

SIMPLIFIED ASSESSMENT OF STRUCTURAL RESISTANCE TO BLAST LOADS USING DIMENSIONLESS P-I DIAGRAMS

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Abstract:

One of the methods to assess a response spectrum of structural elements to various blast loads is by developing Pressure-Impulse (P-I) diagrams. The P-I diagram is a limit curve that represents the combination of pressure and impulse for which the damage level of the structure is achieved, which is represented by a given maximum dynamic displacement. A common practical approach to evaluating the nonlinear response is by a nonlinear single-degree-of-freedom (SDOF) analysis, and therefore it is a popular approach to constructing P-I diagrams.

This paper presents a dimensionless representation of nonlinear SDOF equations for linear-elastic, elastic-plastic, and elastic-plastic with hardening systems. The dimensionless P-I diagrams are derived for triangular blast loads and are represented by the dimensionless parameters of the problem. The equations are solved numerically and simplified empirical equations are developed through regression analysis to quickly calculate the dimensionless and absolute P-I diagram for a given case. Thus, for a given case, the current study suggests a fast evaluation of the response spectrum without performing any structural or numerical analysis.

The accuracy of the suggested method is proved by statistical parameters and a case study demonstrating its capabilities. The study is limited to a classical SDOF system but can be extended to more realistic scenarios. Overall, the proposed method provides a quick and effective tool for assessing the resistance of a structural system to blast loads.