

A Story-Time Fairy Tale: Case Studies on Designing Theme Parks with BIM

Bill Allen

CEO, President

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About the speaker

CEO, President

Bill Allen is CEO and President of Disrupt Repeat, EvolveLAB, and OnPoint Scans. These firms synergistically work together to support architects, engineers, and contractors to be successful in their implementation and use of Building Information Modeling.

Twitter Handle:

@bill_allen_21 or @Evolve_Lab

About EvolveLAB

- Computational Design**

- Iterative design leveraging computation and algorithmic modeling. We utilize a data driven approach to optimize building daylighting, function, and programmatic information. Using tools like Dynamo, Project Fractal, and optioneering, we optimize projects based on rules and data.

- Building Information Model Management**

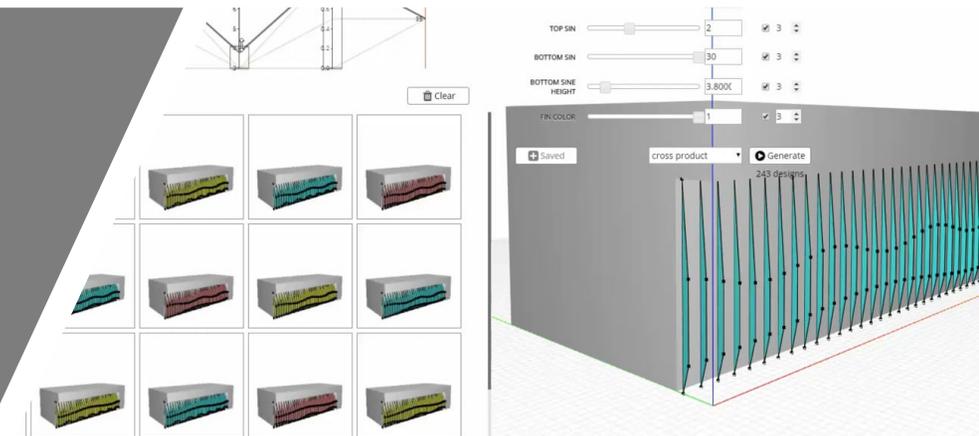
- On Demand Building Information Model Management. This includes content creation, templates, support. We also leverage our team of BIM Managers for 3D Coordination, Building Information Model Authoring, Building Data Authoring, and project support.

- Training**

- Our goal is to make your team more efficient through knowledge. Knowledge in of it'self is not powerful, but knowledge with application. Taking a pragmatic approach to specialized customized workshops is our jam and want to make you more efficient.

- Custom Tools**

- Leveraging open source programming as well as custom API integration, we build out custom Add-ins, Dynamo Scripts, and software solutions. We use data visualization, web dashboards, and custom user interfaces to build out the tools most material to your projects.



About the Client



Architecture

- Known for contextual and culturally relevant design, creativity, and attention to detail. DTJ's architecture complements the environment with artful solutions and thoughtfully integrated indoor-outdoor spaces. We create luxurious environments, crafted details, and memorable experiences. DTJ provides distinctive design for a variety of hospitality, residential, commercial, clubhouses, and amenity buildings.

Planning

Landscape Architecture

- DTJ's projects display a strategic enrichment of the outdoor environment, which enhances competitiveness. Our landscape architecture infuses a remarkable quality and identity through creative design and artistry with topography, structures, materials, and planting palettes. From hotel and club settings, to residential neighborhoods, the public realm, and community amenities; DTJ's strategic landscape design results in notable projects.

Integrated Design Approach

- Our integrated approach differentiates our practice. DTJ's clients realize tangible value, enduring quality, and enhanced reputation through our unique design style. For every project, we consider planning, architecture, and landscape architectural components, whether composed in house, or in collaboration with other experts. DTJ is recognized worldwide for integrating the natural and built environment, specializing in steep topography, and intricate sites.



Learning Objectives

- Understand what challenges come with adopting BIM for unconventional projects
- Learn how to use multiple BIM platforms to synergistically overcome performance issues
- Learn how to capitalize on BIM for large unconventional projects
- Learn what best practices exist for managing complex geometry



The Introduction

Once upon a time....

Chapter 1

Chongqing Mayan Water Park

Location: Chongqing, China





Facts & Numbers

420
ACRES

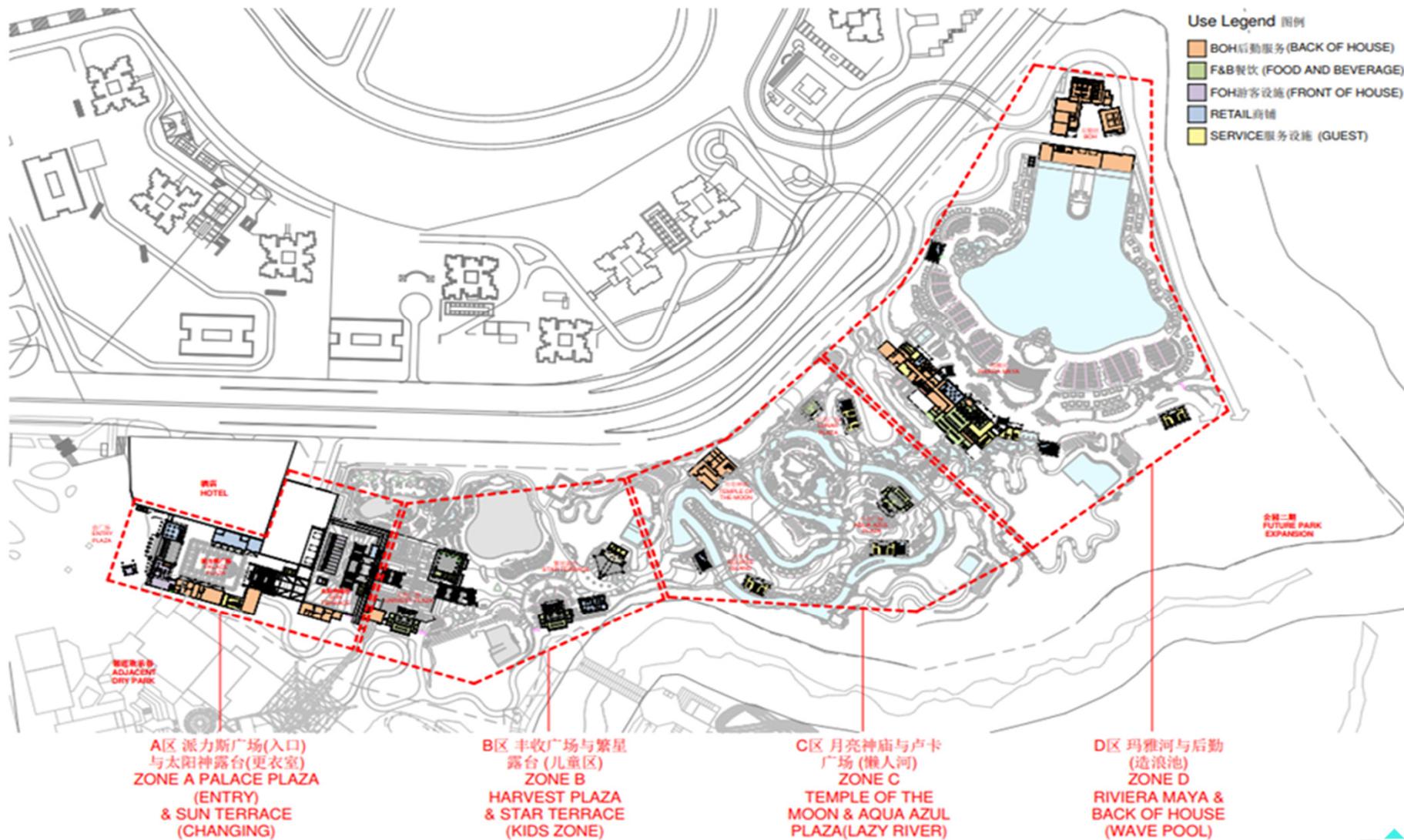
420 acres of theme park attractions

160
METERS

160 meters of fall from one end of the park to the other side

3rd
LARGEST

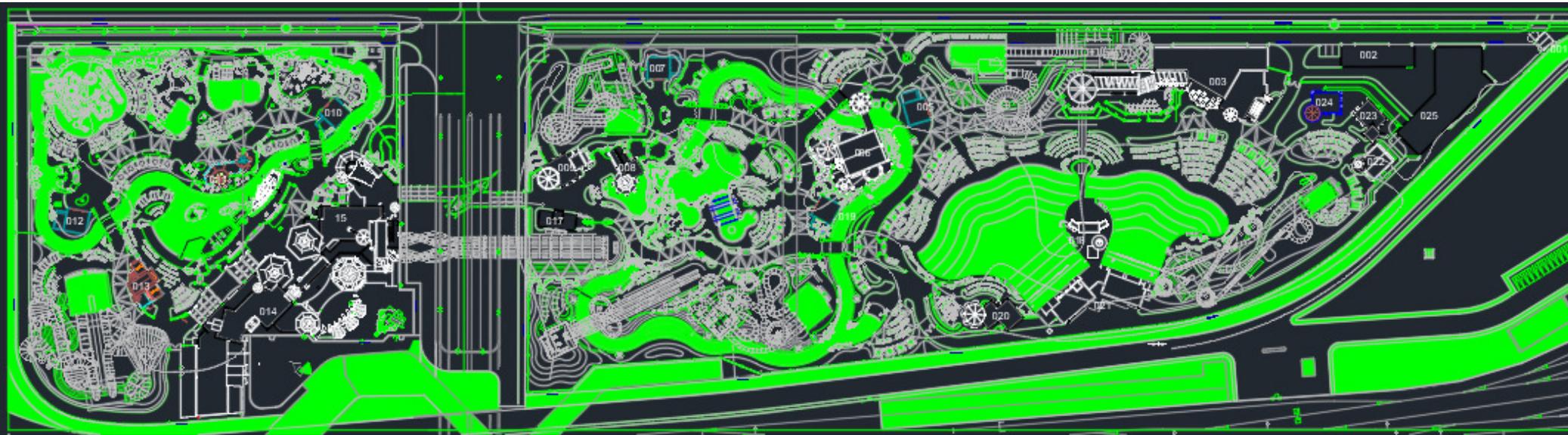
3rd largest wave pool in the world.



1 SITE PLAN / ZONE DIAGRAM 总图与分区示意图
 A001 SCALE: 1:1200

0 12 24 36 48 60m
 1:1200

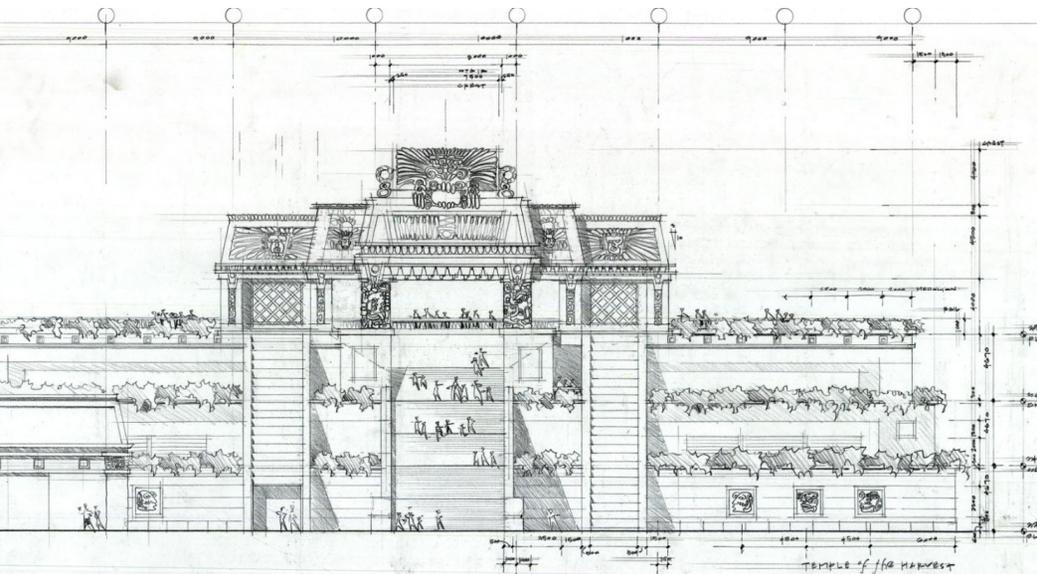




CAD Exports

Given the large integration with landscape, we had to maintain ongoing exports to AutoCAD as that was the program the landscape designers used. This posed a large challenge as the landscape design team was used to architecture working in AutoCAD and utilizing live backgrounds. We set up export views in the site file with view templates assigned and exported all the backgrounds from that file almost daily.

**Note that there are more efficient tools to automate cad exports such as Clarity, but the client had not invested in this software yet.*



Sketch

DTJ Design has some of the most talented designers in the world. Their sketching ability is unlike anything I have ever seen, especially in the AEC space. Sketching in lieu of modeling in SketchUp, FormIt, or Rhino became invaluable in communicating design intent from the principal designer. “The computer just doesn’t give us the freedom or efficiency a pencil does”, he said.



