Optimizing Fast-Paced Scan-to-BIM Projects Using ReCap, Revit, Navisworks

Rehan Amin

BIM Construction Engineer – Projects at Sanveo

Vigny Mathew

BIM Construction Engineer – VDC at Sanveo

About the speaker

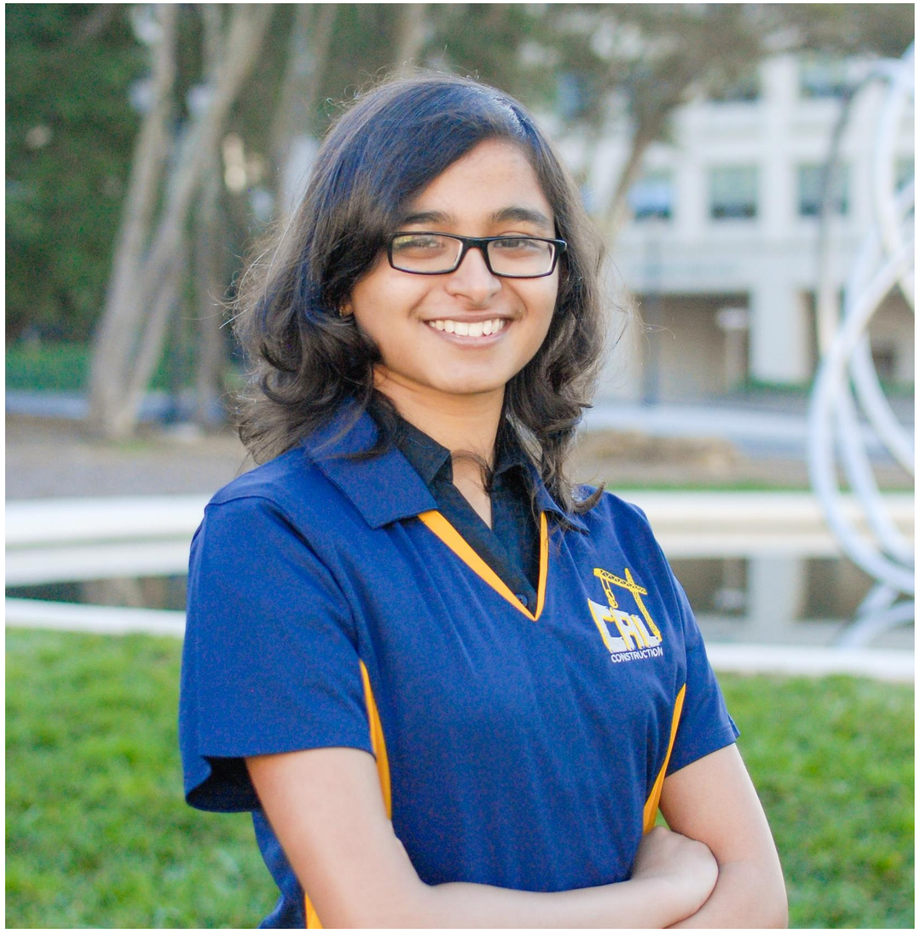
Rehan Amin

A BIM specialist who works in the AEC industry to provide BIM and 3D technology solutions over the life cycle of buildings.

Rehan believes capturing, digitizing and organizing data involved during the life cycle of projects will become very beneficial saving a lot of time.

Rehan has worked at multiple Scan to BIM projects since the beginning of last year and is actively working to improve the schedule by 3-5 times from the industry norm.

Rehan holds a master’s in construction engineering from Purdue University and is a passionate Manchester United fan since last 15 years.



About the speaker

Vigny Mathew

A BIM Construction Engineer working in Sanveo to provide BIM and 3D technology solutions. Vigny has worked on multiple BIM coordination projects since the beginning of 2017 and is working to improve the workflow and streamline the BIM coordination process. Vigny believes that effective BIM coordination and use of technology to simplify the process can eliminate waste and increase value for everyone involved in a construction project.

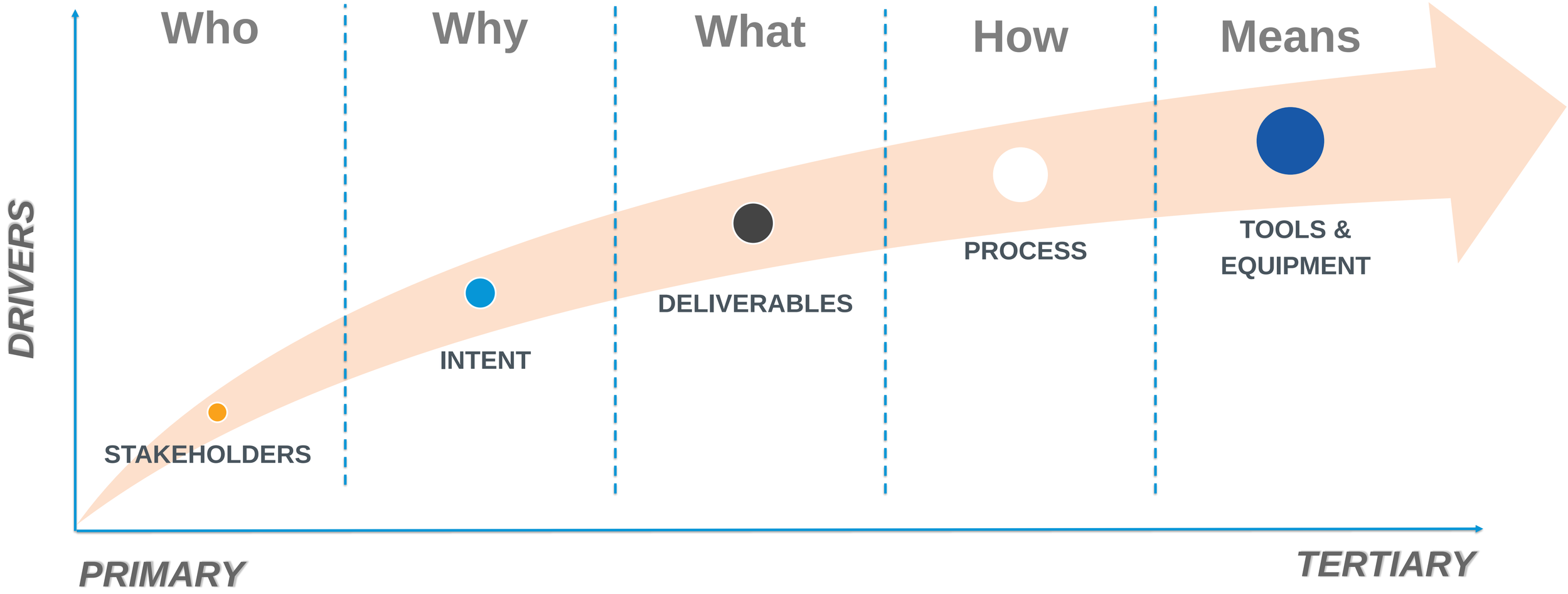
Vigny holds a master’s in engineering and project management from UC Berkeley.

About Sanveo

BIM | VDC | CONSTRUCTION TECH

7	140	200	85%
OFFICES	BIM SPECIALISTS	PROJECTS	REPEAT CUSTOMERS
SF Bay Area | Los Angeles | Denver | Atlanta | Stockton | Middle East | India	40 Prior Field Exp. | 38 Master’s Degrees	BIM/VDC experience worldwide since 2008	10% Referral Rate

What Drives Reality Capture

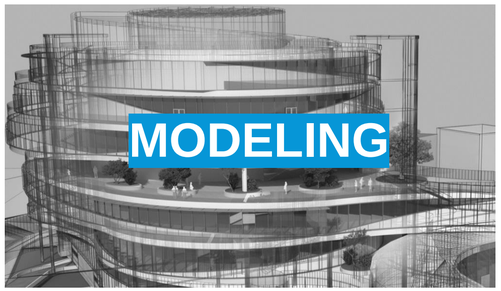


Workflow Overview

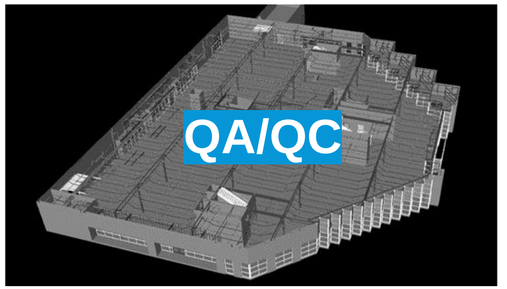
- Problem Statement

- Intent
- Level of Accuracy
- Level of Development
- Extent of Data Capture
- Pre-Scan Logistical Planning

- Technologies & Equipment - Survey
- Scanning Tips
- Processing Point Cloud
- Point Cloud Handling - Tips



- Software Selection
- Pre-Model Planning
- Modeling Tips
- Beyond Manual Modeling



- Software Selection
- QA/QC Tips

Introduction to Case Study

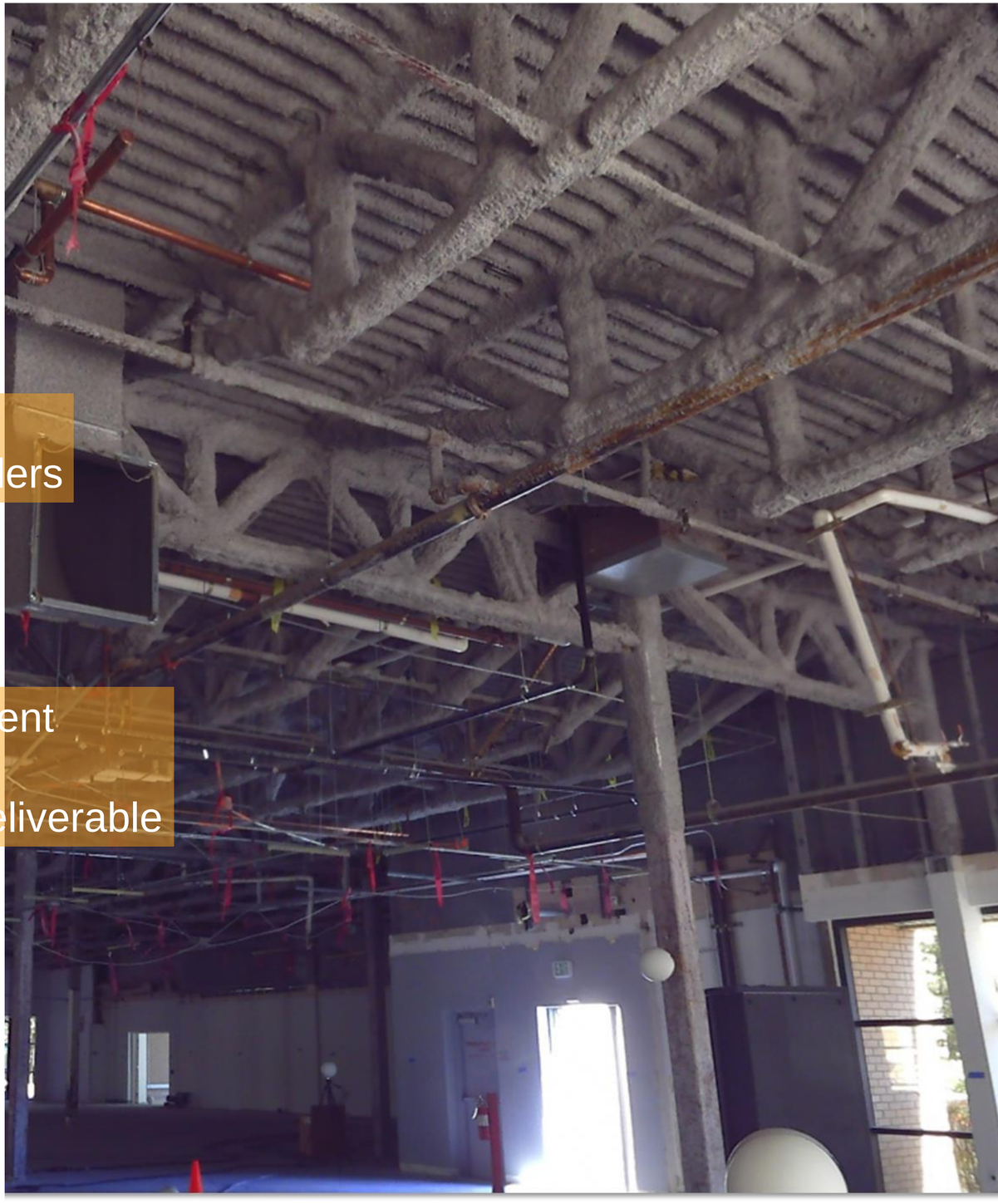
Problem Statement

- General Contractor :- Novo Construction
- Technology Partner :- Sanveo
- Users :- Architect, Structural Engineer, MEPF Engineers, General Contractor

