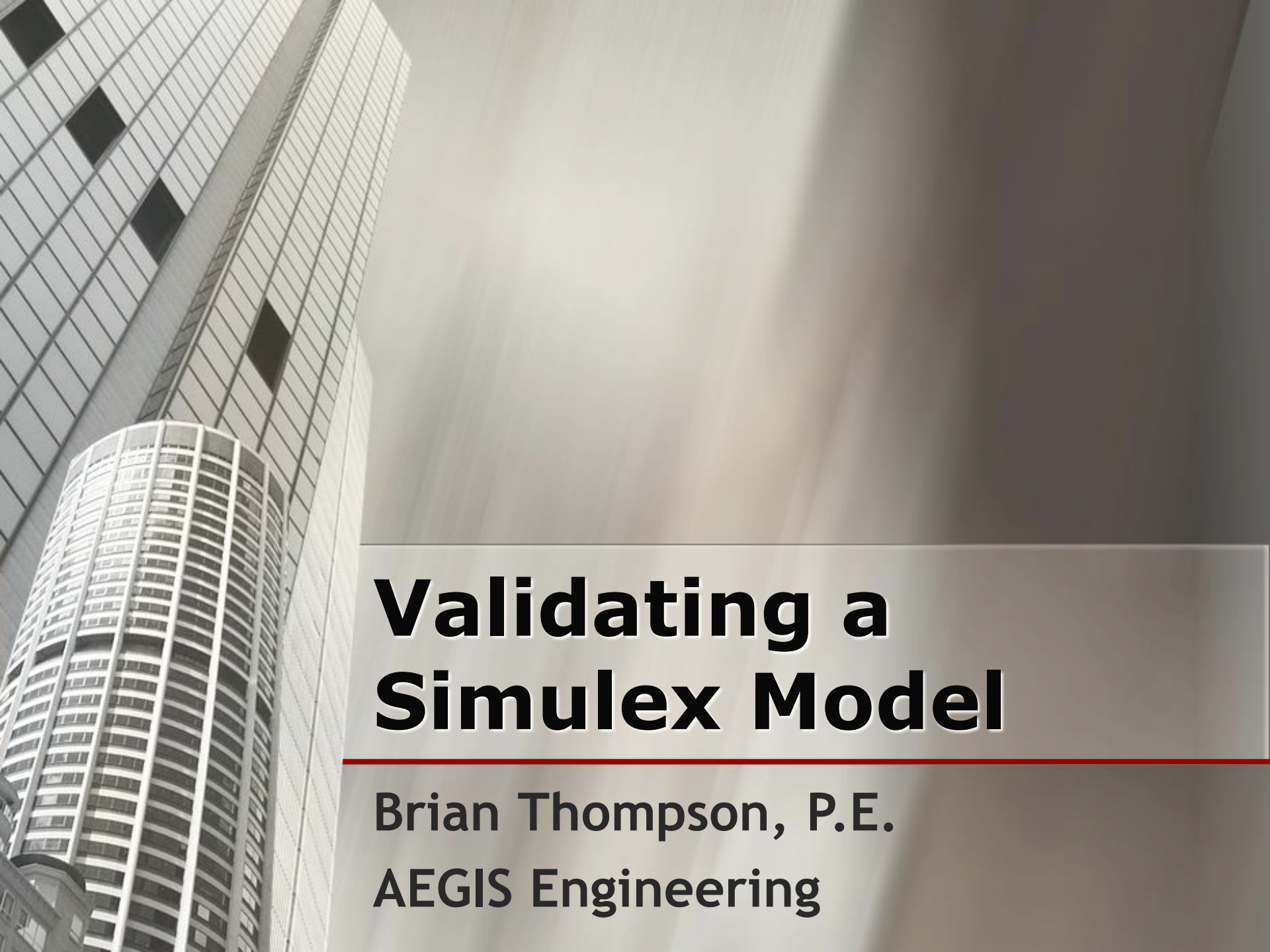

Validating a Simulex Model

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AEGIS Engineering

Considerations

- Evacuation conditions
- Validation of software
- Simulex algorithm
- Selection of occupants
- Construction of geometry
- In practice

Evacuation Conditions

Simulation Parameters

- Occupants accounted for
- Environmental conditions
- Movement characteristics

Occupant Accounting

- **Partial Evacuation**
- **Full Evacuation**

Model Environment

- Smoke-free
- Accumulating smoke layer
- Near tenability threshold

State-of-Mind

- **Laissez-faire/flippant**
- **Intentional/reasoned**
- **Frightened/panicked**

Validation of Software

Partial Behavioral

- Rates of body twist
- Acceleration/deceleration
- Speed fluctuations
- Inter-person distance

Validation Tests

- Department stores
- Office buildings
- Lecture theatres
- Sports stadia egress areas
- University buildings
- Mock-up building geometries

Lecture Theatre

- 1-story + intermediate floor
- 278 occupants
- Simulex travel time: 93 sec.
- Actual travel time: 90 sec.
- IBC (93 x 1.5) = 140 sec.

Law School

- 5-story
- 494 occupants
- Simulex travel time: 161 sec.
- Actual travel time: 170 sec.
- IBC (161 x 1.5) = 242 sec.

Business School

- 8-story
- 716 occupants
- Simulex travel time: 178 sec.
- Actual travel time: 220 sec.
- IBC (178 x 1.5) = 267 sec.

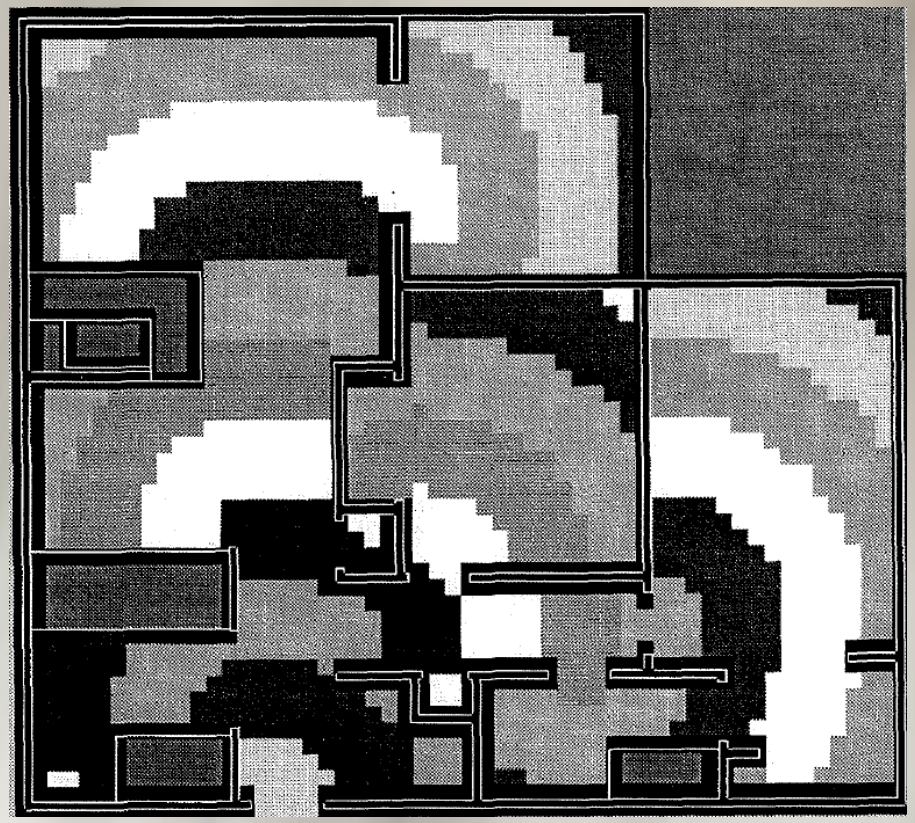
Simulex Algorithm

Operations

- Evaluates building geometry
- Creates “distance map”
- Preset occupant population
- Occupants follow shortest path

Distance Map

- Travel distance isolines
- Geometry gaps



Occupant Travel

- Aligned with distance map
- Perpendicular to isolines
- Inability to get unstuck

