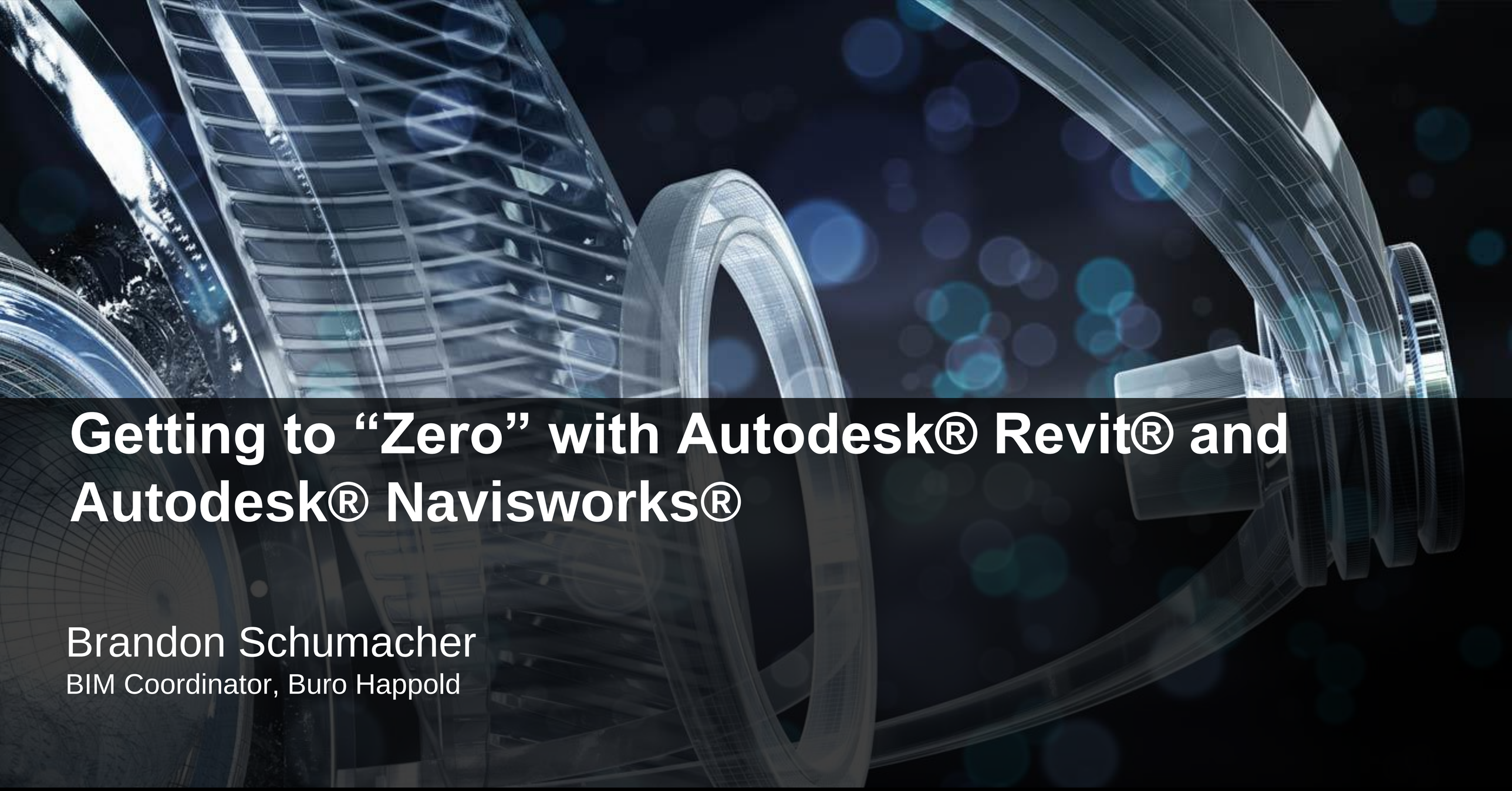


Getting to “Zero” with Autodesk® Revit® and Autodesk® Navisworks®

Brandon Schumacher
BIM Coordinator, Buro Happold

Class Summary

Even with a fully coordinated Revit® model of every discipline, Architectural beauty comes at the cost of a challenging construction phase. In this Lecture, you will learn how coordination on the Yale School of Management was managed using Navisworks in conjunction with fabrication-quality modelling. Rule-based clash detection will be explored as a primary evaluation and visualization method for coordination problems and developing real-time solutions in the BIM Model. Participants will leave the lecture with a clear understanding of how to best integrate and utilize clash detection to coordinate a building of any level of complexity.

Learning Objectives

At the end of this class, you will:

- Realize how to Coordinate MEP systems, structures and architecture in an architecturally complex building.
- Learn the benefits and the pitfalls of using BIM and clash detection to coordinate a project.
- Understand how the coordination processes changes when using BIM, including meetings required, the participants needed and the project workflow.
- Grasp how to include reasonable constructability tolerances in the coordination process to minimize contractor claims in the field and reduce project risk.

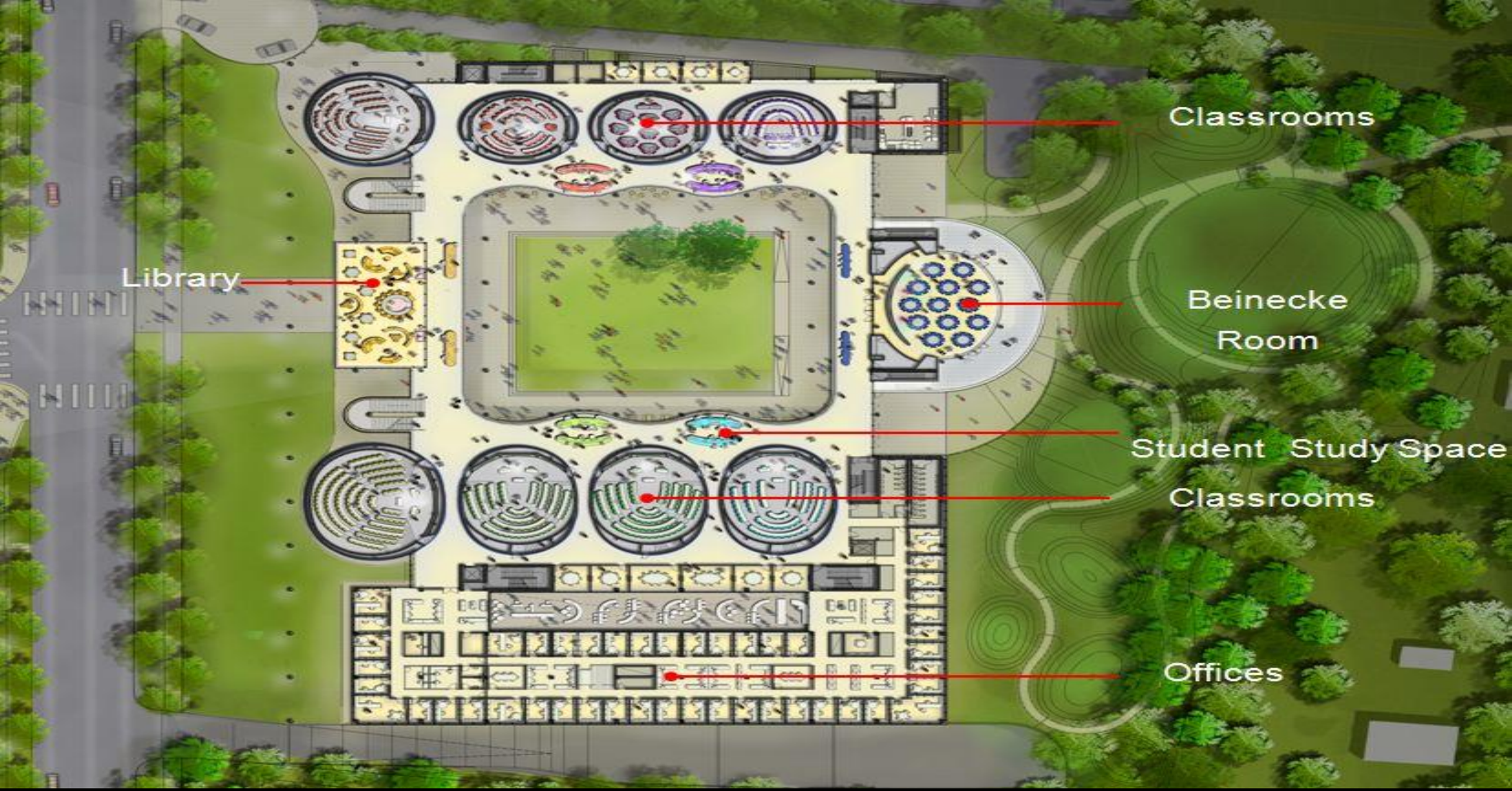
INTRODUCTION

1. THE PROJECT
2. THE BIM PROCESS: PREP & DOCUMENTATION
3. THE CLASH DETECTION PROCESS
    - “ZERO” AND MANAGING THE EXPECTATIONS
    - NAVISWORKS WORKFLOW
    - EVOLVING WEEKLY COLLABORATION
    - QUANTIFIYING DE-CLASHING TIME
    - BEST PRACTICES

THE PROJECT:
Yale School of Management

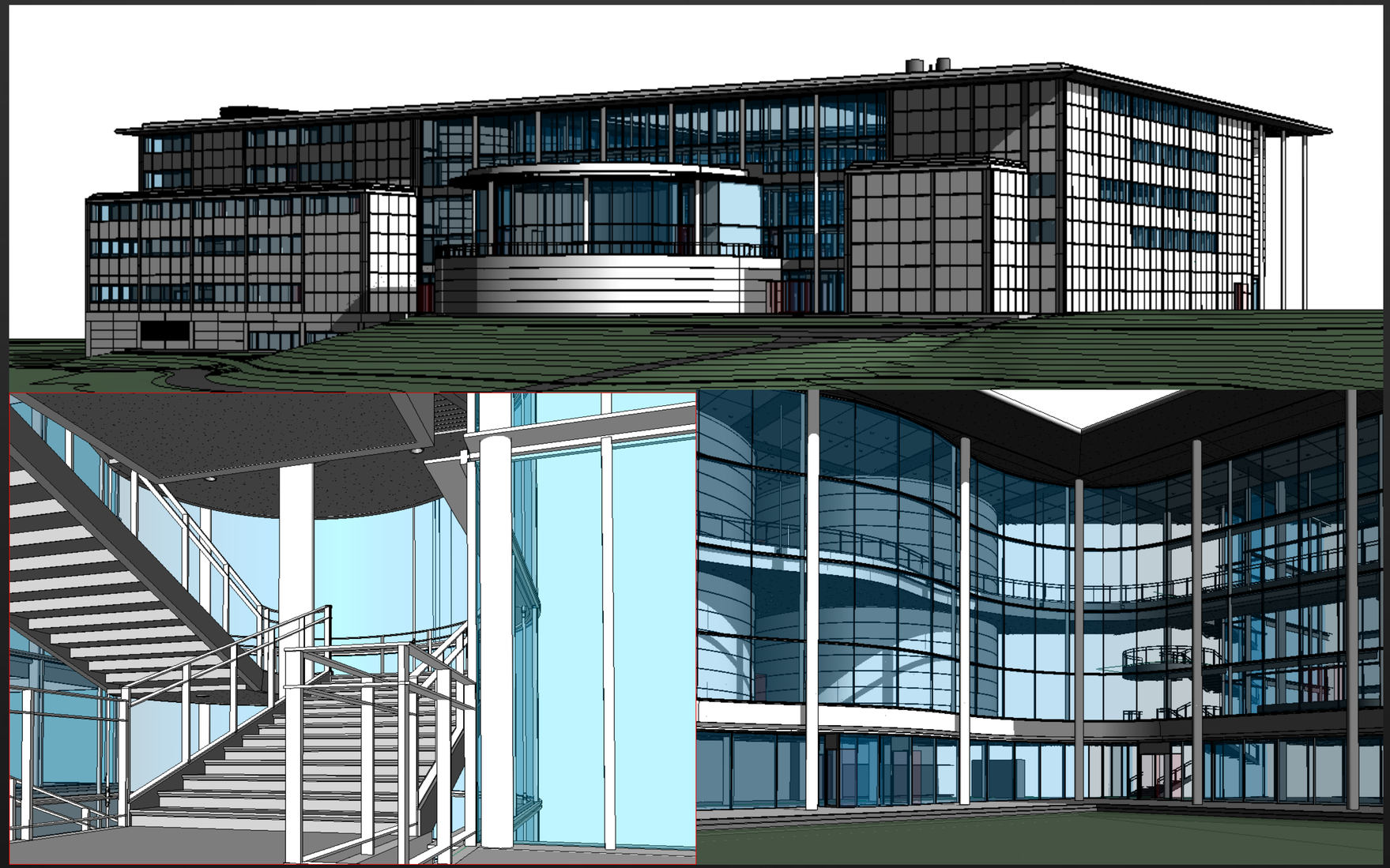
PROJECT QUICK FACTS:

- DESIGN ARCHITECT: FOSTER + PARTNERS
- ARCHITECT OF RECORD: GRUZEN SAMTON
- GENERAL CONTRACTOR: DIMEO
- SITE: YALE UNIVERSITY MAIN CAMPUS, NEW HAVEN, CT
- SIZE: 235,000 SF
- PROJECT VALUE: $250M
- TARGET COMPLETION DATE: APRIL 2014
- SERVICES PROVIDED: S, M, E, P, FP, LEED, COSA
- LEED CERTIFIED

