AUTODESK UNIVERSITY 2013

Laser Scanning Gone Wild: 4D Clash Detection with the Point Cloud

Kristopher Lengieza – Stiles Corporation
Alix Loiseau – ACAI Technologies

RC2261

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.

Learning Objectives

At the end of this class, you will be able to:

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

About the Speaker

Kristopher M. Lengieza earned his Civil engineering degree in 2004, from Lehigh University. In 2006, he joined The Weitz Company, a top ranked national builder and helped the VDC/BIM transformation at Weitz in South Florida. He quickly became a leader in VDC in south Florida and was recognized by both ENR and BD&C as one of the top 40 construction professionals under 40 (southeast and nationwide). He is now leading the VDC integration effort at Stiles Corporation in Ft. Lauderdale. He's been a speaker at several BIM Events including Ecobuild, buildingSMART Alliance, BIMForum, ACE Mentoring, AIA of Broward County and CASF. Kris believes that VDC is the future of construction and collaboration and it is rapidly changing the AEC industry. He is always willing to share his ideas and insight to help better the industry and the market

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

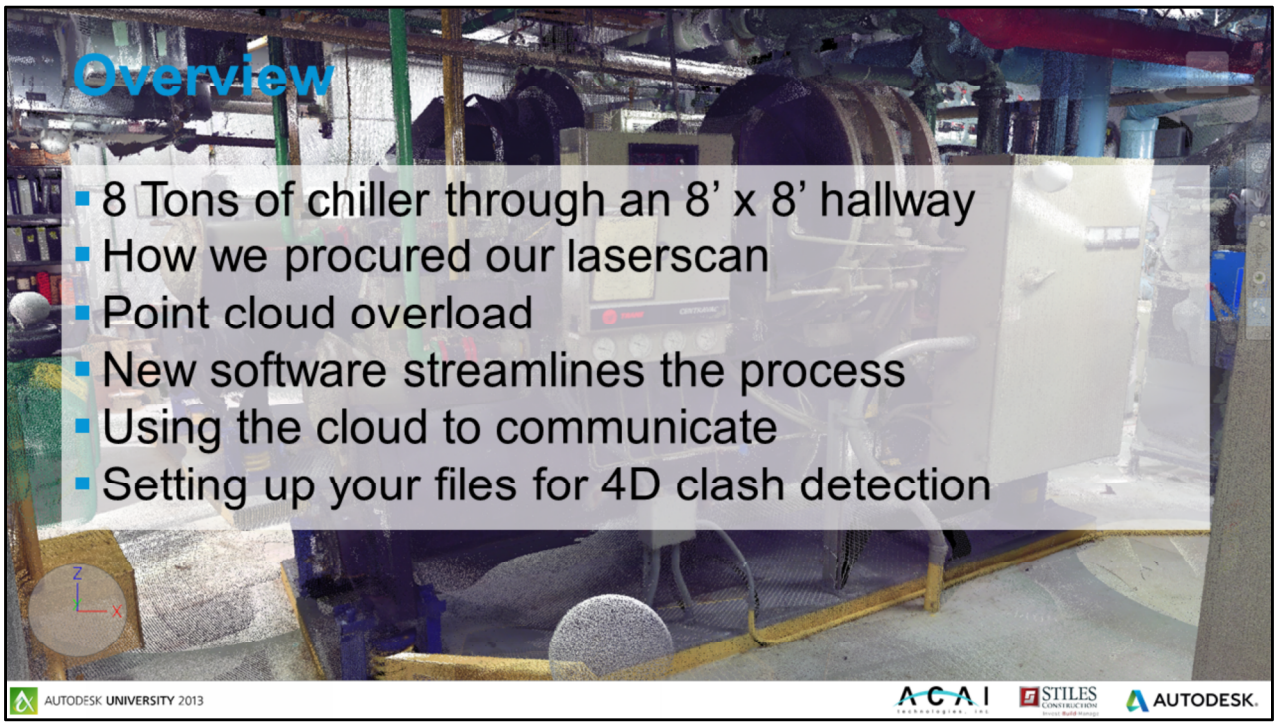
Learn how we used laser scanning and Autodesk® Building Design Suite to coordinate the installation of a new chiller and air handling unit in the basement of one of Florida's premier performance venues. We demonstrate how we used Autodesk® ReCap™, Autodesk® Revit®-based software, Autodesk® Navisworks® 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

BCPA is one of the premier performance venues in South Florida
The current project scope includes an expansion and renovation to the existing facility and a new pavilion building
One of the major renovation projects is replacing an existing chiller located in the basement of the facility
The Chiller is sized appropriately to handle the existing building but would not handle the new expansion and pavillion
Due to a very full performance schedule the work chiller needed to be moved in without disruption as taking one of the 3 chillers down for a short period is acceptable but could not be maintained during shows. The work needed to be completed over one week
Dangers of shutting down any systems were real. The autditorium became so hot during the renovation that condensation actually began to form on the ceiling and it created its own microclimate in the building.



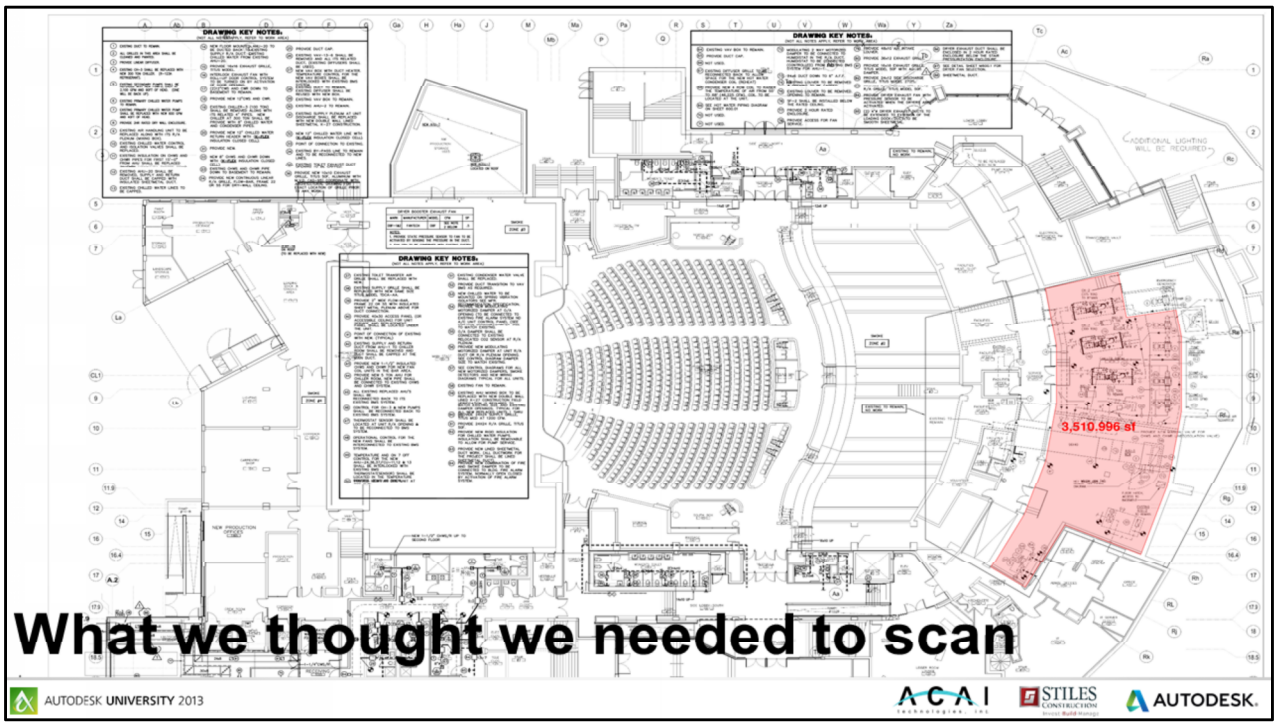
The new chiller weighs over 8 tons and would need to be moved into the basement of the building

We needed a quick turn around on the laserscan to allow us to convince the team that we could complete this work in a timely manner and maintain the warranty of the equipment

The laserscan is relatively large we needed to establish a process that allowed for seamless collaboration and workflow.

