How the Shrinking Concrete ends up with Cracks?

Key Stage 4 Programme

Pupil Name	
Handbook Designed by	Dr Oladiran

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			
6 (Feedback)			
7 (Hand-in)			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Baseline Assignment	
Tutorial 2	Handout/Homework	
Tutorial 3	Handout/Homework	
Tutorial 4	Handout/Homework	
Tutorial 5	Final Assignment	

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight_____ on_____	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Uni Pathways – Pupil Feedback Report

Grade	Marks	Guidance
1st	70+	Performing at an excellent Standard at A-level
2:1	60-69	Performing to a good standard at AS-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below the standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Name of PhD Tutor			
Title of Assignment			
Name of Pupil			
Name of School			
ORIGINAL MARK / 100		FINAL MARK / 100	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the PhD tutor should give an explanation in this section:

Learning Feedback Comment 1 - ***Enter Key Learning Priority Here***	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Learning Feedback Comment 2 – ***Enter Key Learning Priority Here***	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Learning Feedback Comment 3 – ***Enter Key Learning Priority Here***	
What you did in relation to this Key Learning Priority *Enter feedback here*	How you could improve in the future *Enter feedback here*
Resilience Comment	
How you showed learning resilience during the course *Enter feedback here*	How you could build learning resilience in the future *Enter feedback here*

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Course Rationale

Subject Background

The complexities of early-age cracking of concrete and other cement-based materials are not yet fully understood. Although so many researches have been carried out using various tests methods, the complexity of cracking still holds 'high ground'. Cracking can lead to premature deterioration, which shortens the service life of concrete structures and present a potential hazard. We do not have an estimation of the cost of repairing and strengthening concrete structures in the UK at present. However, it is estimated that the total cost of repair, rehabilitation, strengthening and protection of concrete structures in the U.S. alone is between 18 and 21 billion (USD) a year of which at least 6 to 8 billion (USD) are crack related repair (Emmons Sordyl, 2004). These figures were documented about 14 years ago, so we have little idea of what the cumulated cost would be in the present day.

Recent expansion in construction, new cement development and high-strength concrete technology have renewed worldwide concerns on cracking of concrete, among which shrinkage induced cracking in concrete is presented as a unique challenge to engineers.

Purpose of Course

This course will provide the pupil with the background knowledge of shrinkage cracking and some other concepts that will help the pupil understand the process that leads to cracking. Furthermore, the pupil will gain an understanding of how these concepts can be used to detect what time the first crack shows up before it starts to grow.

Course Objectives

The main objectives of this course are as follows:

- To understand how cracking affects concrete structures;
- Outline different test methods as well as their advantages and disadvantages;
- Understand the different concepts in the process of cracking;
- To gain an understanding of the major criteria that leads to shrinkage cracking;
- To be able to demonstrate and present the major concepts in the process.

	Skills	1st (70-100)	2:1 (60-69)	2:2 (50-59)
SUBJECT KNOWLEDGE	Knowledge and Understanding	• All materials used are relevant to the general topic and to the specific question/title • Good understanding of all the relevant topics • Clear justification on how the material used is related to the specific issues that are the focus of the essay	• Most of the materials used are relevant to the general topic and to the specific question/title • Good understanding of most the relevant topics • Adequate justification on how the material used is related to the specific issues that are the focus of the essay	• Some of the materials used are relevant to the general topic and to the specific question/title • Good understanding on some of the relevant topics but occasional confusion on others • Some justification on how the material used is related to the specific issues that are the focus of the essay
CRITICAL THINKING	Research and Evidence	• Use evidence to support claims/assertions/ideas, consistently clearly and convincingly • Evidence of further reading beyond materials provided which were used in an appropriate context	• Use evidence to support claims/assertions/ideas, mostly clearly and convincingly • Evidence of further reading beyond materials provided but not necessarily used in the right context	• Use evidence to support claims/assertions/ideas, at times clearly and convincingly • Limited evidence of further reading beyond materials provided
CRITICAL THINKING	Developing an Argument	• A point of view or position in relation to the title or question is consistently clear • Uses concepts from the tutorials in an unfamiliar context, and does so accurately and confidently	• A point of view or position in relation to the title or question is adequately clear • Use some concepts from the tutorials in an unfamiliar context, and but not always accurate	• A point of view or position in relation to the title or question is somewhat clear • Limited use of concepts from the tutorials in other contexts