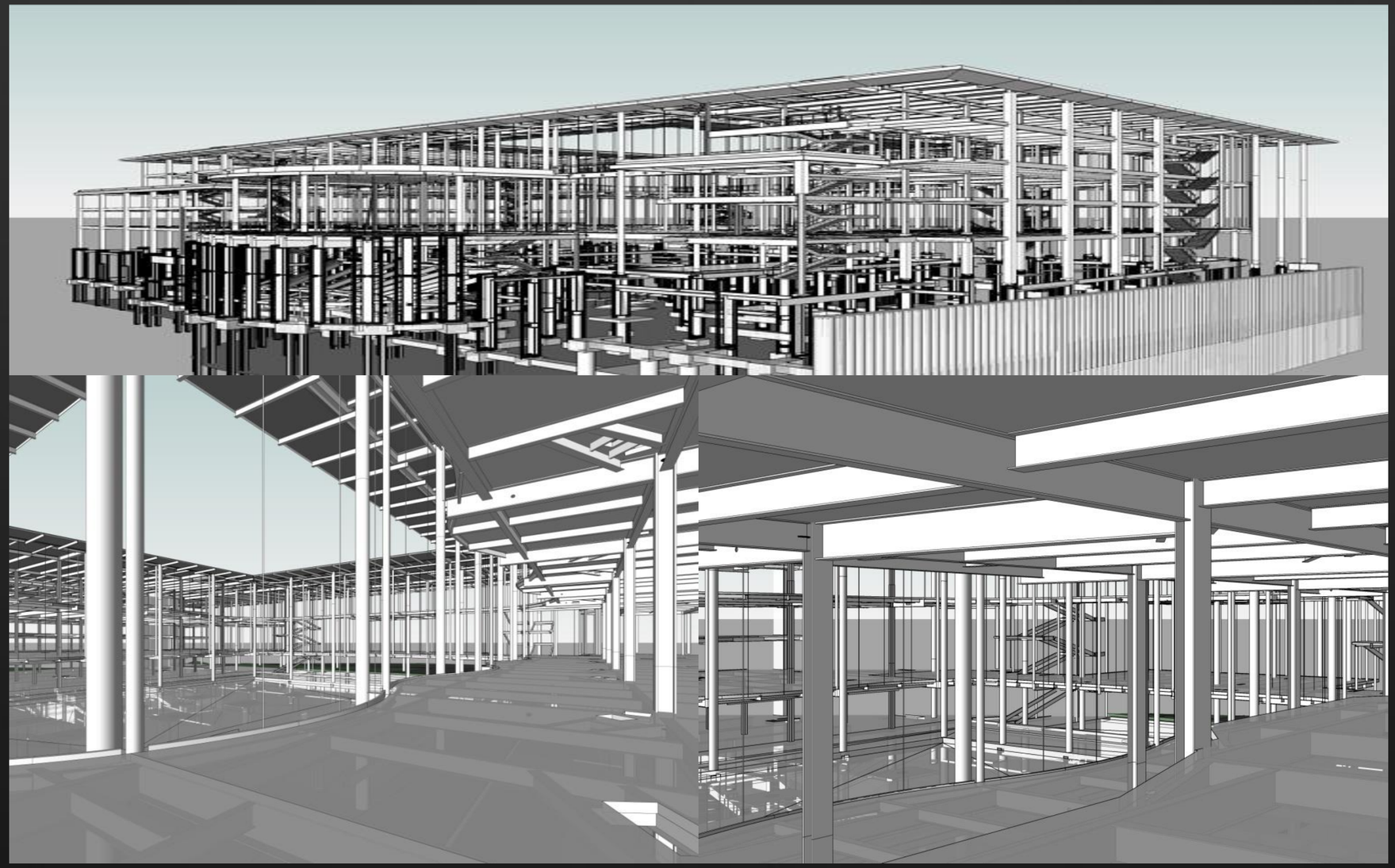


THE BIM PROCESS

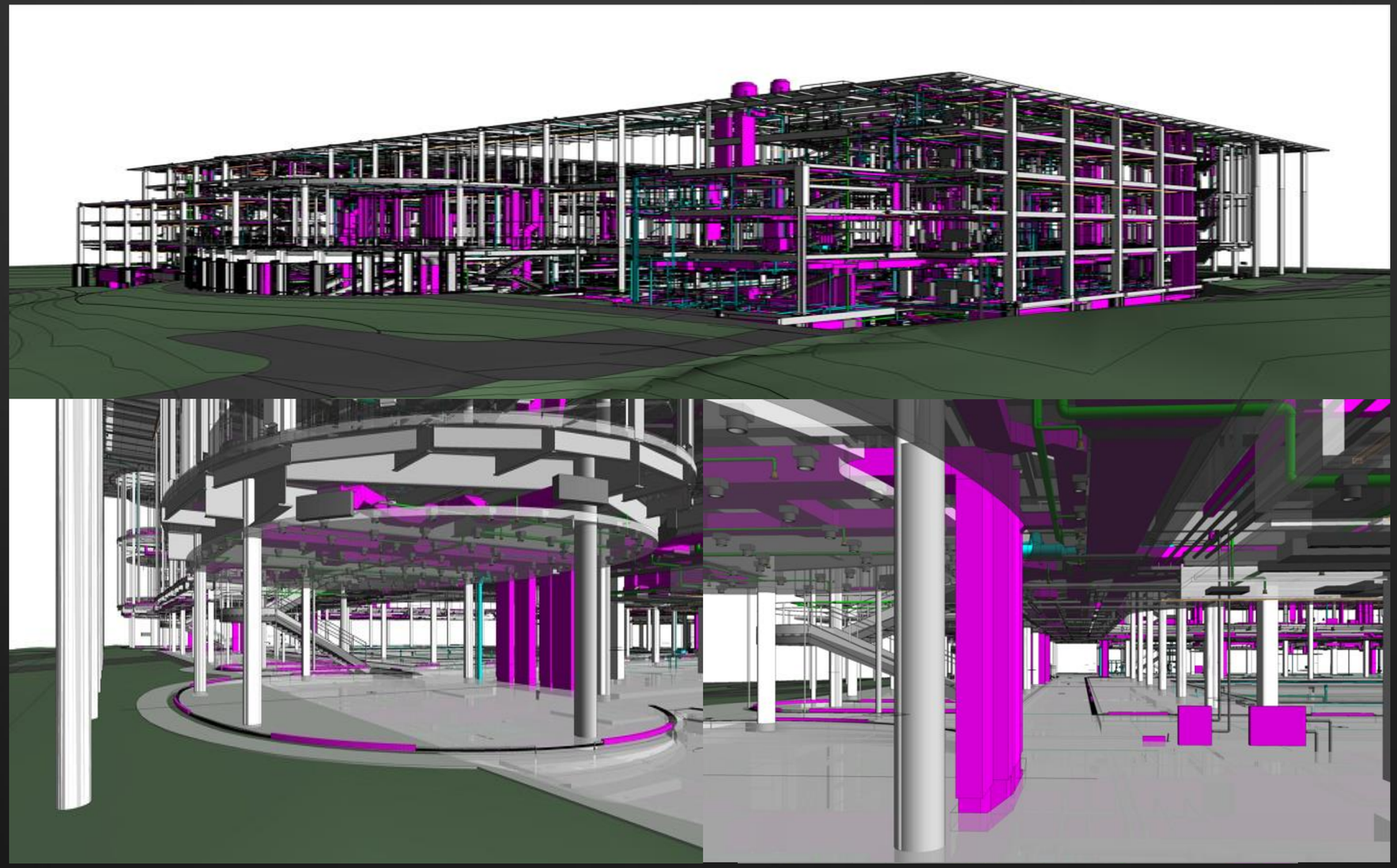
BIM DOCUMENTATION: ARCHITECTURE



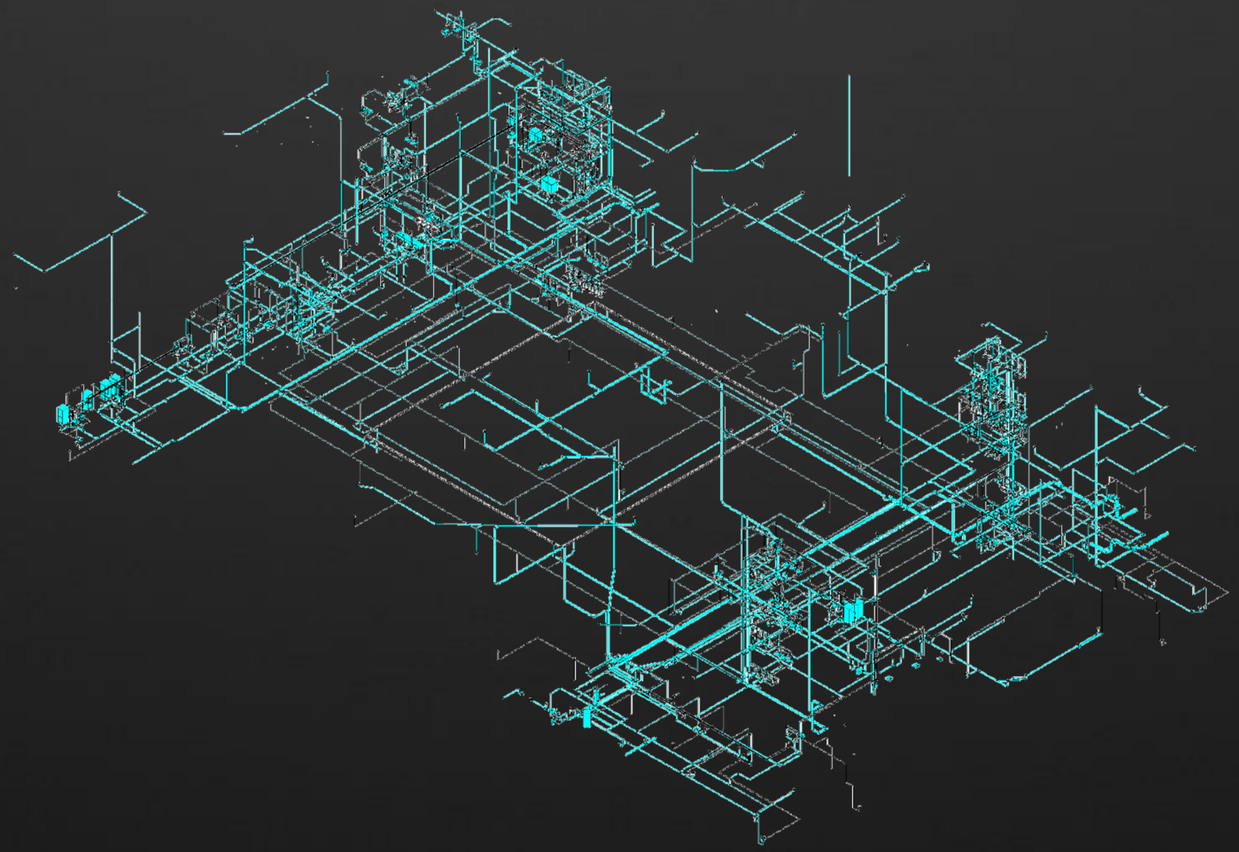
BIM DOCUMENTATION: STRUCTURE



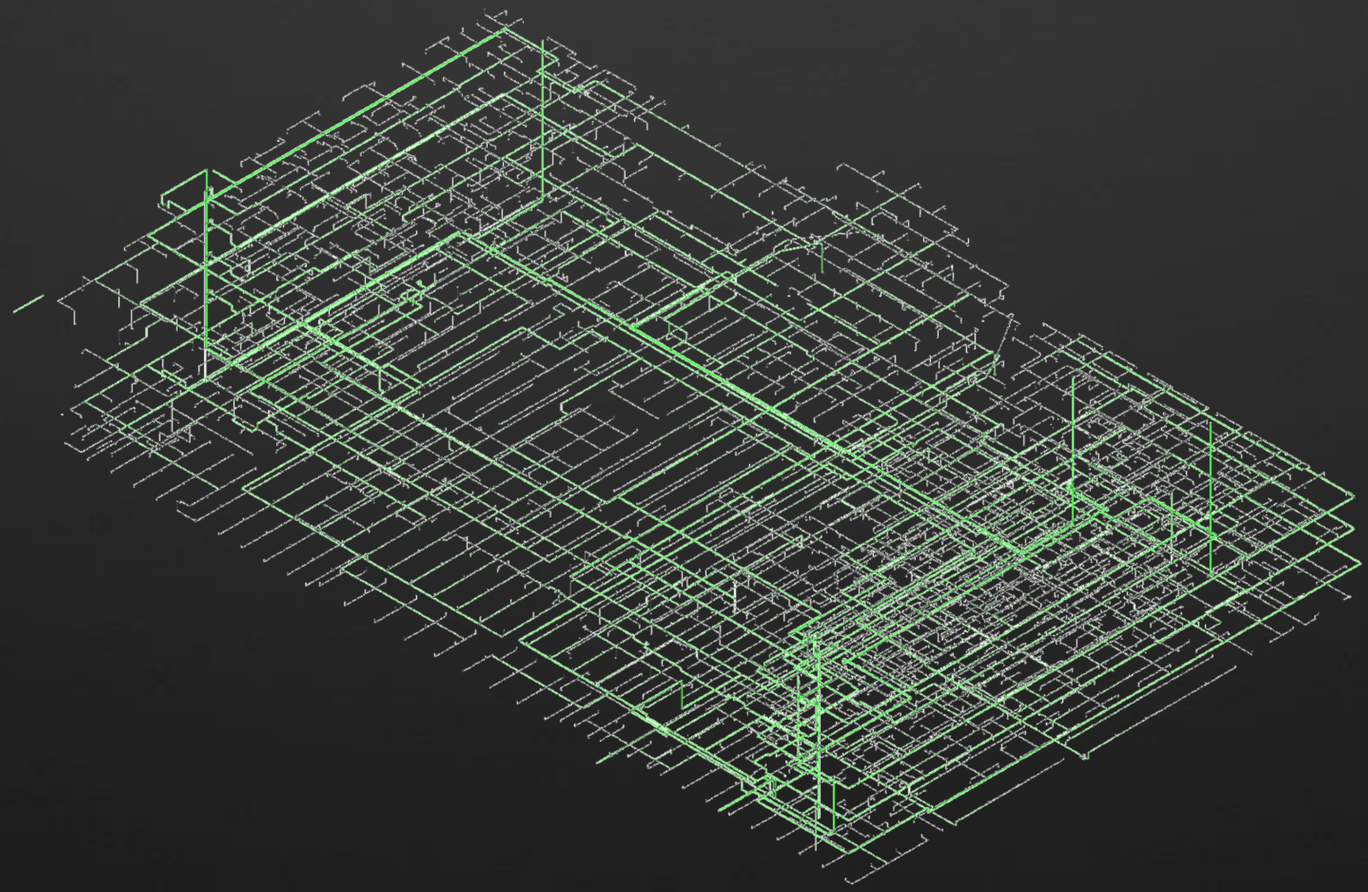
BIM DOCUMENTATION: M, P & FP



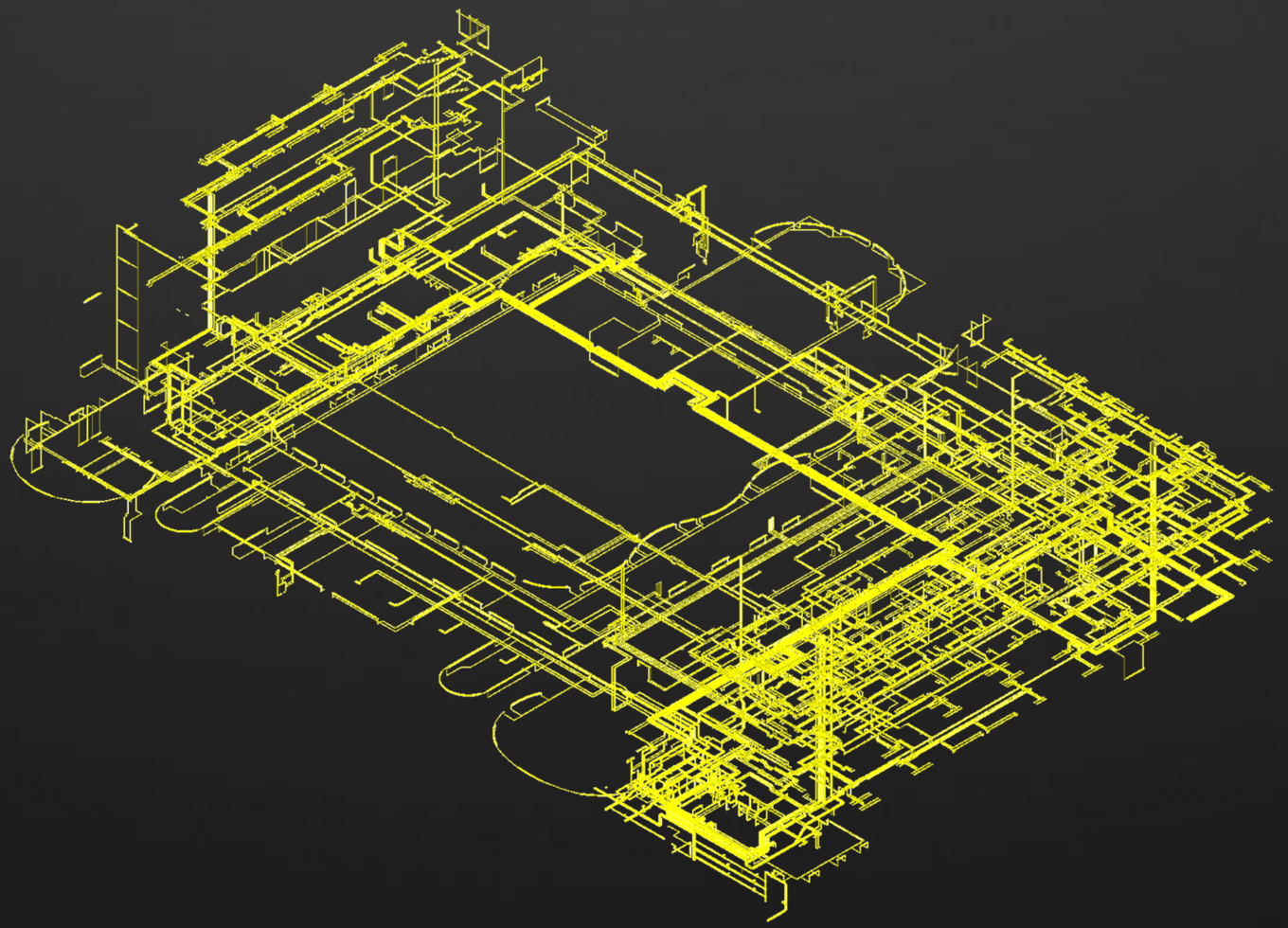
BIM DOCUMENTATION: PLUMBING



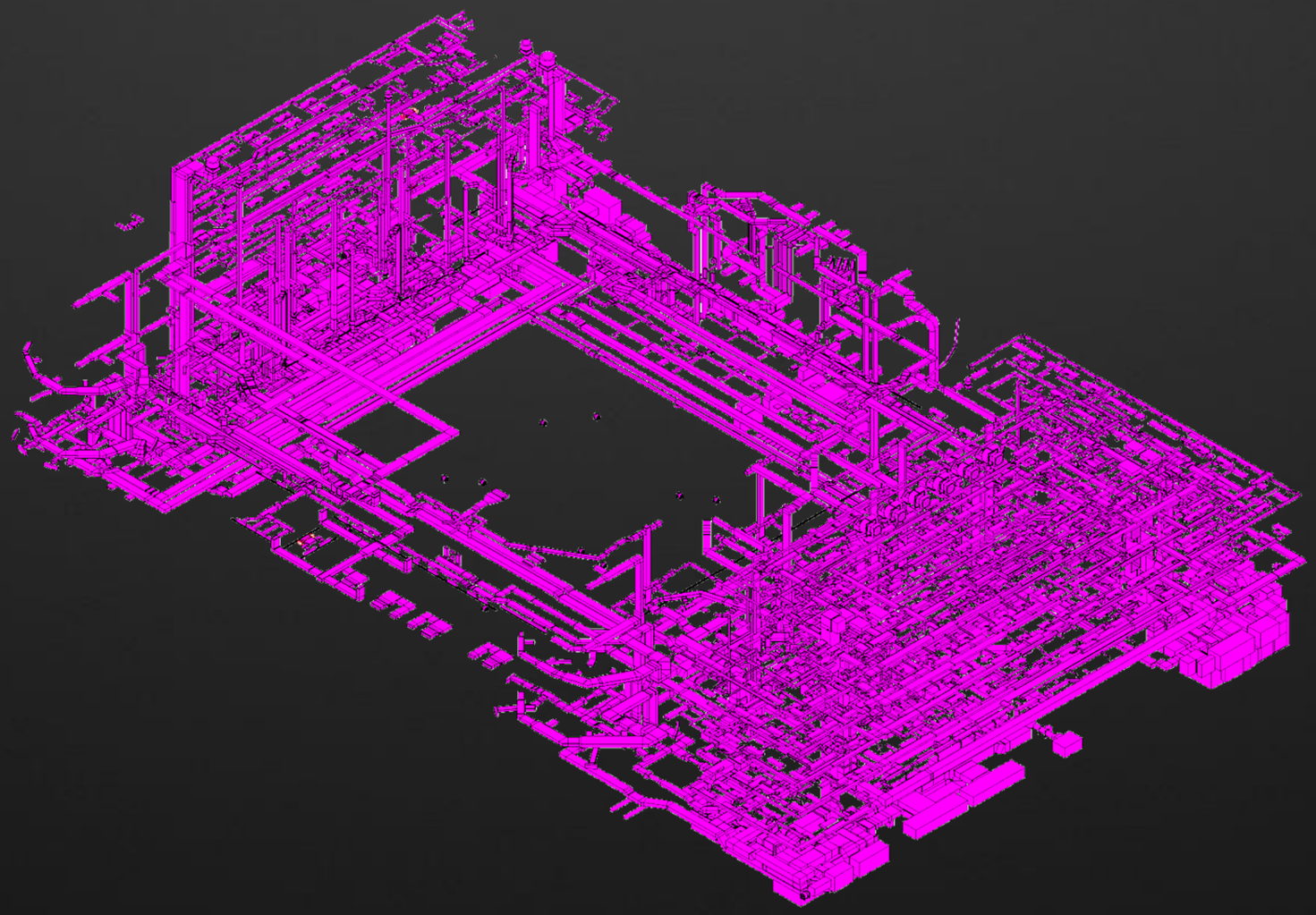
BIM DOCUMENTATION: SPRINKLERS



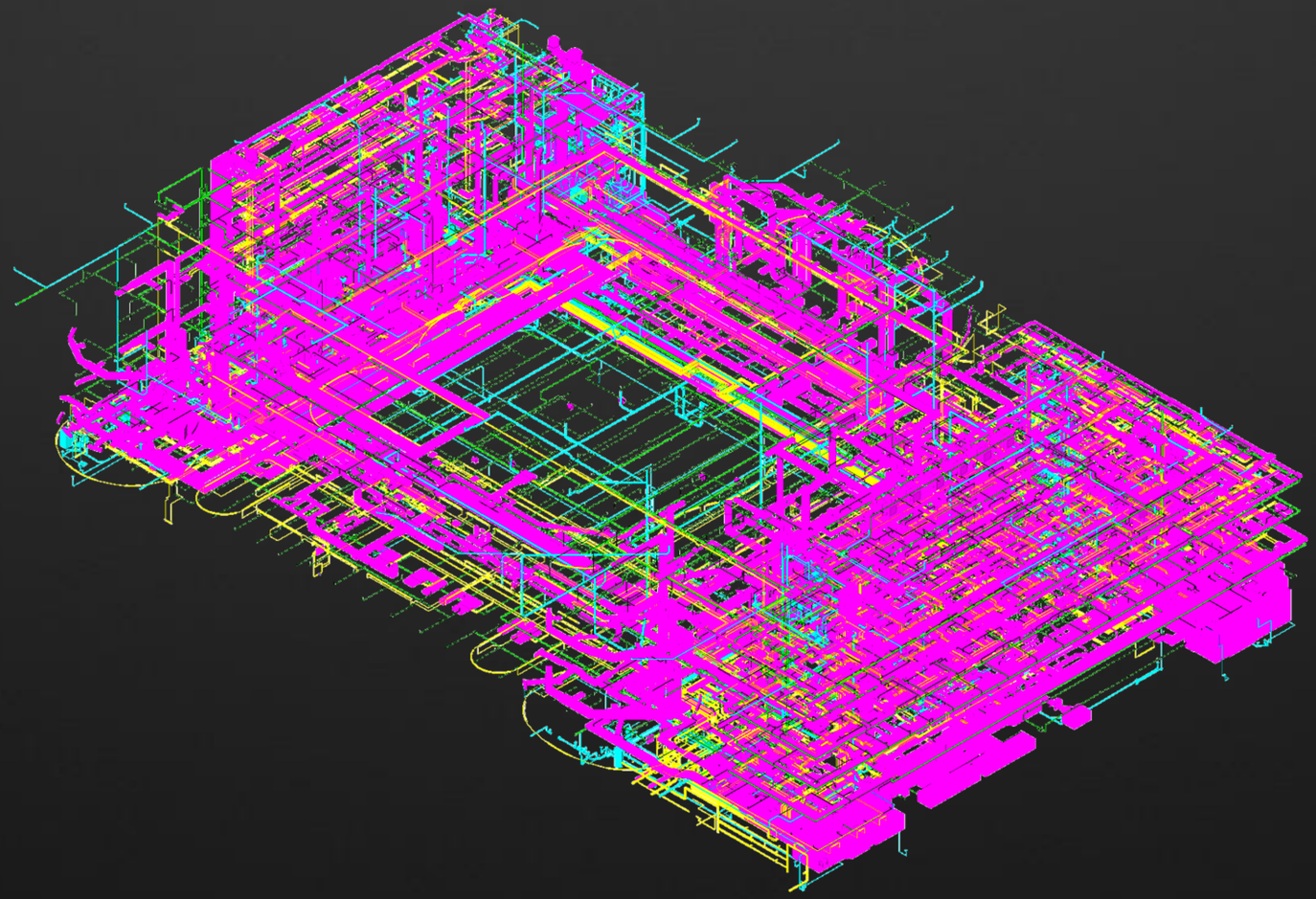
BIM DOCUMENTATION: MECH PIPING



BIM DOCUMENTATION: MECH DUCTS



BIM DOCUMENTATION: M, P & FP

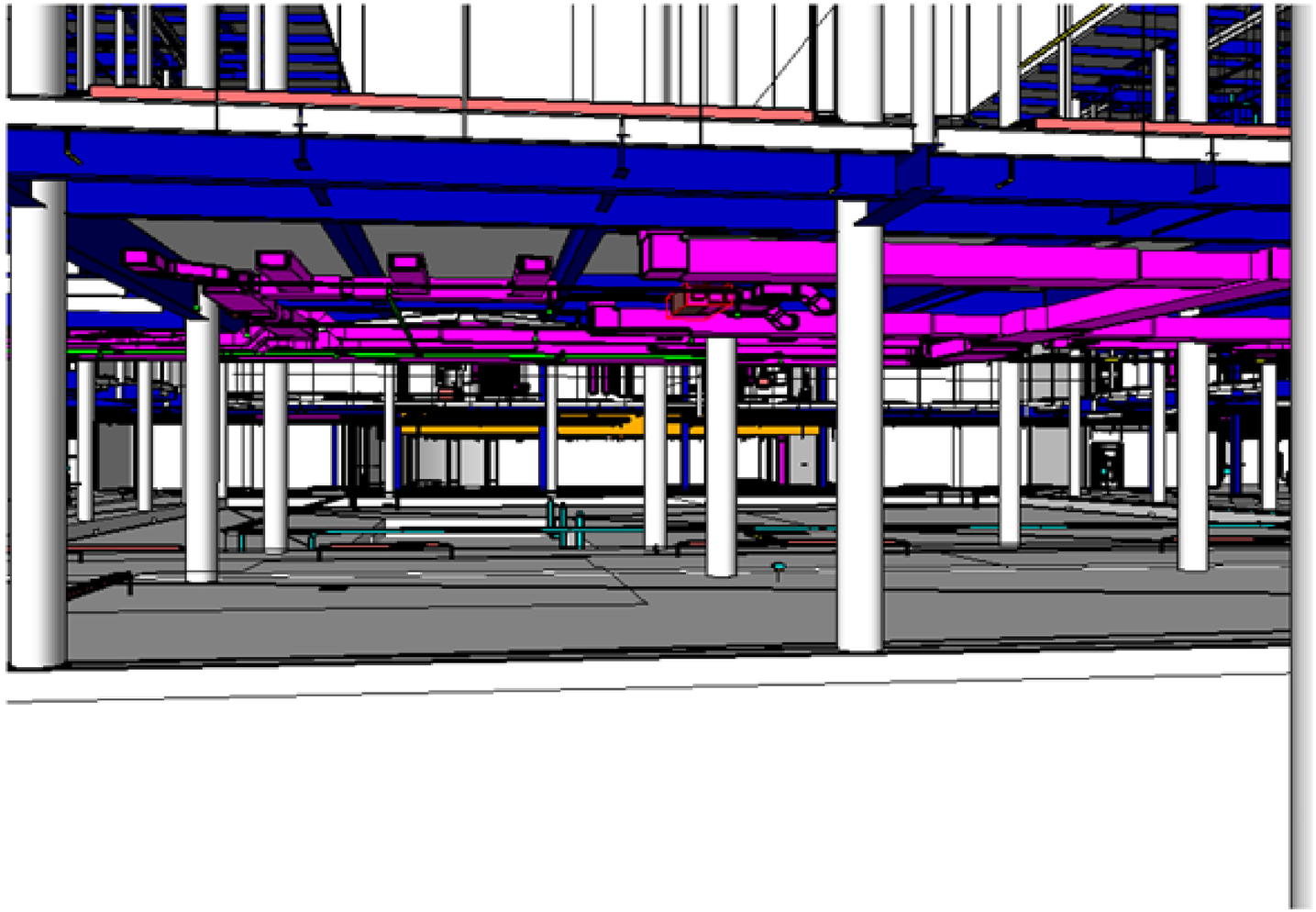


CORRIDOR

FROM COURTYARD

STEEL DETAILS

WALKTHROUGH



BIM DOCUMENTATION: MODELED

MODELED, CLASHED

- DUCTWORK – ALL RISERS, MAIN LINES & BRANCH DISTRIBUTION
- MECH PIPES – ALL RISERS, MAIN LINES & BRANCH DISTRIBUTION
- PLUMBING – ALL RISERS, MAIN LINES & BRANCH DISTRIBUTION
- SPRINKLERS – ALL RISERS, MAIN LINES & BRANCH DISTRIBUTION

MODELED, BUT NOT CLASHED

- PRESSURIZED & BRANCH PIPING 2” OR SMALLER

BIM DOCUMENTATION: NOT MODELED

NOT MODELED = NOT CLASHED

- NO CONDUIT [LOD 400 – 500]
- NO RECEPTACLES, NO DEVICES
- NO BOLTS, GUSSET PLATES, CONNECTIONS

THE CLASH DETECTION PROCESS

CLASH DETECTION – BENEFITS / PITFALLS
LEARNING OBJECTIVE 2

BENEFITS:

- ENABLES AMBITIOUS GOALS TO BE REALIZED.
- ALLOWS IDENTIFICATION OF TIGHT SPOTS DURING DESIGN PHASE [INSTEAD OF CA]
- VISUALIZATION OF THE PROBLEMS ENABLES FINDING QUICK SOLUTIONS

PITFALLS:

- UNDERESTIMATING THE TIME REQUIRED
- MANAGING THE PROCESS & DE-CLASHING TAKES LOTS OF EFFORT / TIME / RESOURCES
- FAILURE TO MANAGE YOUR CLIENT'S EXPECTATIONS

CLASH DETECTION vs. 2D COORD.

LEARNING OBJECTIVE 3

DOES THE COORDINATION PROCESS CHANGE?

