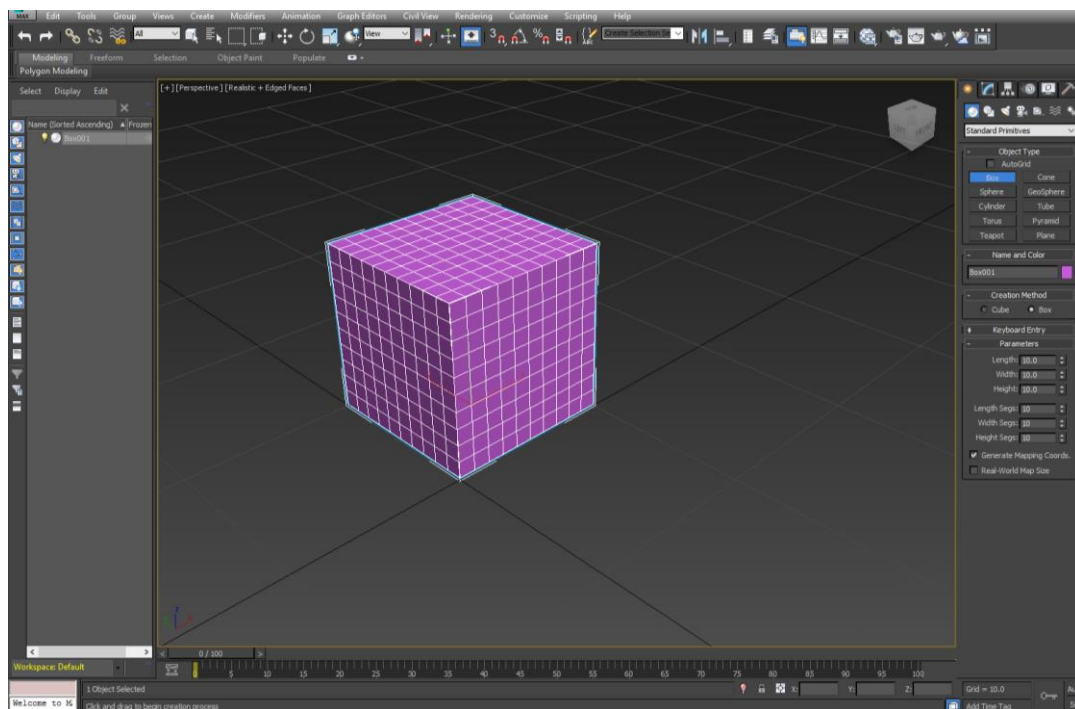


Modelling

Box modelling

A simple primitive such as a cone, cube or square is edited to create the desired form. Reference images may be placed next to the primitive and the modeller may have multiple views, copying the reference, adjusting and editing the form as they progress. The primitive may be **subdivided**.

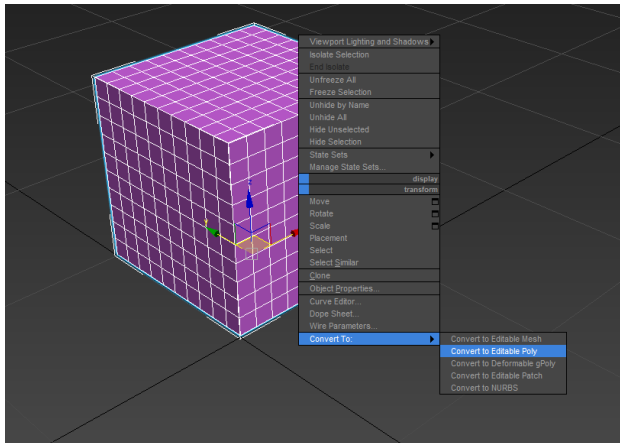
Software: Autodesk 3DS Max 2015 or above



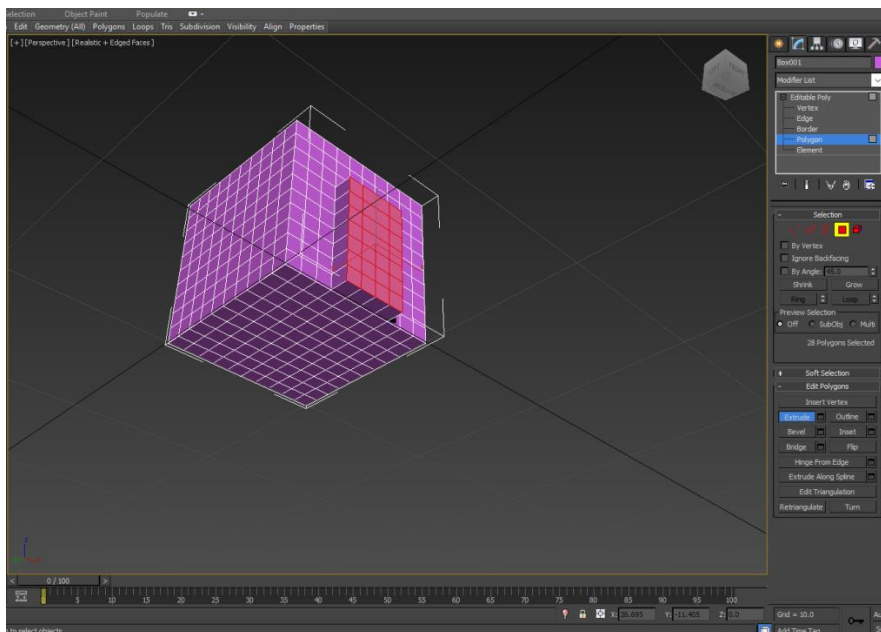
1. Load 3DS Max and start a new scene. Maximise the perspective viewport by clicking on the plus button of the window (the viewport selected will outline in yellow). Dual screens and multiple viewports help the modelling process. On the right-hand panel select *Standard primitive > Box*. Draw a box 10, 10, 10 in length, width and height. Create ten segments for length, width and height.

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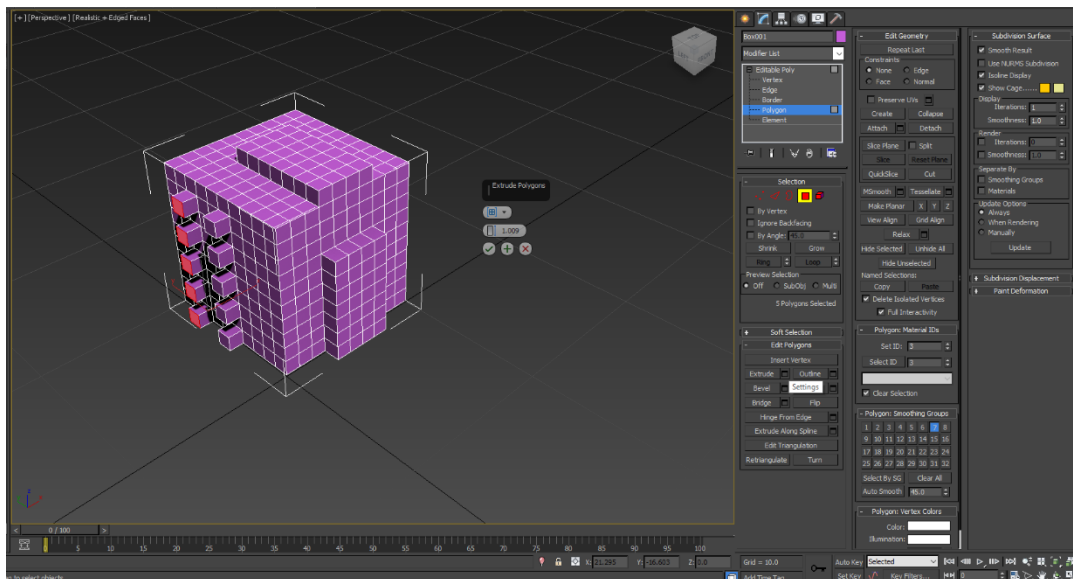
Material to be used for educational purposes and with book companion.



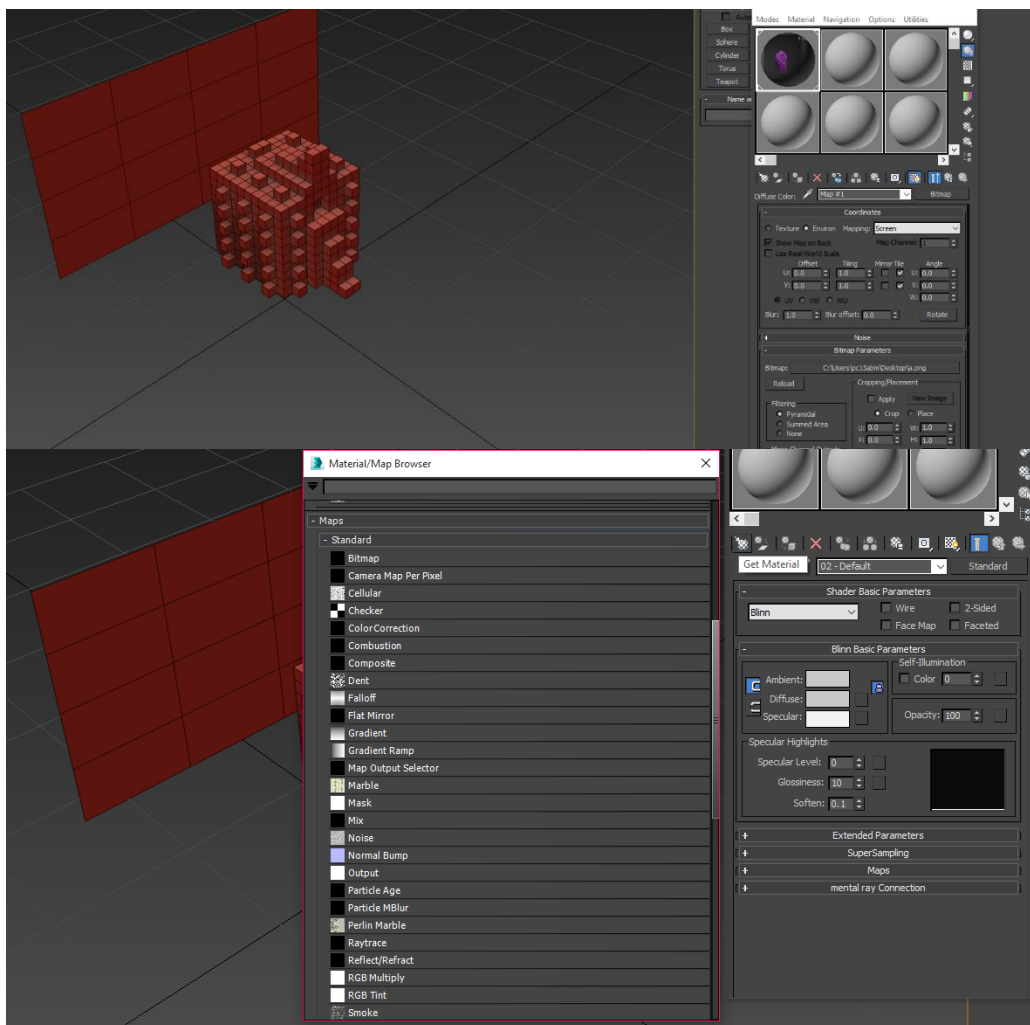
2. Right click on the object and select *Convert to > Convert to editable poly*.