Who – Stakeholders

- 6 Commercial Buildings; 2 floors each – 340,000 sq ft
- Intent :- As-Built model Generation.
- Aggressive schedule :- 30 days

Why – Intent
&
What - Deliverable

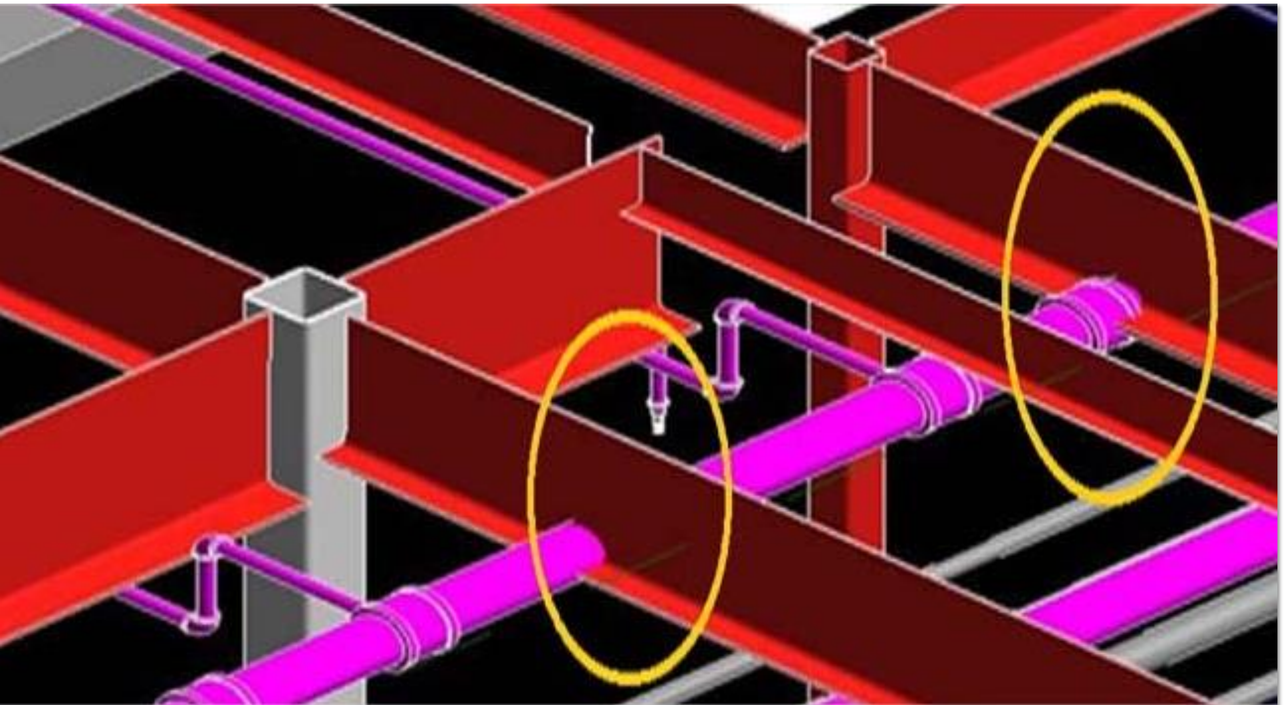


Scope & Project Requirements

Intent

- Defining the project scope
  - Understanding the correct purpose of As-Built

Clash Coordination



Pre-Design Visualization

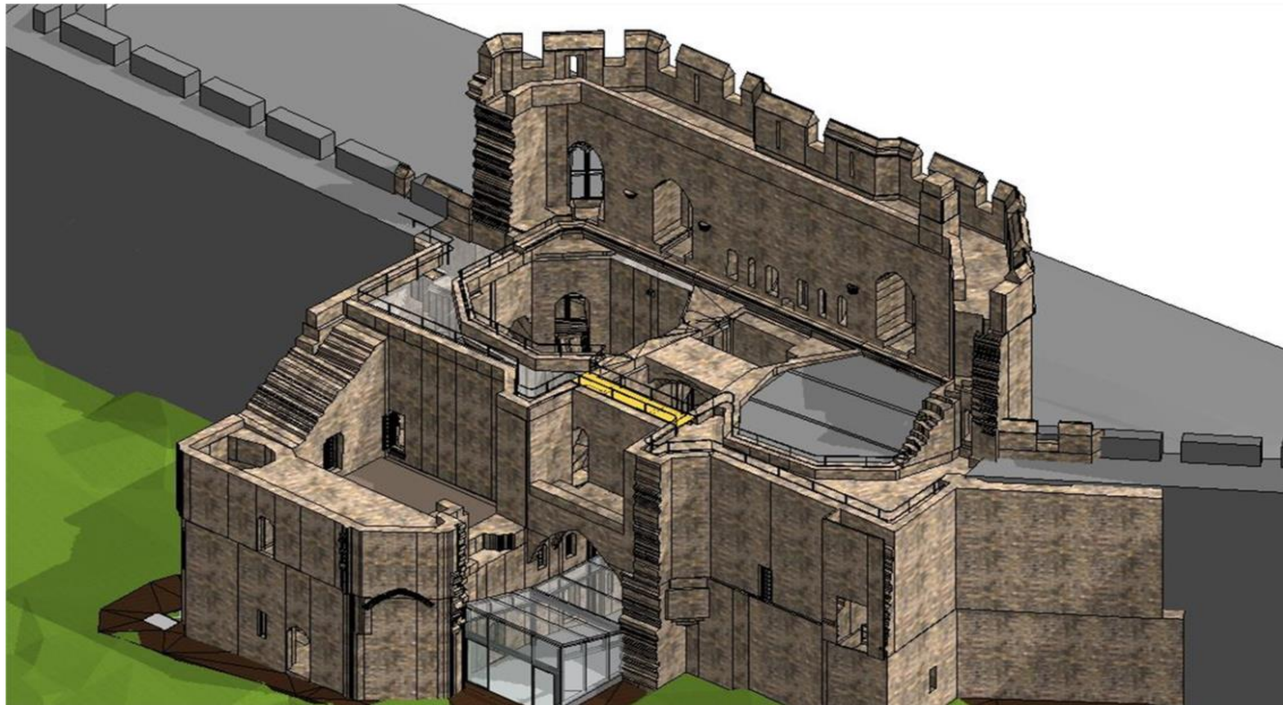
Scope & Project Requirements

Intent

- Defining the project scope
  - Understanding the correct purpose of As-Built

Facility Management

Heritage & Documentation



Scope & Project Requirements

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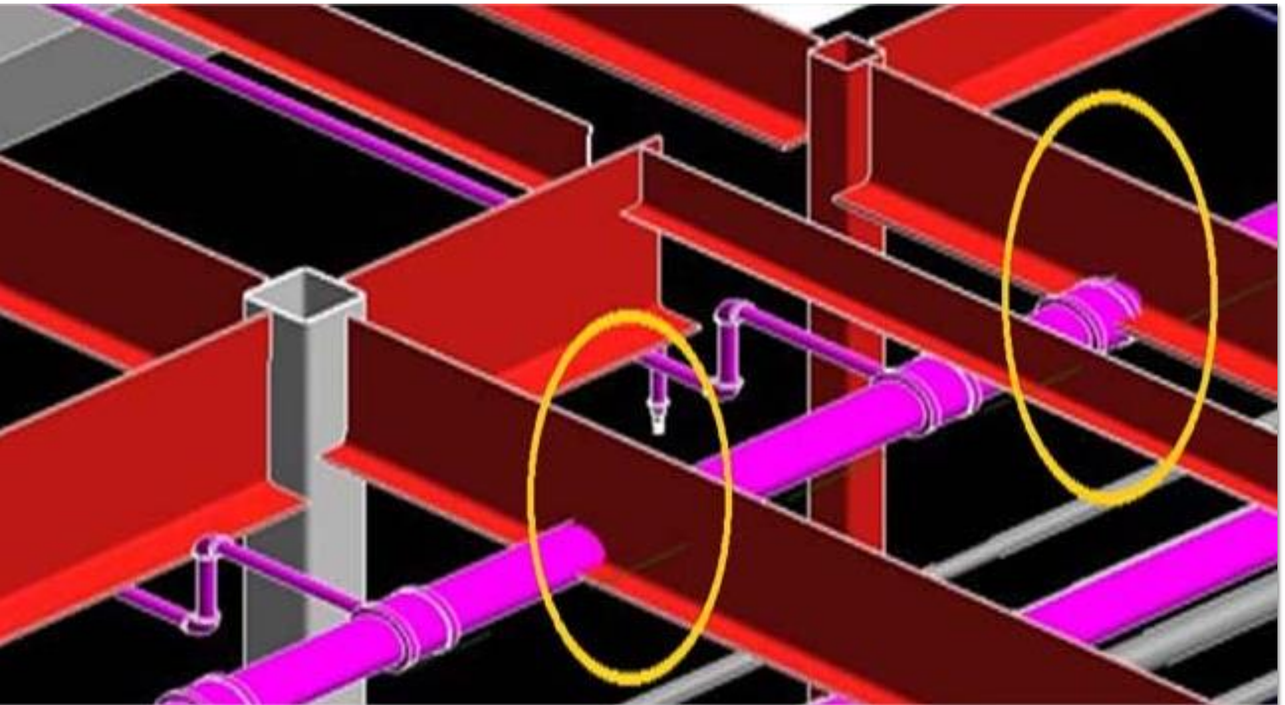
- Level of Accuracy
- Level of Development
- Extent of Data Capture
- Pre-Scan Logistical Planning

Clash Coordination

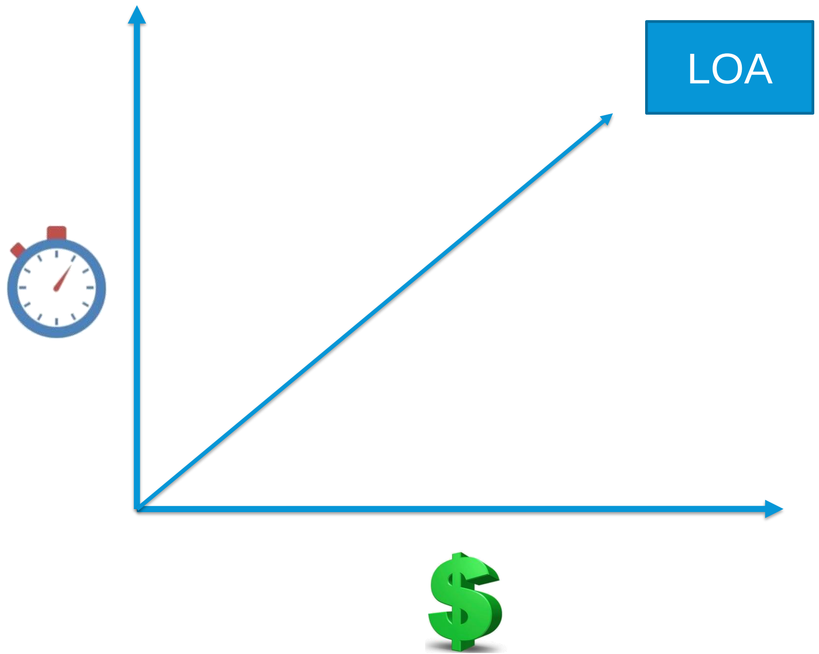


Pre-Design Visualization

Scope & Project Requirements

Level Of Accuracy (“LOA”)

Level of Accuracy | Level of Development | Extent of Data Capture | Pre-Scan Logistical Planning

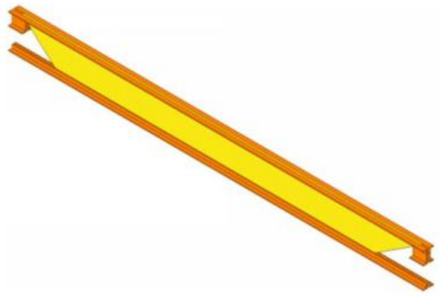


Intent	LOA	Acceptable Limit
Heritage	50	1/16"
Coordination - Clash Detection	30-40	5/8"
Pre-Design - Visualization	20	2"
Facility Management	10	>2"

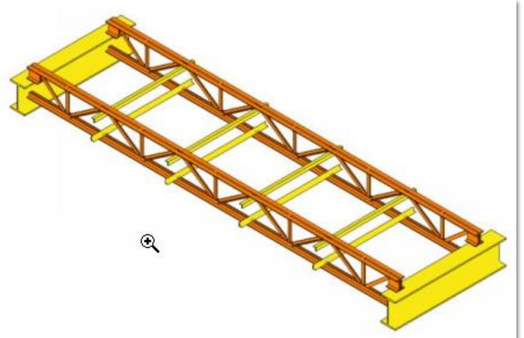
Scope & Project Requirements

Level Of Development (“LOD”)

