EFFECT OF USED ENGINE OIL ON SHEAR CAPACITY OF CONCRETE BEAMS CONTAINING FLY ASH

By

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Dissertation submitted in partial fulfillment of
the requirements for the
BACHELOR OF ENGINEERING (Hons)
(CIVIL ENGINEERING)

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CERTIFICATION OF APPROVAL

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JULY 2007

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 persons.

MUHAMAD HAFIZ B AZLAM

ABSTRACT

This research attempted to study the "Effect of Used Engine Oil on Shear Capacity of Concrete Beam Containing Fly Ash." Due to the high cost for a proper waste disposal and the restrictions in environmental rules and regulations, it has become a trend nowadays to reuse processed and unprocessed industrial wastes as one of the materials in concrete technology. Leakage of used engine oil into cement concrete element in older cement grinding unit gives it a greater resistance to freezing and thawing. This property is quite similar to the admixture of concrete added with commercial air entraining agent. The chemical compound that found in the cement paste containing dosage of 0.15 % of UEO are quite similar to the cement paste contain 100% of cement. No hazardous or contaminated chemicals were present in the cement paste that could harm its properties. Ten full scale beams were fabricated to investigate the effect of UEO in concrete beam. Result shows that beam with 0.15 % UEO enhance its properties strength up to 32.26 % higher than that of normal concrete beam. This strength is quite similar to the beam added with commercial air entraining agent (45.39 % higher compared to normal concrete beam). Other cement replacement admixture, fly ash, rice husk ash, and super plasticizer were also been investigated with the used engine oil. The results were quite impressing and no significant effect in the ultimate load or load deflection behavior on concrete beam was observed.

ACKNOWLEDGEMENT

First and foremost, the author wants to thank to God for fulfilling the author's desire to complete this first semester of final year project. This research is able to be completed within the time frame with the help from some of the people who willingly share their knowledge, ideas and lend their hand in completing this research studies.

The author want to start the appreciative thanks to the author's supervisor AP Dr Nasir Shafiq who has given the author guide, advice as well as shares his expertise knowledge, thoughts and ideas in completing the project. Without his guidance and advice, the author would not be able to perform my research project. Next, special thanks to Ms Chin, the co-supervisor who helps the author during fabrication of the beam and all her kind guidance and knowledge that she gives to the author. She always supervises the author's progress by keep in track with the author's work schedule although she is very busy with her workload as a post graduate student.

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LIST ABBREVIATIONS AND NOMENCLATURES

UEO	Used Engine Oil
NEO	New Engine Oil
PFA	Pulverize Fly Ash
RHA	Rice Hush Ash
SP	Super Plasticizer
SiO_2	Silicon Dioxide
Al_2O_3	Aluminium Oxide
Fe_2O_3	Iron Oxide

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND OF STUDY

Nowadays, the studies of using waste that can be renewed become the trend among the researcher. It is because people are more alert about environment issue. Used engine oil become environment issue because this used engine oil needs to be disposed in proper way in order to avoid pollution that can contaminate the river, sea, lake and destroy the habitats .One way to dispose the used engine oil is by adding the used engine oil into the concrete mixture and at the same time, we try to find the properties of this concrete whether it can enhance the flexural capacity of the concrete.

According to the research conducted by American University Of Beirut, adding used engine oil into the concrete beam can enhance the flexural and shear capacity of used engine oil .This mix is similar when we add air entraining chemical admixtures that enhance the durability properties of concrete. However, no proof can be shown to support the analysis due to the lack of test and experiments, and people who involve in construction work do not trust that the used engine oil can enhance the concrete properties.

1.2 PROBLEM STATEMENT

Waste is always associated with pollution. 40 % of oil pollution came from used engine oil because people do not know how to dispose the used engine oil in the correct way and do not renew it to others products .Used engine oil can be easily found at car workshops and people just throw it away without fully utilize this by- product .This case study is to have full utilization on the processed and unprocessed industrial by-product of oil as raw material in cement and concrete mixing.

1.3 OBJECTIVE AND SCOPE OF STUDY

The objectives of this study were:

1. Determine the effect of used engine oil on the performance of reinforce concrete beams
2. To compare the effects of used engine oil with other admixtures such as new engine oil and super plasticizer
3. To determine the performance of blended cement concrete containing fly ash and rice husk ash

Scope of study of this thesis to investigate the effect of used engine oil on properties of concrete beam containing cement replacement material. To accomplish the project, the authors have conducted the research, work planning, fabricating and testing.

CHAPTER 2
LITERATURE REVIEW

2.1 ENGINE OIL

Motor oil is a type of liquid oil used for lubrication of engine combustion. Motor oil is used to cool the carrying heat from moving engine inhibition in internal combustion engines. Used engine oil can be defined as any oil refined from any petroleum based or synthetic that has been used .Used engine oil is usually contaminated with various impurities such as dirt, water, chemical or metal from engine. Used engine oil can be classified as hazardous material because it contains additives (e.g. rust inhibitors), contaminants (e.g. heavy material generated through engine wear), potentially carcinogenic, polycyclic, aromatics compound (from fuel combustion process) and glycol leaked from the cooling system. Used engine oil needs to be handled with care and disposed correctly to ensure the safety of environment (US Environment Protection Agent).

2.2 REINFORCE CONCRETE

Concrete is the construction material that consists the combination of cement (Portland cement), water and aggregate (combination of gravel and sand). Chemical reaction between the cement and the water (hydration process) causes the cement to harden and the conglomerate to gain strength over a period of time.

Because the cement requires time to fully hydrate before it strengthens and hardens, concrete must be cured once it is placed. Curing is the process of keeping concrete under a specific environmental condition until hydration process is relatively complete. Good curing typically considers providing a moist environment and control temperature. The moist environment promotes hydration since increased hydration lowers permeability and increases strength resulting in a higher quality material.

Allowing the concrete surface to dry out excessively can result in tensile stresses, which the still-hydrating interior cannot withstand, causing the concrete to crack.

Also, the amount of heat generated by the exothermic chemical process of hydration can be problematic for very large placements. Allowing the concrete to freeze in cold climates before the curing is complete will interrupt the hydration process, reducing the concrete strength and can lead to scaling and other damage or failure.

The effects of curing are primarily a function of geometry (the relation between exposed surface area and volume), the permeability of the concrete, curing time, and curing history.

Improper curing can lead to several serviceability problems including cracking, increased scaling, and reduced abrasion resistance.

Concrete is a widely used structural material with application ranging from simple elements such as fence posts, bridges, offshore platforms and high rise building. Concrete is a very variable material, having a wide range of strength and stress-strain curves. When the load is applied, the ratio between the stresses and strains is approximately linear and the concrete behaves almost as elastic material with fully recovery of displacement if the load is removed. When the loads are removed during the plastic range, the recovery would no longer be completed and a permanent deformation would remain. The ultimate strain for most structural concretes tends to be a constant value of approximately 0.0035, irrespective of the strength of the concrete. The precise shape of the curve depends on the duration the load is applied.

Concrete strength increases with the age. The concrete became more gradual with the time .The precise relationship will depend upon the type of cement used. Normally Portland cement is chosen for normal construction.

2.3 STEEL BAR

Rebar, a portmanteau for reinforcing bar, is common steel bar, an important component of reinforced concrete and reinforced masonry structures. It is usually formed from carbon steel, and is given ridges for better frictional adhesion to the concrete dome or shell. Its utility and versatility are achieved by combining the best features of concrete and steel. Concrete is a material that is very strong in compression, but virtually weak in tension. To compensate for this imbalance in concrete's behavior, rebar is cast into it to carry the tensile loads.

Masonry structures and the mortar holding them together have similar properties to concrete and also have a limited ability to carry tensile loads. Some standard masonry units for examples blocks and bricks are made with strategically placed voids to accommodate rebar, which is then secured in place with grout. This combination is known as reinforced masonry.

While any material with sufficient tensile strength can conceivably be used to reinforce concrete, steel and concrete have similar coefficients of thermal expansion: a concrete structural member reinforced with steel will experience minimal stress as a result of differential expansions of the two interconnected materials caused by temperature changes.

	Concrete	Steel
Strength in tension	Poor	Good
Strength in Compression	Good	Good but slender bars will buckle
Strength in shear	Fair	Good
Durability	Good	Corrodes if unprotected
Fire resistance	Good	Poor-suffer rapid loss of strength at high temperature

Table 1.0: Comparison between concrete and steel

Reinforced concrete is a strong durable building material that can be formed into many variable shapes and sizes ranging from a simple rectangular column to a slender curved dome or shell .Its utility and versatility are achieved by combining the best features of concrete and steel. When this material combined (steel bar and concrete), the steel is able to provide the tensile strength and probably some of the shear strength whiles the concrete, strong in compression, protects the steel to give durability and fire resistance.
Tensile strength of concrete is only 10 per cent of its compressive strength .All the reinforced concrete structure are designed based on the assumption that the concrete does not resist any tensile forces.
Reinforcement is designed to carry these tensile forces, which are transferred by bond between the interfaces of the two materials. If the bond is not adequate, the reinforcement bar will slip within the concrete and there will not be a composite action. Members should be detailed so that the concrete can be well compacted around the reinforcement during construction .In addition, some bars are ribbed or twisted so that there is an extra mechanical grip.
In analysis and design of the composite reinforced concrete section, it is assumed that there is a perfect bond, so that the strain in the reinforcement is identical to be the strain in the adjacent concrete.

It can be consider when an unreinforced concrete beam of rectangular in cross section which is simply supported at the ends and carries a distributed load .The beam will deflect due to the bending moment and shear forces induced by the applied loading that resulting in a curved shape .

When the ends of the beam are assumed to remain perpendicular to the longitudinal axis, the material above the axis is in the compression condition and the below is in the tension condition .Since the strain on the material is directly proportional to the distance from the neutral axis, flexural tensile cracking will begin at the extreme bottom fibers and extend towards the neutral axis.

2.4 STEEL LINK

From the research ,it is found that diagonal failure occur at the beam without shear reinforcement due to the transfer of compressive force as well as due to bending and shear force .Most severe at the support ,thus the objective of the link added into the reinforcement is to cater the shear force. The shear failure mechanism is complex and the behavior is normally analyzed in the laboratory experiments. The shear failure also related to the ratio of shear span .There are many type of shear link, this link can stop the shear failure which crosses the crack line of 45^0

2.5 FLY ASH

Fly ash (also known as a coal combustion product, or CCP) is the finely divided mineral residue resulting from the combustion of powdered coal in electrical generating plants. It is also called pulverized fuel ash. Fly ash consists of inorganic, incombustible matter present in the coal that has been fused during combustion into a glassy, amorphous structure. Coal can range in ash content from 2%-30%, and of this around 85% becomes fly ash. (The remaining 15% is called bottom ash and isn't lifted up by the flue gases.)

Fly ash material is solidified while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the particles solidify while suspended in the exhaust gases, fly ash particles are generally spherical in shape and range in size from 0.5 μm to 100 μm. The fly ash is generally finer than cement and mostly consists of silicon dioxide (SiO_2), Aluminium oxide (Al_2O_3) and iron oxide (Fe_2O_3), and are hence a suitable source of aluminum and silicon for geopolymers. They are also pozzolanic in nature and react with calcium hydroxide and alkali to form cementations compounds. Fly ash also contains some heavy metals including nickel, vanadium, arsenic, beryllium, cadmium, barium, chromium, copper, molybdenum, zinc, lead, selenium and radium.

Recently, more fly ash is used beneficially, though more than 65% of fly ash produced from coal power stations is still disposed.

Approximately, 7 million tones (Mt) of fly ash is disposed annually in Australia, 40 Mt in the United States and hundreds of megaton's in India and China. As a result, the disposal of fly ash is a growing concern for many countries worldwide.

In India alone, fly ash landfills and tailing ponds cover an area of 75,000 acres (300 km^2) (2005 numbers in Hindu Business letter). Last 20 years, fly ash are used in concrete industry, however less than 20% of the collected fly ash are reused and most of the reused in concrete industry (Helmut 1987).

Constituents	**% Weight**
SiO_2	23.72
Al_2O_3	5.30
Fe_2O_3	2.8
CaO	65.80
MgO	1.26
K_2O	1.60
Surface area	755 m^2/g

Table 2: Composition of Fly Ash

2.6 SUPER PLASTICIZER

Super plasticizers are chemical admixtures that can be added to concrete mixtures to improve workability. Strength of concrete is inversely proportional to the amount of water added or water-cement (w/c) ratio. In order to produce stronger concrete, less water is added, which makes the concrete mixture very unworkable and difficult to mix, necessitating the use of plasticizers and super plasticizers.

Super plasticizers are also often used when pozzolanic ash is added to concrete to strengthen it. This method of mix proportioning is popular in producing high strength concrete and fiber reinforced concrete.

Adding 2% super plasticizer per unit weight of cement is usually sufficient. Most commercially available super plasticizers come dissolved in water, extra water added need to be accounted for mix proportioning.

Adding an excessive amount of super plasticizer will result in excessive segregation of concrete and it is not advisable. Some studies also show that too much super plasticizer will result a retarding effect.

Plasticizers are commonly manufactured from lignosulfonates, a by-product from the paper industry. Super plasticizers have generally been manufactured from sulfonated naphthalene formaldehyde or sulfonated melamine formaldehye, although new products which based on polycarboxylic ethers are now available. Traditional lignosulfonate-based plasticizers and naphthalene and melamine based super plasticizers disperse the flocculated cement particles through a mechanism of electrostatic repulsion (see colloid). In normal plasticizers, the active substances are adsorbed on to the cement particles, giving them a negative charge, which leads to repulsion between particles. Naphthalene and melamine super plasticizers are organic polymers. The long molecules wrap themselves around the cement particles, giving them a highly negative charge so that they repel each other. *(http://en.wikipedia.org/wiki/Plasticizer)*

The author task are to conduct the lab test to determine the effect of used engine oil on flexural capacity of concrete beam containing fly with additional lab test to compare the result by changing the used engine oil with super plasticizer ,new engine oil and rice hush ash.

2.7 RICE HUSK ASH (RHA)

Rice milling generates a byproduct known as husk .Rice husk is an abundantly available waste material in all rice producing countries including Malaysia .During milling of paddy ,about 78% of weight is received as rice and bran. Others 22% of paddy weight is a rice husk .In certain regions, the rice husk is sometimes used as a fuel for parboiling paddy in the rice mills. The partially burnt rice husk in turn contributes to more environmental pollution. There have been efforts not only to overcome this problem but also to find value of these wastes and use them as secondary source of materials. This husk contains about 75 % organic volatile matter and the balance 22 % of the weight of this husk is converted into ash during the firing process ,which is known as rice husk ash (RHA).Every 1000 kg of paddy milled , about 220 kg (22 %) of husk is produced , and when this husk is burnt in the boilers , about 55 kg (25 %) of RHA is generated.

Rice husk contains nearly 20% silica, which presents in hydrated amorphous form. On thermal treatment, the silica is converted into crystobalite, which is a crystalline form of silica. However, in under- controlled burning conditions, amorphous silica with high reactivity, ultra fine size and large surface area are produced. This micro silica can be a source for preparing advanced materials like SiC, Si_3N_4, elemental Si and Mg_2Si. Due to the high pozzolanic activity, this rice husk silica also finds application in high strength concrete as a substitute for silica fume. Possibility of using this silica as filler in polymers is also studied.

CHAPTER 3

METHOLOGY AND PROJECT WORK

3.1 RESEARCH

The author has conducted the research by referring the journal, reference book and website. This research also not only by read the reading material but also the author ask the surrounding people regarding this project to get the basic idea because from the interview the people surrounding, the author can get their experience and related to the author research.

3.2 PROJECT PLANNING *(refer appendix for the Gantt chart)*

The author has generated Gantt Chart using Microsoft Project for planning this project .The Gantt Chart are useful when to monitor the work progress and to make sure the project will finish on the time . This Gantt chart will represent the date line, finish line, floating of activity, critical activity, man power required and others. This Gantt chart is useful because by doing the proper planning, the work will flow smoothly and finish on time.

3.3 SET UP THE RAW MATERIAL

The raw material will be set up from week 3 to week 8.Preparation of raw material is important because without preparation of raw material ,mixing cannot be done and will delay the progress .The author investigates the place to find the raw material are hardware shop(sand) ,market(jut bag) ,quarry(coarse aggregate) and some raw material already available at lab are steel bar ,steel link and cements.

