



A SIMULATION MODEL WHICH REPRESENTS THE FLOW OF VISITORS THROUGH A PAVILION



NL Agency
Ministry of Economic Affairs

INDUSTRY

Crowd Simulation & Infrastructures

APPLICATION AREA

Commercial Venues

COUNTRY

China

OBJECTIVE

Gain insight into the performance of the pavilion.

RESULTS

With the help of simulation:

- The maximum people allowed was adapted.
- The people responsible for crowd management were more aware of the consequences of the decisions they were making regarding safety.

John Körmeling's views on urban planning as well as on architecture are the basis of his design for Happy Street. Simulation software was used to evaluate the performance of the design!

THE PAVILION HAPPY STREET

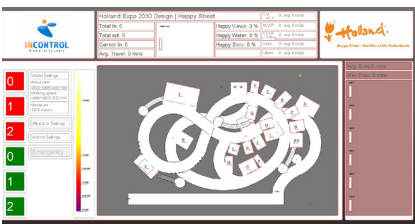
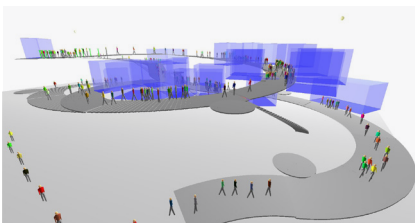
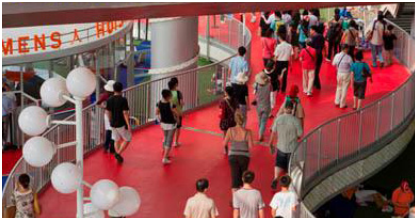
The Dutch pavilion, designed by architect/artist John Körmeling, is called 'Happy Street'. It's an entire street in the shape of the number eight, an auspicious number in Chinese culture. Visitors to the pavilion stroll along houses in different styles that represent Dutch architectural tradition, including designs by Gerrit Rietveld and Jan Wils. During their trip, the visitors will also have the possibility to do an activity (interactive). The simulation model is visualized in both 2D and 3D view of the pavilion.

The simulation model represents the flow of visitors through the pavilion. Inside the pavilion visitors will enjoy the different "houses" which each show a different aspect of the Dutch culture. In the initial design the visitors will not enter the houses but will stroll along the front and look inside the house. During their trip, the visitors will also have the possibility to do an activity. The following activities can be found in het pavilion:

- Happy views: these are viewers that show different architectural pictures. In the initial design there are 12 viewers.
- Water fountains: the visitors can get a cup of water through a water dispenser. In the initial design there are 2 water dispensers.
- Slot machines: at the start of their trip the visitors will receive a coin that can be used as one credit on the slot machines that are positioned at the end of the route. In the initial design there are 8 slot machines.

The visitors will follow a fixed path through the pavilion and during their travel they will stop at the different houses and activities. Due to this speed changing behavior of the visitors along the route congestion can arise in different extents. The visualization and quantitative analysis of the simulation model gives a clear view on different points in the route where this congestion arises.

SHOWCASE THE DUTCH PAVILION 'HAPPY STREET'



PERFORMANCE

In order to create a proper performance analysis, the following performance indicators were defined:

- Density (m^2/p). The density is measured as the amount of square meters per person (m^2/p).
- Activity performance (%). Since the visitors will make a decision about doing the specific activity based on the size of the waiting queue, not all visitors will do this activity. The activity performance indicates the percentage of people that did an activity in relation to the total amount of people that entered the pavilion.
- Arrival Intensity (visitors/hour). In the scenarios there will be a maximum of people that are allowed simultaneously inside the pavilion. Based on the duration of the trip inside pavilion (travel time) this will result into an amount of people allowed to enter the pavilion per hour, the arrival intensity.
- Evacuation time (minutes). In each scenario also a total evacuation was performed. The duration of all visitors leaving the pavilion was measured at the different emergency exits.

RESULTS AND BENEFITS

In order to create a clear view on the "performance" of the Pavilion, several scenarios were created by changing the following parameters:

- Maximum of visitors allowed simultaneously inside the Pavilion (value between 1,000 and 2,500).
- Estimated average duration at the activities (values between 15 and 60 seconds).

Based on the results from these scenarios the following conclusions were made:

- The arrival intensity of the pavilion is significantly dependent on both the maximum people allowed inside the pavilion and the duration of the visitors at the interactive areas.
- The density within the segments of the interactive areas is not significantly dependent on the duration that people stay at the areas houses.
- The density within the segment increases when the maximum number of people allowed increases. In two segments the density even reaches the physical maximum as the maximum people allowed becomes 2,500.
- The density at the activities decreases proportionally as the amount of people/hour increases but does not reach physical levels.
- The percentage of people doing an activity decreases as the arrival intensity increases.
- The evacuation time, both the maximum and the average, increases proportionally when the maximum people allowed in the pavilion increases. Reason for this is the maximum throughput of the different emergency exits.

With the initial maximum of 2,500 people allowed instantly in the pavilion both the density and evacuation time reached levels that were undesirable. The density reached physical levels ($0.5 m^2/p$) and the evacuation time for some emergency exits was more than 8 minutes. For these reasons, and so with the help of simulation, the maximum people allowed will be adapted and the people responsible for crowd management are now much more aware of the consequences of the decision they are going to make.