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FIRE AND EVACUATION MODELING CONFERENCE TECHNICAL CONFERENCE

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Development of the 'Evac4BIM' Add-In for Revit

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Overview

Evac4BIM : Revit add-in that enables data exchange with Pathfinder



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Acknowledgment

Asim Siddiqui, Greenwich University

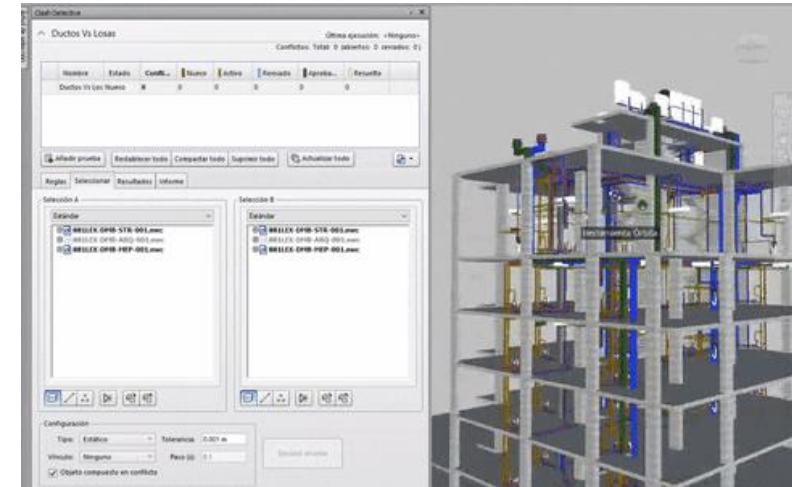
Jimmy Abualdenien, TU München



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Background on BIM

- **Standard platform** for **integrated digital design**
- **Centralizes** knowledge about a building
- **Legal requirement** for public projects (UK, EU)
- **Rapid expansion in uptake**
- **Reduced waste and lower project costs**



* www.giphy.com

FSE integration into BIM

FSE does not fully benefit from these advantages

FSE lagging by its lack of integration into BIM's workflow :

- × **One way data sharing**
- × **Focus** on providing 3D geometry to setup simulations
- × **Lack** of support for FSE in IFC (standard file format in BIM)
- × Assessment results **not recorded** in the BIM model.



Why it is important

This lack of integration results in :

- **Increased** efforts and delays for design evaluation
- **Fragmentation** of design and review processes
- **Inconsistent** documentation and ambiguity in roles and responsibilities.
- Data **loss**



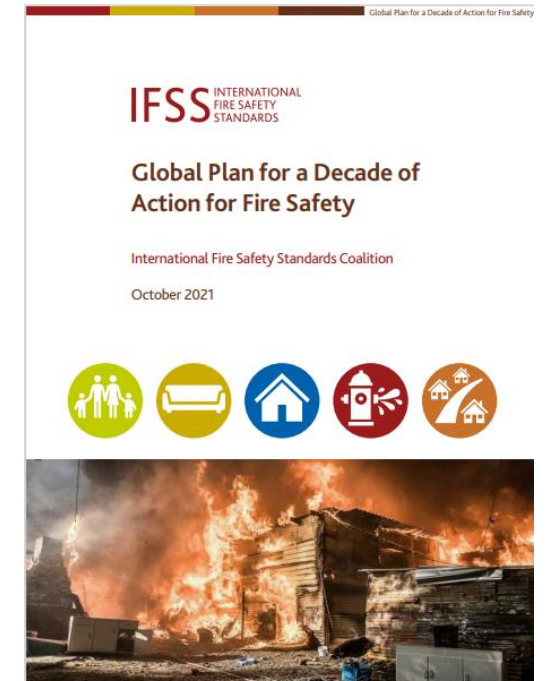
What the FSE community says



Hackitt report (post Grenfell) calls for a **“golden thread of information”**



buildingSMART aims to incorporate **fire and life safety** into the IFC and BIM standards



