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Asymmetric Stress Ribbon Pedestrian Bridge Seismic Responses

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Editorial

The stress ribbon bridge transfers loads using a high-tension ribbon and exhibits geometric nonlinearity when subjected to dynamic seismic excitations. As a prototype, a conventional double-span asymmetric stress ribbon pedestrian bridge was used to examine the effect of ground motion orientation on structural reactions using nonlinear time history analysis. The influence of vertical ground motions was explored, as well as non-pulse and pulse-type ground motions. The vertical and transverse displacements of the stress ribbon bridge were sensitive to the stimulation of the vertical ground motion, according to numerical results. The critical orientation was roughly independent of the vertical ground motion, and no single orientation contributed to the highest critical values in all response indexes. The ground motion orientation affected the negative bending moment of the ribbons, the pier top displacement, and the pier base moment in the transverse direction. For a complete assessment of the stress ribbon bridge's seismic performance, it is required to examine the responses resulting from various orientations [1].

The tension ribbon bridge is an important bridge prototype that has been used for a long time. Cables or ribbons are typically used, with concrete deck slabs laid on top. The cables or ribbons support the vertical dead load and live load in a high-tension state, and the deck slabs transfer the live load to the ribbons. The stress ribbon bridge is lighter than other types of bridges, and it features a catenary design that is both natural and visually pleasing. Notably, the growing usage of high-strength materials can reduce the amount of material and resources used in construction, making stress ribbon bridges more sustainable and, thus, more appealing around the world. The deck can be produced by a monolithic band or combined using precast segments for stress ribbon bridges. High-strength steel materials have advanced significantly in recent years, and the use of high-strength steel plates as bridge ribbons is becoming increasingly prevalent [2]. To bear the loads, the bridges used two ribbons with section sizes of 600 mm 30 mm and 460 mm 30 mm, respectively. The use of these high-strength materials reduces both the volume of materials used and the amount of work required during construction. For pedestrian bridges, such a structural prototype is becoming increasingly appealing [3].

Due to the possibility of a considerable change in bridge grade and excessive displacements during the passage of heavy vehicles, stress ribbon bridges are mostly used on pedestrian bridges and are rarely used on highway bridges. The safety of bridges subjected to earthquake excitations, on the other hand, must be properly guaranteed. In seismically high-risk areas, the earthquake may become the most important determinant in determining structural layouts. From an aesthetic standpoint, an urban pedestrian bridge usually has a distinct design. Bridges with irregular configurations, on the other hand, are more vulnerable to seismic excitations, as evidenced by bridge failures and damage in recent big earthquake events. The preceding findings emphasise the importance of estimating the seismic performance of stress ribbon bridges with irregular geometries, which has received little attention in the past [4].

The directionality of earthquake action is frequently determined randomly by the designers in seismic analyses for bridges. Bridges in seismic zones must be able to withstand seismic forces from all directions. Previous study has demonstrated that disregarding the directionality of ground motion might lead to an underestimation of bridge seismic fragility. The influence of ground motion directionality should be researched in order to determine which direction is the most unfavourable and which reaction is the most crucial. As the stress ribbon bridge system grows in popularity around the world, understanding its seismic performance and the elements that influence it has become critical. The geometrical nonlinearity of the stress ribbon bridge makes the theoretical solution of dynamic response problematic. In such cases, numerical analysis using a finite element model is a viable option for solving the problem. Given these facts, the purpose of this paper is to look into the impact of the horizontal bidirectional ground motions' orientation on the reactions of a stress ribbon bridge. The effects of vertical ground motion and ground motion scaling are also examined [5]. The researchers chose two sets of ground motions recorded in near-fault zones, one with notable impulsive characteristics and the other without. A thorough examination of the past is carried out. The ribbons and the pier's tridimensional displacements and related forces are measured and compared.

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