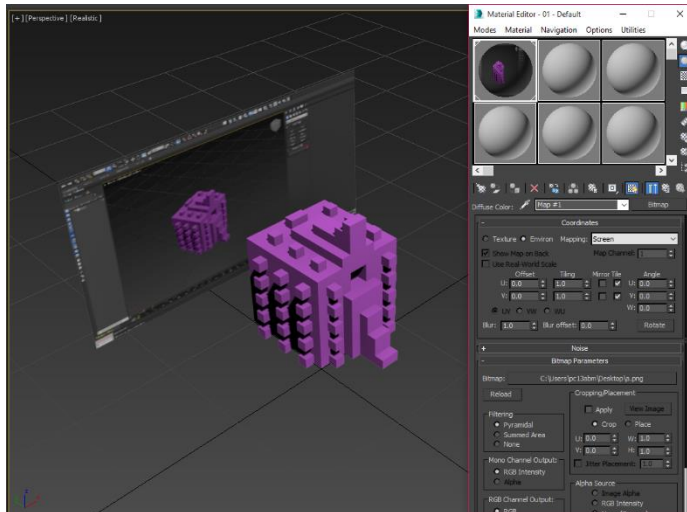


3. Select the modify tab, next to the sun icon on the right-hand panel. The panel states 'editable poly'. Press the plus icon on this and select the polygon icon in red below. You can select different parts or all of the object using the five red symbols: vertex, triangle, boundary, polygon and element.



4. A new set of windows appears in the modify tab. Select *Extrude* and click on various faces. You may use the mouse to extrude the selected element. Clicking the extrude settings lets you specify a specific unit to which the polygon will be extruded. Experiment with these settings, dragging the extrude feature within the square to create a void.



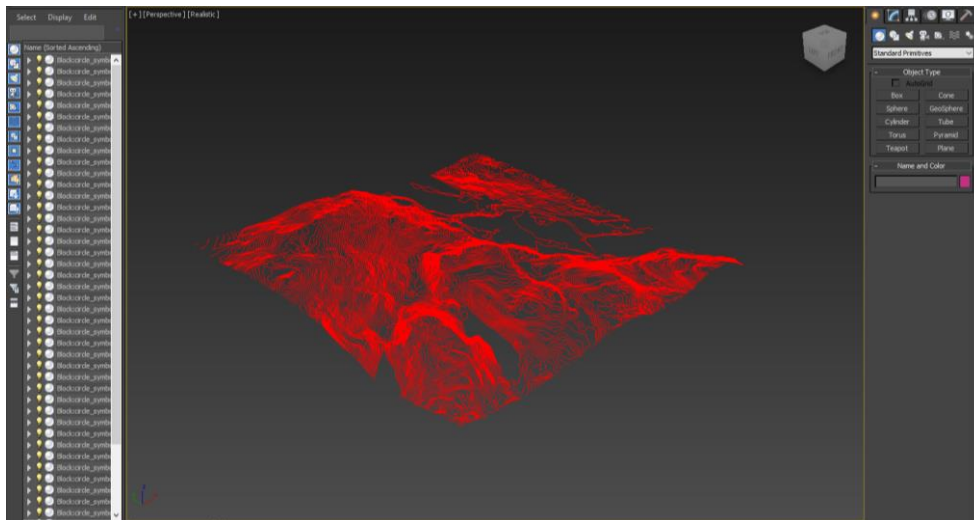


5. Add reference images. Select the Front viewport and select *Plane* in the primitive area. Make the image plane the same size as your reference image to avoid pixelisation. Draw a plane behind the object. Select the *Material editor* (M on keyboard). Click on a blank sphere. Click *Modes > Compact material editor* for this exercise. Select *Get material* and select *Maps > Bitmap*. Load the image you wish to reference. Ensure 'use real world scale' is NOT selected. Press *Assign material*, or drag the material and drop it on the image plane. Add additional references on different viewport areas to increase the ability to box model.

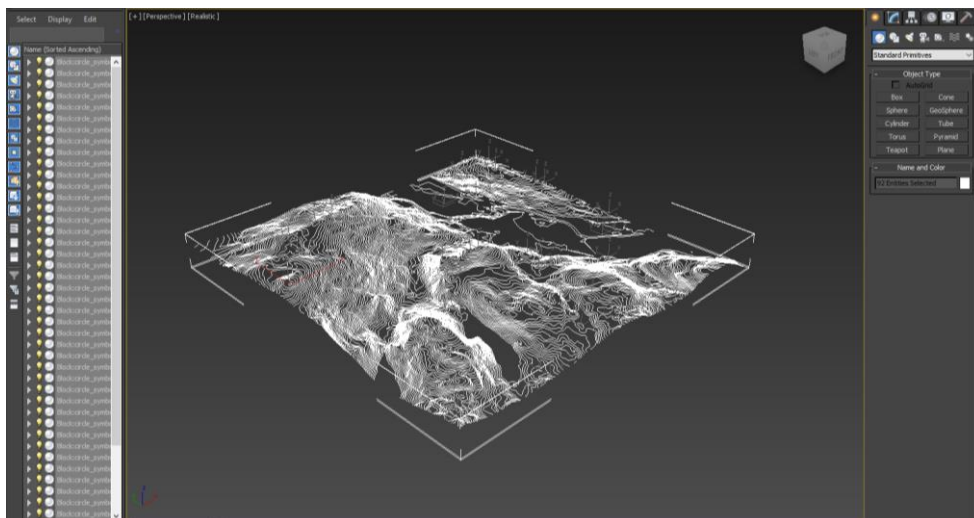
Contour modelling

This is the creation of edges of the form wished to be drawn; the edges are then infilled. This allows greater control than subdividing a primitive. In this case actual contours can be used to create a surface.

Software: Autodesk 3DS Max 2015 or above



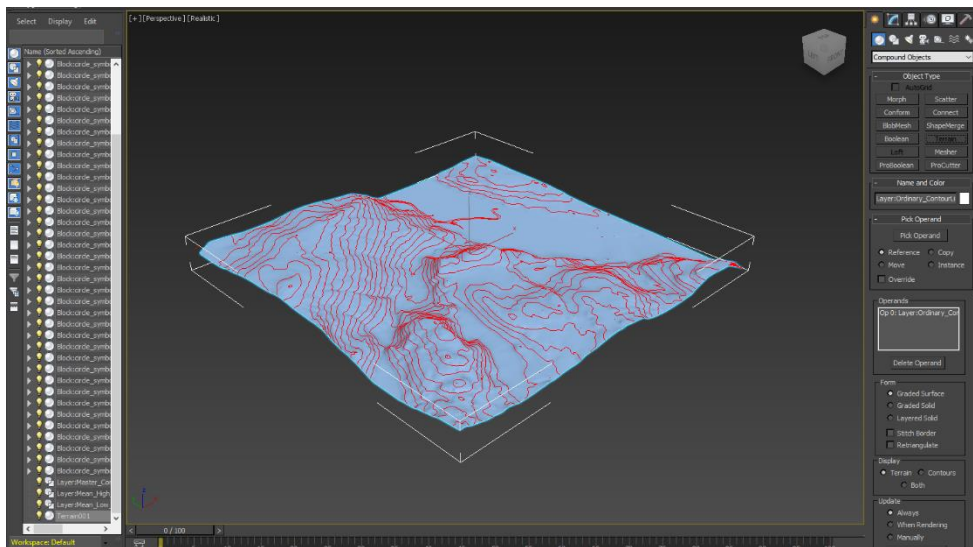
1. Load 3DS Max and *Import* the 5m contours DWG file. Do not adjust the default settings in this case.



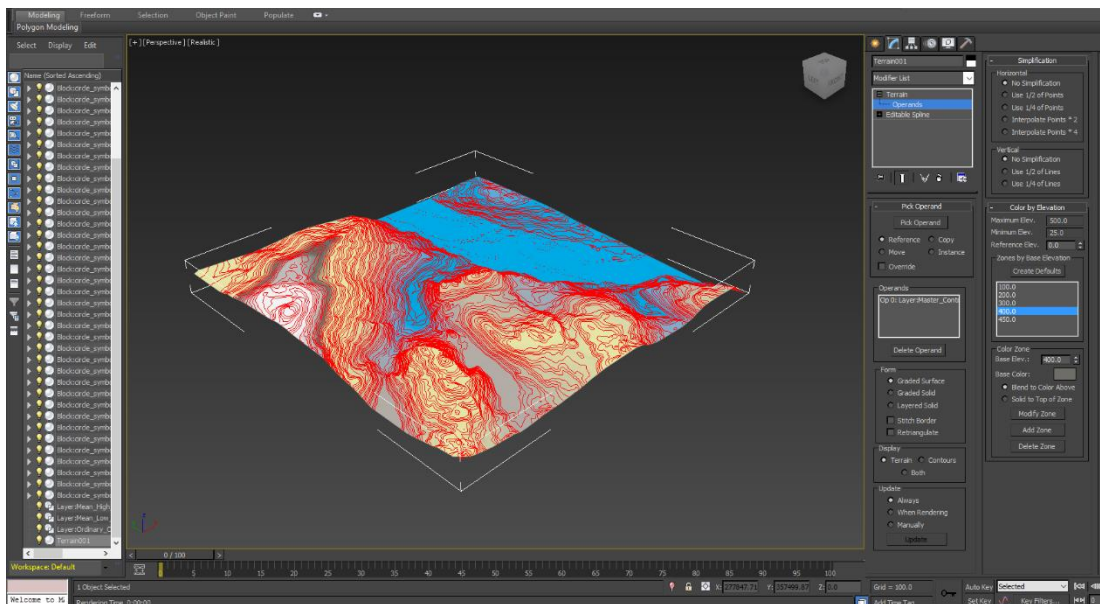
2. Select all of the contours/objects and from the rollout on the right select *Create*, then *Geometry* and choose *Compound objects* from the rollout menu below.