IFSS’s “Decade of Action” calls for a new **framework** to support **audits, compliance-checks** and **global standards**

What this project is about

Solving the current disconnect between BIM and fire evacuation in order to join up a consistent workflow and achieve a “Golden Thread of Information”



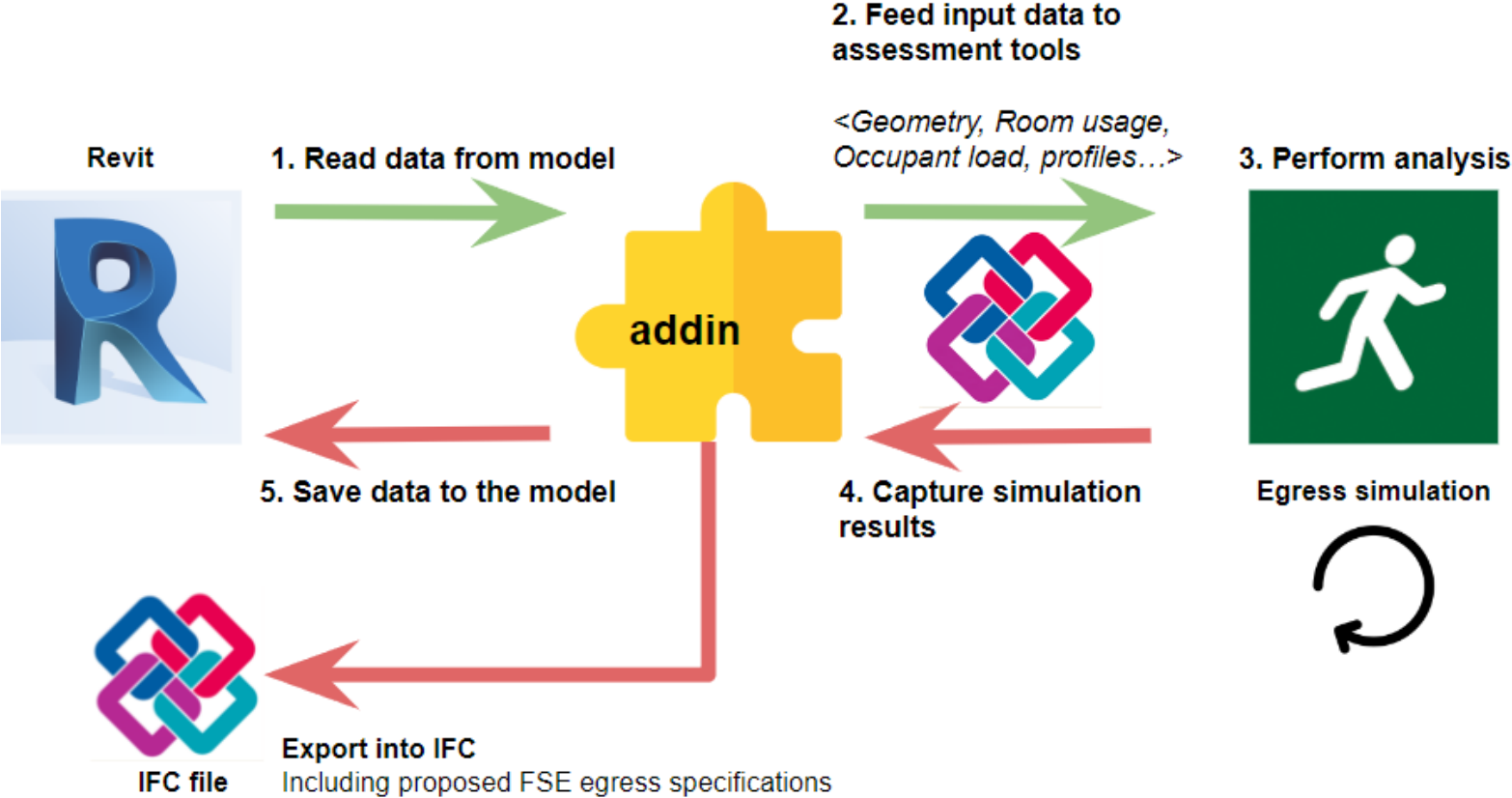
How it works : Expected outcome

- **Two-way** data exchange
- Integrating **evacuation performance** into BIM
- **Digital trail** for asset management, auditing, and forensics
- Review building **design models coupled** with **analysis results**

