COMPARISONS OF THE EFFECTS OF USED ENGINE OIL AND SUPERPLASTICIZER ON THE LOAD DEFLECTION BEAMS MADE OF SILICA FUME AND MIRHA CONCRETE SUBJECTED TO STATIC LOADING

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by

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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July 2009

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or person.

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(WAN MUHAMMAD AKIB BIN WAN ISHAK)

ABSTRACT

This report basically discusses the preliminary research done and basic understanding of the proposed topic, which is Comparison The Effects Of Used Engine Oil And Superplasticizer On The Load Deflection Behavior Beams Made Of Silica Fume And MIRHA Concrete Subjected To Static Loading. The objective of the project is to study and determine the performance and static behavior of used engine oil in high strength concrete base on the static loading test, and also to compare the performance of several design mixes under static load test. In this project, used engine oil is used as chemical admixture in concrete. Some wastes can be used as chemical admixtures and additives, which can alter and enhance selected properties of concrete. Therefore, this project will focus on the statically behavior of high strength concrete with addition of used engine oil as its admixture. Apart from that, the addition of used engine oil to the fresh concrete mix could be similar with adding a chemical admixture such as superplasticizer.

Keywords: **used engine oil beams, static behavior, static loading t est**

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The author would like to express his greatest gratitude to his project supervisor, Associate Professor Dr Nasir Shafiq for his guidance and supervision. The idea of using used engine oil in concrete subjected to static loading is indeed great and brilliant. Thank you for the time that you had spent to guide and supervise the author from the very beginning of the project until the end. Thousand of thanks to the other colleagues Mr Azizul Hawari and Mr Safwan and also Mr Johan and Mr Hafiz technicians from Civil Department who have given fullest support and help in finishing the project during experimental work.

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LIST OF ABBREVIATION

UEO – Superplaticizer
OPC – Ordinary Portland Cement
SP – Superplasticizer
LVDT – Linear Variable Displacement Tranducer

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND OF PROJECT

Wastes used in concrete

There is a current trend all over the world to investigate the utilization of processed and unprocessed industrial by-products and domestic wastes as raw materials in cement and concrete. This has a positive environmental impact due to the ever -increasing cost of waste disposal and stricter environmental regulations.

Based on the founded study and reference research about concrete technology and cement industry indicate that the concrete increasingly resist the freezing when there some leakage of oil into it. This effect is similar to adding an air -entraining chemical admixture to the concrete. Such information is not backed by any research study reported in the literature. From those situations, the objective of the research reported in this paper was to investigate the effects of used engine oil on properties of fresh and hardened concrete and also make comparisons between different admixtures and sand replacement material.

1.2 PROBLEM STATEMENT

Pollution is one of the global problems as the environmental disease arose in many countries. It is estimated that less than 45% of used engine oil is being collected worldwide while the remaining 55% is thrown by the end user in the environment. Human and marine life would risk their entire generations due to wasted oil effects. Absorbed oil in bodies of water rises thus stopped the photosynthesis and leads to the death of the underwater life. Besides, used oil contains some toxic materials that can reach humans through the food chain. From letting go the health hazards range from mild symptoms to death, the environmental impacts should be managed in a proper way according to minimize it.

Accordingly, adding used engine oil to the fresh concrete mix could be similar to adding an air-entraining chemical admixture, thus enhancing some strength and durability properties of concrete while serving as a technique of disposing the oil waste [Bilal S. Hamad, 2003]. Therefore, this project will focus on the static behavior of high strength concrete with addition of used engine oil as its admixture.

1.3 OBJECTIVE

The objectives of project are:

- To determine the performance and static behavior of used engine oil in high strength concrete base on the static loading test.
- To compare the performance of several design mixes under static load test.

1.4 SCOPE OF STUDY

The scope of study for this project would be on the performance of the hi gh strength concrete containing used engine oil as an additive subjected to the static loading test. Nine reinforced concrete beam specimens had been prepared. The nine beams have different type of mix, which means the proportions are different . The beams will be tested statically. The main variables included type of chemical admixtures such as used engine oil and super plasticizer. The effect of the used engine oil on the concrete will be studied and be investigated. The static loading test will be carried out after 28 day of sampl e age and all the results will be collected and the recorded.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Literature review of this project as purposed to review the critical points of current issues in high strength concrete (HPC). Its ultimate goal is to bring the author up to date with current literature on a topic and forms the basis for another goal, such as future research that needed in this study. From the literature review the author will acknowledge with the rel evant ideas with in pursuing the objective which is to identify and compare the different results. Information from reference will support and give effective reasons on continuing the thesis progress.

2.2 DEVELOPMENT OF CONCRETE TECHNOLOGY

In less than one century, concrete has become the most widely used construction material in the world. Cement is still an essential material in making concrete, but, in some modern concretes it is no longer the most important material because these concretes are com posite materials. In a composite material, it is impossible to decide which is the most important material because, by its nature, a composite material has properties that are always much better than the simple arithmetical addition of the individual prope rties of each component.

The development of cement industry contributed in many years and has achieved significant progress, specifically in the field of processes and energy savings. However, here, too, the last word has not been said in spite of the fa ct that, from a thermodynamic point of view, the CaO±SiO2±Al2O3±Fe2O3 phase diagram is still governing Portland cement manufacture. ***Mehta PK*** mentioned that it is already possible to decrease significantly the temperature in cement kilns by having a better control of the use of some so-called mineralizers [Mehta PK, 1993].

The idea of adding admixtures to concrete is not new. Roman statements informed that their masons used to add egg whit es or blood to their concrete [Hammer TA, 1990], and now we can explain why hemoglobin is also an excellent dispersant of Portland cement particles. The recent discovery of the beneficial effects of some organic molecules on very specific properties of concrete has been often quite fortuitous, but it can now be explained s cientifically. For a long time, the technology of chemical admixtures has been a reserved field for a few companies . It must also be recognized that admixture companies have always been, and are still today, very clever at presenting themselves as a comple mentary industry to the cement industry, an industry essentially linked to the world of concrete and not to the world of cement.

P.C. AЄıtcin defined durability problems of ordinary concrete can be associated with the severity of the environment and the use of inappropriate high water/binder ratios. High-performance concrete that have a water/binder ratio between 0.30 and 0.40 are u sually more durable than ordinary concrete not only because they are less porous, but also because their capillary and pore networks are somewhat disconnected due to the development of self-desiccation. In high-performance concrete (HPC), the penetration o f aggressive agents is quite difficult and only superficial. However, self-desiccation can be very harmful if it is not controlled during the early phase of the development of hydration reaction, therefore, HPC must be cured quite differently from ordinary concrete. Field experience in the North Sea and in Canada has shown that HPCs, when they are properly designed and cured, perform satisfactorily in very harsh environments [P.C. AЄıtcin, 2003].

