

## BORANG PENGESAHAN STATUS TESIS

JUDUL : THE EFFECT OF OVER DOSAGE OF CONCRETE RETARDER  
DARATARD 40 IN CONCRETE

Sesi Pengajian : 2005/2006

Saya JAYAKUMARAN A/L GOVINDASAMY

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah)\* ini disimpan di perpustakaan Universiti Teknologi Malaysia dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Teknologi Malaysia.
2. Perpustakaan Universiti Teknologi Malaysia dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. \*\* Sila tandakan (  )

SULIT ( Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD (Mengandugi maklumat TERHAD yang telah ditentukan oleh organisasi/badan si mana penyelidikan dijalankan)

TIDAK TERHAD

.....  
(TANDATANGAN PENULIS)

.....  
( TANDATANGAN PENYELIA)

Alamat tetap : A-13-25 Sri Penara Apartment  
No 6 Jalan Sri Permaisuri 1  
Bandar Sri Permaisuri Cheras  
56000 Kuala Lumpur

Dr. Mohammad Bin Ismail  
Nama Penyelia

Tarikh : 30hb November 2005

Tarikh : 30hb November 2005

Catatan

- \* Potong yang tidak berkaitan
- \*\* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai
- \* Tesis dimaksudkan sebagai tesis bagi Ijazah DoKtor Falsafah dan Sarjana secara Penyelidikan atau disertai bagi pengajian secara kerja kursus dan penyelidikan, atau LaporanProjek Sarjana Muda (PSM)

“I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Master of Engineering (Civil - Structure)”

Signature : .....

Name of Supervisor : Dr. Mohammad Bin Ismail

Date : 30<sup>th</sup> November 2005

THE EFFECT OF OVER DOSAGE OF CONCRETE RETARDER  
DARATARD 40 IN CONCRETE

JAYAKUMARAN A/L GOVINDASAMY

A project report submitted in partial fulfillment of the requirements for the award of the  
degree of Master of Engineering (Civil – Structure)

Faculty of Civil Engineering  
Universiti Teknologi Malaysia

NOVEMBER 2005

I declare that this thesis entitled "The Effect of Over Dosage of Concrete Retarder Daratard 40 in Concrete" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any degree.

Signature : .....

Name : Jayakumaran A/L Govindasamy

Date : 30<sup>th</sup> November 2005

Especially dedicated  
to my beloved family

## ACKNOWLEDGEMENT

In preparation of this thesis, I was in contact with many peoples in the local market who engaged in ready mixed concrete productions, building constructions, as well as academicians and practitioners. They have contributed towards my understanding and thought. I wish to express my sincere appreciation to my main thesis supervisor Dr. Mohammad Ismail for his guidance, encouragement and put me in right direction while I am writing this thesis and the lab test. I am also expressed my thanks to Dr. Abd. Aziz Saim, Dr. Abd. Rahman Md. Sam and Dr. Jamaluddin Mohd.Yatim for theirs comment and advice during the presentation of master pre project.

I wish to express my sincere appreciation to Mr. Sivabalan, QA/QC Manager of Strong Mixed Concrete Sdn Bhd for the concrete materials and allows to conduct the testing in they concrete laboratory. I would like to record very grateful thanks to Mr. Suen, C. M. of Fosroc (M) Sdn Bhd and Mr. Deva of Sika Kimia Sdn Bhd for their comment and suggestion of the usage of concrete retarder admixtures in the concrete field.

I would like to thank the Universiti Teknologi Malaysia especially the Faculty of Civil Engineering lecturers in providing the knowledge and make the programme into reality. Thanks to my colleagues at work and during my studies for all valuable ideas and helpful advice. Lastly I wish my deeply appreciation and gratitude to all my family members.