HOW: ALL 3D DESIGN MODELS VS. 2D SEQUENTIAL OVERLAY

WHO: THE DESIGN MODELERS VS. PROJECT LEADS

WHEN: VARIES VS. AFTER DESIGN IS DONE

▪ VS

THE CLASH DETECTION PROCESS

GOALS:

1. “ZERO” CLASH BIM MODELS – OWNER REQ.
2. REDUCE EFFORTS REQUIRED FOR CONTRACTOR COORDINATION

CONSTRAINTS:

- 12 WEEKS
- 5 BH STAFF RESOURCED TO THIS TASK
- WEEKLY PROGRESS MEETINGS
- ENTIRE DESIGN TEAM PARTICIPATED

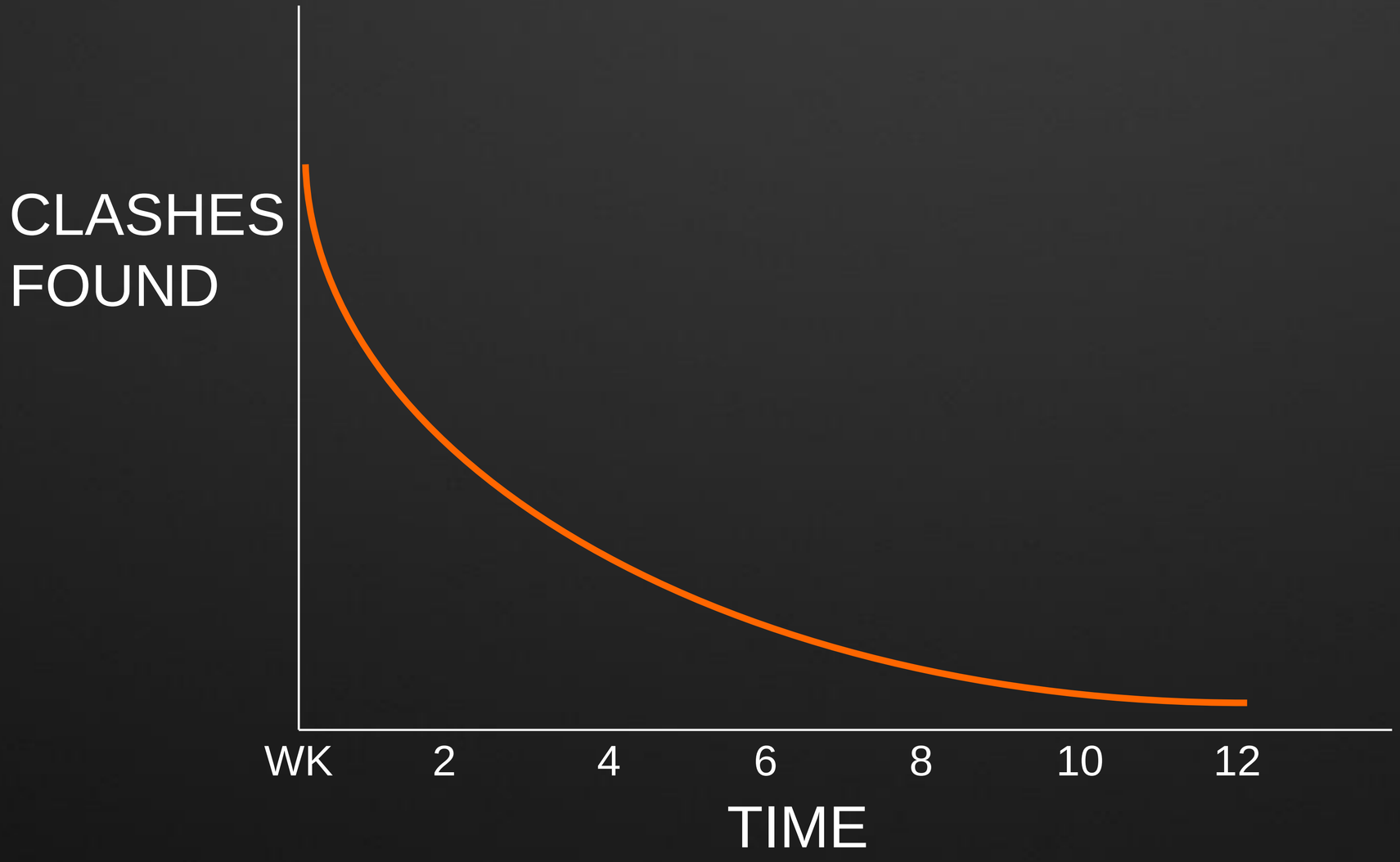
WHAT IS “ZERO” ?:

- ZERO CLASHES FOUND WITH ALL PITCHED PIPING MODELED
- ZERO CLASHES FOUND WITH ALL SERVICES 2” OR LARGER MODELED
- CONTRACTOR ABSOLVES DESIGN TEAM OF RESPONSIBILITY FOR ANYTHING SMALLER / PRESSURIZED **

*** MAY BE MODELED, BUT IGNORED DURING CLASH DETECTION CONSIDERED TO BE RESOLVED WITH COORDINATION IN THE FIELD*

THE CLASH DETECTION: NAVISWORKS WORKFLOW

…”ZERO”

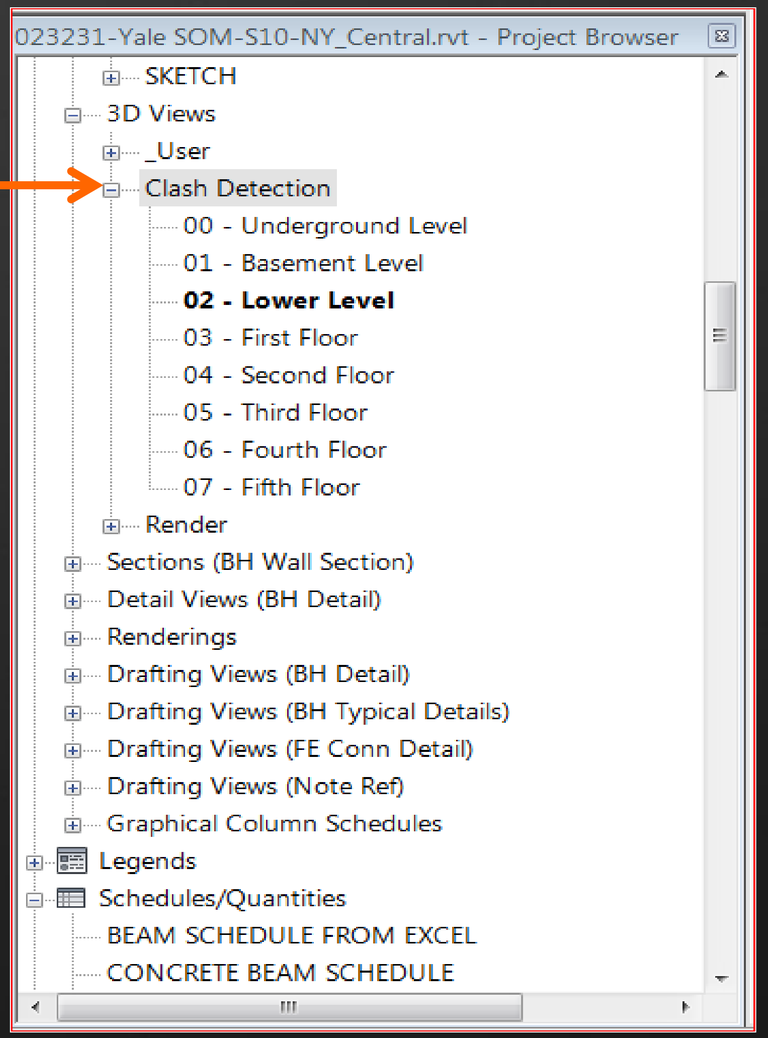


REVIT EXPORT VIEWS

3D EXPORT VIEWS SET UP FOR EACH LEVEL, IN EACH MODEL [M, P, FP] **

***NO LINK GEOMETRY WILL BE EXPORTED*

BEST PRACTICE: CREATE & APPLY VIEW TEMPLATE TO ISOLATE ELEMENTS BEFORE EXPORTING TO NAVISWORKS



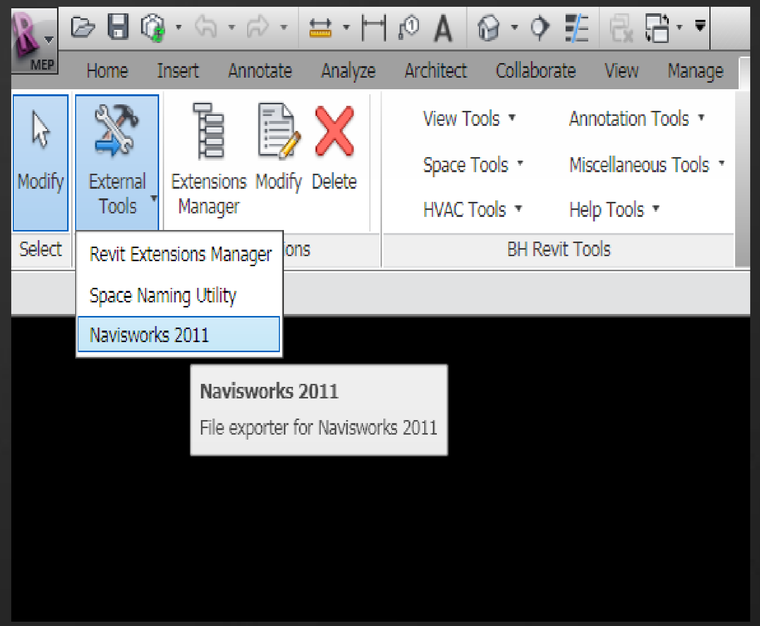
EXPORT [REVIT ADD-IN]

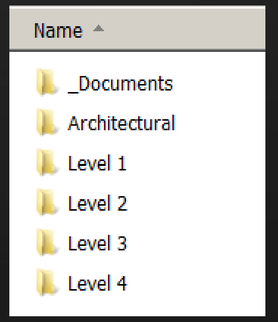
NAVISWORKS GEOMETRY CAN BE EXPORTED FROM REVIT AS .NWC FILE FORMAT.**

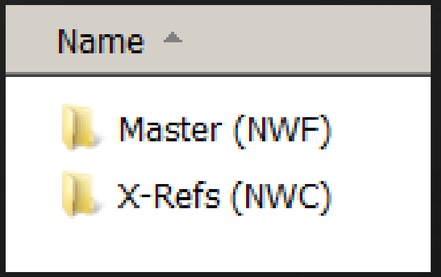
***CAN BE TIME CONSUMING*

BEST PRACTICE: USE CONSISTENT FOLDER STRUCTURE

- ONE .NWF FILE FOR EACH BUILDING, FLOOR, ZONE.
- ONE .NWC FILE FOR EACH CLASH TYPE, I.E. ONE FILE DEDICATED TO HVAC V STRUCTURES







NAVISWORKS FILE TYPES

NWC (SIMILAR TO X-REF)

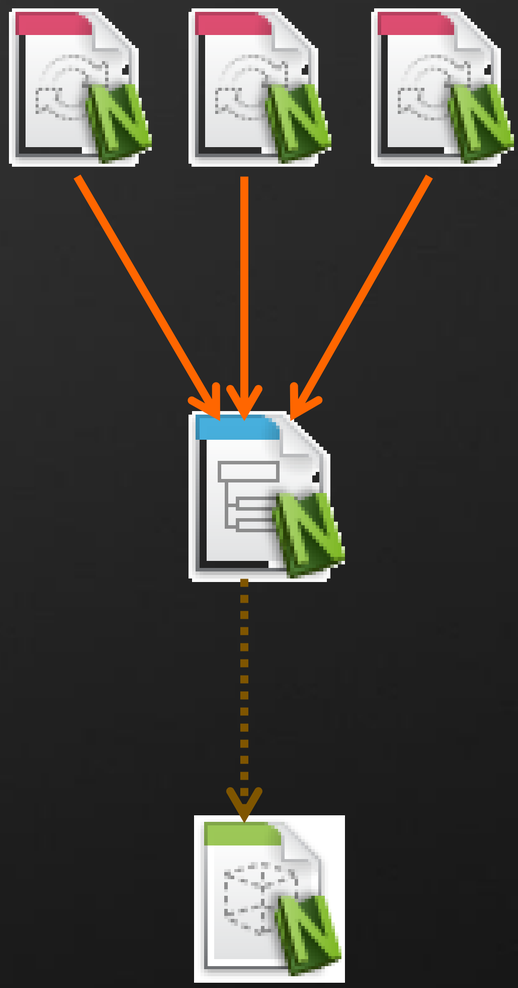
- EXPORTED DIRECTLY FROM REVIT (TYPICALLY 2-5MB MAX)

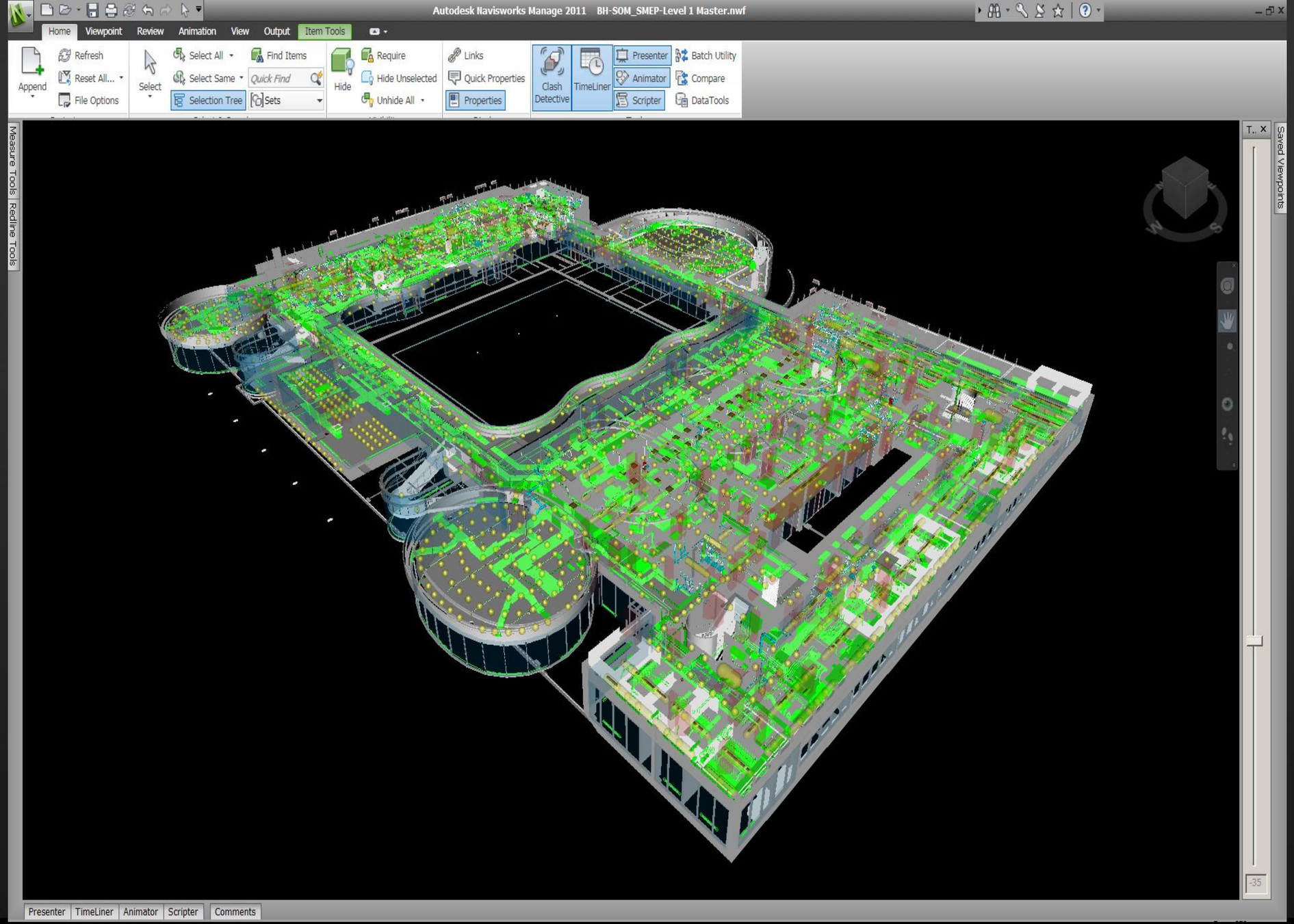
NWF (MASTER FILE)

