

Practical 4D Construction Simulation Using Revit and Navisworks

Ken Flannigan

Global BIM Solution Owner, KONE



Timing

- 25 minutes – What and Why
- 25 minutes - Demonstrations
- 10 minutes - Q&A



About the speaker

Ken Flannigan

KONE Global BIM Solution Owner since 2016

Live in Frisco, Texas

Started career in architecture, spent 10 years as consultant and trainer

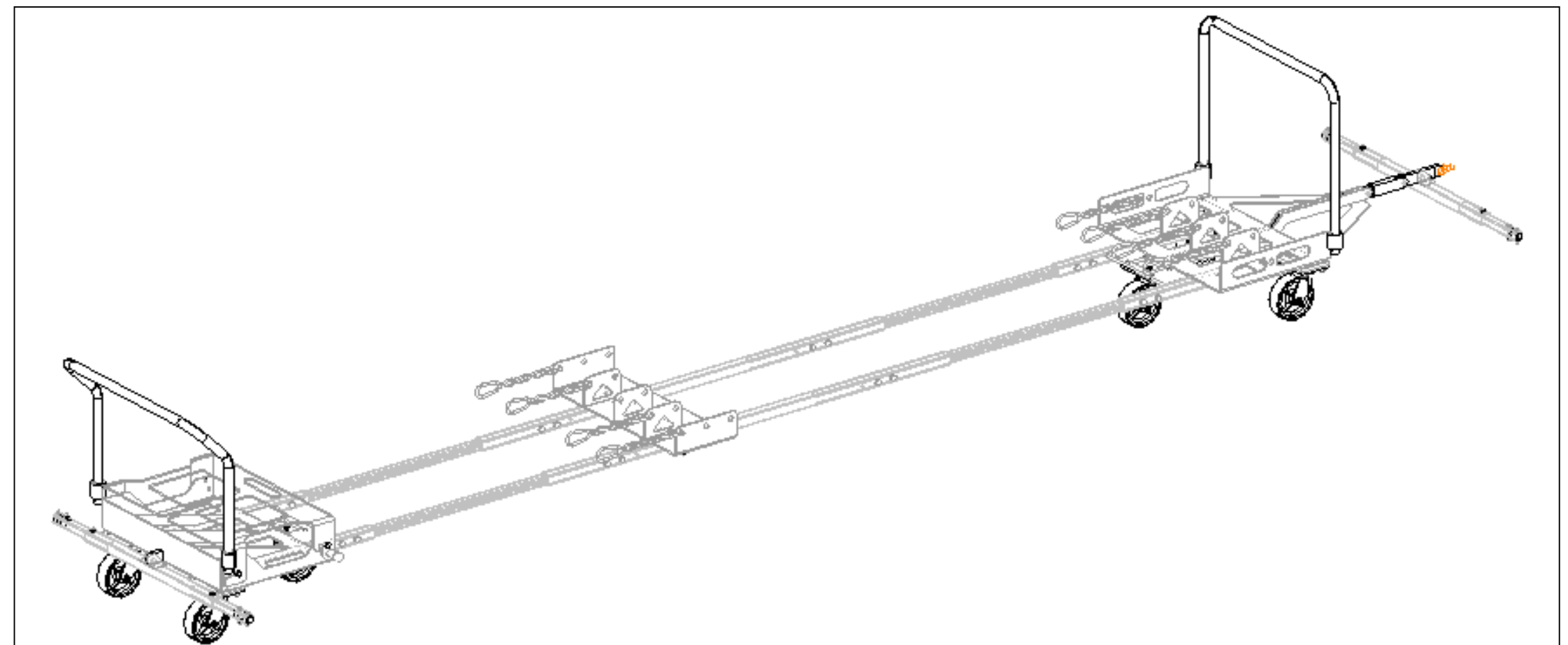
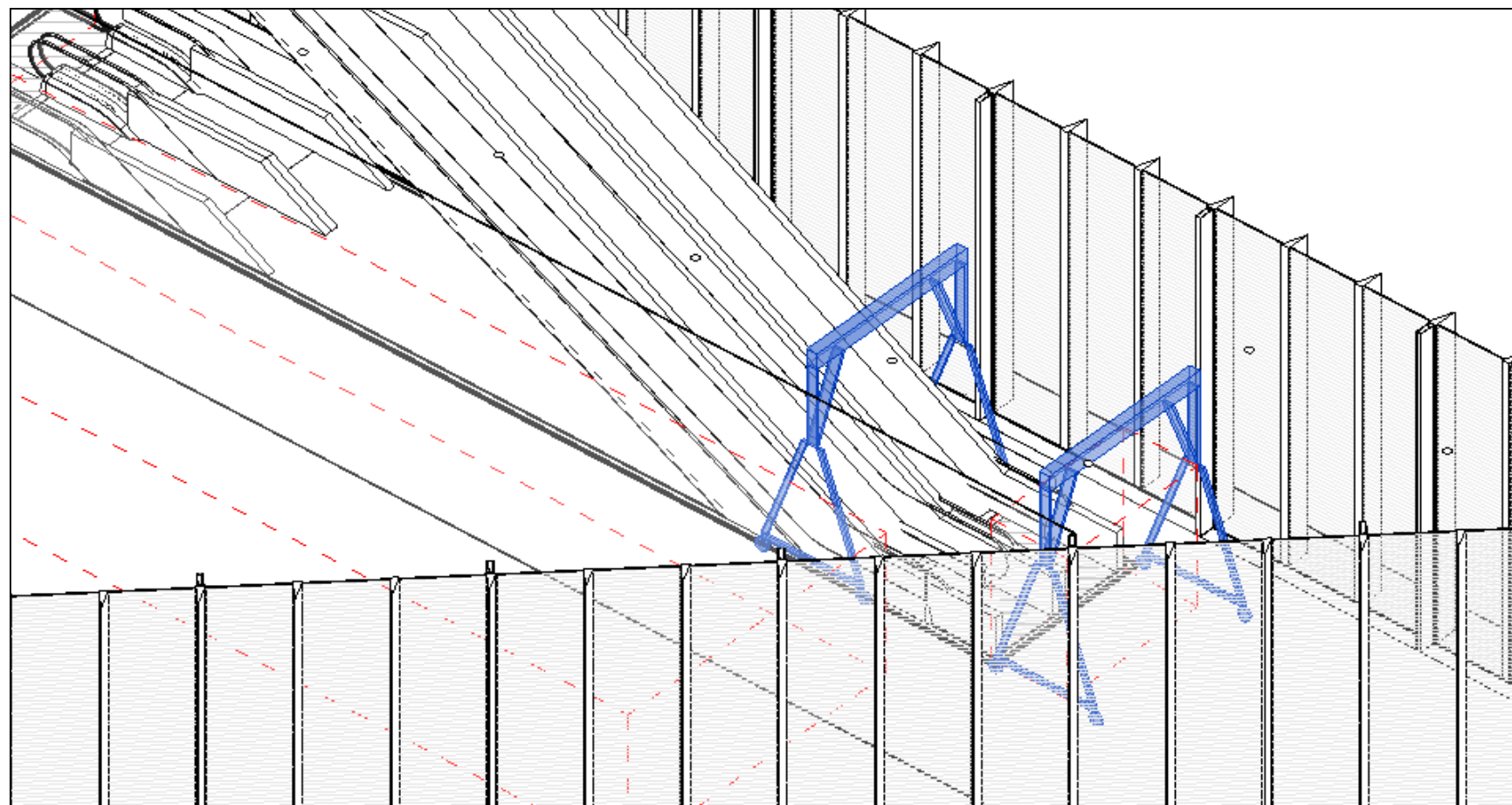
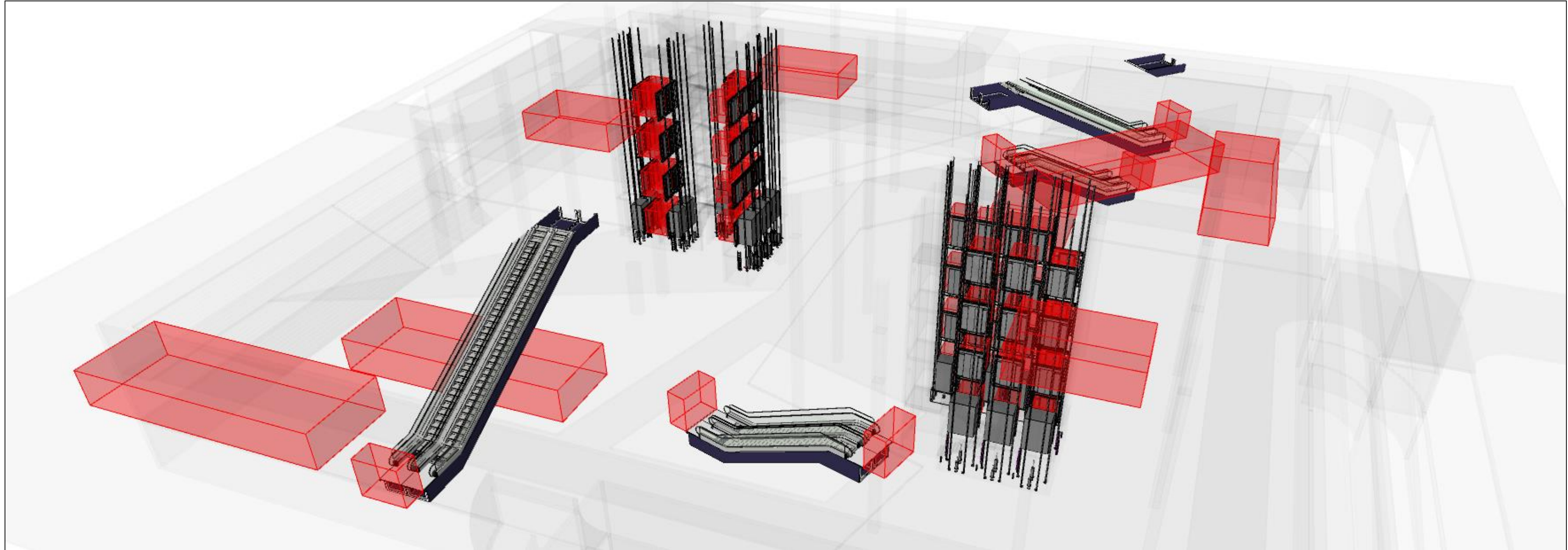
LEED AP



Today, most BIM coordination uses geometry in its final installed position.

What are we missing?

Construction Modeling and Simulation



An aerial photograph of the Hollywood Sign on a hillside. The sign is made of large, white, three-dimensional letters. In the background, there are some industrial buildings and a cityscape under a clear sky. The hillside is dry and brownish.

90% of 4D use is:

HOLLYWOOD

“Hollywood BIM”

BIM deliverables, images, and animations made for entertainment purposes only. Also, NOT what we are interested in.

Photo credit goes here

https://commons.wikimedia.org/wiki/File:Aerial_Hollywood_Sign.jpg

We use “Hollywood BIM” too



Let's remember back, how it all started...

The Year was 2008.

...The United Nations designated 2008 as the International Year of the Potato.

...The price of a movie ticket was \$7.00

...Global stock prices plunged to record lows and the Dow Jones Industrial Average lost 33.8% of its value.

...The most popular song was Low by Flo Rida with T-Pain

We were just beginning our 3D coordination journey

We coordinated what we could, we modeled items outside of our scope to understand design and construction better

What are your problems?

Can we understand them
better virtually?

Practical 4D Construction Simulation

SITE LOGISTICS MODELING

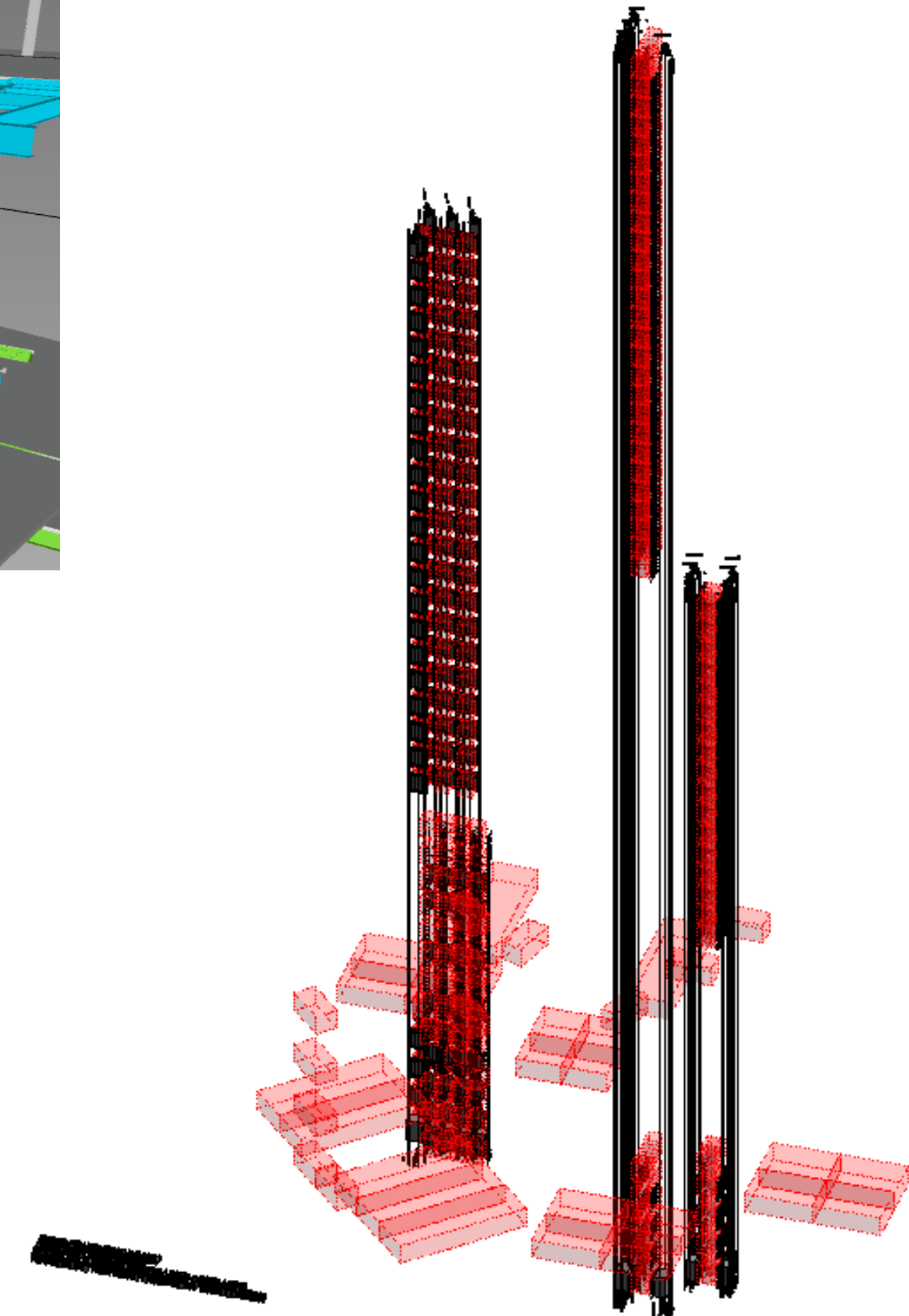
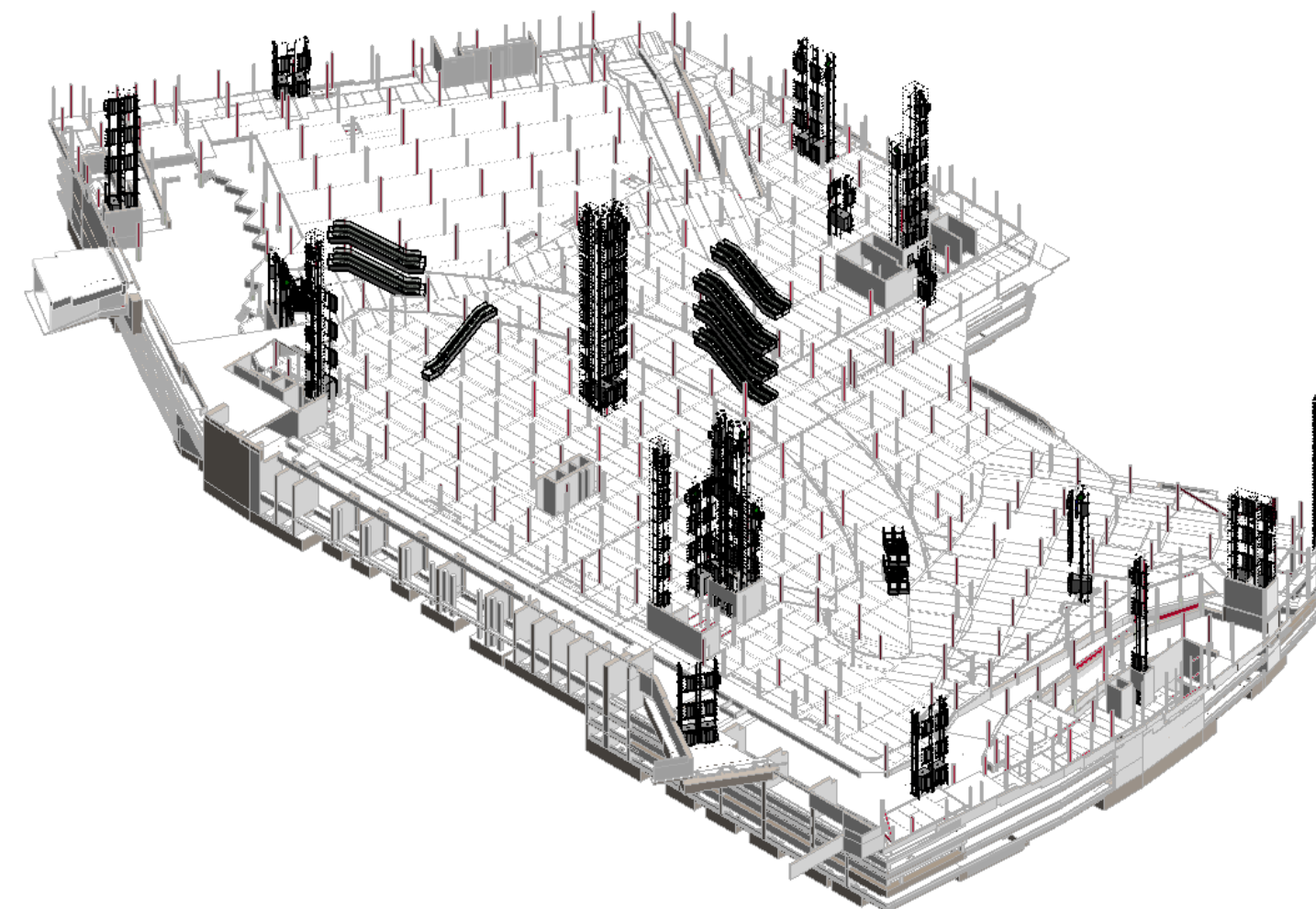
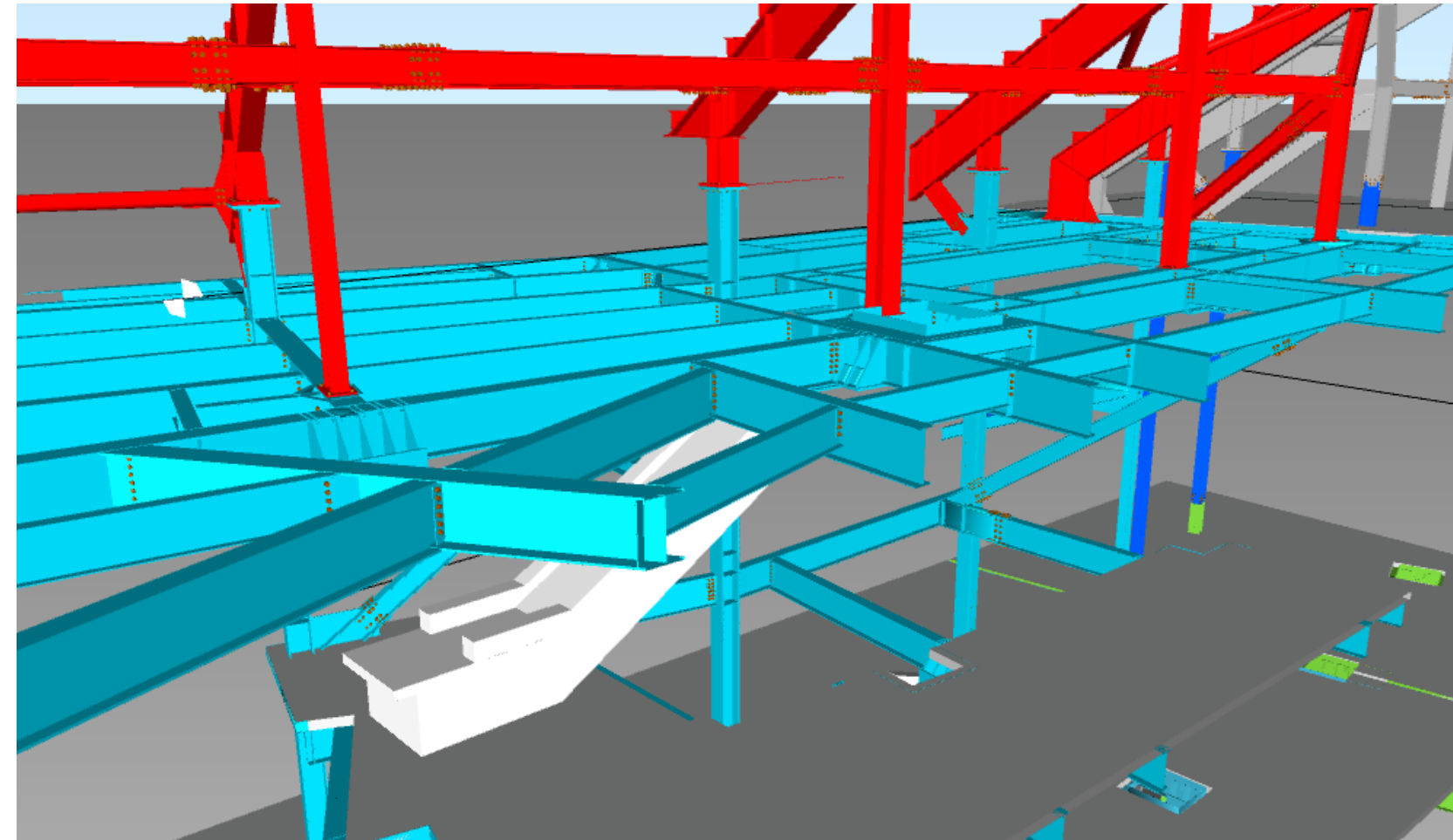
3D models of clear work areas, material laydown areas, delivery and staging areas

EQUIPMENT ROUTING ANIMATION

Animation of an object that needs to be moved from a delivery or staging area into its installed position.

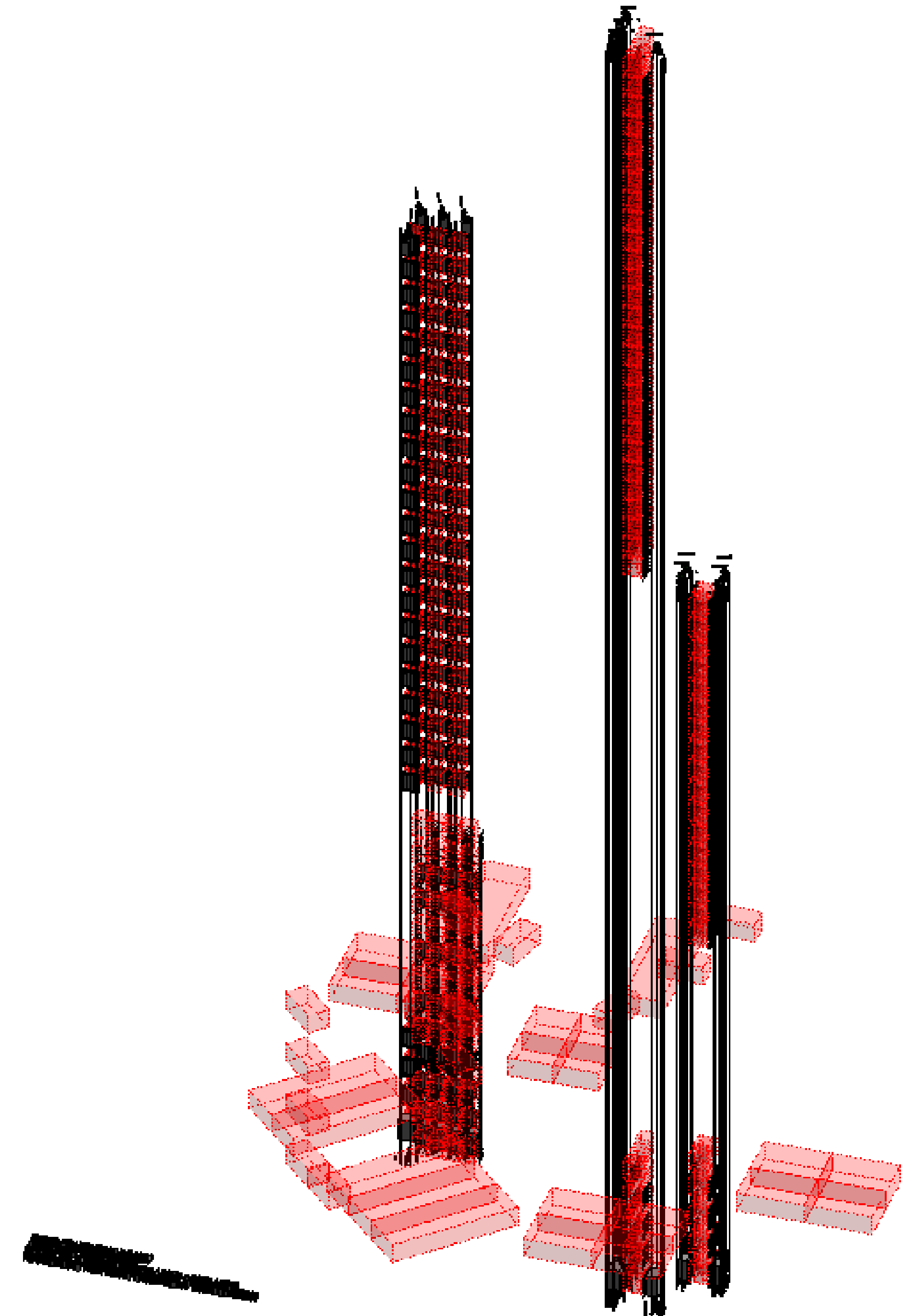
PROJECT TIMELINE SIMULATION

Animation showing building elements changing visual properties, usually color and transparency, during a series of tasks.



Site Logistics

- Improving communication of onsite material storage and clear work area requirements
- Coordinate equipment installation sequencing
- Communicate and optimize the space needed by multiple trades during construction



Site Logistics is usually
communicated in a site
readiness guide or checklist



Site Requirements Checklist

The following requirements must be completed prior to starting the escalator installation. Once all items have been completed and checked off, place your initials next to the check box for each item and fax the completed form to the local KONE Superintendent. Upon receipt of this form, your KONE representative will contact you to discuss and schedule an installation start date.