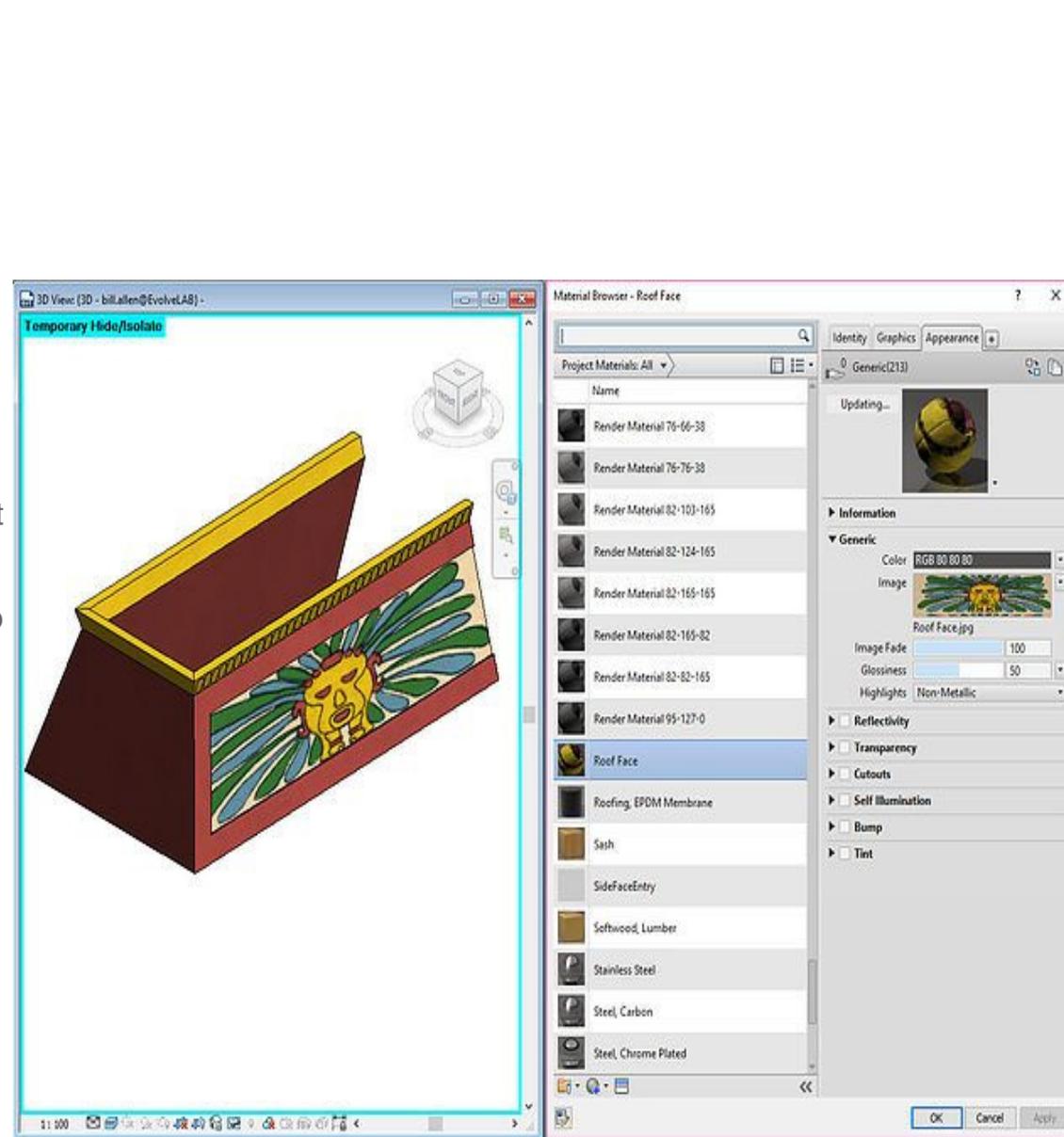
BIM

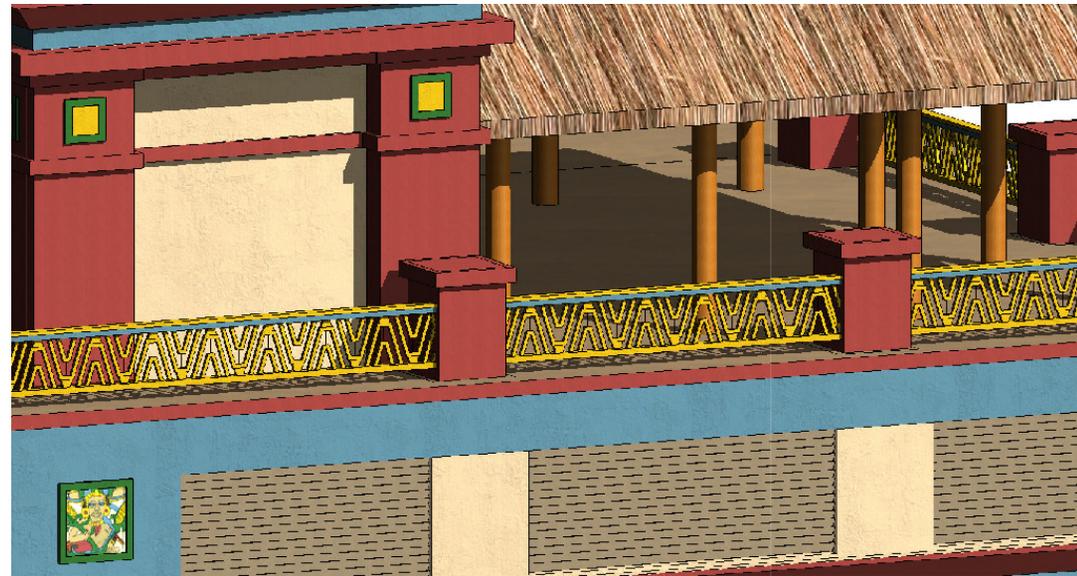
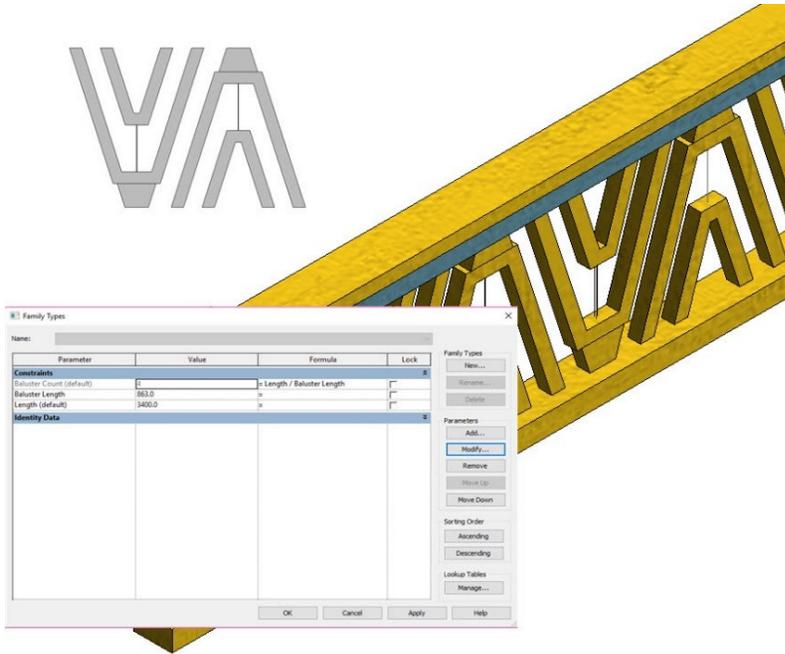
Scalable sketches became the vehicle for feeding myself and the rest of the team information about the project. The output from what was given was a fully 3D built Building Information Model was pretty incredible.

Less is more...Efficient

Given the quick turn around and this being the architects first project in Revit, we took a leaner approach to this specific project. We decided to photoshop the sketches from the designer, and import these images as materials that could then be “painted” to the surface of the geometry. The materials were scaled up so that they represented a 1:1 ratio on the surface to mitigate any kind of unwanted repeatability.

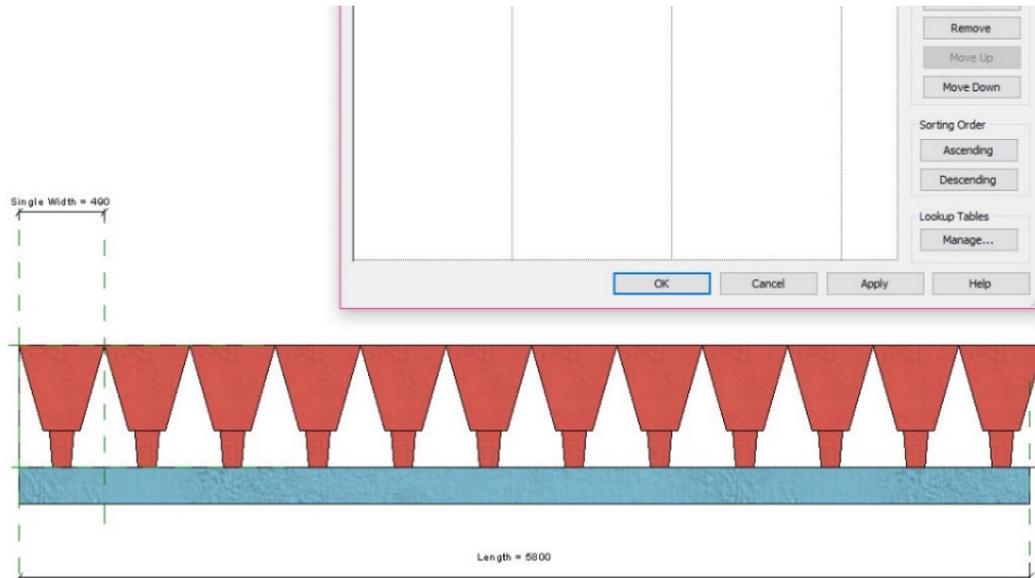
Note: one of the reasons we used materials in lieu of Revit decals was that decals will give you a phantom box around the image if the surface you are applying the decal is not square/rectangular. Given the vast amount of irregular shapes we were applying the graphics to, painting was the better option.





Railings

Another major task was to create componentized families that could be used throughout the project from one file to the next. I built out parametric line-based families for the railings as the Revit out of the box balusters weren't going to cut it.



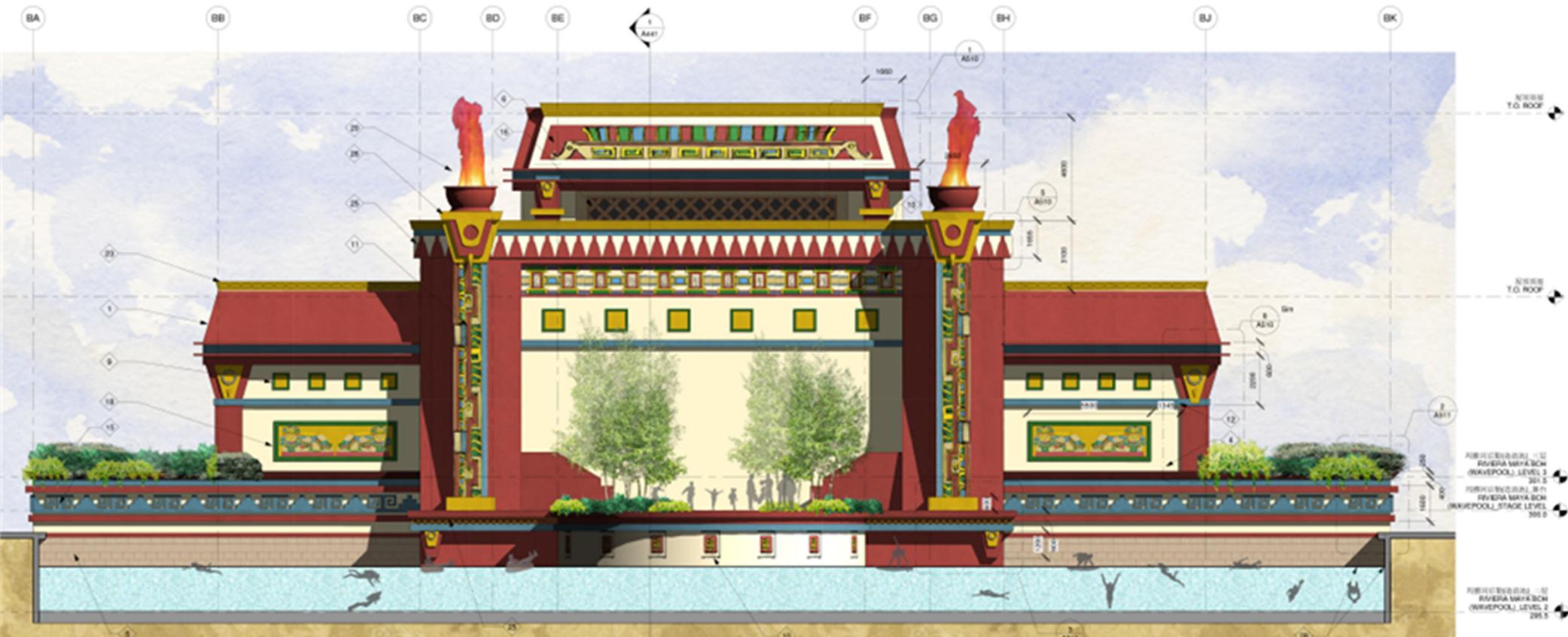
Decorative Fascia

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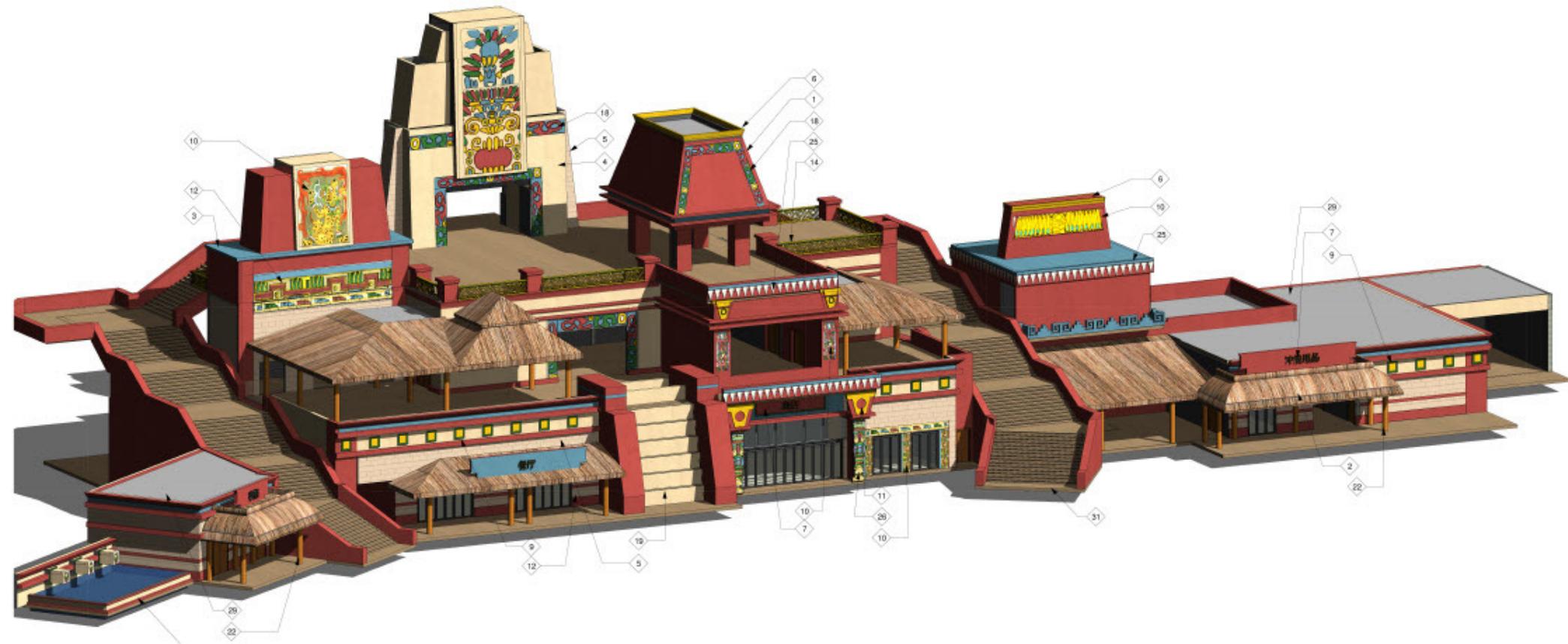
Elevations

