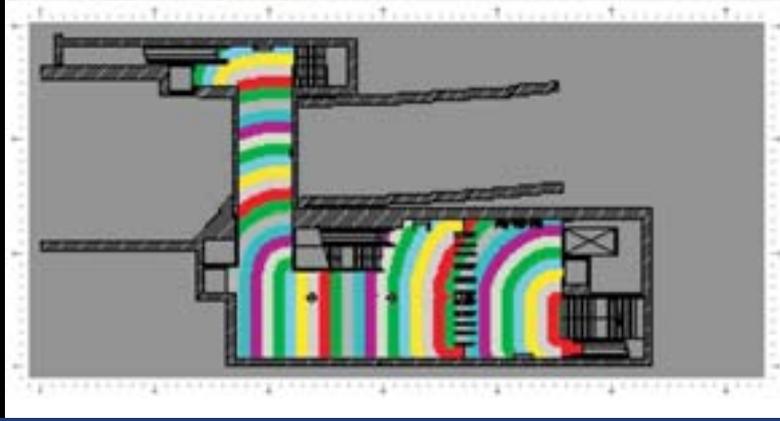


RAILGETAWAY



Ardanuy

MOVEMENT OF PERSONS AND EVACUATION DRILL
IN RAILWAY OPERATIONS



Ardanuy Ingeniería uses a program for the simulation of an evacuation of people from large areas, simulating the individual movements of people through geometrically defined spaces.

The program allows the user to create a 3-D model of a building by using a number of CAD-designed floor plans, connected by staircases. The program will automatically calculate all travel distances and routes throughout the building space.

Occupation is defined based on the specific needs of the project, making it possible to evaluate the surroundings and exceptional occupation conditions. The occupants are placed into the building, either one-by-one or as groups, and they can be characterized individually or as a group.

When the building population has been defined, and the potential routes calculated, then a simulation can be carried out. The algorithms for the movement of individuals are based on real-life data, collected by using computer-based techniques for the analysis of human movement, observed in real-life footage, allowing us to obtain results close to those obtained in an emergency simulacrum.

When the building population has been defined, and the potential routes calculated, then a simulation can be carried out. The algorithms for the movement of individuals are based on real-life data, collected by using computer-based techniques for the analysis of human movement, observed in real-life footage, allowing us to obtain results close to those obtained in an emergency simulacrum.

• Main functions of the software

The program shows the evacuation process graphically on the screen, with ground views of individual floors and staircases displayed in separate windows. Graphics representing a ground view of the occupants can be viewed during the whole simulation process. The occupants move towards pre-defined exits, with individual walking speeds dependant upon individual characteristics and the proximity of other people.

When all the occupants have moved through the exits, the total evacuation time is displayed on the screen, and a data file for the results is written to disk.

The software simulates with the results the movement of people and is visualized at 0.1 second intervals, and a whole floor can be observed or areas of particular interest by using the “zoom” tool.

The simulation model evaluates the evacuation times bearing in mind the variations in movement speed on an escape route with regards to the density of occupation.

The application of the evacuation model involves the following stages:

- • Modelling the system that is under study
- • Determining the values for the parameters of the evacuation model
- • Proposal of calculation assumption for the evacuation model

• Modelling

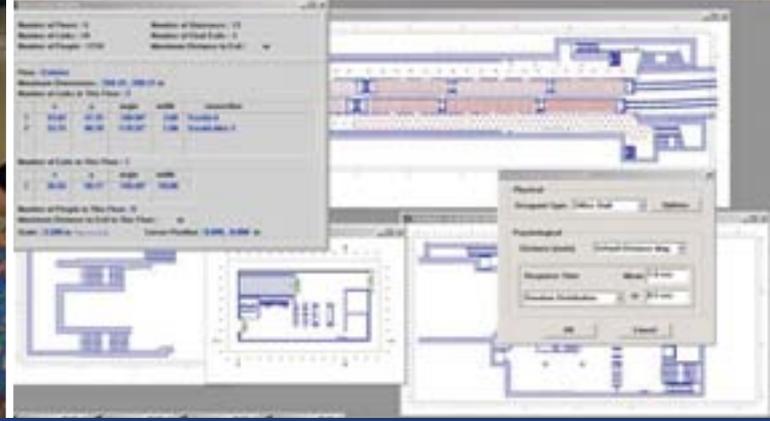
The evacuation model carries out calculations based on a development of finite elements whose cells will be sections of the route in predetermined length and width and to which an occupation value will be assigned and therefore a density, with the entry and exit of people at each time-step based on the conditions.