3.4 LABORATORY WORK

The laboratory work start from week 4 until the end of semester. The laboratory work start from the cutting steel bar and link, prepared the form work, bend the steel bar, tie the steel bar to become steel frame and mixing the concrete beam .This laboratory work continue with the static concrete beam test that using Universal Testing Machine (UTM) to determine the 1 capacity of the concrete beam and compacting test to determine the workability of the concrete beam .Others equipment that involve in the laboratory work are concrete mixer, bending machine and conventional link bend set

3.5 DETAIL OF BEAM FABRICATE

No	Beam
1	Control
2	0.15% Used Engine Oil
3	0.15 % New Engine Oil
4	0.15 Super Plasticizer
5	80 % cement + 20 % PFA
6	20% PFA + 80 % Cement
7	20% PFA + 0.15 % S.P
8	20 % RHA + 80% Cement (Control RHA)
9	20 % RHA + 0.15 UEO
10	20 % RHA + 0.15 % S.P

Table 3: Detail of Beam Fabricate

3.6 CALCULATION AND MIX PROPORTIONAL

Before the author start the project and the laboratory, the author do the calculation to determine the mixing proportional

The mix proportions are done by referring to the literature review and also by discussion with supervisor and master student. This part is very important because it is the front part before the laboratory work can been done .From the calculation, the author can determine the exact value for steel bar size, reinforcement size and the mix proportion.

In the mix concrete, it contains several materials which are course aggregate, sand, water and cement. Admixture that added into the mixing are Used Engine Oil, New Engine Oil ,Super plasticizer and Pulverize Fly Ash .This variable are added to determine the effect of this by product on effect of flexural capacity compared to the normal mixture.

Beam	**Cement (Kg)**	**Water (Kg)**	**Sand (Kg)**	**Coarse Aggregate (Kg)**	**UEO (Kg)**	**Neo (Kg)**	**PFA (Kg)**	**RHA (Kg)**	**SP (Kg)**
Control	25.68	14.12	59.82	89.86	-	-	-	-	-
0.15% Used Engine Oil	25.68	14.12	59.82	89.86	0.038	-	-	-	-
0.15 % New Engine Oil	25.68	14.12	59.82	89.86	-	0.038	-	-	-

0.15 Super Plasticizer	25.68	14.12	59.82	89.86	-	-	-	-	0.038
80 % cement + 20 % PFA	20.54	14.12	59.82	89.86	-	-	5.236	-	-
20% PFA + 0.15% UEO	20.54	14.12	59.82	89.86	0.038	-	5.236	-	-
20% PFA + 0.15 % S.P	20.54	14.12	59.82	89.86	-	-	5.236	-	0.038
20 % RHA + 80% Cement (Control RHA)	20.54	14.12	59.82	89.86	-	-	-	5.236	-
20 % RHA + 0.15 UEO	20.54	14.12	59.82	89.86	0.038	-	-	5.236	-
20 % RHA + 0.15 % S.P	20.54	14.12	59.82	89.86	-	-	-	5.236	0.038

Table 4: Proportion of Designed Mix

CALCULATION FOR FLEXURAL CAPACITY

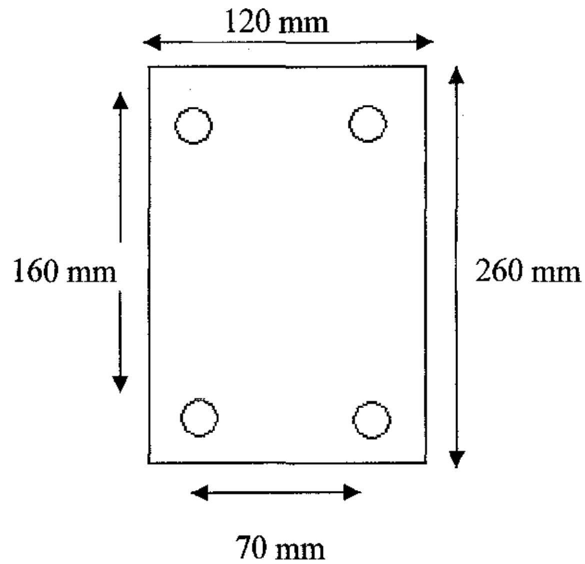


Figure 1: Location of Steel bar

Tensile reinforcement

= 226 (As) (using 12mm diameter steel bar)

Compression reinforcement

= 226 (As') (using 12mm diameter steel bar)

$$As = \frac{K' f_{cu} bd^2}{0.87 f_y Z} + A'$$

$$226 = \frac{K' f_{cu} bd^2}{0.87 f_y Z} + A'$$

Z = 0.775d

d = 0.75 x 210

= 162.75 mm

For Compression reinforcement

$$As' = \frac{M - M_u}{0.87 f_y (d - d')}$$

$M_u = 0.156 \times 30 \times 120 \times 120^2 \times 10^6$

$= 24.77$ KNm

$$As' = \frac{M - M_u}{0.87 f_y (d-d')}$$

$$226 = \frac{(M-24.77) \times 10^6}{0.87(30)(210-25)}$$

$226(4858.5) = (M-24.77) \times 10^6$

$1091241 = (M-24.77) \times 10^6$

$1.091241 = M - 24.77$

$M = 24.77 + 1.091241$

$M = 25.861$ KNm

The flexural capacity is 25.861 KNm

3.7 CONCRETE MIXING

All concrete should be mix thoroughly until it is uniform .The sequence of concrete mix is very important and it must be followed accordingly. It must be follow by the BS 1881 Part 125:1986)

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 8 minutes to let both coarse and fine aggregates to absorb 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. Finally perform hand mixing until the mix is in uniform stage.

Precaution

- Room temperature should be approximately 25-27 ^0C
- All the fine and coarse aggregate must be in dry condition

Figure 2: Concrete Mixing Process

3.8 CONCRETE CASTING

The author using wood mould for casting the beam, all the form work done by the author .Procedure for concrete casting are:

1. Grease is used to prevent the concrete mix from stick to the form work by brush the grease to the form work surface.
2. The form work size are 1900mm X 260 mm X 150 mm
3. The reinforcement bar are located in the form work and steel wire are used to make sure the position of reinforcement bar exactly at the rite location by hanging the reinforcement bar .
4. The concrete mixing are pouring into the form work by 3 layer, at each layer, vibrator are used take out the air that trapped in concrete mix .Trapped air can reduce the concrete strength.
5. After the next day, the reinforcement concrete beam will take out from the form work and curing process will be conducted.

Figure 3: Beam no 5 (80 % cement + 20 % PFA) during mixing on 20th April 2007

3.9 CURING PROCESS

Curing process is to fully hydrate the concrete beam before it acquires strength and hardness because the concrete beam must be *cured* once it has been placed. Curing is the process of keeping concrete under a specific environmental condition until hydration is relatively complete. Good curing is typically considered to provide a moist environment and control temperature.

A moist environment promotes hydration, since increased hydration lowers permeability and increases strength resulting in a higher quality material. Allowing the concrete surface to dry out excessively can result in tensile stresses, which the still-hydrating interior cannot withstand, causing the concrete to crack.

Also, the amount of heat generated by the exothermic chemical process of hydration can be problematic for very large placements. Allowing the concrete to freeze in cold climates before the curing is complete will interrupt the hydration process, reducing the concrete strength and leading to scaling and other damage or failure.

The effects of curing are primarily a function of geometry (the relation between exposed surface area and volume), the permeability of the concrete, curing time, and curing history.

Improper curing can lead to several serviceability problems including cracking, increased scaling, and reduced abrasion resistance.

In the project, the author cannot placed the concrete beam into the curing tank because the size of the beam is too huge and the weight of this beam also very heavy (approximately weight 150kg).For the curing purposes, the author used jut bag to make sure the concrete beam in the moisture condition and the author will spray the water once for every 2 day to make sure the concrete beam in wet condition and the hydration process are fully completed.

Figure 4: Curing Process for Beam No 3 And 4

3.10 LABORATORY TESTING

This testing using Universal Testing machine as mechanism for to determine the maximum capacity of the beam by applying the static load to the beam at rate 0.2 KN/s. By apply the load constantly and observe the behavior of the beam before its failure by marking the crack sequent to determine which portion of the beam have the higher crack and we can determine the part that are critical.

The orientation of the beam are in the picture below by applying two load at 600cm from the end of the beam and we used simply supported beam set up during this laboratory test. The author used BS 1881 part 118 as a guide line for this testing.

During this test also, we determine the bending of the beam before it failure by using the LVDT and data logger equipment .We determine the sag of the beam by putting LVDT at C_1, C_2 and C_3.

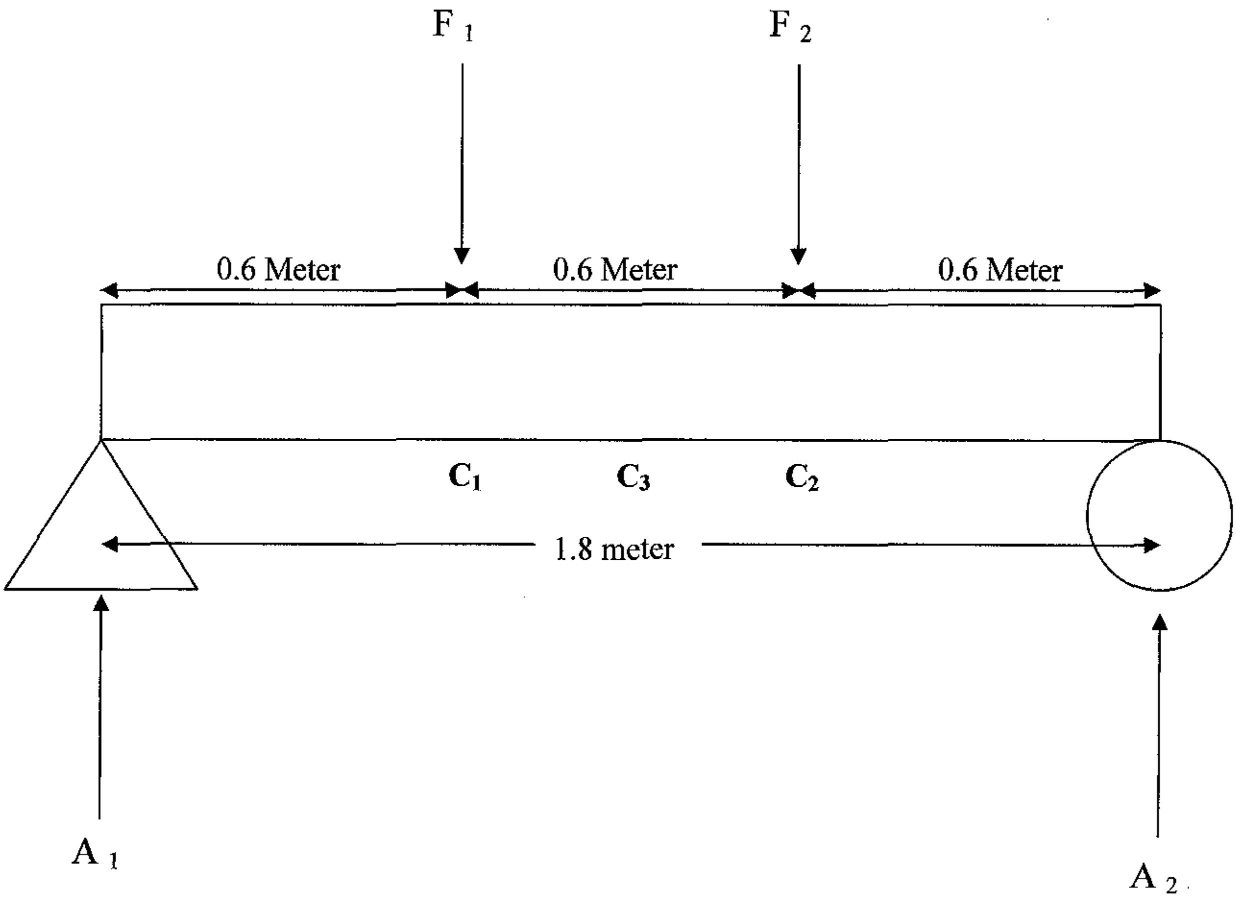


Figure 5: Simply supported beam during lab test

CHAPTER 4

RESULTS AND DISCUSSION

4.1 RESULTS AND DISCUSSION

In order for us to determine the capacity of the beam, the author compiled all data and result in a table form and in a graph so it will be easier for reader to differentiate the concrete beam capacity with different mixing. From the experiments done, the values obtained are concrete beam capacity, deflection of the beam and the chemical composition of the concrete that containing the cement replacement material. Crack pattern are determine during the laboratory test by marking all the crack follow the sequence. Some calculation has to be done to determine the moment capacity of the concrete beam percentage different between the concrete beam with admixture and the control beam.

From the equation $\sum F = 0$

$$F_1 + F_2 - (A1 + A_2) = 0$$

$\sum$Moment at point A_1 =0

$$0.6\,F_1 + 1.8\,F_2 - 1.8A_2 = 0$$

$$A_2 = (0.6\,F_1 + 1.8\,F_2) / 1.8$$

$$A_1 = F_1 + F_2 - A_2$$

We can determine the value of A1 and A2

Maximum moment:

From the shear diagram, we can determine the moment capacity of each beam.

$\sum M = M_1 + M_2 = 0$

$\sum M$ at $_{C1} = - A_1\,(0.6) - M_2 + A_2(1.2) = 0$

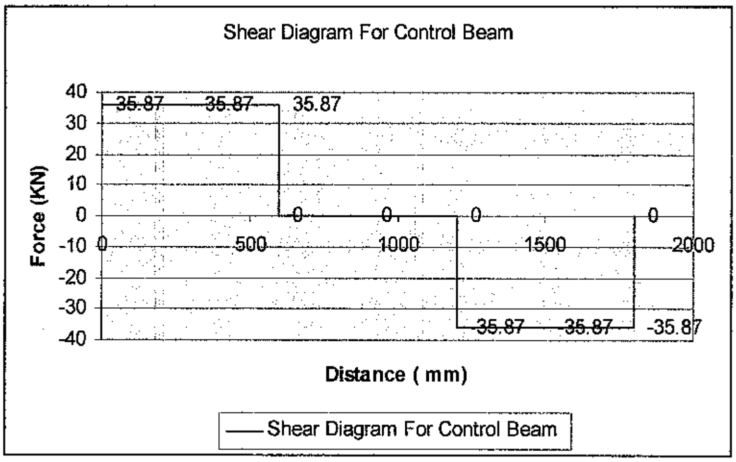


Figure 6: Shear Diagram

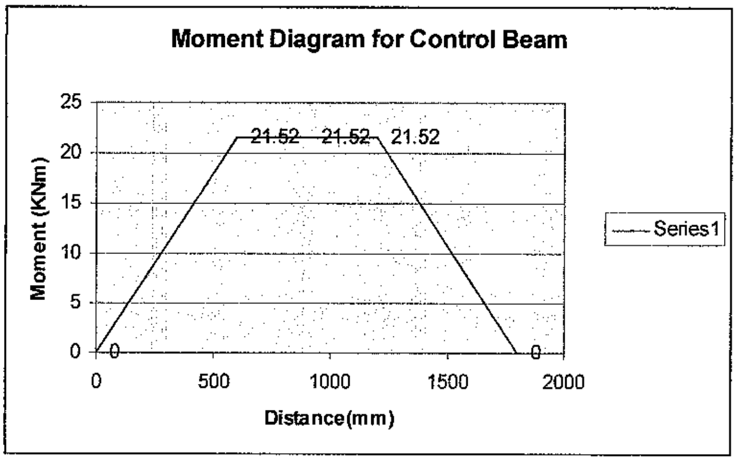


Figure 7: Moment Diagram

No	Beam	Measured ultimate Load (KN)	Maximum Load (KN) at Point		Deflection (mm)	Moment (KN/m) at point F_1 and F_2
			F_1	F_2		
1	Control (100% cement)	71.74	35.87	35.87	9.97	21.52
2	0.15 % UEO	94.83	47.44	47.44	31.57	28.46
3	0.15% NEO	98.87	49.44	49.44	12.05	29.66
4	0.15% SP	104.3	52.15	52.15	13.5	31.29
5	20% PFA + 80 % Cement	96	48	48	16.4	28.8
6	20% PFA + 0.15% S.P	69.1	34.55	34.55	9.5	20.73
7	20% RHA + 80% Cement	72.61	36.3	36.3	14.25	21.78
8	20% PFA + 0.15 % UEO	83.65	41.83	41.83	10.6	25.1
9	20% RHA + 0.15% UEO	87.79	43.89	41.83	15.1	26.33
10	20% RHA + 0.15 % S.P	90	45	45	16.7	27

Table 5: Ultimate Concrete Load

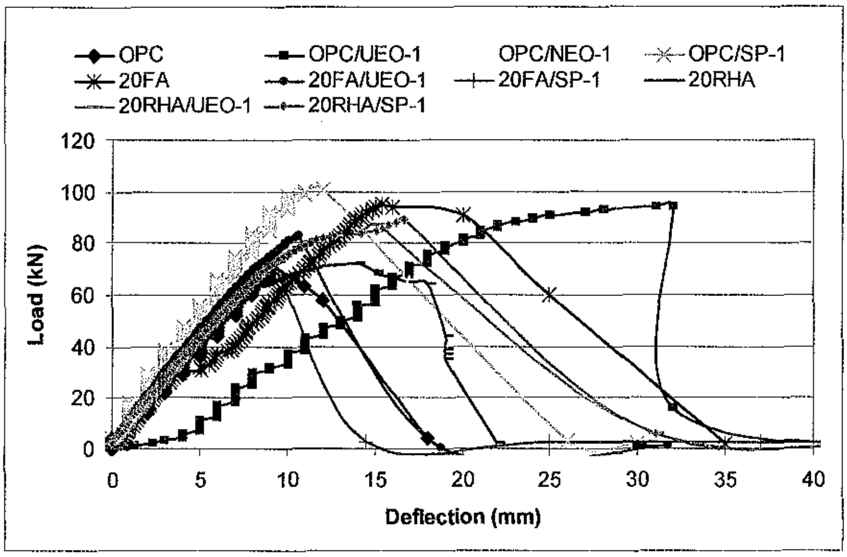


Figure 8: Load vs Deflection

4.2 DEFLECTION AND CRACK PATTERN *(For Crack Pattern Refer Appendix)*

From the experiment conducted, it show that beam contain UEO give higher deflection (31.57mm) before its fail. Compare to others beam, the range are from 9mm to 17 mm .Beam with 20% PFA + 0.15% S.P give the lowest deflation (9.5mm)

This beam contain admixture are more elastic compare to the control beam. It will show the deflections before it fail. While the deflection of UEO beam is higher compare to the control beam, the crack pattern of this 2 beam are similar.

