from DREAM to REALITY

ENCHANTED STORYBOOK CASTLE

AIA TAP BIM AWARDS 2014

Ver. 2014-04-01

1 PROJECT OVERVIEW

2 INITIAL CHALLENGES

3 BIM IMPLEMENTATION STRATEGY

4 BIM ADVANTAGES

5 CONSTRUCTION & RENDERINGS

ENTRY CATEGORY
Category B - Delivery Process Innovation

PROJECT NAME
Enchanted Storybook Castle

PROJECT TYPE
New Construction

PROJECT LOCATION
Pudong New District, Shanghai, China

OVERALL HEIGHT
60 meters (196.8 feet)

NUMBER OF FOUNDATION PILES
1,076

NUMBER OF DESIGN DISCIPLINES
142

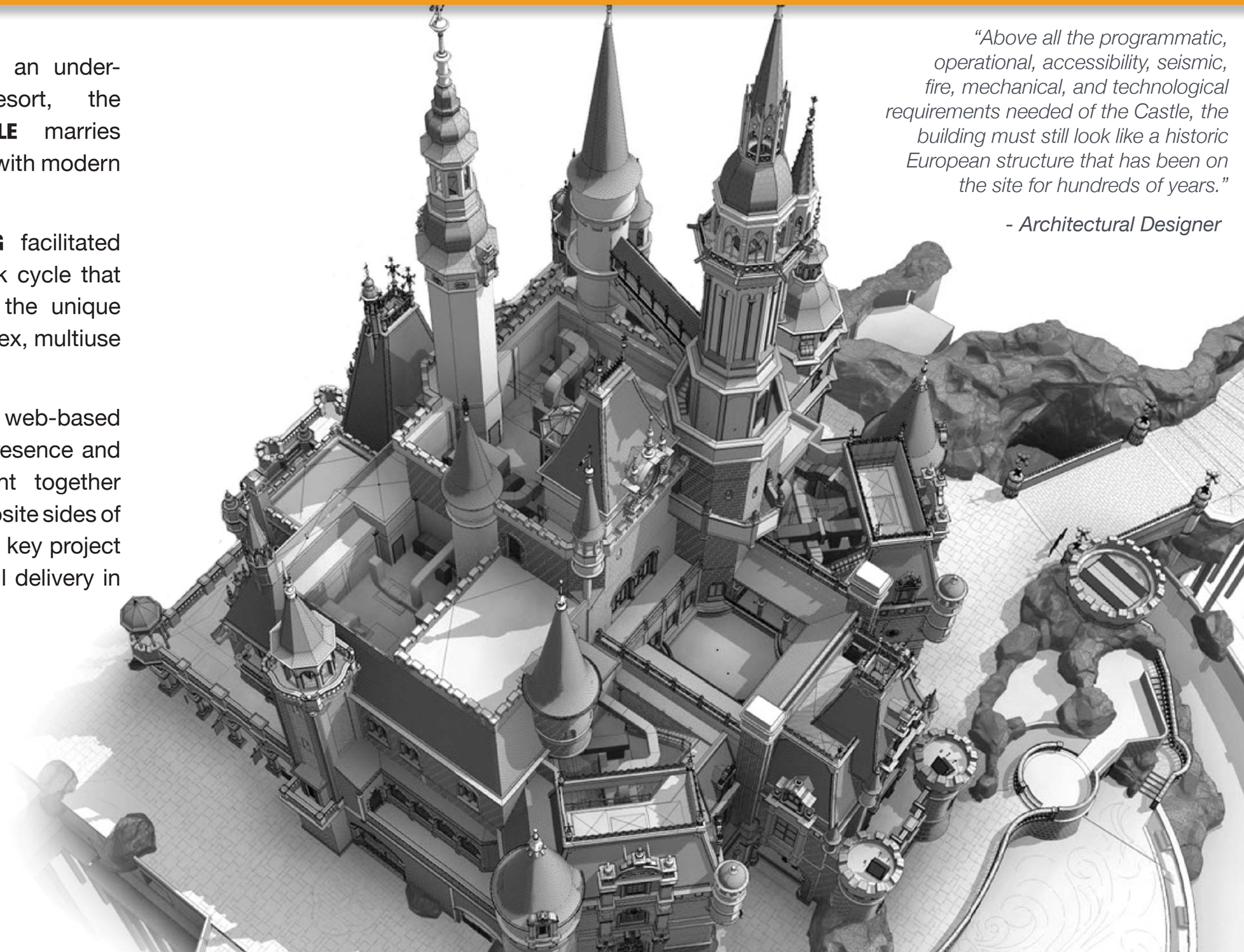
GROUNDBREAKING DATE
April 8, 2011

TARGETED OPENING
Late 2015

Serving as the centerpiece for an under-construction international resort, the **ENCHANTED STORYBOOK CASTLE** marries traditional architectural detailing with modern building technology.

BUILDING INFORMATION MODELING facilitated a real time testing and feedback cycle that helped the project team meet the unique challenges in realizing this complex, multiuse facility.

BIM enabled collaboration using web-based social collaboration, video-telepresence and cloud-based computing brought together dozens of team members on opposite sides of the globe allowing them to reach key project milestones ensuring a successful delivery in **LATE 2015**.



"Above all the programmatic, operational, accessibility, seismic, fire, mechanical, and technological requirements needed of the Castle, the building must still look like a historic European structure that has been on the site for hundreds of years."

- Architectural Designer

RESTAURANT

Fully Functioning Kitchens

Fountain Pumps for Water Show

LARGE OUTDOOR STAGE SHOW

Retractable Theatrical Light Towers

Green Rooms

BOAT RIDE SYSTEM

Fireworks Launchpads

CENTRAL DOUBLE HELICAL GRAND STAIRCASE

Boat Ride Maintenance Facility

Operations Offices

INTERACTIVE WALK-THROUGH ATTRACTION

CHILDREN'S SALON

Photo Studio

Retail Cash Rooms

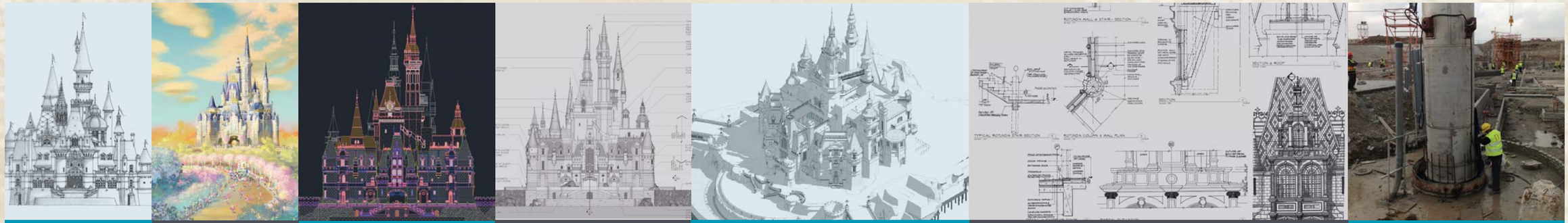
Roof Top Garden

Retail Store

CHARACTER MEET & GREET

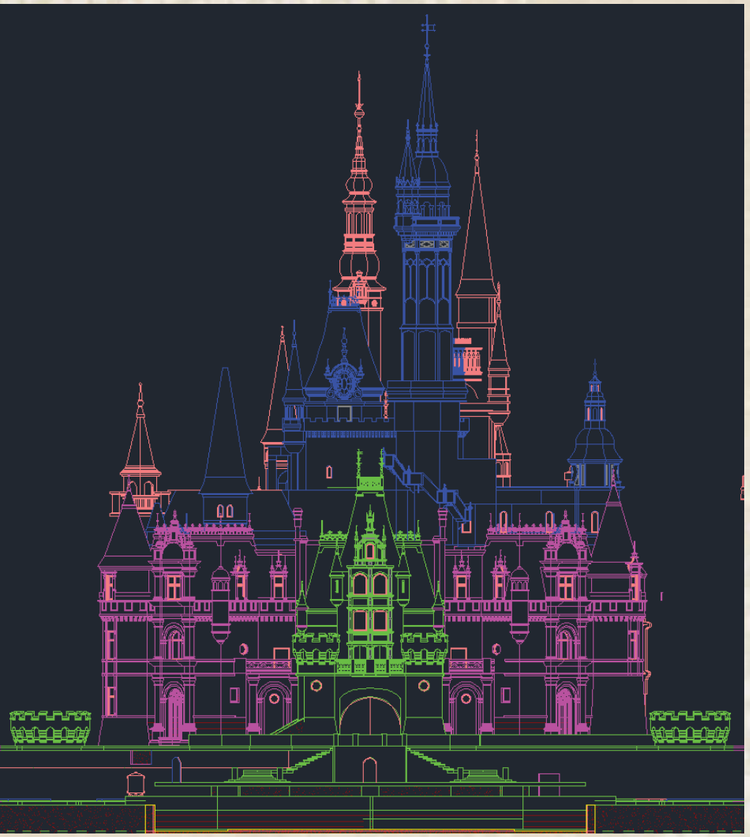
ONE COMPLEX MODERN FACILITY
WITH HISTORIC ARCHITECTURAL DETAILING

Initially, the facility was fully modeled in 3D AutoCAD. The team ran into several limitations with the software, so the project was quickly transitioned to and rebuilt as a full BIM model in Revit.

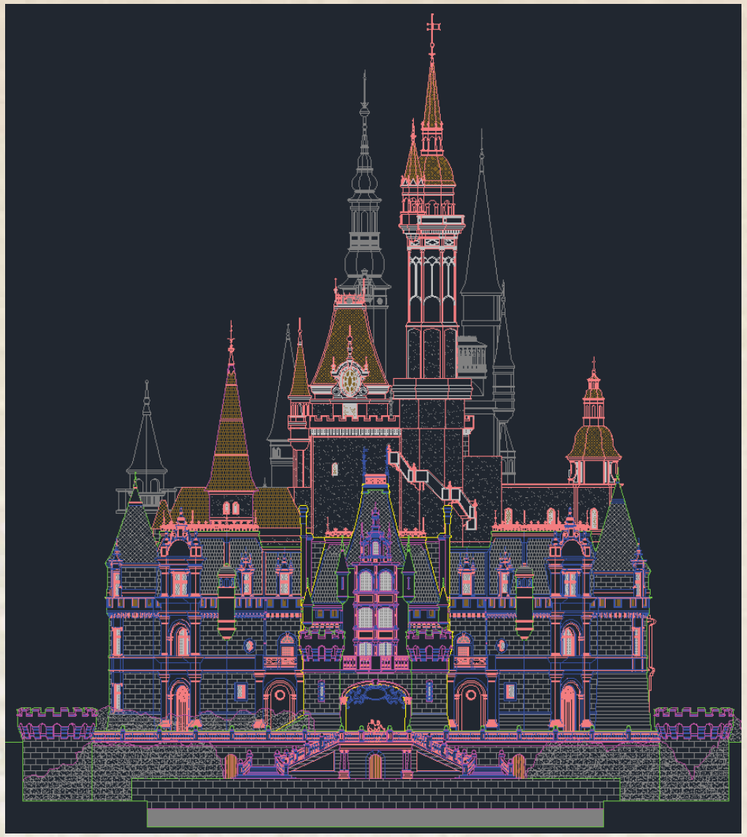


Early in the process, it was evident that a BIM software tool, Revit, had more advantages than the Autocad Architecture software.

