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Determination of the Required Area of Easily Removable Structures to Protect Against Progressive Collapse

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Abstract. The article presents a simulation model for determining the required area of easily removable structures to protect against progressive collapse. The simulation model allows you to calculate the area of easily removable structures depending on the input parameters, to obtain the dynamics of the change in the parameters of the combustible medium depending on the change in the properties of the combustible gases that are in the room.

1 Introduction

Industry often uses a variety of hazardous substances, such as flammable and combustible liquids and gases, which must be stored in special conditions [1, 2]. For their storage, appropriate premises are used, which in most cases, according to calculations [3], belong to categorise A and B in terms of explosion and fire hazard. Buildings of these categories must be designed to withstand the effects of a possible overpressure of more than 5 kPa in the room [4]. To withstand such pressure, it is necessary to reinforce the main building structures, which leads to an increase in the cost of construction of buildings and structures of categories A and B for explosion and fire hazard [5 – 7]. When storing a large amount of flammable liquids (FL) and combustible liquids (CL), there is always a possibility of an explosion, the overpressure of which can cause damage to the building's load-bearing structures and, as a result, partial or complete collapse of the entire building, and loss of life [8, 9].

In an explosion, only lightweight structures are destroyed. Lightweight structures is a device or enclosing building structure designed to prevent the formation of excessive explosion pressure in the volume of an explosive and fire hazardous room that does not exceed the permissible explosion pressure by ensuring the connection of the volume of this room with the outside space. This ensures the safety of people who may be in these buildings and premises, and the load-bearing building structures remain intact, and only the lightweight structures need to be replaced, the cost of which is much less than the cost of a new building [10, 11].

2 Analysis of Publications

In [12], professors at the Polytechnic University of Turin performed comprehensive finite element modelling of key metal elements of buildings to improve the assessment of the strength of structures exposed to the combined effects of fire and explosion. The results showed that structural steel is sensitive to strain rate, retaining its ability to strengthen with increasing strain rate. An explicit nonlinear dynamic analysis of a steel column under fire followed by an explosion was performed using LS-DYNA. A method for a realistic approach to multiple hazards by studying the

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