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Behavior of Foam Particles Lightweight Concrete with Time

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Statement

This thesis is submitted to Faculty of Engineering, Ain Shams University, Cairo Egypt, for the degree of Master of Science in Structural Engineering.

The work included in this thesis was carried out by the author in the Department of Structural Engineering, Ain Shams University, from July 2012 to March 2015.

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

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Sohila Ahmed El Khouly

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Abstract of the M.Sc. Thesis Submitted by

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Title of the thesis:

BEHAVIOR OF FOAM PARTICLES LIGHTWEIGHT CONCRETE WITH TIME

ABSTRACT

The time dependent behavior of lightweight concrete with polystyrene foam particles (LWC) was experimentally and theoretically evaluated in this study. Polystyrene foam is used as lightweight aggregate to produce lightweight structural concrete with unit weight 1900 kg/m^3. The experimental program consisted of two phases; namely, the LWC mechanical properties and the LWC time-dependent behavior. The mechanical properties incorporated the compressive and tensile strength of concrete as well as its elastic modulus. The second phase included the LWC time-dependent behavior under compressive loading with variable stress levels; and the LWC time-dependent behavior under flexural loading with variables stress levels and compression reinforcement. Moreover, steel creep apparatuses were designed and built for this study. In the second phase, nine 15×30 cm cylinders of LWC were cast, tested under three different compressive stress levels (20%, 40% and 60%), and compared its creep behavior with three 15×30 cm cylinders of normal weight concrete (NWC). Test was run on concrete specimens up to an age of 280 days. Furthermore, six LWC beams with cross section (10×20) cm, 95 cm length and span 75 cm were tested under two different sustained loads (25% and 50% of ultimate load) and compared time-dependent behavior with two NWC beams. Beams were subjected to sustained load up to an age of 120 days.

Results showed that LWC with polystyrene foam particles exhibits a significantly higher drying shrinkage than NWC with an increasing percentage of 31%. LWC with polystyrene foam particles and NWC with equal compressive strengths were recorded equal creep strains during the test period. Generally, the time dependent strain (shrinkage plus creep) of the LWC with polystyrene foam particles under compressive sustained load was found to be higher than that of NWC, with the same compressive strength, with an increasing percentage about 9%. The creep strains of LWC with polystyrene foam particles seemed to be proportional to the stress to strength ratio. The time dependent deflections of the LWC with polystyrene foam particles beams were higher than those of NWC beams with increasing percentage about 25%, hence, the time dependent behavior of the LWC with polystyrene foam particles in compression and flexure were almost the same as compared with time dependent behavior of the NWC. Addition of compression steel reinforcement (As`) to LWC with polystyrene foam particles beams reduced time-dependent deflections. Sustained load level and LWC time-dependent deflection was directly proportional.

Finally, models and equations proposed by different codes were used to evaluate the obtained experimental results. From the theoretical study, it was found that Bazant-Baweja B3 Model gave superior shrinkage strains prediction for LWC with polystyrene foam particles. The ACI 209R-92 presented preferable predictions of creep strain and time dependent deflection of LWC with polystyrene foam particles.

TABLE OF CONTENTS

CHAPTER (1)

INTRODUCTION…….…..1

1.1 General..……...……...…….…..……..……....1

1.2 Objectives of Investigation…….…….……..…..…….....2

1.3 Scope of Work…….…….....…2

1.4 Thesis Outlines…….…..…..…..…..2

CHAPTER (2)

