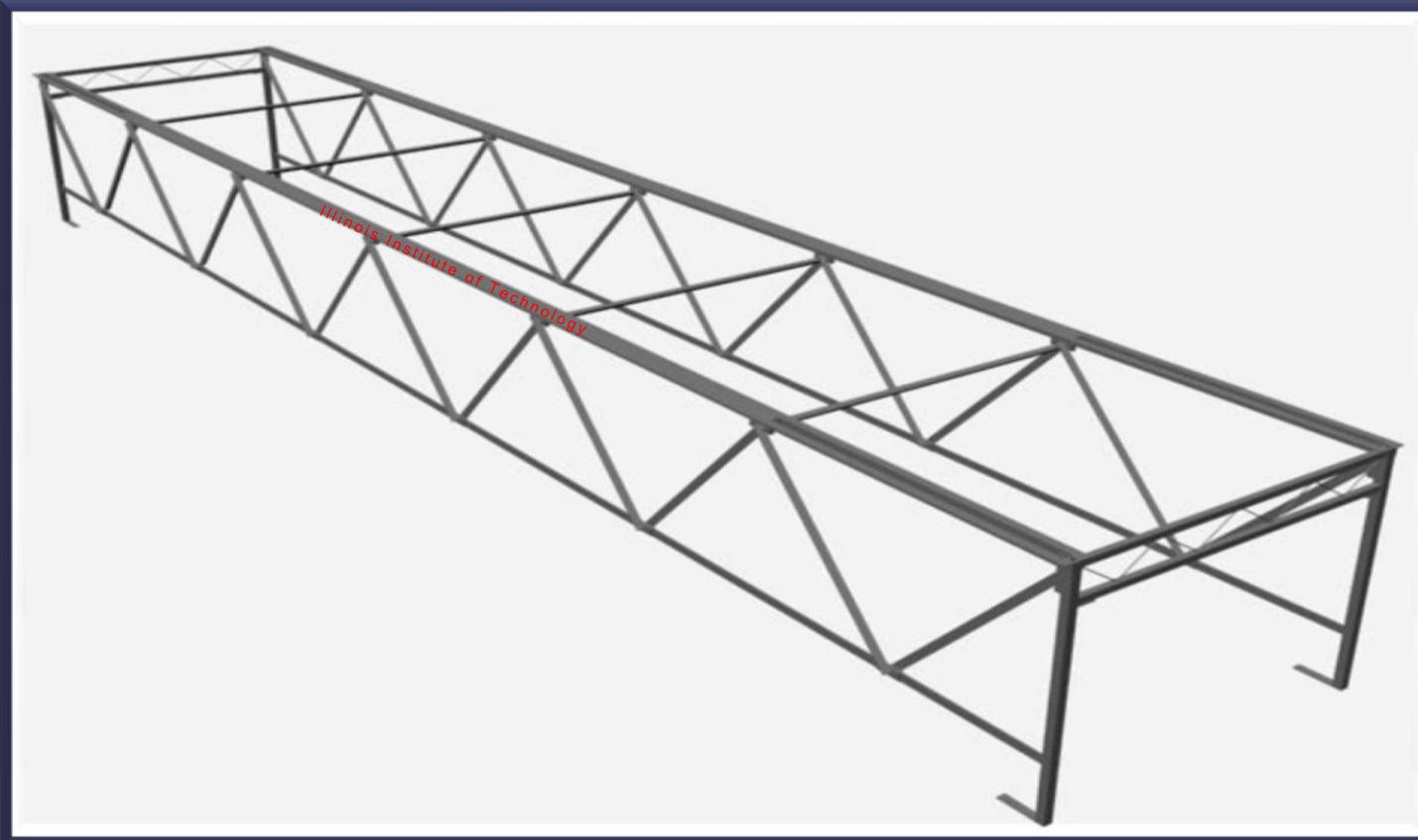


I PRO 326 STEEL BRIDGE



The Mission

The purpose of this IPRO is to simulate a real world design project by producing a scaled steel bridge. This IPRO showcases the actual process required to erect a structure. Students examine the designing aspect as well as the business aspect of such an operation.

The Cause

This IPRO is a contribution to our school's own ASCE chapter. The bridge designed will be fabricated and assembled in the following semester and entered into the ASCE/AISC Student Steel Bridge Competition.

Competition Scenario

A century-old highway bridge that spans a scenic river must be replaced. The bridge carries traffic serving residences and resorts that are the foundation of the economy for this rural region. A quick replacement is necessary because no other crossing is available for miles. The state Department of Transportation (DOT) has requested design/build proposals for replacing the existing bridge.

Motivation for Design

- A deck bridge
- Clearance under the bridge
- Material used is steel

Steel Bridge Crew

Students involved with IPRO 326 are aspiring:

- ◉ Civil Engineers
- ◉ Architects
- ◉ Construction Managers
- ◉ Mechanical Engineers
- ◉ Architectural Engineers
- ◉ & Business majors

- ◎ Brings the aspiring professionals together
- ◎ Replicates real world work place
- ◎ People interaction



I PRO 326

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graph TD; A[I PRO 326] --- B[Team 1]; A --- C[Team 2]; B --- D[ ]; C --- D;
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Team 1

Team 2

- Read the rules of the ASCE Steel Bridge Competition
- Discussed and interpreted the rules to begin designing regulations
- Teams each came up with a preliminary design for the bridge and members, along with timeline and project plan.

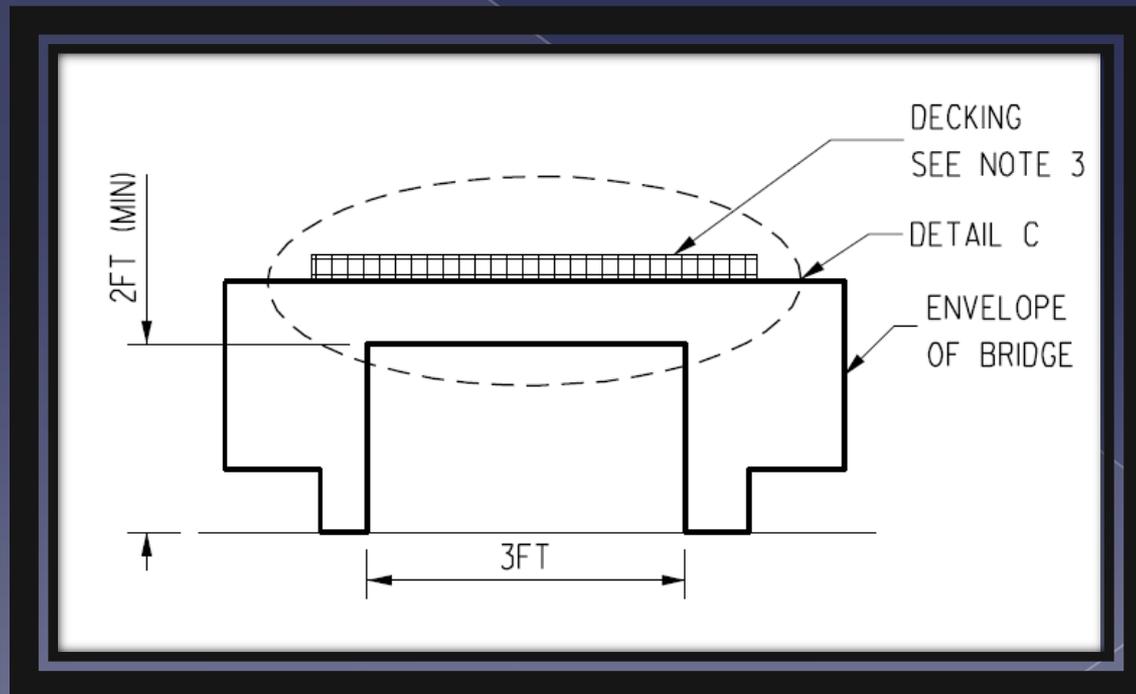
Following the Rules

Rules for the ASCE competition regulate certain areas such as:

- Building envelope
- Member sizes
- Connection design
- Assembly of the bridge
- Loading requirements

Building Envelope

- Bridge must exist inside within given dimensions
- This excludes many design options

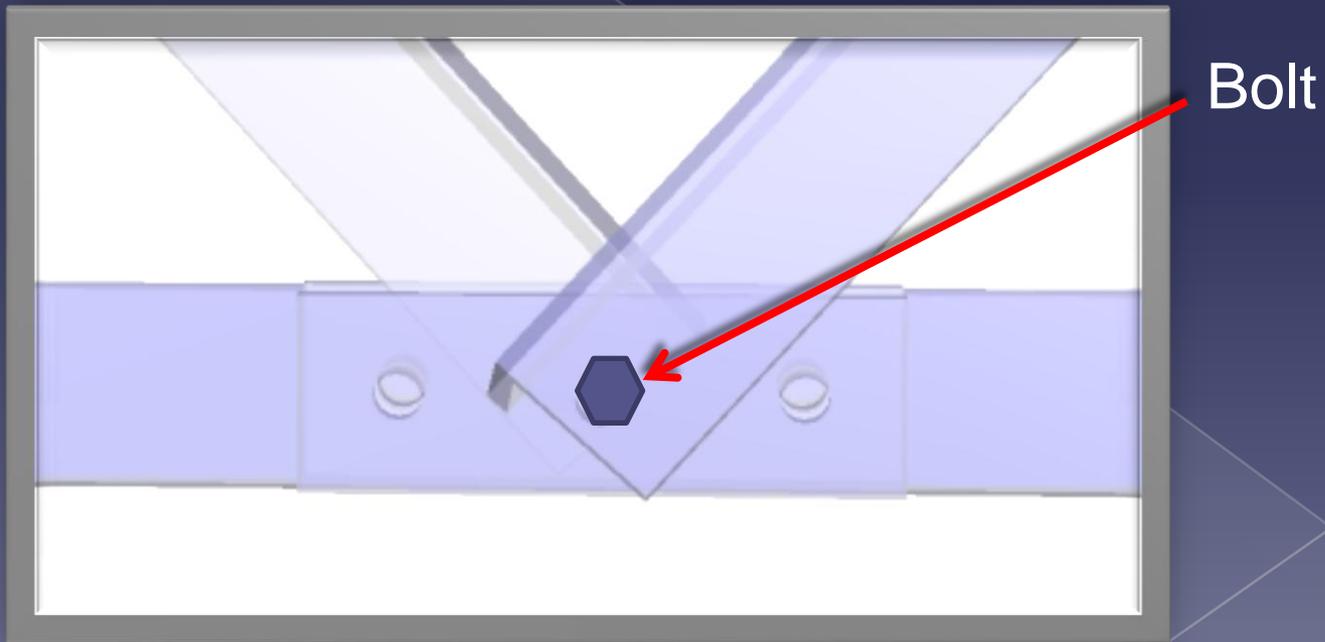


Member Requirements

- ⦿ All members must fit into a 6"x6"x42" box
- ⦿ A member must retain its shape, dimensions, and rigidity during timed construction and load testing.
- ⦿ Hinged, jointed, articulated, and telescoping members are **prohibited**

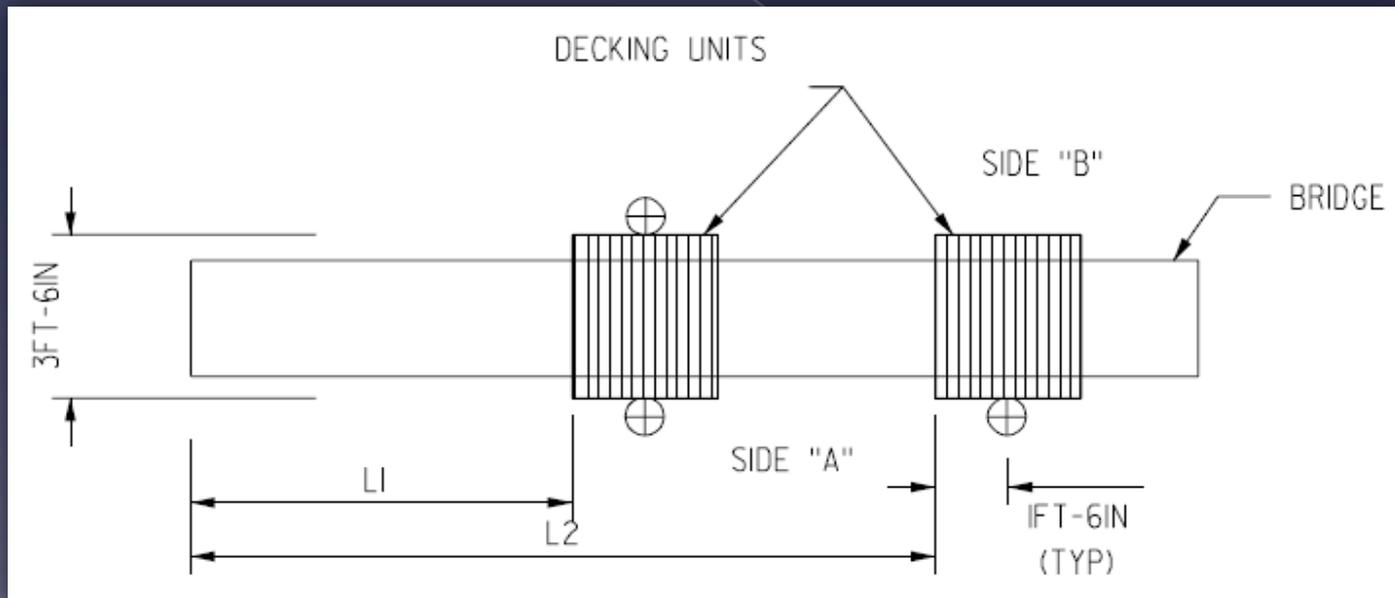
Connections

- Each connection must have one fastener



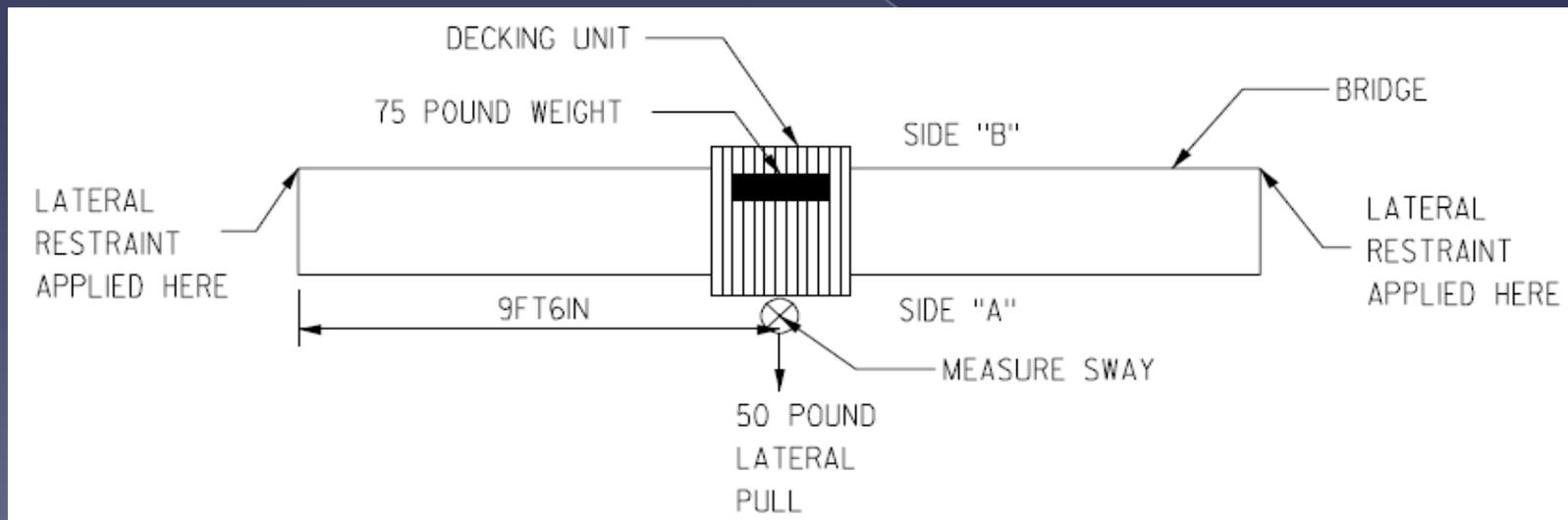
Loading the Bridge

- Initial vertically load tested
- Loading positions are randomly selected



Loading the Bridge

- Also, laterally load tested
- Load position is known



Initial Project Plan

<i>Project Budget</i>		
Items name	Specifications	Cost
Registration:	School	\$ 125.00
	Individuals	\$ 810.00
Hotel:	7 Rooms @ \$80/night * 3 nights	\$ 1,680.00
	Taxes @ 10.75%	\$ 180.60
Travel:	Gas Reimbursement for driving	\$ 1,164.00
Fabrication:		\$ 4,000.00
	Connectors	
	Tools	
	Wooden forms	
	Hard Hats	
Presentation:		\$ 50.00
	Posters	
	Printing	
Bridge Aesthetics:		\$ 200.00
	Paint	
	Decals	
Grand Total:		\$ 8,209.60

I PRO 326

Team 1

Team 2

IPRO 326

Team 1

Team 2

Business Team

Design Team 1

Design Team 2

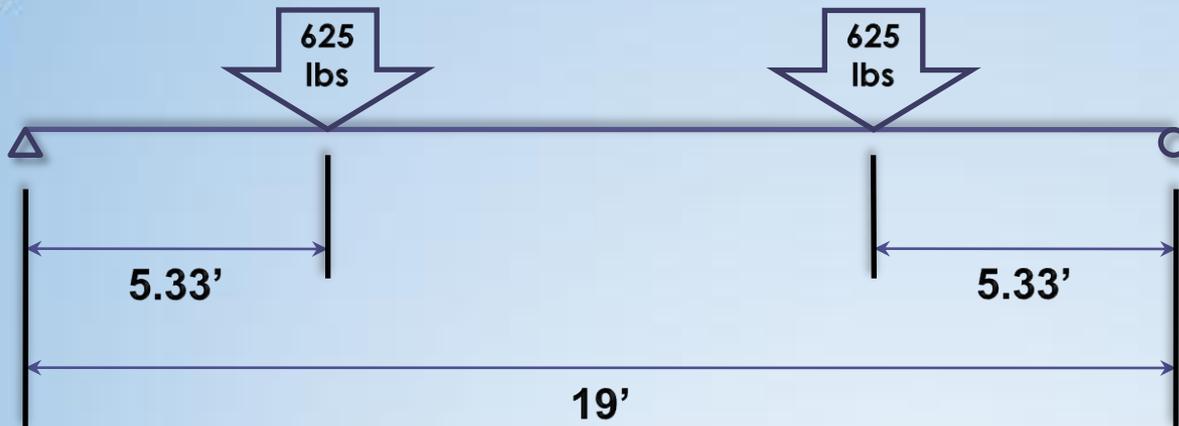
- Created Budget
- Marketing for the project
- Contacted possible sponsors

- Discussed potential bridge layouts
- Ideas for member shapes and sizes
- Preliminary connection design
- Considered likely dilemmas and possible critical spots

Design Approach

- ◎ Find critical loading points
- ◎ Simple load analysis
- ◎ Moment diagrams

Moment Diagrams



Loading

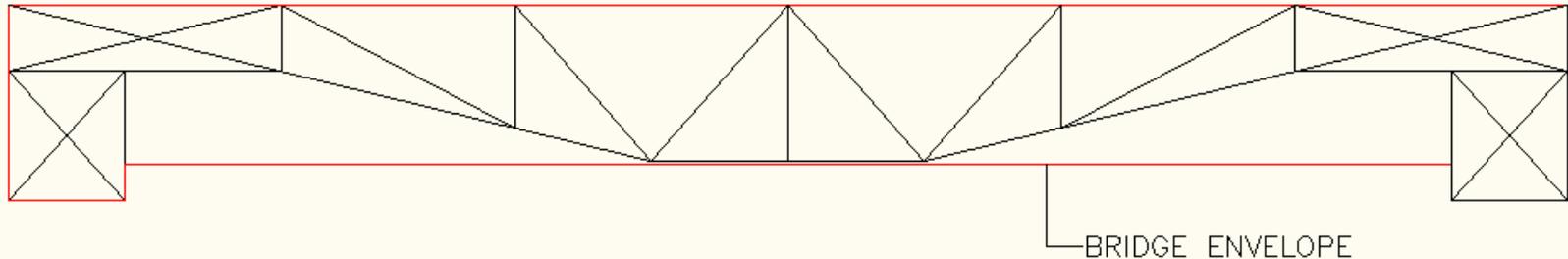
$$M_{\max} = 3331 \text{ ft-lbs}$$



Bending Moment Diagram

Preliminary Bridge Designs

- Several bridge designs were proposed
- Constructability was key

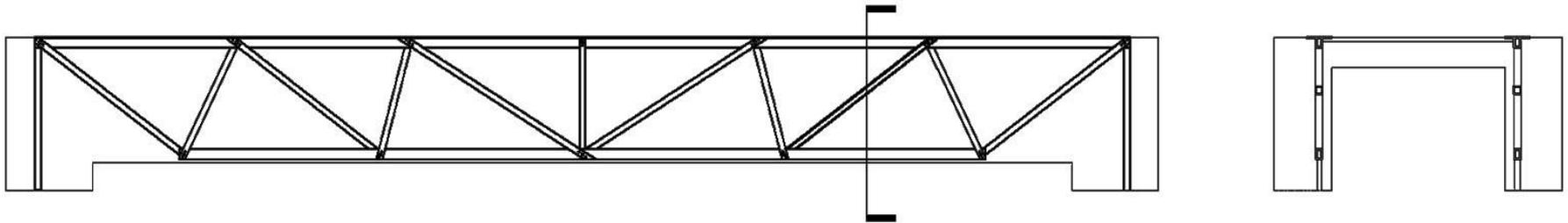


ELEVATION

NOT TO SCALE

Preliminary Bridge Designs

- Web members were carefully considered



IPRO 326

Team 1

Team 2

Business Team

Design Team 2

Design Team 1

SAP 2000
Team

Pier Design /
Oversight

Connection
Design

Shop Drawing

Construction
Planning

SAP 2000 Team

- Conducted load analysis

Finalize geometry

Length of
overall
bridge

Final
shape

Number
and
length of
members

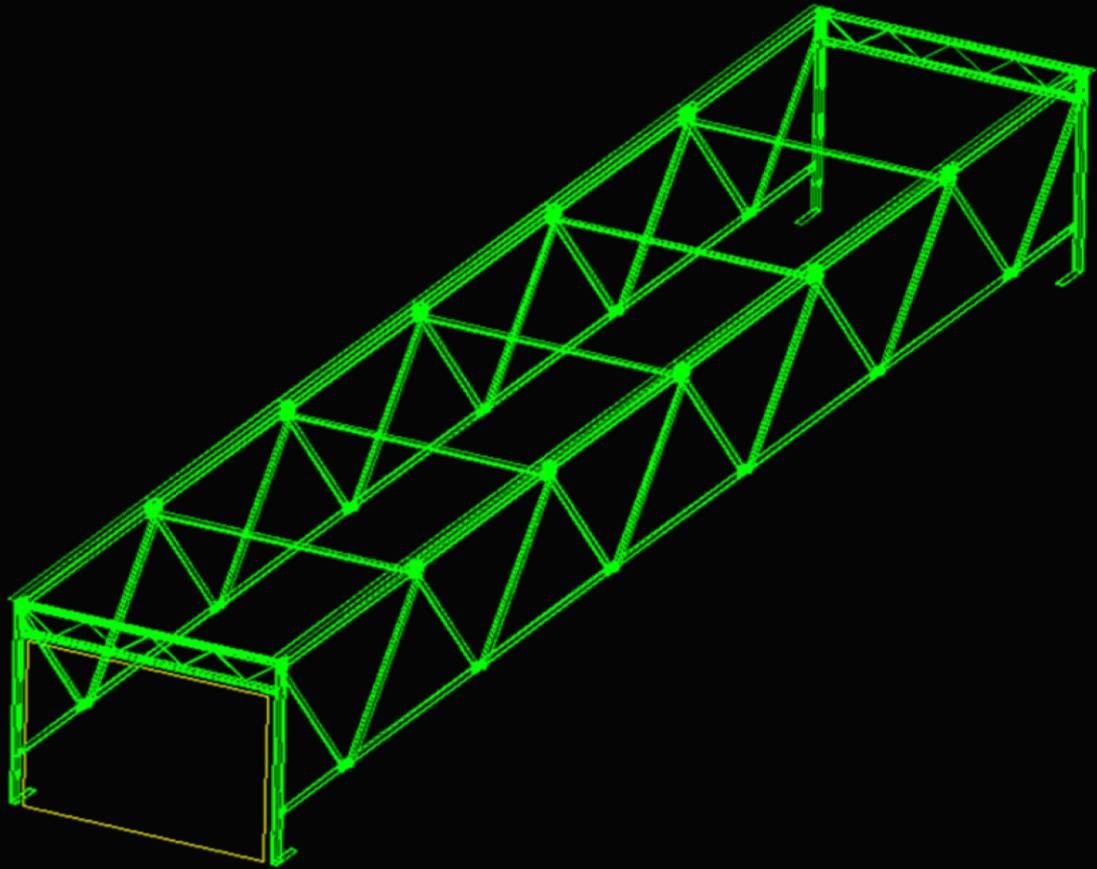
Lateral
bracing

Analysis of Bridge

- ◉ Determining structural integrity using SAP2000
- ◉ Difficulties included determining the proper way in which to model connections and releases
- ◉ Determines best weight to deflection ratio

