

# Laser Scanning Gone Wild: 4D clash detection with the point cloud at Broward Center for Performing Arts

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# Class Summary

Learn how we used laser scanning and Autodesk® Building Design Suite to coordinate the installation of a new chiller and air handling unit in the basement of one of Florida's premier performance venues. We demonstrate how we used Autodesk® ReCap™, Autodesk® Revit®-based software, Autodesk® Navisworks® software, and Apple® iPads® tablets to create a 4D clash detection model to preplan the movement of a 8.5-ton chiller into the existing mechanical room. Because performances scheduled throughout the construction limited downtime, having an efficient process was critical. The virtual design and construction (VDC) team learned the most efficient ways to transfer point cloud files using the ReCap™ RCS format, perform clash detection in the point cloud in Navisworks®, create models, and distribute the information to the team for use in the field. This lean process helped all team members visualize and plan their work, and it provided the owner with a useful as-built model for future work.



# Key learning objectives

At the end of this class you will understand the process for:

- Aggregating point cloud files into ReCap™, navigate the point cloud, take measurements, and distribute data from ReCap™
- Bring laser scans into Revit® to model existing conditions
- Perform clash detection in Navisworks® using laser scans and Revit® files
- Explain why laser scanning is a cost effective way to document as-built conditions and coordinate renovation work

# Broward Center for Performing Arts

## Fort Lauderdale, FL





# Overview

- 8 Tons of chiller through an 8' x 8' hallway
- How we procured our laserscan
- Point cloud overload
- New software streamlines the process
- Using the cloud to communicate
- Setting up your files for 4D clash detection

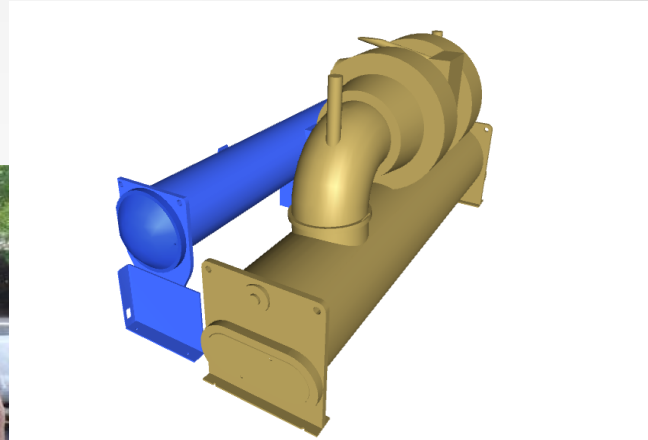






What we thought we needed to scan

# The task at hand



# Laser Scanning Basics

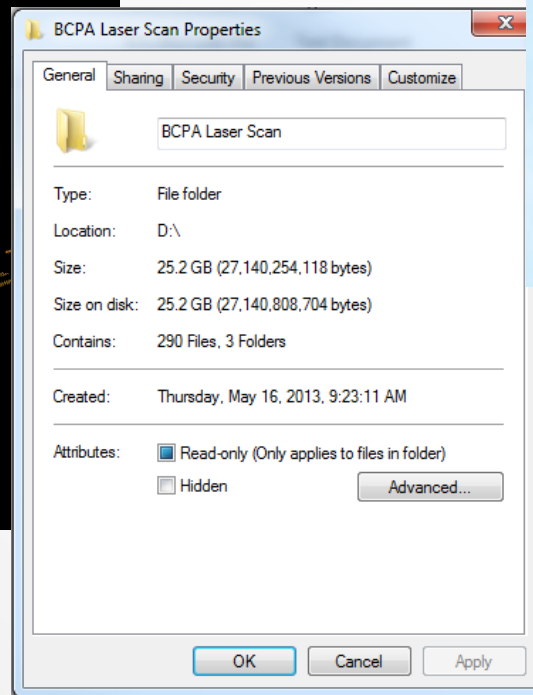
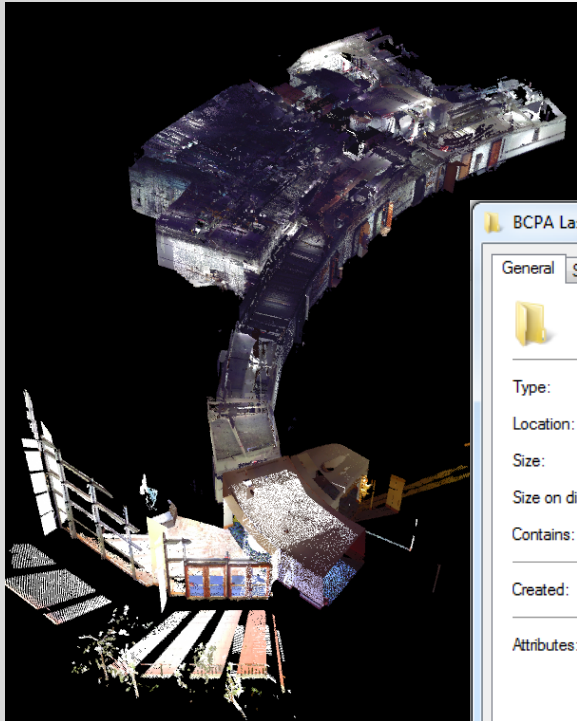
<http://youtu.be/or6JuiFBdbQ>

