Response analysis of resistive structures under the impact force of debris flow using Smoothed Finite Element Methods

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Abstract

In view of the serious losses caused by the impact of debris flow to human society around the world, the resistive structures against debris flow occupy a very important position in the prevention and control of debris flow disasters. The resistive structures will effectively reduce the deposit area of debris flow and weaken the damage of hazard. Thus, we are supposed to pay more attention to the design and construction of the resistive structures against debris flow. The study of the impact response of the resistive structures in the occurrence of debris flow will largely guide the design and construction of the actual projects. Compared with the traditional Finite Element Method (FEM) which is the normal method used in this case, the Smoothed Finite Element Methods (S-FEM) based on smoothed Galerkin weak form has higher computational accuracy and computational stability. This study based on S-FEM simplifies the resistive structures into cantilever beam for response analysis. At the beginning of the article, we apply the S-FEM to analyze the stress characteristics of the resistive structures against debris flow with several different material properties under static conditions. After that, we introduce the dynamic constitutive equation into S-FEM to have an analysis of the resistive structures. Then, we use the empirical formula to obtain the time history curve of the impact force caused by debris flow. The analysis carries out on the simplified cantilever beam. Finally, this article compares the calculation accuracy of the traditional Finite Element Method and the Smoothed Finite Element Methods. It proves that S-FEM is a better way to design the resistive structures against debris flow in the future.

Keywords: Resistive structures; Debris flow; Impact force; S-FEM