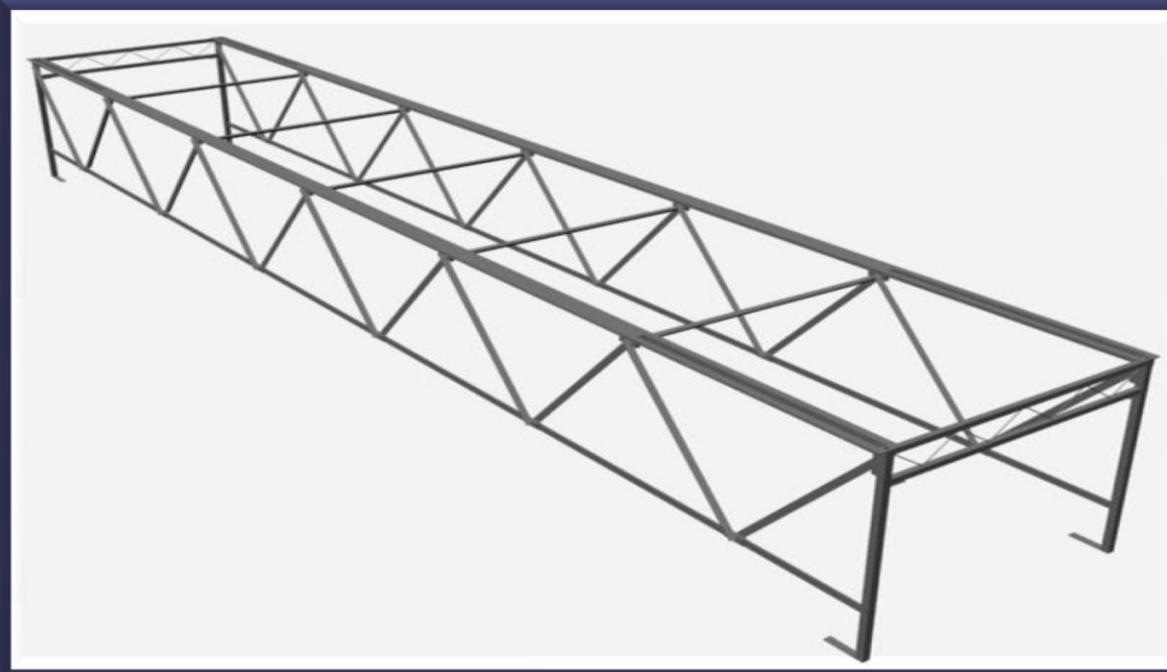
Analysis

Analysis of various load possibilities was done on the proposed bridge design until the correct sized members and connections were perfected.



Bridge of Choice

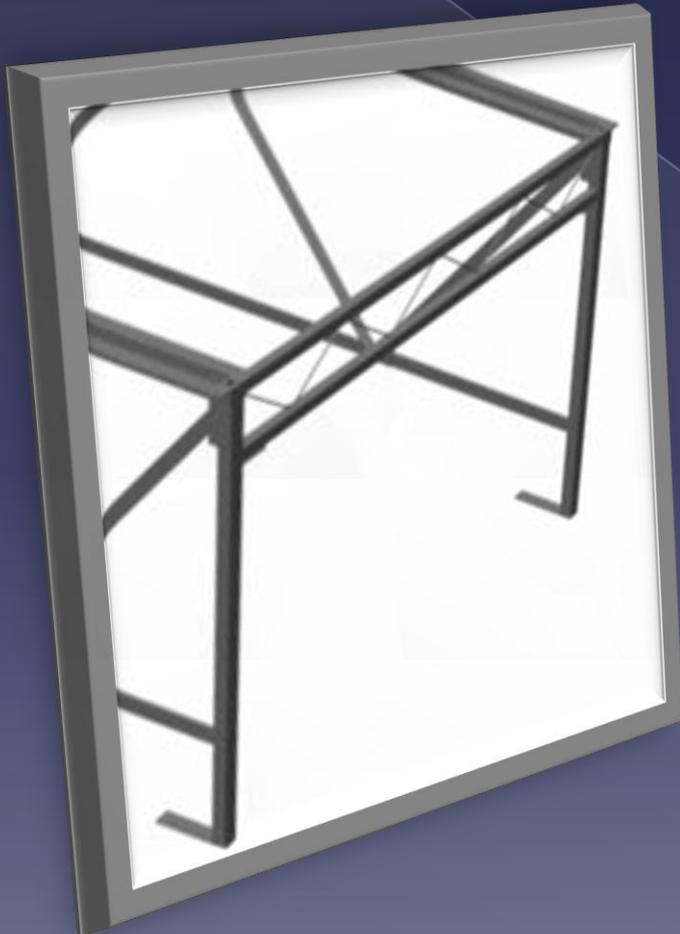
- The final selected bridge consists of simple truss with both the upper chord and lower chord connecting to the pier.



Pier Design/Oversight

- ◉ Proposed connection/design for the piers.
- ◉ Made a simple model to show the slipping of the feet on the pier
- ◉ Placed an overview of the rules on Igroups that can be viewed should there be any questions

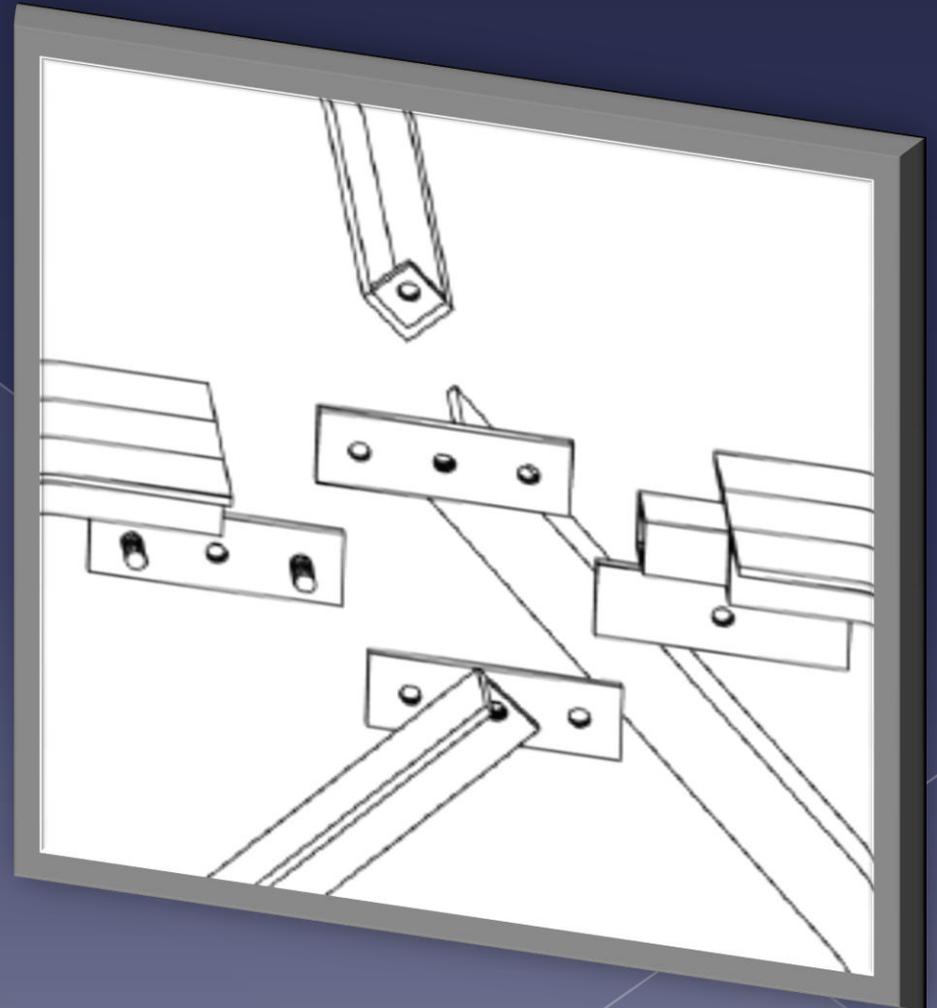
Pier Design



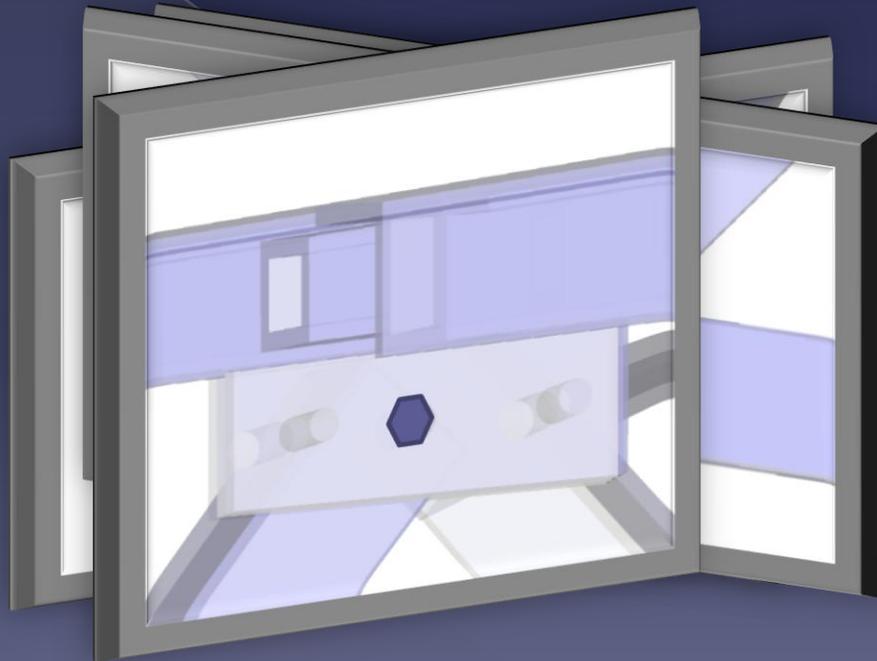
- The pier was a simple design. This inevitably cut down on weight
- Needs to support bridge while building

Connection Design

- Plan the position of connecting members
- Decide location of bolts

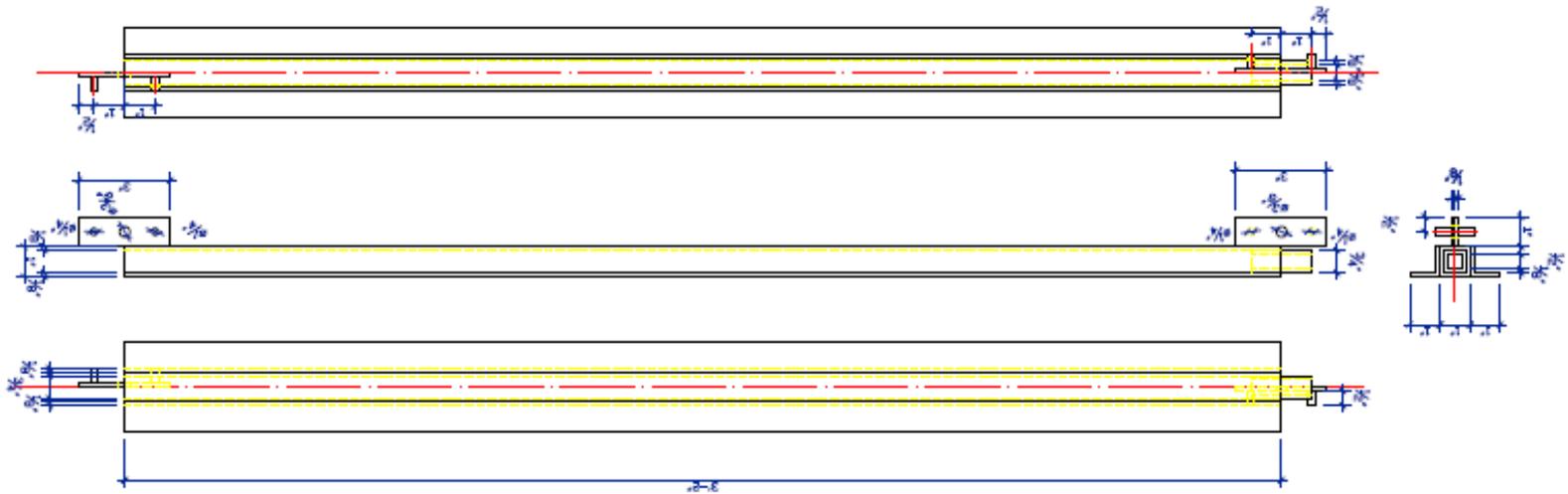


Connection Design



Shop Drawings

- Detailed drawings of individual members
- All dimensions are clearly marked so fabricators can put the members through production
- Each drawing is assembled in a title block to label where it belongs on the bridge



PAGE TITLE: TOP CORD

I PRO 326: STEEL BRIDGE DESIGN

3330 S FEDERAL ST., CHICAGO, IL, 60616

DRAWN BY:

I PRO 336 SHOP DRAWINGS TEAM

OCTOBER 21st, 2008

2

Construction Planning

- ◉ Develops a plan to assemble the bridge
- ◉ Reviewed ASCE competition rules to See how it will allow us to function
- ◉ Develop a time frame of construction
- ◉ Plan the purchase of tools and materials