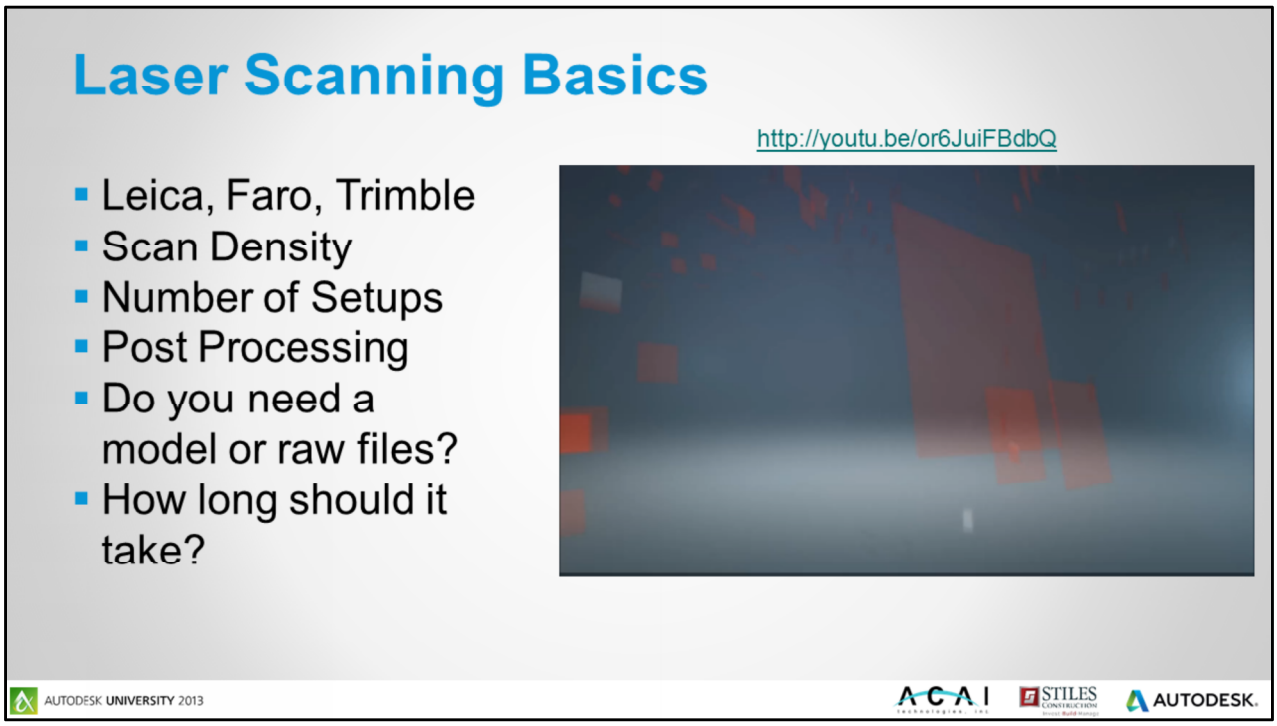
We found during our process that there was new software available that could help streamline our process, Recap changed how we looked at laser scanning

We also needed to find the best way to run and communicate a 4D clash detection check to the team.



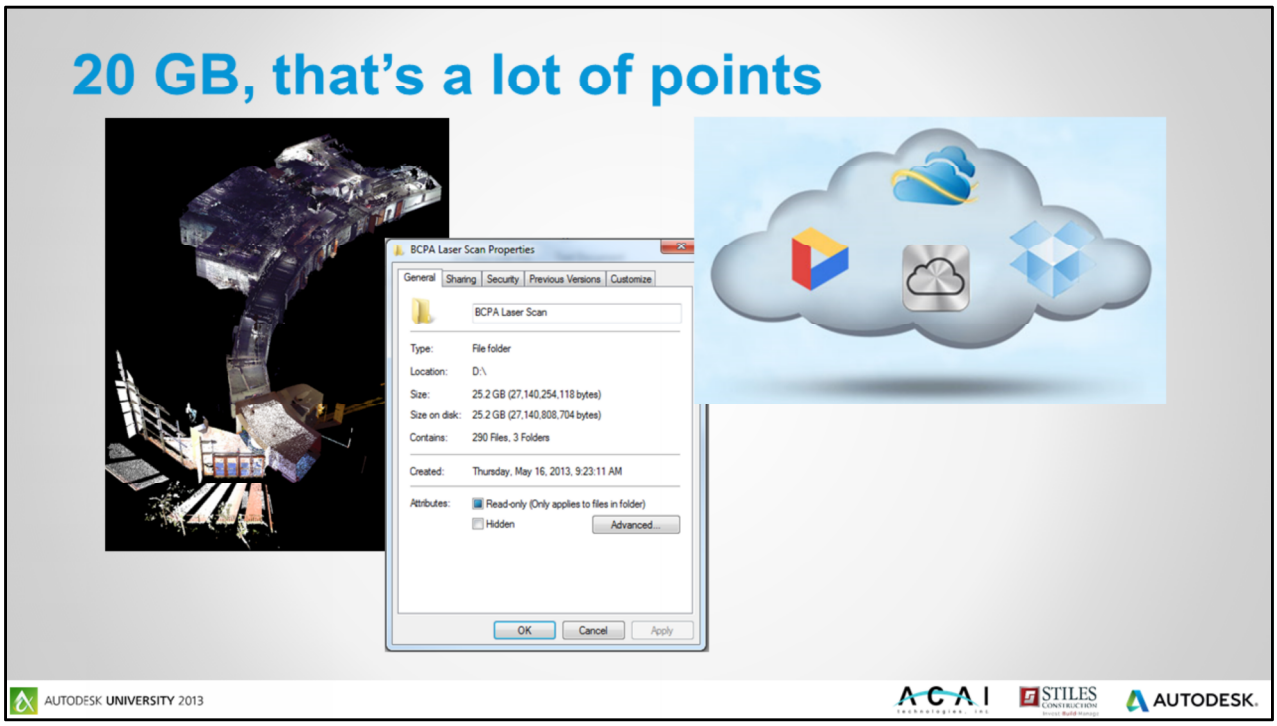
Our initial plan was to laser scan about 3500 SF of Mechanical and Chiller rooms
We noticed when we were on site that the hallway posed as many concerns to the work as the rooms themselves
We decided we would scan the hallway at the same time

Photos of the chiller as delivered before we disassembled
Trane wanted us to only take the chiller apart into 2 pieces, and that was our initial plan
You will see how we found that it was not possible to do it in 2 pieces.