Obviously for the crack pattern, beam using NEO show more crack compare to others beam. This observation just used human as mechanical to draw the crack pattern and no machine or device are available for marking this crack

The major crack lines are 45^0 from the point load and the distribution of the crack are equal in length. Its means that the distances from each crack are quite similar with others crack line. It shows that the properties of in the concrete beam are quite same and the distribution loads are equal.

% Different of shear capacity:

$$\frac{\text{(Shear capacity beam – Shear capacity control beam)}}{\text{(Shear capacity control beam)}}$$

For 0.15 % Used engine oil:

= (94.83-71.74) / 71.74 * 100%

=32.26 %

% Different in Moment Capacity:

$$\frac{\text{(Moment capacity beam 0.15\% UEO – Moment capacity control beam)}}{\text{(Moment capacity control beam)}}$$

For 0.15 % Used engine oil:

= (28.46- 21.52) /21.52 * 100%

= 32.25 %

No	Beam	Total Capacity Beam (KN)	Total Capacity Control Beam (KN)	Different of Shear Capacity (%)	Moment Capacity Beam at F_1 and F_2 (KNm)	Moment Capacity Control Beam at F_1 and F_2 (KNm)	Different of Moment Capacity (%)
1	Control (100% cement)	71.74	71.74	-	21.52	-	-
2	0.15 % UEO	94.83	71.74	32.26	28.46	21.52	32.25
3	0.15% NEO	98.87	71.74	37.83	29.66	21.52	37.83
4	0.15% SP	104.3	71.74	45.39	31.29	21.52	45.40
5	20% PFA + 80 % Cement	96	71.74	33.82	28.8	21.52	33.83
6	20% PFA + 0.15% S.P	69.1	71.74	-3.68	20.73	21.52	-3.67
7	20% RHA + 80% Cement	72.61	71.74	1.20	21.78	21.52	1.21
8	20% PFA + 0.15 % UEO	83.65	71.74	16.62	25.1	21.52	16.64
9	20% RHA + 0.15% UEO	87.79	71.74	22.36	26.33	21.52	22.35
10	20% RHA + 0.15 % S.P	90	71.74	25.45	27	21.52	25.46

Table 6: Percentage Different In Moment and Shear Capacity

4.3 BEAM CAPACITY

From the laboratory conducted, the higher value obtained are using 0.15 % SP and follow by :

1. 0.15 % NEO,
2. 20% PFA + 80 % Cement
3. 0.15% UEO
4. 20% RHA + 0.15 % SP
5. 20% RHA + 0.15% UEO
6. 20% PFA + 0.15 % UEO
7. 20% RHA + 80% Cement
8. Control (100% cement)
9. 20% PFA + 0.15% S.P

From this experiment, the value obtain for used engine oil, new engine oil and super plasticizer are quite similar from each others. The percentage different to the control for this 3 mixture are 28-31 % higher compare to the control. However the lowest value is using 20% PFA + 0.15% S.P.

4.4 CHEMICAL COMPOSITION

Chemical Composition (%)	**Used engine oil**	**New engine oil**
SiO_2	-	0.85
Fe_2O_3	0.43	0.18
CaO	15.9	21
SO_3	37	36.3
P_2O_5	8.95	13.4
ZnO	17.7	25.6
Cl-	15.9	-

Table 7: chemical composition of Used Engine Oil And New Engine Oil

Chemical Composition (%)	Ordinary Portland Cement	Fly ash	Rice husk ash
SiO_2	21.98	51.19	86.1
$Al_2 O_3$	4.65	24	0.17
Fe_2O_3	2.27	6.6	2.87
CaO	61.55	5.57	1.03
MgO	4.27	2.4	0.84
SO_3	2.19	0.88	0.41
K_2O	1.04	1.14	4.65
Na_2O	0.11	2.12	-

Table 8: chemical composition of OPC, PFA and RHA

The composition of CaO is low in the fly ash, from the ASTM C618, fly ash that we used are contain less than 10% lime (CaO) (Class F fly ash). However, this fly ash contain higher SiO_2 (51.19%) and $Al_2 O_3$ (24%). It required Portland cement, quicklime, and water in order to react and produce cementations compounds.

Compare to the Class C fly ash, it contain more than 20% lime (CaO) and has some self cementing properties and gain the harden and strength over time .Class C fly ash does not required an activator to produce cementations compounds.

Rice hush ash that used for this experiment contain higher than 20% of SiO_2 .it show that this RHA can be replace the silica fume because after the author process the rice hush to become RHA , the SiO_2 contain are 86.1 % .It give high pozzolanic activity to form cementations compound

Chemical composition in cement paste

Oxide composition	Percentage (%)
SiO_2	20.7
Al_2O_3	5.29
Fe_2O_3	5.17
CaO	62.9
MgO	1.36
SO_3	2.92
K_2O	0.67
Na_2O	0.12

Table 9: Chemical composition in cement paste

Chemical composition of used engine oil in cement paste

Oxide composition	Percentage (%)
SiO_2	20.4
Al_2O_3	5.21
Fe_2O_3	5.29
CaO	63.1
MgO	1.26
SO_3	2.94
K_2O	0.68
Na_2O	0.13

Table 10: Chemical composition of UEO in cement paste

Chemical composition of new engine oil in cement paste

Oxide composition	Percentage (%)
SiO_2	20.6
Al_2O_3	5.52
Fe_2O_3	5.19
CaO	62.9
MgO	1.38
SO_3	2.87
K_2O	0.60
Na_2O	0.10

Table 11: Chemical composition of NEO in cement paste

Chemical composition super plasticizer in cement paste

Oxide composition	Percentage (%)
SiO_2	20.3
Al_2O_3	5.11
Fe_2O_3	5.33
CaO	63.4
MgO	1.30
SO_3	2.98
K_2O	0.50
Na_2O	0.10

Table 12: Chemical composition of SP in cement paste

From the table above, the chemical composition of each admixture are quite similar with each others, the value of different is around +- 5 %.Cement that used for experiment are already contain higher CaO (62,2%) and SiO_2 (20.7%). While variable admixture are added into the cement paste, the composition of this cement are not different with the 100% cement paste .It show when some admixture are added into the cement paste, the chemical composition are not affected.

4.5 PROBLEM

In this project ,the author determine that there are still have a problem while the author conduct the project that can affected the schedule and the results of laboratory. The problems are:

Coarse aggregate

Laboratory coarse aggregate are not clean and fully covered by the quarry dust. This quarry dusk can affect the strength of the concrete mix because this quarry dust cover the coarse aggregate surface and prevent the cement from bind with coarse aggregate. It makes the coarse aggregate loose easily when the load applied because cement doesn't 100% bind the aggregate.

Before conduct the mixing ,the author wash the coarse aggregate with the clean water (tap water) to wash away all the quarry dusk from coating the coarse aggregate .This process make the job more complicated because after washing the aggregate , the author must drying the coarse aggregate before measure it for mixing .

Laboratory apparatus

Laboratory apparatus is not sufficient because when the peak hour of laboratory usage, the author must consecutively with others student because lack of equipment .In example in the lab, only 1 hammer present in the laboratory. It makes more time required for laboratory work because lack of equipment facilities in the lab. Moreover, the laboratory gauges is not sufficient and the author cannot conduct the test on time.

CHAPTER 5
CONCLUSION

In conclusion, the work progress for the FYP lab finished early from the schedule .Some lagging of activities occur but it not affected the completed date of the beam that the author estimated for the 1st semester 5 beams are fabricated and the remaining 5 beam are fabricated in the 2nd semester .From the Gantt chat ,the date line for fabrication of 5 beam are on 14 April 2007 .However , in the real situation , the author can finished the last beam on 20 April 2007 .It late 6 days from the schedule ,but it not effect the schedule because this activities is not critical path activities and the floating time from the schedule given extra time for lagging situation and will not affected the date line of fabrication .

Although the cement for the this experiment using the composite cement, the performance of concrete beam using used engine oil, new engine and super plasticizer are higher compare to the control beam. The effect of used engine oil and new engine oil are quite similar on concrete strength and also similar to the commercial air entrained agent (Super Plasticizer).

The author can conclude that used engine oil one of the main waste material in the world can be added into the concrete mixing to enhance the concrete capacity of the concrete beam.

Findings from this research will lead to a new era in building construction technology. The used engine oil will be a cost effective alternative to concrete beam to enhance their capability in flexural capacity. Hopefully with findings from this research, pollution and environmental issue regarding used engine oil can be reduced.

CHAPTER 6
RECOMMENDATION

Recommendation

After conducting this project, some recommendation that is recognize for the future purposes, there are:

Dynamic Load

From the static load, the author suggests to expend the experiment by conducted the dynamic load for the beam containing this admixture to know the behavior when dynamic load is applied. It because for the high rise building, dynamic load is one of the main factor that must be consider in the design of concrete. If this material can sustain high dynamic load, it can be applied for constructing the high rise building and the bridge.

Corrosion test

Test the corrosion of the concrete containing used engine oil by determine the chloride effect to the beam and the performance of this concrete beam with the time .This is important to know the future behavior of this concrete beam either the performance of this concrete are same like normal concrete or higher in performance.

Self compacting concrete

50 % cost of construction are from the labor cost, if used engine oil added into the concrete and can be used as self compacting concrete, this 50 % can be save up due to 80% of faster pouring the concrete into the form work and also reduced the wear and tear of formwork .Furthermore, no vibrators are needed to compact the concrete and it will decrease the time and the cost.

7.1 REFERENCE:

1. R.C Hibbeler Structure Analysis fifth edition book
2. http://www.matsuo-bridge.co.jp/english/bridges/basics/arch.shtmzz
3. http://en.wikipedia.org/wiki/Plasticizer
4. http://en.wikipedia.org/wiki/fly ash
5. https://www.sciencedirect.com/science
6. Department of Civil and Environmental Engineering, American University of, Beirut, Lebanon
7. BS 1881 Part 118, 1983

8.0 APPENDIX

Calculation for mix Proportion

Beam size	:	120mm X 260mm X 1900mm
		$=0.0624m^3$
Slab size	:	0.15^3
		$=0.003m^3$
Volume	:	$0.0624\ m^3 + 0.0034\ m^3 + 0.003\ m^3$
		$=0.0688m^3$
Total Volume	:	Volume concrete + 15% Wastage
		$=0.0688\ m^3 + 0.15X0.0688\ m^3$
		$=0.079\ m^3$
1 part	:	$\frac{2400\ kg}{7.38\ m^3} = 325\ Kg / m^3$
Cement content		$= 1\ X\ 325\ Kg / m^3$
		$= 325\ Kg / m^3$
Sand content		$= 2.33\ X\ 325\ Kg / m^3$
		$= 757.25\ Kg / m^3$
Coarse Aggregate		$= 3.5\ X\ 325\ Kg / m^3$
		$= 1137.5\ Kg / m^3$
Water		$= 0.55\ X\ 325\ Kg / m^3$
		$= 178.75\ Kg / m^3$

Calculation for 1 beam

Cement content	$= 0.079\ X\ 325\ Kg / m^3$
	= 25.68 Kg
Sand content	$= 0.079\ X\ 757.25\ Kg / m^3$
	= 59.82 Kg
Coarse Aggregate	$= 0.79\ X\ 1137.5\ Kg / m^3$
	= 89.86 Kg
Water	$=0.79\ X\ 178.5\ Kg / m^3$
	= 14.12 Kg

Calculation for additional admixture beam

1. 100 % cement
   a. Cement : 25.68 Kg

2. 100 % cement + 0.15 % used engine oil
   a. Cement : 25.68 Kg
   b. Used engine oil :
      0.0015 X 25.68 Kg
      =0.03852 Kg
3. 100 % cement + 0.15 % New Engine Oil
   a. Cement : 25.68 Kg
   b. New Engine Oil :
      0.0015 X 25.68 Kg
      =0.03852 Kg

4. 100 % cement + 0.15 % Super Plasticizer
   a. Cement : 25.68 Kg
   b. Super Plasticizer :
      0.0015 X 25.68 Kg
      =0.03852 Kg

5. 80 % cement + 20% Fly Ash
   a. Cement : 80% X 25.68 Kg
      = 20.54 Kg
   b. Fly Ash : 20% X 25.68
      = 5.236 Kg

PICTURE OF WORK PROGRESS

Figure 8: Beam no 3 (0.15 % New Engine Oil)

