Implementing Assisted Evacuation and Integrated Fire Model Results in Pathfinder and PyroSim

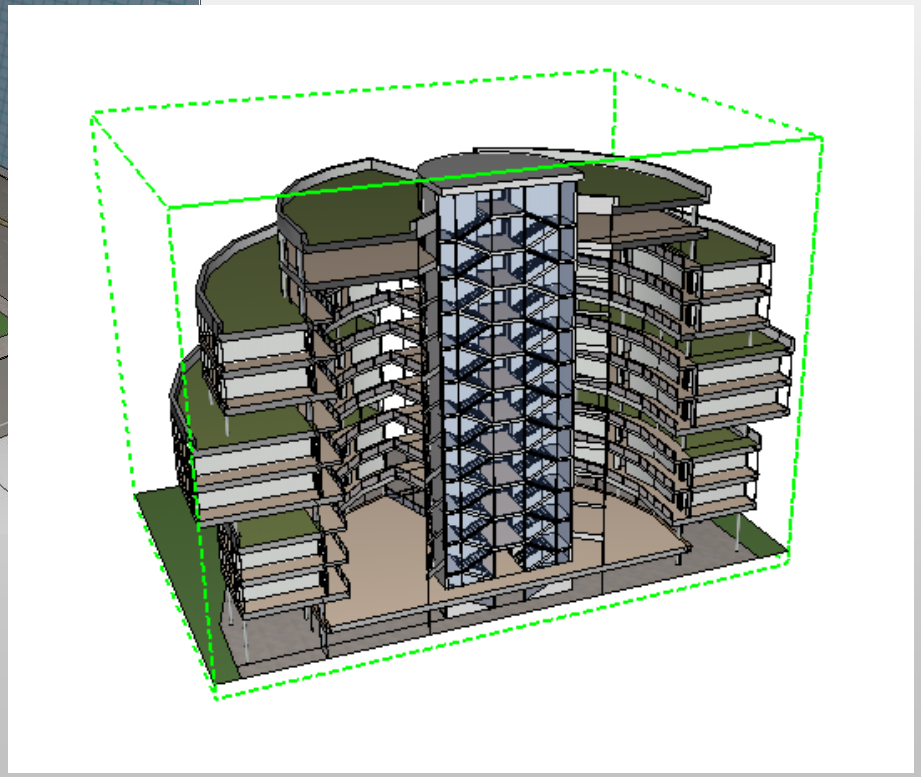
Pathfinder

PyroSim

Recent Improvements

- PyroSim
  - Saved Views
  - Clipping & Section Boxes
  - Lighting/Rendering Improvements
  - CAD Support: FBX/OBJ Files
  - FDS Syntax Highlighting

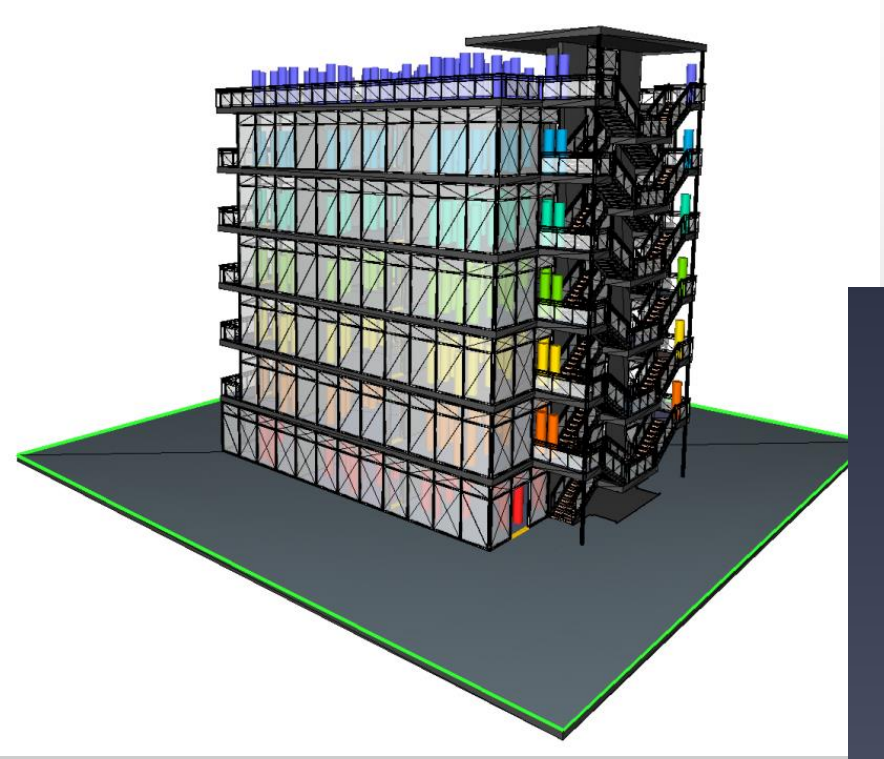
Section Boxes and Clipping

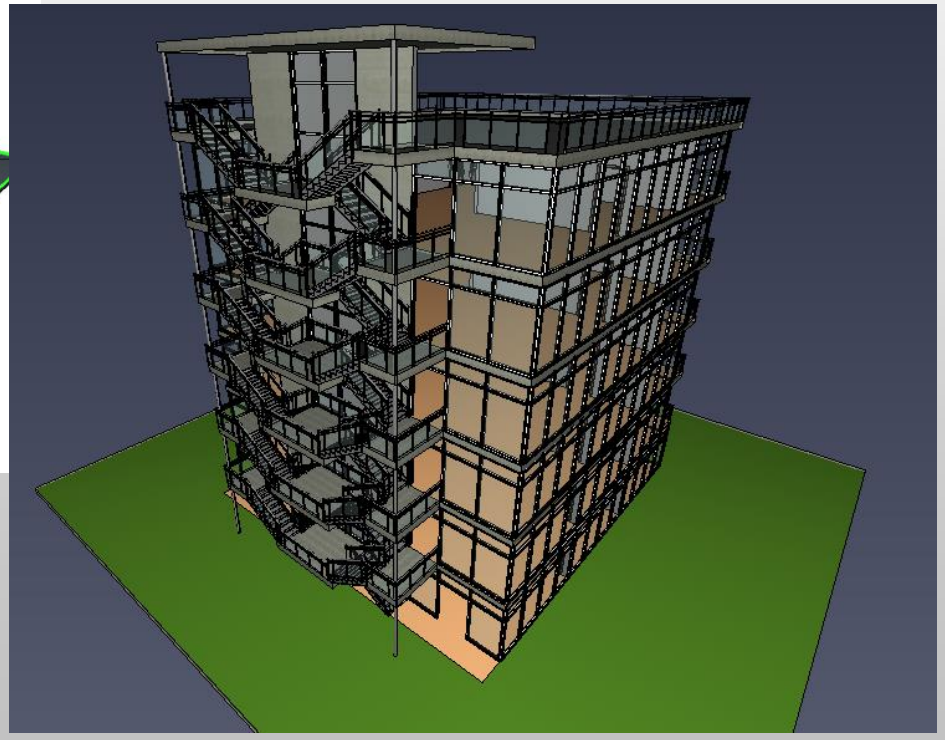


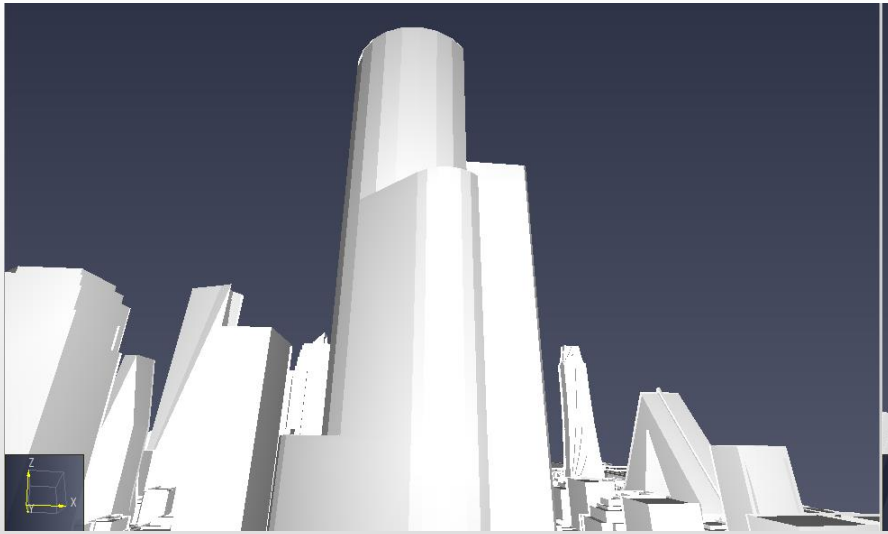
Improved CAD Support (FBX)