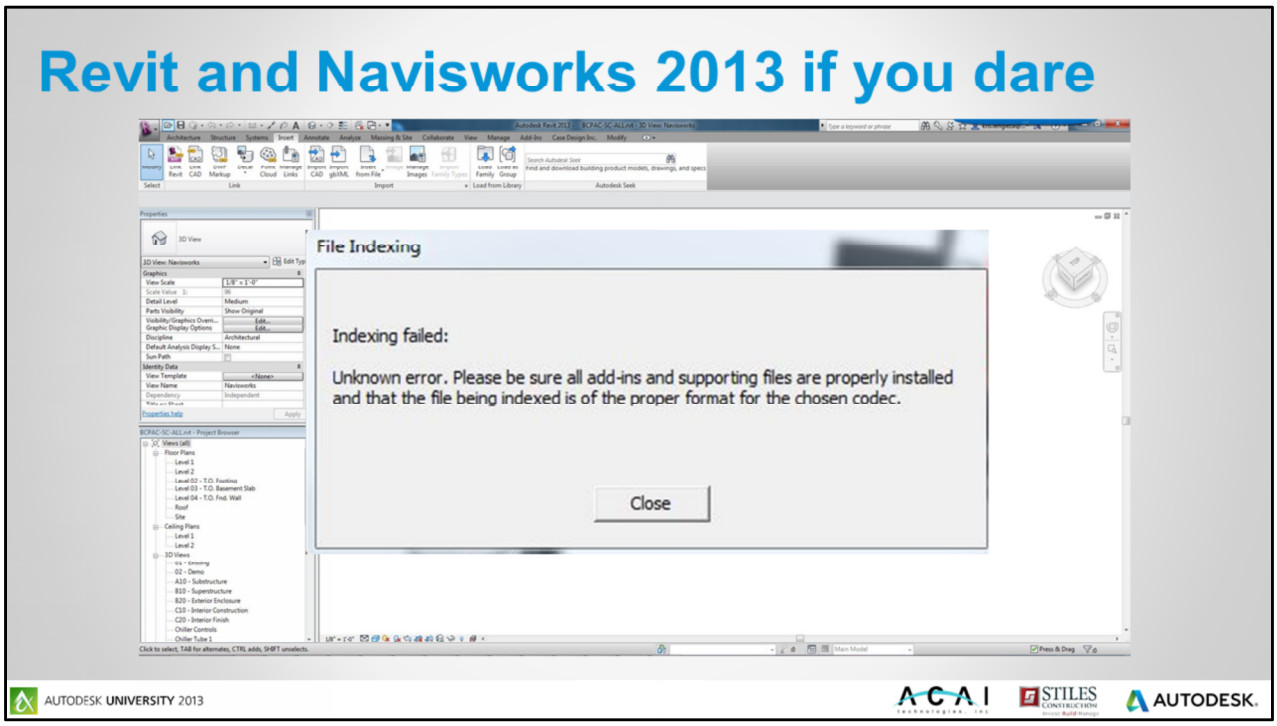


Link to Video on YouTube http://youtu.be/or6JuiFBdbQ

- The video shows the process of laser scanning, showing the importance of reference points, and setup.
- It also shows the end product once loaded into Recap

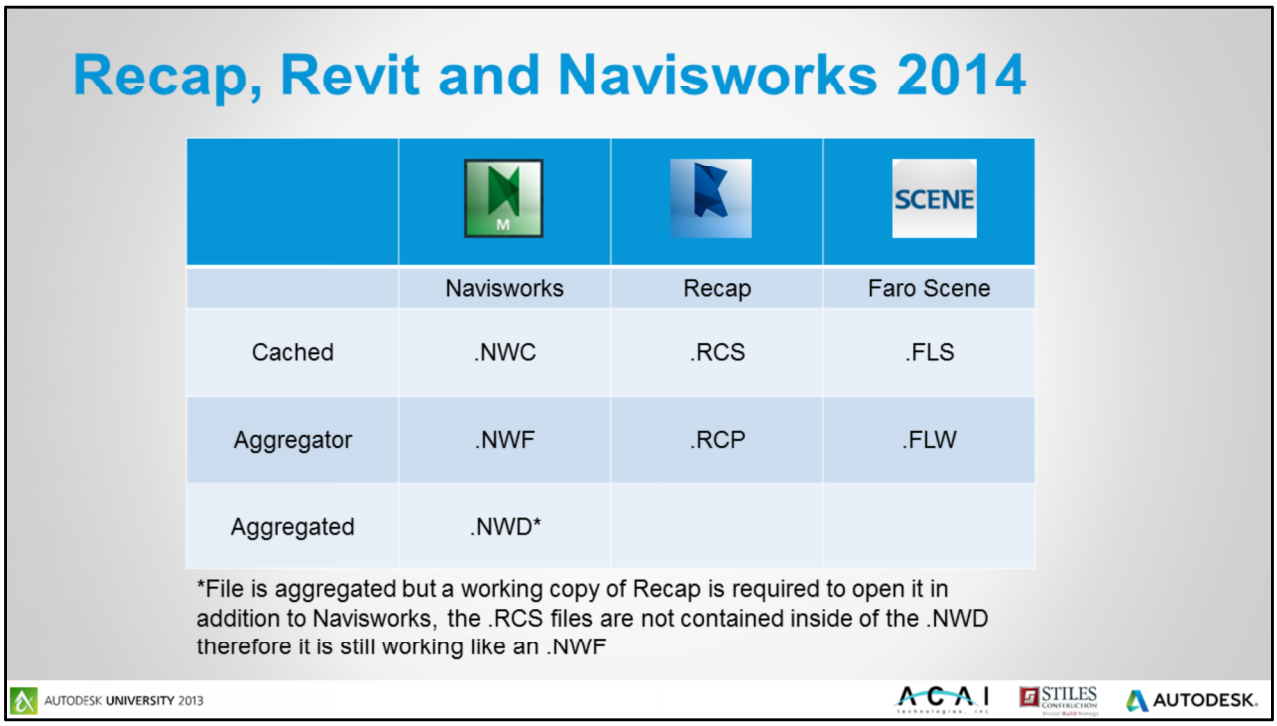


The size of the files were immense so we had to provide a good platform to share our files and allow all team members to work in an effective mannor



- When we initially started working with the point cloud we found that there was a common error that would not allow us to bring the clouds into Revit or Navisworks
- A coworker pointed out to us a new product called Recap and we initially used that to convert the point clouds and continued to use 2013 Revit

- Midway through our process Autodesk released 2014 product and we had to try and see if there was a fix to our Revit and Navisworks problems.



- To help other better understand the relationship between Recap, Navisworks, and Raw Laser Scan files here is a chart that breaks it down to how they relate to Cached, Aggregated or Aggregator files.
- The one hang up that currently exists is that any NWD files that are created with Recap files inside require a working copy of Recap on that same machine to read the file.

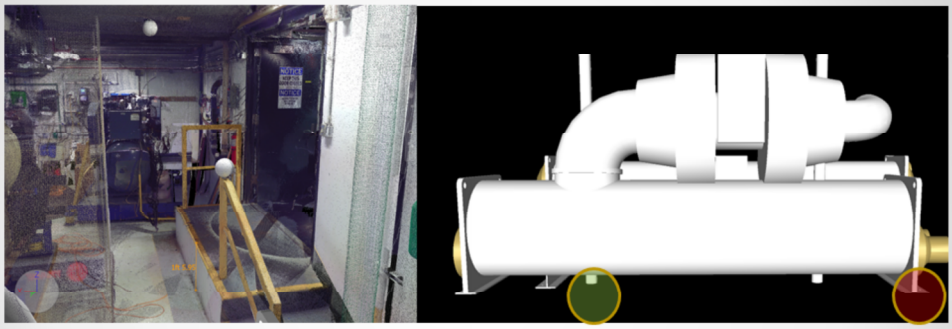
Link to YouTube Video http://youtu.be/bCTf_mIBSs8

- This video shows the workflow of bringing raw files into recap
- Then bringing those files into Revit and finally into Navisworks.
- We used Revit to create key items in the model we knew we had to locate such as columns and walls.
- We also used it to place our final chiller location and coordinate access areas.