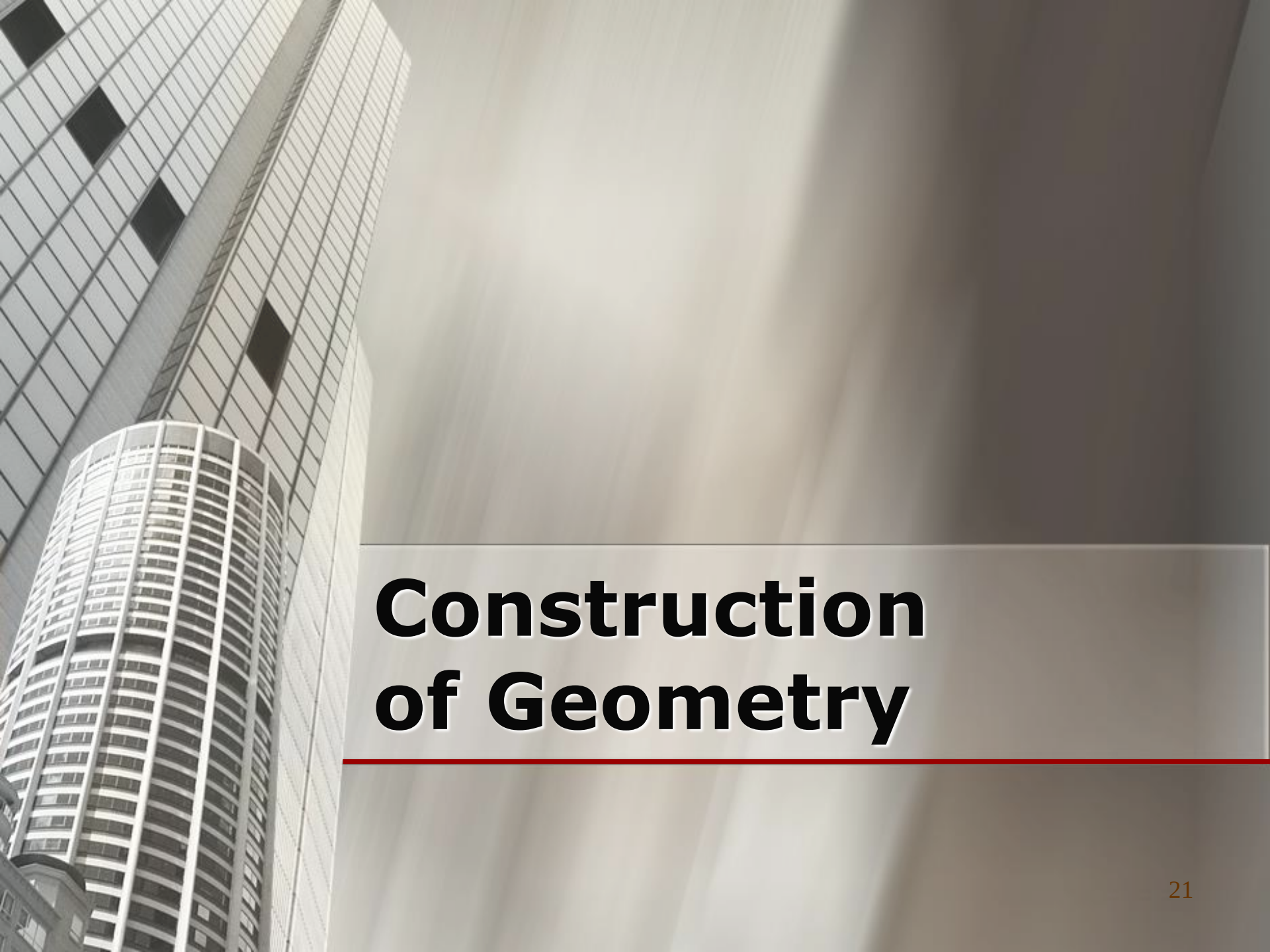
Occupant Population

Population Group

- **Body size variable**
- **Speed 0.8 - 1.7 m/s**

Location

- **Boundary-free**
- **Distance map**



Construction of Geometry

Building Geometry

- Refinement
- Alterations
- Iterative modifications

Refinement

- **Automatic**
- **Manual**

Alterations

- Aisle width
- Narrow gaps

Iterative Modifications

- **Remove impediments**
- **Modify distance map**

Case Studies

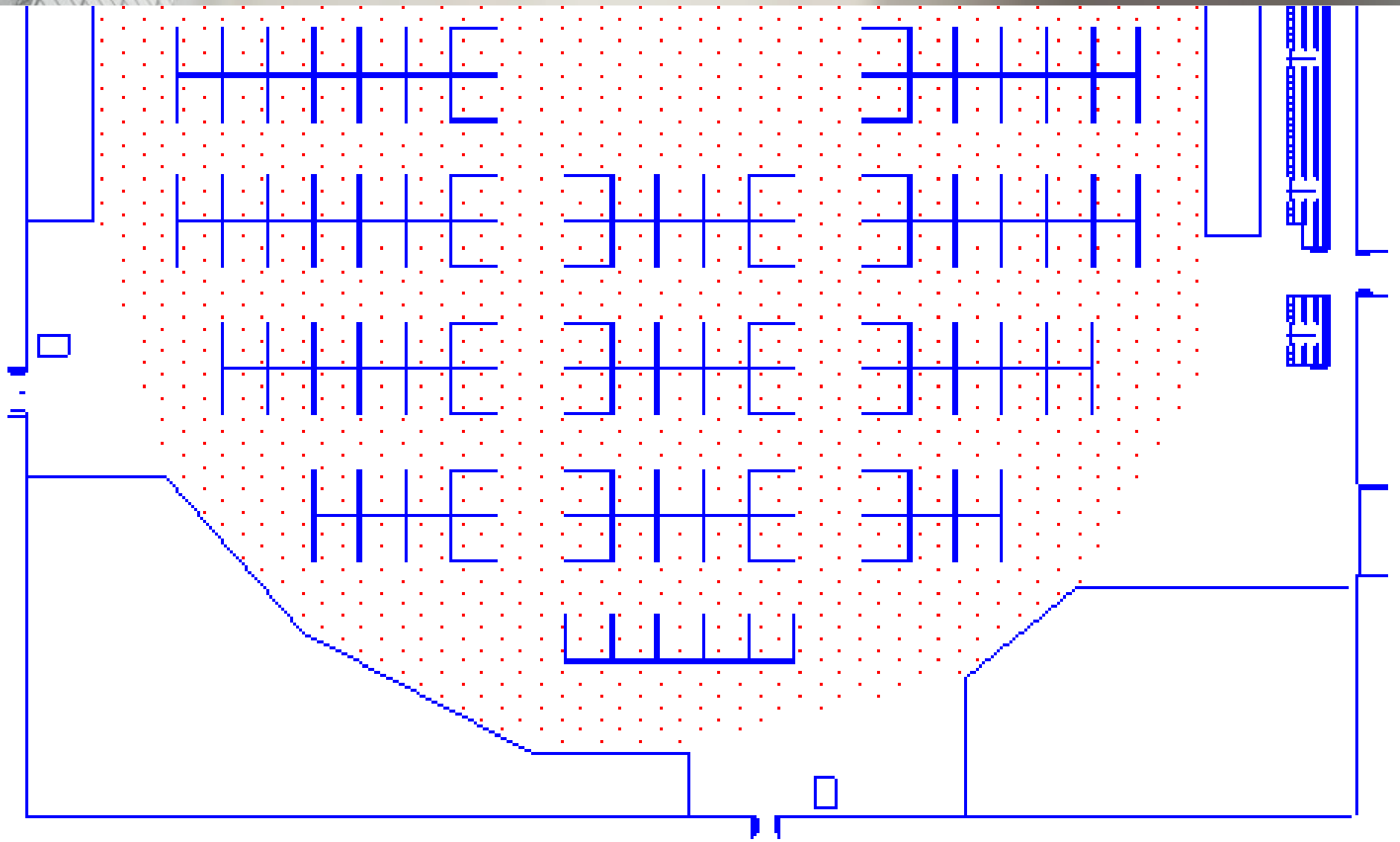