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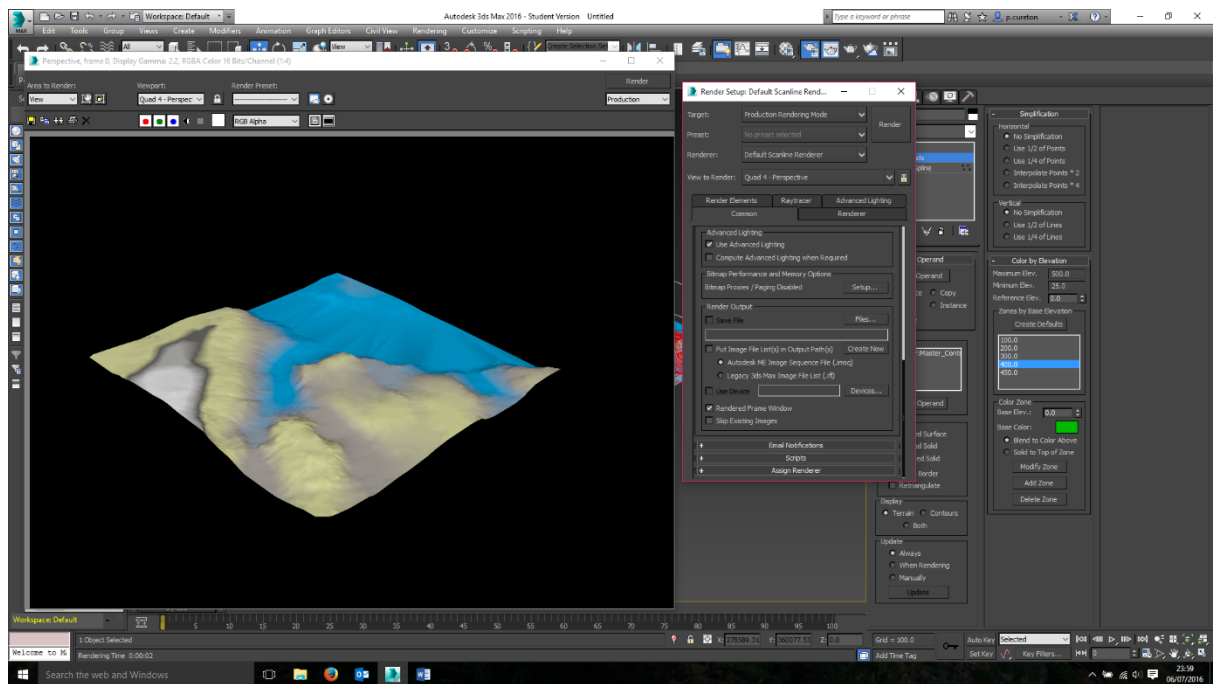
Material to be used for educational purposes and with book companion.



3. Select the *Terrain* tab in the compound object selection to create a surface between lines (like sandbox tools in Sketchup).



4. Select the *Colour by elevation* tab and maximise. You can specify contour interval colours or set to default.

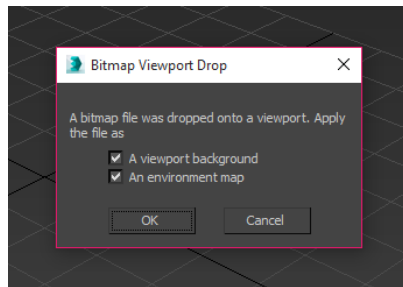


5. You can also apply a material texture of a map or correlated satellite photo to the contour area. Once these choices are complete, render the scene (teapot icon) through the normal default scanline to view the contour model with gradated colours.

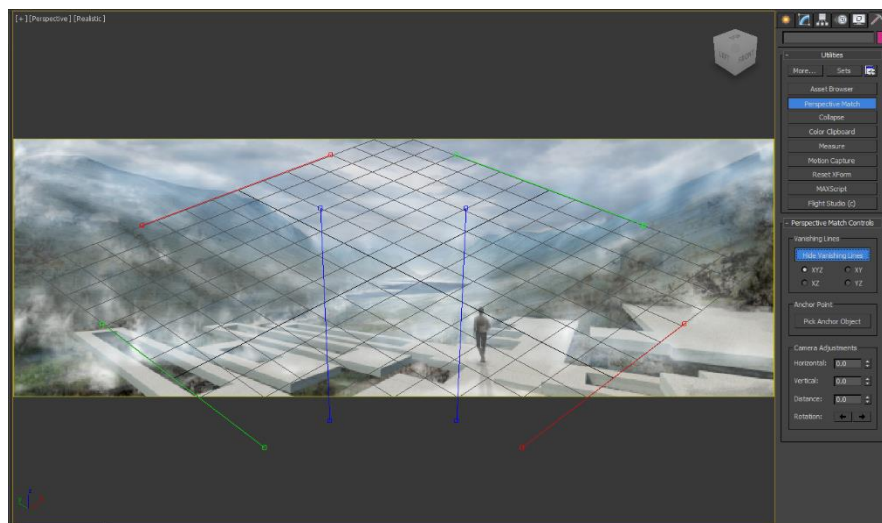
Perspective match tool

The *Perspective match* tool in 3DS Max is similar to the Trimble Sketchup *Match photo* technique and Trimble Vision for accurate photo stitching and verified views (**Chapter 3**). The tool matches a background to a 3D model and coordinate plane.

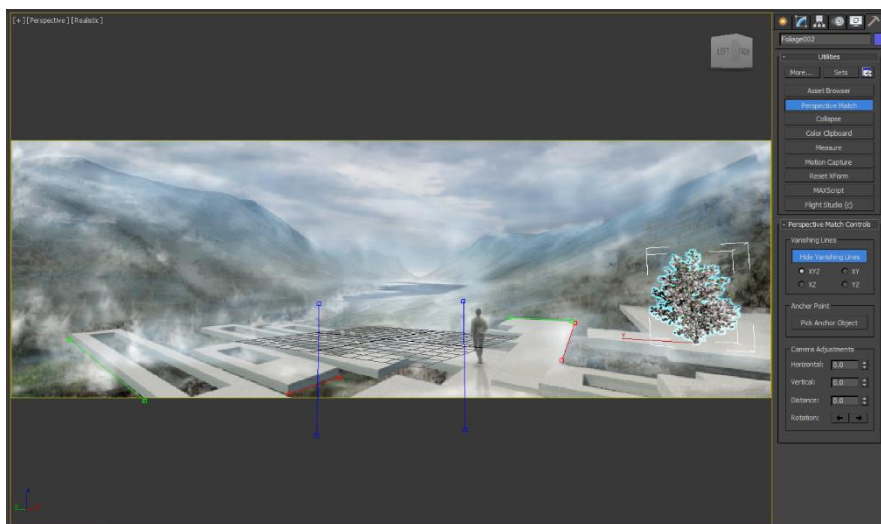
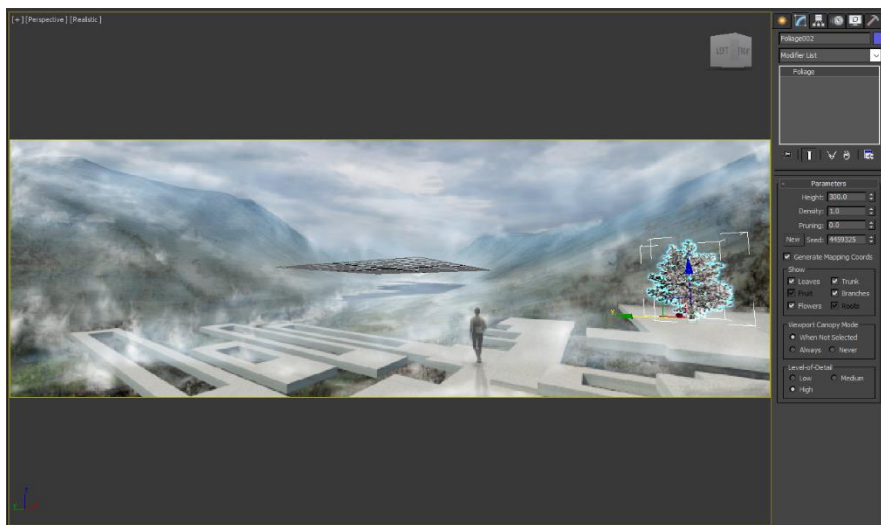
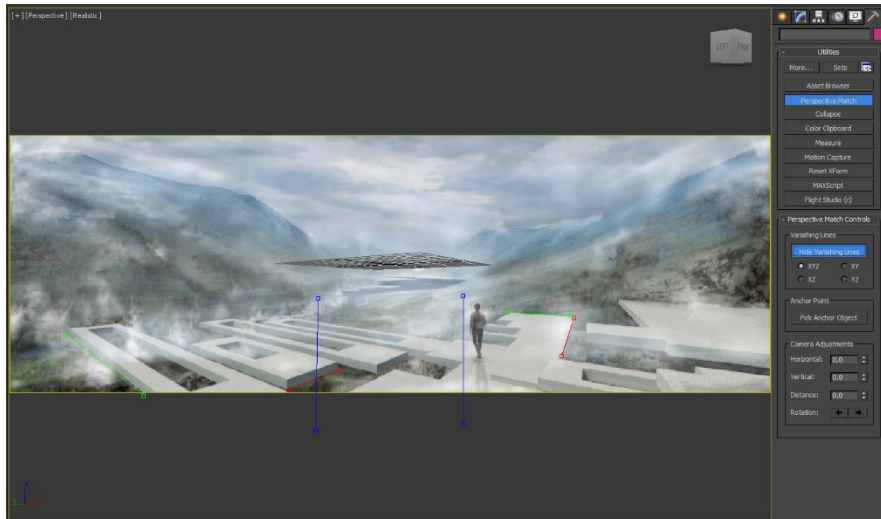
Software: Autodesk 3DS Max 2015 or above



1. Load 3DS Max and maximise the Perspective viewport. Drag an image reference to the picture plane. 3DS Max asks whether the image is a background or environment map.
2. The reference image aspect ratio (width and length of image) needs to match the camera aspect ratio. Thus, if an image is 1028 px wide, the camera needs the same setting.



3. Click the *Utilities* icon on the right-hand side panel, and select *Perspective match*.

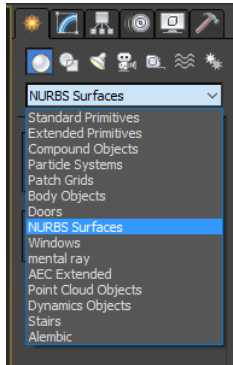


4. Click *Show vanishing lines* to display the vanishing points. Adjust the red and green for vanishing points and blue lines for the angle of model to background photograph. Adjust the field of view, dolly and hand tool to further adjust the perspective match.

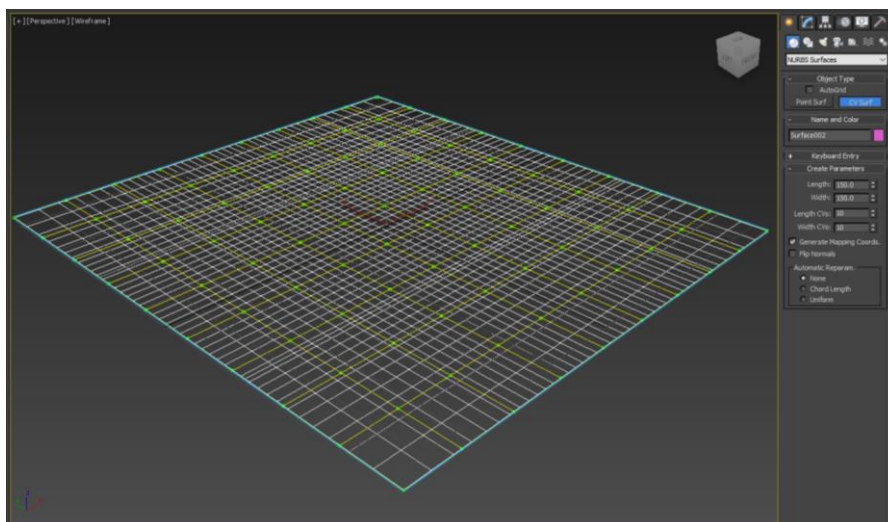
NURBS surfaces

NURBS (non-uniform rational basis spline) surfaces are edited by manipulating control points or control polygons. Additional points may be added for complexity.

