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Developing a neutral equilibrium device as dynamic virtual piers for an emergency relief bridge

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Every year, many natural disasters strike Taiwan, destroying bridges and disrupting traffic. To allow shipping of relief provisions and salvage, fabricated steel bridges are often used to construct emergency relief bridges. This kind of bridge must meet strength and functionality requirements. Strength depends on the materials used, while functionality depends on displacement control. These two requirements affect the section design of the bridge deck. In order to quickly build a light-weight bridge for emergency relief with displacement control, a neutral equilibrium mechanism is proposed and developed to control the deflection of an emergency relief bridge. A neutral equilibrium mechanism is a system with an internal control mechanism that can actively change the internal structure. Structural transformation causes the size variation of the action force to respond to continuous changes in bridge deflection. This mechanism can expand the effective span of the bridge, maintain its strength and functionality and increase the convenience of building and mobility. Experimental results reveal that a virtual pier at the center of a bridge with this proposed mechanism installed can control vertical deflection caused by vehicles carrying heavy loads. Test and analysis records also reveal that the vertical displacement at the center of a bridge with the neutral equilibrium mechanism installed is close to zero. The practicality of this neutral equilibrium mechanism has been verified by experiment.

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