Contract number _____
 Project name _____
 General contractor name (print) _____
 General contractor signature _____
 If you have questions, contact your KONE representative.
 KONE, Inc. Superintendent _____ Call phone _____
 Office phone _____ Fax _____

Safety and OSHA/Local code requirements

- Barricades:** Provide free-standing, removable barricades at top, bottom and the length of the wellway per OSHA 29 CFR 1926.502 and/or any applicable local codes. Barricades should allow 4-5 ft (1.5-2 meters) work space to escalator truss.
 - Stair access:** Provide safe stairway access to all floors per OSHA 29 CFR 1926.1052 and/or any applicable local codes.
 - Work area:** Provide clear work area with OSHA and/or any applicable local code lighting, free of debris and tripping hazards.
- Under no circumstances can other trades work in or around areas above the escalator installers and or escalator wellway while escalator installers are working in wellway.*

General

- Hoisting method:** Coordinate with KONE representative the type of method to be used for setting trusses into wellways (crane, chain hoists, etc.) prior to shipment of material.
- Hoisting points:** Provide prearranged hoisting points capable of withstanding loads designated in KONE Final Layout Drawings.
- Work space:** Provide unloading/work area outside of building with space to splice trusses with forklifts.
- Access from unloading area:** Provide roll-able access from unloading area (smooth concrete with adequate room to maneuver truss around building structure, through doors, etc.).
- Three-phase power:** Install three-phase power with characteristics required in Final Layout Drawings, at each escalator/autowalk upper pit. Coordinate layout and location of disconnect with KONE representative after truss is set in wellway.
- Electrical equipment:** Install 110 volt, 20 amp GFCI dual gang receptacle and light fixture with switch located at upper and lower end of each escalator (each end of walk) per ASME A17.1/CSA B44; 6.1.7.1.2. Coordinate location of receptacle, light fixture and light switch with KONE representative after truss is set in wellway.



- Storage space:** Provide clean, dry storage space near escalator wellway for easy access to parts/tools. Storage space is typically 80 feet x 20 feet (18 x 6 m) per escalator.
- Prohibited attachment:** Be aware that screwing/welding to truss angles and or pan is not permitted.
- Refuse disposal:** Provide refuse containers for crating and packaging.
- Lighting:** Provide task lighting in and around the escalator work area for a safe work environment.
- Demarcation lights circuit:** Escalator demarcation lights require a separate circuit and should be energized from Building Emergency Power Circuit.
- Optional circuitry:** Special options for the escalators (heating rods, handrail lighting, skirt lighting, remote monitoring, etc.) may require more circuits and/or work by others. Discuss this with your KONE representative prior to final design and procurement.

Pit

- Pit construction:** Construct pit to KONE final approved layouts.
 - Verify finished floor heights.
 - Verify pocket dimensions.
- Pit condition:** Provide clean, dry pit.

Wellway

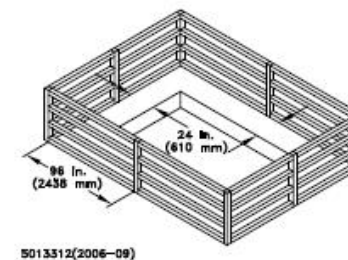
- Wellway construction:** Construct wellway per KONE final approved layouts.
- Intermediate supports:** Construct intermediate supports per KONE final approved layouts.
- Reaction load evaluation:** Reaction loads of each escalator as shown on KONE final approved layouts must be evaluated by engineer of record.
- Pocket dimensions:** Nominal pocket depth and width must match dimensions on KONE final approved layouts.
- Penetrations:** Provide penetrations for piping separators, sumps and electrical lines in correct locations. (Coordinate with local KONE representative.)
- Ventilation:** Vent wellway per local building codes.
- Temporary structures:** Remove temporary supports and forming materials prior to KONE start date.
- Wellway condition:** Provide wellway that is clean and free of obstruction and debris.



Details for Site Requirements Checklist

Safety and OSHA/Local code requirements

- Barricades:** Provide free-standing, removable barricades at top, bottom and the length of the wellway per OSHA 29 CFR 1926.502 and/or any applicable local codes. Barricades should allow 4-5 ft (1.5-2 meters) work space to escalator truss.



5013312(2006-09)



- Stair access:** Provide safe stairway access to all floors per OSHA 29 CFR 1926.1052 and/or any applicable local codes.



- Work area:** Provide clear work area with OSHA and/or any applicable local code lighting, free of debris and tripping hazards.

Under no circumstances can other trades work in or around areas above the escalator installers and or escalator wellway while escalator installers are working in wellway.

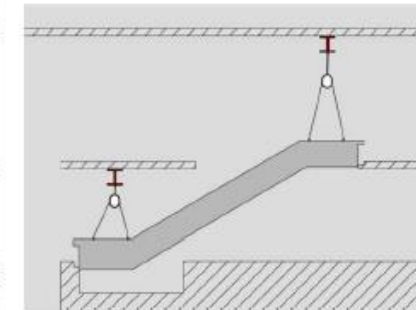
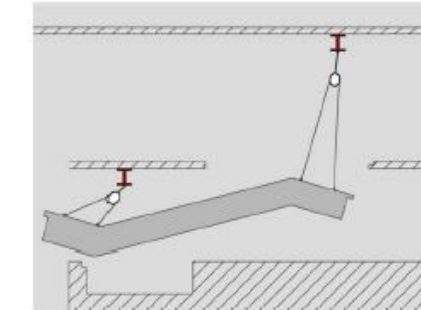


General

- Hoisting method:** Coordinate with KONE representative the type of method to be used for setting trusses into wellways (crane, chain hoists, etc.) prior to shipment of material.



- Hoisting points:** Provide prearranged hoisting points capable of withstanding loads designated in KONE Final Layout Drawings.
 - Hoisting points or beams capable of supporting the entire load of the escalator must be located above the escalator wellway.
 - In cases where KONE uses an A frame to hoist the escalator, the contractor must provide a suitable anchorage point to anchor the A frame to the building floor.
 - In cases where multiple escalators share a wellway, if the overhead hoisting member is required to support multiple units at one time, structural support members must be capable of supporting the gross load of all applicable escalators being hoisted.



- Work space:** Provide unloading/work area outside of building with space to splice trusses with forklifts.



- Access from unloading area:** Provide roll-able access from unloading area (smooth concrete with adequate room to maneuver truss around building structure, through doors, etc.).



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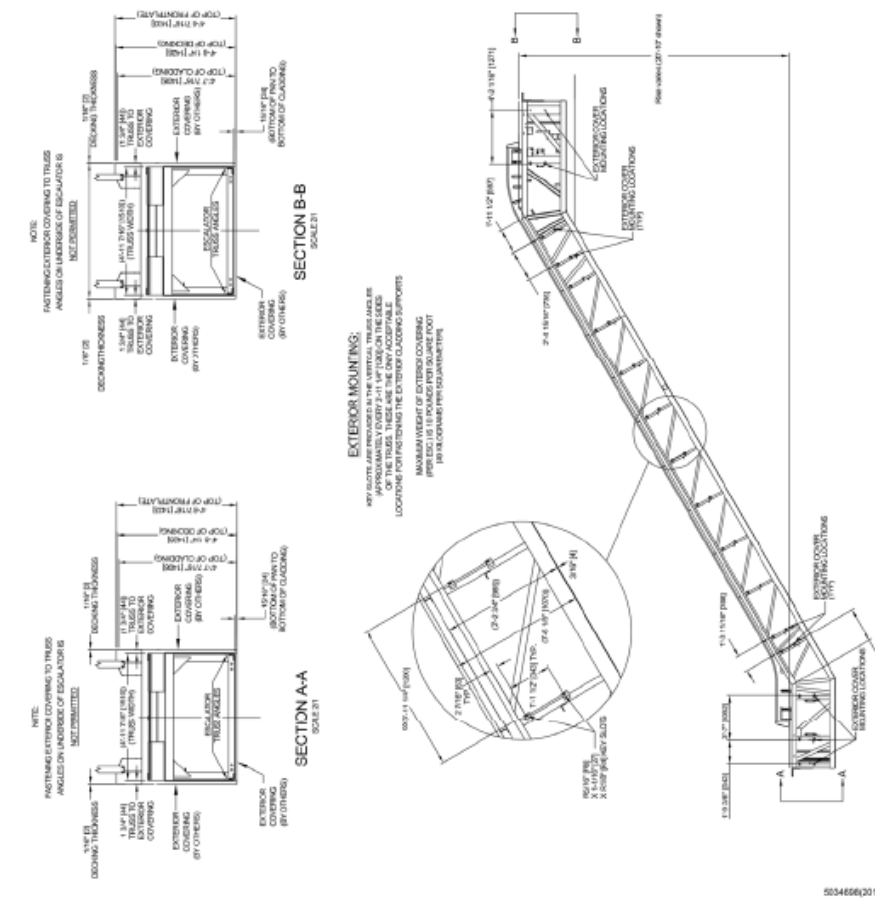
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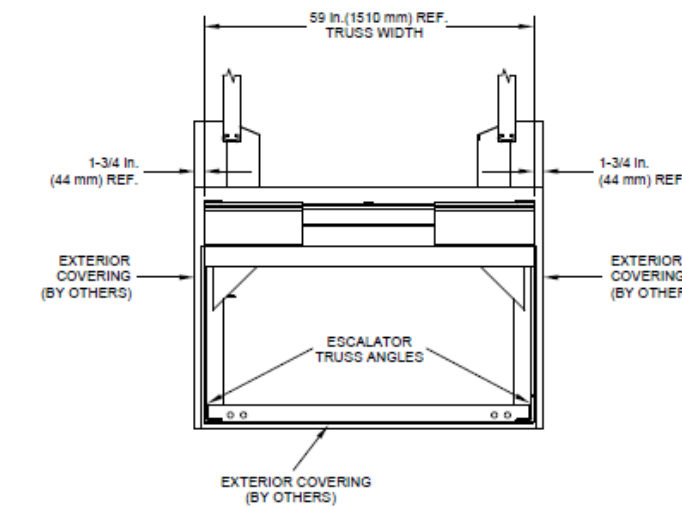
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- Outer cladding:** See next page.



- Prohibited attachment:** Be aware that screwing/welding to truss angles and or pan is not permitted.



- Refuse disposal:** Provide refuse containers for crating and packaging.
- Lighting:** Provide task lighting in and around the escalator work area for a safe work environment.
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- Optional circuitry:** Special options for the escalators (heating rods, handrail lighting, skirt lighting, remote monitoring, etc.) may require more circuits and/or work by others. Discuss this with your KONE representative prior to final design and procurement.

What Does Site Logistics Modeling Enable?

PROJECT SEQUENCING DISCUSSION

Communicate the space needed during installation to help guide the sequence of construction / equipment installation

ONSITE MATERIAL STORAGE OPTIMIZATION

Placing onsite storage required areas in optimal locations may mean we spend less labor hours onsite.

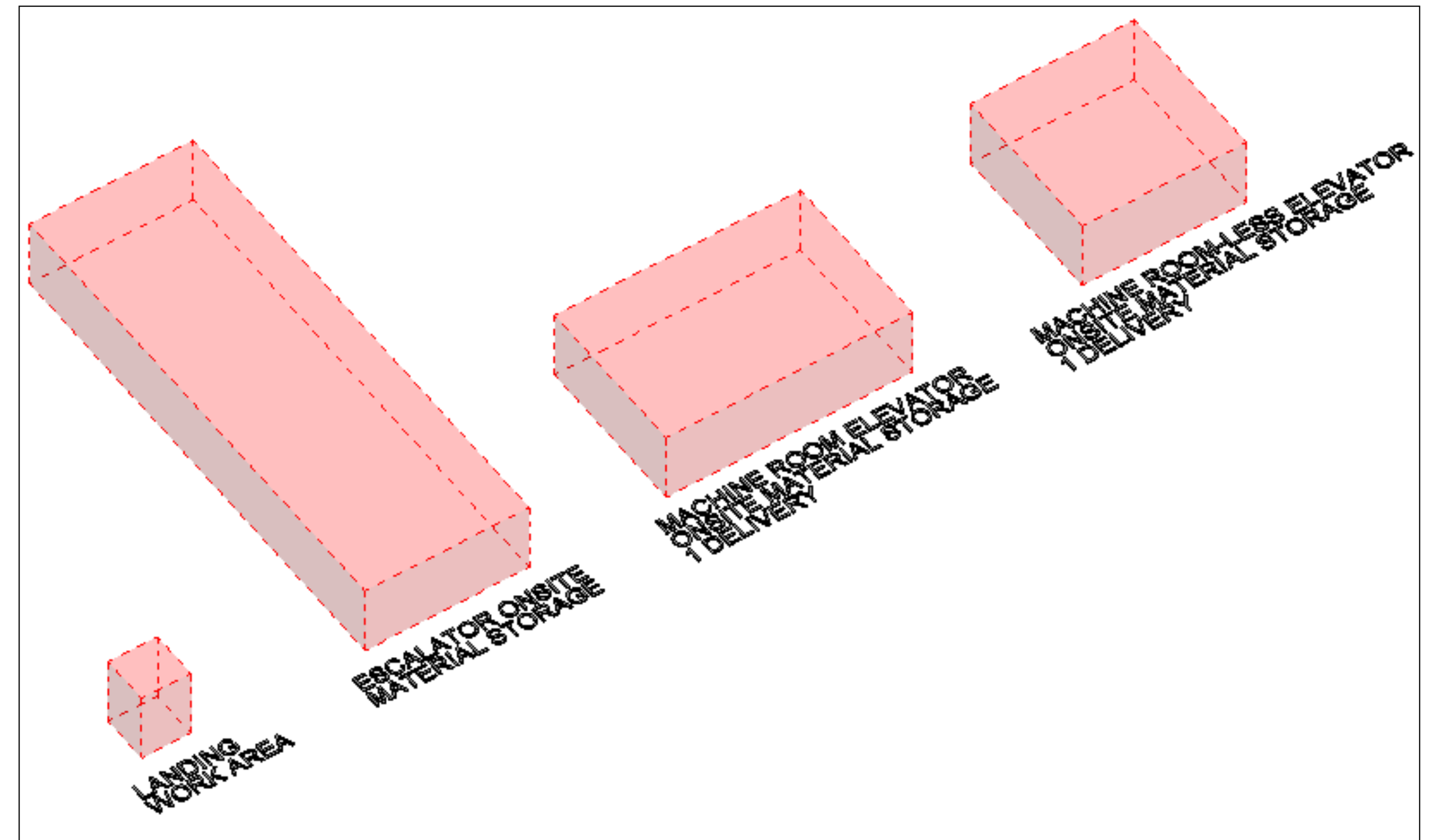
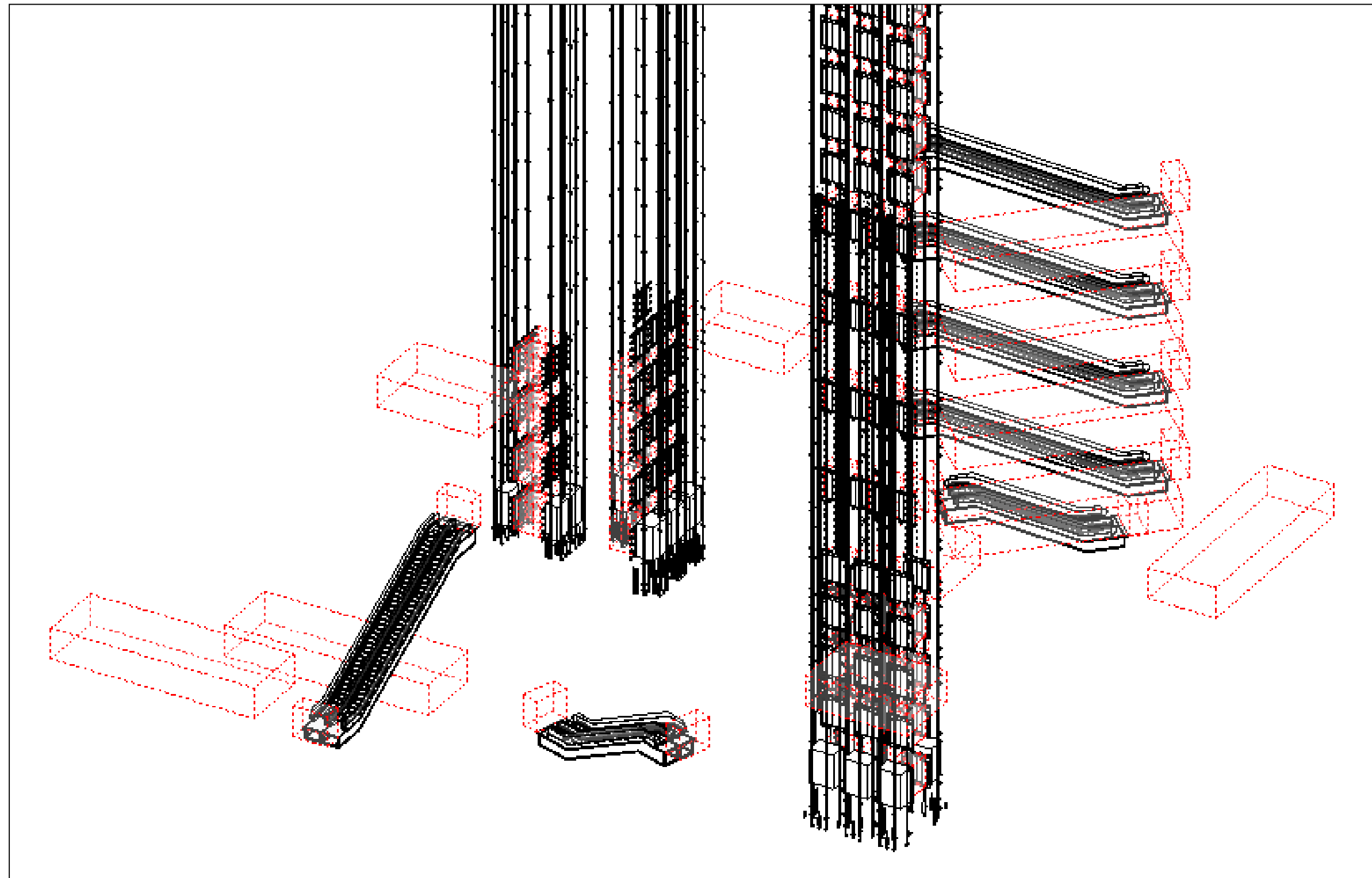
PLAN FOR MULTIPLE DELIVERIES

While we require a certain space per installation, we almost never get that space. Here we can use the 3D model to realistically plan for multiple deliveries.

3D/4D CONSTRUCTION SITE SPACE PLAN

If all trades are modeling their construction-time space requirements, there is an opportunity to computationally solve for an optimized sequence the same way generative design tools allow for early design optimization

What Does a Site Logistics Model Look Like?



Site Logistics in Revit and Navisworks

REVIT

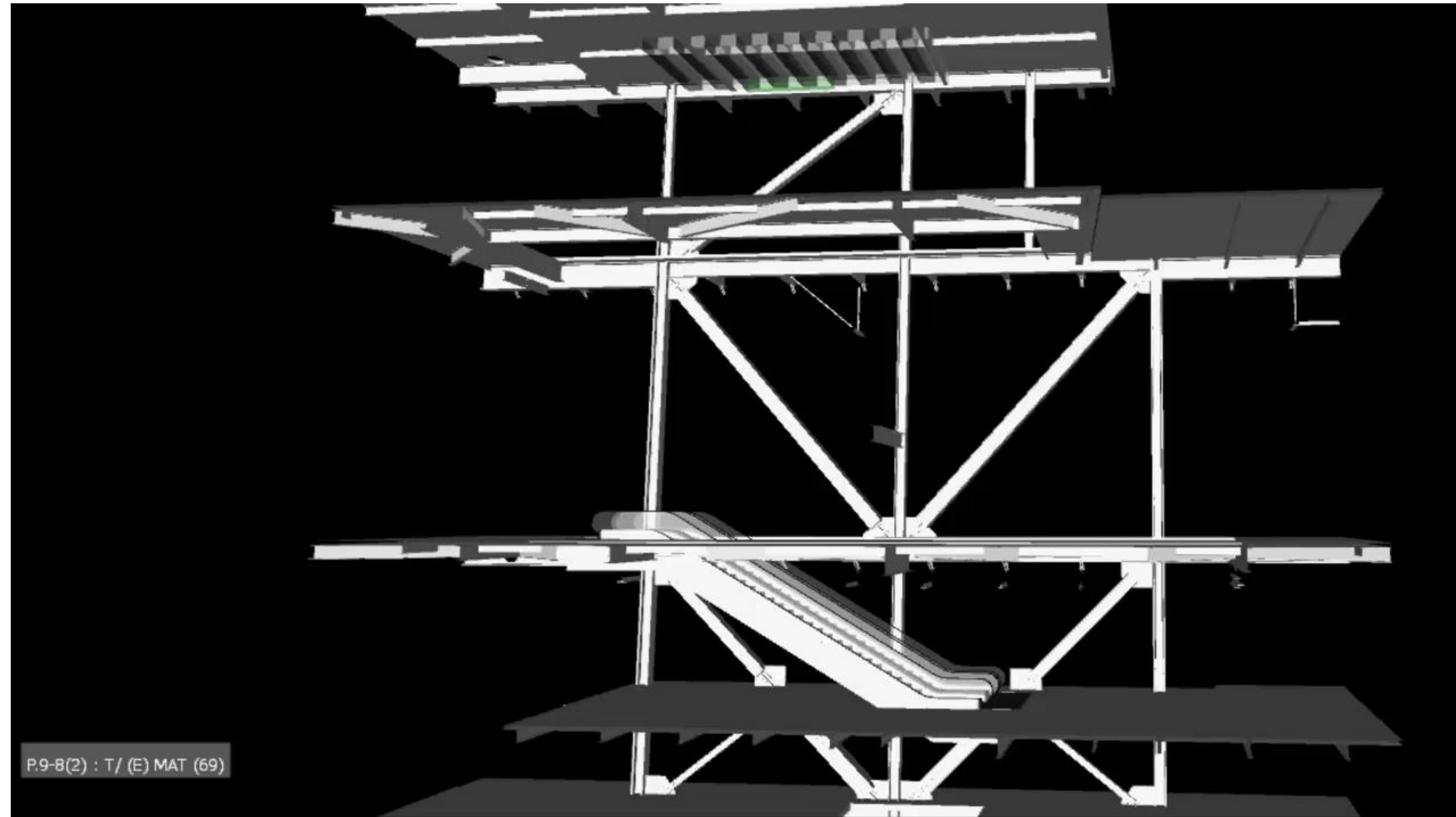
1. Link Equipment models and architectural/structural models
2. Copy important levels and Acquire Coordinates
3. Place the site logistics components on each level, as required
4. Hide Linked models and export 4D Site Logistics model to desired format (DWF)

NAVISWORKS

1. Append the site logistics model exported from Revit, we use DWF or IFC.
2. Isolate building floors with site logistics using sectioning tools.
3. Save Viewpoint(s)
4. If necessary, select the object and use the Item tools to Move, Rotate, or Scale
5. Screen capture or export image formats.