## **ABSTRACT**

More than 70 % of insitu concrete is produced now by the ready mixed concrete industry in Malaysia. With the increases in economic growth and demand for highrise buildings as well as infrastructures make the industry to determine its own standards of the production by trial mixed design. The issues involves in the properties of fresh concrete during the casting stage. A high degree of workability is planned to speed up the construction. The suitable concrete retarder is being used in the fresh concrete to avoid the formation of cold joint due to time needed to place a large volume of concrete in a continuous operation. The chances to over dosage the concrete with retarder become so great and critical at the construction site. Sometimes it takes 2 to 3 days for the concrete to set and harden. It creates many doubt and disputes to engineers in the industries about the strength and durability of the concrete in long run. The study of behavior of the concrete with different dosage of retarder Daratard 40 has been conducted in the lab test prior to practical concrete practice. The investigation may help the industry to achieve the optimum dosage of concrete retarder without compromising the concrete strength. The relationships between slump test and optimum dosage of the Daratard 40 concrete retarder has been established from the study. Slump test a cheap, suitable and more reliable testing method use to detect the cause of over dosage in fresh concrete consent on consistency before placing and compaction works at the site.

## ABSTRAK

Pada masa kini sebanyak 70 % konkrit tuang disitu menggunakan konkrit siap bancur (ready mixed concrete) dalam industri konkrit di Malaysia. Dengan perkembangan ekonomi yang pesat dan bertambahnya keperluan bangunan pencakar langit serta infrastruktur/kemudahan asas membolehkan industri pengeluar konkrit siap bancur menyediakan rekabentuk bancuhan konkrit mereka tersendiri secara cubaan (trial mix). Kesan dan masalah yang dihadapi oleh konkrit yang baru siap bancur (fresh concrete) dari segi sifat (properties) semasa konkrit dalam proses penuangan di tapak bina adalah perlu dikaji. Bagi mempercepatkan dan memudahkan sesuatu proses kerja pembinaan, konkrit pada tahap darjah kebolehankerjaan (slump) yang tinggi dan praktikal sangat diperlukan supaya kerja pembinaan itu senang di bina. Bahan kimia seperti bahan campur kelambatan (concrete retarder) digunakan dalam industri konkrit siap bancur bagi tujuan mengelakkan pembentukan sambungan sejuk (cold joint) semasa proses pemejalan konkrit dan penuangan konkrit dalam isipadu dan keluasan yang besar dengan cara operasi yang berterusan. Kebarangkalian bagi menambahkan dos bahan campur kelambatan yang berpatutan adalah amat tinggi dan kritikal semasa menerima konkrit di tapak bina. Ini adalah kerana kecuaiian operator yang tidak sengaja dilakukan semasa membancur konkrit siap bancur di tapak lokasi yang lain dan berjauhan dari tapak bina yang sediada. Kadangkala 2 hingga 3 hari konkrit yang tuang dalam papan acuan tidak akan keras dan menjadi pejal. Ini menjadikan banyak tanda tanya dan bahan perbincangan dikalangan jurutera dalam industri pembinaan mengenai tahap kekuatan dan ketahanan ataupun tempoh perkhidmatan disepanjang hayat struktur konkrit tersebut. Satu kajian mengenai sifat konkrit akibat dos yang berbeza terutamanya berlebihan dos kepada bahan tambah kelambatan dalam konkrit telah dijalankan dalam makmal, ianya mirip dengan keadaan sebenar



yang berlaku di tapak bina. Hasil kajian ini akan membantu industri konkrit untuk menetapkan nilai optimum dos bahan tambah konkrit Daratard 40 dengan kekuatan izin konkrit yang maksimum. Hubungan diantara keboleherjaan (slump) dan nilai optimum dos bahan tambah konkrit dapat dijadikan sebagai pedoman. Satu alat pemantau/pengukuran seperti keboleherjaan (slump test equipments) yang murah serta sesuai dengan keadaan tapak bina dapat membantu mengesan dos bahan tambah konkrit yang berlebihan dalam konkrit sebelum dituangkan kedalam papan acuan serta pemadatan konkrit.

## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	TITLE PAGE	i
	DECLARATION OF ORIGINALITY AND EXCLUSIVENESS	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	viii
	LIST OF TABLES	xiii
	LIST OF FIGURES	xv
	LIST OF SYMBOLS	xvi
	LIST OF APPENDIXES	xvii

<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	<b>1</b>
	1.1 Introduction	1
	1.2 Problem Statement	5
	1.3 Objectives of the Study	5
	1.4 Scope of the Study	6
<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>	<b>8</b>
	2.1 General	8
	2.2 Concrete Retarder	9
	2.3 Sugar	22
	2.4 Retarding water reducing admixture for concrete	22
	2.5 Durability of Concrete	25
	2.6 Common Defects and Repair to the Surface of Concrete	30
	2.6.1 Popouts	30
	2.6.2 Dusting	30
	2.6.3 Honey Combing	31
	2.6.4 Cavitation	32

2.6.5	Cold Joints	32
2.6.6	Efflorescence	33
2.6.7	Alkalis Silica Reaction	33
2.7	Deformation of Concrete	35
2.7.1	Early Shrinkage in Plastic Concrete	35
2.7.2	Drying Shrinkage	37
2.7.3	Creep	38
2.8	Cracking in Concrete	39
2.8.1	Structural Effects of Temperature	39
2.8.2	Heat Generation and Thermal Movement	40
2.8.3	Cracking	41
2.8.4	Cause of Cracking	46
<b>CHAPTER 3</b>	<b>METHODOLOGY/EXPERIMENTAL WORK</b>	<b>47</b>
3.1	Introduction	47
3.1.1	Ordinary Portland Cement	47
3.1.2	Retarder	48
3.1.2.1	Reaction of Retarder	49

3.1.3	Fine Aggregates	50
3.1.4	Coarse Aggregates	51
3.1.5	Water	51
3.2	Concrete Mix Design	52
3.3	Casting and Batching of the Specimens	55
3.4	Testing	57
3.4.1	Compressive Strength Test	57
3.4.2	Slump Test	58
3.4.3	Compaction Factor Test	64
3.4.4	Proctor Penetration Test	66
3.4.5	Water Penetration Test	68
3.4.6	Water Absorption Test	73
<b>CHAPTER 4</b>	<b>RESULTS</b>	<b>77</b>
4.1	Slump and Compaction Factor Test	77
4.2	Proctor Penetration Test	82
4.3	Compressive Strength Test	84
4.4	Water Penetration Test according to DIN 1048 Part 5	88
4.5	Water Absorption Test according to BS 1881: Part 122: 1983	90

<b>CHAPTER 5</b>	<b>DISCUSSIONS</b>	92
	5.1	Setting Time 92
	5.2	Loss of Workability/ Slump 93
	5.3	The Compaction Factor Ratio 93
	5.4	Compressive Strength 94
	5.5	Water Penetration 95
	5.6	Water Absorption 96
<b>CHAPTER 6</b>	<b>CONCLUSION AND RECOMMENDATION</b>	98
	6.1	Conclusion 98
	6.2	Recommendation 99
	<b>LIST OF REFERENCES</b>	101
	References	101 – 105

**APPENDIXES**

106

Appendixes

105 - 132

## LIST OF TABLES

TABLE NO.	TITLE	PAGE
Table 1.1	Sample of Specimens for Testing	7
Table 2.1	Addition Rate of Retarding Dispersing Components of Type A & D Admixtures	17
Table 2.2	Performance Requirements and Tests	20
Table 2.3	Typical Results of Compressive Strength For Dosage of Admixture	23
Table 2.4	Dosage of Admixture, Slump and Ambient Temperature	24
Table 2.5	Durability Requirements (BS 8110: Clause 3.3.3)	29
Table 3.1	Physical and Chemical Properties of OPC	48
Table 3.2	Properties of Retarder (Daratard 40)	49
Table 3.3	Detail of Mix Proportion of Daratard 40 (Concrete Retarder) to the Grade 30 Concrete	54



Table 3.4	Description of Workability and Magnitude of Slump	62
Table 3.5	Comparison of Workability Measurement	63
Table 4.1	Slump and Compaction Factor Test Results	78
Table 4.2	Setting Time of Concrete Results	82
Table 4.3	Compressive Strength Results	84
Table 4.4	Water Penetration Test Results	88
Table 4.5	Water Absorption Test Results	90