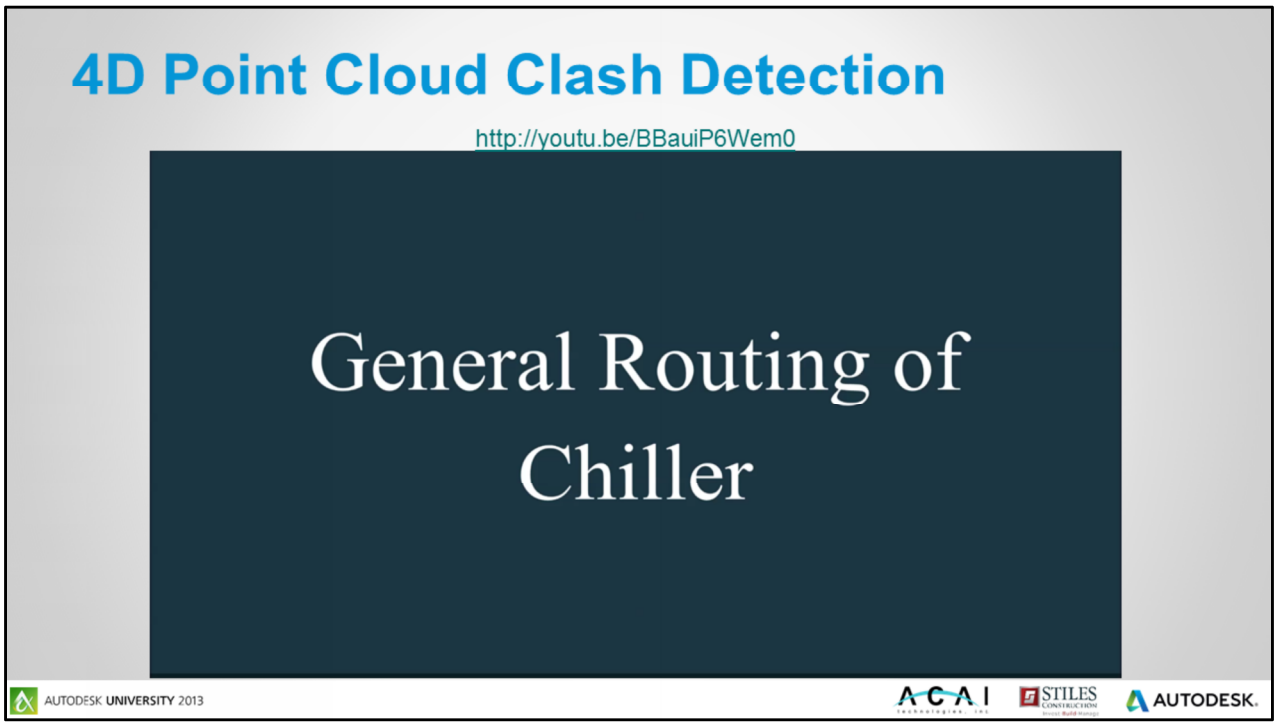
- So we had our laser scan done so now it was time to review and see what was really in the way.
- We found that there were several low hanging ducts and pipes in the hallway as well as two 6-8" doorways we would need to cross

- We were able to walk through the point cloud and the process with our entire team.
- The Mechanical contractor also took the point cloud back to his team to use in planning the structural supports for placing the unit.
- They also prefabricated the pipe fittings so that the unit could be brought back on line as soon as possible.

Communicating with the team

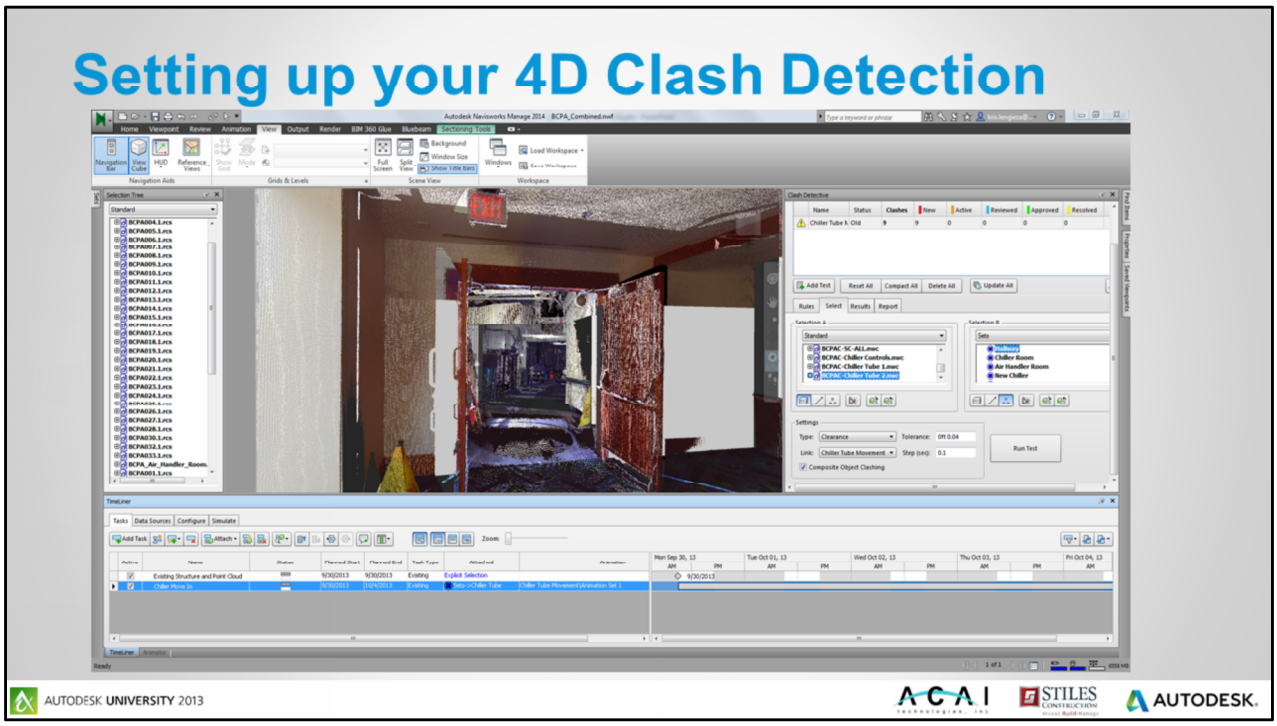


- Reflect Trade Knowledge in the model
  - What kind of skates to be used?
  - Relocating skates during the move?
  - How we will lower it down the step?
  - What will the Manufacturer allow?