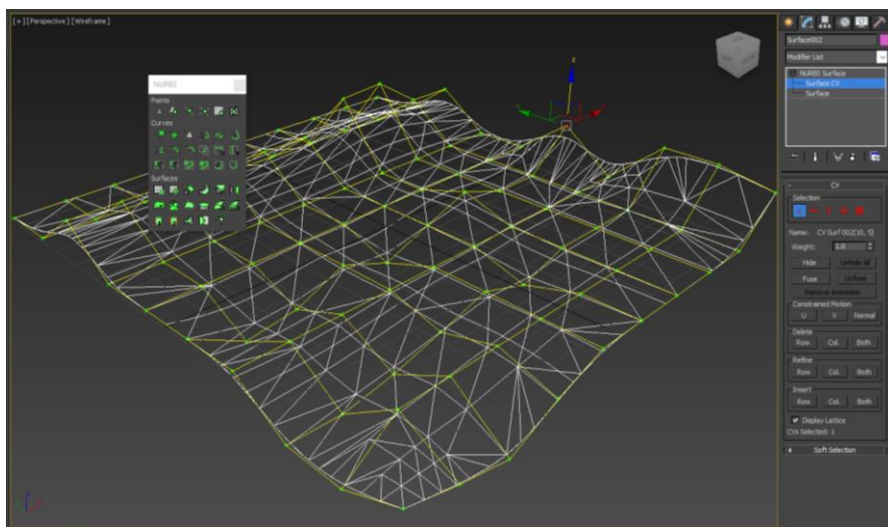
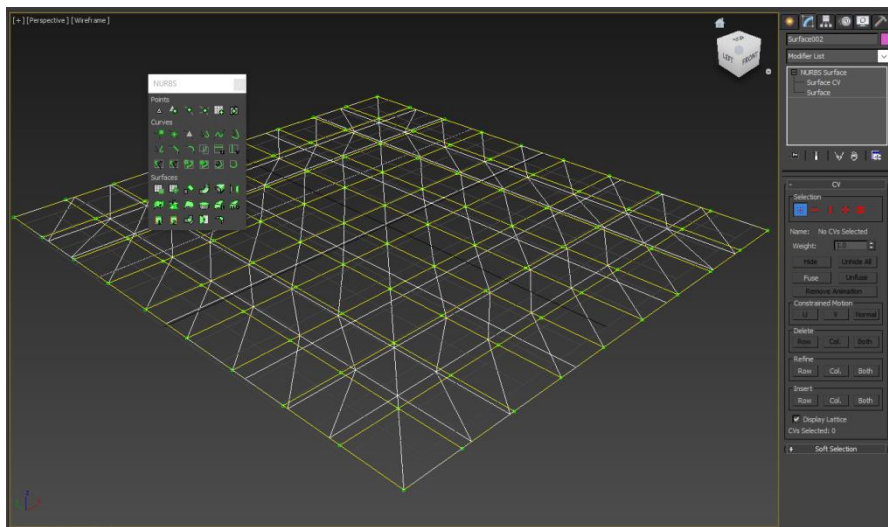
Software: Autodesk 3DS Max 2015 or above



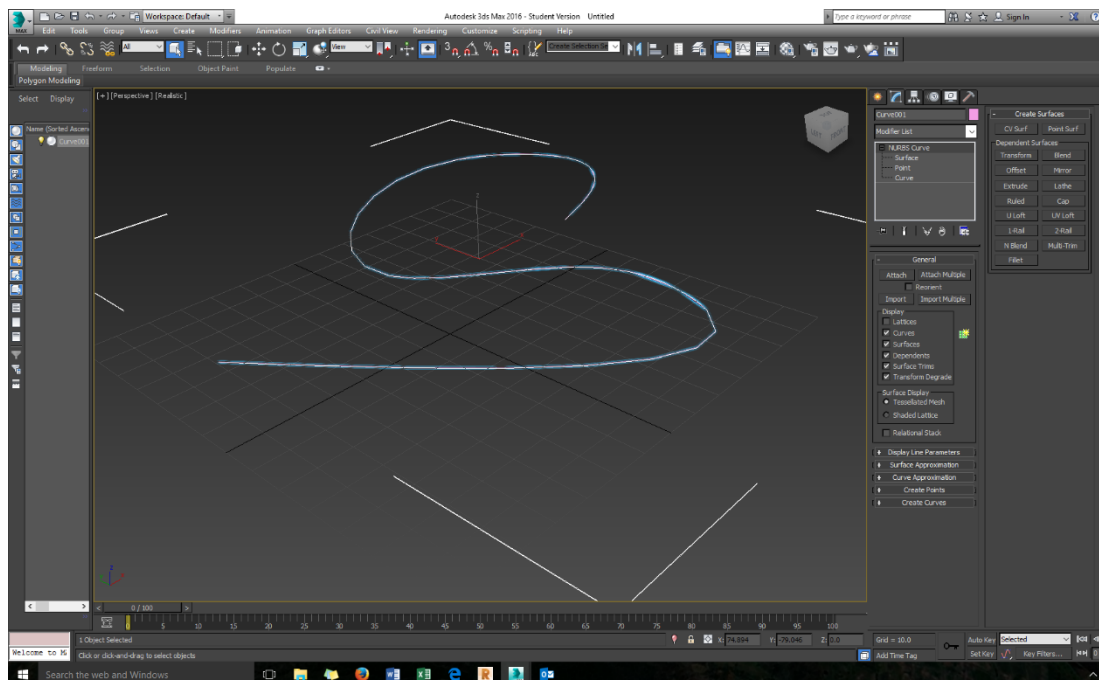
1. Open a new file in 3DS Max and select *NURBS surfaces* in the *Create* tab on the right-hand side. Select *CV surf*, and enter the length 150 and width 150. Enter the CVs length and width as 10.



2. Click the *Modify* tab and select *Surface CV*. Select *Single point* and the *Select and move* tool (S on keyboard). Manipulate each point to create a curved topo surface. You may add a texture map or photograph using the *Material editor* (M on keyboard) once the surface is to your liking.

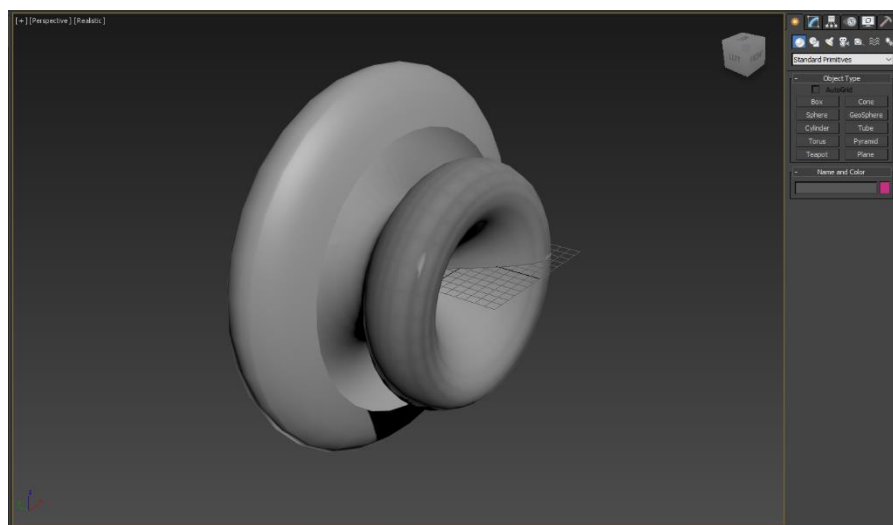
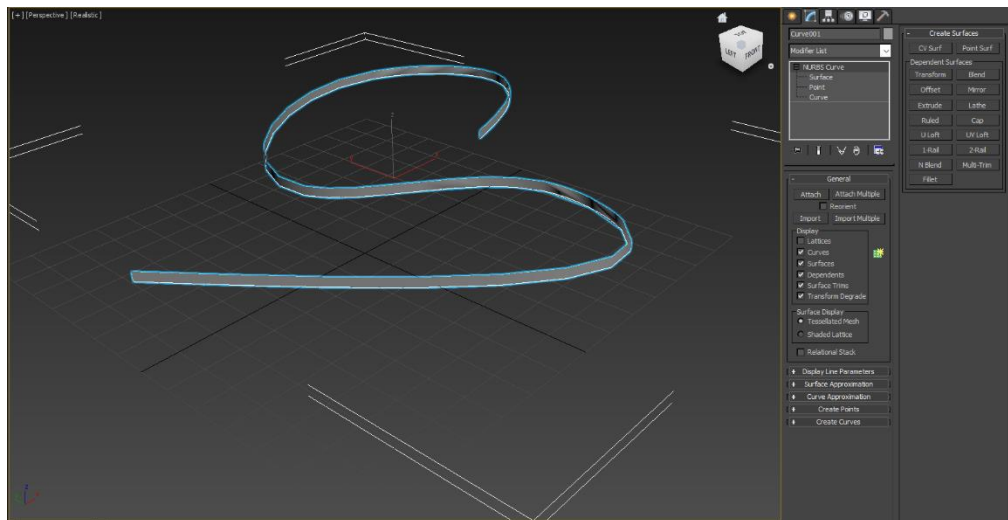


3. Open a new file in 3DS Max and select *Shapes* in the *Create* tab and select *NURBS curves*.



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Material to be used for educational purposes and with book companion.



4. Select *CV curve* and map a curved line. Select *Modify* and maximise the NURBS curve area; select *Curve* and then select *Create surfaces* and *Extrude*. Enter a unit of your choice to extrude the line, selecting the axis in which this is to extrude, X, Y or Z.

Additional links

<https://knowledge.autodesk.com/support/3ds-max/learn-explore/caas/CloudHelp/cloudhelp/2016/ENU/3DSMax/files/GUID-FD120DDE-E8BE-4DB9-A2CA-62069059B4FF-htm.html>

<http://help.autodesk.com/view/3DSMAX/2016/ENU/?guid=GUID-FD120DDE-E8BE-4DB9-A2CA-62069059B4FF>

