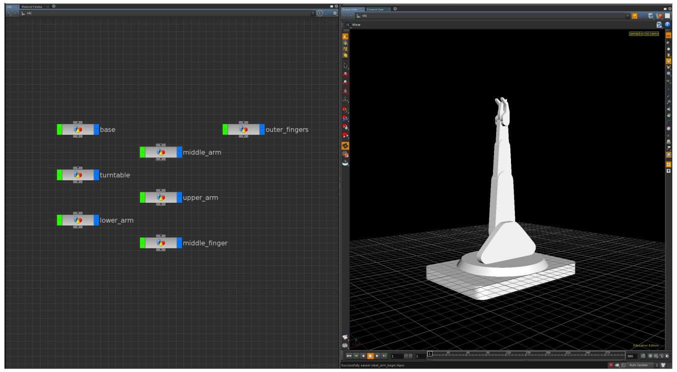
PARENTING OBJECTS

The transformation of one object can be inherited by another object. This is a hierarchical process known as parenting. A parent object passes its transformations to a child object. A child object can also pass down its transformations to other child objects if so required. A child object however cannot pass its transformations back up to its parent object.



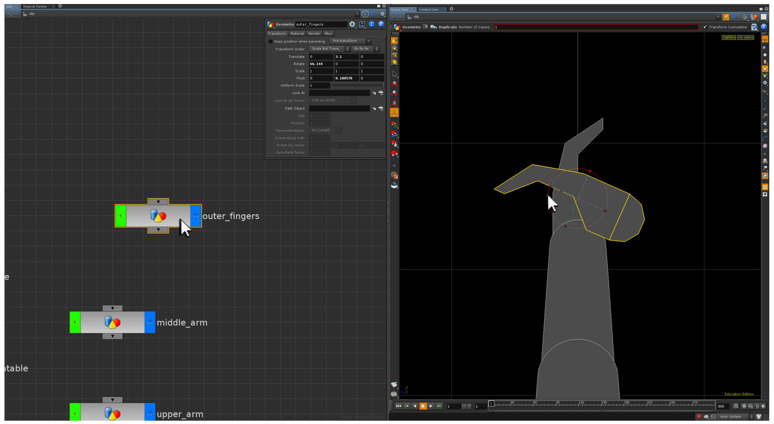
Open the scene **robot_arm_begin.hipnc**. This scene contains a series of independent geometry objects that together form a mechanical arm.

Parenting one object to another takes place at **Object Level** and can be done either interactively in the **Viewer** using the **Parent** tool (**TAB – parent**) or by manually wiring nodes together in the **Network Editor**. If the output of one object (the parent), is wired into the input of another object (the child), transforming the first object (the parent) will result in the same transformations being applied to the second object (the child).

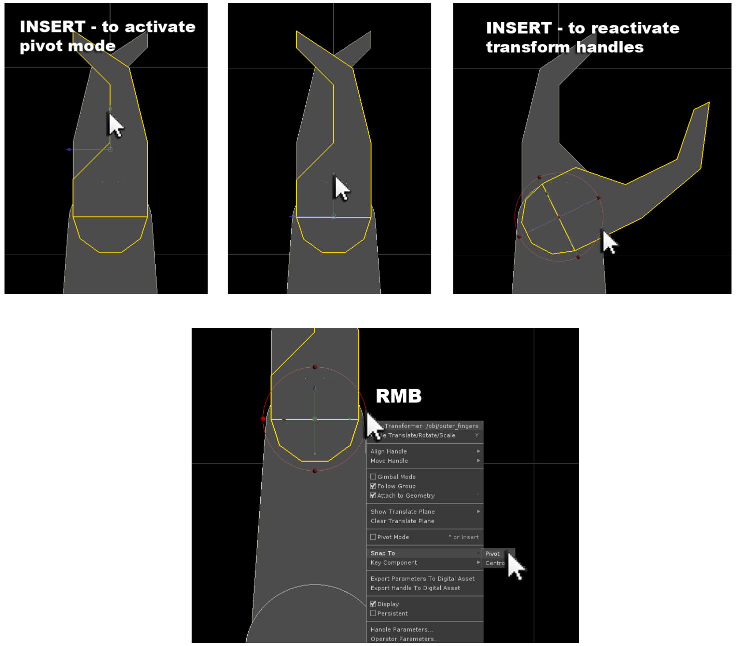
ADJUSTING THE PIVOTS

Each object has its own pivot point, from which any transformation begins. A door for example, opens using hinges on one of its edges. The pivot point of a door is therefore determined by the position of its hinges. For CG objects, a pivot point can be set anywhere in space and affect an object accordingly. For the robot arm, each pivot for each object needs assigning to the most appropriate location for animation purposes.

With the mouse over the **View Pane** press **SPACEBAR + 4** to switch to the Right Orthographic View, and select the **outer_fingers** object. At present, its pivot is set to the centre of the object rather than at its base. If the object is rotated, the object does not move correctly given the context of the object.



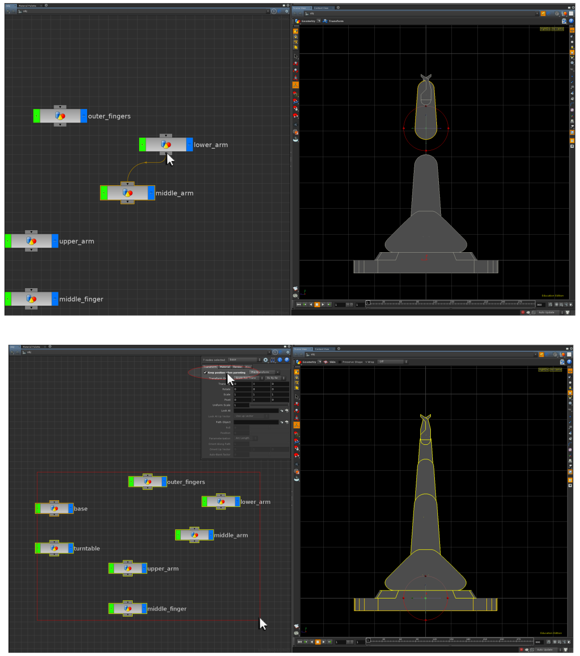
Return the **outer_fingers** object to its original position, and press **INSERT** on the keyboard. This will activate the **Pivot Mode** for the object. The pivot for the object can then be moved into the correct position. With the pivot in the correct position, **INSERT** can be pressed on the keyboard once more to **exit** out of **Pivot Mode**. With the restoration of the Transformation handles, the new pivot position can be tested.



If the Pivot position is correct but the Transform handle still does not align with it, **RMB** on the **Transformation Handle** and from the resulting menu choose **Snap To > Pivot**. Examine and adjust the Pivots for all objects in this scene, to ensure they are correct for animating the robot arm.

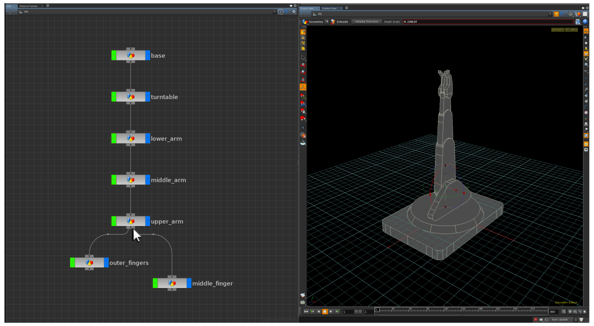
GEOMETRY POSITIONS AND PARENTING

By default, a child object will ‘leap’ to the transform position of its parent whenever a parent is assigned. For example, if the output of the **lower_arm** object (**the parent**) is wired into the input of the **middle_arm** object (**the child**), the middle_arm object will be translated by its own Translate Y value plus the Translate Y value of the lower_arm object. If the two nodes are disconnected once again, the geometry returns to its original transform position.



To prevent this behaviour, the **Keep position when parenting** option can be activated simultaneously for every object in a scene by selecting them all, and activating the **Keep position when parenting** option located in the **parameters**. This should be done before any parenting takes place. The objects in the scene can now be parented to each other without the objects leaping to their parent’s position.

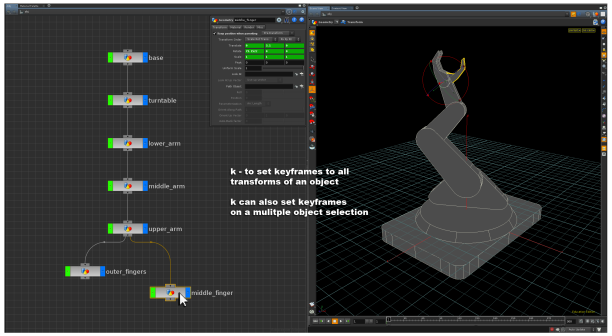
To use the Viewer Parent Tool, press **TAB** and type **parent** with the mouse over the **Viewer**. The **Help Bar** at the base of the interface will ask for the **Child object** to be selected and then **ENTER** to be pressed; it will then ask for the **Parent object** to be selected. It is however just as simple to **parent objects** to each other **directly** in the **Network Editor**. This is simply a case of wiring the appropriate nodes together in the correct order.



