Autodesk University 2012

# Getting to "Zero" with Autodesk® Revit® and Autodesk® Navisworks®

Brandon Schumacher - BIM Coordinator, Buro Happold

**MP3730** 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 be able to:

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

## About the Speaker

*Brandon Schumacher, LEED AP, has a Bachelor's of Architecture from Iowa State University and a Master's of Mechanical Engineering from Stevens Institute of Technology. Prior to joining Buro Happold as BIM Coordinator, Mr. Schumacher has 6 years experience in the design industry, 5 years in the construction industry and has served as a project manager of an award-winning design-build randy Brown Architects, BIM Specialist and Project Engineer at SHoP Architects and BIM Director at Cook + Fox Architects. Brandon's current projects include Yale Residential Colleges, PNC Tower and Columbia Business School. He is also responsible for unifying and implementing BIM Standards across Buro Happold's North American offices and for coordinating all BIM training, automation and support initiatives for BHNY. Brandon is also a regular attendee and member of the NYC Revit Users Group.*

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## Introduction:

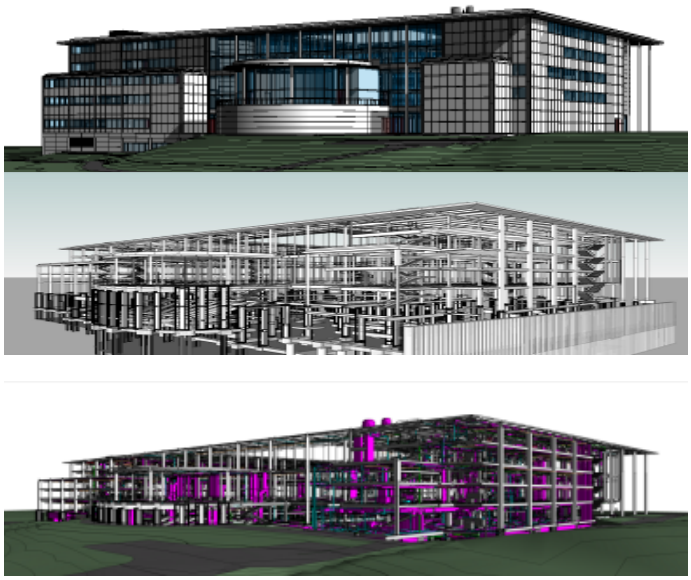
- The Project
- The BIM Process
- The clash detection process
    - "ZERO" and managing the expectations
    - Evolving weekly collaboration
    - Quantifying the De-Clashing time
    - Navisworks Workflow
    - Best Practices

## THE PROJECT: Yale School of Management

- Design Architect: Foster + Partners
- Architect of Record: Gruzen Samton
- 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



MODELED, CLASHED

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

MODELED, NOT CLASHED

- PRESSURIZED & BRANCH PIPING 2” OR SMALLER
- NOT MODELED = NOT CLASHED
- NO CONDUIT [ LOD 400 – 500 ]
- NO RECEPTACLES, NO DEVICES
- NO BOLTS, GUSSET PLATES, CONNECTIONS

## THE CLASH DETECTION PROCESS

- Benefits:
    - Ambitious goals realized.
    - IDENTIFY tight spots DURING DESIGN PHASE [ NOT IN CA ]
    - Visualization of the problems YIELDS AIDS 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

(Learning objective 2)

**DOES THE COORDINATION PROCESS CHANGE?**

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

WHO: **THE DESIGN MODELERS** VS. PROJECT LEADS

WHEN: **VARIES**, **POSSIBLY THROUGHOUT** VS. AFTER DESIGN IS DONE

**CLASH DETECTON SUMMARY FOR YALE SCHOOL OF MANAGEMENT**

GOALS:

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

CONSTRAINTS:

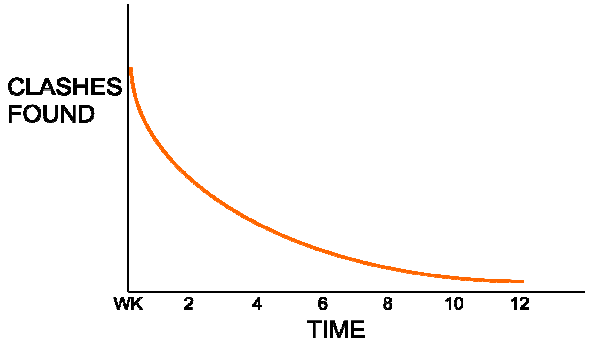
- 12 WEEKS
- 5 BH STAFF RESOURCED TO THIS TASK
- WEEKLY PROGRESS MEETINGS

- ENTIRE DESIGN TEAM PARTICIPATED

**WHAT IS "ZERO" ?:**

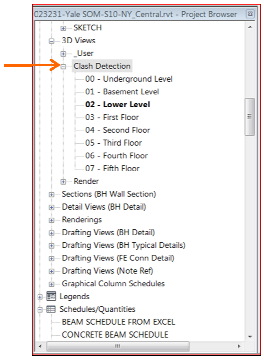
- ZERO CLASHES FOUND WITH ALL PITCHED PIPIING MODELED
- ZERO CLASHES FOUND WITH ALL SERVICES 2" OR LARGER MODELED
- CONTRACTOR ABSOLVES DESIGN TEAM OF RESPONSIBILITY FOR ANYTHING SMALLER / PRESSURIZED **

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




## THE CLASH DETECTION: NAVISWORKS WORKFLOW

### REVIT EXPORT VIEWS

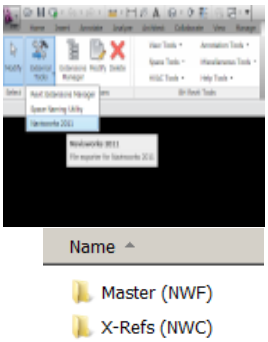



3D export views set up for each level, IN EACH MODEL [M, P, FP] **

***NO LINK GEOMETRY WILL BE EXPORTED*

BEST practice: create & apply view template to isolate elements before exporting to Navisworks

### EXPORT [ REVIT ADD-IN]



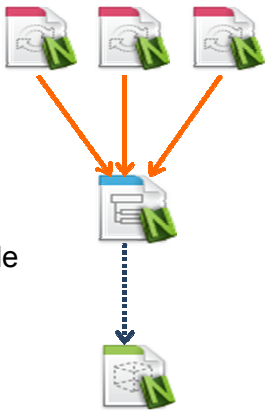

NAVISWORKS GEOMETRY CAN BE EXPORTED FROM REVIT AS .NWC FILE FORMAT.**

***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

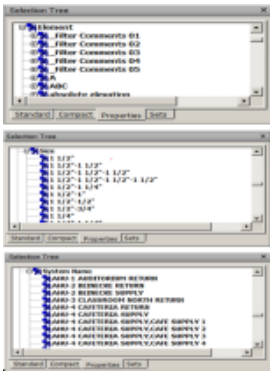
NWD

- 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*

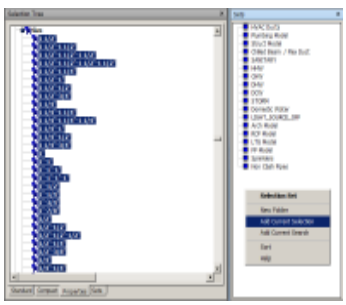
## SETS: SELECTION SETS



- 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)

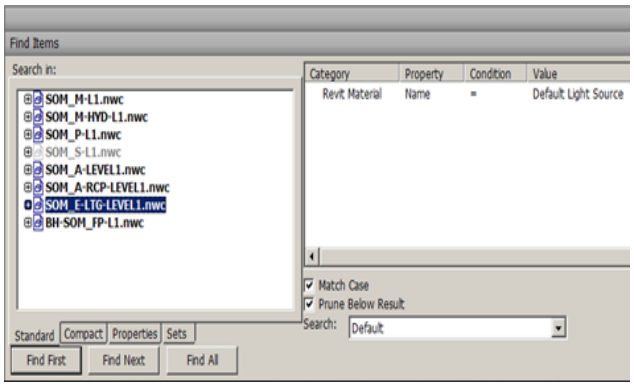
## SETS: SELECTION SET CREATION

- Navigate to the parameters you're isolating
- Select multiple parameters
- In the Sets menu, right click and select Add Current Selection
- The Selection set is now defined and will be available for use in the rule templates