Figure 9: Beam no 5 (80 % cement + 20 % PFA) during mixing on 20th April 2007

Figure 11: Beam no 5 (80 % cement + 20 % PFA) during mixing on 20th April 2007

Figure 12: Curing Process For Beam No 1 And 2

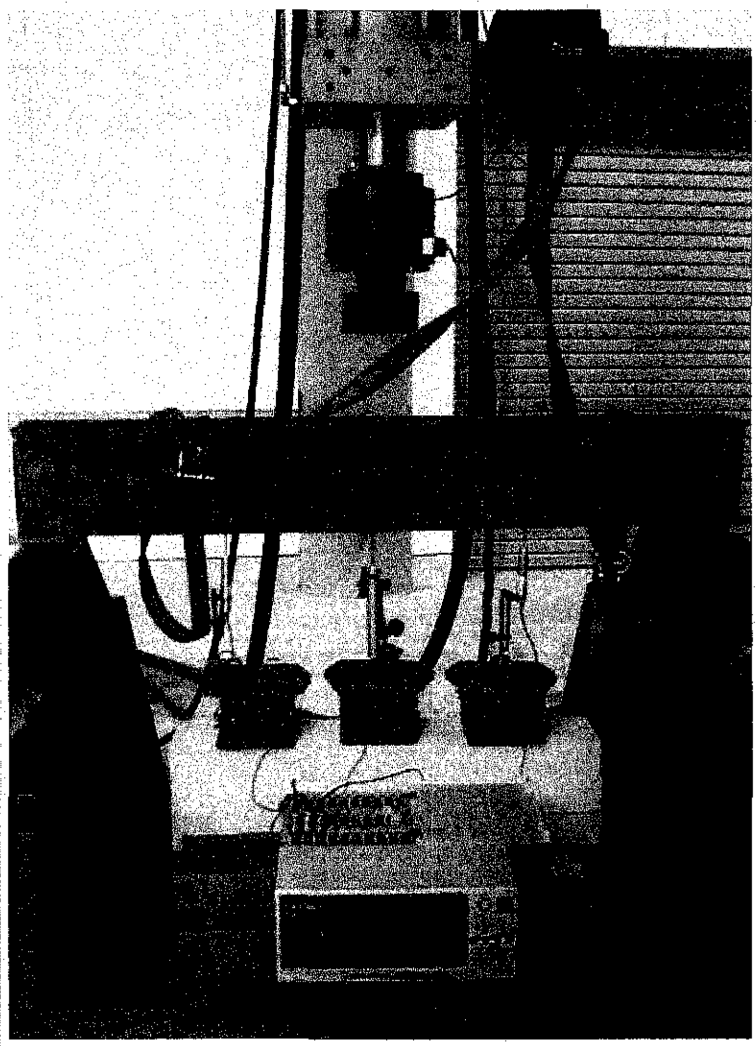


Figure 14 : Set Up Of Laboratory Apparatus

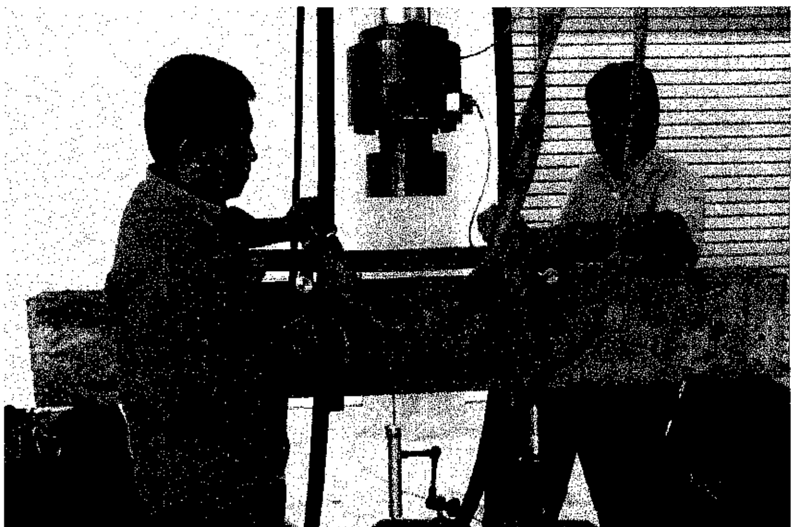


Figure 15 : Author and Lab Technician Set Up the Beam

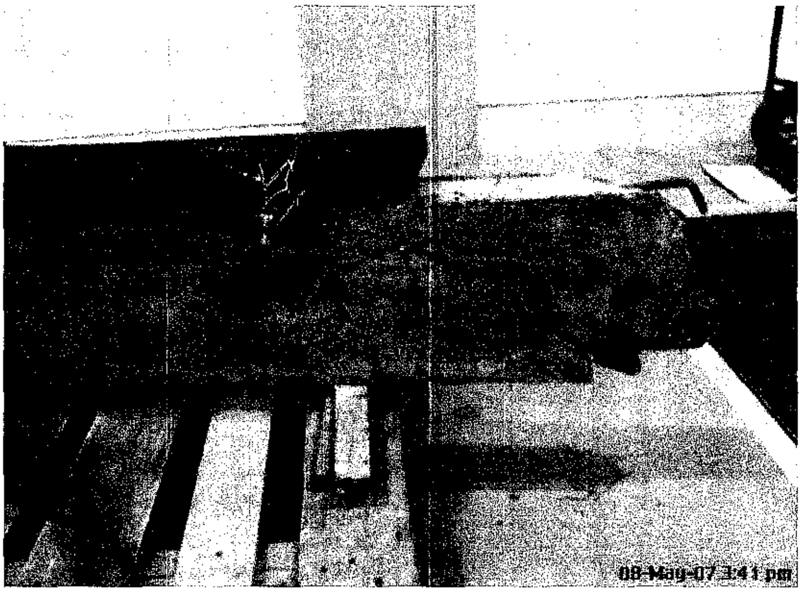


Figure 16 : Crack At Beam

Figure 17 :Discussion with Dr Nasir Shafiq After the Lab Test

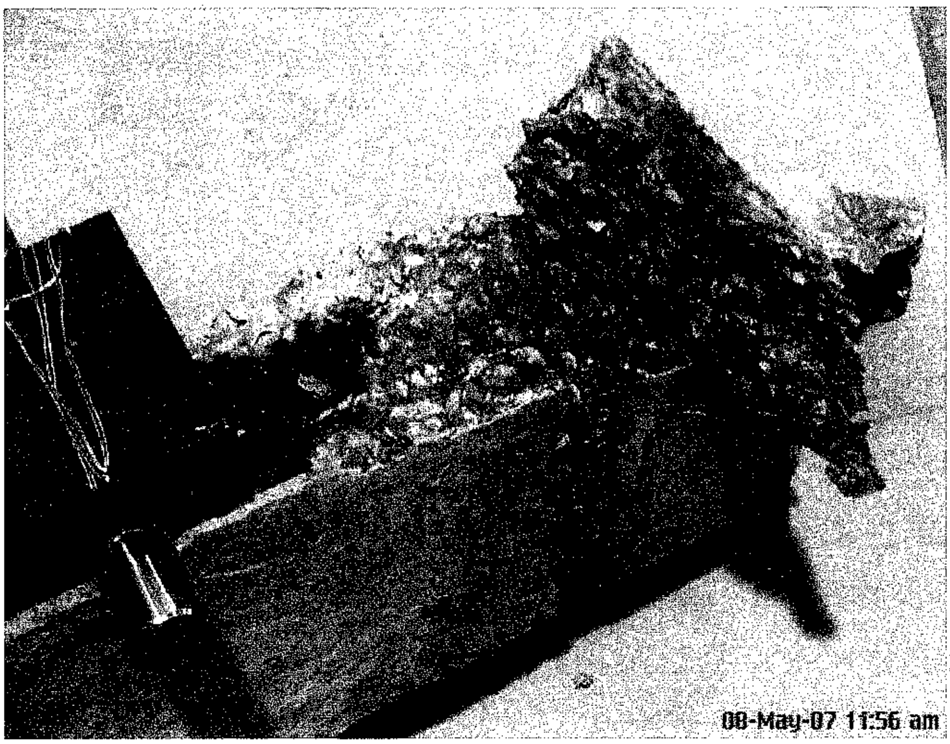


Figure 18 : 0.15 % UEO Beam after lab test

BEAM CRACK PATTERN

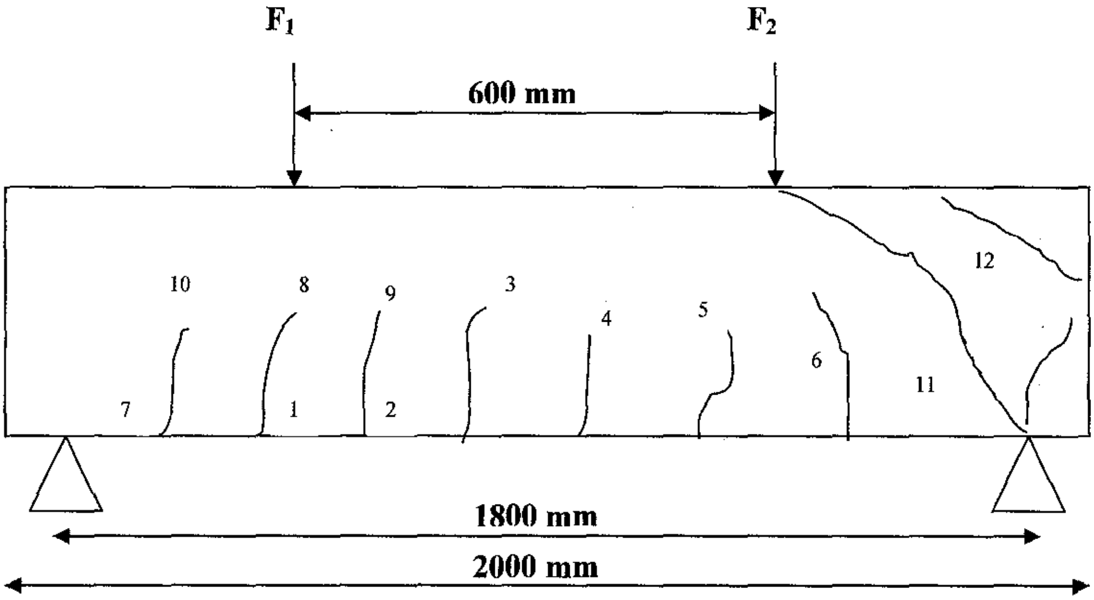


Figure: Control Beam (100% Cement)