Both the **outer_fingers** object and the **middle_finger** object should be children of the **upper_arm** object. The hotkey **I** can be pressed with the mouse over the Network Editor to tidy the nodes.

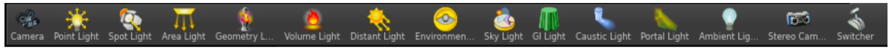
QUICK KEY-FRAMING

With parenting complete, the robot arm can be animated. If an object is selected, all of its **Transformation Parameters** can be **simultaneously key-framed** by pressing **k** on the keyboard. This hotkey allows for quick blocking of animation. Make a short **250-frame** animation for the robot arm using the k keyframe hotkey. See file **robot_arm_end.hipnc**



CREATING LIGHTS IN HOUDINI

Lights in Houdini are created at **Object Level**. Lights in Houdini can be created by using either the **Lights and Cameras Shelf Set**, or by utilising the **TAB menu system** (press **TAB** and type **light** with the mouse over either the **View Pane** or the **Network Editor**). The Shelf Lights are pre-configured to perform specific tasks.



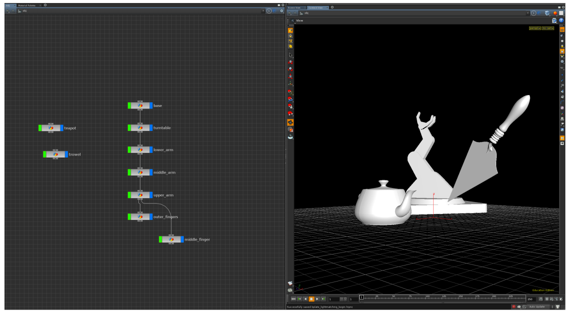
DIFFERENT LIGHT TYPES

Point Light	An omni-directional light emulating for example candlelight
Spot Light	A theatrical cone light for highlighting specific objects
Area Light	A soft light utilised for describing light emitting from small areas (for example a skylight or window).
Distance Light	A light that emulates distant light sources such as the Sun
Environment Light	A light that emulates a special type of shadow called Ambient Occlusion or uses Images (including HDRI) for lighting a scene.
Ambient Light	For adding a uniform brightness to objects in the scene (can be better utilised for texturing tricks than direct lighting effects)
Sky Light	A Distant Light and Environment Light with a sky reflection map
GI Light	Adds (or increases) the amount of bounce light in a scene.
Caustic Light	Adds caustic light effects to scene objects.
Portal Light	An Environment Light that only casts through doorways or windows
Geometry Light	Turns objects into lights (including their textures).
Volume Light	Turns volumes into light sources

NOTE: all lights (aside from an Ambient Light) are the same Light Object reconfigured.

LIGHT MATCHING EXERCISE

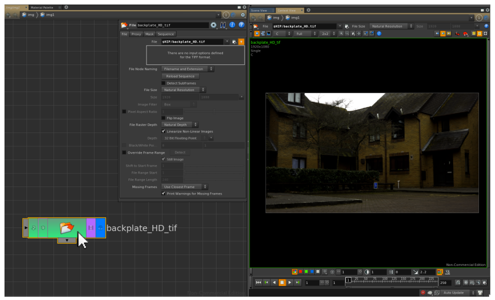
Open the scene bplate_lightmatching_begin.hipnc



This scene contains some simple geometry that can be used for light matching with a background plate.

PREPARING THE BACKGROUND PLATE

Head to the **/img level** of Houdini, and create an **Image Network node**. Inside this network, create a **File COP** to read in the **backplate_HD.tif** image.

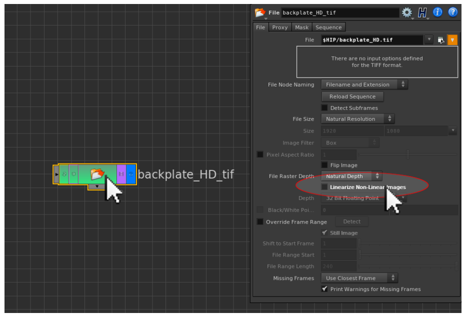


HOUDINI'S LINEAR IMAGE WORKFLOW

By default, the Houdini 14 environment is now configured for a linear workflow. This means that **8bit images** (with gamma adjustments embedded) are **automatically up-converted** to a **16bit linear image** (with no gamma adjustments embedded). All 8 bit images read into Houdini (including textures) are automatically up-converted in this way.

This allows for the **final renders** to be **16bit linear images** for **16bit linear** (no gamma) **compositing**. When the compositing process is complete, the final output is converted to 8bit with gamma embedding re-assigned as a final step.

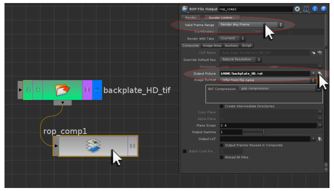
Sometimes the **File COP** can make the **wrong presumption** about an **above 8bit image**. In this case, the **16bit linear background plate image** is **overtly dark** in the Viewer, suggesting that the **File COP** is making an **additional gamma adjustment** to the image when none is necessary.



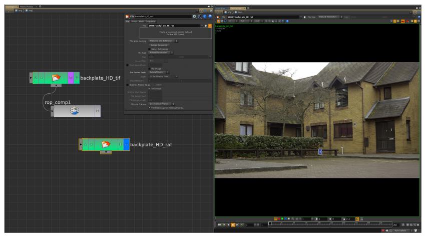
In the **parameters** for the **File COP**, un-tick the **Linearize Non-Linear Images** option. This will restore the natural colour of the background plate.

It is also useful to resave images in a **Houdini native image format** (**.rat**). This native image format is more internally efficient than standard image formats. A **.rat** means **R**andom **A**ccess **T**exture. Append to the **File COP** a **ROP File Output COP**, and in its **parameters** specify:

Valid Frame Range	**Render Any Frame**
Output Picture	**$HOME/backplate_HD.rat**



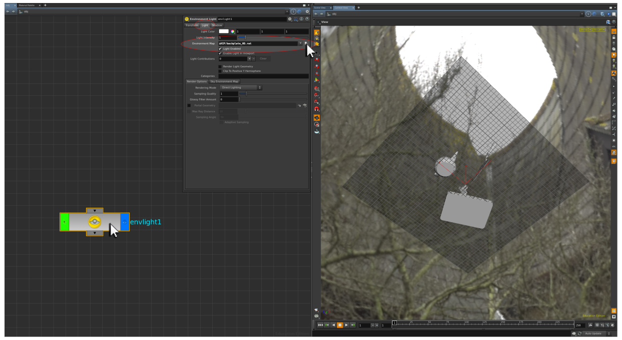
When the **Render** button is pressed, this will create a new .rat file version of the background plate in the $HOME area. A **second File COP** can be used to check the **backplate_HD.rat** file to see if it has been correctly generated.



This image will be used both as a background plate and also as a faux environment map for getting a light match established.

BEGINNING A LIGHT MATCH

Return back to the **/obj level** of Houdini, and in the **Network Editor**, create an **Environment Light**. This can be used to give the general lighting information found in the background plate as a starting point for a light match. In the **parameters** for the **Environment Light**, load the **backplate_HD.rat** file into the **Light > Environment Map parameter**.



When the **Viewer** is **tumbled** to look up to the top of the environment sphere preview, the pinching of the background plate at the polar caps can be seen. This is creating a very small sky area as compared with the one implied by the background plate image itself. A formal polar HDR Image would not have this problem; however when using a background plate also as an environment map, additional lights can be added to the scene to help compensate for this effect.

NOTE: Formal application of HDR Images as environment maps will be taught later in the programme; however this exercise demonstrates how a light match can be established with only a background plate image to work with.

