Seismic Analysis of and Provisions for Dry-Stack Concrete Masonry Wall Systems with Surface Bond

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Dry-stack masonry is a construction method to build masonry without mortar between the blocks. Currently, the only provisions for constructing with dry-stack masonry come from the International Building Council (IBC) which gives limits to allowable stress from various forces. Additionally, when constructing with dry-stack masonry no seismic parameters exist (such as the overstrength factor, ductility reduction factor, and displacement amplification factor) to quantify the forces acting on dry stack masonry, but instead relies on the parameters that exist for traditional masonry. The objective of this research is to develop seismic parameters for dry-stack masonry systems with surface bond. Particularly, the overstrength, ductility reduction, and displacement amplification factors will be determined. In addition, design equations for the in-plane shear capacity of dry-stack masonry with surface bond will be developed. Research for the seismic parameters will follow the guidelines outlined by the "Quantification of Building Seismic Performance Factors 2009" from the Federal Emergency Management Agency (FEMA). FEMA requires both experimental analysis and computer modeling to develop the seismic parameters. The experimental analysis is done to obtain material properties for the wall system, especially the shear modulus and component properties, such as compressive strength of grout. To get the component properties, tests on the grout, steel, surface bond, and block are done. To obtain the shear modulus, the diagonal tension test and in-plane shear test are done following American Society for Testing and Materials (ASTM) E 519 and C 1717, respectively. Computer modeling is done to simulate test data, and then determine how the structure will react in an earthquake by performing a dynamic pushover analyses from a variety of time histories. Computer modeling is being accomplished in a 2-dimensional finite element analysis program called VecTor 2. Eight diagonal tension tests and 12 in-plane shear tests of a dry-stack masonry system with surface bond have been completed. The tests were accomplished with varying amounts of grout and reinforcement in each wall sample. From these tests preliminary design equations were developed for the in-plane shear capacity of these walls. Preliminary results shown dry-stack masonry with surface bond is able to resist seismic forces. This research will enable the design and construction of dry-stack masonry with surface bond in seismically active areas. Currently, when designing for dry-stack masonry, estimates of the seismic forces are based on traditional masonry and may not be appropriate for these new systems. This research will develop seismic parameters that are more adequate for dry-stack systems. This will enable the cheaper and faster construction that dry-stack systems offer in seismically active areas.