REHABILITATION OF EXISTING CONCRETE AND/OR MASONRY STRUCTURES IN SEISMIC REGIONS. A PERMANENT CHALLENGE FOR CIVIL ENGINEERS

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Abstract

The assessment of the protection level of constructions generally and particularly of reinforced concrete and/or masonry structures has become a constant preoccupation of all the specialists involved in design, construction and monitoring of structures.
The habilitation thesis presents research and case studies connected to the structural rehabilitation aspects as follows:

- Introduction to: durability problems; behaviour at seismic actions; repair and strengthening of existing structures.
- Rehabilitation of existing concrete and masonry structures: experimental research; case studies.

The vulnerability of existing structures under seismic motions may be due to structural system weaknesses and specific detailing. Structural weaknesses are characterised by various irregularities and discontinuities or by general structural vulnerabilities. Specific detailing of existing structures is function of building materials: reinforced concrete; steel; masonry; wood. The rehabilitation solutions adopted in the case of deterioration of building component parts depend on the structural material.
EXISTING REINFORCED CONCRETE STRUCTURES are strengthened in order to increase its strength, stiffness and ductility. In case of reinforced concrete framed structures, these goals are to be achieved by jacketing of beams, columns and joints. The jacketing is performed by reinforced concrete, steel profiles, carbon fibres CFRP, etc. CFRP may be used for increasing ductility and slightly increased stiffness.
Experimental studies were performed on the RC jacketing strengthening method. Different techniques for increasing the bond between the old (existing) and new (jacketing) concrete layers were studied and presented in the thesis.
Experimental studies were also performed for strengthening of reinforced concrete framed structures in seismic zones by using Carbon Fiber Reinforced Polymers (CFRP). The main system's advantages as rehabilitation solution are: increase of load-carrying capacity; structures designed at gravity loads will be able to withstand seismic loads.
The reinforced concrete structures' rehabilitation case studies presented are: Western University of Timisoara; tanks supporting structure; office building; Palace Building; apartment house affected by a gas explosion; reinforced concrete silos; industrial building; frame structure at the Timisoreana Brewery; block of flats.
EXISTING MASONRY STRUCTURES present some important vulnerability in seismic zones: the overall lateral stiffness values along the two main axes are different; lack of seismic joints to divide building parts having different dynamic characteristics; lack of reinforced concrete straps at each level; defects of wall connections at corners, crossings and ramifications as well as the presence of cracks; inadequate bearing capacity at normal forces on the walls.
Experimental research was performed on modern rehabilitation solution known as Near-Surface-Mounted Reinforcement (NSMR), which implies that steel bars/rods mainly of CFRP are bonded in sawn grooves in the masonry or concrete cover. The main advantages of this technology are: no requirement for surface preparation work, no change of the existing structure dimensions.
The masonry structures' rehabilitation solutions presented are: Banatul Museum, Timisoara – by classic solution; historical structures – by modern solution; tower structure – by modern solutions.

The full abstract at:
http://www.upt.ro/img/files/2016-2017/doctorat/abilitare/dan/Rezumat_habilitation_thesis_en_Sorin_Dan.pdf

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