2D CAD CHALLENGES: INEFFICIENT WORKFLOW

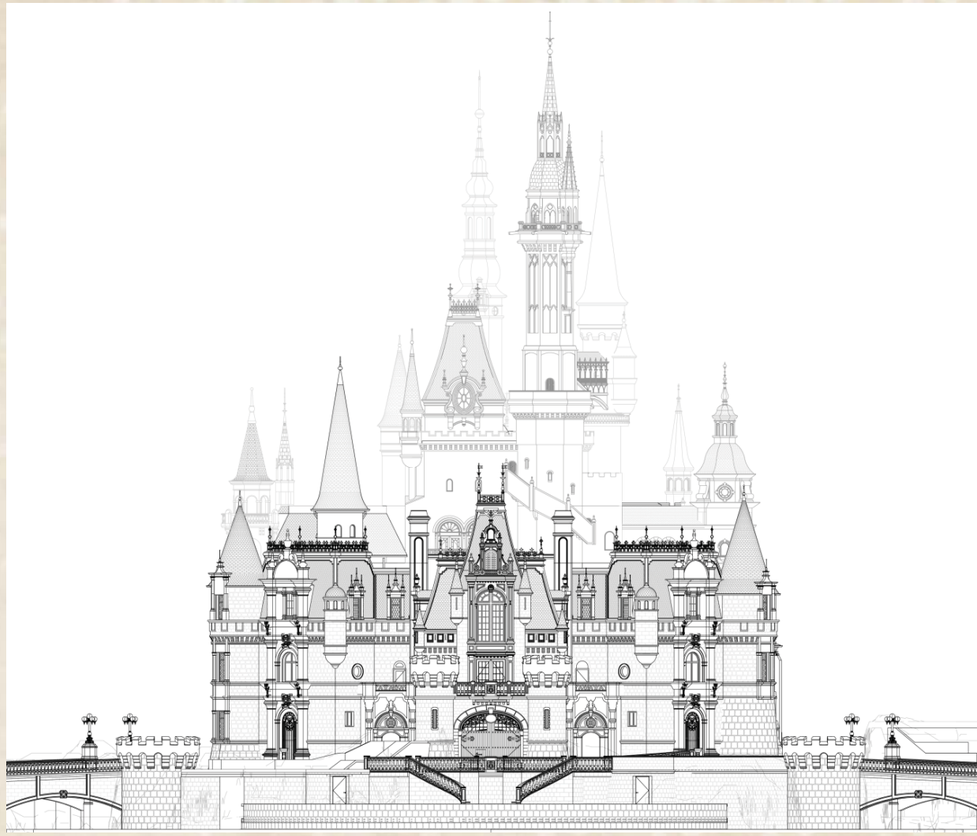


Frozen AutoCAD Architecture Model
Front Elevation



Final AutoCAD Front Elevation with
20 hours of cleanup and manual linework

VERSUS



Automatic 2D Drawing Generation from BIM Model
30 minutes of cleanup

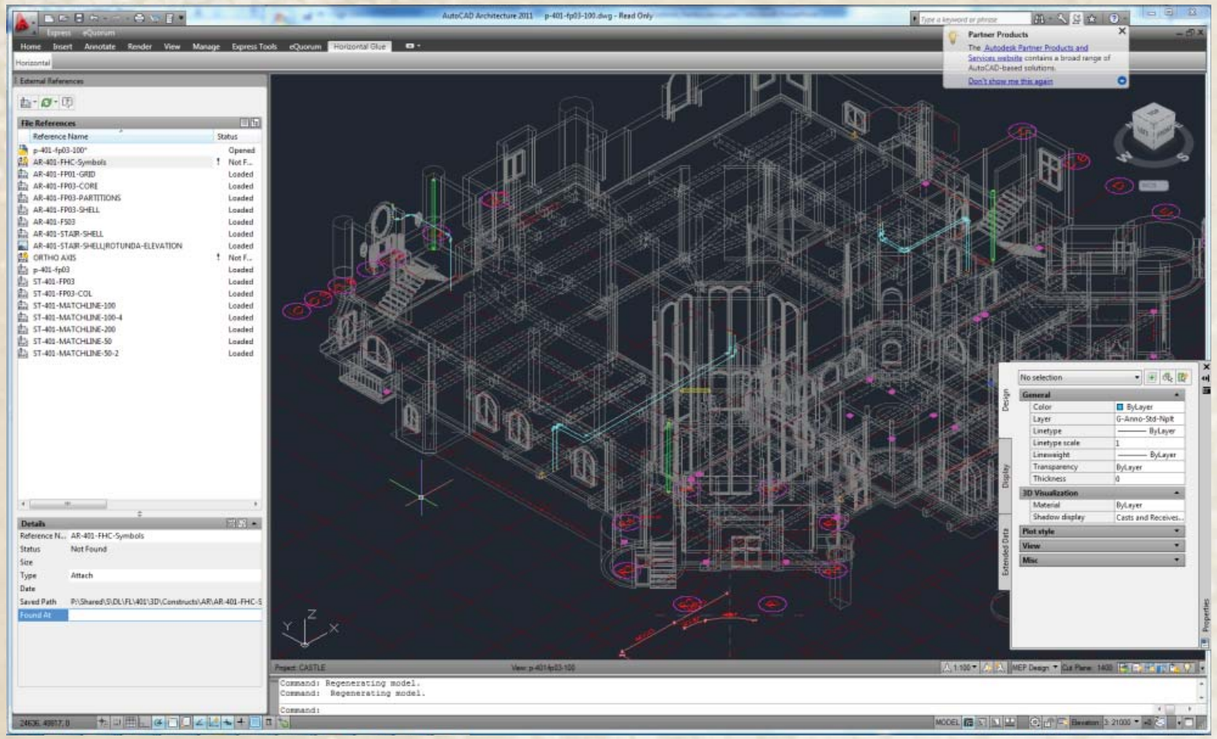
20 HOURS/ELEVATION X 4 = 80 HOURS/RELEASE

20 MINS/ELEVATION X 4 = 2 HOURS/RELEASE

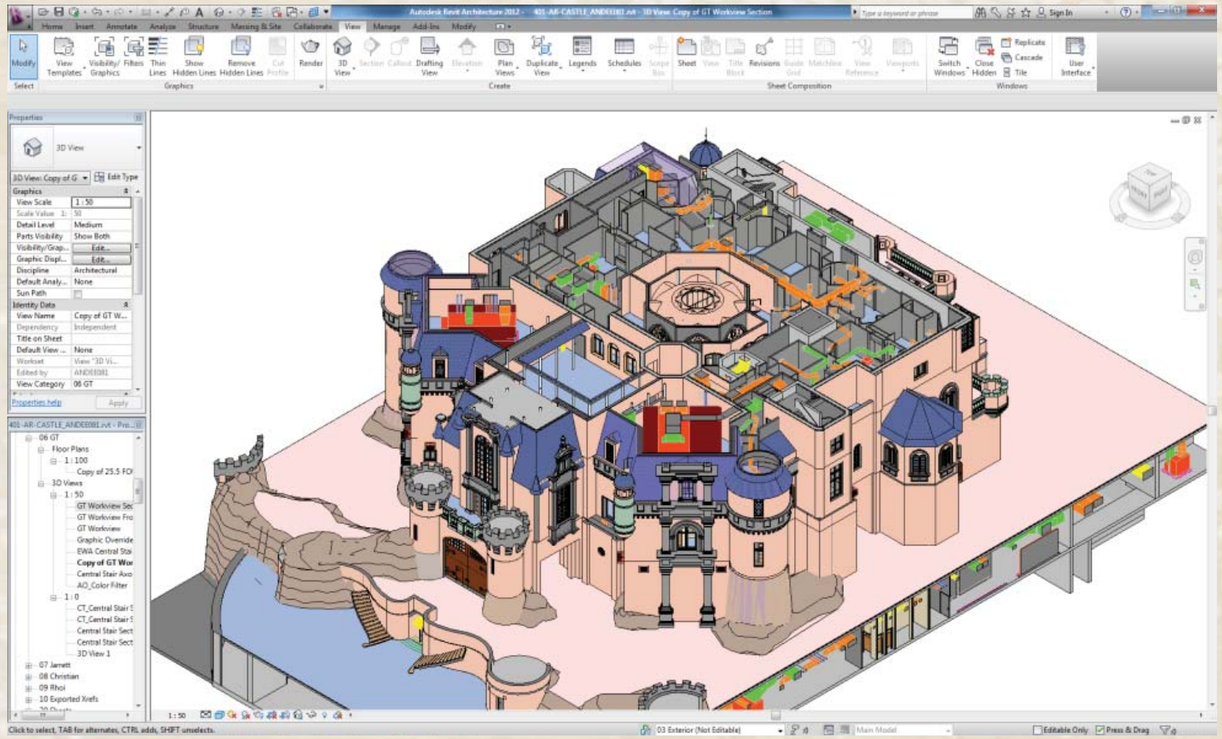
Without a software package that was truly BIM, the Architecture team spent hundreds of hours duplicating effort in order to produce acceptable drawing packages. By switching to a BIM solution, many time consuming steps could be omitted from the traditional clean-up process. Instead of manually adjusting each 2D drawing, the drawings exported from the BIM model .

2D CAD CHALLENGES: INEFFICIENT DATA SHARING

Sharing data from AutoCAD proved to be a time consuming process. Without a BIM model, it was difficult to create accurate, realistic, and quick visualization studies to share between all discplines, gather quantity-take off information for our project estimators, and track and coordinate architectural ornamentation with our outside vendors.

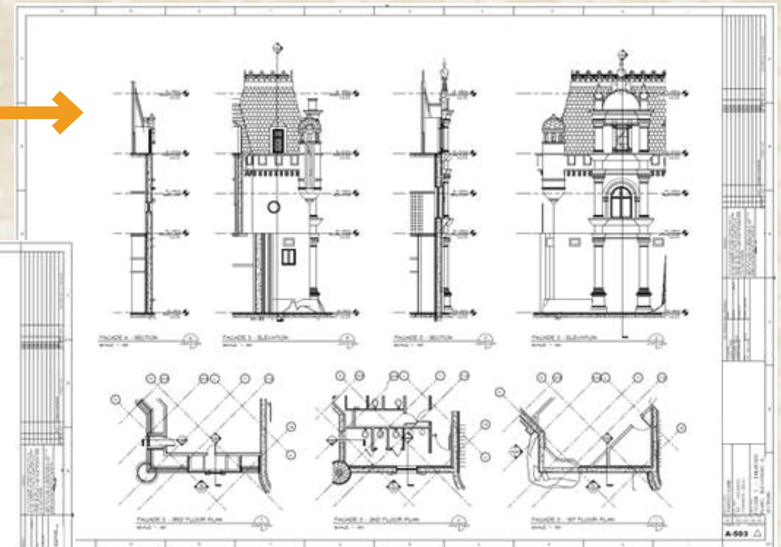


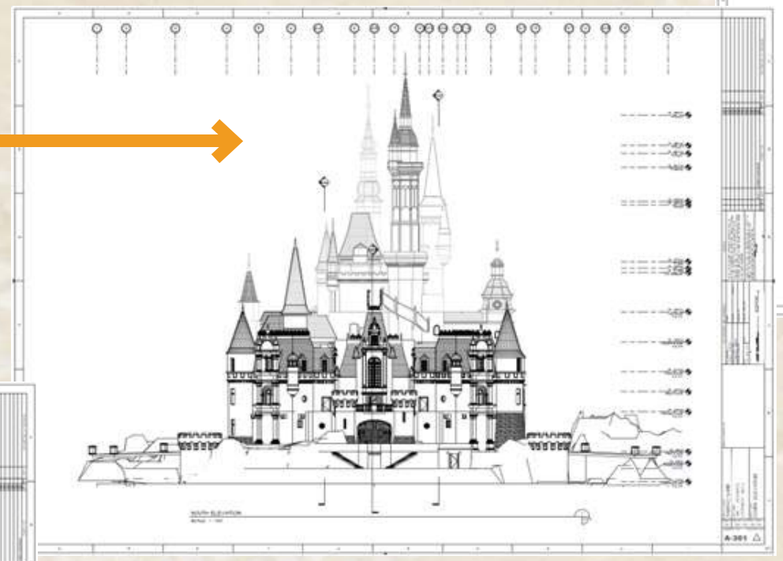
AutoCAD Architecture Wireframe
Lacks necessary information

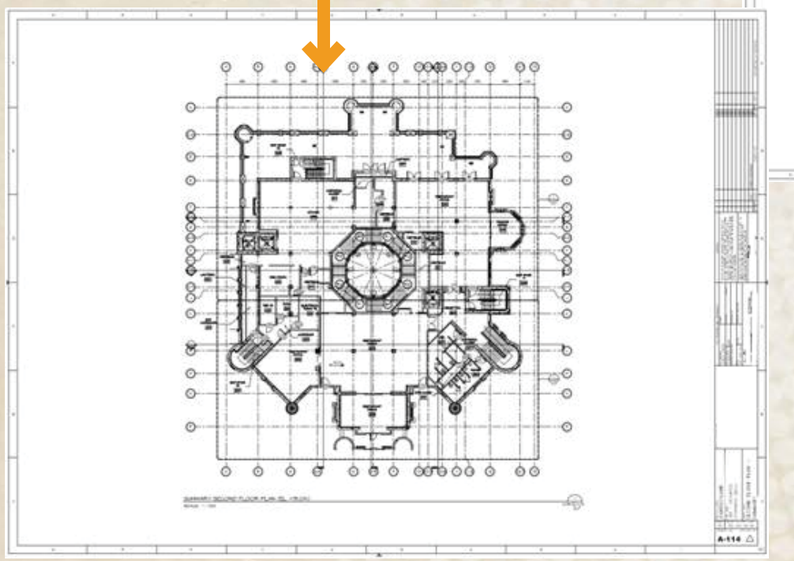


Revit Architecture Shaded View
More realistic view, includes all information

2D CAD CHALLENGES: DRAWING TRACKING



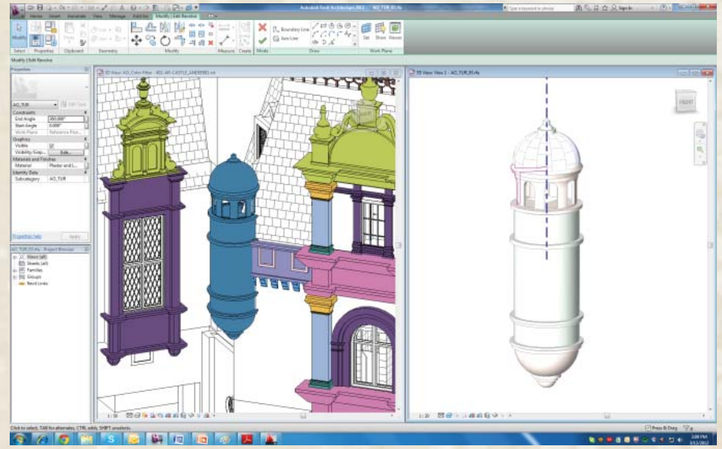


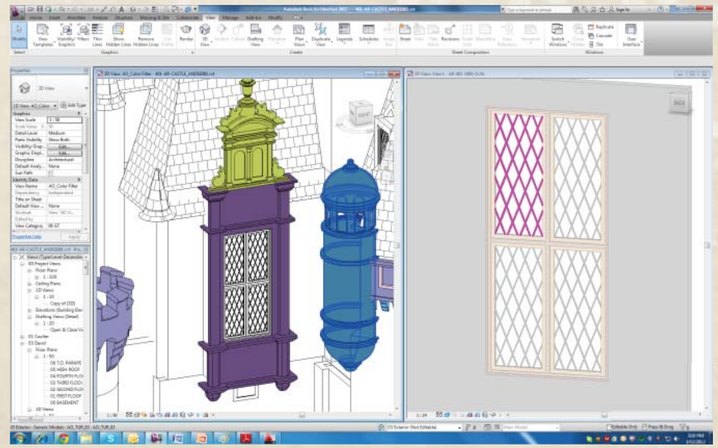


"Without a BIM model, it was difficult to rapidly set up and coordinate hundreds of sheets of construction documents and their constituent parts. The time saved with BIM allowed a more detailed investigation and evaluation of complex decorative architectural elements to occur without impacting project schedule."