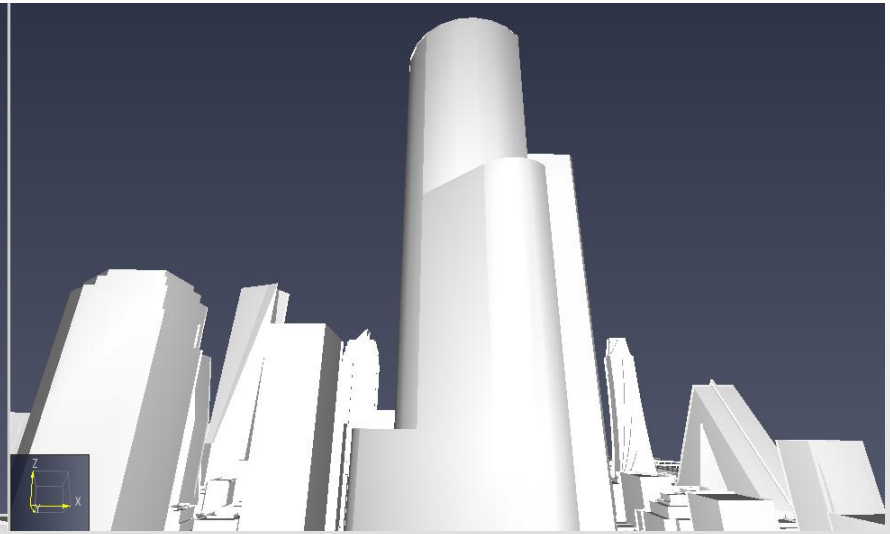
Z
Y
X

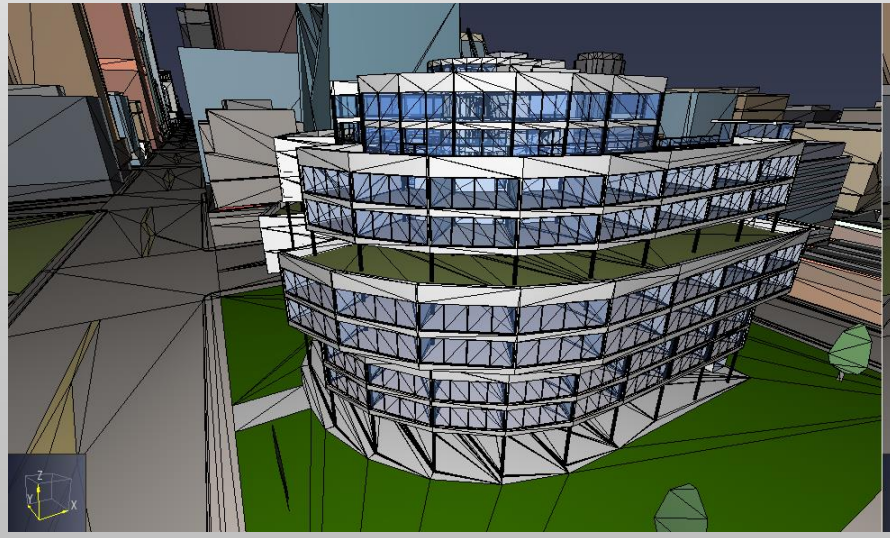
Rendering and Lighting Changes

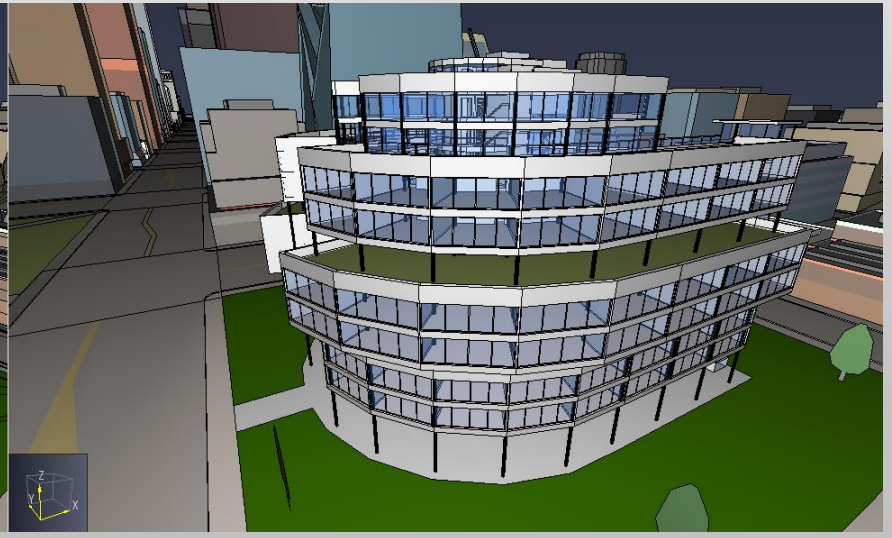




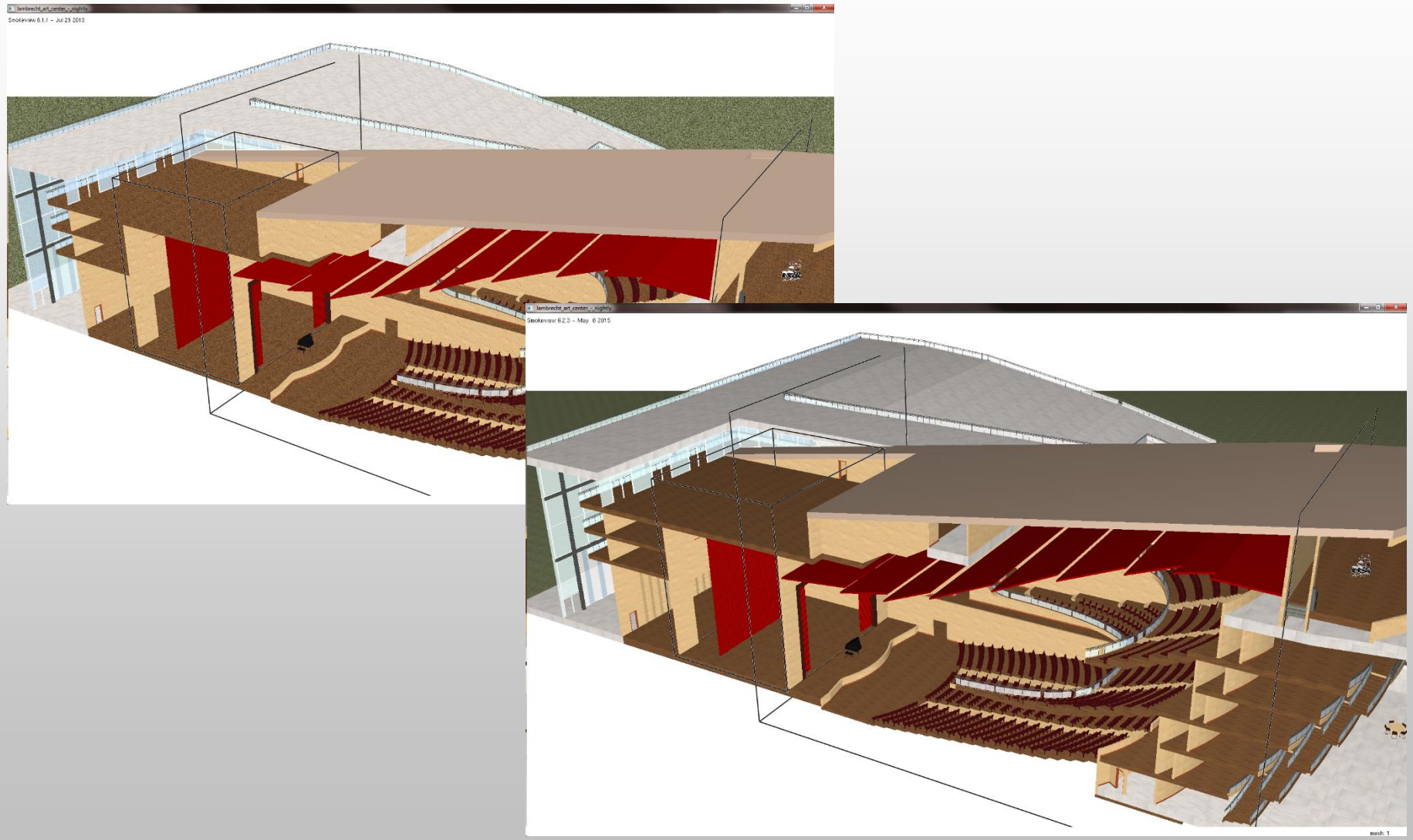








Smokeview Rendering Changes



Model Records (Read-Only):

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--------------------PyroSim-generated Section--------------------

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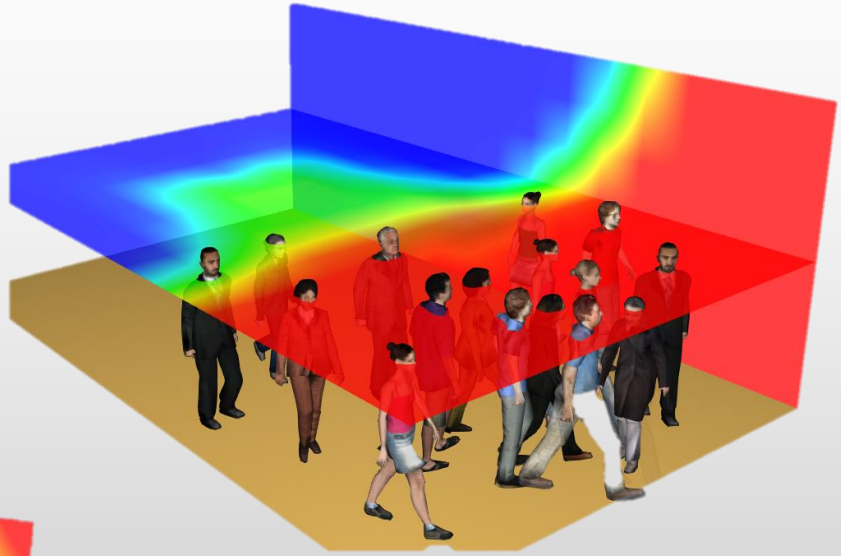
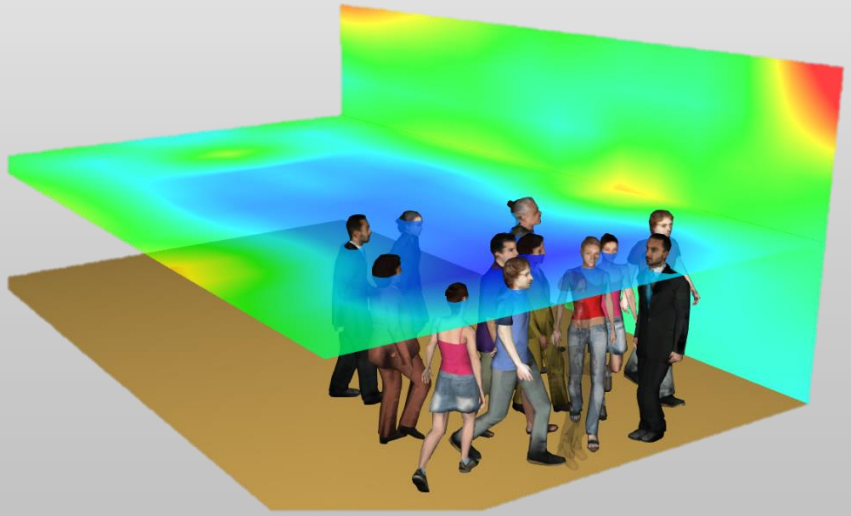
Recent Improvements

- Pathfinder
  - FDS Slice Display
  - Dynamic Contours / Heat Maps
  - Fundamental Diagram Customization
    - Separate settings for up/down stairs/ramps
  - Movement Improvements
    - Doors, Corners, boundary layer, counterflow
  - Performance Improvements
  - Exposure Tracking (FED)