ALIGNING THE ENVIRONMENT LIGHT

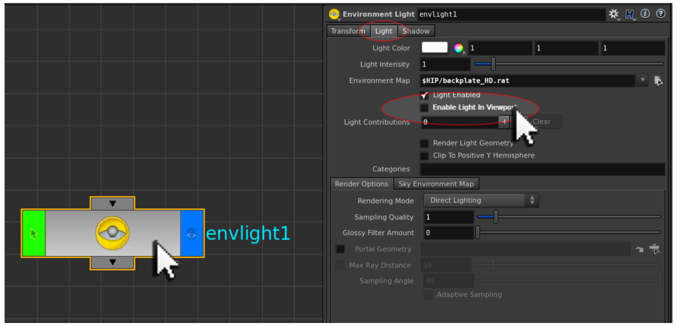
It is good practice to align the environment as closely possible with the background plate scene. In the **Transform parameters** of the **Environment Light**, specify:

Rotate	**0**	**12**	**0**

This will rotate the tree region of the environment map closer to the actual tree position of the background plate.

H14 - BUG ALERT

When the Environment Map is aligned, **deactivate** the **Enable Light in Viewport option**. This will make the environment light preview in the viewer invisible.

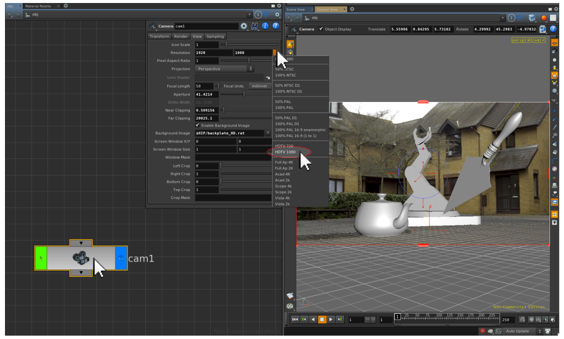


Save the scene to your **$HOME area**, and **quit Houdini**. When Houdini is re-launched, the Viewer will be able to successfully load in a background image for a camera, without being overridden by the Environment Map preview.

This is a bug that has been reported to Side Effects Software.

ADDING A CAMERA

In the **Viewer** create a **New Camera** from the yellow **No Cam drop down menu**. This will place the camera at the current view position. In the **parameters** for the camera, specify a **View > Resolution** of **HDTV 1080**. Load the **backplate_HD.rat image** into the camera view by using the **View > Background Image** file chooser parameter.

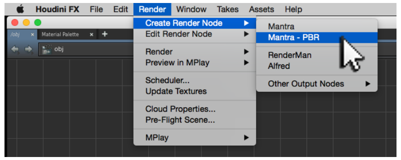


NOTE: The **Viewer's Display Background button** will also need to be activated to see the background plate image through the camera view.

NOTE: The **camera** can also be **locked to the Viewer** and its position adjusted if necessary to get a better alignment of the scene to the background image.

CREATING A MANTRA PBR RENDERING NODE

From the main **Render menu** choose **Create Render Node > Mantra PBR**. This will create a **Mantra ROP** for PBR (Physically Based Rendering) at the **/Outputs** level of Houdini.



Ensure the Viewer is looking through the **camera**, and if necessary **reactivate** the **Display Background Image** option. A formal render of the scene can be generated by **RMB** on the **Film Spool** button of the **Viewer** and choosing **mantra1**. This will launch **MPlay** (Houdini's image viewer).

If necessary the **background plate** image can also be **loaded into MPlay** by pressing **d** with the mouse over MPlay to bring up its **Display Options**.

NOTE: If the camera background image **automatically appears** in **MPlay** without having to load in the background plate image into MPlay, then the **alpha channel** for this render will be a **sold white**. This means that the **camera background image** will need to be **deactivated** when the light match has been established, **before** any **final rendering takes place**.

The current render of the scene is very dark by comparison to the background plate. This is partially due to the pinching of the environment map at its polar regions, creating dark environmental lighting. The environment is however giving the overall bounce light colour of the houses found in the background plate image.

Keep MPlay open, so that any further renders can be compared with earlier ones. Similarly, keeping MPlay open will also keep the displayed background image active as the render background.

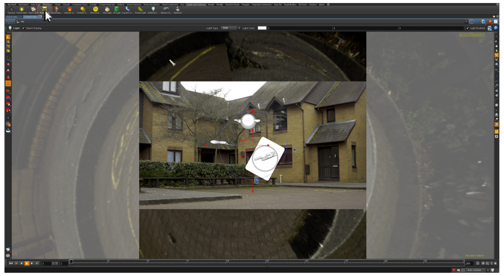
SETTING THE ENVIRONMENT LIGHT INTENSITY

In the **Light parameters** of the **Environment Light increase** the **Intensity parameter** to **2**. This will boost the effect of the environment light in the render. When the scene is rendered again, a more natural bounce light colour can be seen on the scene geometry.

The overall intensity of the Environment Light can also be revisited later on if necessary after other lights have been added to the scene. **See file bplate_lightmatching_stage1.hipnc**

ENHANCING THE LIGHT MATCH USING 3 POINT LIGHTING PRINCIPLES

Whilst a formal 3-point lighting setup would not be appropriate for a background plate light match; **the principles of 3 point lighting can be applied to this light matching scenario**. This is where a key light, rim light and fill light can all be added to the scene to help improve the look of the render. As the **background plate** implies **a large white overcast sky area**, this can be considered as the **rim lighting** for the scene.



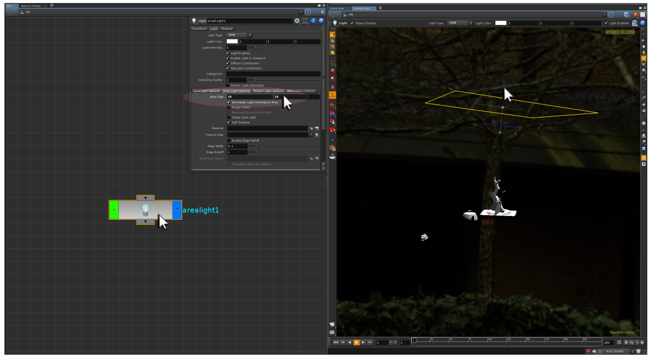
Maximise and **Tumble** the **Viewer** so it looks down on the scene from a **high vantage point**, and from the **Lights and Camera Shelf**, **CTRL + LMB** an **Area Light**. This will place an area light at the current view position. An **Area Light** will give **diffuse lighting** similar to the overcast day of the background plate.

NOTE: If the scene were sunlit with vivid sharp shadows, then a **Distance Light** would be more appropriate for this step.

Restore the **camera view**, and in the **parameters** for the **Area Light**, specify:

Area Size	**10**	**10**

This will create a larger sized area for the light to better represent the implied size of the sky described by the background plate. The position of the Area Light can also be further adjusted relative to the overall scene.



When the scene is formally rendered again, the effect of the area light can be seen. Rim lighting is now occurring, and the scene geometry looks closer to its natural white state than before. The influence of the Environment Light can however be seen.

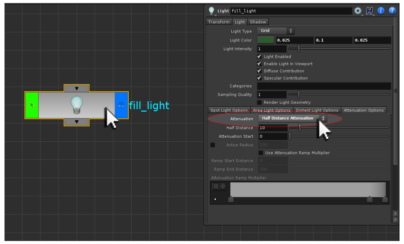
ADDING A FILL LIGHT

The background plate has some green from the hedge area that can discretely contribute to the render as **fill lighting**. As the hedge is a long strip, another **Area Light** can be used to represent this.

Create a **second Area Light**, and adjust is **size** and **position** to cover the **hedge area behind** the **main scene geometry** relative to the implied position of the hedge. In its **parameters** specify a **dark green** as its colour. When the scene is rendered again, the influence of this fill lighting can be seen. Currently however it is too vivid in the render and needs dialing back.

Activating **Attenuation** for this light can achieve this. Attenuation controls the intensity distance of the light over distance, so activating it can localize the effect of the green fill light only to the back regions of the scene geometry. In the **Attenuation Options parameters** for the Fill Light, specify:

Attenuation **Half Distance Attenuation**



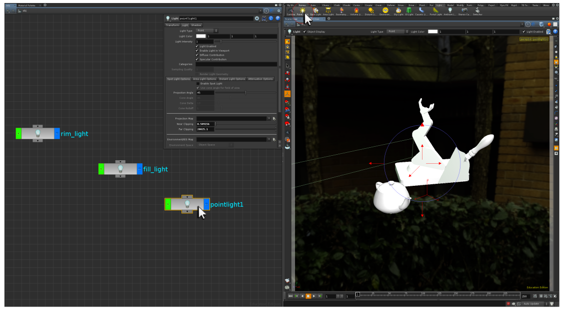
When the scene is rendered again, the influence of this green fill light can still be seen; however it is much more discrete and localized to the back surfaces of the scene geometry.

