基腳沖刷線空間差異影響臨河崩坍地之河道土砂運移評估

River Sediment Transport Estimation of the Toe Erosion Line Setup on Riverbank Landslide Area

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摘　要

近年來，台灣中部地區頻繁出現極端天氣事件，例如長時間豪雨、洪水與颱風接連不斷，導致山坡地區不穩定，造成大量土石移動，引發多起嚴重山崩與土石流事件，對人員與財產造成重大損失。坡度大於 30 度的地區通常具有較高的崩塌風險，這是由於重力對土體的作用所致，當坡度超過臨界值時，土壤無法維持穩定性，進而導致崩塌，尤其在強降雨條件下更為明顯。降雨使得水分充滿土壤顆粒間的孔隙，導致土壤質量增加，濕潤沉重的土體在光滑的滑動面上更易產生滑動。該過程初期可能較為緩慢，但隨著裂縫的產生與擴展，滑動速度迅速增加，進而導致大規模山崩。當土石流入溪流或匯流區域時，將形成具破壞力的土石流。為降低此類災害風險，深入探討河岸侵蝕機制具有重要意義，可作為未來設計有效護岸工程之依據。本文提出應用 SRH-2D 水理—泥砂運輸模式，模擬土砂運移與坡地失穩過程，並進行邊坡穩定性監測與預警。此外，建議規劃並建設如堤防、護岸與排水系統等崩塌防治工程，這些措施有助於引導與排除地表與地下逕流，降低土體孔隙水壓，維持邊坡穩定性。最後，本文強調建置一套簡單有效之邊坡監測系統，對即時掌握災害潛勢並提供預警具有關鍵作用，尤為適用於台灣中部山區等高風險地區。

關鍵詞：SRH-2D、二維數值模式

Abstract

The weather has changed in recent years, the central region of Taiwan has frequently experienced extreme weather events, including prolonged heavy rainfall, flooding, and successive typhoons. These events have led to the destabilization of hillslopes, resulting in the mass movement of soil and rock, and triggering numerous serious landslides and debris flows that have caused significant human and economic losses. Areas with slopes steeper than 30 degrees are generally at higher risk of landslides due to the influence of gravitational forces acting on the soil mass. When the slope exceeds a critical threshold, the soil structure becomes unstable and prone to collapse, especially under conditions of intense rainfall. Rainwater infiltrates into the pore spaces between soil particles, increasing the soil's weight. The saturated, heavier soil mass becomes more susceptible to sliding along smooth failure planes. Initially, the movement may occur slowly, but as cracks develop and propagate, the sliding velocity accelerates rapidly, leading to large-scale landslides. When the dislodged soil and debris flow into rivers or convergence zones, they can evolve into destructive debris flows. To mitigate the risks associated with such natural disasters, it is essential to conduct in-depth studies on riverbank erosion mechanisms, which can serve as the foundation for designing effective riverbank protection structures in the future. This paper proposes the application of the SRH-2D hydrodynamic–sediment transport model to simulate soil and sediment transport processes and slope instability, enabling the monitoring and early warning of potential slope failures. Furthermore, the study recommends the planning and construction of landslide mitigation structures such as levees, revetments, and drainage systems. These measures can facilitate the collection and discharge of surface and subsurface water from hazardous areas, reducing pore water pressure and helping to maintain slope stability. Finally, the paper emphasizes the importance of establishing a simple and effective slope monitoring system to enable real-time hazard assessment and early warning, which is particularly suitable for high-risk mountainous areas in central Taiwan.

Keywords: SRH-2D、2D numerical model、Central Taiwan.