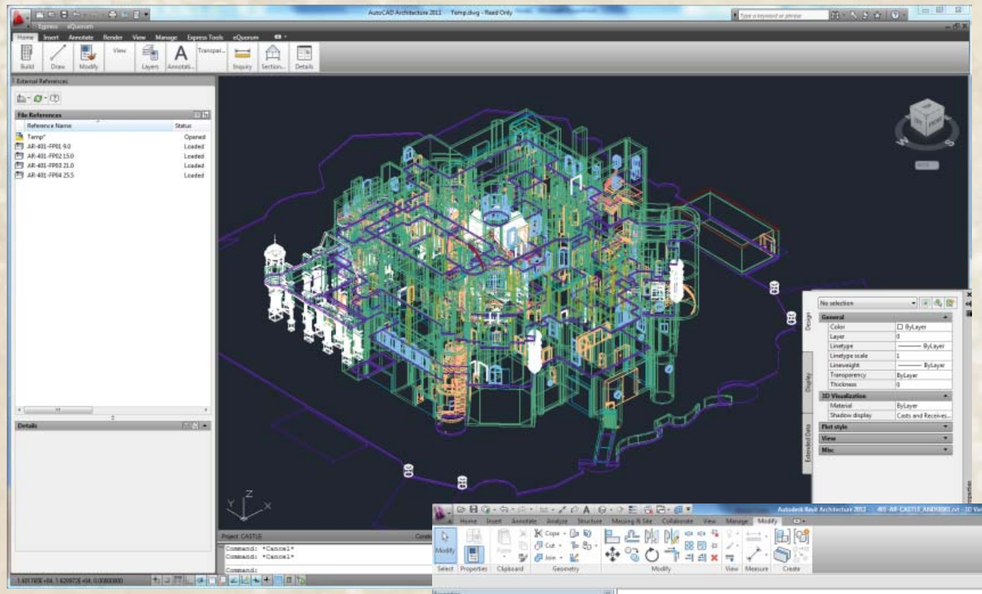
-Concept Architect

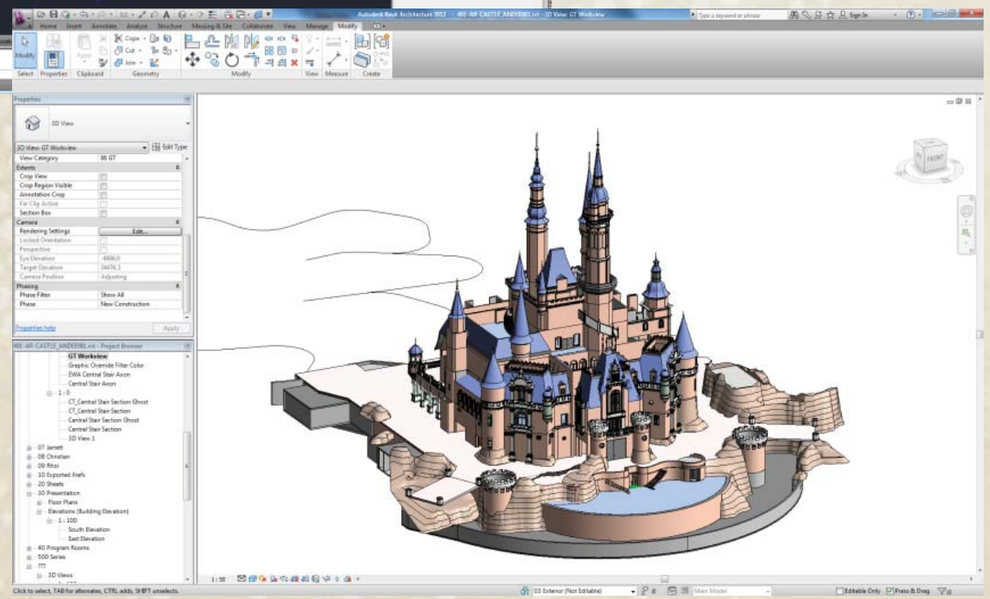
At the onset of the project, team members had varying degrees of skill using Revit. In response, a BIM Coordinator was hired to ease the transition. During Design Development, software learning sessions were provided twice a week, allowing the team to get project-specific training. It gave team members immediate opportunities for questions and answers.





Although the architectural team made the conversion to Revit, the Structural and MEP disciplines continued to use Auto-CAD. In order to facilitate data exchange between the disciplines, an in-house workflow was developed. Custom scripts allowed our Revit and AutoCAD files to easily and automatically provide a daily output of architectural Revit information for other disciplines.





Scripts.txt - Notepad

File Edit Format View Help

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AR_00RevitToConstructs.bat

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call "P:\Shared\S\DL\FL\401\3D\Revit\Revit_Export\Scripts\AR_CreateConstructs.bat"
call "P:\Shared\S\DL\FL\401\3D\Revit\Revit_Export\Scripts\AR_RenameConstructs.bat"

AR_ExportIFC.bat
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"C:\Program Files\Autodesk\Revit Architecture 2012\Program\Revit.exe" "P:\Shared\S\DL\FL\401\3D\Re
del "P:\Shared\S\DL\FL\401\3D\Revit\Revit_Export\Scripts\journal.0001.txt"

AR_ExportIFC.txt
Dim Jrn
Set Jrn = CrsJournalScript
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        , "$AllUsersAppData\Templates\US Metric\DefaultMetric.rte"
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Jrn.Directive "Version"  _
        , "2012.000", "2.122"
'H 09-Apr-2012 08:50:40.348;   0:<
Jrn.Directive "Username"  _
        , "ANDEE081"
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 Jrn.AppButtonEvent 0 , "Application Menu is closing"
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        , "IDOK", "P:\Shared\S\DL\FL\401\3D\Revit\Central-File\401-AR-CASTLE.rvt"
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        , "Custom", 0
 Jrn.Data "TaskDialogResult"  _
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          "Overwrite existing file", "1001"



AR_CreateConstructs.bat
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AR_CreateConstructs.scr
-AECIFCIMPORT
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NO
P:\Shared\S\DL\FL\401\3D\Revit\Revit_Export\401-AR-CASTLE.dwg
IMPORT

_QUIT
Y
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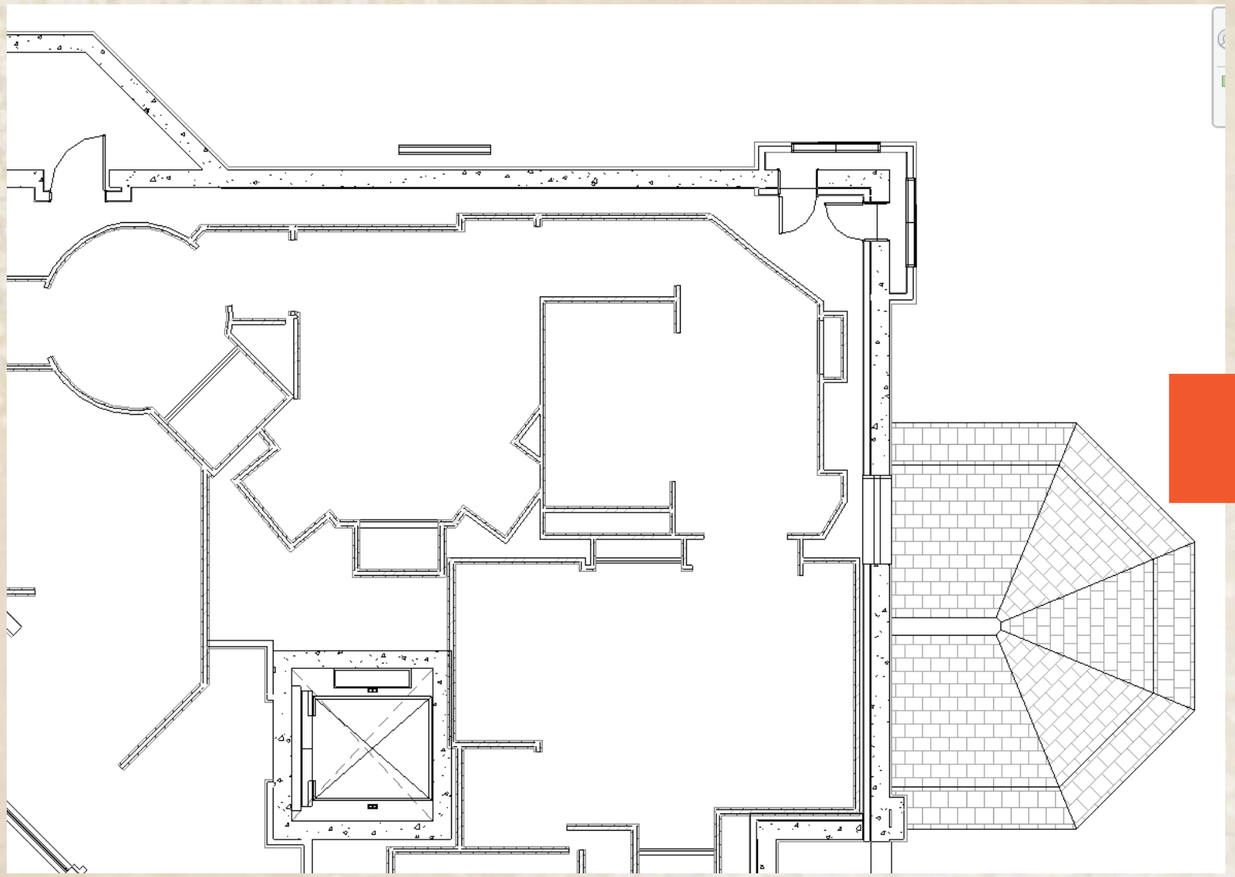
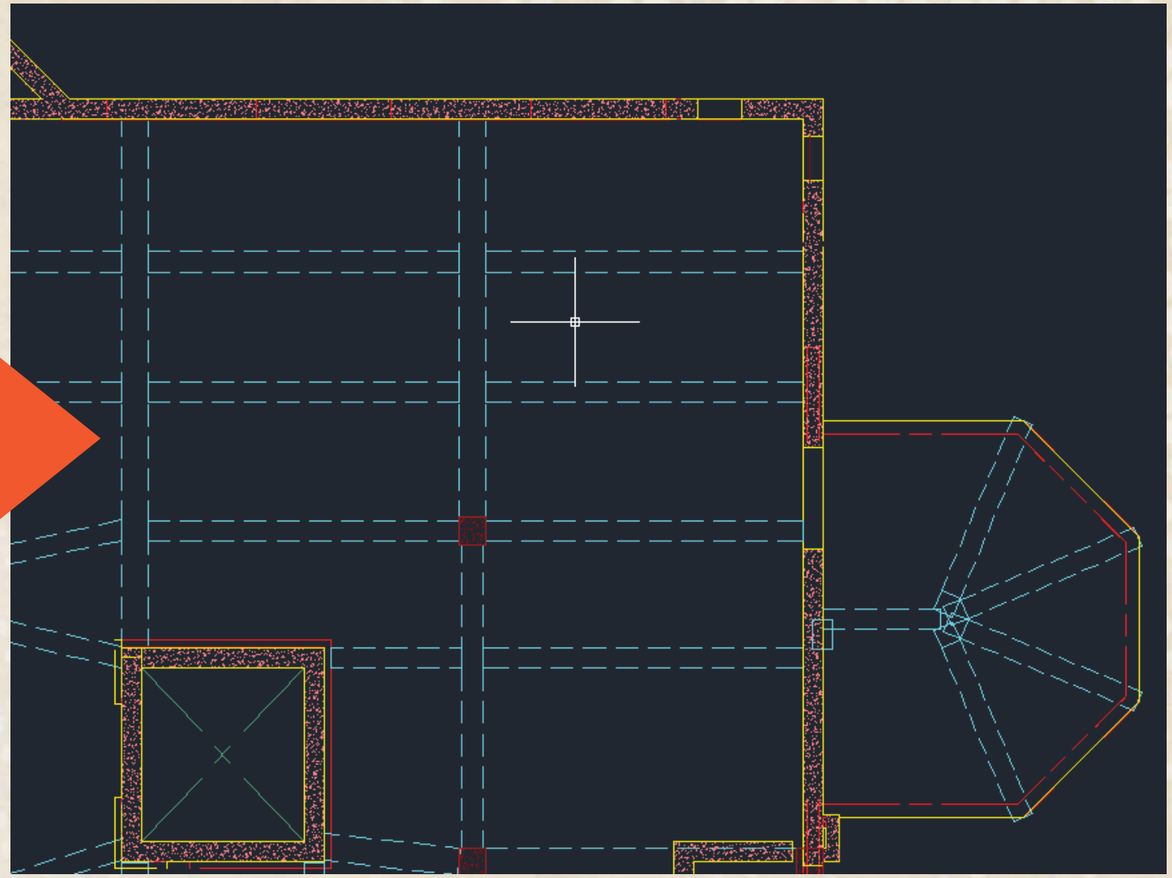