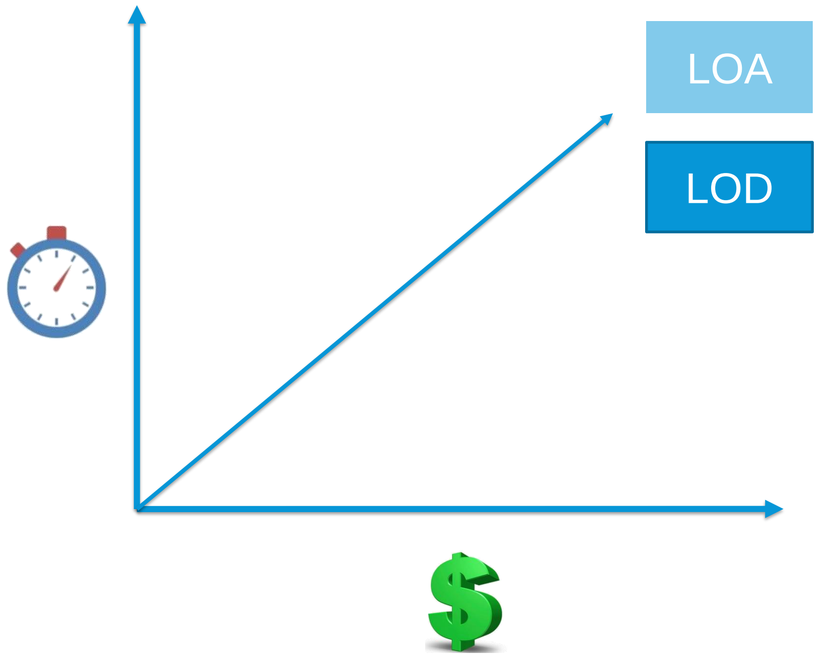
Level of Accuracy | **Level of Development** | Extent of Data Capture | Pre-Scan Logistical Planning



39 B1010.10-LOD-300 Floor Structural Frame (Steel Joists)



40 B1010.10-LOD-350 Floor Structural Frame (Steel Joists)



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Scope & Project Requirements

Extent Of Data Capture

Level of Accuracy | Level of Development | **Extent of Data Capture** | Pre-Scan Logistical Planning

Architectural & MEPF – Scope Definition

Architectural	Y/N
Exposed Metal Studs	Y
In-wall Modelling (inside boundary)	N
Vermiculite on elements	Y
Penetrations	Y
Exact Risers and Treads	Y
Exact Railings	N
Generic Railings	Y
Exact Wall Thickness (includes veneer, insulation, interior skin, airspace)	Y
Window frames & Mullions	Y
Actual exterior wall texture	N
Flooring Material variation	N
Smooth wall trims	Y
Furniture	N
Ceiling and Wall Elements	N
Casework	N
Signage	N
Open gaps in wall surface/joinings	Y

Electrical	Y/N
J Hooks	Y
Custom Supports	N
Hanger Struts	Y
Seismic support	Y
Wall Elements (receptacles, lights)	N
Minimum diameter of conduit to model	2"
Wires and Cables	N
Flexible conduit	N
Equipment supports pads	Y
Generic lighting fixtures	N
Exact lighting fixtures	N

Plumbing/Fire	Y/N
J Hooks	Y
Custom Supports	N
Hanger Struts	Y
Seismic support	Y
Minimum diameter of pipes	1"
Insulation(cover point cloud)	Y
Flanges/Valves	N
Flexible Pipes	N

Mechanical	Y/N
J Hooks	Y
Custom Supports	N
Hanger Struts	Y
Seismic support	Y
Insulation(cover point cloud)	Y
Exact Mechanical Piping Connections	Y

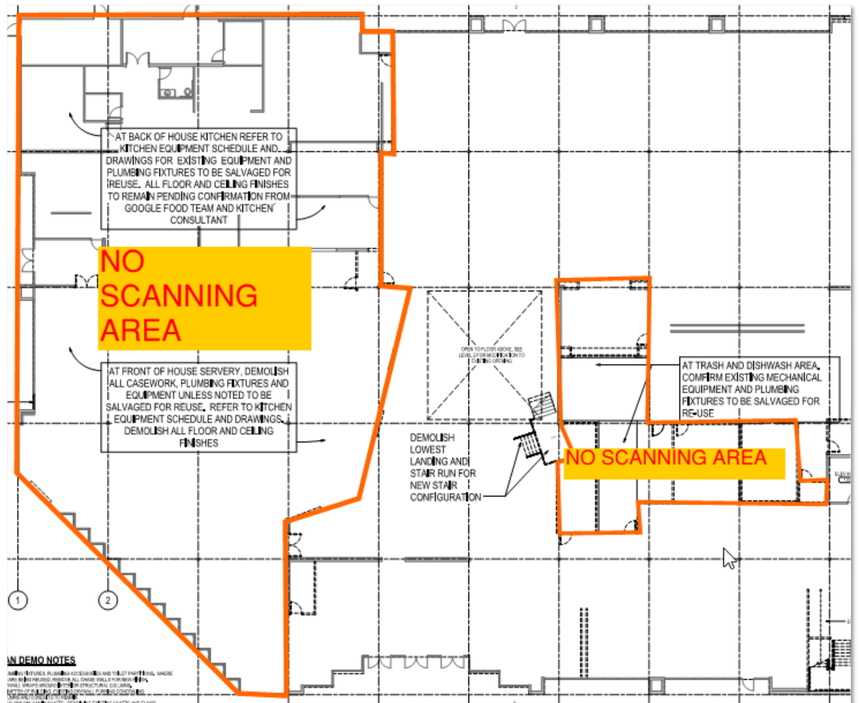
Scope & Project Requirements

Pre-Scan Logistical Planning

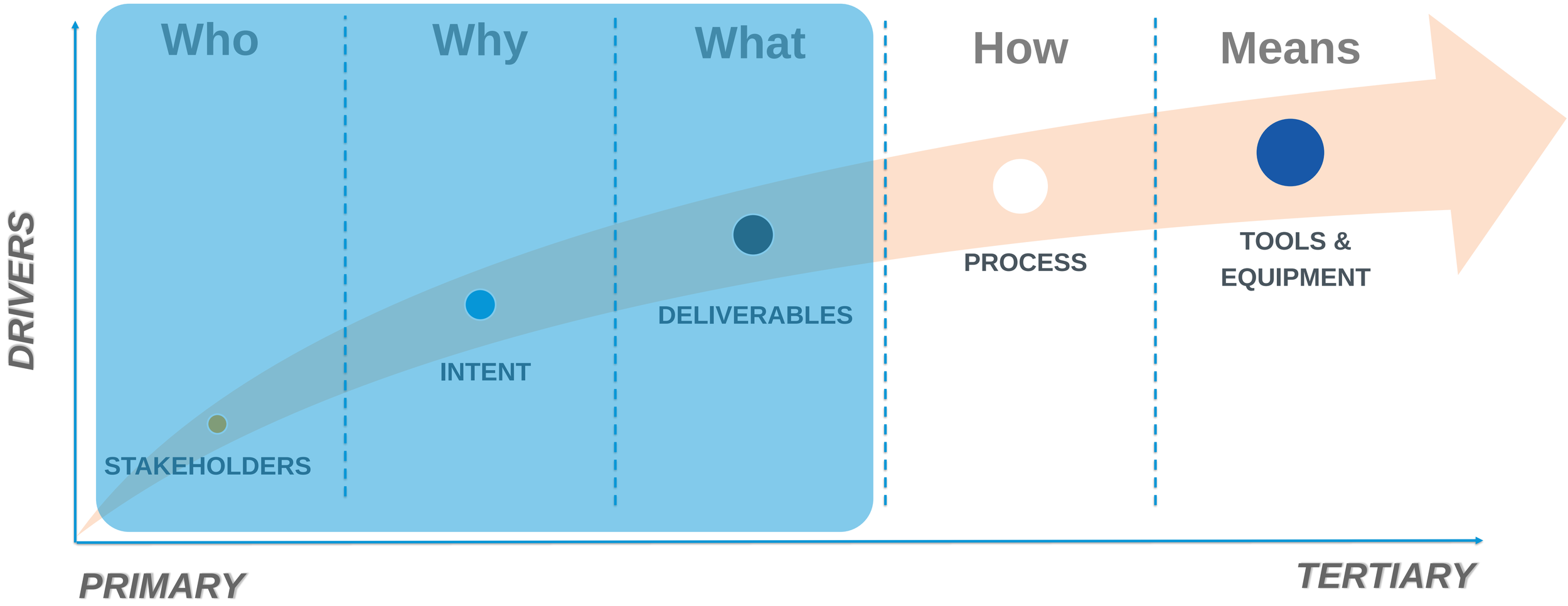
Level of Accuracy | Level of Development | Extent of Data Capture | Pre-Scan Logistical Planning

Site Walk-Through

Exceptions

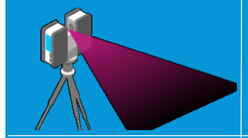


What Drives Reality Capture



Field Execution

Technologies And Equipment - Survey

	3D LASER SCANNING	PHOTOGRAMMETRY
		
Stationery	 PROS Most Accurate; Best Quality CONS Slow; Expensive	 PROS Fast; Good Quality; Affordable CONS Lower Accuracy
Handheld		
Mobile		
Aerial		

Field Execution

Technologies And Equipment - Survey

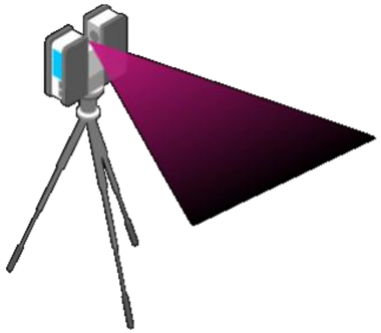
- Level of Accuracy
- Level of Development
- Extent of Data Capture

→ LOA 30-40

→ LOD 300-350

→ 3D Laser Scanning

→ Stationery



Field Execution

Scanning Tips

- Scanning time
  - Color mode ON ~ 6 minutes/scan
  - Color mode OFF ~ 3 minutes/scan
- Time is saved by using normal 360 camera
- Size of output scans is less
  - Time is saved in file transfer
- Up to 40 % of time is saved

Field Execution

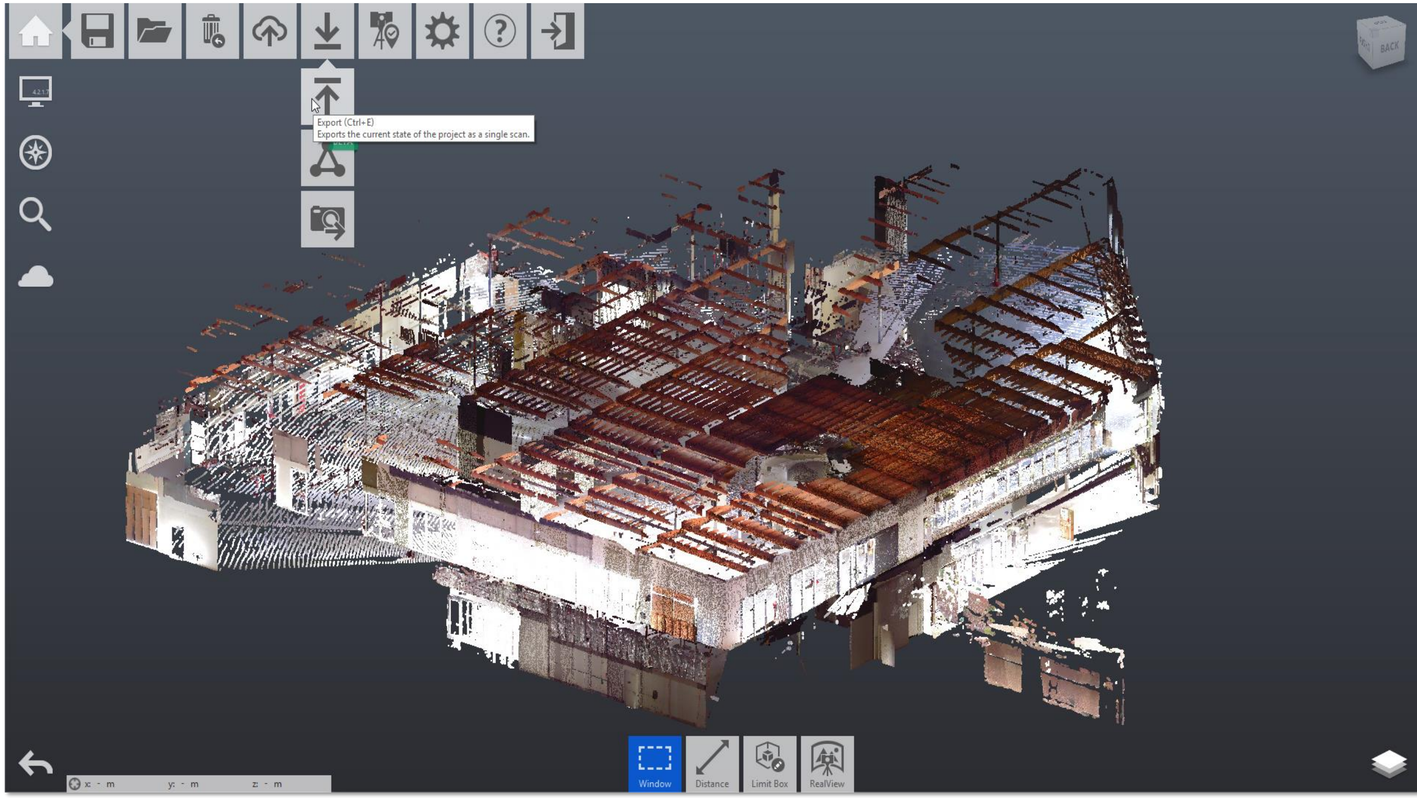
Processing Point Cloud

- Autodesk Recap Pro
  - Prior experience of team
  - Affordable
  - Easy user interface
  - QA/QC
  - Time saved
- Faro Scene
- Leica Cyclone
- Trimble Real works

