LOCAL GYPSUM & ITS USES IN BUILDING CONSTRUCTION

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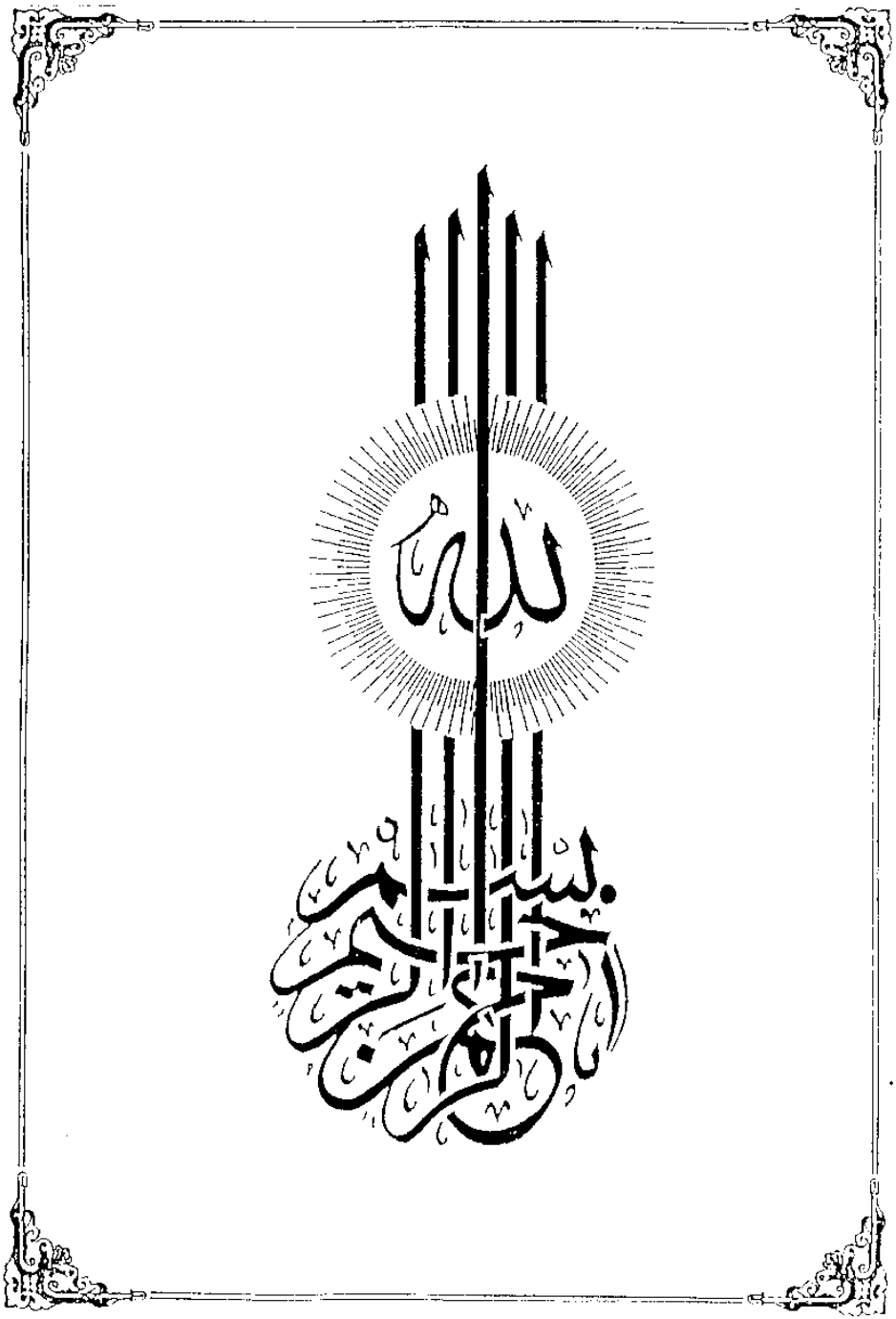

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INTRODUCTION

Gypsum is one of the oldest building materials; it was widely used by Ancient Egyptians as a coating material for walls and ceilings of dwellings and temples besides its use as a cementing material for repairs. Herodotes stated its abundant ores and its common and vast uses in Egypt at that time such that gypsum name is derived from the name of Egypt. After that time, other civilizations passed away with its big attention to gypsum uses, especially, the Islamic civilization where its use extended to be a material for manufacturing structural elements.

Nowadays, Arab Republic of Egypt is in thirst need for local building materials, and since the gypsum ore is found in many big quarries in Egypt besides the initiative begining of manufacturing gypsum blocks and gypsum boards, therefore this research work was carried out to determine the properties of local gypsum and gypsum blocks from the results of experimental investigation to get handy data for users in building area about the chemical, physical and mechanical properties. This will be useful as technical data in construction zone and as an advantage to national economy.

