

DEPARTMENT OF STRUCTURAL ENGINEERING Piazza L. Da Vinci, 32, 20133 Milano – Italy

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Test report

Subject: Comparison between mechanical properties measured on cores obtained from concrete casted in wood or metallic mesh formworks.

Introduction

The Material Testing Laboratory (LPM) – Concrete section of D.I.S. received four prismatic formworks (two made of wood and two made of metallic mesh) with square base (side 0.3m) and height of 1m.

On 24/4/2008 formworks were filled with two different mixtures.

The same mix-design was used for both mixtures.

The slump with Abram's' cone was as follows:

 $cast \ 1: \ 10 \ cm$

cast 2 : 5 cm

associated to consistency class S3-S2

In order to obtain comparable situations, formworks (Picture 1) have been filled with the same mixture



At the same time, with the same material, cubic and cylindrical specimens were cast, consolidating concrete on the vibrating table for a maximum of 10 seconds.



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During the first week, specimens were cured in climatic chamber ($20^{\circ}C - 95\%$ UR), and in laboratory afterwards ($20^{\circ}C - 70\%$ UR)

Six cores were extracted from each column with a diamond drill, for a total of 12+12 specimens. Certificates report (for each cast) the compressive test results on cylinders, cubes and cores extracted from columns cast into two different formworks. All cores and cylindrical specimens were subjected to microseismic measurements.

Discussion

A statistical analysis of the results of each cast has been performed. The five cubes of the first cast delivered the following average results:

			Density		
Rcm (MPa)	23,87	2252,25	kg/m ³		
dev. st.	0,63	4,94	dev. st.		
coef. var.	2,66	0,22	coef. var.		
The nine cylinders of the first cast furnished the following average results:					
Dencity					

fcm	20,86	2287,45	kg/m ³
dev. St.	1,50	19,11	dev. st.
coef. var.	7,19	0,84	coef. var

The six cores extracted from the wood formwork of the first cast presented the following average results:

			Density
fcm	17,12	2360,46	kg/m ³
dev. St.	1,42	15,19	dev. st.
coef. var.	8,28	0,64	coef. var.

The six cores extracted from the metallic mesh DB formwork of the first cast furnished the following average results:

			Density
fcm	19,64	2388,34	kg/m³
dev. St.	0,90	25,51	dev. st.
coef. var.	4,56	1,07	coef. var.

The five cubes of the second cast furnished the following average results:

Rcm	25,85	2275,15	Density kg/m ³	
dev. St.	0,91	29,56	dev. st.	
coef. var.	3,53	1,30	Coef. Var.	
		0.1		1.1

The nine cylinders of the second cast delivered the following average results:

fcm	22,62	2299,56	Density kg/m ³	
dev. St.	1,25	56,14	dev. st.	
coef. var.	5,55	2,44	coef. var.	



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Gianpaolo Rosati, Ph.D. Professor Phone: (+39) 02 2399 4377 FAX: (+39) 02 2399 4220 E-mail: rosati@stru.polimi.it The six cores extracted from the wood formwork of the second cast presented the following average results:

-			Density
fcm	18,34	2396,14	kg/m ³
dev. St.	3,01	16,07	dev. st.
coef. var.	16,40	0,67	coef. var.

The six cores extracted from the metallic mesh DB formwork of the second cast furnished the following average results:

			Density
fcm	19,98	2415,38	kg/m ³
dev. St.	1,05	36,84	dev. st.
coef. var.	5,24	1,53	coef. var.

Irements	First cast cylinders	Second Cast cylinders	First Cast cores wood	First cast cores metallic mesh	Second cast cores wood	Secondary cast cores metallic mesh
ISE	3.897	3.990	4.148	3.983	4.073	4.110
Jea	3.938	4.021	4.100	4.091	4.084	4.211
	3.785	3.960	4.067	3.995	4.170	4.154
, Li	4.003	3.914	3.975	4.068	3.902	4.038
isi	3.868	3.922	4.020	3.973	4.131	4.079
Se	3.822	3.944	3.997	3.992	4.060	4.089
cro	3.909	3.932				
ž	3.891	4.004				
	3.957	4.070				
Average velocity (m/s)	3.897	3.973	4.051	4.017	4.070	4.114
Standard deviation (m/s)	66,81	52,12	65,91	49,55	91,92	61,07
Coefficient of variation						
(%)	1,71	1,31	1,63	1,23	2,26	1,48

Statistical analysis of microseismic results is presented in the table

The second cast has slightly higher mechanical properties, but this does not affect the comparison.



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The cylindrical/cubic strength ratio is 0.87 in both cases. Cores with diameter/height ratio equal to 0.5 show lower average strength than cylindrical ones, because of the damage due to extraction with diamond drilling.

There is a clear correlation between strength and density.

Specimens with higher density show higher strength. The ultrasonic measurements confirm this relationship, indeed velocity increases with the compaction grade.

The average strength of cores extracted from columns casted in metallic formwork is about 11% higher than the corresponding cores extracted from columns casted in wood formworks. The wood formwork is not water-proof and tends to absorb water.

Conclusions

With reference to the consistency class of the associated casts, the considered data allow to obtain a better a higher quality of casts in DB metallic mesh formworks compared to wood formworks. It is worth mentioning that it is not possible to extend results to higher strength class or self-compacting concretes. The use of more "fluid" concretes is increasing in various application fields, it is thus necessary to carefully consider the increasingly demand for water-proof formworks. Furthermore, concrete shrinkage is affected by humidity exchange between concrete surface and surrounding environment.

Prof. Ing. G. Rosati