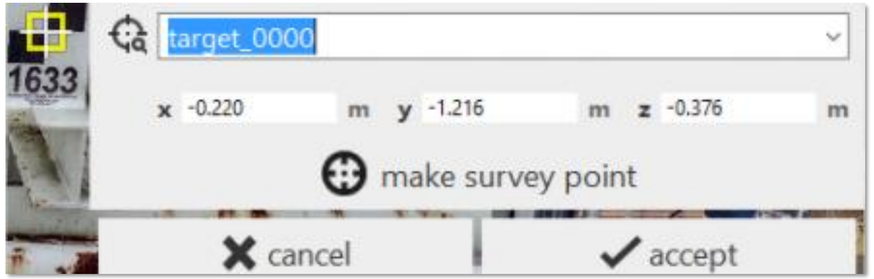
Field Execution

Point Cloud Handling - Tips

- Handling the large size of point clouds
  - Limit Project File Size
  - Divide project into various zones
  - Each RCP to have 50-75 scans
  - RCP → Unified RCS
  - Time saved in file transfer
  - Revit works more smoothly



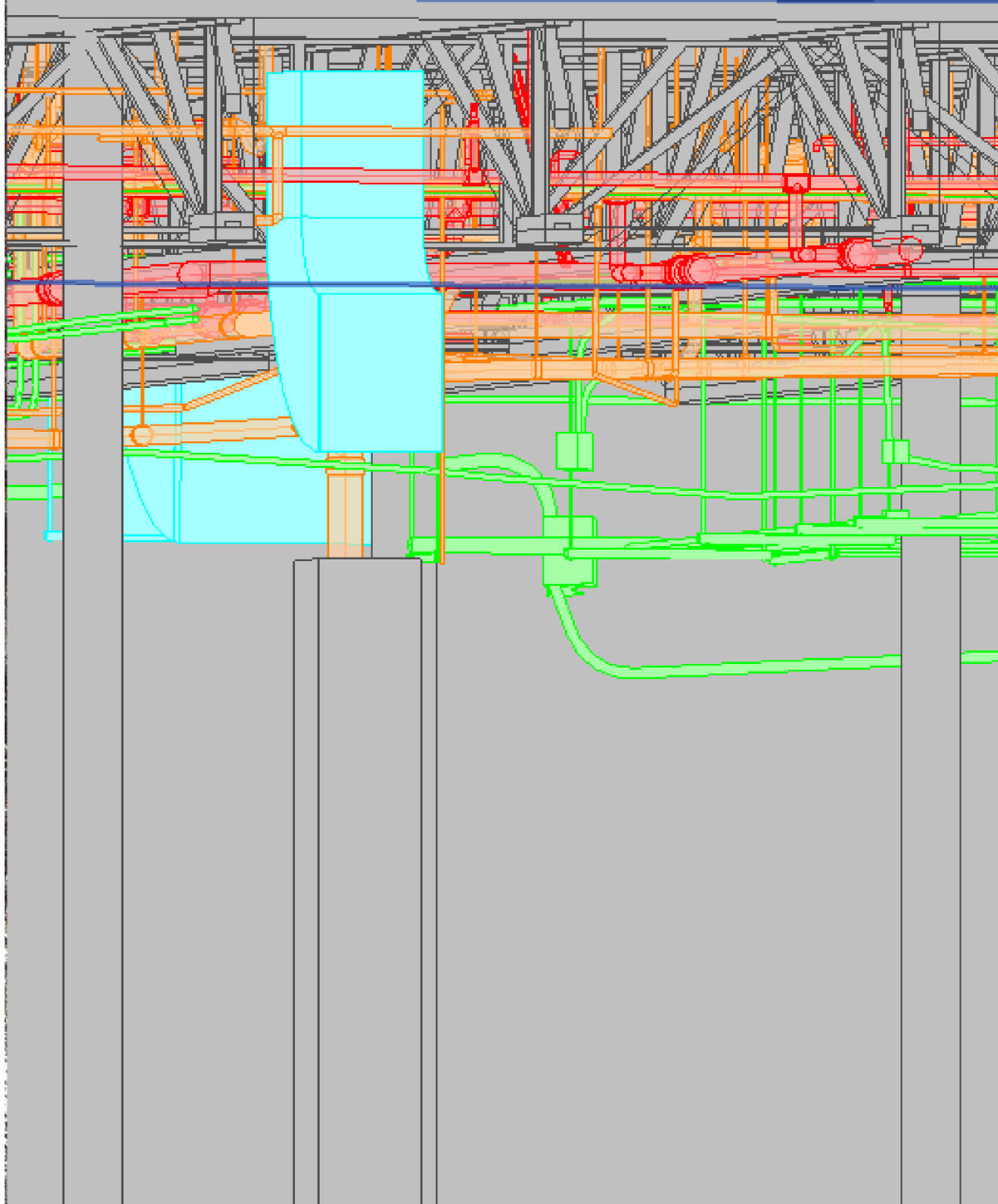
- Geo-Reference RCP to avoid wasting time in alignment



Modeling

Software Selection

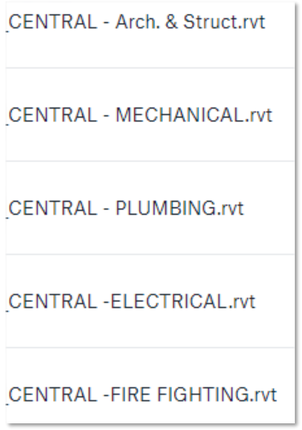
- Autodesk Revit
  - Prior experience of team
  - Easy Collaboration
  - Stakeholders requirement



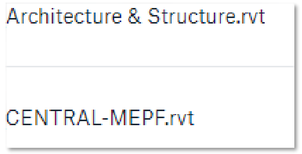
Modeling

Pre – Model Planning

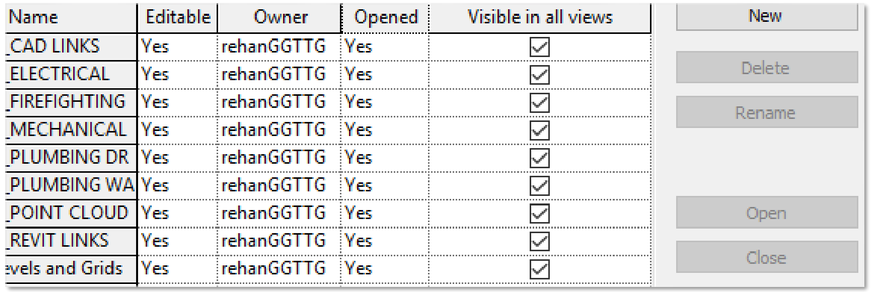
- Time saved when working in collaboration
- Developing standard Revit 3D Model
  - Organization of Revit Model
    - Trade-wise



    - Core & shell and interiors



- Inclusion of column grids and setting project north
- Define the use of work sets
  - By Trade
  - By Level
  - By Area

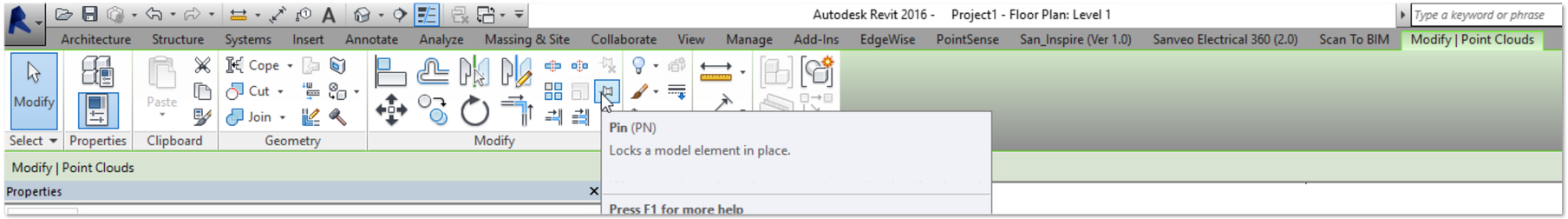


Name	Editable	Owner	Opened	Visible in all views
_CAD LINKS	Yes	rehanGGTTG	Yes	☑
_ELECTRICAL	Yes	rehanGGTTG	Yes	☑
_FIREFIGHTING	Yes	rehanGGTTG	Yes	☑
_MECHANICAL	Yes	rehanGGTTG	Yes	☑
_PLUMBING DR	Yes	rehanGGTTG	Yes	☑
_PLUMBING WA	Yes	rehanGGTTG	Yes	☑
_POINT CLOUD	Yes	rehanGGTTG	Yes	☑
_REVIT LINKS	Yes	rehanGGTTG	Yes	☑
evels and Grids	Yes	rehanGGTTG	Yes	☑

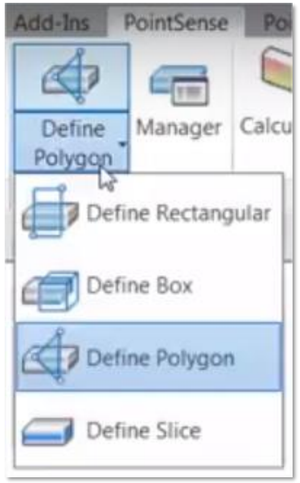
Modeling

Modeling – Tips

- Always Pin the point-cloud
  - Time saved by removing possible mistakes during modeling



- Use Plug-Ins like FARO Point-Sense for Revit for clipping and sectioning
  - Time saved in modeling process



Modeling

Beyond Manual Modeling – Survey Of Tools

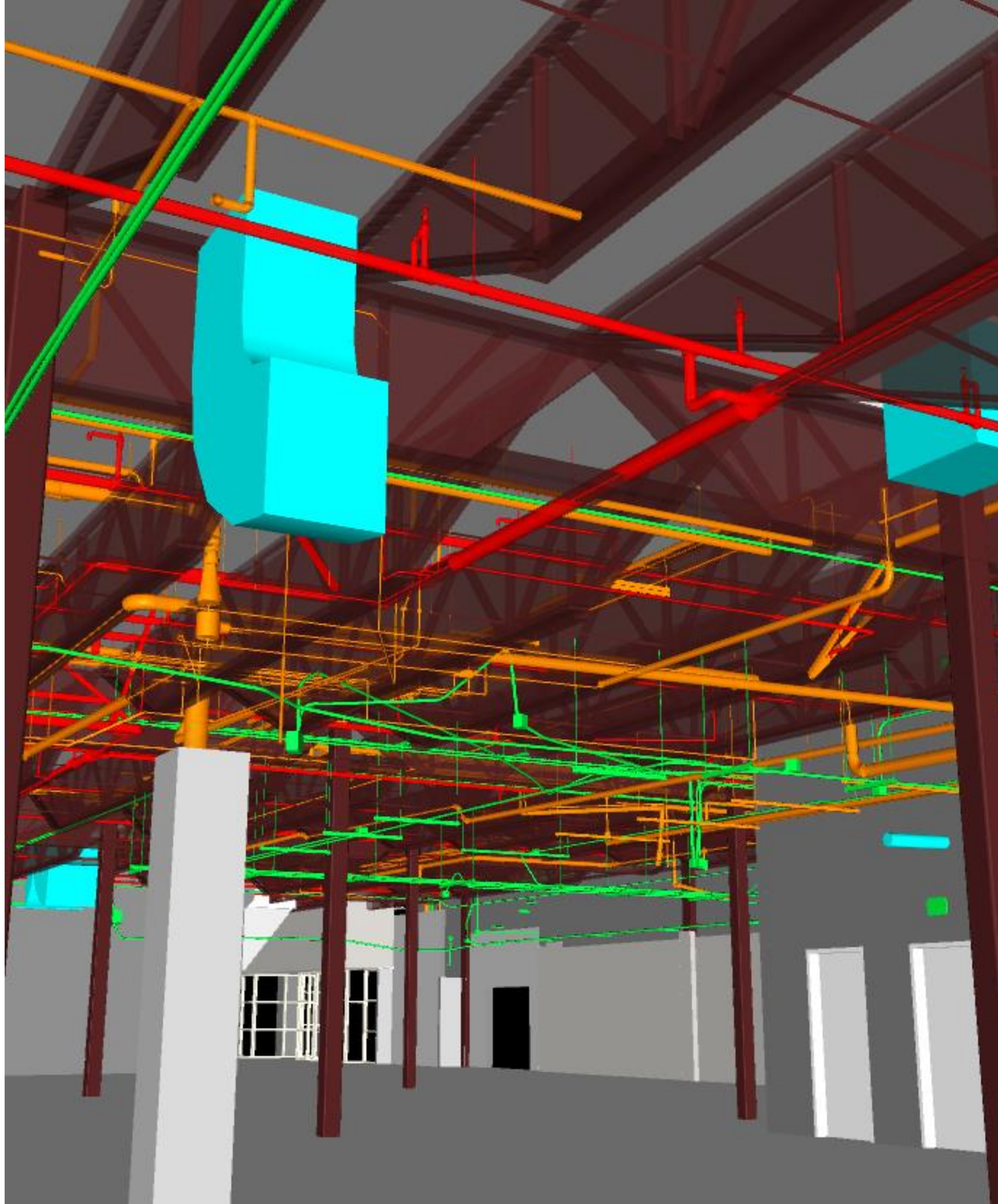
- Manual modeling and QA/QC can be slow
- Variety of software/plug-ins

