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Analysis of the Behavior of the Structure Under Internal Anfo Explosion

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Abstract : Although extensive explosion-related research has been performed in the past several decades, almost no research has focused on internal blasts. However, internal blast research is needed to understand about the behavior of a containment structure or building under internal blast loading, as in the case of the Chornobyl and Fukushima nuclear accidents. Therefore, the internal blast study concentrated on RC and PSC structures is performed. The test data obtained from reinforced concrete (RC) and prestressed concrete (PSC) tubular structures applied with an internal explosion using ammonium nitrate/fuel oil (ANFO) charge are used to assess their deformation resistance and ultimate failure load based on the structural stiffness change under various charge weight. For the internal blast charge weight, ANFO explosive charge weights of 15.88, 20.41, 22.68 and 24.95 kg were selected for the RC tubular structures, and 22.68, 24.95, 27.22, 29.48, and 31.75 kg were selected for PSC tubular structures, which were detonated at the center of cross section at the mid-span with a standoff distance of 1,000mm to the inner wall surface. Then, the test data were used to predict the internal charge weight required to fail a real scale reinforced concrete containment vessels (RCCV) and prestressed concrete containment vessel (PCCV). Then, the analytical results based on the experimental data were derived using the simple assumptions of the models, and another approach using the stiffness, deformation and explosion weight relationship was used to formulate a general method for analyzing internal blasted tubular structures. A model of the internal explosion of a steel tube was used as an example for validation. The proposed method can be used generically, using factors according to the material characteristics of the target structures. The results of the study are discussed in detail in the paper.

Keywords : internal blast, reinforced concrete, RCCV, PCCV, stiffness, blast safety
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