See file bplate_lightmatching_stage2.hipnc

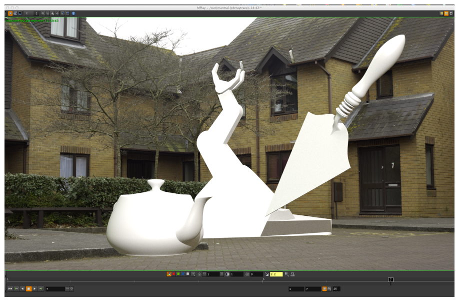
ADDING A KEY LIGHT

While the Environment Light is creating a surround of brown from the houses of the background plate; there is no sense of the open area in front of the scene geometry where the camera was positioned at the time of filming. Whilst it is unknown what was behind this area, the background plate infers that it is an open space that may or may not have similar houses on its other side.

A **Key Light** can therefore be added to the front area of the scene in order to better represent the sky lighting information that would naturally bounce around this open area. This Key light however needs to be subtle as to not detract too much from the overhead lighting described by the rim light.



Tumble the Viewer so looking down slightly on the scene geometry and create a Point Light. When the scene is rendered again, initially this additional light will cause a white out to the render. The shadows created by the Point Light are also too severe at the moment.



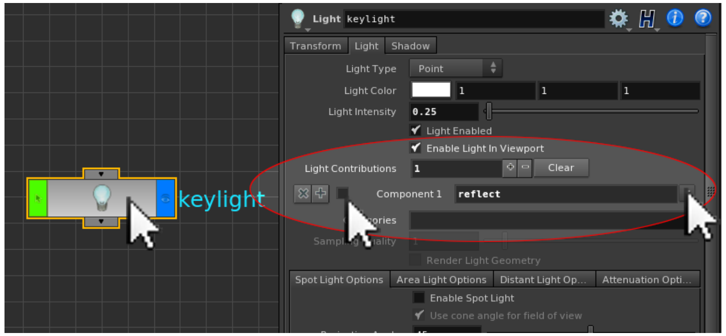
In the **parameters** for this **Point Light** specify:

Intensity	**0.2**

When the scene is rendered again, a much more tempered key light now illuminates the scene.

TURNING ON AND OFF LIGHTING CONTRIBUTIONS

Currently this light contributes to all of the surface properties of the scene geometry. As this background plate was filmed on an overcast day, all the key lighting would be diffuse rather than diffuse and specular (the highlight). To deactivate the specular highlight component, it must be called as a **Light Contribution** and then deactivated.



In the **Light** section of the **parameters** for the key light, increase the Light Contributions parameter to 1, and using the Component 1 drop down menu set:

Component 1	**reflect**

Deactivating the **Component 1 tick-box** will turn off the reflection contribution of this light. When the scene is rendered, the effect of the point light is a lot more discrete.

SOFTENING DIRECT LIGHTING SHADOWS

By default, all **Direct Lights** such as the **Point Light** will **cast sharp shadows**. The trowel for example casts a sharp shadow onto the robot arm. In order to **soften** this shadow, **Depth Map** shadows can be activated instead of **Ray-Traced** (sharp) shadows. In the **parameters** for the **Point Light**, specify under the **Shadow** section:

Shadow Type	**Depth Map Shadows**	
Shadow Blur	**0.03**	
Resolution	**1024**	**1024**
Pixel Samples	**4**	**4**

This will soften the shadows coming from the Point Light, so that they become less dominant in the render.

As a final step, the render quality settings of the Mantra PBR ROP can be adjusted for production rendering. Other lights can also be added if required.

In conclusion, by using the principles of 3-Point Lighting, a good light match between a filmed background plate and scene geometry can be created. This is where the background plate is also being used to create the overall environmental lighting.

Artistic discretion is however required to understand the emphasis that each 3-Point light should bring to the render. In this example the rim light is behaving slightly like a key light, and the key light is behaving slightly like a fill light etc. Similarly conventions about specular contributions and shadows differ slightly from the classic Hollywood 3-Point lighting setup.

If an animated object is traversing through a scene, additional 3 point lighting rigs could be added for other key areas of the background plate; positioned spatially relative to the scale of the scene. This would allow for an object to go between differing lighting rigs relative to differing lighting conditions that may be found on the background plate.

Good light matching should ultimately be an invisible aspect of Digital Effects work; helping the CGI elements to sit naturally in the background plate.

See file bplate_lightmatch_complete.hipnc

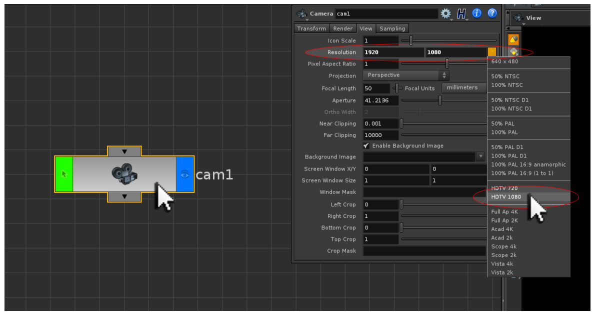
CAMERA MATCHING BY HAND

For custom light passes that interact with filmed background plates, or for simulations that appear to interact with the background plate, geometry representing the scene must be created. This begins by matching the camera to the filmed scene. There are four methods for matching a camera:

1. Software Solution (for example PF Track)
2. Mathematical Calculation based on location survey data (see the Camera object Help Card)
3. Eye Matching with some camera information
4. Eye Matching with no camera information

Before working with automated methods of camera matching, it is useful to know how to camera match a scene by eye.

In a **new Houdini scene**, with the mouse over the **Network Editor**, press **TAB** and type **camera**. This will create a camera object at the origin of the scene.



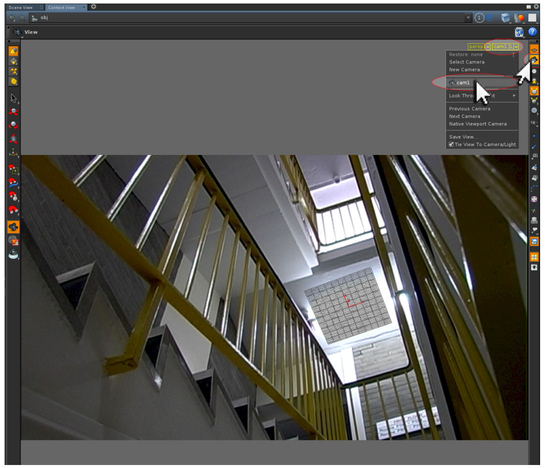
In the **parameters** for this **camera** specify:

Resolution	**HDTV 1080**
Background Image	**Stairwell_Backplate_HD.rat**

This will automatically set the resolution fields to **1920** x **1080** and load in the background plate to the camera view.

PRIMARY ALIGNMENT

Use the camera menu to set the Viewer to look through the cam1 object, and then lock the camera to the Viewer using the Camera Lock button. Tumble the Viewer so that the Construction Plane is aligned to the first ceiling area of the stairwell background plate. As the camera lock button is activated, this will reposition the camera to this view.



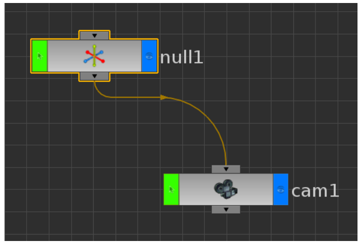
As this part of the background plate is perpendicular to the vertical walls of the background image, it makes a useful place to begin primary alignment. Depending upon the background plate, it may be simpler or harder to identify where the primary alignment should happen. The ideal scenario is to identify perpendicular perspective lines; however is some cases a best guess is required to align the construction plane. It is important to understand which lines are vertical, horizontal, and which lines only appear to be so.

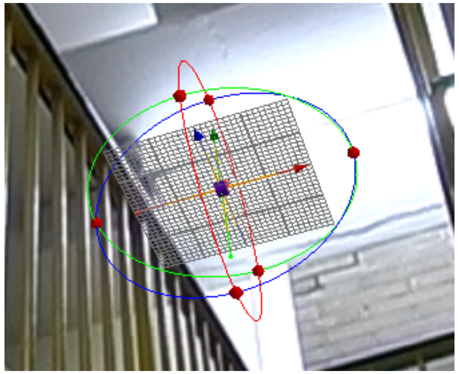
NOTE: The placement of the construction plane relative to the camera must adhere to the real world shooting conditions of the location. In the case of the stairwell, the camera is beneath the scene looking upwards at a steep angle. This is reflected by the construction plane being aligned to the ceiling area, and the camera pointing up towards it at a similarly steep angle.