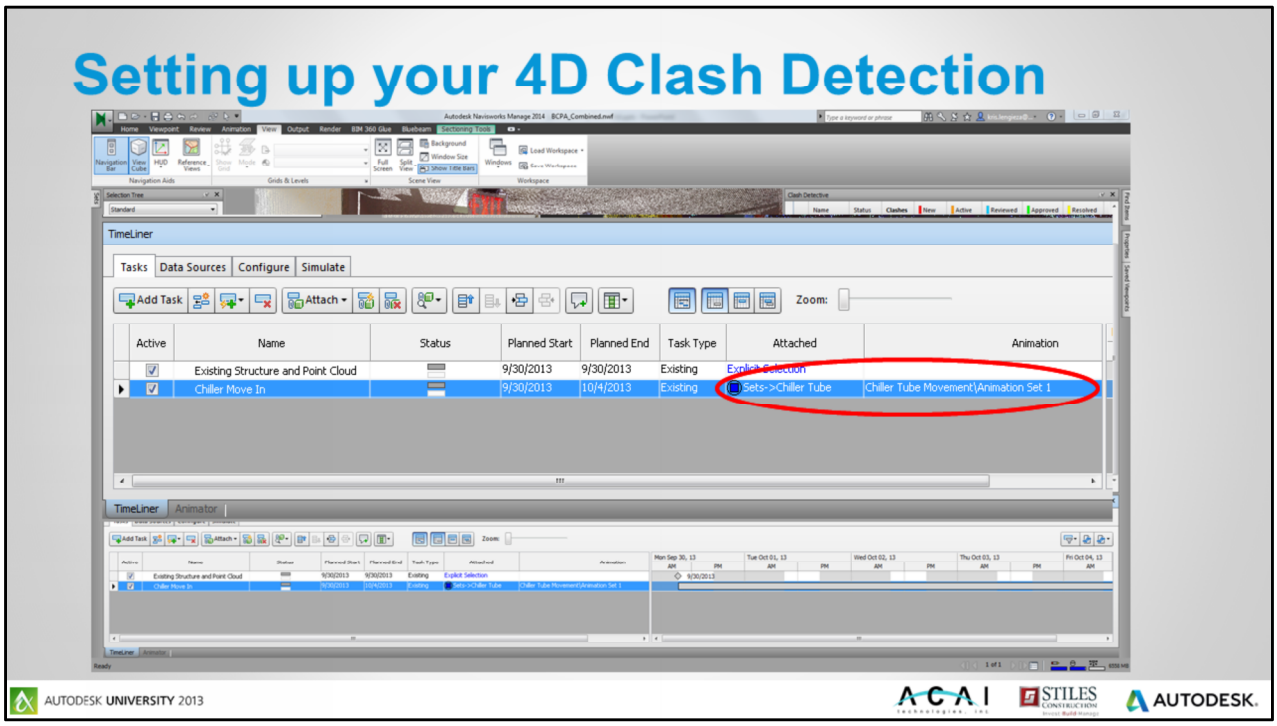


Link to YouTube Video http://youtu.be/BBauiP6Wem0

- The video shows the original path and plan of splitting our chiller into two pieces
- First we planed our path and then we checked it against our existing structure.



- Setting up your 4D clash takes some work.
- First we start with adding our animation to our task.


Setting up your 4D Clash Detection
TimeLiner
Tasks
Data Sources
Configure
Simulate
Add Task
Attach
Zoom:
Active
Name
Status
Planned Start
Planned End
Task Type
Attached
Animation
Existing Structure and Point Cloud
9/30/2013
9/30/2013
Existing
Explicit Selection
Chiller Move In
9/30/2013
10/4/2013
Existing
Sets->Chiller Tube
Chiller Tube Movement\Animation Set 1
TimeLiner
Animator
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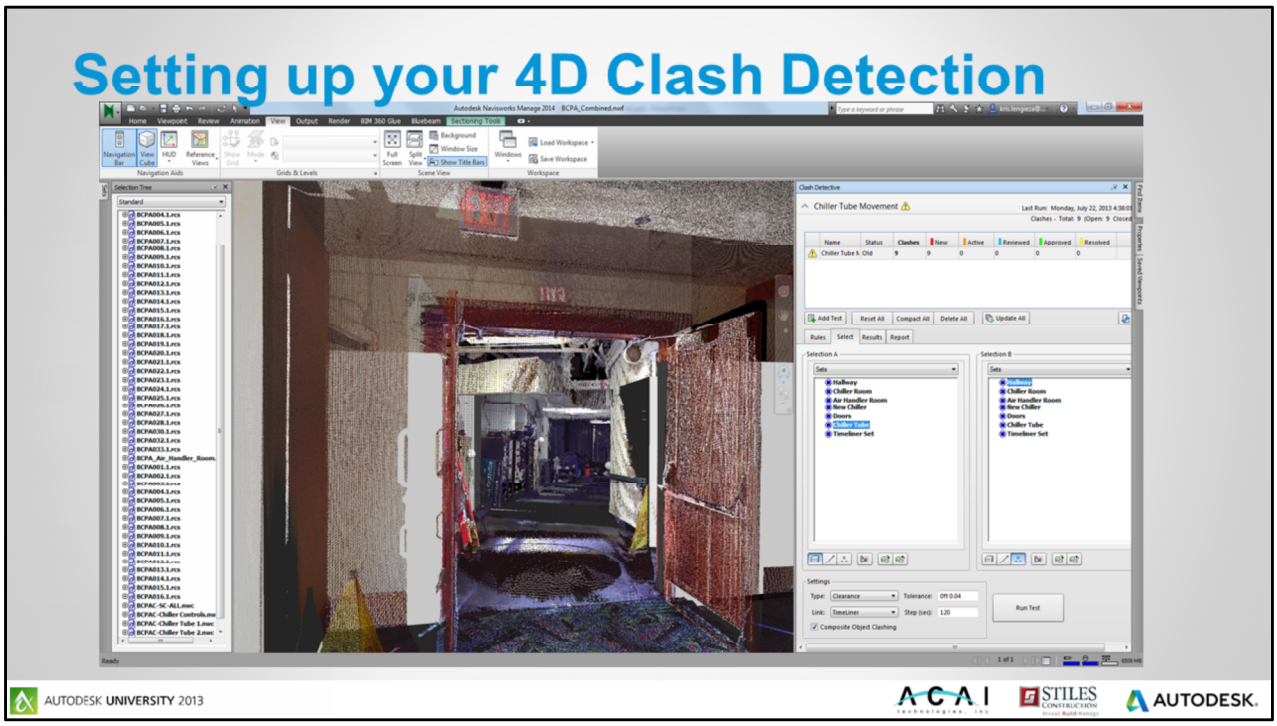
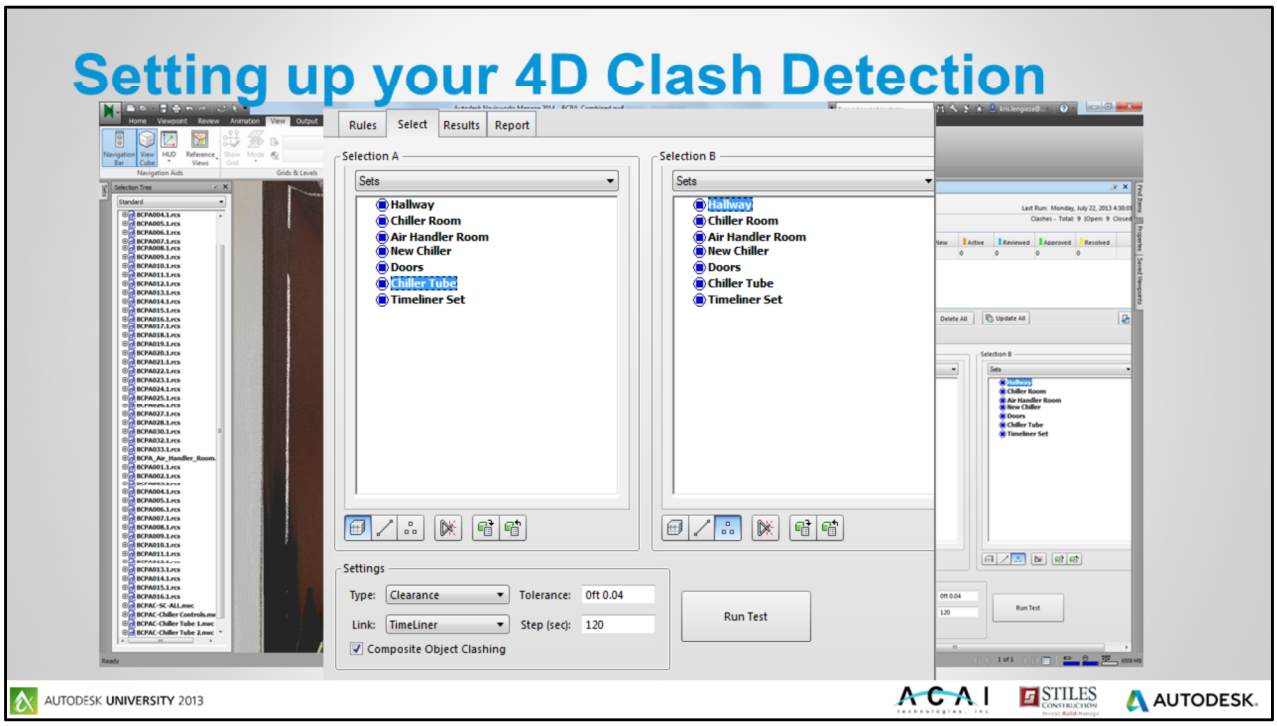