Equipment Routing

- Improve installation planning by animating the path and associated equipment and rigging

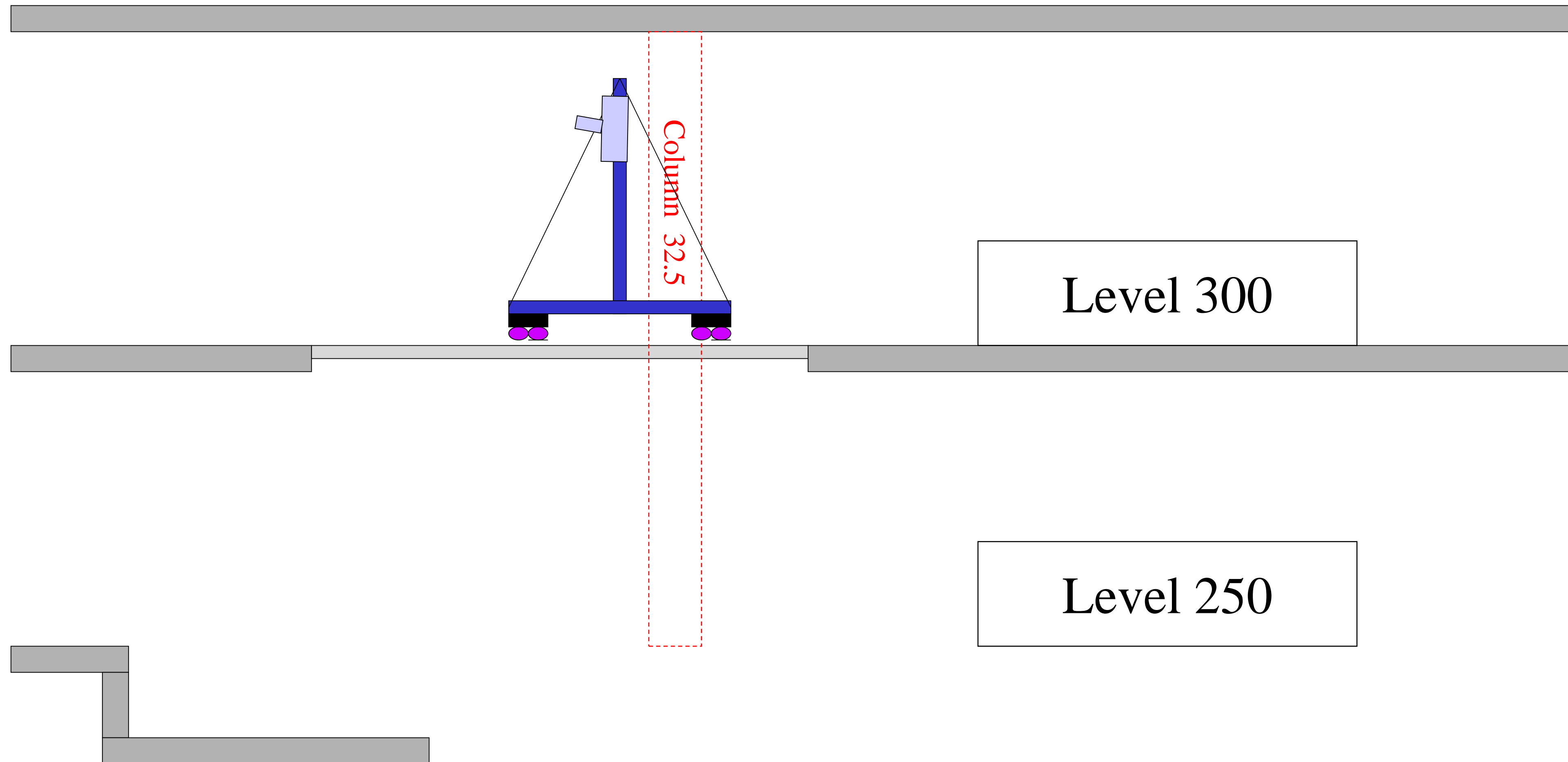


The way it was done before,

Rig & Hoist



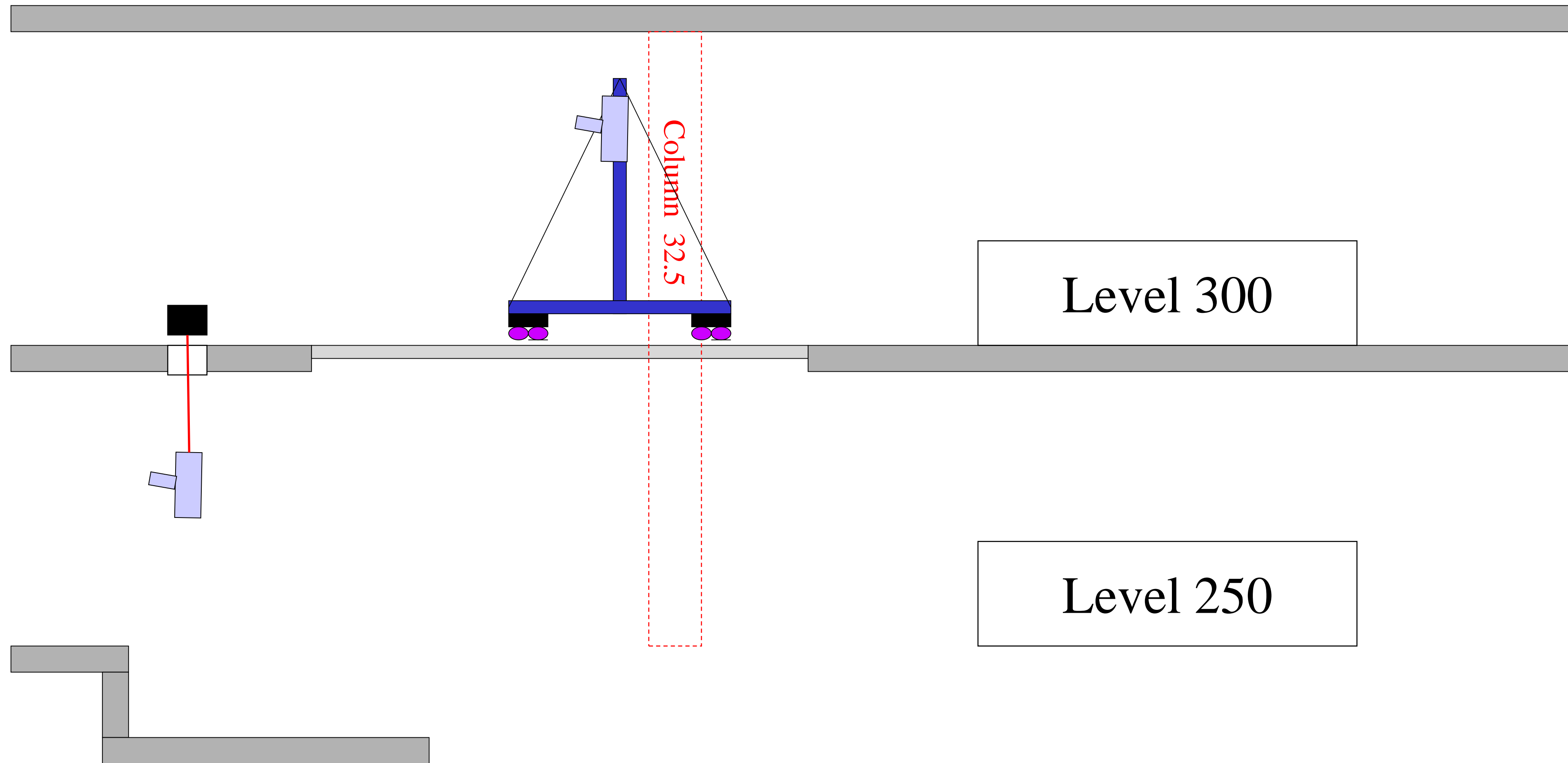
- Installation with rolling A-frames:



Rig & Hoist



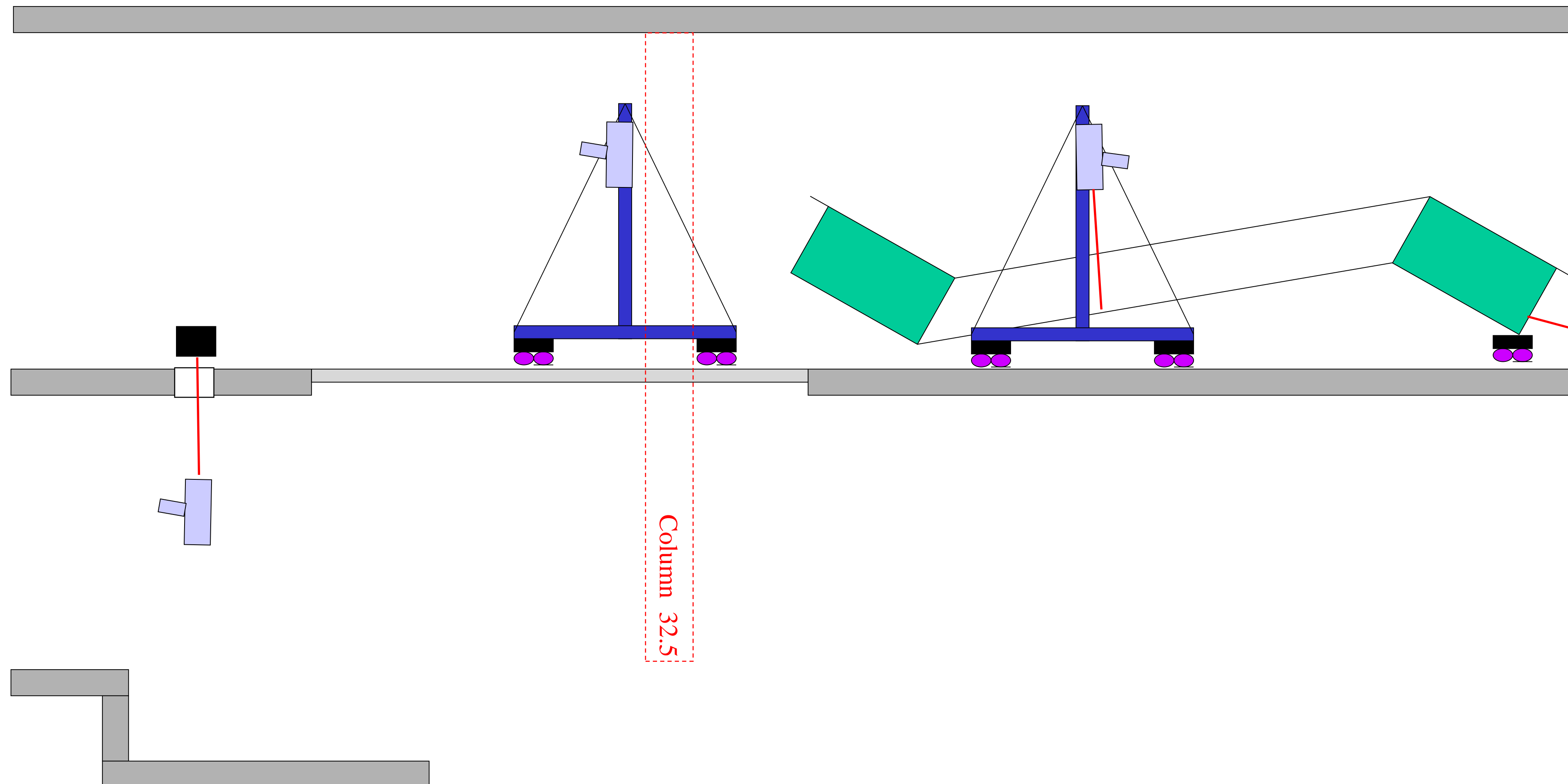
- Installation with rolling A-frames:



Rig & Hoist



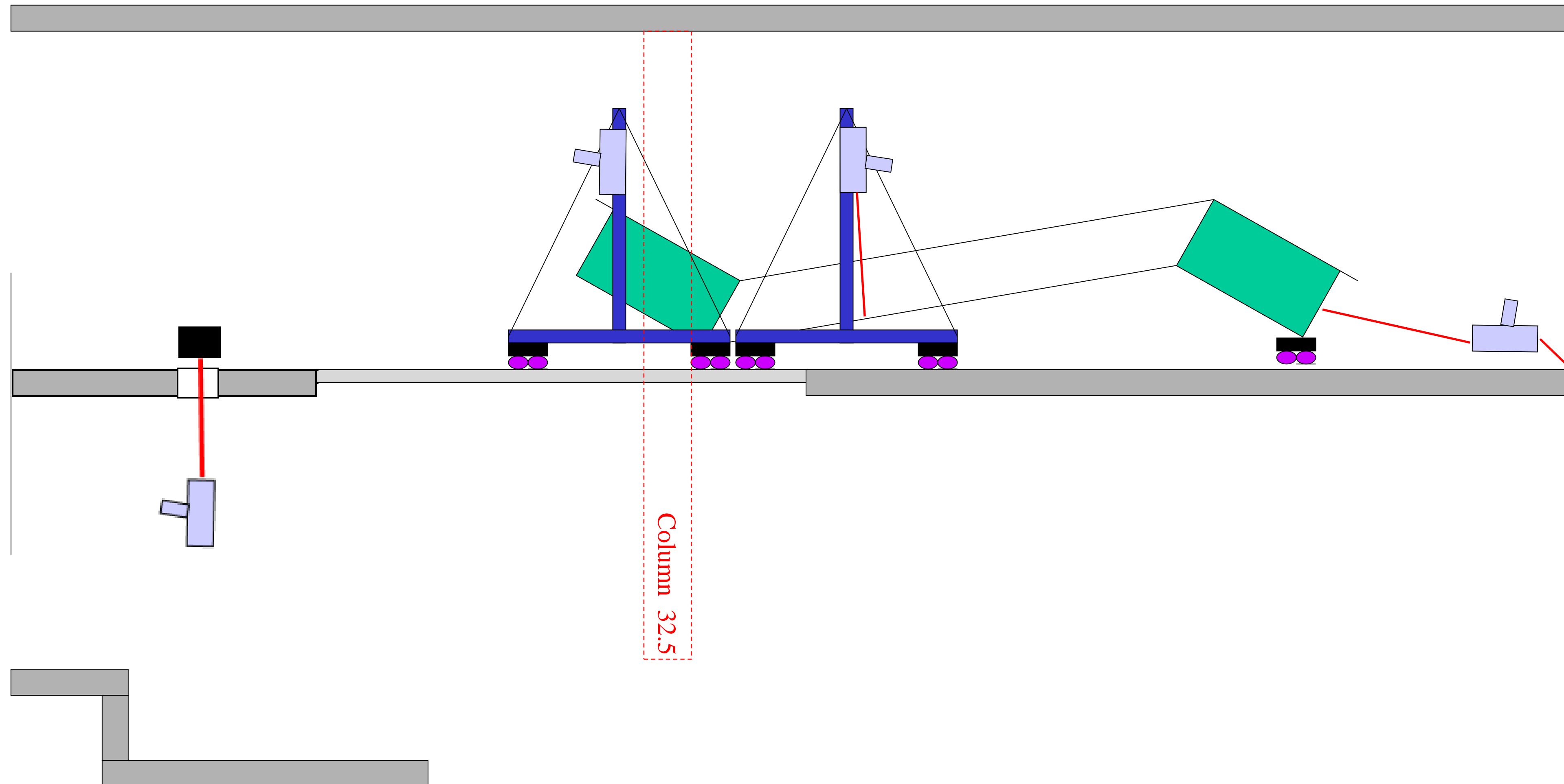
- Installation with rolling A-frames:



Rig & Hoist



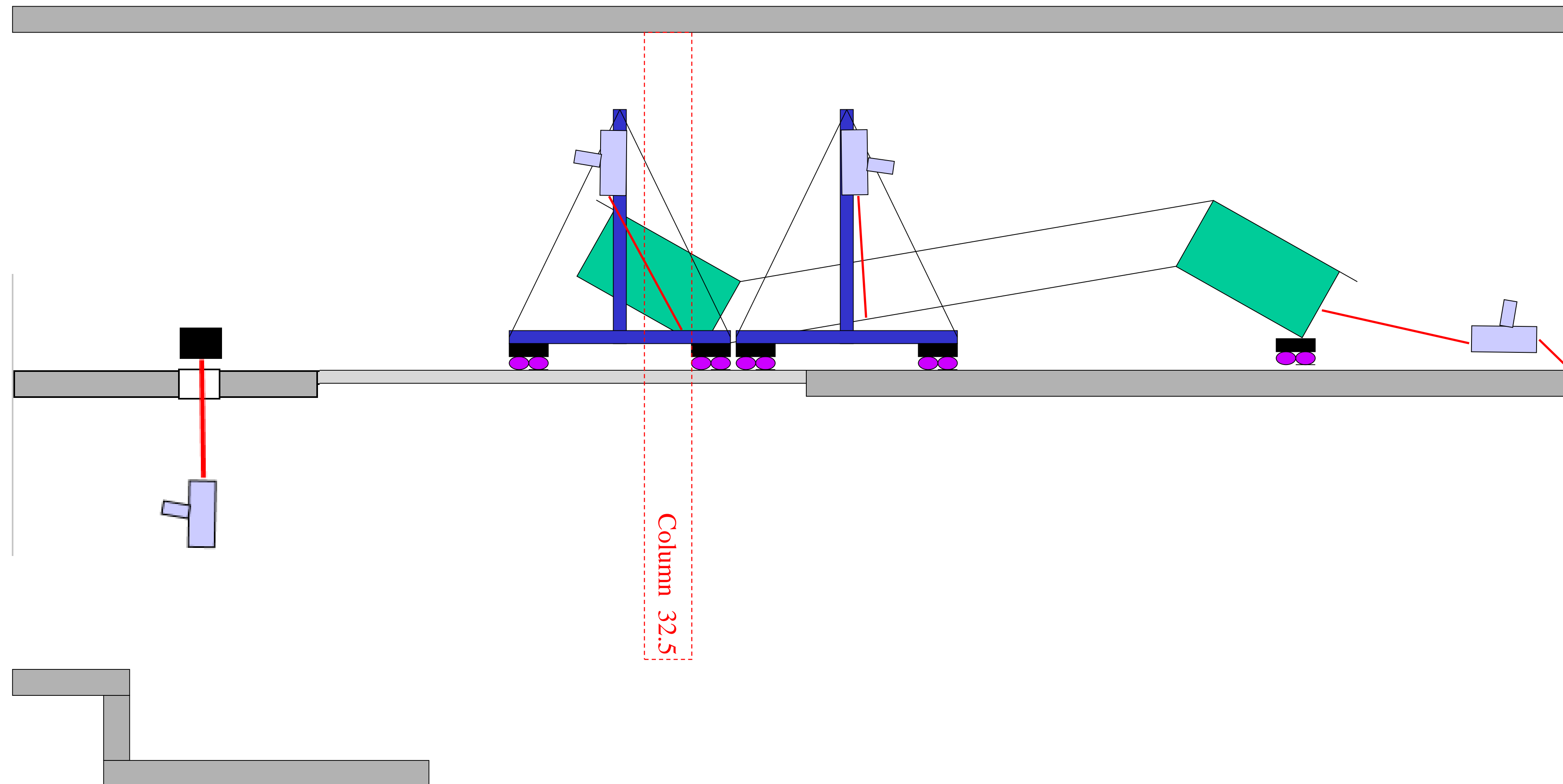
- Installation with rolling A-frames:



Rig & Hoist



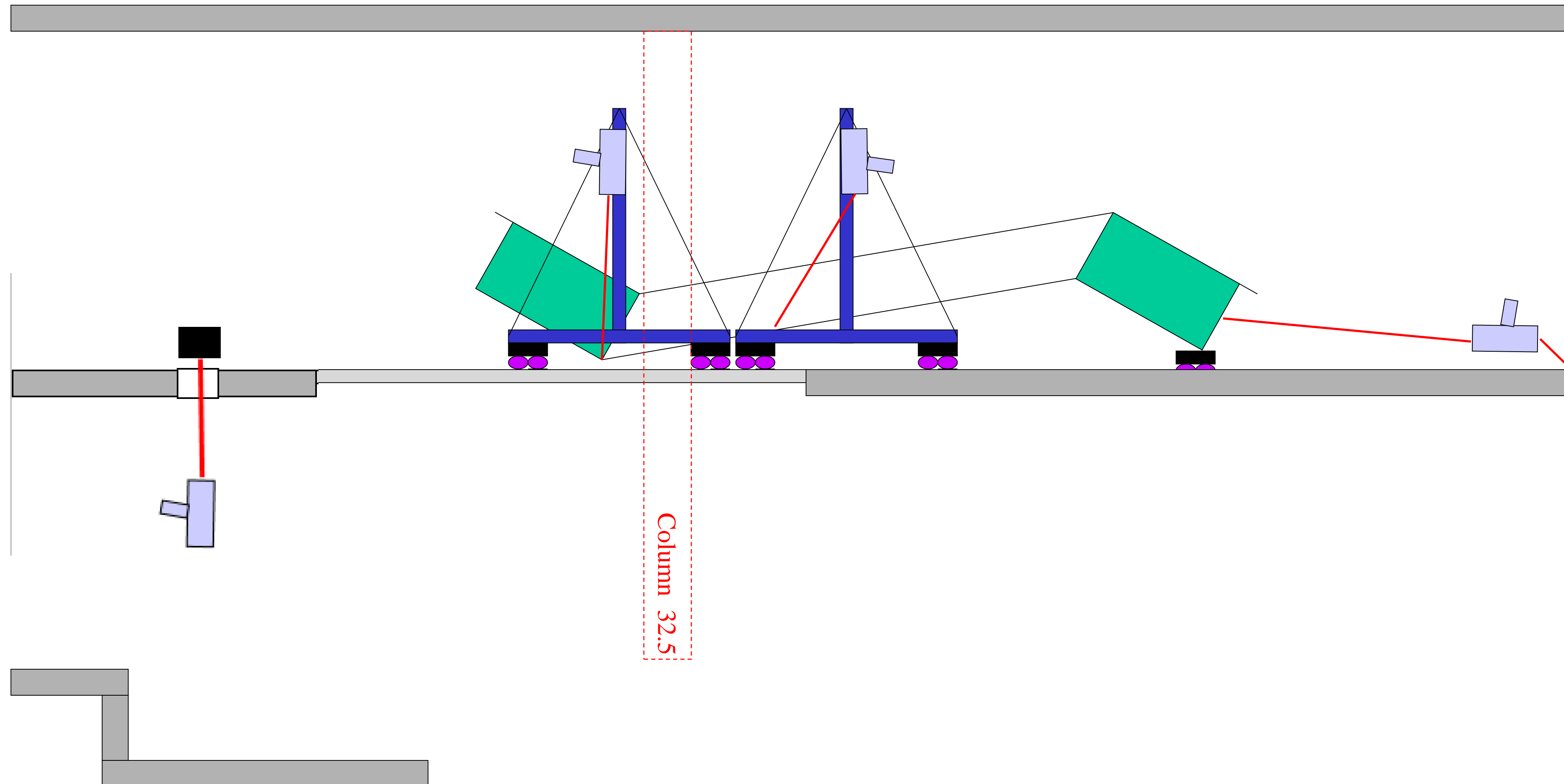
- Installation with rolling A-frames:



Rig & Hoist



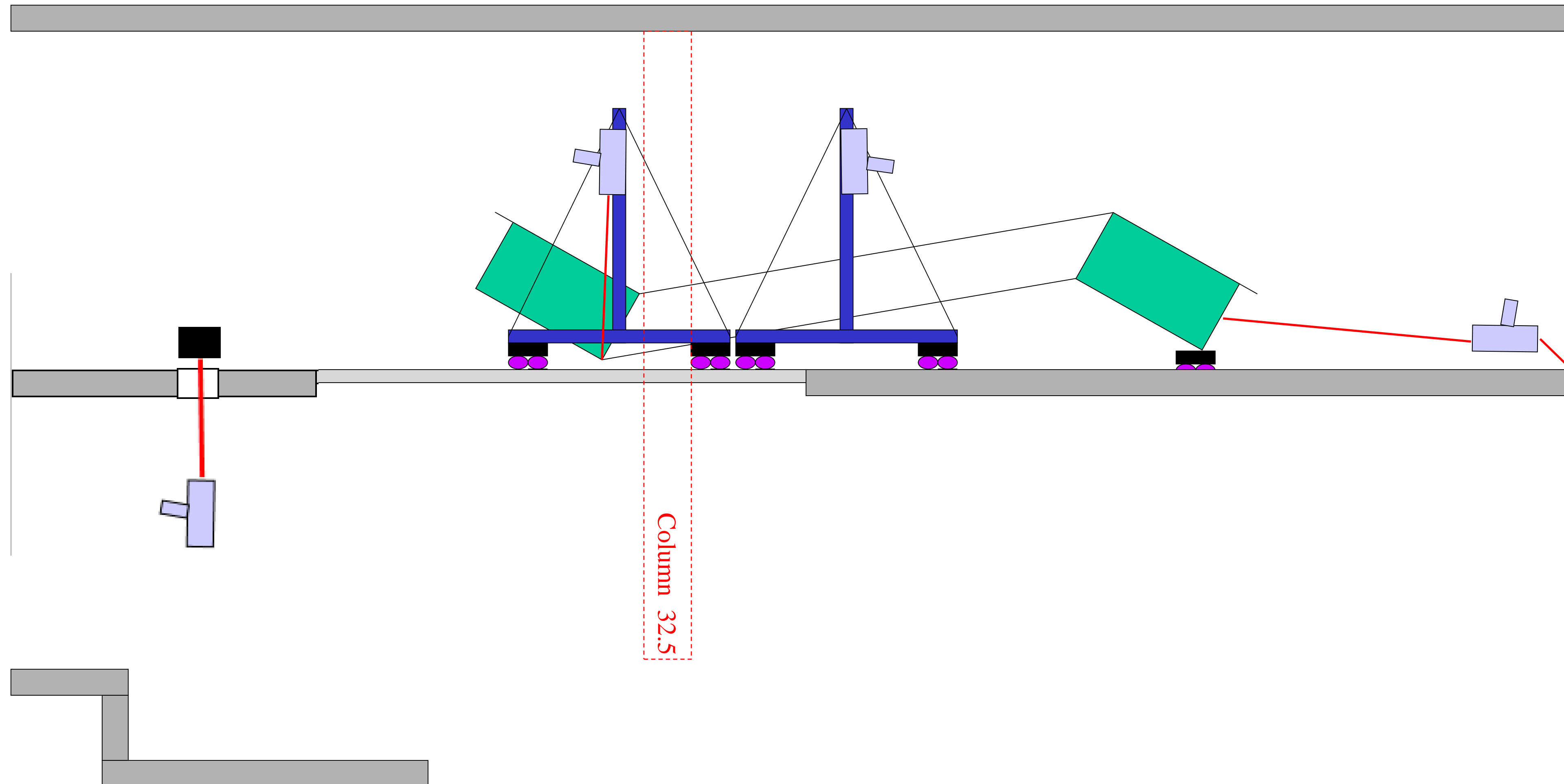
- Installation with rolling A-frames:



Rig & Hoist



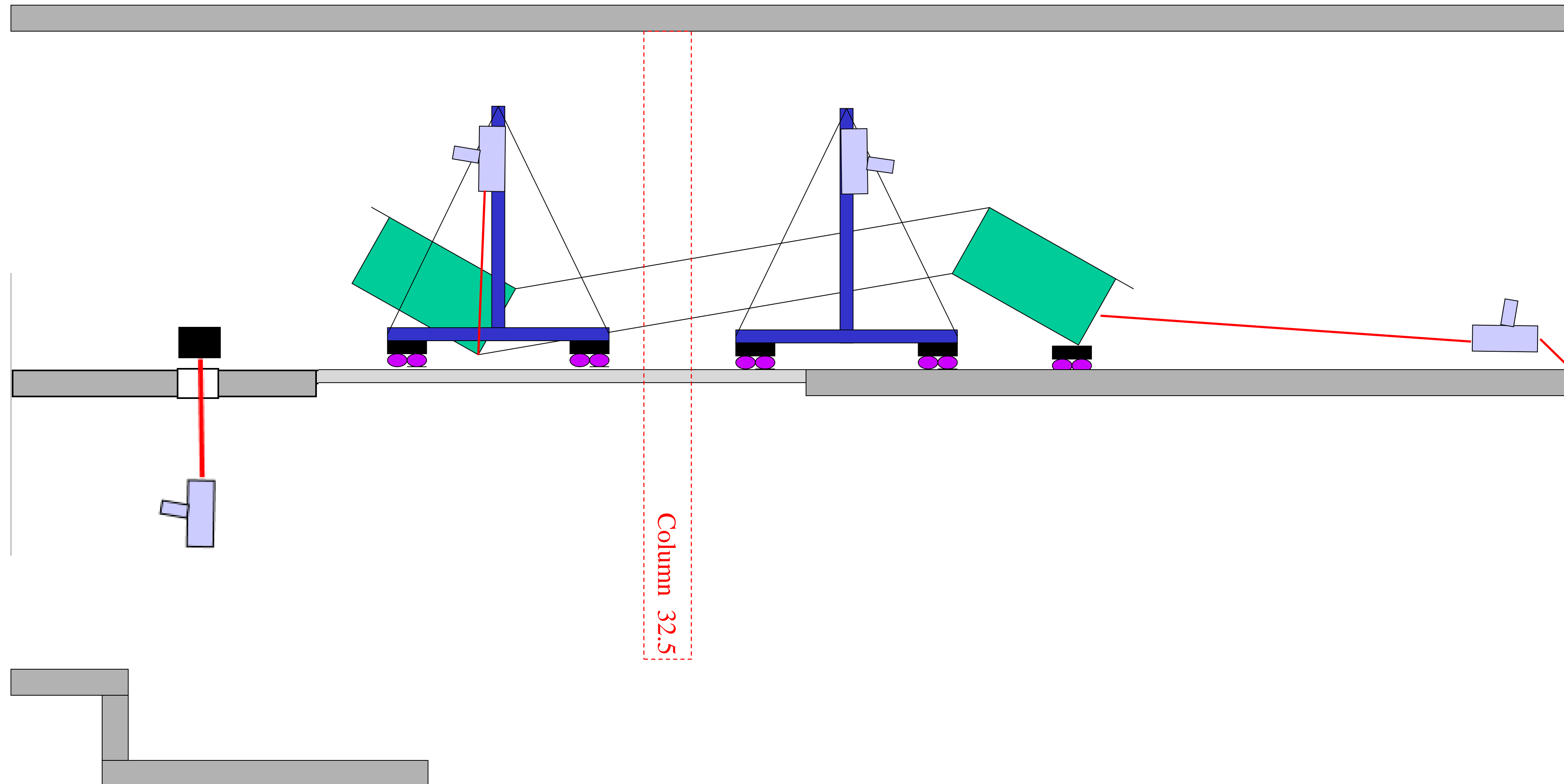
- Installation with rolling A-frames:



Rig & Hoist

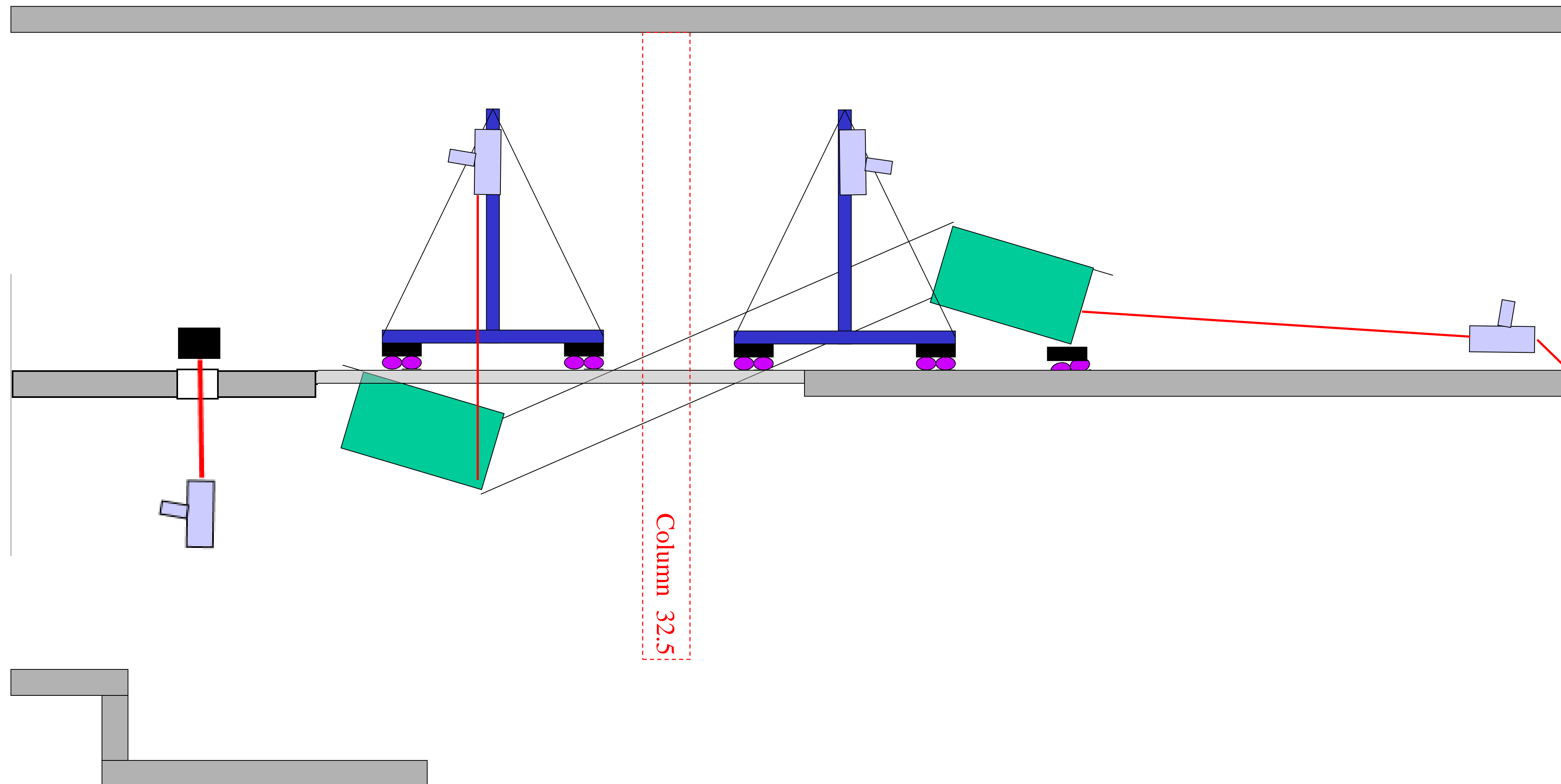


- Installation with rolling A-frames:



Rig & Hoist

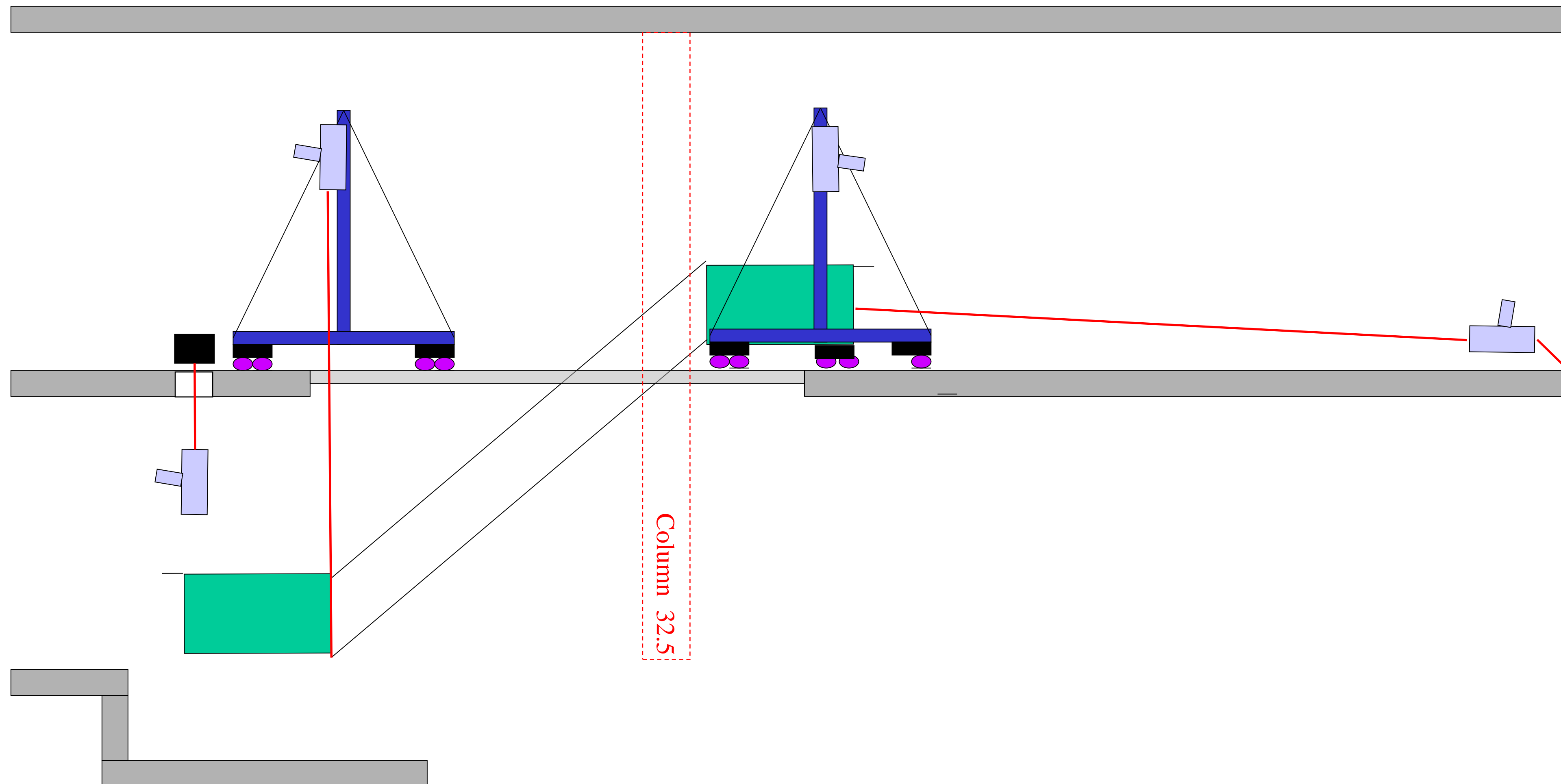
- Installation with rolling A-frames:



Rig & Hoist



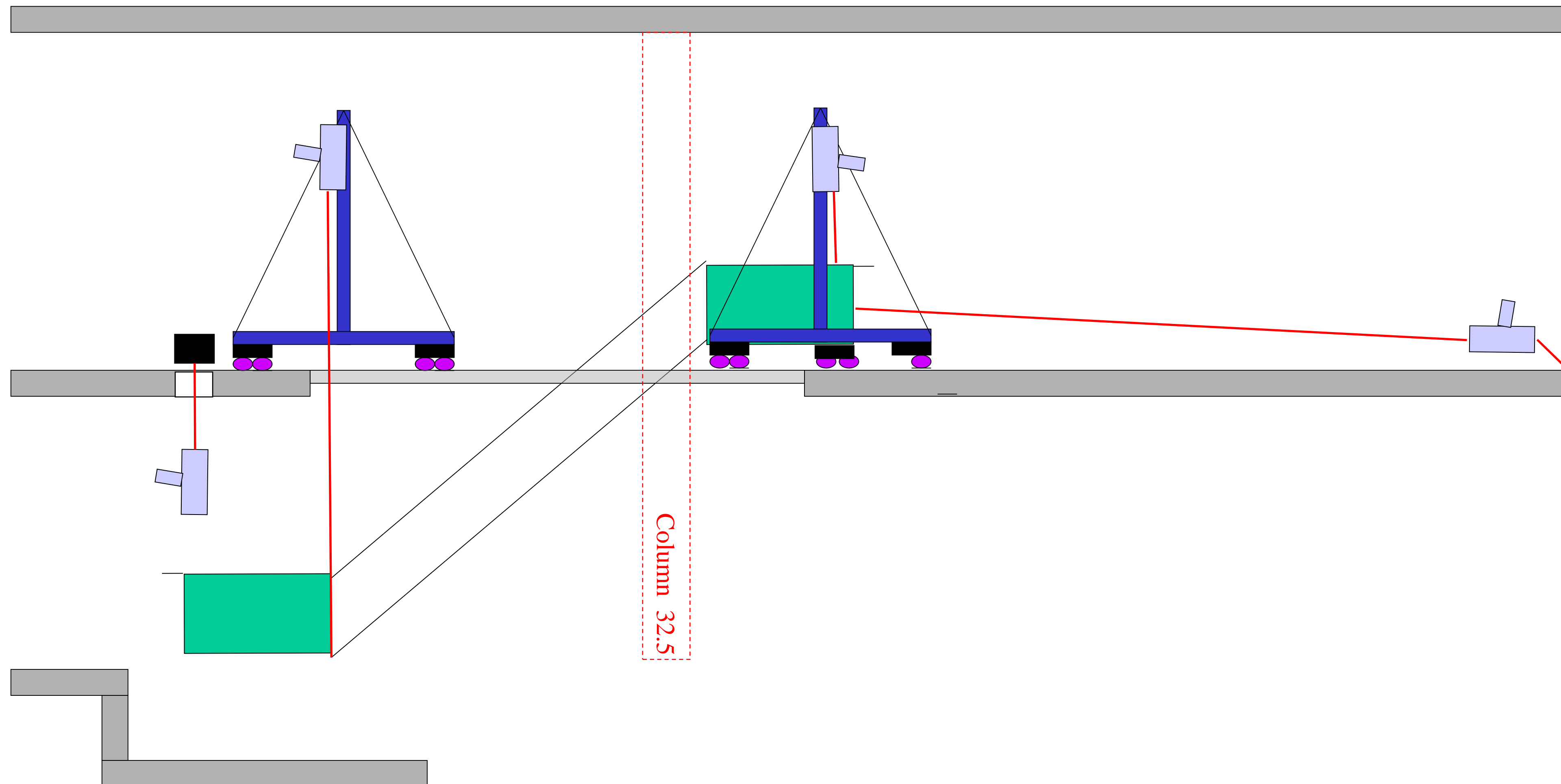
- Installation with rolling A-frames:



Rig & Hoist



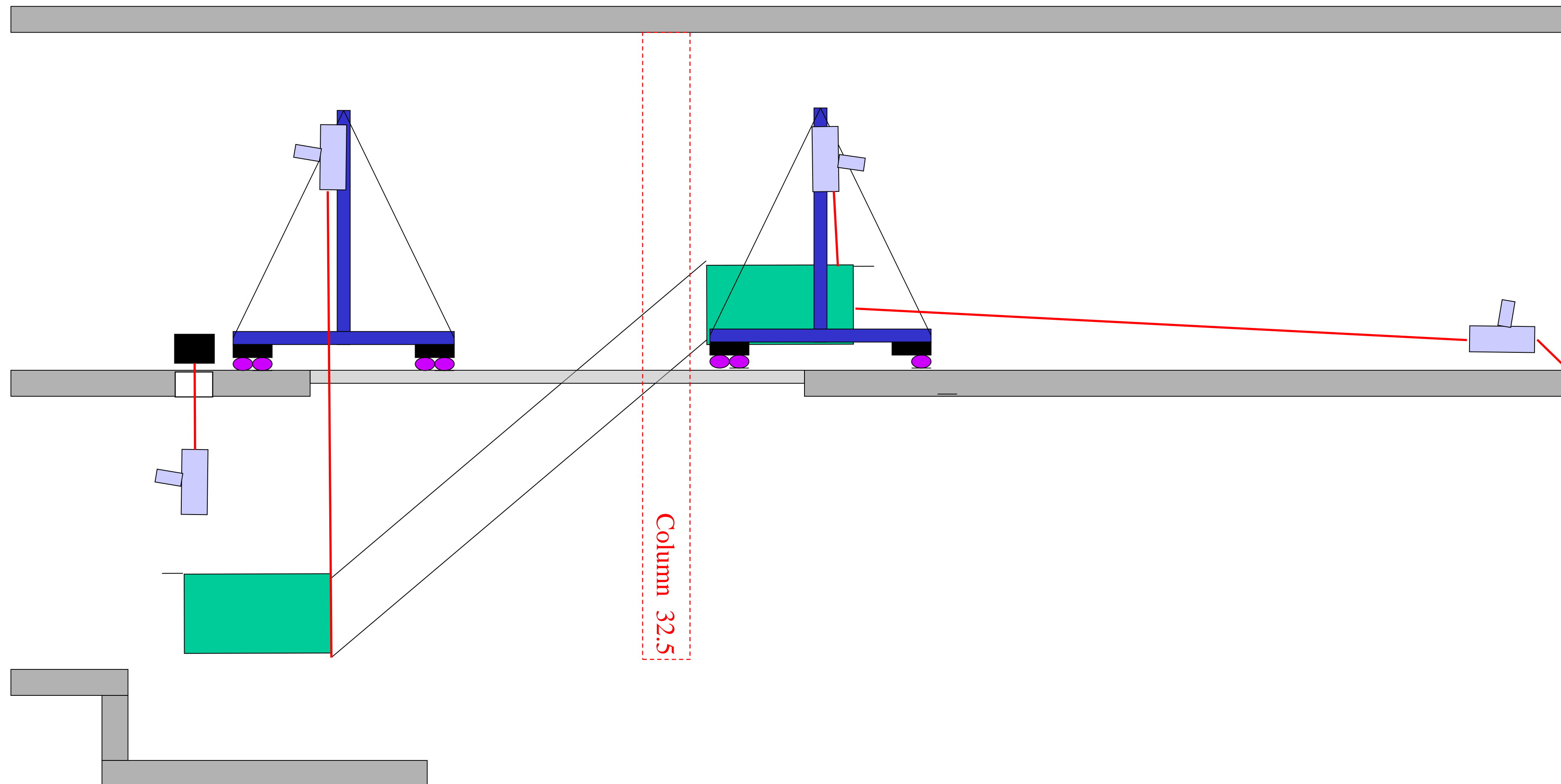
- Installation with rolling A-frames:



Rig & Hoist



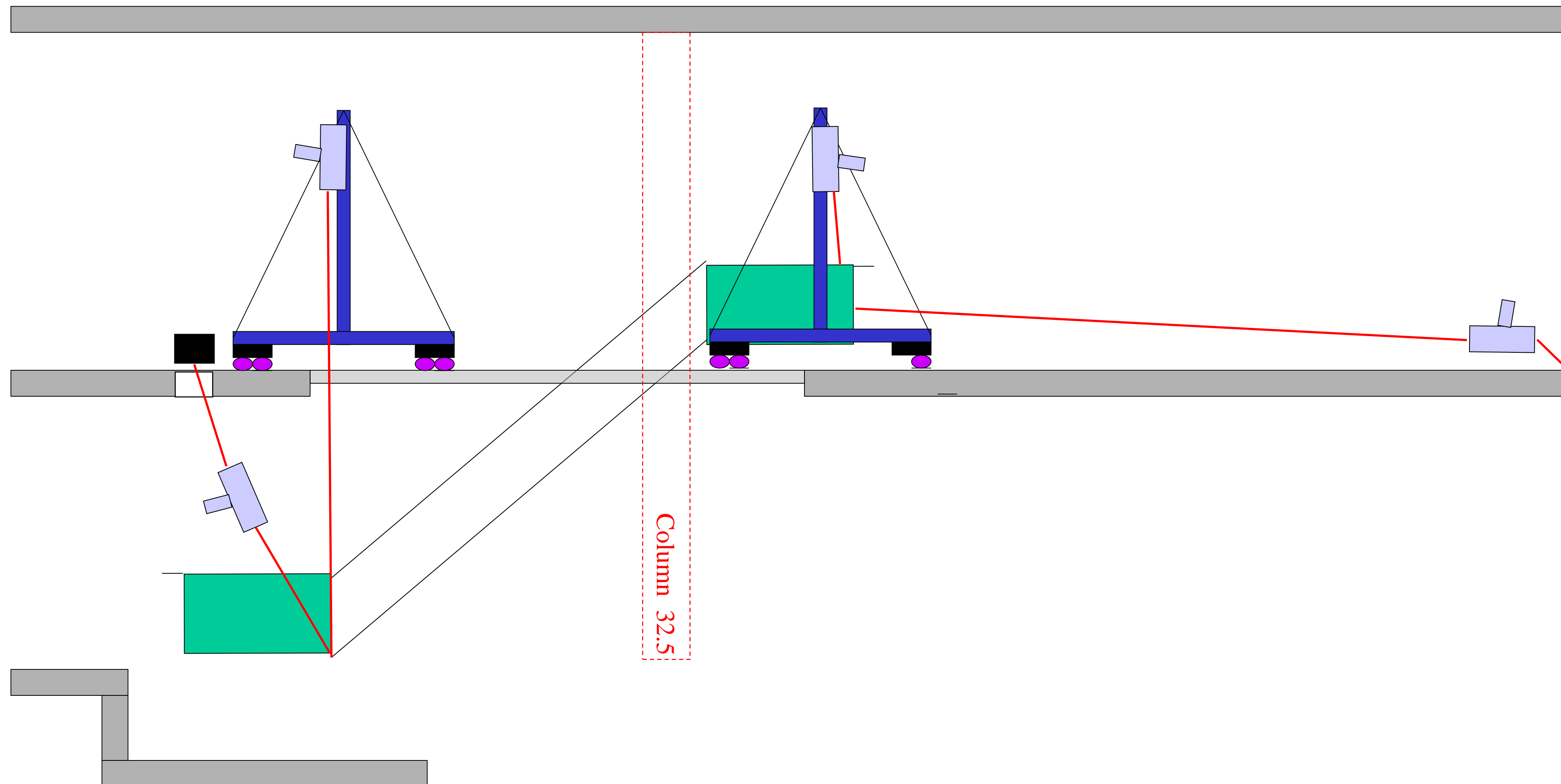
- Installation with rolling A-frames:



Rig & Hoist



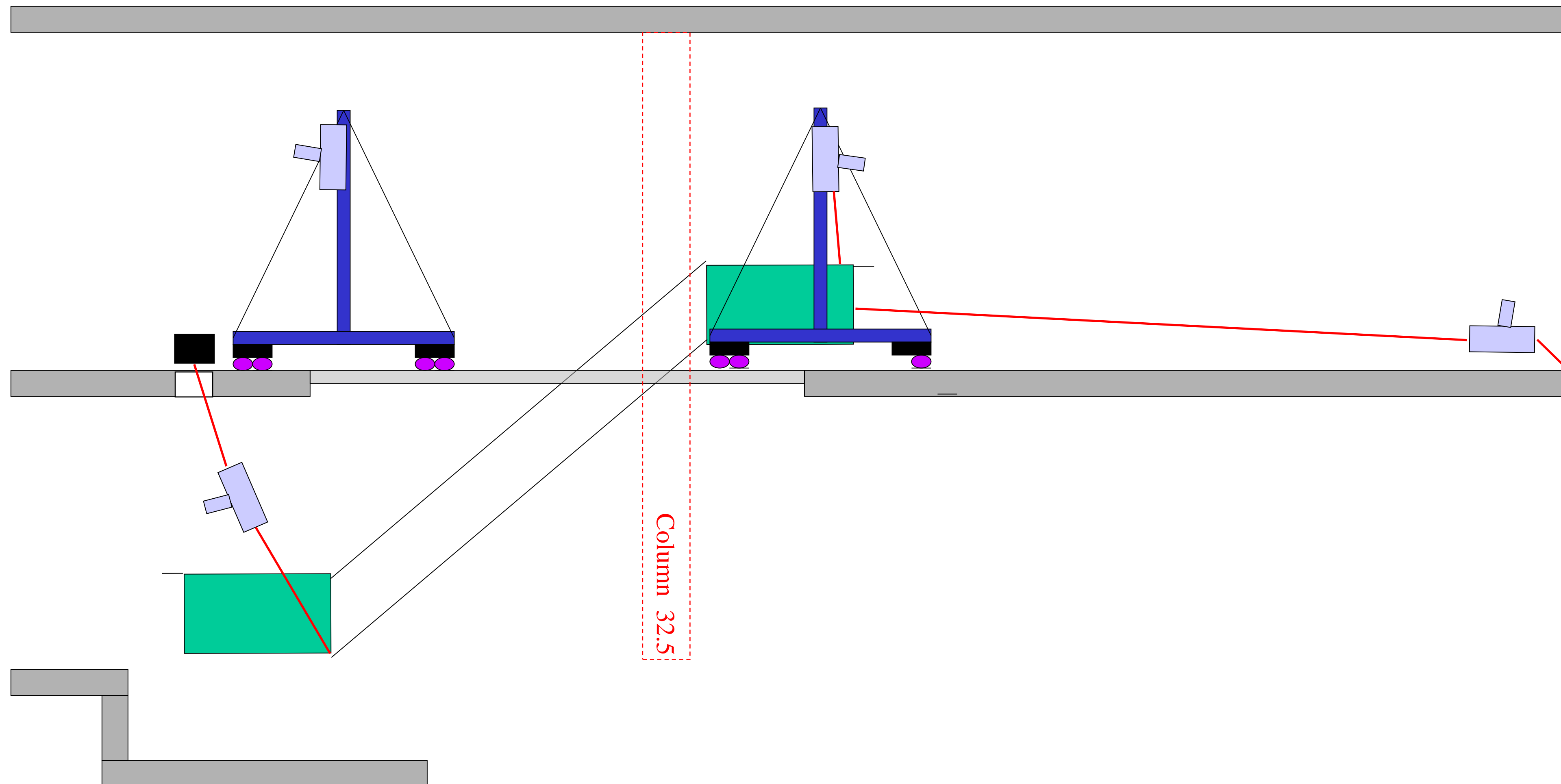
- Installation with rolling A-frames:



Rig & Hoist

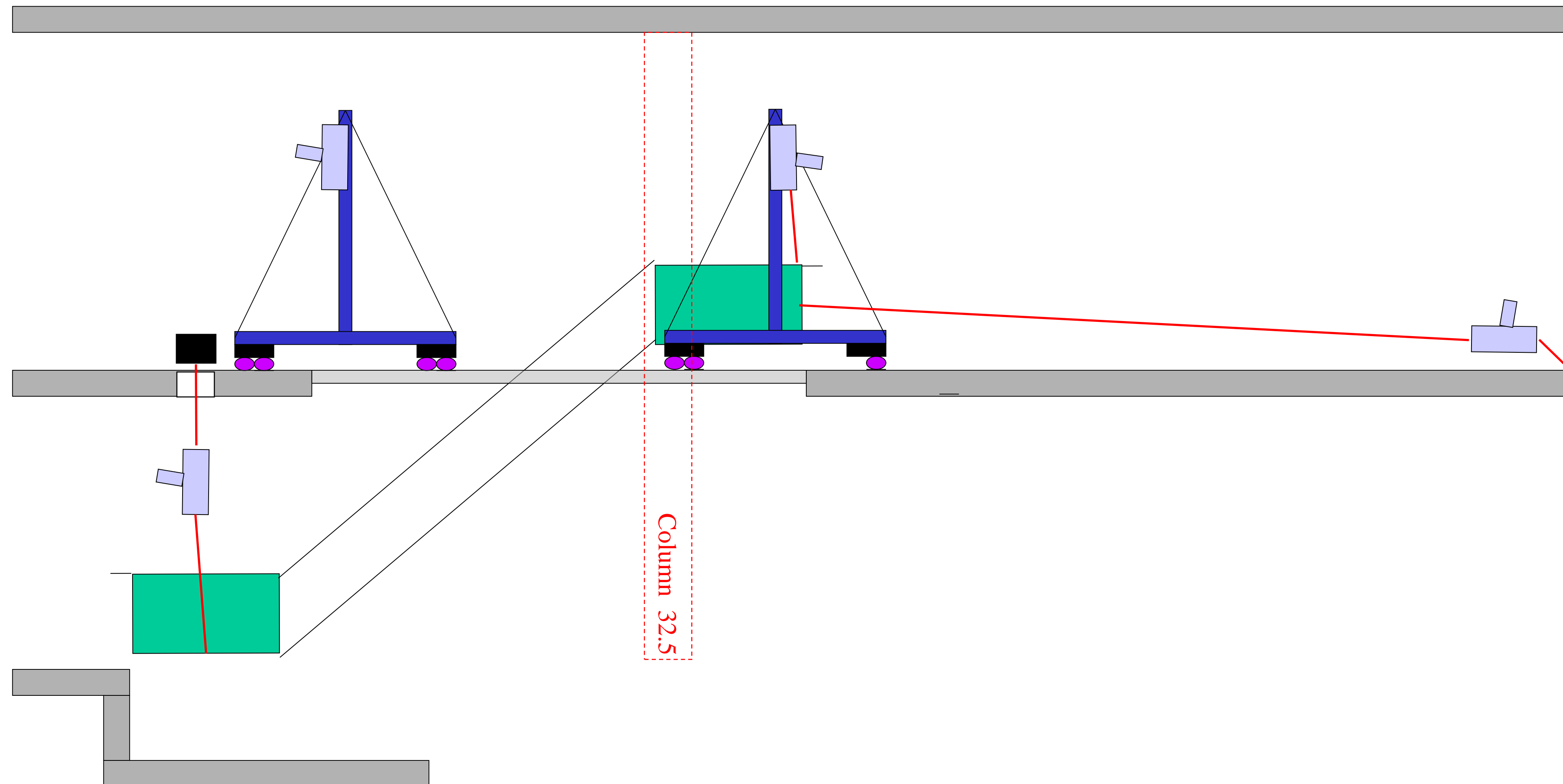


- Installation with rolling A-frames:



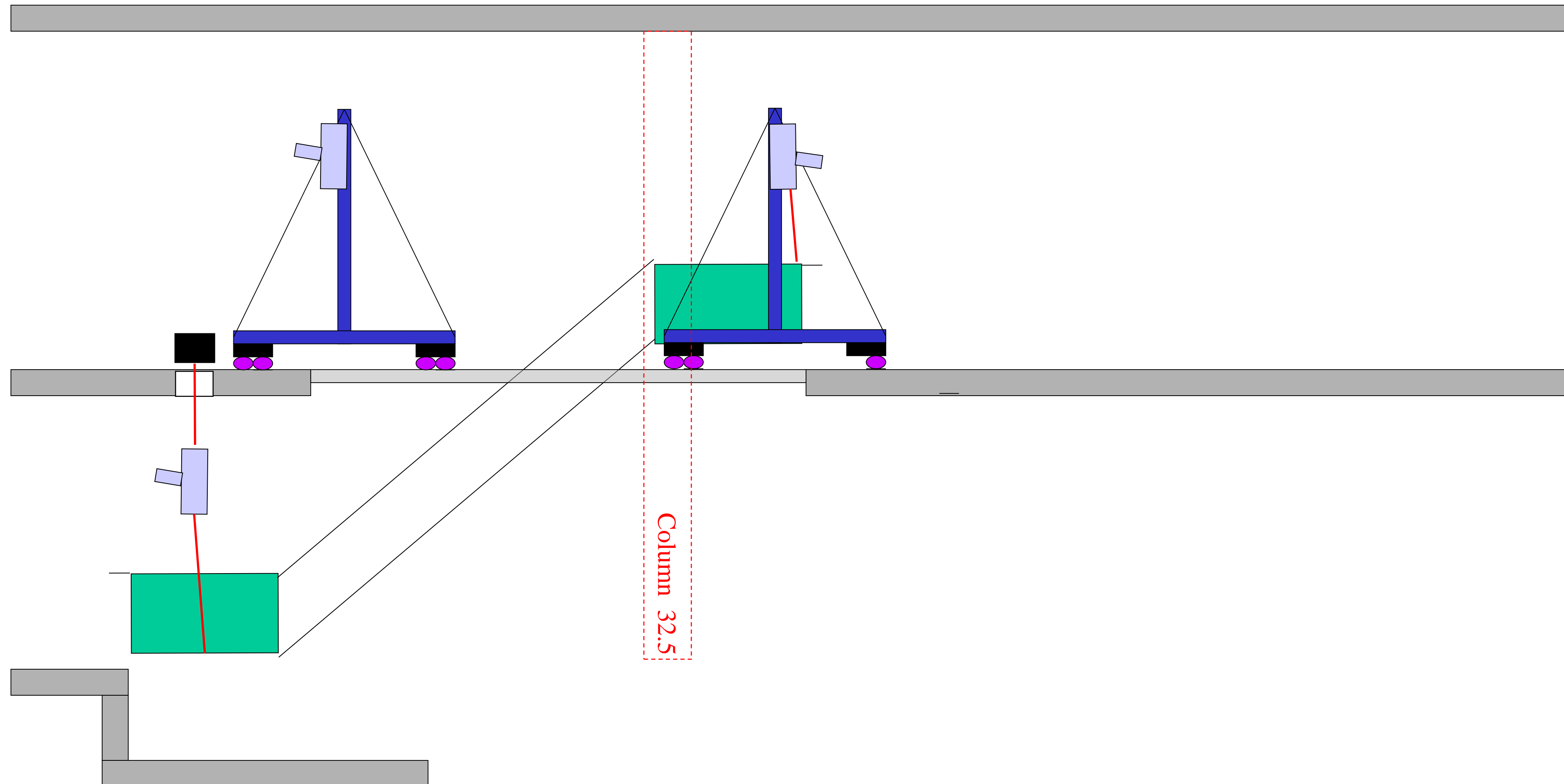
Rig & Hoist

- Installation with rolling A-frames:



Rig & Hoist

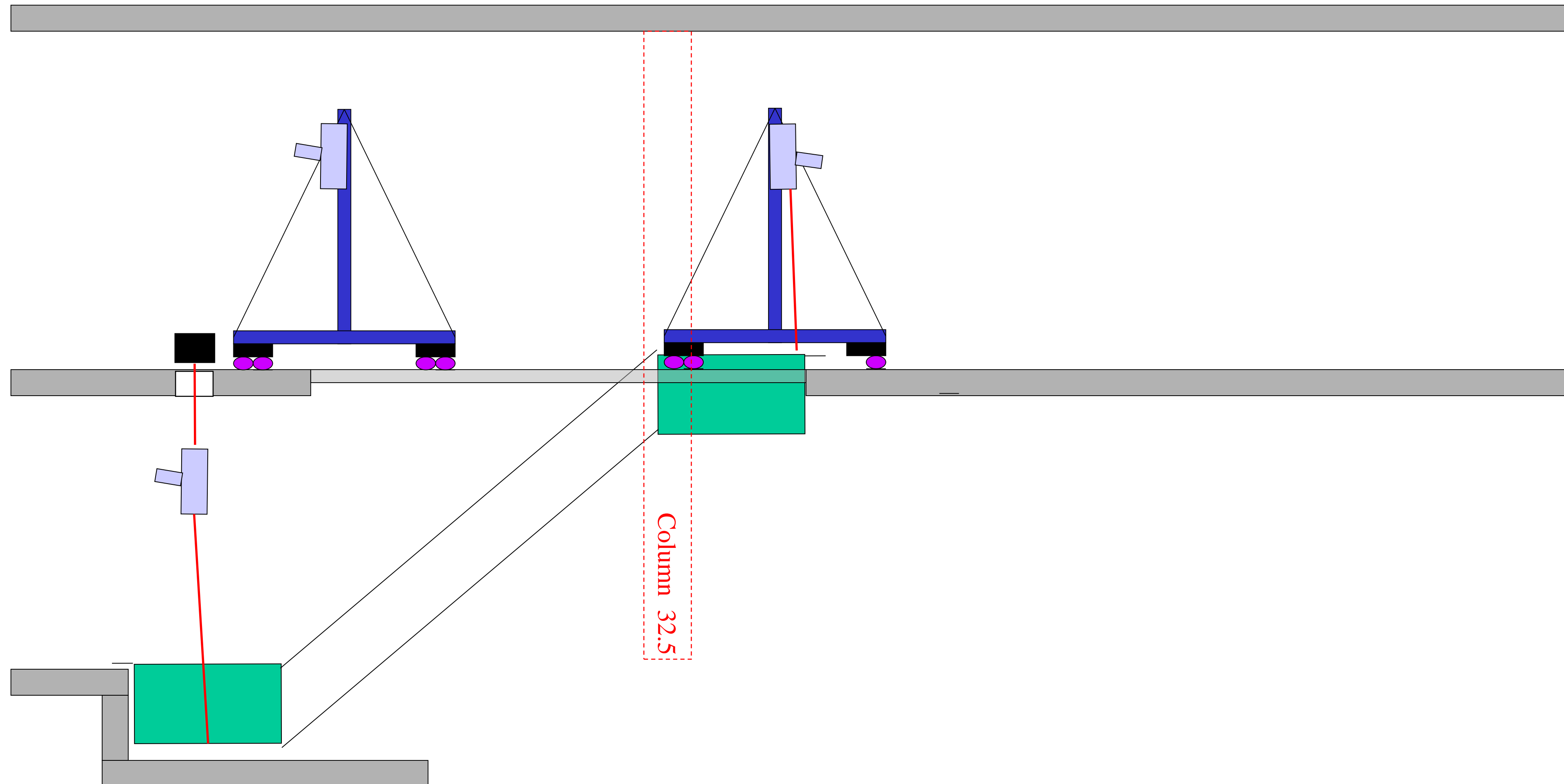
- Installation with rolling A-frames:



Rig & Hoist

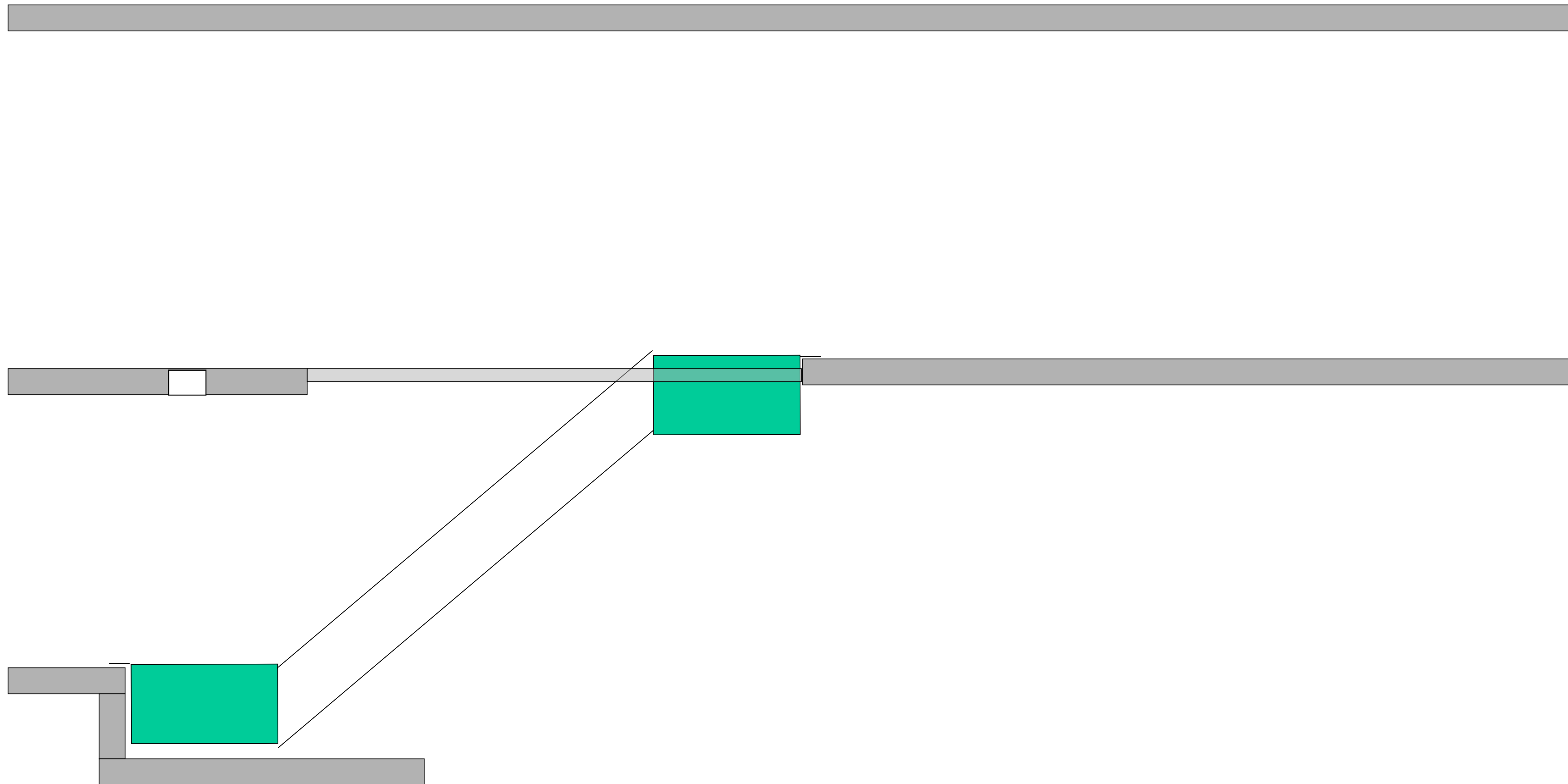


- Installation with rolling A-frames:



Rig & Hoist

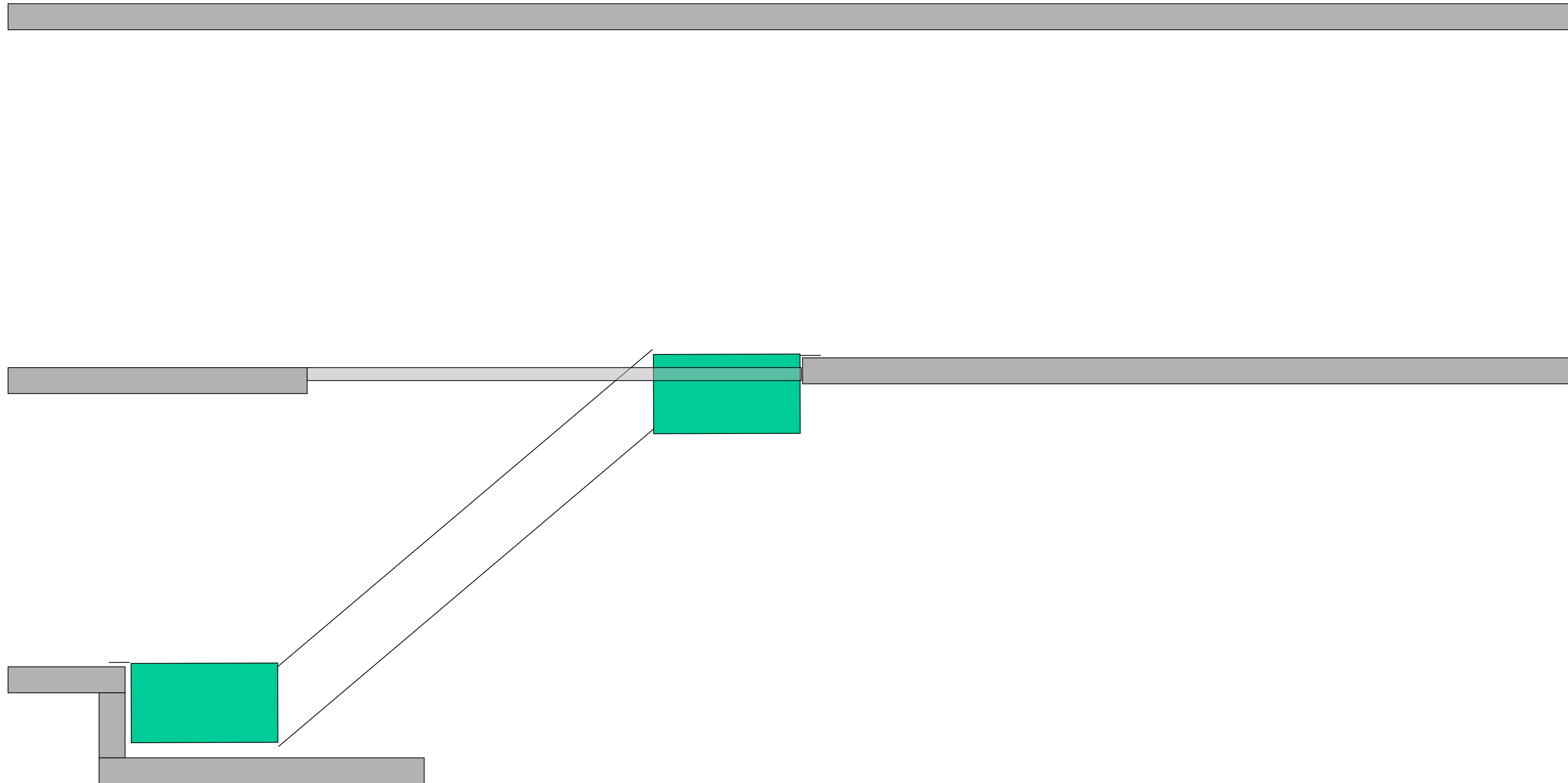
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Rig & Hoist

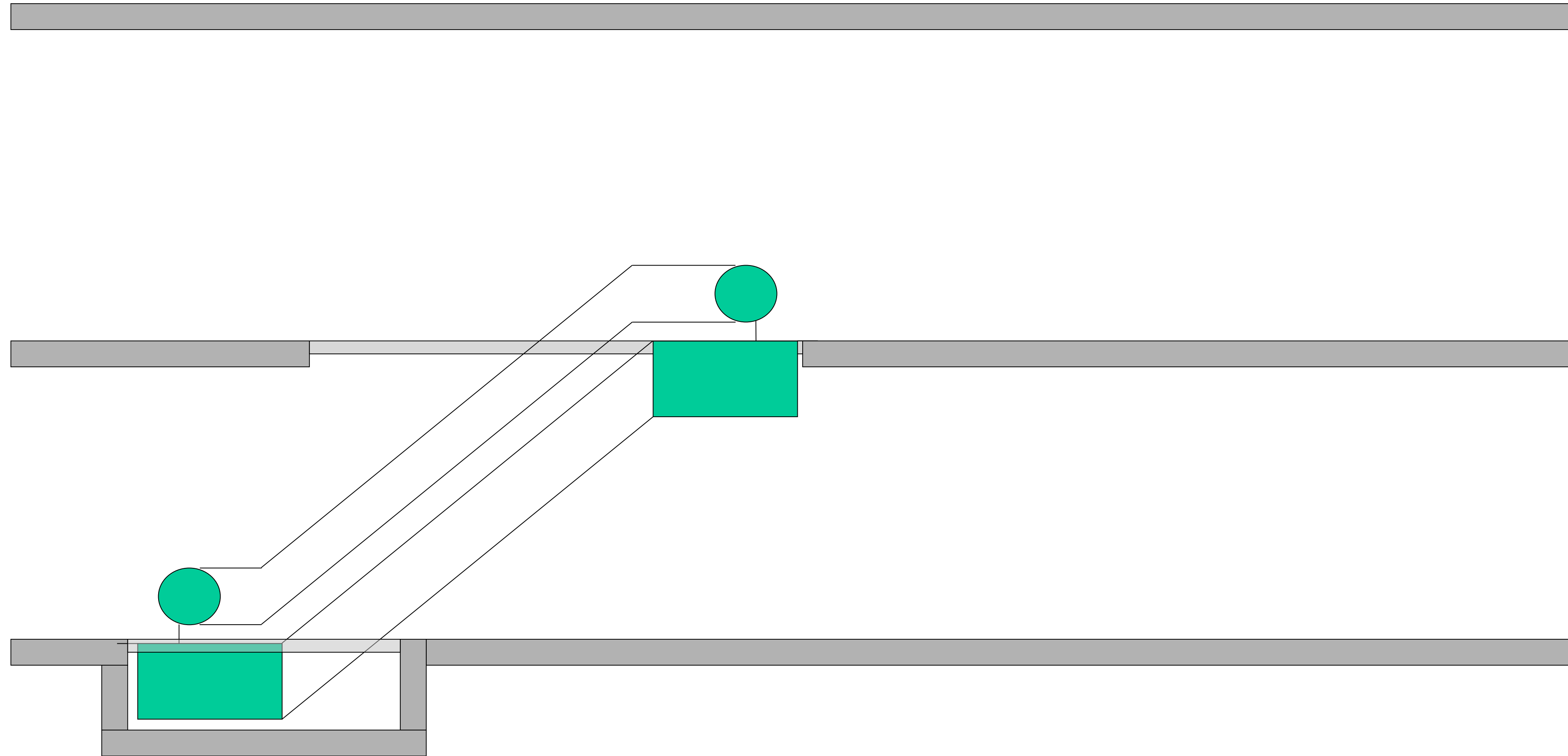


- Installation with rolling A-frames:



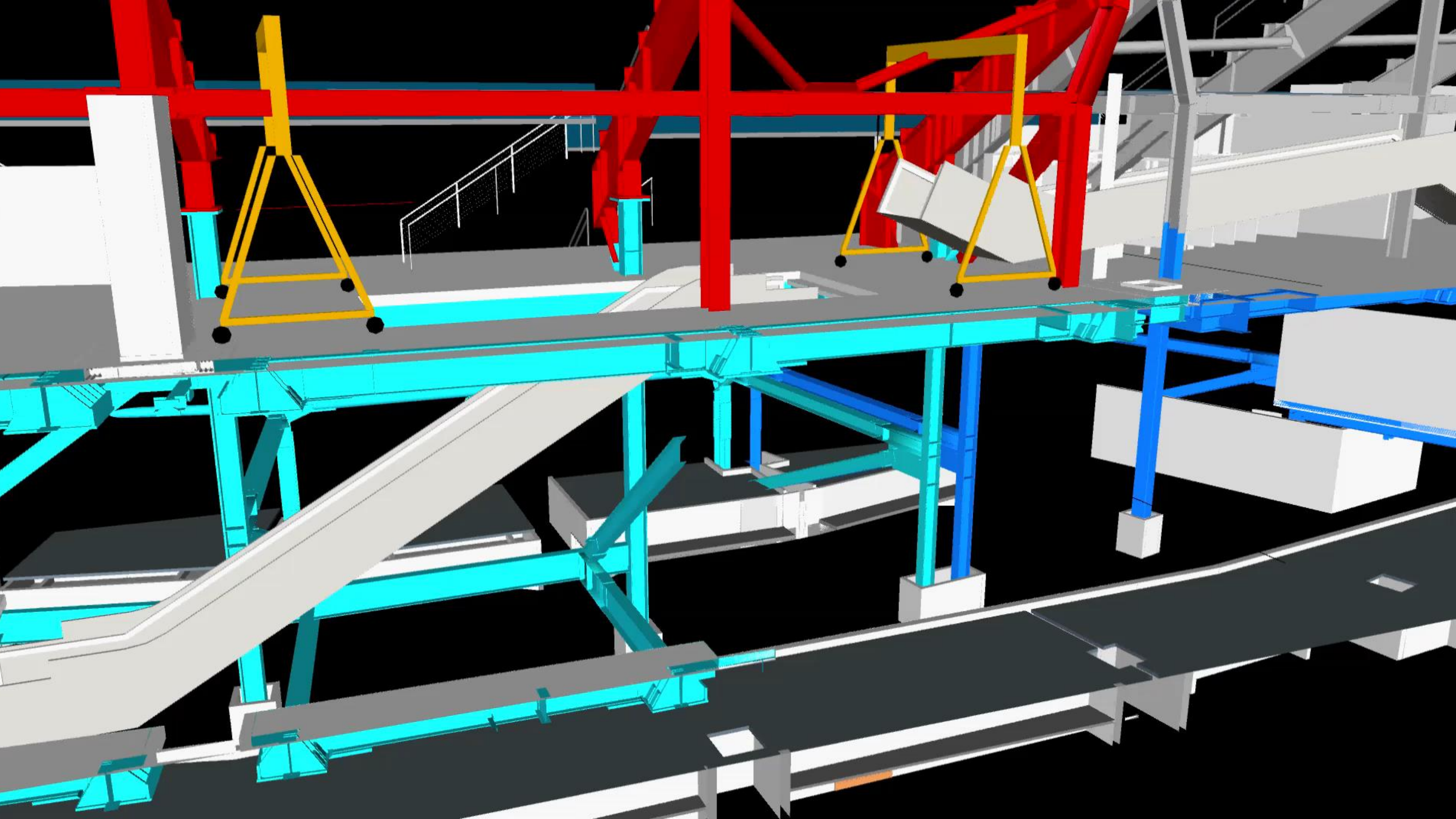
Rig & Hoist

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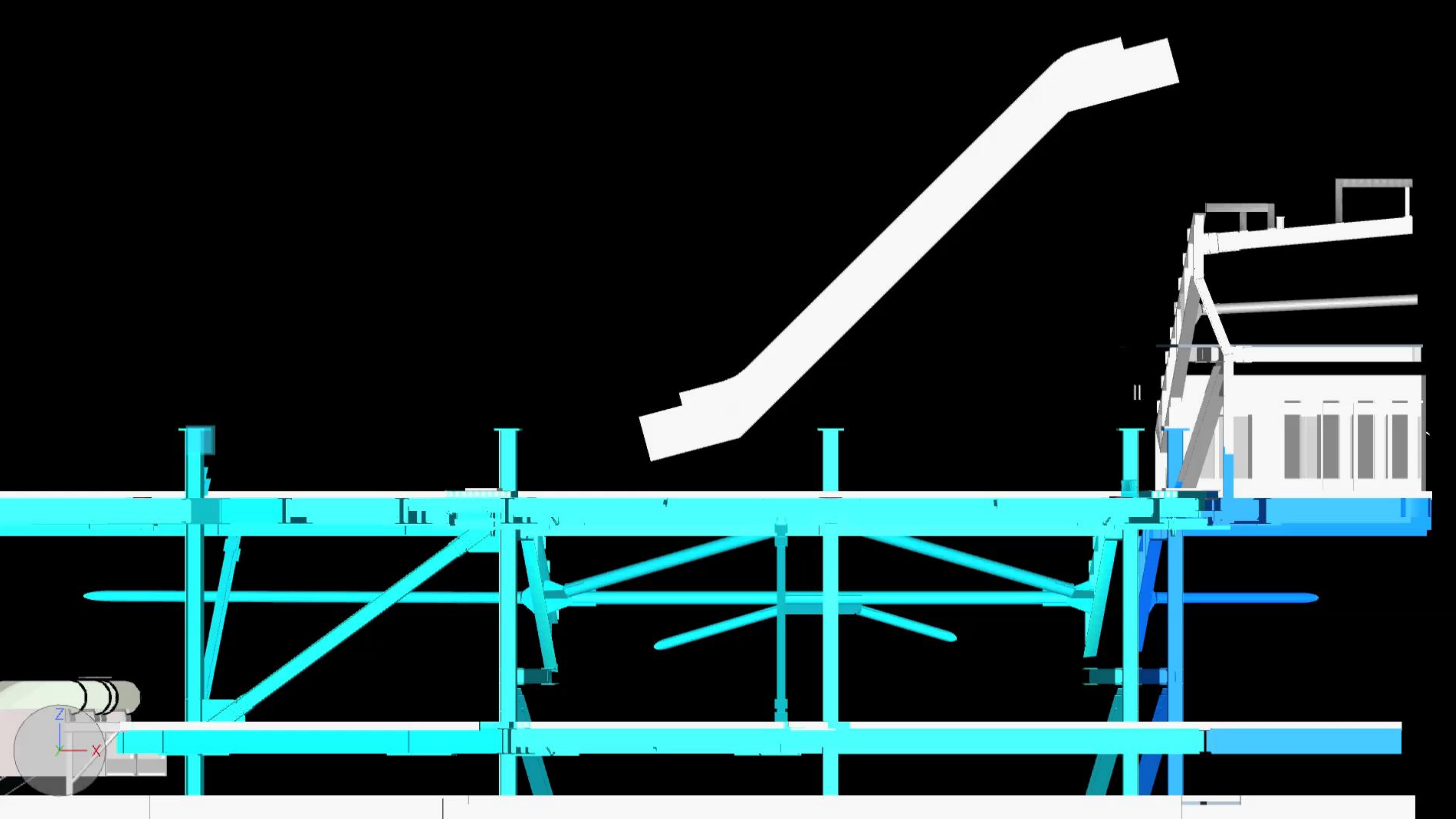
Good Luck

When You Use 3D To
Simulate That Solution:



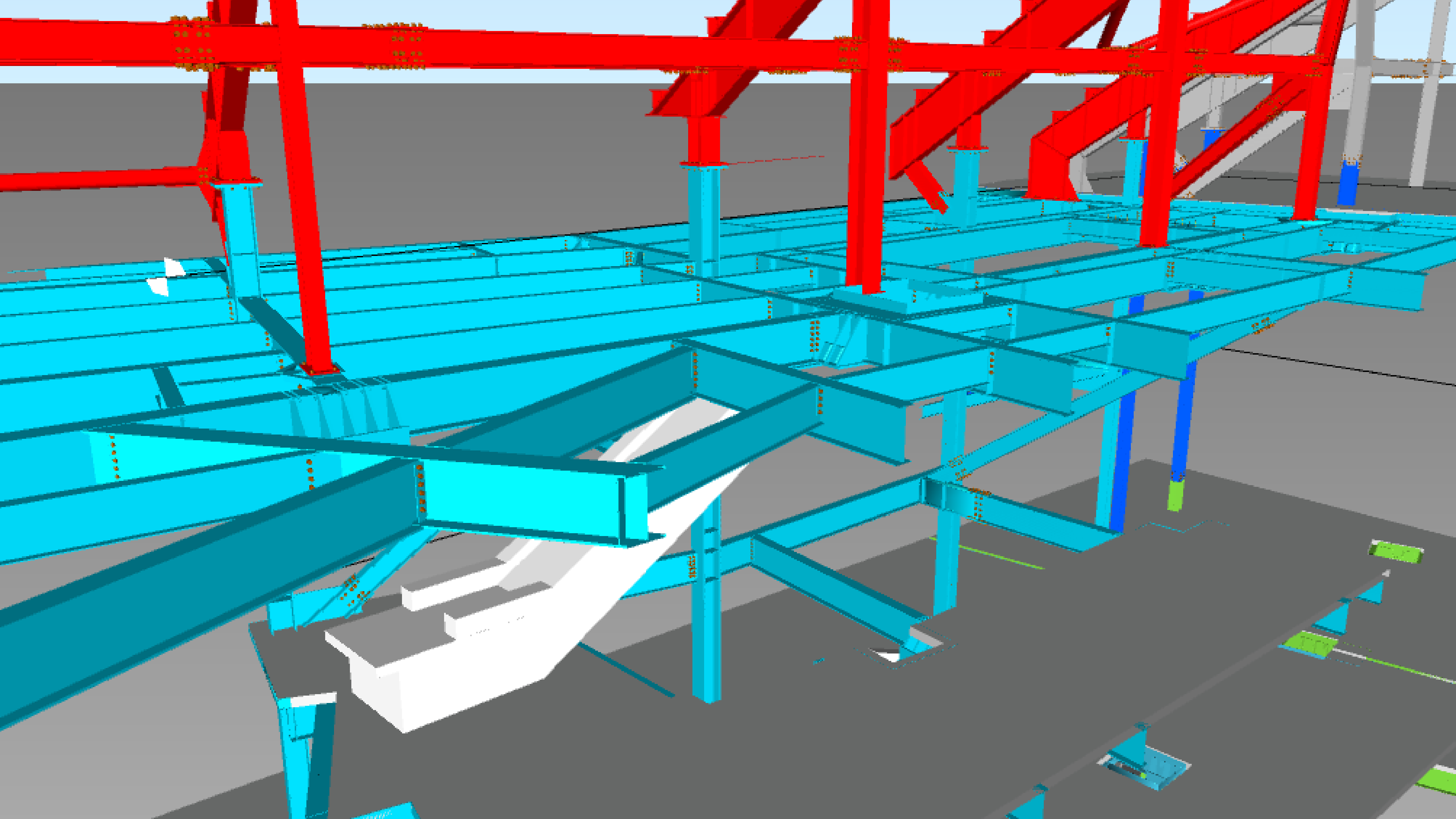
Let's Simulate A Better Plan...