The elevation quality for this project was extremely impressive. We not only showed the project in color with shadows on, but we also needed to represent rockwork, trees, shrubs, waterfalls, and architectural information beyond. Please note this was before the Revit “depth cueing” feature.



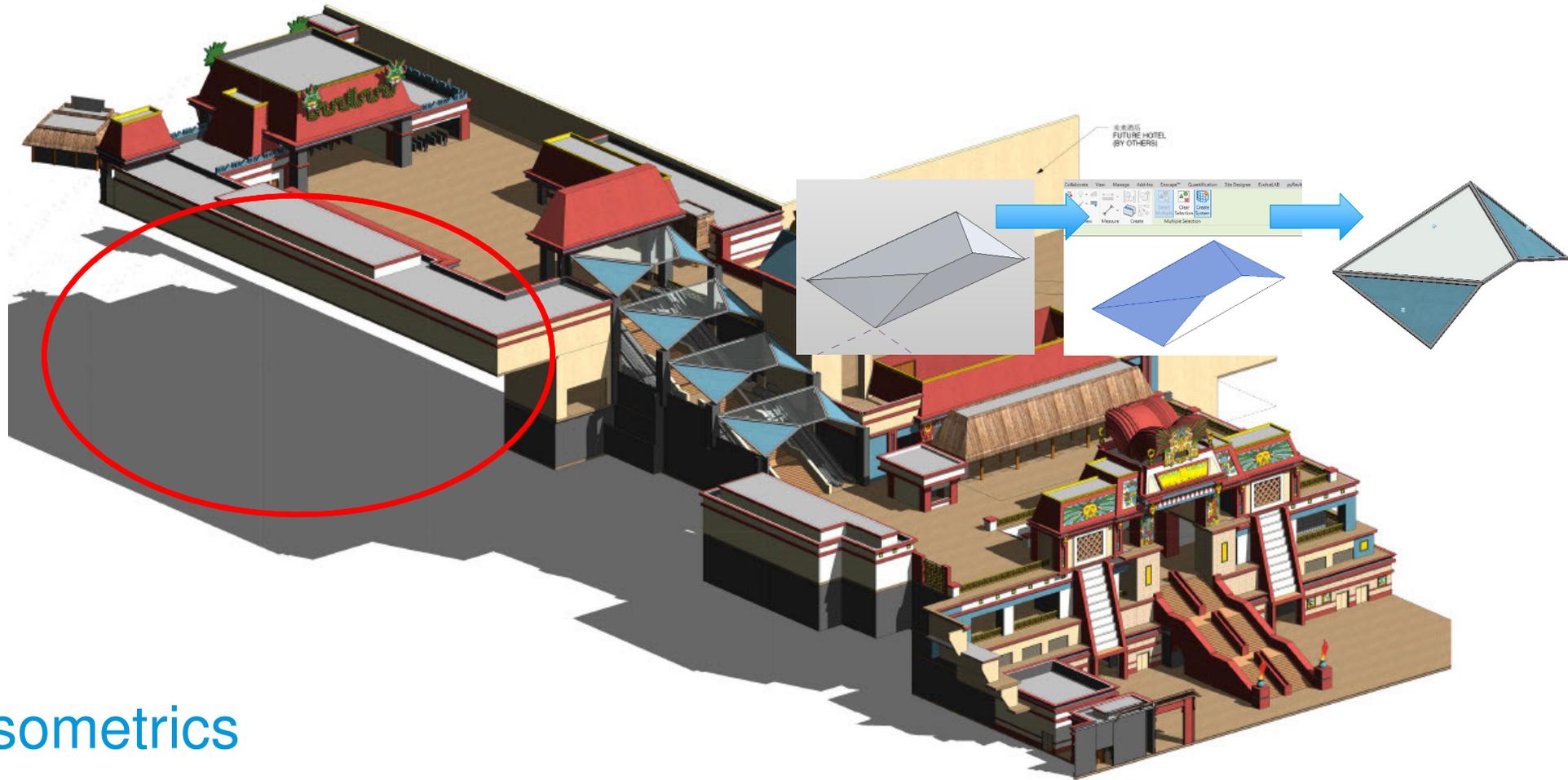
Elevations

In short it required an intense amount of photoshop. We didn't have time to wait to be done modeling to hand it off to the photoshop artist, so we exported "rough" elevations for them that would be put on a separate layer and they would begin photoshoping while we continued modeling. As new updates came in, they would replace the old building layer with the new one.



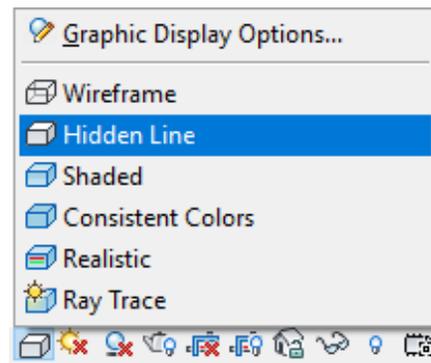
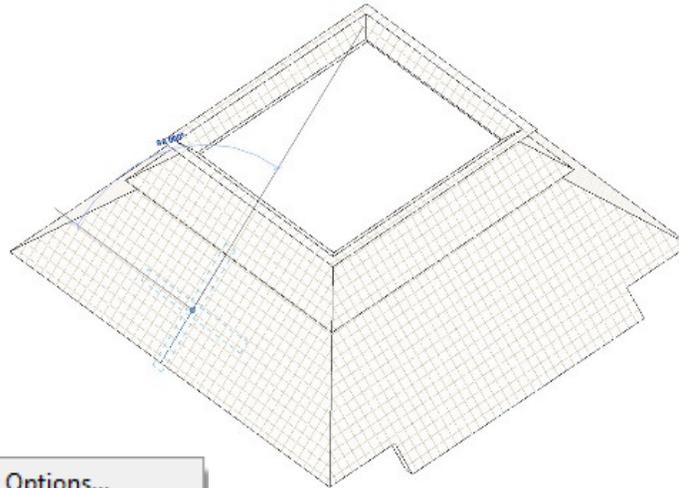
Isometrics

We also decided to include isometrics of the project to help inform the architect of record as well as the contractor how the theming components wrapped around edges and surfaces. We didn't want it to look like a Hollywood set where only the front of the building had these theming components.



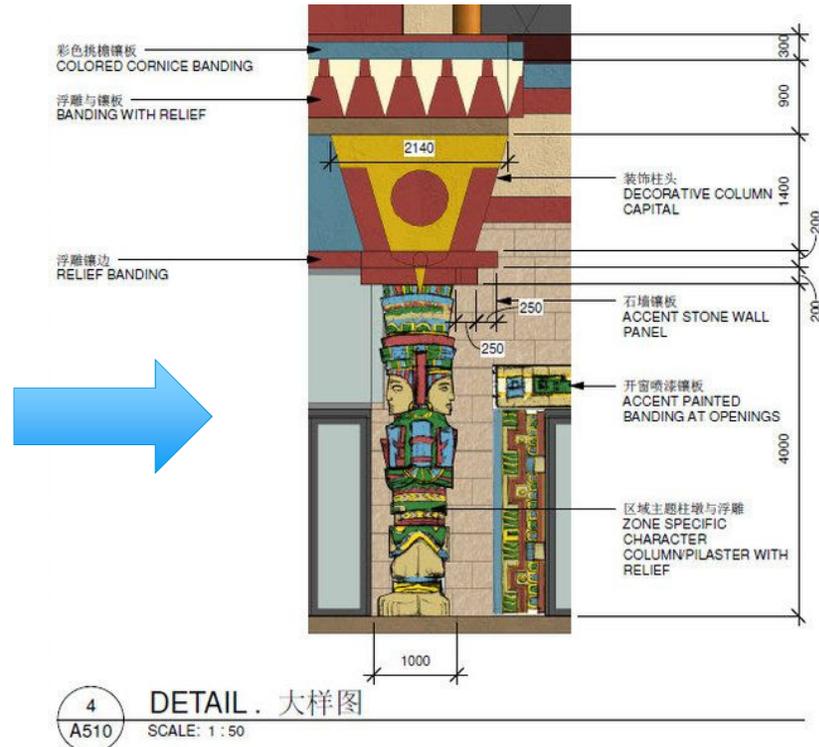
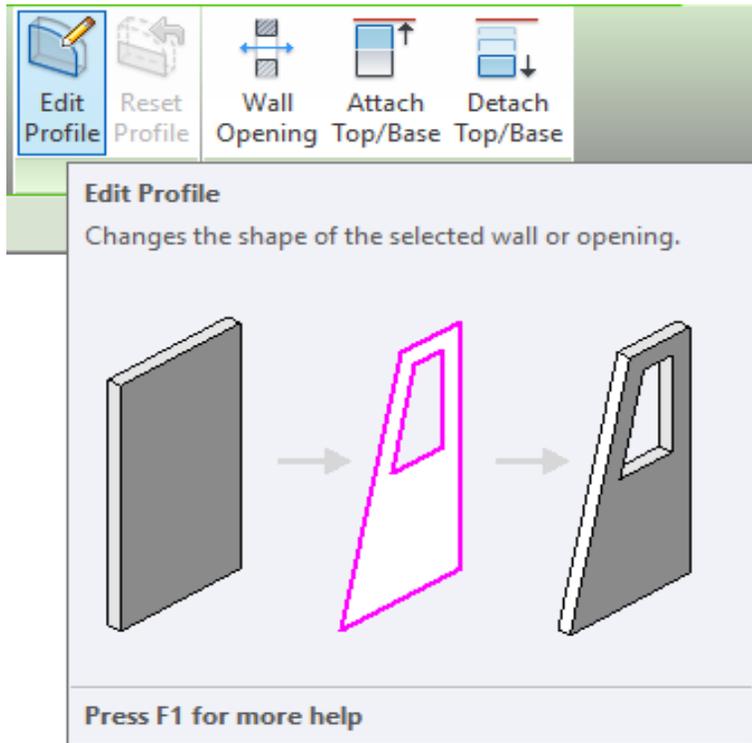
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Shade Structures

Rather than modeling the roof thatch which would have been very processor heavy, we modeled the general shape, and then applied the material of the thatch to the shape. We also applied a hatch pattern to the material so when it wasn't set to realistic, we would have a grid pattern to rotate to make sure the patterning was going the correct direction.