Sample Projects

- **Multi-purpose arena**
- **Theatre**

Multi-Use Arena

- Trade shows
- Sporting events
- Concerts

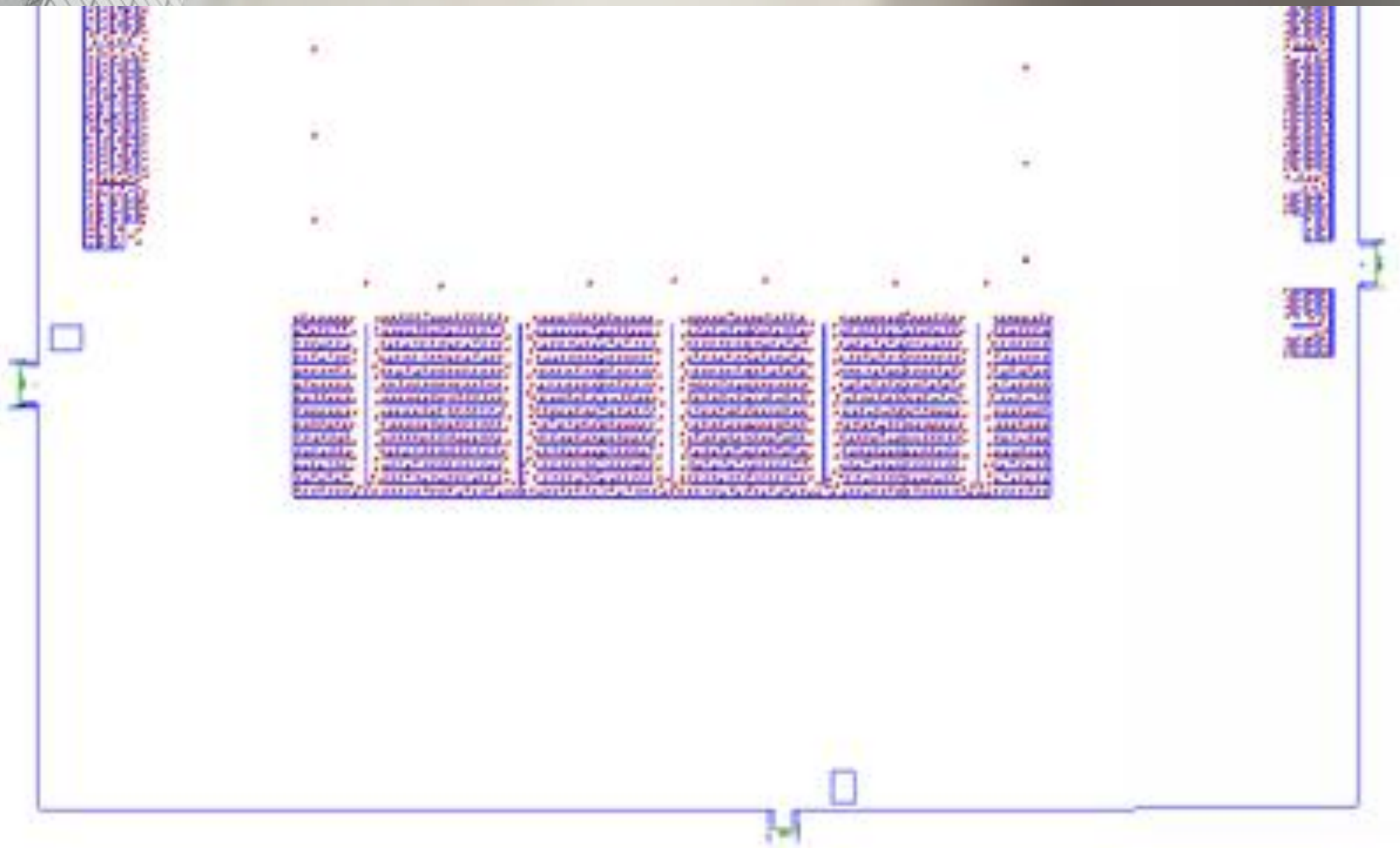
Trade Show



Observations

- Distributed population
- Generally free movement

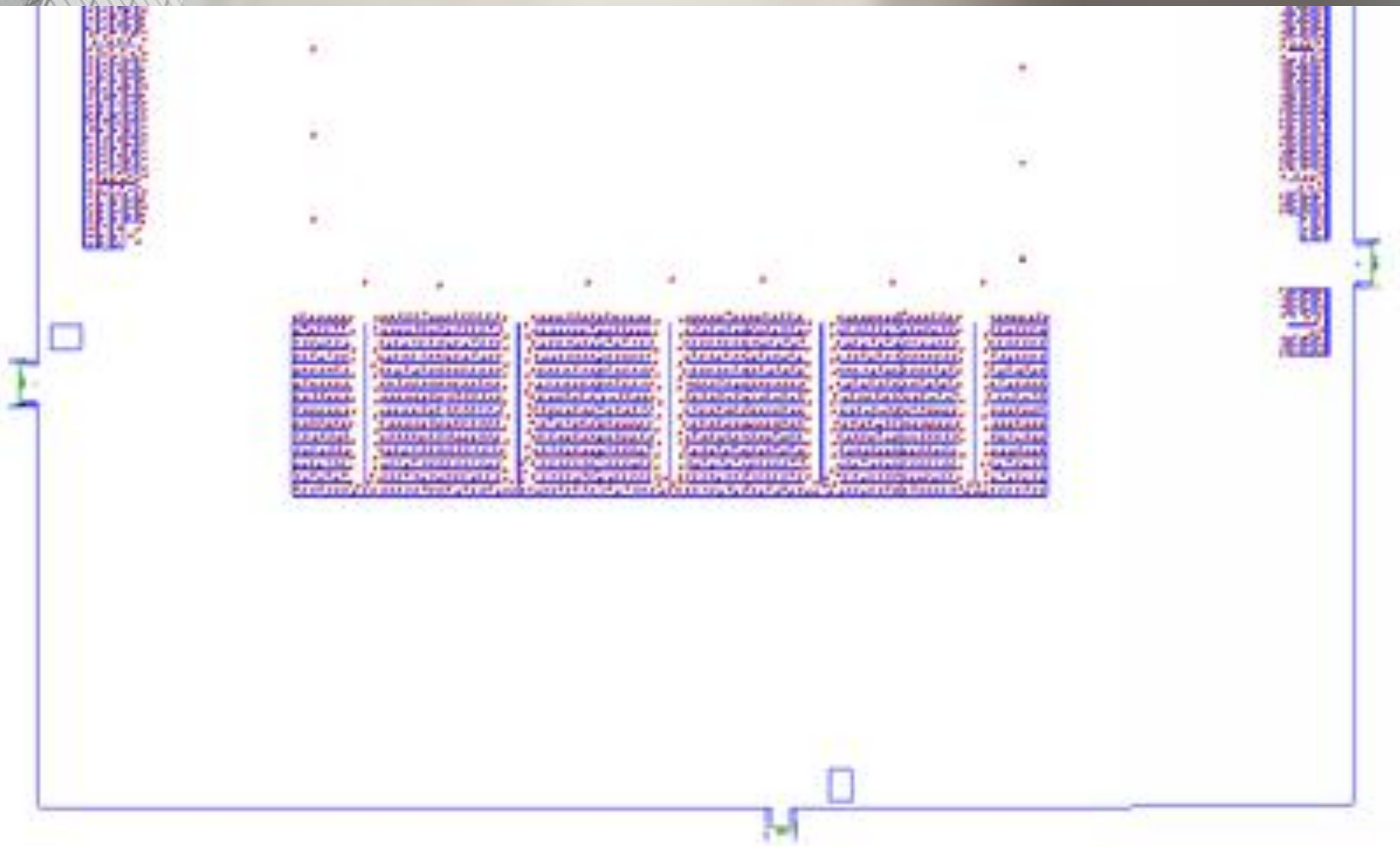
Sporting Event



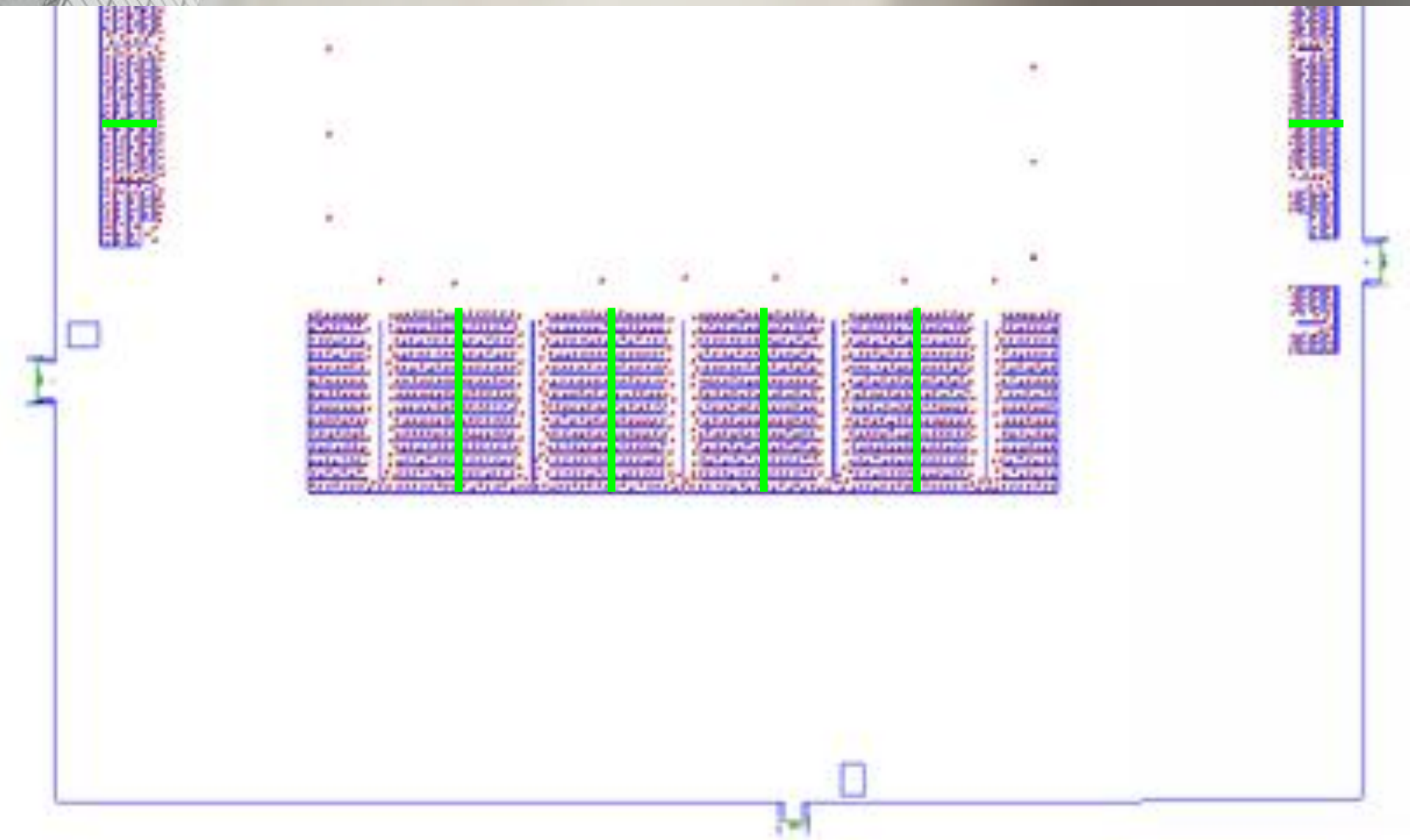
Observations

- Concentrated population
- Restricted movement

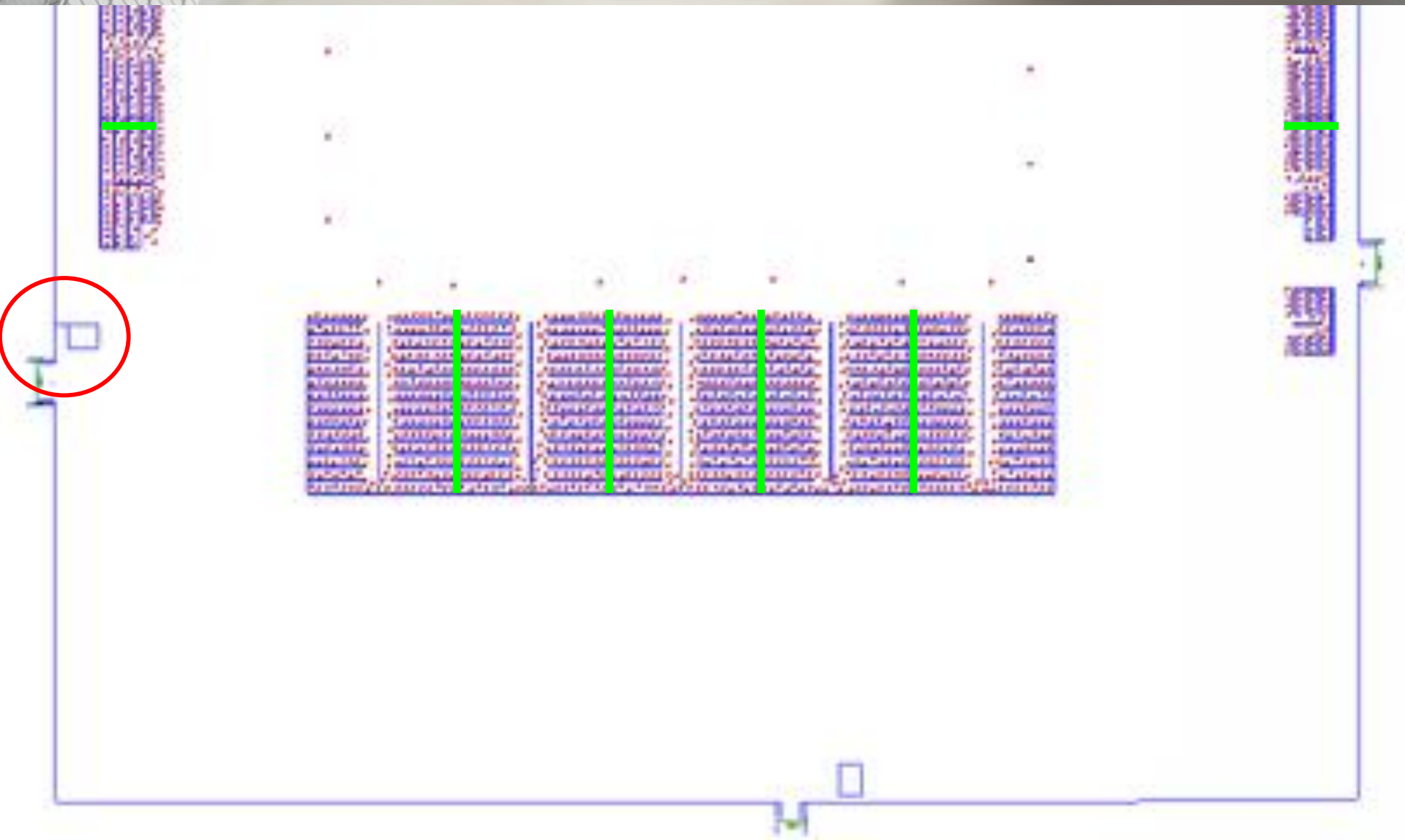
Grandstands



Divide Rows



Eliminate Gap