- Leica, Faro, Trimble
- Scan Density
- Number of Setups
- Post Processing
- Do you need a model or raw files?
- How long should it take?

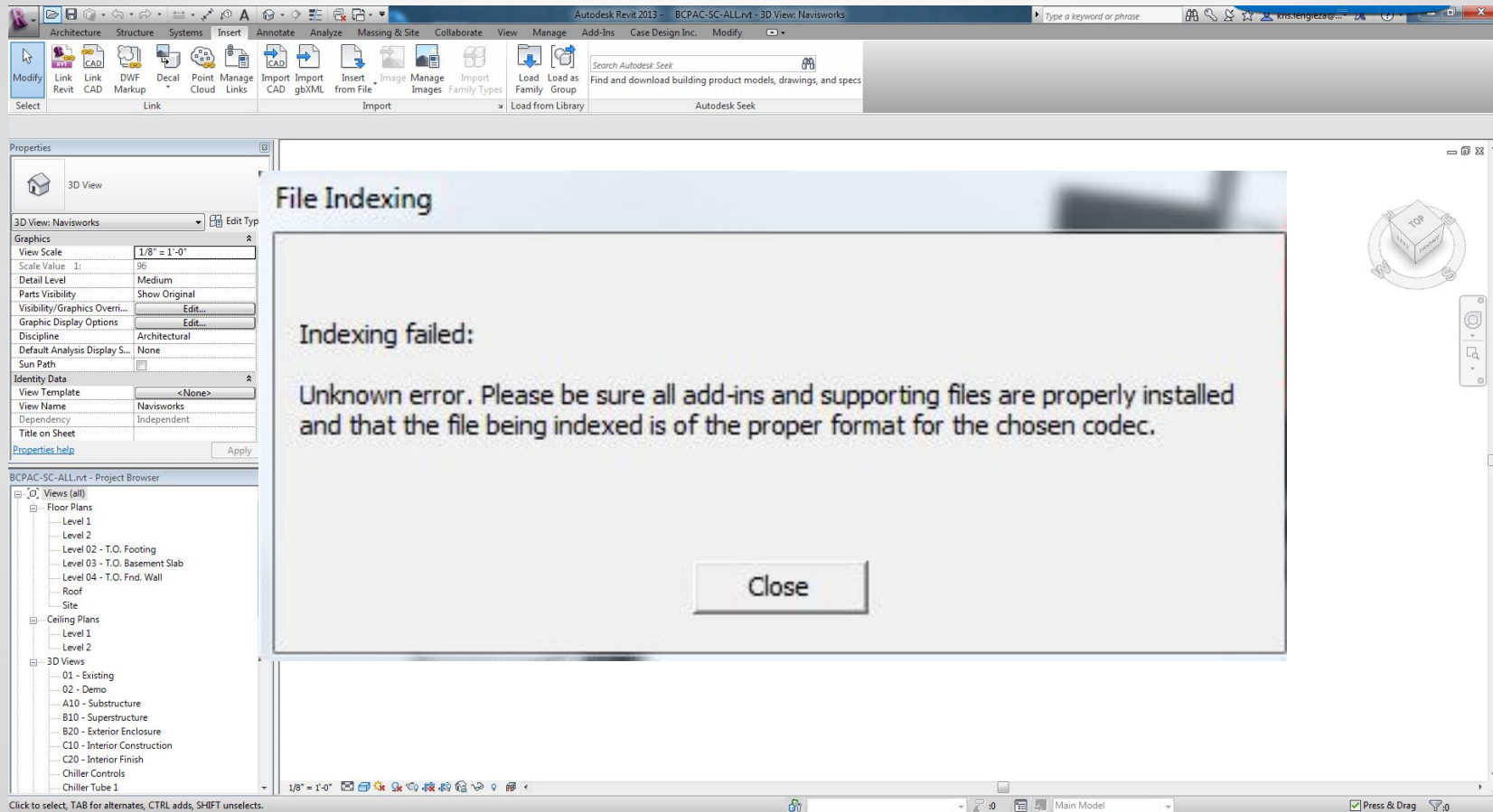




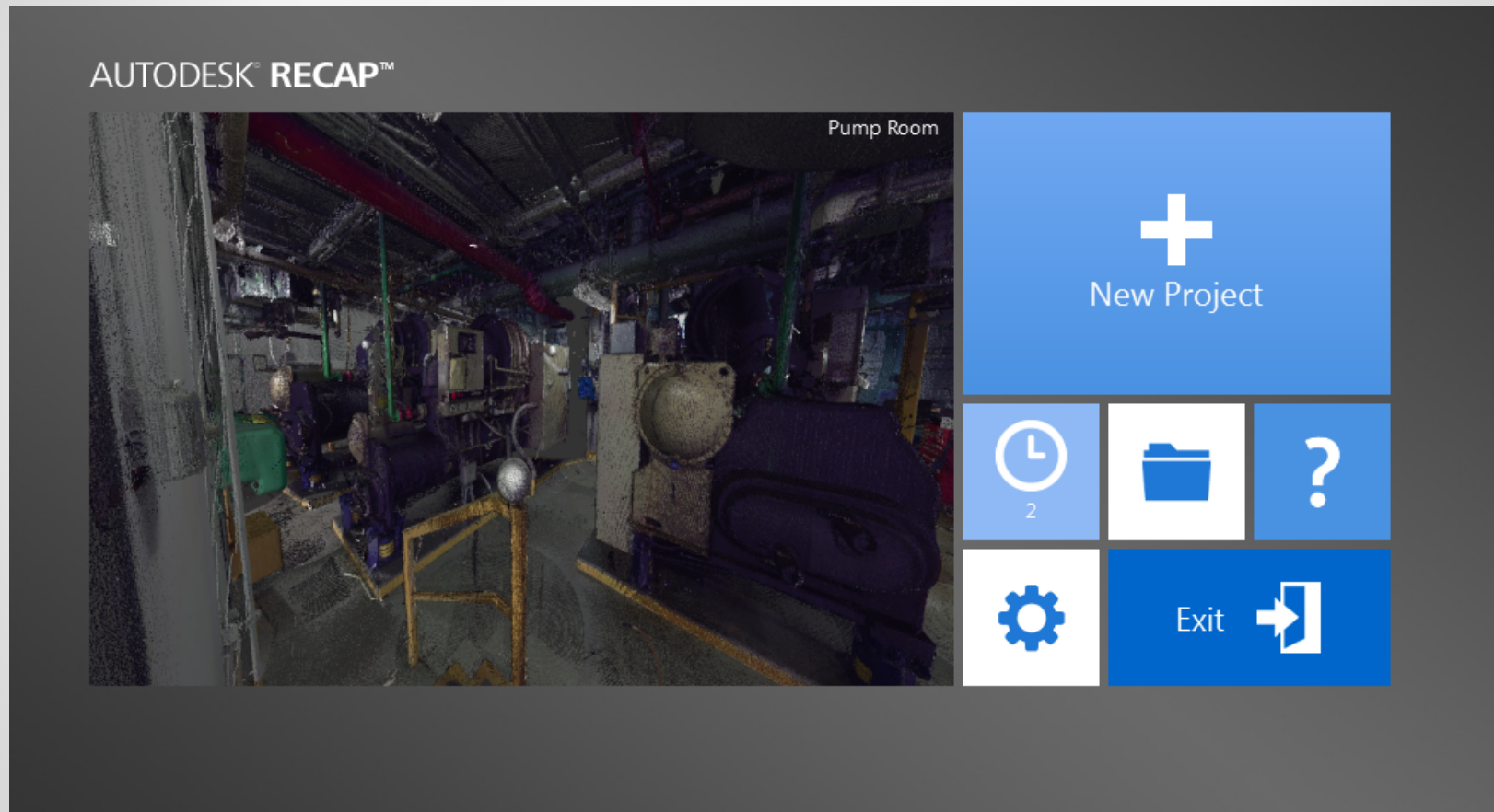
# 20 GB, that's a lot of points



# Revit and Navisworks 2013 if you dare





# Recap, Revit and Navisworks 2014





# Recap, Revit and Navisworks 2014

			
	Navisworks	Recap	Faro Scene
Cached	.NWC	.RCS	.FLS
Aggregator	.NWF	.RCP	.FLW
Aggregated	.NWD*		

\*File is aggregated but a working copy of Recap is required to open it in addition to Navisworks, the .RCS files are not contained inside of the .NWD therefore it is still working like an .NWF

# Recap and Autodesk 2014

[http://youtu.be/bCTf\\_mIBSs8](http://youtu.be/bCTf_mIBSs8)







