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Faculty of Engineering  
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# **LONG TERM PERFORMANCE OF PORTLAND LIMESTONE CEMENT CONCRETE**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿ وَعِنْدَهُ مَفَاتِحُ الْغَيْبِ لَا يَعْلَمُهَا إِلَّا هُوَ وَيَعْلَمُ  
مَا فِي الْبَرِّ وَالْبَحْرِ وَمَا تَسْقُطُ مِنْ وَرَقَةٍ إِلَّا  
يَعْلَمُهَا وَلَا حَبَّةٍ فِي ظُلْمَتِ الْأَرْضِ وَلَا رَطْبٍ وَلَا

يَابِسٍ إِلَّا فِي كِتَابٍ مُبِينٍ ﴿٥٩﴾

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## **STATEMENT**

This thesis is submitted to Ain Shams University, Cairo, Egypt, in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering.

The work included in this thesis was carried out by the author at properties and testing of Materials lab of the faculty of engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or qualification at any other university or institute.

Date :            /    / 2011

Name :            Jehan Mahmoud Ali Elsamni

Signature :        *Jehan Elsamni*

To my father,  
You are always remembered and greatly missed

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Abstract of M.Sc. Thesis submitted by: Jehan Mahmoud Ali  
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LIMESTONE CEMENT CONCRETE “**

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### **ABSTRACT**

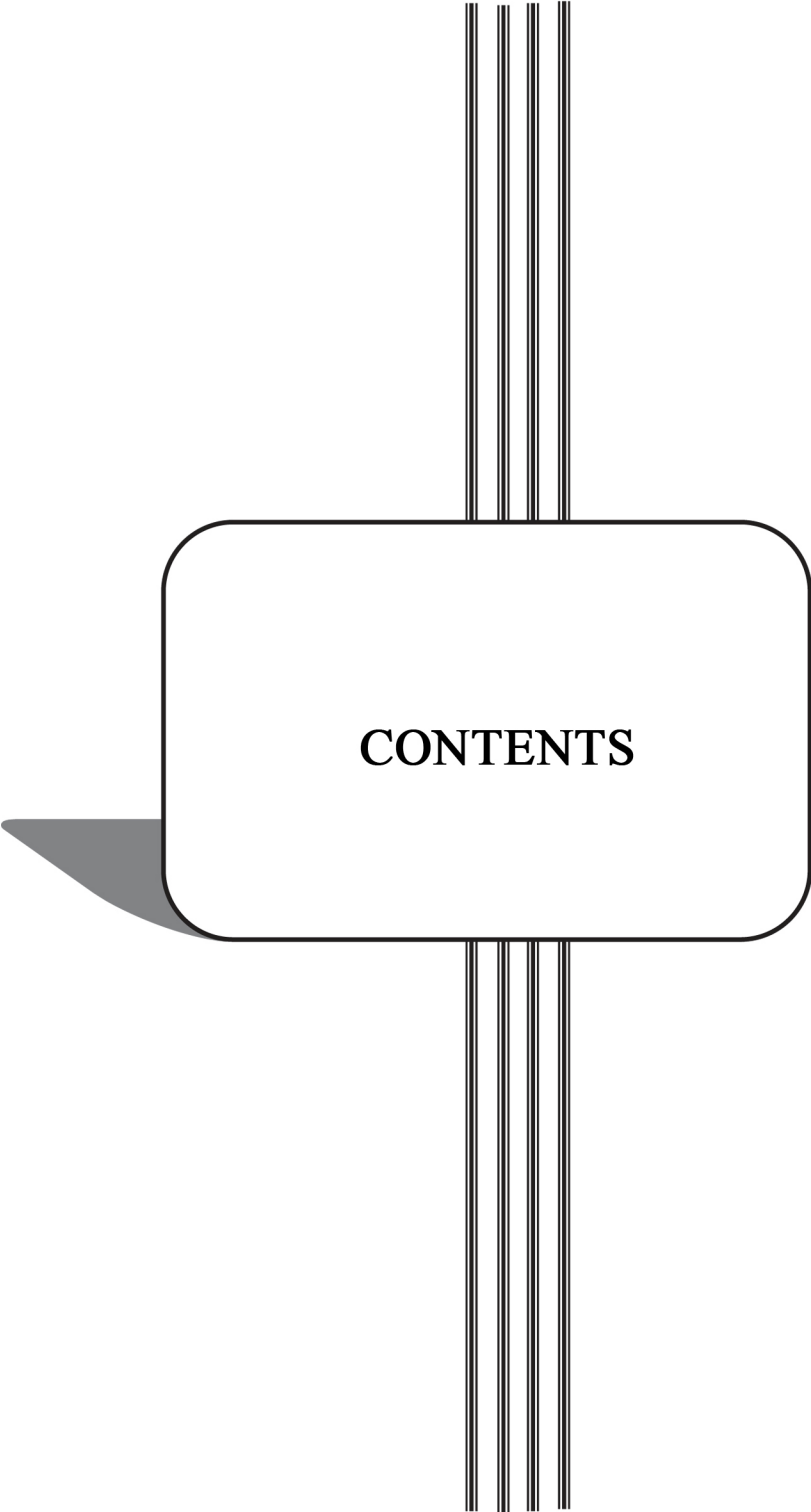
New edition of the Egyptian Standard Specifications 4756-1/2005, for different types of cement has been issued recently following the European Specification EN 197-1/2004 for common cements. These specifications contain different categories of cements including Portland blended cements (Designated by CEM II) which compose mainly of Ordinary Portland Cement (OPC) with a percentage varies from 65 to 94 % and pozzolanic materials or inert fillers with a percentage varies from 6 to 35%. One of the popular types of the Portland blended cement is Portland Limestone Cement (PLC) where Ordinary Portland Cement is