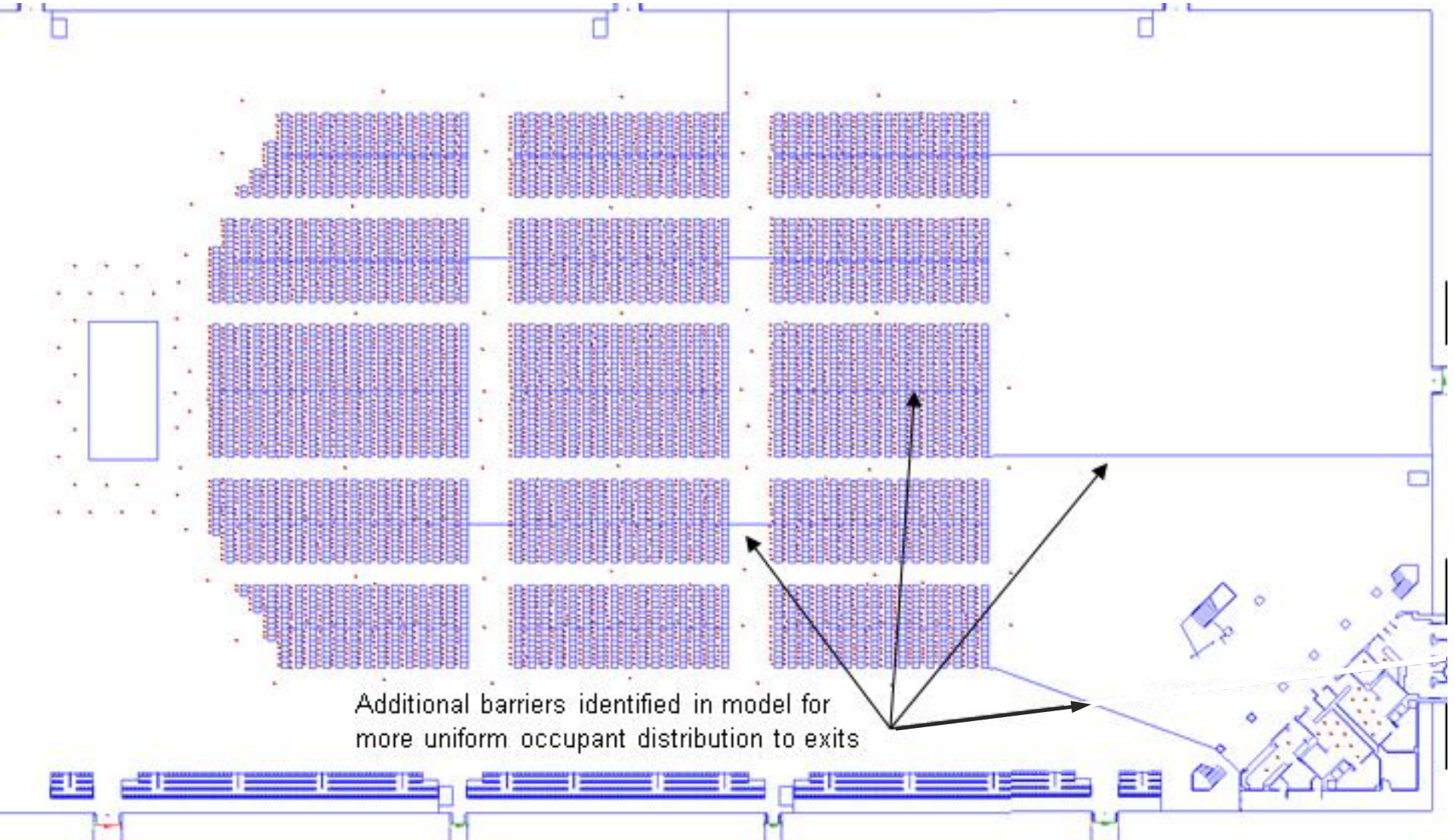


Exit Distribution

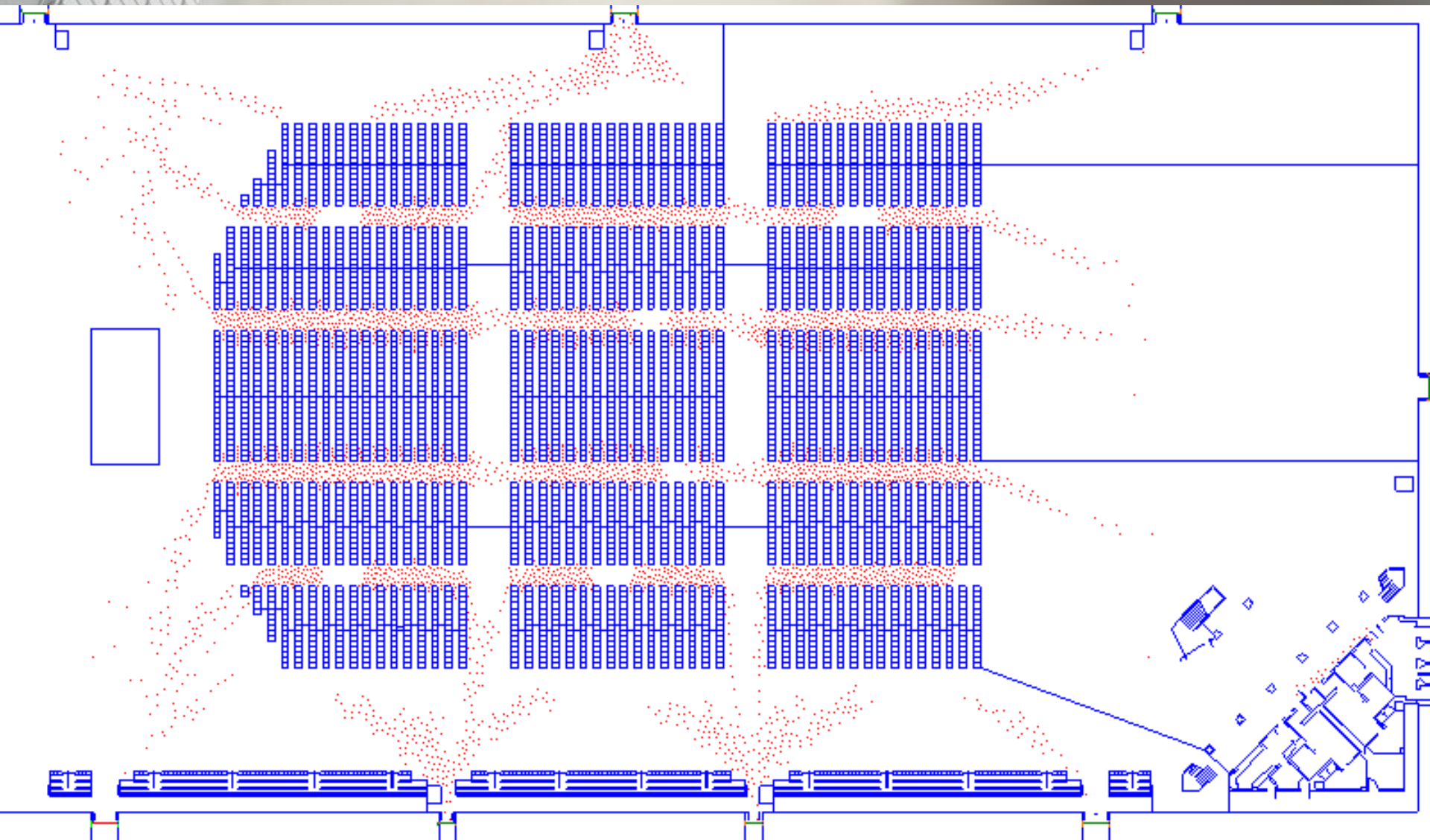
Engineering Judgment

- Reduce bleacher depth
- Limit travel in seating row
- Invert exit access

Concert


Additional barriers identified in model for
more uniform occupant distribution to exits

Time 0:15



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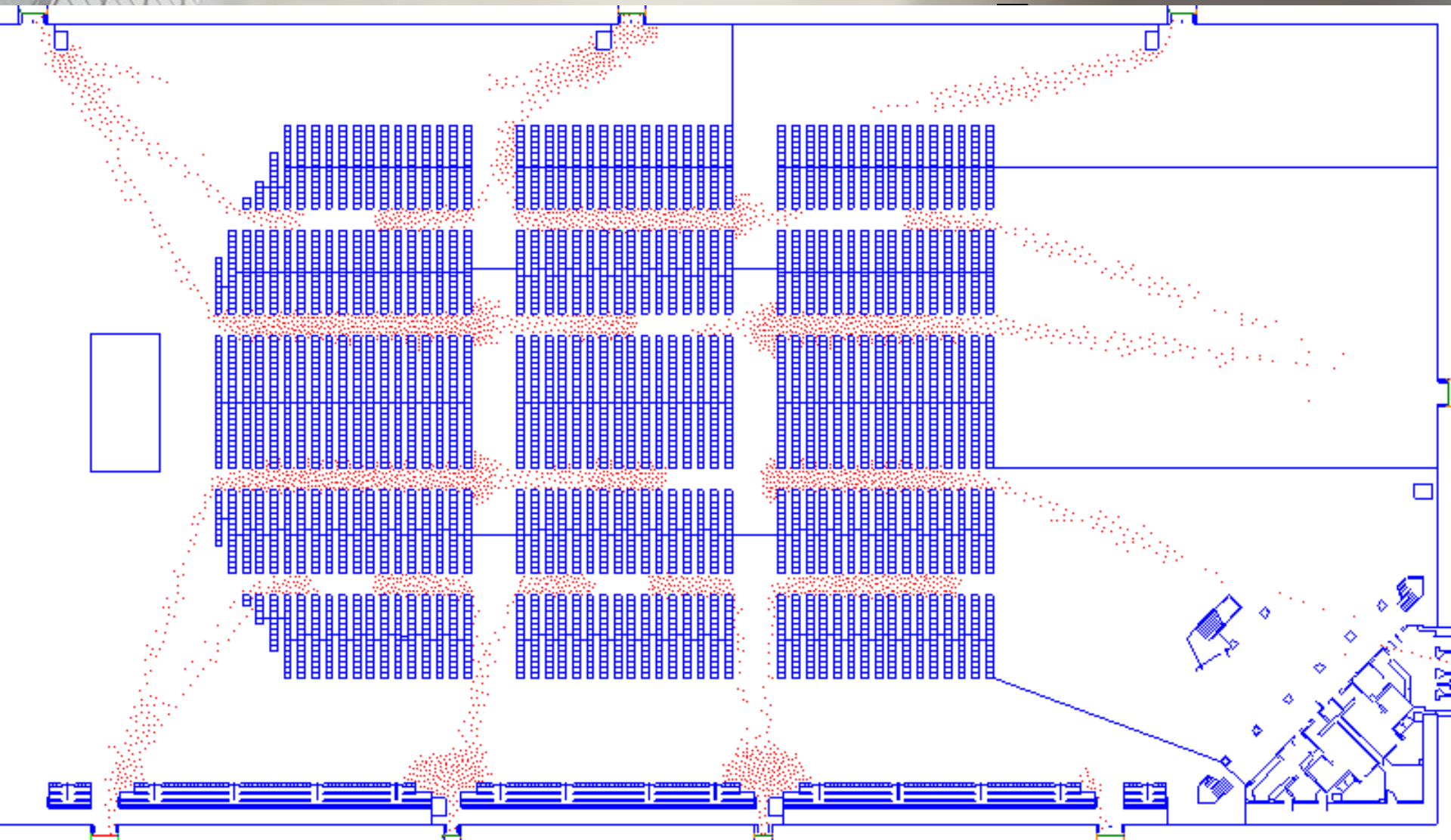

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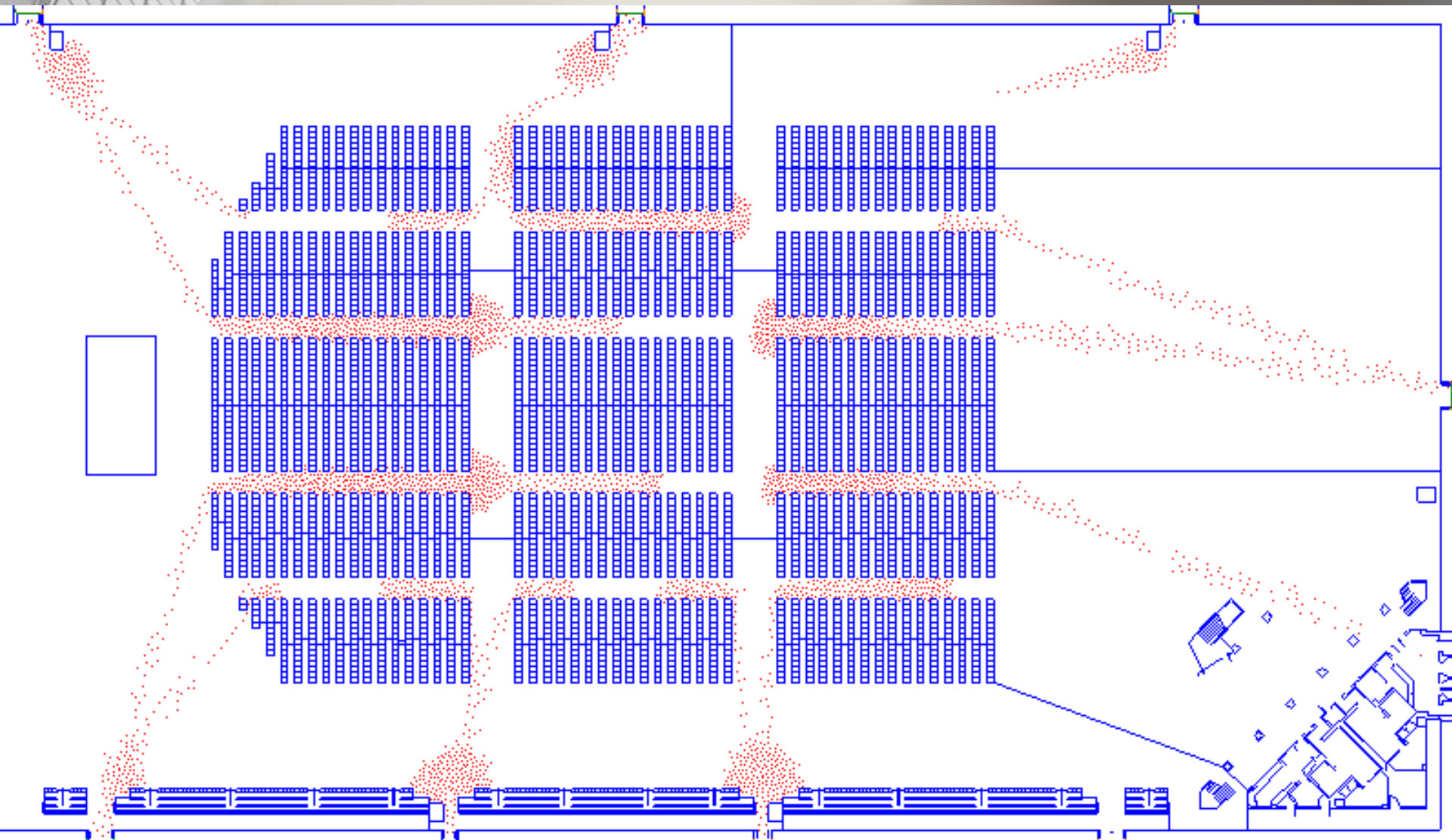

