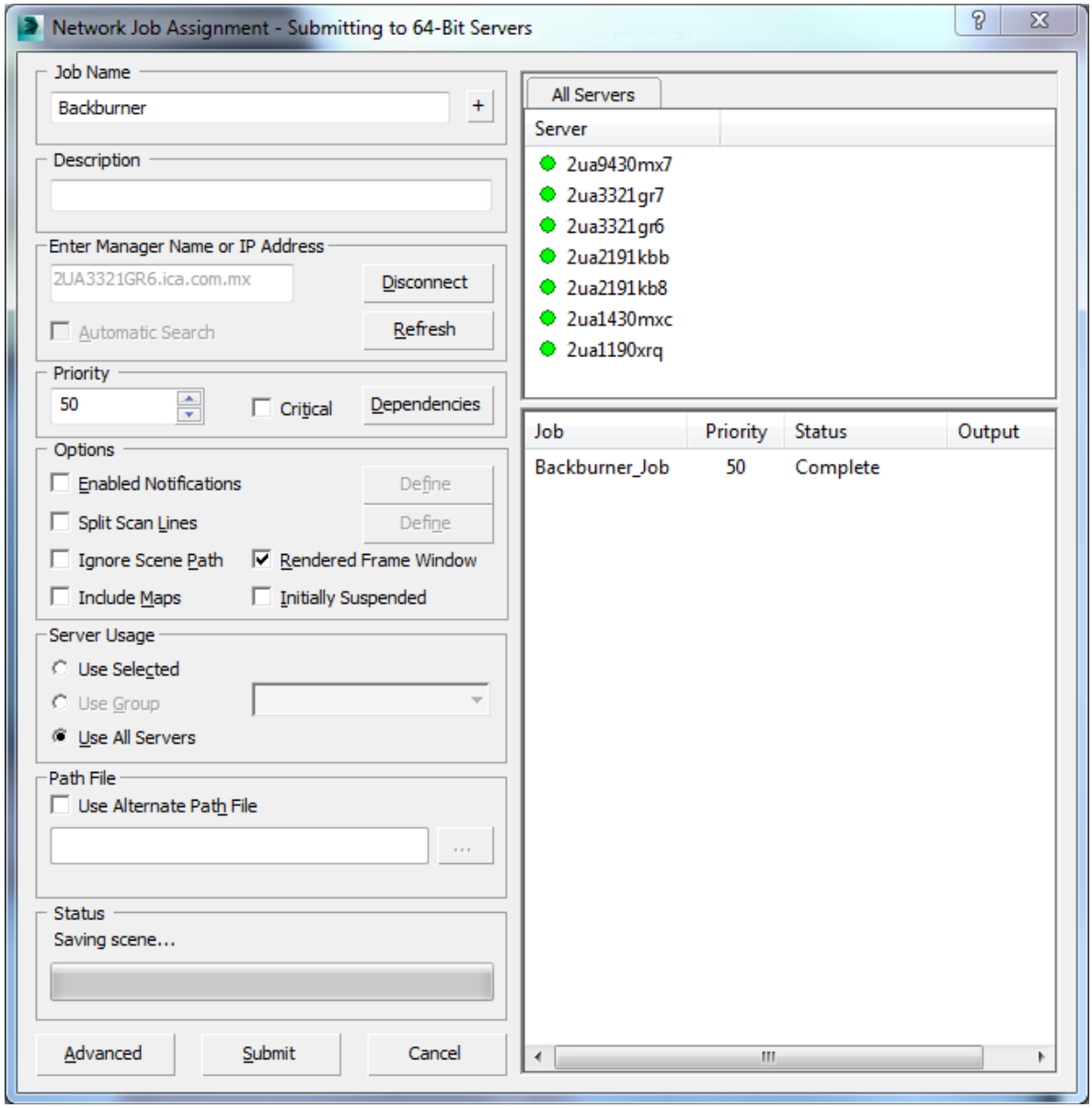
Once you have all the Servers connected to your Manager, connect the Monitor to the main computer as well. Now you must be able to see all the connected computers in the Monitor.



Everything is good to go now, the next step is to submit the render from the Network Rendering in 3ds Max. Don't forget to set the frame range in the Render Setup window.

3ds Max will prompt the Network Job Assignment window. Here you can give the job a name. Before submitting the render, you'll need to connect to the Manager too. Uncheck the Automatic Search option and use the Full Network Name.

The connected servers shall be displayed in the server section of the window. Now, you're ready to submit the rendering job.



That's it! Now your job was submitted to every server you connected. A frame buffer will open and they will work on its assigned frame, doing rendering faster. The frame buffer depends on the render engine you are working with. Remember, **it needs to be installed on every computer.**

You can keep track of the rendering process on every server inside the Monitor. There you can look which frame is each server working on and if there are errors with the frames. It will also tell you the job progress.

Compositing the Shot

Great, we got our scene rendered faster thanks to Backburner. The last step is to put our different sources together.

According to The VES Handbook of Visual Effects compositing gets defined as “the manipulated combination of at least two source images to produce an integrated result”.[i]

You can find the final composition and shot breakdown in dropbox.

For this final task, you can use the compositing software of your choice. The goal is to get both CG graphics and live footage integrated in one seamless animation.

I like to work with separate render passes. Beauty, Occlusion or GI, Shadows and Color ID, will work for most shots.

Beauty will set the general colors and textures. Occlusion brings contact shadows the ones generated by objects occluding each other. Shadow pass gives all the directional light interaction. Finally Color ID, really useful, with it you can get different mattes and masks getting more control while tweaking different parts of the image.

After some blending modes, color correction, rotoscoping and following a lot of real life references, we finally get the entire workflow to an end.

Conclusion

By integrating different Autodesk software into our pipeline, we’ve been able to deliver friendlier and easy to understand visualization jobs to our customers.

Working with parametric models, real life movement limits, sticking to the engineering processes and design details, we deliver imagery that our sales department can use in order to present to the general audience and explain in a comprehensible way, exactly what the infrastructure project is about.

We do BIM, and with few visual effects principles and Autodesk Software we can do Sexy BIM.

[i] Okun, Jeffrey A., & Zwerman, Susan (2010). The VES Handbook of Visual Effects: Industry Standard VFX Practices and Procedures, Appendix C (p. 848). Burlington, MA: Focal Press.