

HIGHER TECHNICAL INSTITUTE

CIVIL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

Design of high strength concrete with
 $f_{cu}=40\text{N/mm}^2$

C/778

Papadopoulos Ioannis, 3CE2
Christodoulou Despo, 3CE1

JUNE 1996

HIGHER TECHNICAL INSTITUTE	PROJECT NO 2524
----------------------------------	--------------------

SUMMARY

DESIGN OF HIGH STRENGTH CONCRETE WITH $f_{cu} = 40\text{N/mm}^2$

The objective of this project was to create cubes with $f_{cu} 40\text{ N/mm}^2$.

To be able to accomplish this strength we had to determine the characteristics of each and every element that consist the concrete.

To achieve that we separated the project into two parts :

- a. The theoretical
- b. The experimental

CONTENTS

	Page No
Acknowledgment.....	1
Summary.....	2
Chapter 1 - Cement	3
1.1 Termination of cement.....	3
1.2 Types of cement.....	3
1.2.1 Portland cement.....	3
1.2.2 Rapid-hardening Portland cement.....	4
1.2.3 Extra-rapid-hardening Portland cement.....	4
1.2.4 Low-heat Portland cement.....	4
1.2.5 Sulphate-resisting Portland cement.....	5
1.2.6 White Portland cement.....	5
1.2.7 Coloured Portland cement.....	5
1.2.8 Air-entraining Portland cement.....	5
1.2.9 Portland-blastfurnance cement.....	6
1.2.10 Pozzolanitic cements.....	6
1.2.11 Supersulphated cements.....	6
1.2.12 High Alumina cement.....	7
1.3 Portland cement.....	7
1.4 Manufacture of O.P.C.....	8
1.5 Setting.....	8
1.6 Hardening.....	8
1.7 Hydration.....	9
1.8 Fineness of cement.....	10
1.9 Cement storage.....	10
1.10 Tests for Portland cement.....	11
1.10.1 Fineness.....	11
1.10.2 Chemical position.....	11
1.10.3 Strength.....	12
1.10.4 Setting time.....	12
1.10.5 Soundness.....	13
Chapter 2 - Aggregates	14
2.1 Introduction.....	14
2.2 General classification of aggregates.....	14
2.3 Properties of aggregates.....	15
2.3.1A Sampling of aggregates for testing.....	15
2.3.1B Sample reduction.....	16
2.3.2 Sieve analysis(Grading).....	18
2.3.3 Particle shape and texture.....	20
2.3.4 Strength of aggregates.....	21
2.3.5 Specific gravity.....	22

2.3.5.1 Bulk density.....	24
2.3.6 Absorption and surface moisture.....	25
2.4 Cleanliness.....	26
2.5 Lightweight aggregates.....	26
Chapter 3 - Admixtures	28
3.1 Introduction.....	28
3.2 Accelerators.....	28
3.3 Retarders.....	29
3.4 Water-reducing admixtures.....	29
3.5 Air-entraining admixtures.....	30
Chapter 4 - Fresh Concrete	33
4.1 Introduction.....	33
4.2 Definition of workability.....	33
4.3 Factors affective workability.....	34
4.3.1 Water content.....	34
4.3.2 Aggregate properties.....	35
4.3.3 Cement content.....	35
4.4 Measuring workability.....	35
4.4.1 The Slump test.....	36
4.4.2 Compacting factor test.....	38
4.4.3 "V-B" consistometer test.....	39
4.5 Segregation.....	39
4.6 Bleeding.....	40
4.7 Mixing of concrete.....	41
4.7.1 Hand mixing.....	41
4.7.2 Machine mixing.....	42
4.8 Vibration of concrete.....	42
4.9 Transport of concrete.....	43
4.10 Curing.....	43
Chapter 5 - Concrete	45
5.1 Strength of concrete.....	45
5.1.1 Introduction.....	45
5.1.2 Compressive strength.....	45
5.1.3 Effect of age on strength of concrete.....	46
5.1.4 Flexural and indirect tensile strength.....	47
5.1.5 Influence of temperature on strength of concrete.....	48
5.1.6 Durability.....	48
5.1.7 Permeability.....	49
5.1.8 Cold weather concreting.....	49
5.1.8.1 Freezing conditions occur before initial set.....	49
5.1.8.2 Freezing conditions occur after initial set.....	50
5.1.9 Resistance to fire.....	50
5.1.10 Deformation of hardened concrete.....	51

5.2 Variability of concrete strength.....	51
5.2.1 Factors influencing compressive strength.....	51
5.2.2 Factors contributing to the overall variation.....	52
5.2.3 Distribution of results.....	53
5.2.4 Characteristic strength.....	54
5.2.5 Margins required for mix design.....	54
5.3 Mix design.....	55
5.3.1 Introduction.....	55
5.3.2 Basic consideration.....	56
5.3.2.1 Cost.....	56
5.3.2.2 Specification.....	56
5.3.3 The process of mix design.....	58
5.3.4 Design of normal concrete mixes : method.....	58

Appendices

Comments

Recommendations

References