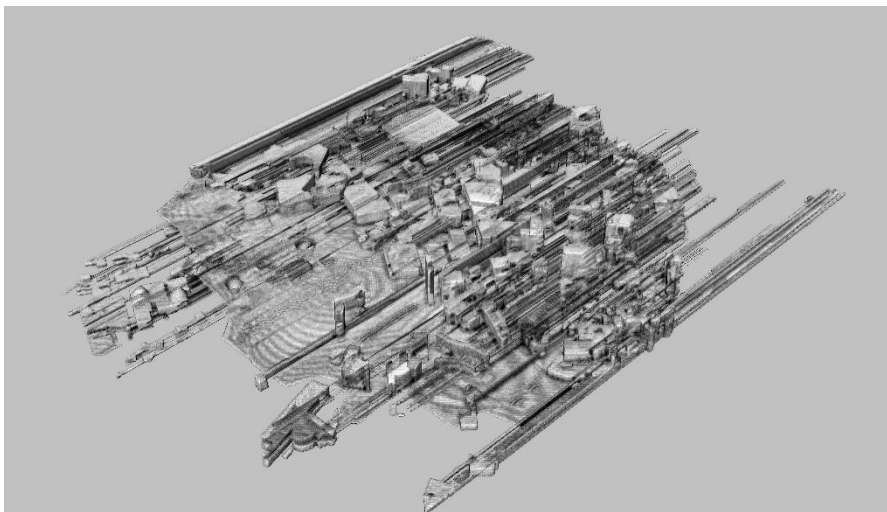
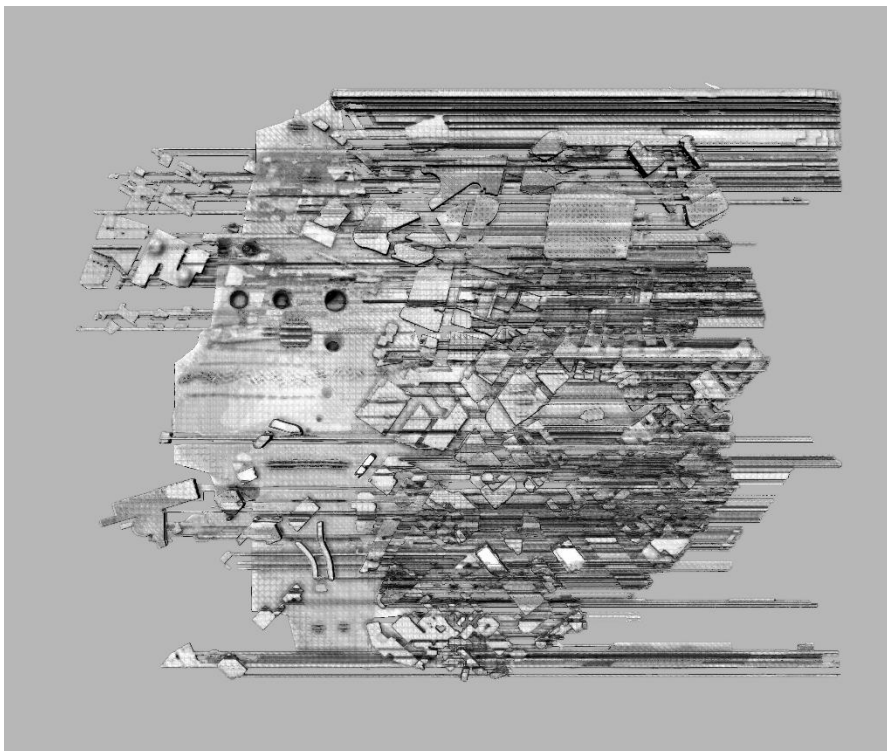
Sculpting

This involves direct manipulation of surfaces – carving, pulling, pushing – and is a newer modelling mode, useful for imaginative speculation of terrains and intuitive and tactile creation of meshes from scratch. Additional features allow the direct texture painting on the surface mesh, allowing quicker modelling processes to be realised.

Software: Autodesk Mudbox 2016 or above

Interoperability note: you may use the FBX file format to import references. You may also use a 2D image as a reference (*Window* tab > *Image browser*). You can export your model to Photoshop as a still PSD, Softimage or as a scene in 3DS Max.

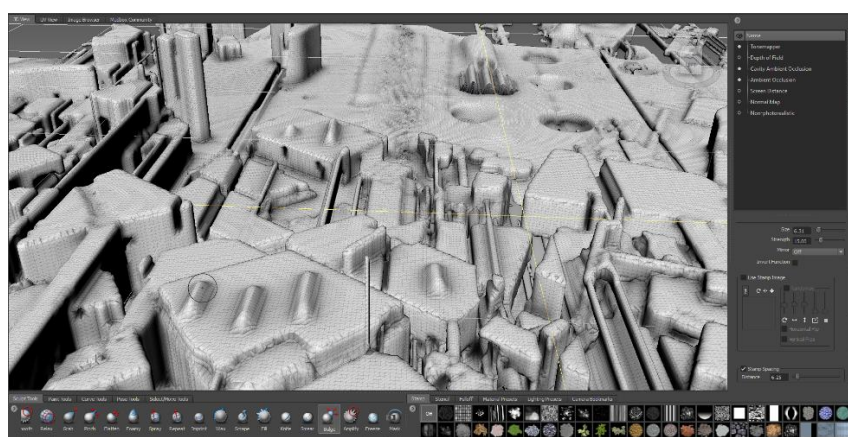
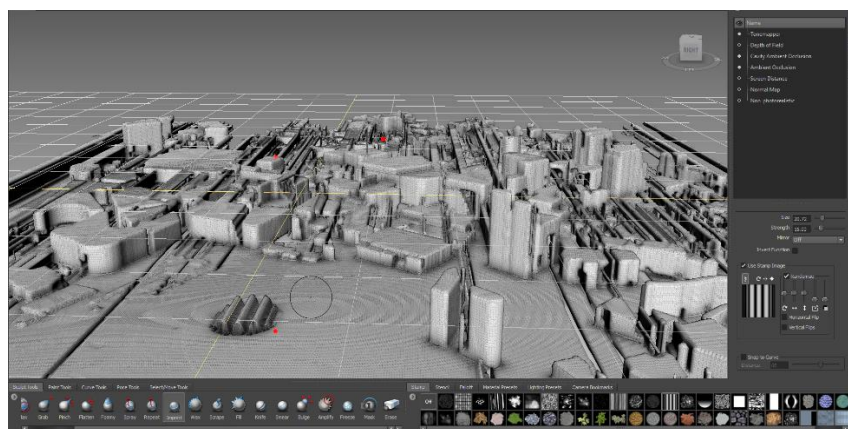
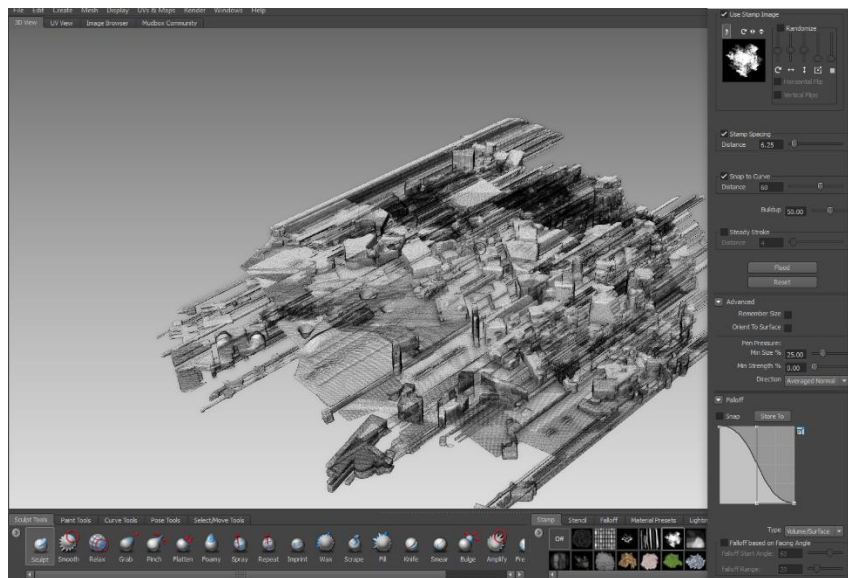
(Navigate keyboard shortcuts: Rotate the camera = Alt + left mouse; Track = alt + left mouse; focus on location = F; frame all = A).



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Material to be used for educational purposes and with book companion.

1. A fictional city area has been generated through scripts and extruding meshes in 3DS Max. Open Mudbox and go to *File > Import* and select the sculpting FBX file.

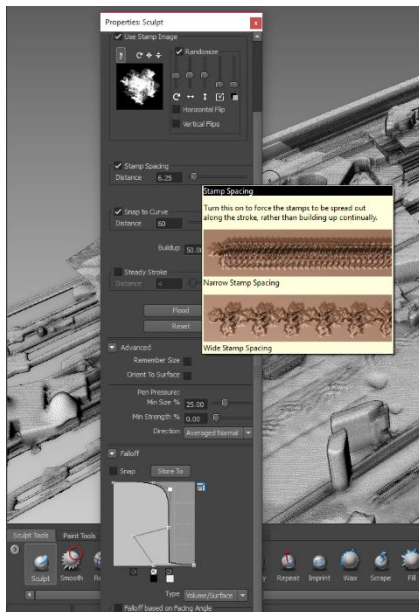


2. This mesh can be sculpted using the pre-set tools in Mudbox. Select *Sculpt* and navigate to an area and push and pull the mesh. Use the *Grab* feature to create fictional building heights. The properties window (*Display > Properties > Sculpt*) shows the *Sculpt* tool settings. A 3D stamp brush can be used either from the default or through add-in brushes. To create the building heights here the *Stamp* tool was turned off. Adjust the falloff curves further down the properties window to determine the cross-section shape of the tool. You may wish

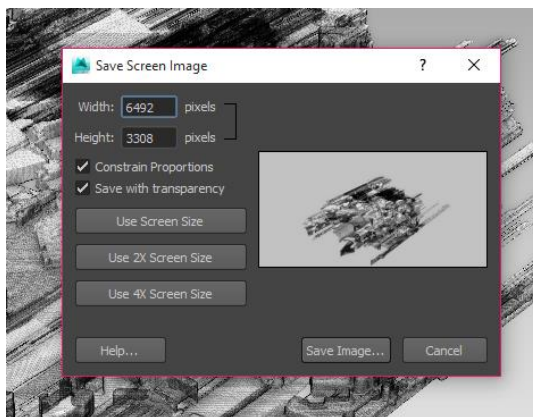
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to sculpt and paint with a Wacom tablet, and the pen pressure settings can assist in the model capability here.



3. You may mask the tip of the sculpting tool by using a stamp. Select *Randomise* and adjust the horizontal and vertical jitter, scale and opacity. Select the spacing tool to spread the stamp image to allow repeat patterns with no overlap. For straight sculpting, select *Steady curve* in the properties window. The stamp works to the distance of the cursor, not the movement of it.



4. Select the *Render* tab and select *Save screen image* once you have a view you are comfortable with. You may also record a movie in a variety of sizes and formats and navigate around the model.

Additional links

Mudbox guide:

http://docs.autodesk.com/MBXPRO/2016/ENU/?_ga=1.57982312.335103882.1460620998#!/url=../files/mePortal.htm

3D brushes: www.textures.com/browse/3d-brushes/114539

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Dynamo

Scripting: also known as procedural modelling, such as L-systems, fractals and generative modelling. This procedure involves the instigation of rule- or value-based parameters on a form to control it (Burry, 2011). For example, the application Speed Tree allows specification of vegetation, growth and wind simulation. Dynamo has a similar visual programming interface like Grasshopper.

Software: Dynamo 0.9.2 or above

Plug-in: Elk – www.hksinc.com/hksline/2015/10/26/elk-mapping-plugin

This Dynamo tutorial is transcribed from instructions of use for the Elk plug-in, developed by Timothy Logan from HKS: www.hksinc.com/hksline/2015/10/26/elk-mapping-plugin. The short tutorial follows Timothy Logan's research and instruction: www.hksinc.com/hksline/author/tlogan.