2.3 CONCRETE INGREDIENTS

2.3.1 Aggregates: Coarse and Fine

The material combined with cement and water to make concrete is called aggregate. Aggregate makes up 60 to 80 percent of concrete volume. It increases the strength of concrete, reduces the shrinking tendencies of the cement, and is used as economical filler. Aggregates are divided into fine (usually consisting of sand) and coarse categories. For most building concrete, the coarse aggregate consists of gravel or crushed stone up to 1 1/2 inches in size. However, in massive structures, such as dams, the coarse aggregate may include natural stones or rocks ranging up to 6 inches or more in size. The large, solid coarse aggregate particles form the basic structural members of the concrete. The voids between the larger coarse aggregate particles are filled by smaller particles. The voids between the smaller particles are filled by still smaller particles. Finally, the voids between the smallest coarse aggregate particles are filled by the largest fine aggregate particles. In turn, the voids between the largest fine aggregate particles are filled by smaller fine aggregate particles, the voids between the smaller fine aggregate particles by still smaller particles, and soon. Finally, the voids between the finest grains are filled with cement. You can see from this that the better the aggregate is graded (that is, the better the distribution of particles sizes), the more solidly all voids will be filled, and the denser and stronger will be the concrete.

2.3.2 Water and Cement

The water-cement ratio is the weight of the mixing water divided by the weight of the cement. High-quality concrete is produced by lowering the water-cement ratio as much as possible without sacrificing the work ability of fresh concrete. Through a chemical reaction called hydration, the cement paste hardens and gains strength. The character of the concrete is determined by quality of the paste. The strengt h of the paste depends on the ratio of water to cement. [M.L. Gambhir, 2004].

Curing process in concrete in influenced by water. This process begins after the exposed surfaces of the concrete have hardened sufficiently. The hydration value of the cement and the concrete strength is determined by water. The longer the concrete kept moist, the stronger and more durable it will become. Most of the hydration and strength gain take place within the first month of concrete's life cycle. Hydration is still continues at a slower rate for many years. This shows that concrete continues to get stronger as it gets older [John Newman, 2003].

Cement is one of the main compositions derived from the concrete. Cement is used to bond the aggregates together with the concrete. It has the adhesive and cohesive properties. The common cement used is the Ordinary Portland Cement (OPC). The main compositions of the cement are mortars and plasters. A mixture of finely divided clay and hard limestone are heated until CO_2 is to get rid off in furnace. All Portland cements are hydraulic cements that set and harden through a chemical reaction with water. During hydration, a node forms on the surface of each cement particle. The node grows and expands until it links up with nodes from other cement particles or adheres to the nearby aggregates. The building up process results in progressive stiffening, hardening, and strength development. The right portion of cement must be applied in order to get strong concrete. Some types of OPC can be chosen because the observation on concrete properties can be done in normal hydration process hence the advantages of MIRHA usage in concrete can be optimized [S. Beddu, 2008].

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2.4 CHEMICAL ADMIXTURE

2.4.1 Super-plasticizer

Admixtures are sometimes used in concrete mixtures to improve certain qualities, such as workability, strength, durability, water tightness, and wear resistance. They may also be added to reduce segregation, reduce the heat of hydration, entrain air, and accelerate or retard setting and hardening. Super-plasticizers are additives that increase the plasticity or fluidity of the material to which they are added including plastics, cement, concrete, wallboard and clay bodies (A.M.Neville, 2002). It consists of a composition of sodium salt due to high molecular weight sulphonic polymer, which is the main component is sulfur. The usage of superplasticizer is a found that its specialty formulated for production of high quality, high early and ultimate strength water-tight concrete that possesses excellent workability retention. The longer time for concrete to harden, the sufficient concrete strength get as its function is to delay the time for the mix to change from the plastic to the hardened state by the range of 90 minutes to 360 minutes. Durability increases as the concrete workability at given water -cements ratio. The aggregates, cement and water are strongly bonded as the superplasticizer affects the production of self-compacting concrete. This is reducing the shrinkage and cracks in concrete. When it is hardened, the addition of superplasticizer does not affect the properties of the final product. The quality of workability improves as superplasticizer affects the water required within 15 – 20%. It takes time shorter to get up early strength development and improves the ultimate strength of the concrete [M.L Gambhir, 2004].

2.4.2 Used Engine Oil as Concrete Admixture

To enhance the HSC, Used engine oil is suggested to be added in the concrete mixing. In this study case, it is added together with RHA during mixi ng. Used oil includes crankcase oil, compressor oil, cutting oils, synthetic oils, etc [Bilal S Hamad, 2002].

Used engine oil improves the workability and slump of the concrete mix and air content of the fresh concrete. So it could be used in concrete to improve fluidity and air content without adversely affecting strength properties and struct ural behavior. It acts as air entraining agent replacing the normal admixtures. The advantages of adding air-entraining agents or admixtures to the con crete mixture also improve the durability, chemical resistance and appropriate the water/cement ratios us es.

Entrained air improves the workability of concrete, reduces segregation and bleeding in freshly mixed and placed concrete, and increases pump -ability of fresh concrete if introduced in low percentages up to 6%. Air entrainment also reduces the flexural strength, the splitting tensile strength, and the modulus of elasticity of hardened concrete. The recommended amount of air to be used in air -entrained concrete depends on many factors such as type of structure, climatic conditions, and number of freeze – thaw cycles, extent of exposures to deicers, and extent of exposure to sulfates or other aggressive chemicals in soil or waters. At constant water cement ratios, increases in air will proportionally reduce strength. For moderate -strength concrete, each per centile of entrained air reduces the compres sive strength approximately 2–6%(Bilal S Hamad and Ahmad A Rteil, 2002).

2.5 CEMENT REPLACEMENT MATERIAL

2.5.1 Silica Fume

The usage of silica fume benefits in reducing water cement ratio and produce high strength concrete, (A.M.Neville, 2002). Silica fume is a relatively new pozzolonic material. It is a substance that is produced by reduction of high -purity quartz with coal in electric furnaces in the production of silicon and ferrosilicon alloys. It contains primarily of amorphous (non crystalline) silicon dioxide, very fine particles where its properties are hard, shiny and transparent like glass. Silica fume is also known as micro silica. It is a highly effective pozzolanic material due to its ex treme fineness and high silica content [David Whiting, 1999].

Silica fume is too fine, it reacts with aggregates and cements fully complete the pores in aggregates during the mixing. The chemical bonding within the particular increase leads the concrete to harden. In addition, silica fume as a sand replacement material will increase the concrete strength, according to the concrete designs. The range of the strength increases from 30 percent to 100 percent.