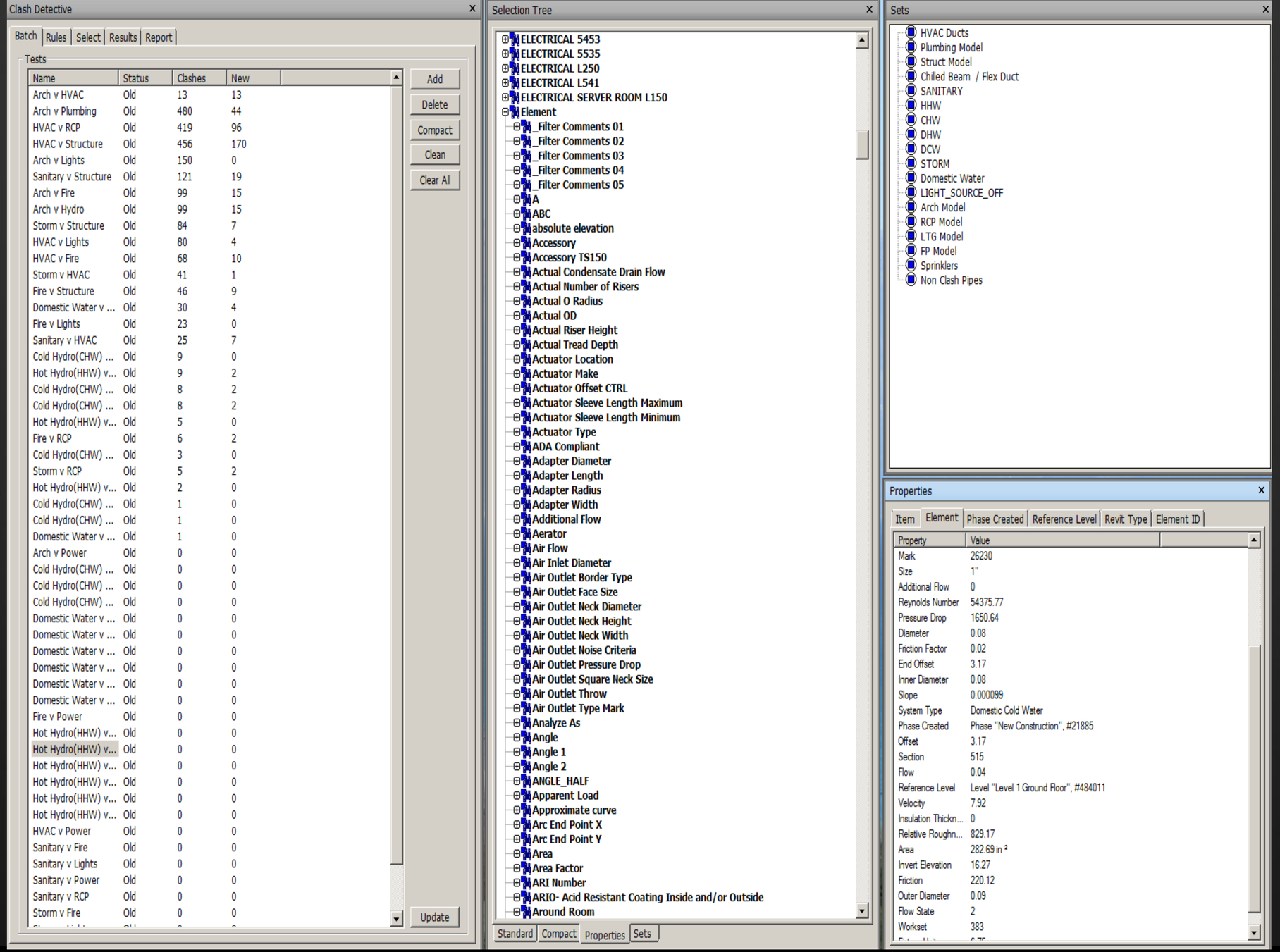
- ALL CLASH DETECTION / ADDED RULES ETC. ARE CARRIED OUT IN THIS FILE

NWD

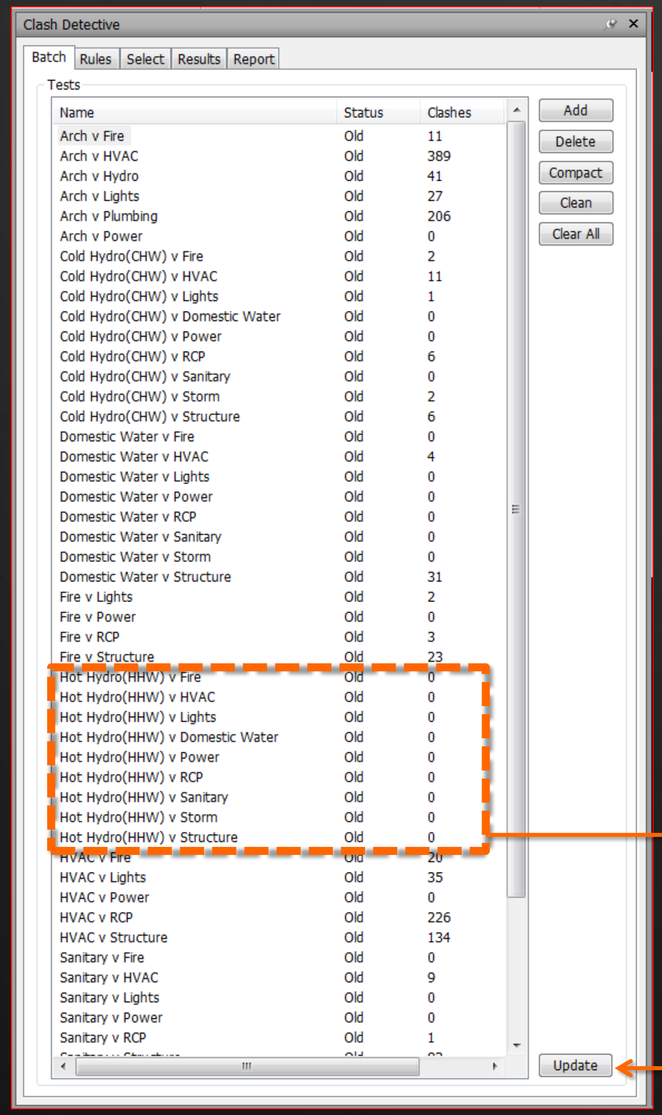
- SIMILAR TO BOUND DWG / PDF







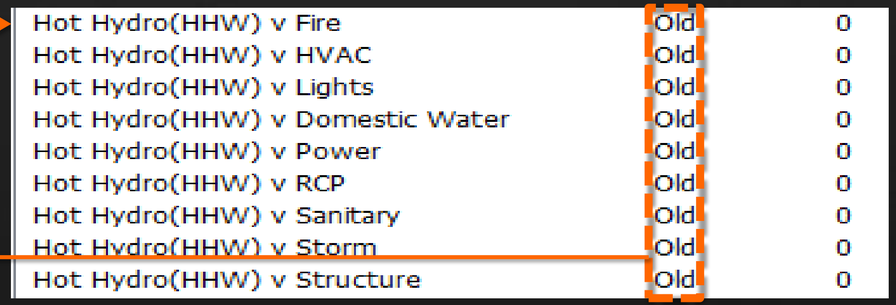
CLASH DETECTIVE (BATCH TAB)



BATCHES CREATED TO CLASH EVERY DISCIPLINE COMBINATION OF A,S,M,E,P,FP

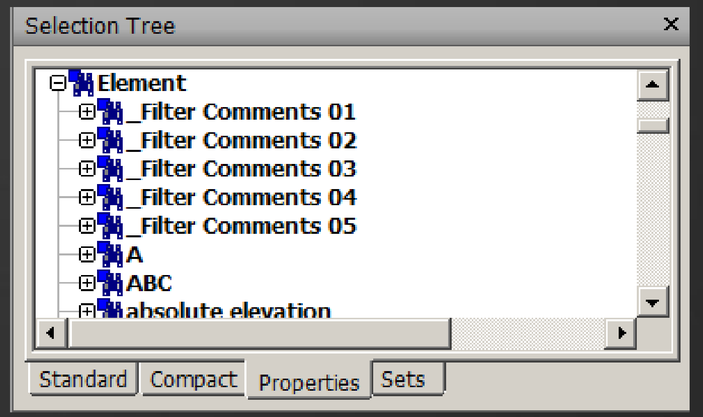
BEST PRACTICE ON NEW BATCH CREATION, FOLLOW THROUGH THE REMAINING TABS TO ENSURE PROPERTIES, RULES, TOLERANCES ARE CORRECTLY SET

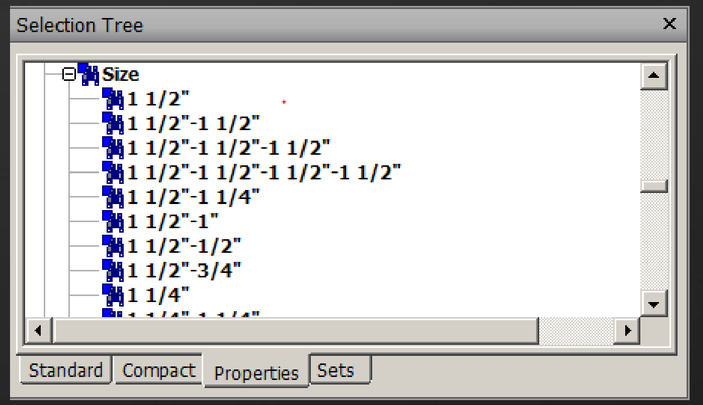
***CREATING NOTES/SCREEN SHOTS AS A GUIDE MAY BE HELPFUL*

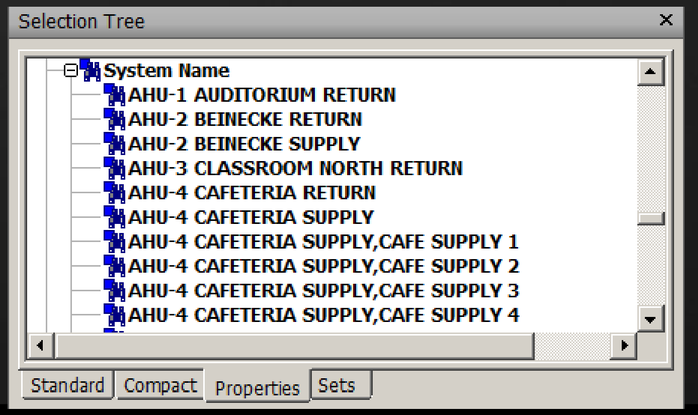


SETS: SELECTION SETS

- CREATE THESE SELECTION SETS USING THE SELECTION TREE
- **PROPERTIES TAB**-> ISOLATE MODEL ELEMENTS BY VARIOUS PROPERTIES
- DESPITE AN EXTENSIVE RANGE OF PROPERTIES, WE ONLY USED: SIZE, SYSTEM NAME, LIGHT SOURCES, VARIOUS PIECES OF EQUIPMENT (CHILLED BEAMS)

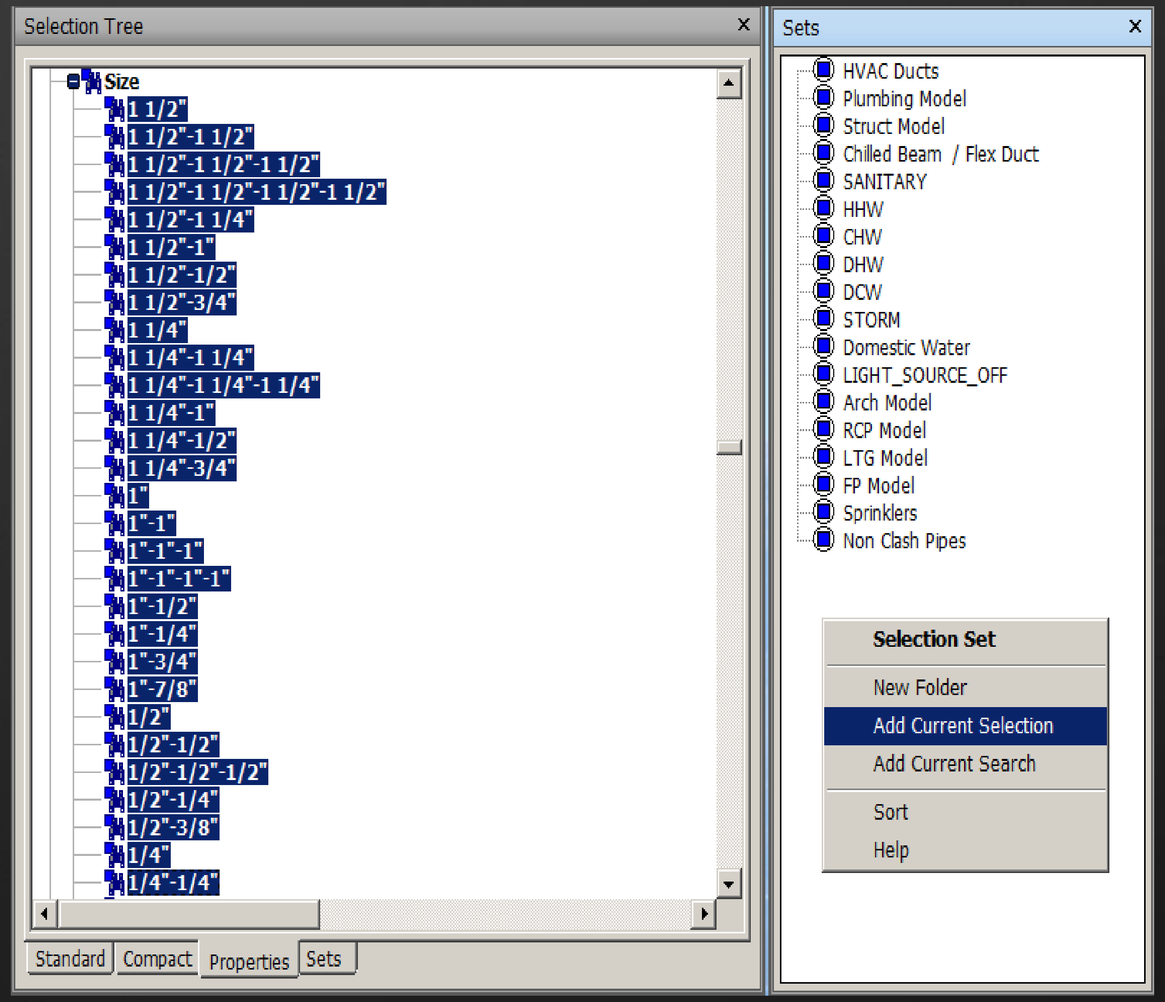




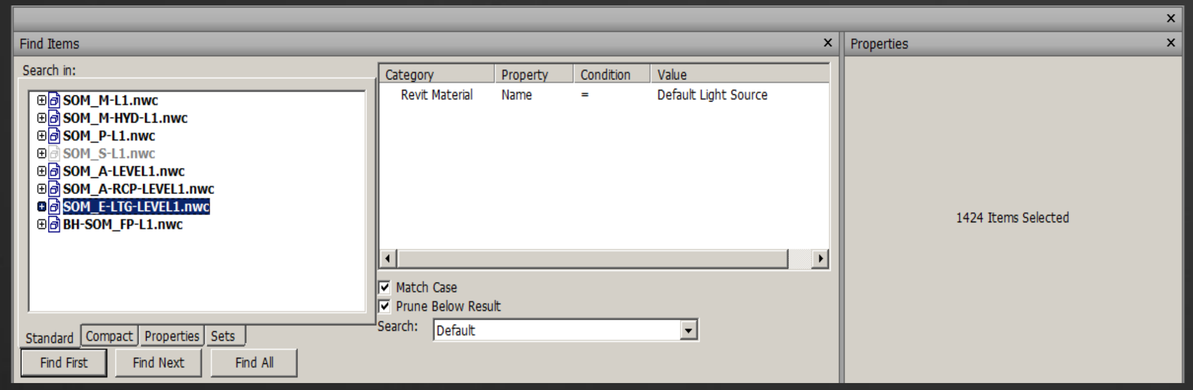


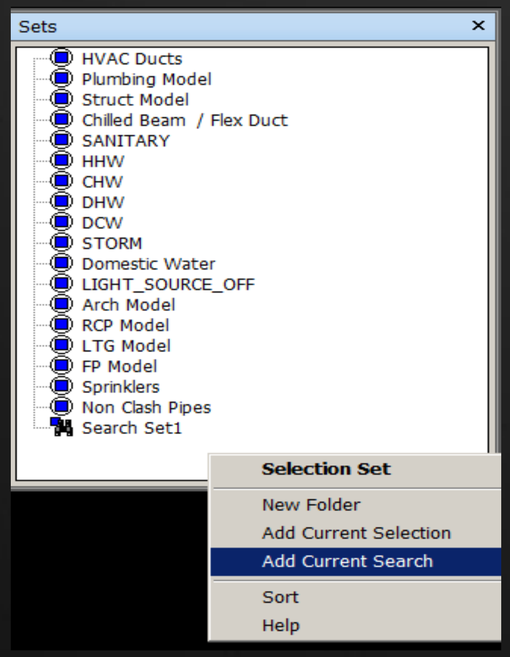
SETS: SELECTION SET CREATION

1. NAVIGATE TO THE PARAMETERS YOU'RE ISOLATING
2. SELECT MULTIPLE PARAMETERS
3. IN THE SETS MENU, RIGHT CLICK AND SELECT ADD CURRENT SELECTION
4. THE SELECTION SET IS NOW DEFINED AND WILL BE AVAILABLE FOR USE IN THE RULE TEMPLATES