Option 1: Single truss installation if
sequenced before upper steel is
erected



OR...

Option 2: Split truss installation if sequenced after upper steel (red) is erected



Equipment Routing in Revit and Navisworks

REVIT

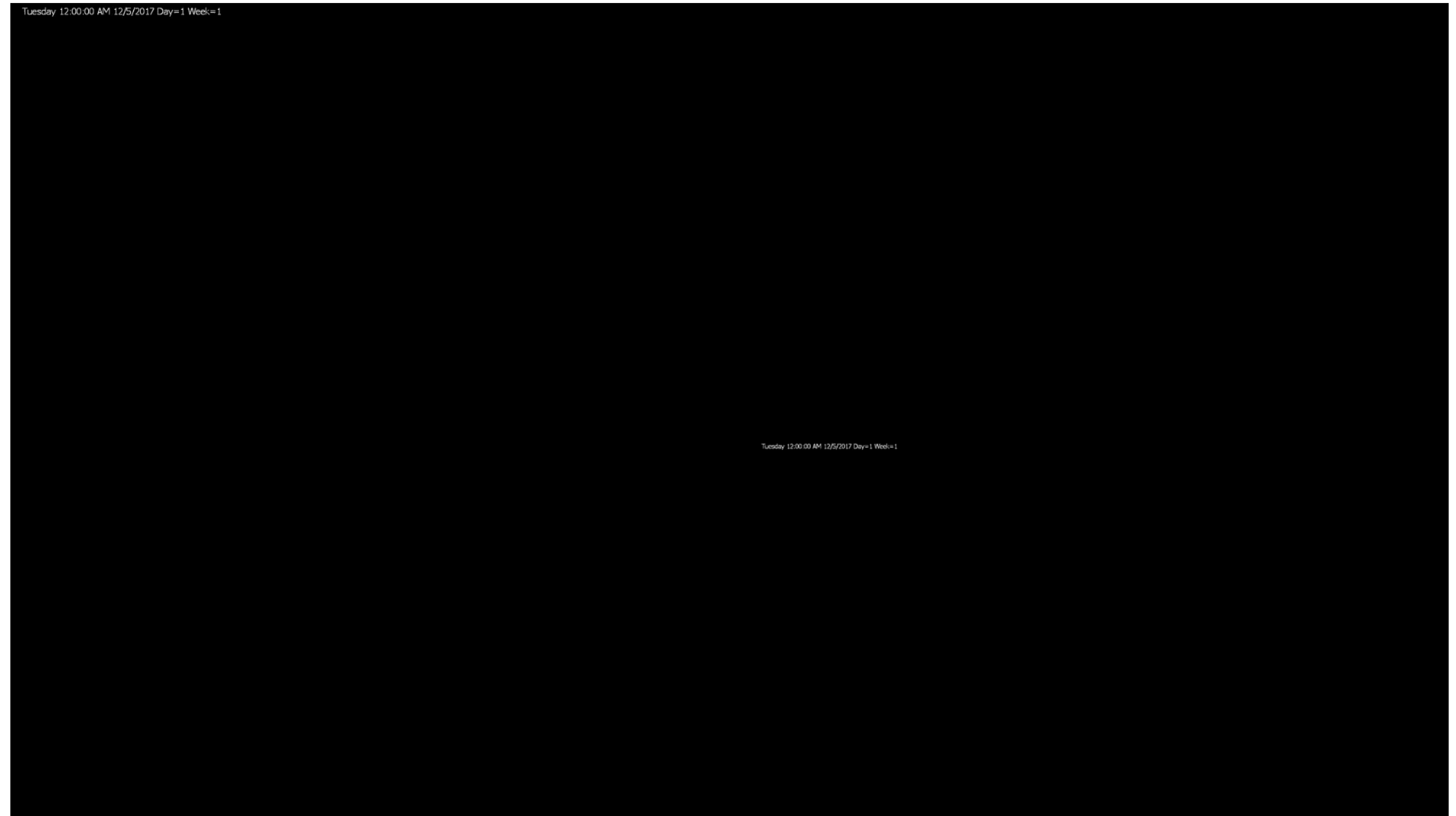
1. Use the Site logistics model as a starting point, if available.
2. Insert onsite construction equipment to be used in routing
3. If adding rigging elements to an item, use an In-Place model to generate a simplified version of the crane rigging, as necessary to more completely represent the size of the routed equipment.

NAVISWORKS

1. Move the time bar to the starting keyframe (~40 seconds in)
2. Capture a key frame – this represents the end of the animation
3. Move the time bar earlier (2-5 seconds) so now we are at the time 35 – 38 seconds
4. Choose one or more transform and move the equipment animation set to the condition representing the culmination of movement and/or visibility changes from the previous key frame.
5. Capture a key frame.
6. Repeat steps 3-5 until the position and/or visibility of the equipment animation set is in its starting position.
7. Play the animation and re-position each keyframe to achieve a pleasant speed.

Timeline Simulation

- Animation of the overall construction process and can/should include site logistics geometry and equipment routing animations.



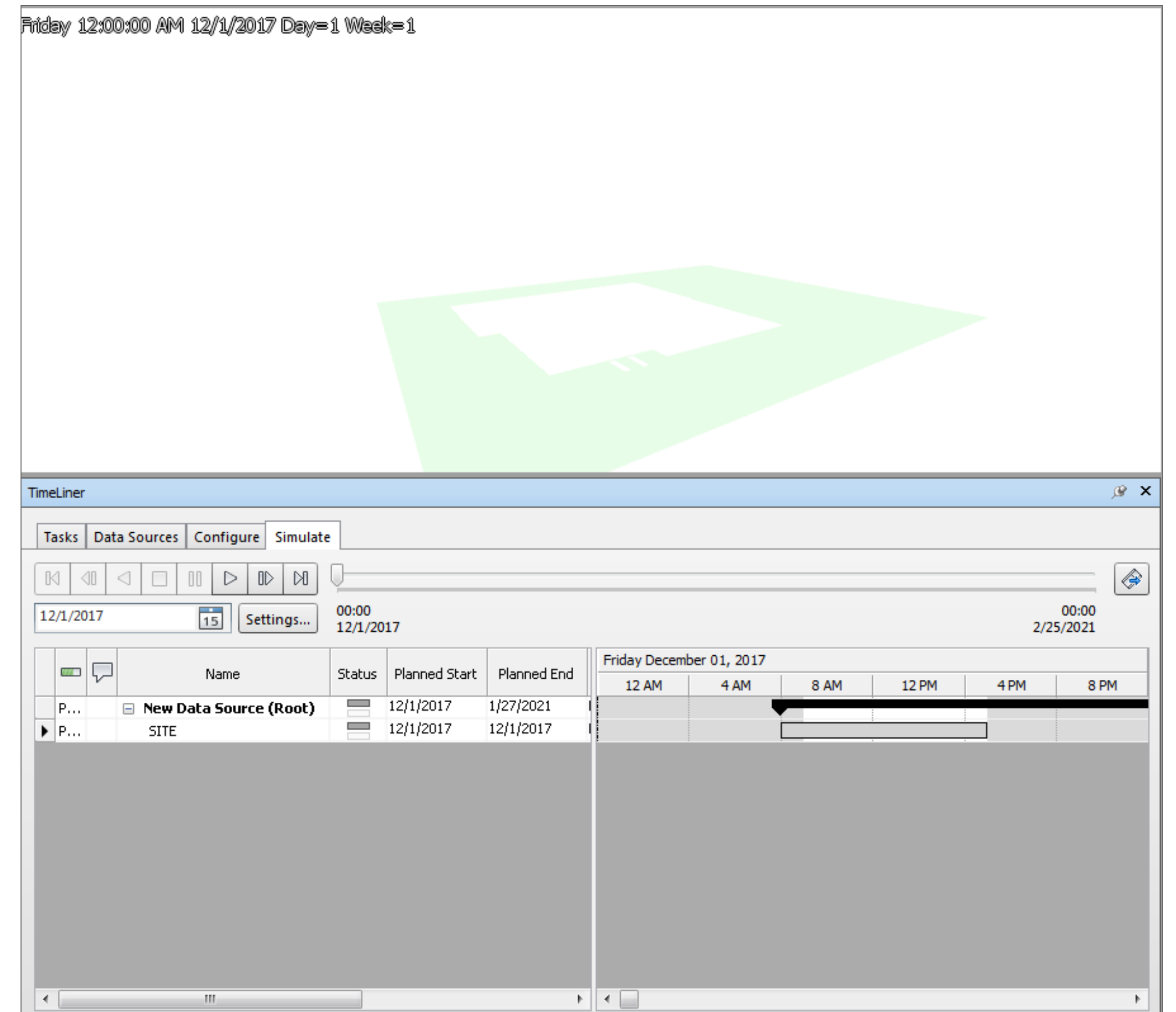
Practical Timeline Simulation

WHAT IT IS

- High level tasks representing major milestones
- Site logistics components appear as temporary tasks
- Model Text geometry representing milestones not easily communicated through equipment model geometry

WHAT IT IS NOT

- Minute-by-minute work plan that we may use internally to measure performance of an installation team
- Photorealistic animations of all elements on a construction site.



Timeline Simulation in Revit and Navisworks

REVIT

1. Working in a 4D template, use model text based component to add notes to the 4D model
2. Position the model text component outside of the building model in an easily viewed area from the standard isometric views.

NAVISWORKS

1. Create tasks
2. Add start /End dates
3. Set the Task type:
 - a) Construct – For equipment elements to be installed
 - b) Temporary – For site logistics geometry only used during construction
4. Attach selection and animation
5. Simulate to customize, preview and export the animation

An aerial photograph of a city highway with multiple lanes, surrounded by greenery and a dense urban skyline in the background under a hazy, sunset sky. The text 'Instructional Demonstrations' is overlaid in white on the left side of the image.

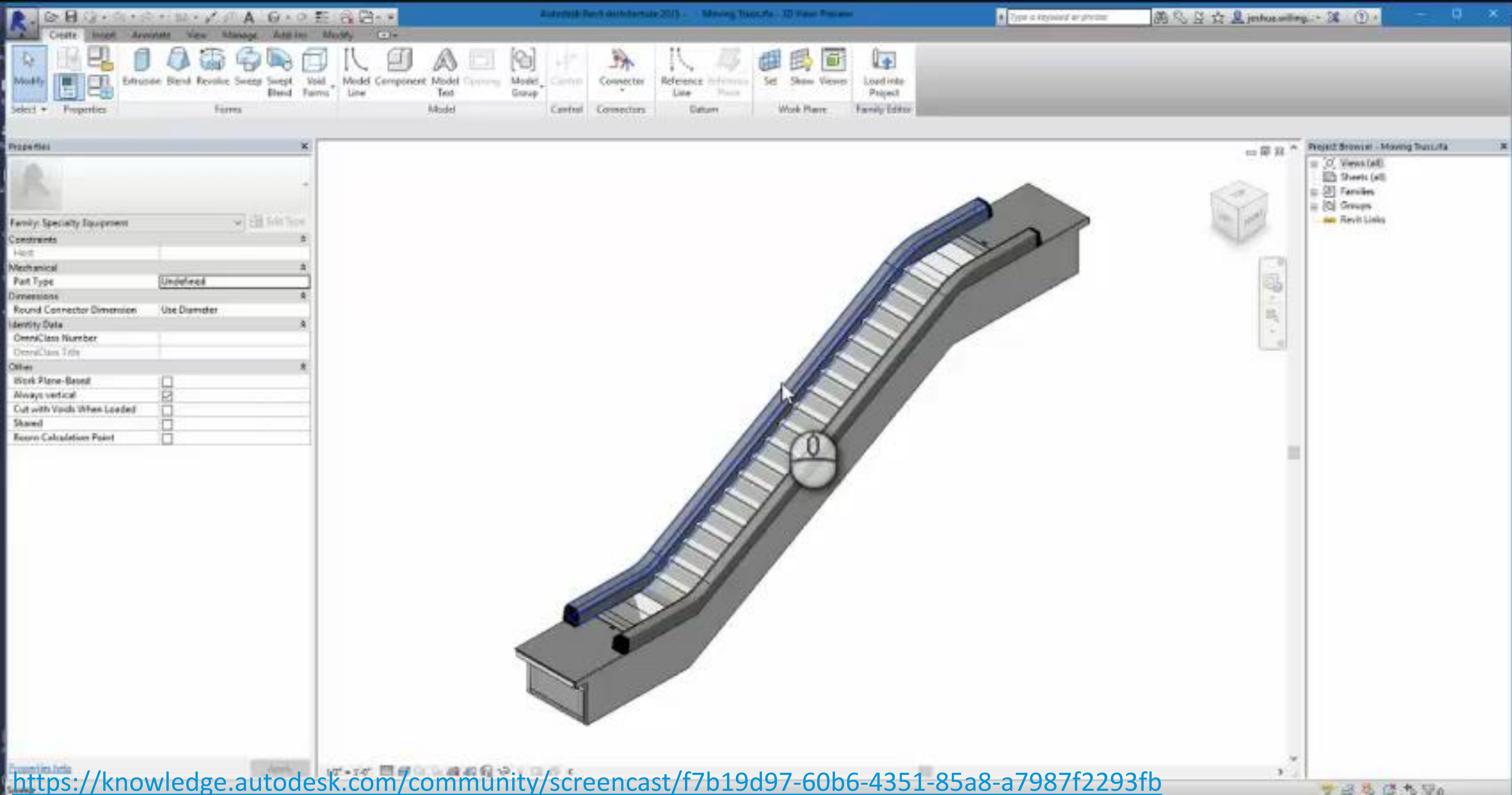
Instructional Demonstrations

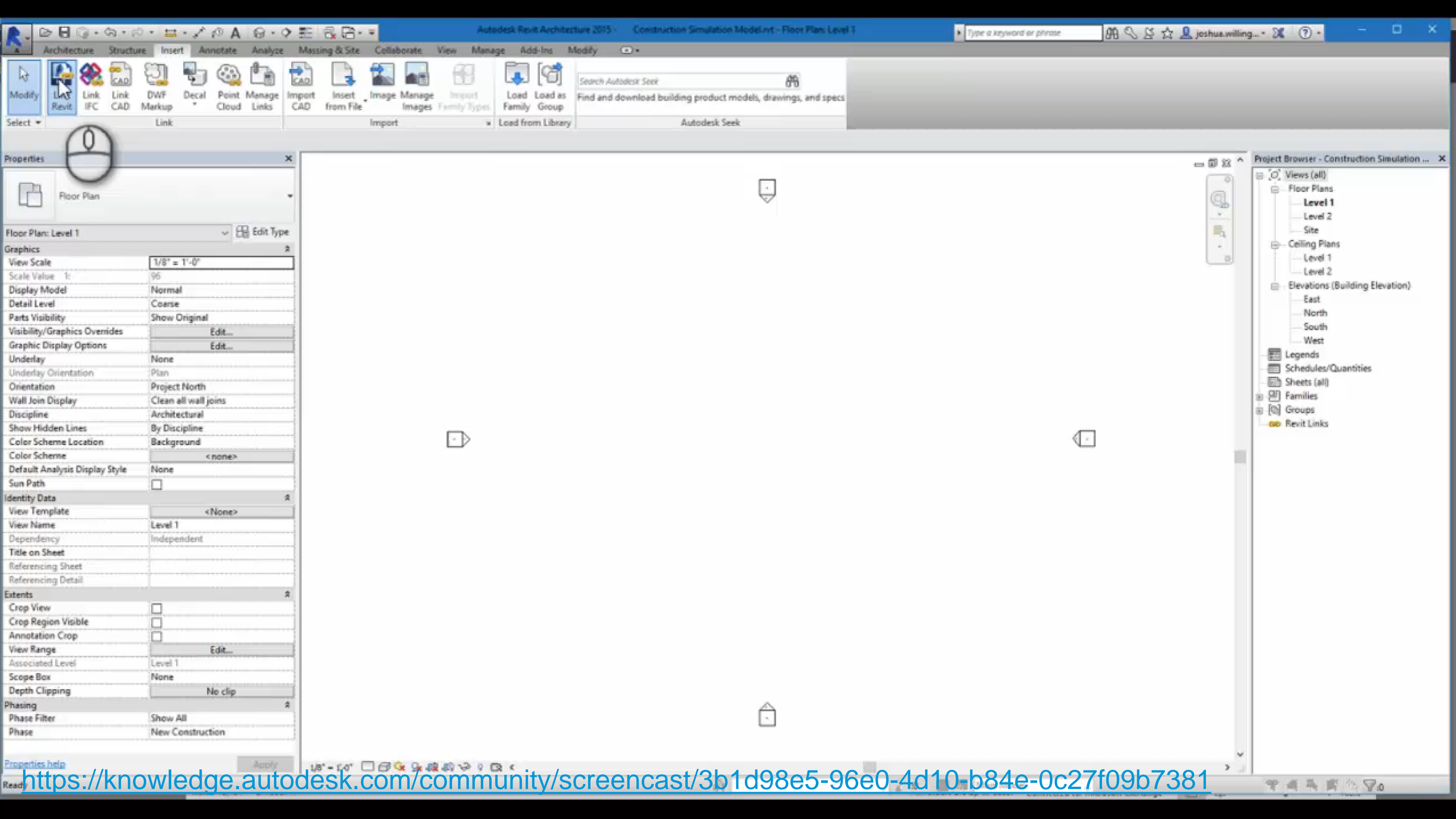
Revit 4D Project Setup

1. Creating a 4D Project File
2. Customizing the model for equipment routing
3. Placing site logistics and key milestone indicators
4. Exporting to Navisworks

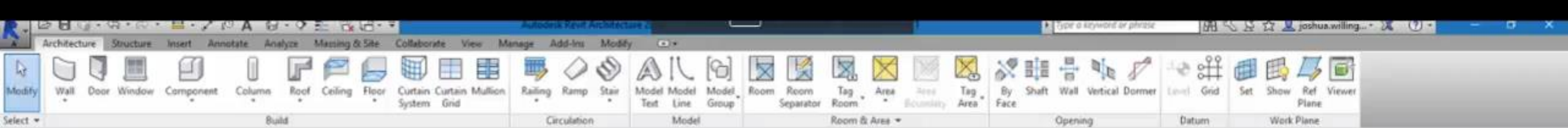
Navisworks 4D Workflows

1. Adding 4D models to Navisworks
2. Managing Viewpoints
3. Animating equipment routing
4. Creating a Construction Timeline





<https://knowledge.autodesk.com/community/screencast/3b1d98e5-96e0-4d10-b84e-0c27f09b7381>



Properties

Floor Plan

Floor Plan: Level 1

Graphics

View Scale	1/8" = 1'-0"
Scale Value 1:	96
Display Model	Normal
Detail Level	Fine
Parts Visibility	Show Original
Visibility/Graphics Overrides	Edit...
Graphic Display Options	Edit...
Underlay	None
Underlay Orientation	Plan
Orientation	Project North
Wall Join Display	Clean all wall joins
Discipline	Architectural
Show Hidden Lines	By Discipline
Color Scheme Location	Background
Color Scheme	<none>
Default Analysis Display Style	None
Sun Path	<input type="checkbox"/>

Identity Data

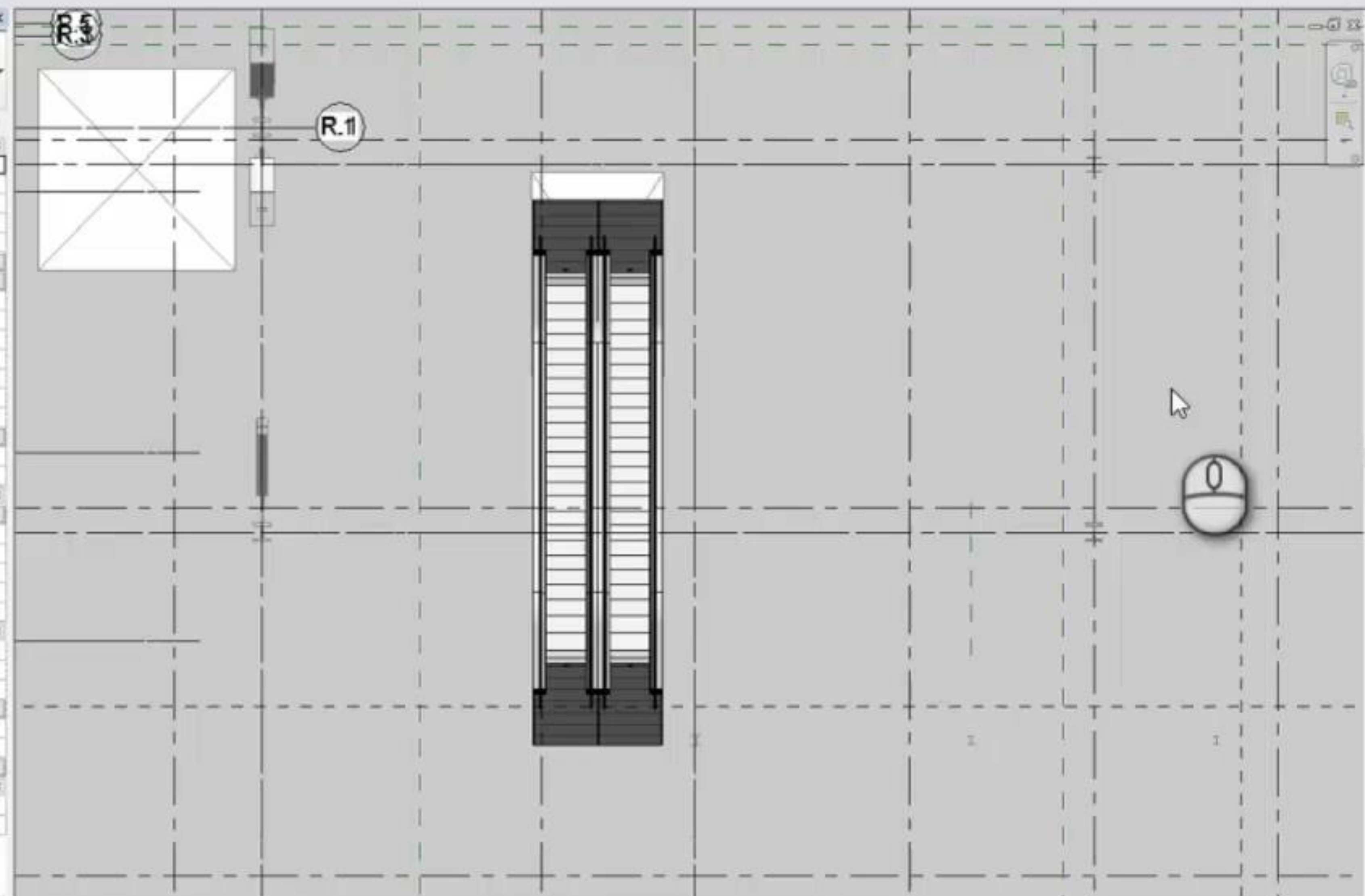
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View Name	Level 1
Dependency	Independent
Title on Sheet	
Referencing Sheet	
Referencing Detail	

Extents

Crop View	<input type="checkbox"/>
Crop Region Visible	<input type="checkbox"/>
Annotation Crop	<input type="checkbox"/>
View Range	Edit...
Associated Level	Level 1
Scope Box	None
Depth Clipping	No clip

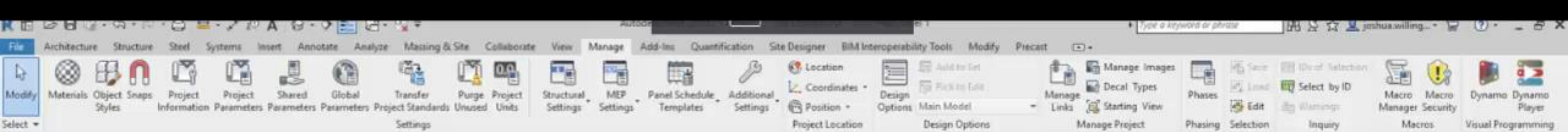
Phasing

Phase Filter	Show All
Phase	New Construction



Project Browser - Construction Simulation ...