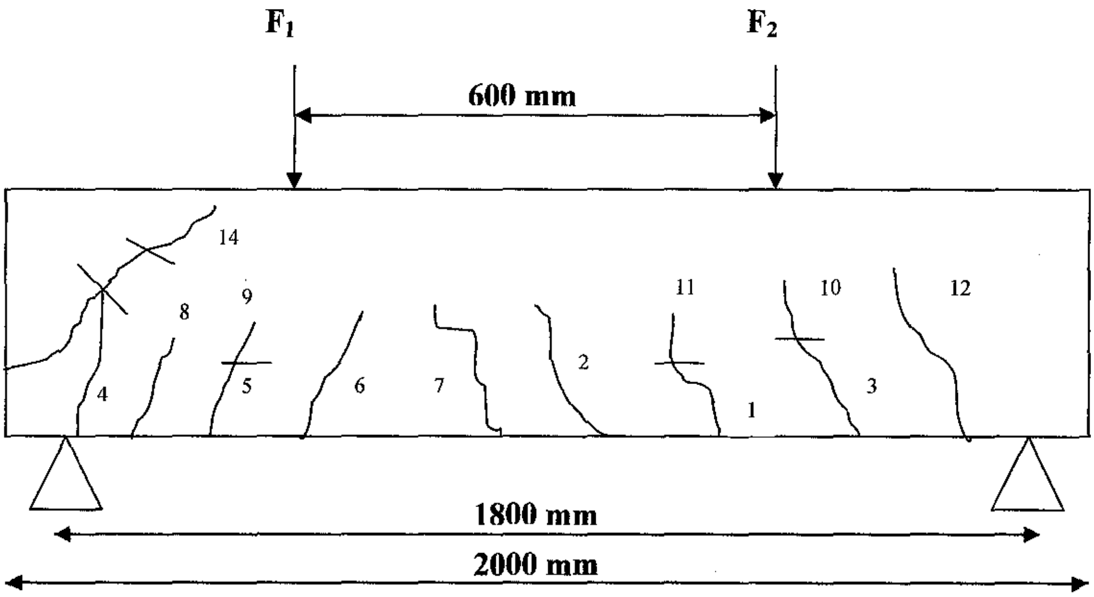


Figure: 0.15% UEO crack pattern

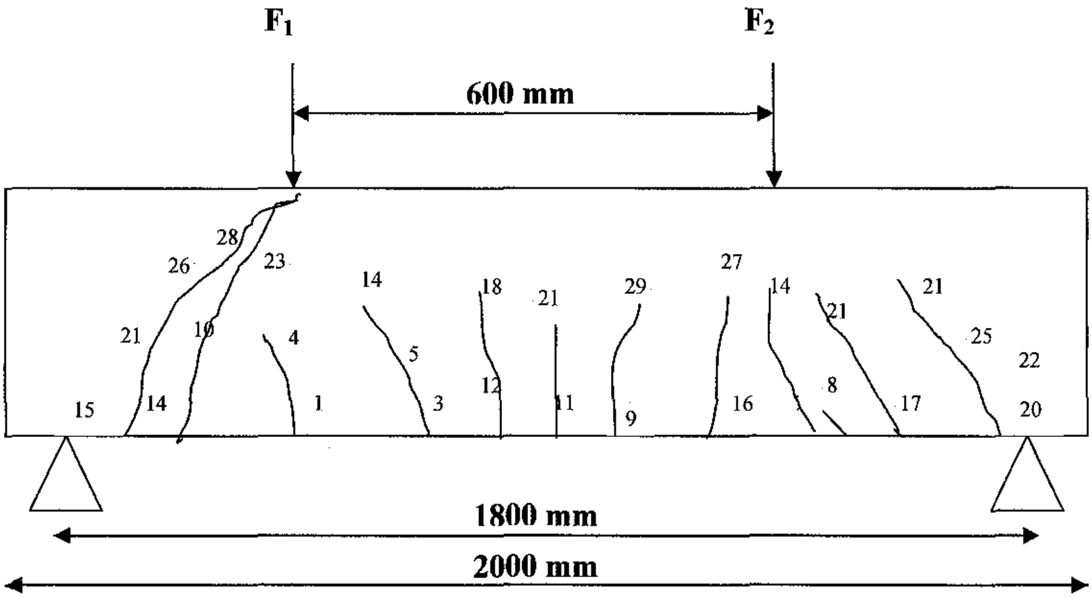


Figure : 0.15% NEO crack pattern

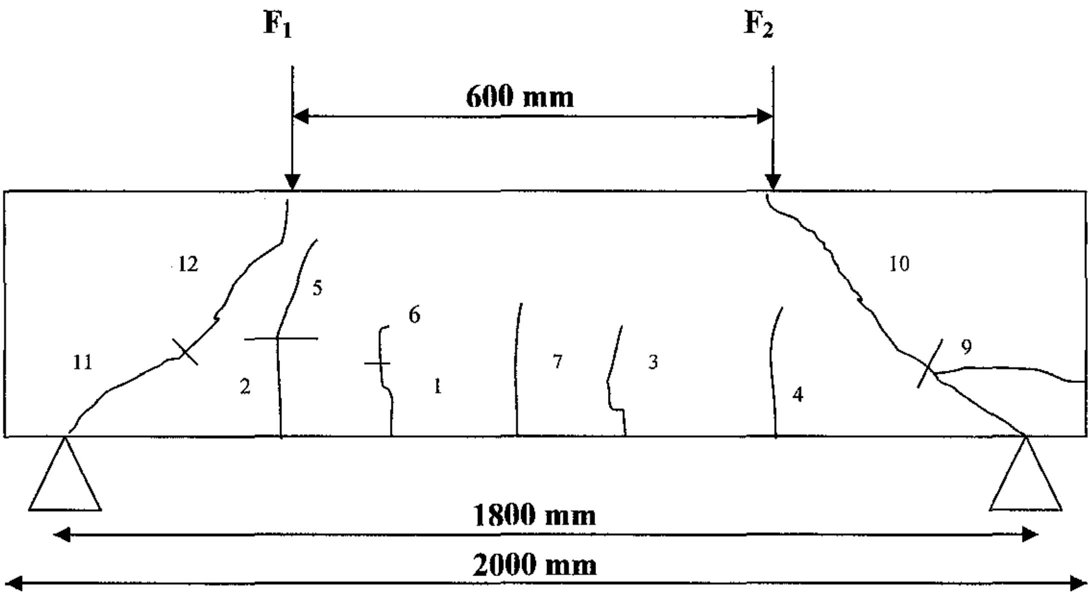


Figure : RHA Control crack pattern

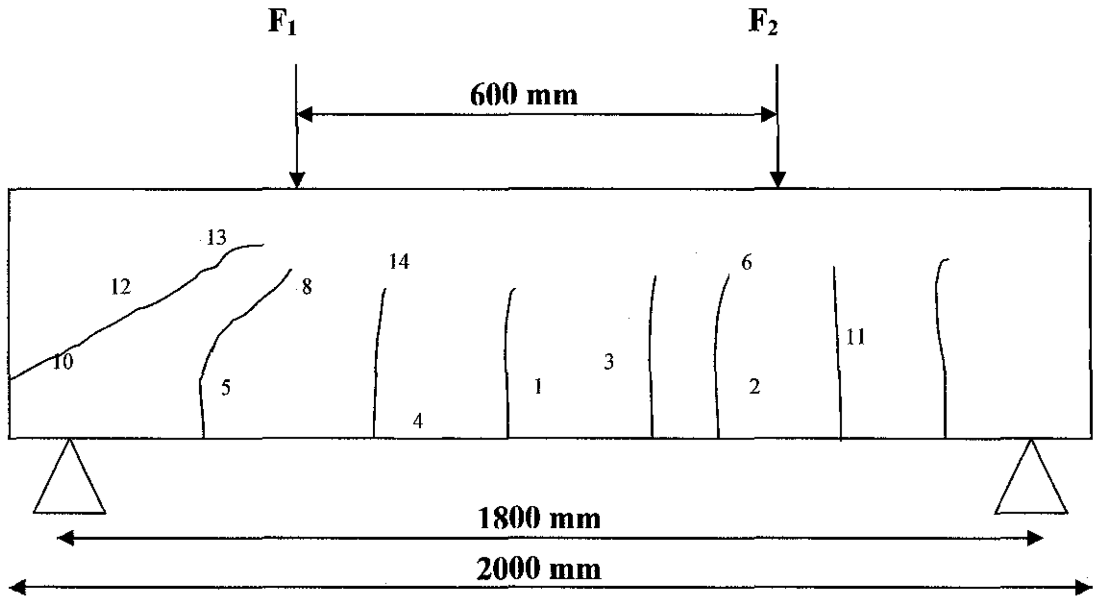


Figure: 20% PFA + S.P crack pattern

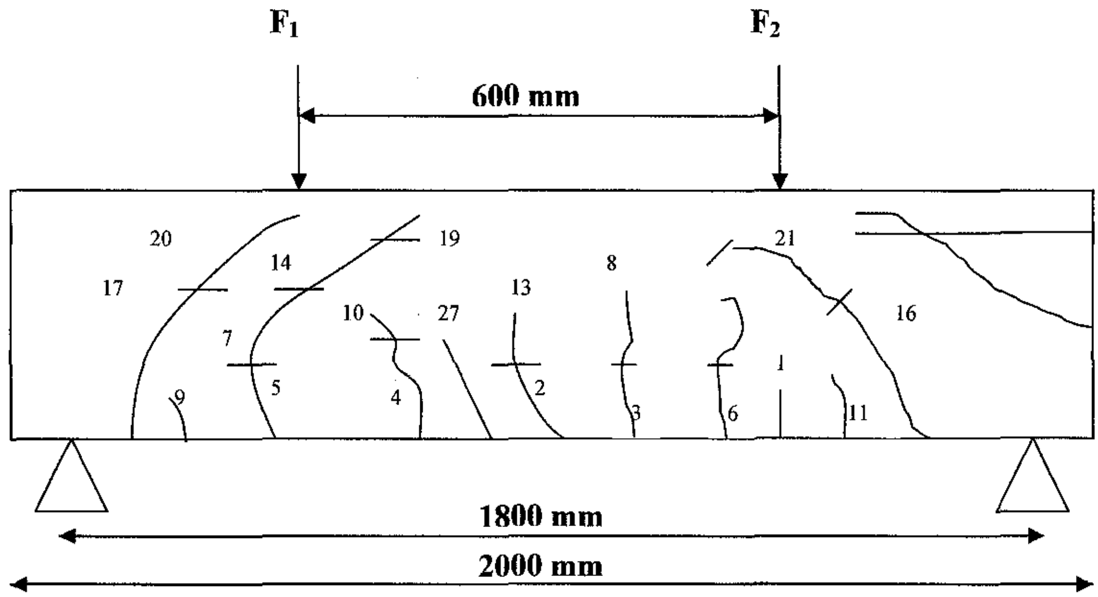


Figure: PFA Control crack pattern

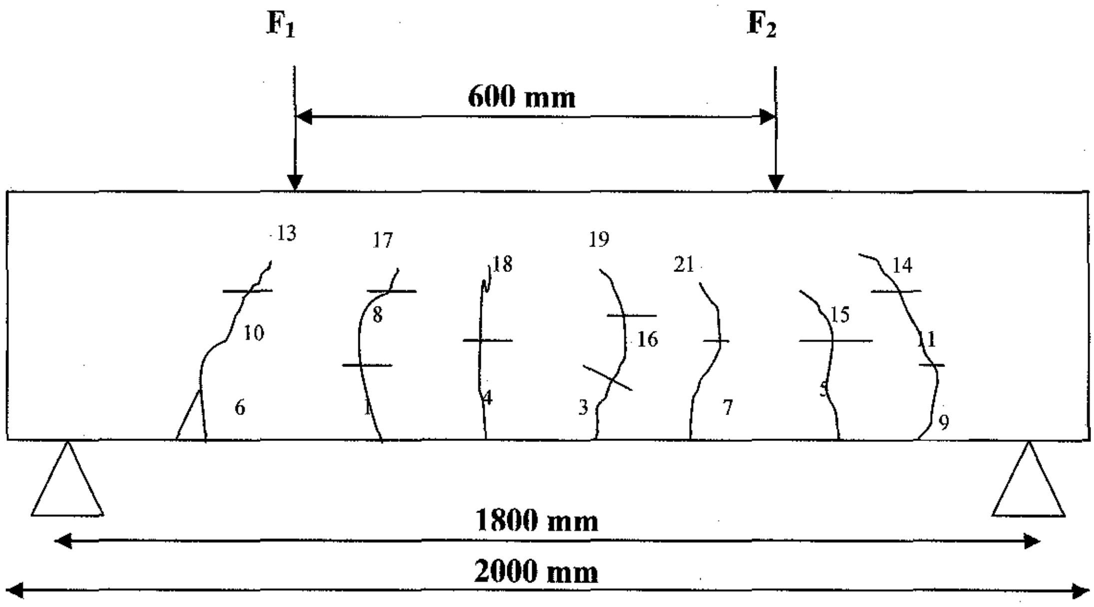


Figure: 0.15 % S.P crack pattern

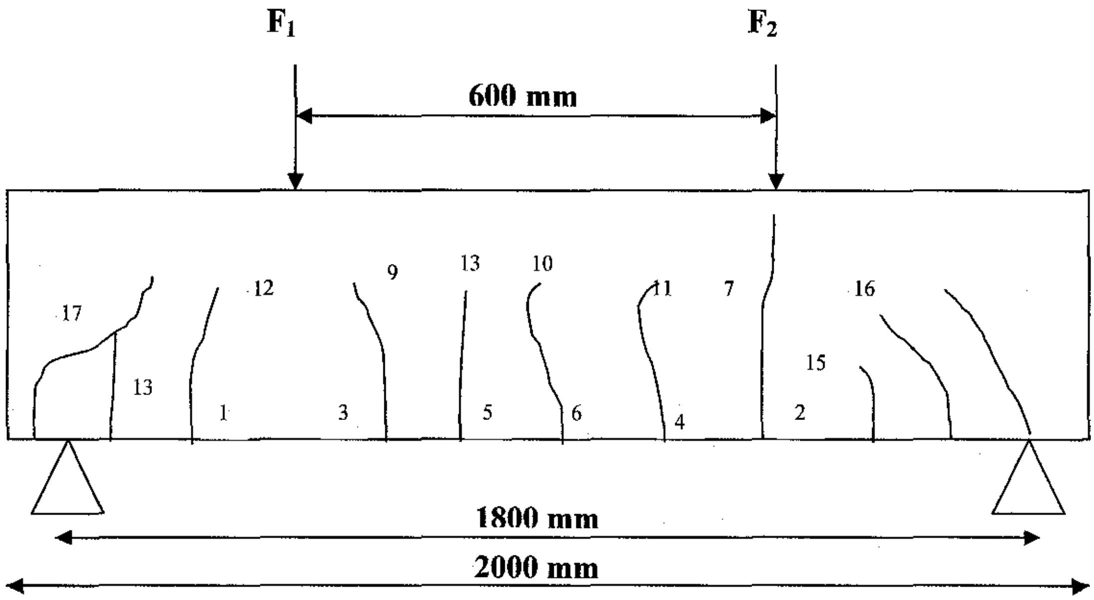


Figure: 20% RHA + S.P crack pattern

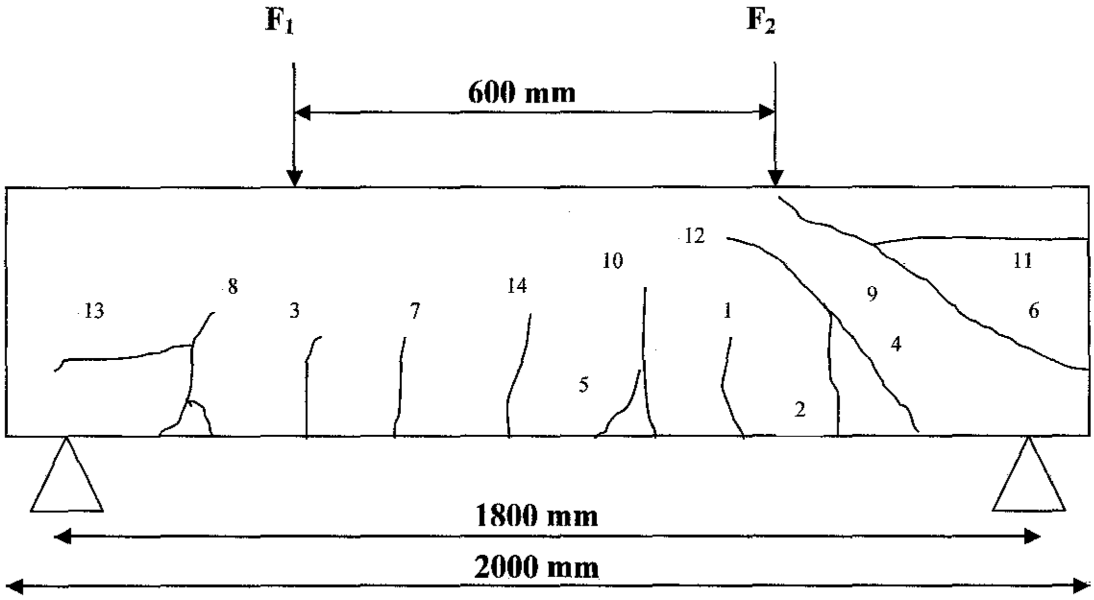


Figure: PFA + UEO crack pattern

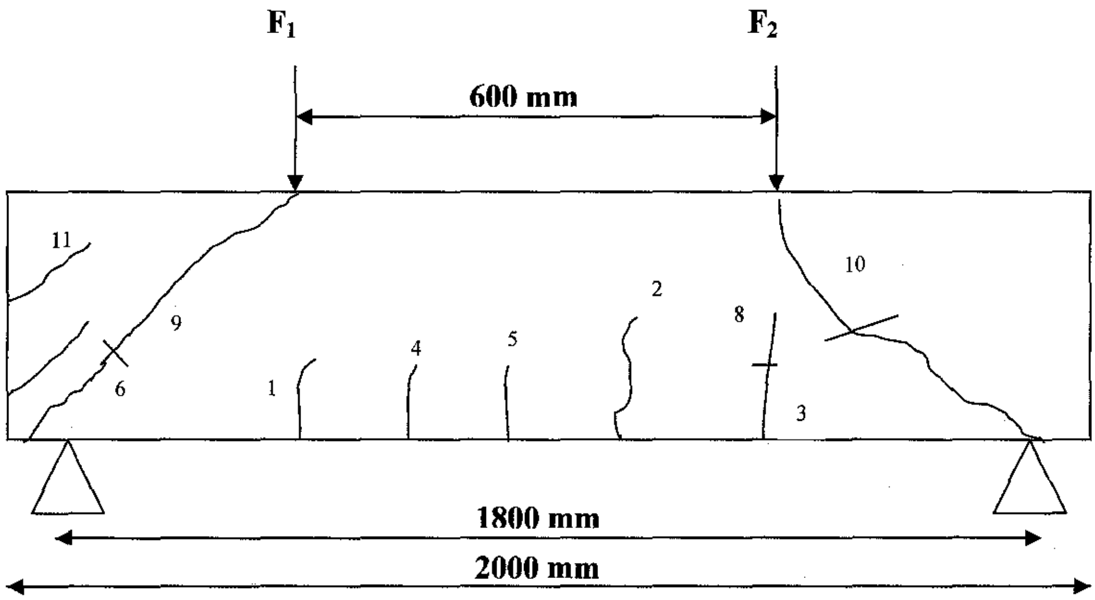
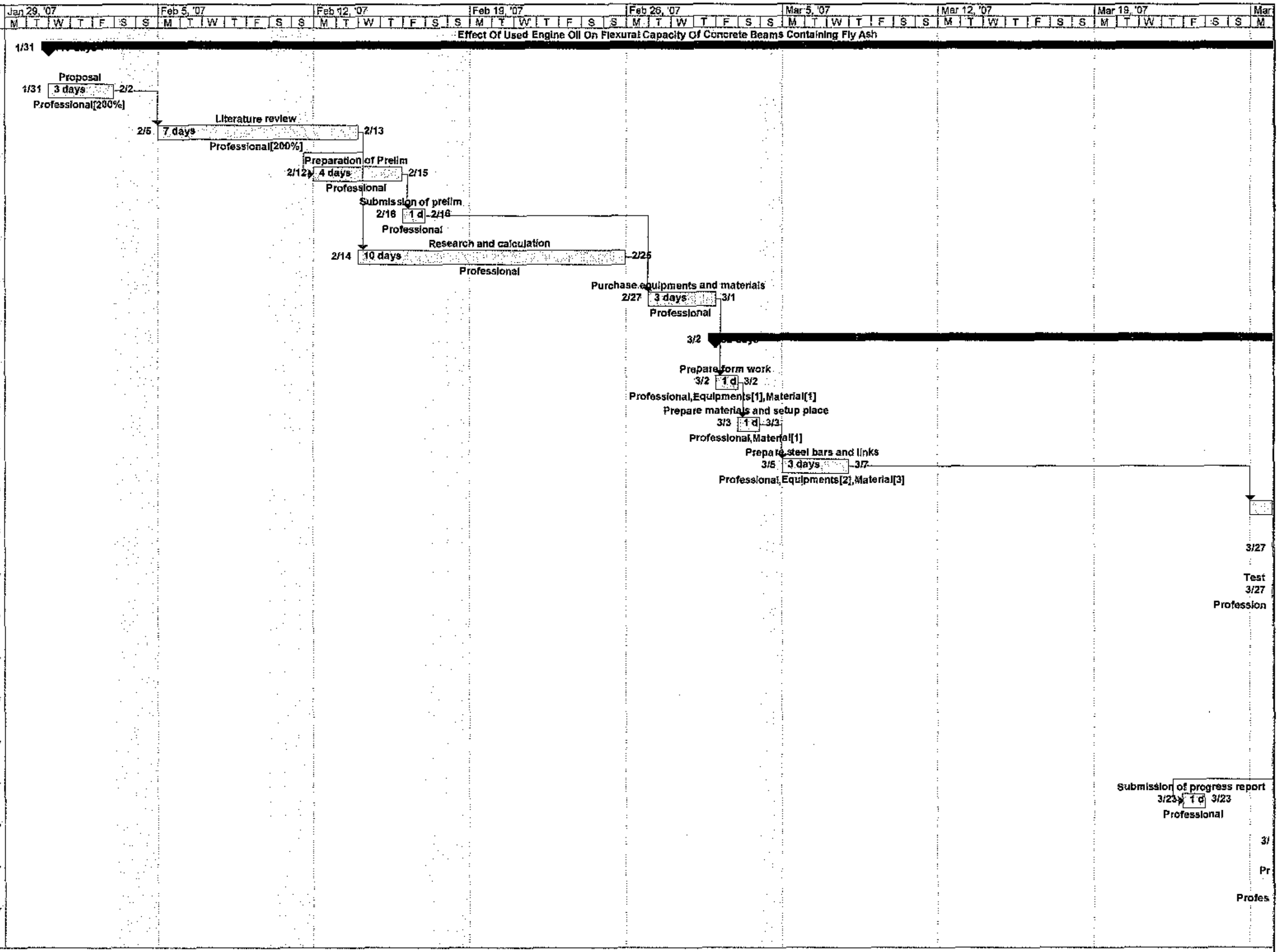