Name	Developer	Type	Pros
Scan to BIM	Imaginit	Plug-In	Good for Walls and Columns
Edgewise	ClearEdge3D	Separate Application	Comprehensive auto-extraction for Arch, Struct, Pipes
PointSense	FARO	Plug-In	Good for Walls/Columns/Windows/Doors, Pipes; Awesome sectioning/slicing tool
Cloudworx	Leica	Plug-In	Good Slicing/Sectioning tool

QA/QC

Software Selection

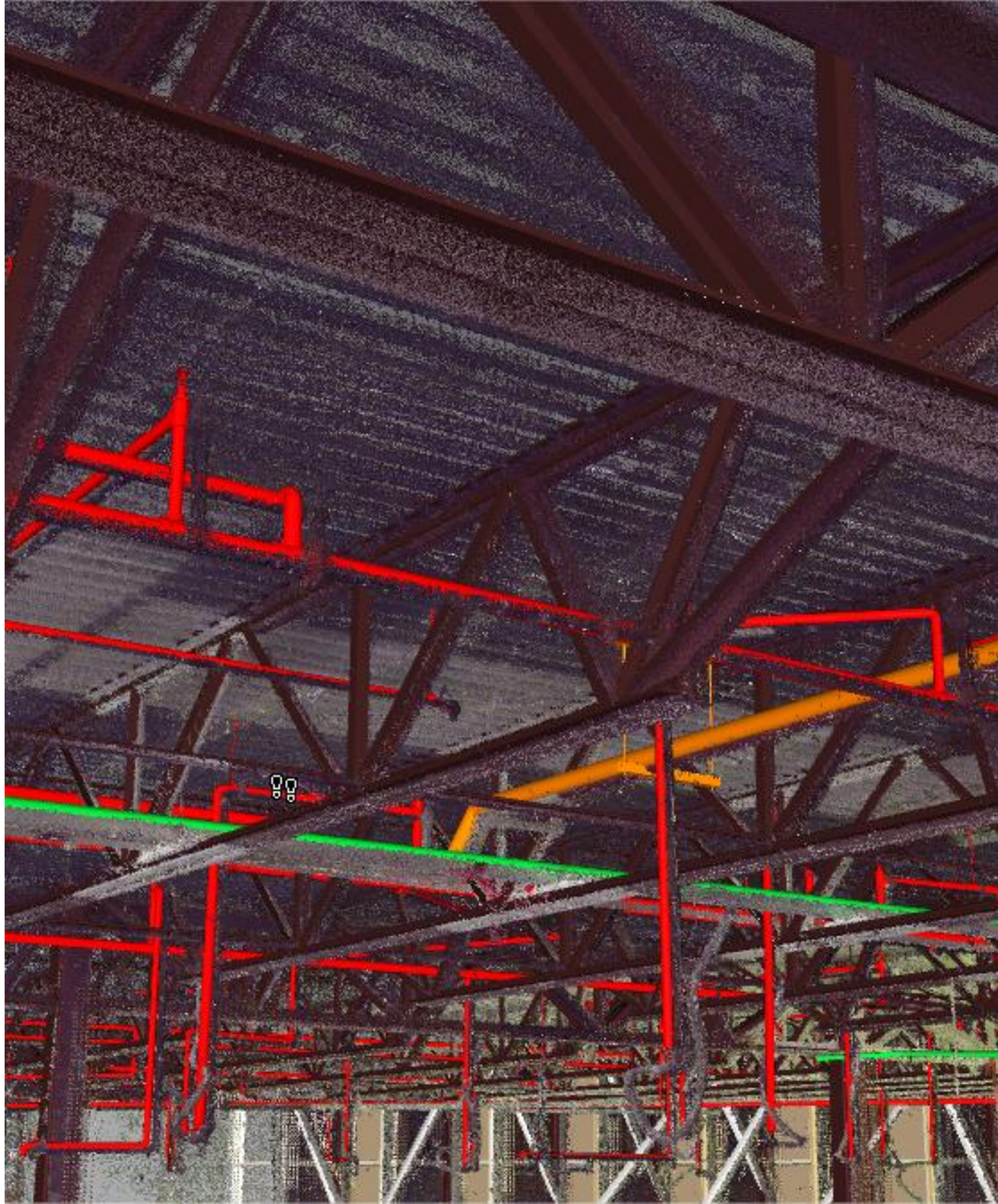
- Autodesk Navisworks Manage
  - Prior experience of team
  - Faster and accurate QA/QC



QA/QC

QA/QC – Tips

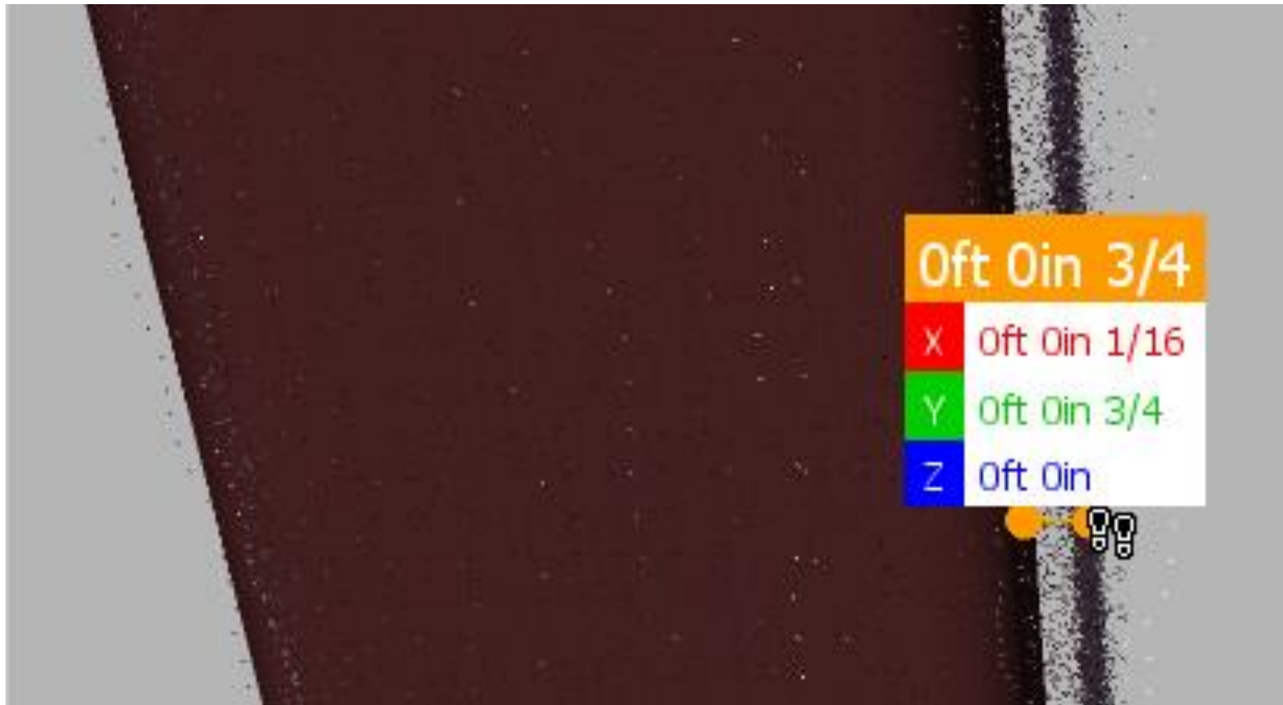
- Crucial for quality deliverable
- Append RCS with NWC
- Better visualization between Point Cloud and Model



QA/QC

QA/QC – Tips

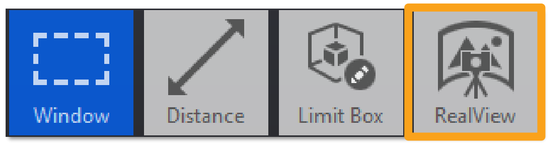
- Walk through the model
- Find missing modeled elements
- Measure deviation



QA/QC

QA/QC – Tips

- Time saved in QA/QC process
- Performing effective QA/QC



- NWD in Recap's photo view
  - Quick verification of missing modeled elements

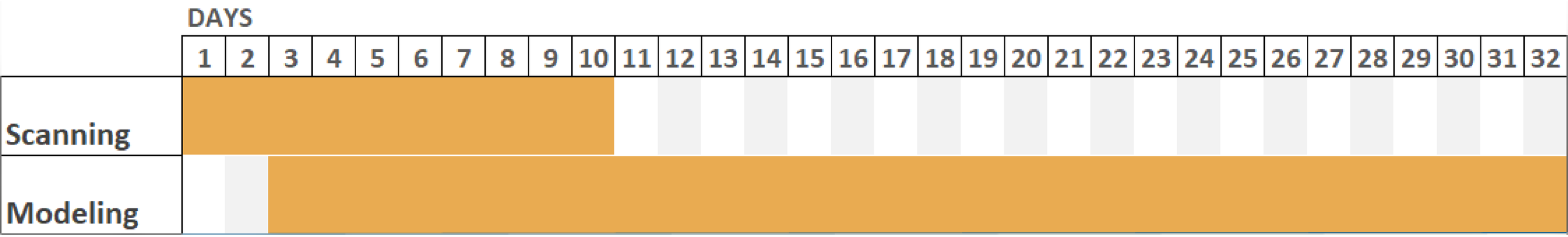
Summary

Requirement

- 6 Commercial Buildings; 2 floors each – 340,000 sq.ft
- Aggressive Schedule Required:- 30 days

Result

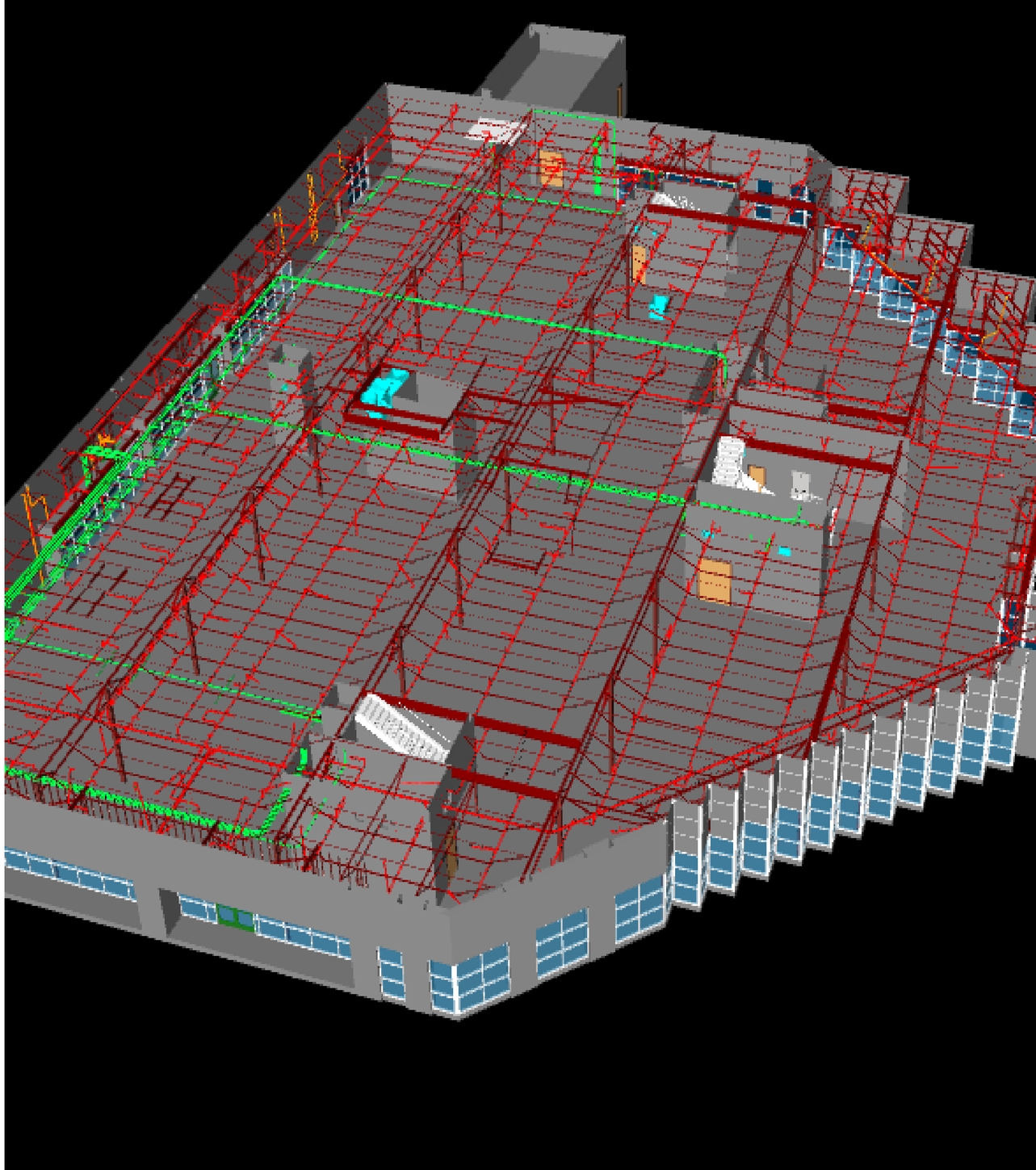
- Time spent in Scanning – 2 weeks
- Time Spent in Model Generation – 30 days
- Overall Project Time – 32 days