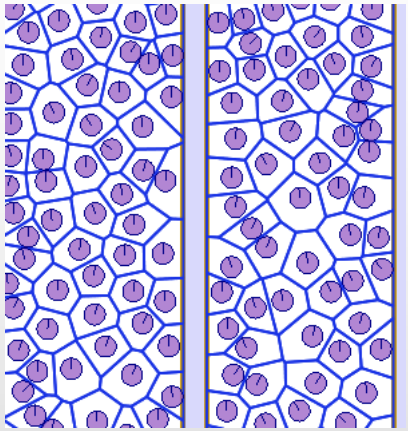
FDS Slices

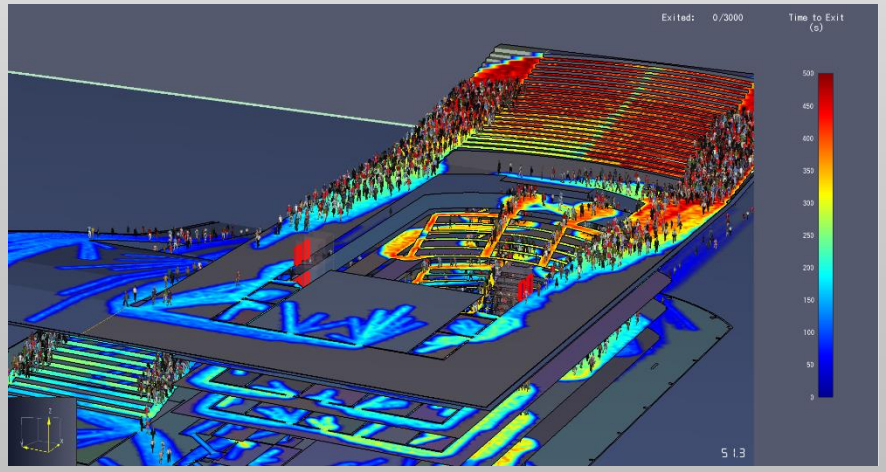


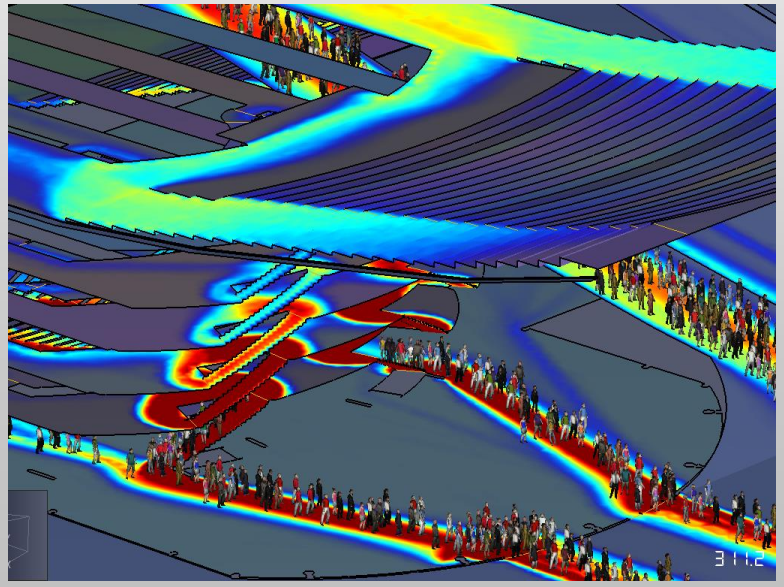


Movement Result Contours

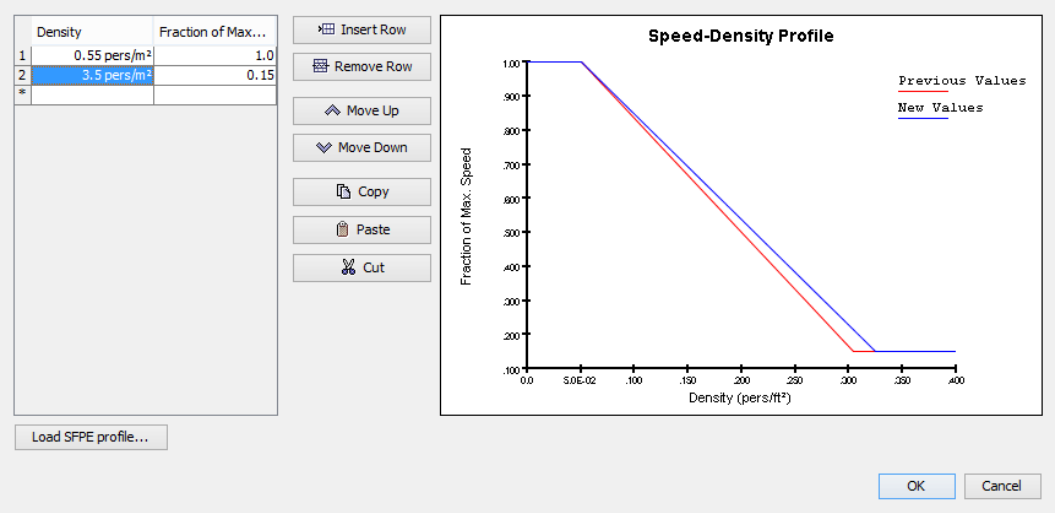
- Density
- Speed
- Level of Service
- Time to Exit

