ISSN 2349-4506
Impact Factor: 3.779
Global Journal of Engineering Science and Research Management

GYPSUM USING IN PRODUCTION OF REINFORCED CONCRETE BEAMS

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DOI: 10.5281/zenodo.1422469

KEYWORDS: plaster of pairs, concrete, aggregate, normal gypsum, reinforcement ratio, curing, and moisture.

ABSTRACT

This research is investigating the possibility of using plaster instead of cement in some internal structural parts and non-exposed to moisture by casting (Twelve) samples dividing in four group, first group plaster of pairs concrete, second plaster of Paris with a ratio of aggregate concrete group, third normal gypsum group and finally normal gypsum with a ratio of aggregate concrete group. All of them have the same dimension (1000×150×200) mm and same reinforcement ratio. All Groups are curing in an isolated place far away of the moisture. All sample design to be the Failure as flexural failure, the process of testing divided in two ways, one for properties of material that used as explain above (Compressive Strength (f 'c) & (fcu), Splitting Tensile Strength (fct) and Flexural Strength (Modulus of Rupture) (fr)), second for samples were tested under (two-point load) for several curing period time (7, 28 and 90) days. Each period consists of three samples one from each group above. The result showed that the second group (plaster of Paris with a ratio of aggregate concrete) approximately closer or exceeded the design values. While the first group (plaster of pairs concrete) not worse when compared with the second group because of the missing aggregate.

INTRODUCTION

Mesopotamia is the oldest in using plaster rocks and its product. Throughout the ages, with evidence of characterization of the successive civilizations, as research and studies conducted in archaeological sites are shown the best selection of materials and the most appropriate to the environment, Through the physical residues of archaeological and heritage materials since the start of rural settlements and the emergence of buildings with distinctive architectural features and distinct. Plaster is an important material as it is used as a whitish material in construction, joining the bricks, also used in (mortar, arches, domes, bonding materials, whiteness, decoration and light blocks). Plaster properties can be improved by adding some materials like tar, fiber plants, cement etc.

Plaster has been used since ancient times for many purposes, in recent decades, production has doubled globally by building factories, improving their productivity, and developing new and more sophisticated products [1]. The most important of these products can be presented as follows:

- Reinforced plaster panels as internal partitions (reducing dead loads of construction parts in multi-story buildings and consequent lower cost of foundations) and plaster panels for secondary ceilings [2].
- Fireproof plaster plates to prevent the rapid transition of heat to other parts of origin with same times safely and without damage, the plaster works naturally as a fire-resistant spraying system because the plaster contains about 21% of the water united within the crystalline structure, so delays heat transfer [3].
- Moisture resistant plaster panels using natural and chemical additives.
- Heat insulating panels after mixing with insulation materials (cork and mica pieces) or mixed with chemicals or other materials that increase its porosity and increase thermal insulation factor [4].
- Sound-proof plastered panels with plant materials with cellulose fibers such as wood saw reeds, glass fibers or mineral wool with porous or decorative facets and the resulting face with high sound absorption.
- Plaster blocks of different types (normal, lightweight, armed with agricultural waste, improved with Nora and additives to improve products using glue and others)

The density of plaster castings ranges between 900-1500 kg / m3, which is less than the usual concrete (2400) Kg / m3 [5].

- Concrete plaster (in different sizes) mixed with sand, sand and Nora, rubble (brick breaker), rubble (waste and debris of buildings).
- Load and Non-load bearing walls (precast, casting site).
- Exterior walls (tiling, plates, scattering).

According to (ASTM C 317/C 317M – 00 and C 956 – 04) [6][7]. The gypsum concrete is a mixture of the type of gypsum with aggregates, wood chips, or wood shavings.