NOTE: If strong lens distortion on the background plate is evident, the background plate may need to be undistorted in Nuke before a successful hand camera match will occur. Software solutions for matching a camera such as PF Track will automatically generate camera data based on an undistorted image. If camera matching on a background plate with lens distortion takes place, the majority of the camera alignment will be fine; however geometry may not fully align around the edges. It is however important to remember that any dummy geometry created for a scene only needs to align in the key areas necessary for creating a successful light pass or simulation interaction region.

REFINING THE ALIGNMENT

In the parameters for the camera, activate the **Keep Position When Parenting** option, and in the **Network Editor**, **parent** the **camera** to a **Null Object**.



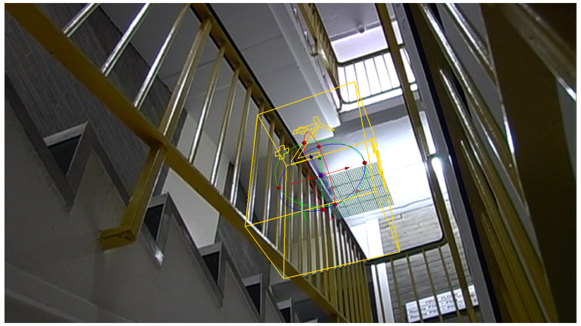


This will create a locator at the centre of the construction plane, whose transformation handles can be used to more easily reposition the camera. The **position of the camera** can also be set by **selecting the camera** in the Network Editor and pressing **ENTER** with the **mouse over the Viewer**.

While this method may appear to be the most natural one for matching the camera, it can be more cumbersome than initially anticipated. It is better therefore to position the camera using the parented Null Object instead.

THE CAMERA MATCHING LOOP

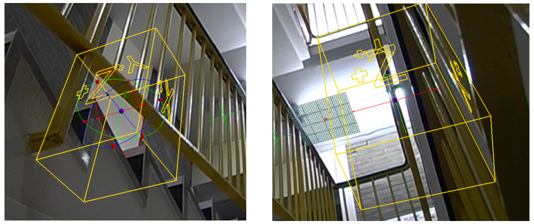
Camera Matching is the navigation between the camera position relative to its **Focal Length** and its **Aperture** settings. In the context of **Eye Matching** only the **Focal Length** needs to be adjusted, as both parameters will adjust the curvature of the camera's perspective in the scene. The success of the camera match is determined by **creating a piece of test geometry**, and **translating it around the scene** to see **where it aligns** and **where it doesn't**.



This then allows for the **position of the camera** to be moved **using the Null Object**, and the **Focal Length** parameter of the camera to be modified, to increase or decrease the amount of curvature visible on the scene geometry. While the scale of the test geometry does not matter (and therefore can be increased to help see it better in the Viewer), the test geometry must be an undistorted box shape, and must not be rotated relative to the scene.

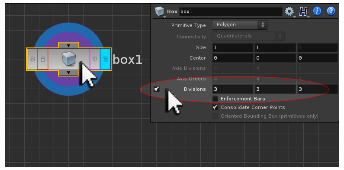
DETERMINING THE CAMERA MATCH SUCCESS

Taking the test geometry 'for a walk' around the scene will determine the success of a camera match. When the camera match has been established, the test geometry can be placed anywhere in the screen space and it will align with the background image. If areas of the background plate do not align, the position and Focal Length of the camera can be gently adjusted, and the process of taking the test geometry 'for a walk' around the scene begins again. This is an iterative process that may take some time to get correct.

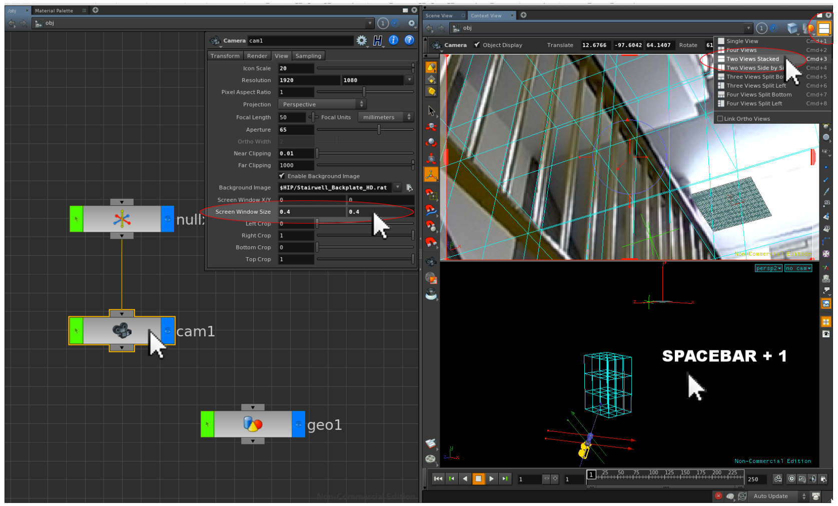


CAMERA MATCHING STRATEGIES

Replacing the contents of the test geometry with a **Box SOP** with the **Divisions** parameter **activated** can also be a useful strategy for determining camera match success. This creates a cage that better reveals the cubic space of the camera's perspective. The scale of the test geometry can also be modified at Object Level to enlarge or decrease the cubic space.



Decreasing the **Screen Window Size** parameter of the **Camera** object will zoom the camera view into the background plate.

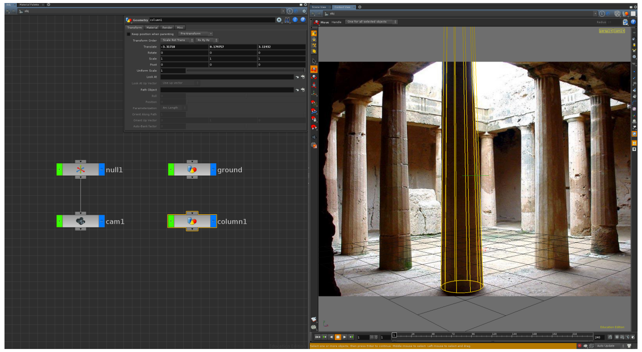


The Viewer can also be split as **Two Views Stacked** in order for the zoomed in camera view and a separate new perspective view (**SPACEBAR + 1** with the mouse over the viewer). This separate perspective view can be used to easily select transform handles off screen from the zoomed in camera view.

See file stairwell_match_end.hipnc

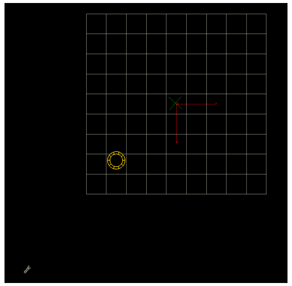
BUILDING DUMMY GEOMETRY

In the context of the DE Nucleus Aquascape project, dummy geometry must be generated for a scene for the purposes of creating a custom light pass that will reveal the original daytime background plate in the lit areas of an underwater background plate in the composite. Open the scene **columns_stage1.hipnc**

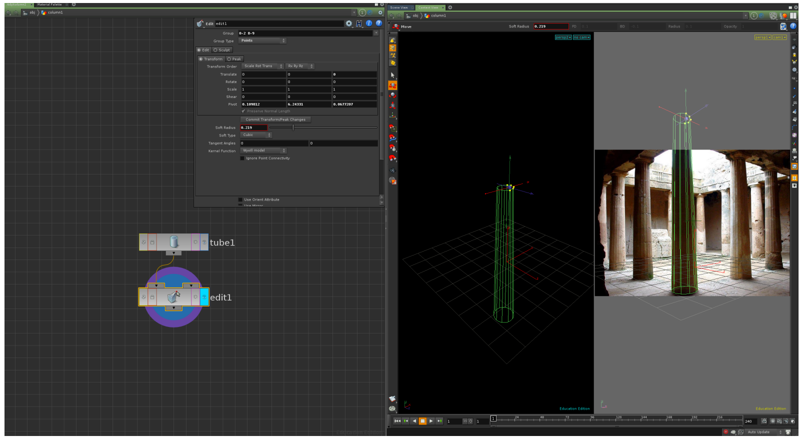


This scene contains a matched camera and the beginning of some dummy geometry creation. **When creating Dummy Geometry, it is important that the construction of the geometry adheres to the real world scene that was filmed**.

In this example, the tube has been moved to the front corner of the grid object. When the scene is examined from a top orthographic view, the placement of the tube is appropriate to the overall construction of the real world scene. It is important to check the scene from different views and angles to ensure that modelling is not taking place relative to the camera but relative to the real world environment being recreated.