Proposed Assemblage of the Bridge



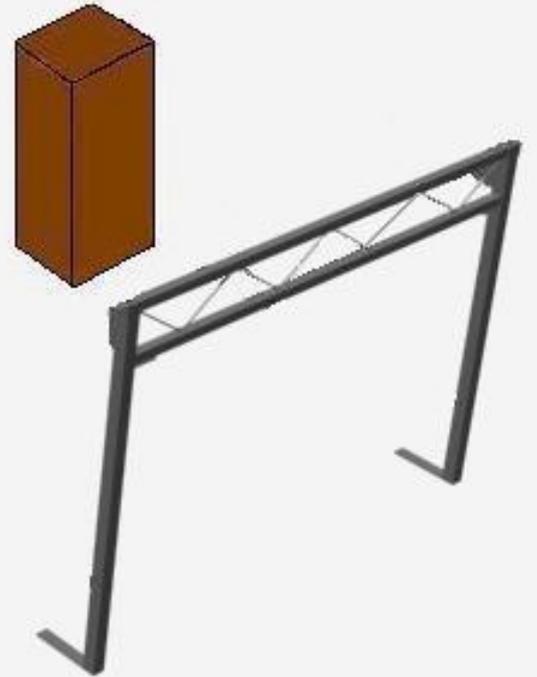


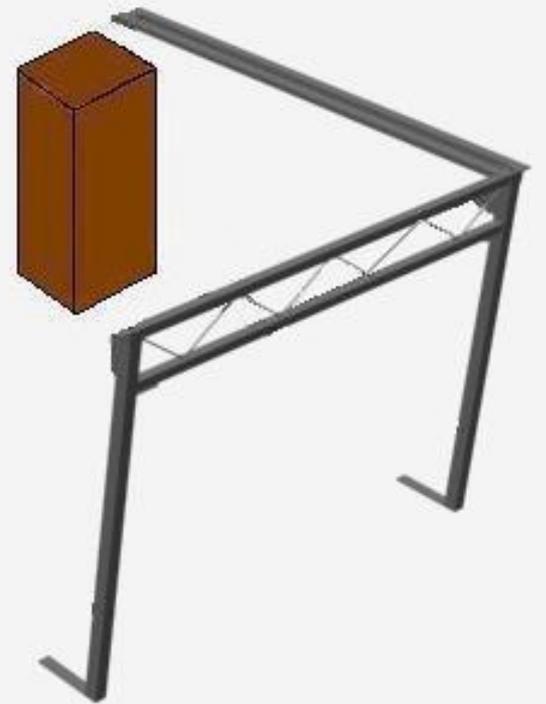


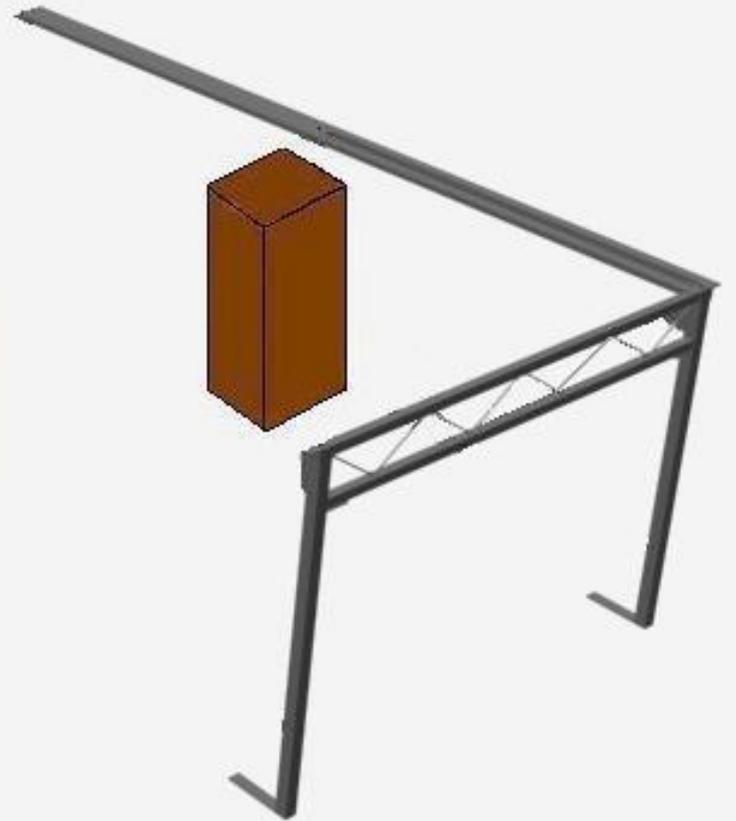


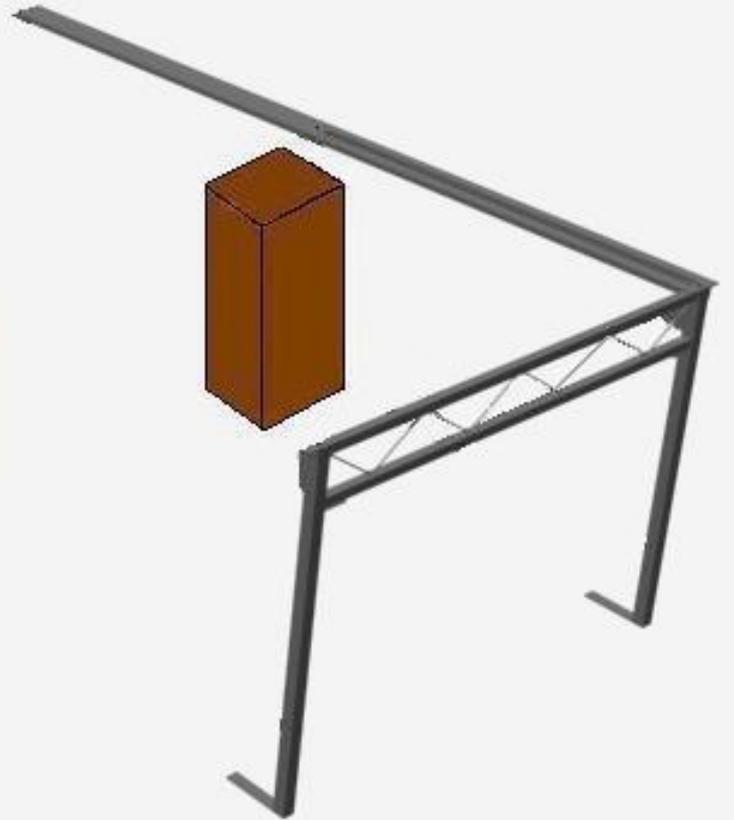


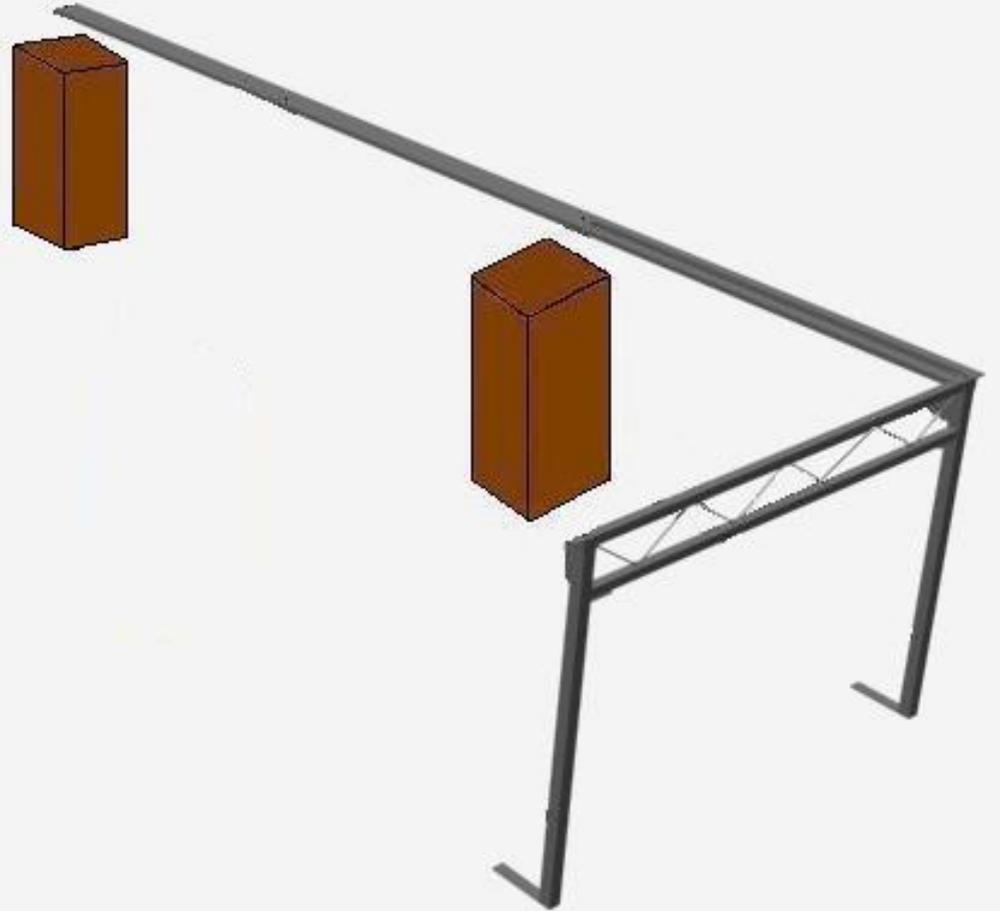


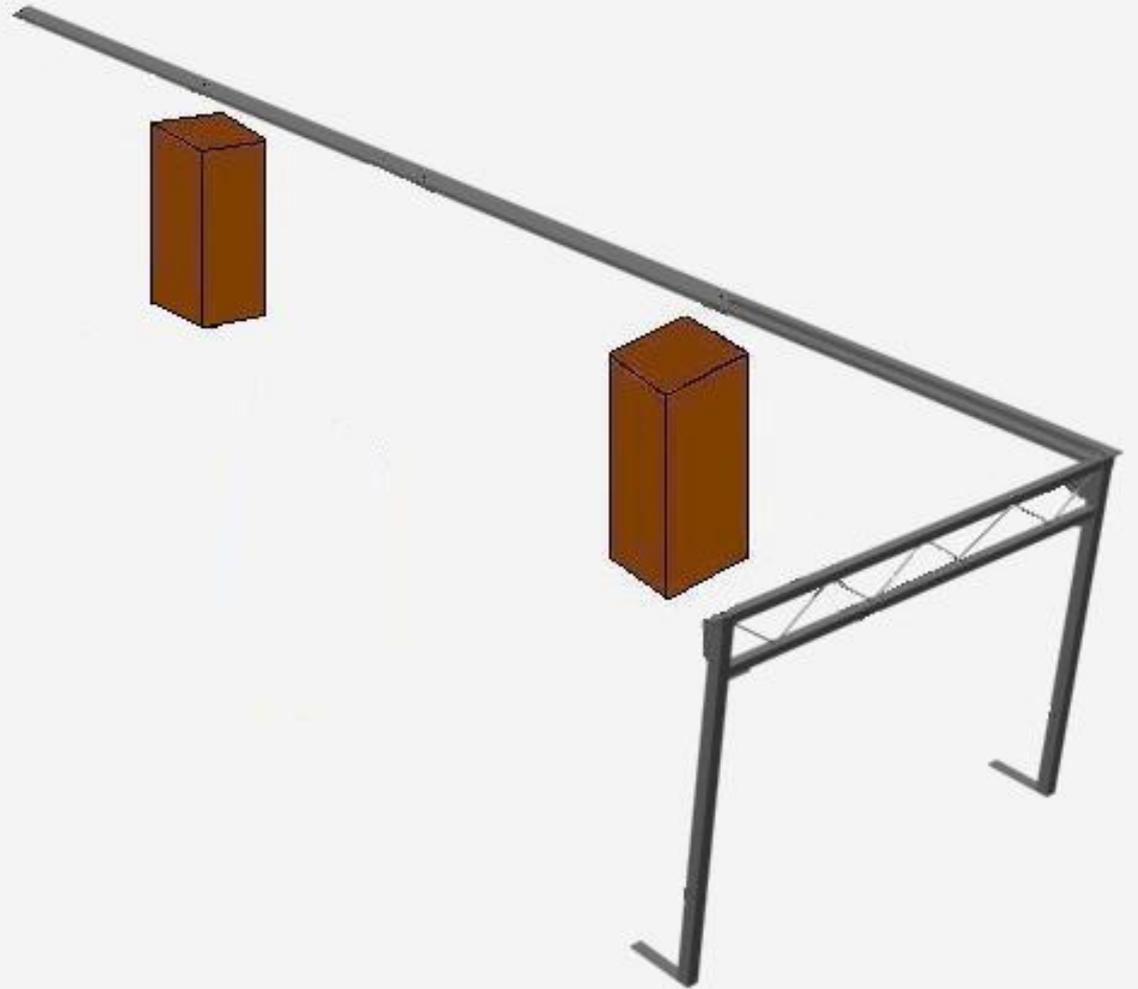


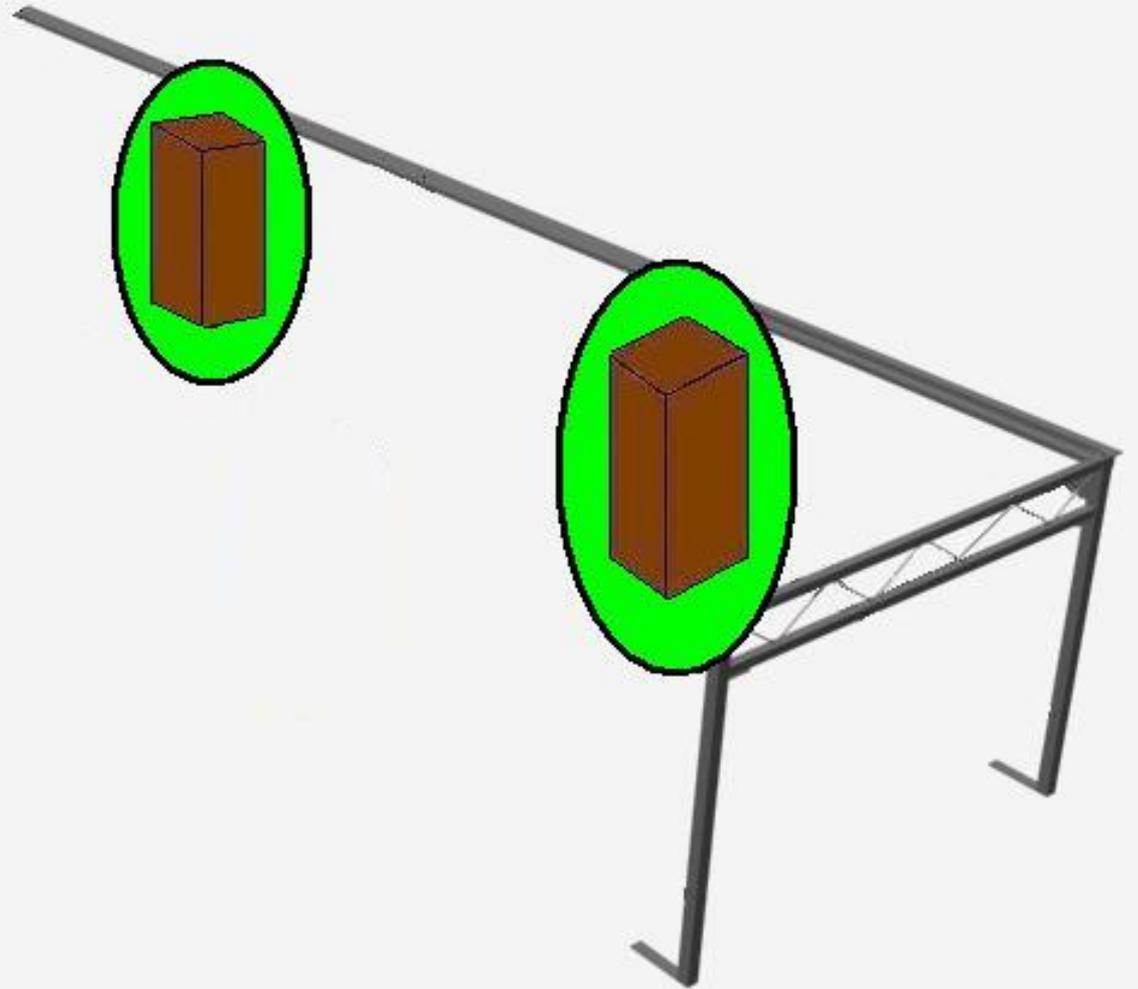


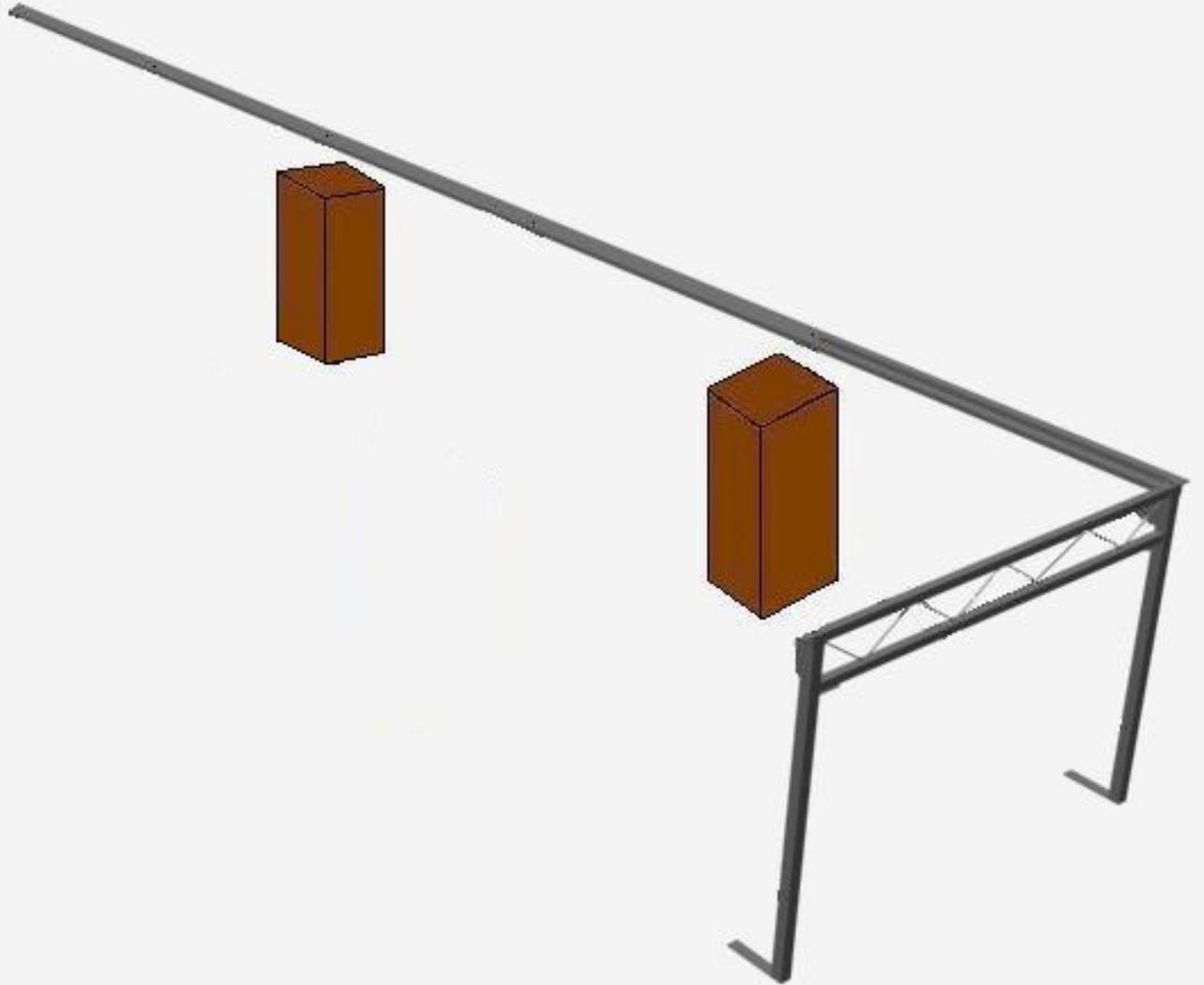


