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APPROACHES TO THE DEVELOPMENT OF THE DYNAMIC MODEL OF THE ENGINEERING PROJECT IN THE CIVIL PROTECTION

Abstract. Task of developing the dynamic model of the engineering project in the system of civil protection is considered in scientific article. As an example, the task of developing a model of predicting the time of evacuation of the stadium by means of computer simulation is taken. General simulation model of the process of people evacuation from stadium by means of the theory of multi-agent systems is developed

Keywords: dynamic model, civil protection system, engineering, infrastructure projects, evacuation time, stadium.

Introduction. Implementation of large-scale infrastructure projects inevitably associated with many risks. One of the main risks of major infrastructure projects is its sustainability after project completion phase, which involves the further operation of the product of the project. When it comes to large infrastructure projects, operation of the product which involves presence of large number of people, then the successful completion of necessary approvals from all agencies of civil protection is required. This is mainly related to safety of the product of infrastructure projects.

Statement of the problem. To successfully passing the final phase of the project the actual are the tasks of development of dynamic models that allow simulation of the critical parameters of the product of infrastructure project at the conceptual design stage or at the planning stage. Take the example of a project to build the stadium. In order to pass it into operation it is required to confirm main critical parameters of product of project with services of civil protection. The main critical parameter for the project of the stadium construction is the evacuation of people. To solve this problem can be spent engineering infrastructure project in the conceptual stage of the project.. To solve this problem can be engineering of

infrastructure project carried out in the conceptual stage of the project. It is necessary to build a dynamic model of evacuation of people from the stadium using geometric parameters of the structure as input [1-2].

Results. Development of a simulation model of evacuation of the stadium done in multi-agent simulation environment Anylogic and partly some of the items in 3D MAX Studio. Fig. 1 shows a logical circuit design simulation model of evacuation.

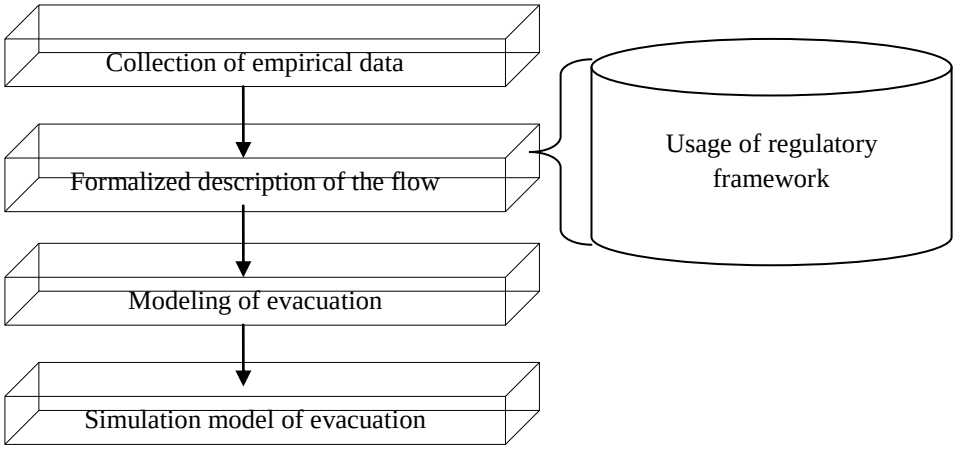

Fig. 1. Logical development of a simulation model of evacuation

Parameters of dynamic models used in the environment Anylogic [3]:

- Value stream (the number of people in this thread);
- ntensity of flow (number of visitors per minute per unit of linear space, which is available for transfer);
- Flux density (number of viewers per unit area of space that is available to move).

Circuit simulation of evacuation among Anylogic (Fig. 2) involves setting the physical characteristics of the object (walls, barriers, turnstiles) and means of embedded graphic editor - the location or appearance of the audience.

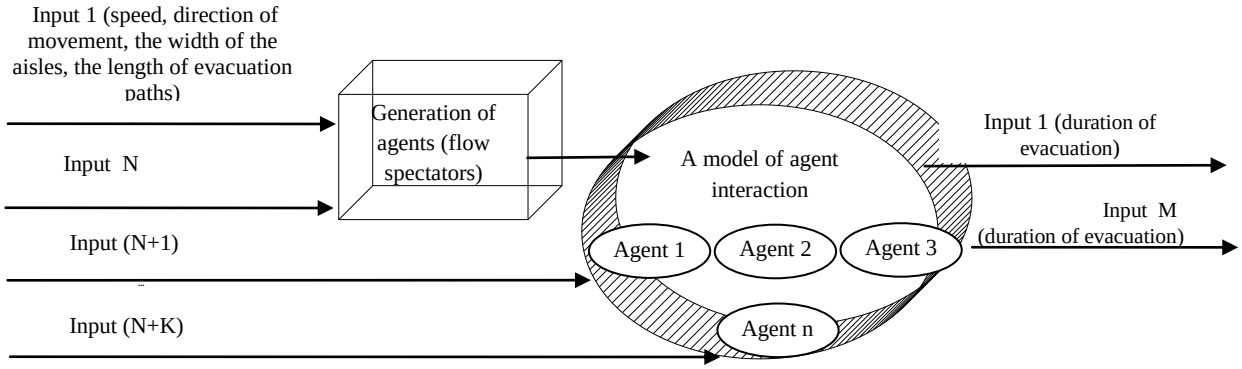

Fig. 2. Circuit simulation process of evacuation

Modes of operation flow of visitors posed in Fig. 3.

