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# Structural Performance of Mechanically Connected Stone Panels under Cyclic Loading: Application to Aesthetic and Environmental Building Skin Design

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**Abstract :** Building designers in the Mediterranean region and other parts of the world utilize natural stone panels on the exterior façades as skin cover. This type of finishing is not only intended for aesthetic reasons but also environmental. The stone, since the earliest ages of civilization, has been used in construction and to-date some of the most appealing buildings owe their beauty to stone finishing. The stone also provides warmth in winter and freshness in summer as it moderates heat transfer and absorbs radiation. However, as structural codes became increasingly stringent about the dynamic performance of buildings, it became essential to study the performance of stone panels under cyclic loading – a condition that arises under the building is subjected to wind or earthquakes. The present paper studies the performance of stone panels using mechanical connectors when subjected to load reversal. In this paper, we present a theoretical model that addresses modes of failure in the steel connectors, by yield, and modes of failure in the stone, by fracture. Then we provide an experimental set-up and test results for rectangular stone panels of varying thickness. When the building is subjected to an earthquake, its rectangular panels within the structural system are subjected to shear deformations, which in turn impart stress into the stone cover. Rectangular stone panels, which typically range from 40cmx80cm to 60cmx120cm, need to be designed to withstand transverse loading from the direct application of lateral loads, and to withstand simultaneously in-plane loading (membrane stress) caused by inter-story drift and overall building lateral deflection. Results show correlation between the theoretical model which we derive from solid mechanics fundamentals and the experimental results, and lead to practical design recommendations. We find that for panel thickness below a certain threshold, it is more advantageous to utilize structural adhesive materials to connect stone panels to the main structural system of the building. For larger panel thicknesses, it is recommended to utilize mechanical connectors with special detailing to ensure a minimum level of ductility and energy dissipation.

**Keywords :** solid mechanics, cyclic loading, mechanical connectors, natural stone, seismic, wind, building skin
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