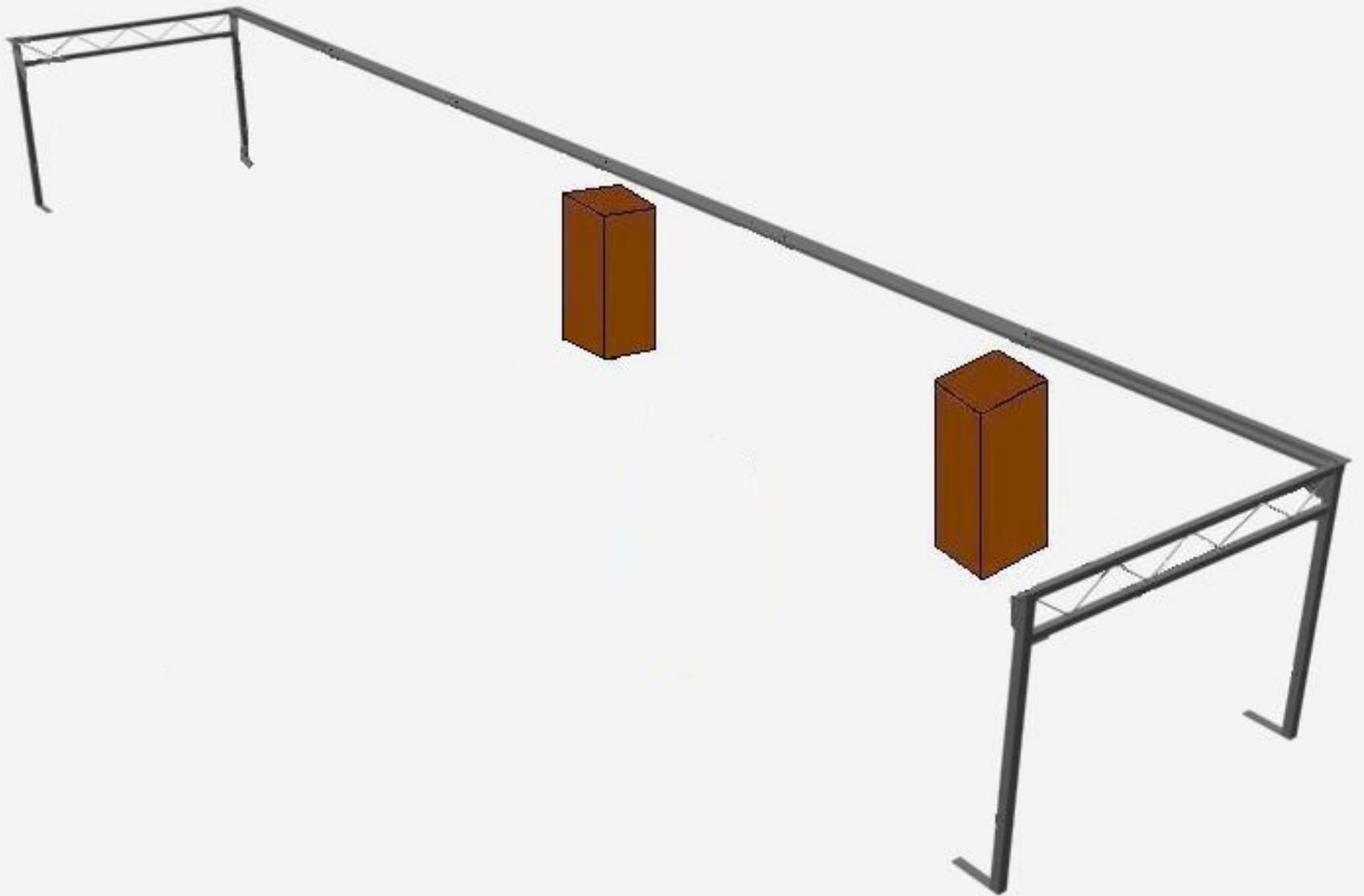


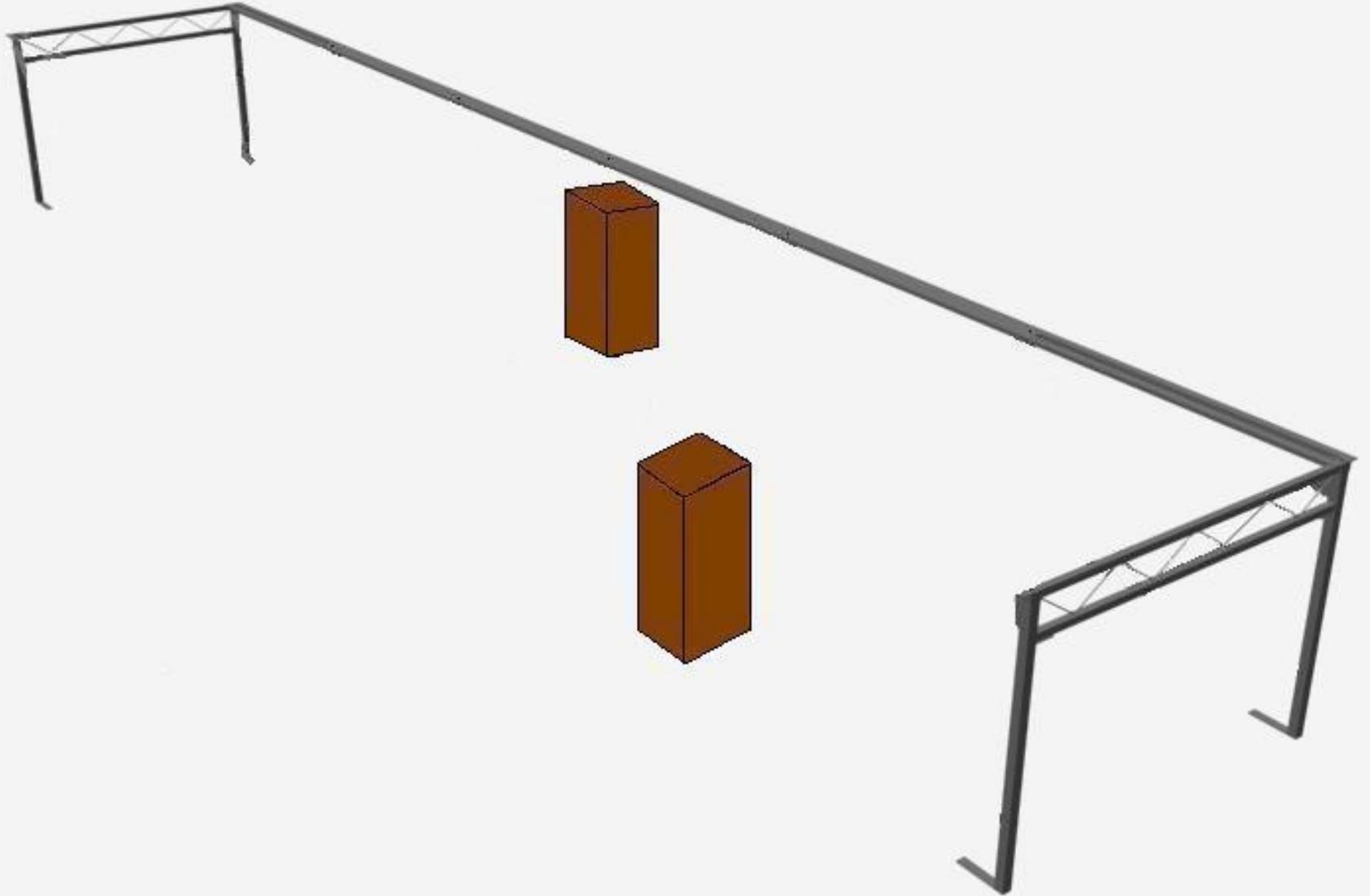


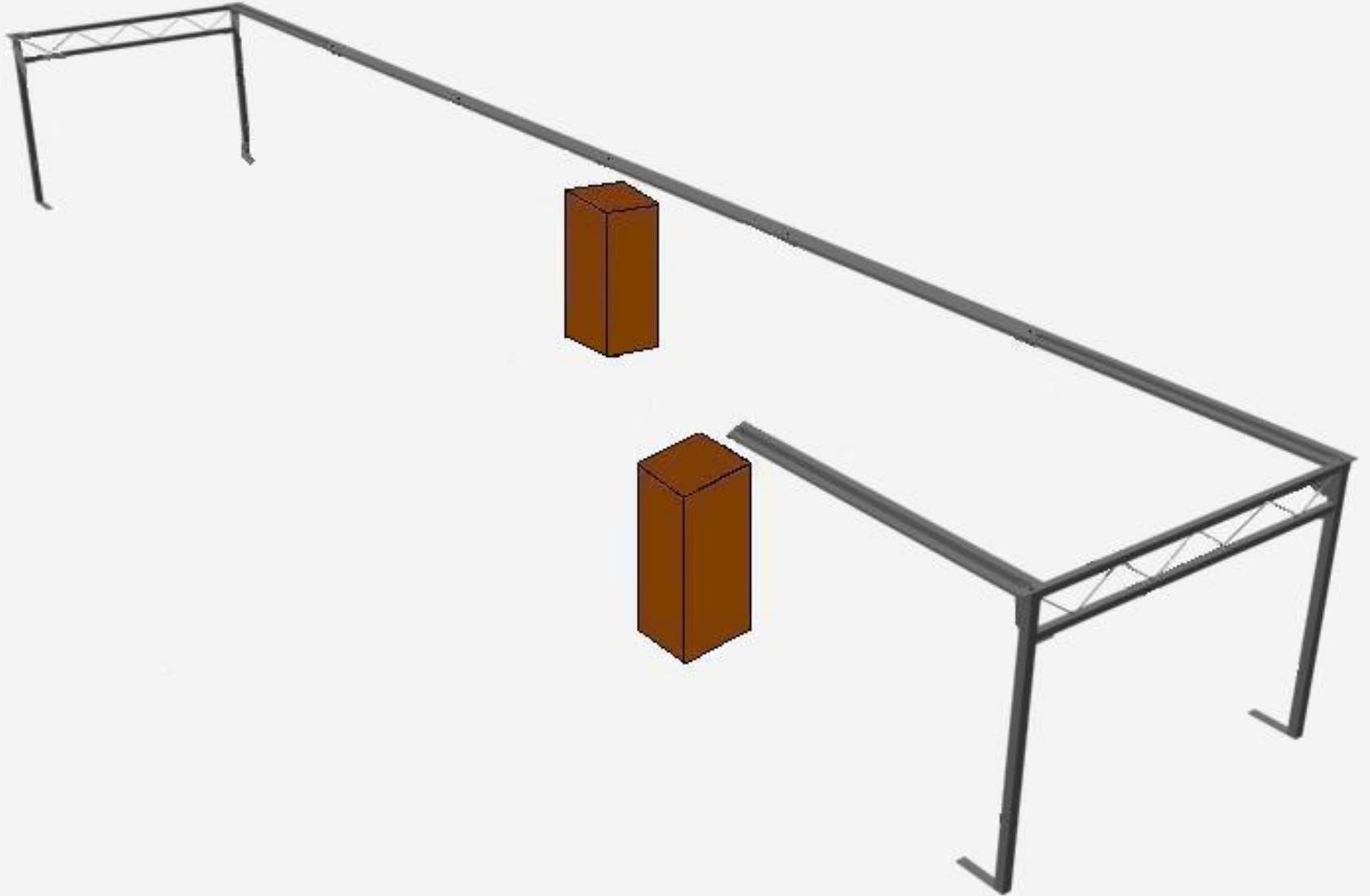


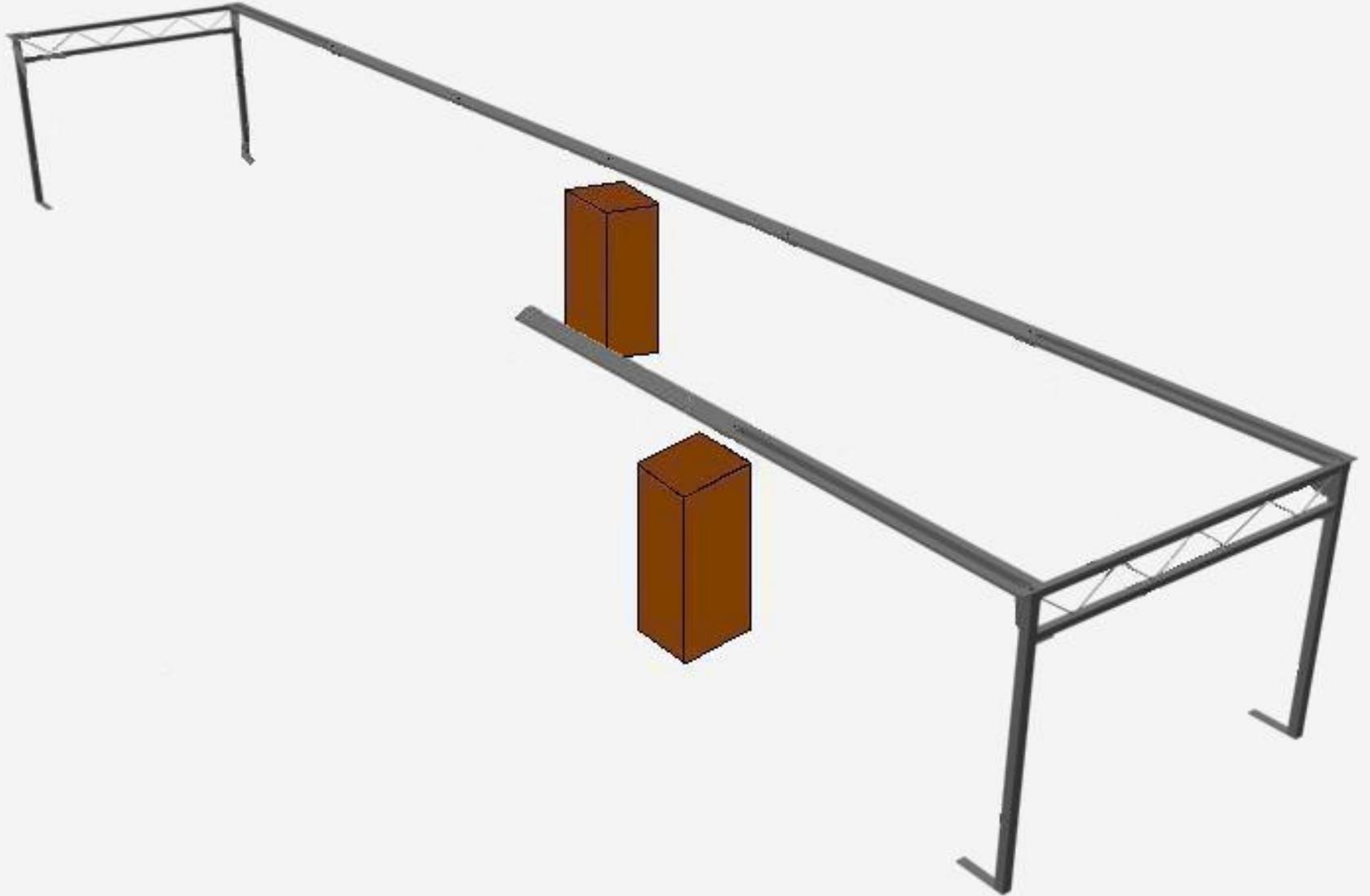


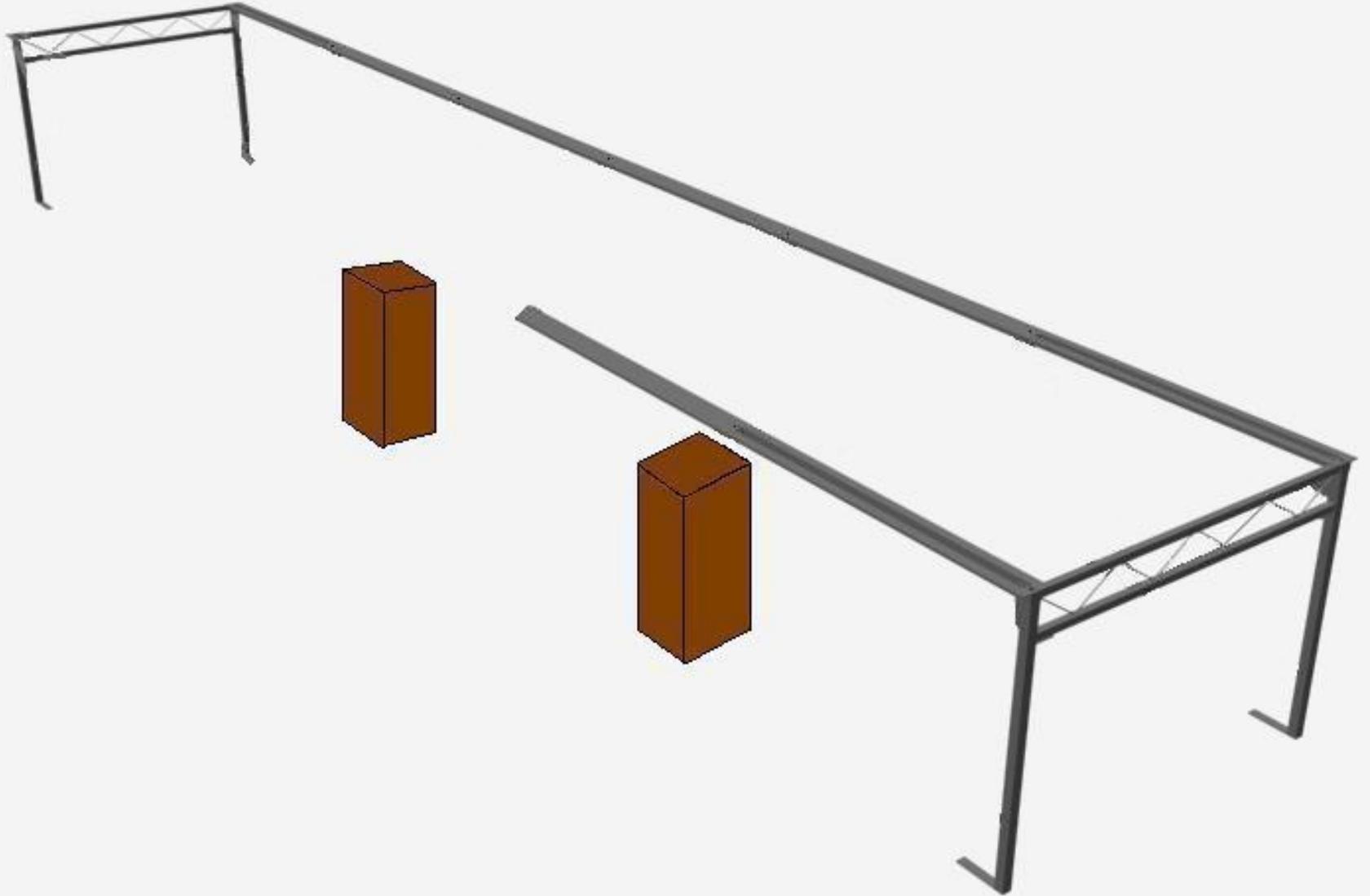


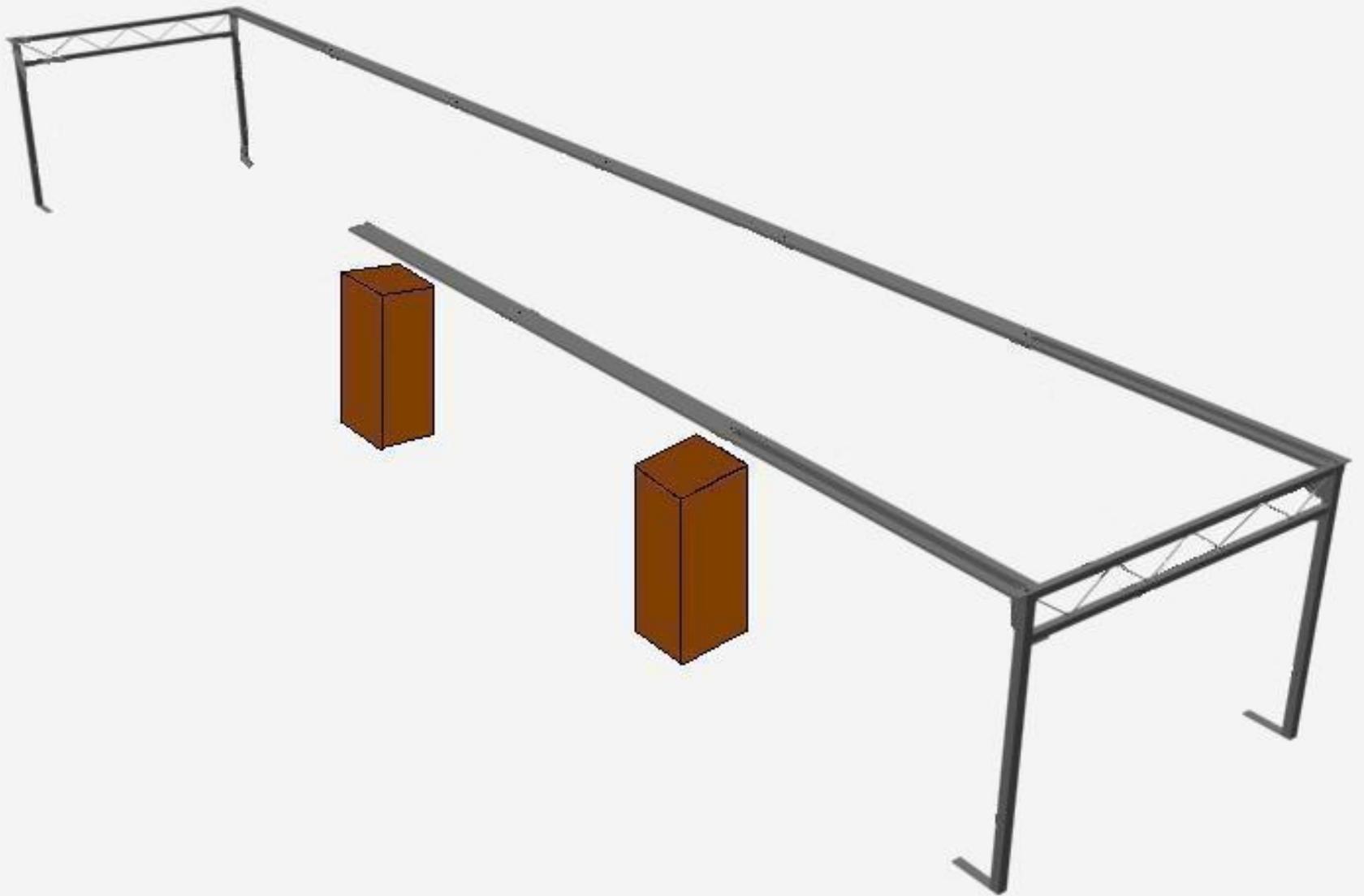


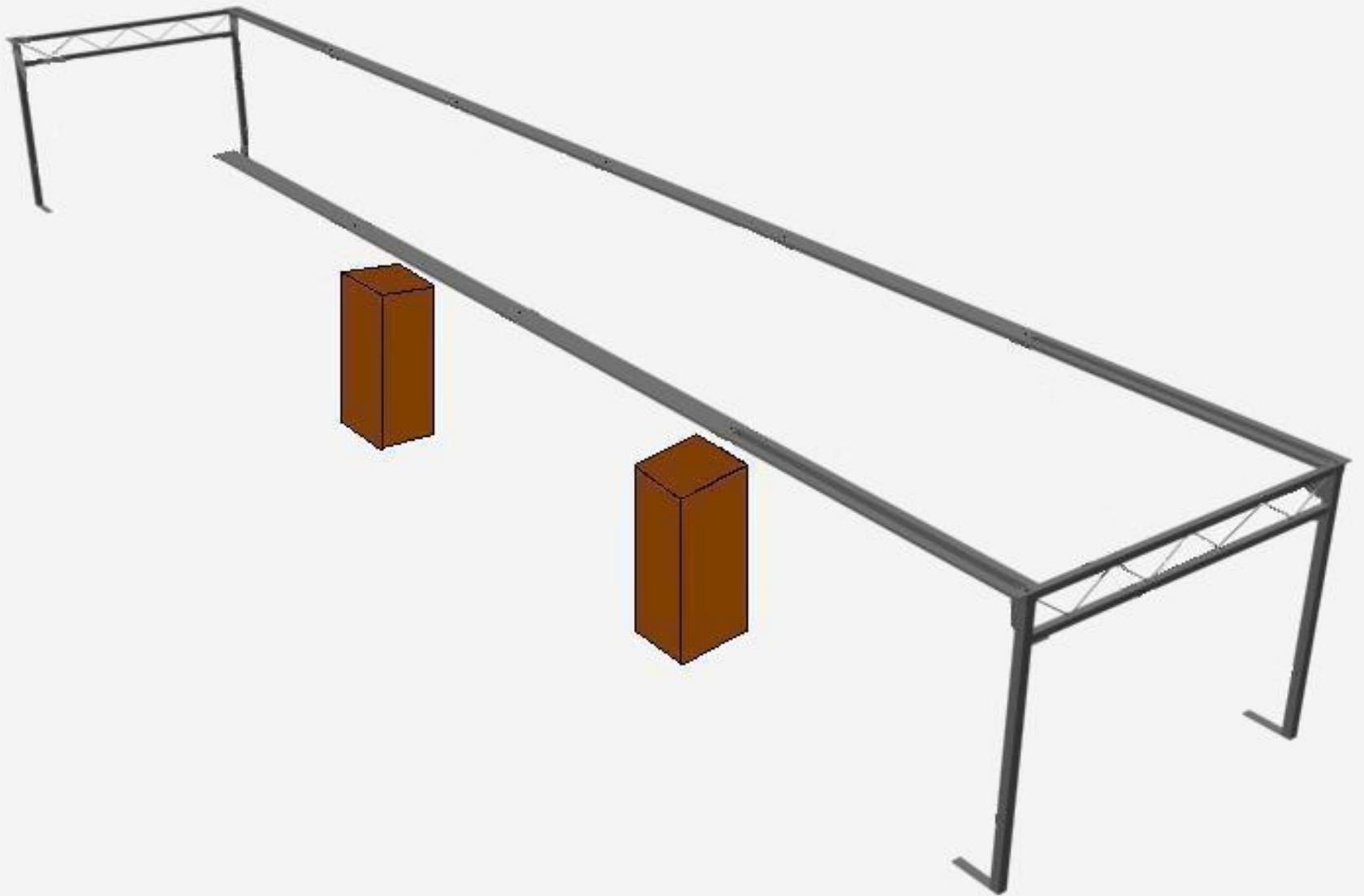


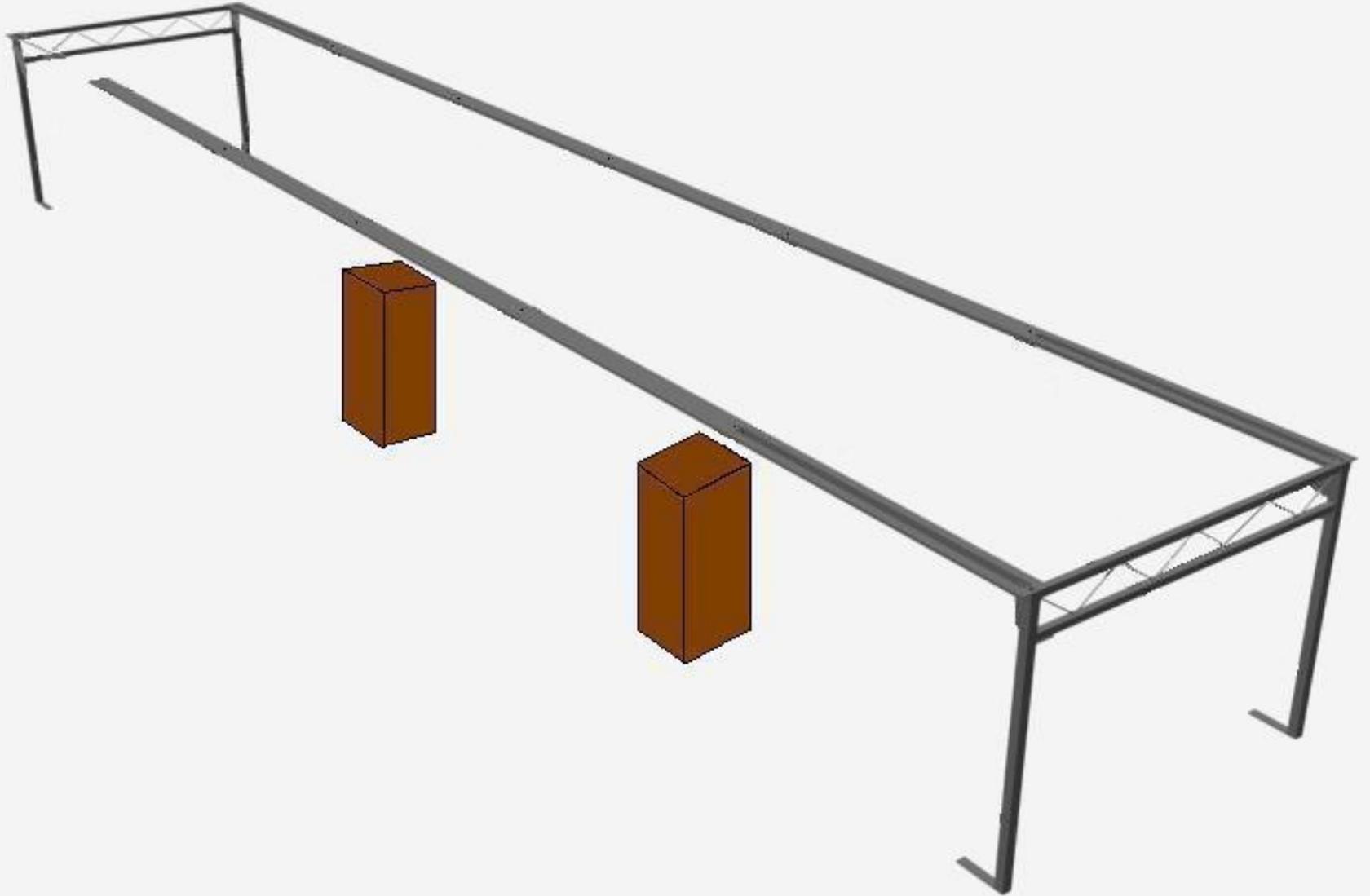


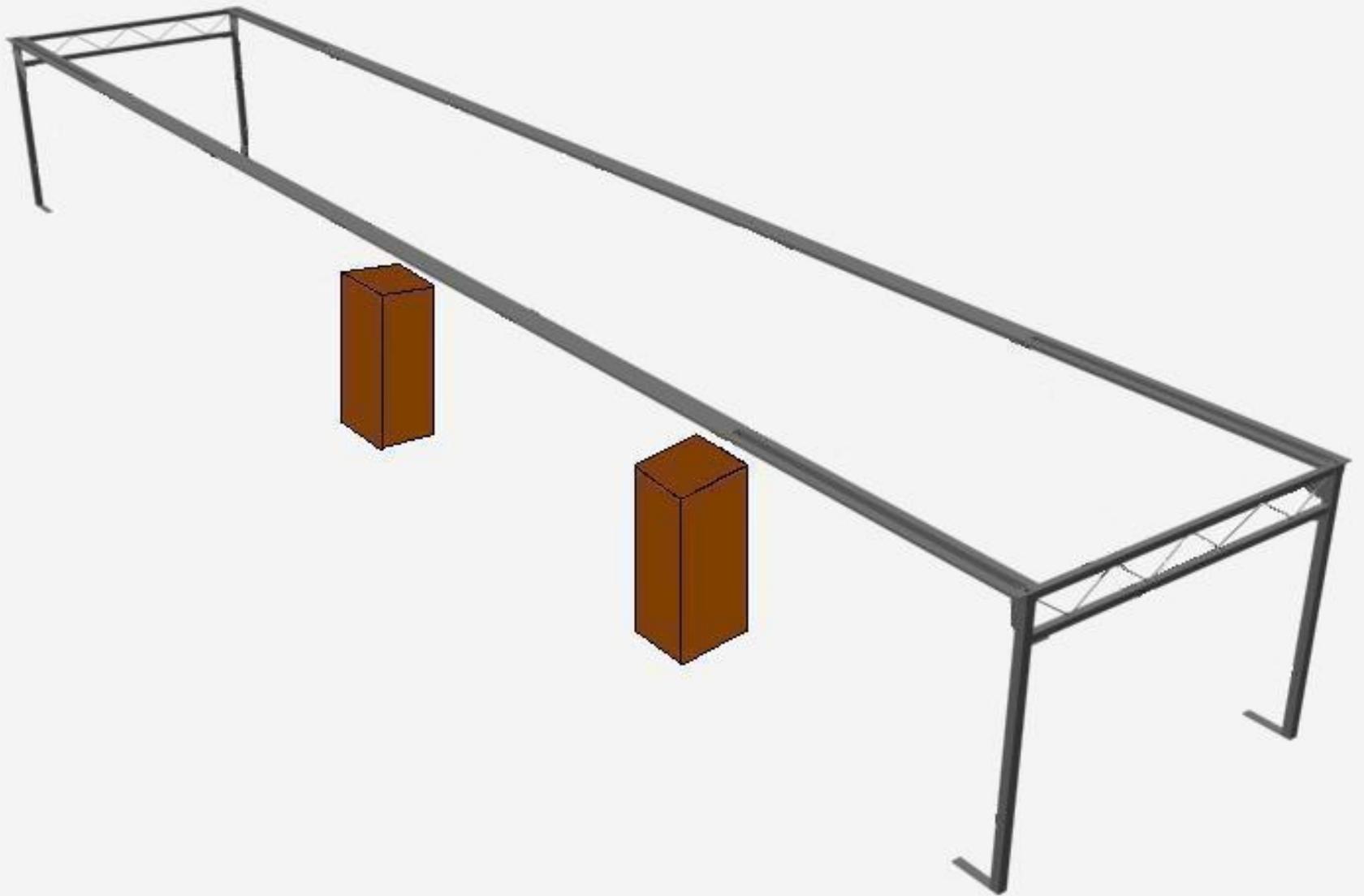