LITERATURE REVIEW…….....4

2.1 Introduction……..……..…….……..….....…4

2.2 Time Dependent Behavior Of Concrete……..……....…...4

2.2.1 Creep in Concrete……..……..…….……...…….5

2.2.1.1 Creep Components Definition ……..……..….6

2.2.1.2 Significance of Studying Creep Behavior of Concrete……...……..……..…7

2.2.1.3 Factors Affecting Creep……...……....……...……...…….....8

2.2.1.3.1 Cement Paste…….....…..…8

2.2.1.3.2 Aggregate……..……...…....9

2.2.1.3.3 Water-cement Ratio……...……...….…10

2.2.1.3.4 Relative Humidity…….…….11

2.2.1.3.5 Age at Loading……...……11

2.2.1.3.6 Stress/Strength Ratio…….....…..12

2.2.1.3.7 Shape and Size……...…….....13

2.2.1.3.8 Temperature……...…….....13

2.2.2 Shrinkage in Concrete……..…….……14

2.2.2.1 Significance of Studying Shrinkage Behavior of Concrete ……....…….15

2.2.2.2 Factors Affecting Shrinkage……..15

2.3 Lightweight Concrete…….……..16

2.3.1 Definition of Structural Lightweight Concrete…….…….....….16

2.3.2 Classification of Lightweight Concretes…….…….…..16

2.3.3 Types of Lightweight Aggregates…….……...…….…….17

2.3.4 Mix Design of Structural Lightweight Concrete……..……..……....17
2.3.4.1 Aggregate Proportion.…….……...……...…18
2.3.4.2 Mixing Procedure……..18
2.3.5 Properties of Structural Lightweight Concrete……..…..…….……..…18
2.3.5.1 Compressive Strength…….....……...……..18
2.3.5.2 Unit Weight……...……19
2.3.5.3 Modulus of Elasticity and Stress-Strain Relationships……...……...……...19
2.3.5.4 Tensile Strength……...…….....…19
2.3.5.5 Creep…….19
2.3.5.6 Shrinkage……...……22
2.3.6 Uses of Structural Lightweight Concrete……...…….……...24
2.4 Innovative Mix Design of Lightweight Concrete……..……...…25
2.5 Previous Research on The Innovative Concrete Mix……...……....26
2.6 Need for The Current Research……...……..…..….27
CHAPTER (3)
EXPERIMENTAL PROGRAM……...…….28
3.1 Introduction……..……..……..28
3.2 Concrete Mixtures evaluated……..…….….28
3.2.1 Mix Proportions…….……28
3.2.2 Mix Ingredients……..…….…...…29
3.2.2.1 Water……...…….….29
3.2.2.2 Cement……..…….29
3.2.2.3 Fine Aggregate……..29
3.2.2.4 Coarse Aggregate……..29
3.2.2.5 Polystyrene Foam……..29
3.2.2.6 Silica Fume……...…….29
3.2.2.7 Super Plasticizer…….....30
3.3 Mechanical Properties of Tested Concrete…….....……..30
3.3.1 Compressive Strength Test…….……...……30
3.3.2 Splitting Tensile Strength Test…….……..30
3.3.3 Elastic Modulus Test…….…….31

3.4 LWC Time-Dependent Behavior……..……..31
3.4.1 Time-Dependent behavior of LWC Specimens under Compressive Loading…..…..……31
3.4.1.1 Creep Test……..……31
3.4.1.1.1 Test Apparatus……..……....….31
3.4.1.1.2 Test Specimens……..…34
3.4.1.1.3 Instrumentation……..36
3.4.1.1.4 Procedure……...…36
3.4.1.2 Shrinkage Test……...38
3.4.2 Time-Dependent Behavior of Reinforced LWC Beam under Flexural Loading…..……..39
3.4.2.1.Test Apparatus…….....……39
3.4.2.2.Test Specimens…….……41
3.4.2.2.1. Formwork……...……44
3.4.2.2.2. Reinforcement……..……..44
3.4.2.2.3. Fabrication……..…45
3.4.2.3.Instrumentation……..45
3.4.2.4.Procedure…….…..45
CHAPTER (4)
EXPERIMENTAL RESULTS AND DISCUSSIONS…….47
4.1 Introduction…….……...……..47
4.2 Mechanical Properties of Tested Concrete……...……47
4.2.1 Compressive Strength Test Results……...……47
4.2.2 Splitting Tensile Strength Test Results…….……..…48
4.2.3 Elastic Modulus Test Results…….....…48
4.3 LWC Time-Dependent Behavior…….49
4.3.1 Time-Dependent Behavior of LWC Specimens under Compressive Loading…....….49
4.3.1.1 Shrinkage Test Results……...……...…….……49
4.3.1.2 Creep Test Results……...……...…….…..50
4.3.1.3 Creep Strain……...……..……..55
4.3.1.4 Creep Coefficient……...……...…56
4.3.1.5 Specific Creep……...……....58
4.3.1.6 Time-Dependent Strain……...…..60