Figure 2.1: Various types of silica fume

Silica fume used in concrete is available in wet or dry forms. It is normally added during concrete production at a concrete plant. Silica fume has been used as an addition to concrete up to 15 percents by weight of the cement in the concrete. With an ad dition of 15 percents silica fume, a very strong and brittle concrete could be well produced. Silica Fume is used in concrete to improve its properties. It has been found that Silica Fume improves compressive strength, bond strength, and abrasion resistance; reduces permeability; and therefore helps in protecting reinforcing steel from corrosion. [John Newman, 2003].

2.5.2 Rice Husk Ash (RHA)

Rice husk ash (RHA) has been used as a highly reactive pozzolanic material to improve the microstructure of the interfacial transition zone (ITZ) between the cement paste and the aggregate in high-performance concrete. Mechanical experiments of RHA blended Portland cement concretes revealed that in addition to the pozzolanic reactivity of RHA (chemical aspect), the particle grading (physical aspect) of cement and RHA mixtures also exerted significant influences on the blending efficiency. The relative strength increase is higher for coarser cement.

Rice husk ash is a highly reactive pozzolanic material produced by controlled burning of rice husk. The existence of RHA in concrete provides several advantages, such as improved strength and durability properties, reduced materials costs due to cement savings, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions. The existence of fly ash and slag in concrete may affects the fracture energy of the concrete.[Bharatkumar, 2005].

Based on the study from Mehta (1992) and Aminul (1997), substitution of 10% of RHA with Portland cements indicate that excellent performance when compared to control concretes. So that means there is a lot of researcher working on it as Mehta in 1992 studied on supplementary cementing material. 5 years later in 1997, Aminul reported on concrete behavior with addition of mineral admixture and RHA. He found that high strength concrete could be produced by adding RHA into the normal strength concrete (NSC). Rice-husk ash is recognized as a mineral admixture for concrete, and much data has been published concerning its influence on the behavior of concrete.

The addition of RHA to cement has been found to enhance cement properties:

- The addition of RHA speeds up setting time, although t he water requirement is greater than for OPC.
- At 35% replacement, RHA cement has improved compressive strength due to its higher percentage of silica.
- RHA cement has improved resistance to acid attack compared to OPC, thought to be due to the silica present in the RHA which combines with the calcium hydroxide and red uces the amount susceptible to acid attack.
- More recent studies have shown RHA has uses in the manufacture of concrete for the marine environment. Replacing 10% Portland cement with RHA can improve resistance to chloride penetration.
- Several studies have combined fly ash and RHA in various proportions. In general, concrete made with Portland cement containing both RHA and fly ash has a higher compressive strength than concrete made with Portland cement containing either RHA or fly ash on their own.

Rice husk ash (RHA) was obtained by burning RH in a furnace with a controlled temperature in order to establish the optimum burning temperature and burning time. Grinding of RHA aims to achieve the best specific surface area. It was found that the most convenient and economical temperature required for conversion of the RH into ash was 600°C for 3 h (El-Karmouty 2000). The RHA that was used had a specific surface area of 5.6×10^6 mm^2/g, and the unit weight was 2.06×10^3 kg/m^3.

The chemical composition of the RHA was 87.0% SiO^2, 1.75% Al^2O^3, 2.5% Fe^2O^3, 2.5% CaO, 2.3% MgO, and 2.5% K^2O. The silica content of the ash was derived from the amorphous silica present in the cellular structure of the husks. X -ray diffraction of the RHA showed that the RHA contained mai nly amorphous materials with a very small amount of crystallized quartz . (El-Karmouty 2000).

Classification of Rice Husk Ash

The chemical composition of rice husk is similar to that of many common organic fibers and contains:

- cellulose ($C_5H_{10}O_5$), a polymer of glucose, bonded with B-1.4.
- lignin ($C_7H_{10}O_3$), a polymer of phenol.
- hemicellulose, a polymer of xylose bonded with B-1.4 whose composition is like xylem ($C_5H_8O_4$), and d) SiO_2 the primary component of ash.

The holocellulose (cellulose combined with hemicellulose) content in rice husk is about 54%, but the composition of ash and lignin differ slightly depending on the species, as shown in Table 2. The critical composition of rice husks from different species also varies slightly (Table 3). After burning, most evaporable components are slowly lost and the silicates are left. The characteristics of the ash are dependent on the components, temperature and time of burning. In order to obtain an ash with high pozzolanic activity, the silica should be held in a non-crystalline state and in a highly microporous structure. Hence, the burning process should be controlled to remove the cellulose and lignin portion while preserving the original cellular structure of rice husk. Traditional open -field burning can create air pollution that is suspected to cause lung and eye diseases within the human population, as well as damage to plant life.

Table 2. Chemical Composition of Rice Husks.

Rice Husk	Extractives			Chemical Composition(%)			ref.
	Alcohol-benzene	1% NaOH	Hot Water	Holo-cellulose	Ash	Lignin	
Japonica	1.8	32.3	5.4	53.9	13.6	24.8	[3]
Indica	2.1	30.6	5.1	54.3	11.7	25.8	[3]
Anhydrous Rice Husk	-	-	8~15	40~50	15~20	25~30	[1]

Table 3. Ultimate Analysis of Rice Husk, Hwang and Wu [3].

Chemical Composition (Wt%)							
C	H	O	N	S	Cl	Ash	Ref.
38.3	5.7	39.8	0.5	0.0	0.0	15.5	[5]
39.4	5.5	36.1	0.5	0.2	0.2	18.2	[6]
39.5	5.5	37.7	0.8	0.0	0.0	16.5	[7]

CHAPTER 3
METHODOLOGY

3.1 INTRODUCTION

There are some procedures are develop in order to carry out this project. This is to ensure the project flow is smooth and accomplish in the given period. Below here is the flow chart activities for this project (see Figure 3.1).

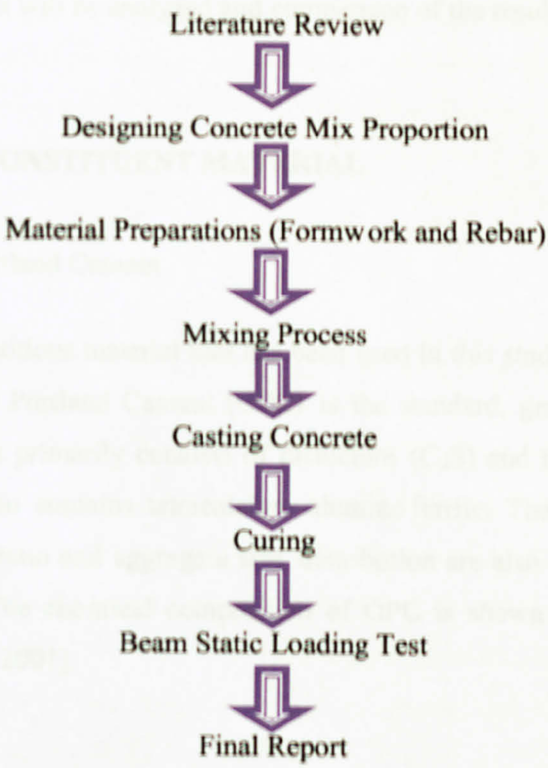

Figure 3.1: Flow Chart activities

3.2 EXPERIMENTAL PROGRAM

To have an understanding of this project, the research has been done by referring the journals, reference books and websites. Nine samples beams are being constructed due to its proportion each. The concrete that been used to cast a beam was also cast into 3 mixes of cube. The research also has been carried out by getting details explanation from supervisor and post graduate's student that has been experienced on related topic of this project. From the previous research, the optimum compressive strength for concrete which consist of Used Engine Oil is 0.5%. So this project is applying that implication on beams to study the static behavior with several proportions. Universal Testing Machine is used to apply the static loading test on beams. Then the static loading test will be analyzed and comparison of the results will be discovered.