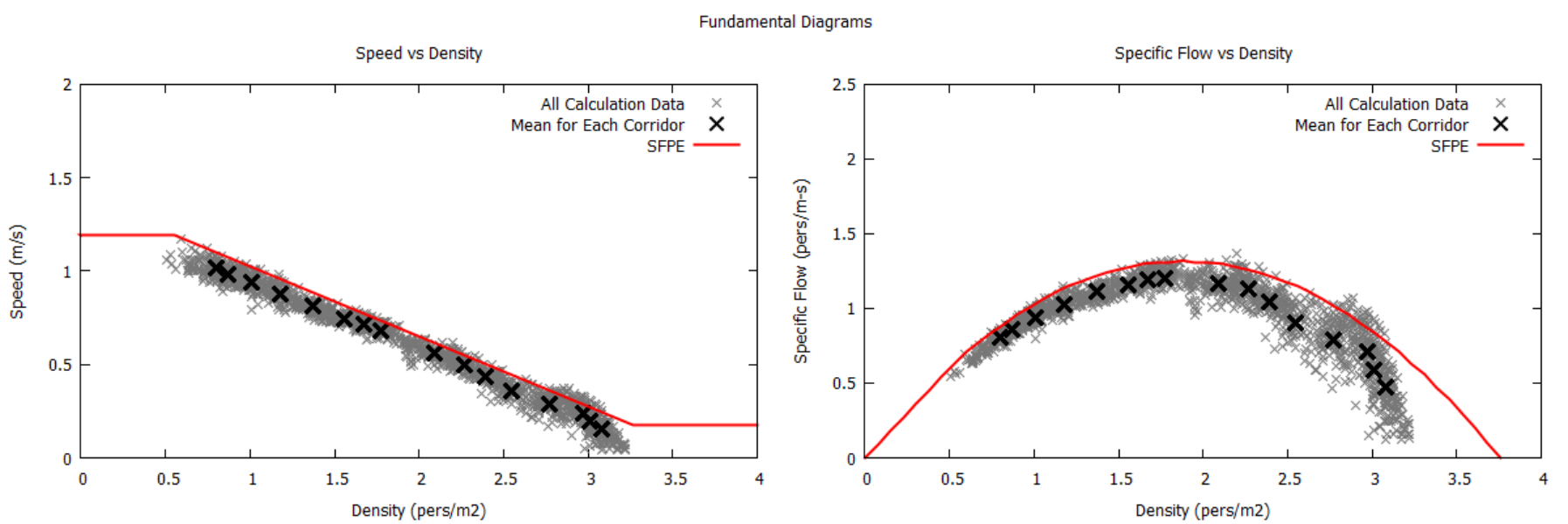




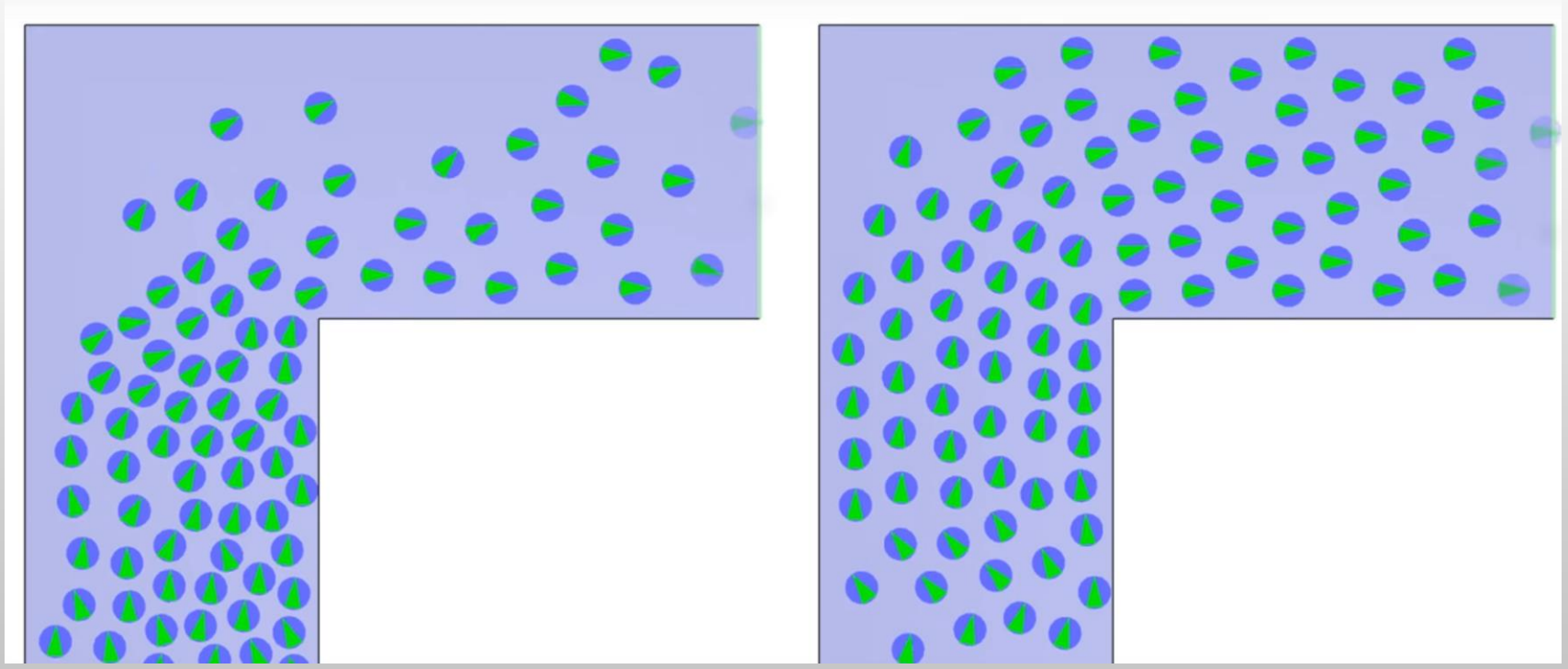


Speed-Density Customization





Improved local movement



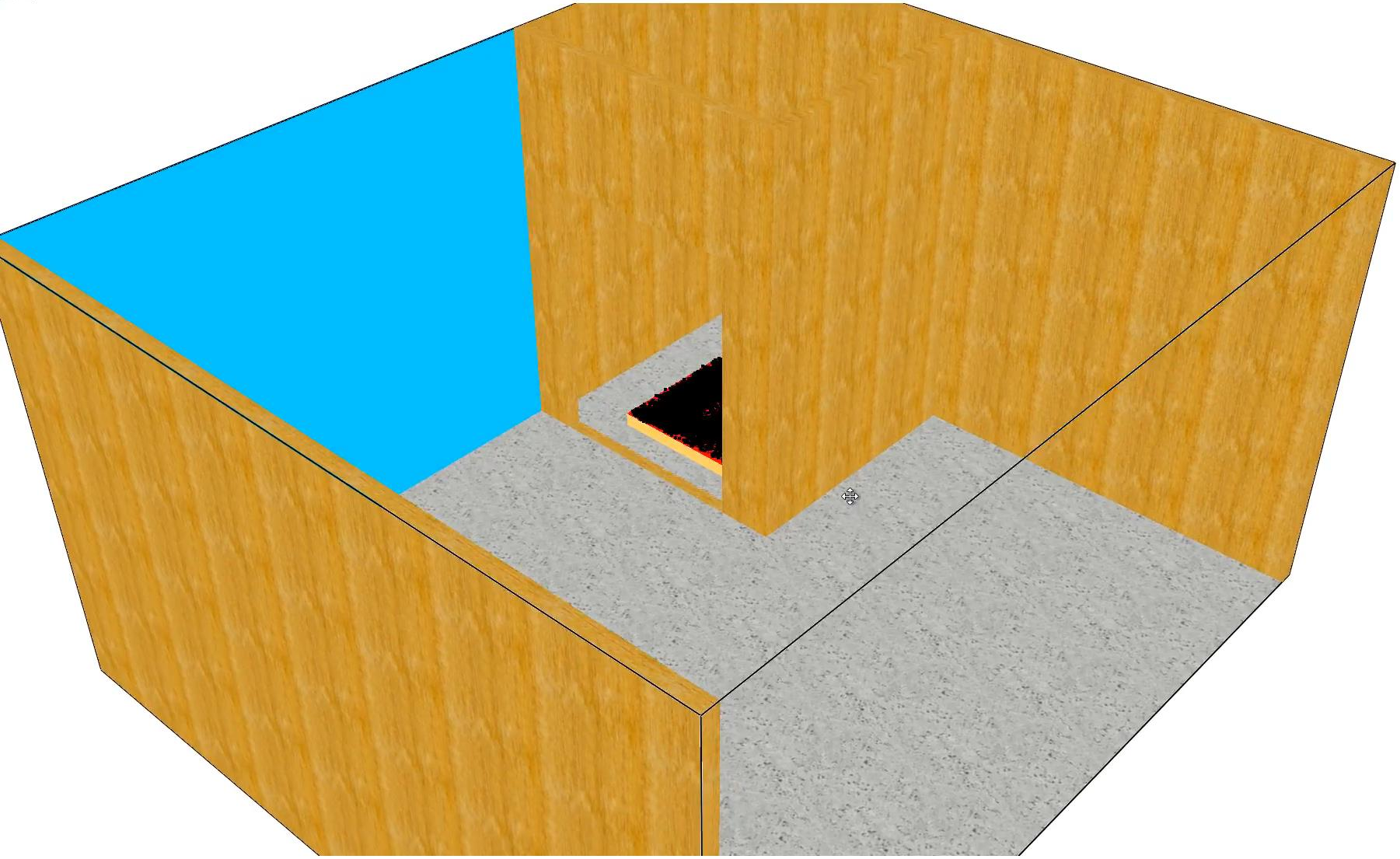
Results Integration

- Display fire and evacuation results simultaneously
- Began with FDS slice data in Pathfinder
- All-new code required to integrate with our products
- Most FDS data support complete
- User interface still under development

Challenges

- Large datasets – slow load times
  - File Streaming --> less memory and faster loading
- Choppy animation – large time between output data
  - Interpolation in time domain
- Slow frame rates
  - Implement on GPU
  - Parallelize CPU-intensive tasks

carport

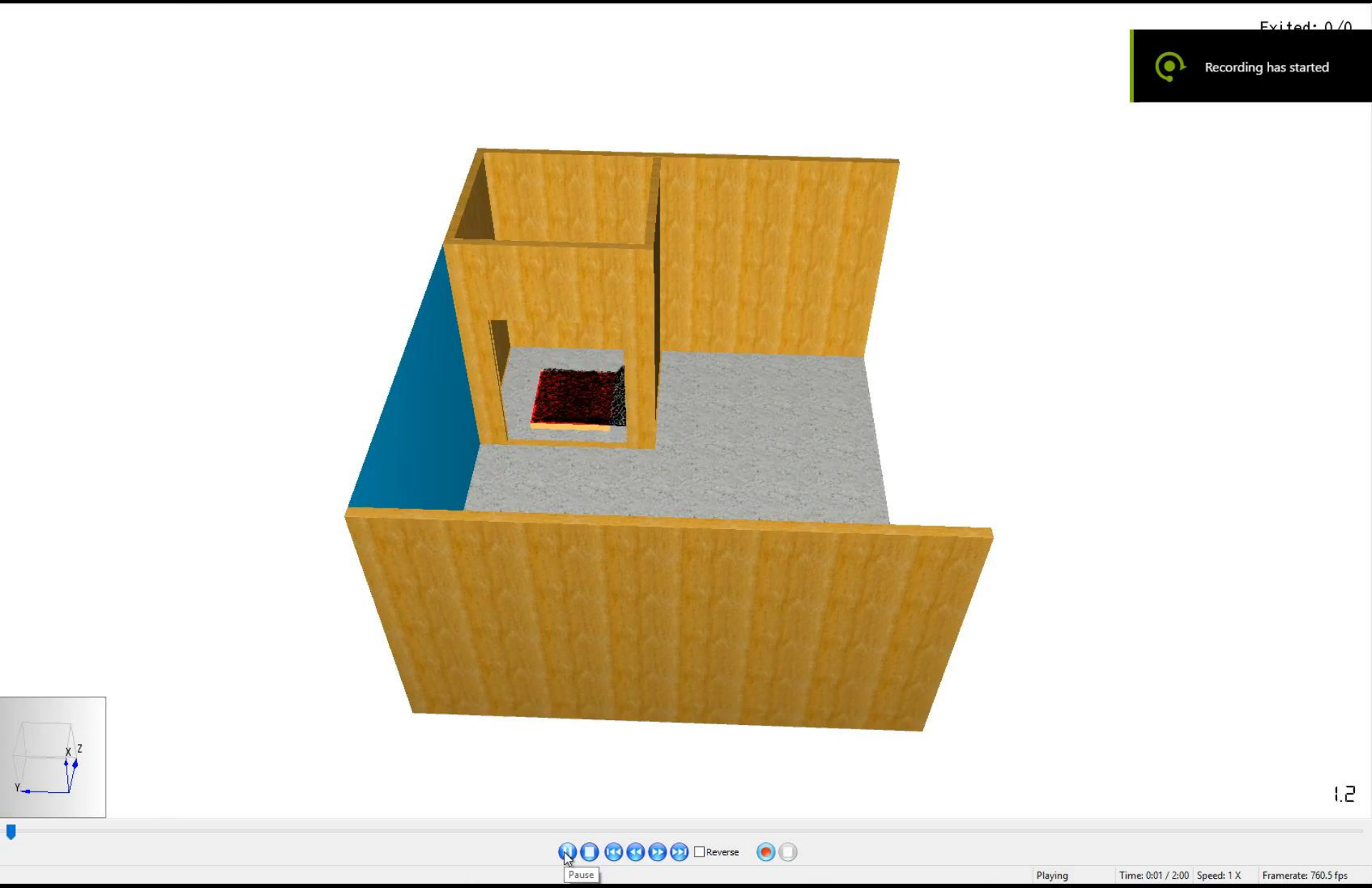


Time: 2.4

Search the web and Windows

ENG
US

4:44 PM
4/20/2016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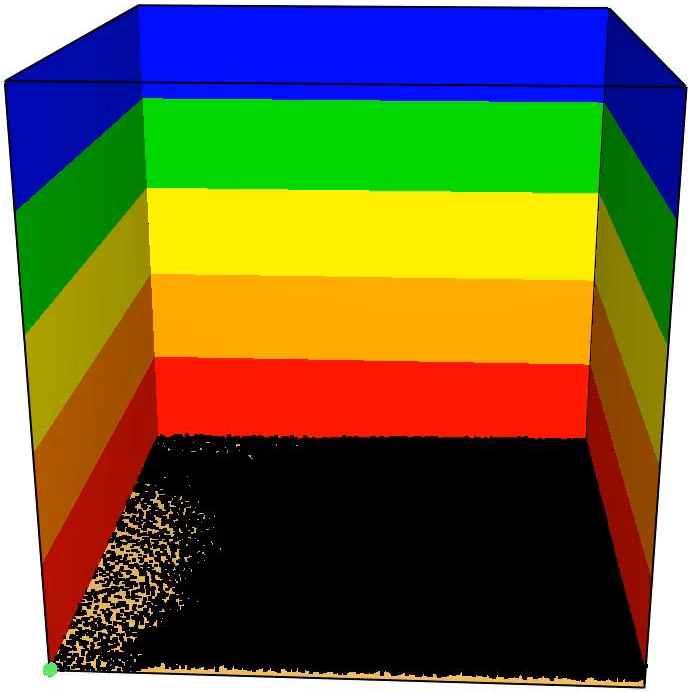
X
Z
Y
1.2
Reverse
Pause
Playing
Time: 0:01 / 2:00
Speed: 1 X
Framerate: 760.5 fps

tornado_fds5

Recording has started



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Y
X
12.4
Pause
Reverse
Playing
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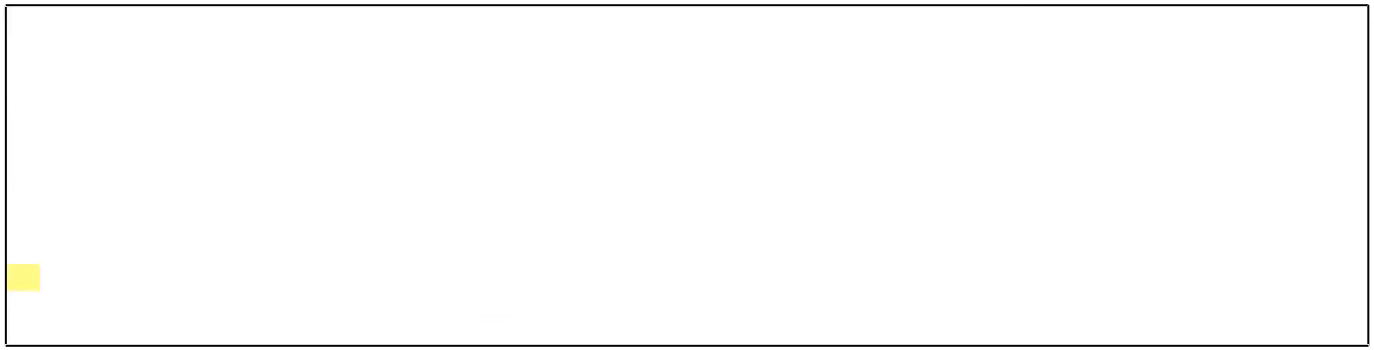
Framerate: 334.4 fps