	Regulators	FSE Eng.	Owner	Contractor	Consultants
Digital audit trail	X		X		X
Compliance checking	X	X	X	X	X
Informed decision making	X	X	X	X	X
Automation*		X	X	X	X
Safety**			X	X	X



How it works : Proposed framework



How it works : Development steps

Based on A.Siddiqui (2019) : **Conceptual Strategy** for Enhanced Data Sharing Between FSE and BIM

1. Identify semantic data for evacuation simulation tools.
2. Prototype the coupling of Revit BIM with engineering tools via a vendor-neutral format (IFC)
3. Evaluate the prototype tool.

IFC is the standard exchange format of geometry and data in the AEC



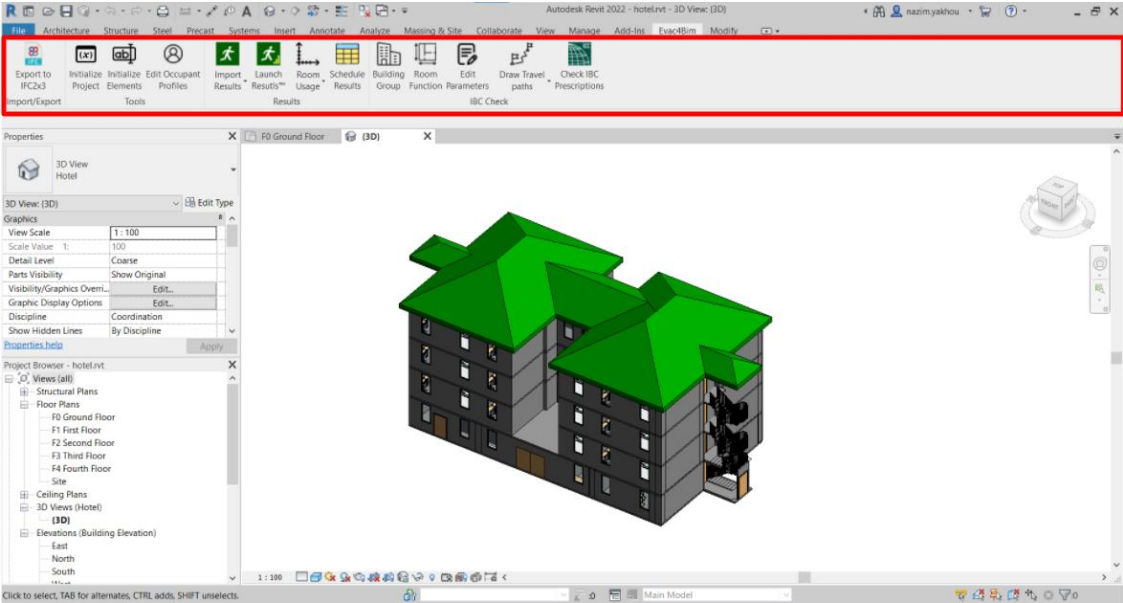
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How it works : Data Schema

Simulation input	Simulation output
Alarm time Pre evacuation time Number of occupants Occupant load Peak number of occupants Building occupancy day/night Component status Required door flow rate Occupant profiles Admitted profiles	Simulation Brief Initial Occupant Number Evacuation Time Overall Evacuation Time Occupant History Travel distances First occupant in Last occupant out Total use Door Flow rate History Average occ. flow rate



How it works : Revit Implementation



- 5.1 Import Results
- 5.2 Import Results (Multi)