WRITTEN COMMUNICATION	Structure and Presentation	• Ideas are presented in paragraphs and arranged as a logical sequence of ideas • The introduction clearly outlines how the essay will deal with the issues • The conclusion summarises all the main points clearly and concisely	• Ideas are presented in paragraphs with some structure • The introduction adequately describes how the essay will deal with the issues • The conclusion summarises most of the main points clearly	• Ideas are presented in paragraphs and are loosely structured • The introduction mentions how the essay will deal with the issues • The conclusion summarises some of the main points clearly

Mark Scheme Table

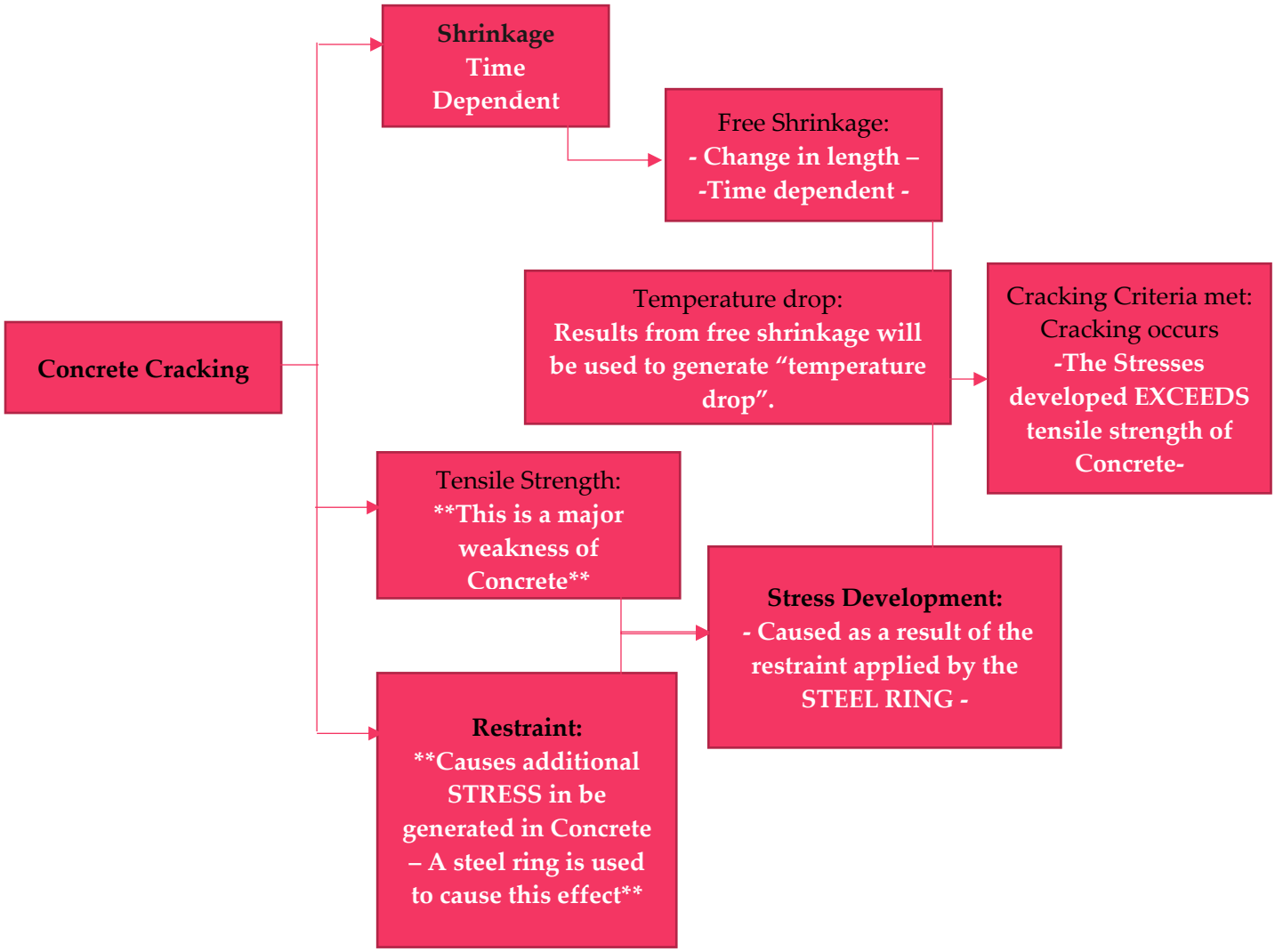
Subject Vocabulary – This Section will be completed in the course of the tutorials