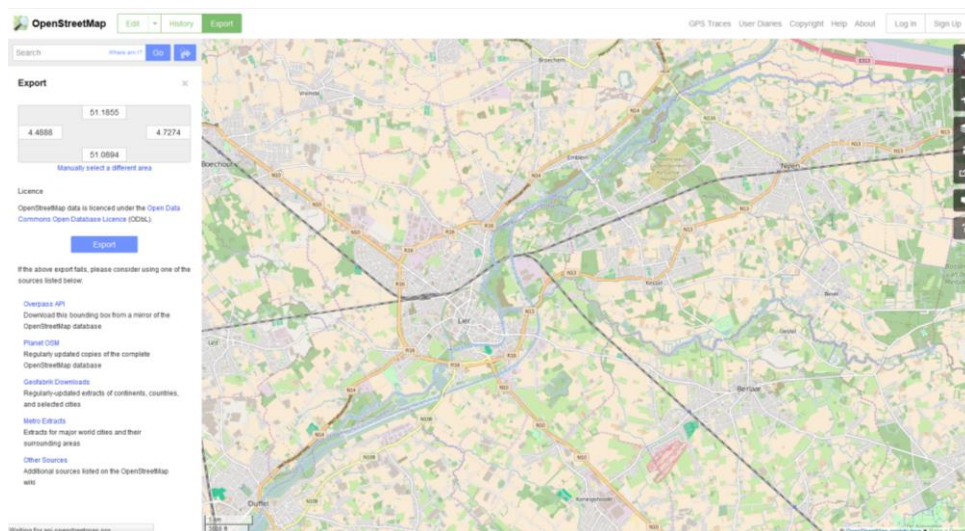
Interoperability note: load Dynamo through Revit (*Add-ons* tab) if you cannot see the 3D geometric preview.

Additional links:

Dynamo Primer: <http://dynamoprimer.com>

GIS into Dynamo then to REVIT: <https://knowledge.autodesk.com/support/revit-products/learn-explore/caas/screencast/Main/Details/5040f6cc-2cfb-4513-9a59-30fd78edeca7.html>

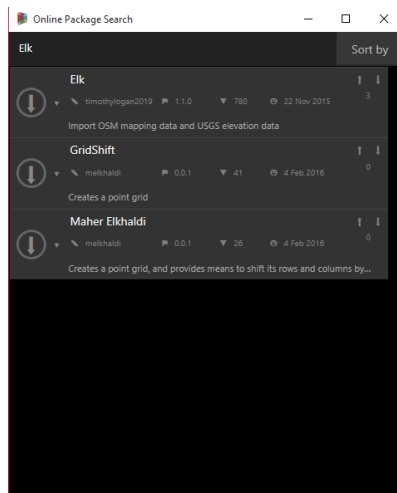
GitHub: <https://github.com/DynamoDS/Dynamo>



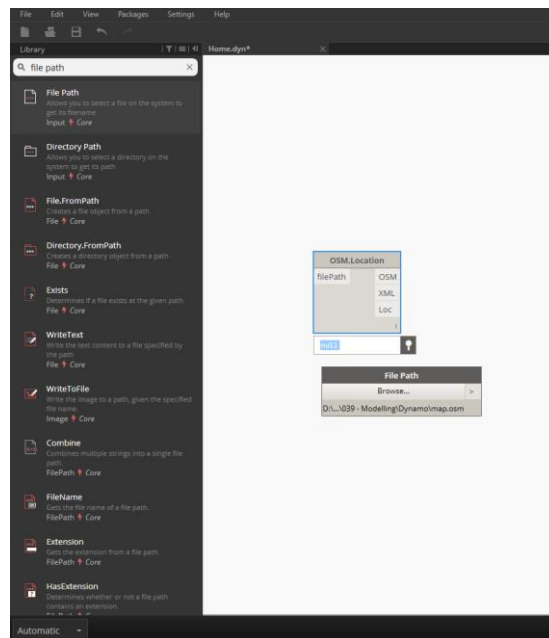
1. Go to Open Street Map > www.openstreetmap.org/#map=15/51.1363/4.5809. Locate an area and click the export button in the top right. The map interface may not be able to export large terrain sets, and provides an error message. Use the mirror sites directed or choose a smaller area. The files are provided as OSM types.

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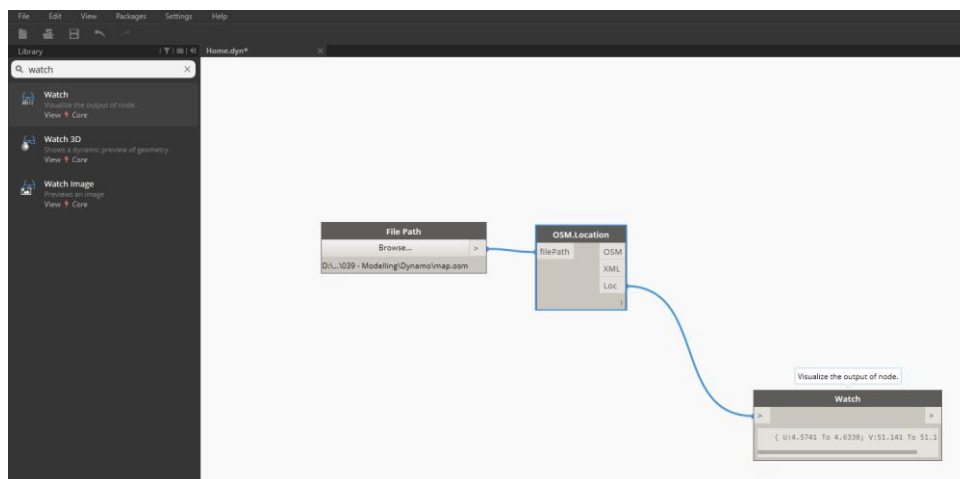
Material to be used for educational purposes and with book companion.

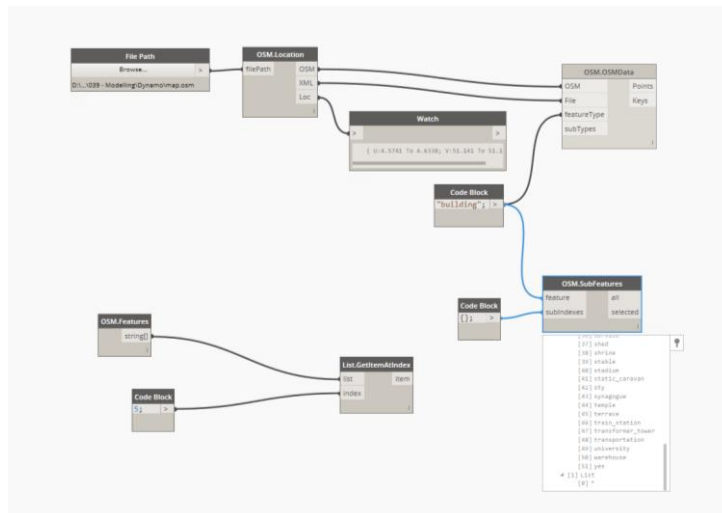


2. Load Dynamo and in the top toolbar click Packages, search for Elk and install it. Create a new file.

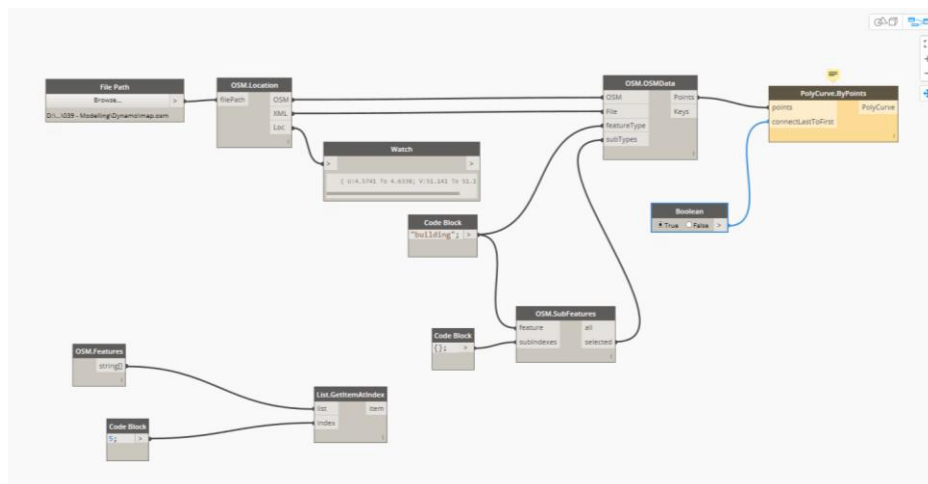


3. Right-click and search or use the top left search toolbar and type 'file path'. This determines the location of the Open Street Map data.





7. Add the sub-features window to the graph viewer. Connect the code block node to the OSM sub-features, feature node. Create a code block '{ }' and connect it to OSM, sub-features (for full display of all the map strings).



8. Connect the OSM sub-features, selected node to OSM data, subtypes node. Create a new geometry window, PolyCurve by Points. Connect the OSM data points node to the points node of the geometry. Right-click, enter Boolean, and 'true' and connect last to first node of the PolyCurve by Points window.

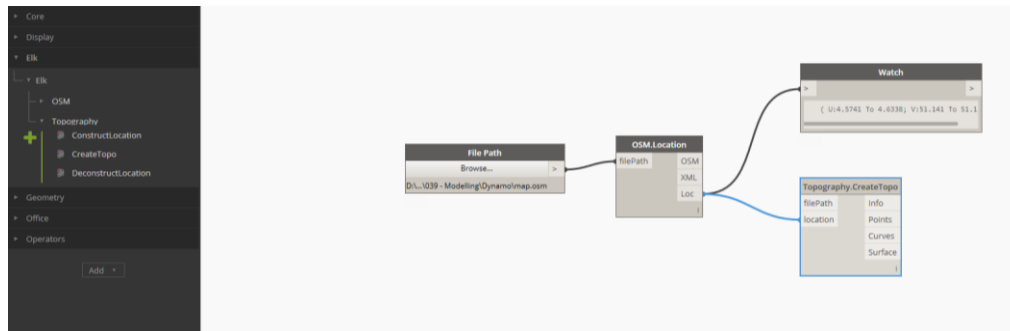


9. Ensure the geometry is displaying. Dynamo standalone may have issues, if this is the case, load Dynamo through the *Add-ins* ribbon in Revit. Finally, tidy the graph and windows as displayed. Add another OSM data window and connect to the code block feature type and subtypes nodes. Create Polygon by Points and connect to the OSM data window.

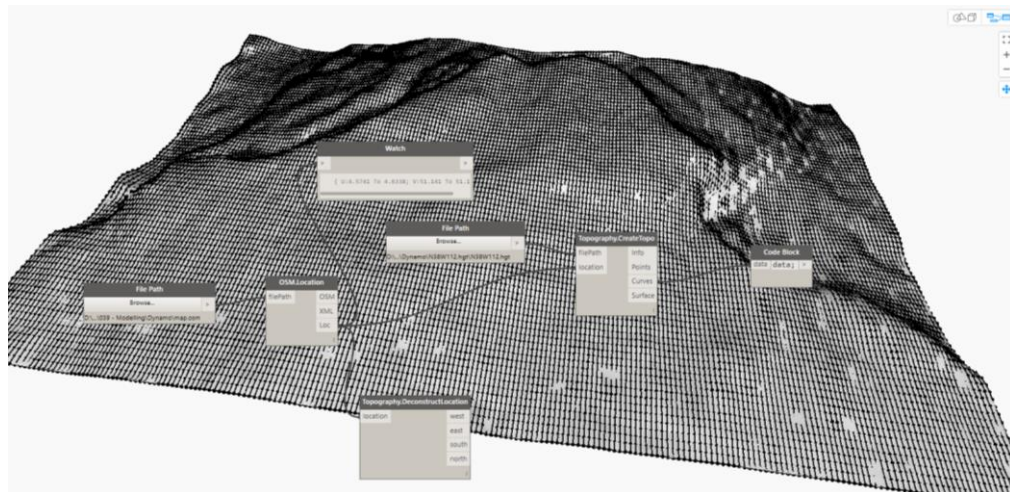
Elk for Topography

Elk may also process HGT or GeoTIFF satellite or UAV data.