Detailing

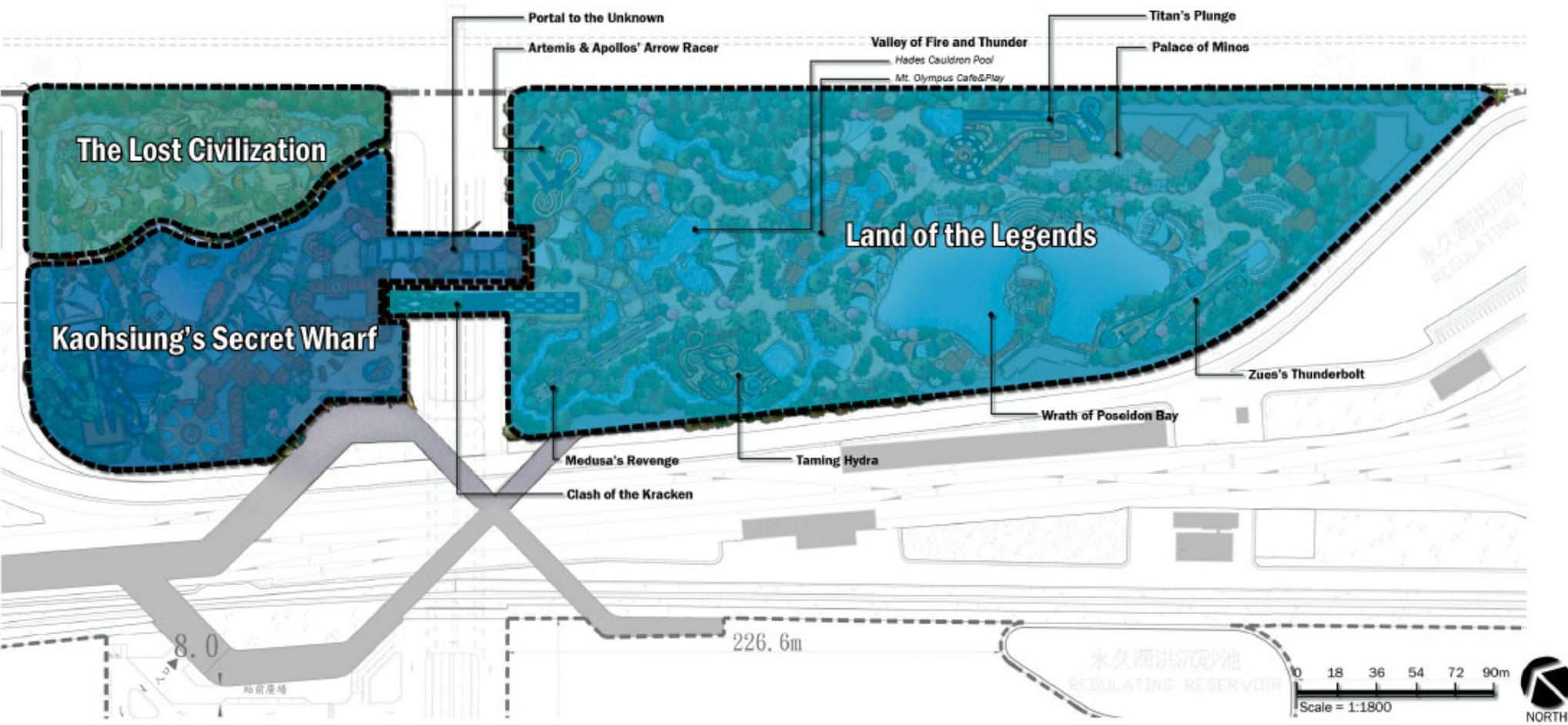
Even though we were delivering a schematic design package, we had a very high level of detailing that occurred for the theming elements on the project which included dimensions, descriptions, and Chinese translations. To accomplish some of these complex shapes, we simply used the wall edit profile tool in Revit and painted the material of the sketch to the front.

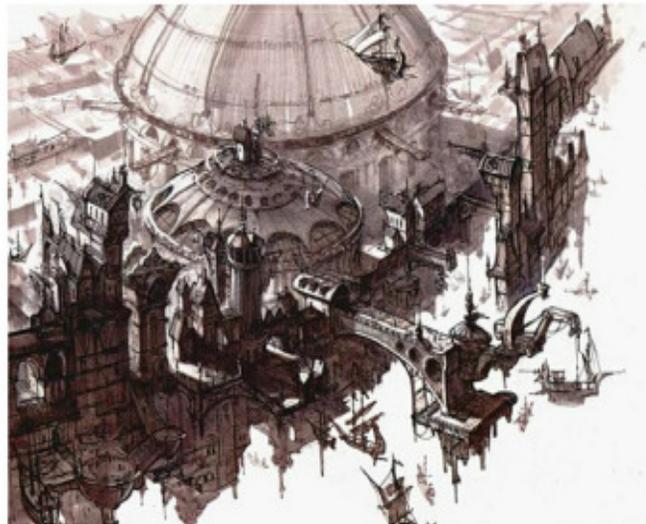
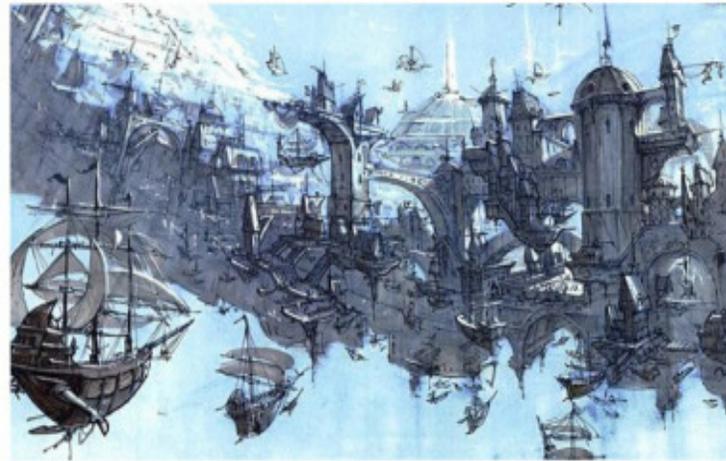
Chapter 2

Leyenda Del Mar Water Park
Location: Kaohsiung, Taiwan

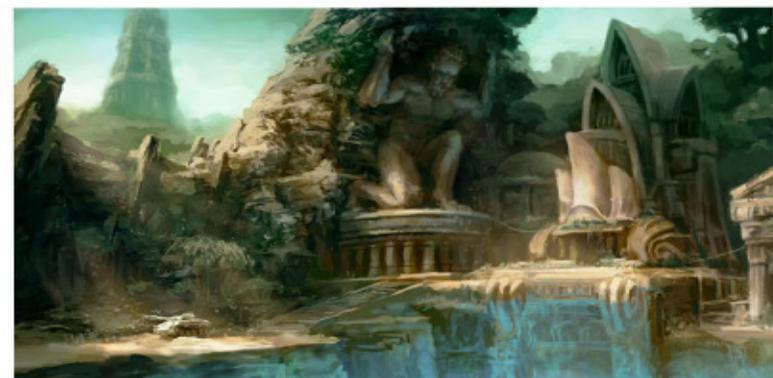
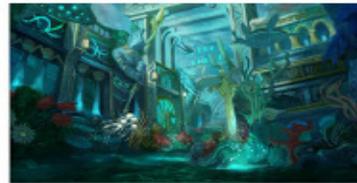




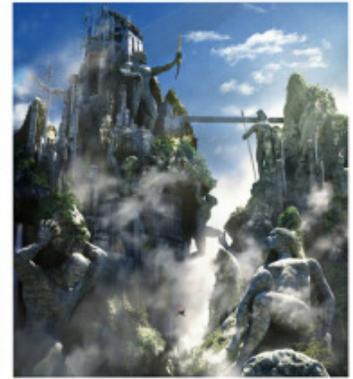


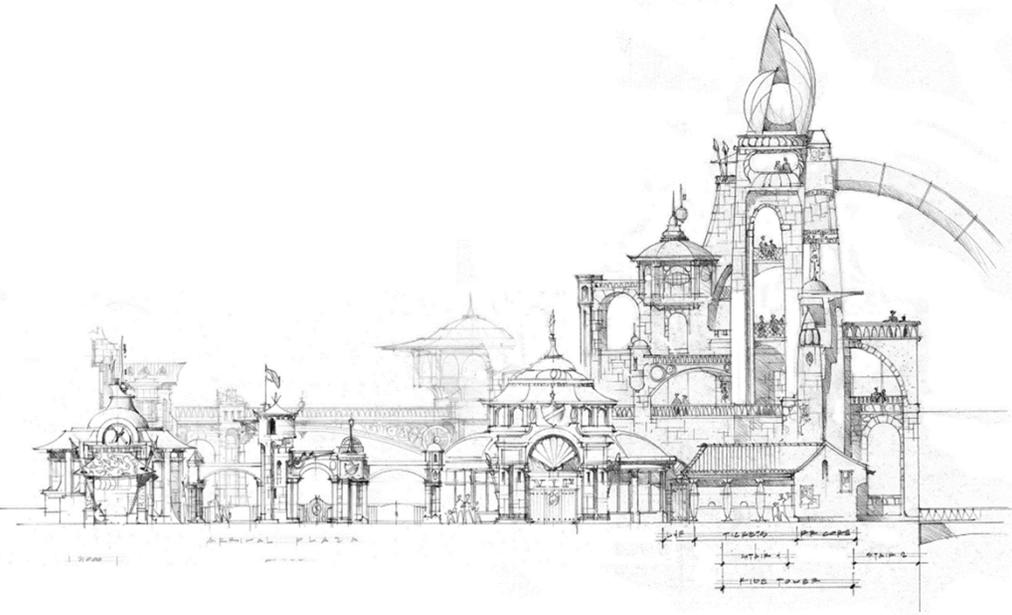


The Lost Civilization



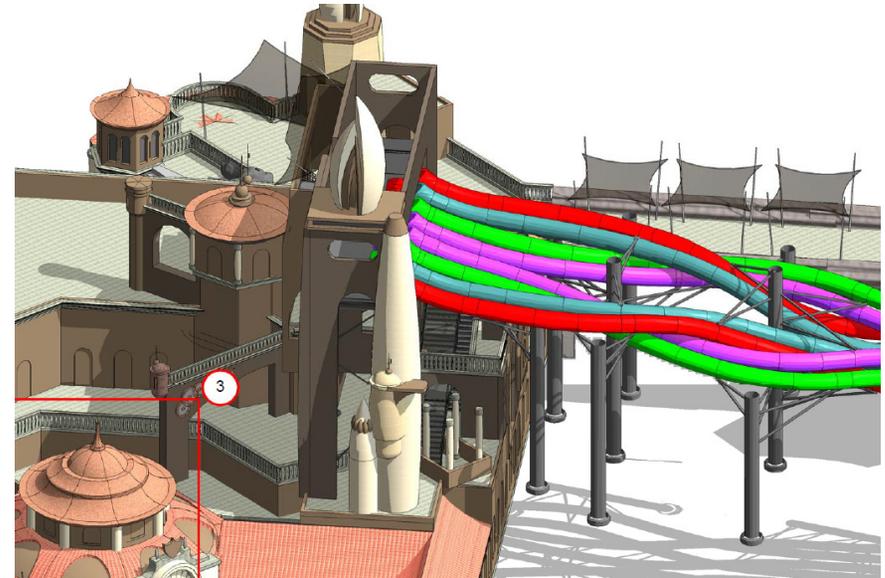
Land of the Legends





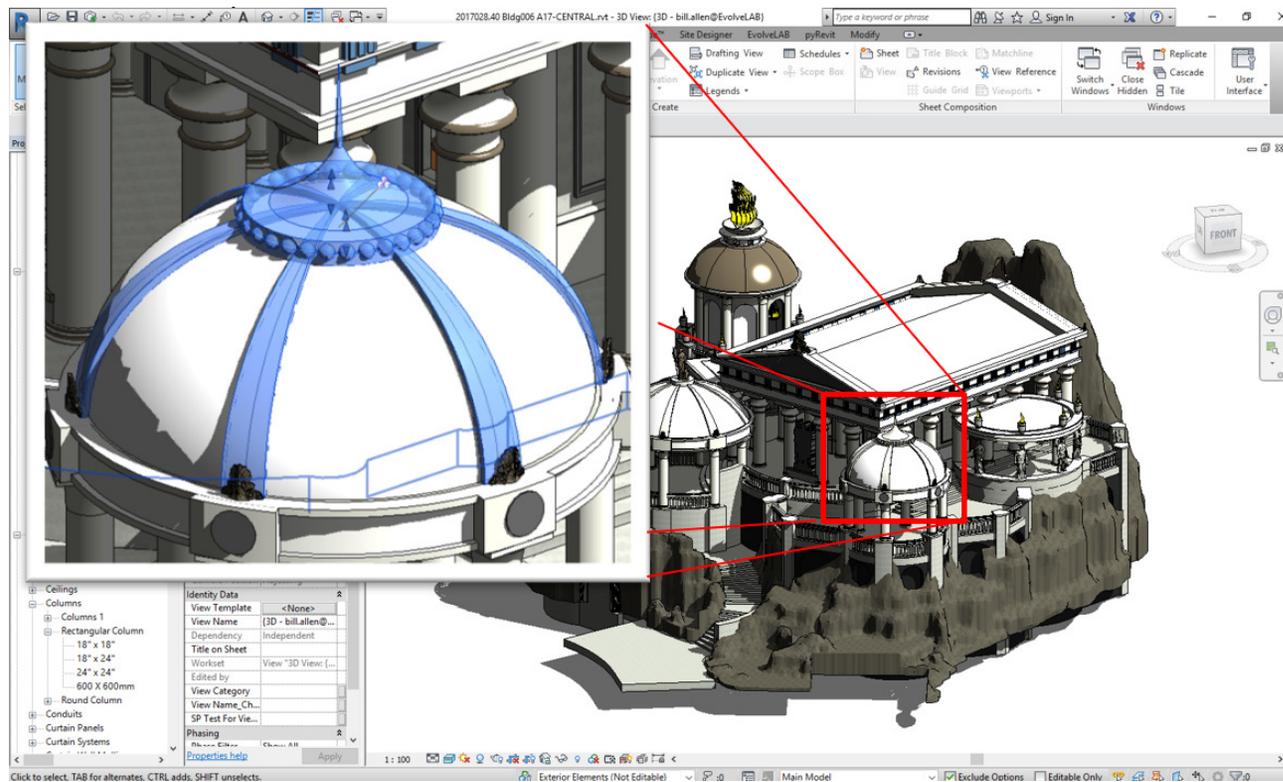
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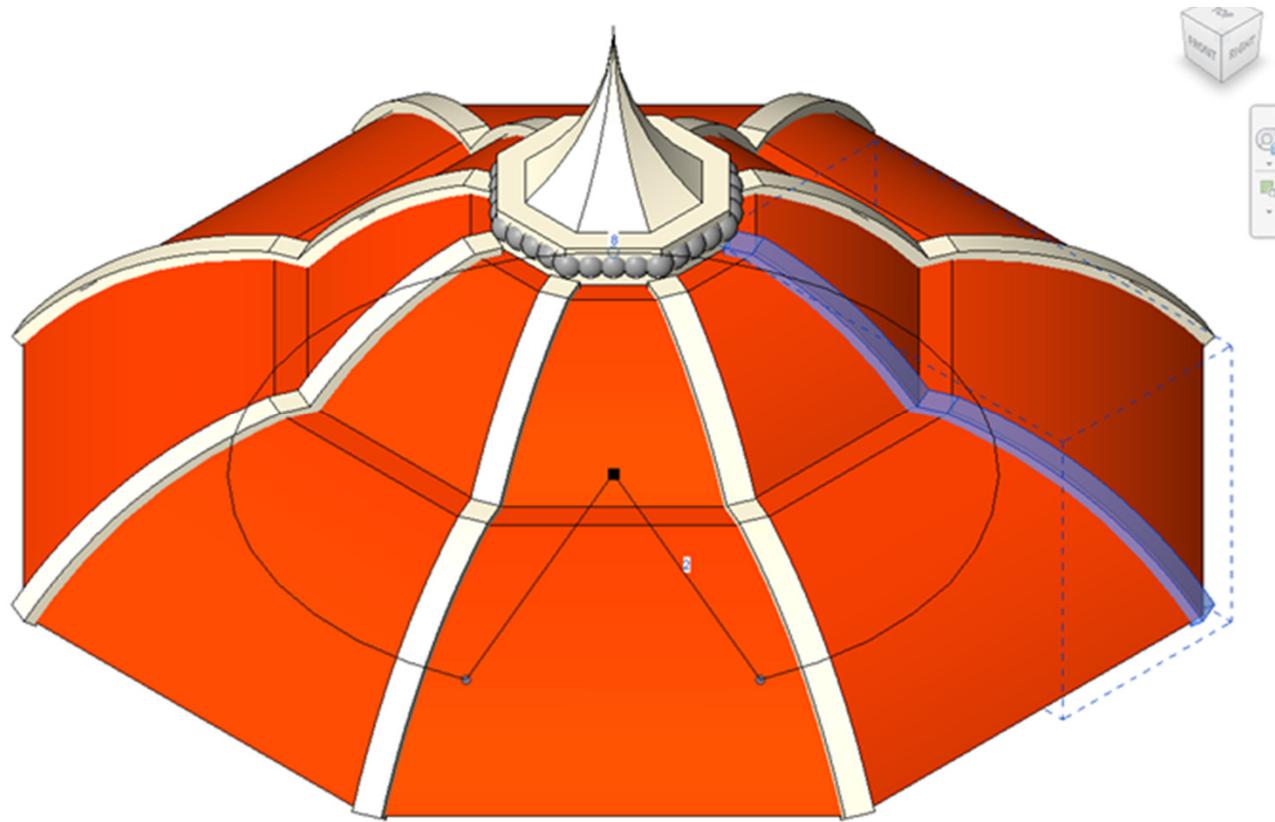
BIM

