



## System Requirements

### Operating System

Windows 7, 8 or 10, 32-bit or 64-bit

### Graphics Card

Dedicated graphics card with at least 1 GB memory and full OpenGL support

### Processor

Intel i5, i7, or Xeon processor of at least 3 Ghz

### Memory

At least 8 GB of RAM for 32-bit edition and 16 GB for the 64-bit edition

### Hard Disk

100 GB of spare disk space on a fast (7,200 rpm or above) hard drive (to store several large results files)

### Microsoft Excel

Microsoft Excel 2007 or later to enable data file input. LEGION supports all Excel file formats, including 'xlsx' and 'xism'

**Find out about Bentley at: [www.bentley.com](http://www.bentley.com)**

### Contact Bentley

1-800-BENTLEY (1-800-236-8539)  
Outside the US +1 610-458-5000

### Global Office Listings

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## LEGION Simulator At-A-Glance

### Principle of Least Effort

- Uses the concept of least effort, or cost minimization, as the cornerstone of pedestrian logic
- Dissatisfaction is caused by physical and psychological factors that degrade journey quality. The following three factors contribute to entity dissatisfaction:
  - » Inconvenience - desire line divergence stress
  - » Discomfort - personal space compression stress
  - » Frustration - preferred speed relinquishment stress

### Unbounded Movement Choice

- Model space is continuous, rather than structured, based on a pixel grid
- Select any vector when optimizing step choice to satisfy individual preferences and objectives in the context of changing physical constraints
- This approach follows a two-stage process:
  - » **Macro-navigation**
    - The selection of an entity's desired direction to its next target, from its current position
    - Represented by a sequence of intermediate, focal targets that trace the shortest path from an entity's location to the place where it leaves the model (or reaches its final target or destination)
  - » **Micro-navigation**
    - Uses advanced, proprietary, artificial intelligence algorithms to apply micro-navigation to its entities, within a simulation
    - Algorithms enable entities to exhibit realistic pedestrian movement
    - Entities have an area of perception that adjusts dynamically, based on instantaneous information and accumulated memories
    - Entities assess information to decide their best immediate step
    - Micro-navigation algorithm takes several important considerations into account, including:
      - › Early detection and avoidance of physical obstacles
      - › Accommodation of personal space, preferred speed and other personal requirements
      - › Maneuvering to avoid collisions
      - › Learning from accumulated memories
      - › Entity adaptation, in the ability to adjust individual preferences and attributes

### Intelligent Entities

- Social, physical, and behavioral characteristics are assigned probabilistically from empirically established profiles
- Social characteristics include gender, age, culture and pedestrian type, all of which shape typical movement preferences
- Physical characteristics determine body sizes
- Behavioral characteristics include memory, adaptability, and preferences for unimpeded walking speeds, personal space, and acceleration

### Output and Analyses

- Numerical and graphical outputs derived from a LEGION Simulator model and user-defined areas,

interrogated to provide user-defined combinations of these, based on user-defined thresholds

- Measure and quantify the performance of a site with respect to experience, circulation, and safety
- Examples of key metrics include counts, flows, distances, densities, journey times, speeds, and levels of service
- Heat maps provide intuitive overviews of these, from which to identify areas meriting deeper analyses, including line graphs, histograms, stacked histograms, cumulative data, or even raw data, which can then be used for statistical analyses

### Social Distancing Enhancements

- Quickly and intuitively design and simulate socially distanced queuing areas of any scale, shape, and social distance
- Rapidly create socially distanced pedestrian waiting areas, ensuring those waiting maintain the desired distance from each other
- Compare desired occupancy ratings and capacity factors of a venue with the reduced maximums, identifying areas needing pedestrian management, helping to plan ingress, occupancy and egress rates to remain operational while complying with social distance requirements
- Identify socially distanced capacity limits for delay points and waiting zones
- Configure delay point and waiting zone capacities when models are based on a density requirement rather than an absolute number
- Social-distance proximity-breach maps that highlight a venue's pressure points, showing areas susceptible to breaches of social distancing and quantify the duration of those breaches
- Entity proximity zone indicators, in which each entity indicates the number of neighbors encroaching the social-distancing zone surrounding them. The degree of breaching helps identify areas needing operational intervention to help respect social distancing

### OpenBuildings Station Designer

- OpenBuildings Station Designer is Bentley's multidiscipline station design application that enables BIM strategies and allows designers to efficiently explore design alternatives
- It provides information-rich models for the design, simulation, analysis, and documentation of buildings
- This single application includes capabilities for planning, architectural, structural, mechanical, and electrical systems design and construction documentation
- LEGION Model Builder is delivered in OpenBuildings Station Designer as a companion application and used to create accurate, predictive models of how a space will be used

### LEGION Simulator API

- LEGION Simulator integrates with traffic simulation software Aimsun Next
- Two interaction methods are possible:
  - » Aimsun Next provides pedestrian infrastructure elements modeled using the LEGION Simulator API. This minimizes user effort to include pedestrians in Aimsun Next models
  - » For users experienced with LEGION modeling, any complexity of LEGION model is possible

**For additional information, and to read about the extraordinary projects designed using LEGION Simulator, visit <https://www.bentley.com/legion/>**