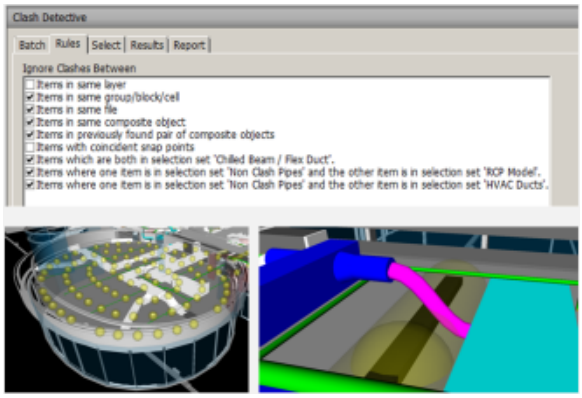
- navigate to the parameters we want through the Find Items function

## SETS: SEARCH SETS




- This searches through selected models for available parameters
- In the Sets menu, right click and select Add Current Search
- Export your Rules / Search Sets

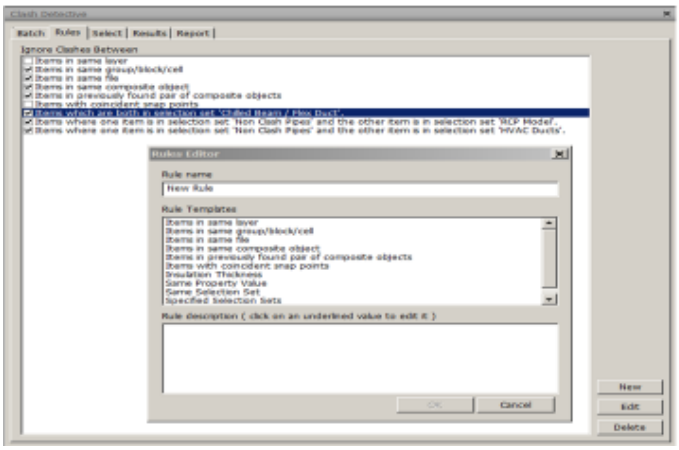
## CLASH DETECTIVE (RULES TAB)

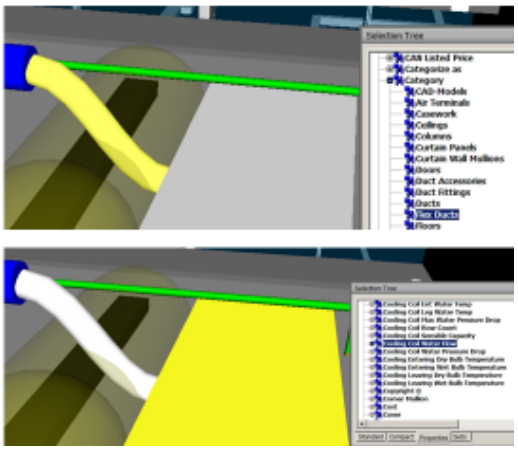



- Rules created to ignore clashes between certain elements.
  - Pipes <= 2”
  - Light Sources
  - Inherent clashes within Revit eg. Flex ducts “clashing” with the Chilled Beams…

## 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?

### SELECTION SETS

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]