Figure: RHA + UEO crack pattern

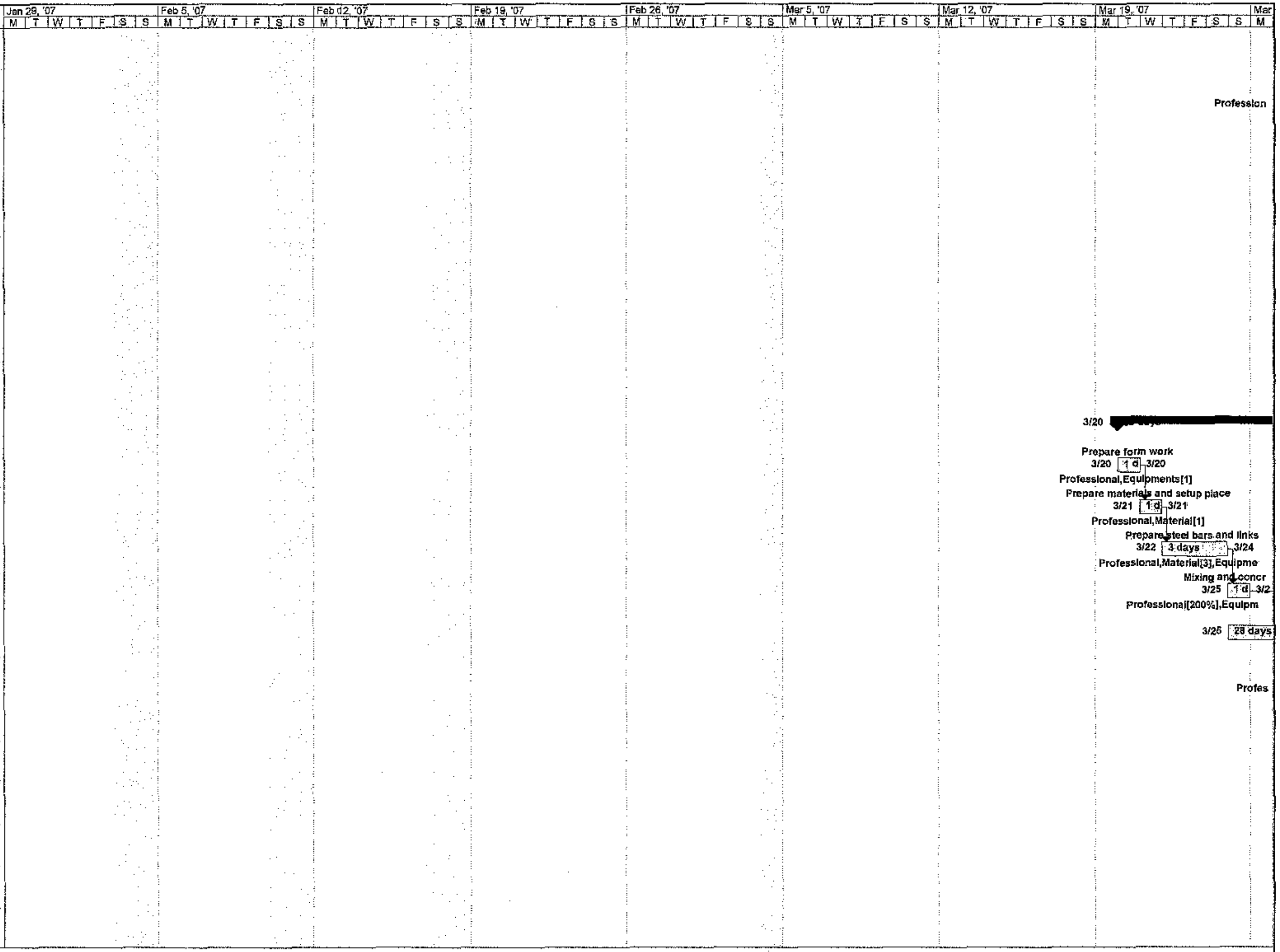
GANTT CHART PLANNING FOR 1 SEMESTER

ID	Task Name	Duration	Start	Finish
1	**Effect Of Used Engine Oil On Flexural Capacity Of Concrete Beams Containing**	**119 days**	**Wed 1/31/07**	**Fri 6/8/07**
2	Proposal	3 days	Wed 1/31/07	Fri 2/2/07
3	Literature review	7 days	Mon 2/5/07	Tue 2/13/07
4	Preparation of Prelim	4 days	Mon 2/12/07	Thu 2/15/07
5	Submission of prelim	1 day	Fri 2/16/07	Fri 2/16/07
6	Research and calculation	10 days	Wed 2/14/07	Sun 2/25/07
7	Purchase equipments and materials	3 days	Tue 2/27/07	Thu 3/1/07
8	**Fabricate beam 1**	**52 days**	**Fri 3/2/07**	**Tue 4/24/07**
9	Prepare form work	1 day	Fri 3/2/07	Fri 3/2/07
10	Prepare materials and setup place	1 day	Sat 3/3/07	Sat 3/3/07
11	Prepare steel bars and links	3 days	Mon 3/5/07	Wed 3/7/07
12	Mixing and concreting	1 day	Mon 3/26/07	Mon 3/26/07
13	Curing	28 days	Tue 3/27/07	Tue 4/24/07
14	Test at 3rd days	1 day	Tue 3/27/07	Tue 3/27/07
15	Test at 7th days	1 day	Mon 4/2/07	Mon 4/2/07
16	Test at 14th days	1 day	Tue 4/3/07	Tue 4/3/07
17	Test at 28th days	1 day	Wed 4/4/07	Wed 4/4/07
18	Prepare progress	4 days	Tue 3/27/07	Fri 3/30/07
19	Submission of progress report	1 day	Fri 3/23/07	Fri 3/23/07
20	**Fabricate beam 2**	**30 days**	**Wed 3/28/07**	**Fri 4/27/07**
21	Prepare form work	1 day	Wed 3/28/07	Wed 3/28/07
22	Prepare materials and setup place	1 day	Sat 3/31/07	Sat 3/31/07



Project: project cm Date: Thu 12/6/07	Task		Milestone	◆	Rolled Up Critical Task		Split		Group By Summary
	Critical Task		Summary		Rolled Up Milestone	◇	External Tasks		Deadline
	Progress		Rolled Up Task		Rolled Up Progress		Project Summary		

ID	Task Name	Duration	Start	Finish
23	Prepare steel bars and links	3 days	Tue 4/3/07	Fri 4/6/07
24	Mixing and concreting	1 day	Thu 3/29/07	Thu 3/29/07
25	Curing	28 days	Fri 3/30/07	Fri 4/27/07
26	Test at 3rd days	1 day	Fri 3/30/07	Fri 3/30/07
27	Test at 7th days	1 day	Sat 3/31/07	Sat 3/31/07
28	Test at 14th days	1 day	Mon 4/2/07	Mon 4/2/07
29	Test at 28th days	1 day	Mon 4/16/07	Mon 4/16/07
30	Prepare 1st draft	8 days	Wed 4/25/07	Wed 5/2/07
31	Submit 1st draft	1 day	Thu 5/3/07	Thu 5/3/07
32	**Fabricate beam 3**	**33 days**	**Tue 3/20/07**	**Sun 4/22/07**
33	Prepare form work	1 day	Tue 3/20/07	Tue 3/20/07
34	Prepare materials and setup place	1 day	Wed 3/21/07	Wed 3/21/07
35	Prepare steel bars and links	3 days	Thu 3/22/07	Sat 3/24/07
36	Mixing and concreting	1 day	Sun 3/25/07	Sun 3/25/07
37	Curing	28 days	Sun 3/25/07	Sun 4/22/07
38	Test at 3rd days	1 day	Wed 3/28/07	Wed 3/28/07
39	Test at 7th days	1 day	Mon 4/2/07	Mon 4/2/07
40	Test at 14th days	1 day	Sun 4/8/07	Sun 4/8/07
41	Test at 28 days	1 day	Sun 4/22/07	Sun 4/22/07
42	**Fabricate beam 4**	**40 days**	**Fri 3/30/07**	**Wed 5/9/07**
43	Prepare form work	1 day	Fri 3/30/07	Fri 3/30/07
44	Prepare materials and setup place	1 day	Sat 3/31/07	Sat 3/31/07



Project: project cm
Date: Thu 12/6/07

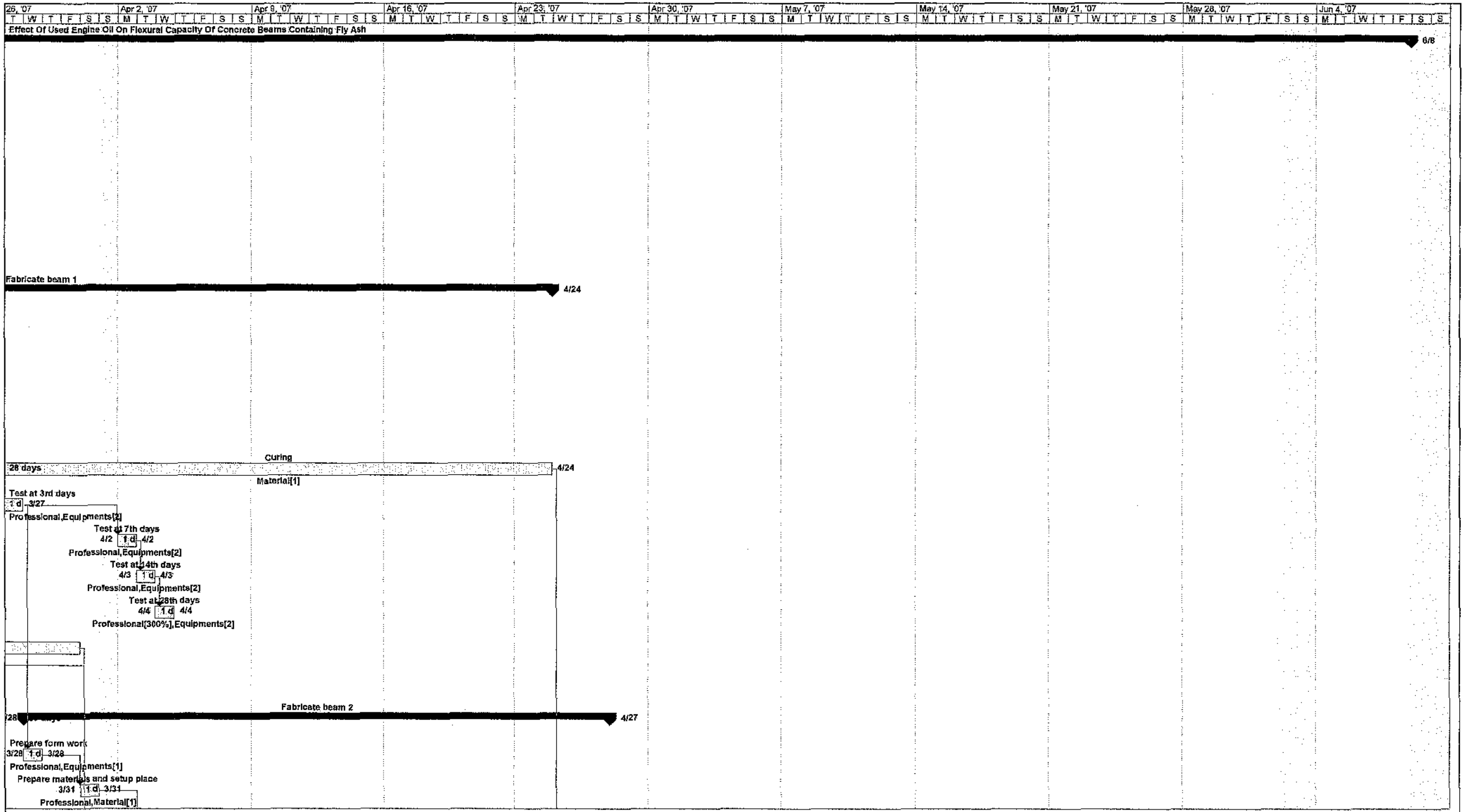
Task		Milestone		Rolled Up Critical Task		Split		Group By Summary	
Critical Task		Summary		Rolled Up Milestone		External Tasks		Deadline	
Progress		Rolled Up Task		Rolled Up Progress		Project Summary			

ID	Task Name	Duration	Start	Finish
45	Prepare steel bars and links	3 days	Tue 4/3/07	Fri 4/6/07
46	Mixing and concreting	1 day	Wed 4/11/07	Wed 4/11/07
47	Curing	28 days	Thu 4/12/07	Wed 5/9/07
48	Test at 3rd days	1 day	Thu 4/12/07	Thu 4/12/07
49	Test at 7th days	1 day	Fri 4/13/07	Fri 4/13/07
50	Test at 14th days	1 day	Tue 4/17/07	Tue 4/17/07
51	Test at 28th days	1 day	Fri 5/4/07	Fri 5/4/07
52	**Fabricate beam 5**	**34 days**	**Fri 4/13/07**	**Wed 5/16/07**
53	Prepare form work	1 day	Fri 4/13/07	Fri 4/13/07
54	Prepare materials and setup place	1 day	Sat 4/14/07	Sat 4/14/07
55	Prepare steel bars and links	3 days	Sun 4/15/07	Tue 4/17/07
56	Mixing and concreting	1 day	Wed 4/18/07	Wed 4/18/07
57	Curing	28 days	Thu 4/19/07	Wed 5/16/07
58	Test at 3rd days	1 day	Thu 4/19/07	Thu 4/19/07
59	Test at 7th days	1 day	Sat 4/21/07	Sat 4/21/07
60	Test 14th days	1 day	Sat 4/28/07	Sat 4/28/07
61	Test at 28th days	1 day	Sat 5/12/07	Sat 5/12/07
62	Prepare final draft	4 days	Thu 5/10/07	Sun 5/13/07
63	Submit final draft	1 day	Mon 5/14/07	Mon 5/14/07
64	Presentation	1 day	Wed 6/6/07	Wed 6/6/07
65	Submission of interim	1 day	Fri 6/8/07	Fri 6/8/07

Timescale: Jan 29, '07 | Feb 5, '07 | Feb 12, '07 | Feb 19, '07 | Feb 26, '07 | Mar 5, '07 | Mar 12, '07 | Mar 19, '07 | Mar (M T W T F S S per week)

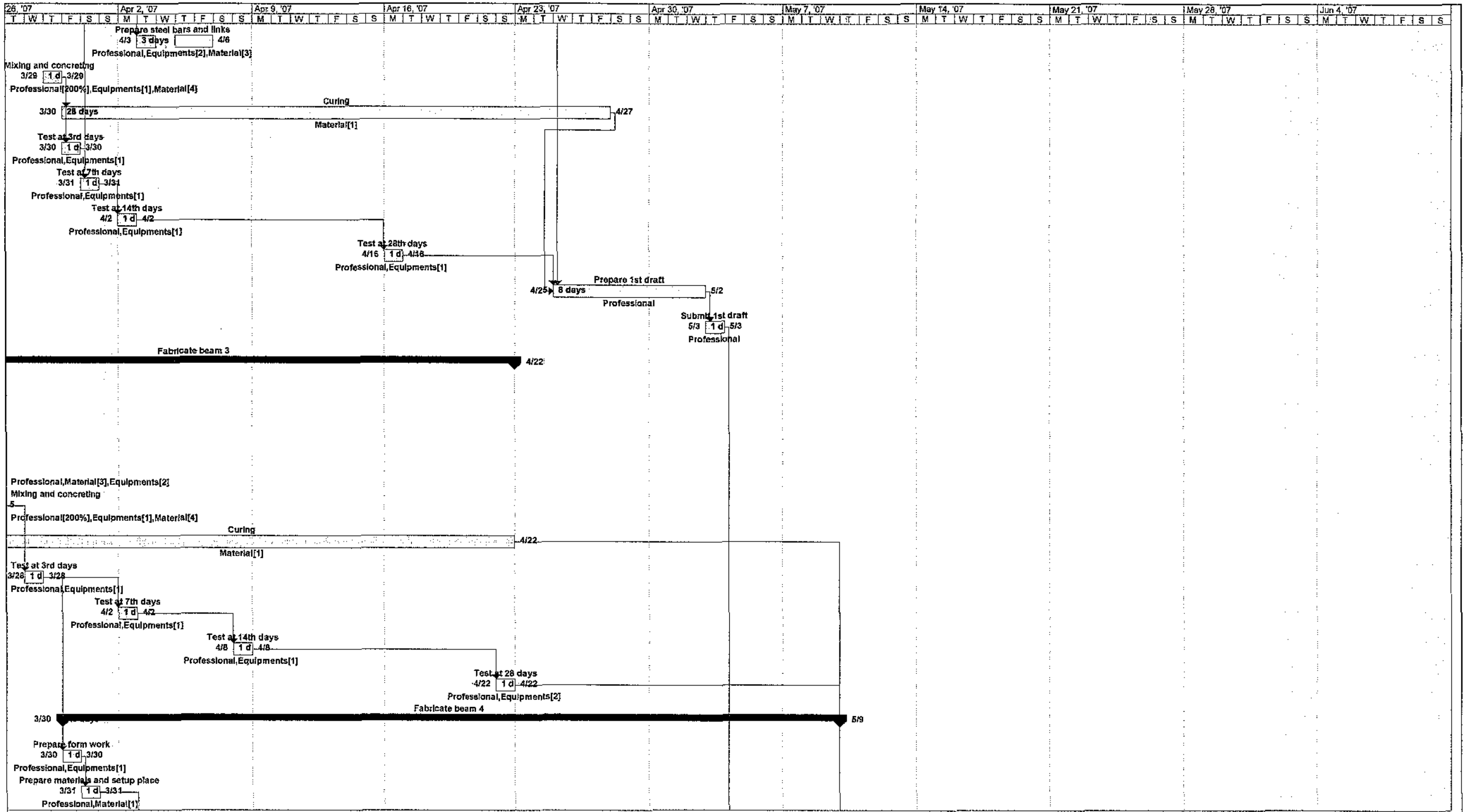
Project: project cm
Date: Thu 12/6/07

Task	Milestone	Rolled Up Critical Task
Critical Task	Summary	Rolled Up Milestone
Progress	Rolled Up Task	Rolled Up Progress
Split	Group By Summary	
External Tasks	Deadline	
Project Summary		