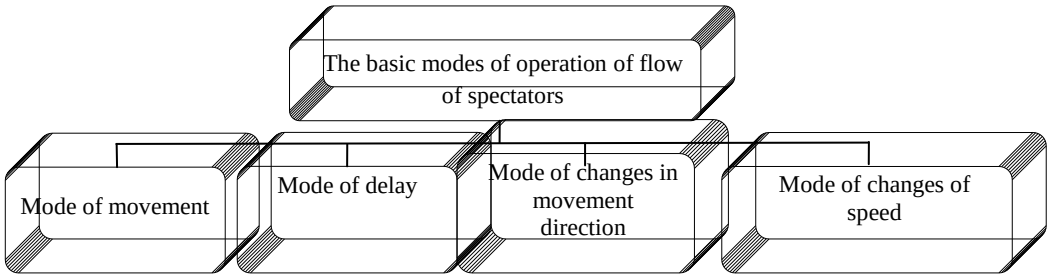

Fig. 3. Modes of operation flow of spectators

By means of embedded graphic editor system broken lines highlighted areas where possible congestion in the characteristics and asked the speed limit, change speed, direction, etc., in the aggregate life cycle process is the evacuation of the stadium (Fig. 4).

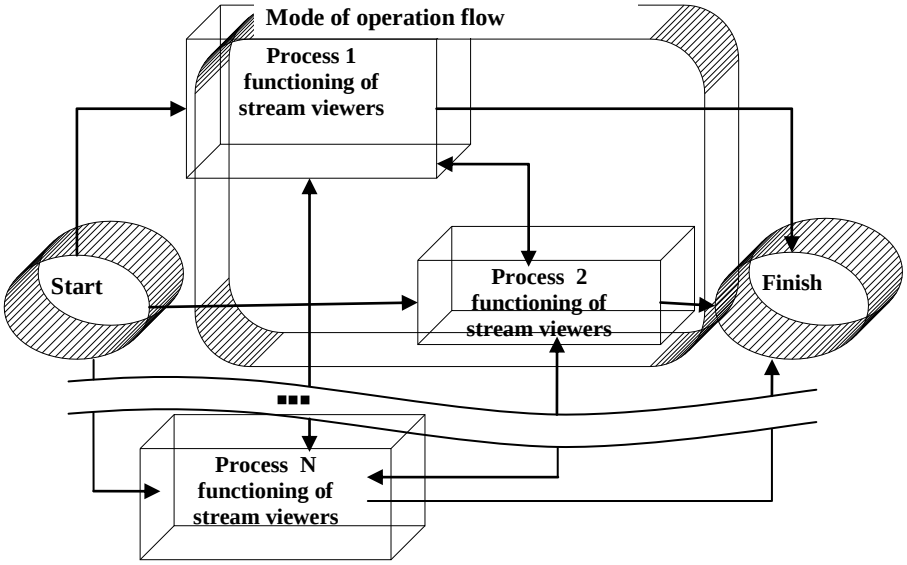

Fig. 4. Life cycle process of evacuation

Fig. 5 shows a plot of evacuation from the Gaza lower tier. Stairway surrounds a broken line and asked the audience deceleration mode, due to crowded.

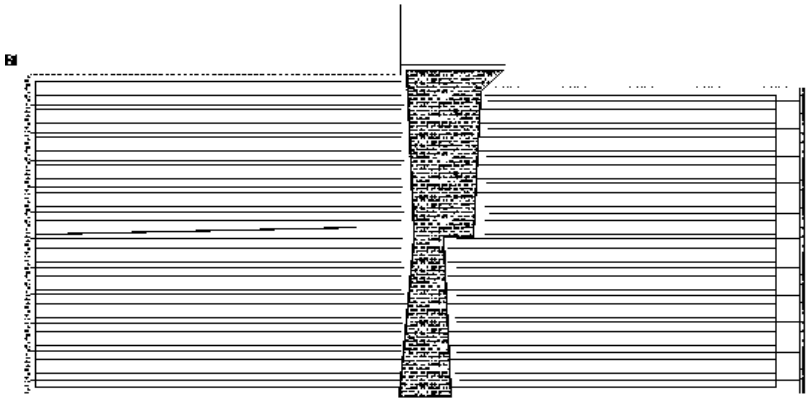

Fig. 5. Sector Scheme in the lower tier environment Anylogic

For the simulation of evacuation of used elements pedestrian library Anylogic. In particular, element PedSource gives the appearance of spectators, their intensity, quantity and speed. Element PedGoTo system Anylogic - the ultimate goal of evacuation, PedGround - allows you to set lines and other graphic elements that will serve as walls and obstacles to the movement, PedArea - mark sites that may delay or reduce speed.