Summary

Best Practices

- In an aggressive timeline, save time by
  - Choosing the technology and equipment which brings value for the right application
  - Switching off photo mode during scanning
  - Using best suited Auto Extraction tool during modeling
  - Using of Navisworks for faster QA/QC process

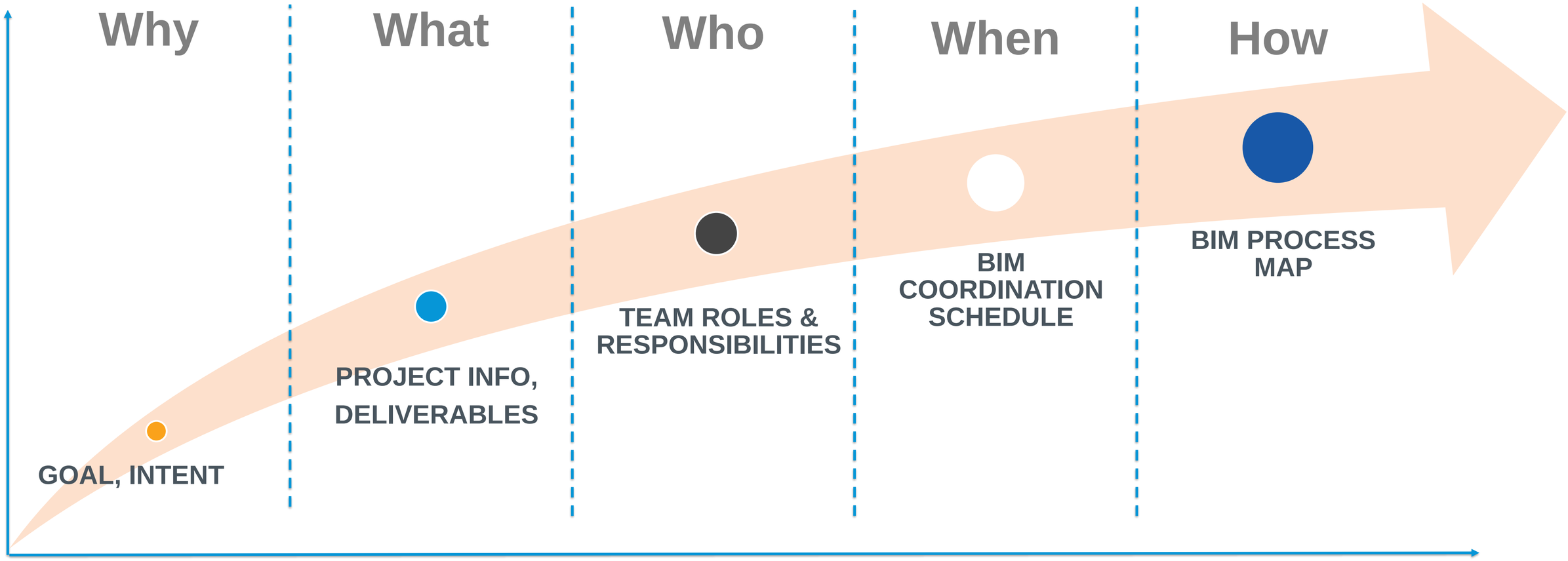


BIM Coordination Process

Workflow Overview

- THE BIM EXECUTION PLAN
- SETS AND CLASH TESTS IN AUTODESK NAVISWORKS
- REPORTS
- LESSONS LEARNED

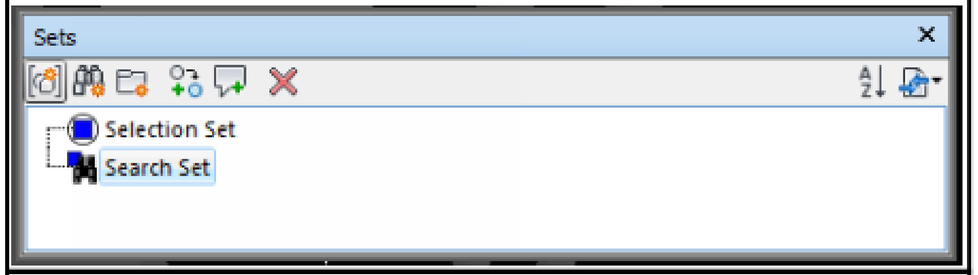
The BIM Execution Plan



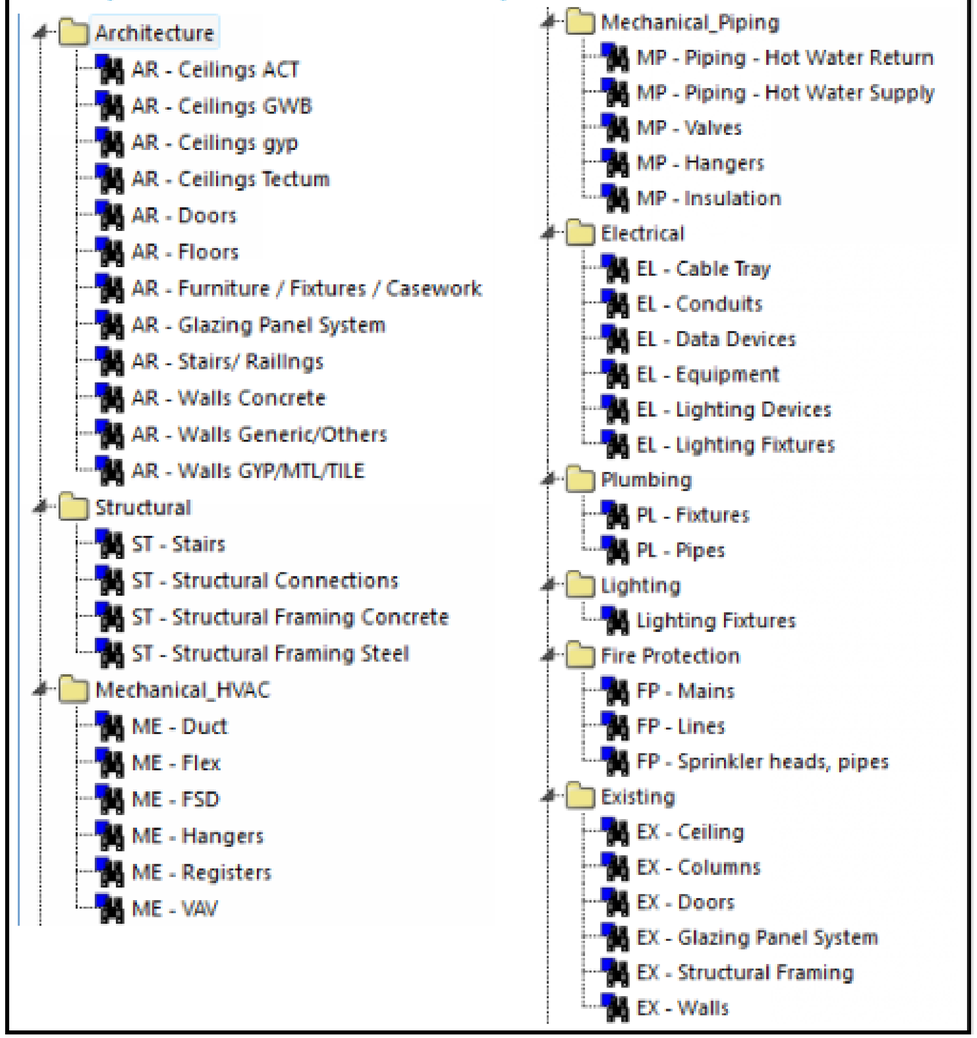
Sets

- To review models in Navisworks
- Can be organized into folders
- Selection Sets
  - Static
  - Cannot be exported and re-used
  - Use for model specific items, quick review, changing appearance/ hiding selected items
- Search Sets
  - Dynamic
  - Can be exported and re-used
  - Use for Appearance Profiler, Clash Detective, TimeLiner