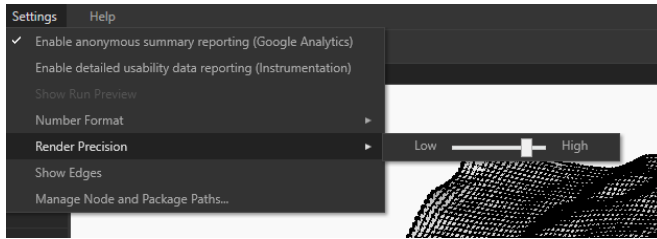
This tutorial uses SRTM data. The Shuttle Radar Topography Mission (SRTM) obtained elevation data on a near-global scale to generate the most complete high-resolution digital topographic database of earth. SRTM consisted of a specially modified radar system that flew onboard the Space Shuttle Endeavour during an 11-day mission in February 2000. SRTM is an international project spearheaded by the National Geospatial-Intelligence Agency (NGA) and the National Aeronautics and Space Administration (NASA). These data are for educational purposes only.



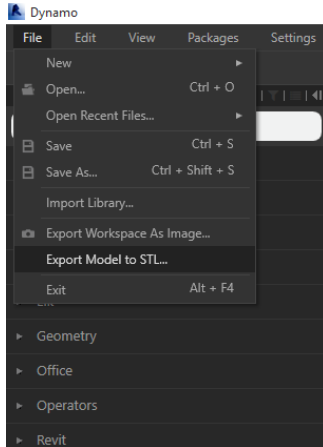
1. Expand the Elk interface in Dynamo. Create a file path (search) and specify the map.som file supplied for this tutorial. Create an OSM location window and drag the file path node. Create a watch window and connect to the OSM Location, loc node. Drag a CreateTopo operator from the left panel and connect the loc node in OSM Location to the loc node in CreateTopo.



2. Drag a Topo deconstruct location operator to the graph window. Connect the OSM Location, loc node to the location node of the new operator. This assists in determining the extent and geographical position of the data set. Create a file path, select the N38W112.hgt file and connect to the file path of the CreateTopo window. Connect the curves node to a new code block with 'data' as its parameter.



3. Go to settings and render precision to increase the display values.



4. Go to file and export as an STL to prepare the file for 3D printing in Meshmixer, or return to Revit to load the data-driven data into the BIM environment.

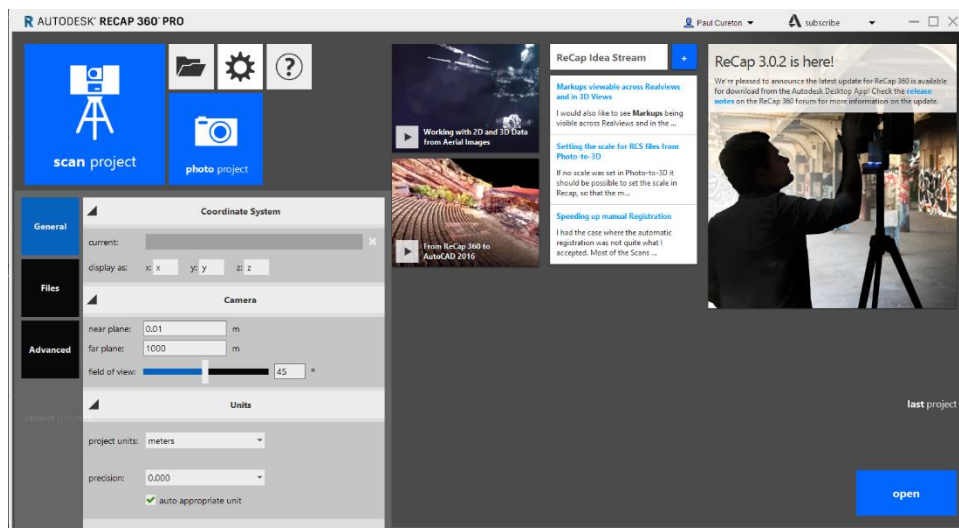
Other methods of modelling

Software: Autodesk Recap, Remake (formerly Memento) 2016

Photogrammetry: this is the deriving of 3D assets from 2D images to create 3D meshes or photographic point clouds. Distances are measured between the camera position and the object; colour spectrum is also calculated to create a 3D mesh. A number of free software programs allow this creation using cameras, phones and tablets as well as drones. For complex calculations, GIS preparation is required involving ortho-rectification, feature extraction and height calculations. ESRI City Engine and ArcGIS Pro and 3D GIS Stream Services, among other software, are dramatically decreasing the production time and accessibility of data.

Point clouds: Laser scanning (LiDAR) is the laser scanning of real-world places or objects which form bases in which to model. Received as a point cloud, the data require rasterising, or can be manipulated or repaired – see **Chapter 1** exercises for LiDAR processing to a raster surface.

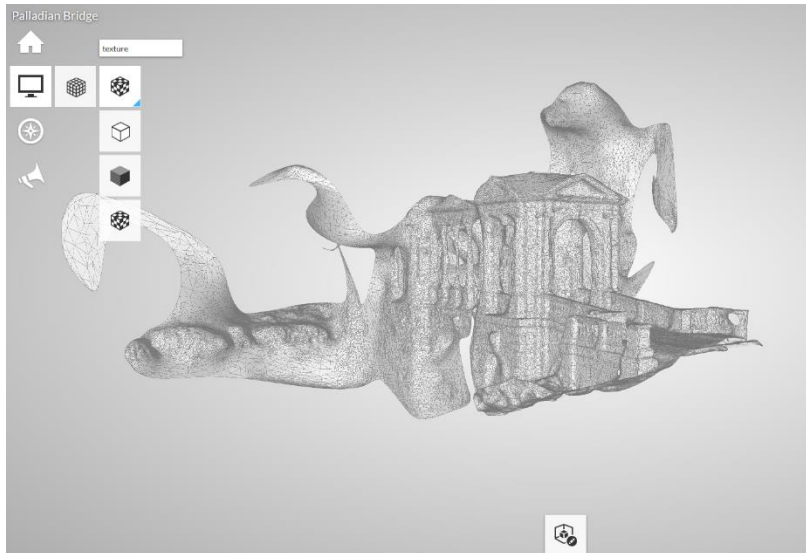
Interoperability note: to add a point cloud in 3DS Max go to the *Create* panel, select *Geometry* rollout > *Point cloud objects* > *Object type rollout* > *PointCloud*.



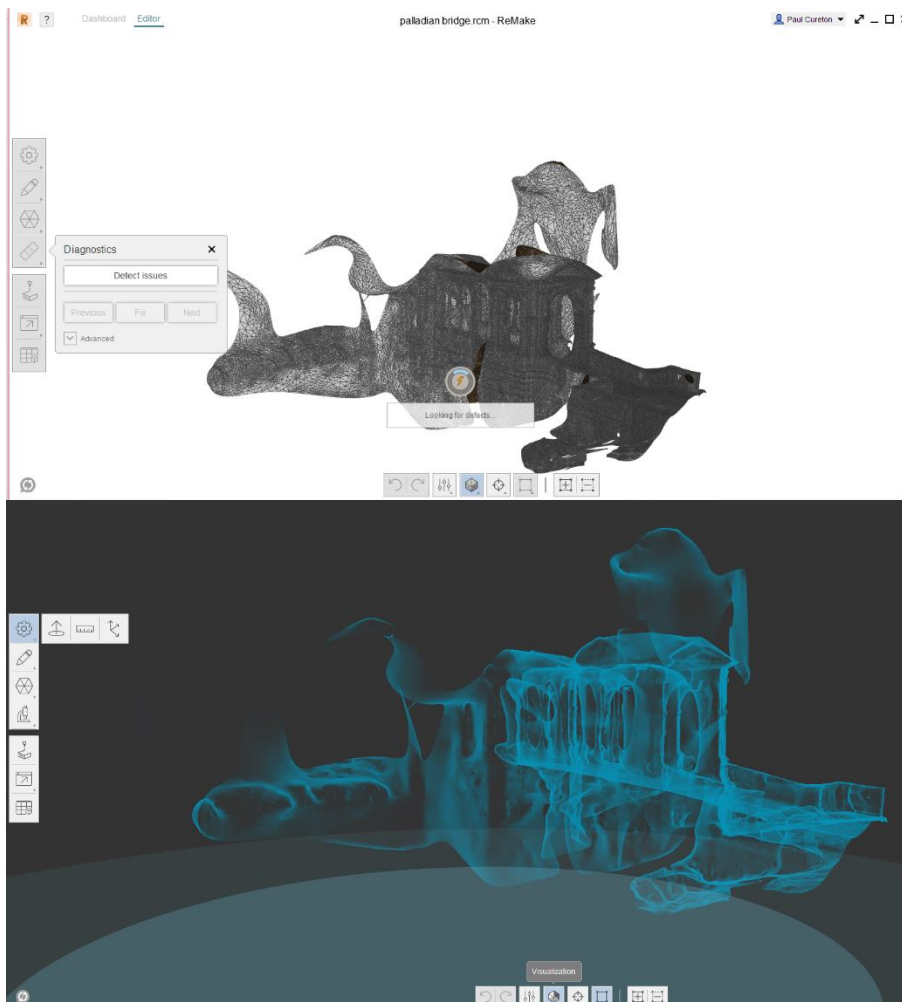
1. Load a series of photos in Autodesk Recap or create a scan project. Recap has more capability and precision than 123D Catch (**Chapter 1, Tea House**).
2. Press the *Settings* button to add a coordinate system, unit of measurement and adjust the field of view.

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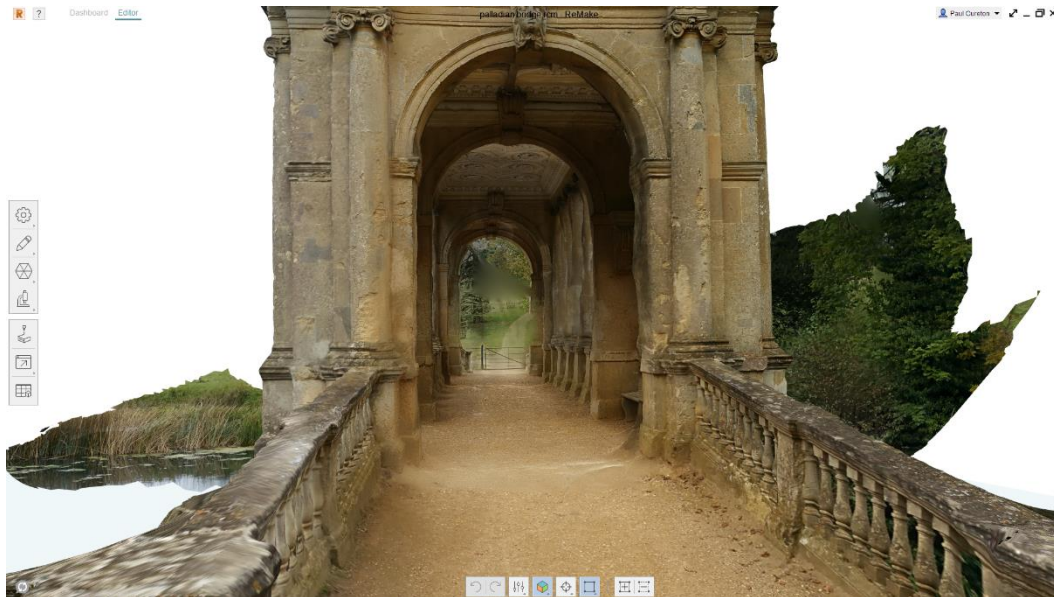
3. The upload works in the Cloud and is processed. Once complete you can view the model and change the texture, with a shader, wireframe or clay display.