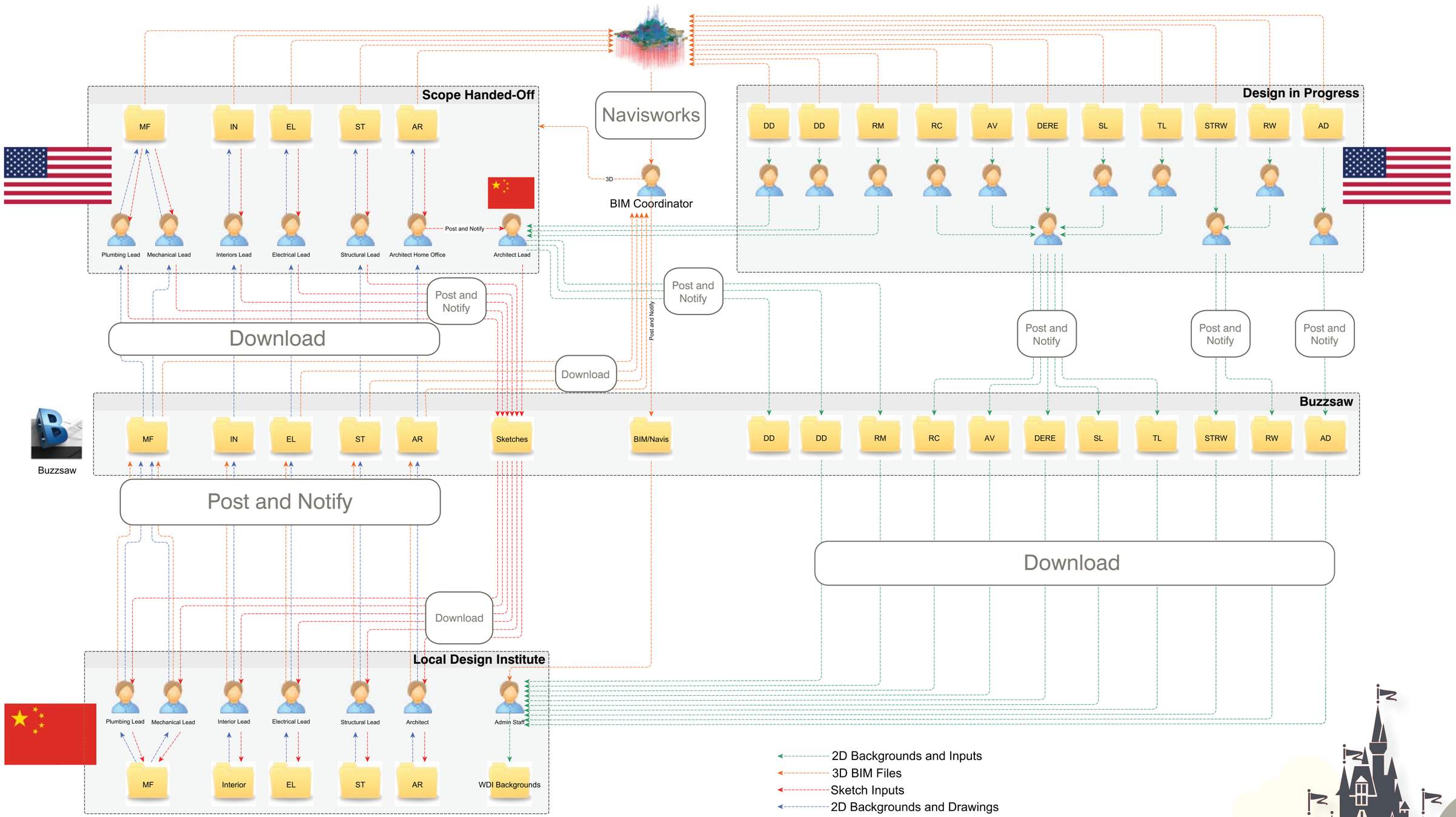
2D Revit Export Drawings



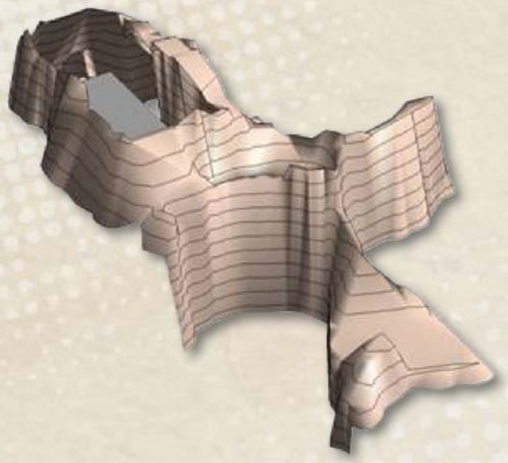
Structure Backgrounds without extra clean-up.

Previously when using AutoCAD Architecture, 2-3 days of cleanup were needed each time Architecture provided Structures with an xref. Our custom scripts allowed Revit to export automatic, cleaned-up xrefs, allowing for concurrent design rather than a 2-3 day latency in design.

142 disciplines - each with its own team - worked on opposite sides of the globe to design the project. Because of issues with internet connectivity in China, Buzzsaw was used to transfer updates to the BIM model back and forth between the U.S. and China.

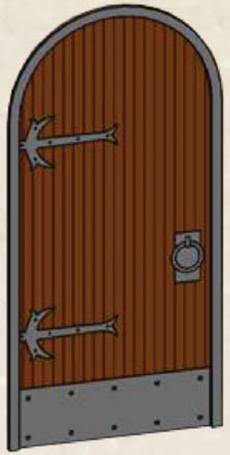

Scope Handed-Off
MF
IN
EL
ST
AR
Plumbing Lead
Mechanical Lead
Interiors Lead
Electrical Lead
Structural Lead
Architect Home Office
Post and Notify
Architect Lead
Navisworks
3D
BIM Coordinator
Design in Progress
DD
DD
RM
RC
AV
DERE
SL
TL
STRW
RW
AD
Post and Notify
Post and Notify
Download
Post and Notify
Post and Notify
Post and Notify
Download
Buzzsaw
MF
IN
EL
ST
AR
Sketches
BIM/Navis
DD
DD
RM
RC
AV
DERE
SL
TL
STRW
RW
AD
Buzzsaw
Post and Notify
Download
Download
Local Design Institute
Plumbing Lead
Mechanical Lead
Interior Lead
Electrical Lead
Structural Lead
Architect
Admin Staff
MF
Interior
EL
ST
AR
WDI Backgrounds
2D Backgrounds and Inputs
3D BIM Files
Sketch Inputs
2D Backgrounds and Drawings

Now that our model was properly set up, a BIM "surge team" assisted in creating intelligent, parametric content within the Revit Model

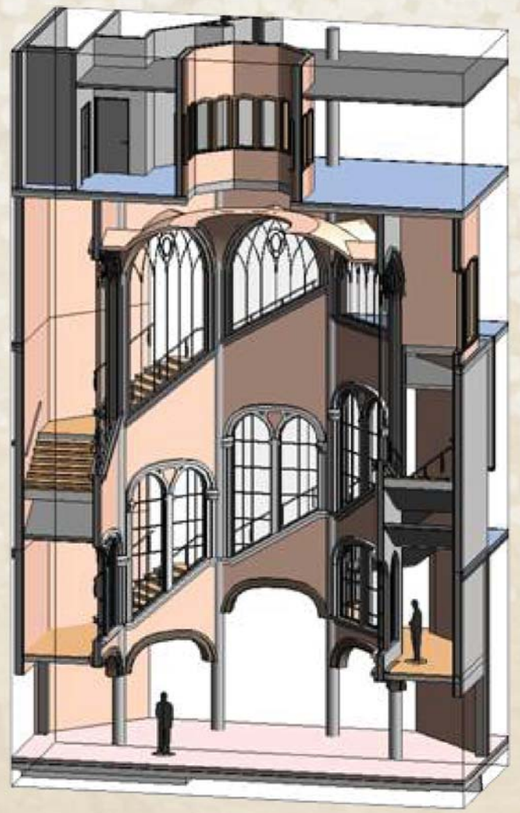


Terrain (Rockwork Sketch)

Architectural Ornamentation

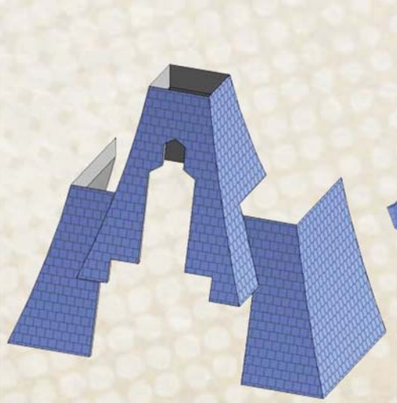


Doors



Central Stair

Windows



Complex Roof Shapes

A strategy to catalog the kit of part to generate the AO was establishment in order to facilitate an improved quantity extraction and construction management.

Concept design drawings to BIM model

Shanghai Castle Architectural Ornamentation Codes

Color	Code	Name	Description
	AO_CAP	Capital	Head of a pillar or column
	AO_CAR	Character	Character Busts or Sculpture
	AO_CBL	Corbel	A projection to support a structure above it.
	AO_COL	Column	Does not include capital or plinth/base
	AO_CRS	Cresting	Ornamental sculpture pattern elements on top of a roof
	AO_ENT	Entablature	Horizontal continuous lintel above columns
	AO_FIN	Finial	Ornament at the apex of a roof or similar structure
	AO_FRZ	Frieze	Broad horizontal band of sculpted decoration
	AO_PED	Pediment	Triangular element surmounting a portico of columns
	AO_PLI	Plinth	Base of column or other element
	AO_SPN	Spandrel	Zone above an arched window
	AO_TRM	Trim	Linear decorative elements typically along the edge
	AO_TUR	Turret	Small tower attached to a larger building element
	AO_DOM	Dome	A rounded vault forming a roof or ceiling
	AO_WTR	Window Trim	Trim elements surrounding windows

AO_Schedule	
Type	Count
AO-COL-03	1
AO-COL-03	1
AO_CAP_01	8
AO_CAP_01_B	4
AO_CAP_03	2
AO_CAP_04	2
AO_CAP_05	2
AO_CAP_Arcade_01	4
AO_CAP_Arcade_03	5
AO_CAP_Arcade_06	2
AO_CBL_001	43
AO_CBL_001_Line	39
AO_CBL_03	4
AO_CBL_04	8
AO_CBL_05_Line	2
AO_CBL_07	8
AO_CBL_08	8
AO_CBL_North Entry Chamfer	1
AO_CBL_T6 Base	1
AO_CBL_T6_Turret Base	1
AO_CHM_Chimney Cap_01	1
AO_CHM_Chimney Cap_02	2
AO_CHM_Chimney Stack_01	2
AO_CHM_Chimney Stack_02	2
AO_CHR_01	4
AO_CHR_02	4
AO_CHR_03	4
AO_COL_01_A	4
AO_COL_01_B	4
AO_COL_01_C	4
AO_COL_03	2
AO_COL_04_A	2
AO_COL_04_B	1
AO_COL_05	2
AO_COL_6	2
AO_COL_7	2
AO_COL_Arcade_01	4
AO_COL_Arcade_04	5
AO_COL_Arcade_06	2
AO_COL_Cloist1	18
AO_COL_Cloist2	6
AO_COL_Cloist3	2
AO_COL_Cloist4	2
AO_COL_Cloist5	4
AO_COL_CS_02	1
AO_COL_CS_03	1
AO_COL_CS_04	1
AO_COL_CS_05	1
AO_COL_CS_06	1
AO_COL_CS_07	1
AO_COL_V	6
AO_CRS_001	12
AO_CRS_002	2
AO_CRS_003	2
AO_CRS_004	1
AO_CRS_005	2
AO_CRS_006	1
AO_CRS_007	1

AO_Schedule	
Type	Count
AO_DEC_01	2
AO_DEC_02	8
AO_DOM_03	1
AO_DTR_08	2
AO_DTR_A	1
AO_DTR_DoorMTrim	1
AO_DTR_H	1
AO_DTR_M	3
AO_DTR_T2_01	8
AO_ENT_01_A	2
AO_ENT_01_A	1
AO_ENT_01_B	2
AO_ENT_BRG_18-Baluster Pendant	1
AO_FIN	4
AO_FIN_407	2
AO_FIN_505	1
AO_FIN_506	1
AO_FIN_507	1
AO_FIN_510	1
AO_FIN_511	1
AO_FIN_513	1
AO_FIN_514	1
AO_FIN_516	2
AO_FIN_BRG_01	12
AO_FIN_T1-01	1
AO_FIN_T6_02	1
AO_FIN_T7_02	8
AO_FIN_T8_01	1
AO_FIN_T9_01	1
AO_FIN_T9_02	1
AO_FIN_TJ_01	1
AO_FRZ_01	16
AO_FRZ_01_Line	8
AO_FRZ_02	1
AO_FRZ_03	1
AO_FRZ_BRG_11	10
AO_PED_01	2
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AO_PED_I	1
AO_PED_I2	2
AO_PED_I3	1
AO_PED_I4	1
AO_PED_O	2
AO_PED_P	2
AO_PED_YY	1
AO_PLI_001	4
AO_PLI_002_A	12
AO_PLI_002_B	2
AO_PLI_003_B	2
AO_PLI_003	1
AO_PLI_004	2
AO_PLI_010-Central Stair	8
AO_PLI_010-Central Stair	36
AO_PLI_011	1
AO_PLI_012	3
AO_PLI_014	1