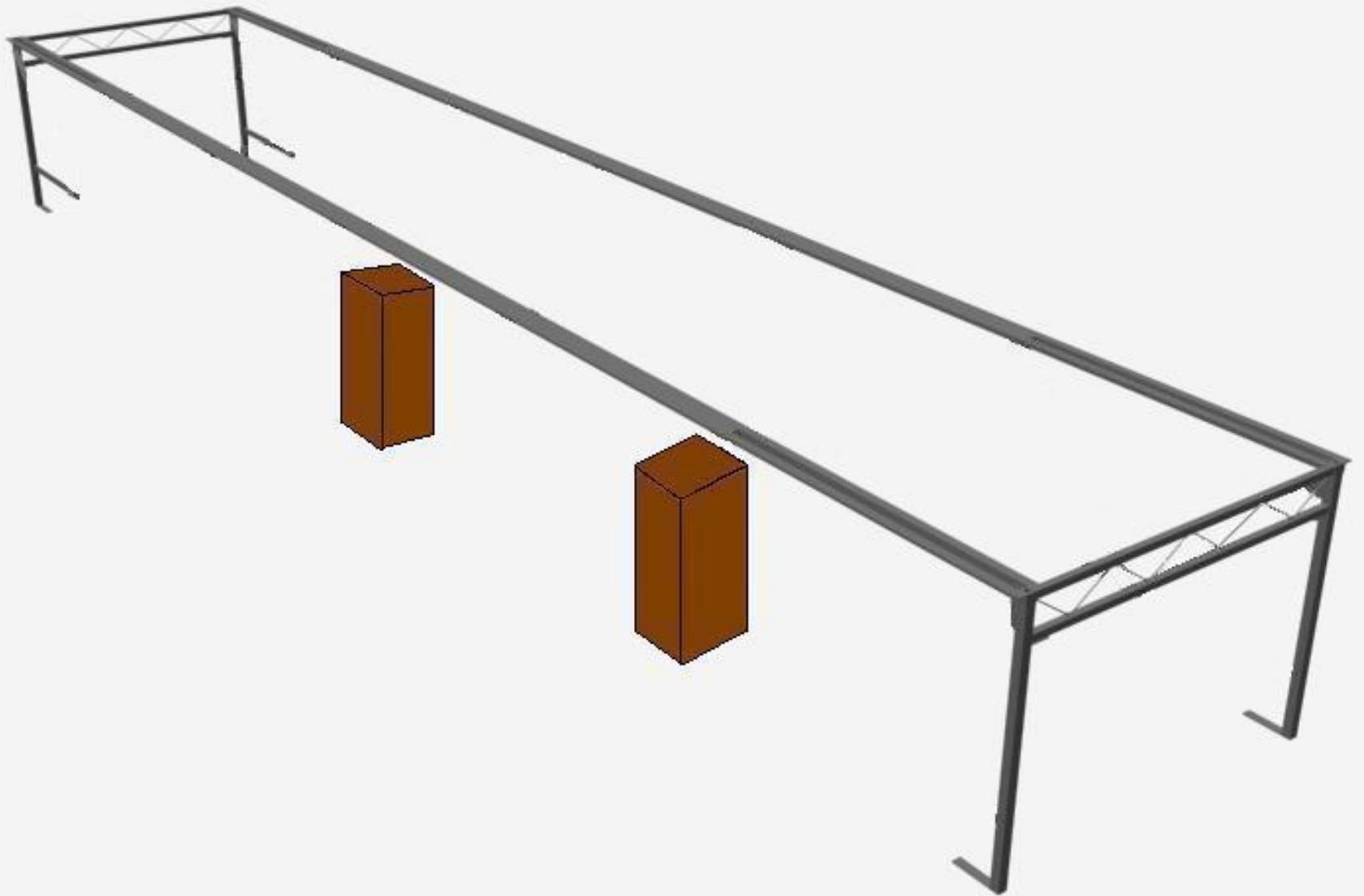


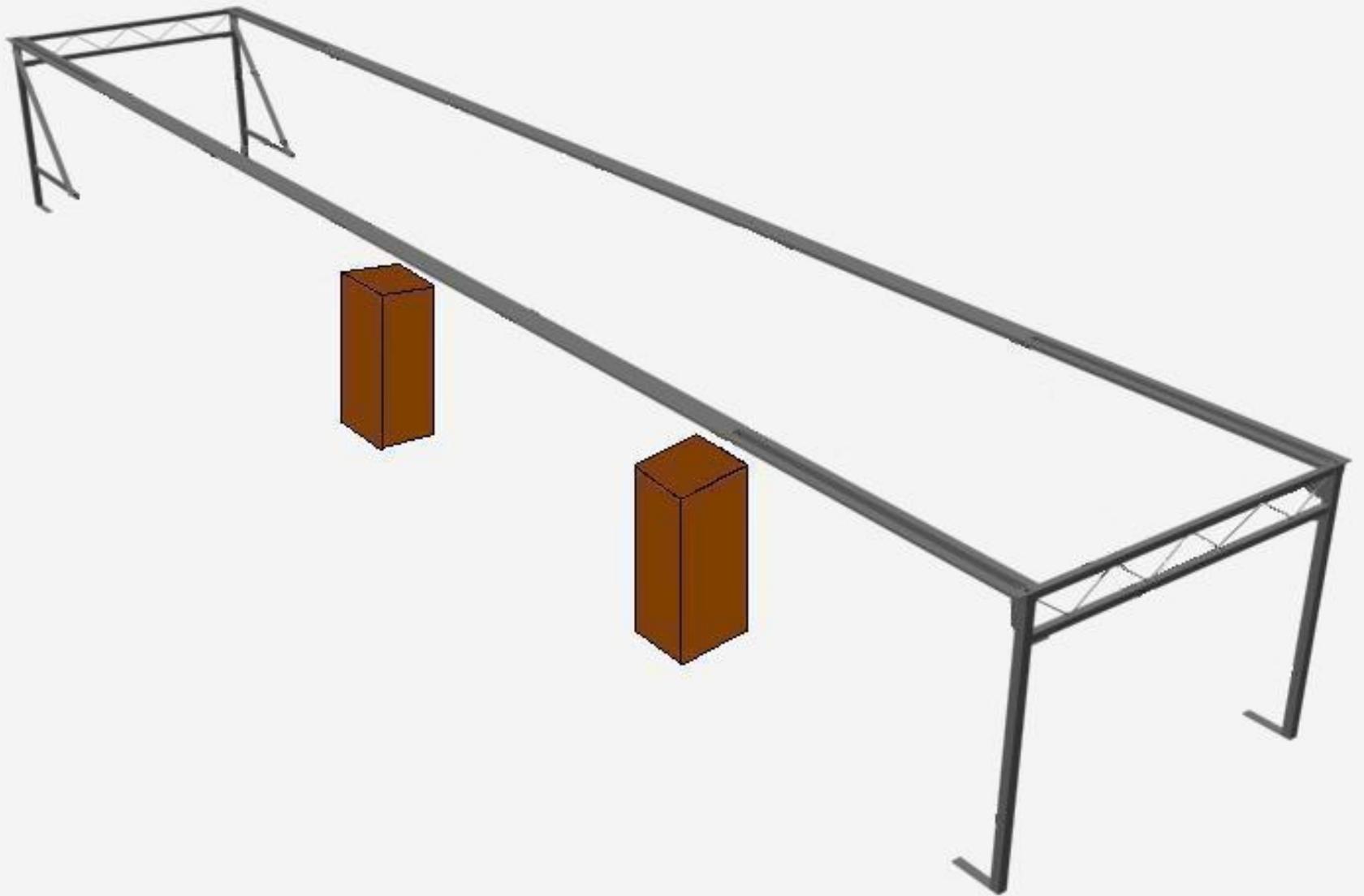


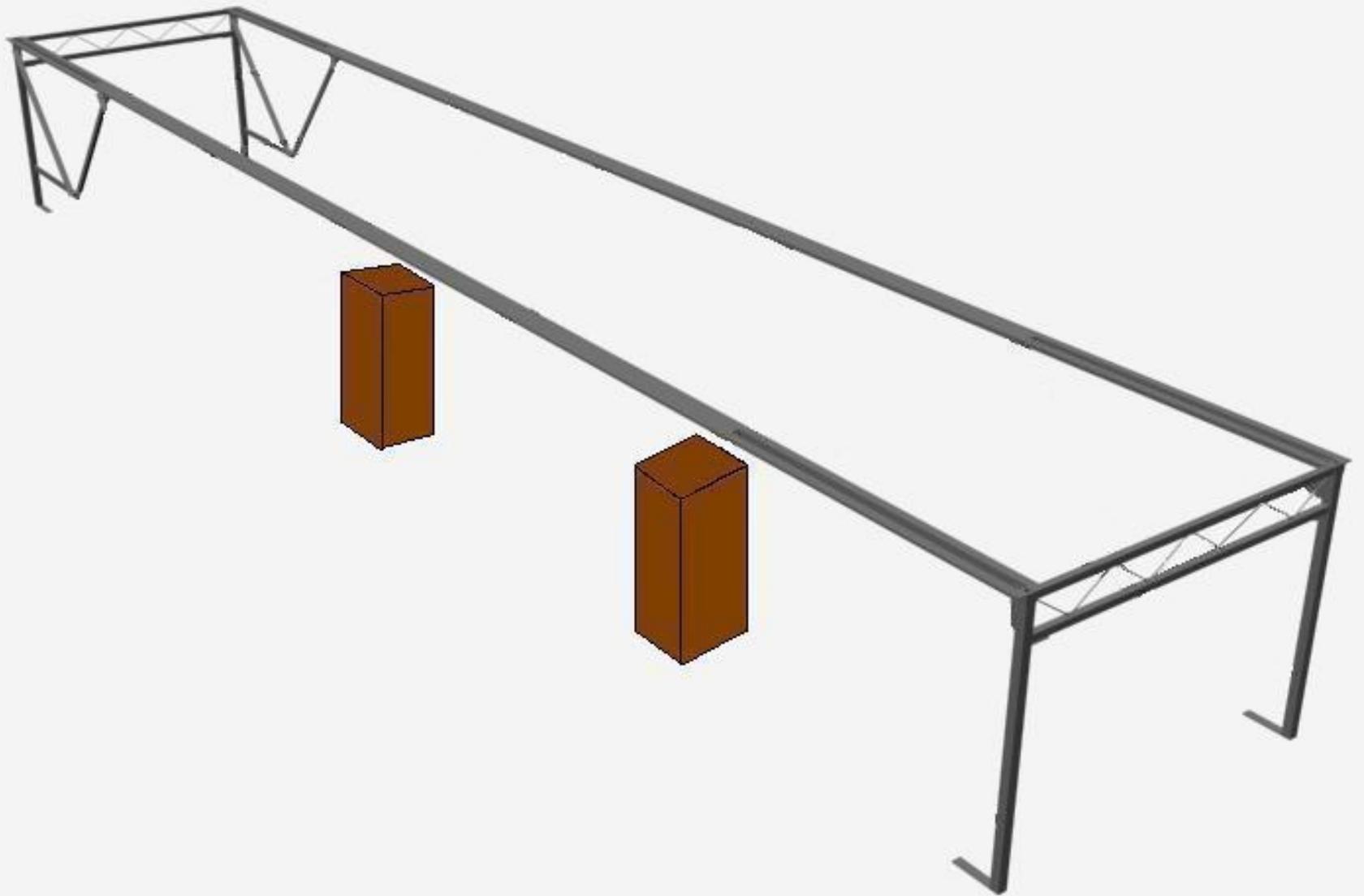


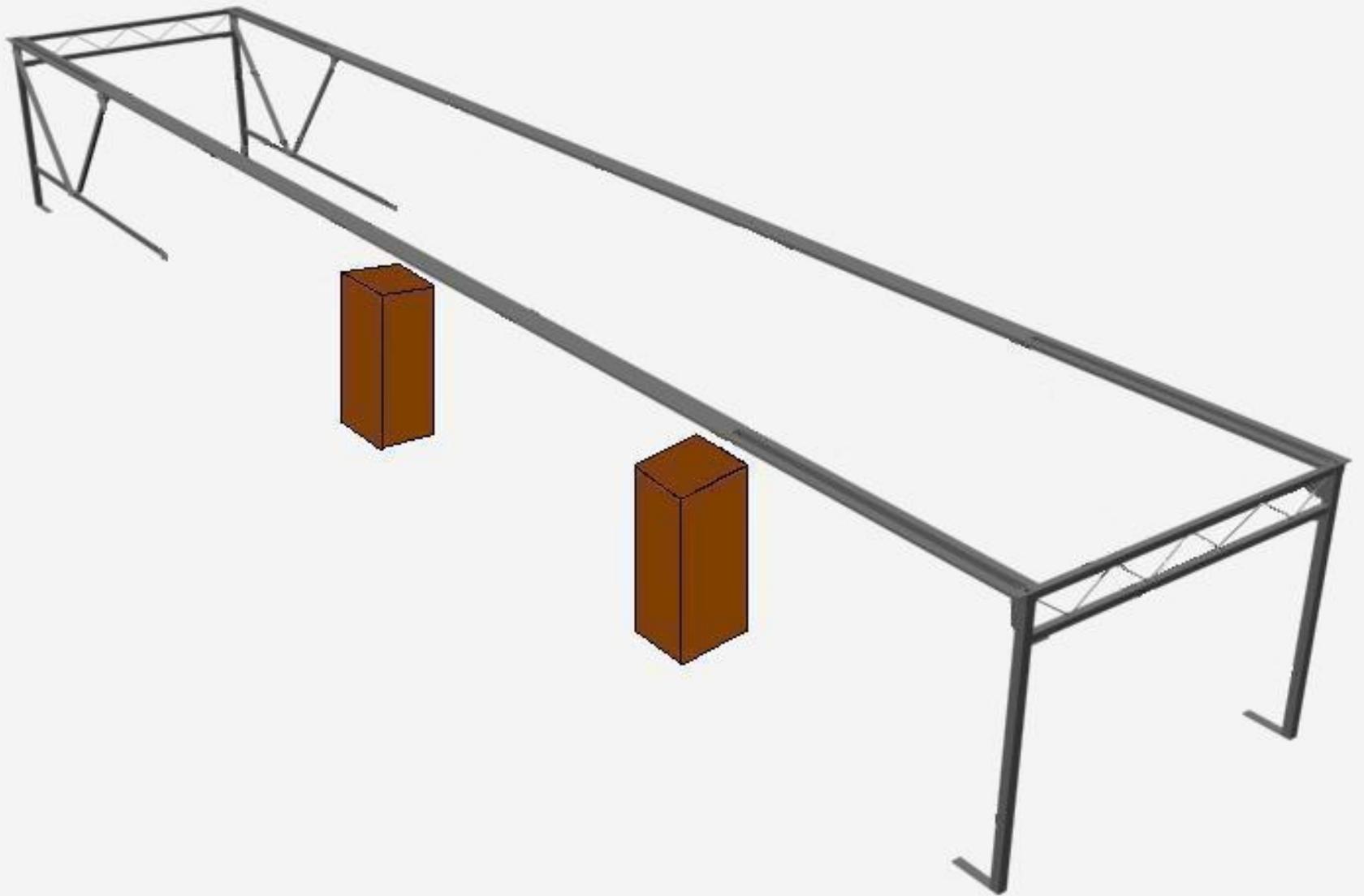


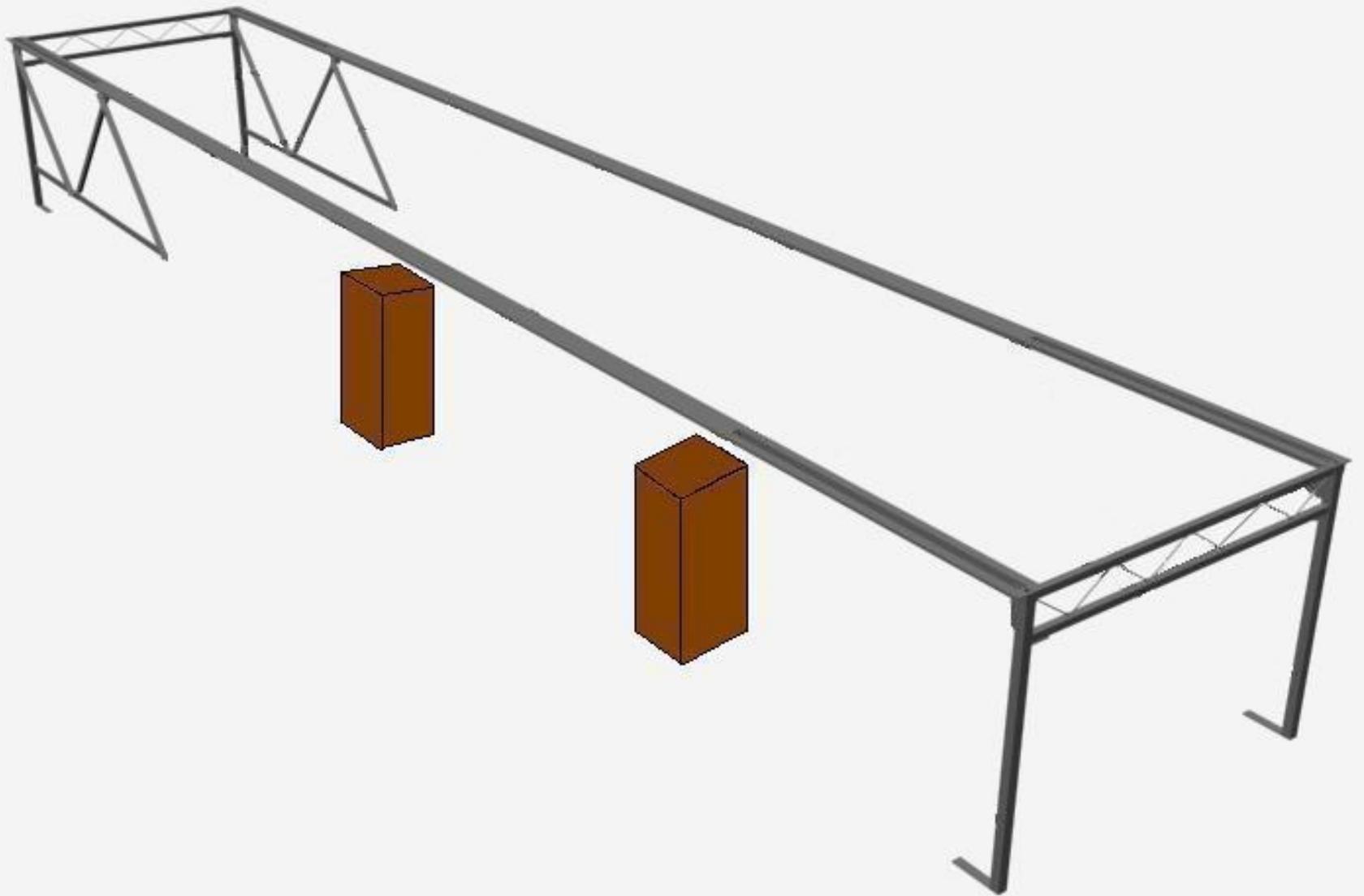


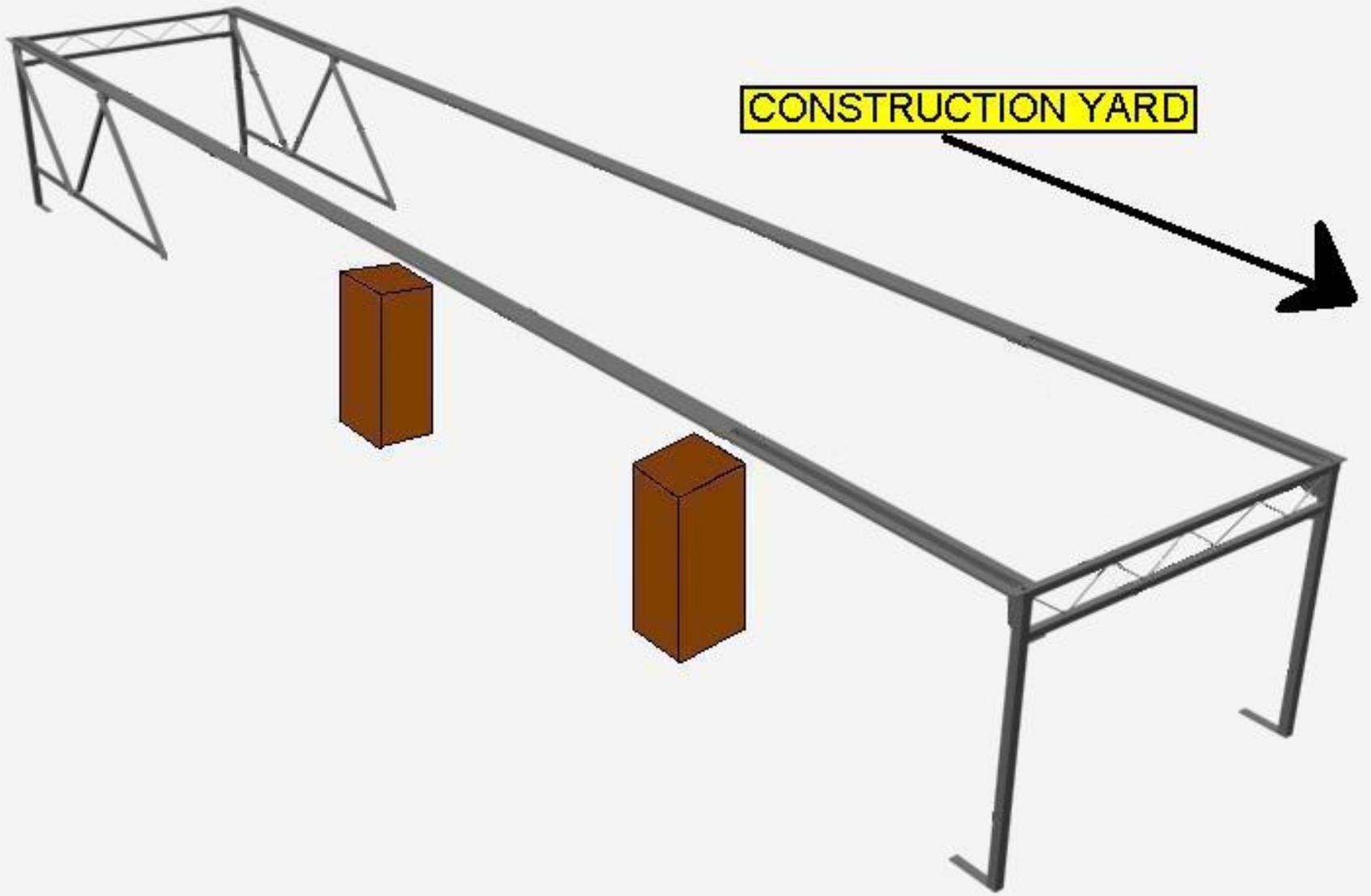




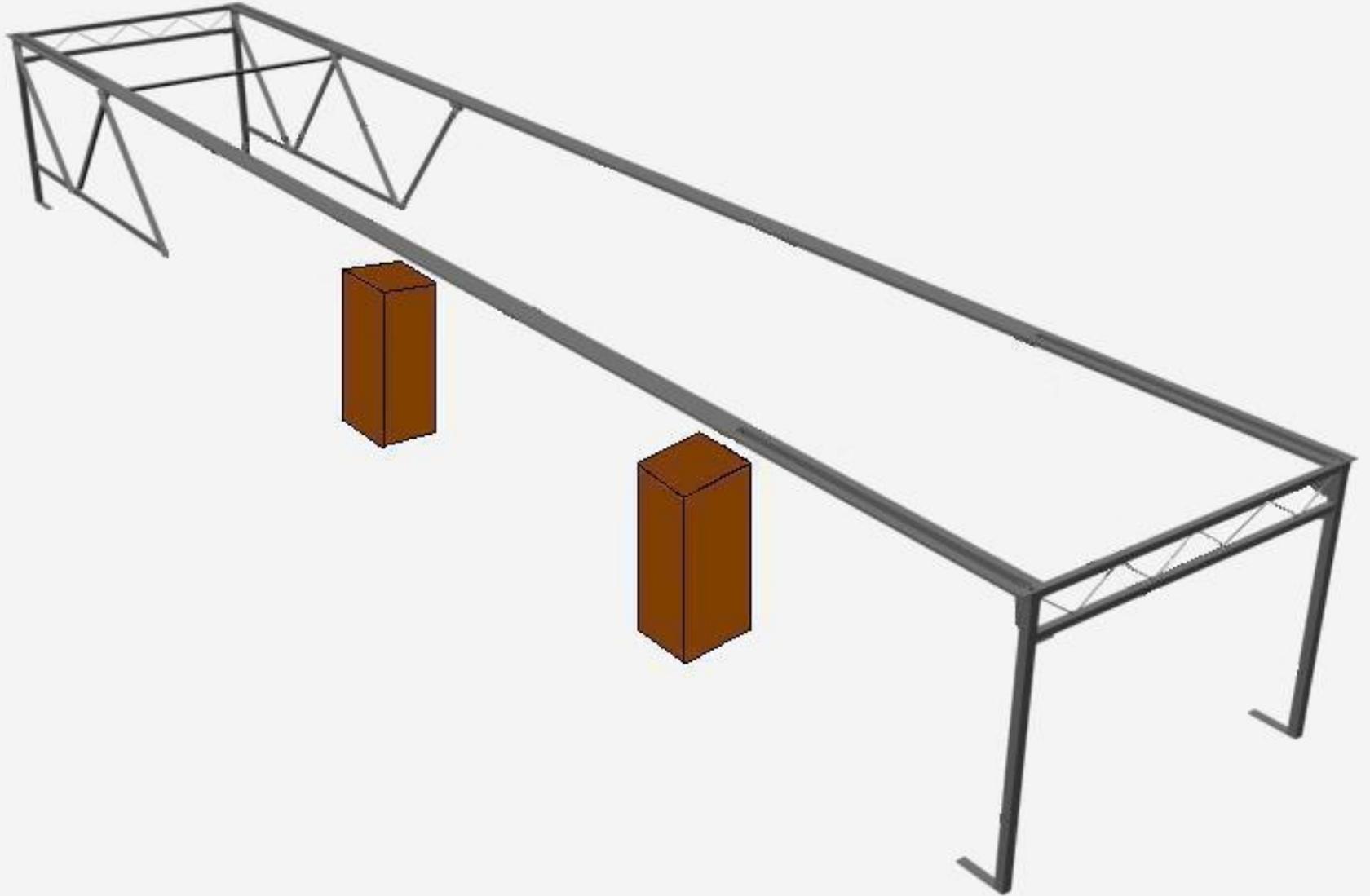


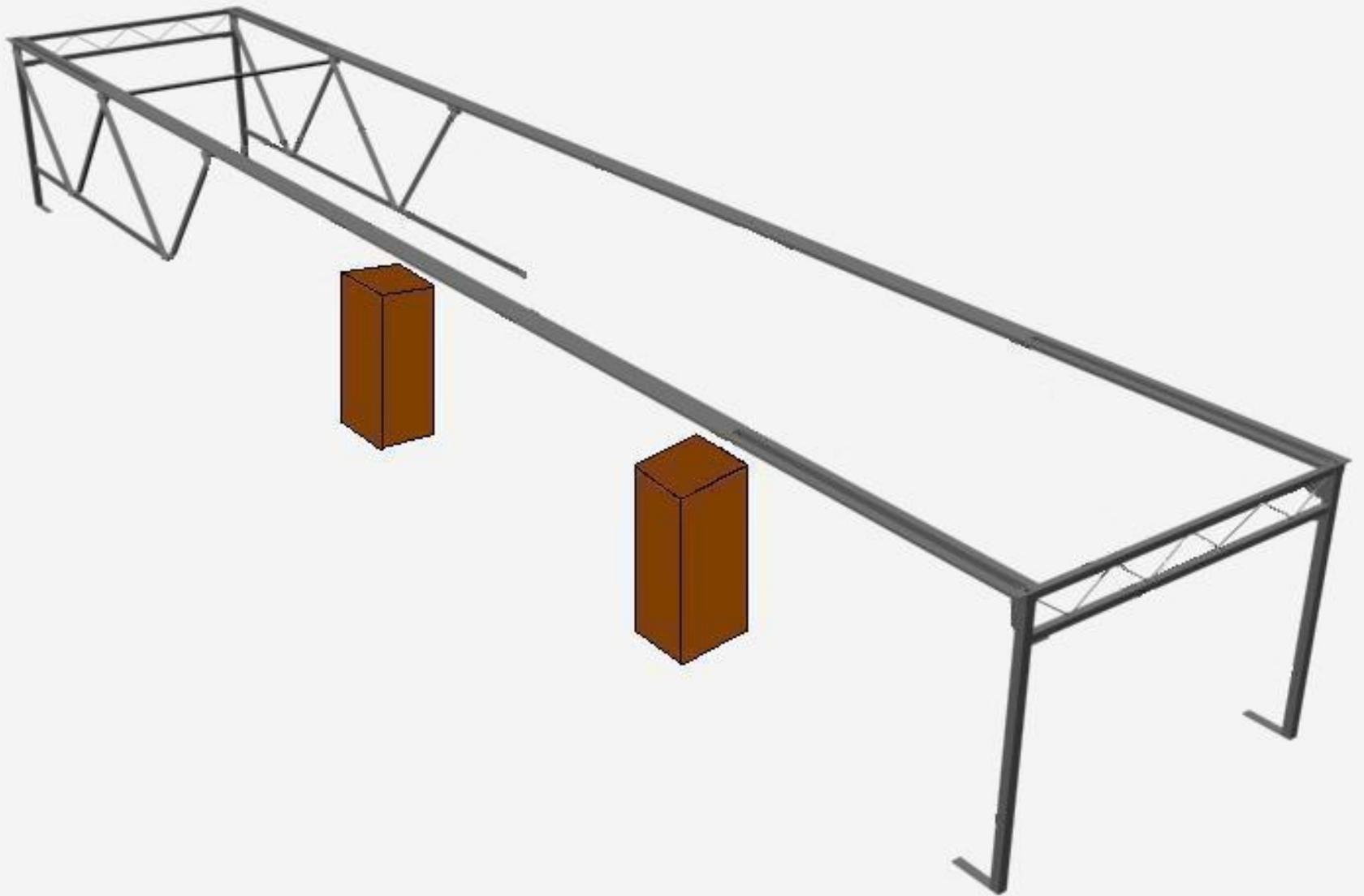