## LIST OF FIGURES

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
Figure 2.1	Effect of concentration of dispersant on The degree of cement particles surface coating	18
Figure 2.2	Permeability and Porosity	27
Figure 2.3	Present of water in capillary pores in concrete in equilibrium with a non saturated atmosphere	27
Figure 3.1	Concrete Cube Dimensions	56
Figure 3.2	Compressive strength testing machine	58
Figure 3.3	The slump test apparatus and type of downward movement of the fresh concrete	60
Figure 3.4	A true slump measurement	61
Figure 3.5	Comparison of slump, vebe and compaction factor test	64

Figure 3.6	The compacting factor test	66
Figure 3.7	Proctor penetration probe	67
Figure 3.8	Water penetration test apparatus in the laboratory	70
Figure 3.9	Indication of water penetration depth in Control Mix	71
Figure 3.10	Indication of water penetration depth in over dose with concrete retarder Daratard 40 (1000 ml and 1200 ml/ 100 kg of cement)	72
Figure 3.11	Specimen of water absorption test in the Control Mix and the recommended dosage 450 ml/ 100 kg of cement by manufacturers	75
Figure 3.12	Water absorption test in the over dose concrete retarder Daratard 40 1200 ml/ 100 kg of cement	76
Figure 4.1a	Slump loss behavior against time for the difference Dosage of concrete retarder Daratard 40	79
Figure 4.1b	Slump against difference dosage of concrete Retarder Daratard 40 in the fresh concrete	80
Figure 4.1c	Relationship between the results of slump and compaction factor test	81
Figure 4.2	Effect of concrete retarder Daratard 40 on setting time	83

Figure 4.3a	The compressive strength of concrete for the difference dosage of concrete retarder Daratard 40 against time (days)	86
Figure 4.3b	The early strength of concrete	86
Figure 4.3c	Compressive strength (N/mm <sup>2</sup> ) shown in bar chart	87
Figure 4.4a	Water penetration depth against difference dosage of concrete retarder Daratard 40	89
Figure 4.4b	Compressive strength at 28 days against water penetration in difference dosage of concrete retarder Daratard 40	89
Figure 4.5a	Water absorption (%) against difference dosage of concrete retarder Daratard 40	91
Figure 4.5b	Compressive strength at 28 days against water absorption (%)	91
Figure Appendix 2a	Simplified model of cement paste structure representing the gel particles and gel pores (c)	109
Figure Appendix 2b	Structure of hydrate silicas	110
Figure Appendix 2c	Types of water within calcium silicate hydrate (C-S-H)	116

## LIST OF SYMBOLS

<b>Ø</b>	=	Diameter of cylinder
<b>C</b>	=	Compressive strength
<b>P</b>	=	Applied load
<b>W</b>	=	Width of cube
<b>L</b>	=	Length of cube
<b>d</b>	=	Depth of penetration of water
<b>h</b>	=	Absorption of water
<b>M<sub>w</sub></b>	=	Mass increases in the specimen due to immersion of water
<b>M<sub>d</sub></b>	=	Mass of dry specimen

## LIST OF APPENDIXES

APPENDIXES	TITLE	PAGE
Appendix 1	Dosage Calculation for 1 m <sup>3</sup> of Concrete (340 kg of cement)	106
Appendix 2	Normal Concrete Mix	107
Appendix 3	Chemical Composition	119
Appendix 4	The four main compounds in Portland Cement	120
Appendix 5	Schematic Diagram of Formation and Hydration of Cement	121
Appendix 6	Hydration of Cements	122
Appendix 7	Classification of Admixtures in British and American Standards	123
Appendix 8	Recommended Slump for Various Type of Construction	124
Appendix 9a	Concrete Mix Design by Strong Mixed Concrete Sdn Bhd	125

Appendix 9b	Design of Normal Concrete Mixes	126
Appendix 10	Test Certificate of Ordinary Portland Cement	127
Appendix 11	W. R. Grace Manufactures Test Report on Concrete retarder Daratard 40	128
Appendix 12	Sieve Analysis Report for Mining Sand	129
Appendix 13	Sieve Analysis Report for 20 mm Granite Aggregates	130
Appendix 14	Water Test Report	131