Fig. 6 show a computer simulation of the process of evacuation of the lower tier format shows a computer simulation of the process of evacuation of the lower tier in format 3D and format 2D.

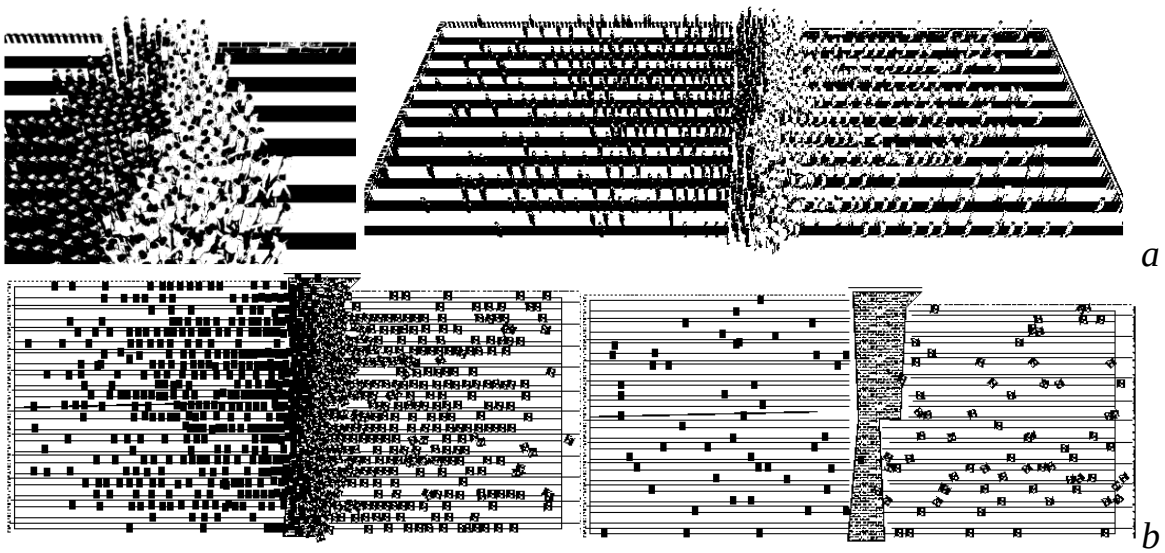

Fig. 6. Computer simulation in:
a – 3D format
b - 2D format

Dynamic evacuation of spectators from Level 2 is made taking into account the results obtained in calculating the time of evacuation of spectators with a sector level. Accordingly, when developing a dynamic model of the evacuation of spectators with 2 level was used as input output table of the intensities of people on the promenade).

To calculate the time of evacuation from some sections of the stadium a program "Topal-EVAKAS 1.0" was developed. The "Topal-EVAKAS 1.0" is designed to simulate the time of the evacuation of the stadium, built in preparation for EURO 2012. The results of the program is the evacuation of people from the stadium, the evacuation of parts of the building, the flux density at any time in any part of the building, capacity building and other parts.

The data in the fields of information characteristics that affect the evacuation of people from Lviv stadium already introduced, but users can change their program to simulate the evacuation time. However, keep in mind that changing some features may not affect the evacuation time. This is because of the evacuation will affect only the change in characteristics (length of the evacuation areas way aisle width), which lie on the critical path of evacuation. Changing the characteristics of other sites does not change the evacuation because of them in the model takes into account the intensity of human flows, aggregation, and separation of streams and more.

Результатами роботи програми є час евакуації людей з стадіону, час евакуації з частин будівлі, щільність потоків у будь-який момент часу в будь-якій частині будівлі, path capacity of parts of building and other. The results of the program are the time of evacuation of people from the stadium, the time of evacuation from different parts of building, flux density at any time in any part of the building, path capacity of parts of building and other.

Input fields that are on the scheme sector, designed to be administered in these characteristics that affect the evacuation of people. The data in these fields already introduced, but users can change their program to simulate the evacuation time. However, keep in mind that changing some features may not affect the evacuation time. This is because of the evacuation will affect only the change in characteristics (length of the evacuation areas way aisle width), which lie on the critical path of

evacuation. Changing the characteristics of other sites does not change the evacuation because of them in the model takes into account the intensity of human flows, aggregation, and separation of streams and more. To start working with the program and calculate the evacuation must be in the program menu to choose the lower or upper tier of the stadium (Fig. 7).

Fig. 7. The main window of software "TOPAL-EVAKAS 1.0"

Conclusions. Scientific approaches to the management of engineering project in the system of civil protection related to the planning of infrastructure project of the stadium construction are considered in the article. Results are the following:

- the approaches to the formalization of the project environment of infrastructure projects in the civil protection system for further engineering using dynamic models are proposed;
- the dynamic model of the evacuation of spectators from the stadium by means of simulation modeling in system Anylogic is developed.

Literature

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3. Official website Anylogic: http://www.xjtek.ru/