

## 土石流巨石撞擊攔砂結構之力學理論與分析方法

余志鵬<sup>[1]</sup> 段錦浩<sup>[2]</sup>

**摘要** 本文目的為回顧古典碰撞理論，將之應用於土石流所產生之巨石撞擊問題。藉由推導不同假設情境之結構模式的理論解，有系統的建立土石流攔阻結構受巨石撞擊時之力學行為評估方式。所依據之力學理論包括；基本赫茲定律、包含結構撓曲變形之修正赫茲定律以及功能定理。同時，為推估緩衝設施之消能與緩衝效應，提供進行中之實體實驗設計相關參考依據，本文亦說明以單自由度非線性彈簧系統進行緩衝設施力學行為評估之簡易步驟。最後，本文發表理論探討過程中一項附帶之研究成果 - 「準靜力分析概念」，其計算巨石碰撞作用力之過程較之於傳統赫茲定律公式精簡，且具合理之物理意義與偏向保守設計之特性。

**關鍵詞：**赫茲碰撞理論，巨石撞擊，準靜力分析，土石流，攔阻結構。

## On the Impact Responses of Retaining Structures Due to Massive Rocks in Debris Flows Theory and Analytical Approaches

Chih-Peng Yu<sup>[1]</sup> Ching-Hao Tuan<sup>[2]</sup>

**ABSTRACT** It is intended in this paper to propose a systematic approach for the analysis of dynamic responses of retaining structures subjected to significant impacts due to sliding rocks caused by debris flows. The derived formulae were obtained from different structural models based on classical impact theory, namely the Hertz law, with and without the consideration of flexural deformations of structures, and Energy Theorem as well. To assess the potential effect of tire-type cushions in reducing the impact forces and pressures acting upon the retaining structure, a nonlinear SDOF model was used to illustrate the proposed evaluating procedure. Finally, as a supplementary outcome of this study, a Quasi-Static approach in determination of impact forces is proposed in this work. Such an approach provides not only a simple but also a conservative way for analyzing the impact responses of retaining structures when comparing to the Hertz formulation.

**Key Words:** Hertz Contact Law, impact by rock, quasi-static analysis, debris flow, retaining structure.