### SEARCH SETS

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

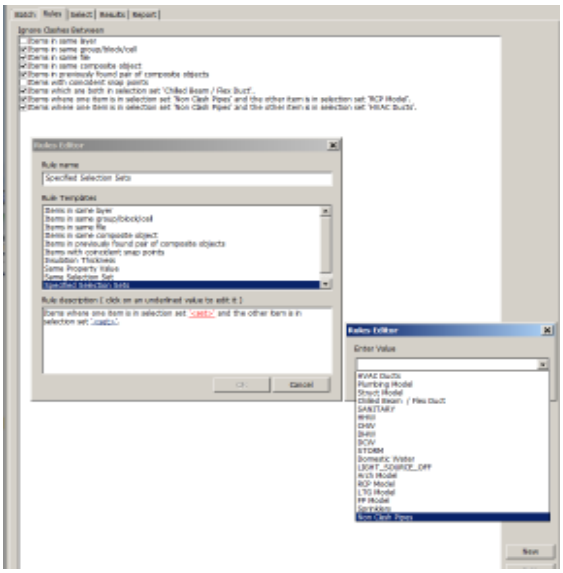
BENEFITS

- 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 |

## 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

SETTINGS CONTROL AUTO-ZOOM / DIMMING,

ETC. OF EACH CLASH

**RESULTS – ORGANIZATION**

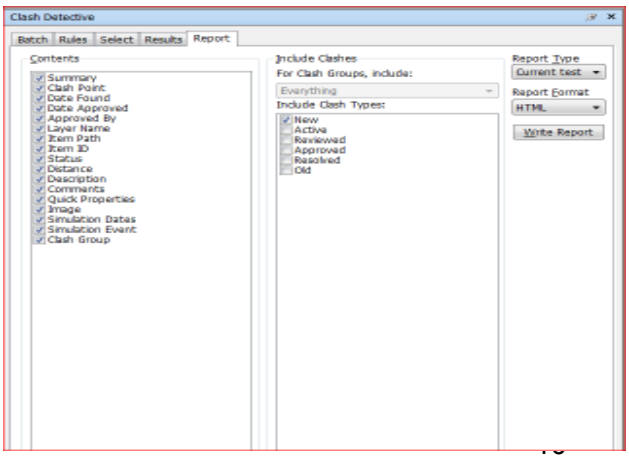
RESULTS CAN BE GROUPED

POSSIBLE GROUPING:

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

**REPORT GENERATION**

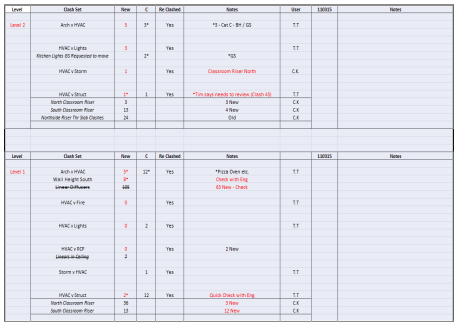
- CUSTOMIZABLE REPORTS TO DISPLAY ONLY THE PROPERTIES YOU WANT
- CAN BE EXPORTED AS HTML, XML, PDF – CAN BE VIEWED BY DESIGN TEAM, OWNER, ETC…



## CLASH TRACKING

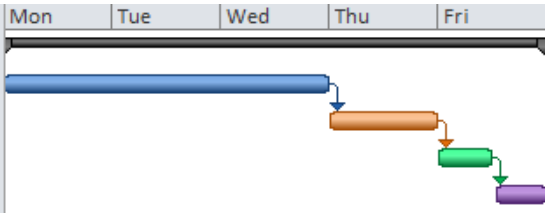
IN THIS CASE, EXCEL SPREADSHEET

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

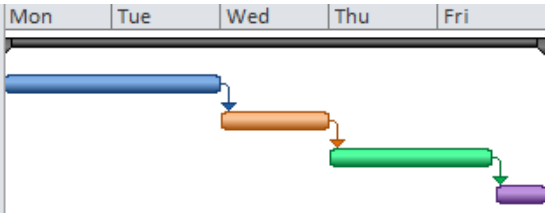


## EVOLVING WEEKLY COLLABORATION

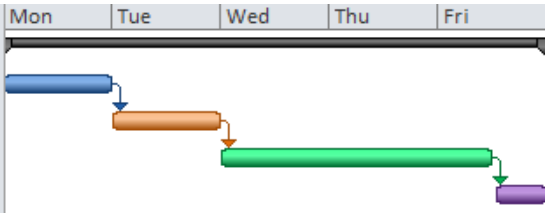
| | |
|---|---|
| **INITIAL PROCESS** | **5 days** |
| CLASH REVIEW [CC] | 3 days |
| TEAM CLASH REVIEW MTG ON-SITE [ALL] | 1 day |
| DE-CLASH [BH] | 0.5 days |
| UPLOAD .nwc's [BH] | 0.5 days |