Sets Window

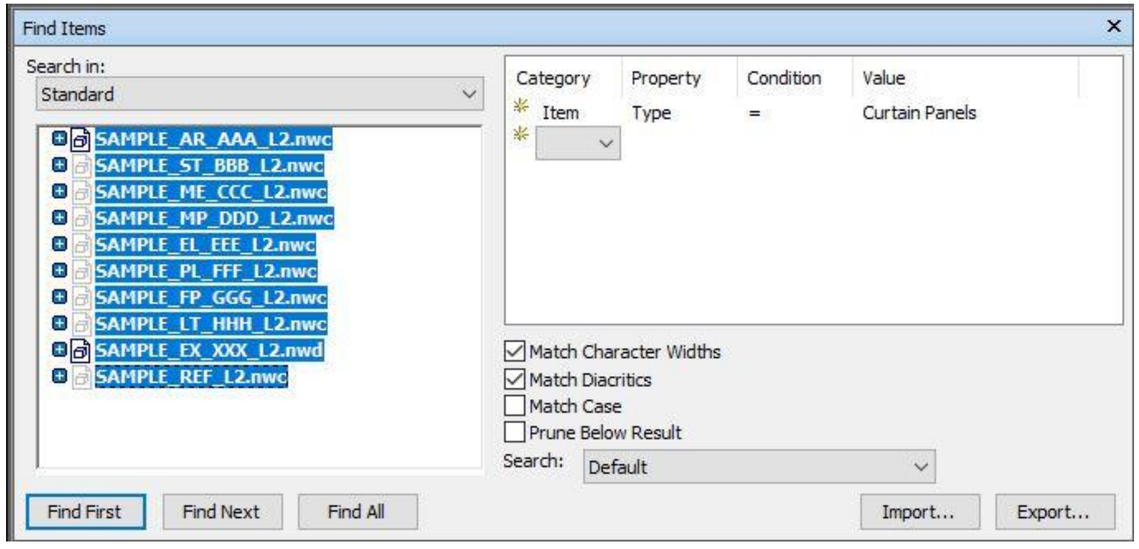


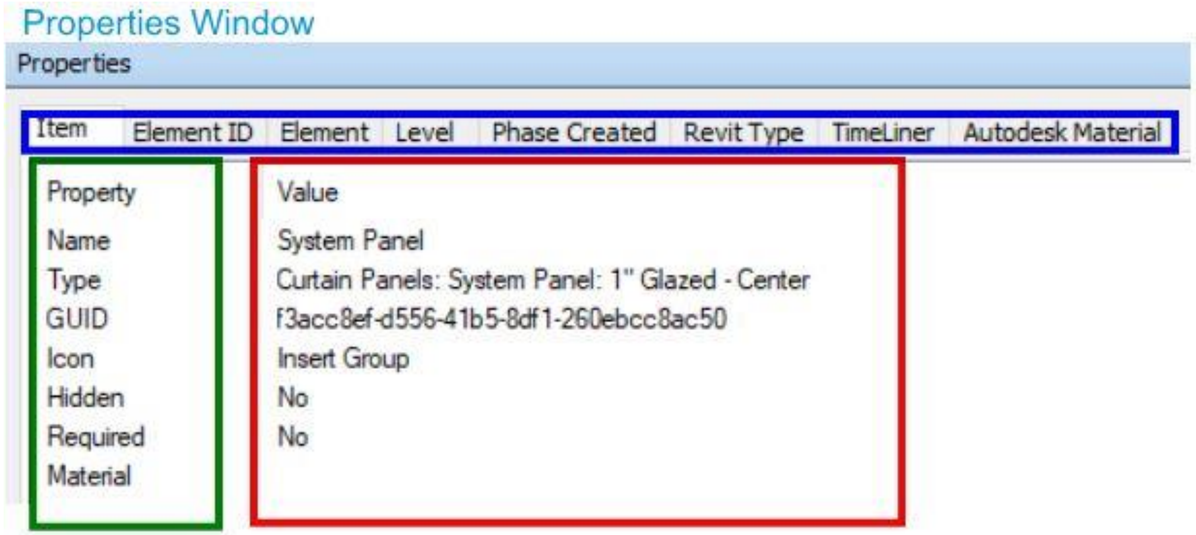
Sample Search Sets Template

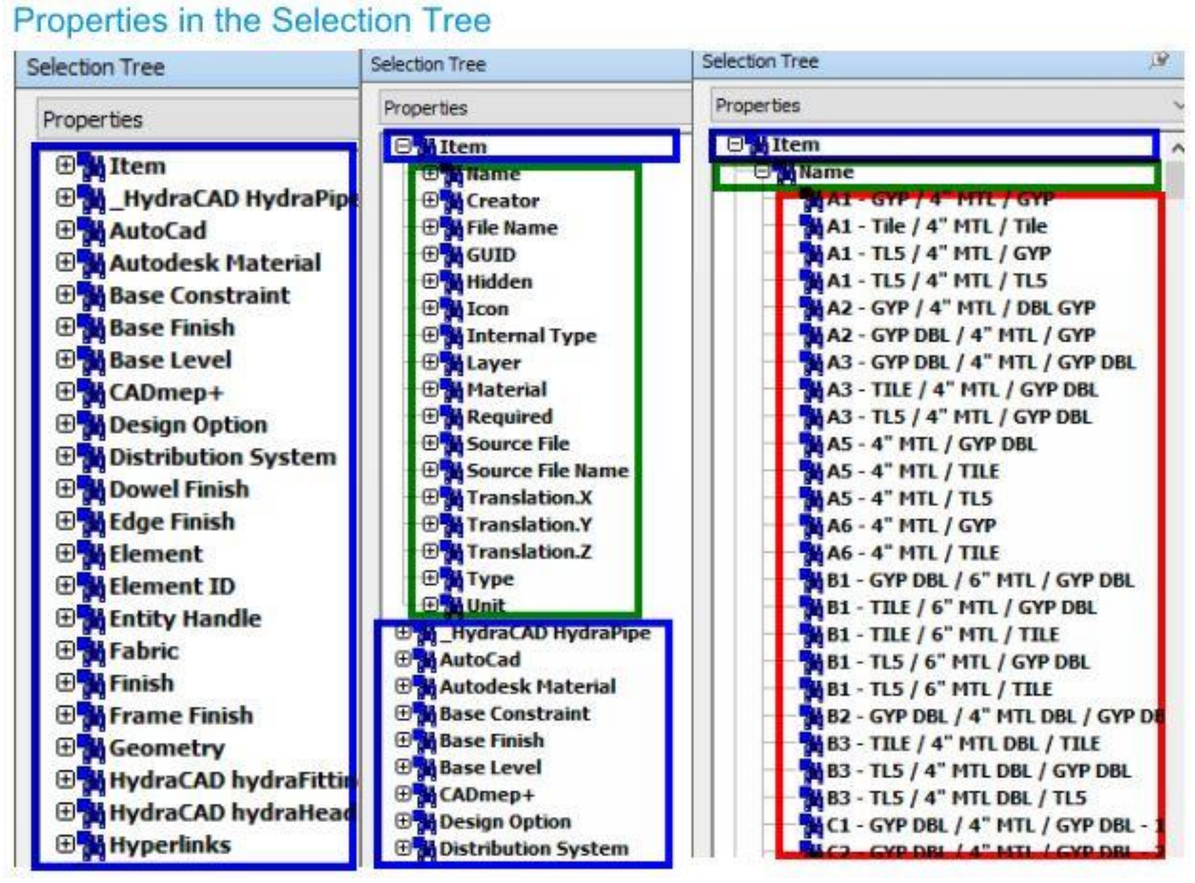


Searching by Criteria

- Category > Property > Value
- Review properties of a selected object using the Properties window
- Define criteria in the Find Items window
- Tip: Switching to Properties in the Selection Tree and clicking on a property/ value automatically populated criteria in the Find Items tool

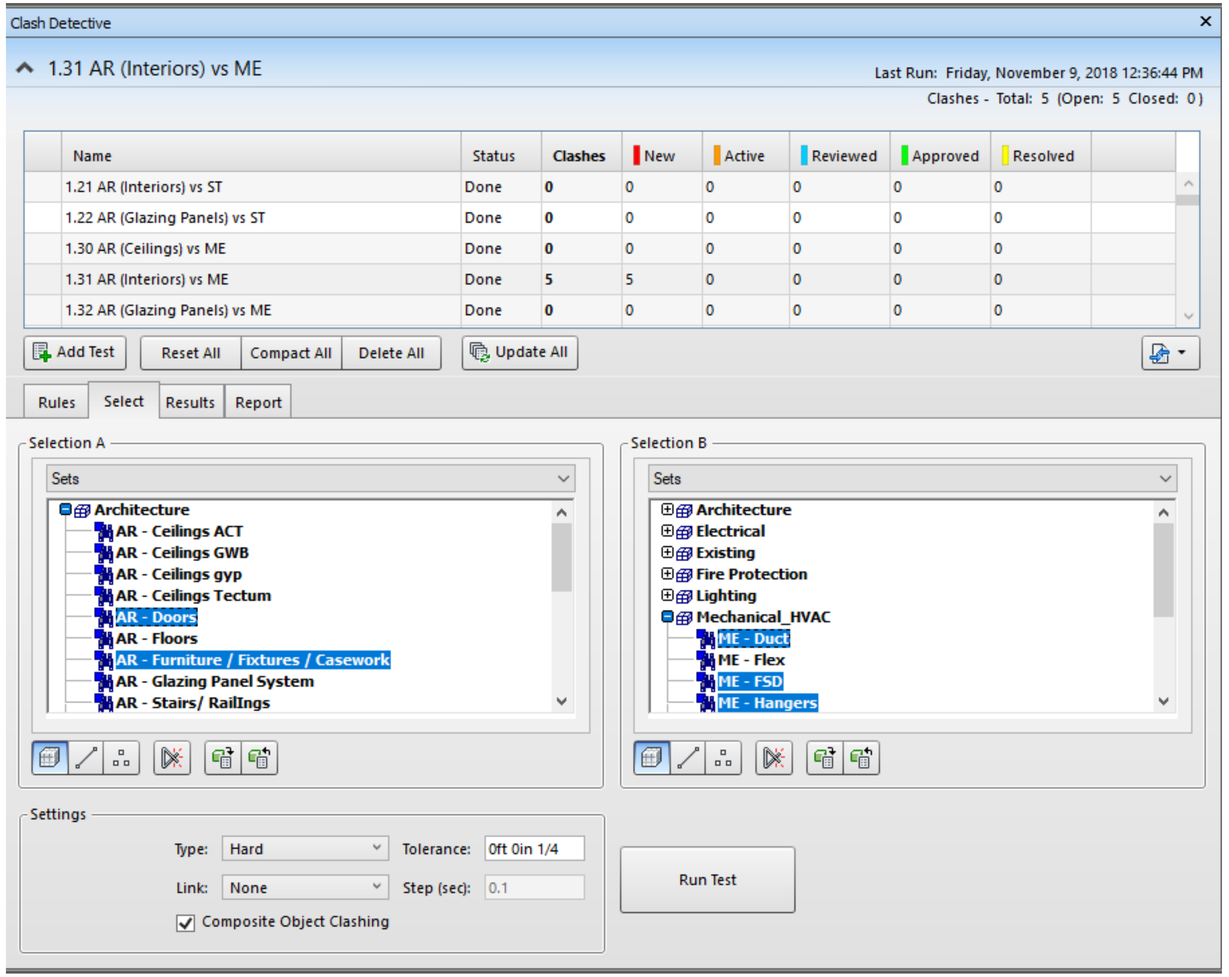






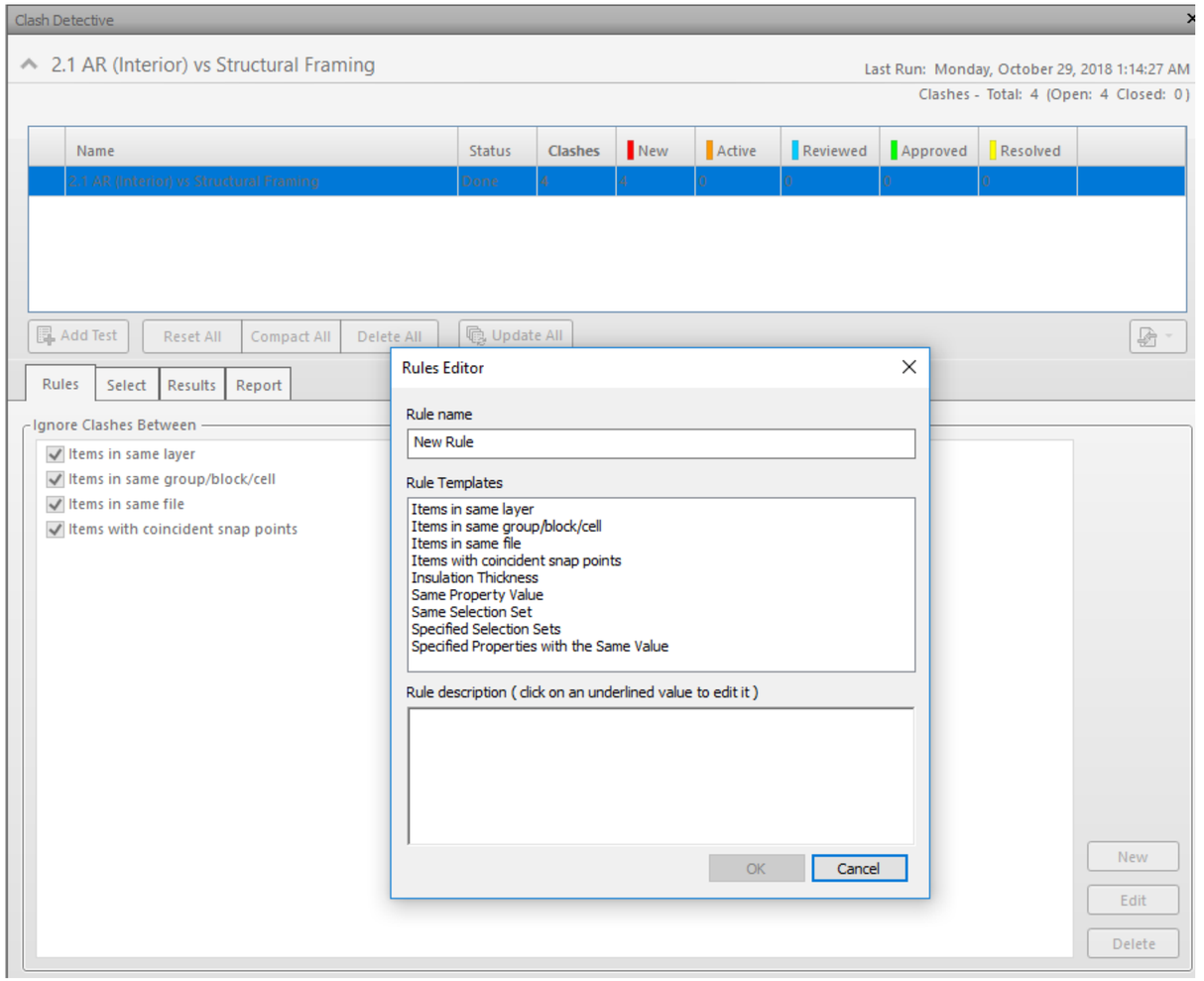
Clash Tests

1. Add Test
2. Rename Test
3. Choose Sets in Selection A, select sets
4. Choose Sets in Section B, select sets
5. Choose Type
6. Add Tolerance
7. Composite Object Clashing
8. Run Test