3.3 PROPERTIES CONSTITUENT MATERIAL

3.3.1 Ordinary Portland Cement

The cementitious material that has been used in this study was Ordinary Portland Cement. Ordinary Portland Cement (OPC) is the standard, grey cement used for most purposes. OPC is primarily consists of dicalcium (C_2S) and tricalcium silicates (C_3S). Besides that it also contains tetracalcium alumino ferrite. The water/cement ratio, the cement/aggregate ratio and aggregate size distribution are also important to the strength of the concrete. The chemical composition of OPC is shown in the Table 3-3 below [Edward G.Nawy, 2001]

Table 3.3.1: Chemical compositions of OPC, silica fume and used engine oil

Chemical Composition	Ordinary Portland Cement (%)	Silica Fume (%)	Used Engine Oil (%)
SiO_2	21.98	91.7	-
Al_2O_3	4.65	1	-
Fe_2O_3	2.27	0.9	0.43
CaO	61.55	1.68	15.9
MgO	4.27	1.8	-
SO_3	2.19	0.87	37.0
K_2O	1.04	-	-
Na_2O	0.11	0.1	-
CaO	-	-	15.9
P2O5	-	-	8.95
ZnO	-	-	17.7
Cl-	-	-	15.9

3.3.2 Preparation of Microwave Incinerator Rice Husk Ash (MIRHA)

Rice husks used in this research were taken from rice milling plant Bernas, Malaysia. Rice husks were dried under direct sunlight to reduce their moisture content so when they were burnt would not produce large amount of smoke. Dried rice husks were then burnt in automatic microwave incinerator as shown in Figure 3.2 to produce amorphous Microwave Incinerated Rice Husk Ash (MIRHA). The controlled combustion of MIRHA was done in two stages since the composition of silica content is very high [S.Beddu, M.F. Nuruddin, N.Shafiq, 2007].

Table 3.3.2: Burning Procedure for Microwave Incinerator [S.Beddu, M.F. Nuruddin, N.Shafiq, 2008]

Phase	Temperature	Duration	Remarks
Phase I	25° C - 150° C	1.5 hours	To remove the carbon and other volatile materials
Cooling	25° C	-	To ensure excess heat is not generated that can cause crystalline MIRHA for the next burning stage
Phase II	25° C - 550° C	2.5 hours	To achieve amorphous silica content of MIRHA.

At the first stage, rice husk was burnt in microwave inciner ator with temperature was set to a maximum of 150° C. This process objective is to remove the volatile materials from rice husk. The rice husk ash was then cooled until reached ambient temperature. After that it is burned again in the second stage. At this stage, the microwave incinerator temperature was set to a maximum of 550° C. This stage is to achieve MIRHA with quality pozzolanic reactivity [S.Beddu, M.F. Nuruddin, N.Shafiq, 2008].

Figure 3.2: Microwave Incinerator

3.3.4 Aggregate preparation

Soaking the aggregate in the water is to remove the aggregates surface from dirt. If not, the dirt chemically will react within the cements and affects the strength or proportion of the concrete. This is also to ensure the aggregates to be in saturated surface dried (SSD) condition at the room temperature.

3.3.5 Water

Water used in mixing concrete must be clean and free from acids, alkalis, oils, and organic materials. Most specifications recommend that the water used in mixing concrete be suitable for drinking, should such water be available.

3.4 MIX PROPORTION

By considering other admixtures, several mix proportion have been proposed and tested throughout compressive strength test at 28 days. The admixtures that have been used in the design were Rice Husk Ash, Silica Fume, Super Plasticizer and Used Engine Oil. Each mix was designed to be consisted of two different types of admixtures in order to achieve the optimum compressive strength. The table below is the mix proportion table of concrete cube that is being experiment by the other students to find the exact proportion. The finding is 0.5% of used engine oil is the optimum compressive strength for high strength concrete. Consequently, the value of those results is used by author to apply th e proportion on beams. The table below shows the mix proportion for the nine beams.

Table 3.4.1: Mix proportion for 1 kg/m^3 beam

Mix	Name	OPC	SF	MIRHA	CA	FA	w/c	UEO	SP
		(kg/m^3)						(%)	(%)
1	OPC	325	-	-	1137.5	757.3	0.55	-	-
2	OPC-UEO	325	-	-	1137.5	757.3	0.55	0.5	-
3	OPC-SP	325	-	-	1137.5	757.3	0.55	-	0.5
4	MIRHA	260	-	65	1137.5	757.3	0.55	-	-
5	MIRHA-UEO	260	-	65	1137.5	757.3	0.55	0.5	-
6	MIRHA-SP	260	-	65	1137.5	757.3	0.55	-	0.5
7	SF	260	65	-	1137.5	757.3	0.55	-	-
8	SF-UEO	260	65	-	1137.5	757.3	0.55	0.5	-
9	SF-SP	260	65	-	1137.5	757.3	0.55	-	0.5

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2	OPC-UEO	325	-	-	1137.5	757.3	0.55	0.5	-
3	OPC-SP	325	-	-	1137.5	757.3	0.55	-	0.5
4	MIRHA	260	-	65	1137.5	757.3	0.55	-	-
5	MIRHA-UEO	260	-	65	1137.5	757.3	0.55	0.5	-
6	MIRHA-SP	260	-	65	1137.5	757.3	0.55	-	0.5
7	SF	260	65	-	1137.5	757.3	0.55	-	-
8	SF-UEO	260	65	-	1137.5	757.3	0.55	0.5	-
9	SF-SP	260	65	-	1137.5	757.3	0.55	-	0.5

3.5 SAMPLE PREPARATION

Before proceeds to the mixing process, all materials should be prepared according to the proper procedure. It is to make sure that the raw materials are ready and the most important thing it must be done days before the mix to avoid error during the mixing.