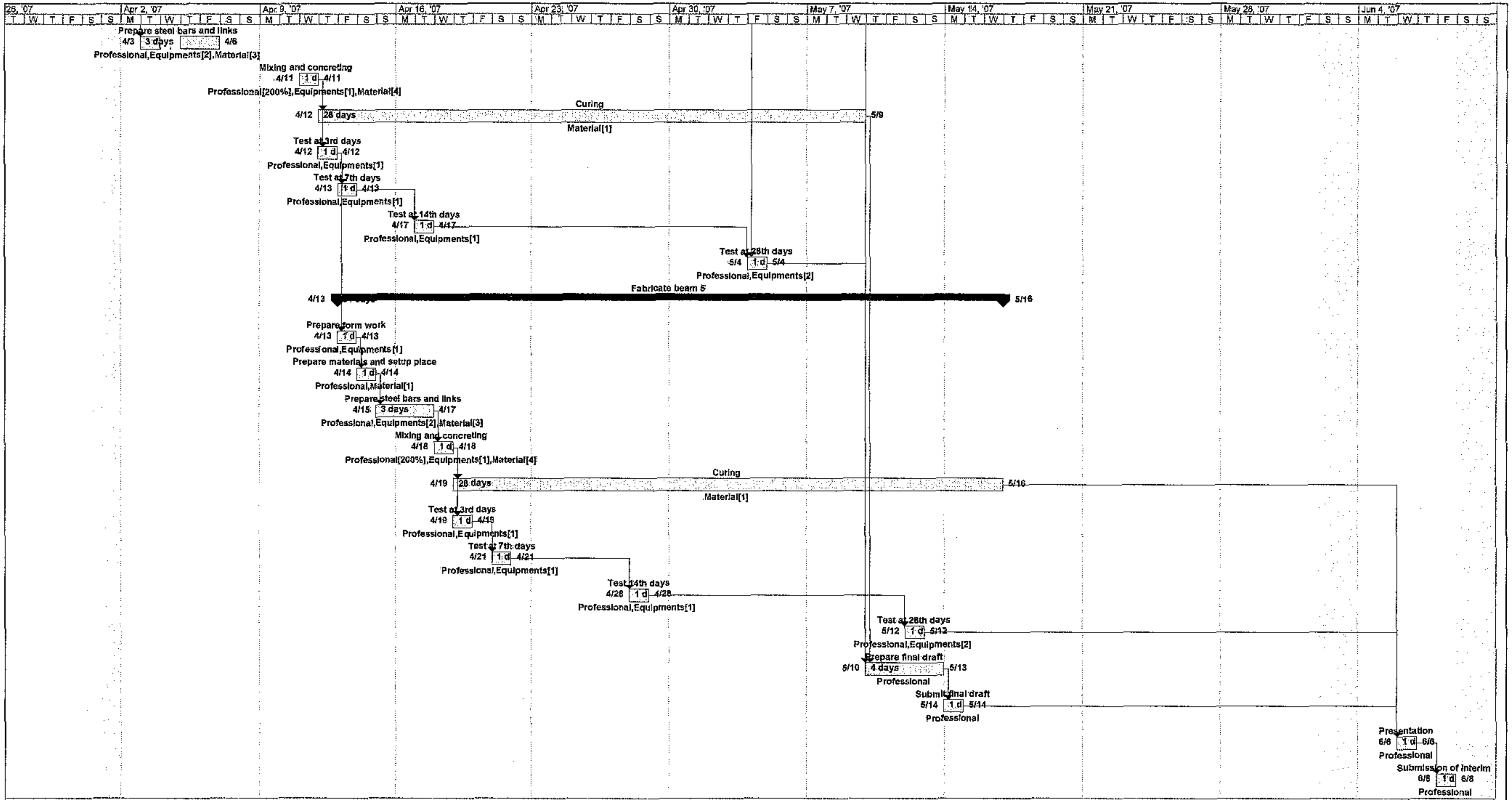
Project: project cm
Date: Thu 12/6/07

Task		Milestone		Rolled Up Critical Task		Split		Group By Summary	
Critical Task		Summary		Rolled Up Milestone		External Tasks		Deadline	
Progress		Rolled Up Task		Rolled Up Progress		Project Summary			



Project: project cm
Date: Thu 12/6/07

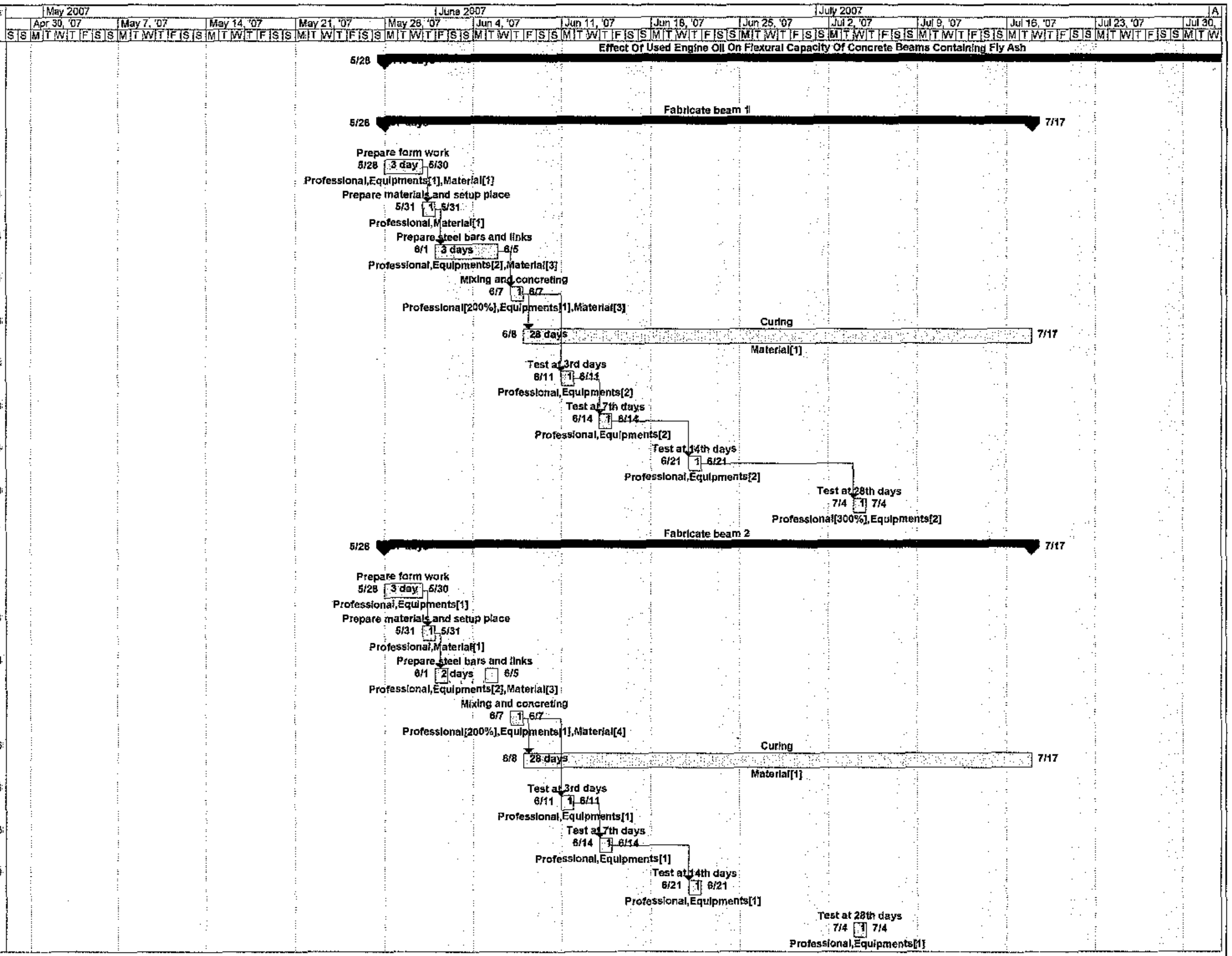
Task		Milestone		Rolled Up Critical Task		Split		Group By Summary	
Critical Task		Summary		Rolled Up Milestone		External Tasks		Deadline	
Progress		Rolled Up Task		Rolled Up Progress		Project Summary			



Project: project cm Date: Thu 12/6/07	Task		Milestone		Rolled Up Critical Task		Split	Group By Summary
	Critical Task		Summary		Rolled Up Milestone		External Tasks	Deadline
	Progress		Rolled Up Task		Rolled Up Progress		Project Summary	

GANTT CHART PLANNING FOR 2 SEMESTER

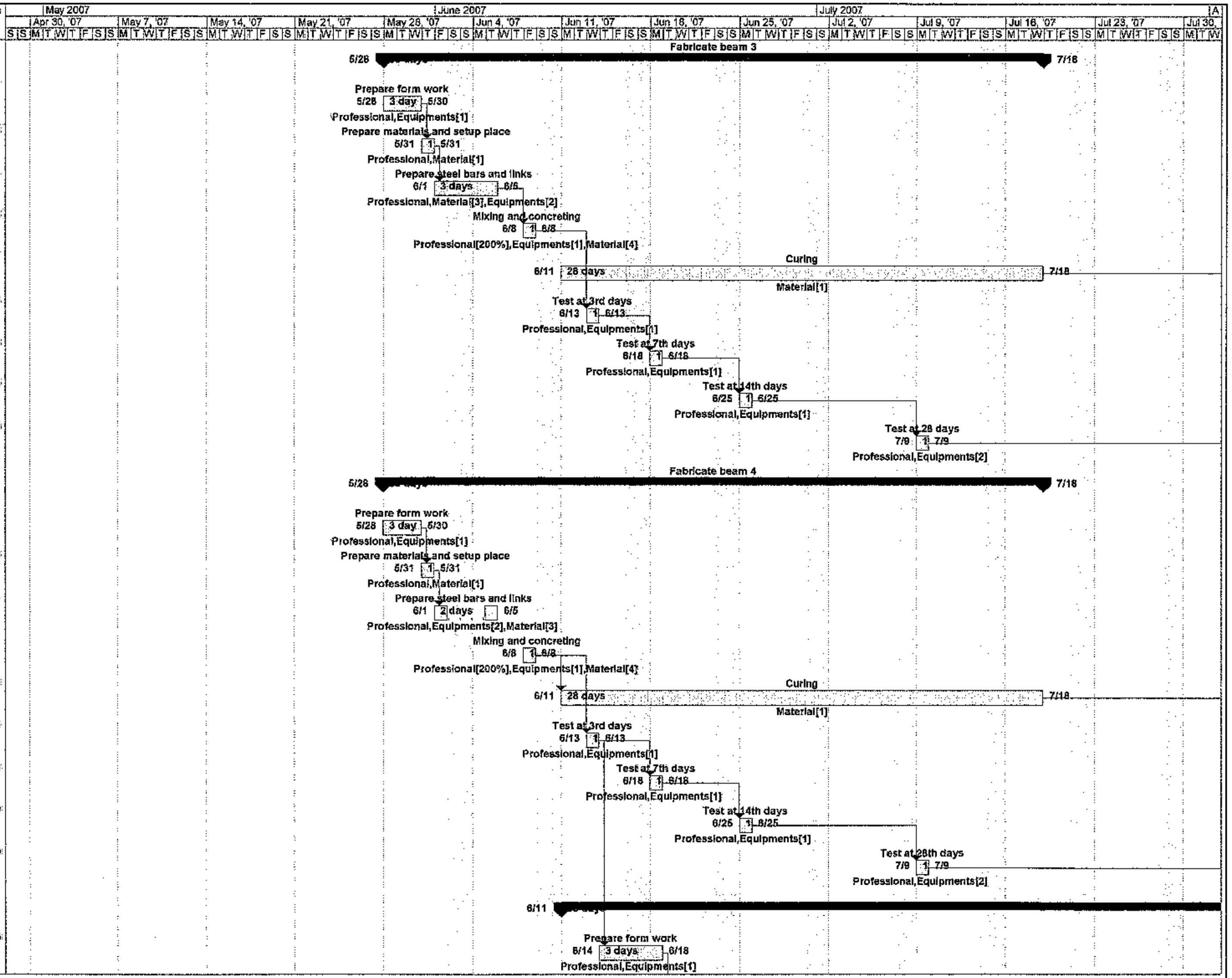
ID	Task Name	Duration	Start	Finish	Predecessors
1	**Effect Of Used Engine Oil On Flexural Capacity Of Concrete Beams Containing Fly Ash**	**148 days**	**Mon 5/28/07**	**Fri 12/14/07**	
2	**Fabricate beam 1**	**37 days**	**Mon 5/28/07**	**Tue 7/17/07**	
3	Prepare form work	3 days	Mon 5/28/07	Wed 5/30/07	
4	Prepare materials and setup place	1 day	Thu 5/31/07	Thu 5/31/07	3
5	Prepare steel bars and links	3 days	Fri 6/1/07	Tue 6/5/07	4
6	Mixing and concreting	1 day	Thu 6/7/07	Thu 6/7/07	5
7	Curing	28 days	Fri 6/8/07	Tue 7/17/07	6
8	Test at 3rd days	1 day	Mon 6/11/07	Mon 6/11/07	6
9	Test at 7th days	1 day	Thu 6/14/07	Thu 6/14/07	8
10	Test at 14th days	1 day	Thu 6/21/07	Thu 6/21/07	9
11	Test at 28th days	1 day	Wed 7/4/07	Wed 7/4/07	10
12	**Fabricate beam 2**	**37 days**	**Mon 5/28/07**	**Tue 7/17/07**	
13	Prepare form work	3 days	Mon 5/28/07	Wed 5/30/07	
14	Prepare materials and setup place	1 day	Thu 5/31/07	Thu 5/31/07	13
15	Prepare steel bars and links	2 days	Fri 6/1/07	Tue 6/5/07	14
16	Mixing and concreting	1 day	Thu 6/7/07	Thu 6/7/07	
17	Curing	28 days	Fri 6/8/07	Tue 7/17/07	16
18	Test at 3rd days	1 day	Mon 6/11/07	Mon 6/11/07	16
19	Test at 7th days	1 day	Thu 6/14/07	Thu 6/14/07	18
20	Test at 14th days	1 day	Thu 6/21/07	Thu 6/21/07	19
21	Test at 28th days	1 day	Wed 7/4/07	Wed 7/4/07	



Project: project cm
Date: Thu 12/6/07

Task	Milestone	Rolled Up Critical Task	Split	Group By Summary
Critical Task	Summary	Rolled Up Milestone	External Tasks	Deadline
Progress	Rolled Up Task	Rolled Up Progress	Project Summary	