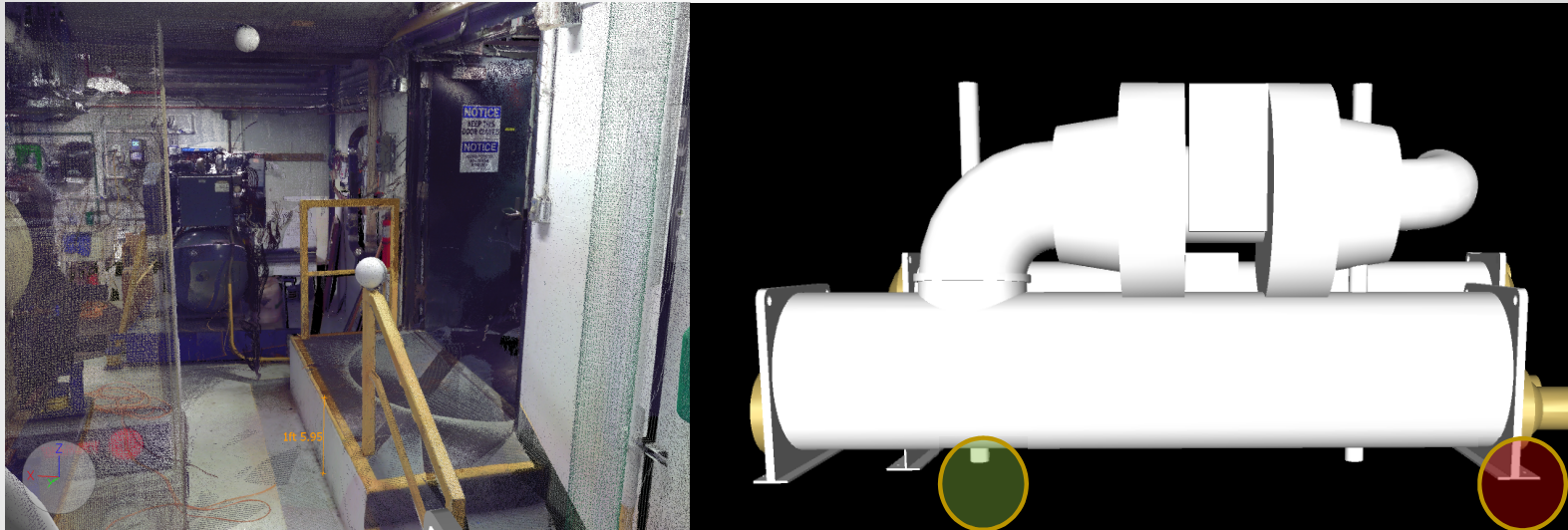
Lets figure out what's in the way



# Communicating with the team



# Communicating with the team



- Reflect Trade Knowledge in the model
  - What kind of skates to be used?
  - Relocating skates during the move?
  - How we will lower it down the step?
  - What will the Manufacturer allow?

# 4D Point Cloud Clash Detection

<http://youtu.be/BBauiP6Wem0>

## General Routing of Chiller



# Setting up your 4D Clash Detection

The screenshot displays the Autodesk Navisworks Manage 2014 interface for a project named 'BCPA\_Combined.nwf'. The main viewport shows a 3D model of a building interior with a red 'EXIT' sign. The left pane shows a 'Selection Tree' with a list of BCPA001.1.rcs through BCPA033.1.rcs. The right pane shows the 'Clash Detective' tool with a table of clashes and a 'Run Test' button. The bottom pane shows the 'TimeLiner' tool with a table of tasks and a timeline view.

**Clash Detective Table:**

Name	Status	Clashes	New	Active	Reviewed	Approved	Resolved
Chiller Tube 1, Old	9	9	0	0	0	0	0

**TimeLiner Table:**

Active	Name	Status	Planned Start	Planned End	Task Type	Attached	Animation
<input checked="" type="checkbox"/>	Existing Structure and Point Cloud	Existing	9/30/2013	9/30/2013	Explicit Selection		
<input checked="" type="checkbox"/>	Chiller Move In	Existing	9/30/2013	10/4/2013	Sets>>Chiller Tube	Chiller Tube Movement(Animation Set 1)	



# Setting up your 4D Clash Detection

Autodesk Navisworks Manage 2014 - BCPA\_Combined.nwf

Home Viewpoint Review Animation View Output Render BIM 360 Glue Bluebeam Sectioning Tools

Navigation Bar View Cube HUD Reference Views Show Grid Mode

Grids & Levels Scene View Workspace

Selection Tree Standard

TimeLiner

Tasks Data Sources Configure Simulate

Add Task Attach

Zoom:

Active	Name	Status	Planned Start	Planned End	Task Type	Attached	Animation
<input checked="" type="checkbox"/>	Existing Structure and Point Cloud		9/30/2013	9/30/2013	Existing	Explicit Selection	
<input checked="" type="checkbox"/>	Chiller Move In		9/30/2013	10/4/2013	Existing	Sets->Chiller Tube	Chiller Tube Movement\Animation Set 1

TimeLiner Animator

Add Task Attach

Zoom:

Active	Name	Status	Planned Start	Planned End	Task Type	Attached	Animation
<input checked="" type="checkbox"/>	Existing Structure and Point Cloud		9/30/2013	9/30/2013	Existing	Explicit Selection	
<input checked="" type="checkbox"/>	Chiller Move In		9/30/2013	10/4/2013	Existing	Sets->Chiller Tube	Chiller Tube Movement\Animation Set 1

Mon Sep 30, 13 Tue Oct 01, 13 Wed Oct 02, 13 Thu Oct 03, 13 Fri Oct 04, 13

AM PM AM PM AM PM AM PM AM

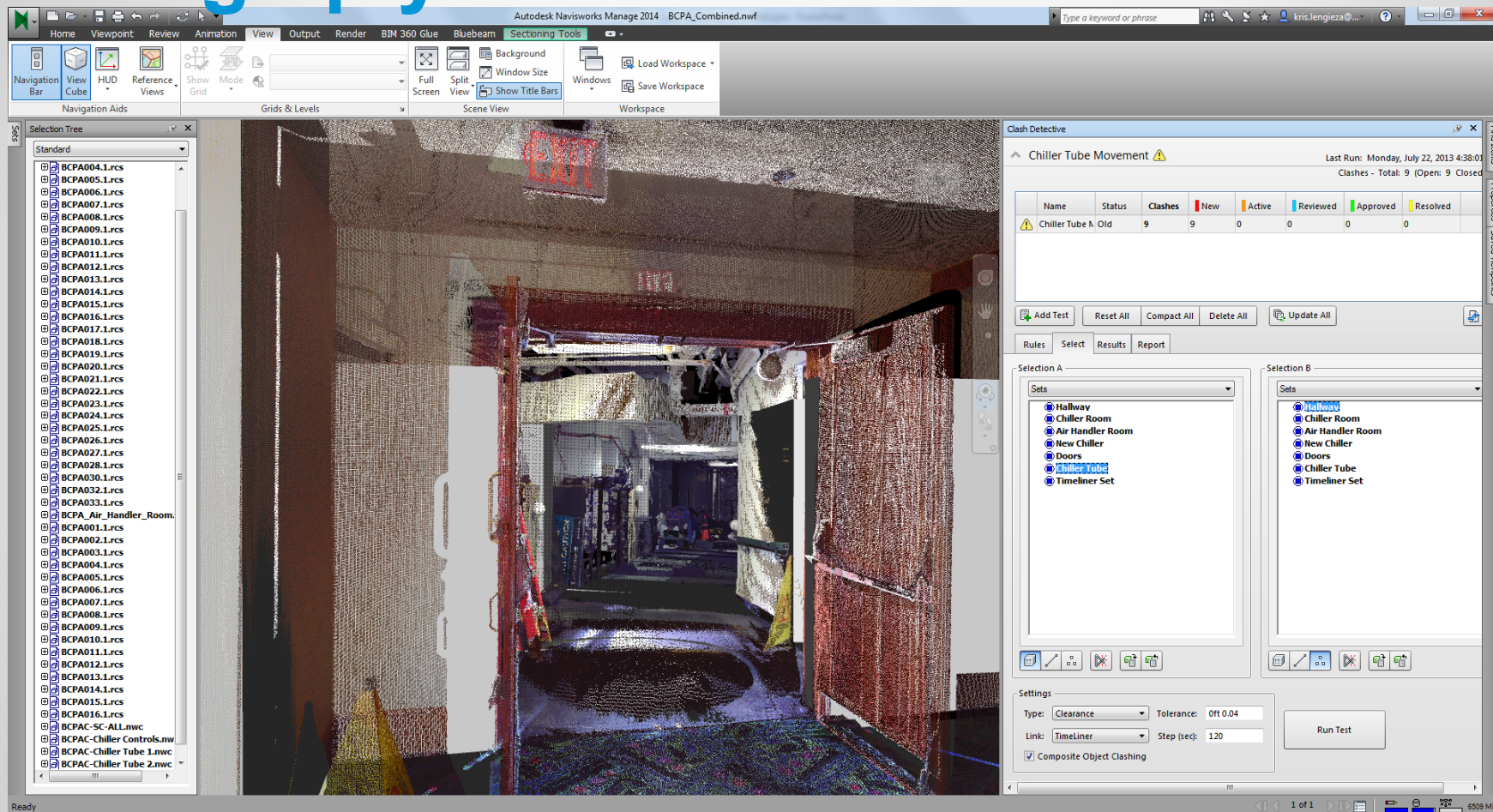
9/30/2013

Ready

1 of 1

6558 MB

# Setting up your 4D Clash Detection





# Setting up your 4D Clash Detection

The screenshot displays the Autodesk Navisworks software interface for setting up 4D Clash Detection. The main window is titled "Autodesk Navisworks Manage 2014 - BCPA\_Combined.nwf". The interface is divided into several panels:

- Selection Tree:** Located on the left, it lists various project elements such as BCPA004.1.rcs, BCPA005.1.rcs, BCPA006.1.rcs, BCPA007.1.rcs, BCPA008.1.rcs, BCPA009.1.rcs, BCPA010.1.rcs, BCPA011.1.rcs, BCPA012.1.rcs, BCPA013.1.rcs, BCPA014.1.rcs, BCPA015.1.rcs, BCPA016.1.rcs, BCPA017.1.rcs, BCPA018.1.rcs, BCPA019.1.rcs, BCPA020.1.rcs, BCPA021.1.rcs, BCPA022.1.rcs, BCPA023.1.rcs, BCPA024.1.rcs, BCPA025.1.rcs, BCPA026.1.rcs, BCPA027.1.rcs, BCPA028.1.rcs, BCPA030.1.rcs, BCPA032.1.rcs, BCPA033.1.rcs, BCPA\_Air\_Handler\_Room, BCPA001.1.rcs, BCPA002.1.rcs, BCPA003.1.rcs, BCPA004.1.rcs, BCPA005.1.rcs, BCPA006.1.rcs, BCPA007.1.rcs, BCPA008.1.rcs, BCPA009.1.rcs, BCPA010.1.rcs, BCPA011.1.rcs, BCPA012.1.rcs, BCPA013.1.rcs, BCPA014.1.rcs, BCPA015.1.rcs, BCPA016.1.rcs, BCPAC-SC-ALL.nwc, BCPAC-Chiller Controls.nwc, BCPAC-Chiller Tube 1.nwc, and BCPAC-Chiller Tube 2.nwc.
- Rules Panel:** Located in the center, it contains two sections: "Selection A" and "Selection B". Both sections have a "Sets" dropdown menu and a list of selected items. In "Selection A", the items are Hallway, Chiller Room, Air Handler Room, New Chiller, Doors, Chiller Tube, and Timeliner Set. In "Selection B", the items are Hallway, Chiller Room, Air Handler Room, New Chiller, Doors, Chiller Tube, and Timeliner Set. Below these sections are icons for selection and deletion.
- Settings Panel:** Located at the bottom left, it includes a "Type" dropdown set to "Clearance", a "Tolerance" input field set to "0ft 0.04", a "Link" dropdown set to "TimeLiner", a "Step (sec)" input field set to "120", and a checked checkbox for "Composite Object Clashing". A "Run Test" button is located to the right of the settings.
- Clash Detection Results Panel:** Located on the right, it shows the results of the clash detection. It includes a "Last Run" date and time (Monday, July 22, 2013 4:38:01), a "Clashes - Total: 9 (Open: 9 Closed: 0)" summary, and a table with columns for "New", "Active", "Reviewed", "Approved", and "Resolved". The table shows 0 for all categories. Below the table are "Delete All" and "Update All" buttons.

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- Rules Panel:** Located in the center, it shows two selection sets, Selection A and Selection B. Both sets contain the following elements: Hallway, Chiller Room, Air Handler Room, New Chiller, Doors, Chiller Tube, and Timeliner Set. The "Chiller Tube" element is highlighted in blue in both sets.
- Settings Panel:** Located at the bottom, it includes the following settings:
  - Type: Clearance
  - Tolerance: 0ft 0.04
  - Link: TimeLiner
  - Step (sec): 120
  - Composite Object Clashing: ☒
- Run Test Button:** A button labeled "Run Test" is located to the right of the settings panel.
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- Settings Panel:** Located at the bottom, it contains the following settings:
  - Type: Clearance
  - Tolerance: 0ft 0.04
  - Link: TimeLiner (highlighted with a red circle)
  - Stop (sec): 120
  - Composite Object Clashing: ☒
- Run Test Button:** A button labeled "Run Test" is located to the right of the settings.
- Clash Detection Results Panel:** Located on the right, it shows the results of the clash detection. It includes a table with columns for New, Active, Reviewed, Approved, and Resolved. The table shows 0 for each column. Below the table, there is a "Delete All" button and an "Update All" button. The panel also displays the last run date and time: "Last Run: Monday, July 22, 2013 4:38:01".