SETS: SEARCH SETS





1. NAVIGATE TO THE PARAMETERS WE WANT THROUGH THE FIND ITEMS FUNCTION

2. THIS SEARCHES THROUGH SELECTED MODELS FOR AVAILABLE PARAMETERS

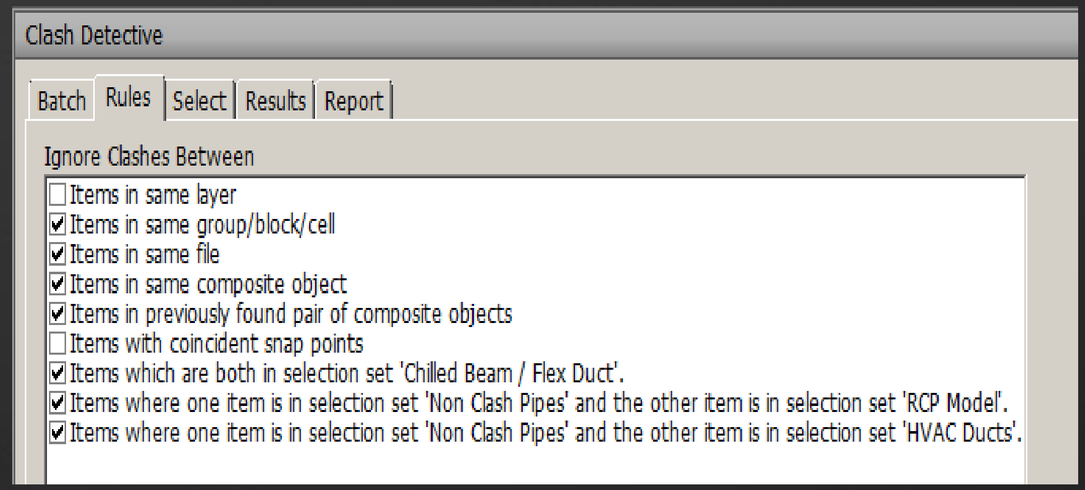
3. IN THE SETS MENU, RIGHT CLICK AND SELECT ADD CURRENT SEARCH

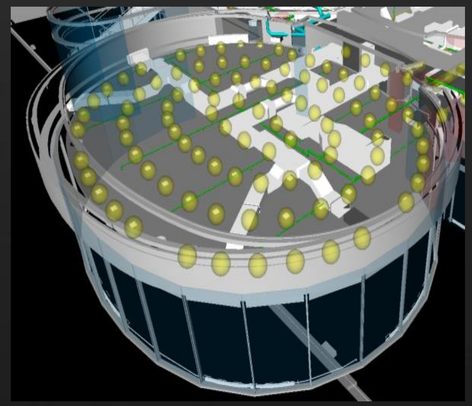
4. EXPORT YOUR RULES / SEARCH SETS

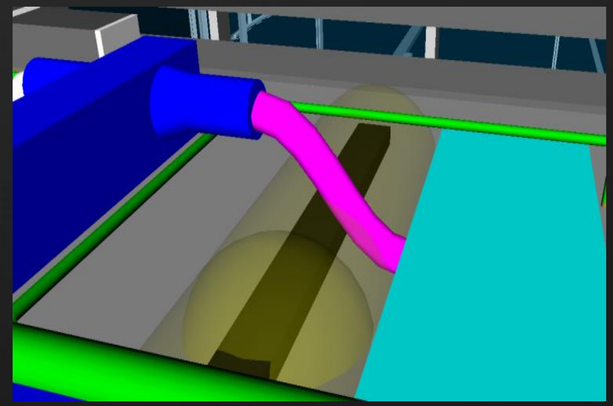
SEARCH SETS

CLASH DETECTIVE (RULES TAB)

- RULES CREATED TO IGNORE CLASHES BETWEEN CERTAIN ELEMENTS.
  - PIPES <= 2”
  - LIGHT SOURCES
  - INHERENT CLASHES WITHIN REVIT EG. FLEX DUCTS “CLASHING” WITH THE CHILLED BEAMS…



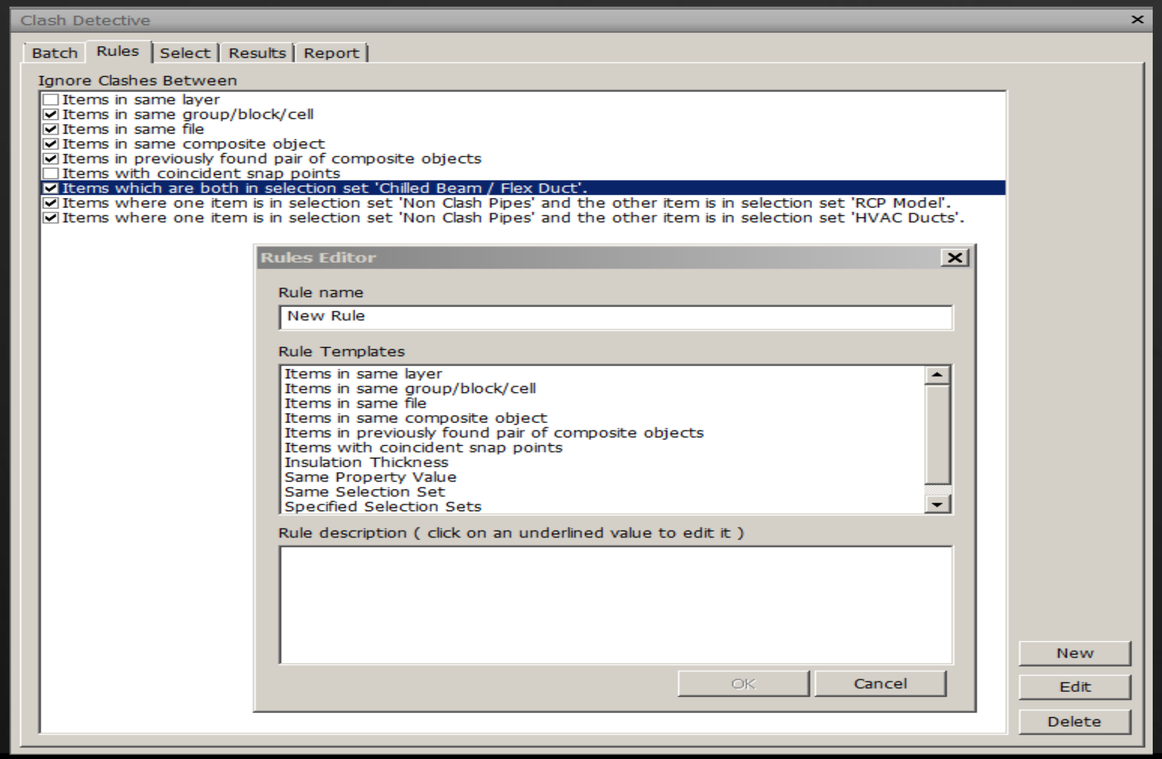


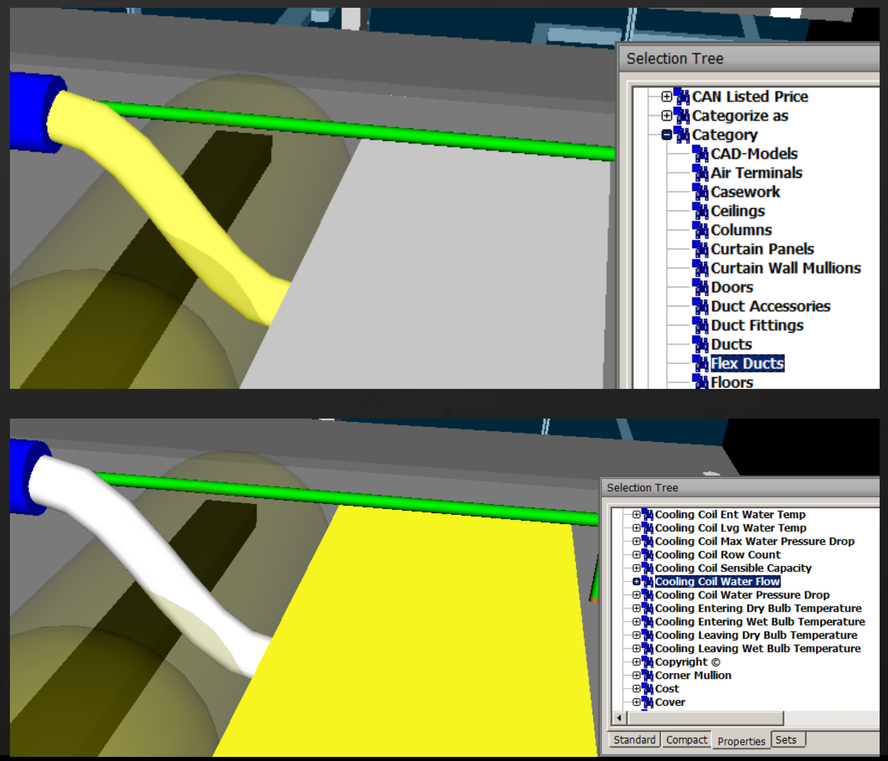


SELECTION / SEARCH SET – RULES

1. BY USING TWO DIFFERENT SELECTION SETS AGAINST EACH OTHER.

2. BY PUTTING ELEMENTS IN THE SAME SELECTION SET – SEE EXAMPLE BELOW





SELECTION SETS vs. SEARCH SETS
IS THERE A DIFFERENCE?

MADE BY SELECTING **GEOMETRY**** IN THE FILE AND ADDING IT TO A SET

*** ONE-TIME SELECTION OF OBJECTS*

BENEFITS

- FAST TO CREATE
- EASY TO SET UP RULES FOR

PITFALLS

- EMPTY SET ONCE YOU BRING IN NEW GEOMETRY [FROM A DIFFERENT FLOOR, WHEN DOING A SAVE-AS]

MADE BY SELECTING A **CRITERIA** SET THAT GEOMETRY IS SEARCHED FOR AND SELECTED AUTOMATICALLY

BENEFITS

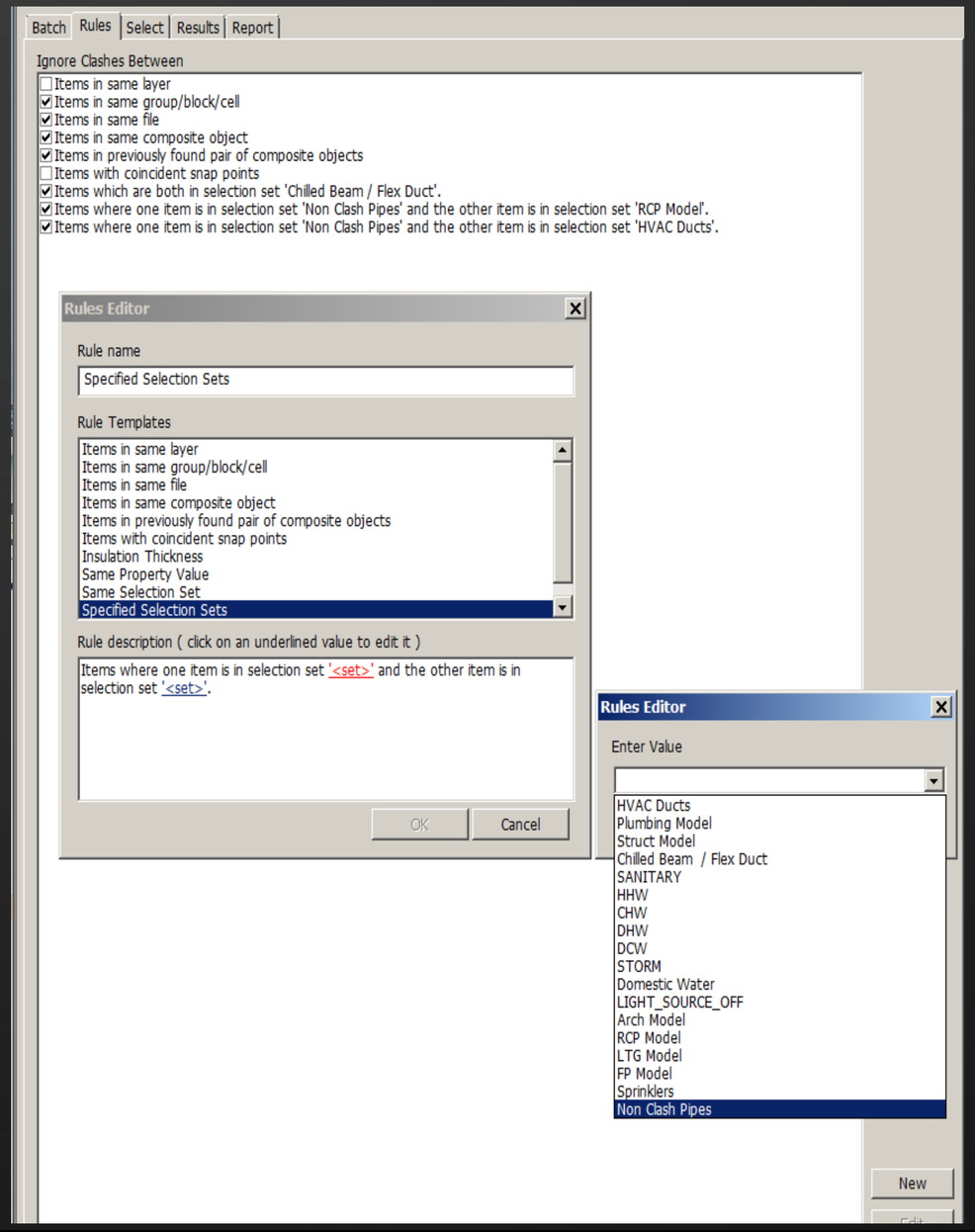
- PARAMETRIC SELECTION – CAN BE RE-USED
- CAN BE EXPORTED FOR THE NEXT FILE SET-UP USE

PITFALLS

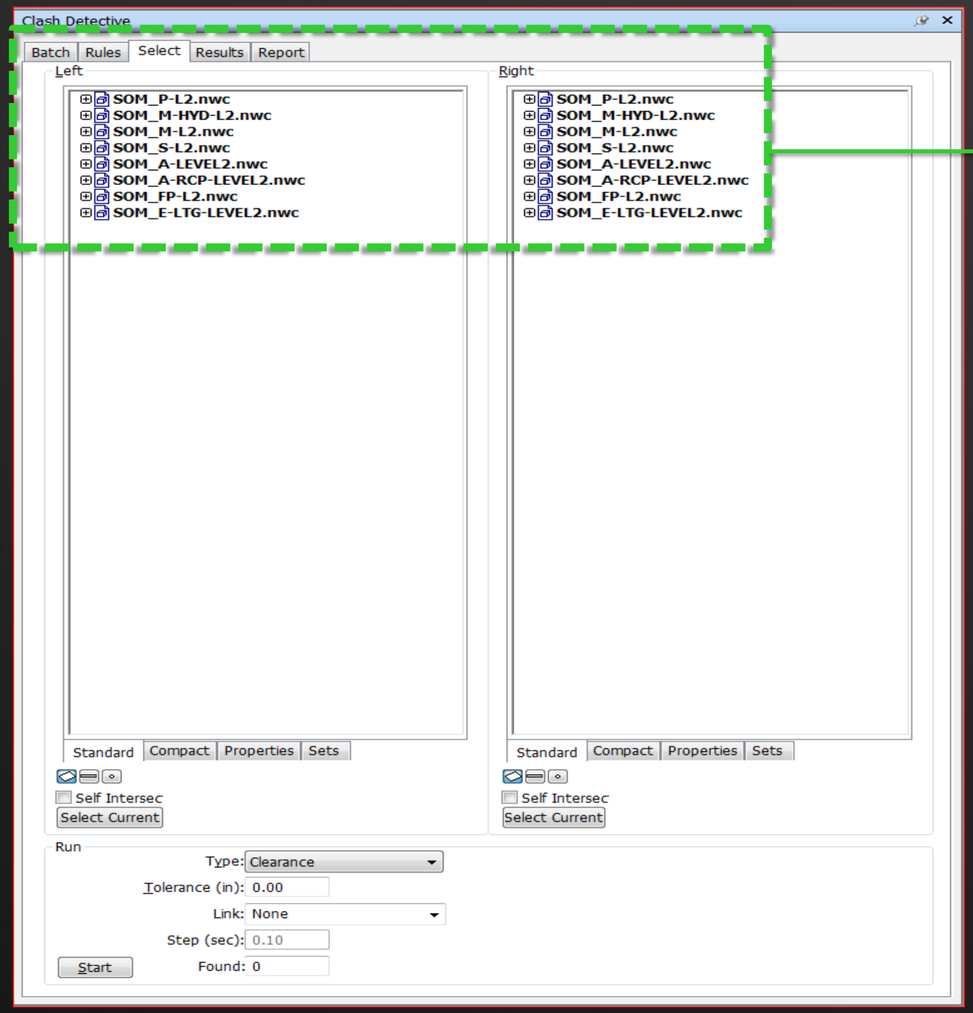
- TAKES LONGER TO SET UP
- TAKES LONGER TO CREATE RULES

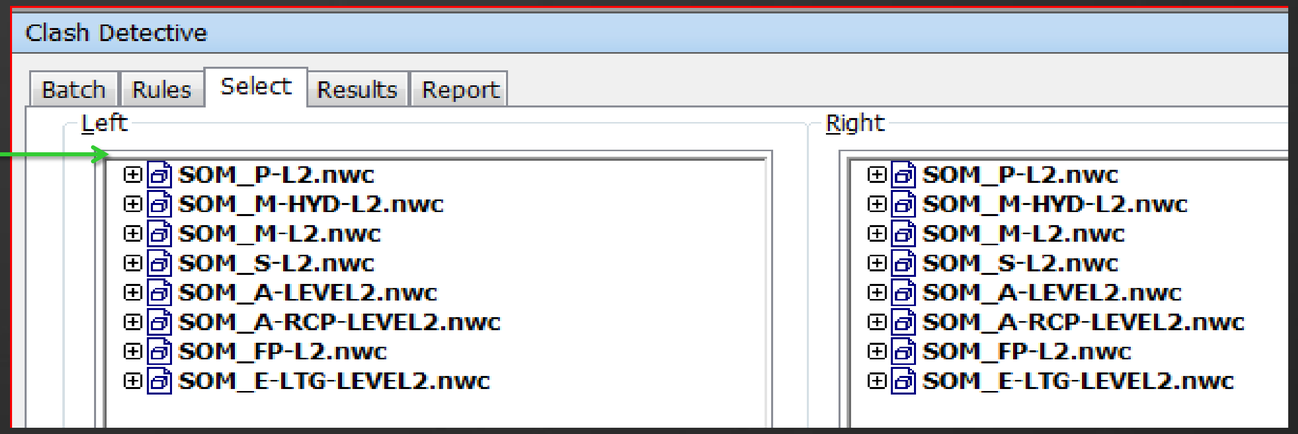
ADDING RULES

- RULES ARE CREATED USING PREDEFINED SELECTION SETS & SEARCH SETS TO POPULATE BASIC VALUES IN GIVEN RULE TEMPLATES
- SET - GROUP OF ELEMENTS FROM THE REVIT MODEL THAT CAN BE ISOLATED WITHIN NAVISWORKS
- THERE ARE DIFFERENT WAYS TO DEFINE SETS IN NAVISWORKS: BY BOTH SELECTION AND SEARCHING
- SEARCH SETS CAN BE EXPORTED TO OTHER NAVISWORKS FILES TO SAVE TIME



CLASH DETECTIVE (SELECT TAB)





MODELS OR SETS CHOSEN ACCORDING TO THE BATCH

DEFINE:

1. WHAT'S CLASHED

2. TOLERANCE DISTANCE

CLASH BATCH TOLERANCES

WAS INSULATION MODELED?