4.3.1.7 Effect of Stress to Strength Ratio on Creep Strain……..…..63
4.3.1.8 Effect of Stress Level on Creep Coefficient……..65
4.3.2 Time-Dependent Flexural Behavior of LWC Beams Test Results……...……...….66
4.3.2.1 Comparison between LWC and NWC Beams…….....……73
4.3.2.2 Effect of As`/As Ratio on The Time-Dependent Deflection of LWC Beams ……..77
4.3.2.3 Effect of Load Level on The Time-Dependent Deflection of LWC Beams…….....…80
CHAPTER (5)
CODE PREDICTIONS…….…….83
5.1 Introduction…….……...……..83
5.2 Models to Calculate Shrinkage and Creep in Concrete…….…...…83
5.2.1 ACI 209R-92 Method……...……...……..……85
5.2.2 Bazant-Baweja B3 Model……...…….…..87
5.2.3 CEB MC90-99 Model……88
5.2.4 GL2000 Model……...90
5.2.5 Egyptian Code of Practice (ECP203-2007)…….…..91
5.3 Comparison between Experimental Results and Codes Predictions …….…....92
5.3.1 Prediction of Shrinkage Strain……...……...…….....…92
5.3.2 Prediction of Creep Strain……...……...……....99
5.4 Methods to Predict Time-Dependent Deflection ……...…116
5.4.1 ACI Equation……...……...…….……116
5.4.2 ECP Equation……...……..……..116
5.5 Comparison between Measured and Calculated Tim-Dependent Deflections……...…117
CHAPTER (6)
SUMMARY AND CONCLUSIONS……..….120
6.1 Summary…….……...……120
6.2 Conclusions……...….121
6.3 Recommendations for Future Research……..123
REFERENCES……...…124

LIST OF FIGURES

Figure 2.1 Various strains in concrete with time……..…...5
Figure 2.2 Definition of creep under a constant stress……5
Figure 2.3 Representation of the three stages of creep……...6
Figure 2.4 Creep and creep recovery in concrete……...…….7
Figure 2.5 Effect of replacing ordinary Portland cement with high-calcium fly-ash on creep of concrete……..…..….9
Figure 2.6 Effect of replacing ordinary Portland cement with granulated blast-furnace on creep of concrete……..…..9
Figure 2.7 Difference in creep for concrete with variation of aggregates ……..…...9
Figure 2.8 Effect of volumetric content of aggregate on creep…….....10
Figure 2.9 Relative creep as a function of water/cement ratio (other factors adjusted)……...….10
Figure 2.10 Creep of concrete cured in fog for 28 days, then loaded and stored at different relative humidity……....11
Figure 2.11 Effect of age at application of load on creep of concrete…….….11
Figure 2.12 Effect of stress level on creep of cement paste..……....12
Figure 2.13 Creep of concretes of different strengths …….…….12
Figure 2.14 Effect of stress to strength ratio on basic creep of cement mortars……...…12
Figure 2.15 Effect of volume/ surface ratio on creep…….……...13
Figure 2.16 Effect of ambient temperature on creep…….....14
Figure 2.17 Effect of water-cement ratio and volume of aggregate on shrinkage….....16
Figure 2.18 Approximate unit weight and use classification of LWA concretes…….....17
Figure 2.19 Relationship between 28-day compressive strength and one-year specific creep for LWC and NWC…….....20
Figure 2.20 Relationship between compressive strength of LWC and one-year specific creep for (a) normally cures concrete (b) steam-cured concrete…….....21
Figure 2.21 Relationship between 28-day compressive strength and one-year drying shrinkage for LWC and NWC …….....23
Figure 2.22 Ultimate drying shrinkage values for different lightweight concretes……..24
Figure 3.1 Test set-up for performing the elastic modulus test…….….31
Figure 3.2 Creep test apparatus….....32