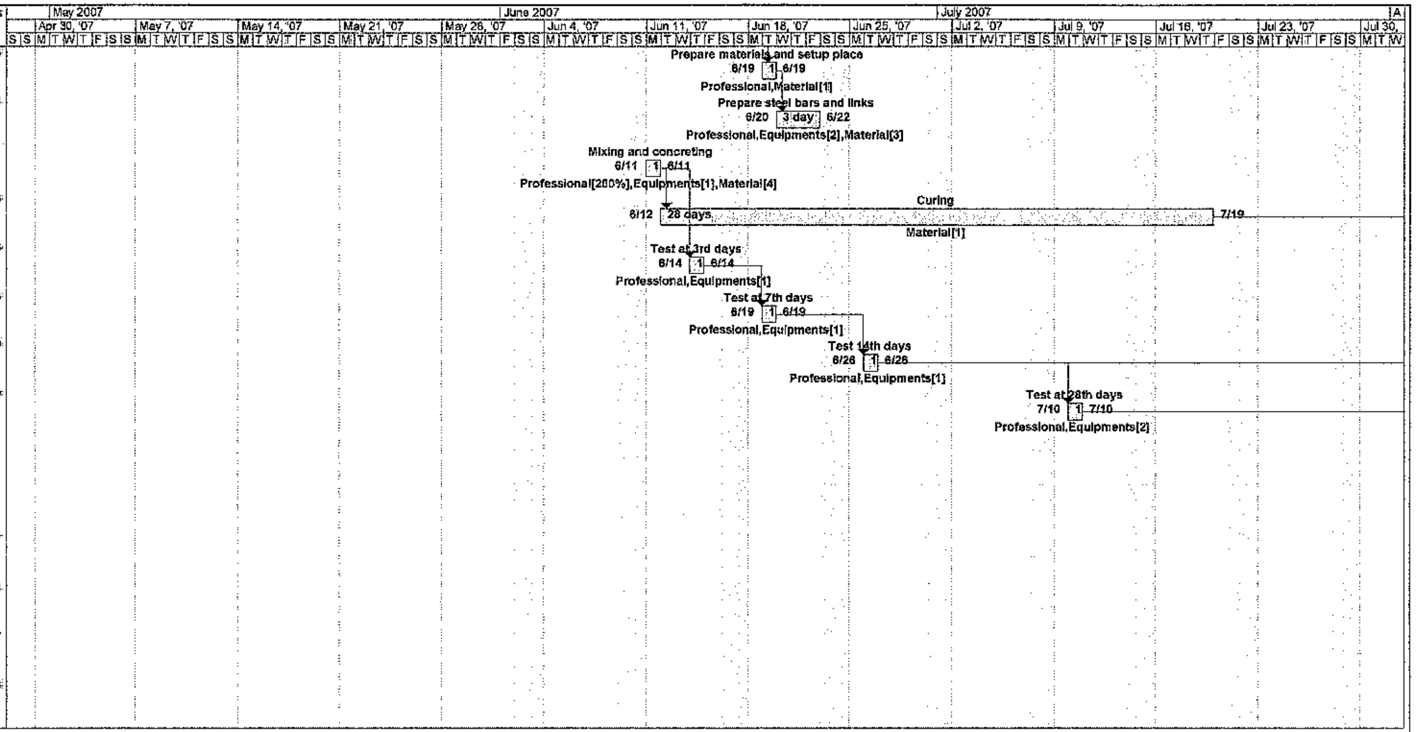
ID	Task Name	Duration	Start	Finish	Predecessors
22	**Fabricate beam 3**	**38 days**	**Mon 5/28/07**	**Wed 7/18/07**	
23	Prepare form work	3 days	Mon 5/28/07	Wed 5/30/07	
24	Prepare materials and setup place	1 day	Thu 5/31/07	Thu 5/31/07	23
25	Prepare steel bars and links	3 days	Fri 6/1/07	Tue 6/5/07	24
26	Mixing and concreting	1 day	Fri 6/8/07	Fri 6/8/07	25
27	Curing	28 days	Mon 6/11/07	Wed 7/18/07	
28	Test at 3rd days	1 day	Wed 6/13/07	Wed 6/13/07	26
29	Test at 7th days	1 day	Mon 6/18/07	Mon 6/18/07	28
30	Test at 14th days	1 day	Mon 6/25/07	Mon 6/25/07	29
31	Test at 28 days	1 day	Mon 7/9/07	Mon 7/9/07	30
32	**Fabricate beam 4**	**38 days**	**Mon 5/28/07**	**Wed 7/18/07**	
33	Prepare form work	3 days	Mon 5/28/07	Wed 5/30/07	
34	Prepare materials and setup place	1 day	Thu 5/31/07	Thu 5/31/07	33
35	Prepare steel bars and links	2 days	Fri 6/1/07	Tue 6/5/07	34
36	Mixing and concreting	1 day	Fri 6/8/07	Fri 6/8/07	
37	Curing	28 days	Mon 6/11/07	Wed 7/18/07	36
38	Test at 3rd days	1 day	Wed 6/13/07	Wed 6/13/07	36
39	Test at 7th days	1 day	Mon 6/18/07	Mon 6/18/07	38
40	Test at 14th days	1 day	Mon 6/25/07	Mon 6/25/07	39
41	Test at 28th days	1 day	Mon 7/9/07	Mon 7/9/07	40
42	**Fabricate beam 5**	**83 days**	**Mon 6/11/07**	**Wed 10/3/07**	
43	Prepare form work	3 days	Thu 6/14/07	Mon 6/18/07	38



Project: project cm
Date: Thu 12/6/07

Task	Milestone	Rolled Up Critical Task	Split
Critical Task	Summary	Rolled Up Milestone	External Tasks
Progress	Rolled Up Task	Rolled Up Progress	Project Summary
Group By Summary	Deadline		

ID	Task Name	Duration	Start	Finish	Predecessors
44	Prepare materials and setup place	1 day	Tue 6/19/07	Tue 6/19/07	43
45	Prepare steel bars and links	3 days	Wed 6/20/07	Fri 6/22/07	44
46	Mixing and concreting	1 day	Mon 6/11/07	Mon 6/11/07	
47	Curing	28 days	Tue 6/12/07	Thu 7/19/07	46
48	Test at 3rd days	1 day	Thu 6/14/07	Thu 6/14/07	46
49	Test at 7th days	1 day	Tue 6/19/07	Tue 6/19/07	48
50	Test 14th days	1 day	Tue 6/26/07	Tue 6/26/07	49
51	Test at 28th days	1 day	Tue 7/10/07	Tue 7/10/07	50
52	Progress Report	1 day	Fri 8/17/07	Fri 8/17/07	
53	Pre EDX Poster Presentation	1 day	Wed 10/3/07	Wed 10/3/07	
54	Prepare final draft	12 days	Thu 11/1/07	Fri 11/16/07	),41,37,31,27
55	Submit final draft	1 day	Fri 11/23/07	Fri 11/23/07	54
56	Presentation	1 day	Tue 12/4/07	Tue 12/4/07	55,51,47
57	Submission of interim	1 day	Fri 12/14/07	Fri 12/14/07	56



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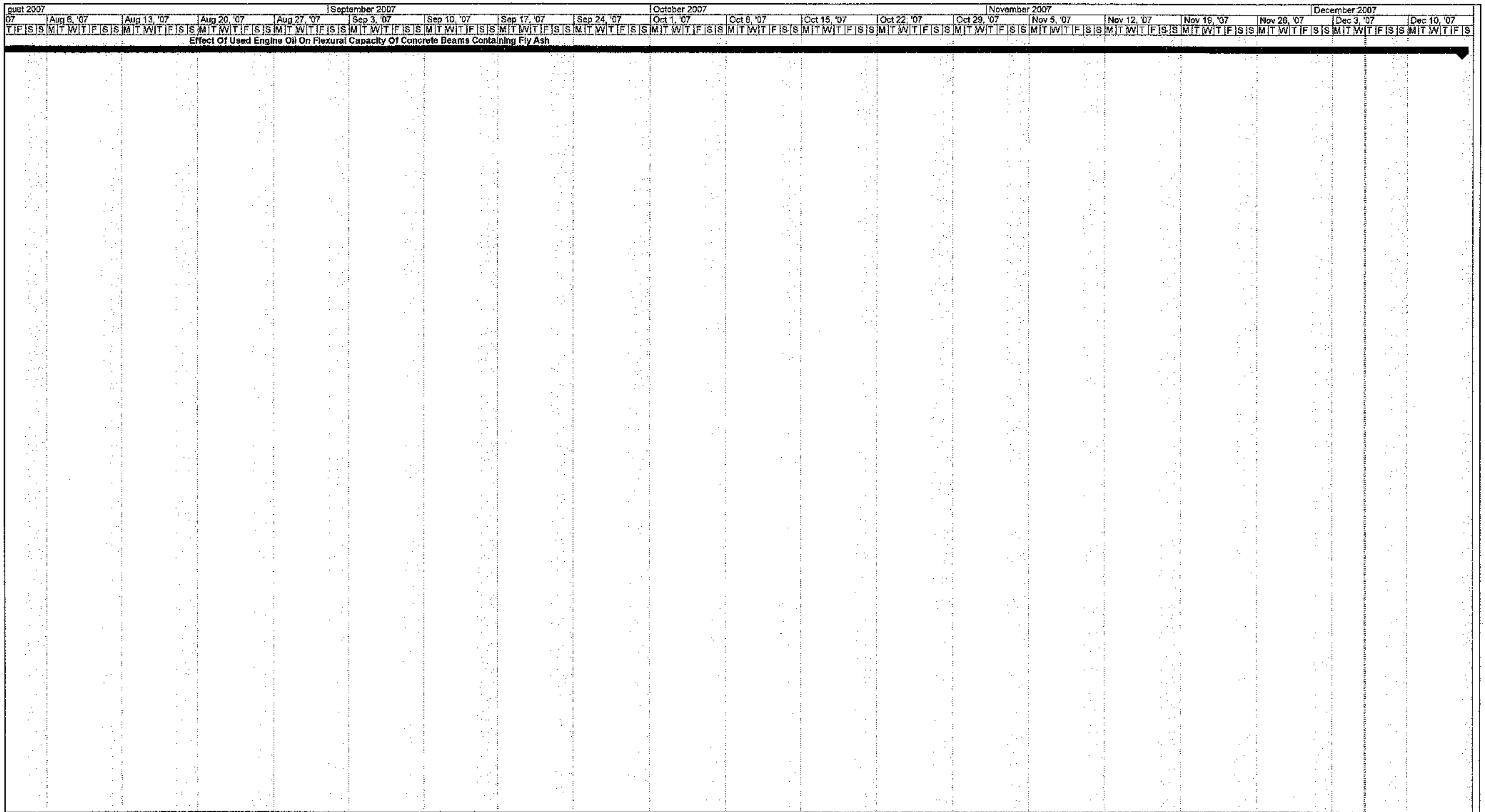
Date: Thu 12/6/07

Task | Critical Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Critical Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary | Deadline



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Task		Milestone		Rolled Up Critical Task		Split		Group By Summary	
Critical Task		Summary		Rolled Up Milestone		External Tasks		Deadline	
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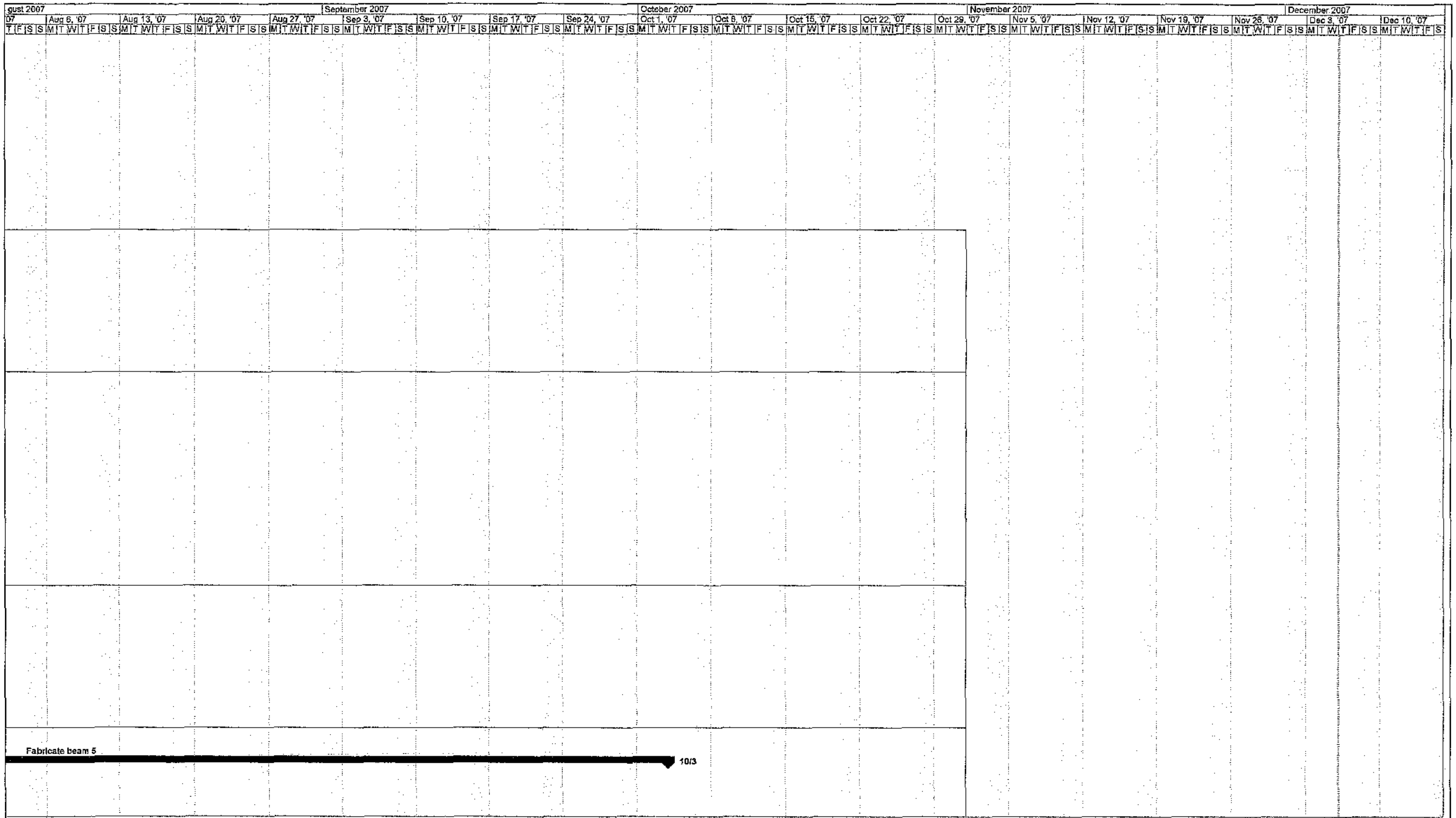

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Task		Milestone		Rolled Up Critical Task		Split		Group By Summary	
Critical Task		Summary		Rolled Up Milestone		External Tasks		Deadline	
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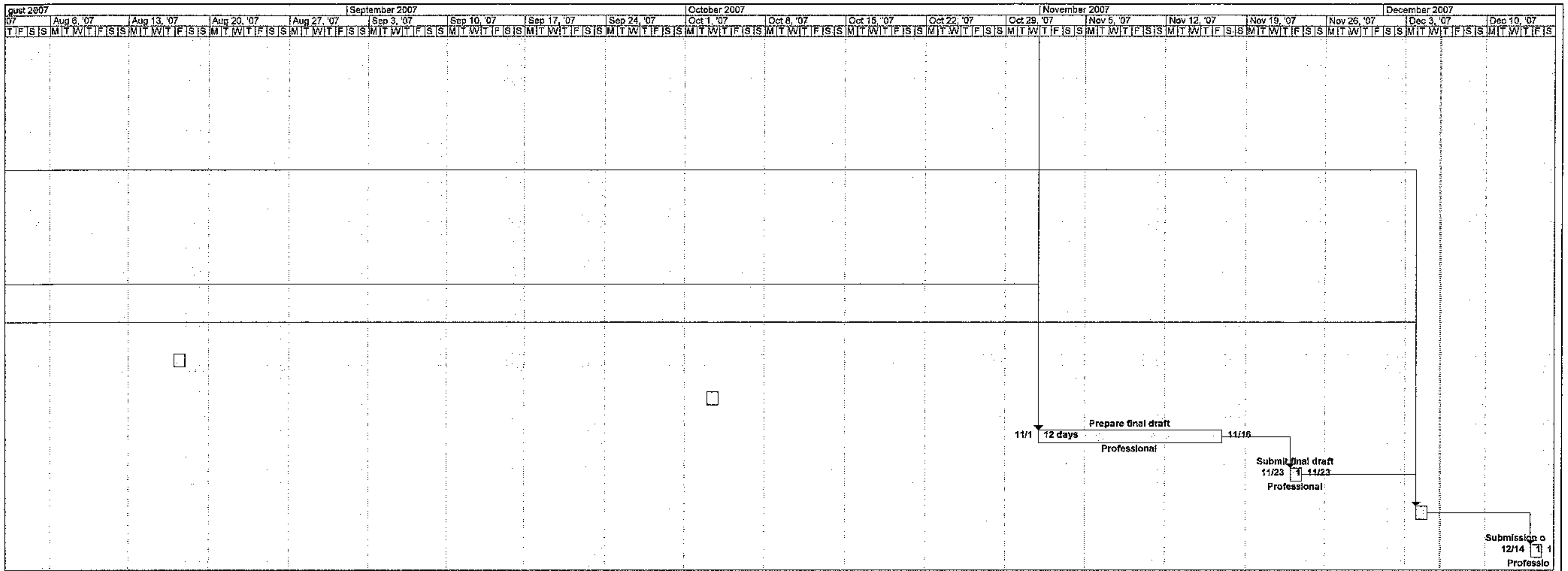

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	Critical Task		Summary		Rolled Up Milestone		External Tasks		Deadline	
	Progress		Rolled Up Task		Rolled Up Progress		Project Summary			