pipe_rupture_v3



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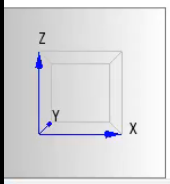
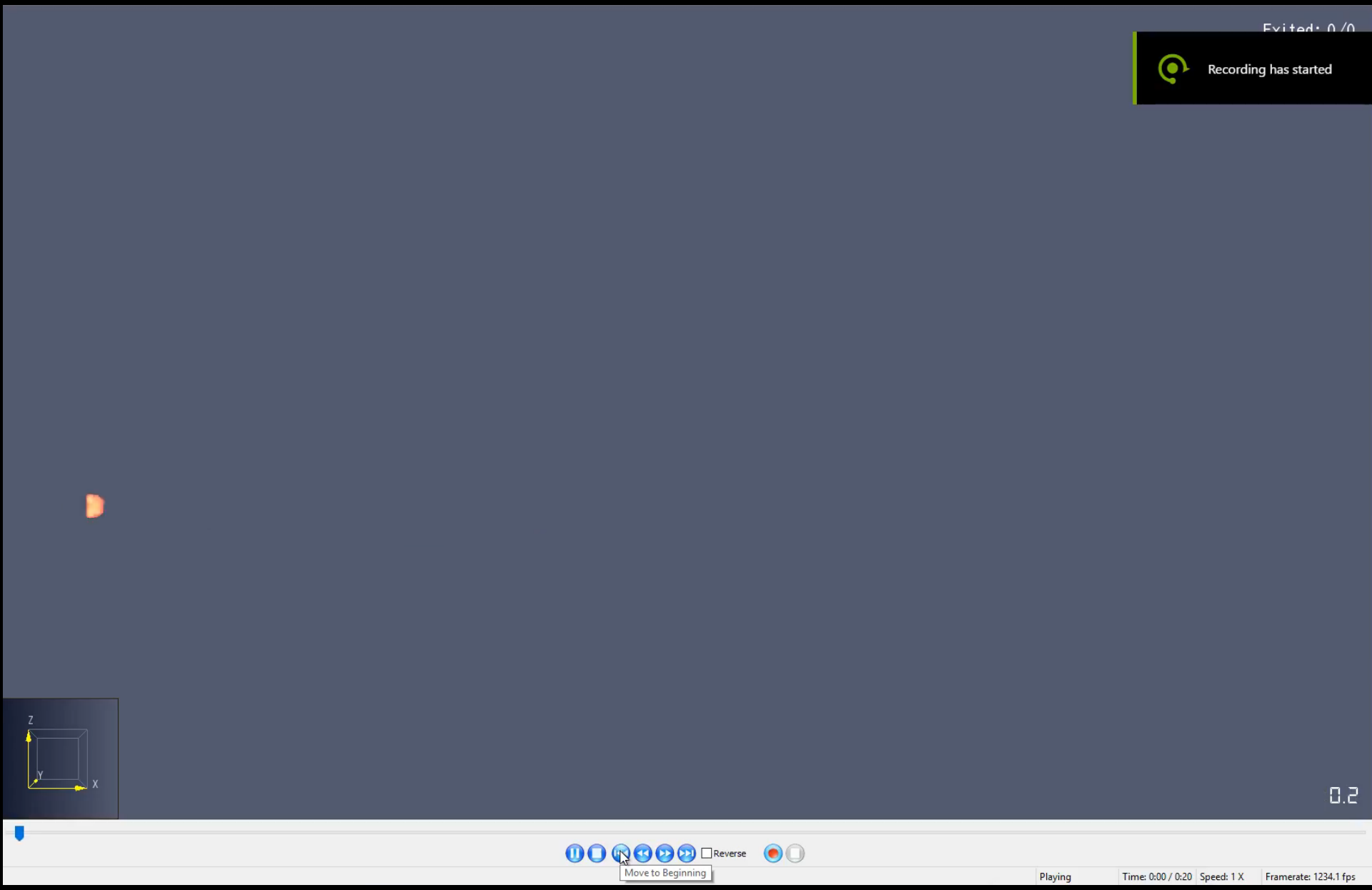


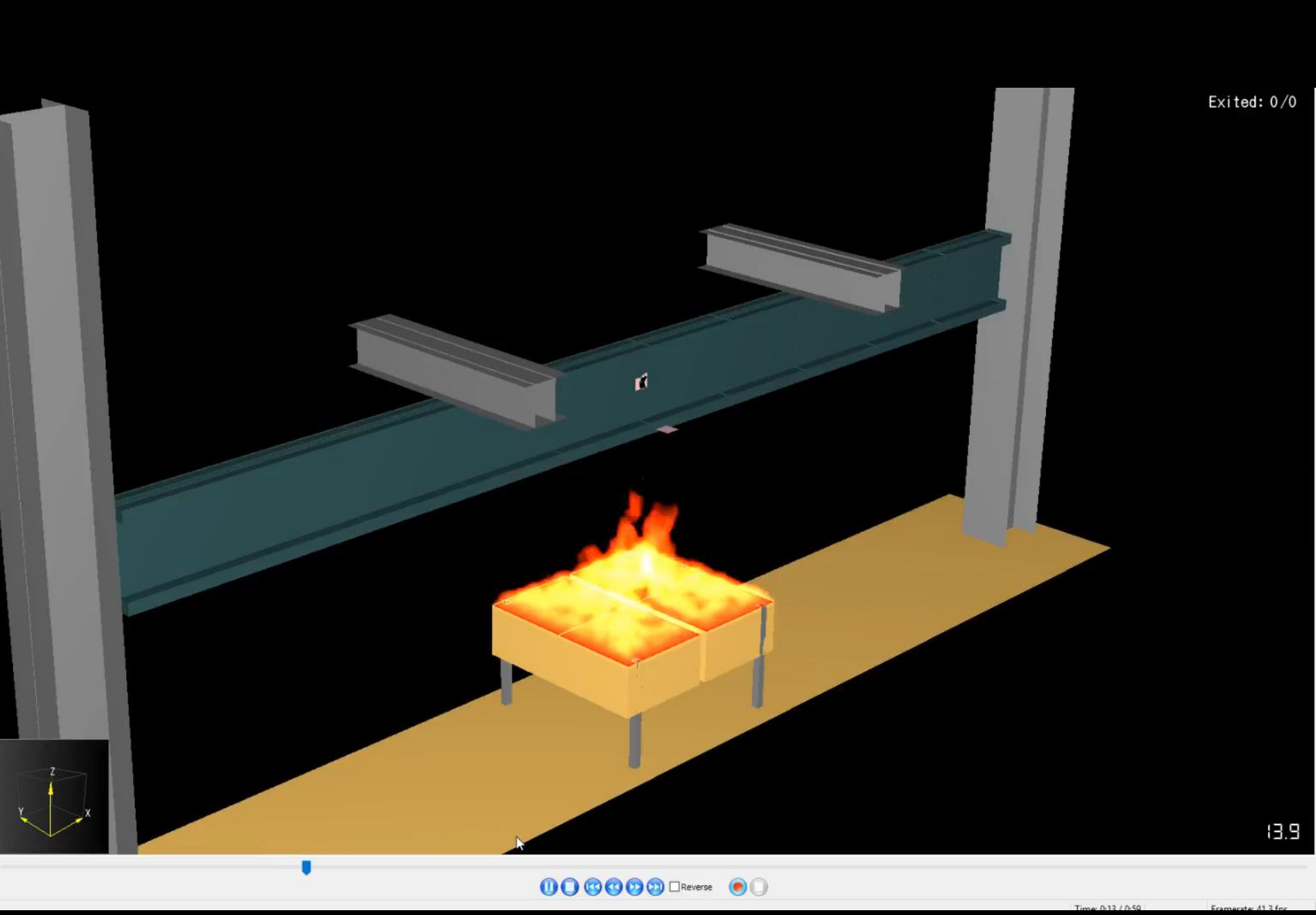
0.0

Reverse

Move to Beginning

Playing | Time: 0:00 / 0:20 | Speed: 1 X | Framerate: 107.0 fps


Exited: 0 /0
Recording has started
Z
Y
X
0.2
Reverse
Move to Beginning
Playing
Time: 0:00 / 0:20
Speed: 1 X
Framerate: 1234.1 fps


Exited: 0/0
13.9
Z
Y
X
Reverse

Pathfinder 2016 x64 - The Office Building

File Agents Scene Debug Analysis View Help

Floor Separation (m): 0 Set Wall Height (m): 0 Set

- Cameras
  - Viewpoints
    - View00
    - View01
    - Inside
  - Tours
    - Tour01
    - **Inside**
- Occupant Contours
  - Density
  - Level of Service (Queu
  - Level of Service (Stairw
  - Level of Service (Walk
  - Normalized Speed
  - Speed
  - Time to Exit
  - Usage[Accumulated]
  - Usage[Instantaneous]
- **FDS Results**
  - **3D Smoke**
  - **HRRPUV**
  - **SOOT MASS FRAC**
  - Boundaries
    - CONVECTIVE HEA
    - NET HEAT FLUX
  - Isosurfaces
    - TEMPERATURE
      - TEMPERATURE
      - TEMPERATURE
  - **Particles**
    - **Tracer**
  - Slice Vectors
    - TEMPERATURE
      - Y = -470.000
  - Slices
    - TEMPERATURE
      - Y = -470.000
    - U-VELOCITY
      - Y = -470.000
    - V-VELOCITY
      - Y = -470.000
    - W-VELOCITY

Set trail time for Tracer: 0.26

Set smoke and fire sample: 0

Set fire intensity: 0.09

Set smoke thickness: 2

Set fire max temperature (°C): 1200

Exited: 0 /3491

Recording has started

Z Y X

0.8

Reverse

Pause

Playing | Time: 0:00 / 2:18 | Speed: 1 X | Framerate: 248.2 fps

Pathfinder 2016 x64 - The Office Building

File Agents Scene Debug Analysis View Help

Floor Separation (m): 0 Set Wall Height (m): 0 Set

- Cameras
  - Viewpoints
    - View00
    - View01
    - Inside
  - Tours
    - Tour01
    - Inside
- Occupant Contours
  - Density
  - Level of Service (Queuing
  - Level of Service (Stairway)
  - Level of Service (Walkway
  - Normalized Speed
  - Speed
  - Time to Exit
  - Usage[Accumulated]
  - Usage[Instantaneous]
- **FDS Results**
  - **3D Smoke**
  - **HRRPUV**
  - **SOOT MASS FRACTIC**
- Boundaries
  - CONVECTIVE HEAT FL
  - NET HEAT FLUX
- Isosurfaces
  - TEMPERATURE
    - TEMPERATURE=2
    - TEMPERATURE=3
- Particles
  - Tracer
- Slice Vectors
  - TEMPERATURE
    - Y = -470.000
- Slices
  - TEMPERATURE
    - Y = -470.000
  - U-VELOCITY
    - Y = -470.000
  - V-VELOCITY
    - Y = -470.000
  - W-VELOCITY
    - Y = -470.000