- Views (all)
- Floor Plans
 - Level 1
 - Level 2
- 3D Views
- Elevations (Building Elevation)
 - East
 - North
 - South
 - West
- Legends
- Schedules/Quantities
- Sheets (all)
- Families
- Groups
- Revit Links

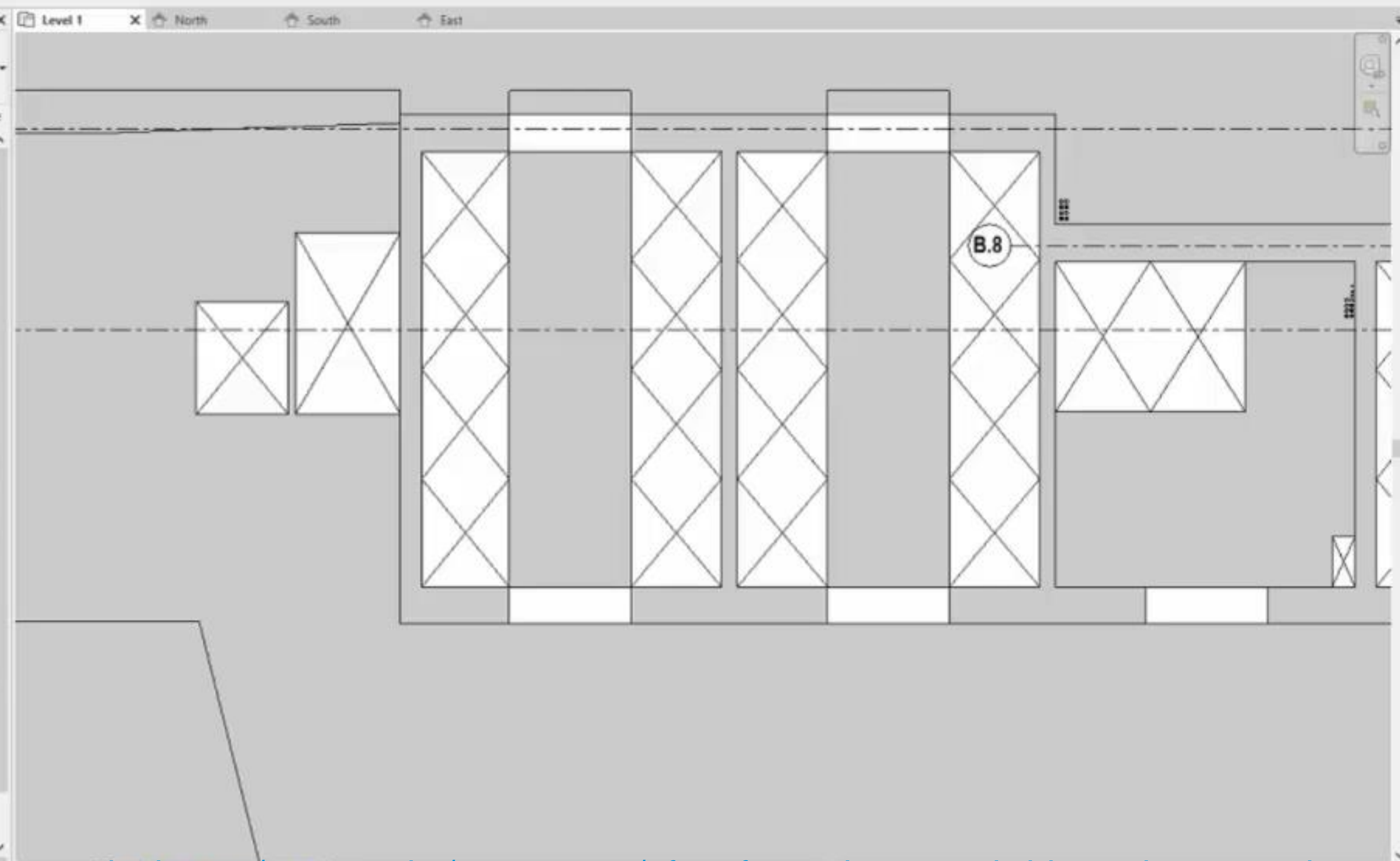


Properties

Floor Plan

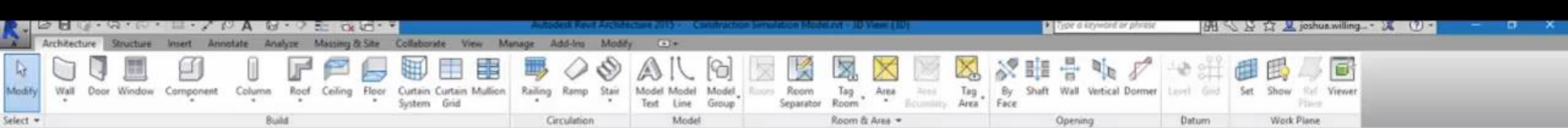
Floor Plan: Level 1

Graphics	
View Scale	1/8" = 1'-0"
Scale Value	1: 96
Display Model	Normal
Detail Level	Fine
Parts Visibility	Show Original
Visibility/Graphics Ove...	Edit...
Graphic Display Options	Edit...
Orientation	Project North
Wall Join Display	Clean all wall joins
Discipline	Architectural
Show Hidden Lines	By Discipline
Color Scheme Location	Background
Color Scheme	<none>
System Color Schemes	Edit...
Default Analysis Displa...	None
Sun Path	<input type="checkbox"/>
Underlay	
Range: Base Level	None
Range: Top Level	Unbounded
Underlay Orientation	Look down
Extents	
Crop View	<input type="checkbox"/>
Crop Region Visible	<input type="checkbox"/>
Annotation Crop	<input type="checkbox"/>
View Range	Edit...
Associated Level	Level 1
Scope Box	None
Depth Clipping	No clip
Identity Data	
View Template	<None>
View Name	Level 1
Dependency	Independent
Title on Sheet	
Referencing Sheet	
Referencing Detail	
Phasing	
Phase Filter	Show All
Phase	New Construction

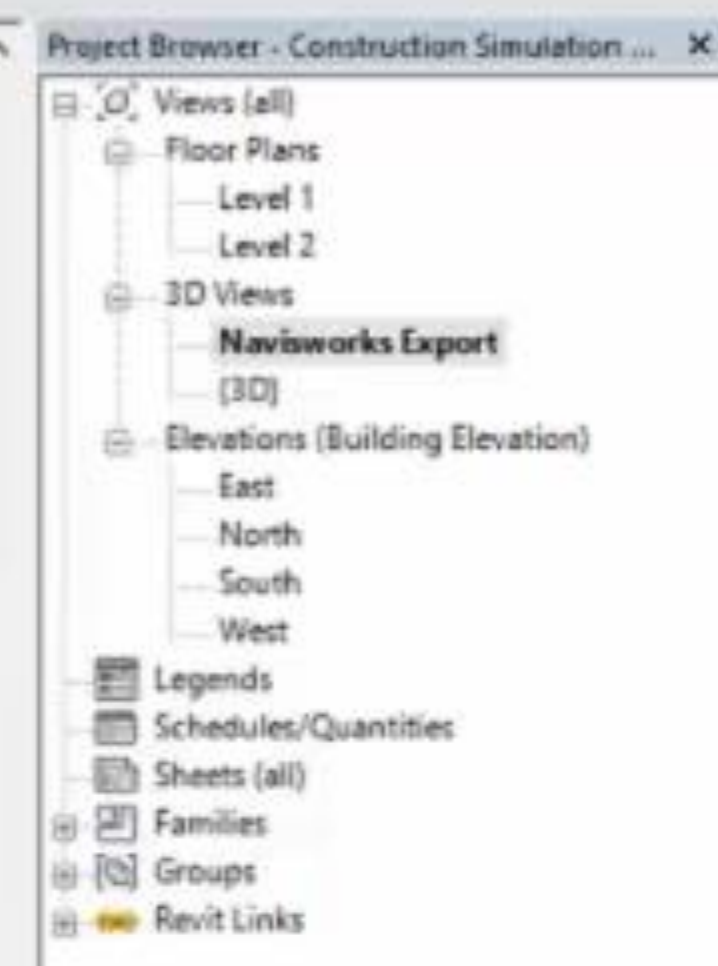
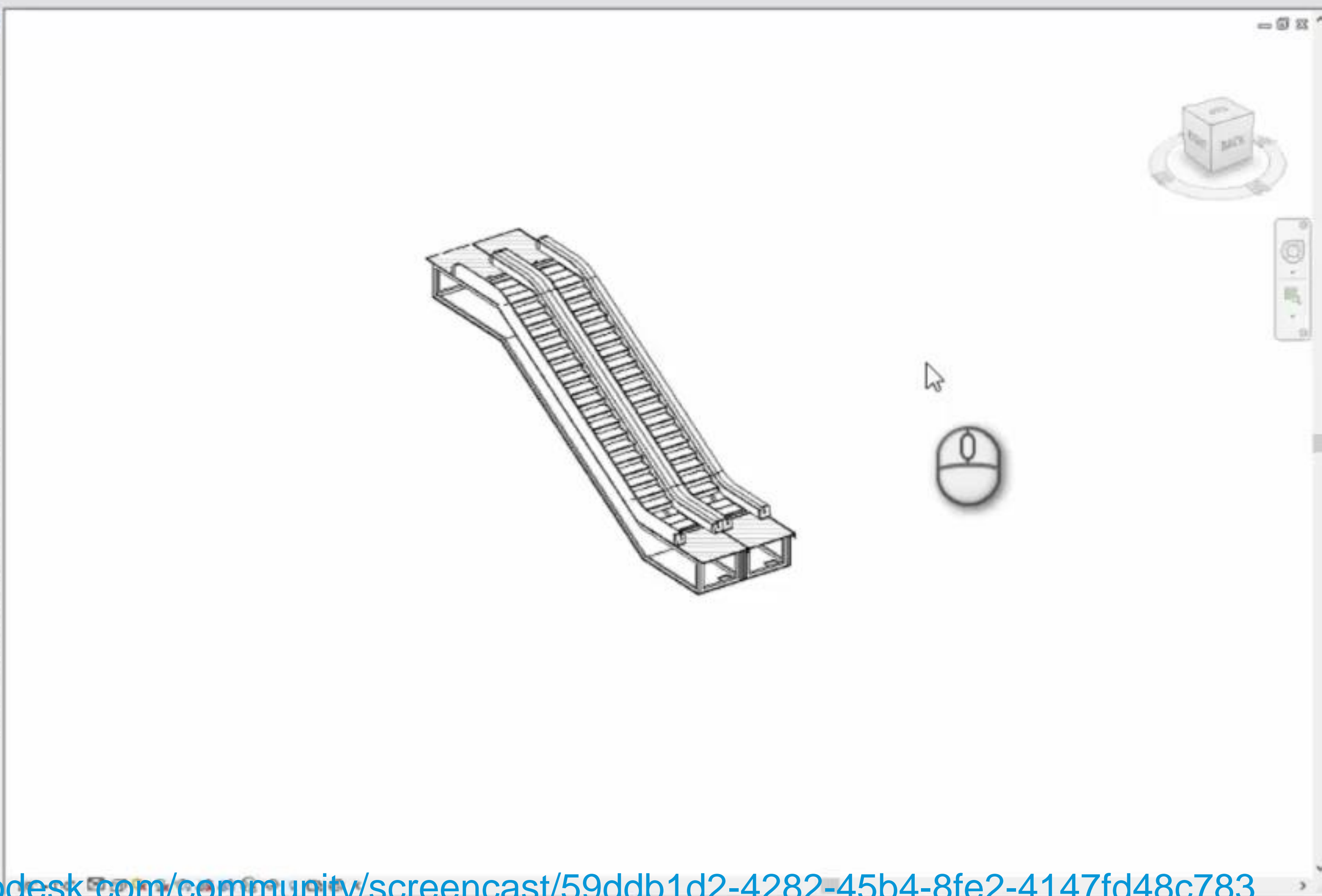


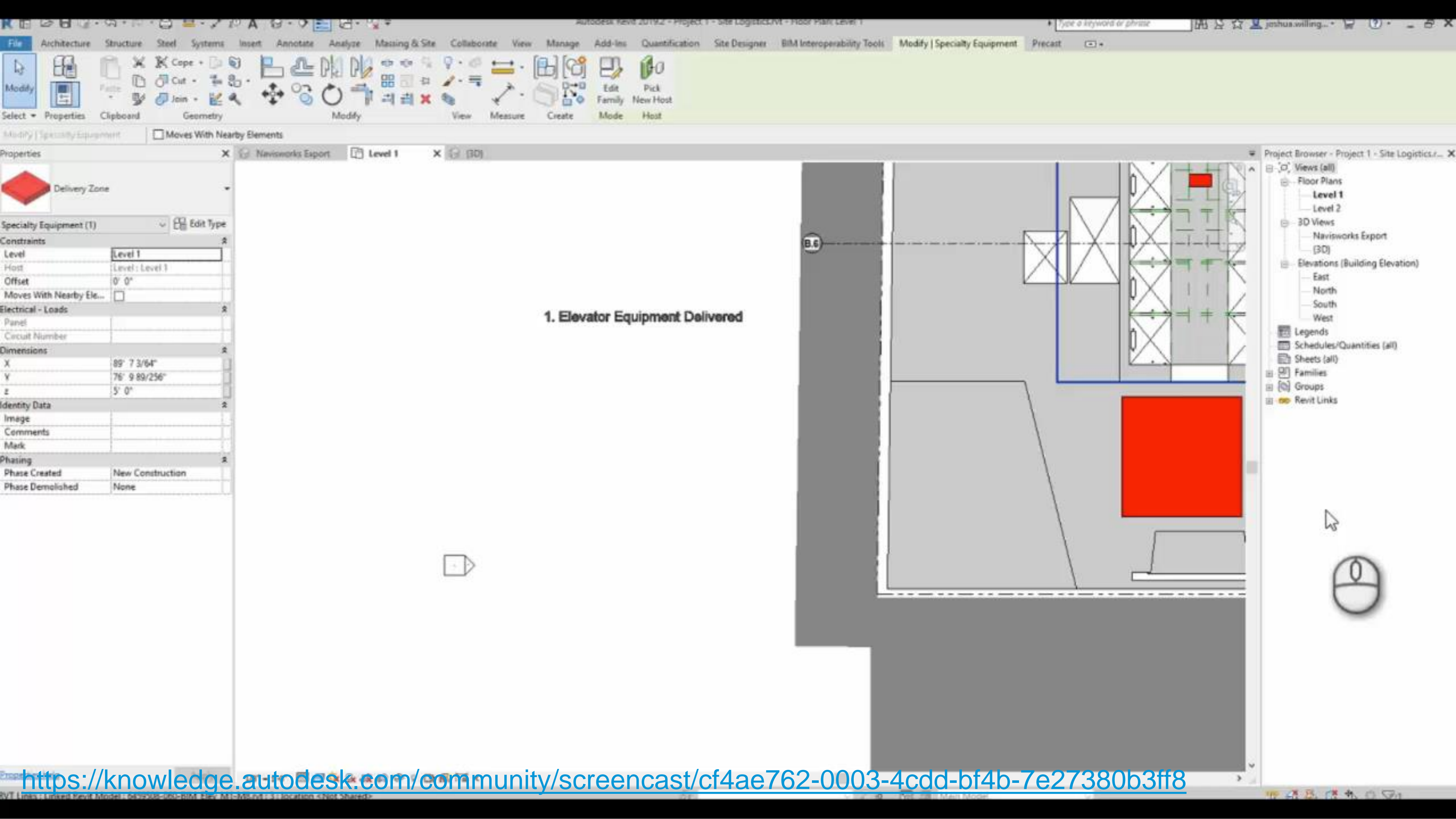
Project Browser - Project 1 - Site Logistics...

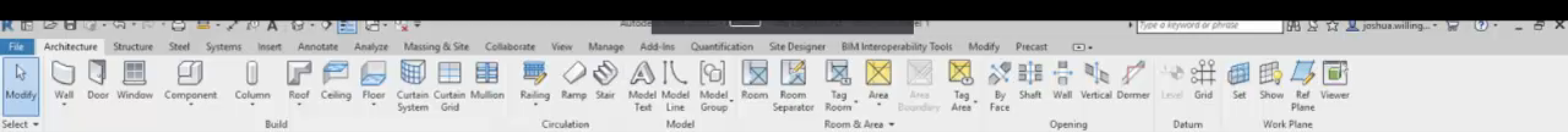
- Views (all)
- Floor Plans
 - Level 1
 - Level 2
- Elevations (Building Elevation)
 - East
 - North
 - South
 - West
- Legends
- Schedules/Quantities (all)
- Sheets (all)
- Families
- Groups
- Revit Links



Properties	
3D View	
3D View: Navisworks Export	
Graphics	
View Scale	1/8" = 1'-0"
Scale Value 1:	96
Detail Level	Medium
Parts Visibility	Show Original
Visibility/Graphics Overrides	Edit...
Graphic Display Options	Edit...
Discipline	Architectural
Show Hidden Lines	By Discipline
Default Analysis Display Style	None
Sun Path	<input type="checkbox"/>
Identity Data	
View Template	<None>
View Name	Navisworks Export
Dependency	Independent
Title on Sheet	
Extents	
Crop View	<input type="checkbox"/>
Crop Region Visible	<input type="checkbox"/>
Annotation Crop	<input type="checkbox"/>
Far Clip Active	<input type="checkbox"/>
Section Box	<input type="checkbox"/>
Camera	
Rendering Settings	
Locked Orientation	<input type="checkbox"/>
Perspective	<input type="checkbox"/>
Eye Elevation	75' 11 125/128"
Target Elevation	60' 4 35/64"
Camera Position	Adjusting
Phasing	
Phase Filter	Show All
Phase	New Construction

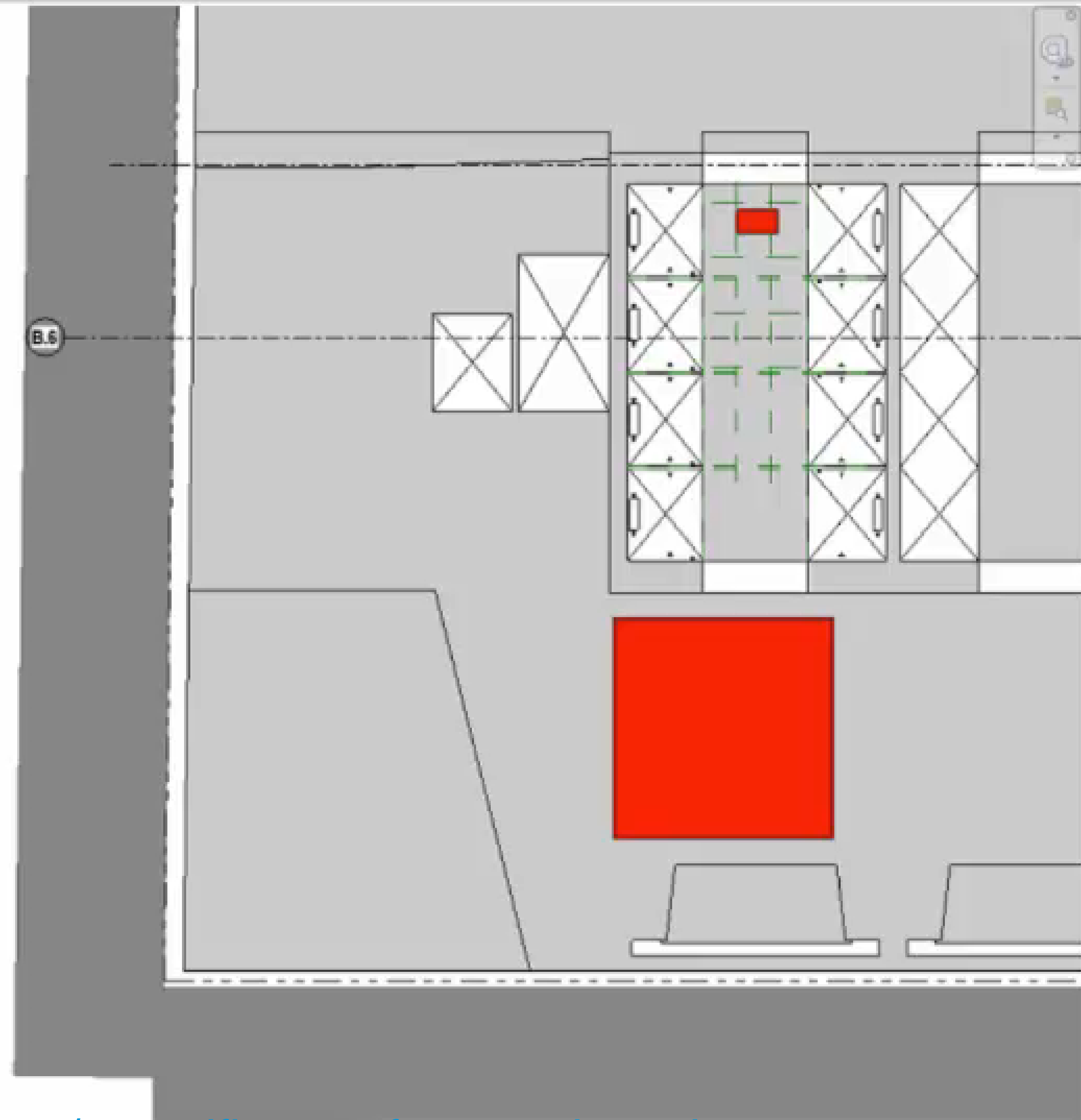






Graphics	
View Scale	1/8" = 1'-0"
Scale Value	1:96
Display Model	Normal
Detail Level	Fine
Parts Visibility	Show Original
Visibility/Graphics Over...	Edit...
Graphic Display Options	Edit...
Orientation	Project North
Wall Join Display	Clean all wall joins
Discipline	Architectural
Show Hidden Lines	By Discipline
Color Scheme Location	Background
Color Scheme	<none>
System Color Schemes	Edit...
Default Analysis Displa...	None
Sun Path	<input type="checkbox"/>
Underlay	
Range: Base Level	None
Range: Top Level	Unbounded
Underlay Orientation	Look down
Extents	
Crop View	<input type="checkbox"/>
Crop Region Visible	<input type="checkbox"/>
Annotation Crop	<input type="checkbox"/>
View Range	Edit...
Associated Level	Level 1
Scope Box	None
Depth Clipping	No clip
Identity Data	
View Template	<None>
View Name	Level 1
Dependency	Independent
Title on Sheet	
Referencing Sheet	
Referencing Detail	
Phasing	
Phase Filter	Show All
Phase	New Construction

1. Elevator Equipment Delivered
2. Pit Work Starts
3. Elevator Tops Out
4. Control Room Complete
5. Elevator Group Complete

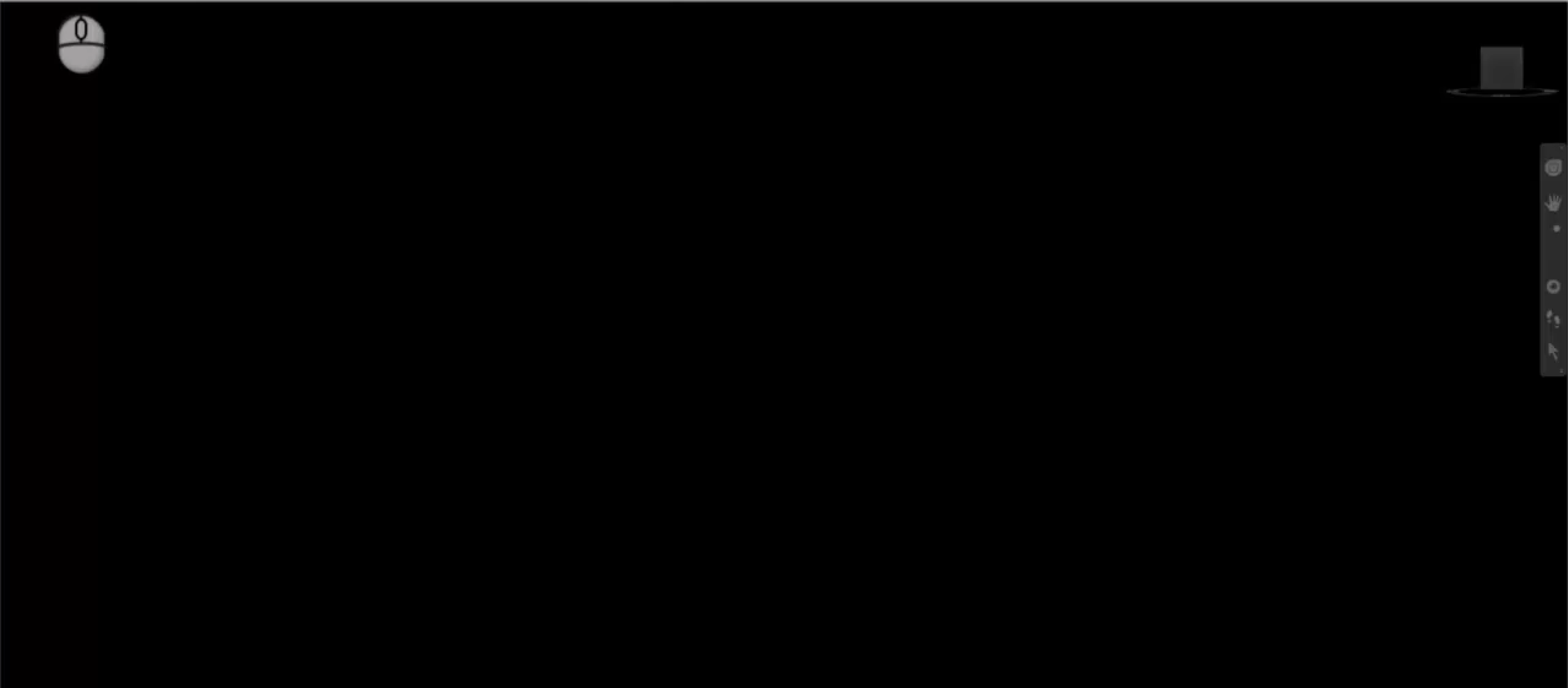


Project Browser - Project 1 - Site Logistics...	
Views (all)	
Floor Plans	
Level 1	
Level 2	
3D Views	
Navisworks Export [3D]	
Elevations (Building Elevation)	
East	
North	
South	
West	
Legends	
Schedules/Quantities (all)	
Sheets (all)	
Families	
Groups	
Revit Links	