The objective of this study is to investigate the flexural behavior (in terms of first crack load (Pcr), ultimate flexural strength (Pu), ultimate deflection (Δu), load-deflection behavior, failure mode, load-crack behavior and crack pattern at failure) of simply supported singly reinforced beam having dimensions of 1000×150×200 mm under symmetrical two points loads, and the other main objective of this study is the focus on the influence of concrete constituents on the materials properties of all type concrete are used in this study.

Most of the previous researchers were partially replace Portland cement in construction products while the purpose of this research is to study the possibility of using plaster instead of concrete in some internal structural parts and non-exposed to moisture.

MATERIALS AND METHODS

All the samples were designed according to (ACI-318-14) [8]. as shown in figure (1):

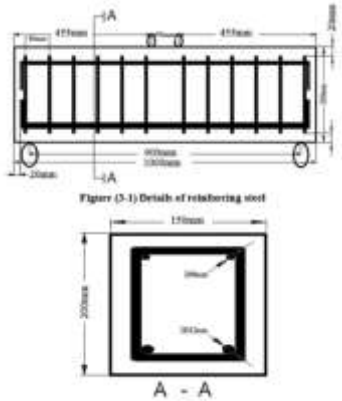


Figure. 1 Steel Reinforcement details

Twelve structural specimens (reduced-scale) beam (sometimes called replica models) are prepared for the experimental work purposes. These specimens are divided into four groups, each group consists of three beams of dimensions (1000 x 150 x 200) mm as shown in Table. 1 with all details:

Table 1. Complete details of specimens

Type of Material	Group no.	Beam Name	Aggregate ratio	curing times(D)
Plaster of Paris concrete	Group One	BP1	0.0	7
		BP2	0.0	28
		BP3	0.0	90
Plaster of Paris concrete	Group Two	BP1. A	0.5	7
		BP2. A	0.5	28
		BP3. A	0.5	90
Normal Gypsum	Group Three	BG1	0.0	7
		BG2	0.0	28
		BG3	0.0	90
		BG1.A	0.5	7

Normal Gypsum	Group Four	BG2.A	0.5	28
		BG3.A	0.5	90

[a.] where B: Refers (beam). P: plaster of pairs. A: Aggregate. G: Gypsum

Then two group mixtures are used in Plaster of Paris concrete. The first mix is Plaster of Paris only with (water/powder =0.45) by weight, this mix used for the first group. The second is Plaster of Paris with Coarse Aggregate (0.5) and (water/powder =0.45) by weight, designed according to (ASTM C 317/C 317M – 00 and C 956 – 04) recommended the practice, used for group two, as shown in the table. 2 below:

Table 2. Plaster of paris concrete proportion mixture

Groups	Plaster of Paris (kg/0.09 m^3)[a]	Gravel (kg/0.09 m^3)[a]	Water (Litter/0.09 m^3)[a]
1	180	0	85
2	180	90	85

a. These quantities are equal multiply (3× 0.2×0.15×1) m.

lastly, two mixes are used in Gypsum concrete preparation, the first gypsum only with (water/powder =0.35) by weight, this mix used for Groups three. The second mix is gypsum with Coarse Aggregate (0.5) and (W/P =0.35) by weight, designed according to (ASTM C 317/C 317M – 00 and C 956 – 04) recommended the practice, used for Groups four, as shown in the Table. 3 below:

Table 3. Gypsum concrete proportion mixture

Groups	Gypsum (kg/0.09 m^3)[a]	Gravel (kg/0.09 m^3)[a]	Water (Litter/0.09 m^3)[a]
3	180	0	63
4	180	90	63

[a.] These quantities are equal multiply (3× 0.2×0.15×1) m.