The gypsum ore at Ballah area northen Ismaillia is the base of gypsum used in this research; the specimens were

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extracted from the center of the quarry where the ore is pure. Also specimens of the ore were extracted from quarry extremities where the ore is impure. Gypsum plaster was manufactured from the ore by incomplete dehydration from each of pure and impure ore by calcination at different temperatures 100°, 130°, 160°, 190°, 220°, 250°, 300° and 400°C. This is to determine the effect of calcination heat on the produced gypsum plaster and to determine also the degree of calcination for economically incomplete dehydration giving gypsum plaster with suitable properties for constructional uses. Also grinding process was carried out for either pure & impure ore before calcination and after calcination to state which of the four cases of such processes is suitable for manufacture of gypsum plaster. The produced gypsum, as previously mentioned was tested for fineness, setting time and flexural strength according to the Egyptian Standard Specifications.

Specimens of locally manufactured gypsum - from pure ore calcined at 190°C and ground after calcination - were prepared by adding materials to gypsum plaster to get better required properties. Such materials were Alumn, Clay, Coloured materials, Karnak cement, Lime and Sodium chloride. These additives were taken as percentage of gypsum plaster weight namely 0%, 1%, 2%, 3%, 5% and 8% for each case except for Karnak cement and Lime 20% also was added. Then tests were

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carried out for getting the workability, setting time, 7 days compressive strength and one & seven days flexural strength, according to the Egyptian Standard Specification. This is to determine the effect of each of these additives on the previously mentioned gypsum properties to recommend its advantageous use.

The study was also carried out for gypsum blocks as found in the market with dimensions 66X50X8 & 10 cms as solid blocks or as block with cylinderical holes. These two types of gypsum blocks were tested in two cases; in the first case, tested specimens were prepared from the gypsum block to determine the unit weight, absorption %, abrasion resistance, flexural strength and compressive strength for dry specimens, Also, compressive strength was determined for wet specimens resulting from the immersion of dry pieces in water for ½, 1, 3, 12 & 24 hours. Besides other dry pieces were subjected to heat of 200°C for 0, 1, 2, 3 & 6 hours to determine such effect on compressive strength of the specimens. The second case for testing gypsum blocks was to apply compression load for blocks as one block or as unit prepared from two or three blocks glued together as continuous or staggered joints. Then for each tested compression piece the lateral deformation were recorded at each applied load; besides the max. Load and the state of failures were recorded. Hardness testing were carried out for the surface of these blocks and hardness survey was made by drawing the hardness contour lines.

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Also, the gypsum blocks were tested as a wall of 4 blocks in length and 2 blocks in width, cemented in staggered joints. This wall which was made once from solid blocks and in the other case from hollow blocks, and every wall was subjected to lateral flexural uniformily distributed load to represent the case of side push during service of the wall. This load was applied gradually using layers of sand, till failure. The deflections were recorded along the span of the wall between supports, besides, the strains were also measured at different points of the wall cross section using electrical resistance and mechanical strain gages. Also, the maximum load and the state of failure were noticed for each of the tested walls.

The thesis consists of six chapters and references. The first chapter contains the review of literature which includes historical note, the gypsum ores, types and quarries in Egypt and summary of researchs carried out in Egypt about gypsum and gypsum products. Chapter two states the research programme. Chapter three contains the effect of calcination at different temp. degrees from 100°C into 400°C on the resulted gypsum properties which is ground before calcination and after calcination. Chapter four shows the effect of additives - of alumn, clay, coloured materials, Karnak cement, Lime and sodium chloride - on gypsum plaster properties. Chapter five includes the test results of solid and hollow blocks

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as prepared specimens from gypsum blocks or as unity, as glued unit of 2 or 3 blocks with continuous or staggered joints, and as a wall of glued blocks with staggered joints. This chapter also, includes the discussion of Egyptian Standard Specifications for gypsum blocks compared to that of the American Standard Specifications. Chapter six gives the conclusions and recommendations.

The experimental investigation in this thesis reaches important results as illustrated later with respect to the effect of impurities, the effect of calcination temperature degree and the effect of certain additives on gypsum plaster properties. Other important results were obtained with respect to the properties of gypsum specimens prepared from gypsum blocks taken from Egyptian market as old product in 1984 and as a new product in 1985. Besides, the properties of solid and hollow gypsum blocks as a result of the previously mentioned tests were determined. The thesis reaches important recommendations with respect to the degree of calcination for gypsum ore to be 220°C instead of 165° to 195°C used in many Egyptian factories, and with respect to the advantageous use of certain additives.

The thesis also recommends carrying out studies to improve the resistance of gypsum blocks to water effect and heat effect and to increase its rigidity and strength by adding

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certain fibers to gypsum mix. Other recommendations are given with respect to ameliorating the Egyptian Standard Specifications for gypsum blocks No 1554/1985 by carrying out certain amendements leading to benificial items for quality control for the local production. The work of this research recommends also, the studying of a newly manufactured local gypsum boards to make it in suitable condition before putting it in service to avoid the defective points raised in this research against gypsum blocks.

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C H A P T E R [I]

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