Set smoke and fire sample: 0

Set fire intensity: 0.09

Set smoke thickness: 2

Set fire max temperature (°C): 1200

Exited: 0/3491

Recording has started

Reverse

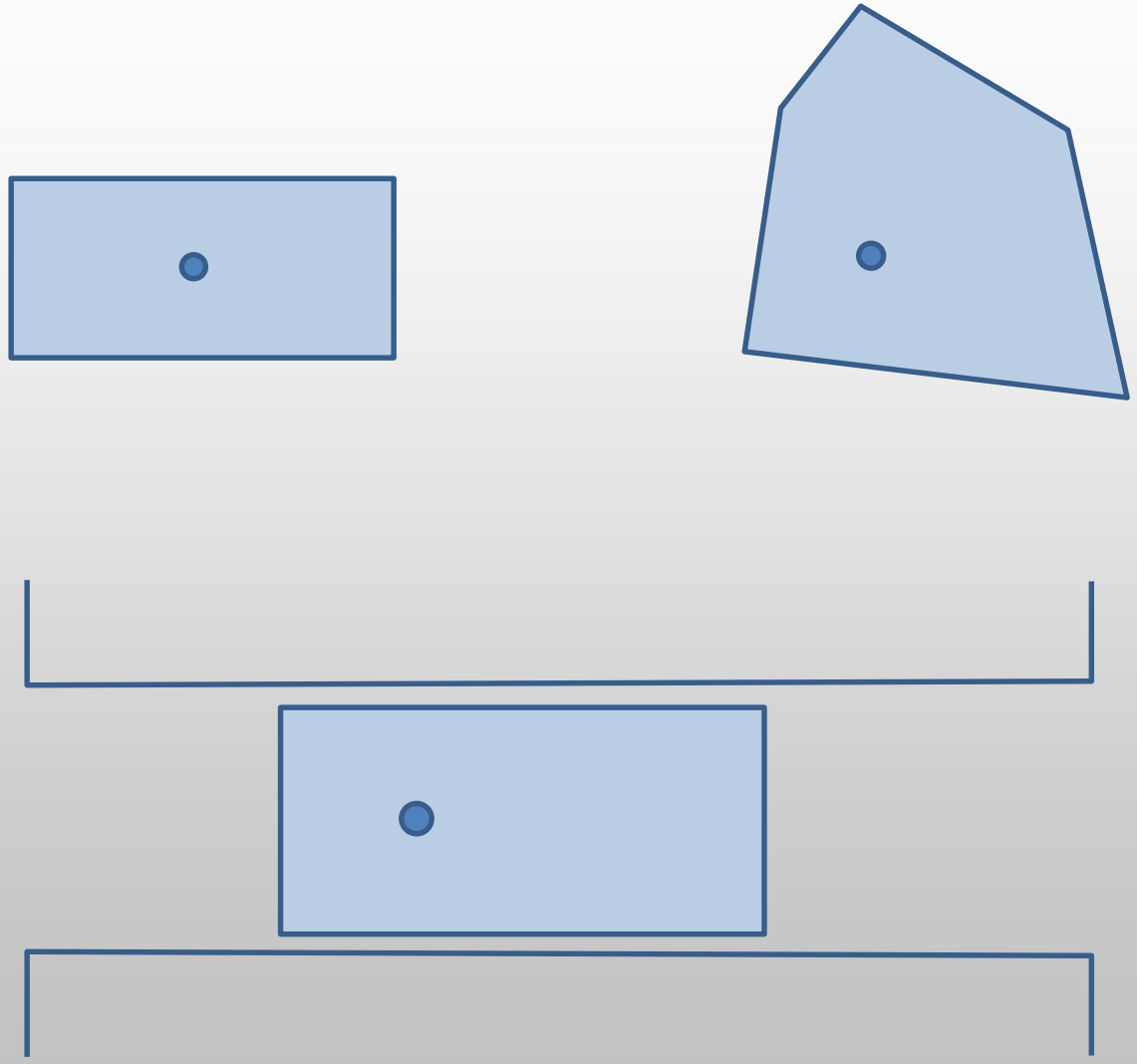
Pause

Playing | Time: 0:01 / 2:18 | Speed: 1 X | Framerate: 37.2 fps

Pathfinder 2016.2

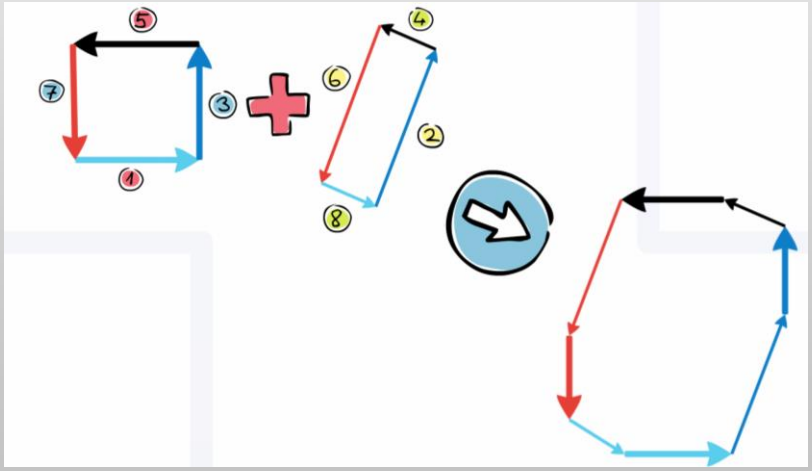
- Occupant Sources
  - Room/Door generation of agents
- Vehicle movement
  - Wheelchairs
  - Beds
  - Carts
- Assisted Evacuation
  - Mobile
  - Non-Mobile
- Assembly Areas
  - Refuge Room/Floor
  - Assembly / Staging

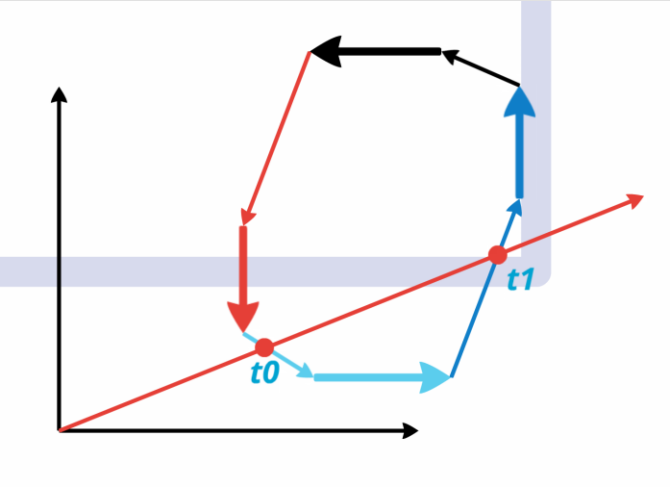
Vehicle Agents



Vehicle Collision Detection

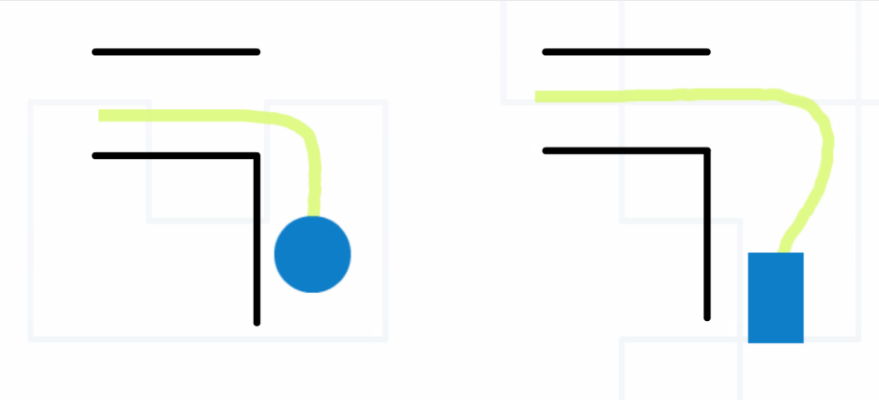
- Minkowski Sum/Difference
  - Transforms to efficient intersection
  - Applies to convex shapes