AO_Schedule	
Type	Count
AO_PLI_015	2
AO_PLI_016	4
AO_PLI_406	4
AO_PLI_doorMrim-left	1
AO_SPN_A	2
AO_SPN_BRG_12	10
AO_SPN_BRG_16	1
AO_SPN_BRG_17	1
AO_TRM - 4516x2040	2
AO_TRM - 4566x2040	2
AO_TRM - 5509x2040	2
AO_TRM - 5518x2040	2
AO_TRM_001_In-Place	1
AO_TRM_3000x1090	4
AO_TRM_3000x1090	3
AO_TRM_3000x1090	1
AO_TRM_3020x1090	1
AO_TRM_3020x1090	1
AO_TRM_3050x1090	15
AO_TRM_3300x1090	2
AO_TRM_3300x1090	1
AO_TRM_3440x1090	2
AO_TRM_3550x1090	1
AO_TRM_3550x1090	1
AO_TRM_3600x1090	1
AO_TRM_3600x1090	1
AO_TRM_4249.7x1090	2
AO_TRM_4375.1x1090	2
AO_TRM_4449.7x1090	2
AO_TRM_4518x2040	3
AO_TRM_4566x2040	3
AO_TRM_4634.9x1090	2
AO_TRM_4677.2x1090	2
AO_TRM_5440x1090	3
AO_TRM_5440x1090	1
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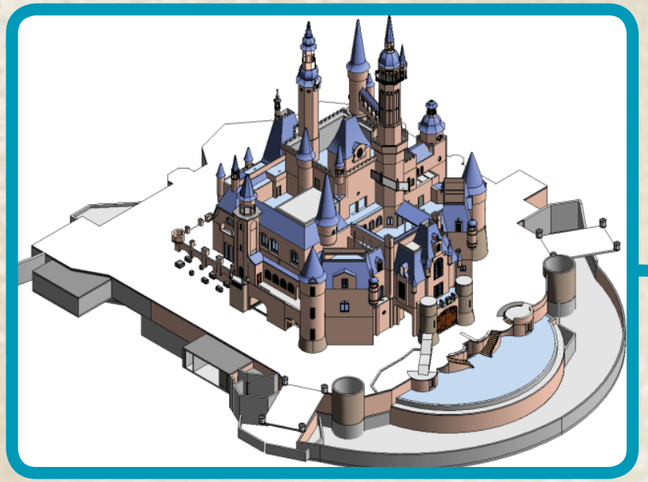
AO_TRM_6236.7x1090	2
AO_TRM_6438x1090	2
AO_TRM_Barrel Vault Arch_02	10
AO_TRM_Barrel Vault Arch_03	16
AO_TRM_Barrel Vault Arch_04	30
AO_TRM_BAT_01	23
AO_TRM_BAT_01_InCorner	2
AO_TRM_BAT_01_OutCorner	2
AO_TRM_Breeze Way_03	5
AO_TRM_Breeze Way_04	12
AO_TRM_Breeze Way_04	12
AO_TRM_Breeze Way_08	8
AO_TRM_BRG - SWEEP 1	1
AO_TRM_C3	6
AO_TRM_CloisterC1	17
AO_TRM_CloisterC2	7
AO_TRM_CloisterF1	11
AO_TRM_Cornice Sweep Under Brackets	1
AO_TRM_Cornice Sweep Under Small Turrets Near Front Window	1

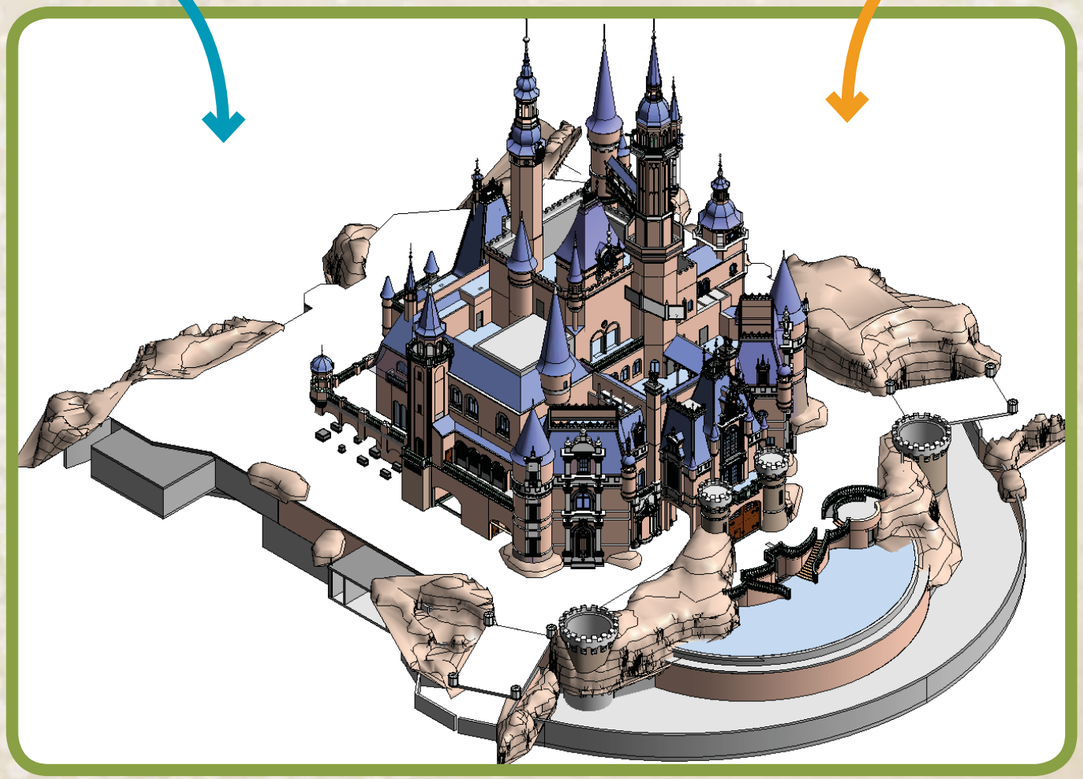
"We used BIM to track and manage items such as the manufactured architectural items and architectural ornamentation for the facility, and coordinated breakpoints for fabrication of the structural Towers with the factory produced glass fiber reinforced concrete components. This aided our Scheduling and Planning team to work out logistic lay down and craning areas to support construction."

-Project Manager

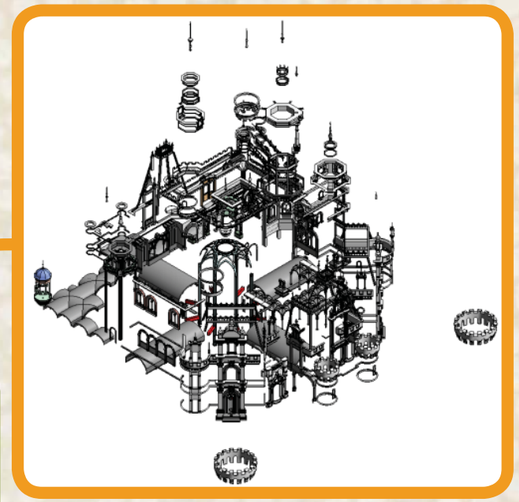
Teams were able to work on different elements of the model. The separate files were then Revit model organized to facilitate work sharing.