3.5.1 Formwork

Firstly, the formwork need to be fabricated at laboratory and should been casted with the dimension of 140mm x 260mm x 1710mm. The formwork is made from the plywood (see Figure 3.3).

Figure 3.3: Formwork

3.5.2 Rebar

The rebar is designated to act as a frame to the beam. The purpose is to give the support to the beams from any load that imply on the beams (see Figure 3.4).

Figure 3.4: Reinforced Bar

3.5.3 Mixing Process

The sequence of concrete mix is very important to make sure the mix uniform. The procedures must be as per BS 1881 (Part 125:1986) . (See Figure 3.5)

1. Wetted the mixer with water
2. Pour all coarse and fine aggregates into the mixer and mix for 25 seconds to ensure uniform distribution between both materials.
3. Pour half of the water and mix for 1 minute.
4. Leave the mixes for 8minutes to let the both coarse and fine aggregates to abs orb water.
5. Pour all Portland cement into the mixer and mix for 1 minute.
6. Pour another half of the water and mix for 1 minute.
7. Lastly perform hand mixing until the mix in uniform stage.

Figure 3.5: Mixing process

3.5.4 Casting Concrete Process

Three formworks made of wood mould for casting the beam. Procedures for concrete casting are:

1. Grease is used to prevent the concrete mix from stick to the formwork by brush the grease to the formwork surface.
2. The formwork size is 140mm x 260mm x 1710mm.
3. Instead of using spacer, the steel wire is used to locate the reinforcement bar in the formwork as per requirement.
4. The concrete mixing are pouring into the formwork by three layers. Vibrator was used to take out the air trapped in the concrete mix for every lay er (see Figure 3.6).
5. After a day of casting, the beam was ready for curing process.

Figure 3.6: Concrete casting

3.5.5 Curing process

Curing is very important to ensure the concrete is fully hydrated before it acquires strength and hardness. Curing is the process of keeping concrete under specific environmental condition until is relatively complete.

3.6 TESTING PROCEDURE

The static load test will be carried out 28 days after casting on the nine beams. All the nine beams were testing by using the Universal Testing machine. All samples of beam are set up as simply supported beam with a span length of 1.71m. As the beam length is 1.71m, at the middle of beam is loaded in one point and the moment region of 600mm. The beams sustain the load applied until it fails under fatigue failure. During testing, the midspan deflection is measured and the maximum load of the beams will be recorded in the computer. All the results and point need to be analyzed and discussed. All beams were tested up to failur e under four-point bending.

3.7 HAZARD ANALYSIS

Table 3.7.1: Potential hazards and recommended controls

POTENTIAL HAZARDS	RECOMMENDED CONTROLS
Improper protection	Personal protective devices shall be used as required.
Exposure to harmful substances	All dusts, mists, fumes, gases, or other atmospheric contaminants in areas where persons are employed shall first be brought within acceptable limits by engineering controls such as ventilation, enclosure, or filtration. If this is not feasible, then administrative controls such as duration of exposure shall be used. When this method is not feasible, protective equipment shall be provided.
Unsafe material handling, storage, and disposal	1. Material in bags, containers, bundles, p allets, or stored in tiers shall be stacked, blocked, interlocked, and limited in height so that it is stable and secured against sliding or collapse. 2. Accessways shall be kept clear. 3. Flammable liquids in a storage building should be in a "No Smoking" area. 4. Handling of materials should be in accordance with safety recommendations for that particular material.
Improper and unsafe use of machinery and mechanized equipment	1. Before any machinery or mechanized equipment is placed in use, it shall be inspected and tested by a competent mechanic and certified to be in safe operating condition. 2. Qualified persons shall maintain and operate equipment in a safe manner that is consistent with the manufacturer's recommendations.
Inadequate or unsafe clothing	Employees shall wear clothing suitable for the weather and work conditions. The minimum shall be short sleeve shirt, long trousers, and leather or other protective work shoes or boots. Canvas, tennis, or deck shoes are not acceptable.
Unsafe operation of machinery or equipment	Machinery or equipment shall not be operated in a manner that will endanger persons or property nor shall the safe operating speeds or loads be exceeded.
Defective tools	Tools having defects that will impair their strengt h or render them unsafe shall be removed from service.
Unsafe machinery or equipment	Before any machinery or mechanized equipment is placed in use, it shall be inspected and tested by a competent mechanic and certified to be in safe operating condition.

CHAPTER 4
RESULTS AND DISCUSSION

4.0 INTRODUCTION

This chapter explained few properties of concrete which is Slump Test, Cube Test, Beam Maximum Load Test and Beam Deflections. The discussions are comparing the concrete type that is OPC Concrete, MIRHA Concrete and Silica Fume Concrete with incorporation of superplasticizer and used engine oil.

4.1 CONCRETE WORKABILITY

Workability of concrete is the ease of concrete to be handled. In this project, workability of concrete is identified by doing the Slump Test. The acceptable slump that shows the concrete is workable is between 50 – 90 mm. The results of workability test are shown in Table 4 -1 below.

Table 4-1: Results for the properties of the concrete

Mix		Slump(mm)	Compressive Strength (MPa)
1.	OPC	18	53.48
2.	OPC-UEO	70	43.48
3.	OPC-SP	80	51.38
4.	MIRHA	6	32.00
5.	MIRHA-UEO	60	40.04
6.	MIRHA-SP	50	38.50
7.	SF	8	52.15
8.	SF-UEO	60	50.22
9.	SF-SP	70	40.67

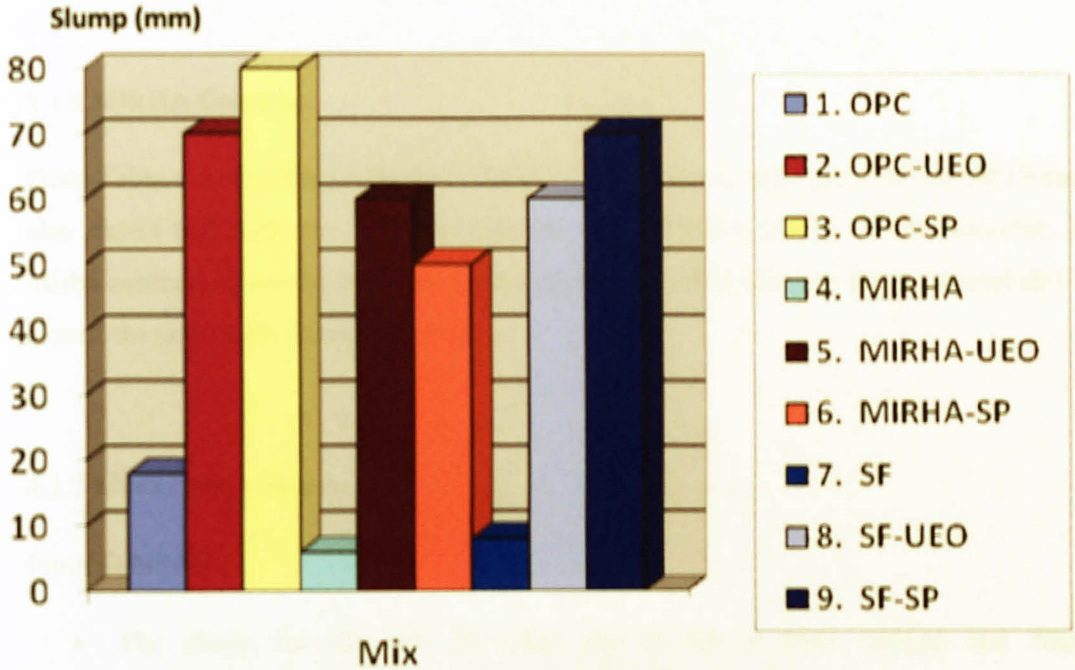

Figure 4.1: Measurement of slumps for each beam.

