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DESTRUCTION PROCESSES IN THE COLLISSION OF AIRCRAFT WITH A HIGH-RISE BUILDING

Despite temporary difficulties in Ukraine of mostly economic nature associated primarily with the annexation of the Crimea and the military confrontation in the East, we can expect that in the coming months hostilities will cease completely. Later, after the renewal of the Ukrainian law on the entire territory of Ukraine, as was the case until 2014, we will observe strong economic growth, the objective conditions for which have already appeared. In the first place, renovation of volume of civil engineering, including high-rise buildings, is expected. One of the hazards associated with the operation of tall buildings is the possibility of their partial or complete destruction in the collision with the aircraft [1, p. 92-93]. This risk has become even more acute in recent years, with an increased activities of radical Islamist movements, one of the directions of which is terrorist acts. The purpose of these actions is, as a rule, the destruction of buildings, so that there may be significant casualties. High-rise buildings are quite convenient targets for terrorist attacks, and it is becoming increasingly difficult to predict and prevent them.

Let's consider the factors that will determine the stability of high-rise buildings at the destruction of supporting structures. Evidently, these factors can be divided into 2 groups [2, p. 18, 19]. The first group is the characteristics of high-rise buildings: the number of floors, the spatial structure, the stability of walls and ceilings against the spread of fire, etc. The factors of the first group prevent the occurrence of significant damage in a high-rise building to some extent, and provide protection of high-rise buildings from the complete destruction.

The second group is the characteristics of the zone of destruction (explosion): height (floor) on which the destruction happened, the location of fracture zones within the floor (in the room or outside) and the power of destruction. Apparently, the destruction from possible terrorist attack can be reduced at the design stage. The problem lies in the use of such spatial structure and materials, which in the conditions of partial destruction of supporting structures can provide, within a predefined time, resistance against high-rise buildings destruction that progresses.

The complexity of this problem is not only the large variety of possible spatial structures of high-rise buildings, but also the inability to predict the characteristics of the aircraft (mass, speed, presence of explosives) and the floor where collision can occur. At the same time, the analysis of certain events that occur in the collision of the aircraft with high-rise buildings seems possible. As high-rise buildings and aircraft are rigid bodies, we consider the moment of their collision within the theory of impact when the plane has against the high-rise

building some momentum $m_l v_l$, where m_l and v_l are the mass of the aircraft and its speed at the time of the collision, respectively.

This allows us to determine the dynamic impact of the aircraft on the supporting structures. After this the partial destruction of a high-rise building and an aircraft begins to the point when the kinetic energy of the aircraft reduces to zero. It is necessary to consider the effect of forces on the supporting structures and floors, using numerical methods. The force will be equal, according to Newton's second law, to the product of the mass of the aircraft by its acceleration. This acceleration will be determined by the initial speed of the aircraft and the time when its speed dropped to zero. The use of reduced physical models of high-rise buildings seems appropriate to determine their stability against destruction that progresses, i.e. the scales and speed of further damage. It is possible to accurately reproduce the spatial structure of high-rise buildings and provide any options of supporting structures destruction using such models, measuring both supporting structures and horizontal beams by the sensors of deformation.

Certain material costs and manufacturing time of this model and difficulty of experimental determining of the impact of high temperature on the stability of structures are disadvantages of this method of research, as it is difficult to create temperatures of hundreds, perhaps thousands of degrees in a small volume. But we can obtain valuable results, taking into account the scale factor without considering the change in the temperature regime in the event of damage.

We believe solid-state computer simulation to be promising, since it is possible to reconstruct the spacious structure of a high-rise building, to load supporting structures by forces, and to investigate the stress state of selected elements of a high-rise building. High temperatures may partly be replaced by introducing additional internal stresses in the material. These stresses caused by high temperature in the actual construction should be calculated in advance.

Obviously, computer modeling is less expensive both financially and in time and allows to explore any options of the constructions of high-rise buildings and loads on the supporting structures. Variables are as follows: the height of buildings and each floor, size, material of manufacture, quantity and relative position of supporting structures, the load on the horizontal overlap, external load (wind on the side walls or seismic on foundation). Therefore, the best decision is to use both of the above methods to address each specific task.

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