3-D APPLIED ELEMENT METHOD FOR PP-BAND RETROFITTED MASONRY

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ABSTRACT :

In this study, we have proposed a new 3-D Applied Element Method (AEM) as an analysis tool for understanding the polypropylene band retrofitted masonry behavior which will be benefit in the future design process and increase the degree of freedoms of failure mode. Unlike the previous version of 3-D AEM, elements can be any rectangular prism which helps reducing the number of elements. Brick and mortar springs are represented by using different spring properties. Nonlinear constitutive law of the mortar spring employed the Gambarotta model which considers the material softening. Polypropylene band is modeled as beam element using plastic constitutive law connected together with the masonry by elastic spring representing the polypropylene band to brick connector. The numerical simulation of non-retrofitted and retrofitted out of plane wallets shows that with the suitable selected parameter the behavior of masonry can be closely reproduced.

KEYWORDS: Applied Element Method, Masonry, 3-D Simulation, Polypropylene band, Retrofit

1. INTRODUCTION

Masonry along with timber structures are among the oldest structures that are still used nowadays. Masonry structures history can be tracked back as early as 8,000-9,000 B.C. near Lake Hullen, Israel (Lourenço, 1996). With its long history, abundance of material, ease of construction and the advantages in thermal property, masonry is widespread used around the world. This type of structure still remains a main building material in many places especially in developing countries (Paola, 2003). Despite its advantages as residential structure, masonry is known as brittle and unsuitable for construction of buildings in seismic zones (Tomaževič, 1999). The 1997 Umbria-Marche, 1999 Bhuj and 2003 Bam earthquakes show that masonry is rather susceptible. A large number of masonry structures collapsed especially in concentrating area of poorly designed and constructed. Moreover, masonry structures collapse also result in high casualty because masonry tends to break into small debris and left insufficient void which reduce the chance of survival.

In order to improve the current situation, the proper retrofitting methods were invented. Several proposed retrofitting methods in the literatures include grout injection and internal reinforcing, ferrocement coatings, FRP composites and adding of steel elements. These methods were reported successfully for increasing the seismic capacity of the building. Besides them, the recent retrofitting scheme considering economic affordability and availability of material and skilled labor called Polypropylene band (referred hereafter as PP-band) retrofitting