

EXTERNAL STRENGTHENING OF MASONRY STRUCTURES WITH NATURAL FIBERS

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ABSTRACT

Masonry construction has a very long tradition and is the most commonly used type of construction. Because of its simple and economical production it will continue to be of major importance also in the future. In particular, its properties in terms of building physics ensure that it remains economically relevant. Nevertheless, low tensile, flexible, and shear load bearing capacity can be a great disadvantage of masonry. In countries with high earthquake risk and social and economic problems, construction materials of poor quality are being used quite often. Especially in rural areas, use is made of bricks and mortar of low tensile strength classes that are hardly used any longer in Europe. The masonry panels used as braces in one and two storey constructions are hardly able to withstand earthquake loads and display a low shear capacity. Since other types of construction are impossible to apply for economic and ecological reasons, these constructions should be strengthened retrospectively after they have been erected. One method used in recent years is the retrospective strengthening using fiber composites applied adhesively to the masonry surface. The most commonly used fibers are carbon fibers (CFRP) and glass fiber-reinforced synthetic materials (GFRP). These materials in combination with synthetic resin systems are already common for example in Switzerland and the USA, but because of their high cost and low availability are hardly used in earthquake regions with economic problems, such as in the Near and Middle East or Latin America. In addition, modern reinforcement materials such as CFRP and GFRP are too rigid for "weak" masonry and can lead to compatibility problems. For this reason, clearly less expensive materials that are adapted to properties of the masonry described are necessary. Natural fibers in combination with filler compound of an epoxy resin base or epoxy resin enriched fine filler on a cement base can, for both cost and compatibility reasons, provide a very attractive alternative. Test results on masonry strengthened with such natural fiber textiles and theoretical investigations as well as a pilot application to the World Cultural Heritage site Arg é Bam (Iran) will be presented. The research whose results are reported in this contribution was conducted at the Institute for Materials Engineering (Professor M. Schlimmer) of the Faculty of Mechanical Engineering in cooperation with the Institute of Structural Engineering (Professor E. Fehling) of the Faculty of Civil Engineering at the University of Kassel. The pilot project at the world heritage site was implemented by the first author in a period of self employment with the support of UNESCO and Sika Schweiz AG.

Key words: External Strengthening, Natural Fibers, Earthquakes, Masonry Structures, Seismic Retrofit, Fiber Reinforced Polymer (FRP).