



Version 1  
2022-01-19

# Concrete and other cement based materials

AF3115, 7.5 ECTS credits

Year 2021/22

## Description

Concrete technology is becoming more complex with new binder types. This is in much due to the environmental impact of cement production. The new trend is to mix different types with co-ground limestone, granulated blast furnace slag and different pozzolanas like fly ash and calcined clays.

This course gives a deep understanding of concrete as a composite material, its properties in the fresh, young and hardened states. The effects from the various basic materials are studied and also how these can be varied to produce concrete and other cement based materials with prescribed properties.

## Content and Objectives

This course will give the basic knowledge and deepened insight in cement and cementitious systems. The course will also treat and discuss durability aspects related to cementitious systems and the relationship with environmental aspects. Moreover, it will give a deepened understanding of different cementitious systems, apart from normal concrete, e.g. shotcrete and injection grout and special concretes.

The major aim is to give deepened understanding of different cementitious systems and durability aspects to graduate students in civil engineering and material science.

- It will provide basic knowledge of how to treat and handle different types of concrete
- It will give a deepened knowledge of the interaction between environment and cementitious products and how to avoid degradation.
- It will give an understanding of the basics of life-time predictions and timing of degradation processes in existing structures.

## **Prerequisites**

Academic knowledge in civil engineering or material sciences. A basic knowledge of chemistry is needed.

## **Attendance**

Last year MSc students, graduate students, researchers and professionals in concrete materials.

## **Course plan**

The course will start in January/February 2022 and finish in May/June 2022. The following areas are included:

- Cementitious materials, hydration mechanisms, properties of aggregates, mix design and admixtures.
- The effects from each basic material on mixed concrete and other cement based materials.
- Cementitious materials co-operation with the environment.
- Durability, repair methods and life-time design.

## **Literature**

Neville, A.M., *Properties of Concrete Technology*, 5th Edition, Prentice Hall, 2011.

## **Examination**

Requirements for final grade (Pass) are participation in all seminars and lectures and a completed laboratory project. If absent from one or more lectures and seminars, a student can be given an extensive written assignment as substitute. For each of the seminars the student should be prepared to discuss the relevant course topics and make a minor presentation for the group of students and teachers. Some seminars may be online via Zoom.

## **Course organisation**

The course is administrated by KTH, with participating teachers and lectures from RISE, Chalmers, KTH, LTH and LTU. The course is free of charge for graduate (doctoral) students from the university divisions connected to the Graduate school of Sveriges Bygguniversitet in Structural Engineering and to other divisions and organizations participating with teachers to the course.

**Contact:** Anders Ansell, [anders.ansell@byv.kth.se](mailto:anders.ansell@byv.kth.se)

## Course schedule

*Please note!* The schedule may change at detail level – but dates and times given are definite.

### **Three days at KTH, Stockholm**

**Tuesday, 1 February – Thursday, 3 February**

*KTH Bygghvetenskap, Brinellvägen 23*

From 13:00 (1/2) to 15:00 (3/2)

### ***Strength properties, cement, aggregate, fresh concrete, mix design!***

Before the course meeting:

- Read chapters 1-4, 6-7, 9-10 and 14 in Neville (2011).
- Study the the questions in the attached Appendix 1.
- Prepare to discuss these questions during the seminars – if needed, prepare revised answers for the seminar.
- Prepare a short presentation (10-15 min) of your PhD project and its connection to, or the interest you may have of, Concrete and other cement based materials.

The course meeting will consist of lectures corresponding to the above chapters in Neville (2011), on:

- Concrete as a Structural Material
- Strength of Concrete
- Elasticity and Creep
- Other Strength Properties
- Cement
- Aggregates
- Fresh Concrete
- Mix design.

The seminar part will consist of:

- Student presentations (15 min each, see above).
- Discussion on the above listed chapters, and the answers to the questions in Appendix 1.
- Preparation for the laboratory assignment of the course.

### **Two days at LTH, Lund**

**Wednesday, 23 March – Thursday, 24 March**

### ***Cement hydration, durability!***

*More info will follow!* This course meeting is planned to be from 10:00 (23/3) to 15:00 (24/3).

### **Three days at KTH, Stockholm**

**Tuesday, 17 May – Thursday, 19 May**

### ***Various types of concrete, temperature problems!***

*More info will follow!* This final meeting is planned to be from 10:00 (17/5) to 12:00 (19/5).

**Appendix 1:** Problems with answers - KTH February 2022 - v2.

## AF3115 Concrete & Other Cement Based Materials

### Schedule, spring 2022

Please, note that this schedule is preliminary. Alternative version. Some lectures are shortened.

Occasion	Week	No of days	Dates	City	University	Host
1	5	3	Tu Feb 1 – Th Feb 3	Stockholm	KTH	A Ansell
2	12	2	We Mar 23 – Th Mar 24	Lund	LTH	L Wadsö
3	20	3	Tu May 17 – Th May 19	Stockholm	KTH	A Ansell

### 1<sup>st</sup> Occasion

Participating teachers: Prof. Anders Ansell, KTH, Dr. Annika Gram, KTH, Prof. Johan Silfwerbrand, KTH; Dr. Björn Lagerblad, previously Swedish Cement & Concrete Research Institute.