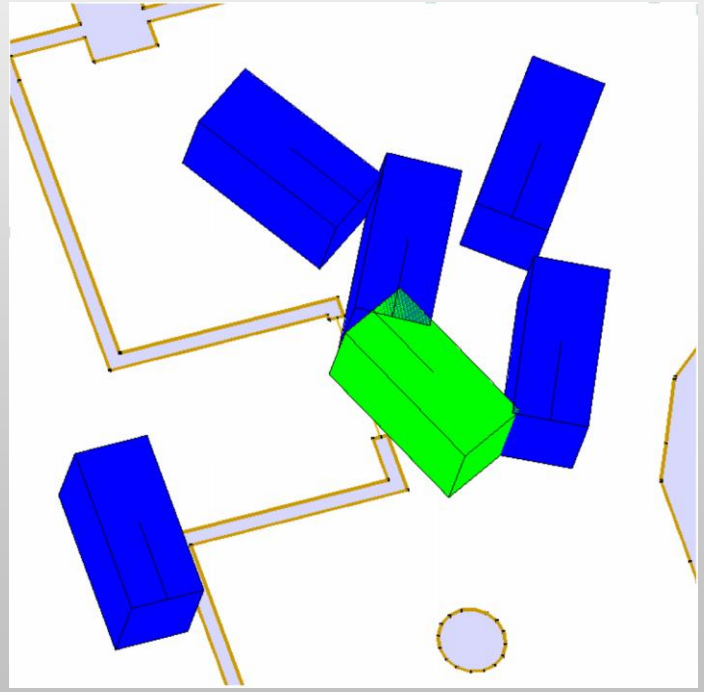




Modified Path Planning

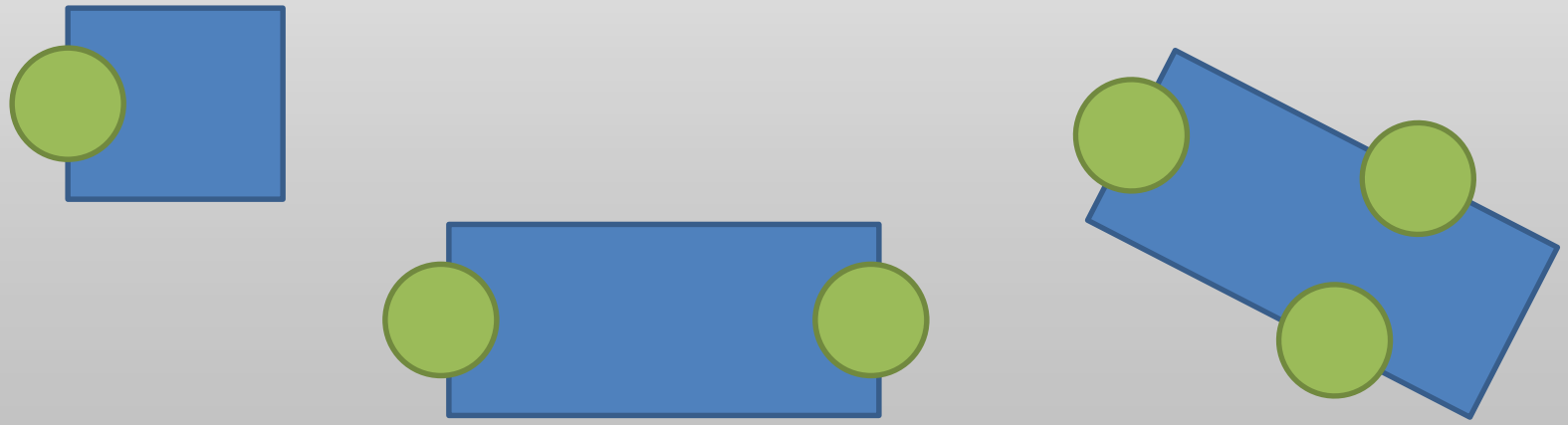
- Vehicle movement different from human agent

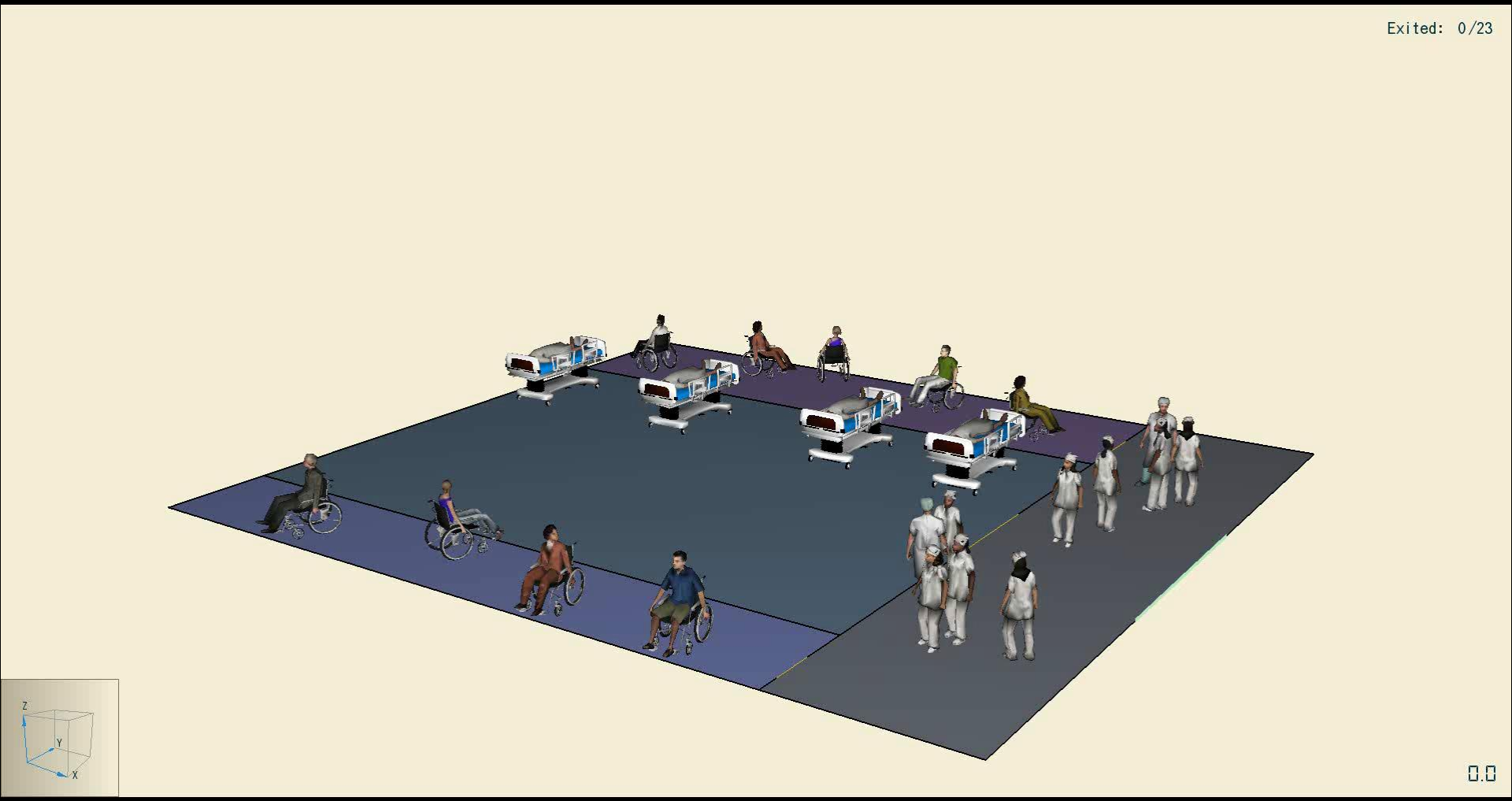


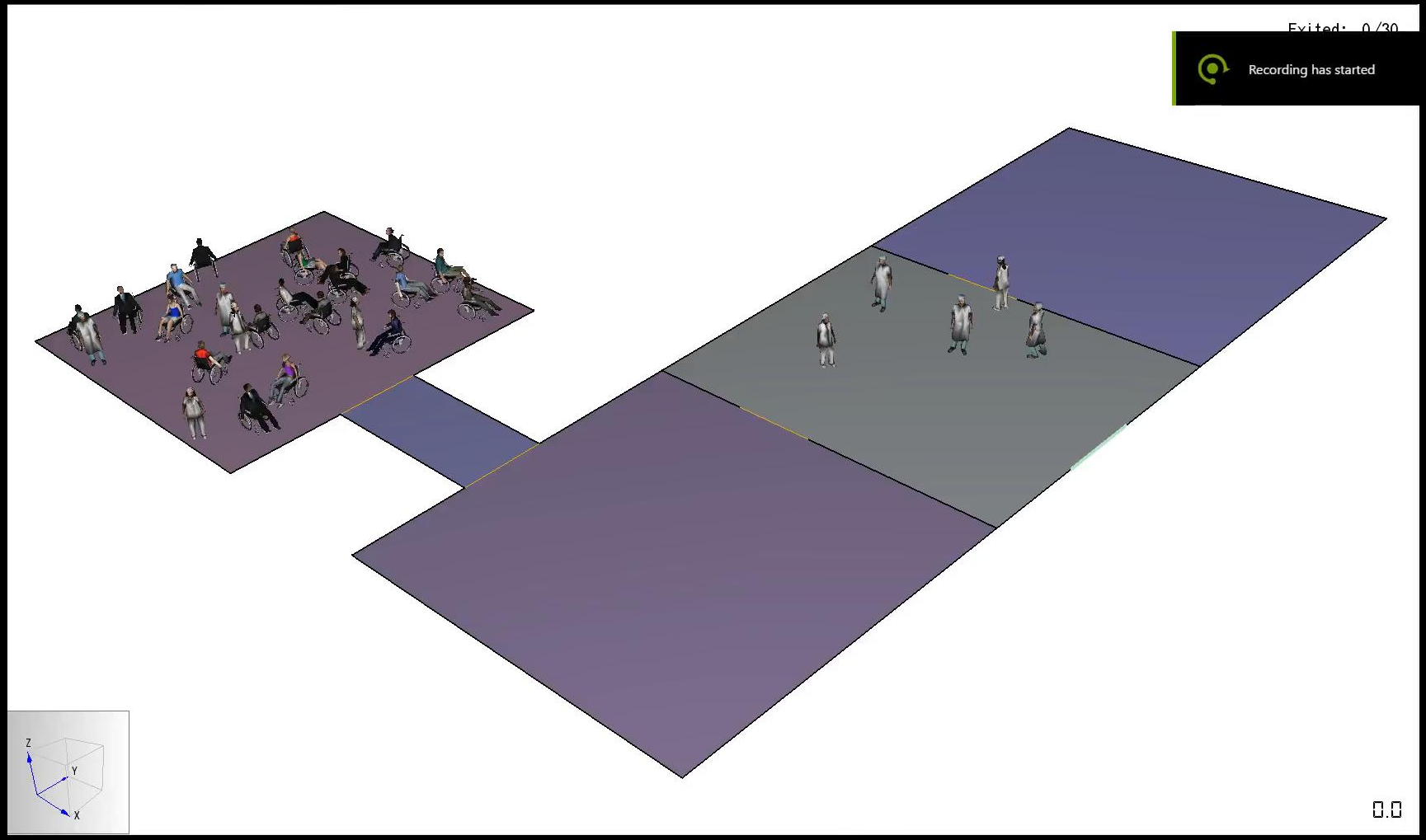


Vehicle Assistance

- Attachment Points
- Mobile or Non-Mobile
- Wait for Assistance
- Vehicle Controls Movement after Attachment




