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FRP Reinforcement for Concrete Frame Buildings at Mexico City Around 1900 to 1960

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1 Introduction

In 1940 cement industry turns into an immense demand because of the appearance of storehouses, departments, office buildings, and skyscrapers (Magaña, 2017). For the next two decades, reinforced concrete systems were used in innovative ways because Mexico City is located in a seismic region with a subsistence ground (Marsal J. and Mazari, 2016). Around 1955 -1960, most of the constructed build just started to integrate geotechnical and seismic studies to evaluate and design structural systems; before that period, only building code was used. Thus, all concrete structures built before 1960 have a probability of exhibiting some damage. Further this possibility, aging of concrete structures be accelerated due to permanent axial load on it (Park and Paulay, 1988), creating disbalance between the load/stress distribution of the structural system and producing fissures, structural cracks, or increasing the one that exists (Muñoz and Mendoza, 2012). Then, it is necessary to fit them according to the current construction regulation code without affecting their patrimonial integrity. It proposed the use of Fiber Reinforced Polymers (FRP) as a rehabilitation/reinforcement system. The hypothesis planted for this research is that if FRP could increase reinforced concrete life- service also could improving ductility and control plastic flow (Metha and Monteiro, 1998).

2 FRP Concrete at Compression Test

To validate the previous hypothesis, six concrete cylinders were manufactured to applied FRP system on three of them and the other three to have control of the concrete mixture. Both specimens were tested 28 days after manufacturing. Tests were made in an INTRON universal testing machine, screw type UTM model MII 400WHVL with capacity for 200 tons, following the standards of ASTM C39M. Test results shown on table 1 and on figure 1 shown tested FRP cylinders.

Table 1. Results of compression test for Control and FRP specimens.

Specimen	Number of CF Layers	Theorical Confined Compressive Strength	Practical Confined Compressive Strength
Control 1	0	-	21 MPa
Control 2	0	-	23.5 MPa
Control 3	0	-	21.7 MPa
FRP 1	1	30.92 MPa	36.5 MPa
FRP 2	1	30.92 MPa	36.7 MPa
FRP 3	1	30.92 MPa	40.5 MPa

Theorical confined compressive strength at table 1 only considers a design target concrete mixture of 25 MPa.

They were two cases of failure at mechanical tests: delamination of overlap section and reached of compressive strength. Nevertheless, FRP system has a semi ductile trend and even delamination failure; it can be controlled the axial and transversal deformation. To contrast the influence of carbon cloth, it was performed the stress-strain curves of all specimens to obtain the average behavior trend, it shown in Figure 1.

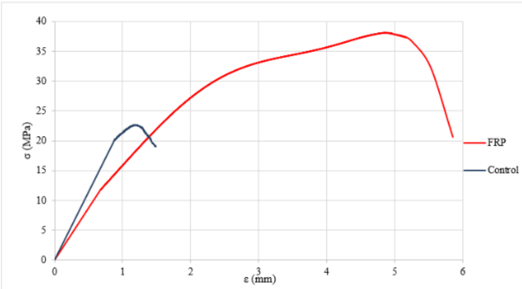

Figure 1. Comparation between FRP and pure concrete specimens.

On Figure 1 it observes that carbon fiber actually extend the plastic zone of concrete.

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Referencias

Magaña, F.C. (2017). El Art Déco en la Ciudad de México: un movimiento arquitectónico 1925-1940. *Arquitectura y Urbanismo, XXXVIII*(3), 23-40 ,https://www.redalyc.org/articulo.oa?id=376854676003

Marsal J.R. and Mazari, M. (2016). *El Subsuelo de la Ciudad de México.* Ciudad de México: Instituto de Ingeniería UNAM.

Metha, P.K. and Monteiro, J.P. (1998). *Concreto: Estructura, propiedades y materiales.* Ciudad de Mexico: Instituto Mexicano del Cemento y el Concreto, A.C.

Muñoz, S.F. and Mendoza, E.C. (2012). La Durabilidad en las Estructuras de Concreto Reforzado des de la Perspectiva de la Norma Española para Estructuras de Concreto. *Concreto y Cemento. Investigación y Desarrollo, 4*(1), 63-86, https://www.redalyc.org/pdf/3612/361233551004.pdf

Park, R. and Paulay, T. (1988). *Estructuras de Concreto Reforzado.* Ciudad de México: Editorial Limusa. S.A. de C.V.