- 7.1 Room Usage
- 7.2 Total Usage
- 7.3 Stair Usage
- 7.4 Door Flowrate

 Revit API



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How it works : Revit Implementation

Main features

1. **Editing and exporting** input parameters for simulations
2. **Capturing** simulation results
3. **Displaying** results to user
4. **Generating** IFC files combining geometry and semantic data according to the draft data scheme



How it works : Pathfinder Integration

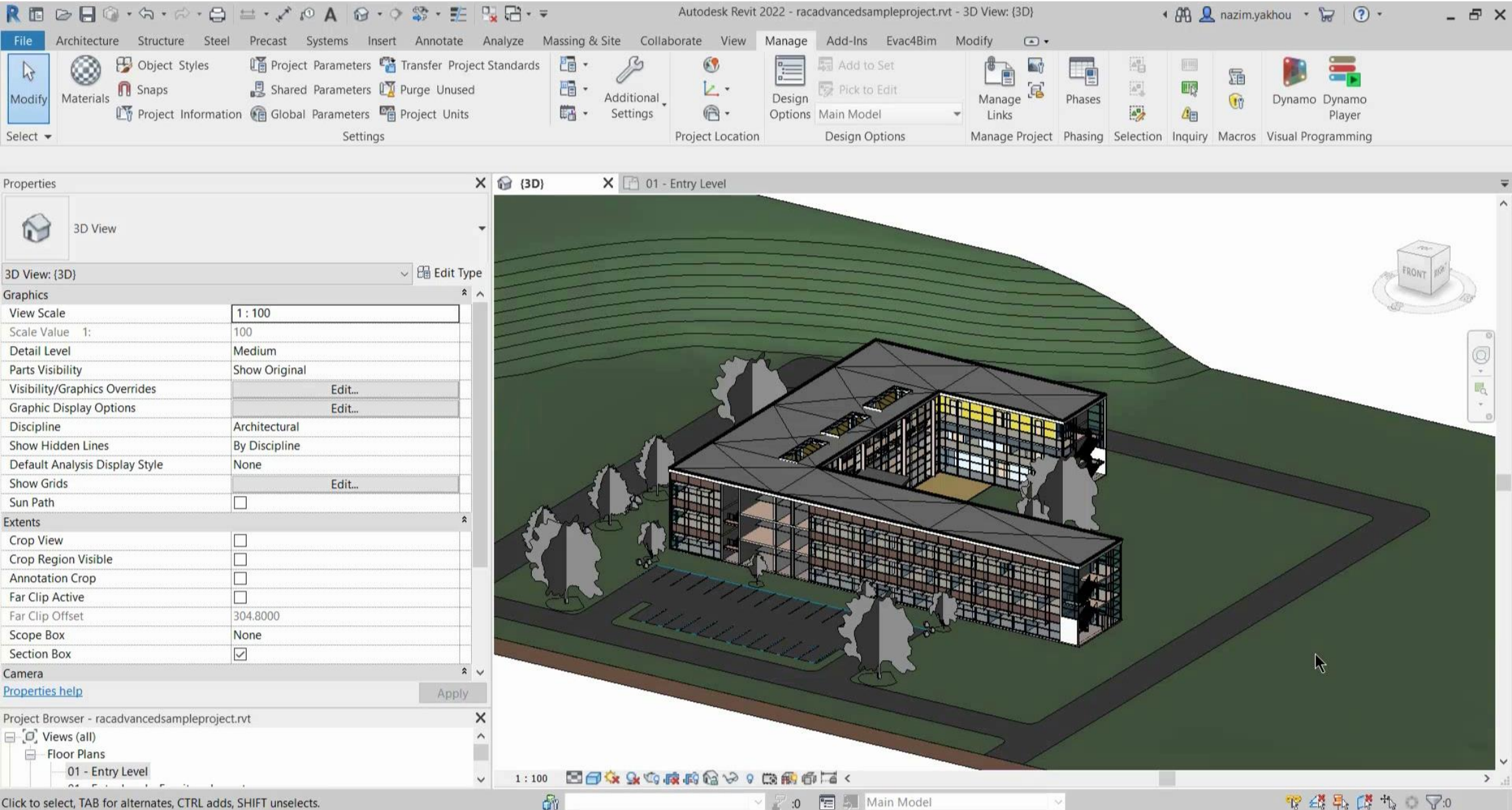


Mapping Revit properties to Pathfinder

Revit / IFC Property	Pathfinder property
OccupancyNumber	Populate space with occupants
AreaPerOccupant	
OccupancyNumberPeak	Room Capacity
ifcName	Room Name
isAccessible	Door State
RequiredDoorFlowrate	Door Flowrate
PreEvacuationTime	Behaviors - Initial delay
OccupantProfilesList	Create new profiles



How it works : Pathfinder Integration



How it works : Pathfinder Integration

The screenshot displays the Autodesk Revit 2022 interface for a floor plan titled "F0 Ground Floor". The ribbon includes the "Evac4Bim" tab with various tools for pathfinding and IBC checks.

Evac4Bim Tools:

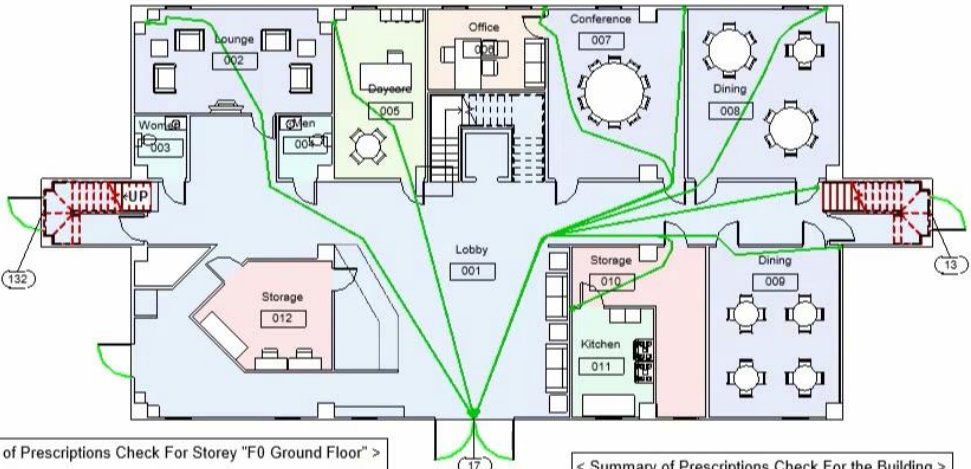