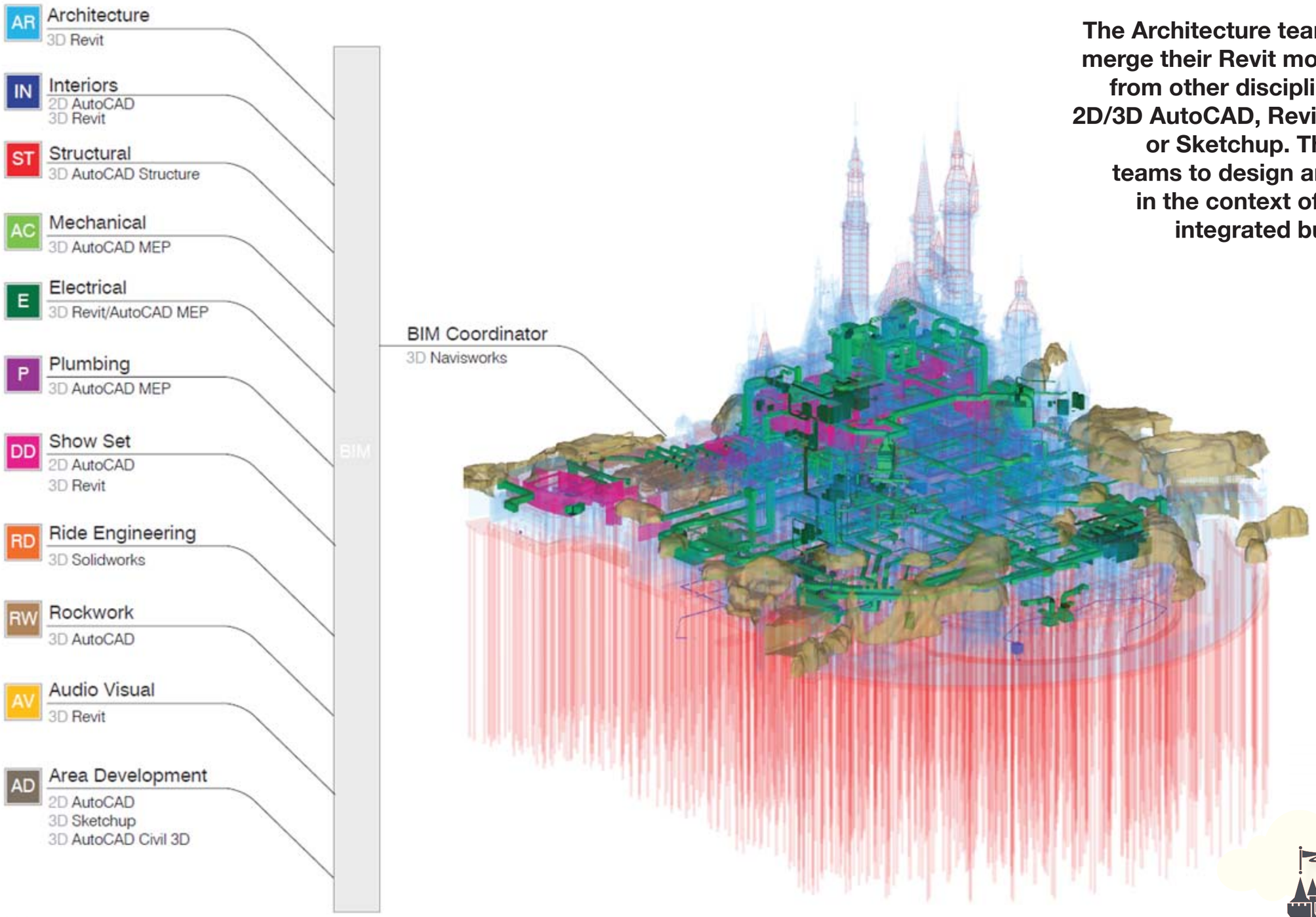
Architecture Core and Shell



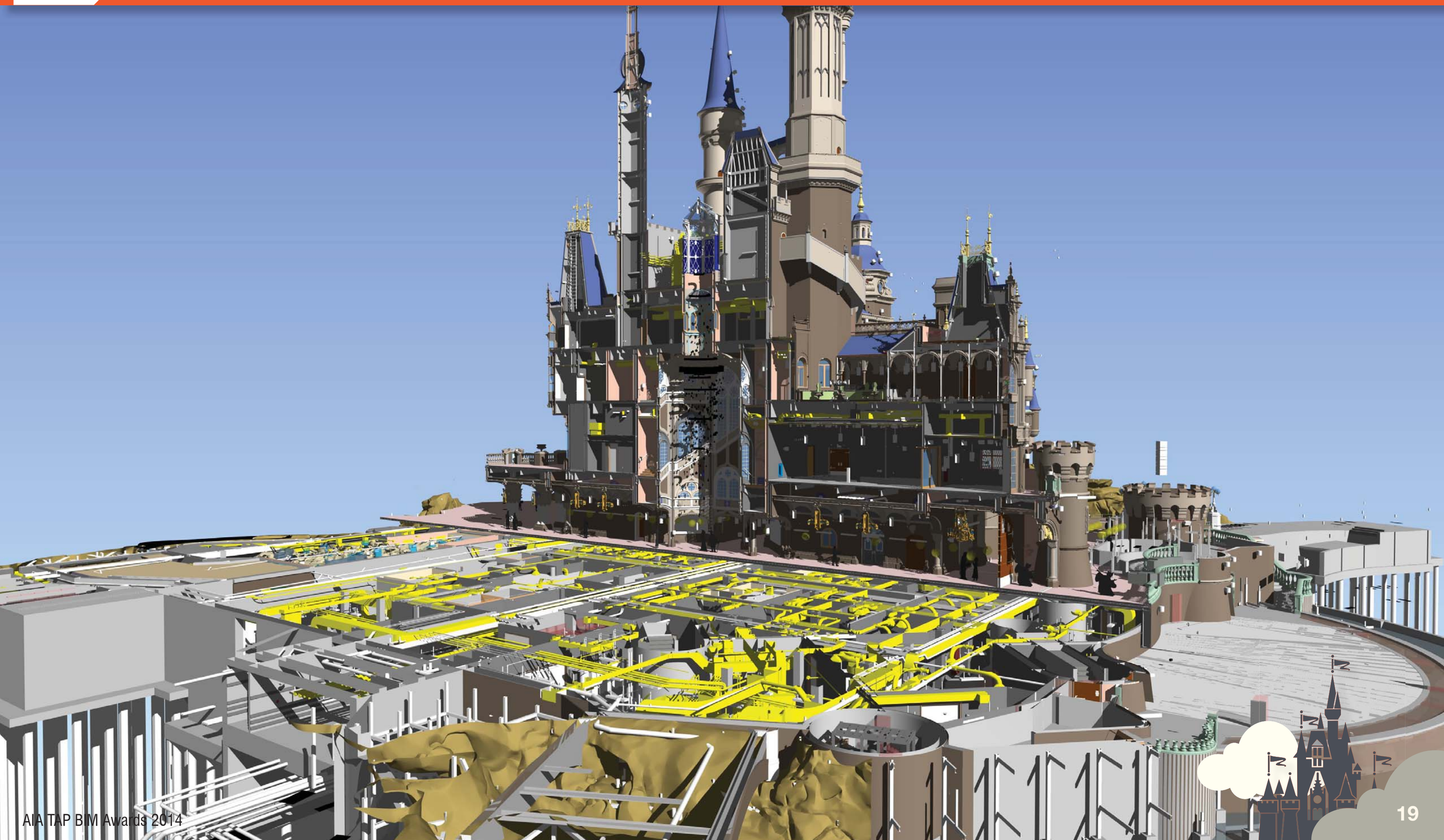
Consolidated Architecture Model

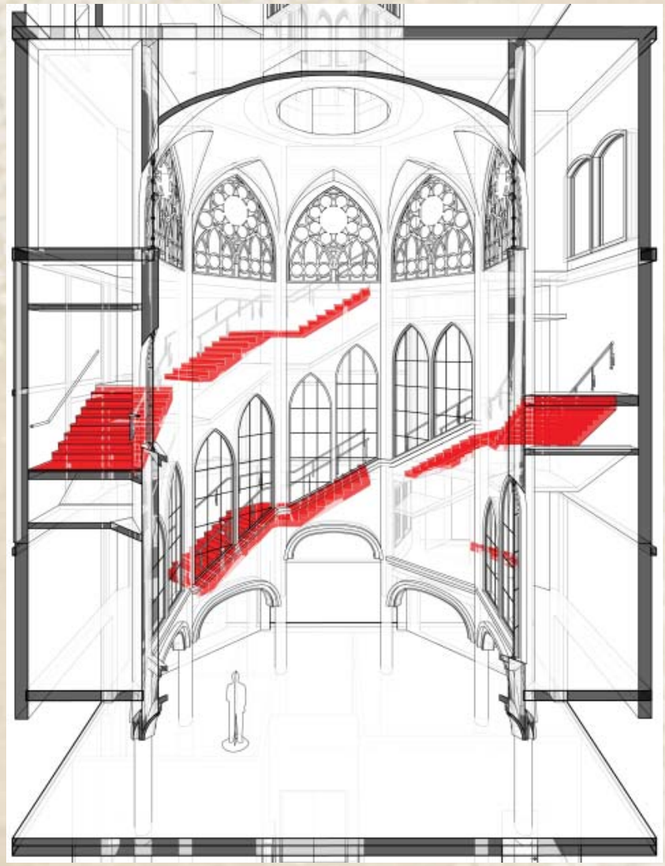


Architecture Ornamentation

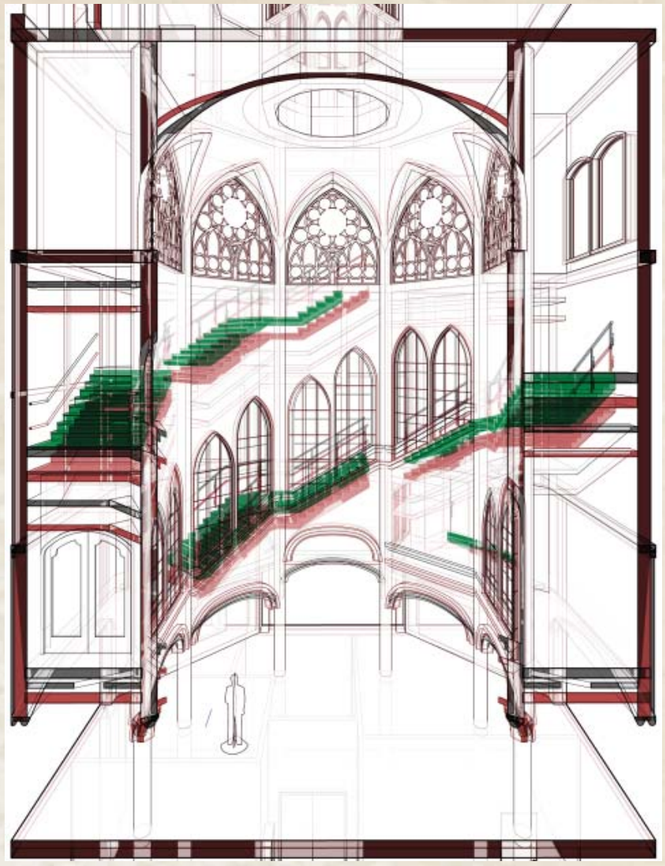


The Architecture team was able to merge their Revit model with input from other disciplines - whether 2D/3D AutoCAD, Revit, Solidworks, or Sketchup. This allowed all teams to design and coordinate in the context of a completely integrated building model.

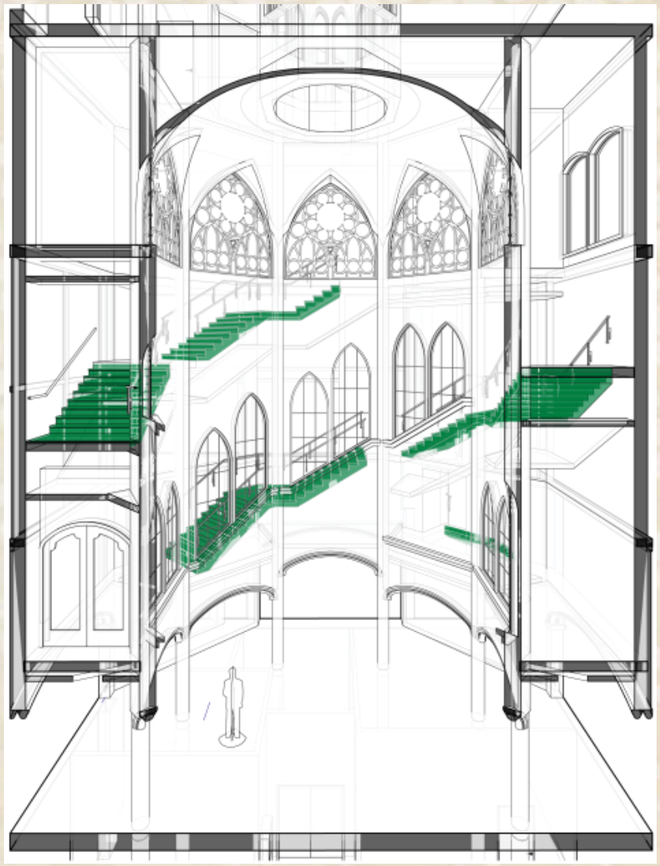




Stair constrained ceiling



Stair adjusted



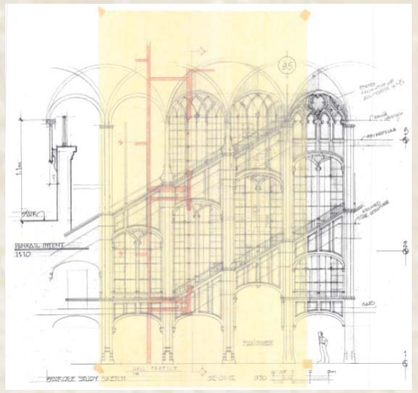
Adjusted stair allows for additional ceiling height

The use of parametric BIM components in a native 3D workspace allowed for a quick update to the stair and window heights. For example, testing a design option for a new monumental staircase integrated with the exterior building envelope was completed in approximately two hours as opposed to several days.

The intelligent BIM model allowed us to quickly redesign by hand, update the model, and then generate new backgrounds for additional hand sketching and design.

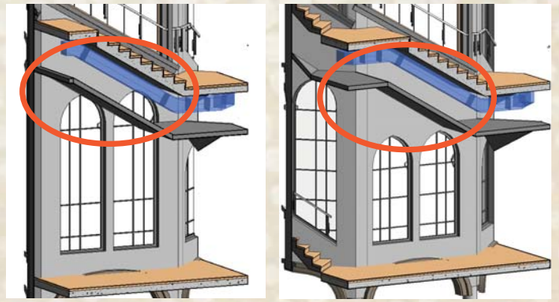
FINAL CONCEPT RENDERING

START

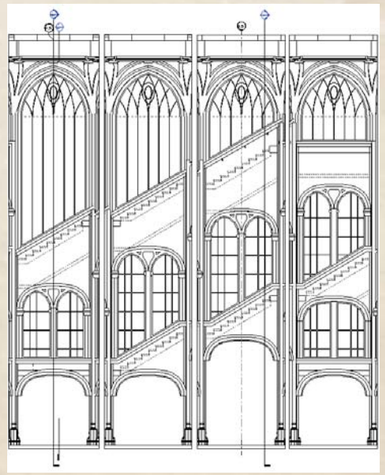


CONCEPT SKETCH

UPDATE REVIT MODEL

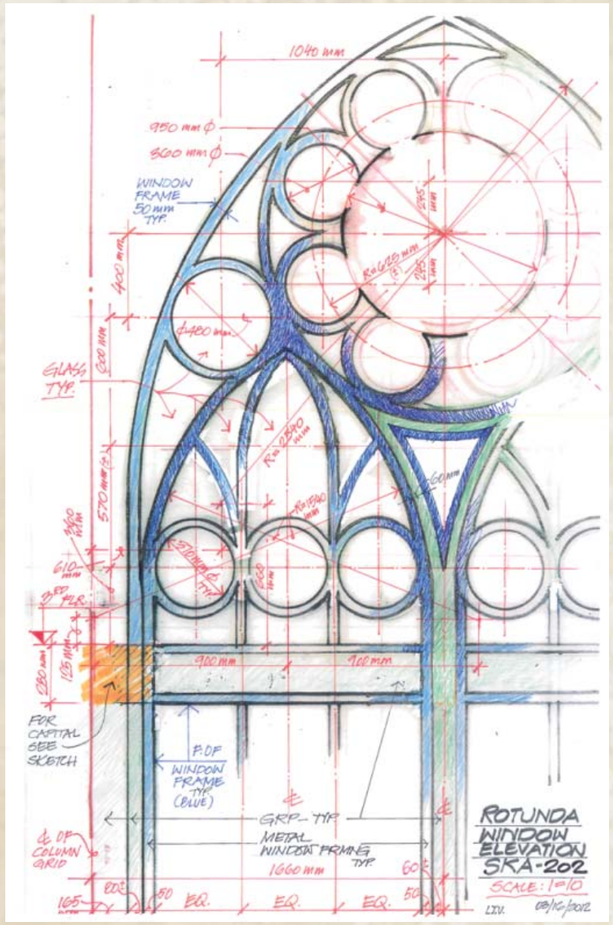


COORDINATE DESIGN

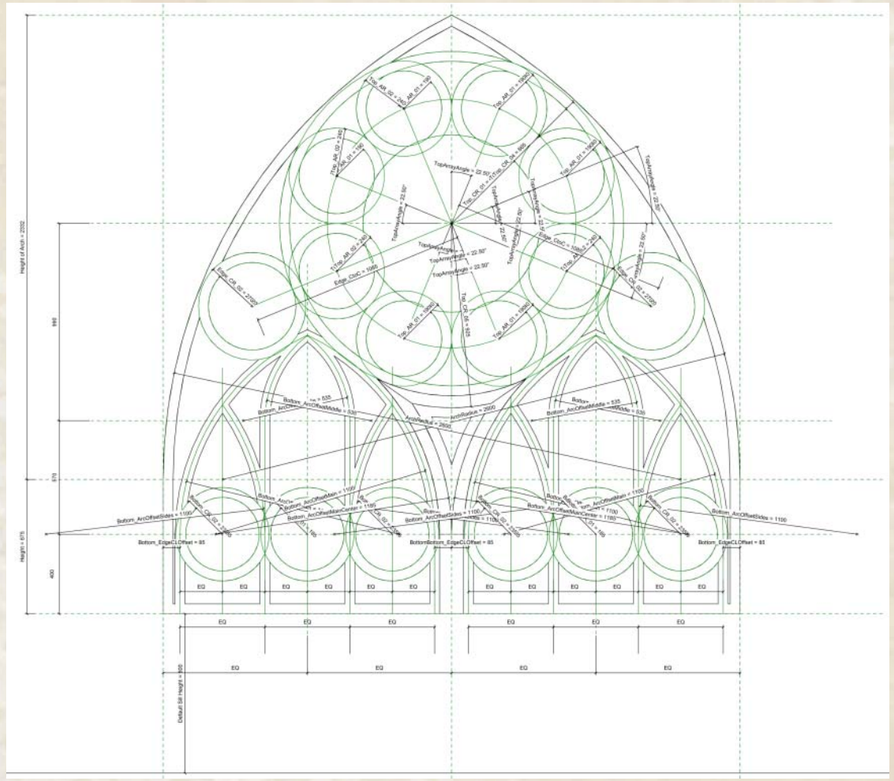


MODEL GENERATES BACKGROUNDS

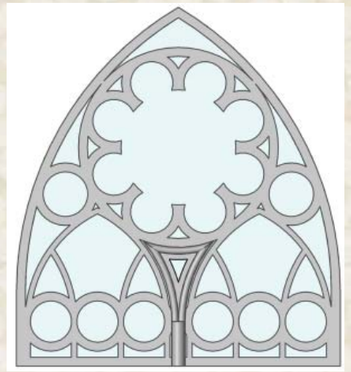
Building geometry with parametric control allows the design to be easily adjusted without re-building the component multiple times. Each adjustment now takes several minutes instead of several days, as almost none of the previous modeling effort is wasted.