The spatial distribution proposed by the software is formed of cells of 0.2 x 0.2 metres. The model considers that each cell presents connections to the four adjacent cells. The occupants of a cell, at the start time of the simulation, will exit it via the most favourable connection based on the parameters introduced in the model.

The models include the concept of effective width of an evacuation element, indicating what should be considered the “physical width” of the evacuation routes in order to adjust the geometry to reality. Since there is a critical behavioural effect at work, where people do not fully use available width but normally leave a margin or separation which remains unused, this width varies from one element to another.



MOVEMENT OF PERSONS AND EVACUATION DRILL IN RAILWAY OPERATIONS



● Emergency exits

Once the geometry, occupation and occupant characteristics have been defined, the next step is to define the emergency exits. As many exits as necessary may be inserted (up to a maximum of 50) allowing occupants to select the exit nearest to their initial location, or specifying their movement towards a more distant exit based on the different established strategies.

● Stairs

Simulating an evacuation from a multi-storey building requires a definition of the typology and geometry of the stairs. With the simulation software we can implement said characteristics bearing in mind the real position of the stairs.

● Calculating evacuation routes

The evacuation routes from a site or building are defined by means of a 'distance map' which consists of a mesh of 0.2 by 0.2m spatial blocks, which is used to represent a 'low-resolution' form of the total building space. The numerical value assigned to each block is equal to the total travel distance to an exit from that block. The program uses the distance maps to direct the occupants to the nearest available exit, and can calculate them before the simulation begins.

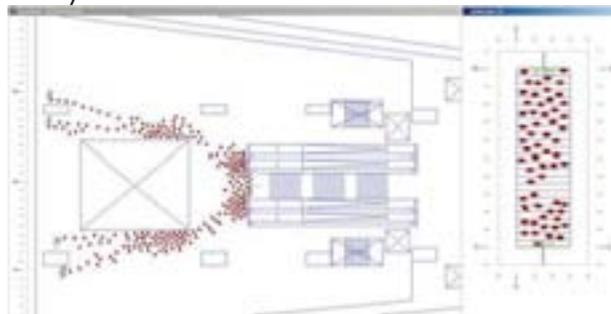
The software allows us to assign final exit destinations for occupants which may not necessarily be the nearest, bearing in mind the different strategies adopted in the self-protection plan under different emergency conditions.

● Defining the occupants

After the evacuation distances are calculated the number of occupants must be assigned to the building.

The characteristics may be defined individually or as a whole for all occupants. This will affect the size and distribution of the occupants and their maximum individual speed. It is also possible to define which emergency exit they will use.

It is possible to assign a random circulation speed to the occupants based on a uniform or a normal distribution. This speed will be affected by proximity to other people and occupation density.



The ground view representation of the 'body' of each person is represented mathematically as three circles.

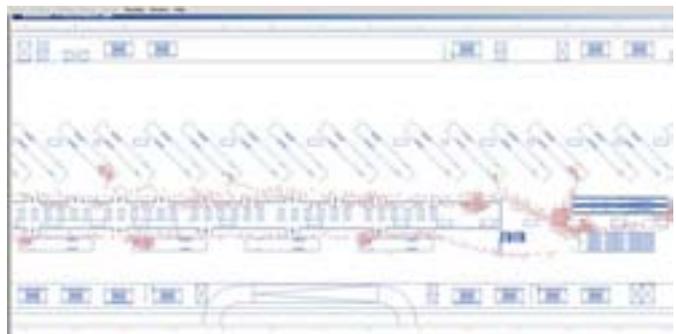
● Occupation loads at stations

The occupant load for a station will be based on the train load for trains entering the station simultaneously on all tracks in normal traffic direction as well as the occupation defined for platforms, lobbies and accesses.