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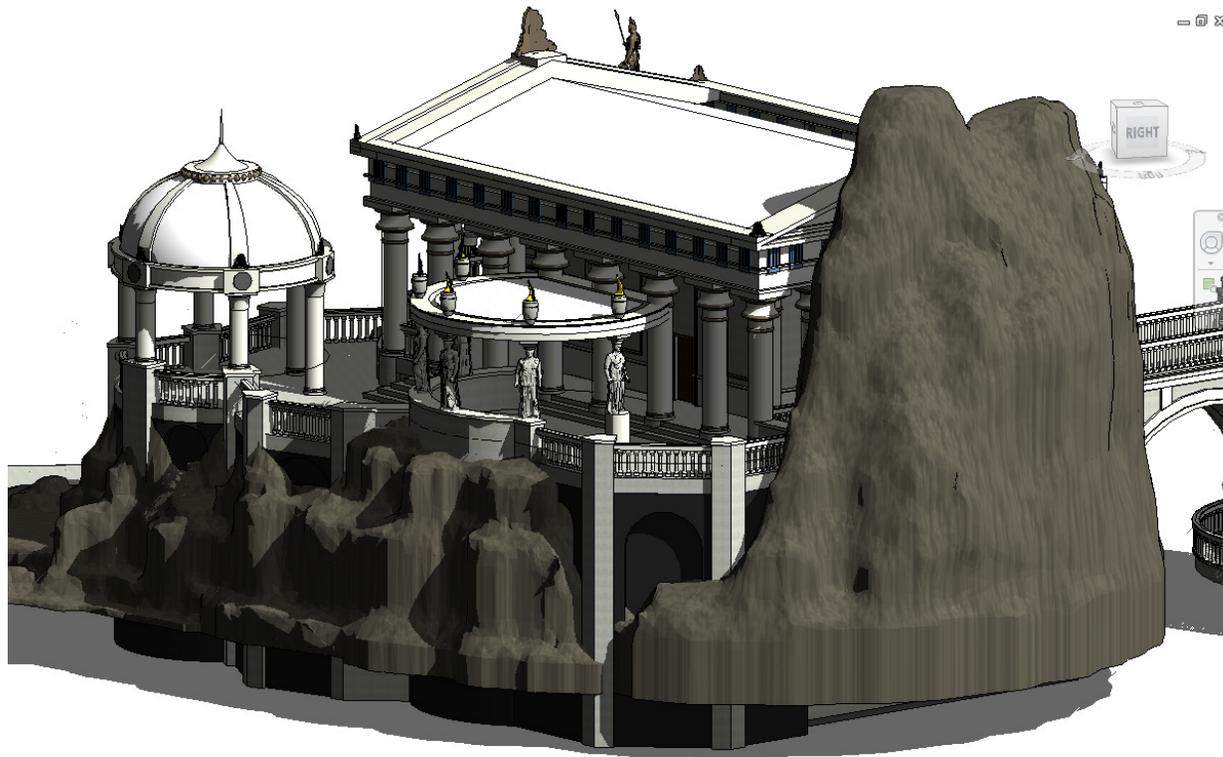
Classical Architecture

The land of legends had this classical Greek architecture with decorative Fascia's, detailed domes, and sculptural columns.



Sweeps and Arrays

We used a series of sweeps and arrays in Revit to accomplish modeling of the domes.

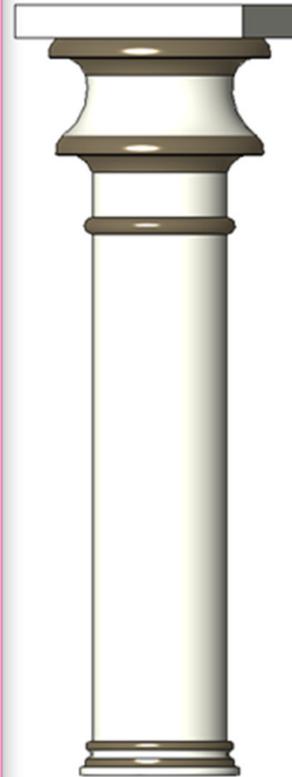


Family Types

Type name: Building 006 Main Columns

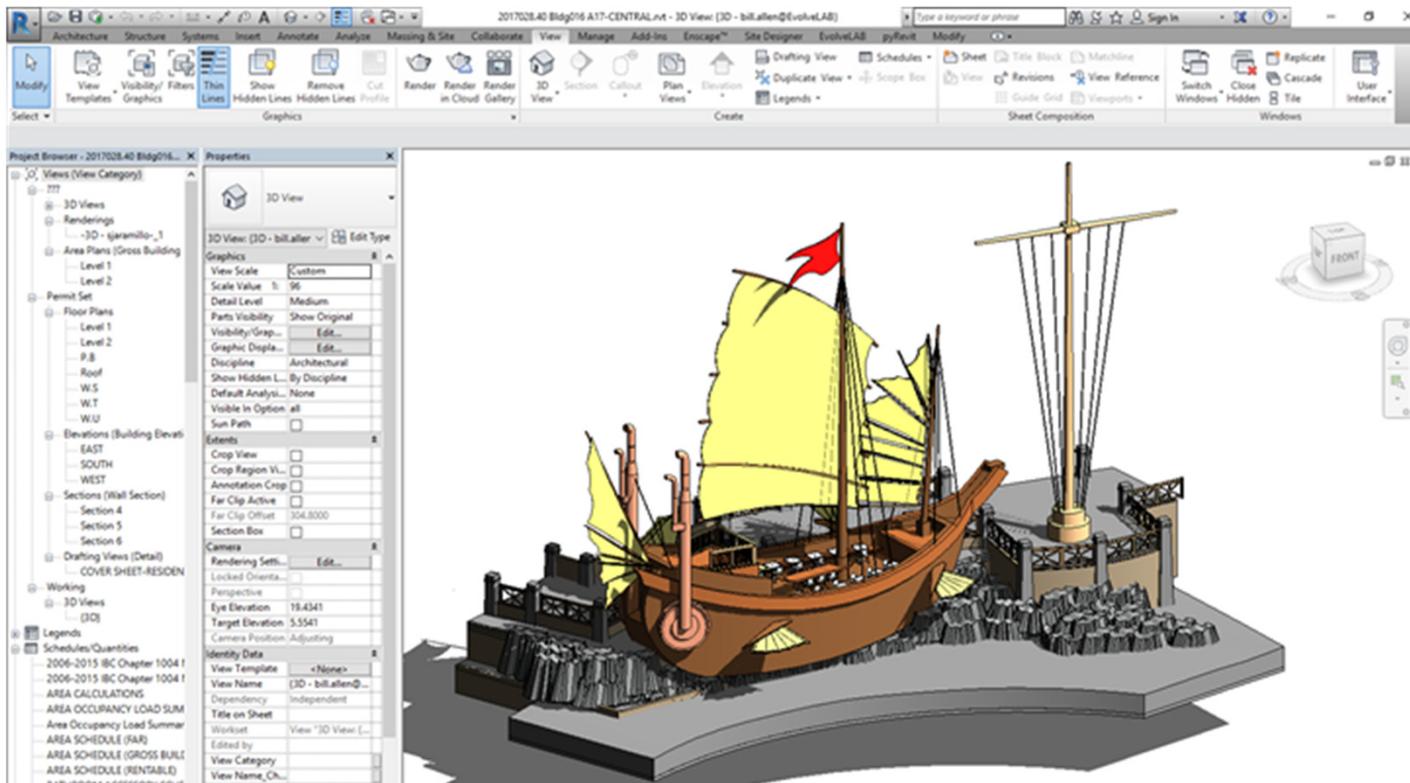
Search parameters

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Base Type<Generic Models>	034800 Column Base 1	=	
Capital Type<Generic Models>	Column Capitals - 006	=	
Half Cut (default)	<input type="checkbox"/>	=	
Quarter Cut (default)	<input type="checkbox"/>	=	
Shaft Type<Generic Models>	034800 Column Shaft - Smooth	=	
Materials and Finishes			
Banding Material	034800 Column Capital 1	=	
Base Material	034800 Column Capital 2	=	
Capital Material	034800 Column Capital 3	=	
Shaft Material	034800 Column Shaft - Fluted	=	
Structural Material (default)	034800 Column Shaft - Shell	=	
	034800 Column Shaft - Smooth	=	
	034800 Column Shaft - Smooth Rules	=	
Dimensions			
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Base Width	1.0000	=	<input type="checkbox"/>
Capital Width	1.0000	=	<input type="checkbox"/>
Height (report)	4.5720	=	<input type="checkbox"/>
Pedestal Height	0.0000	=	<input type="checkbox"/>
Capital Height	1.3600	=	<input type="checkbox"/>
Shaft Diameter	0.8000	=	<input checked="" type="checkbox"/>
Shaft Height (default)	3.0120	= Height - Overall Pediment - Capital Height	<input type="checkbox"/>
Other			
Bulge Amount	0.2032	=	<input type="checkbox"/>
Capital Height Control	1.3600	= if(Capital Height < 0.3048 m, 0.3048 m, Capital Height)	<input type="checkbox"/>
Capital Offset (default)	3.2120	= if(not(Base), Shaft Height, Overall Pediment + Shaft Height)	<input type="checkbox"/>
Overall Pediment	0.2000	= if(Base, Base Height + Pedestal Height, 0 m)	<input type="checkbox"/>
Shaft Height Control (default)	3.0120	= if(not(Base), Shaft Height, if(Shaft Height < 0.3048 m, 0.3048 m, Shaft Height))	<input type="checkbox"/>
Identity Data			



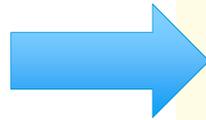
Parametric Classical Columns

We built parametric columns that were formulaically driven with type drop downs for different features needed in different buildings.



Which Category?

A common theme (no pun intended) when modeling theme parks is the sheer amount of geometry that doesn't fit into a Revit category. "Generic Model" and "Specialty Equipment" are some of the most common and usually the most abused. Further, there is a lot of information that is NOT repeatable. When was the last time you need to model an ancient explorer's ship multiple times throughout a project? With these types of geometry, it's best to "model in-place".