Next we have to setup our clash detective with the right settings


Setting up your 4D Clash Detection
Rules
Select
Results
Report
Selection A
Sets
Hallway
Chiller Room
Air Handler Room
New Chiller
Doors
Chiller Tube
Timeliner Set
Selection B
Sets
Hallway
Chiller Room
Air Handler Room
New Chiller
Doors
Chiller Tube
Timeliner Set
Settings
Type: Clearance
Tolerance: 0ft 0.04
Link: TimeLiner
Step (sec): 120
Composite Object Clashing
Run Test
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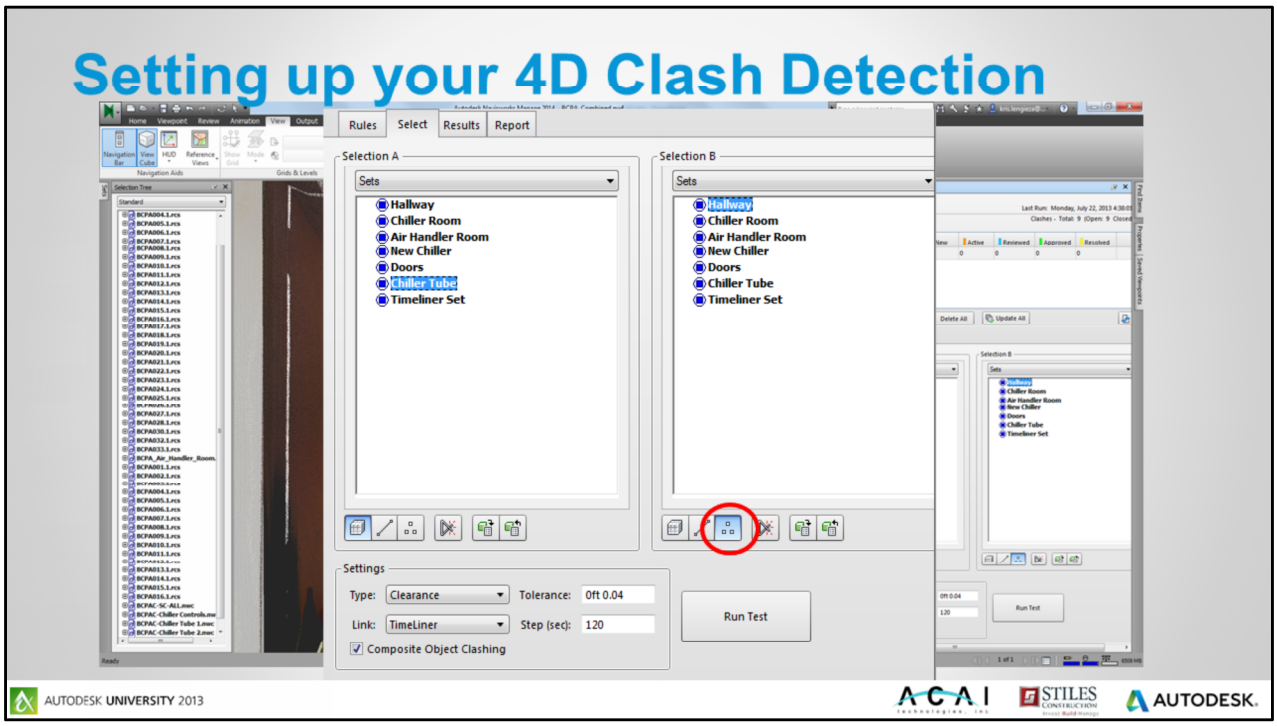
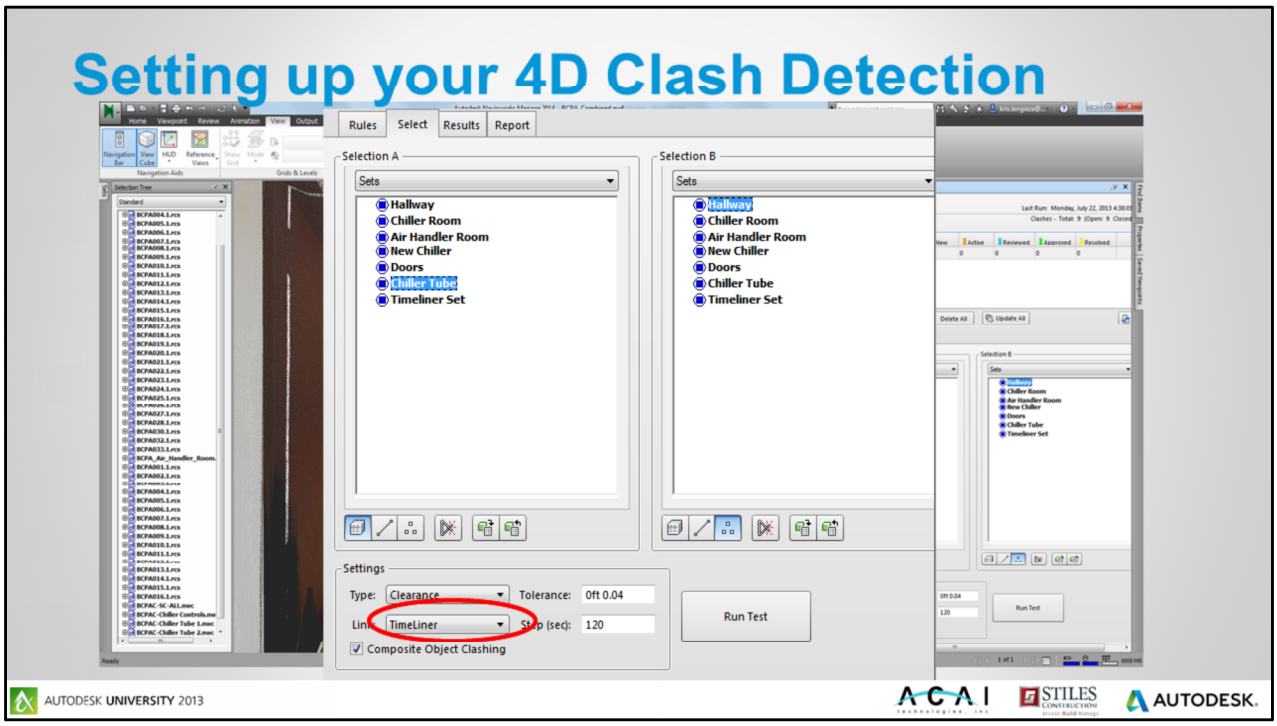
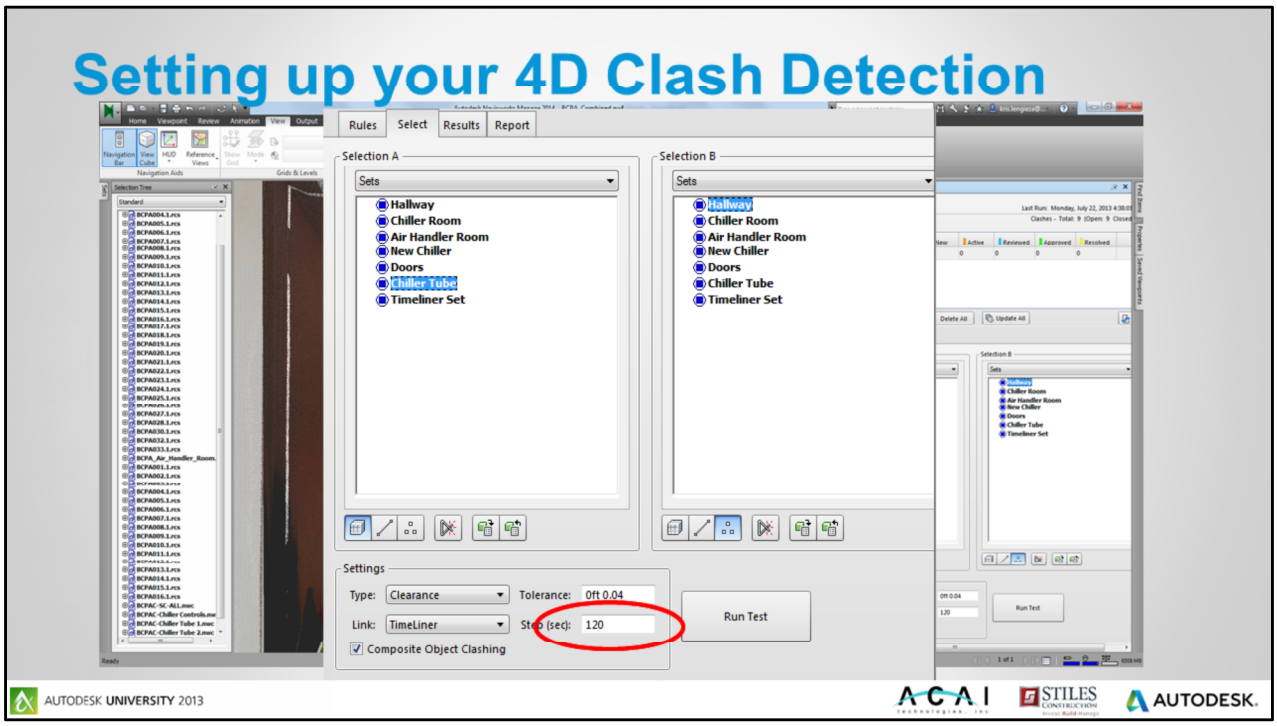