4. Load Autodesk Remake and the newly created model will be available in the Cloud. You can analyse the quality of the mesh and repair, sculpt, clip or smooth the mesh through the editing features to the left-hand panel. You can also prepare the mesh for 3D printing (see **Chapter 5**). These features are similar to Meshmixer, though Remake can handle much larger polygon counts and meshes.

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5. Once editing is complete, use the *Export* button to save the file, either for 3D printing as OBJ type, or as an FBX file for use in Revit, 3DS Max, Stingray, Infraworks or Civil 3D, to name a few.

Interoperability note: Recap can be used to process UAS stitching ortho-photos and create meshes. Once this work is processed in the cloud, Autodesk Remake can allow the editing of meshes, polygon reduction, texture editing and export of the 3D model. The model can then be used in AutoCAD, Infraworks and Civil 3D.

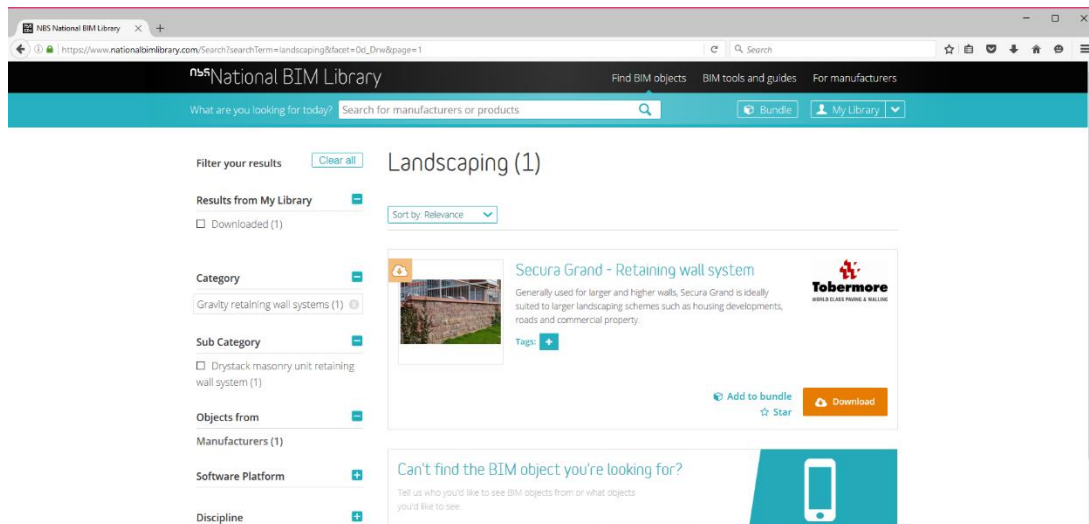
Additional links

Recap workflow: www.youtube.com/watch?v=oA6b5kG8YvI

BIM models: building information models can be used within the modelling process, from manufacturers' products, to energy performance analysis, mass models or other forms. Stereo pair photography can be used to create 3D building models that have high degrees of accuracy and can be brought into the workflow (Institute, 2016). The BIM process could be from inception, or in this case if specific products and building specifications are needed, can be added to the project.

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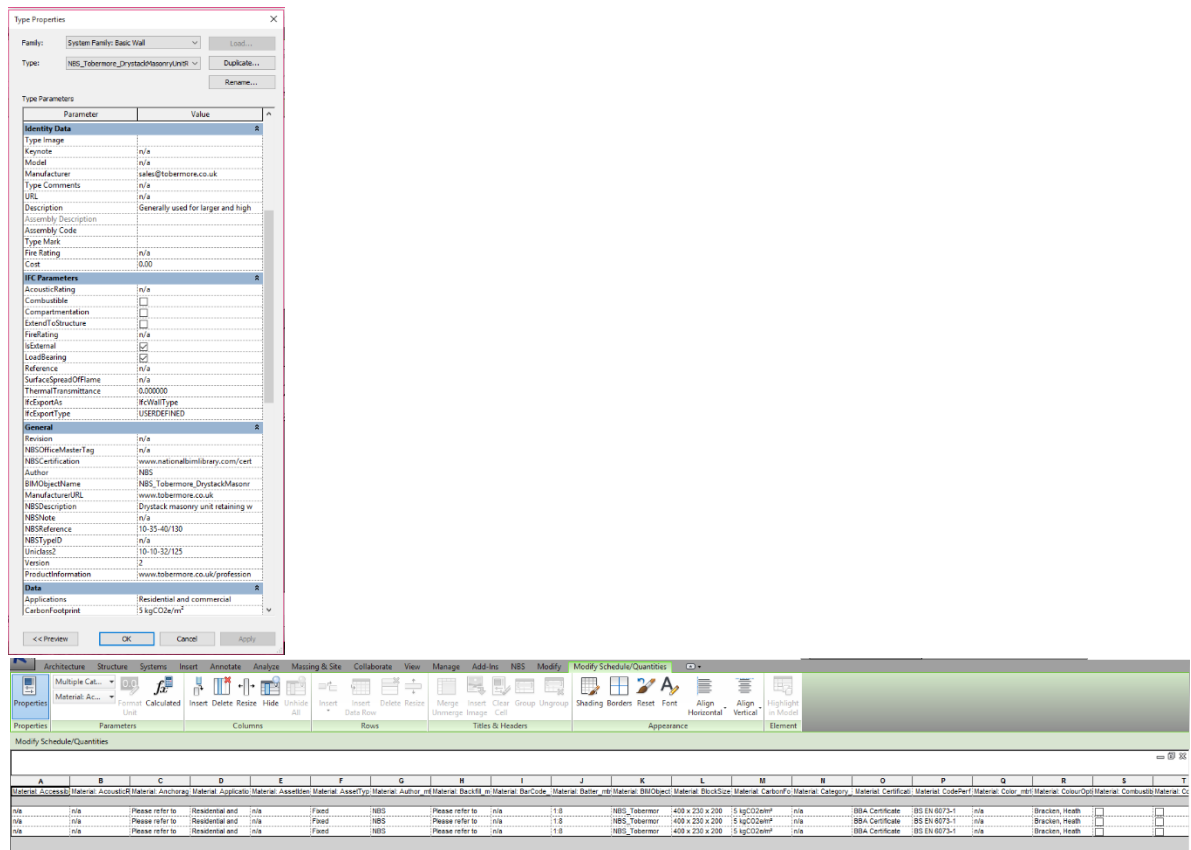
Material to be used for educational purposes and with book companion.



Tobermore Concrete Products Ltd Drystack Masonry Unit Retaining Wall System



1. Visit the National BIM Library (www.nationalbimlibrary.com). Download a retaining wall and open this in Revit. The BIM object has manufacturer details, energy performance and IFC standards. IFC essentially governs the shareability and interoperability of the object. The BIM object is a mixture of geometry and dimensions with product and technical data sheets. BIM objects can be incorporated into Revit schedules, bills of quantities and phases.



2. Select the object and select *Properties*. Select *Viewer* in the *Architecture* tab and select *Properties* if it is not displaying. Press the *Edit* button to view the properties. Additional BIM objects can be loaded directly into the model using the NBS plug-in.

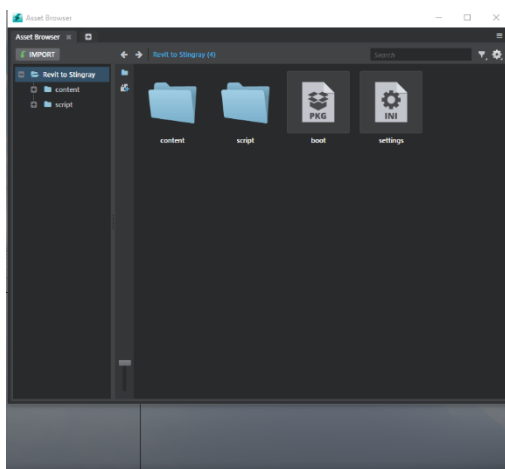
Revit to Stingray

BIM models and components can be visualised and animated in Autodesk's Stingray game engine, allow unprecedented presentation and interaction in BIM landscape works. BIM models based on National Building Specifications can be added to Revit project phases and schedules.

Alternatively, through photogrammetry algorithms in Autodesk Recap, photos can be converted to meshes, edited in Remake, saved as FBX file types then added to Stingray.

Software: Autodesk 3DS Max, Revit 2016, Recap, Remake, Autodesk Stingray

Interoperability note: texture import may not assign textures and may require manual assignment; however, this issue is being resolved at the time of writing for Revit models.



1. Load Revit or Remake and save your model as an FBX file type to allow Stingray to work with it.



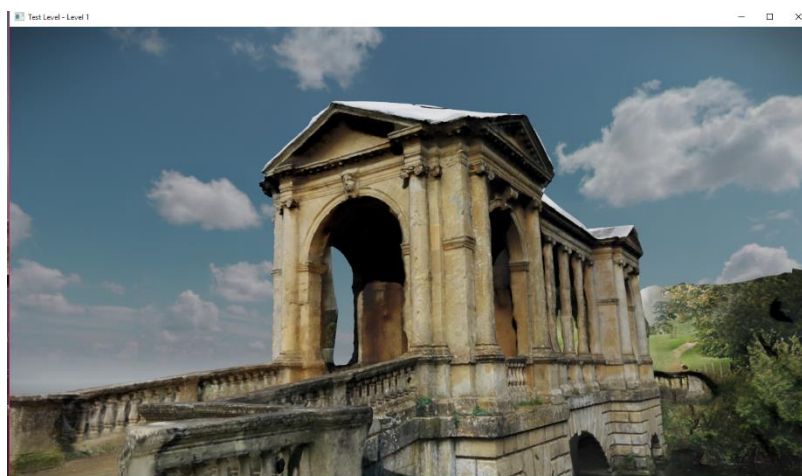
Strategies for Landscape Representation: Digital and analogue techniques, Routledge. ©2017 Paul Cureton.

Material to be used for educational purposes and with book companion.

2. Create a new empty project with a sky dome and environment. Save a local copy. Select the *Asset viewer* and *Import*. Import the FBX file. Adjust any parameters here if material maps are not required. Lights and camera setting from 3DS Max can be recognised.



3. Place the asset in the environment, rotating and scaling as required. Once complete, press the *Play* button and use the keyboard keys w, a, s, d to navigate the space alongside a mouse.



Additional links

Stingray Guidance: <http://help.autodesk.com/view/Stingray/ENU>