Word	Definition	In a sentence
Concrete		
Cracking		
Shrinkage		
Ring test		
Stress Concentration		
Drying		
Compressive Strength		
Tensile Strength		
Tensile Stress		
Stress Development		
Temperature Field		
Area		
Volume		

Ratios		
Moisture loss		
Restraint		
Controlled Environment		
Temperature		
Relative Humidity		

Knowledge Organiser

Learning pathway and knowledge structure



Tutorial 1 – Introduction to Concrete

Purpose of Tutorial

This tutorial will introduce the pupil to the effect of shrinkage cracking in Concrete structures and what can be done to evaluate it. The basic materials of concrete will be highlighted. We will also cover concepts such as shrinkage, temperature field, moisture loss, restraint, compression and tensile strength.

Outcome

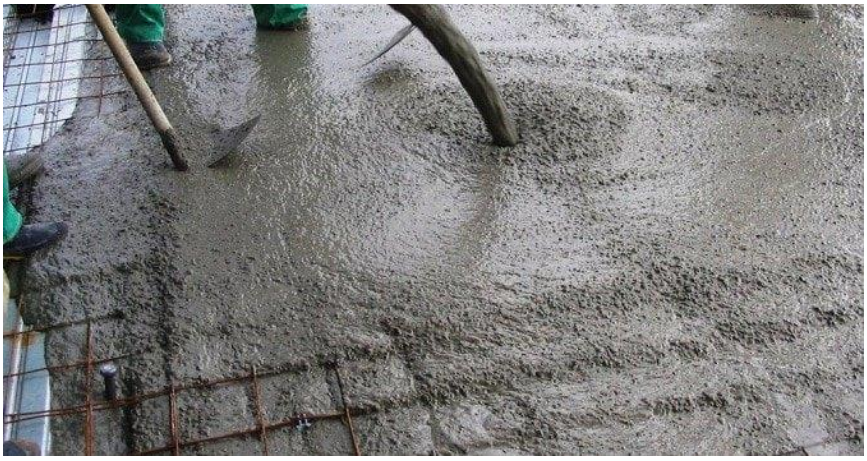
By the end of this tutorial, you should be able to:

- Identify some concrete structures;
- Describe at least 4 of 6 concepts introduced;
- Show an understanding of the effect of cracking in concrete by outlining them.

Baseline assignment

The Baseline assignment is designed to expand the pupil's understanding on some important concepts as it relates to concrete the cracking concept. It will further strengthen their base knowledge on how these concepts are unique and dependent on one another in the process that leads to cracking induced by shrinkage in concrete.

The Creation of a Concrete Mix



Activity 1 – Identify Concrete Structures and materials

A). List at least 4 types of concrete structures

B). List the major materials in making concrete

I). which is most important?

Activity 2 - What are the hazards of cracking in concrete structures?

A). List at least four (4) hazards of cracking in concrete structures

---

B). Why do we have to carry out more research on cracking in concrete structures?

Activity 3 - Describe Concepts with diagrams/ illustrations:

I). Shrinkage:

II). Temperature gradient:

III). Moisture loss:

IV). Restraint:

V). Tensile Strength:

VI). Compressive Strength:

Notes

Homework 1 (Baseline Assignment)

Part A

Describe the following concepts with diagrams (300 – 500) words:

**Shrinkage

**Temperature gradient

**Tensile strength

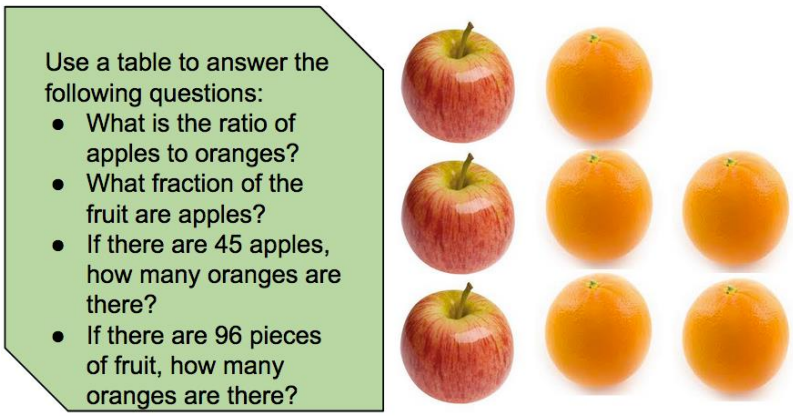
Part B

Calculate the areas and volumes of the following shapes: Choose your own dimensions (e.g. length, width, breath). Use the formula provided

1).