ON DUCTS –> YES

ON PIPES –> NO

FIREPROOFING ON STL. -> NO

HVAC vs. RCP	0.0
HVAC vs. Structure	1.0
Sanitary vs. Fire	0.0
Sanitary vs. Lights	0.0
Sanitary vs. Power	0.0
Sanitary vs. RCP	0.0
Sanitary vs. Structure	1.0
Arch vs. Hydro	0.0
Arch vs. Fire	0.0
Arch vs. HVAC	0.0
Arch vs. Lights	0.0
Arch vs. Plumbing	0.0
Arch vs. Power	0.0
Fire vs. Lights	0.0
Fire vs. Power	0.0
Fire vs. RCP	0.0
Fire vs. Structure	1.0
HVAC vs. Fire	0.0
HVAC vs. Lights	0.0
HVAC vs. Sanitary	0.0
HVAC vs. Plumbing	1.0
HVAC vs. Power	0.0

Plumbing vs. Fire	1.0
Plumbing vs. Lights	1.0
Plumbing vs. Power	1.0
Plumbing vs. RCP	1.0
Plumbing vs. Structure	2.0
Power/Light vs. Structure	1.0
Hot Hydro vs. Fire	2.0
Hot Hydro vs. HVAC	2.0
Hot Hydro vs. Lights	2.0
Hot Hydro vs. Sanitary	2.0
Hot Hydro vs. Plumbing	3.0
Hot Hydro vs. Power	2.0
Hot Hydro vs. RCP	2.0
Hot Hydro vs. Structure	3.0
Cold Hydro vs. Fire	1.0
Cold Hydro vs. HVAC	1.0
Cold Hydro vs. Lights	1.0
Cold Hydro vs. Plumbing	2.0
Cold Hydro vs. Sanitary	1.0
Cold Hydro vs. Power	1.0
Cold Hydro vs. RCP	1.0
Cold Hydro vs. Structure	2.0

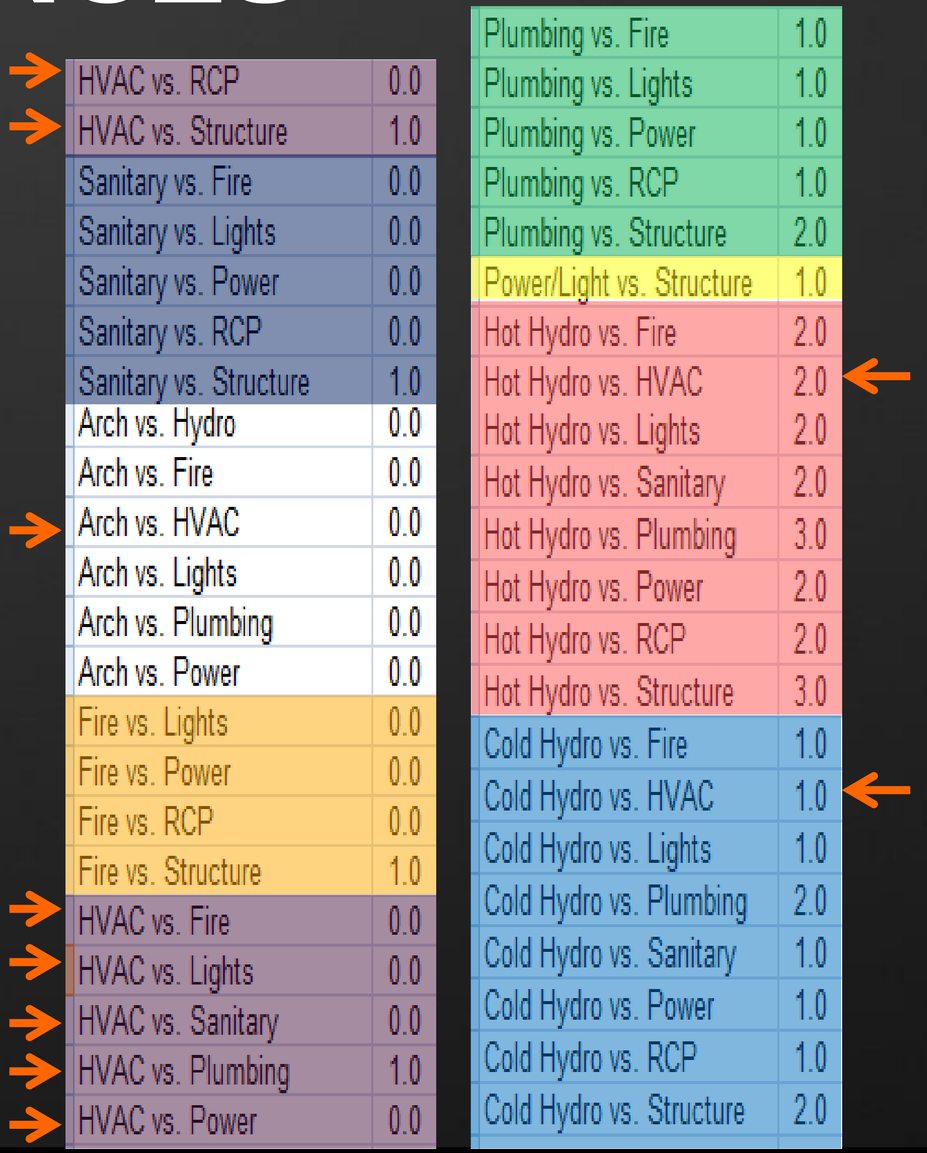
CLASH BATCH TOLERANCES

WAS INSULATION MODELED?

ON DUCTS –> YES = +0”

ON PIPES –> NO = +1” TO +2” VARIES

FIREPROOFING ON STL. -> NO = +1”



HVAC vs. RCP	0.0
HVAC vs. Structure	1.0
Sanitary vs. Fire	0.0
Sanitary vs. Lights	0.0
Sanitary vs. Power	0.0
Sanitary vs. RCP	0.0
Sanitary vs. Structure	1.0
Arch vs. Hydro	0.0
Arch vs. Fire	0.0
Arch vs. HVAC	0.0
Arch vs. Lights	0.0
Arch vs. Plumbing	0.0
Arch vs. Power	0.0
Fire vs. Lights	0.0
Fire vs. Power	0.0
Fire vs. RCP	0.0
Fire vs. Structure	1.0
HVAC vs. Fire	0.0
HVAC vs. Lights	0.0
HVAC vs. Sanitary	0.0
HVAC vs. Plumbing	1.0
HVAC vs. Power	0.0
Plumbing vs. Fire	1.0
Plumbing vs. Lights	1.0
Plumbing vs. Power	1.0
Plumbing vs. RCP	1.0
Plumbing vs. Structure	2.0
Power/Light vs. Structure	1.0
Hot Hydro vs. Fire	2.0
Hot Hydro vs. HVAC	2.0
Hot Hydro vs. Lights	2.0
Hot Hydro vs. Sanitary	2.0
Hot Hydro vs. Plumbing	3.0
Hot Hydro vs. Power	2.0
Hot Hydro vs. RCP	2.0
Hot Hydro vs. Structure	3.0
Cold Hydro vs. Fire	1.0
Cold Hydro vs. HVAC	1.0
Cold Hydro vs. Lights	1.0
Cold Hydro vs. Plumbing	2.0
Cold Hydro vs. Sanitary	1.0
Cold Hydro vs. Power	1.0
Cold Hydro vs. RCP	1.0
Cold Hydro vs. Structure	2.0

CLASH BATCH TOLERANCES

WAS INSULATION MODELED?

ON DUCTS –> YES = +0”

ON PIPES –> NO = +1” TO +2” VARIES

FIREPROOFING ON STL. -> NO = +1”

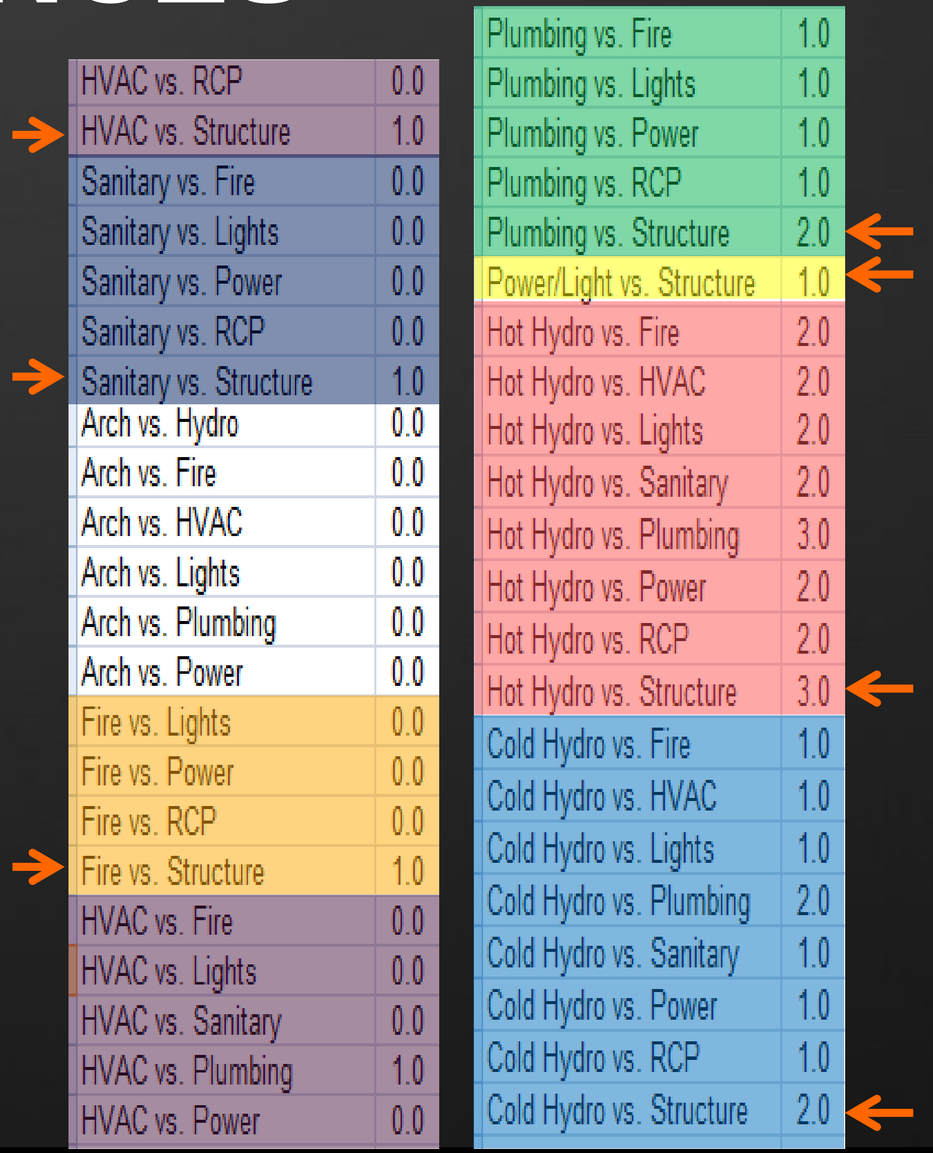
CLASH BATCH TOLERANCES

WAS INSULATION MODELED?

ON DUCTS –> YES = +0”

ON PIPES –> NO = +1” TO +2” VARIES

FIREPROOFING ON STL. -> NO = +1”



HVAC vs. RCP	0.0
HVAC vs. Structure	1.0
Sanitary vs. Fire	0.0
Sanitary vs. Lights	0.0
Sanitary vs. Power	0.0
Sanitary vs. RCP	0.0
Sanitary vs. Structure	1.0
Arch vs. Hydro	0.0
Arch vs. Fire	0.0
Arch vs. HVAC	0.0
Arch vs. Lights	0.0
Arch vs. Plumbing	0.0
Arch vs. Power	0.0
Fire vs. Lights	0.0
Fire vs. Power	0.0
Fire vs. RCP	0.0
Fire vs. Structure	1.0
HVAC vs. Fire	0.0
HVAC vs. Lights	0.0
HVAC vs. Sanitary	0.0
HVAC vs. Plumbing	1.0
HVAC vs. Power	0.0

Plumbing vs. Fire	1.0
Plumbing vs. Lights	1.0
Plumbing vs. Power	1.0
Plumbing vs. RCP	1.0
Plumbing vs. Structure	2.0
Power/Light vs. Structure	1.0
Hot Hydro vs. Fire	2.0
Hot Hydro vs. HVAC	2.0
Hot Hydro vs. Lights	2.0
Hot Hydro vs. Sanitary	2.0
Hot Hydro vs. Plumbing	3.0
Hot Hydro vs. Power	2.0
Hot Hydro vs. RCP	2.0
Hot Hydro vs. Structure	3.0
Cold Hydro vs. Fire	1.0
Cold Hydro vs. HVAC	1.0
Cold Hydro vs. Lights	1.0
Cold Hydro vs. Plumbing	2.0
Cold Hydro vs. Sanitary	1.0
Cold Hydro vs. Power	1.0
Cold Hydro vs. RCP	1.0
Cold Hydro vs. Structure	2.0

CLASH BATCH TOLERANCES

WAS INSULATION MODELED?

ON DUCTS –> YES = +0” **

ON PIPES –> NO = +1” TO +2” VARIES**

FIREPROOFING ON STL. -> NO = +1” **

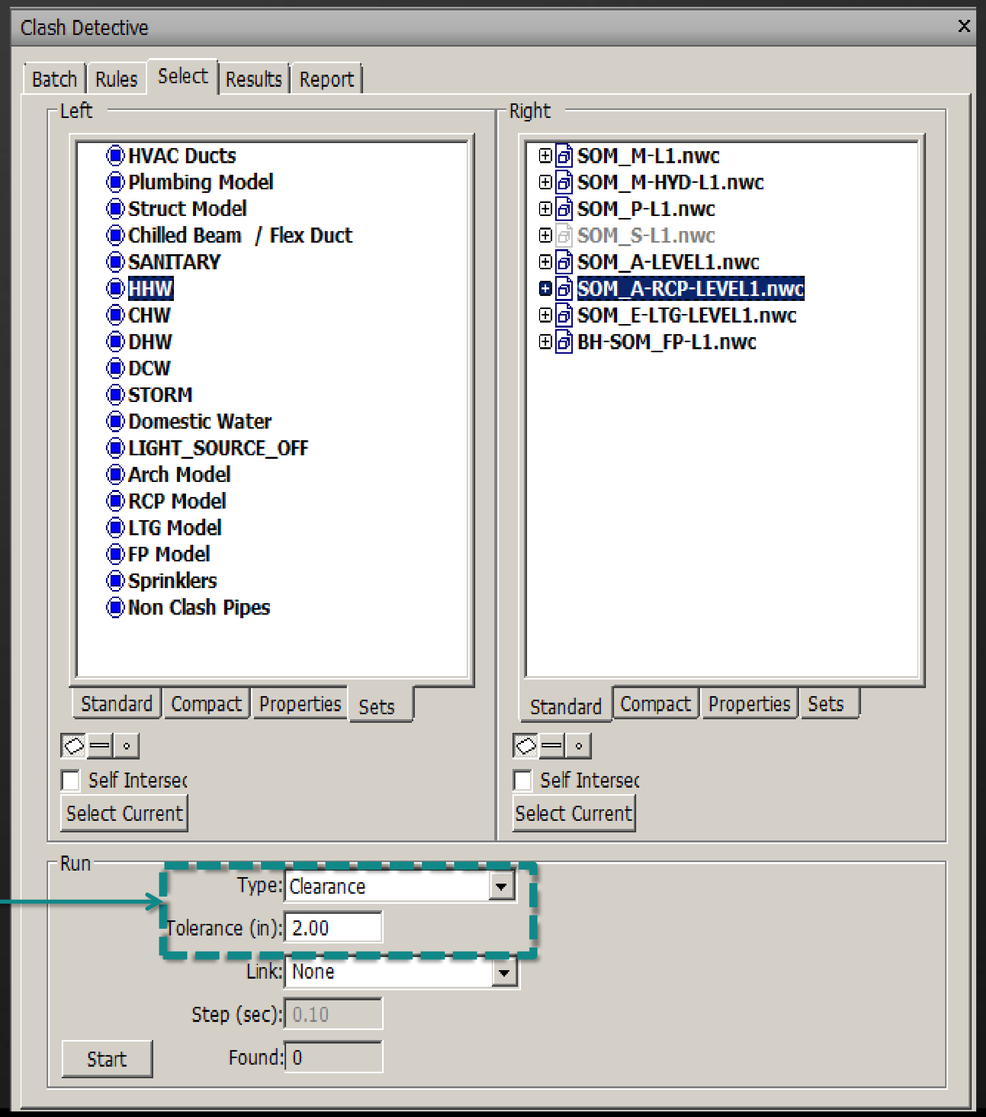
** *ALL TOLERANCES WE AGREED UPON BETWEEN DESIGN TEAM , CONTRACTOR & OWNER*

HVAC vs. RCP	0.0
HVAC vs. Structure	1.0
Sanitary vs. Fire	0.0
Sanitary vs. Lights	0.0
Sanitary vs. Power	0.0
Sanitary vs. RCP	0.0
Sanitary vs. Structure	1.0
Arch vs. Hydro	0.0
Arch vs. Fire	0.0
Arch vs. HVAC	0.0
Arch vs. Lights	0.0
Arch vs. Plumbing	0.0
Arch vs. Power	0.0
Fire vs. Lights	0.0
Fire vs. Power	0.0
Fire vs. RCP	0.0
Fire vs. Structure	1.0
HVAC vs. Fire	0.0
HVAC vs. Lights	0.0
HVAC vs. Sanitary	0.0
HVAC vs. Plumbing	1.0
HVAC vs. Power	0.0

Plumbing vs. Fire	1.0
Plumbing vs. Lights	1.0
Plumbing vs. Power	1.0
Plumbing vs. RCP	1.0
Plumbing vs. Structure	2.0
Power/Light vs. Structure	1.0
Hot Hydro vs. Fire	2.0
Hot Hydro vs. HVAC	2.0
Hot Hydro vs. Lights	2.0
Hot Hydro vs. Sanitary	2.0
Hot Hydro vs. Plumbing	3.0
Hot Hydro vs. Power	2.0
Hot Hydro vs. RCP	2.0
Hot Hydro vs. Structure	3.0
Cold Hydro vs. Fire	1.0
Cold Hydro vs. HVAC	1.0
Cold Hydro vs. Lights	1.0
Cold Hydro vs. Plumbing	2.0
Cold Hydro vs. Sanitary	1.0
Cold Hydro vs. Power	1.0
Cold Hydro vs. RCP	1.0
Cold Hydro vs. Structure	2.0

ADDING TOLERANCES TO A BATCH

- INPUT A SPECIFIC TOLERANCE TO THE CLASH BEING RUN
- THIS TOLERANCE WORKS ALONGSIDE THE VARIOUS RULES TO REFINE AND PRODUCE ACCURATE AND REALISTIC RESULTS



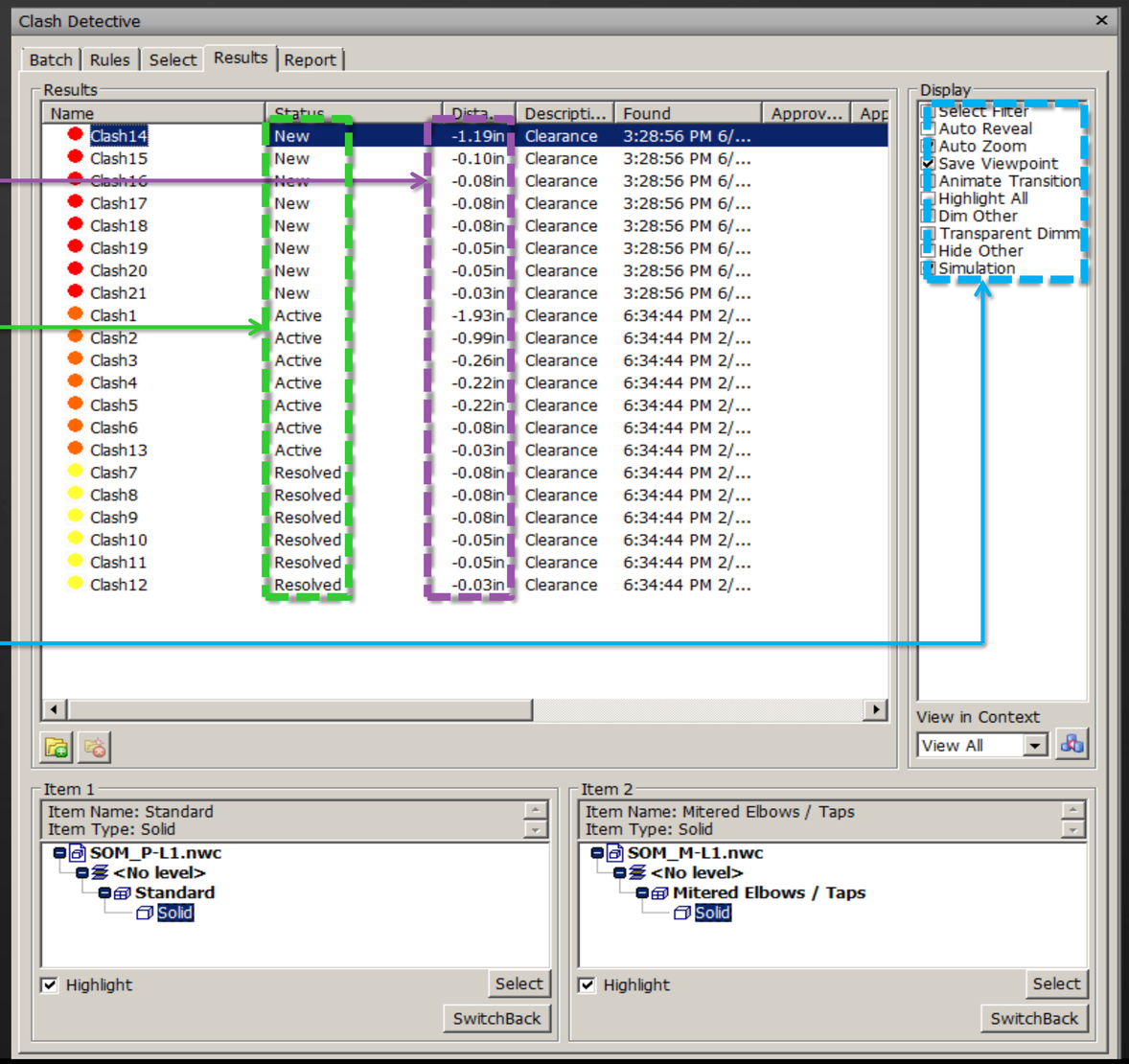
CLASH DETECTIVE (RESULTS TAB)