Item	Hours	Teacher	Heading	Neville*
<b>Tuesday, Feb. 1</b>				
1	13.00 – 13.30	A Ansell	Introduction & Welcome to KTH	
2	13.30 – 14.00	J Silfwerbrand	Concrete as a Structural Material	-
3	14.15 – 15.00	A Ansell	Strength of Concrete – Part I	6
4	15.15 – 15.45	J Silfwerbrand	Strength of Concrete – Part II	6
5	16 - 18		<i>Workshop</i>	
<b>Wednesday, Feb. 2</b>				
6	8.15 – 8.45	J Silfwerbrand	Elasticity	9
7	8.45 – 9.15	J Silfwerbrand	Shrinkage	9
8	9.30 – 10.15	J Silfwerbrand	Creep	9
9	10.30-11.00		<i>Workshop</i>	
10	11.15 – 12.00	A Ansell	Other Strength Properties	6, 7, 10
	12.00 – 13.00		<i>Lunch</i>	
11	13.00 – 13.45	J Silfwerbrand	Introduction to Laboratory Project	1, 2
12	14 - 17		<i>Workshop</i>	
<b>Thursday, Feb. 3</b>				
13	8.15 – 9.00	J Silfwerbrand	Cement	
14	9.15 – 10.00	B Lagerblad	Aggregates	3
15	10.15 – 11.00	A Gram	Fresh Concrete	4
16	11.15 – 12.00	A Gram	Mix Design	14
	12.00 – 13.00		<i>Lunch</i>	
17	13 - 15		<i>Workshop</i>	

Note \* Neville: “Properties of Concrete”, 5<sup>th</sup> Edition, Pearson Education Ltd, Harlow, England, 2011, 846 pp.

**2<sup>nd</sup> Occasion**

Participating teachers: Dr. Katja Fridh, MU, Prof. Tang Luping, Chalmers. Adj. Prof. Ingemar Löfgren, Chalmers & Thomas Betong, Prof. Lars Wadsö, LTH

Item	Hours	Teacher	Heading	Neville
<b>Wednesday, March 23</b>				
1	10.00 – 10.30	L Wadsö	Welcome to Lund	
2	10.45 – 12.00	L Wadsö	Cement Hydration	1
	12 - 13		<i>Lunch</i>	
3	13.00 – 13.30	K Fridh	Development of Strength	6
4	13.30 – 14.00	K Fridh	Development of Strength	6
5	14.30 – 15.15	I Löfgren	Admixtures	5
6	15.30 – 16.15	I Löfgren	Admixtures	5
7	16.30 - 18		<i>Workshop</i>	
<b>Thursday, March 24</b>				
8	8.15 – 9.00	T Luping	Permeability & Durability	10
9	9.15 – 10.00	T Luping	Permeability & Durability	10
10	10.15 – 11.00	K Fridh	Resistance to Freezing & Thawing	11
11	11.15 – 12.00	K Fridh	Resistance to Freezing & Thawing	11
	12.00 – 13.00		<i>Lunch</i>	
12	13 - 15		<i>Workshop</i>	

**3<sup>rd</sup> Occasion**

Participating teachers: Prof. Anders Ansell, KTH, Prof. Mats Emborg, LTU, Dr. Annika Gram, KTH, Prof. Johan Silfwerbrand, KTH

Item	Hours	Teacher	Heading	Neville
<b>Tuesday, May 17</b>				
1	10.15 – 11.00	A Gram	Self Compacting Concrete	(4)
2	11.15 – 12.00	A Gram	Mixing, Handling, Placing & Compacting of Concrete	7
	12 - 13		<i>Lunch</i>	
3	13.00 – 14.00	M Emborg	Temperature Problems in Concreting	8
5	14.30 – 15.00	A Ansell	High Performance Concrete	13
6	15.15 – 15.45	A Ansell	Testing	12
	16 - 18		<i>Workshop</i>	
<b>Wednesday, May 18</b>				
7	8.15 – 9.15	J Silfwerbrand	Fibre Reinforced Concrete	-
8	9.30 – 10.15	J Silfwerbrand	Preplaced Aggregate Concrete & Roller Compacted Concrete	(4)
	10.30 – 11.00		<i>Workshop</i>	
9	11.15 – 12.00	A Ansell	Shotcrete	(4)
	12.00 – 13.00		<i>Lunch</i>	
10	13.00 – 13.45	A Ansell	Shotcrete (cont.)	(4)
	14 - 17		<i>Workshop</i>	
<b>Thursday, May 19</b>				
11	8.15 – 9.00	J Silfwerbrand	Lightweight Concrete	13
12	9.15 – 11.00	All participants	<i>Presentations of Laboratory Projects</i>	
13	11.15 – 12.00	A Ansell & J Silfwerbrand	<i>Summary of the Course</i>	