The mold used in casting the samples of research made of ply-wood lubricated with special oil to resist moisture and joint with a screw to facilitate process removal of samples as shown in figure (2):

Figure. 2 The mold

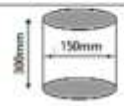
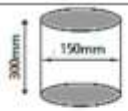
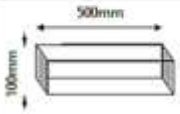
After extruding from the mold, the samples leave in place far away from the moisture for interval time (7, 28 and 90) days as shown in figure (3):

Figure. 3 The samples

RESULTS AND DISCUSSION

The properties of the material that users have been computed according to a standard that showed in the Table. 4:

Table 4. Standard used in test

Specimen	Number of specimens	Test	Standards of test
	3	Cube Compression Strength	B.S: 1881: part 116
	3	Cylindrical Compression Strength	ASTM C39/C39M
	3	Splitting Tensile Strength	ASTM C496
	3	Modulus of Rupture	ASTM 8C7

The compressive strength result obtains in two standards (cube and cylinder). Plaster with two states (with and without aggregate) was the best, because of a manufacturing method that used to produce plaster of Paris depend on, the degree of smoothing, burning temperature with another controlled factor process. That was clearly shown in the table. 5:

Table 5. Material test result

Material	Cube Strength (f_{cu}) MPa	Cylinder Strength (f 'c) MPa	Splitting Tensile Strength f_{ct} (MPa)	Modulus of Rupture f_r (MPa)

Plaster of Paris concrete	23	20.6	1.6	1.73
Plaster of Paris concrete with aggregate	26	22	2.1	2.05
Gypsum concrete	13	10.2	1.26	1.08
Gypsum concrete with aggregate	16.8	13	1.4	1.3

The samples start failure (first crack) at load (from 3 to 27.5) KN, the less amount to (BG1) while the greatest to (BP1) in spite of it was without aggregate. But samples with aggregate give the highest value in ultimate load this can be seen in the table. 6:

Table 6. The result of two-point load test

Group No.	Specimens	First Crack load (F.C.L) (kN)	Ultimate load (U.L) (kN)	$\frac{F.C.L}{U.L}$ (%)
1	BP1	8	44	18.18
	BP2	10	77.5	12.9
	BP3	27.5	87.5	31.43
2	BP1. A	9.5	51.5	18.45
	BP2. A	17.5	82.5	21.21
	BP3. A	20	96.5	20.73

3	BG1	3	14.5	20.7
	BG2	12.5	49.5	25.3
	BG3	10	53.5	18.7
4	BG1.A	6	27.5	21.82
	BG2.A	12.5	56.5	22.12
	BG3.A	17.5	72.5	24.14

Entering the curing time effect in computed Load-Deflection curve can be observed that in figure (4) as well as figure (5), figure (6) and figure (7) all of them in increasing curing time the ultimate load increased with decreased in deflection but the (BP3.A) sample gives the highest value of ultimate load:

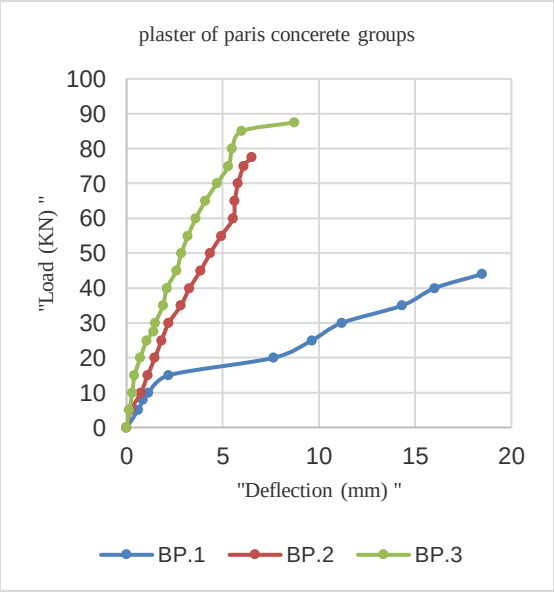


Figure. 4 Load – Deflection Curve of Specimen (BP)