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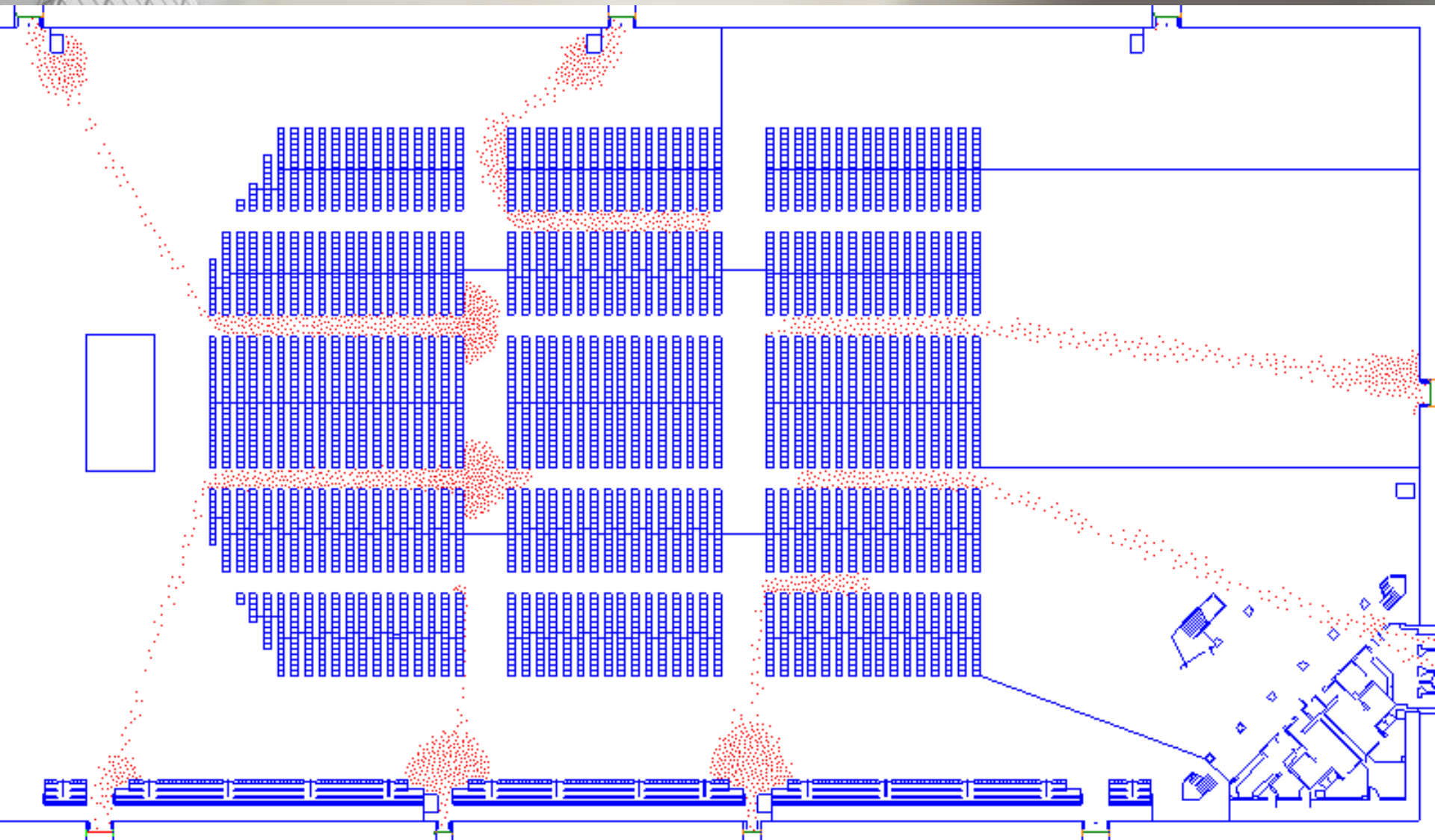

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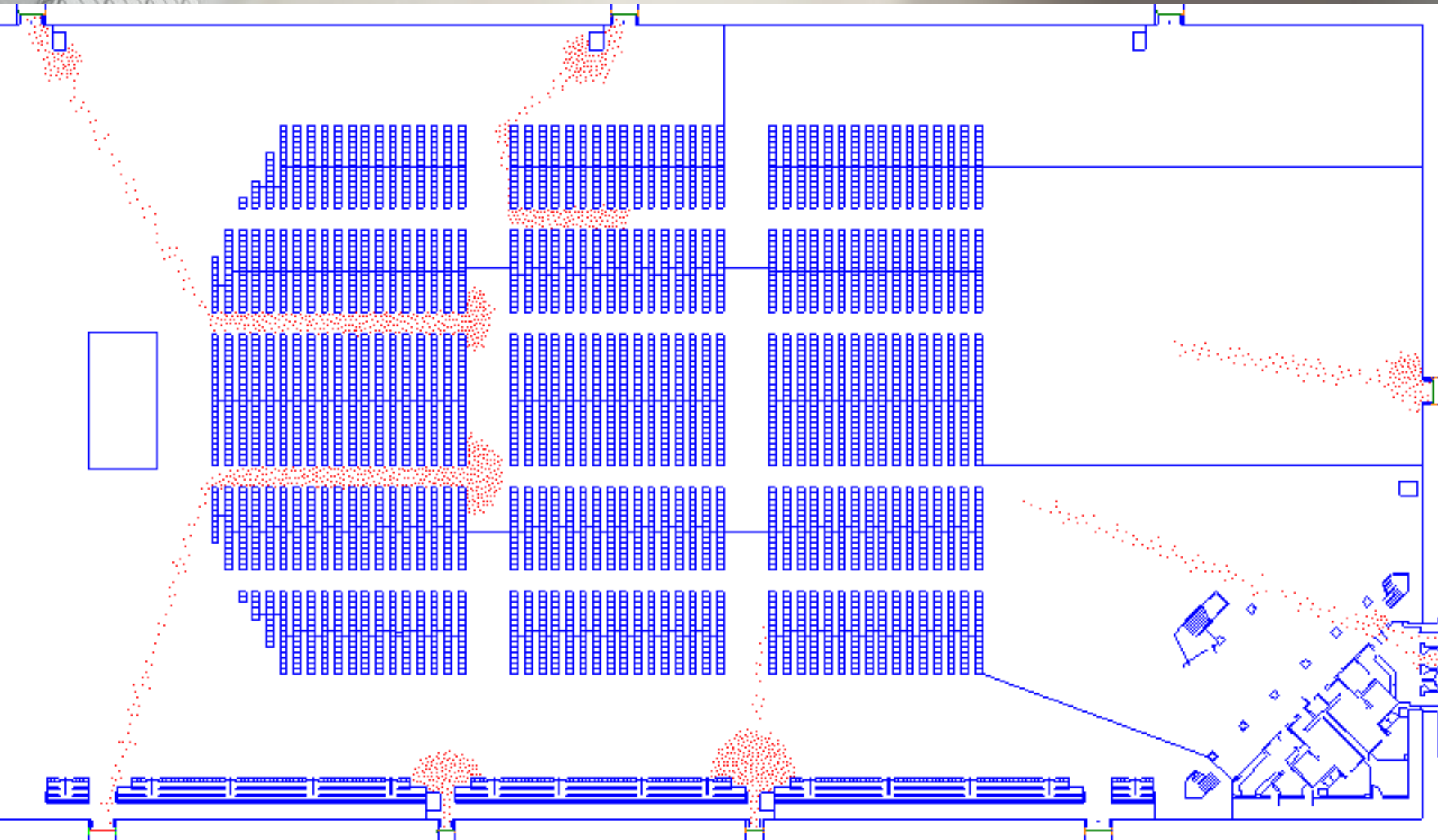

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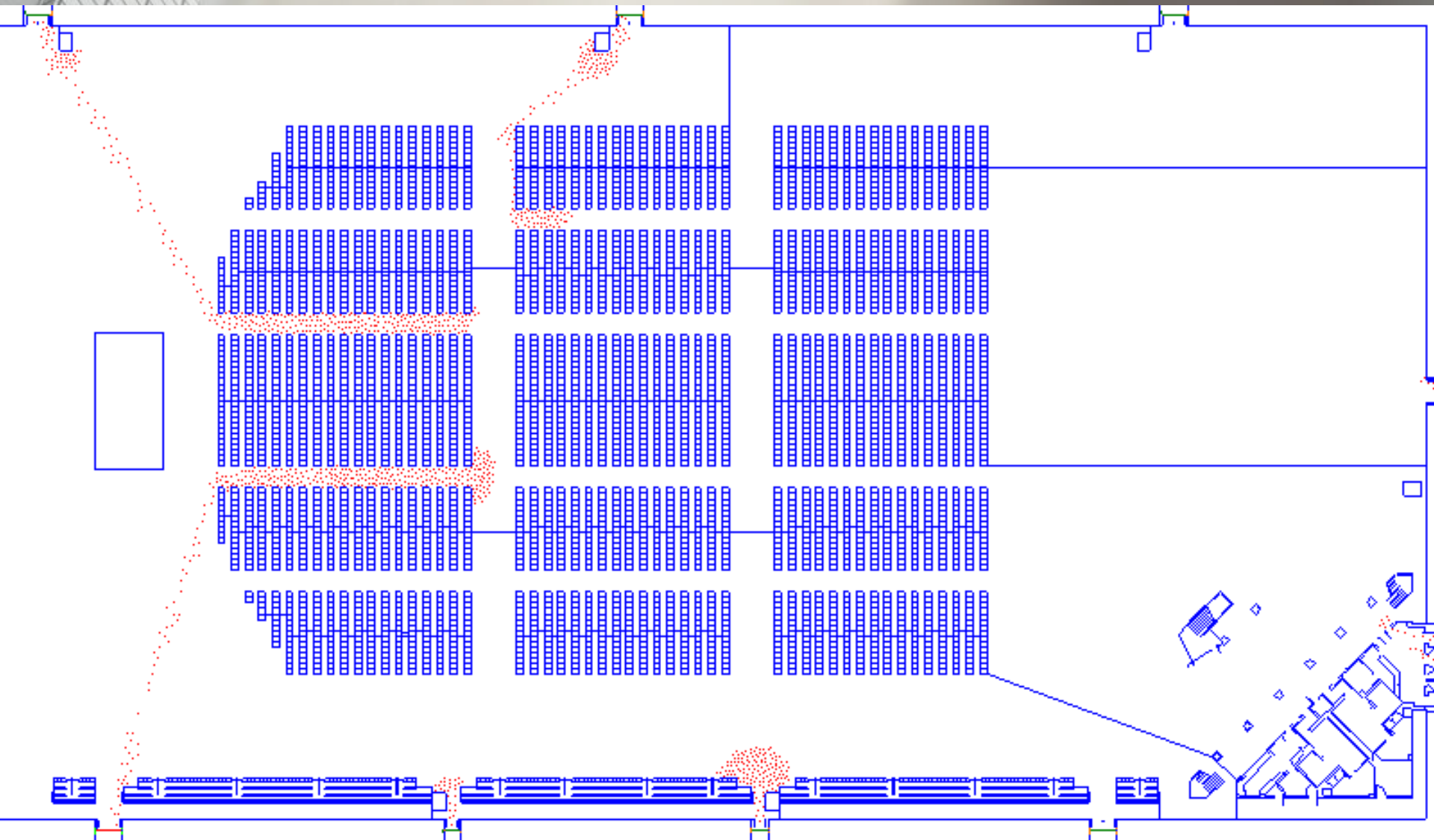

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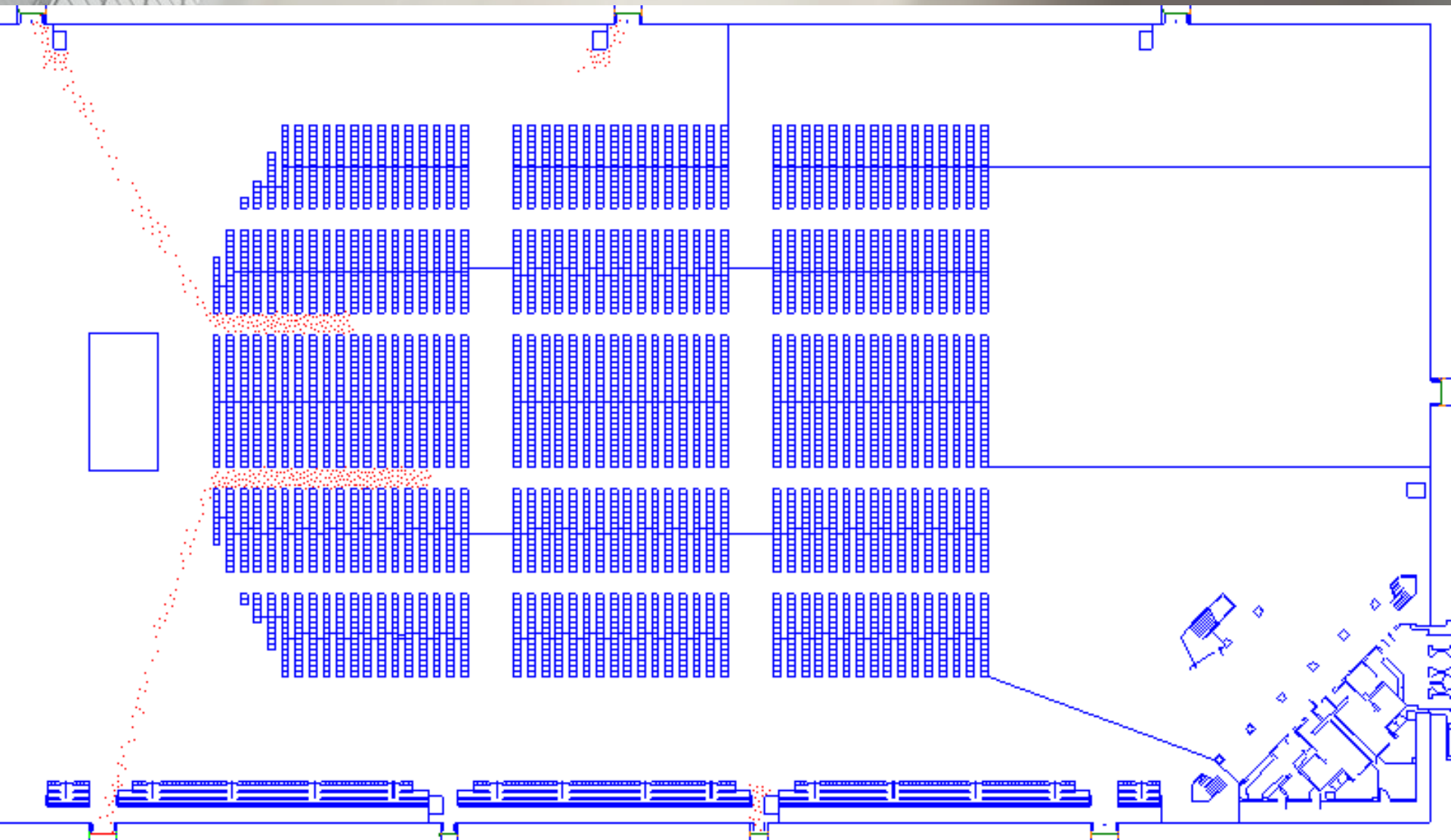