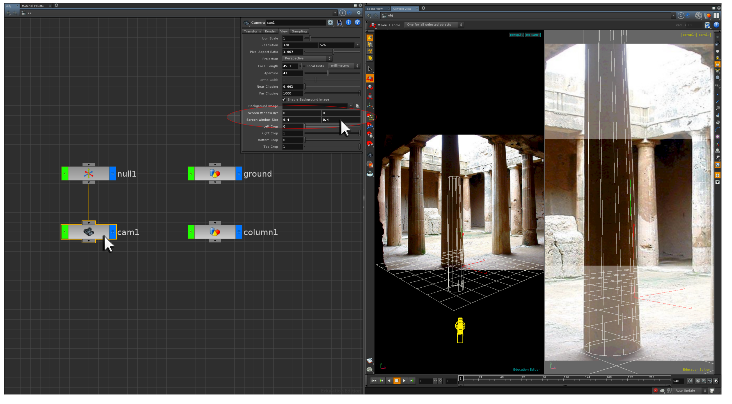


At present the top of the column does not quite align with the background image. This could indicate the camera match could be improved upon; however in certain instances where the overall camera match is acceptable, it can be simpler to edit the geometry into shape. Remember not everything in the real world is as perfect as geometry created in CG.



When editing dummy geometry, it can be beneficial to split the Viewer into two perspective views in order both to gain access to the editing handles in the Viewer as well as being able to see the camera view as well.

Another useful strategy when building and aligning dummy geometry is to reduce the **Screen Window Size** of the **camera parameters**. This allows the viewer to zoom in on specific parts of the camera view.

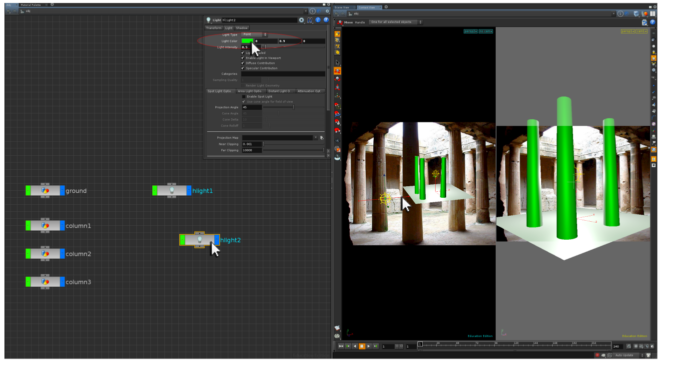


The **Screen Window Size parameter** can also be used in conjunction with the **Screen Window X/Y** parameter that will allow the zoom in camera view to be moved around vertically or horizontally. When the dummy geometry is confirmed as being accurate, these parameters can be reset in order to restore the normal camera view.

With the first column created, the column object can be copied and pasted at Object Level to create the other primary columns of the scene.

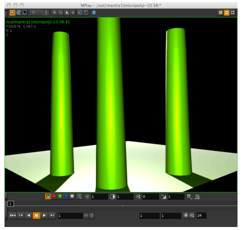
TESTING THE DUMMY GEOMETRY

When the main scene geometry has been created, lights can be added to the scene to help test the success of the dummy geometry. In the **Network Editor**, press **TAB** and type **light**. This will create a light at the centre of the scene. **Interactively position** this light so that it is behind the columns.

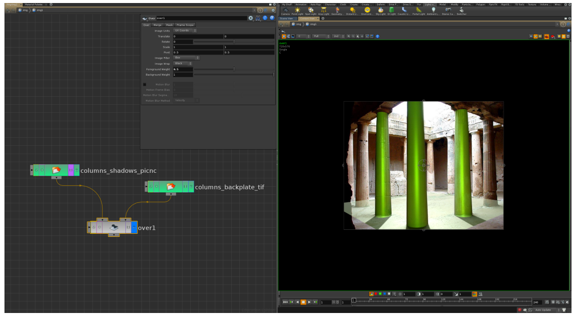


Copy (**CTRL + c**) and **Paste** (**CTRL + v**) this light to create a **second scene light**. **Position** this second light so that it sits **behind the camera**, shining onto the front of the columns. In the **parameters** for this **second light**, set its **colour** to **green** and reduce its **intensity** to **0.5**. This will help accentuate the position of the columns placement on the grid.

At **Outputs Level** of Houdini, create a **Mantra Rop** to render the scene. This will automatically render any scene camera called cam1. The Mantra ROP can be activated by **RMB** on the **filmspool** render button and choosing **mantra1**. When the scene is rendered, shadows from the first light are cast towards the camera from the columns.



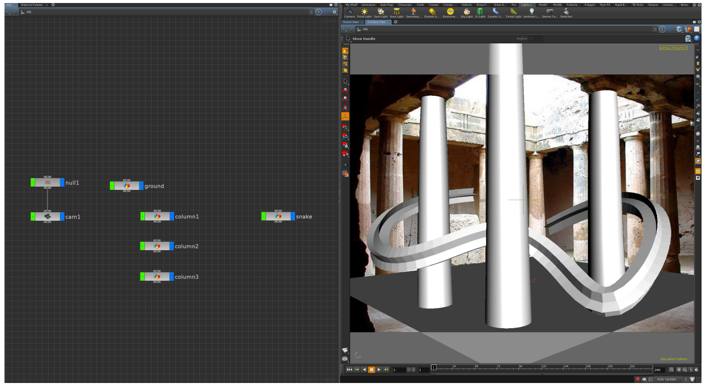
This utility render can be saved to disk and tested by overlaying it with the original background plate in the composite. A simple Over compositing operation can combine the images, and the weight of the render image can be decreased in the Over parameters to see the background plate underneath it. The render can then be examined to help determine the current success of the dummy geometry, and if modifications need to be made.



Examination of the left hand side column reveals that its base needs more adjustment to better match the background plate. Remember though only the dummy geometry that will be affected by the scene's light pass needs to be accurate. **See file columns_stage2.hipnc**

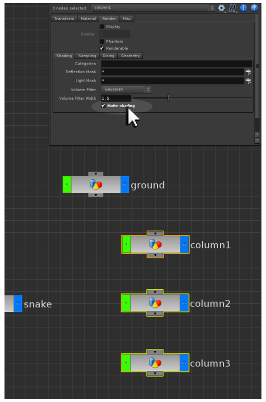
OTHER DUMMY GEOMETRY STRATEGIES

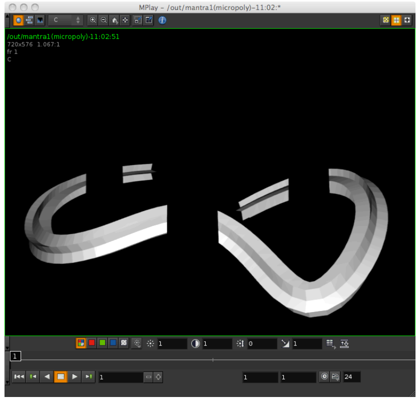
Open the scene **columns_stage3.hipnc**



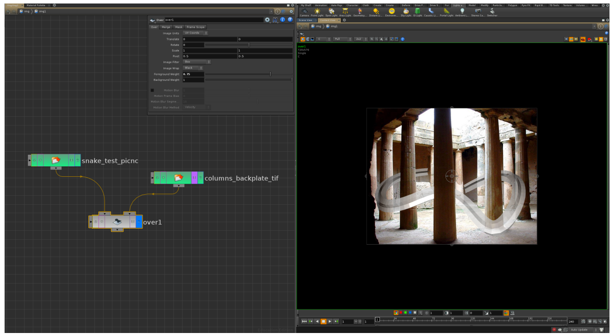
In this scene, the animation path of the Underwater Artefact has been converted into a piece of snake geometry that again can be used to test the accuracy of the dummy geometry match. A simple shape has been swept along the curve to create the snake geometry.

Select all the columns and ground geometry in the **Viewer**, and in their **combined parameters activate** the **Matte Shading option** located under the **Render Section**. This will cause the columns not to render but to cut away the areas of the snake that are occluded by them.





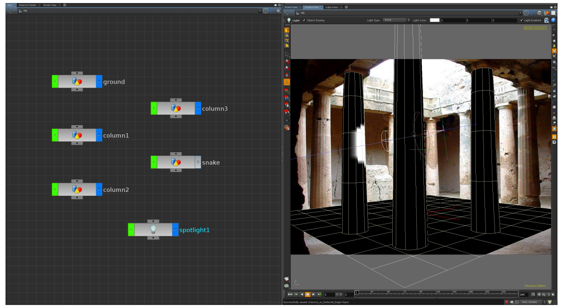
This render can again be saved to disk for the purposes of checking in the composite.