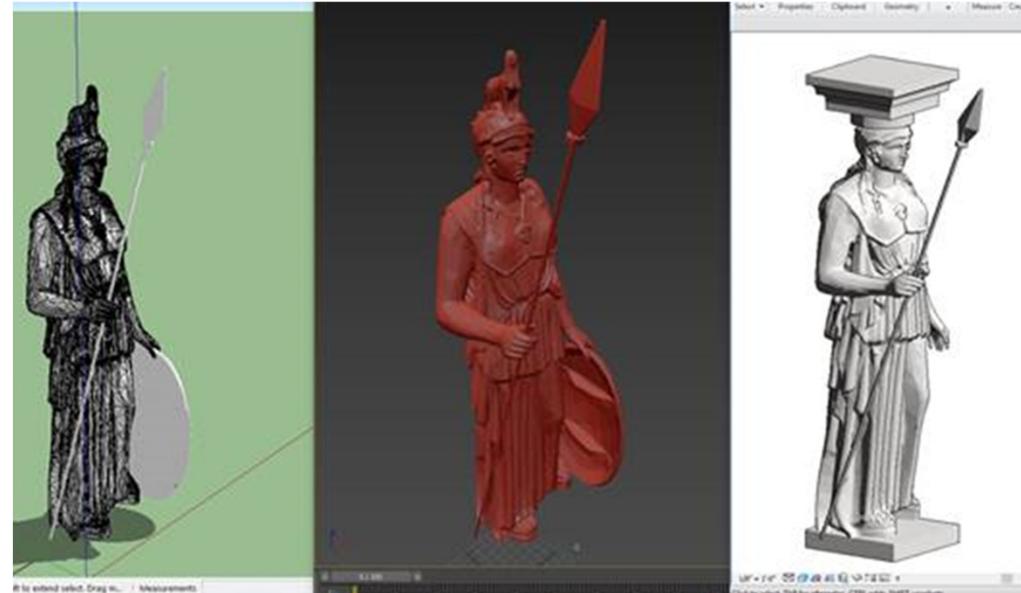


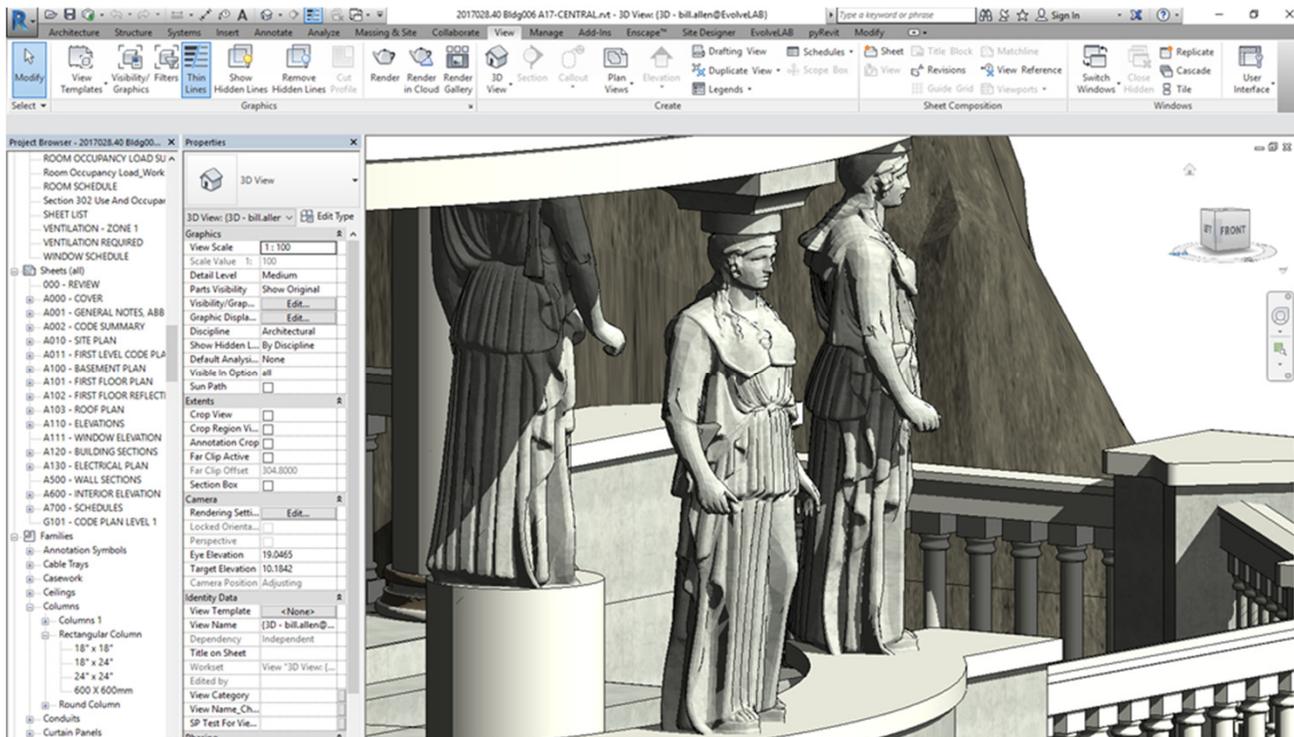
Into The Void

Further the “Void” tool in Revit is completely underutilized. We used the out of the box modeling tools to model the sails on the sail boat simply by creating an extrusion voided out.

SketchUp → 3DS MAX → Revit

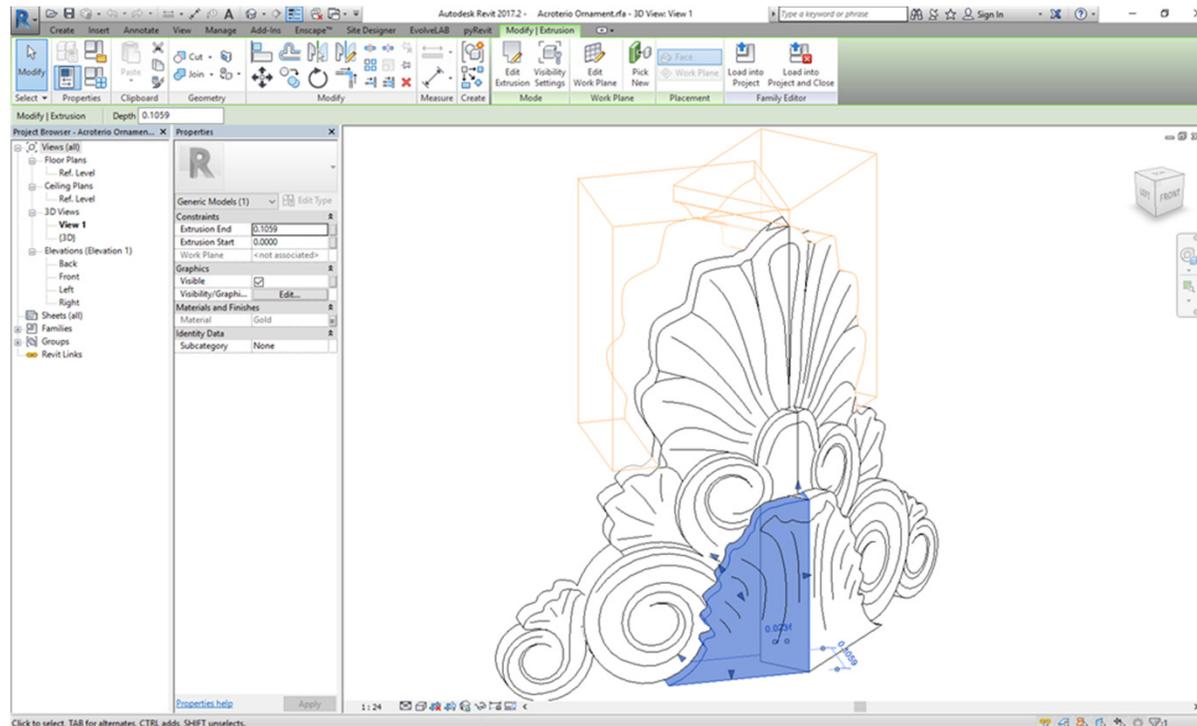
- Import mesh into 3dsMax
- Select the object
- On the palette on the right got to "Modify" tab
- Looking at the modifier stack, if the object isn't an editable mesh → go to the "Modifier List" pulldown → Select "Edit Mesh"
- In the tools below the modifier stack, in the "Selection" group, pick the "Edge" icon to select edge sub objects
- Select the edges
- In the tools below the modifier stack, scroll down to the bottom group "Surface Properties" → Select "Invisible"
- Because Revit prefers to select objects using edges (rather than faces), a few edges still need to be visible. Newer versions of Revit allow you to select by face, but it can still be an issue if you don't have a couple of edges to select.
- Select a few edges on the bottom of the object → Select "Visible"
- Turn off the "edge" sub-object select in the "Select" group
- With the object selected click on the 3DS Max Icon in the upper left → "Export" → "Export Selected"
- Pick a location and file name
- Change "Save as type:" → "AutoCAD (*.dxf)"
- Slick "Save"
- In the "Export of AutoCAD file" dialog change "Export Version" to AutoCAD 2007 DXF or AutoCAD 2004 DXF. The other settings don't matter in this instance, but exporting as 2004 or 2007 does matter.
- Click "Ok"
- Open the exported DXF file in AutoCAD
- If it worked, only the edges that you left visible will be visible.
- Click on the "Layer Properties" button
- Click on the "New Layer" button
- Give the layer an appropriate name for the object. This will allow you to assign materials and change the line weights for the mesh in Revit
- Change the layer's color to white
- Select the Object → using the layer pull down, change the object layer to the new layer
- Verify that under the properties group on the Ribbon, the object color, line weight, and linotype are all set to "By Layer"
- Save (either as a DXF or DWG)
- In Revit → create a new family or in your project under the "Architecture" tab → "Component" button → "Model in-Place". The type of family should match what the object is. Generic Models or Masses are typically good choices
- In the family → "Insert" tab → "Link CAD" or "Import CAD" (Link CAD will only be available in "Model In-Place" families.
- Select your DXF or DWG file and place it (don't forget to check the "Import Units" and the "Positioning")
- The mesh object will come in as an outline with only the edges you left visible still there.





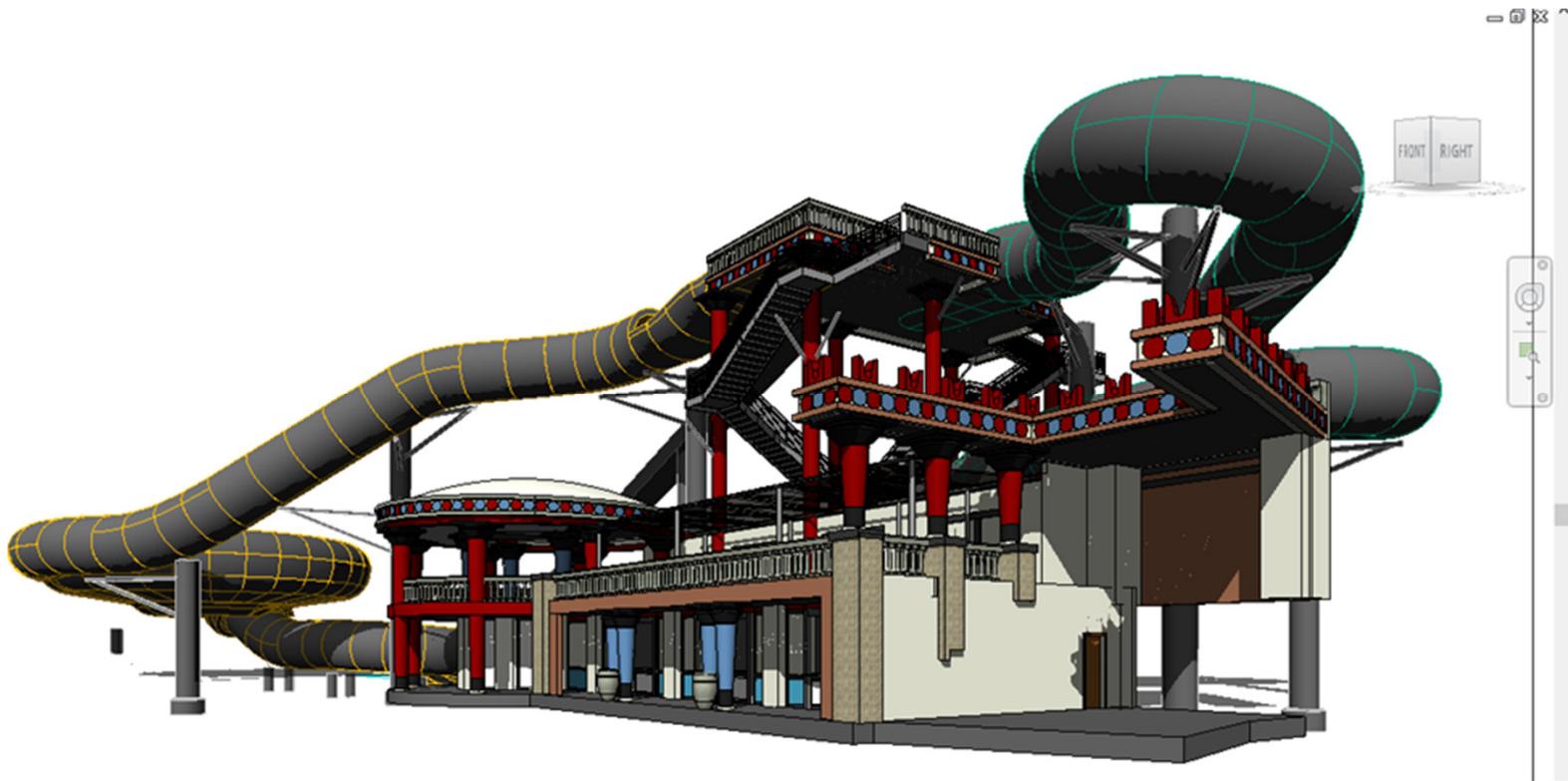
No More Wall Profiles

For this project, we really wanted to push the limits of the column sculptures. This proved challenging not only from a modeling effort, but also because of Revit performance.



Decorative Details

Many of the decorative elements were a combination of voids, extrusions, and model lines built into families that didn't necessarily need to be parametric, so we kept these leaner.