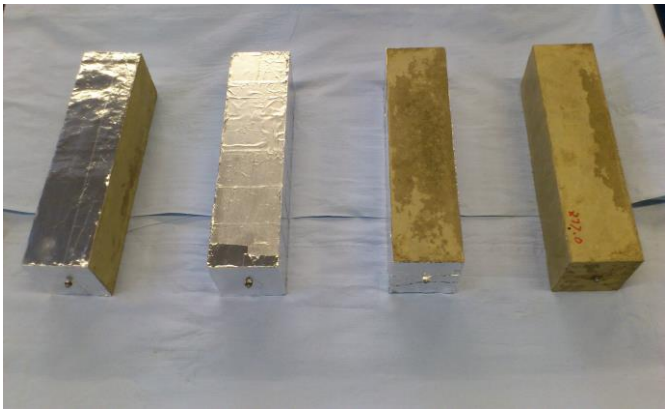
2).

Part C



Notes

Tutorial 2 – Relationships



Purpose of Tutorial

In this tutorial, the pupil will delve deeper into the drying shrinkage and temperature drop as a result of moisture movement. We will make use of prisms (rectangular) to demonstrate how to check to length change as a result of moisture loss. The pupil will also be introduced to the concept of 'free shrinkage' as it relates to the early-age of concrete. A brief instruction of some test methods

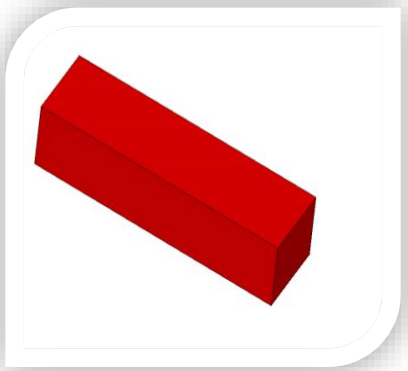
Outcome

By the end of this tutorial, the pupil will be able to:

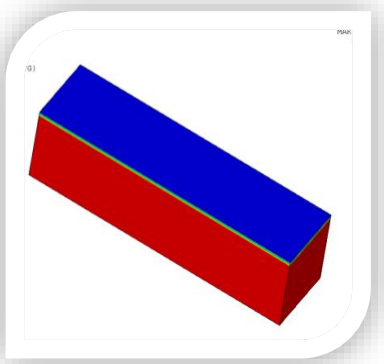
- Demonstrate by expressing the relationship between shrinkage and temperature drop;
- Represent the different drying conditions;
- Represent the different area-to-volume ratio for each drying condition;
- Use date to generate tables and graphs to represent the age-dependent outcome.

Temperature field in Concrete – A covered surface; an exposed surface

Temperature (°C) – All surface



Temperature (°C) – One (1) Surface



Activity 1 - Represent **Area-to-volume ratio** (A/V ratio)

I) Using a sealing material, represent the different drying conditions with A/V ratios in mind.

II) Calculate the AV ratios for each rectangular prism

III) Which do you think will dry out the quickest and why?

(Represent your response using illustrations and/or diagrams)

IV) Using graphs, represent the relationship between Shrinkage (Change-in-length) and the age of concrete rectangular prism.

(A table will be provided for this activity)

Activity 2 - Test methods

I) List the 4 types of tests methods used in checking for crack initiation in concrete

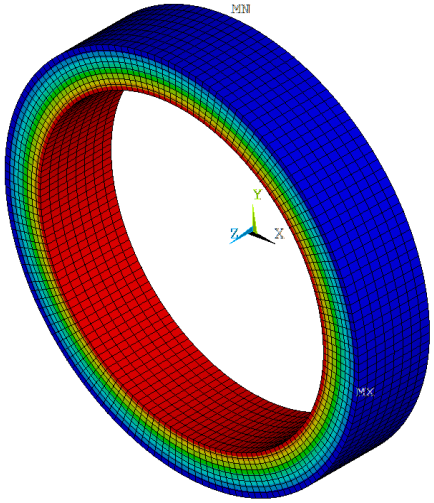
II) Compare at least 2 of these methods, stating at least 2 advantage and 2 disadvantage