The basis for calculating train and entraining loads shall be the peak period ridership figures as projected for design of a new system or as updated for an operating system.

The existing occupation on the platforms will be calculated with the maximum peak hour loads in accordance with:

- The peak hour occupant load will be based on the simultaneous evacuation of the occupation defined for the platforms and the train load for same platform during peak hour.
- The boarding load will be defined by the standard in force or by the most unfavourable occupation conditions defined by the operating characteristics.
- The maximum train load at each track shall be the maximum passenger capacity for the largest capacity train operating on that track during peak time.



● Conclusions

The program allows us to study evacuation alternatives in detail and contemplate the effects of queues as a consequence of different circulation speeds and congestion at exits.

PROVING A SERIES OF ADVANTAGES

- Evaluate and optimize size of facility
- Deliver greater pedestrian capacity
- Rapid elimination of non-performing design alternatives
- Increased customer satisfaction and passenger capacity by creating better passenger flows
- Analyze different designs and layouts to see where risk can be reduced
- Identify significant risk factors within a site at critical locations
- The identification of important risk factors at critical point



Madrid: Av. Europa nº 34 B. 28023
 Tel. (+34) 91.799.45.00
 Fax: (+34) 91.799.45.01
 E-mail: madrid@ardanuy.com

Barcelona: C/ Entença 236-240 Pln. Baja. 08029
 Tel. (+34) 93.206.33.00
 Fax: (+34) 93.206.33.01
 E-mail: catalunya@ardanuy.com

Valencia: Av. Instituto Obrero de Valencia nº 18. 1º-3º-A. 46013
 Tel. (+34) 96.331.86.00
 Fax: (+34) 96.330.22.01
 E-mail: valencia@ardanuy.com

Sevilla: Alcalde Luis Uruñuela, 6.
 Edif. Congreso Pln. 3 Mod. 304.41020
 Tel. (+34) 95.451.65.84
 Fax: (+34) 95.451.63.06
 E-mail: emilio.dominguez@ardanuy.com

Tenerife: C/ Imeldo Serís nº 108, 4º D. 38003
 Tel. (+34) 922.53.11.36
 Fax: (+34) 922.27.67.70
 E-mail: alberto.gonzalez@ardanuy.com

India: C4/145, 3rd Floor B
 Safdarjung Development Area
 New Delhi 110 049.
 Tel. (+91) 11.26518285
 Fax: (+91) 11.26568286
 E-mail: delhi@ardanuy.com

Lithuania: Teatro g. 9B, LT-03107. Vilnius
 Tel. (+370) 5.264.42.00
 Fax: (+370) 5.212.14.99
 E-mail: vilnius@ardanuy.com

Poland: Ul. Morelowa 2 A. 03-192. Warszawa
 Tel. (+48) 227.45.36.00
 Fax: (+48) 227.45.36.01
 E-mail: polska@ardanuy.com

Morocco: 15 bis, Rue Jbele bouyblane
 Angle Fel Ould Oumeir,
 Appartement 7, Agdal Rabat
 Tel: (+212) 530.300.383
 E-mail: maroc@ardanuy.com

United States: 325W 38th Street Suite 405
 New York, NY 10018
 Tel: +1 (212) 706.9800
 Fax: +1 (212) 600.4275
 E-mail: usa@ardanuy.com

Algeria: 19 Rue Louis Pasquier Brond Lot 103 A
 Les Sources · Bir Morad Rais
 Alger 16300
 Tel: (+213) 21.44.89.73
 E-mail: algerie@ardanuy.com

www.ardanuy.com

Ardanuy