ALL CLASHES PER BATCH SHOWN:

1. DISTANCE
2. STATUS OF CLASH

[CHANGES AS GEOMETRY IN .NWF MODELS IS UPDATED]

SETTINGS CONTROL AUTO-ZOOM / DIMMING, ETC. OF EACH CLASH

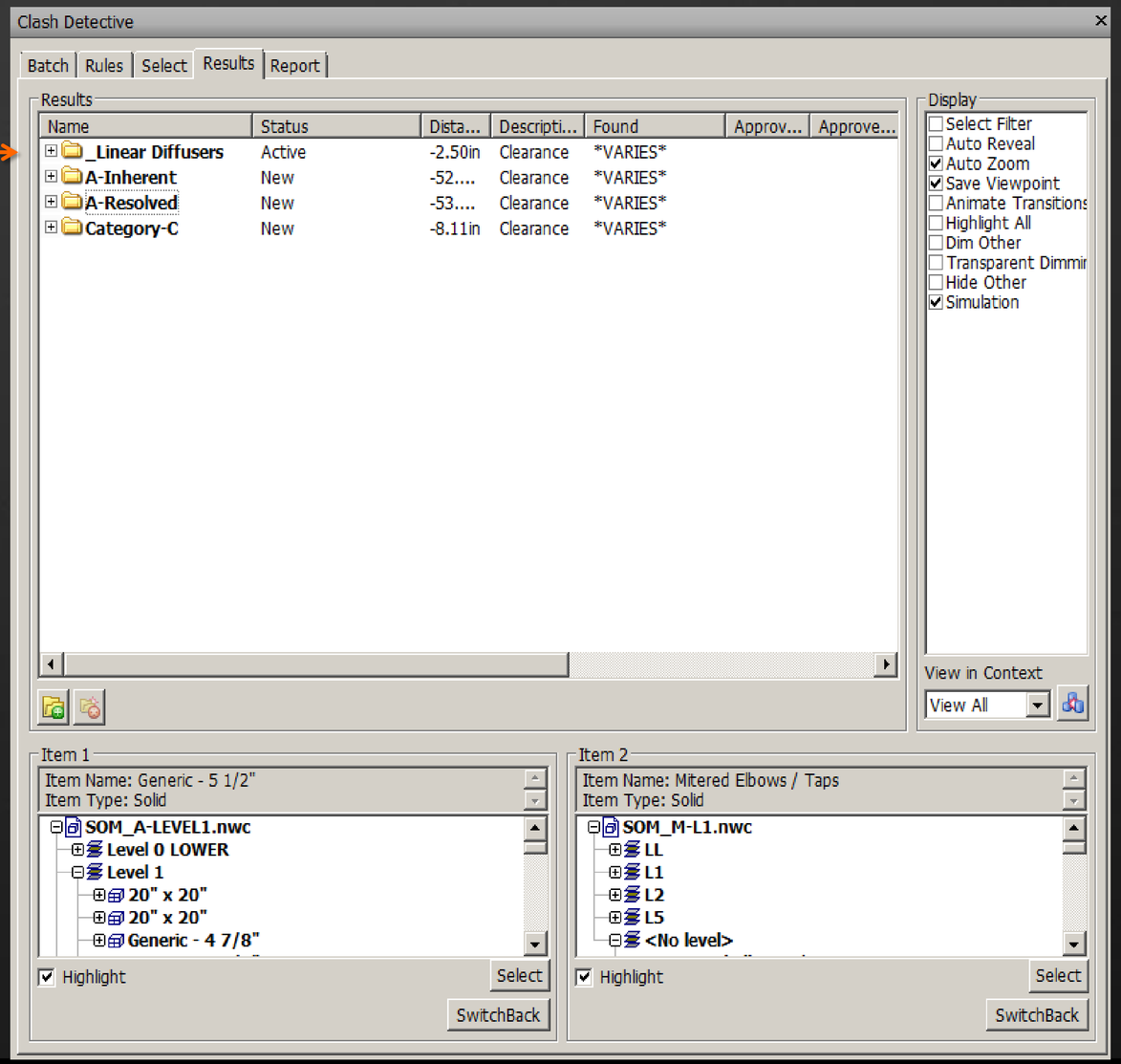


RESULTS - ORGANIZATION

RESULTS CAN BE GROUPED

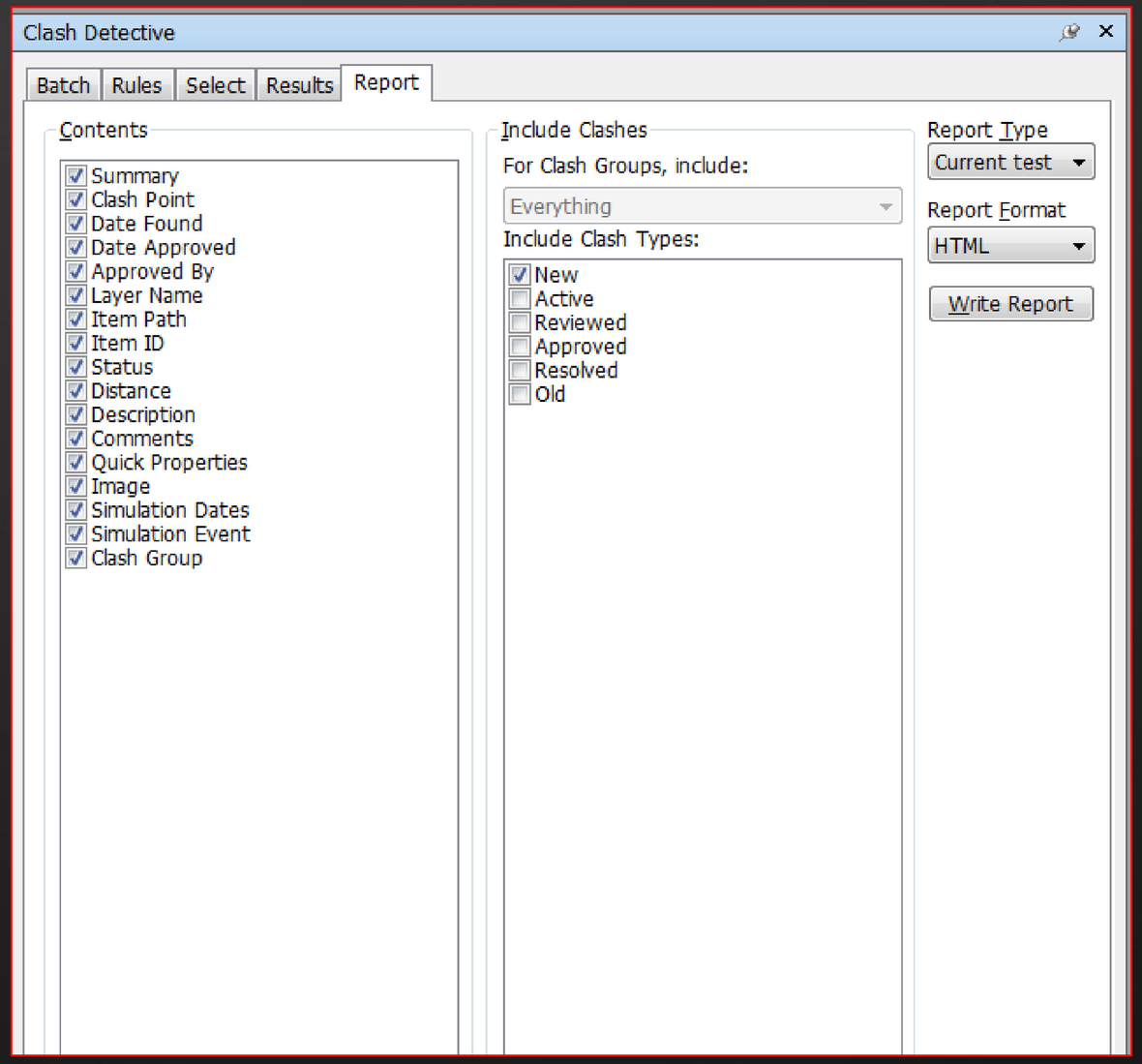
POSSIBLE GROUPING:

- CLASH STATUS
- PER SYSTEM / SERVICE
- TYPE OF EQUIPMENT
- CLUSTERS CONTAINING SEVERAL CLASHING ELEMENTS



REPORT GENERATION

- CUSTOMIZABLE REPORTS TO DISPLAY ONLY THE PROPERTIES YOU WANT
- CAN BE EXPORTED AS HTML, XML, PDF – CAN BE VIEWED BY DESIGN TEAM, OWNER, ETC…



CLASH TRACKING

IN THIS CASE, EXCEL SPREADSHEET

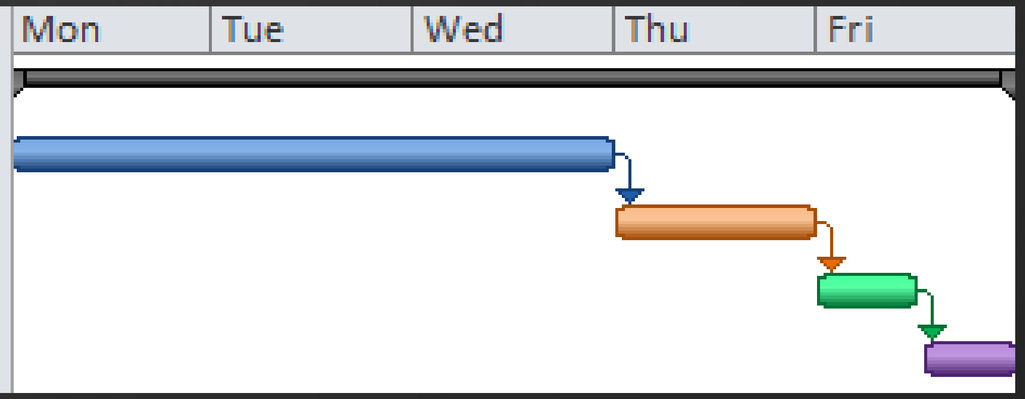
BEST PRACTICE: THIS CAN BE DONE IN MANY WAYS. BUT THERE SHOULD BE 1 CENTRAL RECORD OF WHAT IS GETTING RESOLVED

Level	Clash Set	New	C	Re Clashed	Notes	User	110315	Notes
Level 2	Arch v HVAC	5	3*	Yes	*3 - Cat C - BH / GS	T.T		
	HVAC v Lights	3		Yes		T.T		
	Kitchen Lights GS Requested to move		2*		*GS			
	HVAC v Storm	1		Yes	Classroom Riser North	C.K.		
	HVAC v Struct	1*	1	Yes	*Tim says needs to review (Clash 43)	T.T		
	North Classroom Riser	3			3 New	C.K		
	South Classroom Riser	13			4 New	C.K		
	Northside Riser Thr Slab Clashes	24			Old	C.K		

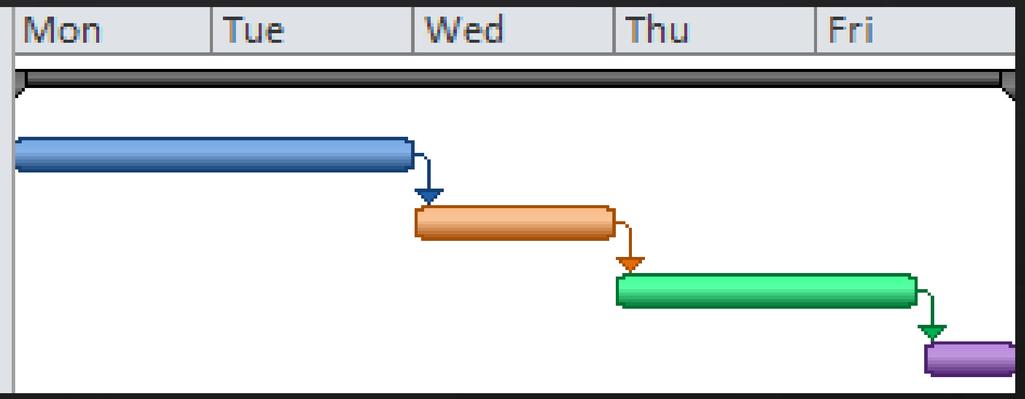
Level	Clash Set	New	C	Re Clashed	Notes		110315	Notes
Level 1	Arch v HVAC	5*	12*	Yes	*Pizza Oven etc.	T.T		
	Wall Height South	8*			Check with Eng			
	~~Linear Diffusers~~	~~105~~			63 New - Check			
	HVAC v Fire	0		Yes		T.T		
	HVAC v Lights	0	2	Yes		T.T		
	HVAC v RCP	0		Yes	2 New			
	~~*Linears in Ceiling*~~	~~7~~						
	Storm v HVAC		1	Yes		T.T		
	HVAC v Struct	2*	12	Yes	Quick Check with Eng	T.T		
	North Classroom Riser	36			3 New	C.K		
	South Classroom Riser	13			12 New	C.K		

EVOLVING WEEKLY COLLABORATION

INITIAL PROCESS	**5 days**
CLASH REVIEW [CC]	3 days
TEAM CLASH REVIEW MTG ON-SITE [ALL]	1 day
DE-CLASH [BH]	0.5 days
UPLOAD .nwc's [BH]	0.5 days

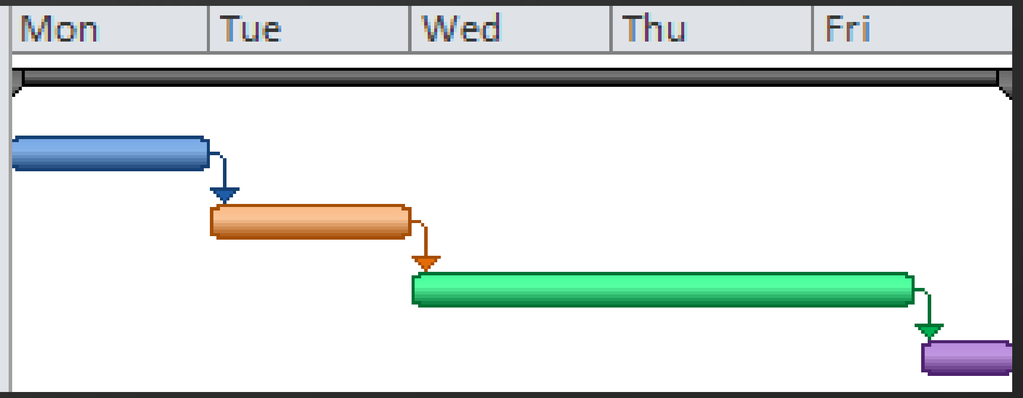


R1 PROCESS	**5 days**
CLASH REVIEW [CC]	2 days
TEAM CLASH REVIEW MTG ON-SITE [ALL]	1 day
DE-CLASH [BH]	1.5 days
UPLOAD .nwc's [BH]	0.5 days

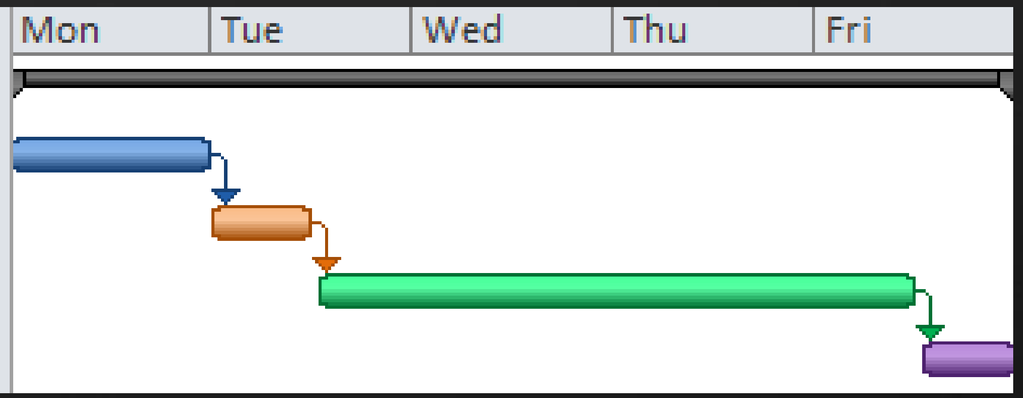


EVOLVING WEEKLY COLLABORATION

R2 PROCESS	**5 days**
CLASH REVIEW [CC]	1 day
TEAM CLASH REVIEW MTG ON-SITE [ALL]	1 day
DE-CLASH [BH]	2.5 days
UPLOAD .nwc's [BH]	0.5 days

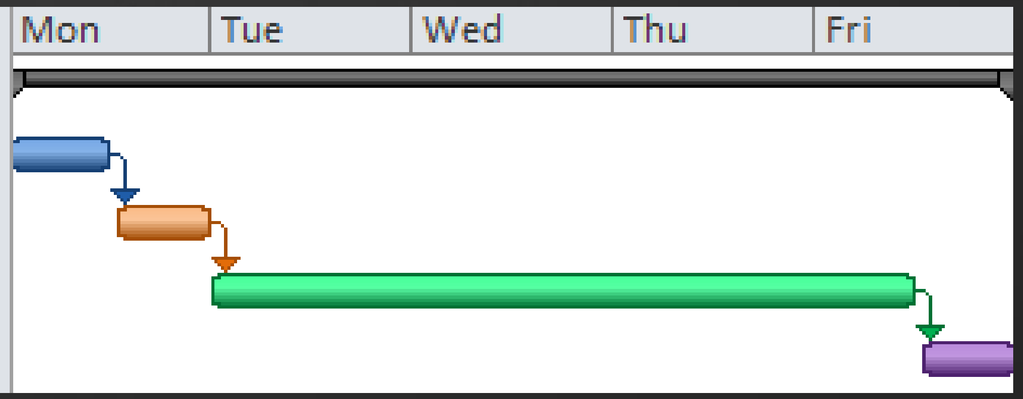


R3 PROCESS	**5 days**
CLASH REVIEW [CC]	1 day
TEAM CLASH REVIEW WEB-CONF [ALL]	0.5 days
DE-CLASH [BH]	3 days
UPLOAD .nwc's [BH]	0.5 days



EVOLVING WEEKLY COLLABORATION

FINAL PROCESS	**5 days**
CLASH REVIEW [CC]	0.5 days
TEAM CLASH REVIEW CALL [ALL]	0.5 days
DE-CLASH [BH]	3.5 days
UPLOAD .nwc's [BH]	0.5 days



= 3.5 DE-CLASHING WORKING DAYS / WEEK

EST. TIME REQ'D TO GET TO "ZERO"

