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THE EFFECT OF CONFINEMENT ON CONCRETE STRENGTH AND DUCTILITY BY FRP JACKETS AND ANGLES

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In this research, by examining and testing cylindrical and cubic concrete models with different strengths and drawing their stress-strain models, the effect of confine concrete on their strength and ductility was evaluated and its results showed improvement in the behavior of confined samples.

For the experiment, 48 cubic specimens dimension 15 × 15 cm2 and 36 cylindrical specimens dimension 15 × 30 cm2 with resistances of 300, 350, 400 kg/cm2 were prepared to increase the accuracy, thereby endeavoring to prepare mean results for analysis. After fabrication, the samples were curing according to standard BS-1881. Then, the capping process was performed in order to apply uniform force on the concrete surfaces. Wrapping was done in three ways: 1. Using carbon fibers; 2. Using glass fibers; 3. Using angles and preheated straps.

Two-component resin was used to wrap the concrete by carbon fiber and glass. The resin and hardener were first combined in a ratio of one to three and then spread over the sample surface. The fibers were then mounted on the models as they were stretched. To wrap the cubic specimens, they must first be rounded to the corners. Otherwise, the fibers will not function and the inactivation will actually be inactive and the fibers will have no effect on the strength and ductility of the specimen. To further investigate the effect of concrete wrapped and confinement, 12 cubic and cylindrical specimens were tested with angles and straps. In order to avoid direct pressure of the hydraulic jack jaws on the four corners and to prevent the participation of angles in axial bearing, the lengths of the jaws were considered to be 0.5 cm smaller than the concrete specimens.

One of the most important issues and characteristics of structures against forces caused by earthquakes is their behavior or the nature of their ductility. In other words, any earthquake-resistant structure must be both fully assemble and its members individually ductile. The ductility of each member means that, first, it is capable of sufficiently tolerating relatively large inelastic deformations without significantly reducing its resistance. And second, be able to absorb, attenuate, and depreciate a significant amount of earthquake-induced energy through sustained hysteresis behavior. There are various ways of defining ductility, including the energy absorbed by its member. The energy absorbed by its member or structure is obtained by considering the area below the deformation-force diagram.

Table of comparison between different modes of resistance and transverse, longitudinal and volumetric deformations to investigate and conclude with regard to the results of experiments on non-wrap specimens, specimens confined with carbon fibers and glass fibers as well as the specimen confined with steel straps have been provided.

By comparing the results of the table we can see that: 1. By confining concrete, its resistance increases substantially, which will sometimes be up to 60%; 2. The effect of increasing the resistance on the wrapping, is strongest with the angles. Then, carbon fibers and finally glass fibers have the effect of increasing the resistance; 3. The strain increase process in the samples with carbon fibers has the greatest impact, then glass fibers and lastly angles; 4. By increasing the compressive strength of the concrete, effect of the confining concrete on the ultimate strength is reduced

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Table 1. Comparison between different modes of resistance and transverse, longitudinal and volumetric deformations.

Resistance								
Specimen		Before Wrapping	Carbon fibers	Increase Ratio	Glass fibers	Increase Ratio	Steel straps	Increase Ratio
Type	Strength							
Cylindrical	30	30.66	47.64	1.55	38.92	1.27		
	35	35.38	53.96	1.53	46.51	1.31		
	40	39.57	57.79	1.46	42.46	1.07		
Cubic	30	31.52	49.22	1.56	45.84	1.45	52.35	1.66
	35	39.07	57.51	1.47	49.86	1.28	60.61	1.55
	40	41.02	58.63	1.43	51.25	1.25	62.47	1.52
Longitudinal Strain								
Specimen		Before Wrapping	Carbon fibers	Increase Ratio	Glass fibers	Increase Ratio	Steel straps	Increase Ratio
Type	Strength							
Cylindrical	30	2.93	5.27	1.80	3.8	1.30		
	35	3.1	6.06	1.95	4.41	1.42		
	40	2.98	5.59	1.88	4.13	1.39		
Cubic	30	3.13	7.51	2.40	5.13	1.64	4.7	1.50
	35	3.29	7.39	2.25	6.1	1.85	5.08	1.54
	40	3.37	7.66	2.27	6.1	1.81	5.34	1.58
Transverse Strain								
Specimen		Before Wrapping	Carbon fibers	Increase Ratio	Glass fibers	Increase Ratio	Steel straps	Increase Ratio
Type	Strength							
Cylindrical	30	0.663	3.32	5.01	2.52	3.80		
	35	0.619	3.06	4.94	1.89	3.05		
	40	0.59	2.92	4.95	1.85	3.14		
Cubic	30	0.623	3.031	4.87	1.51	2.42	1.01	1.62
	35	0.66	3.47	5.26	1.9	2.88	1.18	1.79
	40	0.647	3.05	4.71	1.84	2.84	0.261	1.94
Volume Strain								
Specimen		Before Wrapping	Carbon fibers	Increase Ratio	Glass fibers	Increase Ratio	Steel straps	Increase Ratio
Type	Strength							
Cylindrical	35	4.26	11.91	2.80	7.85	1.84		
	40	4.34	12.18	2.81	8.19	1.89		
	35	4.17	11.42	2.74	7.84	1.88		
Cubic	40	4.37	13.57	3.11	9.29	2.13	6.71	1.54
	35	4.6	14.48	3.15	9.9	2.15	7.44	1.62
	40	4.66	13.77	2.95	9.78	2.10	7.86	1.69

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