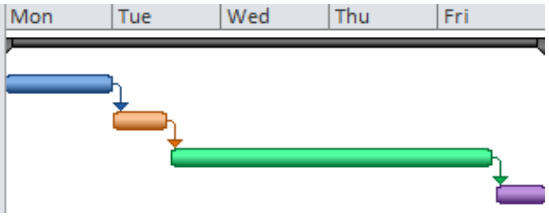

| | |
|---|---|
| **R1 PROCESS** | **5 days** |
| CLASH REVIEW [CC] | 2 days |
| TEAM CLASH REVIEW MTG ON-SITE [ALL] | 1 day |
| DE-CLASH [BH] | 1.5 days |
| UPLOAD .nwc's [BH] | 0.5 days |



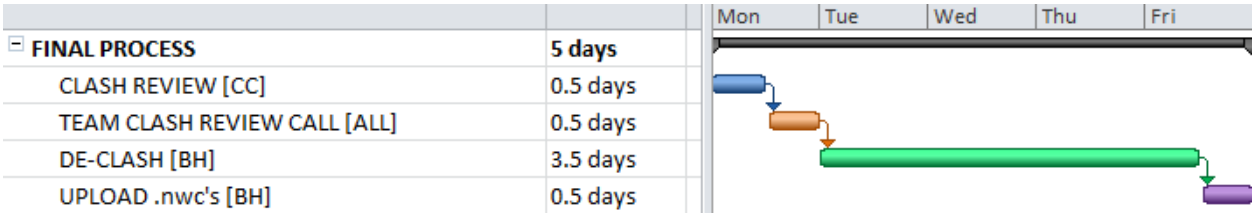

| | |
|---|---|
| **R2 PROCESS** | **5 days** |
| CLASH REVIEW [CC] | 1 day |
| TEAM CLASH REVIEW MTG ON-SITE [ALL] | 1 day |
| DE-CLASH [BH] | 2.5 days |
| UPLOAD .nwc's [BH] | 0.5 days |




| | |
|---|---|
| **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 |




**= 3.5 DE-CLASHING WORKING DAYS / WEEK**




| | |
|---|---|
| **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 |

**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*

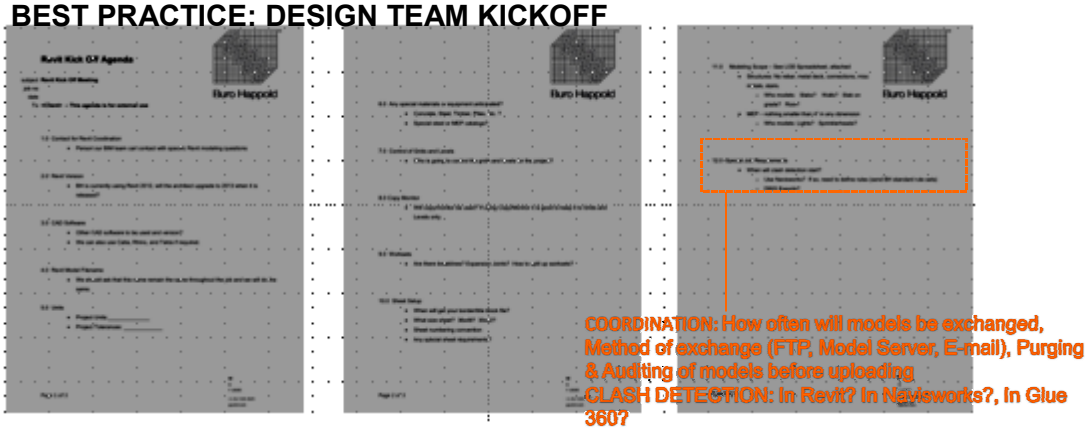
3.5 DE-CLASH DAYS PER WORK WEEK = 7.0 DE-CLASH DAYS / FLOOR