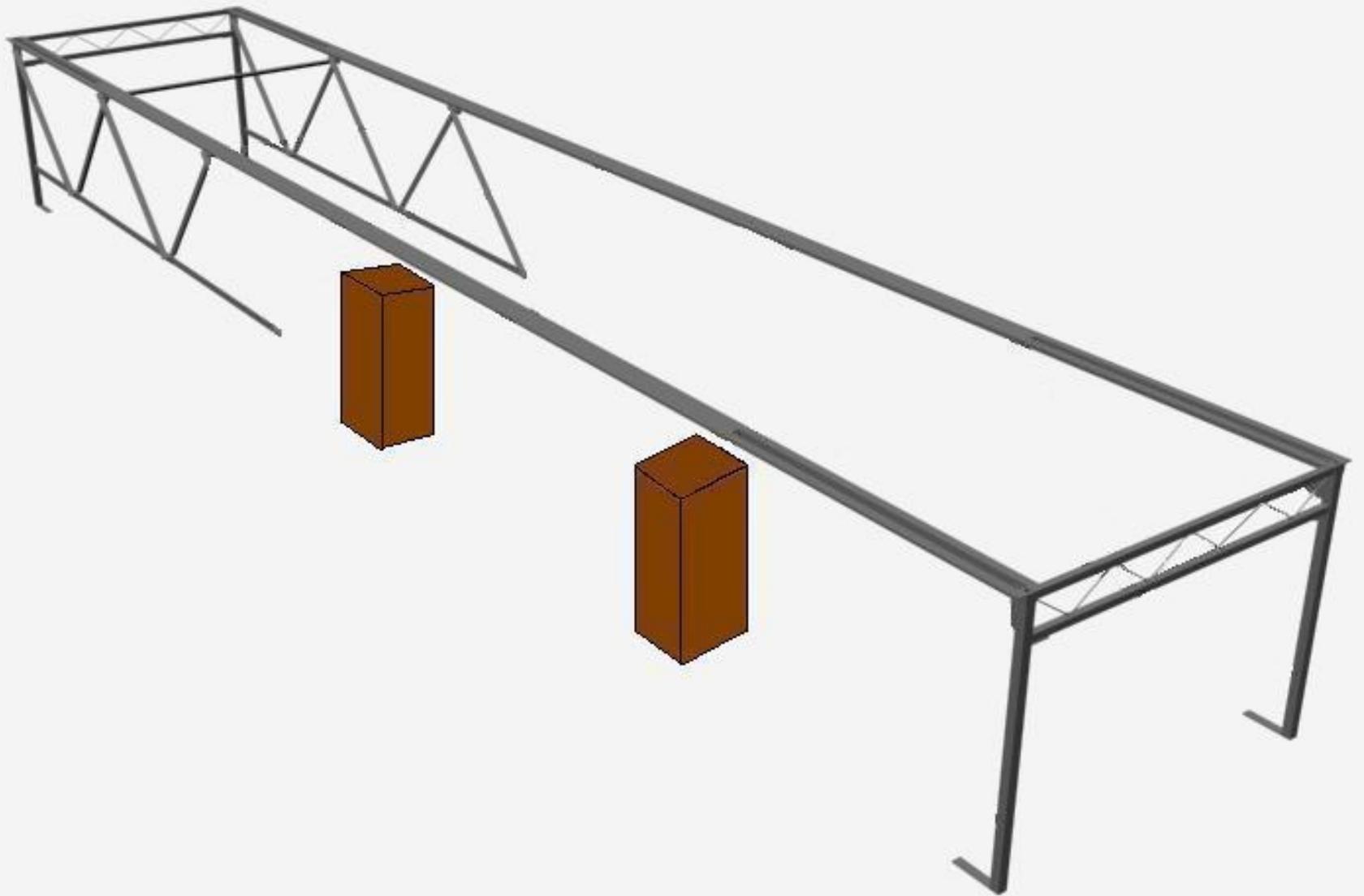


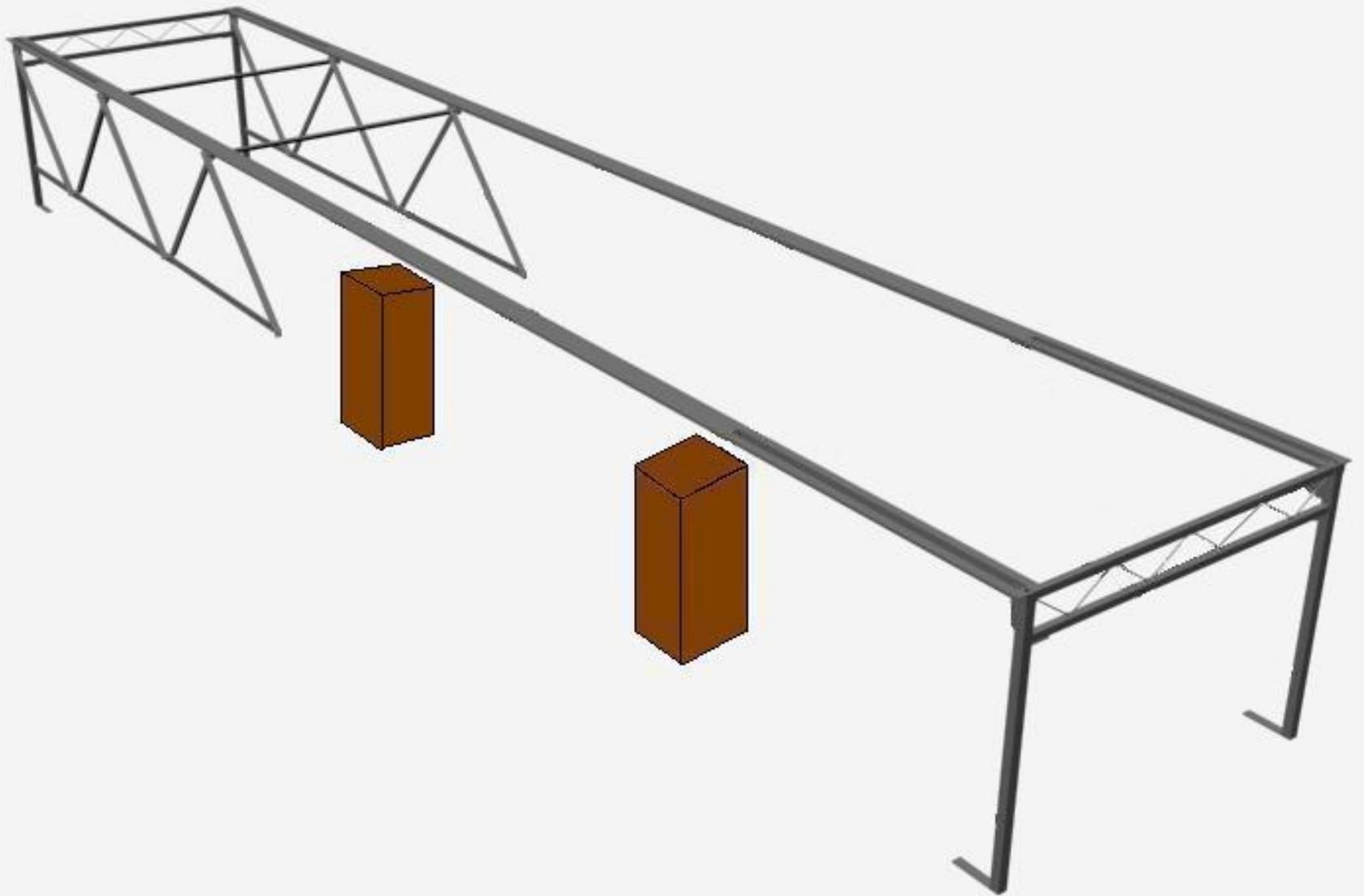


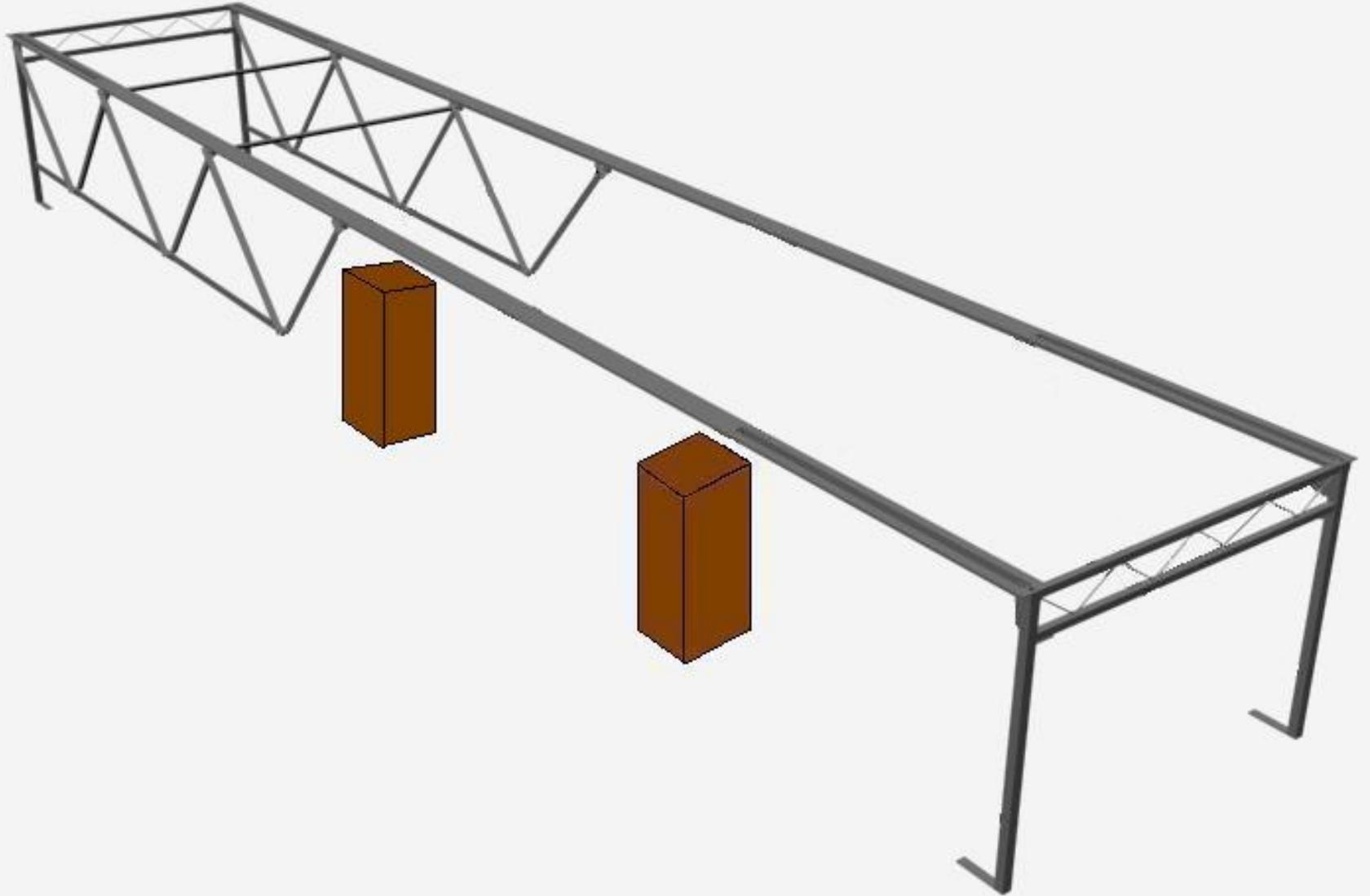
CONSTRUCTION YARD

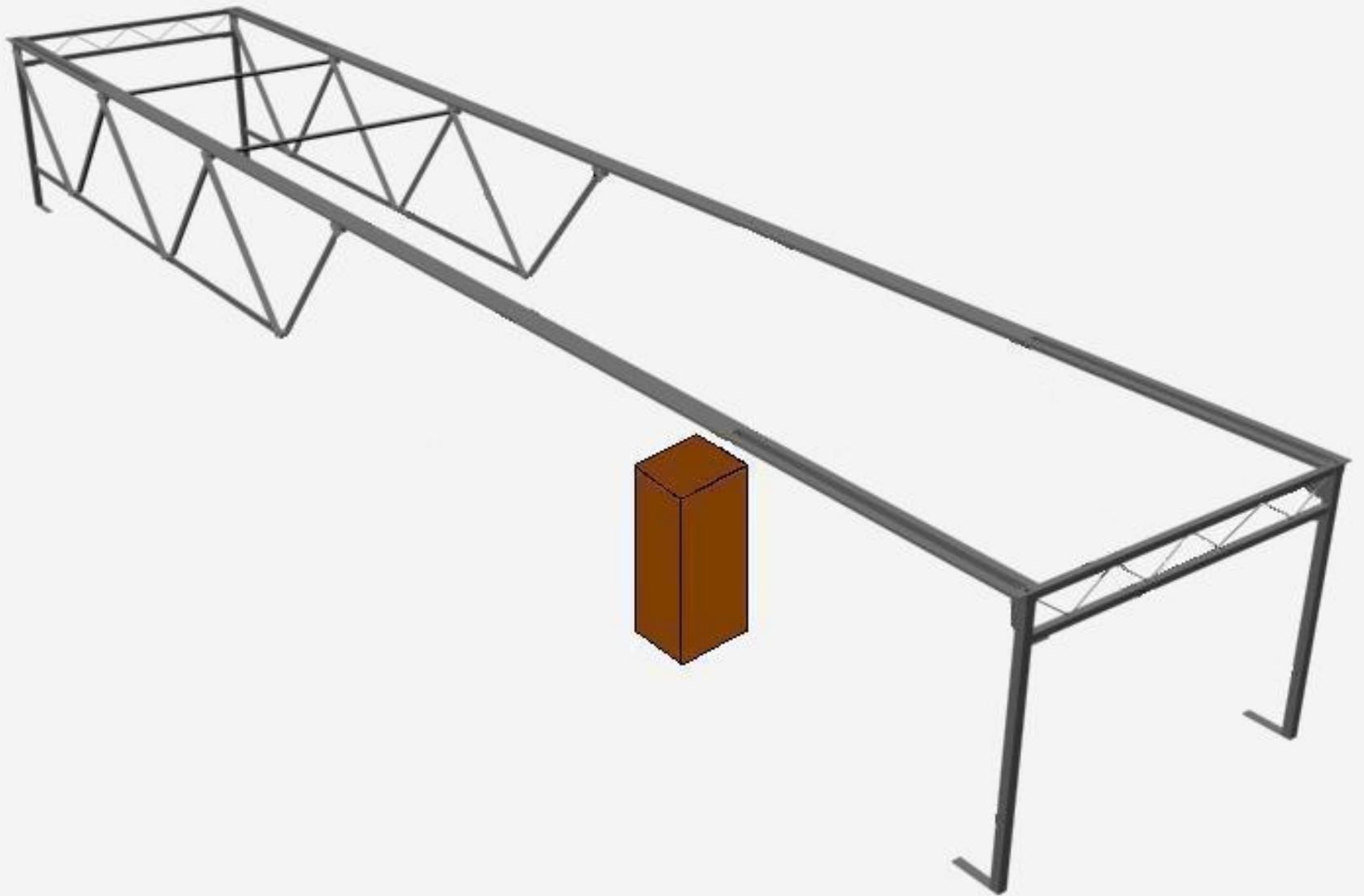


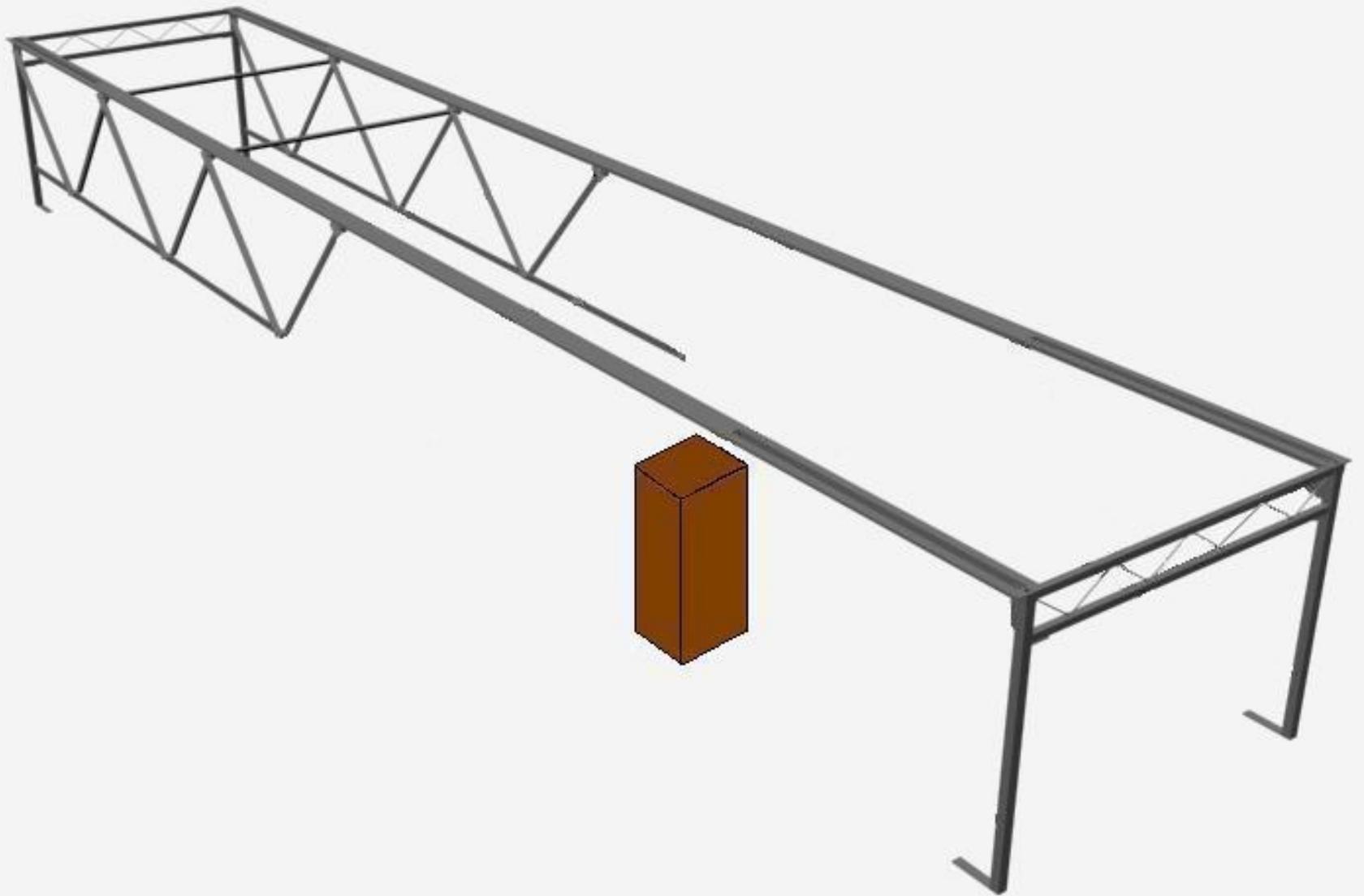


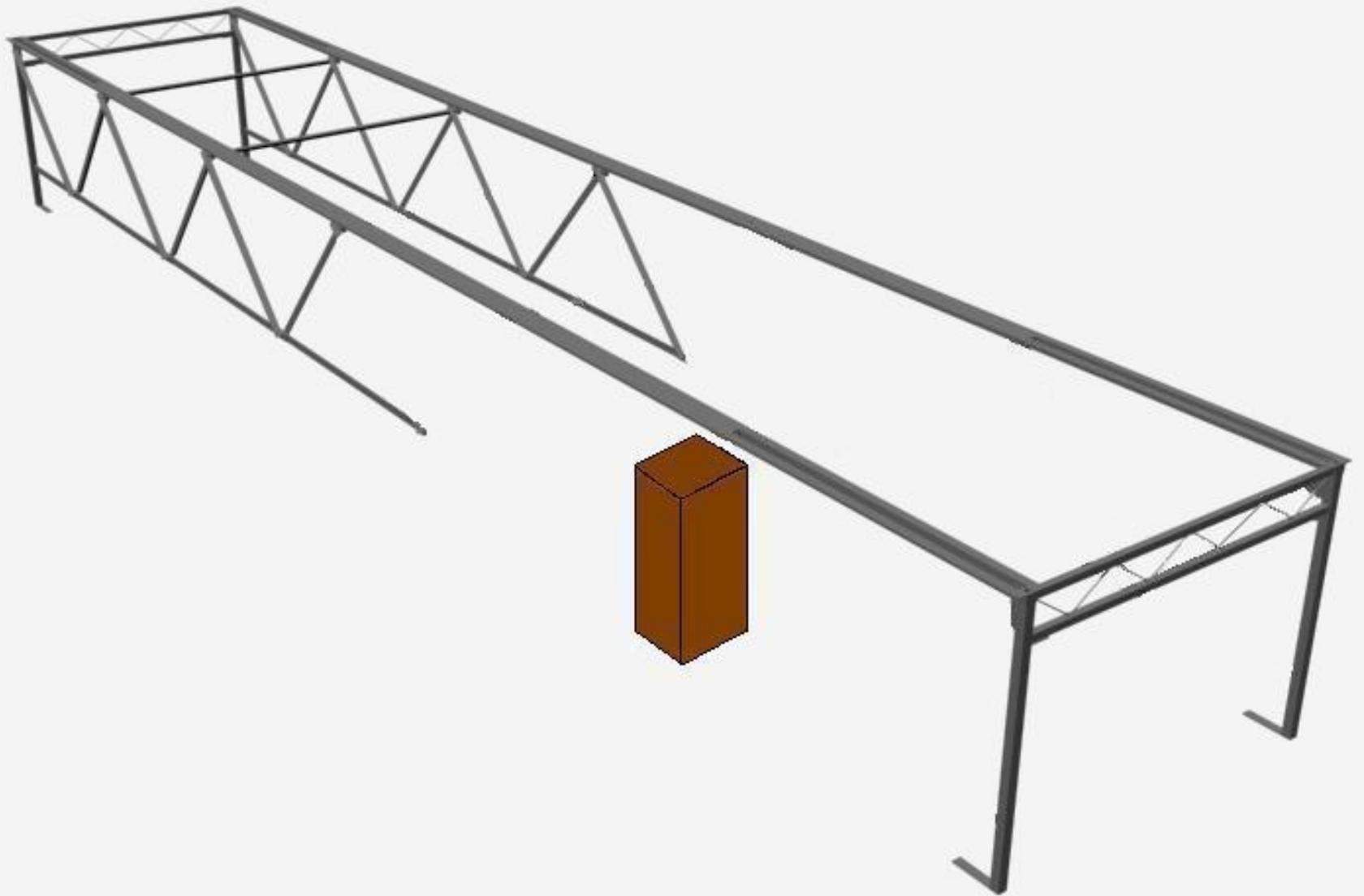


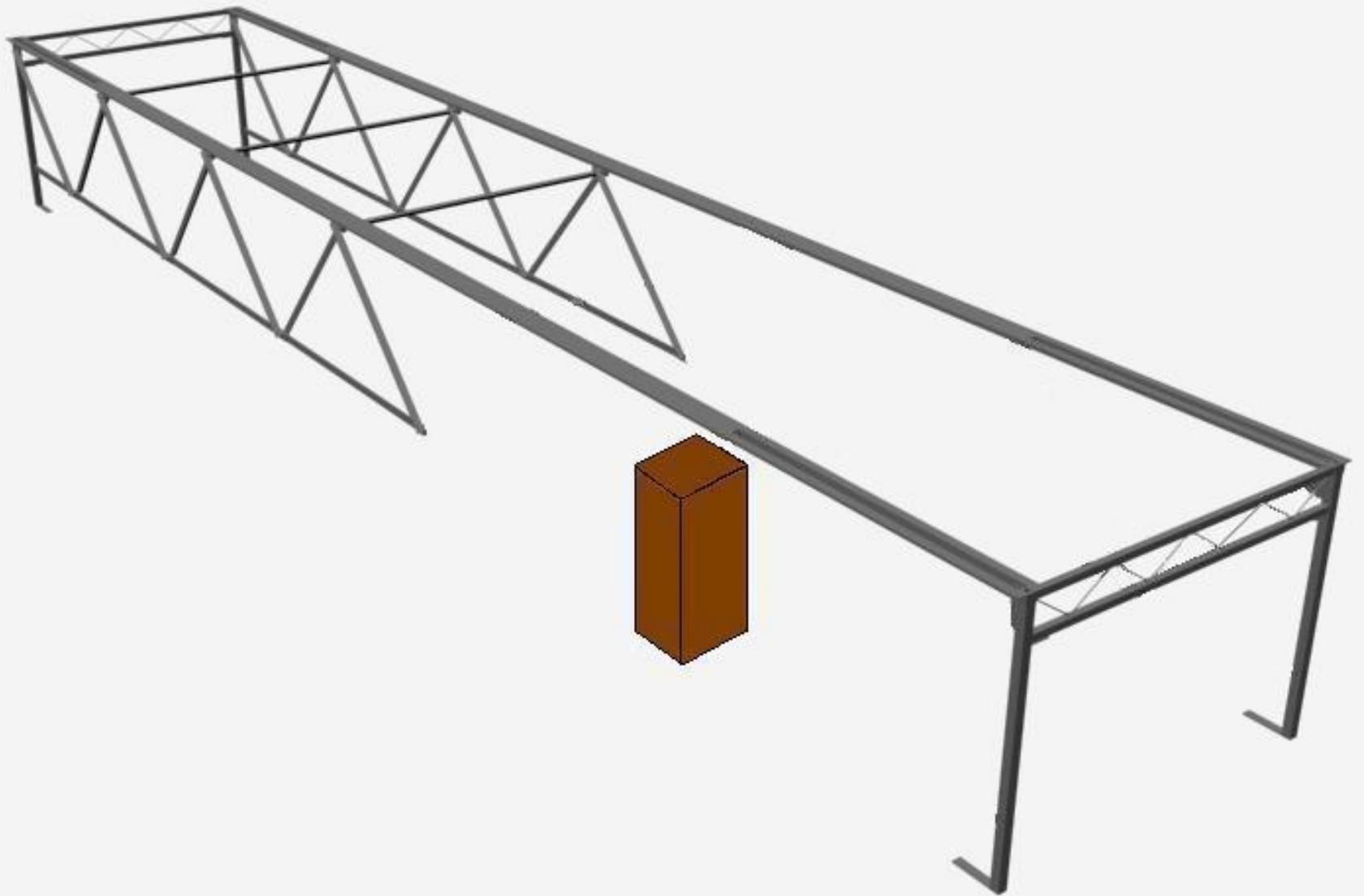


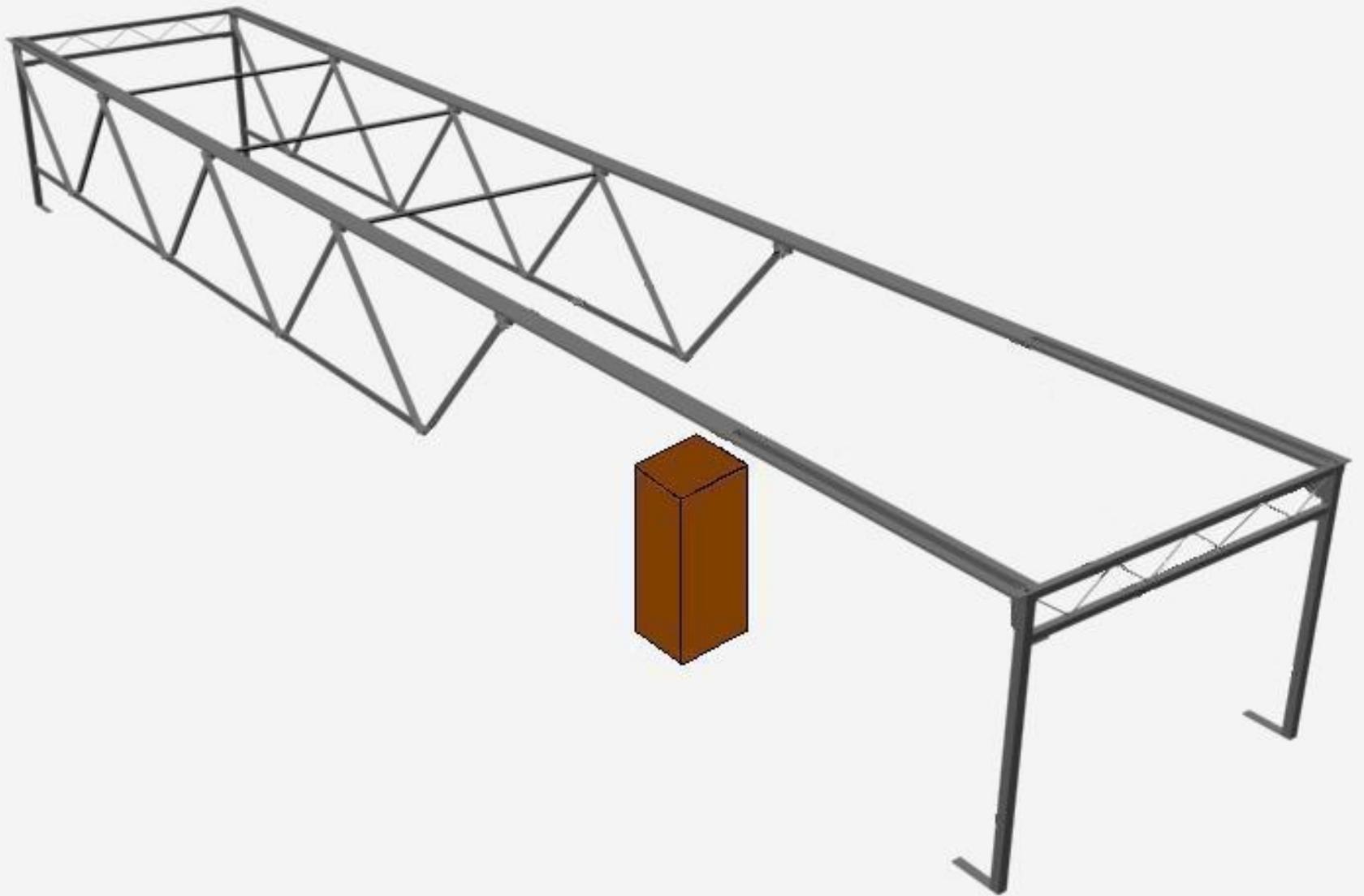


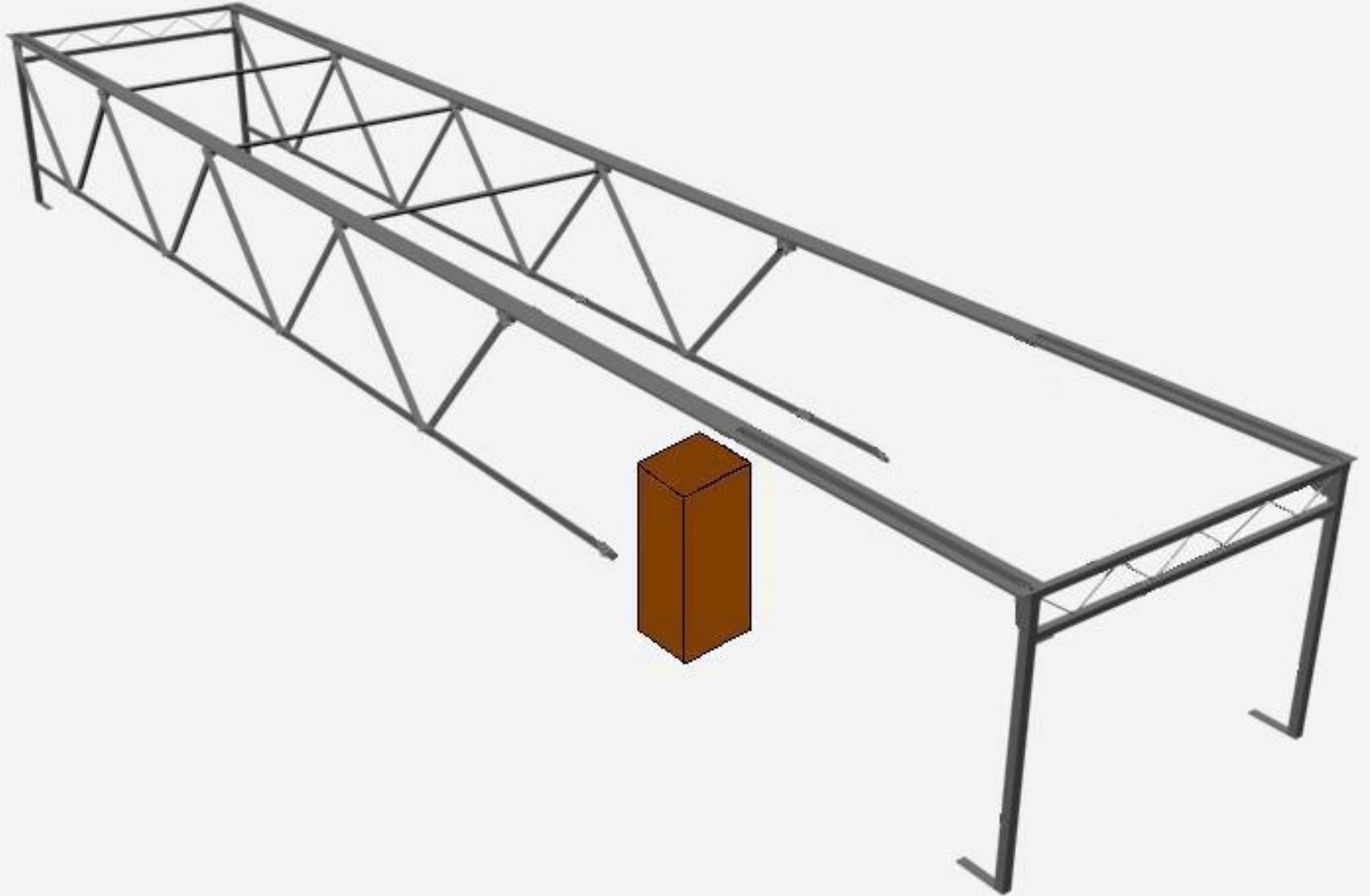