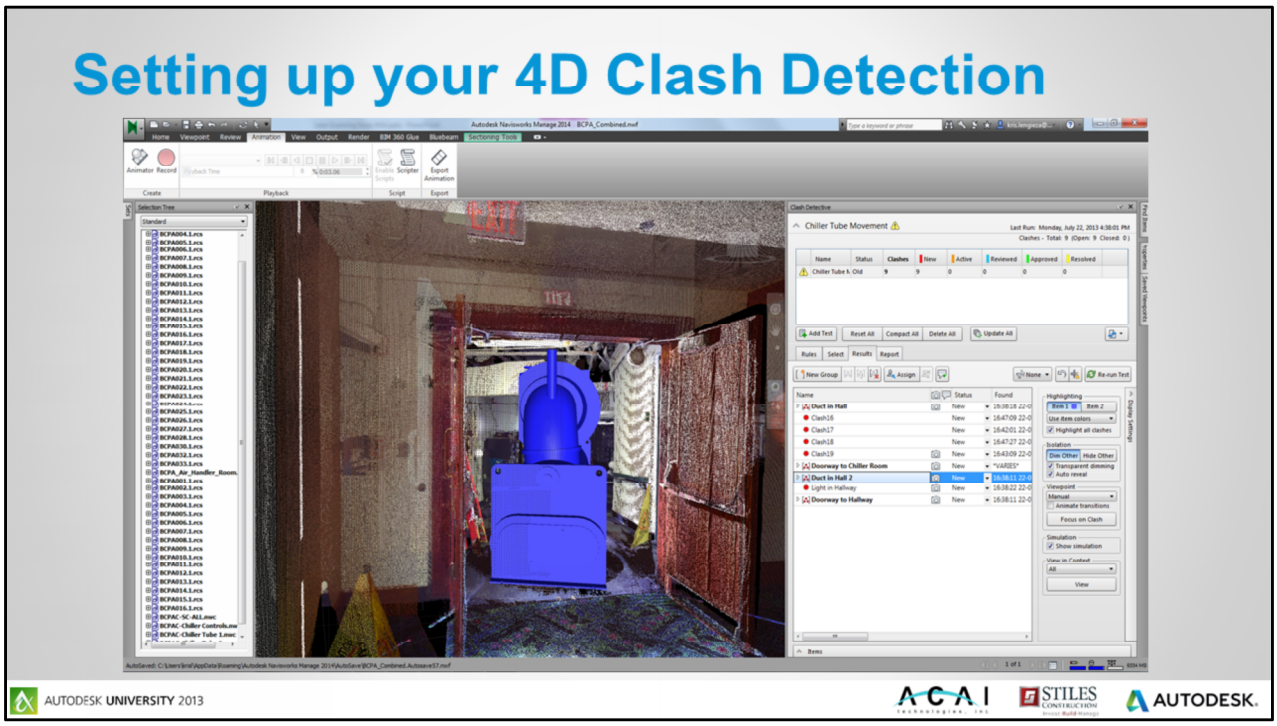
Whenever running a clash check with a point cloud make sure to select the point mode under the correct selection set



- The key to a 4D clash detection is linking it to a timeliner or animation.
- Select the animation of timeliner that you want to check your clash detection against.
- Make sure to have the activities active in your timeliner view that you want clash against.