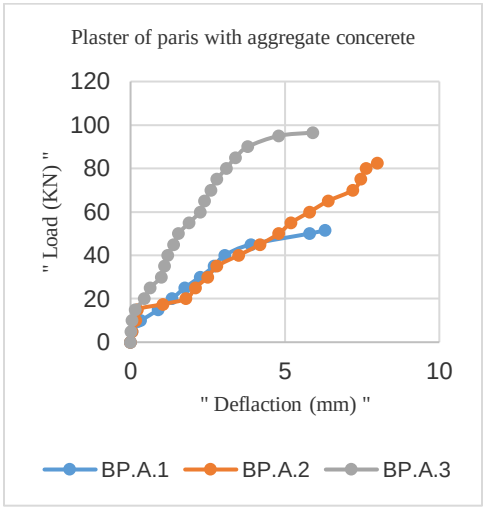


Figure. 5 Load – Deflection Curve of Specimen (BPA)

ISSN 2349-4506
Impact Factor: 3.779

Global Journal of Engineering Science and Research Management

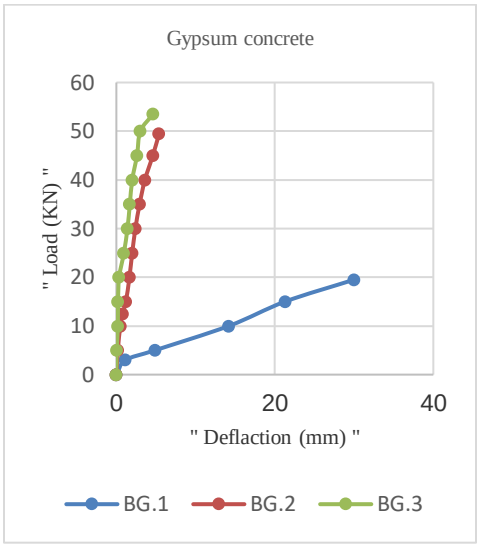


Figure. 6 Load – Deflection Curve of Specimen (BG)

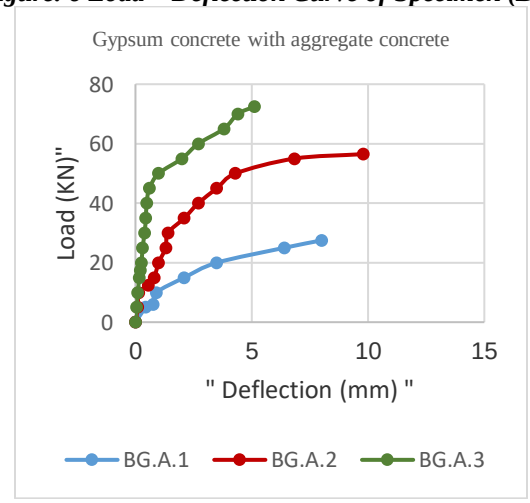


Figure. 7 Load – Deflection Curve of Specimen (BGA)

Figure. 8 The specimen after the test

The hydraulic universal testing machine (MFL system) is used to test all beam specimens. The testing machine has three scale loads (0 to 600 kN, 0 to 1500 kN, 0 to 3000 kN). The machine is shown in figure (9). The high capacity, stiffness, and dimensions of the testing machine make it more adequate to test different types of specimens. All the models were tested in the construction laboratory of Al-Mustansiriyah University College of Engineering. It may be noted that the universal testing machine is calibrated by "The Iraqi Central Organization for Standardization and Quality Control":

ISSN 2349-4506
Impact Factor: 3.779
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Figure. 9 The hydraulic Universal testing machine

CONCLUSION

The plaster of Pairs with aggregate concrete gives the best result in both bear the load and properties of the material, with increasing curing time the strength of samples to load increased with decreased in deflection, lastly, aggregate addition for both (gypsum and plaster of Pairs) lead to improving their properties.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the construction laboratory of Al-Mustansiriyah University College of Engineering and Building Research Directorate – Ministry of Construction and Housing Municipalities and Public Works for their facilitation to complete this research by introducing help to examine the materials and samples.

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