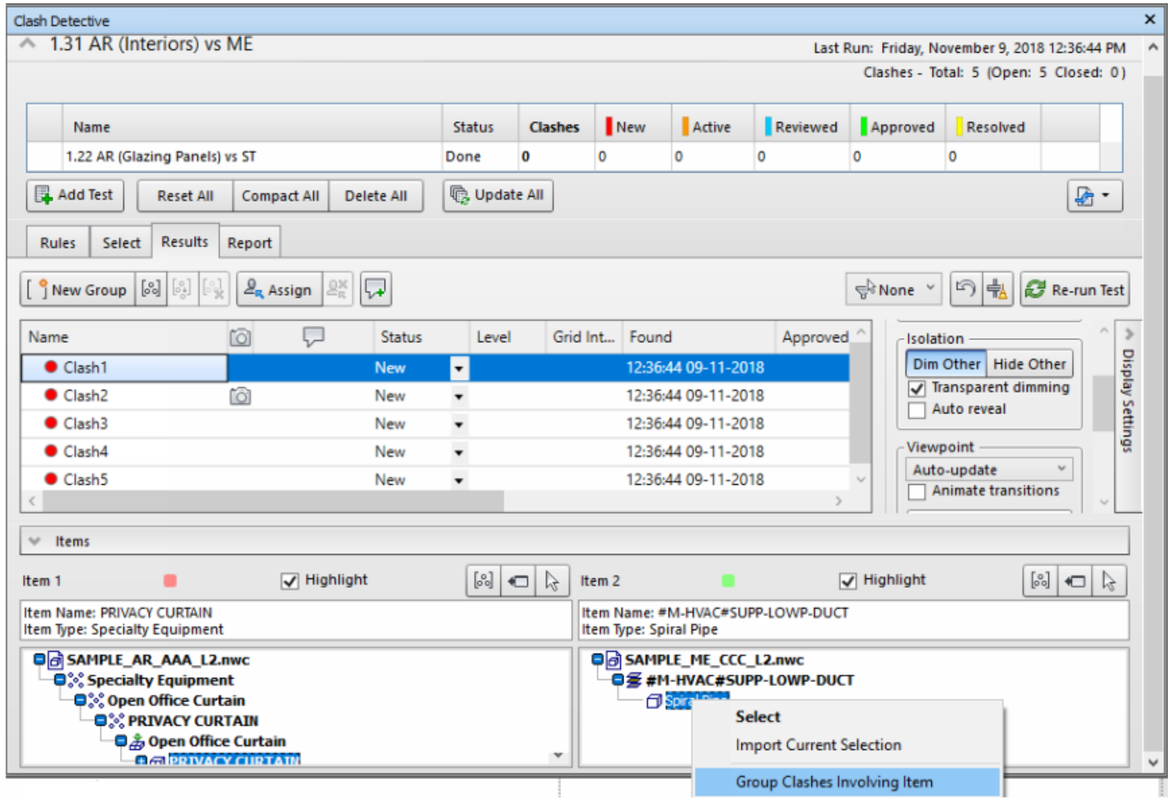
Rules Editor in Clash Detective

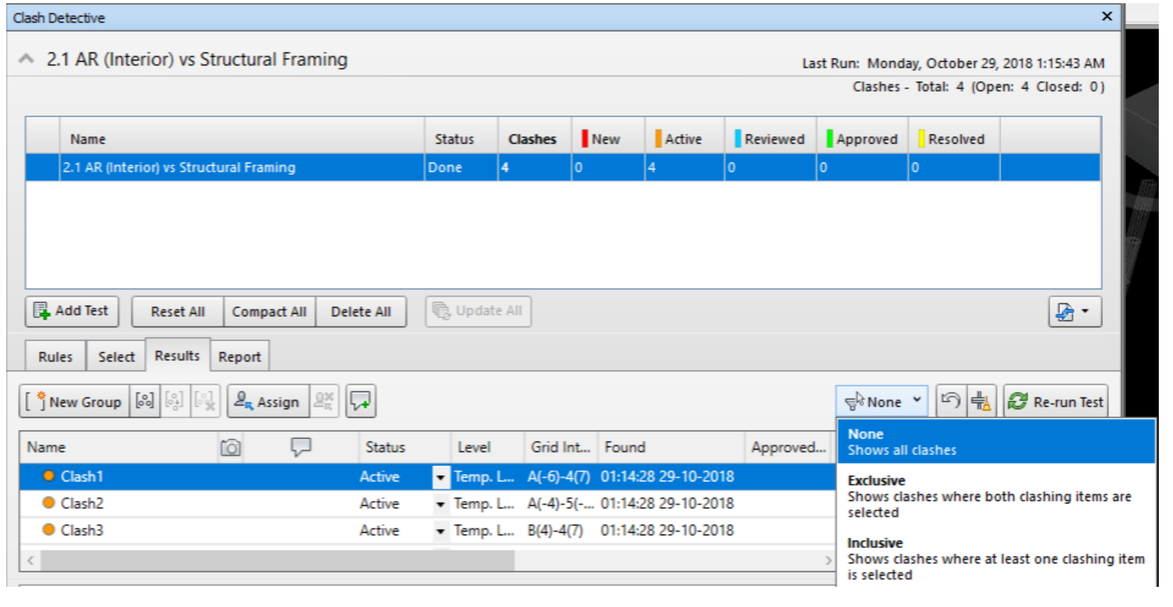
- Setting up clash tests with project specific rules at the beginning can save time later when running the same tests on updated models.
- In addition to the default rules, new rules can be set in Clash Detective using the Rules Editor
- In the Rules tab, click on New to open the Rules Editor window



Grouping and Filtering Clash Results

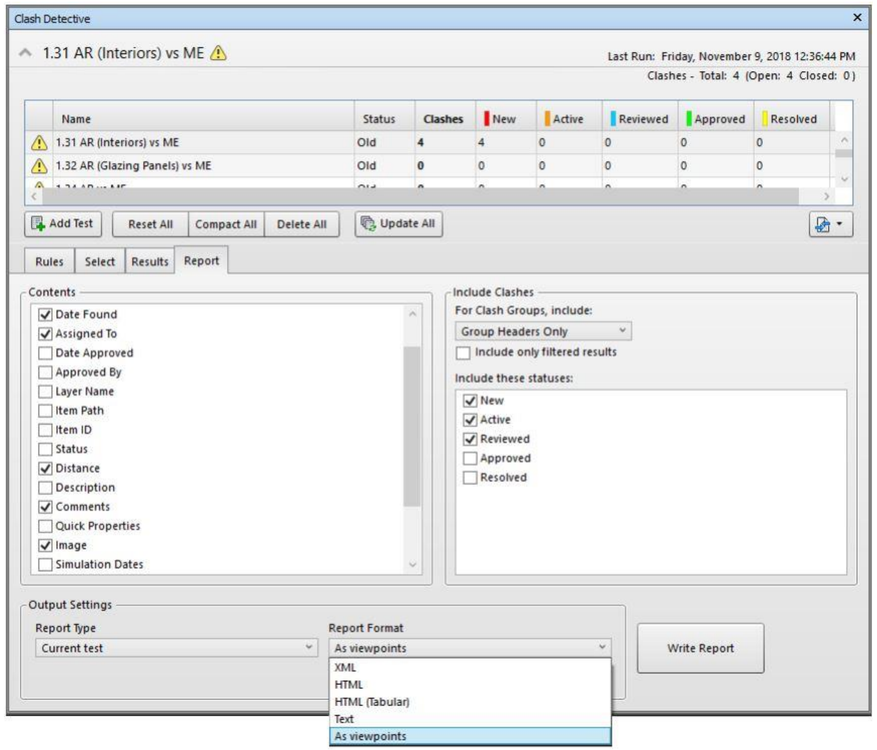
- One way to group clashes is to select the item in the results tab, right click and choose “Group Clashes Involving Item”.
- This will group all clashes involving that item in the clash test under one group.
- Apps available to group clashes by other criteria
- Sanveo developed a plug-in which has a feature to group by Selection A/ Selection B
- Clash results can be filtered by selected items using the Filter By Selection option in the Results tab.

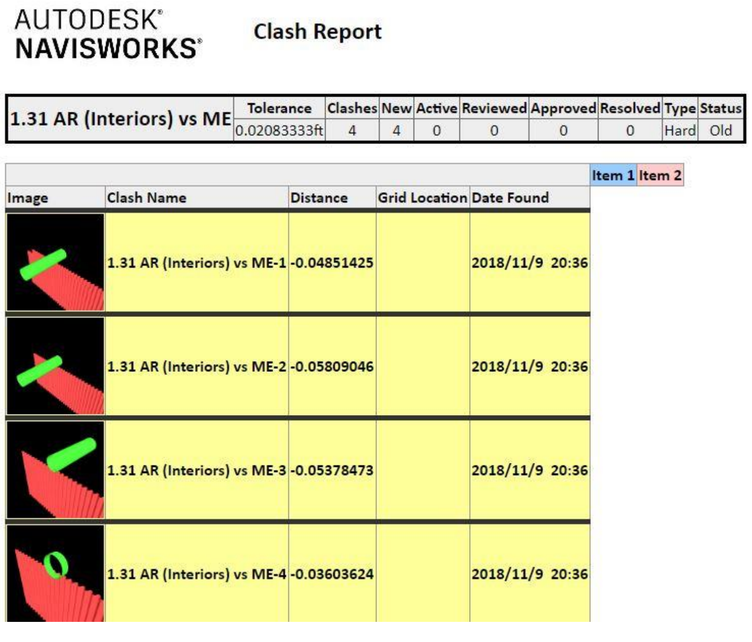




Reports

- Clash results can be exported directly from the Clash Detective in XML/HTML/Text formats (or) exported as Viewpoints and then the viewpoints can be exported as HTML reports
- Difficult to extract information on
  - Total number of clashes
  - Which trade has how many clashes pending
  - How different trades are performing over time

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Clash Report

1.31 AR (Interiors) vs ME	Tolerance	Clashes	New	Active	Reviewed	Approved	Resolved	Type	Status
	0.02083333ft	4	4	0	0	0	0	Hard	Old

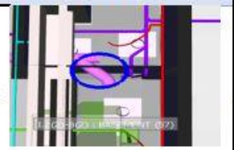
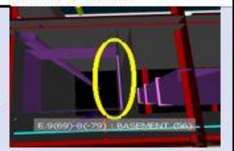
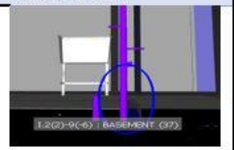
					Item 1	Item 2
Image	Clash Name	Distance	Grid Location	Date Found		
	1.31 AR (Interiors) vs ME-1	-0.04851425		2018/11/9 20:36		
	1.31 AR (Interiors) vs ME-2	-0.05809046		2018/11/9 20:36		
	1.31 AR (Interiors) vs ME-3	-0.05378473		2018/11/9 20:36		
	1.31 AR (Interiors) vs ME-4	-0.03603624		2018/11/9 20:36		

Custom Reports

- Sanveo developed an add-in that exports an Excel Coordination Log
- Extracts information from the viewpoint name on
  - when a clash is opened
  - which trades are involved
  - which trade is responsible for resolving a clash
  - priority
  - clash status
  - if resolved – the date it was resolved

Project Name

Sample Clash Report: DD/MM/YYYY | **Sign Off:** DD/MM/YYYY | **Updated:** DD/MM/YYYY

S.No.	Date Raised	Trade	Viewpoint	Action By	Priority	Status	Date Closed	Notes
1	10/15/2018	AR vs ME	 AR vs ME-01	CCC	Normal	Open		
2	10/15/2018	AR vs ME	 AR vs ME-02	CCC	Normal	Open		
3	10/22/2018	AR vs ME	 AR vs ME-03	CCC	Normal	Open		
4	10/8/2018	AR vs PL	 AR vs PL-01	AAA	High	Open		
5	10/8/2018	AR vs PL	 AR vs PL-12	FFF	Normal	Open		
								

Custom Dashboard

- Developing on the information available in the Excel report, Sanveo developed a dashboard view
- Dashboard content
  - clash matrix
  - bar graph showing no. of open clashes for each trade
  - performance graph showing the % of clashes closed by each trade, and
  - clash count over project duration

Lessons Learnt

- Meeting durations
  - Shorter the better
- Clash Assignment
  - Establish Viewpoint Naming conventions in the BEP
  - Assign every clash to a trade in the saved viewpoints
- Scope and LOD
  - Finalize LOD and scope before BIM coordination starts
  - Example: Light fixtures - modeled by lighting designer or electrical trade, nominal sizes or actual sizes
- Action Item Tracker
  - Shared location, accessible by everyone
  - Keep track of all follow-up items from all meetings

Action Item Tracker

Action Item #	Unique identifier
Action Description	Full description of action item
Assigned To	Person/ trade who is responsible for completing this item
Priority	Relative priority: 1-High, 2-Medium, 3-Low
Date Added	Date this action item was added to this list
Target Date	Desired date this item should be completed
Status	Status of item: 1-Not started, 2-In progress, 3-Complete
Status Comments	Running status comments on item. Format with most recent comment FIRST, include date and initials.
Completion Date	Date this item was complete.
Notes on Completion/ Results	Notes or results on the completion of this item, such as final decision document location, results of implementing requested fix, etc

Thank You

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Reminder

Request to please do the class survey