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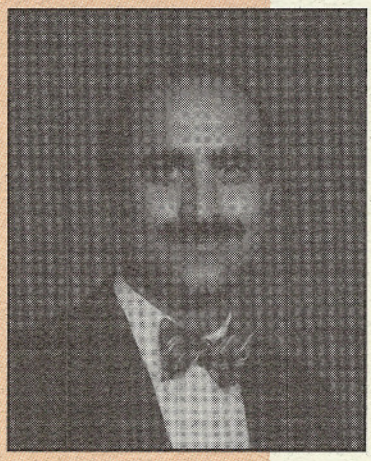
Guest Author – Dr. Mohammad R. Ehsani

Dr. Ehsani received his B.S., M.S., and Ph.D. degrees from the University of Michigan before joining the Faculty of Civil Engineering and Engineering Mechanics at the University of Arizona in 1982. For the past eight years, Professor Ehsani's research has focused on various approaches to the repair and strengthening of existing structures with FRP. Dr. Ehsani has served as a consultant on several projects dealing with the design of bridges and seismic retrofitting of concrete and masonry buildings. He has also worked extensively with the U.S. Army Corps of Engineers on the evaluation of seismic vulnerability and the rehabilitation of intake tower structures.



Dr. Mohammad R. Ehsani
Professor of Civil Engineering
University of Arizona

Dr. Ehsani is an active member of several American Concrete Institute committees and serves as the Chair of a subcommittee of the ACI Committee 440, which recently completed a comprehensive State-of-the-Art Report on FRP Reinforcement for Concrete Structures. A past Director of the Arizona Chapter of ACI, Professor Ehsani has also served as President of the Structural Engineers Association of Arizona. He is co-Chair of the First International Conference on Composites in Infrastructure which will be held in Tucson, Arizona in January 1996.

Recently, Dr. Ehsani served as a consultant for retrofitting a one-story unreinforced concrete masonry (URM) building shown in Figure (1). The building was retrofitted in the late 1980s by providing new steel columns and by tying the roof joists to the URM walls. However, in the 1994 earthquake, the wall located on the south side of the building was severely damaged. This is a common problem in most buildings which have been retrofitted. In older buildings, connections between the walls and floors are the weakest elements; once these elements are strengthened through seismic retrofitting, future earthquakes impose much larger loads on the walls, leading to the failure of these elements. Hence, there is a great need for simple techniques to strengthen URM walls.

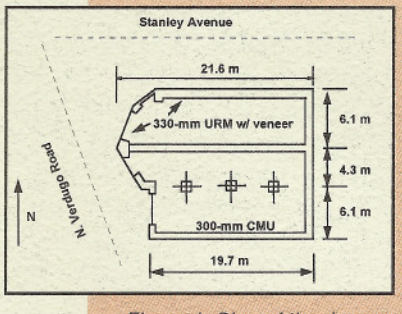


Figure 1. Plan of the damaged building

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Recognizing the limited capacity of URM walls in shear and flexure, a common solution is to attach a gridwork of steel rebars to the face of the existing wall and use shotcrete to increase the wall thickness from 150 to 200 mm. The additional weight increases the dynamic loads on the building, which in turn often requires strengthening of the foundation to support the heavier wall. In the case of this building, however, due to space limitations, this option was not available. As a result, it was decided to retrofit the wall by applying composite fabrics to both faces.

Figure 2. Application of composite fabrics to the URM wall (Courtesy of Structural Rehabilitation Corporation)

After the wall surface was sandblasted and cleaned, a thin layer of a two-part epoxy was applied to the wall. The fabric, which was 915 mm wide and constructed primarily of E-glass, was pressed against the wet epoxy, as shown in Figure (2). The fabric included equal amounts of fibres in 0- and 90-degree directions, with a tensile strength of approximately 175 N/mm in each direction. The edges of the fabrics were overlapped so as to provide continuous reinforcement for the wall. A top coating of epoxy and a layer of ultraviolet-protective paint was also applied to the wall surface. The thickness of the wall was increased by only 5 mm as a result of the retrofit. The project was completed on time and at a cost savings of 30% compared to the conventional technique using shotcrete. This is the first reported field application of such a technique. The retrofitted wall at the completion of the project is shown in Figure (3).

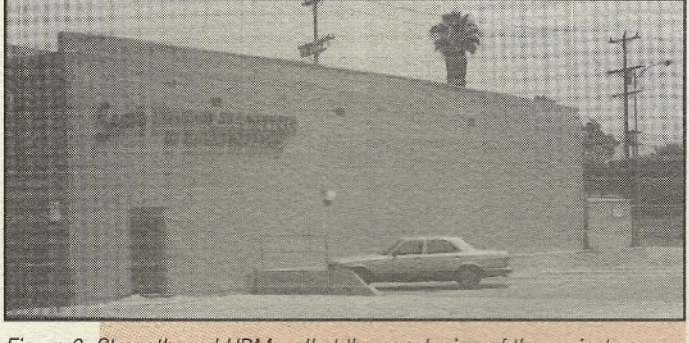

Figure 3. Strengthened URM wall at the conclusion of the project.