Figure 3.3 Positions of springs on the steel plate…….….33
Figure 3.4 Cylindrical specimens molds (a) before casting concrete (b) after casting concrete..34
Figure 3.5 Experimental test program profile……..….35
Figure 3.6 Dial gauges fixed on specimens…….…….36
Figure 3.7 The three creep test apparatus…….37
Figure 3.8 Concrete prisms wooden molds...……....38
Figure 3.9 Concrete prisms foe each concrete mixture…….38
Figure 3.10 Free shrinkage test set-up……..39
Figure 3.11 Schematic configuration of 4-point bending time-dependent test…….....40
Figure 3.12 Experimental test program profile…….42
Figure 3.13 Concrete dimensions and details of tested beams……..43
Figure 3.14 Wooden formwork for the beams…….....44
Figure 3.15 4-point bending time-dependent test ……...…….……46
Figure 4.1 Compressive strength developments for the LWC and NWC …...…….……47
Figure 4.2 Stress strain curve for the LWC and NWC…….48
Figure 4.3 Shrinkage strains of the two concrete mixtures evaluated……..49
Figure 4.4 Total Strain of LWC and NWC (20% load level)……...…54
Figure 4.5 Total Strain of LWC and NWC (40% load level)……...…54
Figure 4.6 Total Strain of LWC and NWC (60% load level)……...54
Figure 4.7 Creep Strain of LWC and NWC (20% load level)……..…55
Figure 4.8 Creep Strain of LWC and NWC (40% load level)……..55
Figure 4.9 Creep Strain of LWC and NWC (60% load level)……..…56
Figure 4.10 Creep Coefficient of LWC and NWC (20% load level)…….....56
Figure 4.11 Creep Coefficient of LWC and NWC (40% load level)…….57
Figure 4.12 Creep Coefficient of LWC and NWC (60% load level)……57
Figure 4.13 specific creeps of LWC and NWC (20% load level)…….....58
Figure 4.14 specific creeps of LWC and NWC (40% load level)……..…59
Figure 4.15 specific creeps of LWC and NWC (60% load level)…….59
Figure 4.16 Time dependent strain of LWC and NWC (20% load level)…….……...61
Figure 4.17 Time dependent strain of LWC and NWC (40% load level)…….....61
Figure 4.18 Time dependent strain of LWC and NWC (60% load level)…….....62

Figure 4.19 Time dependent deformations of LWC and NWC after 280 days of sustained load…….62
Figure 4.20 creep strains of LWC under different stress levels.....…63
Figure 4.21 Relation between stress level and creep strain at 280 days for LWC specimens…..64
Figure 4.22 Relation between stress level and creep strain at 280 days for NWC specimens….64
Figure 4.23 Effects of different stress level on LWC creep coefficient……...65
Figure 4.24 Total mid-span deflection for beam L-1A along test period…….67
Figure 4.25 Total mid-span deflection for beam L-1B along test period…….67
Figure 4.26 Total mid-span deflection for beam L-1C along test period…….67
Figure 4.27 Total mid-span deflection for beam L-2A along test period…….68
Figure 4.28 Total mid-span deflection for beam L-2B along test period…….68
Figure 4.29 Total mid-span deflection for beam L-2C along test period…….68
Figure 4.30 Time-dependent deflections for beam L-1A along test period……..69
Figure 4.31 Time-dependent deflections for beam L-1B along test period……..69
Figure 4.32 Time-dependent deflections for beam L-1C along test period……..69
Figure 4.33 Time-dependent deflections for beam L-2A along test period……..70
Figure 4.34 Time-dependent deflections for beam L-2B along test period……..70
Figure 4.35 Time-dependent deflections for beam L-2C along test period……..70
Figure 4.36 Immediate deflection versus time dependent deflection at day 120, load-level 25%.....72
Figure 4.37 Immediate deflection versus time dependent deflection at day 120, load level 50%.....72
Figure 4.38 immediate deflections versus time dependent deflections at day 120, all beams together……..72
Figure 4.39 total mid-span deflections for beam L-1B and beam N-1B……...74
Figure 4.40 total mid-span deflections for beam L-2B and beam N-2B……...74
Figure 4.41 Time-dependent deflections for beam L-1B and beam N-1B……...…75
Figure 4.42 Time-dependent deflections for beam L-2B and beam N-2B……...…75
Figure 4.43 Time dependent deflections of LWC and NWC beams after 120 days of sustained load…….....76
Figure 4.44 Total mid-span deflection for different additional compression reinforcement, load-level 25%.....78