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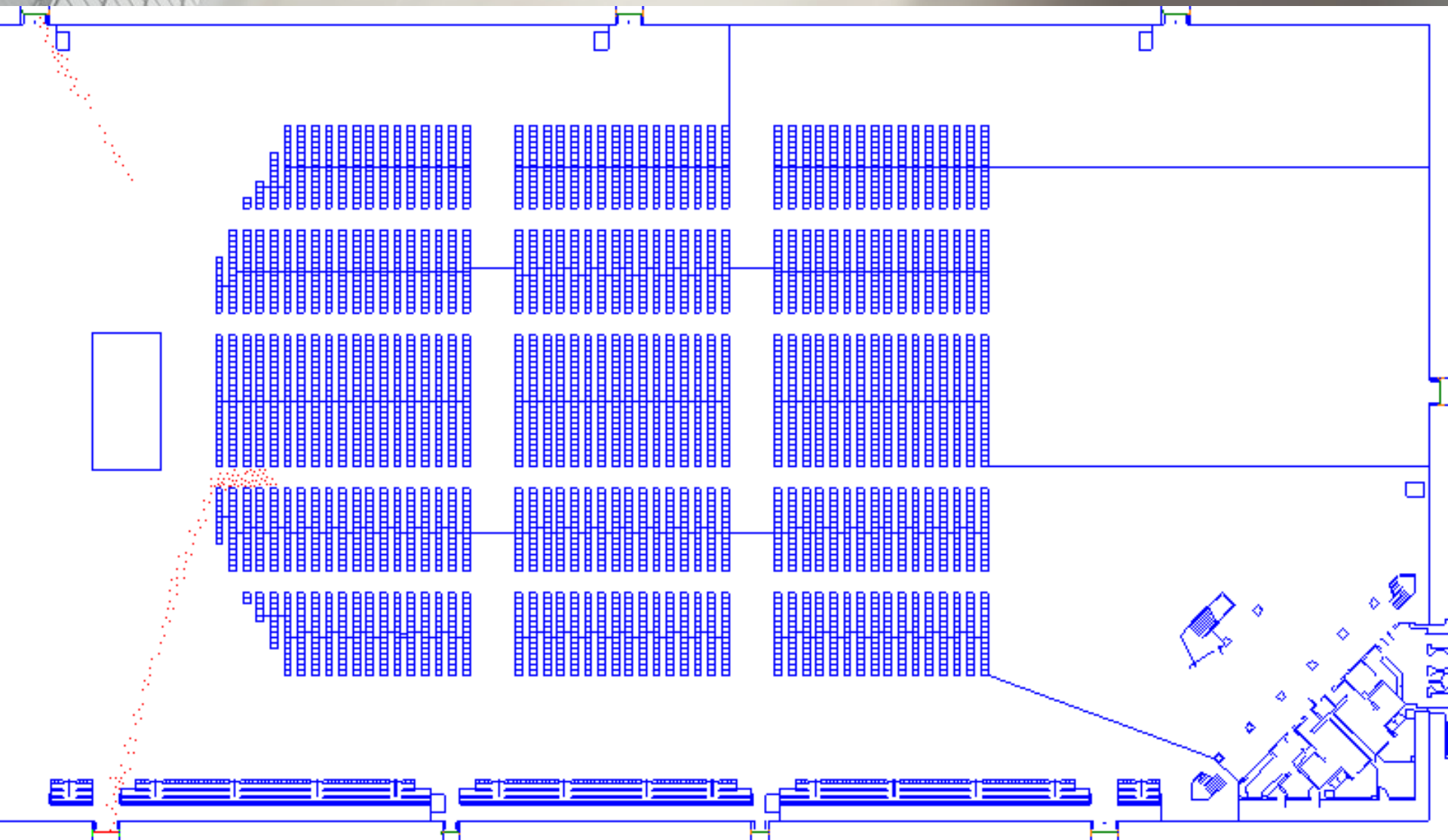
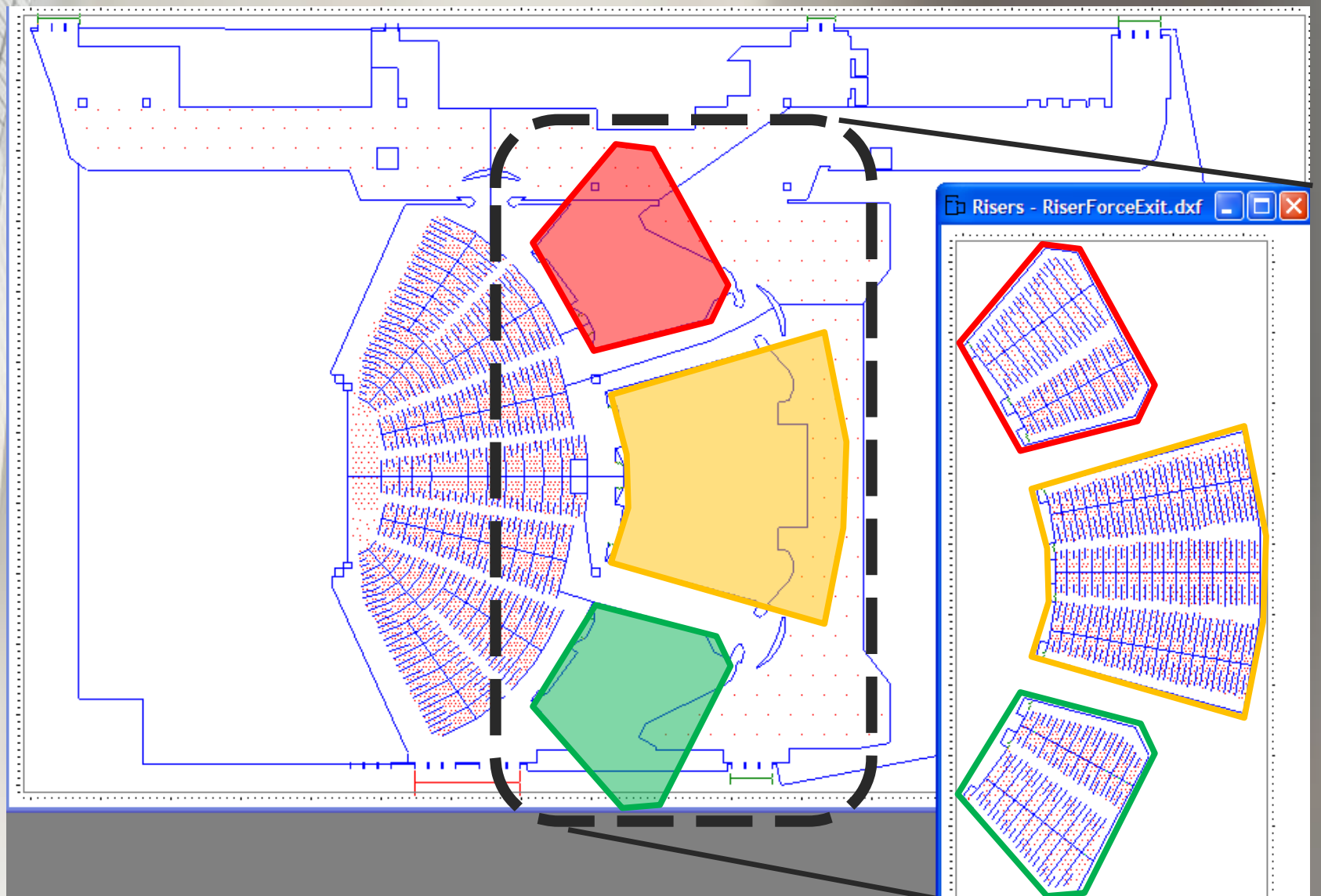


Engineering Judgment

- Limit travel within row
- Forced exit distribution
- Queuing vs. available exits

Tiered Theatre Seating



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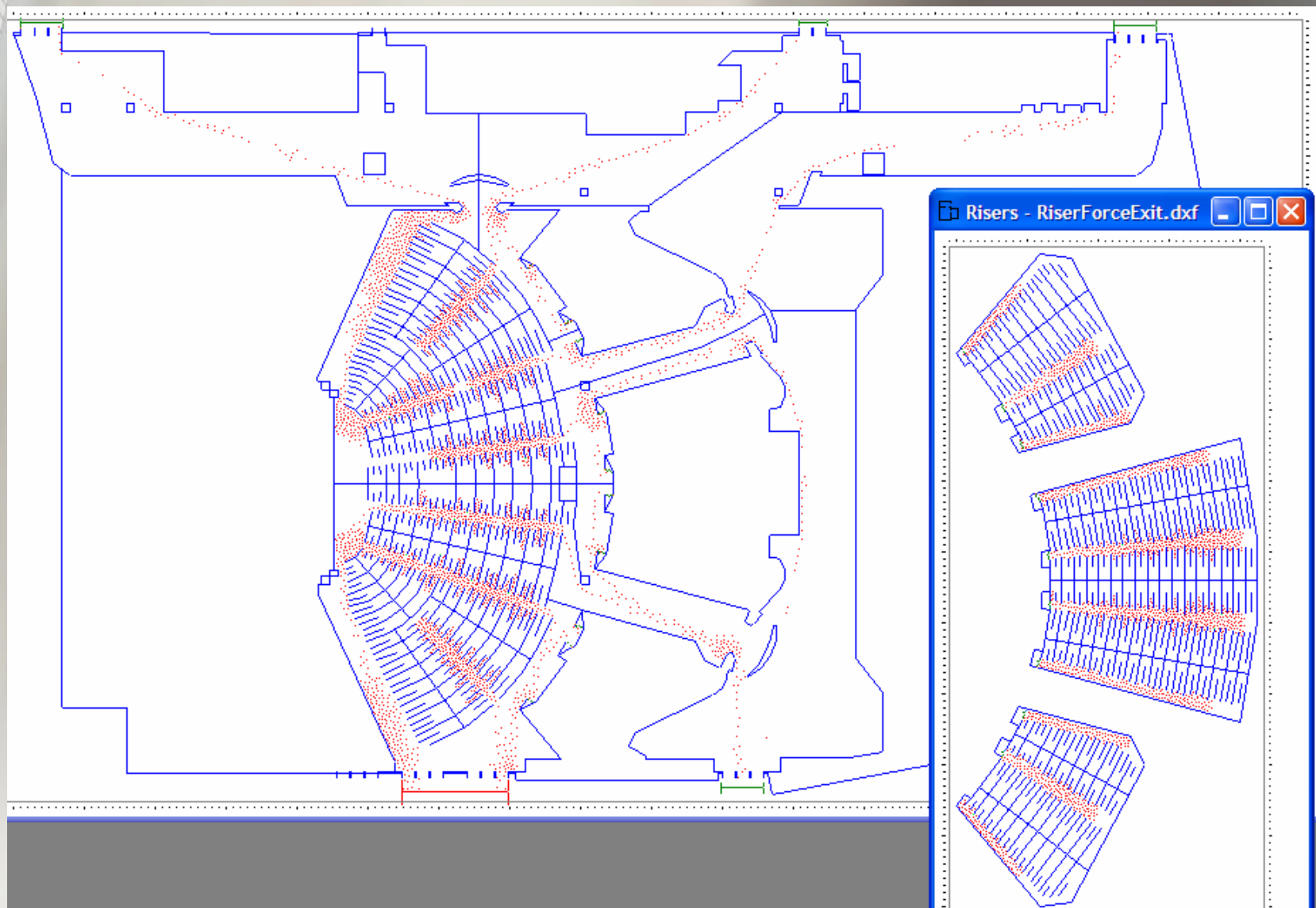