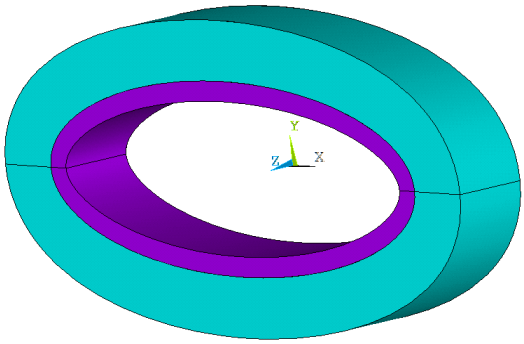
Homework

Research on the major features of an ellipse and a circle and their differences. See today's handout for guidelines.

Notes

Tutorial 3 – Ring Geometries





Purpose of Tutorial

This module will introduce the pupil to 2 ring geometries to test for shrinkage cracking in concrete. The pupil will be involved in outlining differences between the circular and the elliptical rings. There will be greater emphasis on why we use the elliptical rings for this tests as it relates to the geometric effects.

Outcome:

- Pupil will be able the draw out the major differences between these two (2) testing methods;
- Pupil will identify which of the geometries will be more useful in testing for cracking

Activity 1 – Identify Shapes

I) Identify different shapes and their unique features

II) Identify major features of the Circular ring
(Using Diagrams and/or Illustrations)

III) Identify major features of the Elliptical ring
(Using Diagrams and/or Illustrations)

Activity 2 – Illustrate Test features

I) Using sketches from the information provided, represent the test setup of the elliptical ring test

II) Briefly describe the major features of the test setup
(Use bullet point to highlight these features first then describe)

III) Mark where stresses will develop (in the diagram provided) and why?

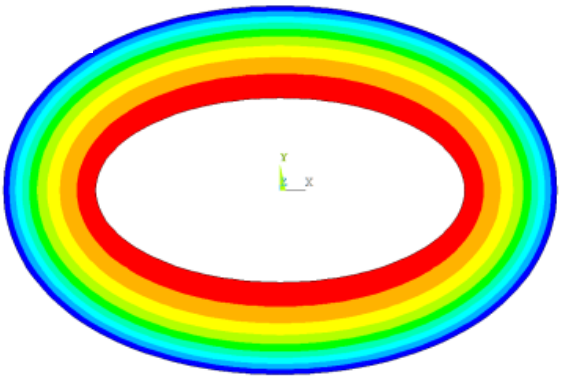
Homework 3

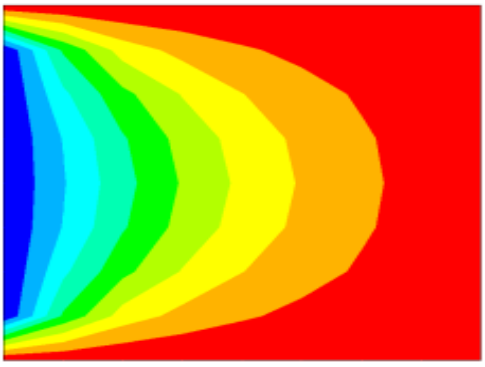
Read and summarise short article (Attached to handout): Using bullet points to highlight 5 areas of importance.

What do you understand by the word **STRESS** after today's lesson – **Use pictures to illustrate**?

Notes

Tutorial 4 – Stress vs Strength





Purpose of Tutorial

This tutorial will introduce the pupil to the concept of stress development and concentration during the early life of concrete. By Illustration and demonstration, the criteria for cracking is exemplified. The tensile strength will be represented as a level that must be passed for failure to occur. This concept will be understood by the pupil with activities to further highlight the major features of this concept.

Outcome:

- Student will be able to demonstrate the process of stress development with a restraint attached
- Pupil will be able to use keywords to illustrate the process stress concentration
- Pupil will be able identify positions of stress development and concentration when under restraint.