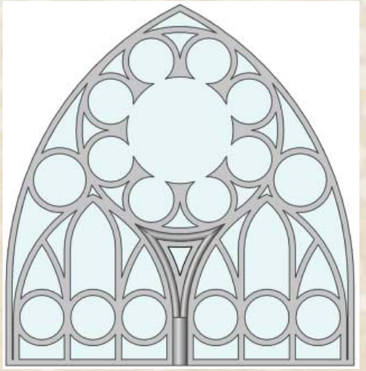


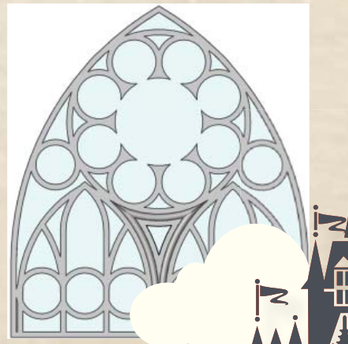
Window sketch with control dimensions



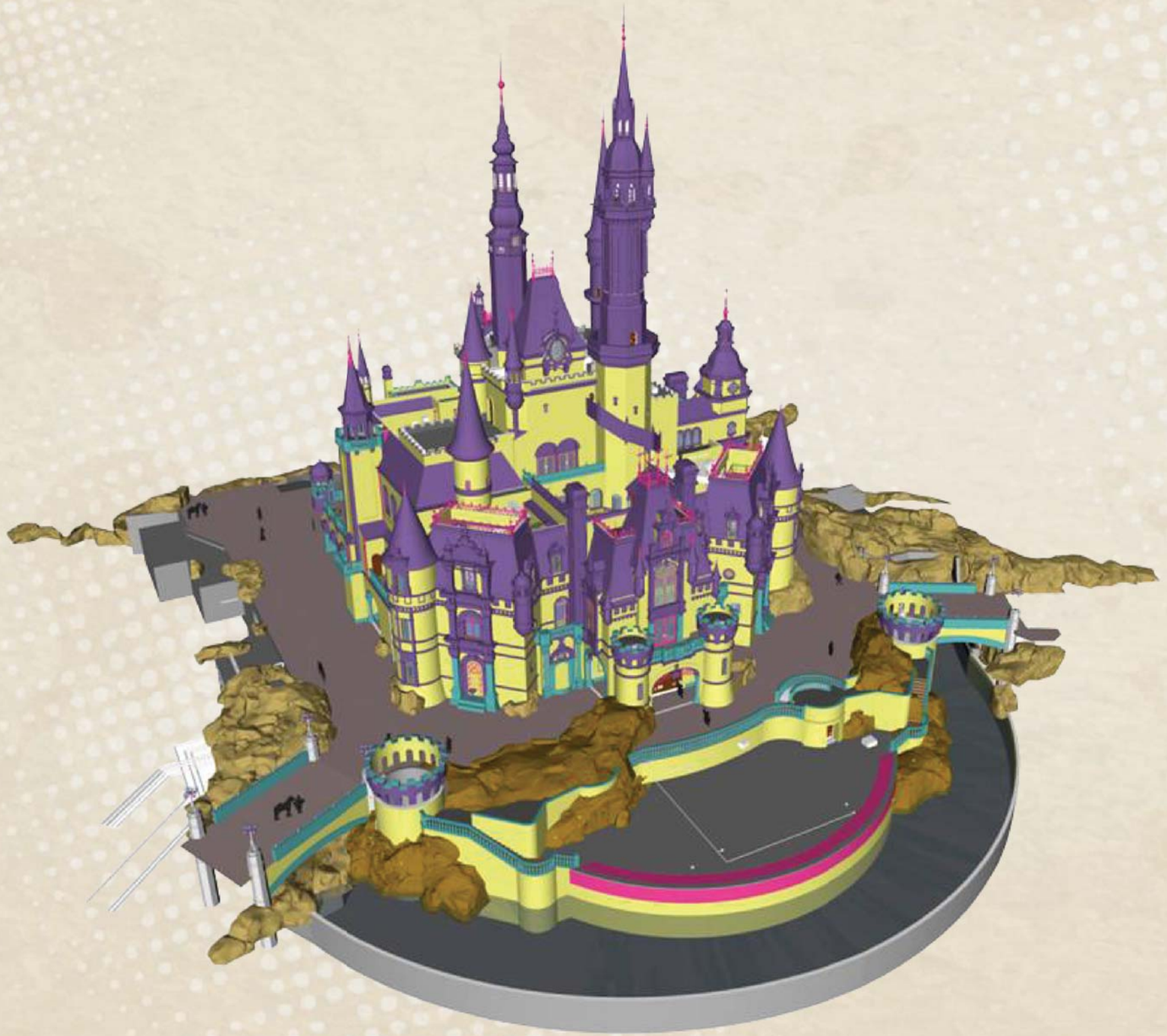
Parametric Revit Window Family



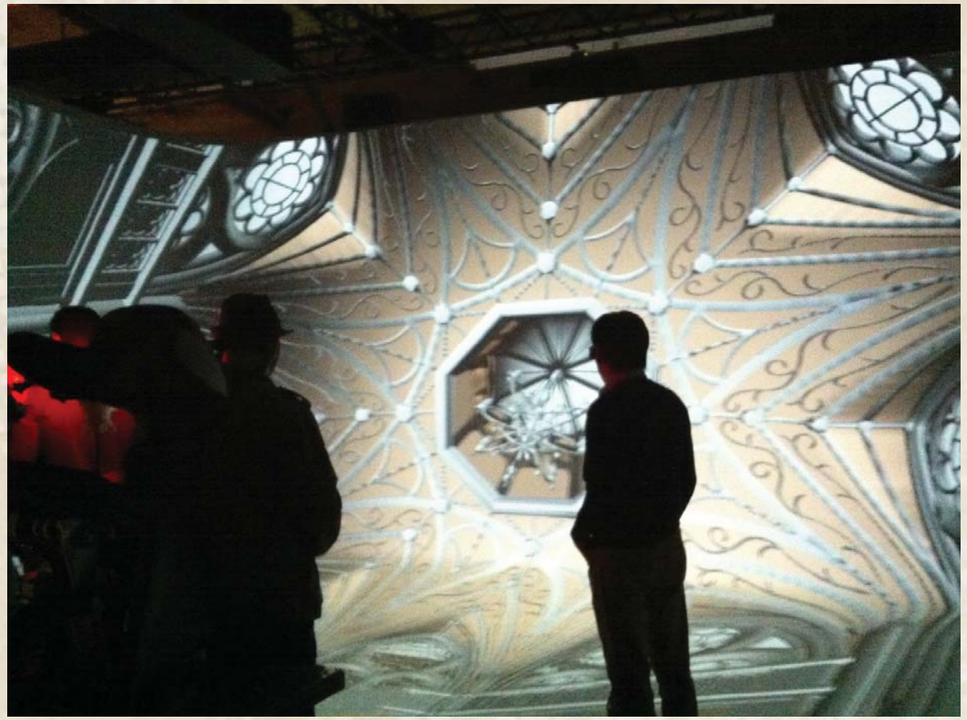




The material attributes assigned to all geometry in the BIM model allows the team to quickly color the model and visualize material types. This helps to inform the work of third-party vendors, the contractor, project estimators, and architects.

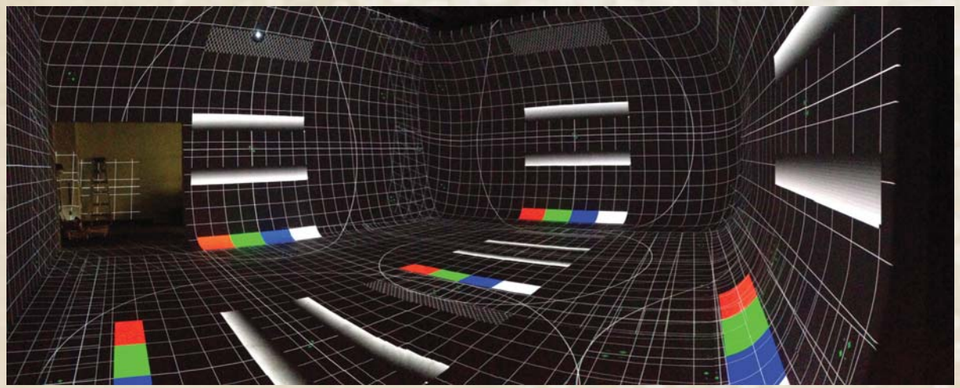


The BIM model allows a complete version of the castle to be visualized during design reviews.



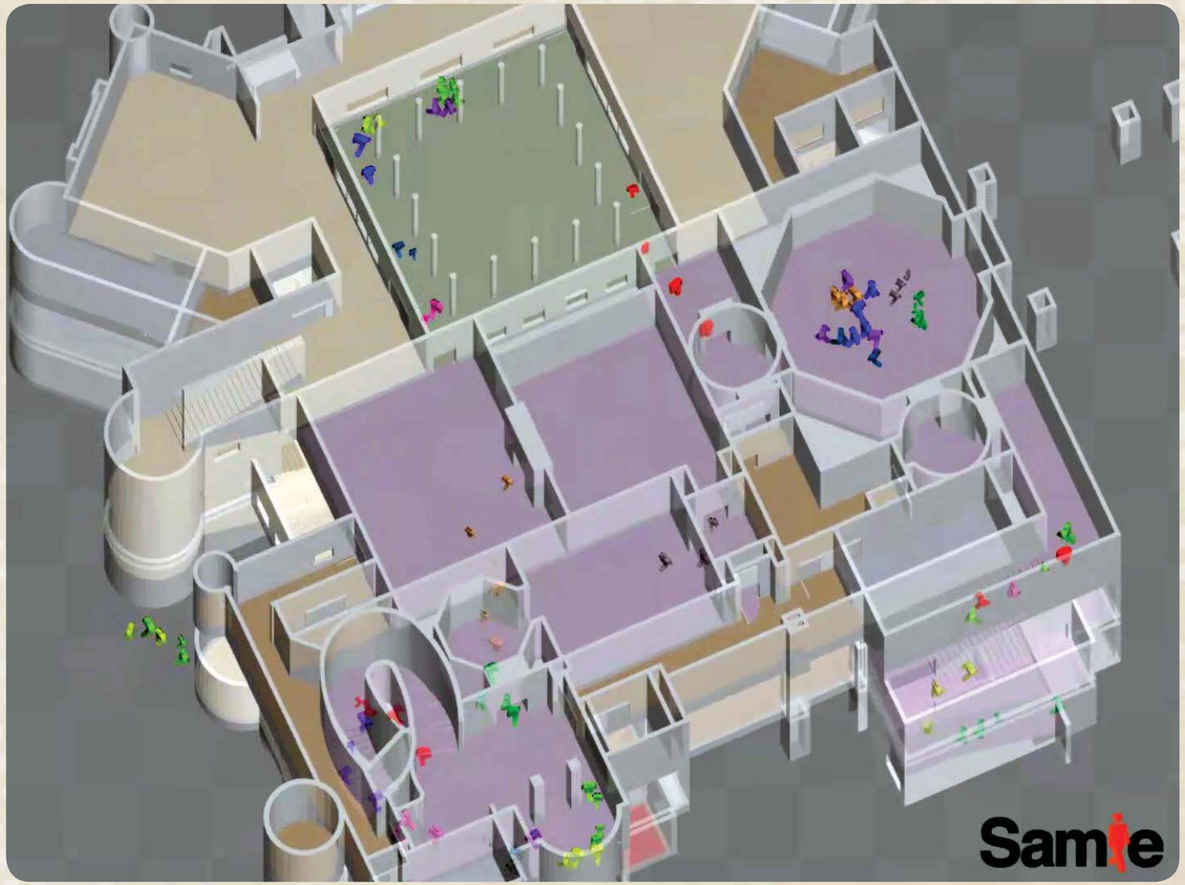
Traditional 2D documents are difficult to understand, especially for those without engineering, architectural, or construction backgrounds. ‘The DISH’ puts end users in the space providing them with an immersive environment to evaluate the spatial aspects of a design.

‘The DISH’ is a fully immersive 3D projected room used for virtual mockups.