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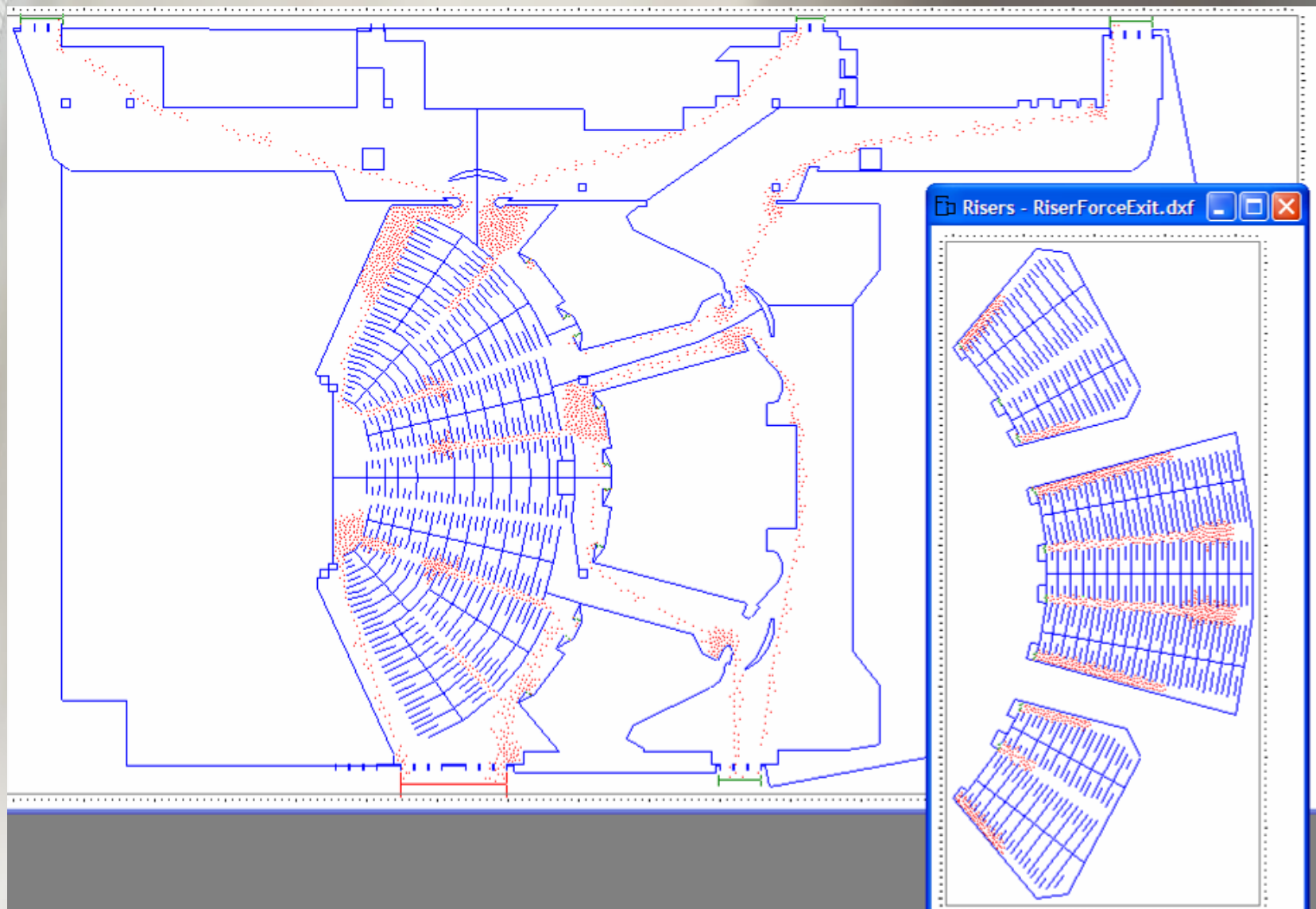

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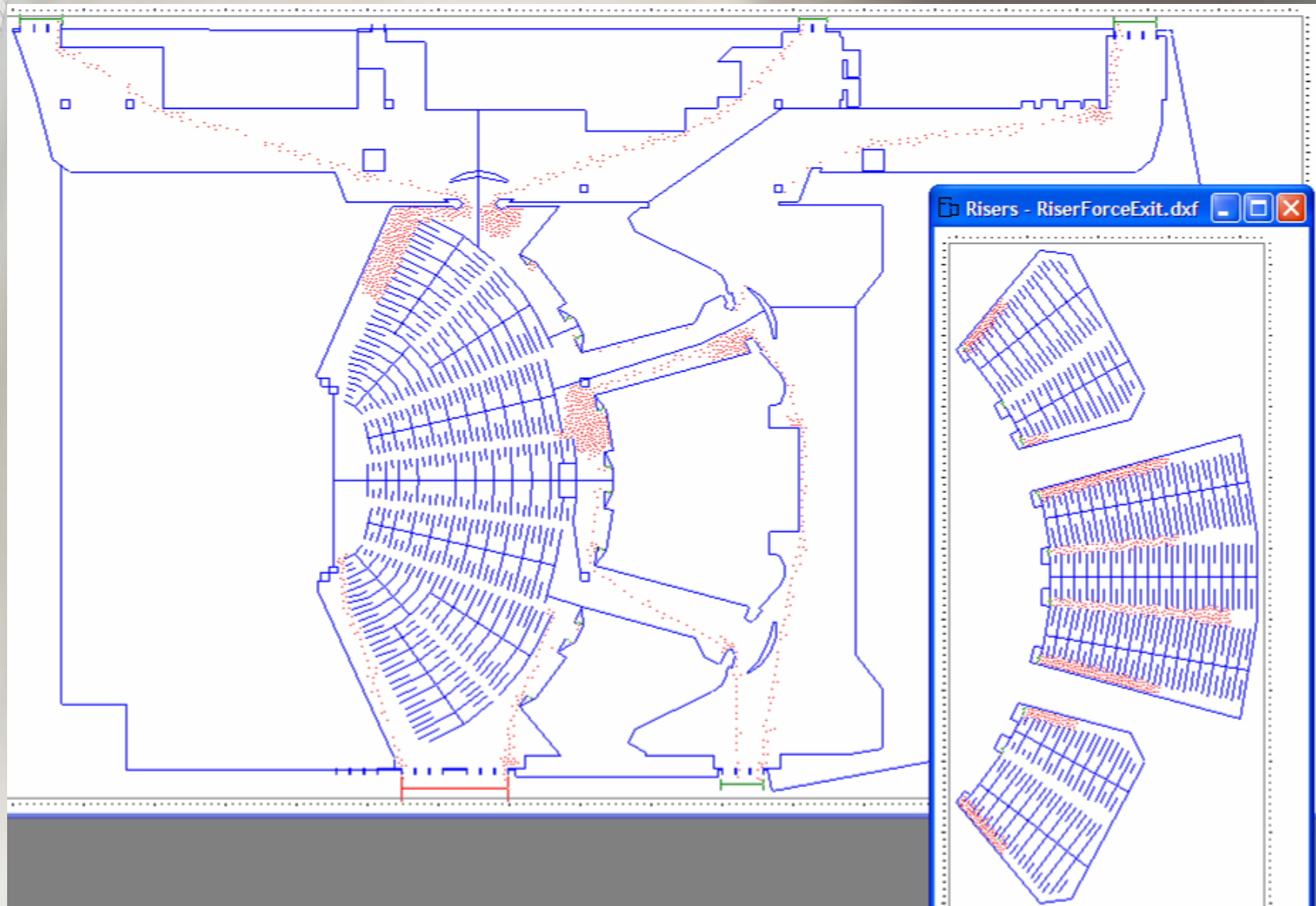

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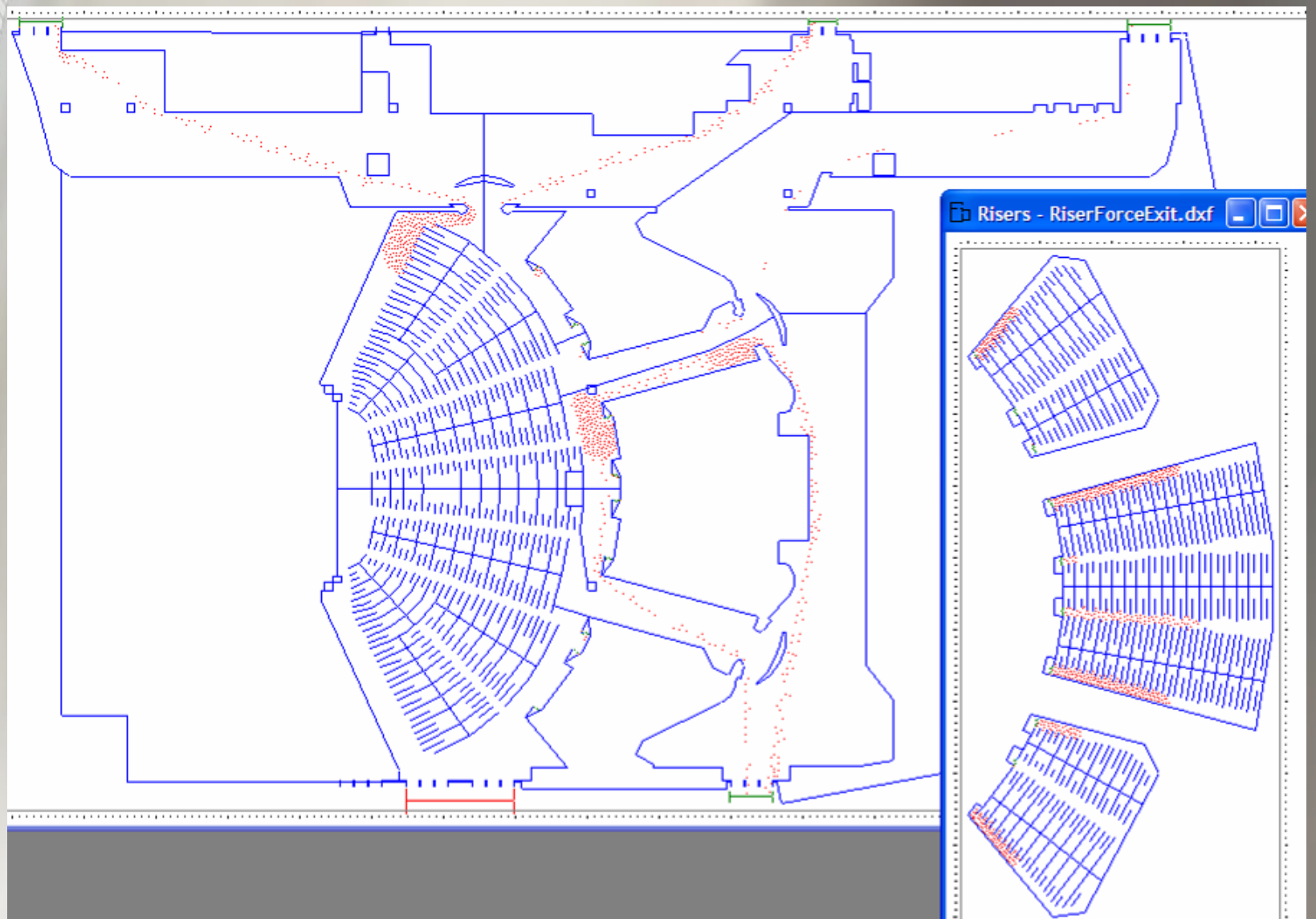