2 STAFF RESOURCED FULL TIME

10 DAYS OF DE-CLASHING WORK / FLOOR

## CONCLUSIONS

**BEST PRACTICE: DESIGN TEAM KICKOFF**

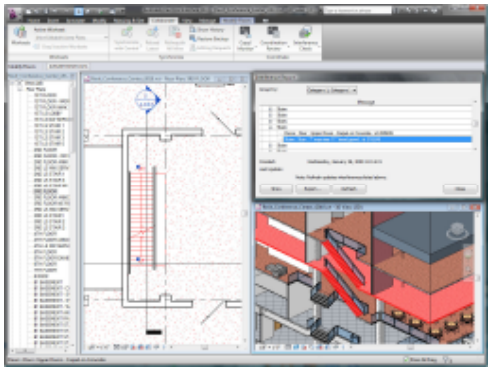



**BIM PROCESS / PREP: LOD MATRIX**

**BIM IDEAL: DESIGN & COORDINATION**

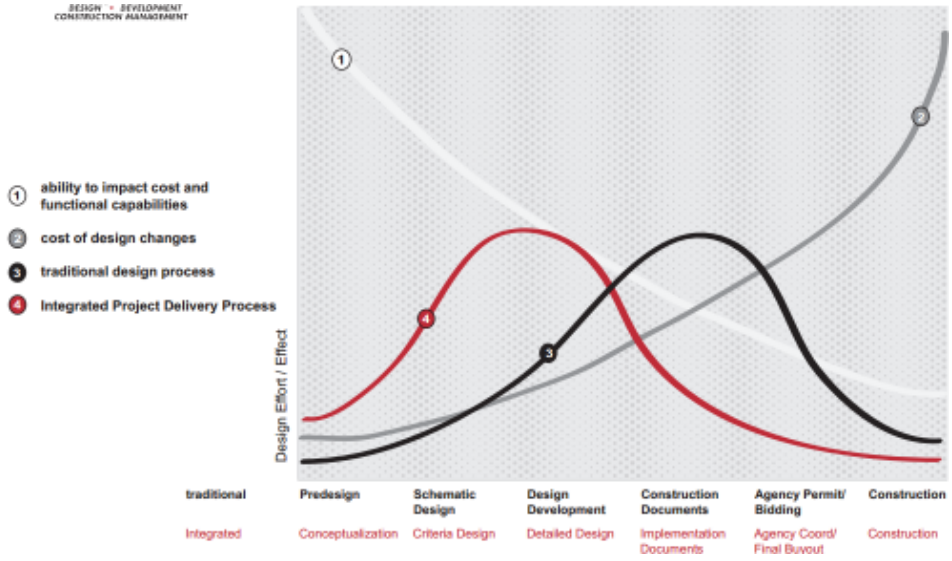
**(LEARNING OBJECTIVE 1)**

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

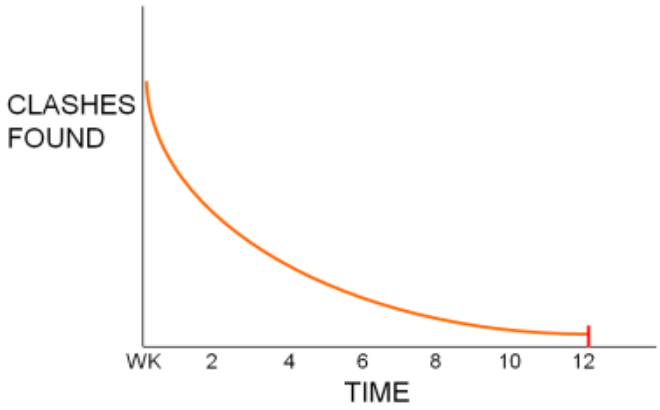


**CLASH DETECTION / PROJ. SCHEDULE**

- <u>WHEN</u> TO CLASH?
  - *TOO EARLY …?*
  - *TOO LATE…?*
- ALL TRADES READY TO CLASH?




**…"ZERO"**


CLASHES
FOUND
WK
2
4
6
8
10
12
TIME