3 MONTHS * 4 WEEKS/ MONTH = 12 WEEKS

6 FLOORS = 2 WEEKS / FLOOR**

*** EA. FLOOR = APPRX. 50,000 SF OF HEAVY ACADEMIC PROGRAM*

3.5 DE-CLASHING WORKING DAYS / WEEK = 7.0 DE-CLASH DAYS / FLOOR

2 STAFF RESOURCED

(14) 8-HOUR DAYS OF DE-CLASHING WORK / FLOOR

CONCLUSIONS

1. BIM PROCESS: PREPARE: FROM KICKOFF ONWARD CLASH DETECTION SHOULD BE KEPT IN MIND

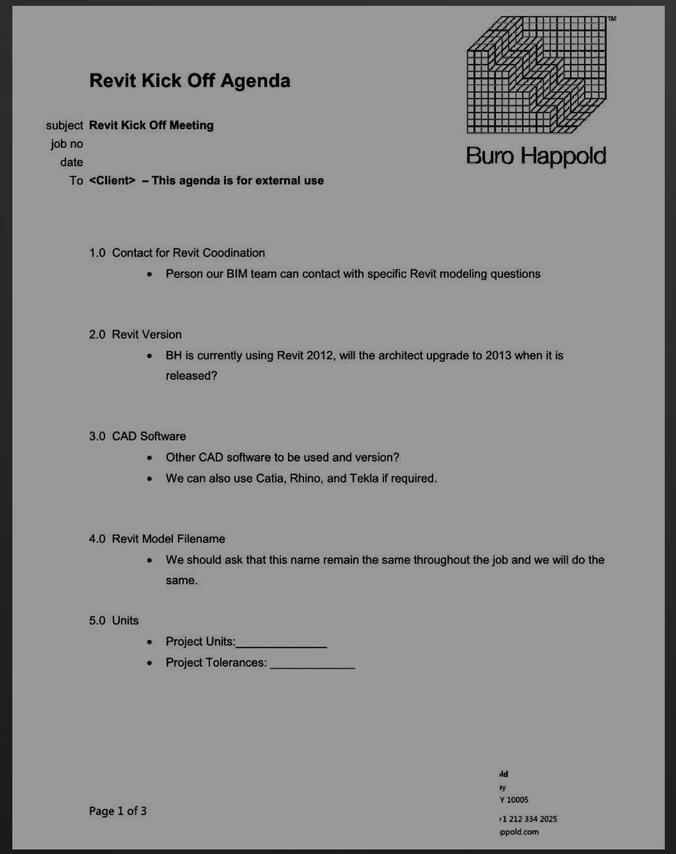
2. BIM PROCESS: DEFINE CLEARLY THE MODELING SCOPE: WHAT AND WHEN
   **ENSURE THE PROJECT IS RIGHT – ALL PARTIES NEED TO CONTRIBUTE EQUALLY TO THE EFFORT*

3. SET & MANAGE EXPECTATIONS:

   - TIME [FEE]
   - RESOURCES
   - DELIEVERABLES

REALIZE THE GOAL: POSTIVELY AFFECT THE BIM & DESIGN PROCESS

BEST PRACTICE: DESIGN TEAM KICKOFF



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Revit Kick Off Agenda

subject **Revit Kick Off Meeting**
job no
date
To **<Client> – This agenda is for external use**

1.0 Contact for Revit Coodination
- Person our BIM team can contact with specific Revit modeling questions

2.0 Revit Version
- BH is currently using Revit 2012, will the architect upgrade to 2013 when it is released?

3.0 CAD Software
- Other CAD software to be used and version?
- We can also use Catia, Rhino, and Tekla if required.

4.0 Revit Model Filename
- We should ask that this name remain the same throughout the job and we will do the same.

5.0 Units
- Project Units:_____
- Project Tolerances: _____

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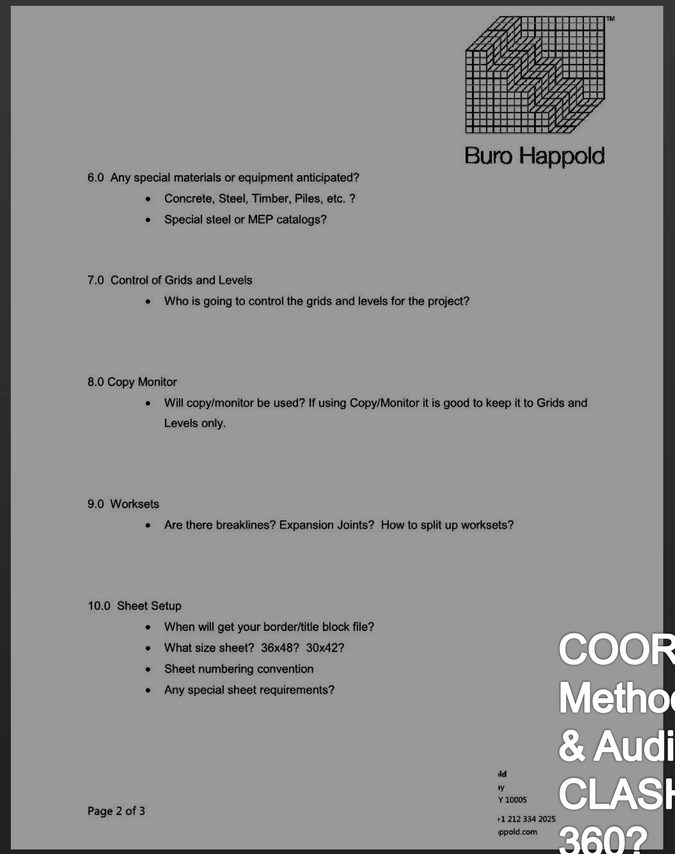

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6.0 Any special materials or equipment anticipated?
- Concrete, Steel, Timber, Piles, etc. ?
- Special steel or MEP catalogs?

7.0 Control of Grids and Levels
- Who is going to control the grids and levels for the project?

8.0 Copy Monitor
- Will copy/monitor be used? If using Copy/Monitor it is good to keep it to Grids and Levels only.

9.0 Worksets
- Are there breaklines? Expansion Joints? How to split up worksets?

10.0 Sheet Setup
- When will get your border/title block file?
- What size sheet? 36x48? 30x42?
- Sheet numbering convention
- Any special sheet requirements?

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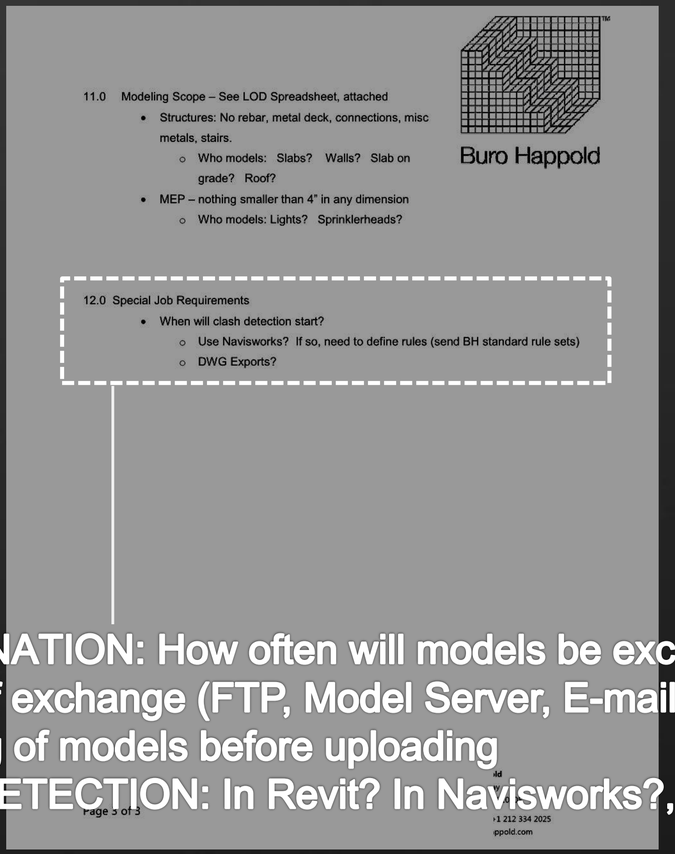

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11.0 Modeling Scope – See LOD Spreadsheet, attached
- Structures: No rebar, metal deck, connections, misc metals, stairs.
  - Who models: Slabs? Walls? Slab on grade? Roof?
- MEP – nothing smaller than 4" in any dimension
  - Who models: Lights? Sprinklerheads?

12.0 Special Job Requirements
- When will clash detection start?
  - Use Navisworks? If so, need to define rules (send BH standard rule sets)
  - DWG Exports?

COORDINATION: How often will models be exchanged, Method of exchange (FTP, Model Server, E-mail), Purging & Auditing of models before uploading

CLASH DETECTION: In Revit? In Navisworks?, In Glue 360?

BIM PROCESS / PREP: LOD MATRIX

DEFINES WHAT & WHEN IT SHOULD BE MODELED

Element (ASTM Uniformat II Classification)					Level of Detail (LOD) and Model Component Author (MCA)							
					100% Schematic Design		100% Design Devleopment		100% Construction Documents		Start of Construction Phase	
					07/01/10		09/01/10		01/01/11		04/01/11	
					LOD	MCA	LOD	MCA	LOD	MCA	LOD	MCA
A SUBSTRUCTURE	A01	General	A0100	Grids (lines and bubbles)	100	ARC	200	STR	300	STR	400	TC
			A0110	Levels (slab elevations)	100	ARC	200	ARC	300	ARC	400	TC
	A10	Foundations	A1010	Pad Footings	100	STR	200	STR	300	STR	400	TC
			A1011	Wall Footings	100	STR	200	STR	300	STR	400	TC
			A1012	Pits (sumps and elvators)	100	STR	200	STR	300	STR	400	TC
			A1013	Mat/Raft foundations	100	STR	200	STR	300	STR	400	TC
			A1014	Piers	100	STR	200	STR	300	STR	400	TC
			A1020	Driven Piles	100	STR	200	STR	300	STR	400	TC
			A1021	Drilled Piers	100	STR	200	STR	300	STR	400	TC
			A1030	Slab on Grade (non-structural)	100	ARC	200	ARC	300	STR	400	TC
			A1031	Structural Slab on Grade	100	STR	200	STR	300	STR	400	TC
				Below slab on grade gravel, vapor barrier	NM		NM		NM		NM	
			A1032	Control and isolation joints in slab on grade	100	STR	200	STR	300	STR	400	TC
	A20	Basement Construction	A2010	Basement Excavation	NM		NM		NM		NM	
			A2020	Basement Walls (including openings)	100	STR	200	STR	300	STR	400	TC
			A2021	Basement Walls Insulation, drainage mat	100	ARC	200	ARC	300	ARC	400	TC
			A2022	Basement Walls - top of wall curbs	100	STR	200	STR	300	STR	400	TC
B SHELL	B10	Superstructure	B1010	Floor and Roof Construction								
			B1011	Concrete Framed Slabs	100	STR	200	STR	300	STR	400	TC
			B1012	Metal Deck+Slab (model as representative thickness	100	STR	200	STR	300	STR	400	TC
				Concrete Reinforcement	NM		NM		NM		NM	
				Misc Metals	NM		NM		NM		NM	

Buro Happold Modeling Scope Matrix

BIM IDEAL: DESIGN & COORDINATION

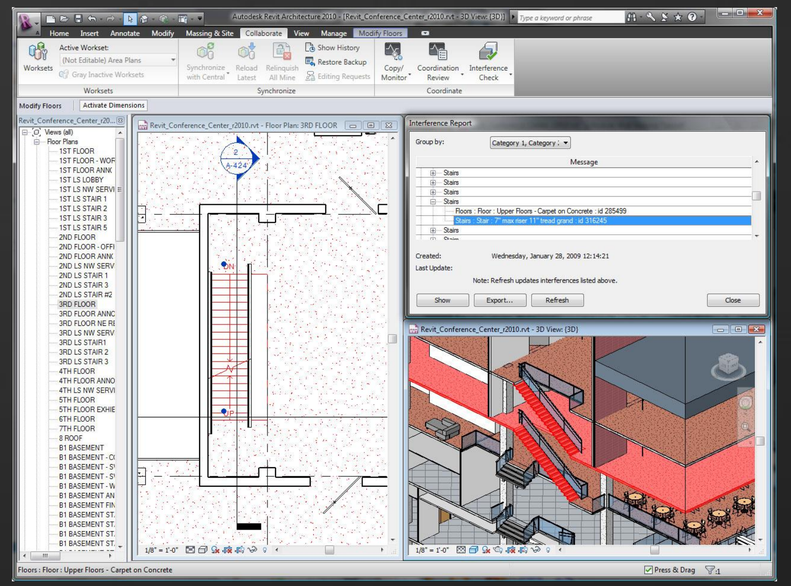
LEARNING OBJECTIVE 1

1. ALL BH TEAM MEMBERS USE REVIT COORDINATION VIEWS WHILE DESIGNING

2. TEAM RUNS PERIODIC CLASH TESTING

3. CLASH FIXING ASSIGNED

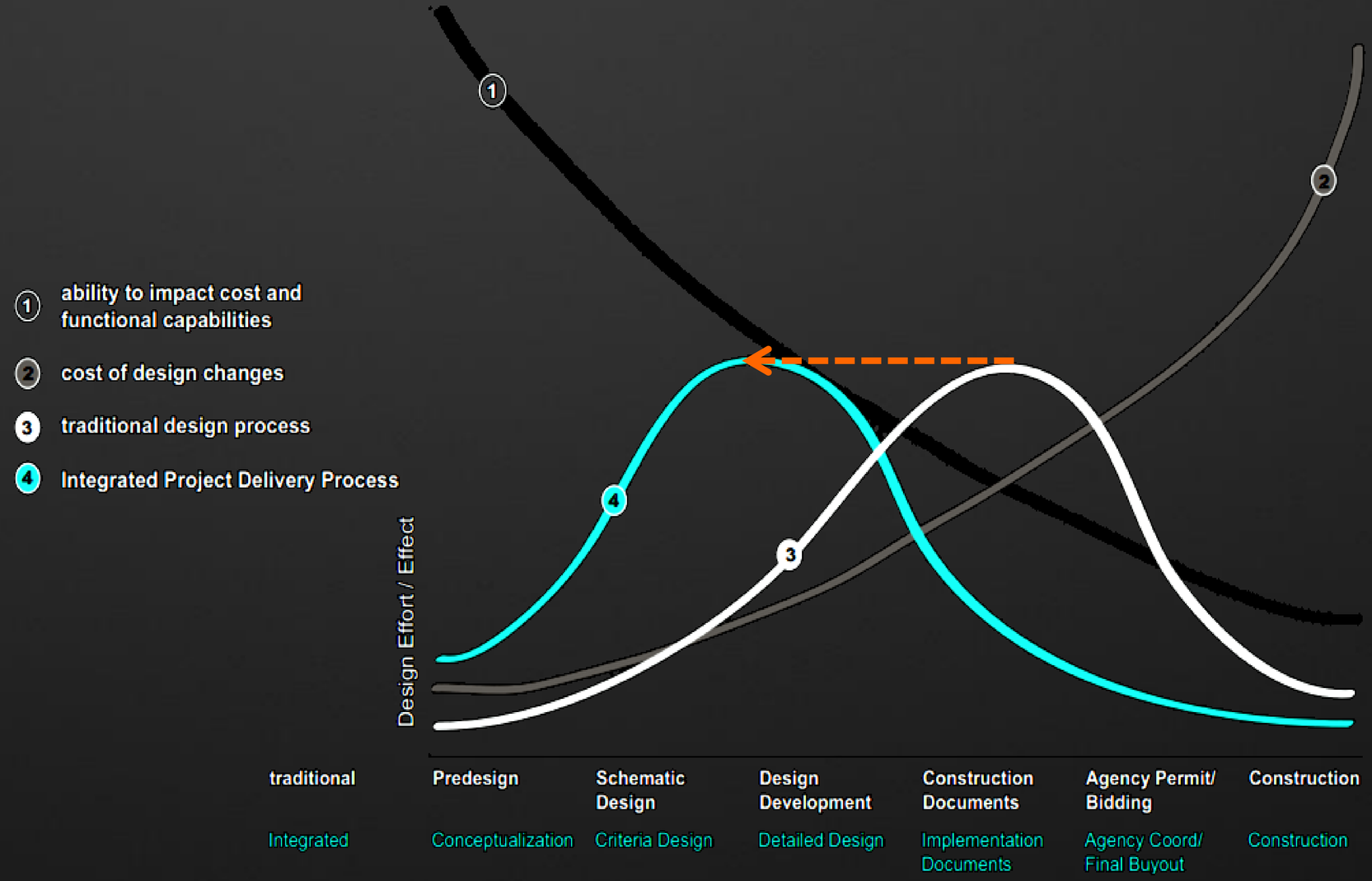
4. RESOLUTION WITHIN NEXT MODEL EXCHANGE BY REQ'D PARTIES



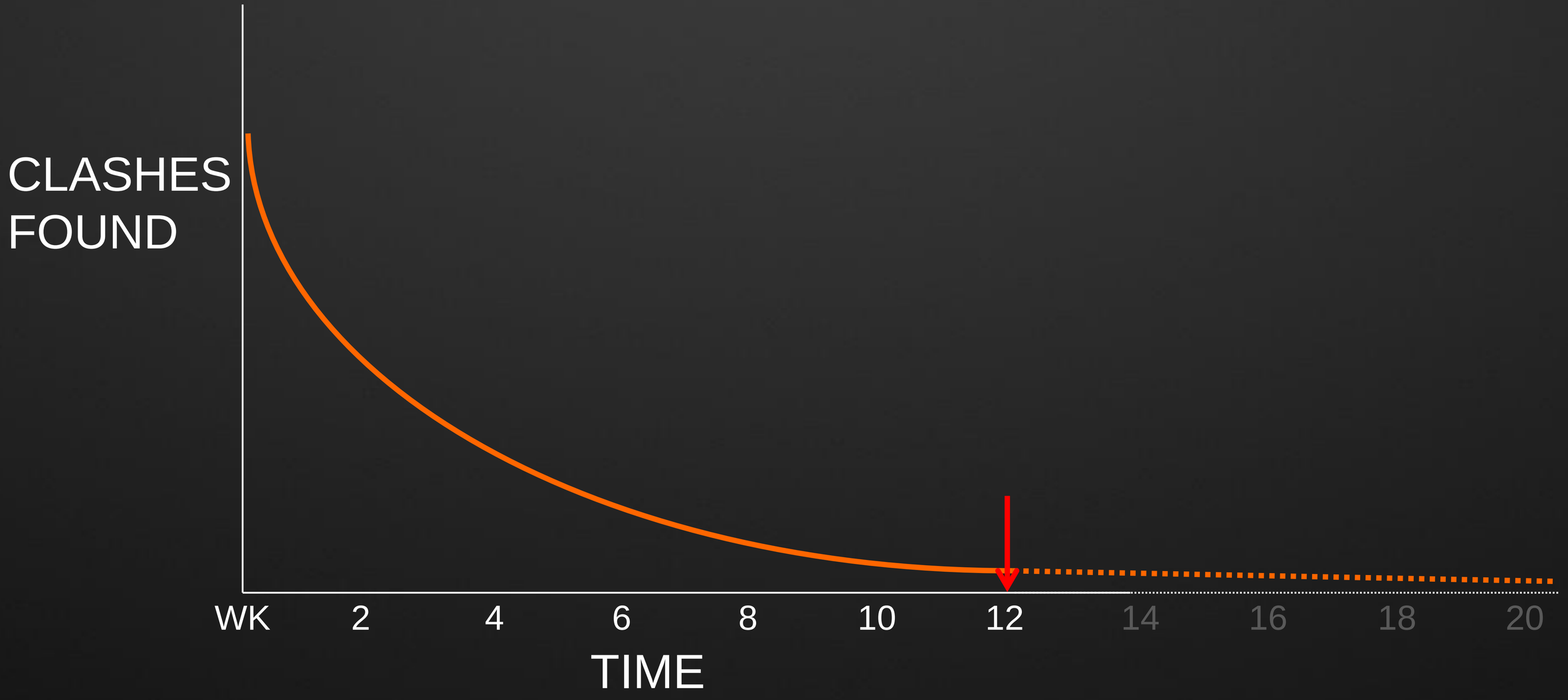
CLASH DETECTION / PROJ. SCHEDULE

- WHEN TO CLASH?
  - *TOO EARLY …?*
  - *TOO LATE…?*

- ALL TRADES READY TO CLASH?



…”ZERO”



Questions?

Brandon.Schumacher@burohappold.com

RENDERING

SITE