blended with finely ground limestone which is considered as chemically inert filler. Blending of limestone powder with OPC has beneficial effect on reducing the amount of energy needed for manufacturing the cement and consequently reducing the cement cost and producing more environmental friendly cement. The limestone powder is inert and does not add to the cement strength, however, owing to its physical properties, it has some advantages on the concrete properties including workability, capillarity, bleeding, and cracking tendency. Compared to OPC concrete, the PLC concrete may have comparable short term strength, but its strength development with time under different exposure conditions and long term performance need to be addressed.

Based on the new specifications, many of the local cement manufacturers have been producing PLC. Properties of these types of cement depend on the manufacturing method and composition of limestone which changes from one location to another. As a new type of cement in the local market, it has not to be used in producing concrete before evaluating the long term performance of the concrete. Therefore, this research has been initiated to study the long term performance and high temperature resistance of the concrete produced by Portland limestone cement. The main variables to be covered in the current study include cement and limestone contents and exposure conditions. The long term characteristics of the concrete to be considered are strength development under different exposure conditions, resistance to sulfate attack and reinforcing steel corrosion, and high temperature resistance.

From the analysis and discussion of the test results obtained in the current research, it is concluded that for the same cement content and water/cement ratio the compressive strength for PLC concrete is less than that of OPC concrete and the reduction in compressive strength is proportional to the limestone content. However, to attain comparable compressive strength with OPC concrete, PLC concrete should contain higher cement content and lower water/cement ratio. It is concluded that if the compressive strengths of both PLC and OPC concretes are comparable, PLC concrete is as good as OPC in both short and long term characteristics. On the other hand, compared to OPC concrete, PLC concrete has lower drying shrinkage and comparable high temperature resistance. Therefore, it is concluded that PLC can be used in producing plain and reinforced concrete provided that the cement content and water/ cement ratio are modified to achieve the specified compressive strength.

**Keywords** : Compressive Strength, Corrosion Resistance, Drying Shrinkage, Pozzolanic materials, Durability, Long Term Performance, Fly Ash, Silica Fume, Ordinary Portland Cement (OPC), Portland Limestone Cement (PLC), Sulfate Attack and Fire Resistance.



# CONTENTS

## **TABLE OF CONTACTS**

|                                                                                | Page  |
|--------------------------------------------------------------------------------|-------|
| <b><u>CHAPTER 1: INTRODUCTION</u></b>                                          | 1     |
| 1.1 Background.....                                                            | 1     |
| 1.2 Organization of the present work.....                                      | 2     |
| <br><b><u>CHAPTER 2: LITERATURE REVIEW</u></b>                                 | <br>3 |
| 2.1. Introduction.....                                                         | 3     |
| 2.2 History of using limestone with Portland cement<br>all over the world..... | 3     |
| 2.3 Hydration and Setting.....                                                 | 10    |
| 2.3.1 Chemistry.....                                                           | 10    |
| 2.3.2 Analysis of composition.....                                             | 13    |
| 2.3.3 Heat evolution .....                                                     | 21    |
| 2.3.4 Microstructure.....                                                      | 22    |
| 2.3.5 Setting time.....                                                        | 23    |
| 2.4 Fresh mortar and concrete.....                                             | 26    |
| 2.4.1 Particle Size Distribution.....                                          | 26    |
| 2.4.1.1 Comminution.....                                                       | 26    |
| 2.4.1.2 Workability of paste, mortar, and<br>concrete.....                     | 30    |
| 2.5 Hardened Mortar and Concrete.....                                          | 35    |
| 2.5.1 Mechanical properties.....                                               | 35    |
| 2.5.1.1 Strength and Strength Development                                      | 35    |
| 2.5.1.2 Volume Stability.....                                                  | 50    |
| 2.5.2 Durability.....                                                          | 54    |
| 2.5.2.1 Permeability.....                                                      | 54    |
| 2.5.2.2 Carbonation.....                                                       | 58    |
| 2.5.2.3 Freeze/Thaw and Deicer Scaling...                                      | 64    |
| 2.5.2.4 Sulfate Resistance.....                                                | 69    |
| 2.5.2.5. Thaumasite .....                                                      | 80    |