Activity 1: Identify areas of stress initiation

I) Identify where the stress will potentially development in the following:

a)

b)

c)

d)

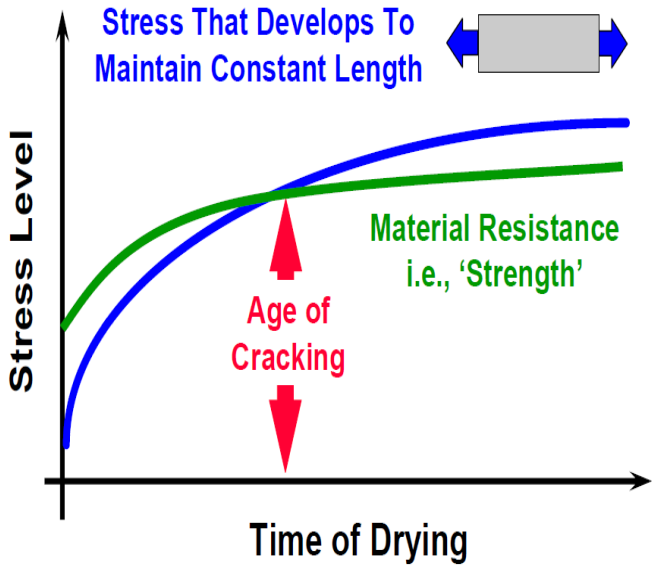
II) Why will it happen at the areas of interest?
(Use keywords to illustrate your point)

Activity 2
Illustrate using diagrams the different concepts described in the last 4 tutorials. Use keywords to highlight the major points.

-Resources will be provided to guide you through this activity-

Notes

Tutorial 5 – Stress vs Strength Part 2



Purpose of Tutorial

This tutorial will expand on the concept of cracking criteria of early-age concrete. The pupil will understand why the study of the tensile strength of concrete is vital to determine its cracking potential. This tutorial will bring all concepts learned in the previous tutorials together. Some time will be set aside to go through the requirements of the final assignment and further guidance will be given as necessary.

Outcome

- Pupil will be able to describe the final process that leads to cracking in concrete;
- Pupil will be able to highlight the cracking criteria using diagrams and illustrations.

Activity 1 – Illustrate Cracking Criteria (In pairs)

I) In pairs, discuss and make notes on one concept in the process of cracking that you will like to research on and why.

Activity 2 – Presentation in groups

In groups of three (3), make a 12-minute presentation (Using PowerPoint slides) on the different concepts covered with this course.

**Each person will present for 4 minutes.

**Choose an Introduction and a Closing (Discuss within yourselves the flow of presentation).

**This activity will account for 20% of the final assignment.

Homework 5 (Final Assignment)

Part 1

Complete your group presentation and make necessary adjustments. Your group is going to present again at the start of the first feedback session.

The presentation should include:
** The concepts outlined and discussed in the course.
**An introduction (brief) and Conclusion.

- It will be a 12 minute presentation (4 minutes per person).

20% of Final Mark

Part 2

Write an abstract for your 4 minutes presentation (What areas you personated).

Use resources made available to you for guidance on how to write and abstract.
Be original and make use of keywords.

150 – 200 words

5% of final mark

All homework completed and returned will constitute 5% of final assignment mark.

10% overall: Abstract (5%) and Module homework (5%)

Part 3

Write a report on the process that leads to shrinkage cracking in concrete (1200 words)

**Use references for your write-up.
**Illustrate using diagrams/table and graphs.
**Using keywords to make your point.

70% of final assignment

Notes

Tutorial 6 – Feedback tutorial

What is the Purpose of Tutorial 6?

- To receive feedback on final assignments.
- To share examples of best practice with the other pupils in your group.
- To write targets for improvement in school lessons.
- To reflect on the programme including what was enjoyed and what was challenging.

Final assignment feedback

What I did well…	What I could have improved on…
•	•
•	•
•	•

My target for future work is…

Tutorial 7 – Feedback tutorial

What is the Purpose of Tutorial 6?

- To receive feedback on final assignments.
- To share examples of best practice with the other pupils in your group.
- To write targets for improvement in school lessons.
- To reflect on the programme including what was enjoyed and what was challenging.

Final assignment feedback

What I did well…	What I could have improved on…
•	•
•	•
•	•

My target for future work is…

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
•   •   •

What did you find challenging about the programme?	How did you overcome these challenges?
• • •	• • •

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should I use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

1. **A marker in your assignment**: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number, e.g. [2].
2. **Bibliography**: This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

    a. **Websites** – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].

    E.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].

    b. **Books** – Author, date published, title of book (in italics), pages where the information came from.

    E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.

    c. **Articles** – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.

    E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

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