4.1.1 OPC Concrete

From Table 4-1:

- The slump of mix OPC, OPC-UEO and OPC-SP are 18mm, 70mm and 80mm respectively.
- The percentage increment for mix OPC-UEO from the control mix (OPC) is 288% and mix OPC-SP is 344% from the control mix.
- From the result obtained, the slump value of mixes containing superplasticizer and used engine oil show higher slump compare to the control mix. Mix OPC-SP that containing superplasticizer shows highest slump value which is provided greater workability compares to the other mixes. The result shows that Used Engine Oil (UEO) can work almost the same with Superplasticizer to improve workability in concrete as its slump is almost value as superplasticizer. The comparable result shown clearly at Figure 4.1.

4.1.2 MIRHA Concrete

From Table 4-1, the slumps for mix MIRHA-UEO (60mm) and mix MIRHA-SP (50mm) also shows that both are workable. Despite, mix MIRHA (6mm) is not workable. In Mirha concrete, it can be identified that existence of UEO also can improve workabil ity almost the same with Superplasticizer.

4.1.3 Silica Fume Concrete

From Table 4-1:

- The slump for mix SF, SF-UEO and SF-SP is 8mm, 60mm and 70mm respectively. The slump of mix SF-UEO and SF-SP indicates that their slumps also are acceptable as in range between 50mm – 90mm.
- The Used Engine Oil also works the same as Superplasticizer which is to improve the concrete workability and as the water reducer silica fume concrete.

4.2 COMPRESSIVE STRENGTH

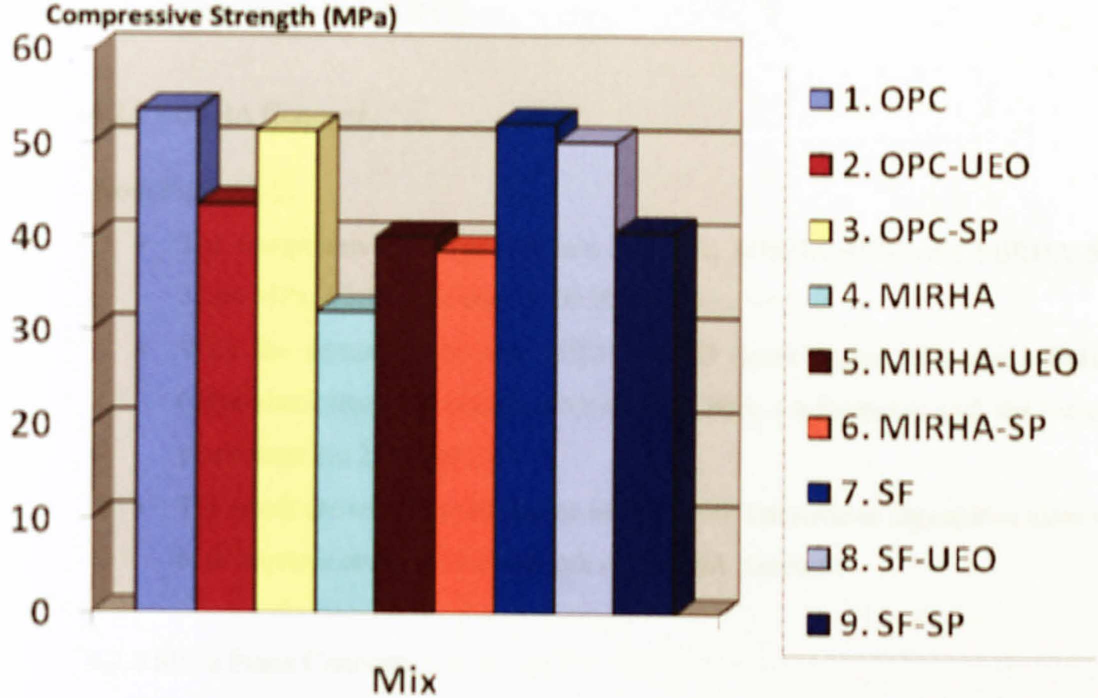

Figure 4.2: Comparison of Compressive Strength of Concrete in 28 days

Each cube from every mix was tested with the co mpressive machine to get its maximum load and compressive strength. This test had been done after 28 days age of concrete.

4.2.1 OPC Concrete

From Figure 4-2:

- The mix OPC shows the greatest compressive strength with value of 53.48 Mpa. The compressive strength for mix OPC-UEO and OPC-SP are 43.48 MPa and 51.38 MPa.
- The percentage decrement of compressive strength for mix OPC -UEO and OPC-SP are 18 % and 4% from control mix (OPC).

- The results shows that the compressive strength for mix OPC -UEO and OPC-SP that contain superplasticizer and used engine oil not less than 20 % performance from control mix(OPC).

4.2.2 MIRHA Concrete

From Figure 4-2:

- The compressive strength for mix MIRHA, MIRHA -UEO and MIRHA-SP are 32.00 MPa, 40.04 MPa and 38.50 MPa respecti vely.
- With the admixture in mix MIRHA-UEO (used engine oil) and MIRHA-SP (superplasticizer), the compressive strength both are increases with the increment percentage are 25% and 21%.
- The result shows that used engine oil can work the same as superplasti cizer which is to improve compressive strength in MIRHA concrete.

4.2.3 Silica Fume Concrete

From Figure 4-2:

- The compressive strength for mix SF, SF-UEO and SF-SP are 52.14 MPa, 50.22 MPa and 40.67 MPa respectively. Refer to the values, the finding is co mpressive strength of SF-UEO and SF-SP is decreased by 4% and 22%.
- Even though both compressive strength of SF-UEO and SF-SP are lower than mix SF (control mix), the value is still over the target compressive strength for this project which is 30 MPa.
- In addition, without the addition of the super plasticizer and used engine oil but it is just silica fume, the strength of the concrete can be increased in Mix 7 which is mix SF. Silica fume (mix SF) which is the cement replacement material produces the higher compressive strength concrete which is 52.15 MPa as it will act as filler and cover all the voids in the concrete.