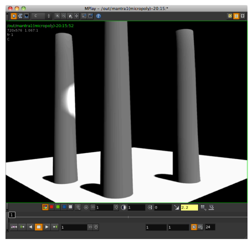
The dummy geometry for the scene can be further refined accordingly. See file **columns_stage3a.hipnc**

CAMERA MAPPING

When dummy geometry has been established, its render can be further improved by a technique called **camera mapping**. This is where the original background plate (or custom textures derived from the background plate) are projected back onto the dummy geometry at render time. **Open the scene columns_uv_textured_begin.hipnc**.

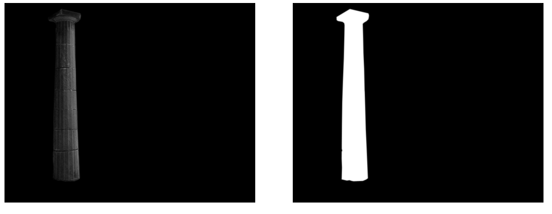


This scene contains some dummy geometry for a background plate that features columns. Custom textures will be added to one of the columns to more accurately cut out the shape of the column and also to add displacement-based features to it. The reason for doing this is to improve any light pass that might be generated from this scene.



A render of the scene reveals all the columns as smooth. Temporary lights have been added to the scene to better demonstrate the camera mapping process. In order to add displacement to the columns relative to the background plate, a **greyscale** version of the **background plate** can be created using software such as **Photoshop** or **Gimp**.

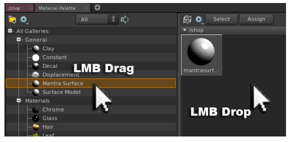
While using a greyscale image of the background plate can generate basic displacement for the overall scene, it can be somewhat crude and visually harsh when assigned as displacement. It can therefore be worth further enhancing the image to remove any overt lighting information, whilst retaining the sense of surface texture.



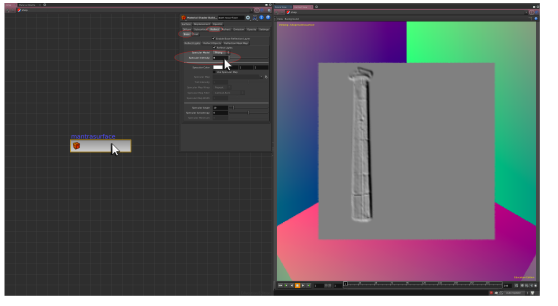
Displacement images can also have **Opacity Maps** (alpha) assigned to them as part of the material configuration. In this example, the left side central column has been isolated, and an additional black and white opacity map created for it.

CREATING A DISPLACEMENT MATERIAL

Activate the **Material Palette** Tab (located alongside the Network Editor Tab); and **LMB Drag and Drop** a **Mantra Surface material** into the palette area.



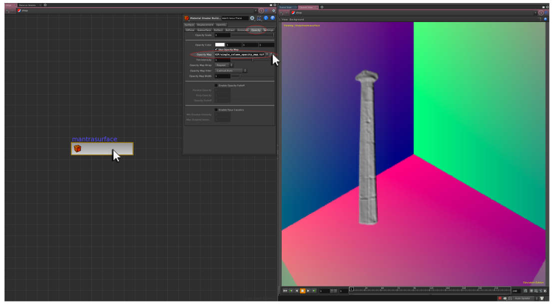
Reset the **Network Editor** tab and head to the **SHOP Level** of Houdini. In the **Displacement** section of the **parameters** for the **Mantra Surface Material**, **activate** the **Enable Displacement Map tick box** and load in **single_column_displace_map.tif** as the **Displacement Map**.



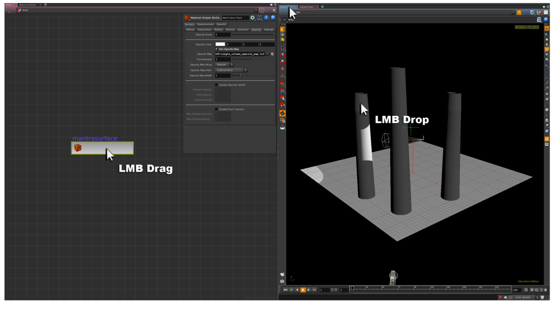
The **geometry preview** can be set to a **grid** by pressing **m** with the **mouse over** the **SHOP Viewer** (m cycles through different preview geometry types).

BUG ALERT – Tumbling the SHOP Viewer will help redraw the material preview geometry if it does not immediately upate.

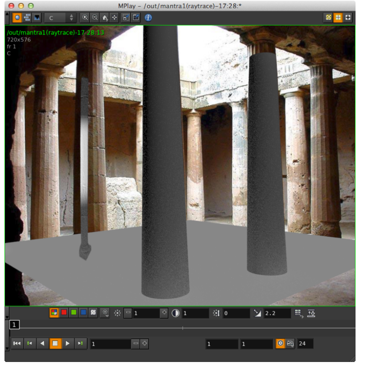
Deactivate the **specular properties** of the **Mantra Surface Material** by **deactivating** the **Surface > Reflect > Enable Base Reflections** option.



Under the **Opacity** section of the **parameters**, activate the **Use Map tick box** and load in **single_column_opacity_map.tif** as the **Opacity Map**. The geometry preview will reflect this opacity cut out effect.



Activate the **Scene View Tab** in the **Viewer**, and **LMB Drag** the **Mantra Surface Material** onto the **column with the spotlight illuminating it**. This will assign the displacement material onto **column3** in its Object Level Material parameter.

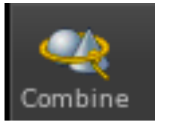


When the scene is rendered, the effect of the displacement material can be seen; however it currently bears little resemblance to the background plate image.

NOTE: in this example only column3 is being worked on. Displacement Materials for the other scene objects could also be developed.

COMBINING OBJECTS

If dummy geometry as separate objects needs to be combined into a single object, this can be done using the **Modify Shelf > Combine Tool**.

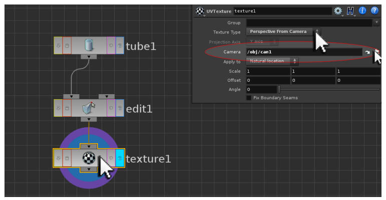


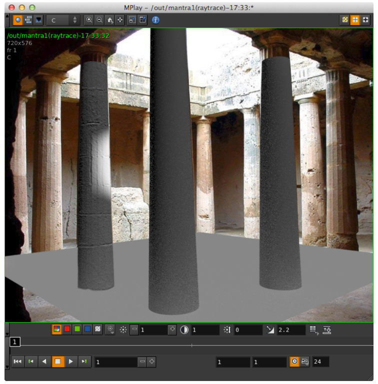
This tool will create a single object by merging all of the selected objects and internal geometry networks together (including any object level transforms).

ASSIGNING THE CAMERA PROJECTION

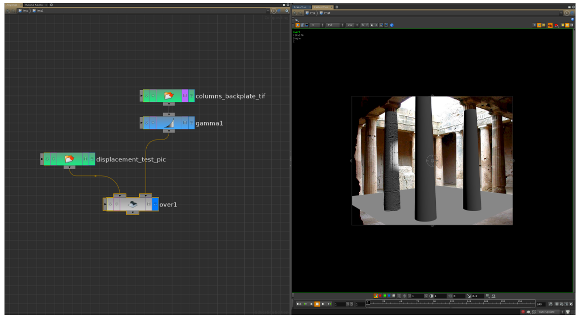
In order for the Displacement Material to work as expected, Camera Projection must be activated. This is a form of **UV Texturing**. Go to the **Geometry Level** of **column3** and append a **UV Texture SOP** to the Edit SOP. In the **parameters** of the UV Texture SOP specify:

Texture Type	**Perspective from Camera**
Camera	**/obj/cam1**





When the scene is rendered again, the displacement of the column now matches the background plate. This process can be repeated for the other dummy geometry of the scene. The accuracy of this render can be tested by saving the image to disk, and in a compositor creating an Over operation to place on top of the background plate image.



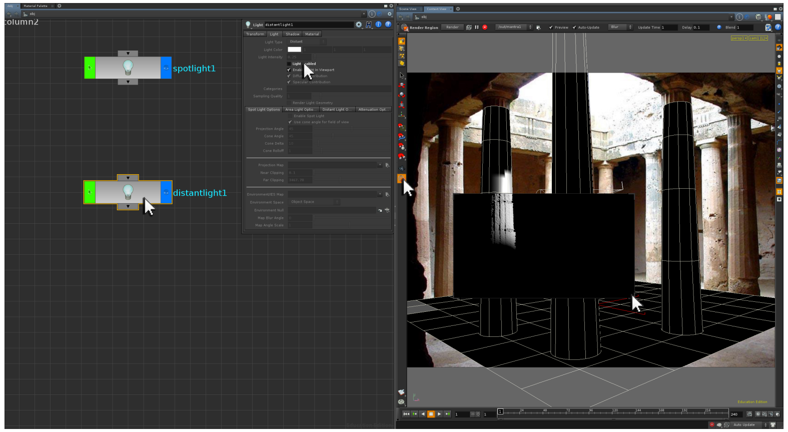
See file columns_uv_textured_stage1.hipnc

IMPORTANT NOTE: If the camera projection of displacement onto dummy geometry does not return the expected result, a **Divide SOP** can be used to **add more topology** to the dummy geometry. This will help ensure the camera projection works as expected.