- Import/Export: Export to IFC2x3
- Tools: Initialize Project, Initialize Elements, Edit Occupant Profiles
- Results: Import Results, Launch Results™, Room Usage, Schedule Results
- IBC Check: Building Group, Room Function Parameters, Edit, Draw Travel paths, Check IBC Prescriptions

Properties Panel:

- Category: Floor Plan
- View Scale: 1 : 100
- Scale Value: 100
- Display Model: Normal
- Detail Level: Coarse
- Parts Visibility: Show Original
- Orientation: Project North

Project Browser:

- Views (all)
- Structural Plans
- Floor Plans
 - F0 Ground Floor**
 - F1 First Floor
 - F2 Second Floor
 - F3 Third Floor
 - F4 Fourth Floor
- Ceiling Plans
- 3D Views (Hotel) (3D)
- Elevations (Buildi...)
- East
- North
- South



- IBC Room Function**
- Accessory storage areas- mechanical equipment room
 - Business areas
 - Day care
 - Kitchens- commercial
 - Locker rooms
 - Standing space
 - Unconcentrated (tables and chairs)

< Summary of Prescriptions Check For Storey "F0 Ground Floor" >

Occupants Served : 140
 Discharge Level : Yes
 Egress Capacity : Pass ✓
 Exit Count : Pass ✓
 Egress Capacity Balance : Pass ✓
 Stair Capacity : n.a
 Stair Count : n.a
 Stair Capacity Balance : n.a