4.3 MAXIMUM LOAD CAPACITY AND DEFLECTION AT FAILURE

Mix (Beam)	Maximum Load (kN)	Deflection at Failure (mm)
1. OPC	129.67	19.63
2. OPC-UEO	115.20	20.12
3. OPC-SP	124.79	23.46
4. MIRHA	72.10	14.20
5. MIRHA-UEO	111.82	12.97
6. MIRHA-SP	99.13	10.64
7. SF	128.78	22.99
8. SF-UEO	106.65	25.00
9. SF-SP	100.89	45.60

Table 4.3: Maximum load of beams and deflection at failure on the s tatic load test.

Each beam was tested by using Universal Testing Machine to measure the maximum load capacity and its deflection at failure under static load test. Table 4 -3 above shows the data collected from the test. The data in the table was tabula ted as maximum load versus deflection at failure, see Figure 4-3. The comparable chart of maximum load and deflection at failure are attached in Appendix 1 and 2.

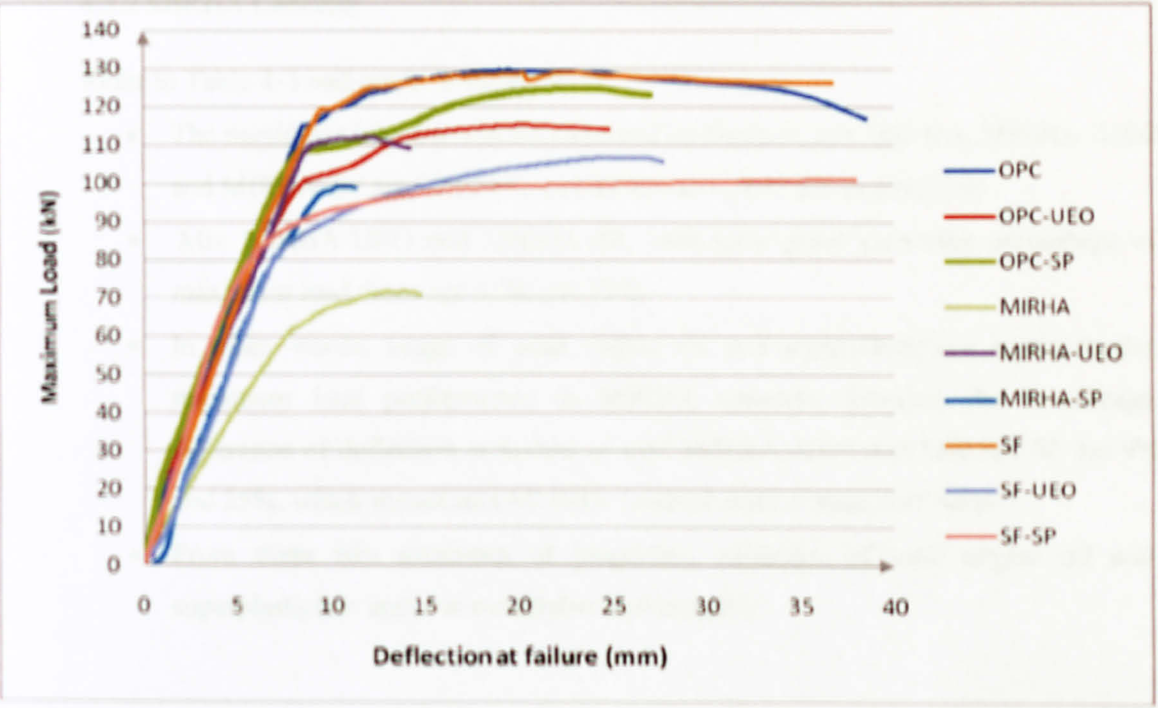

Figure 4-3: Maximum Load (kN) versus Deflection at Failure (mm) for each beam.

4.3.1 OPC Concrete

From the Table 4-3 and graph Figure 4-3:

- The maximum load that can be sustained by beam of mix OPC, OPC-UEO and OPC-SP are 129.67 kN, 115.20 kN and 124.79 kN respectively.
- These can be analyzed that mix OPC-UEO and OPC-SP are different just 10% and 4% from control mix (Mix OPC).
- The deflection at failure of mix OPC, OPC-UEO and OPC-SP are 19.63mm, 20.12mm and 23.46mm respectively. The increment percentage of deflection at failure of mix OPC-UEO and OPC-SP are 3% and 20%.
- The higher value of deflection shows that beam of mix OPC-UEO and OPC-SP are stiff and hard beam as both need to deflect further to crack at failure.
- The result indicates that the performance of used engine oil is almost the same as superplasticizer in OPC concrete due to maximum loading and deflection at failure.

4.3.2 MIRHA Concrete

Refer to Table 4-3 and graph in Figure 4-3:

- The maximum load that can be sustained by beam of mix MIRHA, MIRHA-UEO and MIRHA-SP are 72.19 kN, 111.82 kN and 99.13 kN respectively.
- Mix MIRHA-UEO and MIRHA-SP, both have great increment percentage of maximum load those are 55% and 37%.
- In other words, usage of used engine oil and superplasticizer improves the maximum load performance in MIRHA concrete. Besides, the percentage difference of deflection at failure of mix MIRHA-UEO and MIRHA-SP are 9% and 25%, which means mix MIRHA (control mix) is most stiff beam.
- From these two situations of properties, existence of used engine oil and superplasticizer improve maximum load capacity.

4.2.3 Silica Fume Concrete

- The maximum load that can be sustained by beam of mix SF, SF -UEO and SF-SP are 128.78 kN, 106.65 kN and 100.89 kN respectively (refer Table 4 -3 and Figure 4-3).
- The decrement percentages are 17% for mix SF -UEO and 22% for mix 9 SF -SP. The deflection at failure of beam by mix SF, SF -UEO and SF-SP are 22.99mm, 25mm and 45.60mm.
- With the addition of used engine oil in mix SF -UEO and superplasticizer in mix SF-SP, both mixes indicate that there are increased 9% and 98% in deflection at failure.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

This project can be concluded that the performance of used engine oil can works as the superplaticizer, which is as an water reducer in concrete. It is proven by the sequence of tests and results based on the Slump Test, Cube Test, Beam Maximum Loading Test and Beam Deflection. The ideal suggestion as conclusion is the behavior of concrete containing used engine oil is almost the same as superplasticizer in improving the slump, increasing the chemical bonding between aggregates and cements, enhancing concrete strength and dur ability properties of the concrete.

