



## NICEE'S ROLE IN PROMOTING CONFINED MASONRY AS AN APPROPRIATE TECHNOLOGY FOR BUILDING CONSTRUCTION IN INDIA

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### ABSTRACT

The earthquake problem needs to be attacked from different directions and one important means to achieve seismic safety is to propagate building typologies that are inherently better against earthquakes. The confined masonry is one such building typology that has been shown to perform satisfactorily in resisting earthquake loads despite being low in intricacies of modern technology and being more close to traditional construction practices. National Information Center on Earthquake Engineering (NICEE) at IIT Kanpur in India has taken several initiatives in the recent past to promote confined masonry as an appropriate technology for building construction in India. These initiatives included organizing a group of professional interested in developing various aspects of confined masonry to make it more effective technology, and train artisans. NICEE published two very useful documents on confined masonry: the monograph for building professionals and the guidebook for technicians and artisans.

### Introduction

Performance of many traditionally built buildings and structures in the past earthquakes indicate that earthquake protection is a rather wider concept than mere reinforcement and use of strong materials. In other words, sufficient seismic resistance in buildings type structures can be provided even when 'noble building materials' such as concrete and steel are not used in the form to develop 'noble structural systems' such as moment resisting frames or shear walls. Many of these technologies have their own intricacies and peculiarities which need to be adhered to, rather faithfully, in order for them to succeed. Such requirements are usually too difficult to be met in many areas of the world because of lack of expertise and suitable materials. Hence, for wider coverage of seismic protection, it is necessary to develop new building typologies which use appropriate level of technology not too different from what were traditionally practiced and not too sensitive to minor deviations from the standard practice.

Building and construction typologies vary from place to place depending on availability of materials and skills, climatic conditions and cultural, social and living practices. In the Indian subcontinent following destructive earthquakes, there have been a few successful innovations in house building for better performance in earthquake. Two such examples are: Assam type

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housing in the northeast after the 1897 Assam earthquake and a special type of masonry bond, referred as Quetta bond, to provide for reinforcement in masonry after devastating earthquake of Quetta in 1935 in the northwest areas. The confined masonry construction is another such building typology which can be adopted for modern one to three storey houses in both rural and urban areas, for adequate protection against earthquakes.

National Information Centre of Earthquake Engineering (NICEE) was established in Indian Institute of Technology Kanpur with the mandate to empower all stakeholders in the building industry in seismic safety towards ensuring an earthquake resistant built environment. NICEE maintains and disseminates information resources on Earthquake Engineering. It undertakes community outreach activities aimed at mitigation of earthquake disasters. NICEE's target audience includes professionals, academics and all others with an interest in and concern for seismic safety.

Considering its role in earthquake disaster mitigation, and inherent earthquake resistance of confined masonry construction led NICEE to take up several initiatives to promote the use of confined masonry as an alternative building typology which can serve as a substitute for poorly built reinforced concrete frame buildings and poorly performing unreinforced brick masonry buildings. The confined masonry combines the good qualities of reinforced concrete and masonry, while minimizing their adverse effects resulting from less exacting standards of construction quality. Though the system has been in use in many parts of the world and has performed mostly satisfactorily, there are many aspects of its design and construction which require further investigation. In the following sections, certain activities undertaken by NICEE to popularize this building typology has been summarized.

#### **International Strategy Workshop at IIT Kanpur**

NICEE in collaboration with Earthquake Engineering Research Institute (EERI), and World Seismic Safety Initiative (WSSI) organized an international strategy workshop at IIT Kanpur to discuss various aspects of confined masonry technology and its global dissemination in January 2008. A small group of experts from Canada, USA, Mexico, Peru, Switzerland, Indonesia, China, and India developed a strategy to promote confined masonry worldwide. An action-oriented agenda was developed in the meeting with two major objectives: (a) to improve the design and construction quality of confined masonry where it is currently in use; and (b) to introduce confined masonry in areas where it can reduce seismic risk. One of the most positive outcome of the workshop has been the creation of a confined masonry network to promote safe and economical housing worldwide by bringing quality confined masonry into the design and construction mainstream.