|                                                               |      |
|---------------------------------------------------------------|------|
|                                                               | Page |
| 2.5.2.6 Chlorides.....                                        | 85   |
| 2.5.2.7 Alkali-Silica Reactivity.....                         | 88   |
| 2.5.2.8 Corrosion.....                                        | 89   |
| 2.5.3 Interactions with mineral and chemical admixtures ..... | 92   |
| 2.6 Specifying and Monitoring Quality.....                    | 94   |
| 2.6.1 Limestone.....                                          | 94   |
| 2.6.2 Cement with limestone.....                              | 98   |
| 2.6.3 Concrete.....                                           | 101  |
| 2.7 Needed Research.....                                      | 102  |

### **CHAPTER 3: RESEARCH PROGRAM**

|                                |     |
|--------------------------------|-----|
| 3.1 Introduction.....          | 103 |
| 3.2 Scope .....                | 103 |
| 3.3 Objectives.....            | 103 |
| 3.4 Variables considered.....  | 104 |
| 3.5. Mix proportions.....      | 104 |
| 3.6 Properties considered..... | 104 |

### **CHAPTER 4: MATERIALS USED AND TESTING PROCEDURES**

|                                        |     |
|----------------------------------------|-----|
| 4.1 Introduction.....                  | 108 |
| 4.2 Properties of Materials Used.....  | 108 |
| 4.2.1 Fine Aggregate.....              | 108 |
| 4.2.2 Coarse Aggregate.....            | 109 |
| 4.2.3 Cementitious Material.....       | 109 |
| 4.2.3.1 Cement.....                    | 109 |
| 4.2.3.2 Fly Ash.....                   | 113 |
| 4.2.3.3 Silica Fume .....              | 113 |
| 4.2.4 Admixtures.....                  | 113 |
| 4.2.4.1 High Range Water Reducer ..... | 113 |

|                                                                         |      |
|-------------------------------------------------------------------------|------|
|                                                                         | Page |
| 4.2.5 Reinforcing Steel bars.....                                       | 114  |
| 4.2.6 Materials used to prevent steel bars from corrosion.....          | 114  |
| 4.2.6.1 Epoxy zinc coat.....                                            | 114  |
| 4.3 Testing procedures.....                                             | 114  |
| 4.3.1 Compressive strength test .....                                   | 114  |
| 4.3.2 Accelerated corrosion test. ....                                  | 114  |
| 4.3.3 Sulfate resistance.....                                           | 117  |
| 4.3.3.1 Sulfate resistance of concrete exposed to sulfate solution..... | 117  |
| 4.3.3.2 Potential Expansion of cement mortar exposed to sulfate.....    | 117  |
| 4.3.4 High temperature resistance.....                                  | 118  |

## **CHAPTER 5: TEST RESULTS AND ANALYSIS**

|                                                                                          |     |
|------------------------------------------------------------------------------------------|-----|
| 5.1 Introduction.....                                                                    | 119 |
| 5.2 Compressive Strength and strength gaining.....                                       | 119 |
| 5.2.1 Effect of limestone content on strength and strength gaining.....                  | 121 |
| 5.3 Accelerated Corrosion test .....                                                     | 126 |
| 5.3.1 Corrosion Current.....                                                             | 126 |
| 5.3.2 Mass Loss .....                                                                    | 127 |
| 5.3.3 Crack patterns.....                                                                | 129 |
| 5.3.4 Effect of limestone content on corrosion resistance.....                           | 129 |
| 5.4 Sulfate resistance.....                                                              | 133 |
| 5.4.1 Sulfate resistance of concrete cubes .....                                         | 133 |
| 5.4.1.1 Limestone content effect on Sulfate resistance of concrete cubes .....           | 137 |
| 5.4.2 Sulfate resistance of cement mortar exposed to sulfate (Potential Expansion) ..... | 137 |