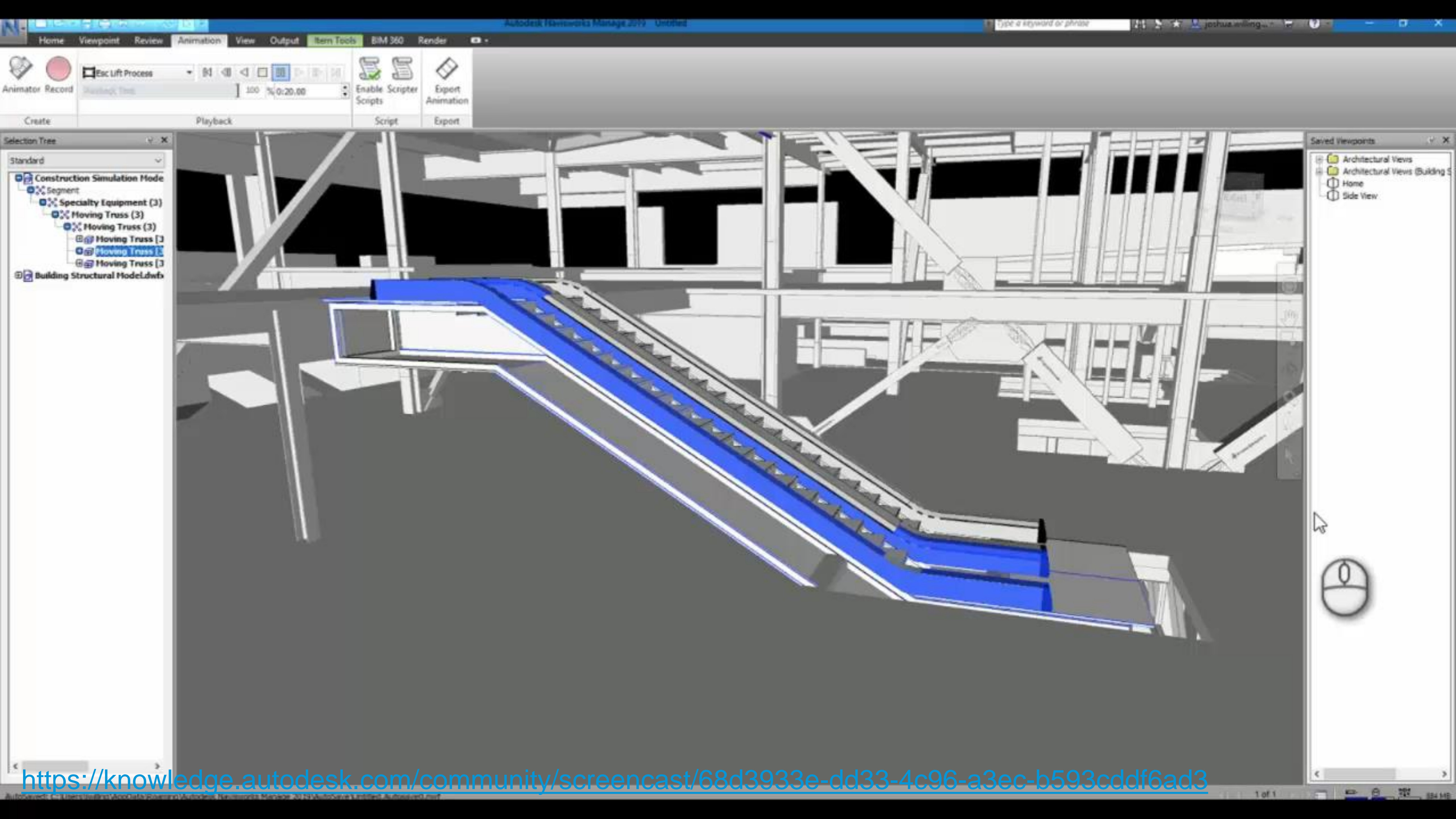
Autodesk Navisworks Manage 2019 - Untitled

Home Viewpoint Review Animation View Output BIM 360 Render

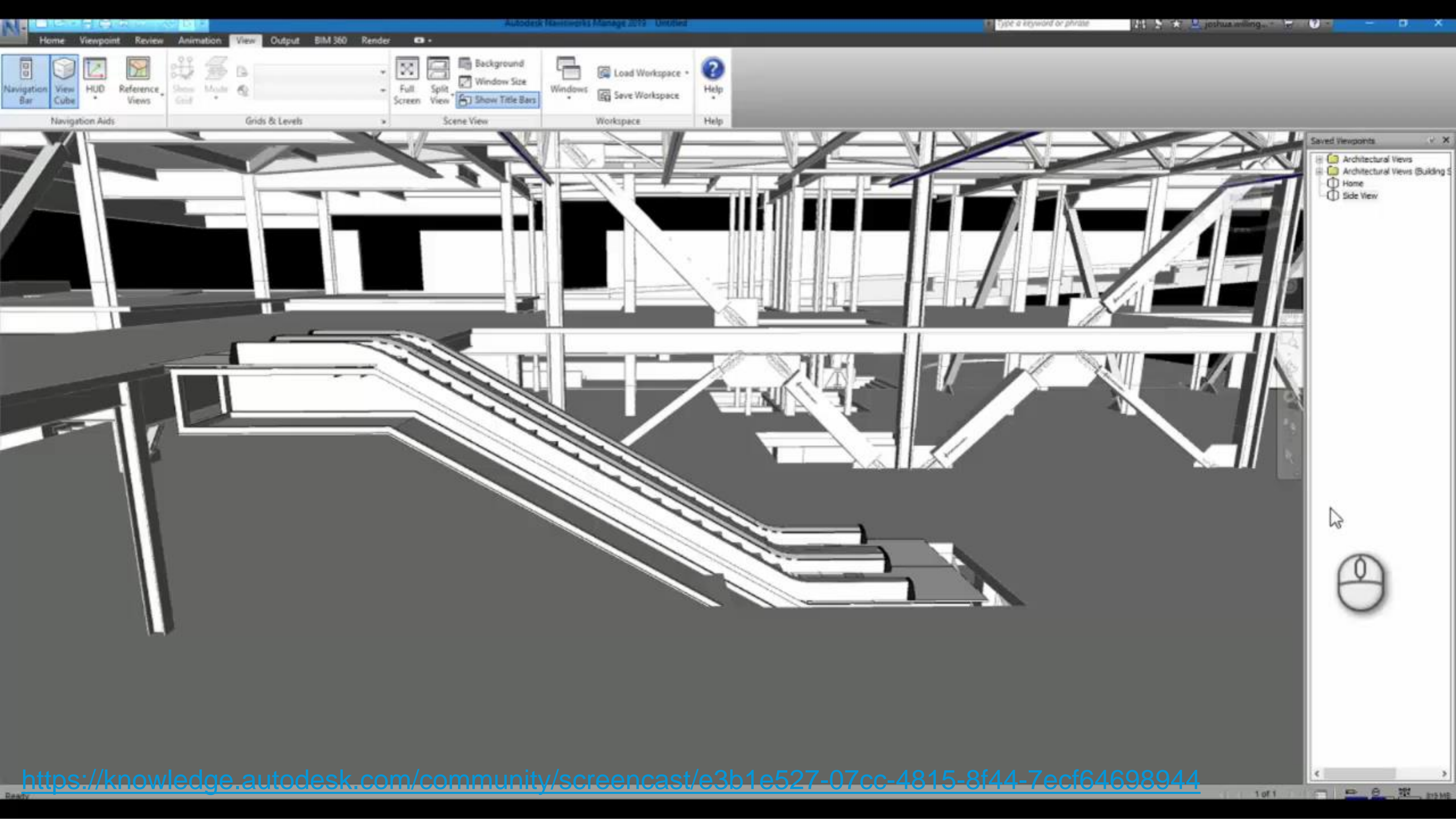
Navigation Bar View Cube HUD Reference Views Show Grid Mode Grids & Levels Full Screen Split View Show Title Bars Background Window Size Windows Load Workspace Save Workspace Help



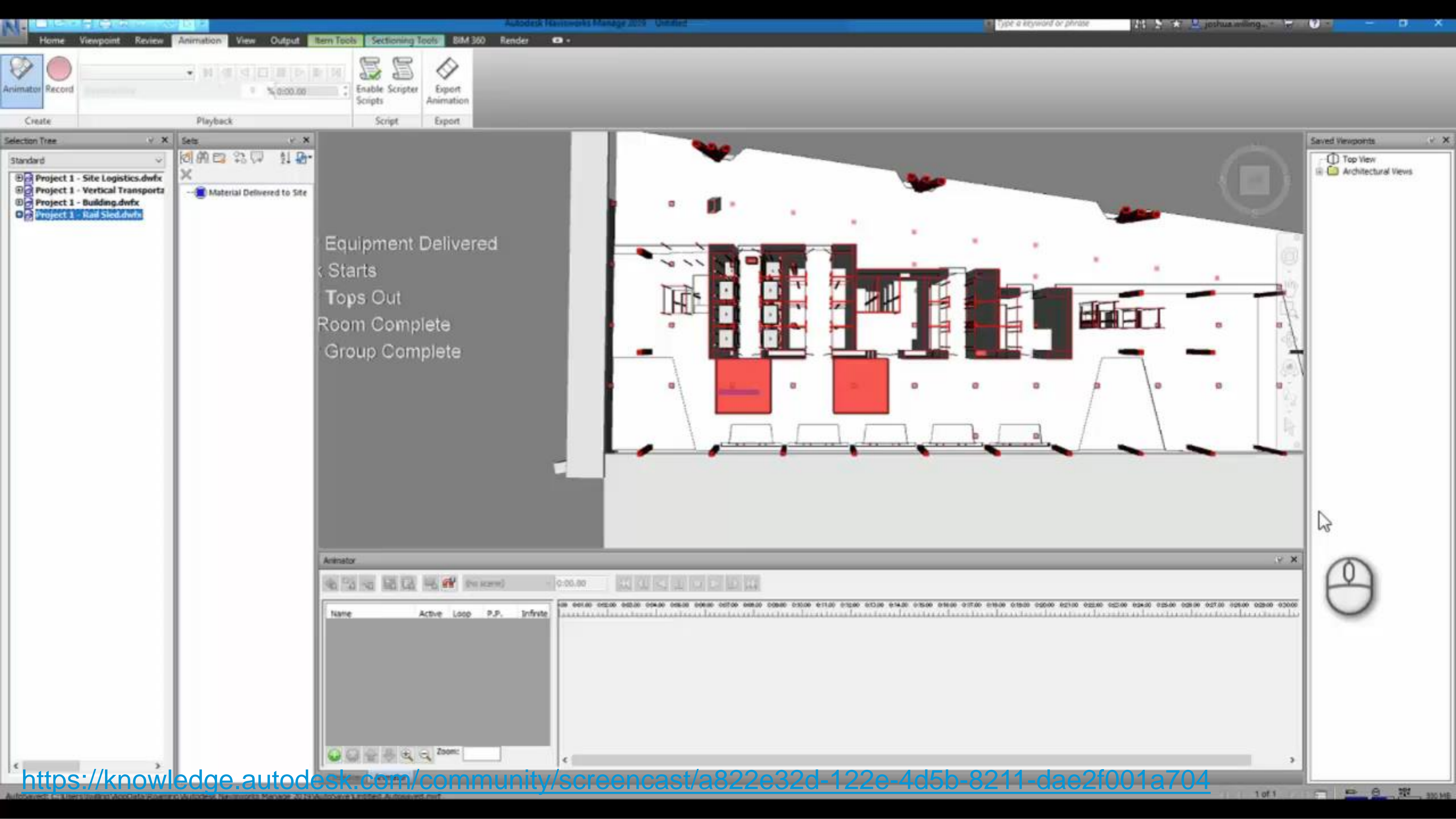
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<https://knowledge.autodesk.com/community/screencast/68d3933e-dd33-4c96-a3ec-b593cddf6ad3>



<https://knowledge.autodesk.com/community/screencast/e3b1e527-07cc-4815-8f44-7ecf64698944>



Selection Tree

- Standard
- Project 1 - Site Logistics.dwg
- Project 1 - Vertical Transport.dwg
- Project 1 - Building.dwg
- Project 1 - Rail Sled.dwg

Sets

- Material Delivered to Site

Equipment Delivered
Starts
Tops Out
Room Complete
Group Complete



Saved Viewports

- Top View
- Architectural Views

Animator

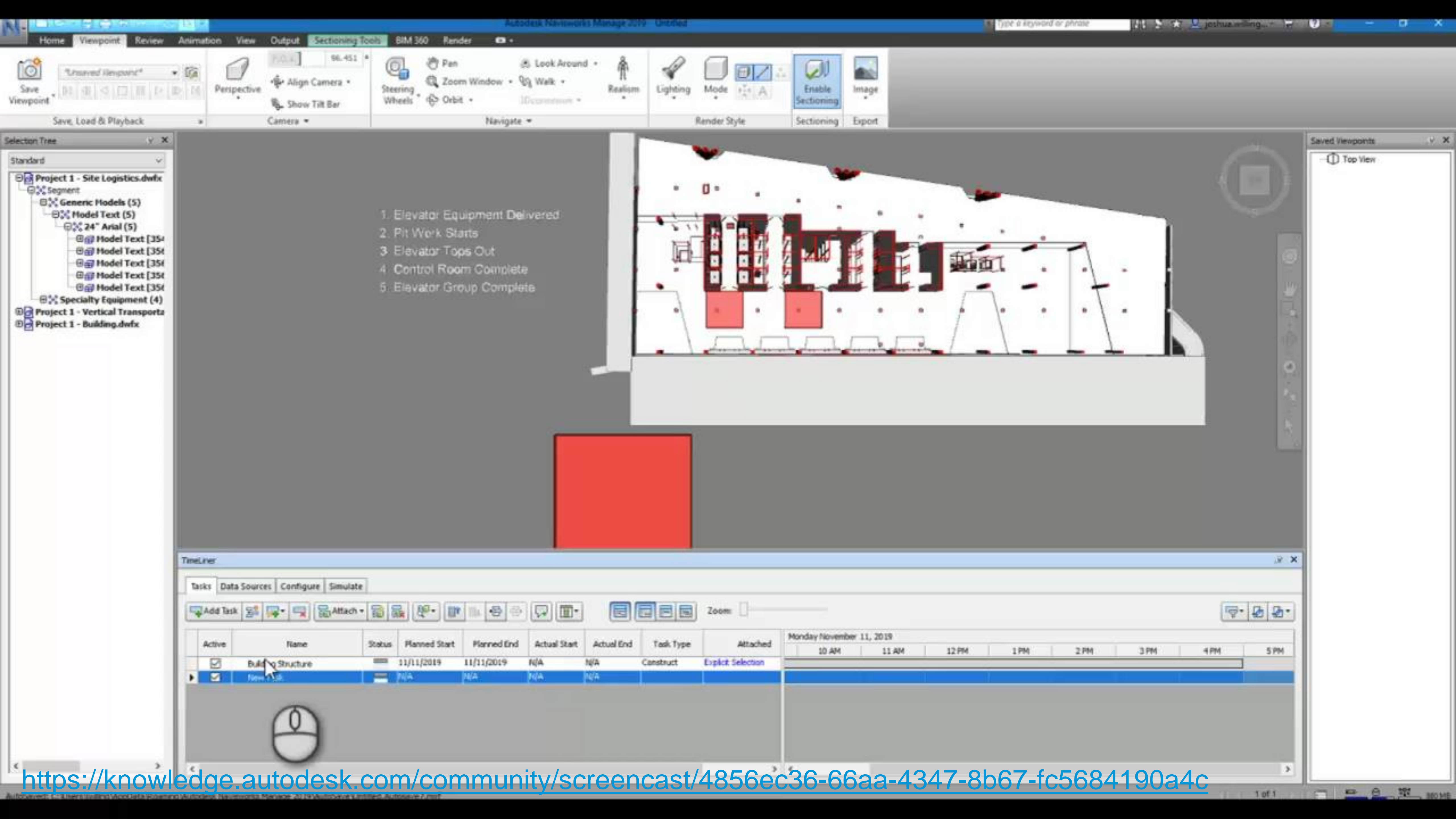
(No scene) 0:00.00

Name	Active	Loop	P.P.	Infinite

Timeline: 00:00.00 00:02.00 00:04.00 00:06.00 00:08.00 00:10.00 00:12.00 00:14.00 00:16.00 00:18.00 00:20.00 00:22.00 00:24.00 00:26.00 00:28.00 00:30.00

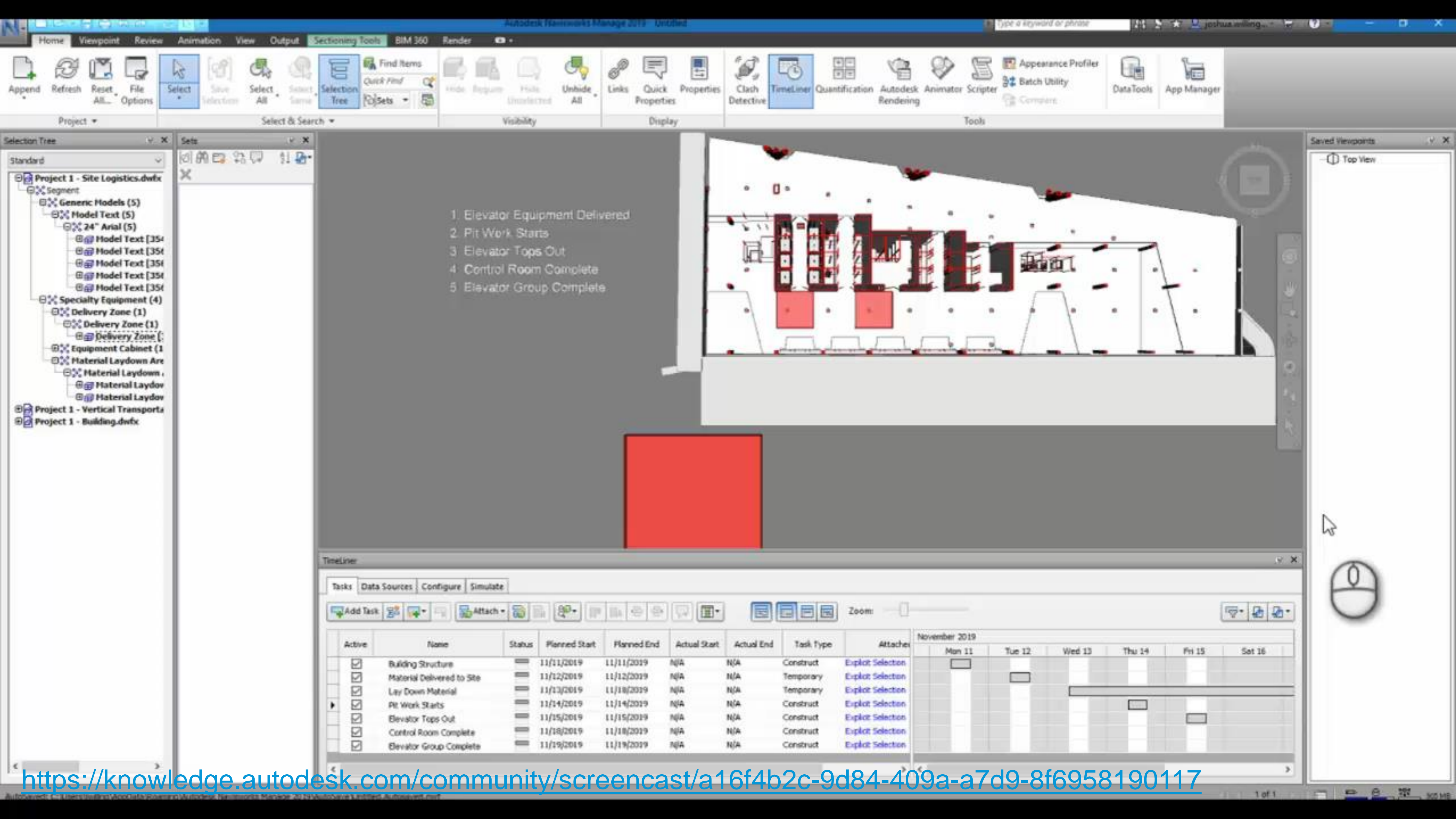
Zoom: [input field]

<https://knowledge.autodesk.com/community/screencast/a822e32d-122e-4d5b-8211-dae2f001a704>



1. Elevator Equipment Delivered
2. Pit Work Starts
3. Elevator Tops Out
4. Control Room Complete
5. Elevator Group Complete

Tasks									Monday November 11, 2019							
Active	Name	Status	Planned Start	Planned End	Actual Start	Actual End	Task Type	Attached	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM
<input checked="" type="checkbox"/>	Build Structure	■	11/11/2019	11/11/2019	N/A	N/A	Construct	Explicit Selection								
<input checked="" type="checkbox"/>	Install...	■	N/A	N/A	N/A	N/A										



1. Elevator Equipment Delivered
2. Pit Work Starts
3. Elevator Tops Out
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5. Elevator Group Complete

TimeLiner

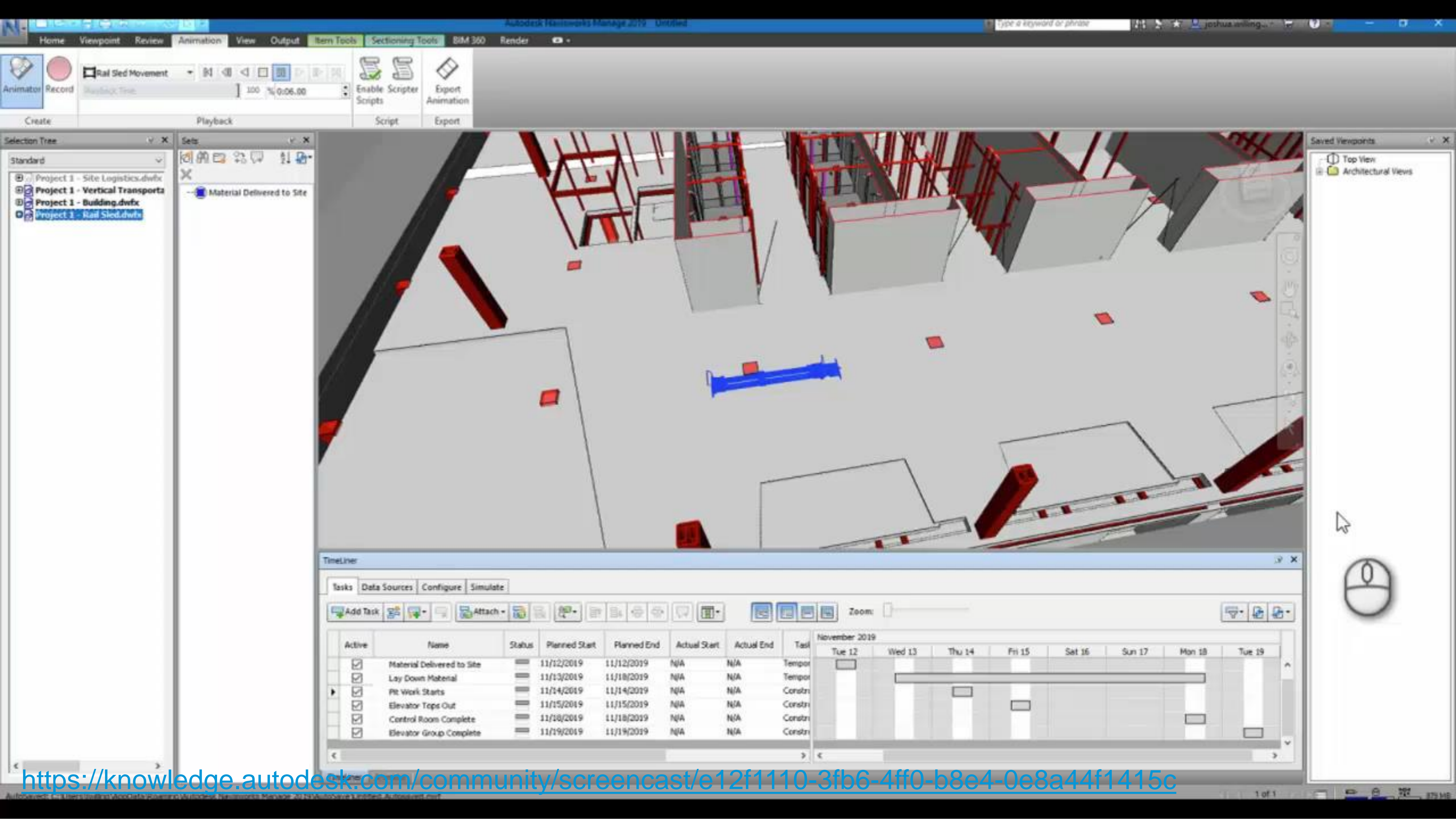
Tasks | Data Sources | Configure | Simulate

Add Task | Attach | Zoom: [Slider]

Active	Name	Status	Planned Start	Planned End	Actual Start	Actual End	Task Type	Attacher
<input checked="" type="checkbox"/>	Building Structure	Complete	11/11/2019	11/11/2019	N/A	N/A	Construct	Explicit Selection
<input checked="" type="checkbox"/>	Material Delivered to Site	Complete	11/12/2019	11/12/2019	N/A	N/A	Temporary	Explicit Selection
<input checked="" type="checkbox"/>	Lay Down Material	Complete	11/13/2019	11/18/2019	N/A	N/A	Temporary	Explicit Selection
<input checked="" type="checkbox"/>	Pit Work Starts	Complete	11/14/2019	11/14/2019	N/A	N/A	Construct	Explicit Selection
<input checked="" type="checkbox"/>	Elevator Tops Out	Complete	11/15/2019	11/15/2019	N/A	N/A	Construct	Explicit Selection
<input checked="" type="checkbox"/>	Control Room Complete	Complete	11/18/2019	11/18/2019	N/A	N/A	Construct	Explicit Selection
<input checked="" type="checkbox"/>	Elevator Group Complete	Complete	11/19/2019	11/19/2019	N/A	N/A	Construct	Explicit Selection

November 2019

Mon 11 | Tue 12 | Wed 13 | Thu 14 | Fri 15 | Sat 16



<https://knowledge.autodesk.com/community/screencast/e12f1110-3fb6-4ff0-b8e4-0e8a44f1415c>

Practical 4D – Building The Digital Construction Site

Project Timeline
Simulation

Include Delivery staging and onsite material storage (Temporary task type) + include equipment routing animation in timeline task

Equipment Routing Animations

Use Delivery staging and onsite material storage from Site Logistics Model In Equipment Routing Animations

Site Logistics Models

What's Next?

4D Construction Digital Twin

Simulative Planning

- Space planning the construction site
- Starts with Site logistics modeling
- Computational solving similar to building program optimization

Real-time feedback

- 3D virtual model container for vast and growing sensor data
- Reality capture provide spatial progress data to update/compare 3D virtual model
- Foundation of operational digital twin

Parting Thoughts

Expect BIM
Coordination from
elevator/escalator
contractor

Consider value of all
trades modeling
construction-time
requirements

Include 4D project
requirements for
specific use cases
(e.g. large
equipment routing)

Thank you.

Ken Flannigan

Global BIM Solution Owner, KONE

Kenneth.Flannigan@kone.com