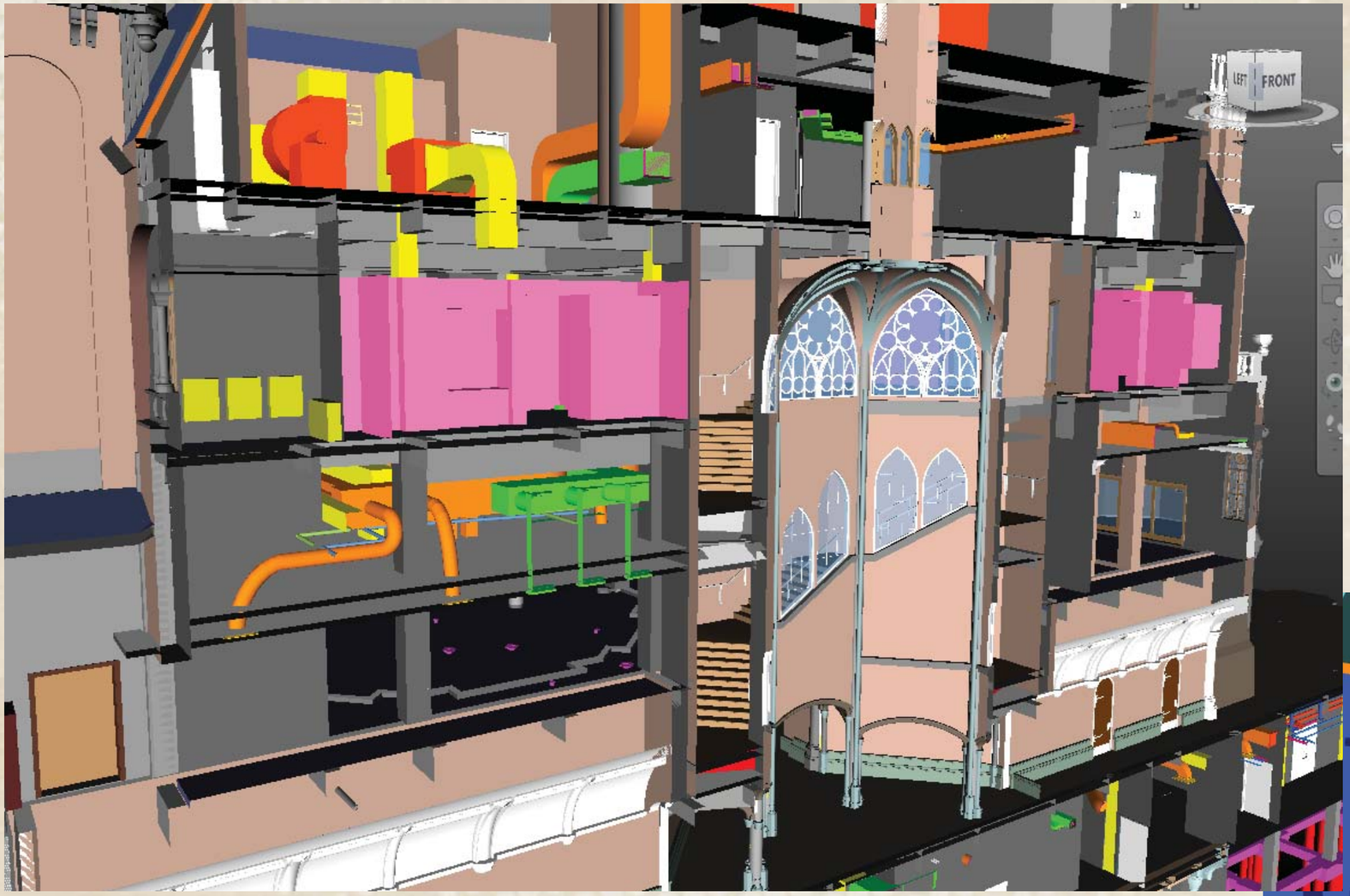


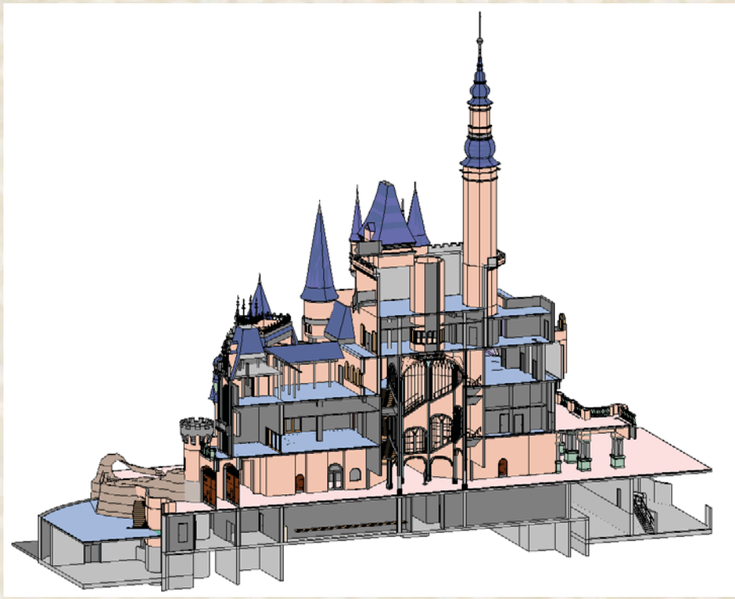
3D CROWD SIMULATION

Partnering with our park operations team, we were able to use the BIM model for crowd simulation studies. Since the space was realistically modeled, our colleagues were able to determine accurate instantaneous demand for all the spaces within the building, as well as determine any pinchpoints in the design.



The project team used the BIM model to solve construction challenges before going into the field.

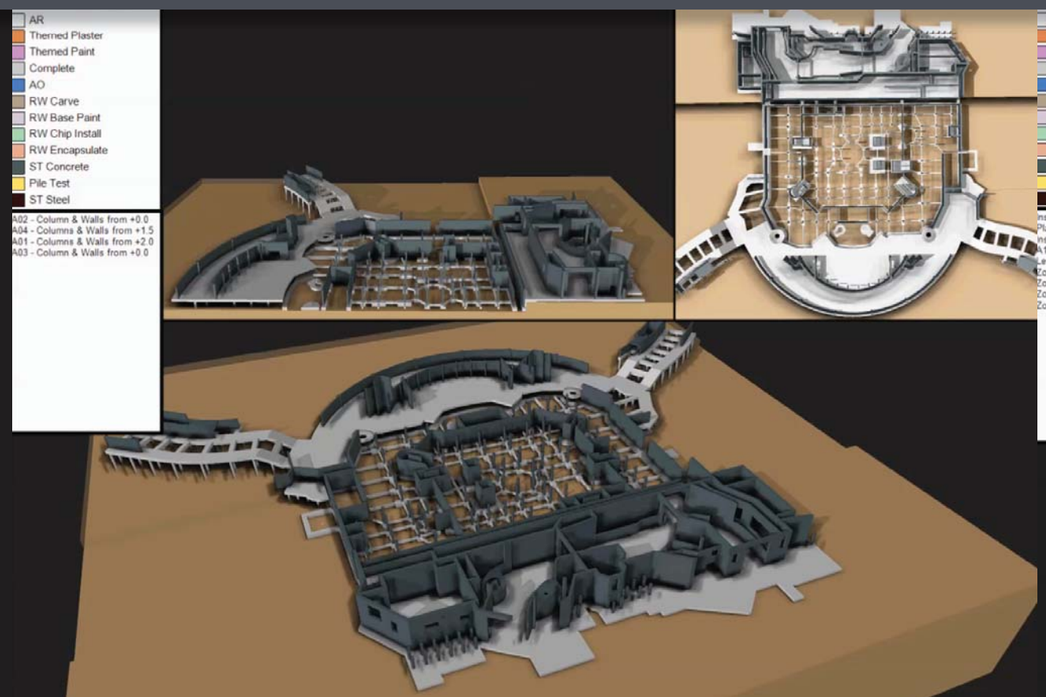




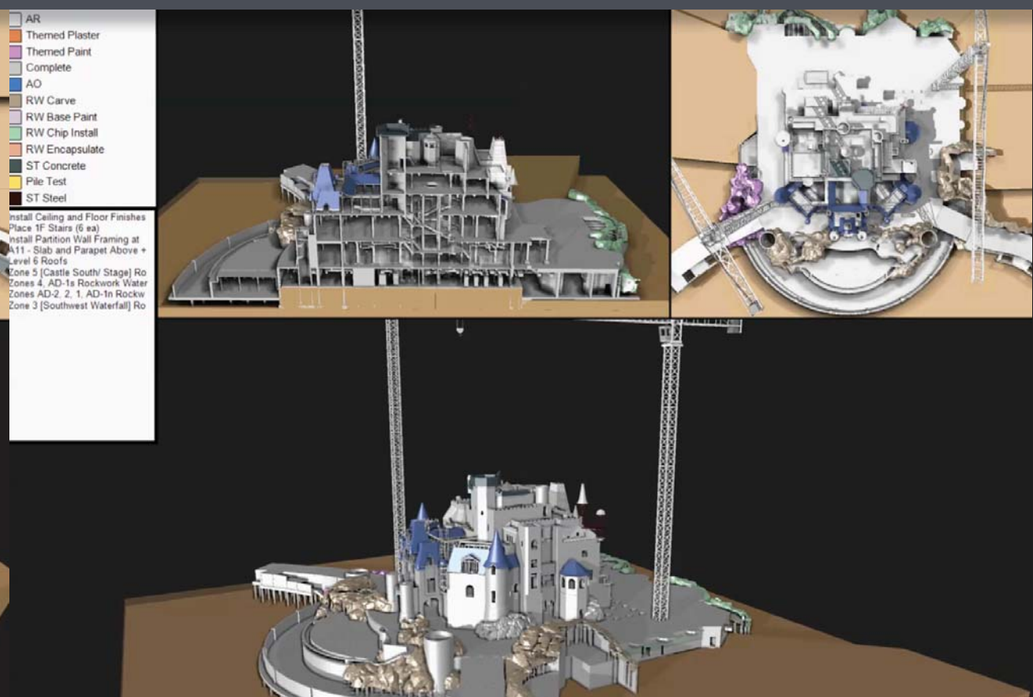
The final model, incorporating all 142 disciplines.

5 4D PLANNING AND VISUALIZATION

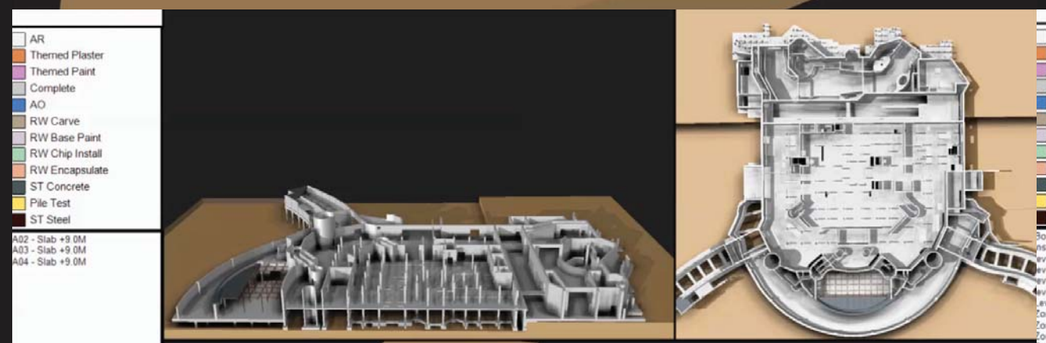
By pairing the BIM model with construction sequencing software, project management is able to test and validate site logistics and practical construction activities, coordinate contractor activities, and keep the project on schedule.



STAGE 1



STAGE 3



STAGE 2

STAGE 4

AR
Themed Plaster
Themed Paint
Complete
AO
RW Carve
RW Base Paint
RW Chip Install
RW Encapsulate
ST Concrete
ST Steel

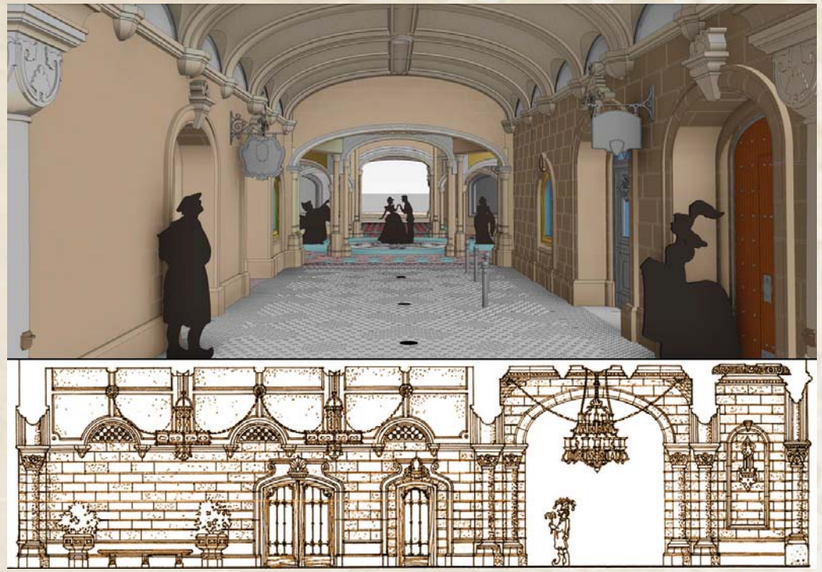
The BIM model is used for on-site construction coordination in our ‘Big Room’, allowing all stakeholders to be represented.

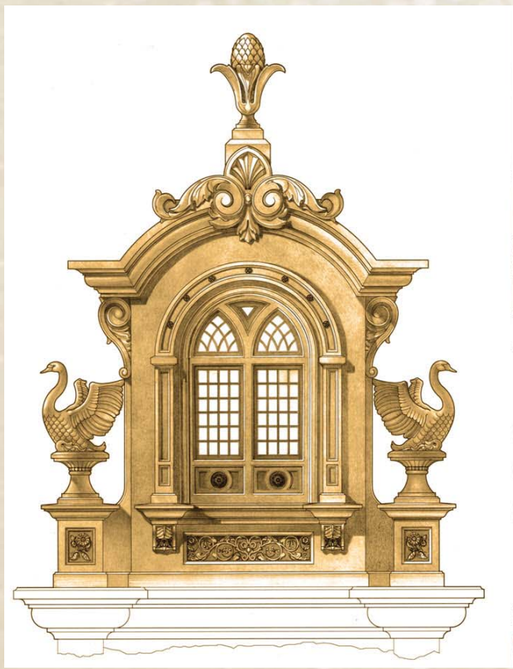
“The years of work we started back in California - as well as the continuing Revit contributions from our local design team in Shanghai - help inform our daily ‘Big Room’ work sessions with our general contractor. This is a great example of how our BIM project is bringing together an international group of team players to help solve solutions.

We now have a trained and experience team of Revit users both in Glendale and Shanghai that can continue the knowledge base.”

- Construction Manager

During construction, the architectural team holds daily meetings with the General Contractor to track vendor progress on Architectural Ornamentation, and ensure the project is staying on schedule. Both the model and the original 2D concept sketches are used to quickly confirm design intent.





5 FINAL ENCHANTED STORYBOOK CASTLE ARTISTIC RENDERING

The model - used as a base for this hand-painted rendering - even finds its place in inspiring the design team, management, construction workers, and the general public.

"This facility is the most complex and architecturally challenging that I've designed in my career: with retail, dining, operations and theatrical spaces... and a ride system running through it. A project with so many moving parts and different disciplines that it would have been absolutely impossible to deliver on time and on budget without having one integrated, central, smart model."

- Project Architect