< Summary of Prescriptions Check For the Building >

Name :
 Occupancy Type : R1
 Total Occupants : 140
 Sprinkler System : Yes
 Alarm System : Yes
 Sprinklers Required : No

How it works : Pathfinder Integration

The image shows the Pathfinder 2021 software interface. The main window displays a 3D model of a building floor plan with various rooms and corridors. A 'Run Simulation' dialog box is open in the foreground, showing the progress of the simulation. The dialog box includes the following information:

- Sim Time (s): 0.0
- Run Time (s): 0.0
- Occs Rem: 0
- Occs Total: 0
- DTG Max (m): 0.0
- DTG Avg (m): 0.0

The dialog box also displays the following progress log:

```
Checking errors...
Done (0.00 s)
Validating model...
Done (0.03 s)
Creating simulation data
Done (1.46 s)
Creating results files
```

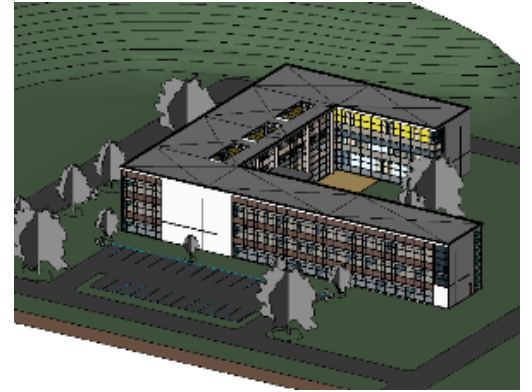
At the bottom of the dialog box, there are checkboxes for 'Show results when finished' (unchecked) and 'Pause if occupants appear to be stuck' (checked). The 'OK' button is highlighted.

The background interface shows the 'Floor: Floor 9.0 m' and 'New Egress Components' panel. The 'New Egress Components' panel includes a 'Group' dropdown set to 'Floor 9.0 m' and a 'Generate Model from BIM...' button. The 'Floor Creation/Sorting' panel includes checkboxes for 'Auto sort egress components' and 'Automatically create floors', and a 'Floor height: 3.0 m' input field.

Validation

- 2 case studies
- Ensuring that
 - + Values and units are **preserved**
 - + Parameters are **mapped correctly** in the IFC schema
 - + Datapoints are **stored correctly** in the Revit BIM model

... using **Solibri validation tools**



Open-source distribution

File	Commit Message	Time Ago
YakNazim Re arrange dirs	a51f733	14 days ago
Evac4Bim	Re arrange dirs	14 days ago
.gitattributes	Add .gitignore and .gitattributes.	3 months ago
.gitignore	Add .gitignore and .gitattributes.	3 months ago
CmdAssignLinkedComponent.png	Added support for vertical travel	23 days ago
CmdBuildingGroup.png	Added new PSets with implementation in UI	2 months ago
CmdCreateSchedules.png	Adding CmdCreateSchedules	2 months ago
CmdEditOccupantProfiles.png	Added new PSets with implementation in UI	2 months ago
CmdEditParameters.png	Added support for Pathfinde Results	last month
CmdEditRoomFunction.png	Added support for Pathfinde Results	last month
CmdExportIfc.png	Add project files.	3 months ago
CmdIBCCheckButton.png	Added new PSets with implementation in UI	2 months ago



github.com/YakNazim/Evac4Bim



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Future work

- **Expanding the scope** of data exchange with simulations tools
- Extraction of **contour files** generated by Pathfinder (e.g Level of service, density)
- **Expanding Pathfinder** to support/parse additional input properties from IFC.
- **Exporting simulation results into IFC** directly from within Pathfinder, according to the proposed IFC schema
- Supporting additional evacuation simulation tools available on the market.
- **Better support for complex datasets** in IFC (such as lists, enumerations, and arrays)





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Thank you for your attention !