For this project, there are a few recommendations that can be suggested in a way to prove that used engine oil can be used as chemical admixture in concrete. Further investigation need to be implicated for the purpose to get precise data and analysis of used engine oil performance in concrete. The author is suggesting that varies sample of used engine oil in concrete with variety of cement content. The specimen of beam should be made more. This idea will help the study to get better results later in identifying the concrete behavior.

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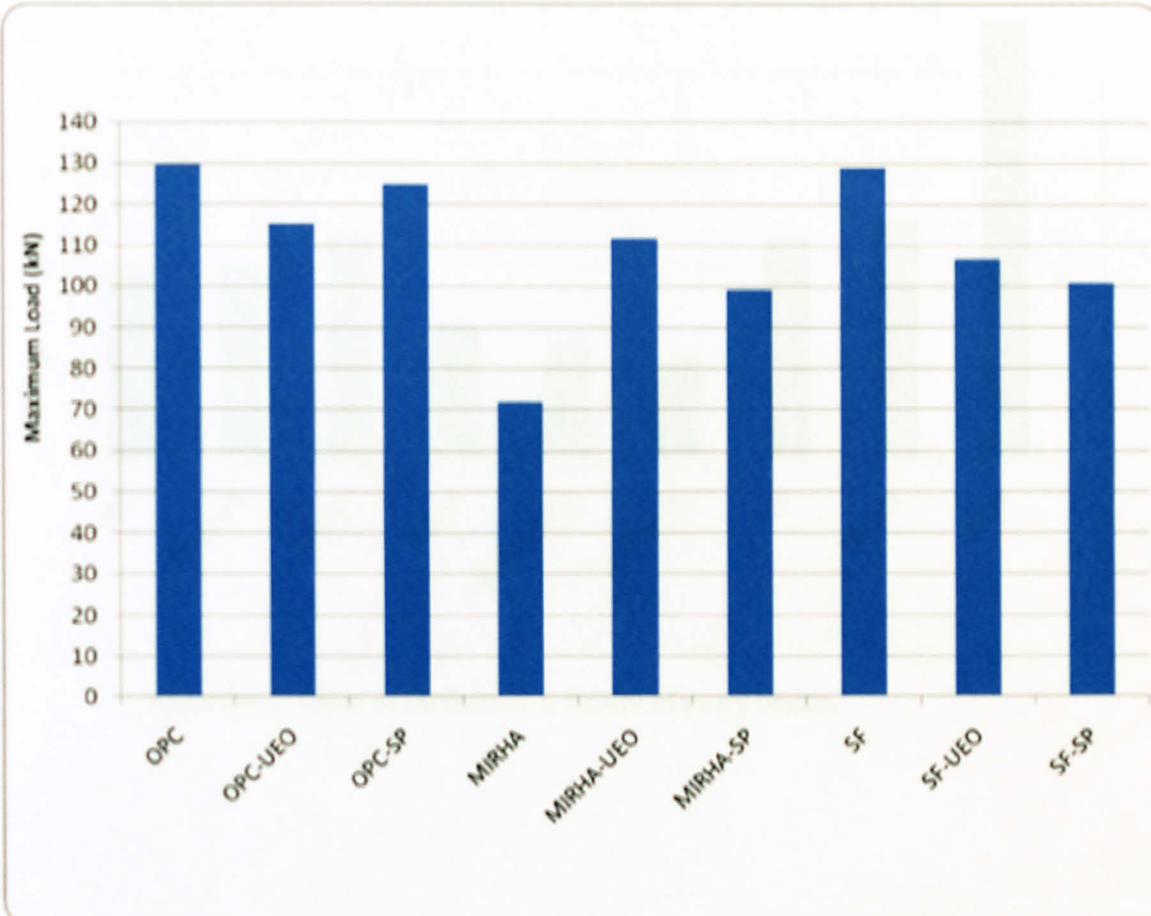
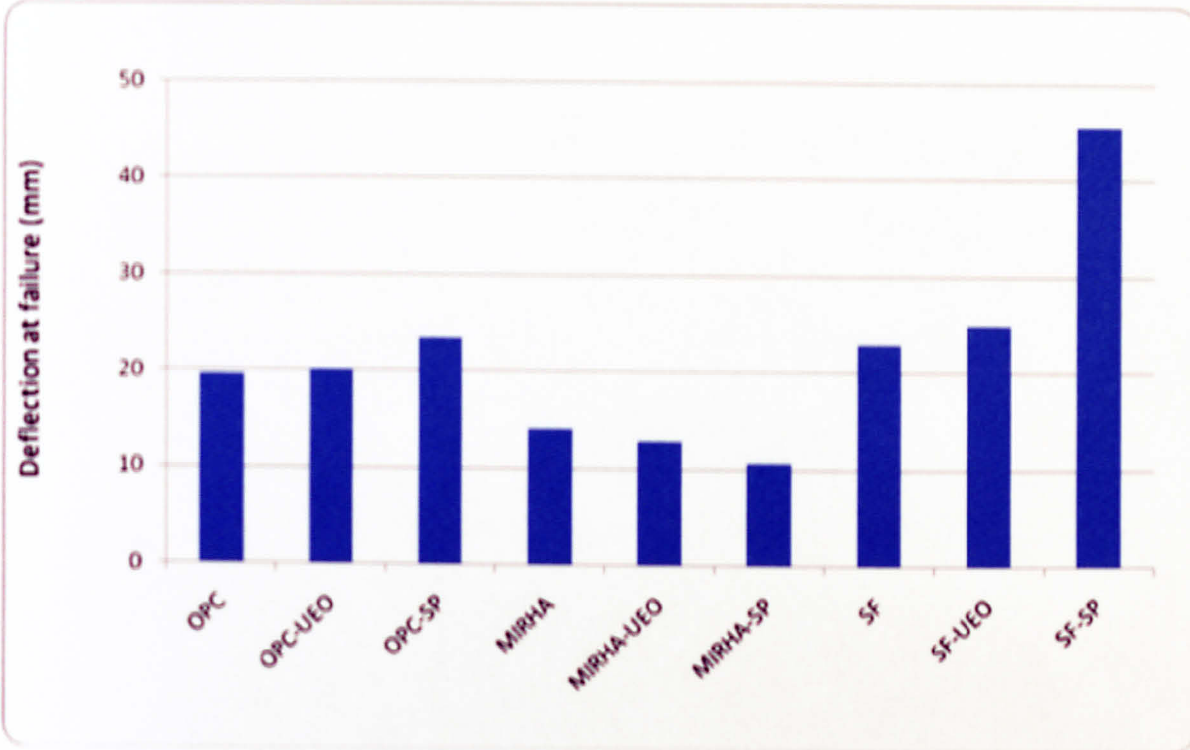
APPENDICES



Appendix 1: Chart of Maximum Load of every beams.



Appendix 2: Chart of Deflection at failure of every beams.