Figure 4.45 Total mid-span deflection for different additional compression reinforcement, load-level 50%.....78
Figure 4.46 Time-dependent deflections for different additional compression reinforcement, load-level 25%.....79
Figure 4.47 Time-dependent deflections for different additional compression reinforcement, load-level 50%.....79
Figure 4.48 Time-dependent deflection ratios for different additional compression reinforcement.....80
Figure 4.49 Total mid-span deflection for different applied load level, As`/As=0.3…..……..81
Figure 4.50 Total mid-span deflection for different applied load level, As`/As=0.6……...81
Figure 4.51 Total mid-span deflection for different applied load level, As`/As=1……..…81
Figure 4.52 Time-dependent deflection for different applied load level, As`/As=0.3…….....82
Figure 4.53 Time-dependent deflection for different applied load level, As`/As=0.6…….82
Figure 4.54 Time-dependent deflection for different applied load level, As`/As=1……82
Figure 5.1 experimental shrinkage strains and predicted shrinkage strains from ACI209R-92 model……..……93
Figure 5.2 Shrinkage strains prediction of the ACI209R-92 model compared to measured values……..……...93
Figure 5.3 experimental shrinkage strains and predicted shrinkage strains from Bazant-Baweja B3 model……..……..94
Figure 5.4 Shrinkage strains prediction of the Bazant-Baweja B3 model compared to measured values……..……...94
Figure 5.5 experimental shrinkage strains and predicted shrinkage strains from CEB MC90-99 model…….....95
Figure 5.6 Shrinkage strains prediction of the CEB MC90-99 model compared to measured values……...…..95
Figure 5.7 experimental shrinkage strains and predicted shrinkage strains from GL2000 model…….....96
Figure 5.8 Shrinkage strains prediction of the GL2000 model compared to measured values…….....96

Figure 5.9 experimental shrinkage strains and predicted shrinkage strains from ECP203-2007 method……....97
Figure 5.10 Shrinkage strains prediction of the ECP203-2007 method compared to measured values……..…...97
Figure 5.11 experimental shrinkage strains and predicted shrinkage strains from the five methods…….....98
Figure 5.12 Shrinkage strains prediction of the five methods compared to measured values…..98
Figure 5.13 Experimental creep strains and predicted creep strain from ACI209R-02 model (stress level 20%)…….101
Figure 5.14 Creep strains prediction of the ACI 209R-02 model compared to measured values (stress level 20%)…….101
Figure 5.15 Experimental creep strains and predicted creep strain from ACI209R-02 model (stress level 40%)…….....102
Figure 5.16 Creep strains prediction of the ACI 209R-02 model compared to measured values (stress level 40%)…….102
Figure 5.17 Experimental creep strains and predicted creep strain from ACI209R-02 model (stress level 60%)…….103
Figure 5.18 Creep strains prediction of the ACI 209R-02 model compared to measured values (stress level 60%)…….103
Figure 5.19 Experimental creep strains and predicted creep strain from B3 model (stress level 20%)…….104
Figure 5.20 Creep strains prediction of the B3 model compared to measured values (stress level 20%)…….104
Figure 5.21 Experimental creep strains and predicted creep strain from B3 model (stress level 40%)…….105
Figure 5.22 Creep strains prediction of the B3 model compared to measured values (stress level 40%)……..…105
Figure 5.23 Experimental creep strains and predicted creep strain from B3 model (stress level 60%)…….106
Figure 5.24 Creep strains prediction of the B3 model compared to measured values (stress level 60%)…….106

Figure 5.25 Experimental creep strains and predicted creep strain from CEB MC90-99 model (stress level 20%)…….107
Figure 5.26 Creep strains prediction of the CEB MC90-99 model compared to measured values (stress level 20%)…….107
Figure 5.27 Experimental creep strains and predicted creep strain from CEB MC90-99 model (stress level 40%)…….108
Figure 5.28 Creep strains prediction of the CEB MC90-99 model compared to measured values (stress level 40%)…….108
Figure 5.29 Experimental creep strains and predicted creep strain from CEB MC90-99 model (stress level 60%)…….109
Figure 5.30 Creep strains prediction of the CEB MC90-99 model compared to measured values (stress level 60%)…….109
Fig. 5.31 Experimental creep strains and predicted creep strain from GL2000 model (stress level 20%)…….110
Fig. 5.32 Creep strains prediction of the GL2000 model compared to measured values (stress level 20%)……110
Figure 5.33 Experimental creep strains and predicted creep strain from GL2000 model (stress level 40%)……111
Figure 5.34 Creep strains prediction of the GL2000 model compared to measured values (stress level 40%)……111
Figure 5.35 Experimental creep strains and predicted creep strain from GL2000 model (stress level 60%)……112
Figure 5.36 Creep strains prediction of the GL2000 model compared to measured values (stress level 60%)……112
Figure 5.37 Experimental creep strains and predicted creep strain from ECP203-2007 model (stress level 20%)…….113
Figure 5.38 Creep strains prediction of the ECP203-2007 model compared to measured values (stress level 20%)…….113
Figure 5.39 Experimental creep strains and predicted creep strain from ECP203-2007 model (stress level 40%)…….114