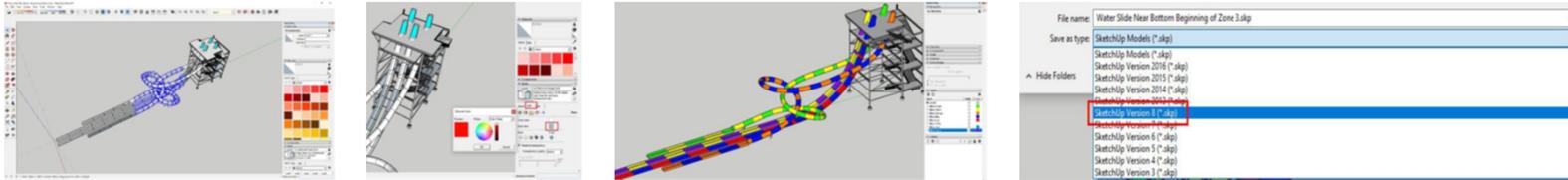


Ride Towers

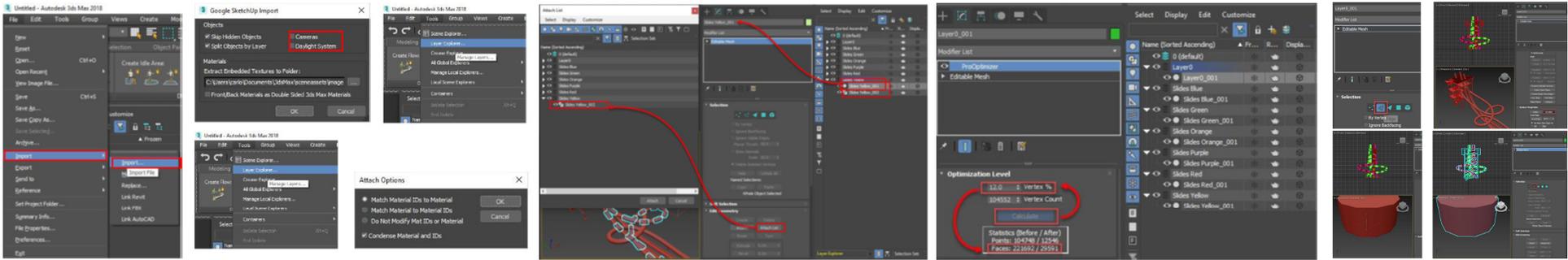
Conversion of DWG or DXF files to something suitable for Revit is a lengthy process, but necessary for eliminating extraneous edges for complex triangulated forms. The process described here is focused around five main concepts:

- Split geometry into layers based on the materials to be assigned;
- Make edges invisible for the mesh geometry in 3ds Max;
- Export the geometry in layers from 3ds Max to the 2007 DXF format and import it into AutoCAD;
- Set all geometry to the correct layer, and set all geometry to use white lines in AutoCAD;
- Import the geometry into a Revit family and use Object Styles to set the materials for each Imported Category subcategory made automatically for the layers.

SketchUp



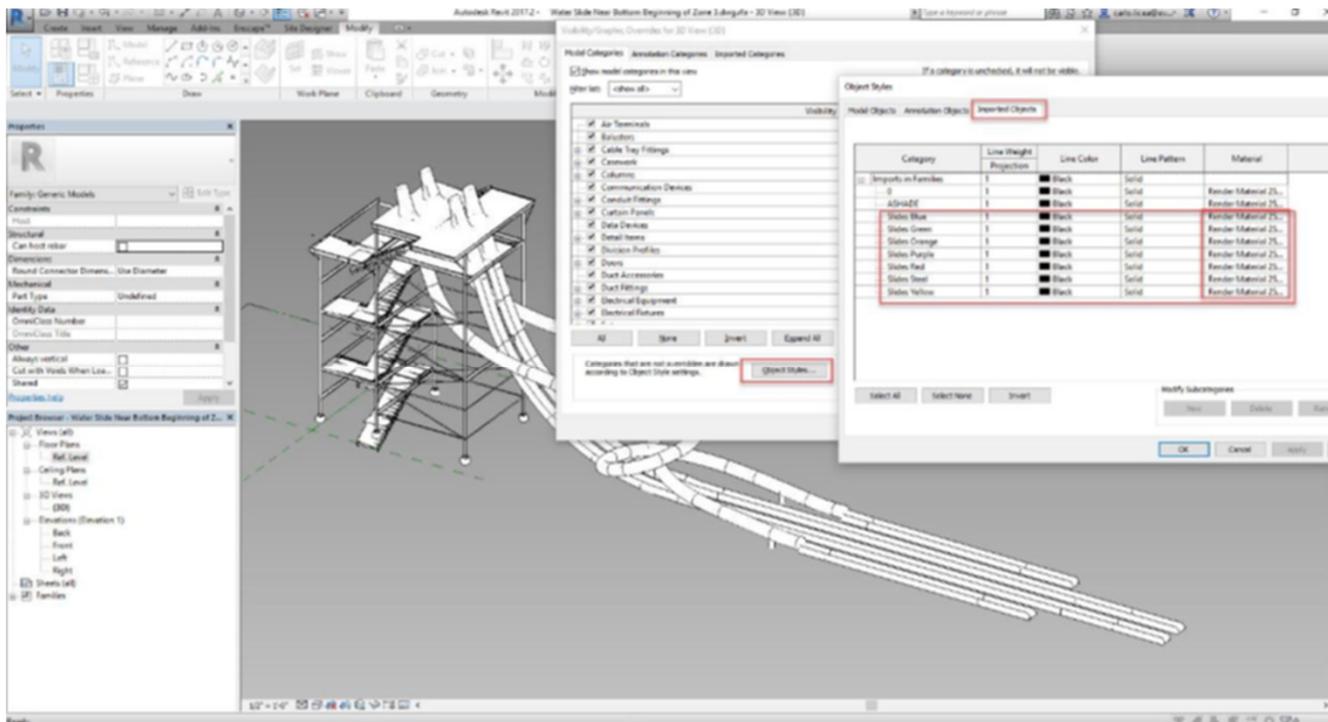
3DS Max



Revit



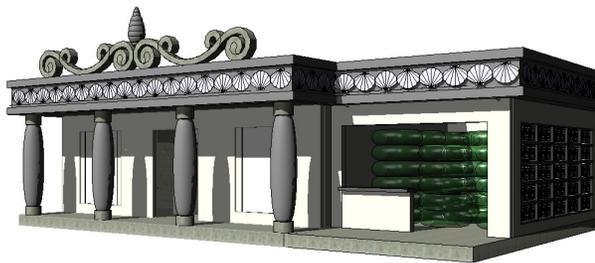
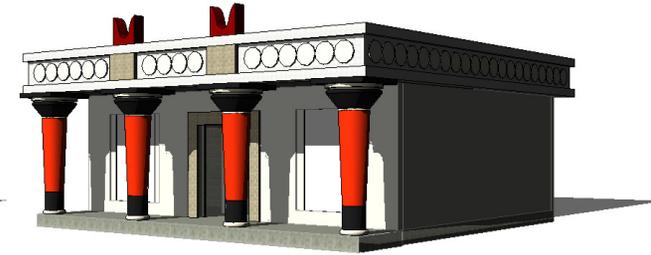
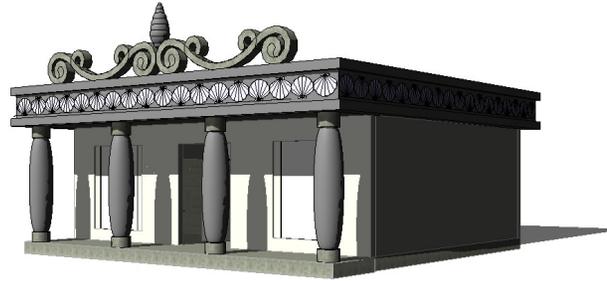
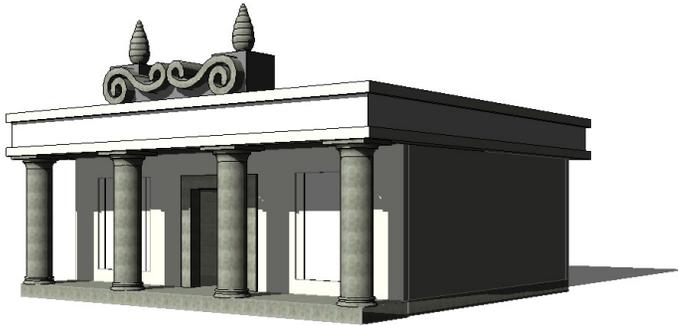
- Strip/Clean layers in SketchUp
- Save-As SketchUp 8
- Clean Up Edges is 3ds max
- Export individually to DXF
- Object Styles Show Up in Revit



Ride Towers

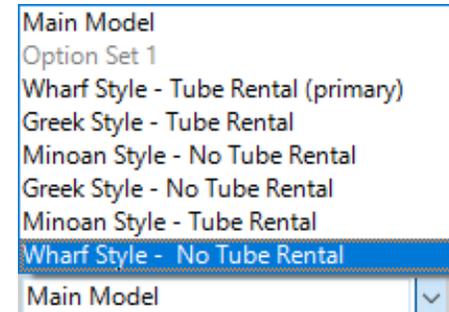
Take Away

- Increase in performance when working with highly complex/detailed geometry
- Greater visibility control in Revit



One Building – Multiple Themes

- The Good: Efficient to update in location
- The Bad: Had to update all views for specific area to correct design option



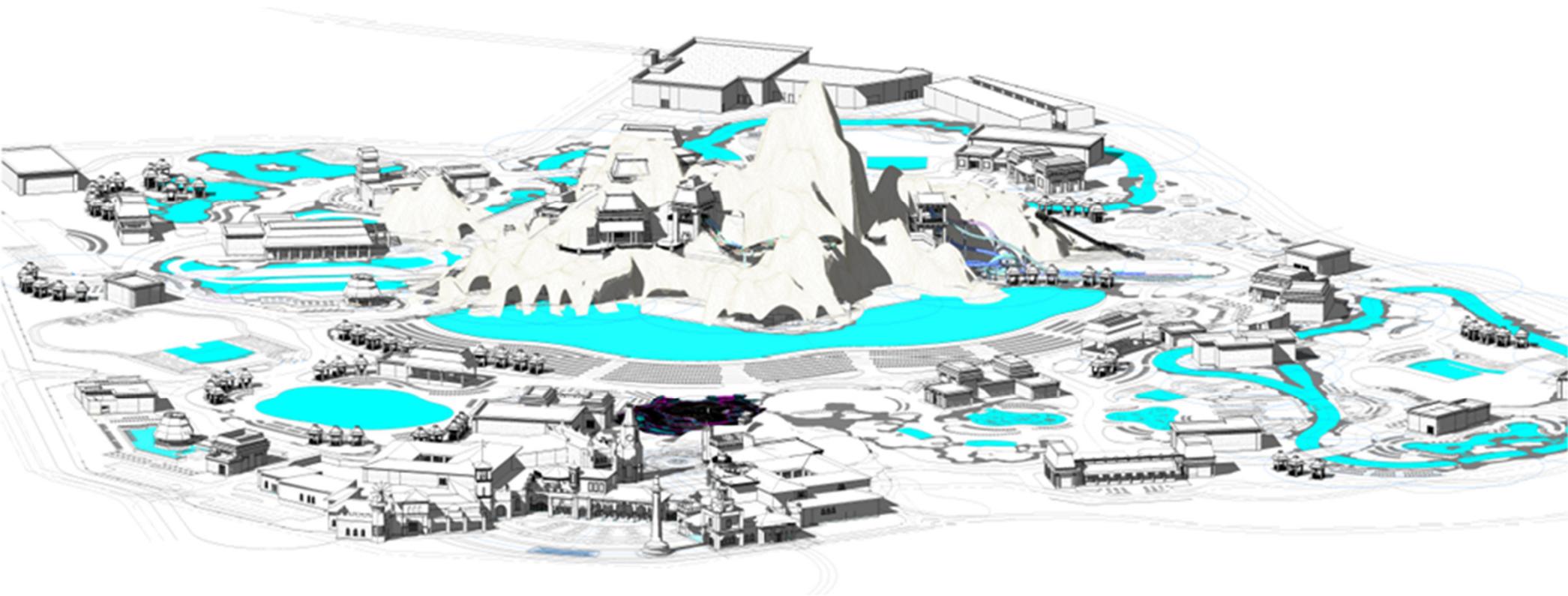
Chapter 3

Confidential Water Park

Location: Undisclosed



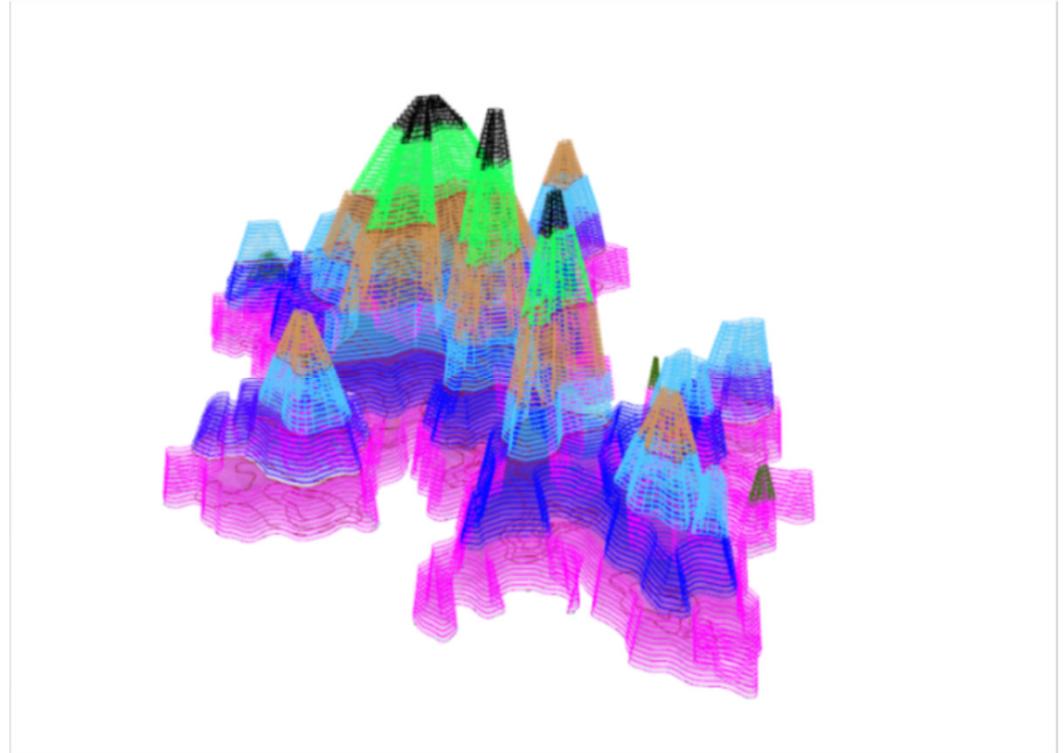
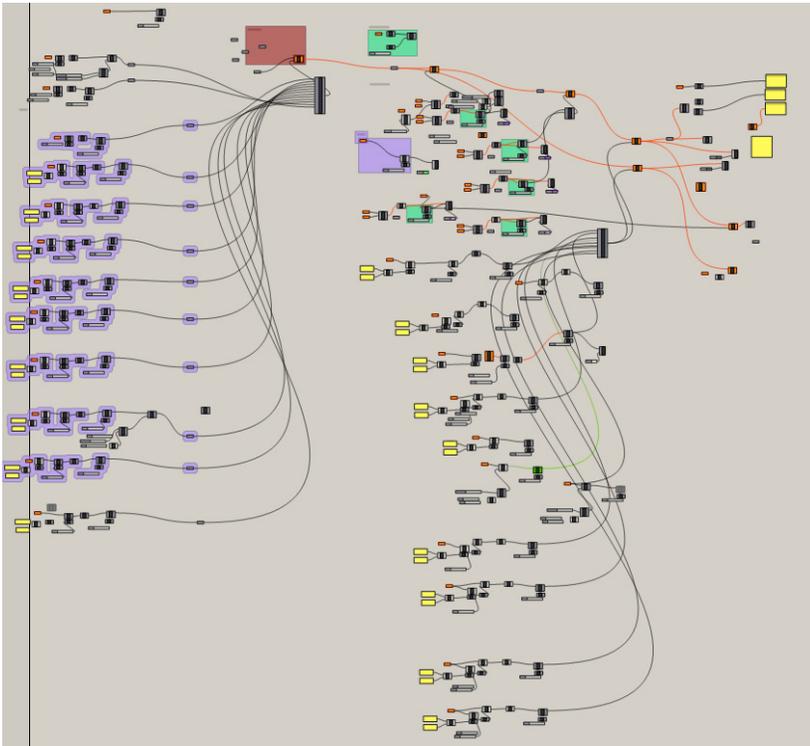