|                                                                                                                     |      |
|---------------------------------------------------------------------------------------------------------------------|------|
|                                                                                                                     | Page |
| 5.4.2.1 Effect of Limestone content on Sulfate resistance of cement mortar exposed to sulfate (Potential Expansion) | 138  |
| 5.5 High temperature resistance.....                                                                                | 139  |
| 5.5.1 Influence of limestone content on high temperature resistance .....                                           | 142  |
| 5.6 The effect of cement and limestone contents on the compressive strength of concrete mixes.....                  | 144  |
| <br><b><u>CHAPTER 6: SUMMARY AND CONCLUSIONS</u></b>                                                                |      |
| 6.1 Summary.....                                                                                                    | 152  |
| 6.2 Conclusions.....                                                                                                | 153  |
| 6.2.1Conclusions regarding compressive strength                                                                     | 154  |
| 6.2.2Conclusions regarding corrosion resistance..                                                                   | 155  |
| 6.2.3 Conclusions regarding sulfate resistance for concrete cubes and linear expansion of mortars....               | 157  |
| 6.2.4 Conclusions regarding heat resistance.....                                                                    | 157  |
| <br><b><u>REFERENCES</u></b> .....                                                                                  | 158  |
| <br><b><u>APPENDICES</u></b>                                                                                        |      |
| Appendix A.....                                                                                                     | 173  |
| Appendix B.....                                                                                                     | 176  |
| Appendix C.....                                                                                                     | 178  |

## **LIST OF FIGURES**

|                                                                                                                                                                                                                                                            | Page |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b><u>CHAPTER 2: LITERATURE REVIEW</u></b>                                                                                                                                                                                                                 |      |
| 2.1 Portland limestone cement market share in Germany.....                                                                                                                                                                                                 | 8    |
| 2.2 Pozzolan cement market share in Italy.....                                                                                                                                                                                                             | 9    |
| 2.3 XRD patterns of PEC pastes (1: ettringite, 2: calcium monosulfate hydrate, 3: Portlandite (C-H), 4: gismondine <sub>2</sub> (CaAl <sub>2</sub> Si <sub>2</sub> O <sub>8</sub> .4H <sub>2</sub> O), 5: quartz, 6: anhydrous compounds of clinker).....  | 19   |
| 2.4 XRD patterns of PLC pastes (1: ettringite, 2: monocarboaluminate hydrate, 3: Ca-Al-Si hydrate)...                                                                                                                                                      | 20   |
| 2.5 XRD patterns of composite cement pastes at 7 days (1:ettringite, 2: calcium monosulfate hydrate, 3: monocarboaluminatehydrate, 4: Ca-Al-Si hydrate).....                                                                                               | 20   |
| 2.6 Cumulative mass distributions of a Portland limestone cement with a limestone content of 12% by mass, as well as of the two individual constituent materials after intergrinding in an industrial ball mill (after Schiller and Ellerbrock, 1992)..... | 28   |
| 2.7 Effect of heat curing on the compressive strength of concretes made with and without limestone. “Test A” contains 4.1% limestone and “Test B” contains 2.3% limestone (after Bédard and Bergeron, 1990).....                                           | 38   |
| 2.8 Strength development of cements.....                                                                                                                                                                                                                   | 41   |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Page |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 2.9 The ratio of compressive strengths for mortars made with Portland cements with up to 6% limestone to that of companion samples made with Portland cement without added limestone. The dashed line connects the mean values at each age. The data represent 374 sets of samples from 11 sources (Bobrowski et al. 1977; Bayles 1985; Crawford 1980; Combe and Beaudoin, 1979; Hawkins 1986; Hooton 1990; Klieger 1985; Livesey 1993; Lane 1985; Matkovic et al. 1981; and Tsivilis et al. 1999)..... | 44   |
| 2.10 The ratio of compressive strengths for concrete made with Portland cement with limestone to that of companion samples made with Portland cement without limestone. The dashed line connects the mean values at each age. The data represent 491 sets of samples from 10 sources (Bayles 1985; Bedard and Bergeron, 1990; Bobrowski et al. 1977; Detwiler 1996; Hawkins 1986; Klieger 1985; Livesey 1993; Matkovic et al. 1981; Nehdi et al. 1996; and Suderman 1985).....                          | 46   |
| 2.11 The ratio of compressive strengths for mortars made with Portland cement with limestone to that of companion samples made with Portland cement without limestone. The dashed line connects the mean values at each age. The data represent 44 sets of samples from 4 sources with cement C <sub>3</sub> A contents less than 8% (Bobrowski et al. 1977, Hawkins 1986, Livesey 1993, and Tsivilis et al. 1999).....                                                                                 | 47   |