#### **Monograph on Confined Masonry Construction**

NICEE published a monograph authored by Brezv (2008) for building professionals interested in learning more about confined masonry construction and for those who would be interested in propagating its usage in areas of high seismic risk. The monograph was developed during the author's one-month visit to IIT Kanpur in 2005 under the sponsorship of National Program on Earthquake Engineering. The document outlines the basic features of confined

masonry construction and illustrates its application worldwide, their performance in past earthquakes and role of its various components in determining its satisfactory response. In the later part, the monograph describes a guideline for the construction of confined masonry buildings starting from the architectural planning to construction sequence and reinforcement placement. This general guideline is intended to help a qualified engineer to develop a design suitable for a particular project. The monograph discusses various advantages and drawbacks of certain construction practices and also includes codal provisions contained in the various building standards for further guidance. The cover page of the second edition of the monograph printed in 2008 is shown in Fig. 1. The first edition was printed in 2007 and the second edition in 2008; about 1500 copies have been distributed till date, indicating the considerable interest it has generated in this building typology.

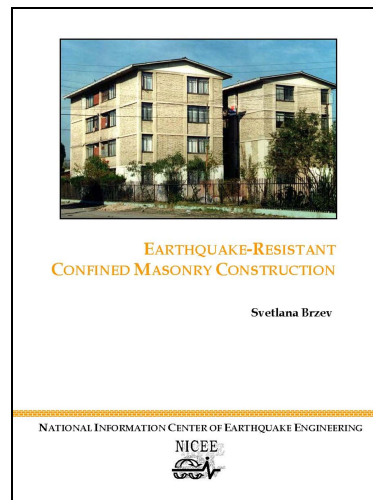


Figure 1. Cover page of monograph on confined masonry construction [Brzev 2008]

#### **Manual on Confined Masonry for Technicians and Artisans**

NICEE published a manual written for technicians, contractors, homeowners, and masons, engaged in the construction masonry buildings. This manual written by Sacher [2009] is a step-by-step guide to confined masonry construction illustrating through easy-to-understand drawings (Fig. 2). Moreover, it provides clear guidance on the construction aspects as well as the do's and don'ts, many of which comes from the author's rich hands-on experience of propagating this technology in Pakistan after the 2005 Kashmir earthquake. A typical page illustrating the construction of tie-columns is shown in Fig. 3.

#### **Concluding Remarks**

Confined masonry construction is a building typology that has been shown to perform satisfactorily in resisting earthquake loads and can be easily adopted for low-rise buildings in urban as well rural areas. National Information Center on Earthquake Engineering (NICEE) at IIT Kanpur has taken several initiatives since it hosted an international strategy meet in January 2008. NICEE has published two very useful documents on confined masonry: a monograph for building professionals and a guidebook for technicians and artisans, which have been well received and have generated considerable interest.



Figure 2. Cover page of the confined masonry manual for one and two storey buildings in low-tech environments [Sacher 2009]

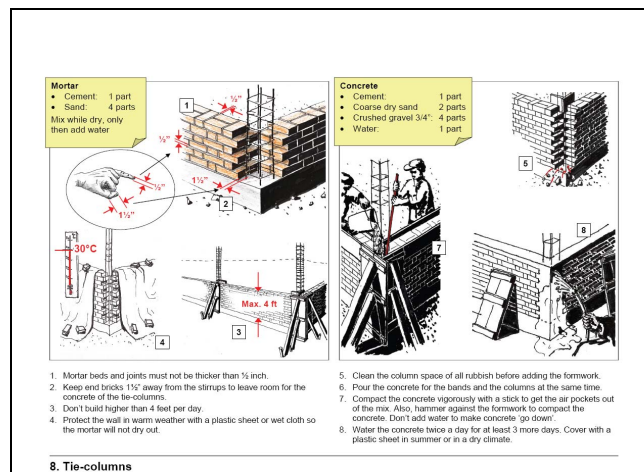


Figure 3. A typical page of the confined masonry manual for illustrating through easy-to-understand sketches and text notes [Sacher 2009]

### Acknowledgments

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