Modeling a Mountain

DTJ deliverables to BIM team for mountain design evolution:

- Locate major elements and components
- Conflict resolution / clash detection of rides with aquatic vault and other BOH programmatic elements (1M clear between ride & vault)
- Paths and points of access, including required rise/run and queues

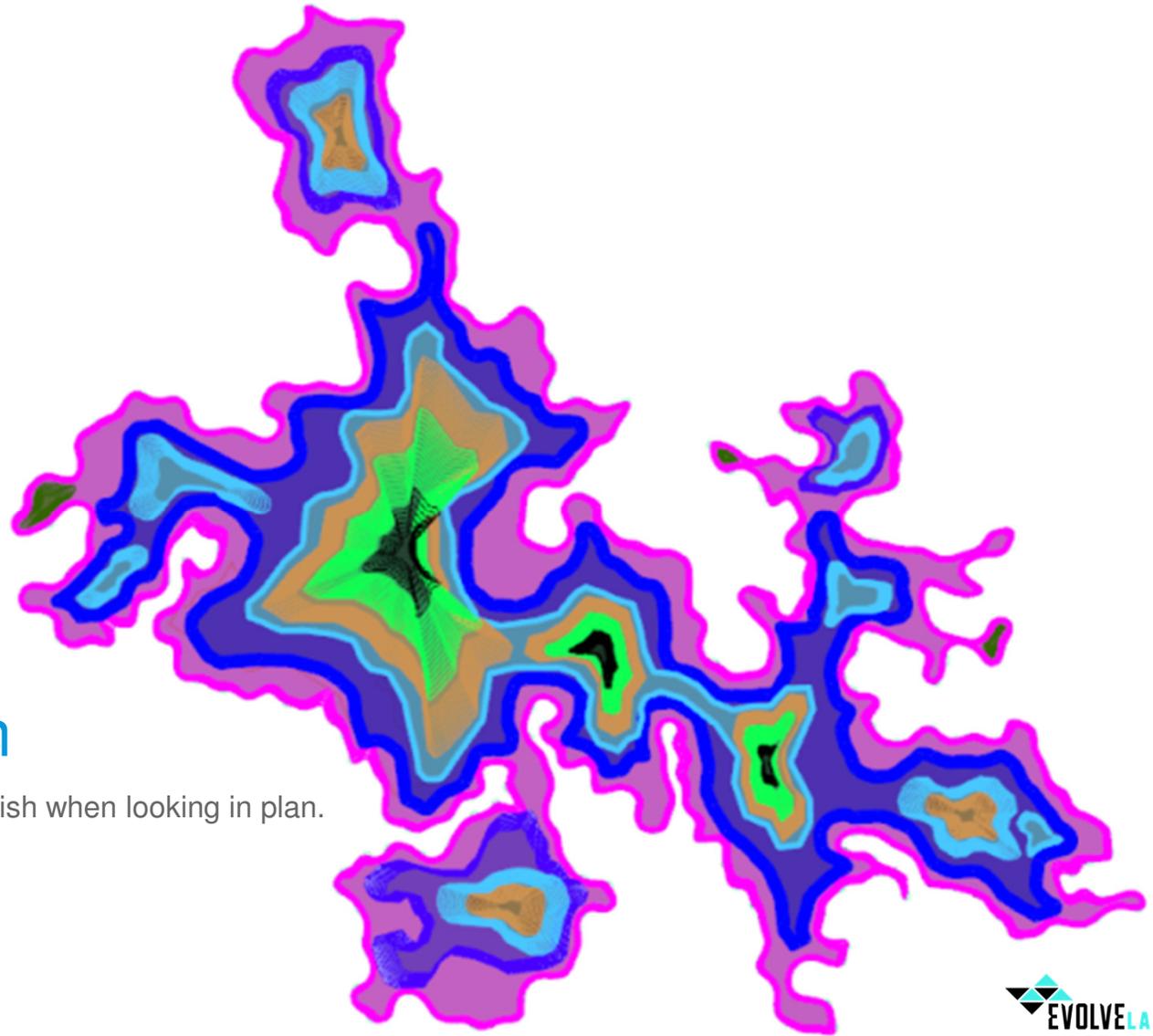


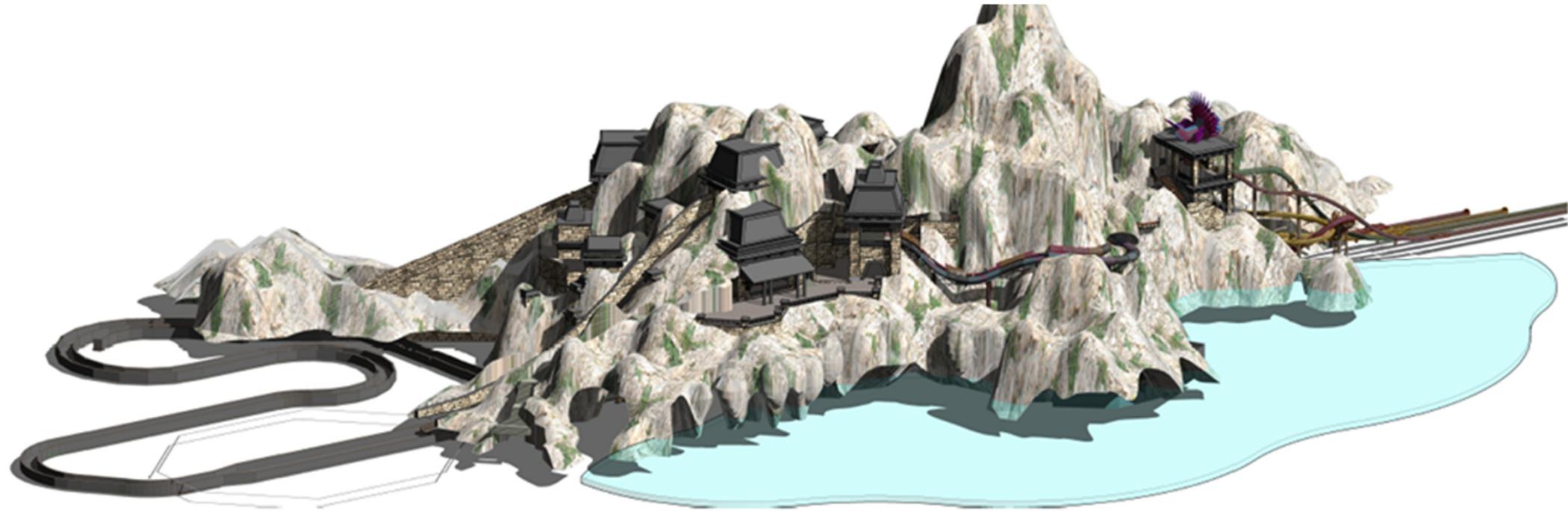
Modeling a Mountain

We used different colors to represent different tiers of elevation and contours we were referencing. It was a great way to graphically see different elevations. It also looked like a Gnarly bacteria in petri dish when looking in plan.

Modeling a Mountain

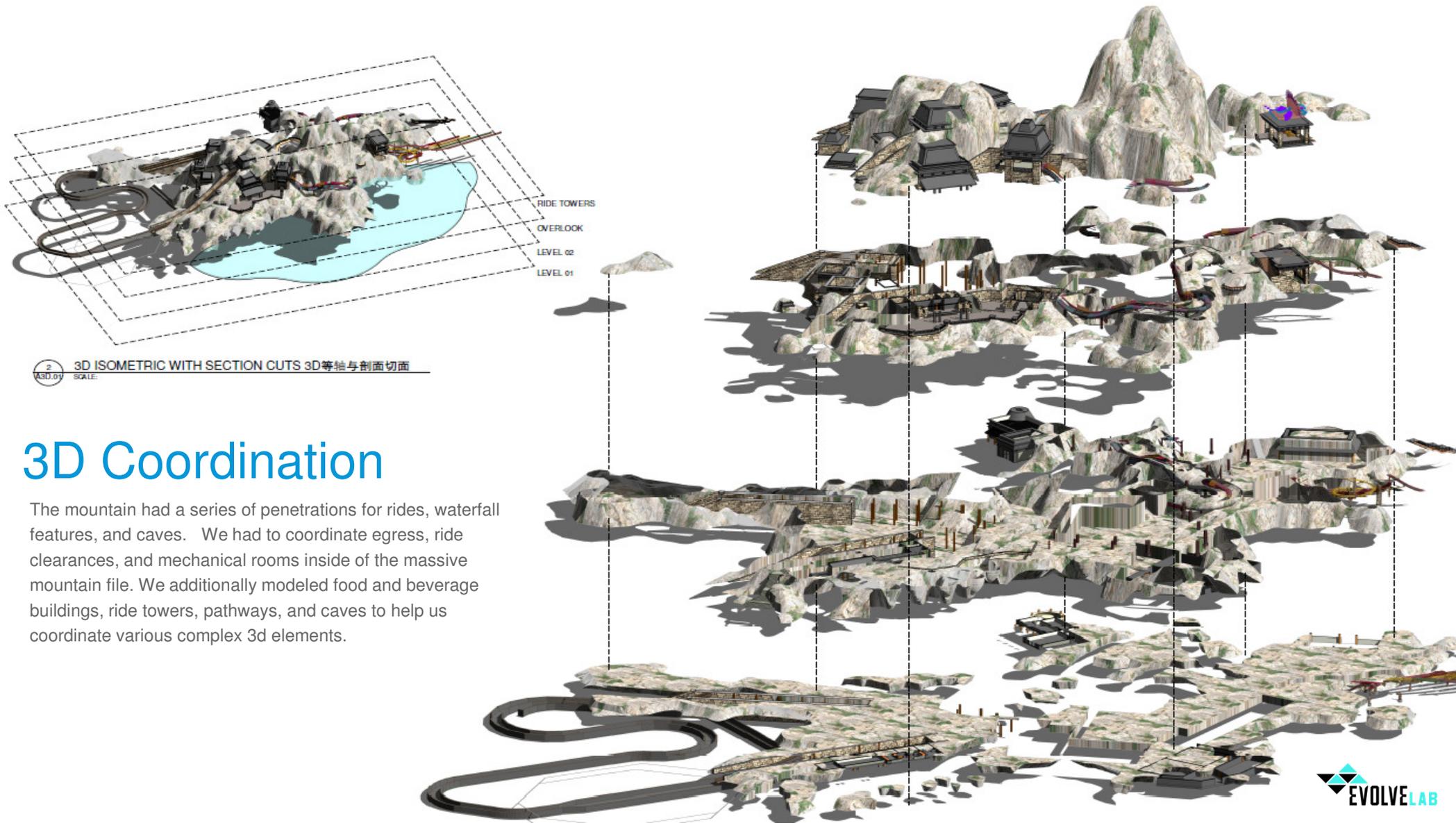
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Applied Bitmap Material To Surface

We applied a bitmap material to the 3D mountain to illustrate moss, rocks, etc. to help add another detail of realism to the mountain.



2 3D ISOMETRIC WITH SECTION CUTS 3D等轴与剖面切面
ASU.DV SCALE

3D Coordination

The mountain had a series of penetrations for rides, waterfall features, and caves. We had to coordinate egress, ride clearances, and mechanical rooms inside of the massive mountain file. We additionally modeled food and beverage buildings, ride towers, pathways, and caves to help us coordinate various complex 3d elements.

Conclusion...



Lessons Learned

- Find ways to model elements “light weight” and keep the files lean
- Document buildings in their respective files/zones. Not in the site file. Caveat would be elements that need to exist in a master file such as programmatic information or an overall site plan.
- Use multiple software platforms synergistically to remove complex vertices
- Leverage the right tool for the right job to accomplish specific tasks, such as parametric model, 3D coordination, and BIM Documentation

Questions?





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