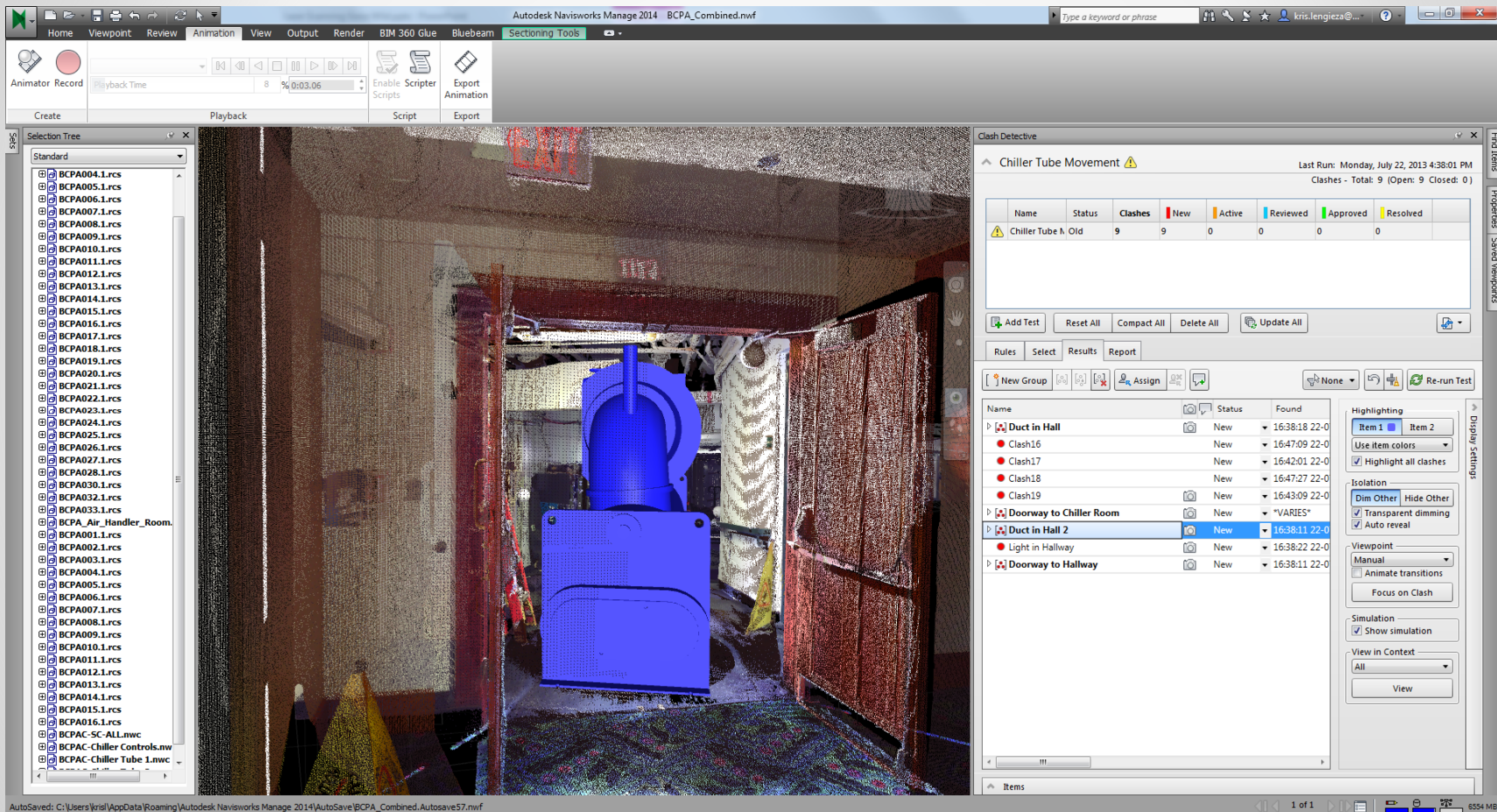
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# Setting up your 4D Clash Detection



# Setting up your 4D Clash Detection

The screenshot displays the Autodesk Navisworks Manage 2014 interface for a project named 'BCPA\_Combined.nwf'. The 'Rules' tab is active, showing a list of clash rules and their status. The 'Duct in Hall 2' rule is selected, and its settings are visible on the right. The 'Highlighting' section shows 'Item 1' and 'Item 2' selected, with 'Use item colors' and 'Highlight all clashes' checked. The 'Isolation' section shows 'Dim Other' and 'Hide Other' selected, with 'Transparent dimming' and 'Auto reveal' checked. The 'Viewpoint' section shows 'Manual' selected, with 'Animate transitions' and 'Focus on Clash' checked. The 'Simulation' section shows 'Show simulation' checked. The 'View in Context' section shows 'All' selected, with 'View' checked. The 'Display Settings' panel on the right shows a summary of clashes: 9 New, 0 Active, 0 Reviewed, 0 Approved, and 0 Resolved. The 'Find Items' panel on the far right shows a search for 'kris.lengieza@...'. The 'Selection Tree' on the left lists various project elements, including 'BCPA004.L.rcs' through 'BCPA033.L.rcs' and 'BCPA\_Air\_Handler\_Room.L.rcs'.