CREATING A LIGHT PASS

When the dummy geometry has been assigned its camera projection, a more formal light pass can be created. This is where only the illuminating light of the scene is rendered. In this example only the spotlight needs to be rendered to create the light pass.

At **Object Level**, **deactivate** the **Distant Light** in the scene so that only the spotlight is visible. This can be verified by a **Render Region Preview**.



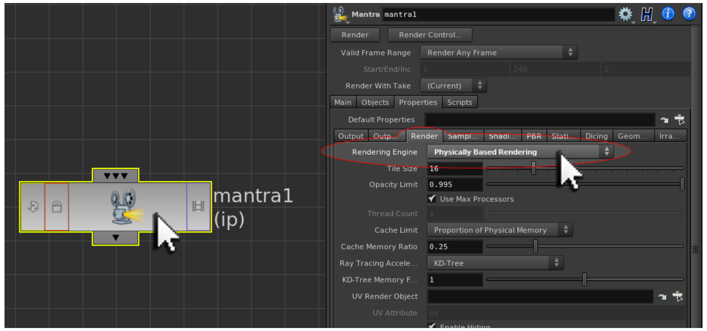
PHYSICALLY BASED RENDERING AND BACKSCATTER

As the light pass light is hitting the dummy geometry, activating Physically Based Rendering on the Mantra ROP can also give **backscatter** to the render. This is where direct lighting from the light itself, hits a surface and then this bounce light then goes onto illuminate other parts of the dummy geometry, or parts of the artefact shining the light.

At the **Outputs Level** of Houdini, locate the **mantra1 ROP** and in its **parameters** specify:

Render >

Rendering Engine	**Physically Based Rendering**



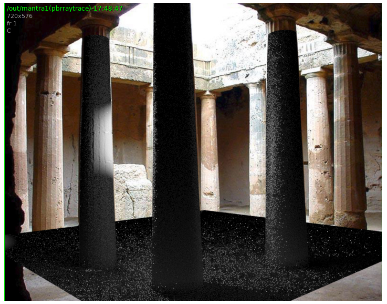
INCREASING BOUNCE LIGHT

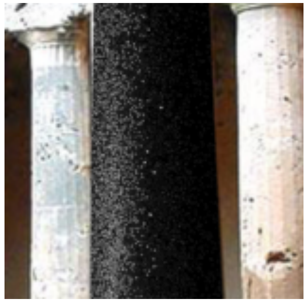
While PBR will automatically add bounce light to a scene, the amount of bounce light can be increased according to artistic requirements. This is done using the GI Light.

Return back to **Object Level**, and from the **Lights and Camera Shelf**, activate the **GI Light**. This will create an Indirect Light in the scene that can **amplify** the **amount of bounce light** taking place in the render. In the **parameters** for this GI Light specify:

Light Intensity	**20**

When the scene is rendered again, the amount of bounce light has increased.





To diminish the amount of noise taking place in the render, the **Mantra ROP** settings can be adjusted to increase quality. At **Outputs Level**, specify in the **mantra1 parameters**:

Properties > Sampling >

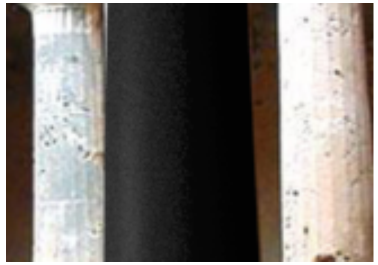
Pixel Sample	**5**	**5**
Min Ray Samples	**32**	
Max Ray Samples	**64**	

Properties > Shading

Diffuse Limit	**5**
Color Space	**Gamma 2.2**

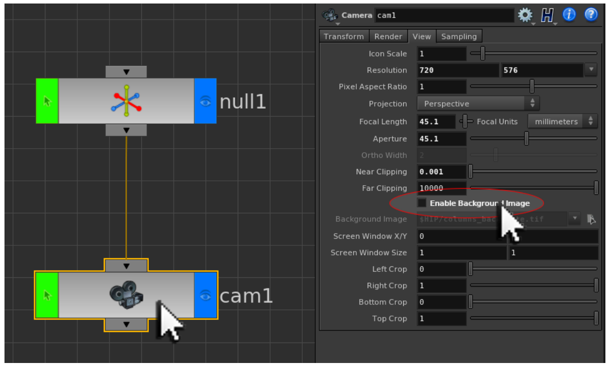
The Sampling parameters will increase the overall quality of the render and diminish the noise. The Shading parameters will allow for more light to bounce more times around the scene (the Diffuse Limit parameter), and darker regions to receive more lighting samples (the Color Space parameter).

When the scene is rendered again, a much finer render is produced; however the render time will increase as a result of these higher render settings.

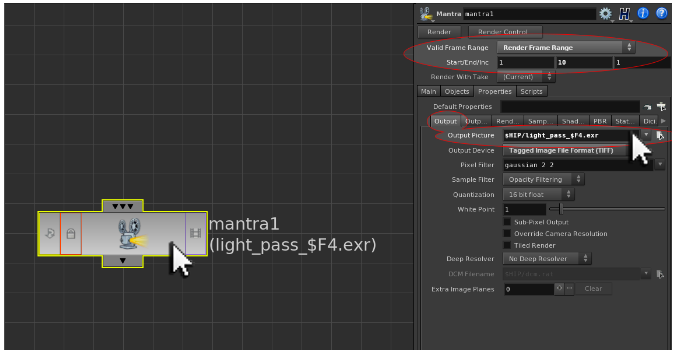


SAVING A RENDER SEQUENCE TO DISK

Camera Background Images will always appear in the render, unless they are deactivated. When the render quality has been established, remember to deactivate the Camera Background parameter to prevent it from appearing at Render Time.



The **spotlight illuminating** the **dummy geometry** can also have some **simple animation** assigned to it using the **k hotkey** to set **keyframes**.

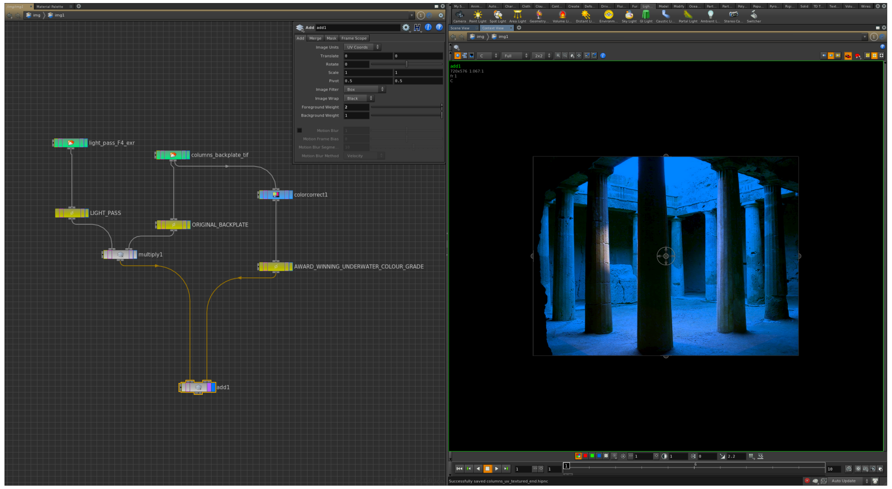


In the **parameters** for the **Mantra ROP**, a **Valid Frame Range** can be **activated**; and under the **Properties > Output** section of the parameters, the **Output Picture parameter** can be set from **ip** (which renders the image to MPlay) to a location on disk. For **image sequences** the **$F4** naming convention should be used to ensure rendered frames receive frame numbers (padded to 4 digits). For example:

Output Picture **/transfer2/DummyGeo/light_pass_$F4.exr**

With this set, the **Render button** of the Mantra ROP (located at the very top of the parameters) can be clicked to start the render.

NOTE: for this example **only 10 frames** needs to be rendered to check the light pass mechanism.



The Light Pass can then be multiplied with the original background plate, and the added on top of an Underwater graded background plate. This will give the illusion that the spotlight is illuminating the scene.

See file columns_uv_textured_end.hipnc