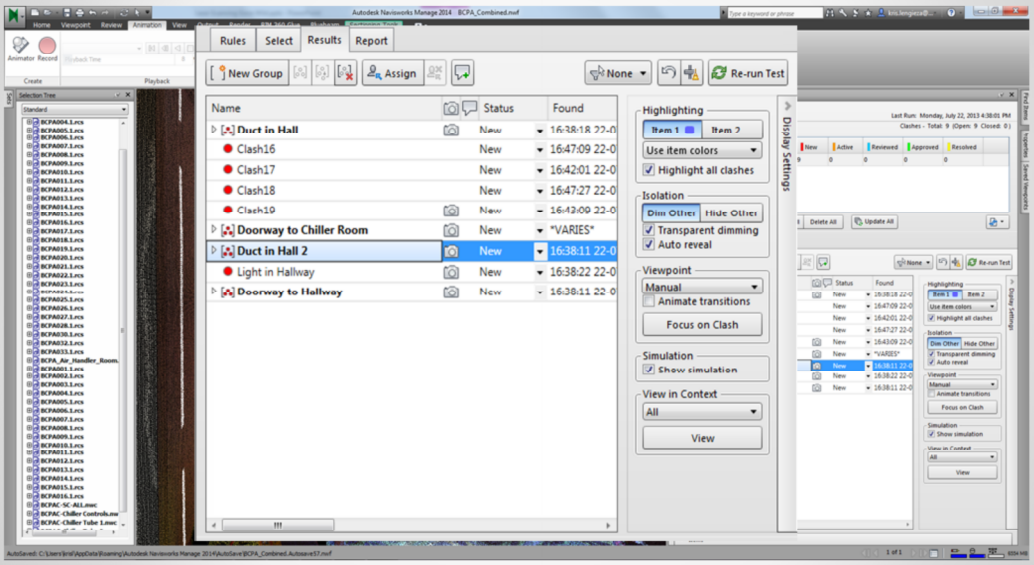


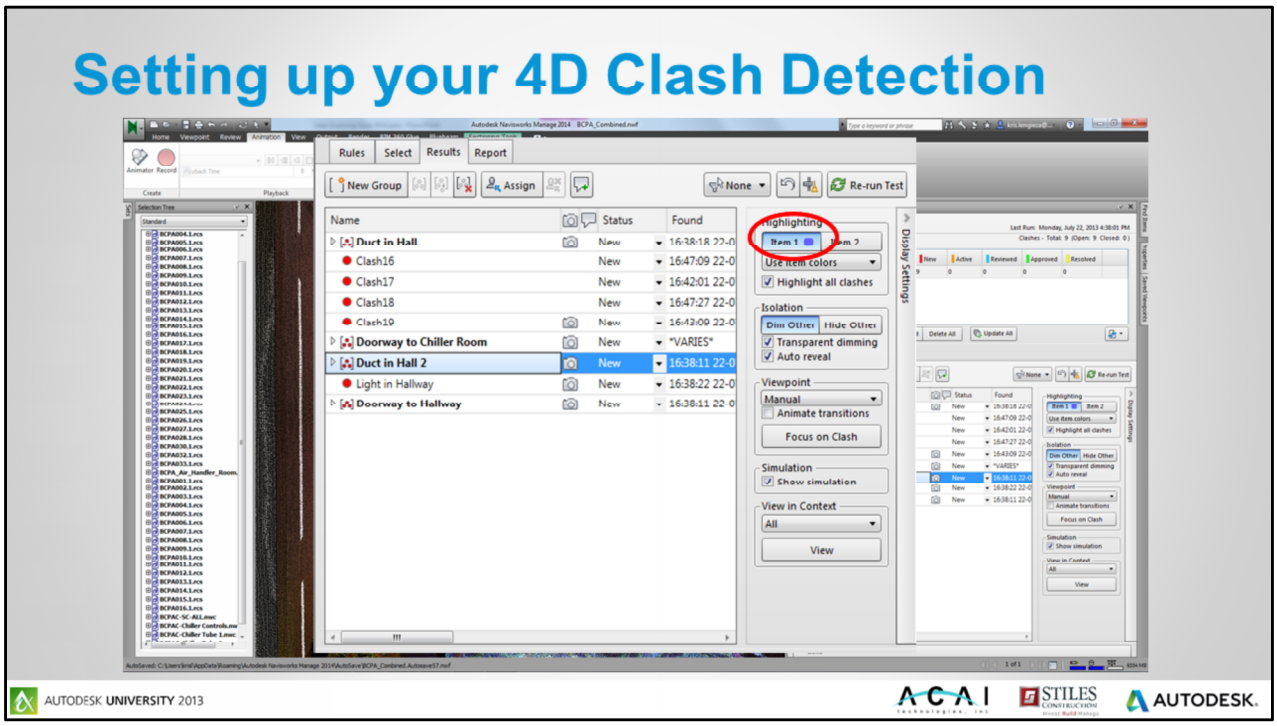
Choose an appropriate time step to check against, too short will give you excess clashes, too long of a step will miss necessary clashes.



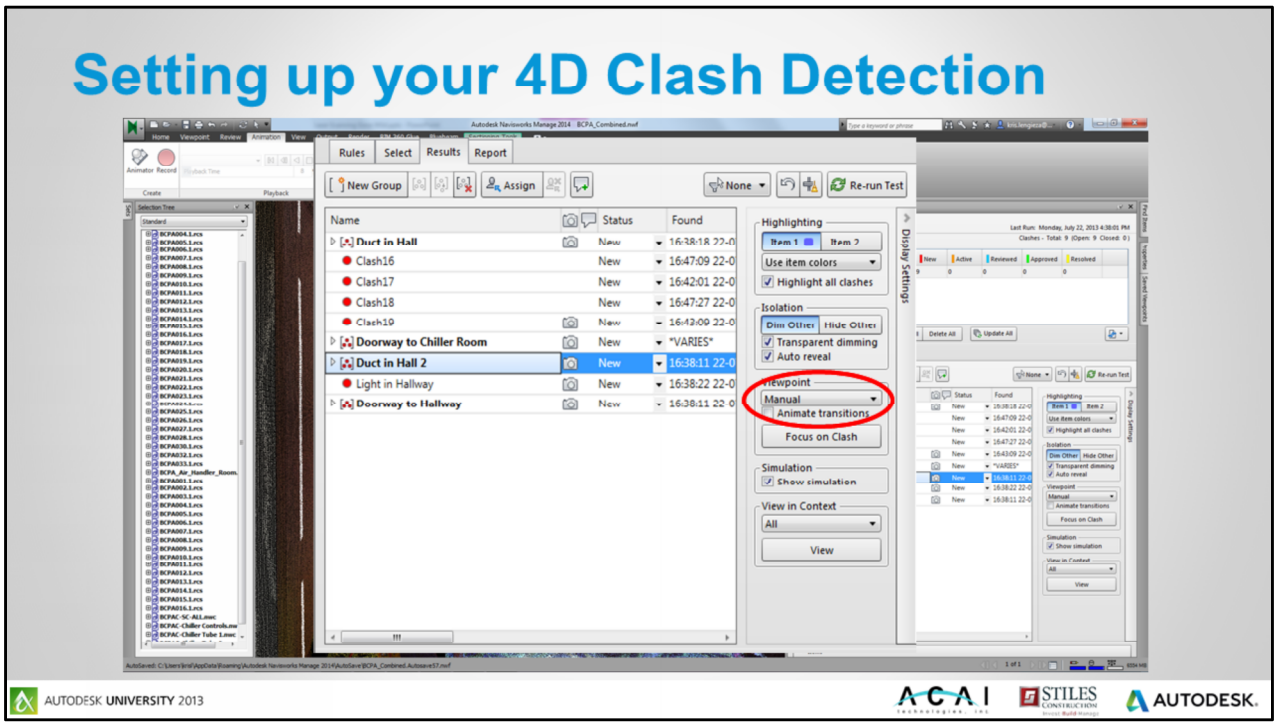
- Next we step to results, to review the clashes we have found.
- As with any clash detection we will need to weed out any false clashes

Setting up your 4D Clash Detection





In order to quickly and easily navigate through clashes, we choose to only highlight the object that is clashes and not the entire point cloud



- We also choose to manually set our viewpoint this allows us to position the camera as we wish for a better vantage point.
- This is also key when exporting to create our videos as we can take snap shots of each step that has a clash and interleave them to the snap shots that do not.

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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