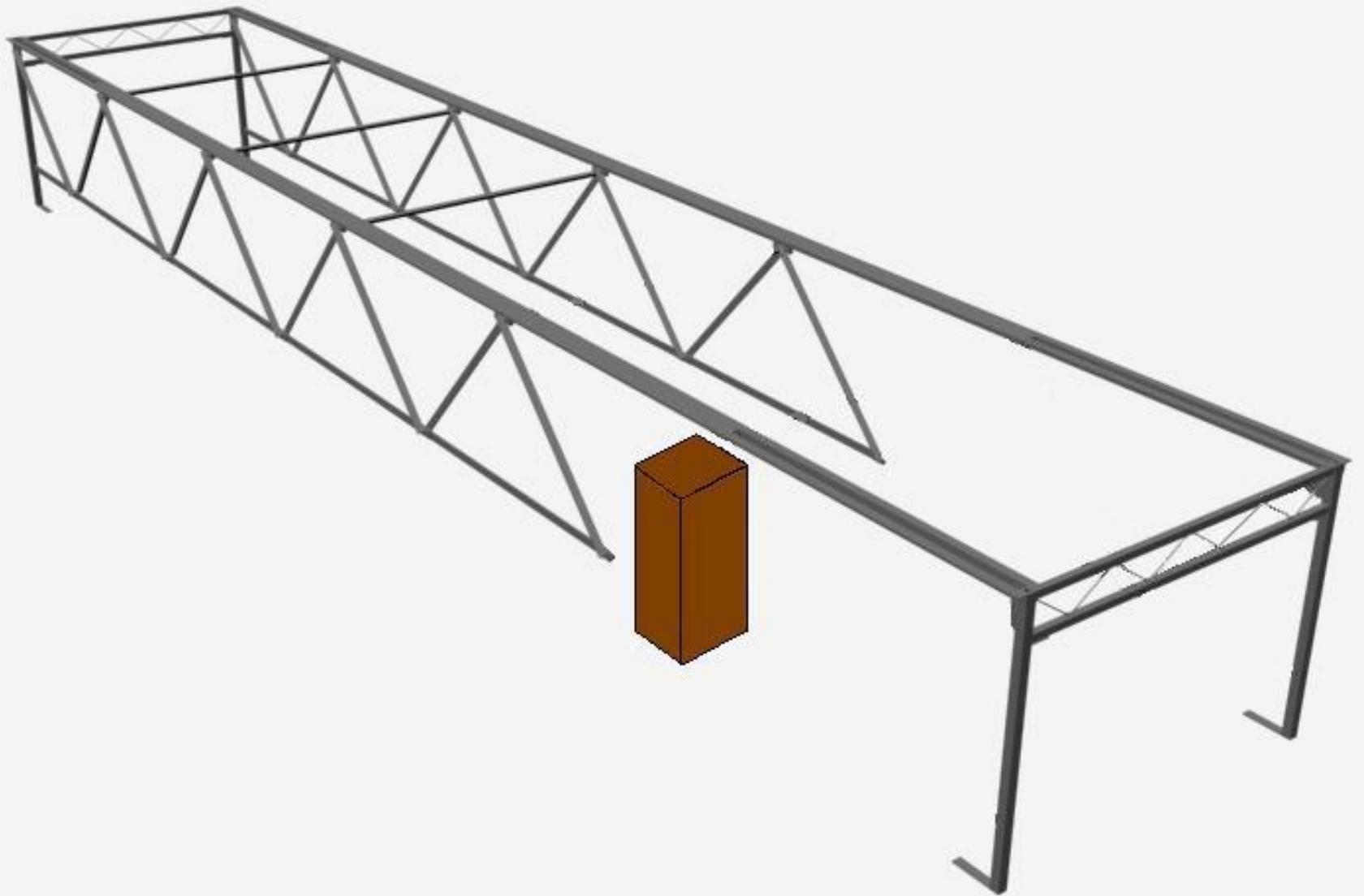


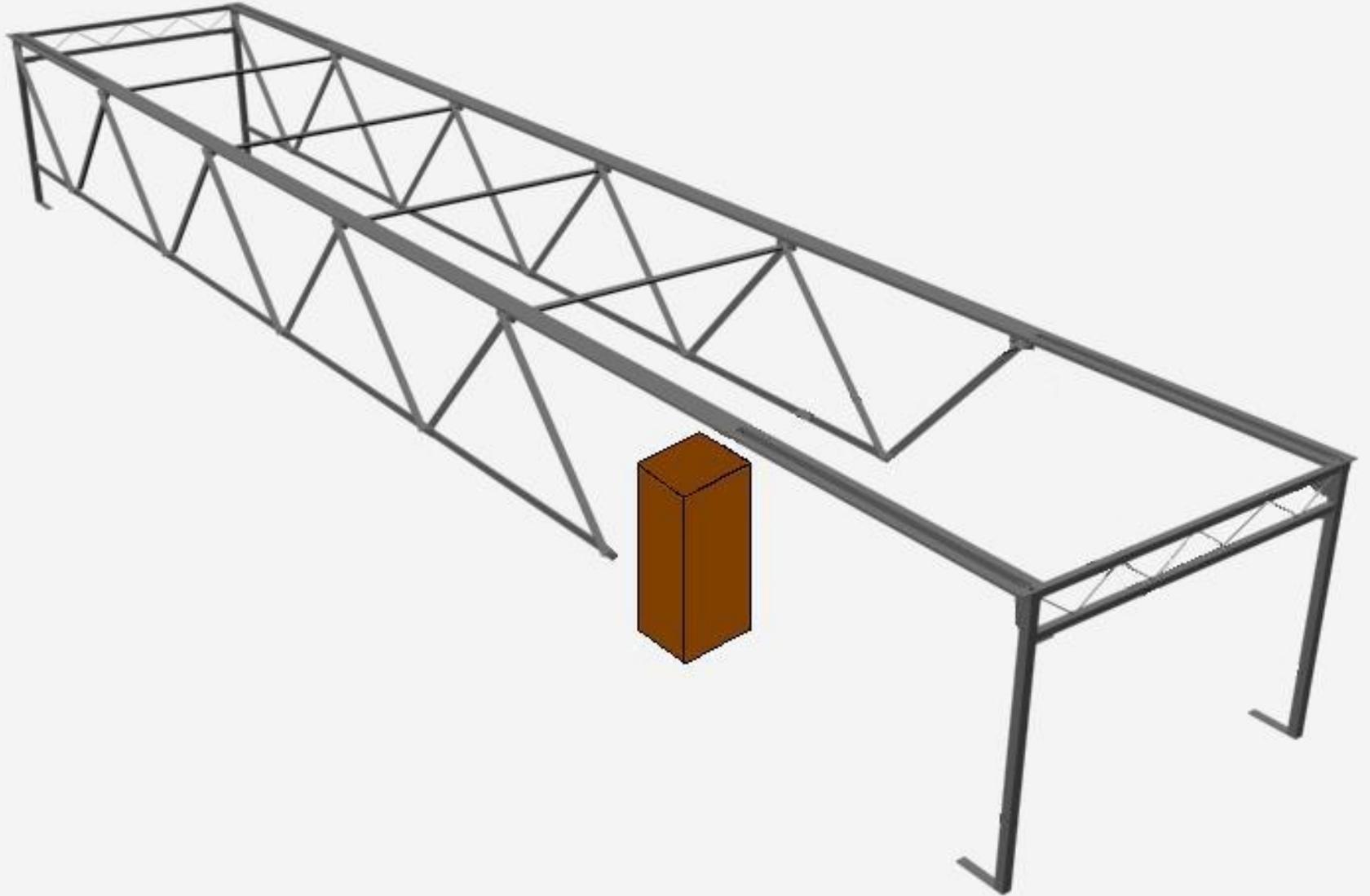


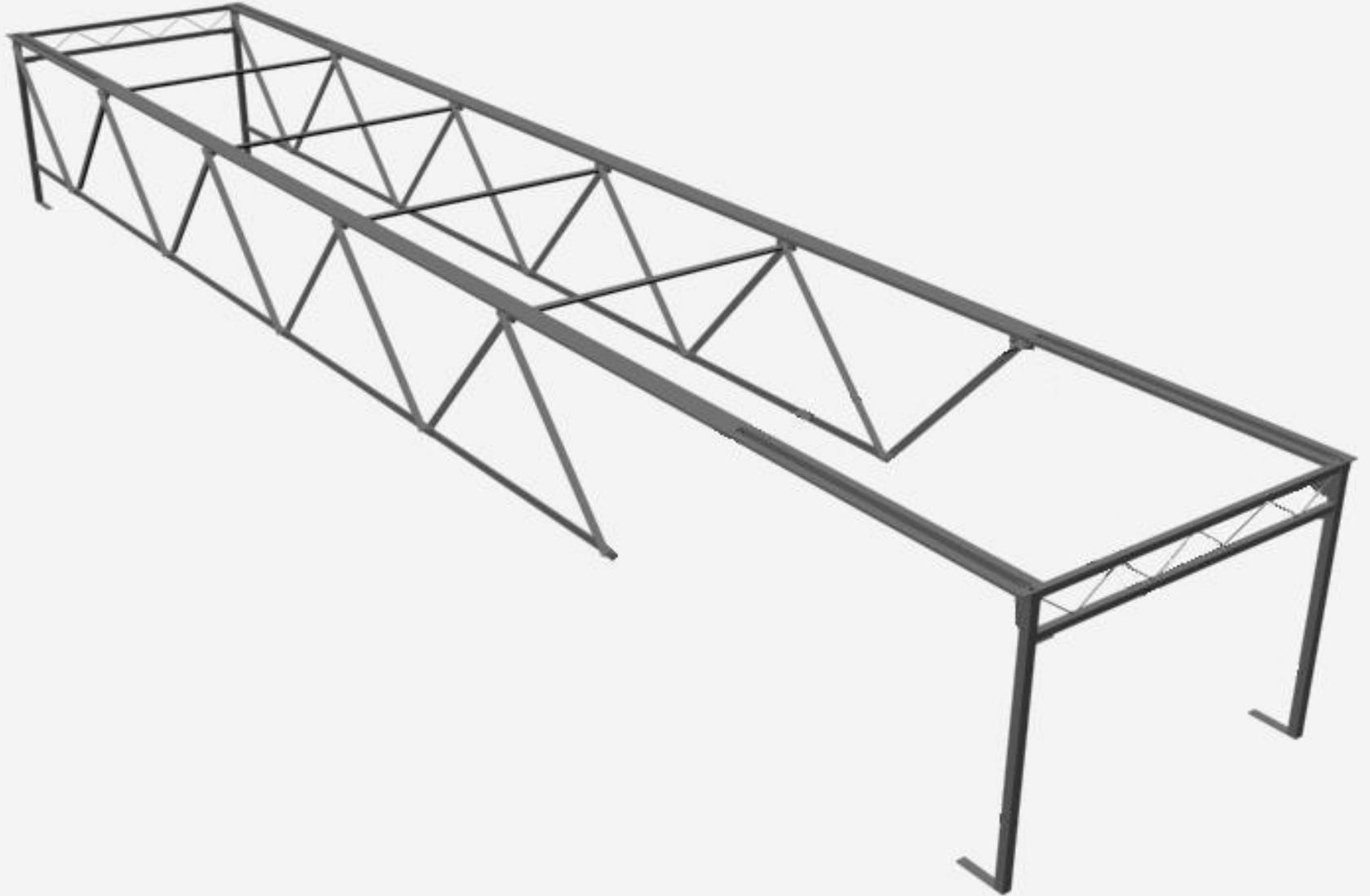


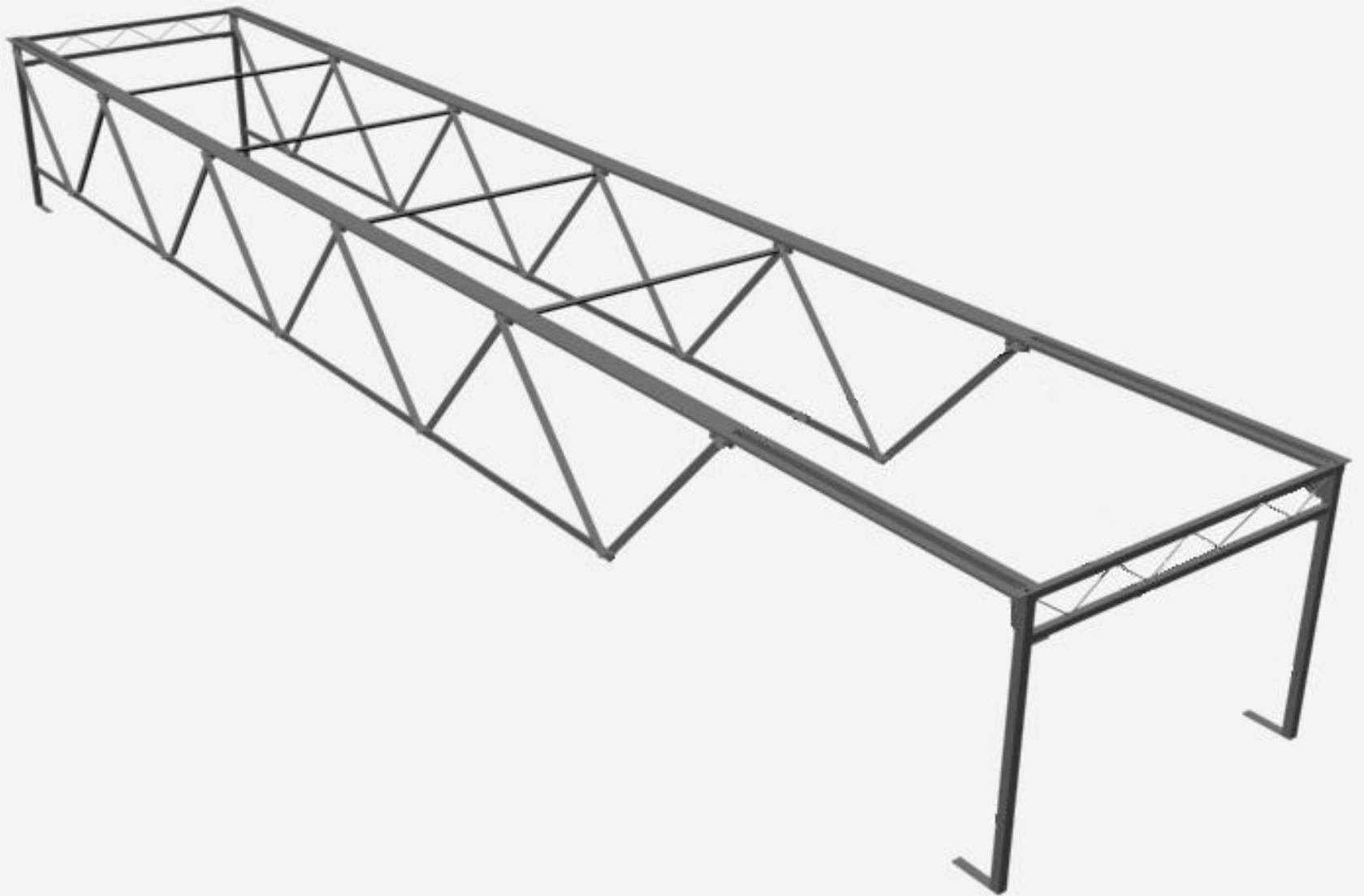


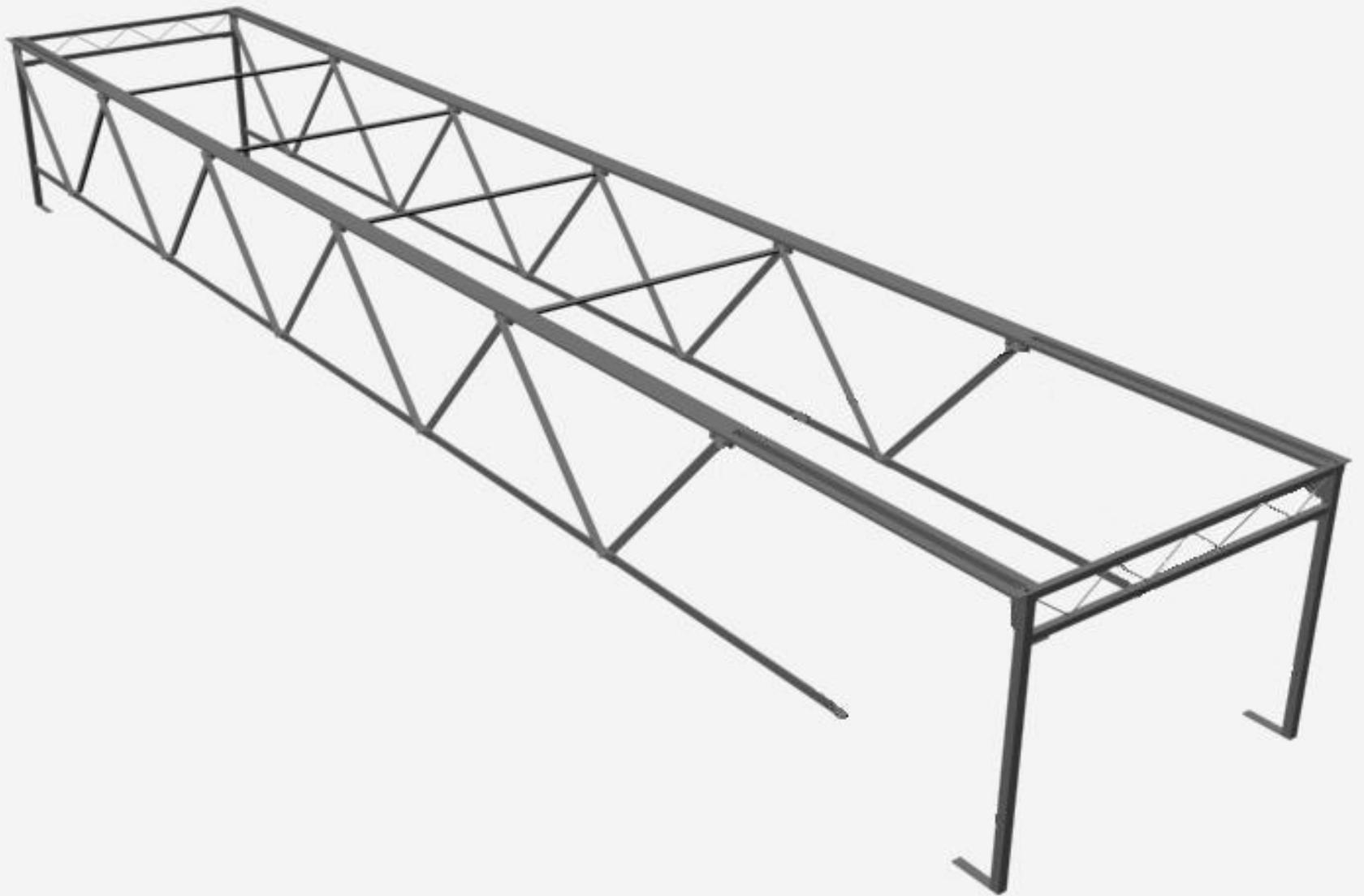


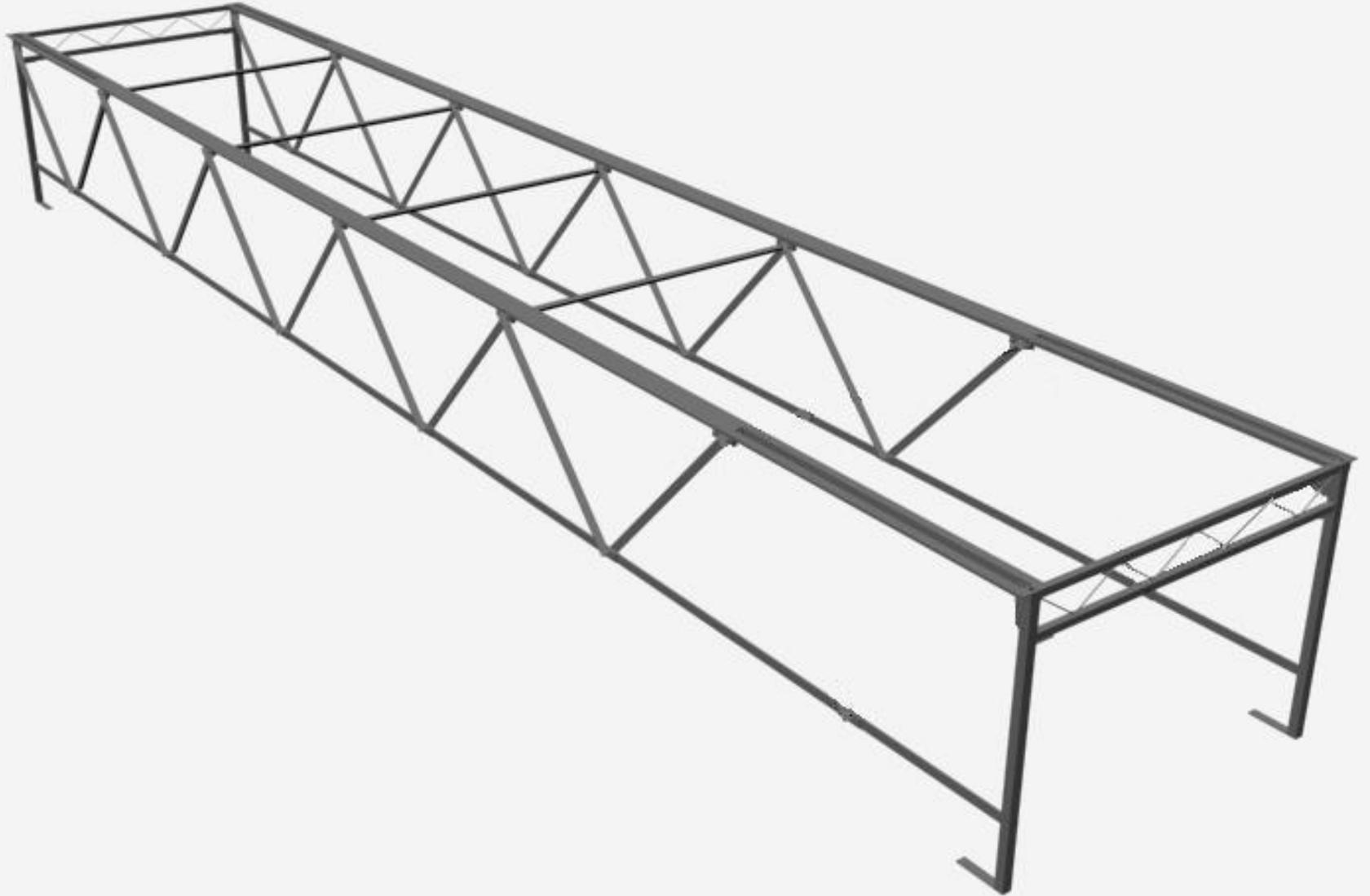


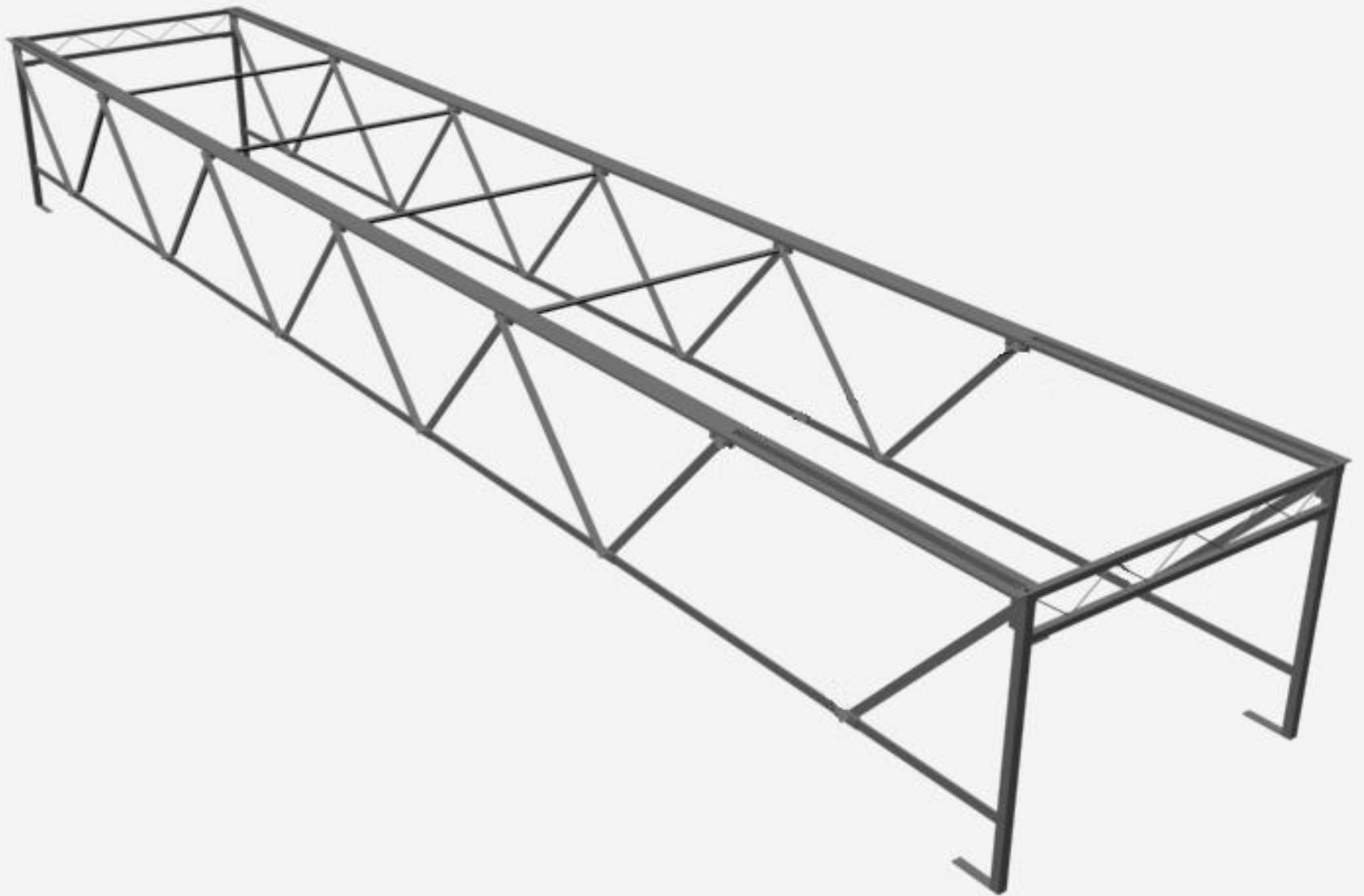


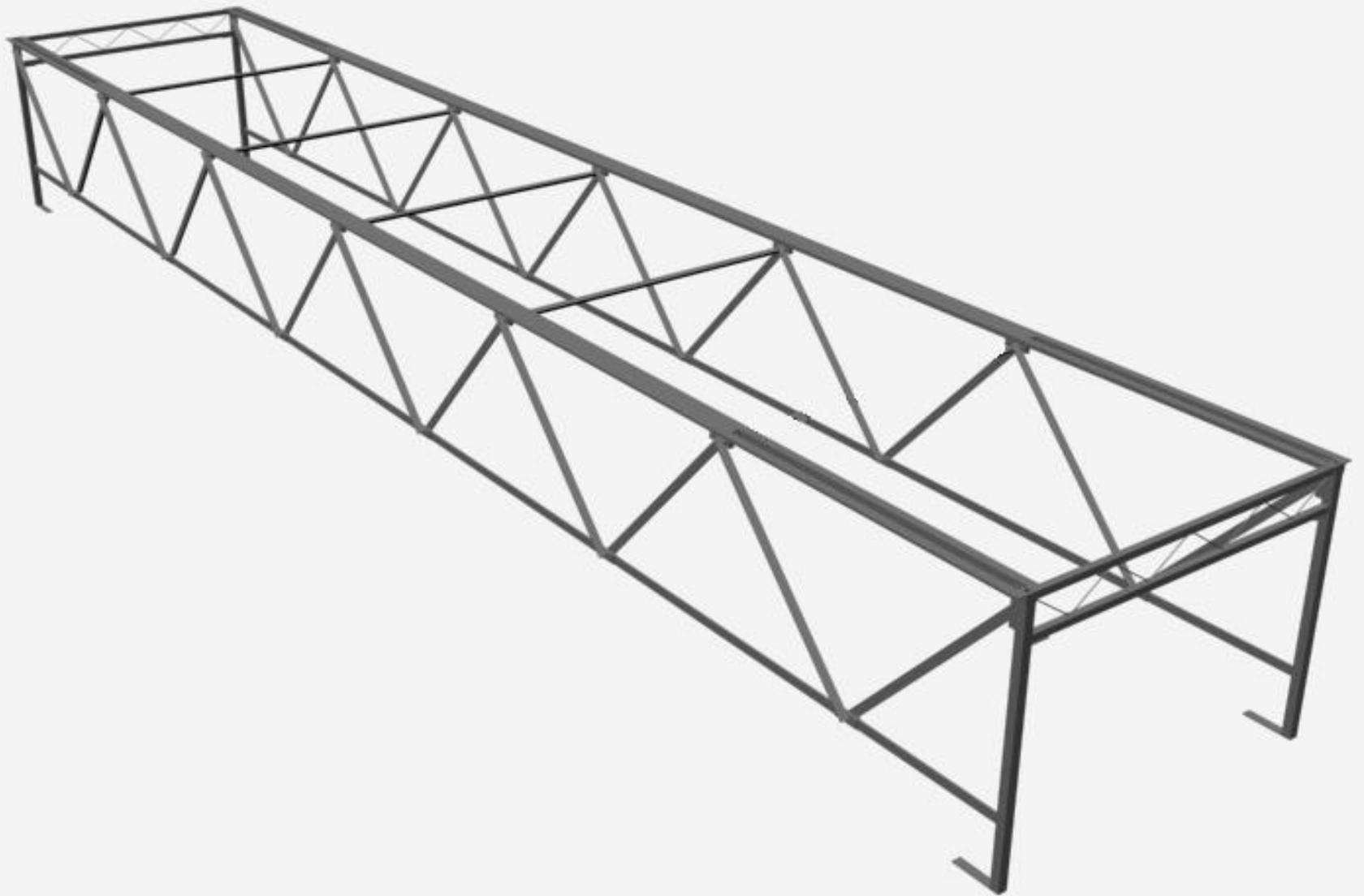


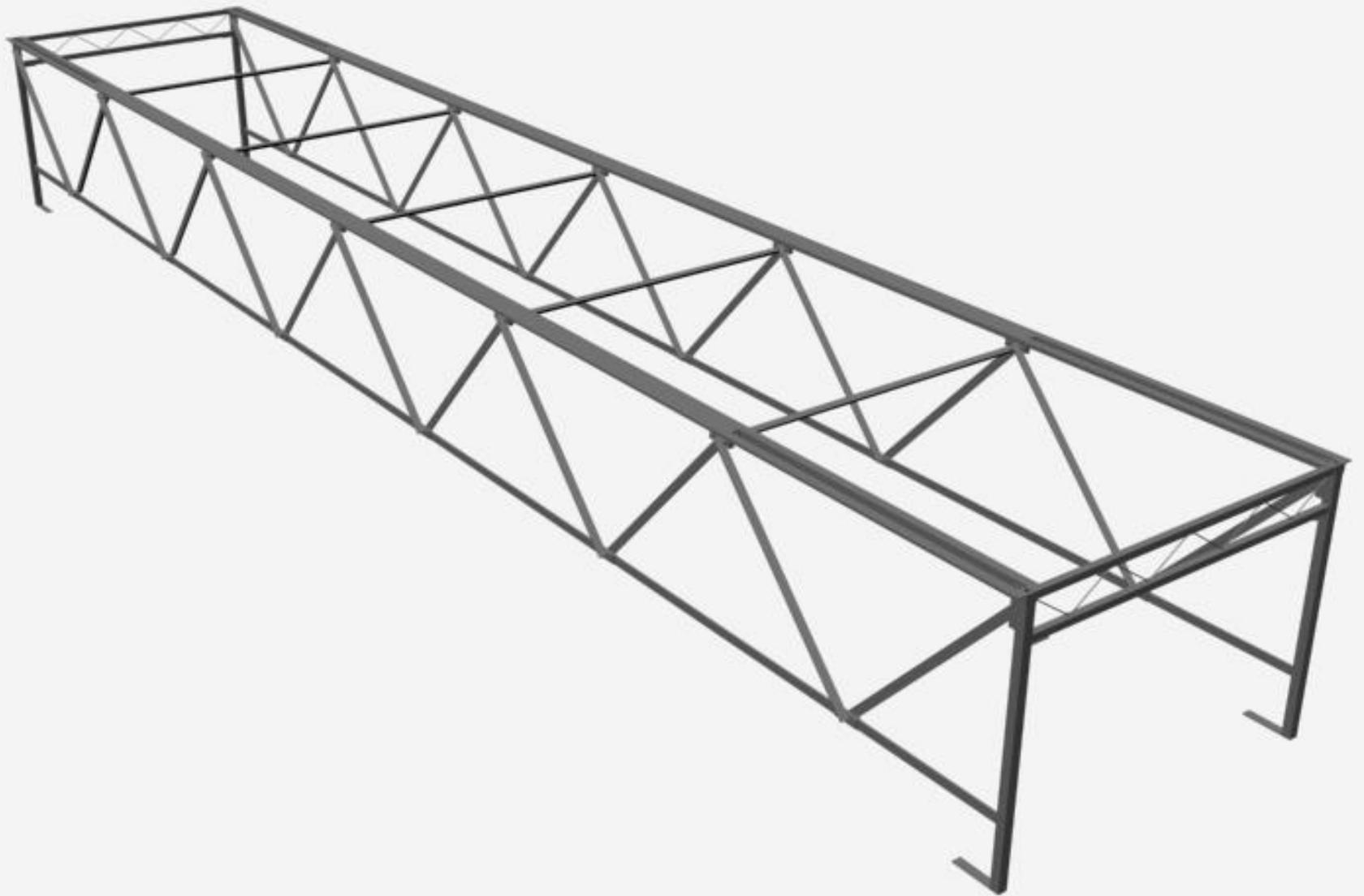












Ethical Issues

- Quebec Bridge Collapse
- Minnesota Bridge
- Kansas City Hyatt



Accomplishments

- The progression of this operation has advanced well beyond last years by this time.
- Giving ASCE plenty of time for preparation for the competition
- This allotted time will ensure our success at the ASCE/AISC Steel Bridge Competition

THANK YOU

FIN