Exited: 0/23
Z
Y
X
0.0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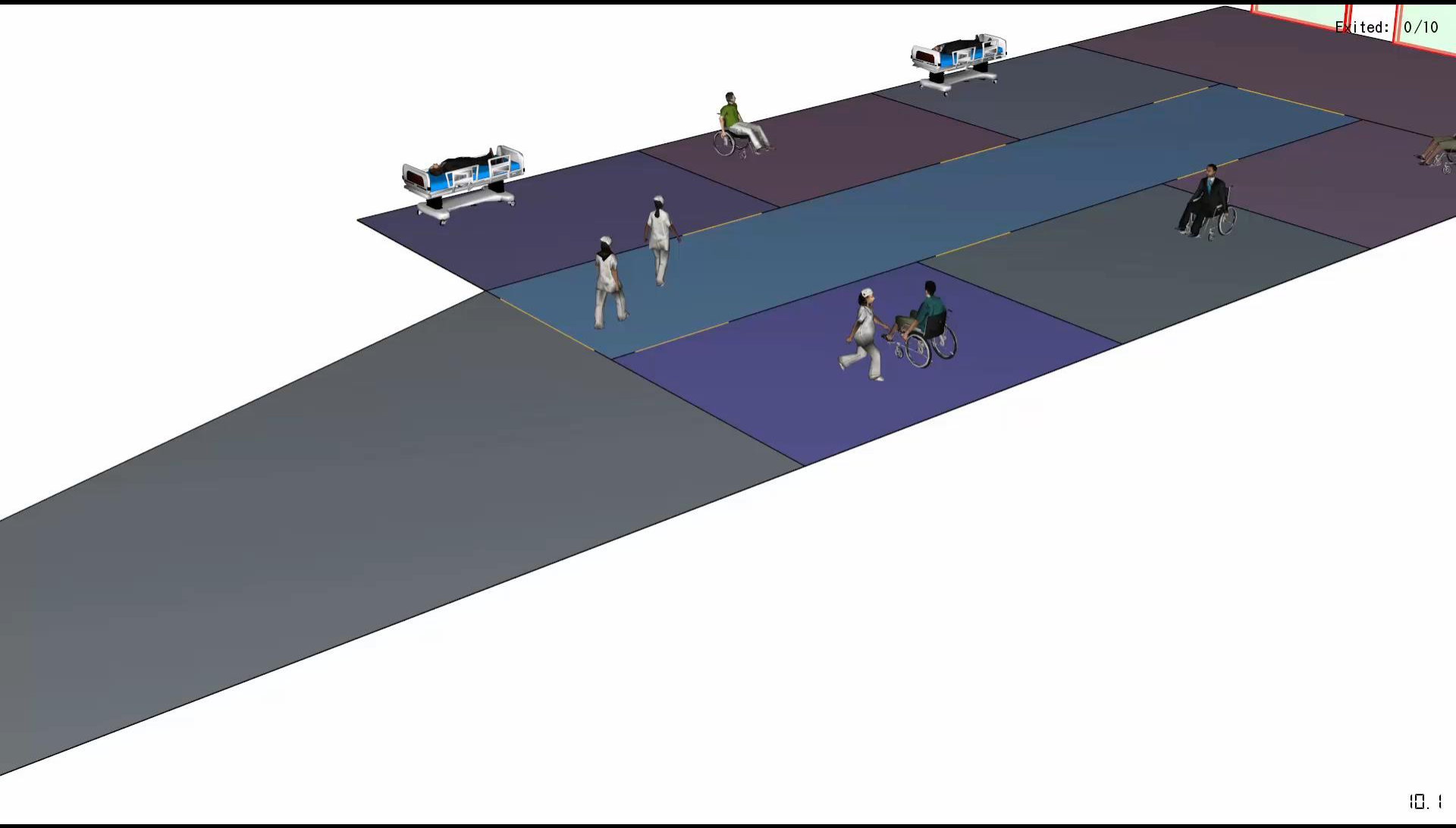
Z
Y
X
0.0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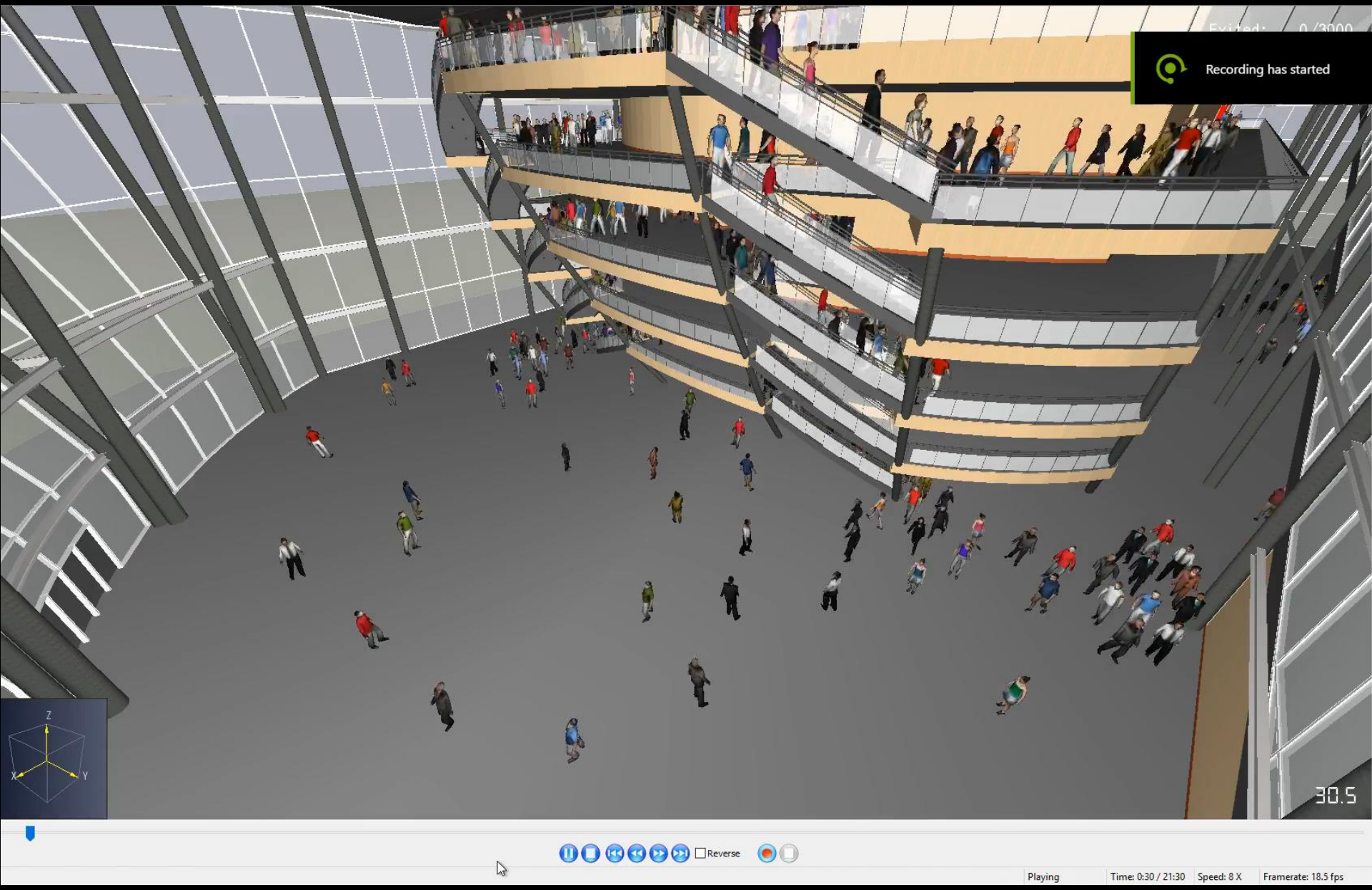
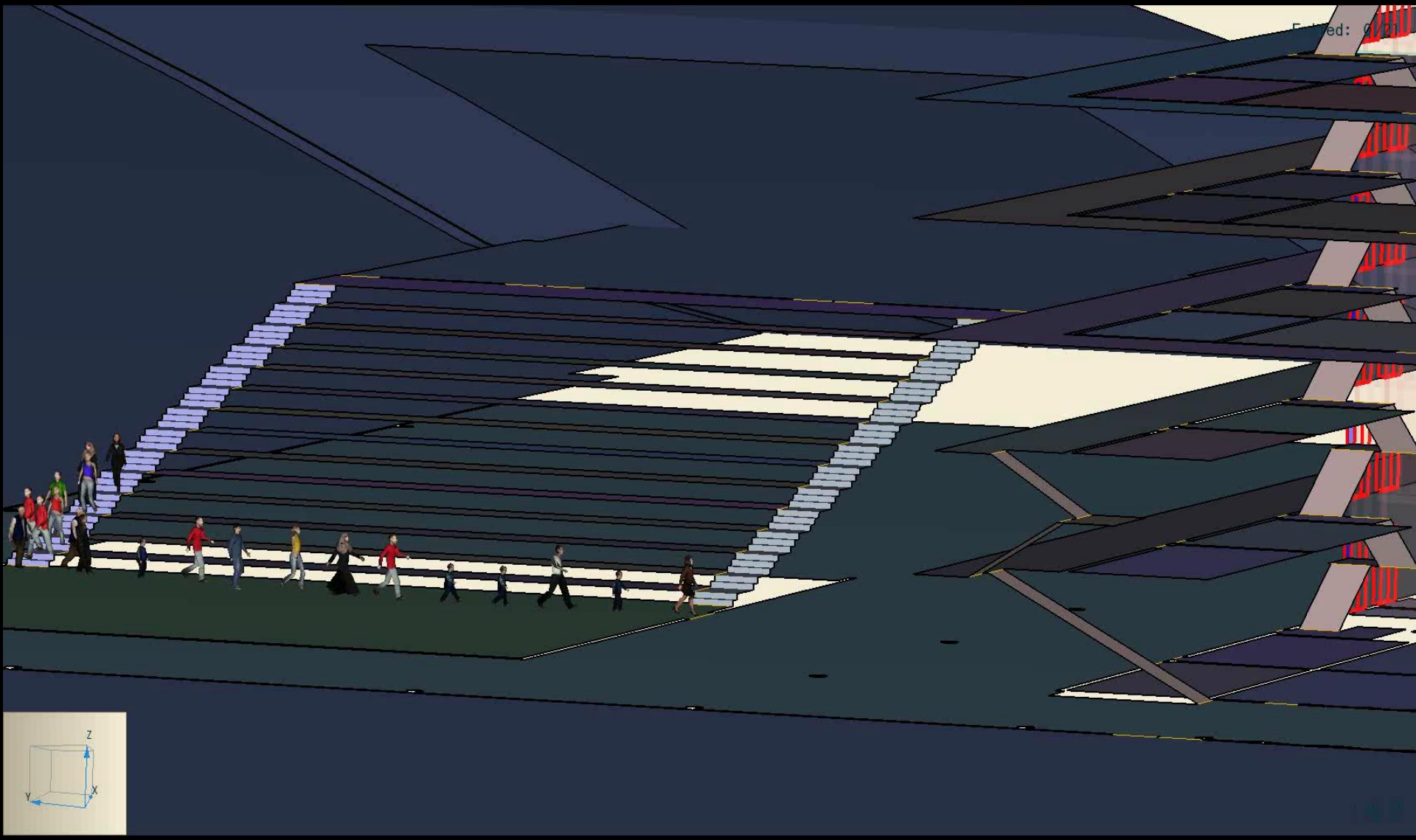

Recording has started
Z
X
Y
30.5
Reverse
Playing
Time: 0:30 / 21:30
Speed: 8 X
Framerate: 18.5 fps

Future Directions

- Support for IBM / FDS 7
- FDS Simulation Server
- Cloud Integration
- Integrated Fire/Evac Modeling
- Grouping
- Advanced Behaviors


Z
Y
X

Thank You

Questions?