Name	Status	Found
▶ Duct in Hall	New	16:38:18 22-0
● Clash16	New	16:47:09 22-0
● Clash17	New	16:42:01 22-0
● Clash18	New	16:47:27 22-0
● Clash19	New	16:43:09 22-0
▶ Doorway to Chiller Room	New	*VARIES*
▶ Duct in Hall 2	New	16:38:11 22-0
● Light in Hallway	New	16:38:22 22-0
▶ Doorway to Hallway	New	16:38:11 22-0

AutoSave: C:\Users\kris\AppData\Roaming\Autodesk Navisworks Manage 2014\AutoSave\BCPA\_Combined.Autosave57.nwf



# Setting up your 4D Clash Detection

The screenshot displays the Autodesk Navisworks Manage 2014 interface for a project named 'BCPA\_Combined.nwf'. The 'Rules' tab is active, showing a list of clash rules. The 'Duct in Hall 2' rule is selected, and its settings are visible on the right. The 'Highlighting' section is circled in red, showing 'Item 1' and 'Item 2' with a blue highlight. The 'Isolation' section shows 'Dim Other' and 'Hide Other' options. The 'Viewpoint' section shows 'Manual' and 'Animate transitions' options. The 'Simulation' section shows 'Show simulation' checked. The 'View in Context' section shows 'All' and 'View' options. The 'Display Settings' panel on the right shows a summary of clashes: 9 New, 0 Active, 0 Reviewed, 0 Approved, 0 Resolved. The 'Find Items' panel on the far right shows a search bar and a list of items.

Name	Status	Found
▶ Duct in Hall	New	16:38:18 22-0
● Clash16	New	16:47:09 22-0
● Clash17	New	16:42:01 22-0
● Clash18	New	16:47:27 22-0
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● Light in Hallway	New	16:38:22 22-0
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AutoSave: C:\Users\kris\AppData\Roaming\Autodesk Navisworks Manage 2014\AutoSave\BCPA\_Combined.Autosave57.nwf

# Setting up your 4D Clash Detection

The screenshot displays the Autodesk Navisworks Manage 2014 interface with the 'Rules' tab selected. The 'Rules' panel shows a list of rules with columns for Name, Status, and Found. The 'Duct in Hall 2' rule is highlighted. The 'Viewpoint' dropdown menu is open, showing 'Manual' and 'Animate transitions' options, with 'Manual' selected. The 'Simulation' section has 'Show simulation' checked. The 'View in Context' dropdown is set to 'All'. The 'Display Settings' panel on the right shows a summary of clashes: Total: 9 (Open: 9 Closed: 0). The 'Find Items' panel on the far right shows a list of items with columns for Status and Found.

Name	Status	Found
Duct in Hall	New	16:38:18 22-0
Clash16	New	16:47:09 22-0
Clash17	New	16:42:01 22-0
Clash18	New	16:47:27 22-0
Clash19	New	16:43:09 22-0
Doorway to Chiller Room	New	*VARIES*
Duct in Hall 2	New	16:38:11 22-0
Light in Hallway	New	16:38:22 22-0
Doorway to Hallway	New	16:38:11 22-0

Clashes - Total: 9 (Open: 9 Closed: 0)

Find Items

Status	Found
New	16:38:18 22-0
New	16:47:09 22-0
New	16:42:01 22-0
New	16:47:27 22-0
New	16:43:09 22-0
New	*VARIES*
New	16:38:11 22-0
New	16:38:22 22-0
New	16:38:11 22-0

# 4D Point Cloud Clash Detection

- Keys to Success

- Load individual point files
- Create your animation and or timeline first
- Make sure you are using the correct Clash Detective Settings
  - Clash against points
  - Link to Animation or Timeliner
  - Set your Step to an appropriate amount
  - Do not highlight point cloud hits
  - Change viewpoints to manual
- Patience
- Keep un-necessary clouds turned off



# Now, would it work



# Conclusion

- Laser scanning can be cost effective
  - Rapid Measurements
  - No return trips
  - Information can be shared with a team
- Software advances are streamlining the process
- Work with a team with a proven workflow
- Make sure you capture all the data you will need
- Involve your team as much as possible

# Contact Us

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