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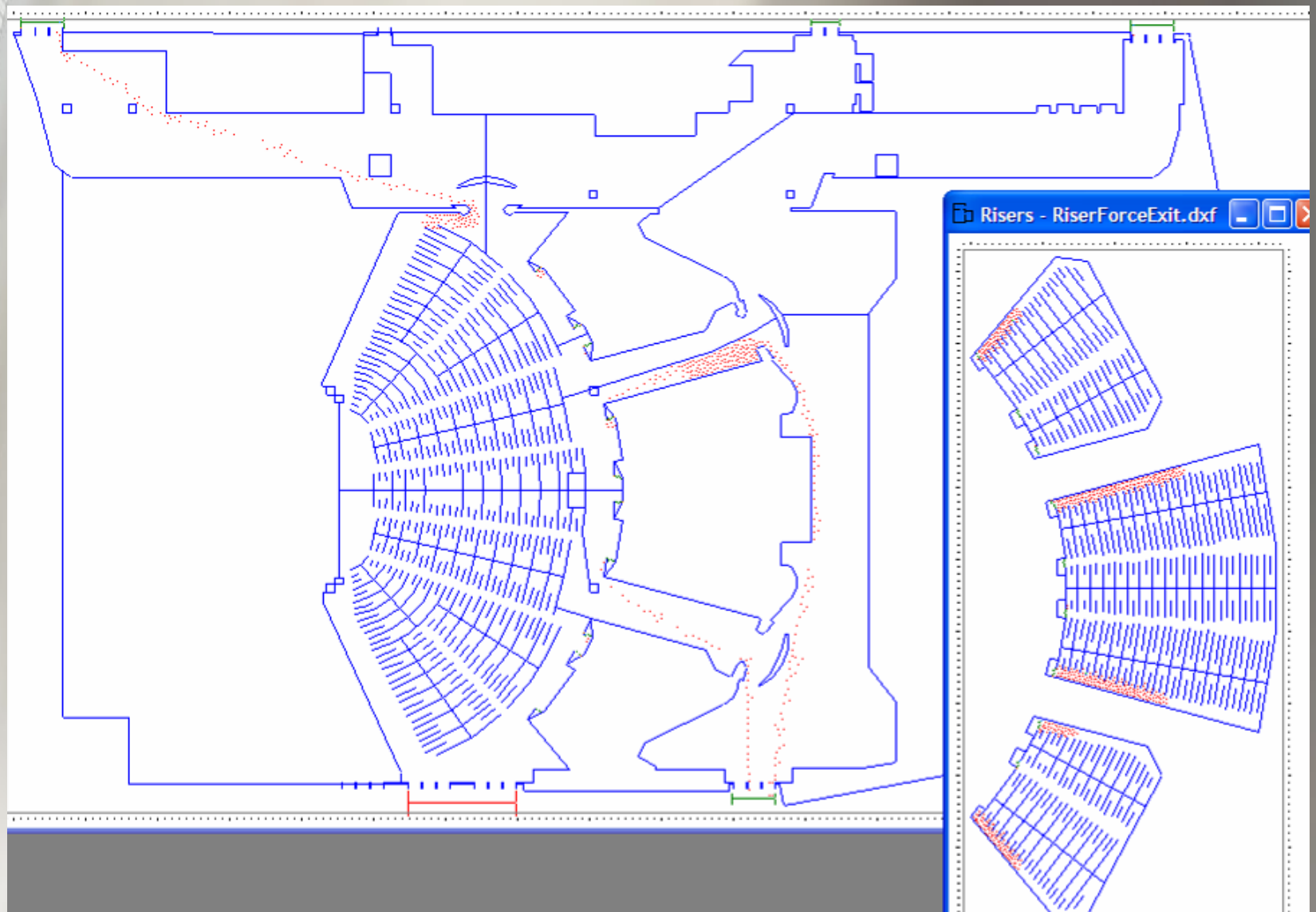

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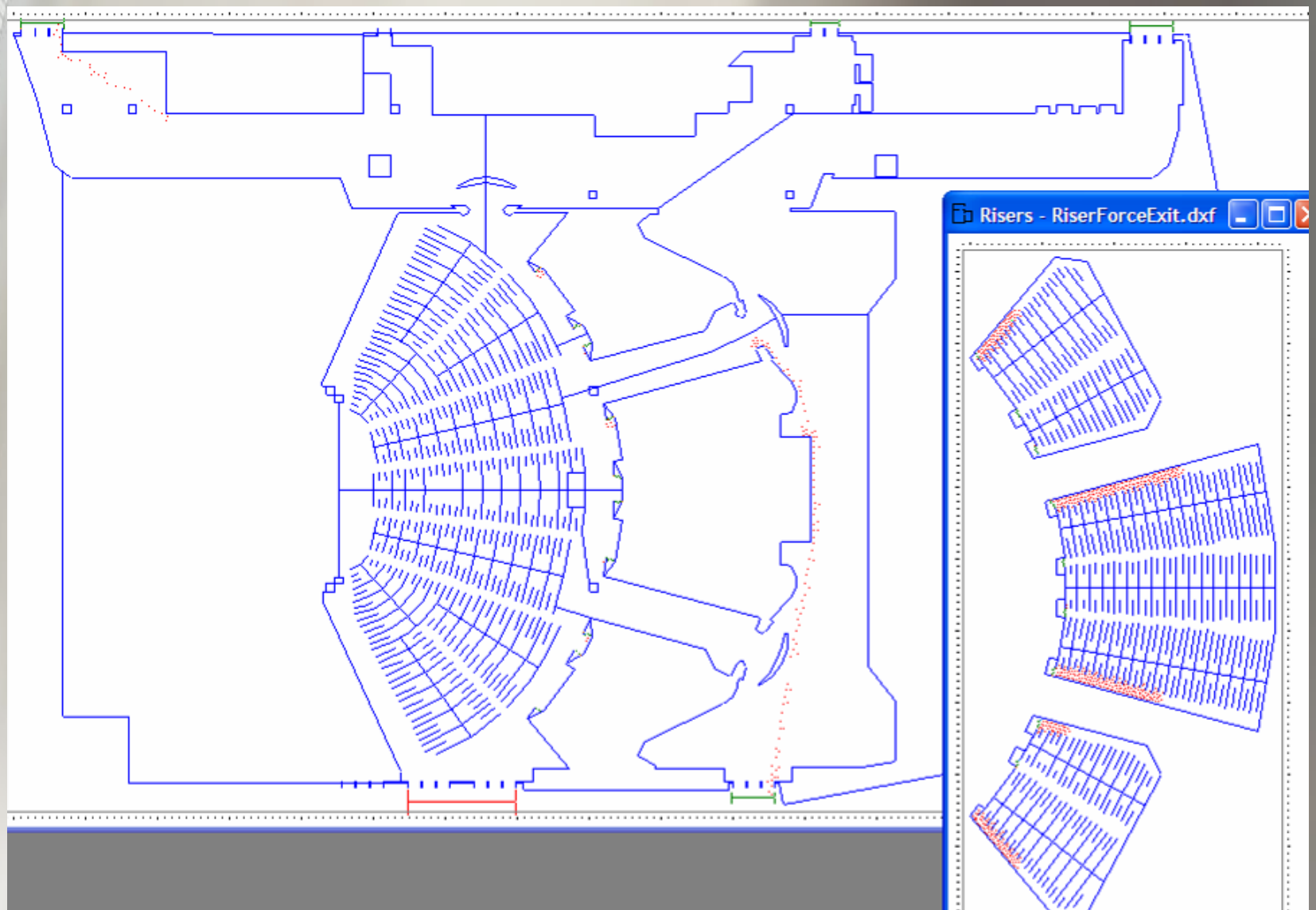

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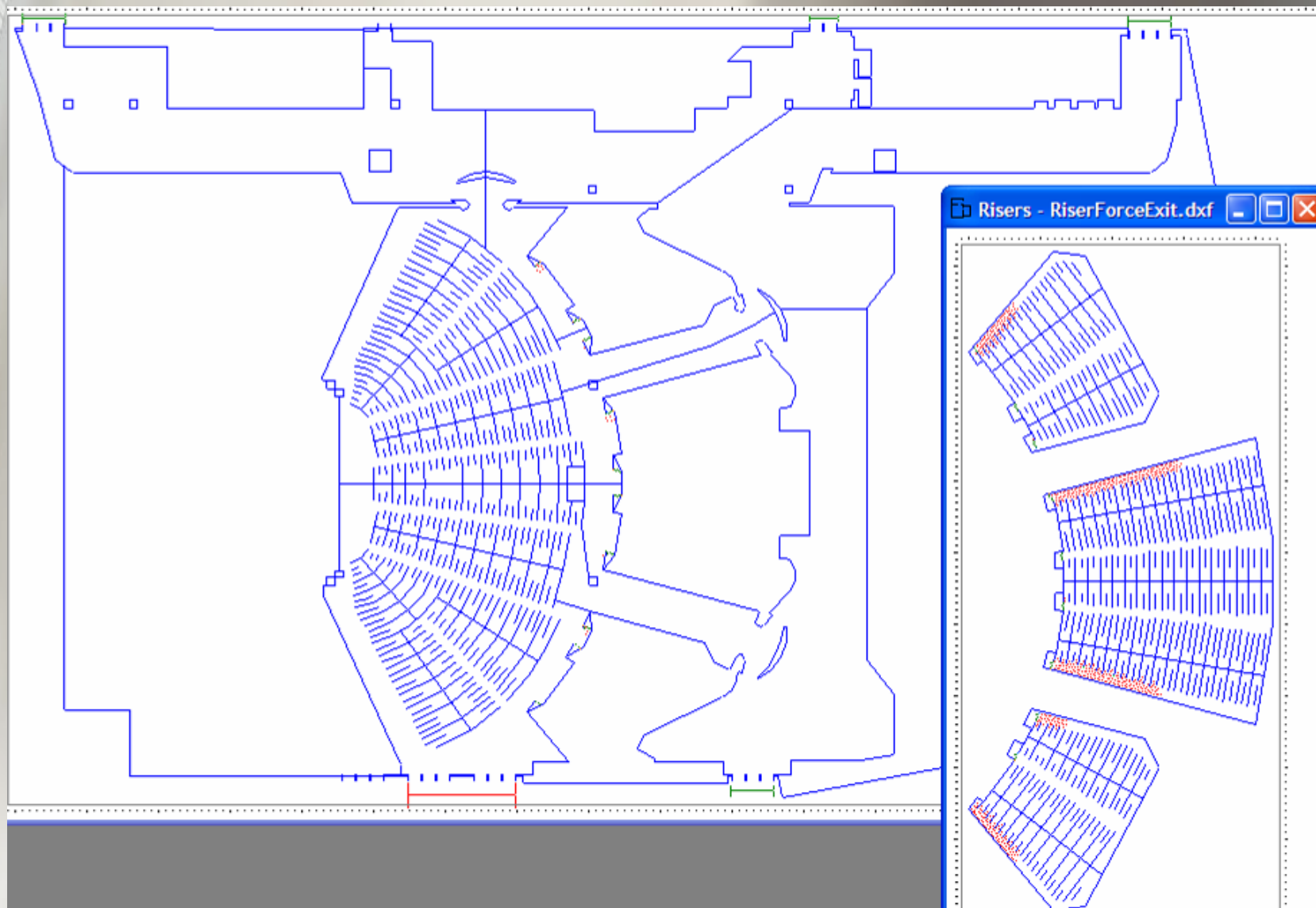

Engineering Judgment

- Deleted seat obstructions
- Limited travel within row
- Forced exit distribution
- Queuing vs. available exits
- Account for jams

Validation Factors

- Comparable to test data
- Absence of panic
- Aisles equalize rows
- Queuing vs. exit availability
- Rational manipulations

Potential Refinement

- Multi-story stairs
- Effects of pillar at exit
- Alter movement speed

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Discussion

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