Title: Materials and Structures (CIVIL -532)

Teacher Dr. Emmanuel Denarié, MER (ED)

Schedule: Tuesdays, 8:15 a.m. to 11 a.m. - Room GR A331 + GIS structures hall according to notice

Session	Date	Contents	c	e	Demo	Teacher
		Part I: Introduction - basics				
1	10.09.2024	Introduction Motivation for the course, presentation of materials, requirements, exposure classes, performance - internal structure - composition relationships, structural functionalities, "Materials-Structures" relationships, examples.	3			ED
2	17.09.2024	Cement and mineral additions Types, hydration reactions, pozzolanic reaction, hydration kinetics and influencing factors, thermal effects. Exercise 1: calculating heat release and maturity from test results.	2	 1		ED

3	24.09.2024	Rheology of fresh cementitious materials: basics, test methods, applications, concrete admixtures: operating principles and influencing factors. Exercise 2: Rheology - analysis of application examples.	2	 1		ED
Part II: Conventional concretes and self-compacting concretes						
4	01.10.2023	Conventional concretes - formulation: theoretical aspects, granular mix and mixing water, aggregates, required qualities, grading curves, fines content, water demand, and required workability. Exercise 3: study of concrete recipes.	2	 1		ED
5	08.10.2023	Self-compacting concrete - SCC History, formulation, fresh and hardened properties, testing, specification. Exercise 4: formulation study for self-compacting concrete.	2	 1		ED
Part III: Fiber-reinforced concretes - FRC						
6	15.10.2023	Fiber-reinforced concretes - general information, mechanical principles and main fiber types History, fiber types, orientation effects, effects on fresh concrete composition and properties, effects on mechanical behavior, and durability.	3			ED
7	29.10.2023	Fiber-reinforced concrete - mechanical behavior, mechanical testing, formulation and processing Methods for testing and designing with fiber-reinforced concrete, with examples of applications. Exercise 5: analysis of test results and application to calculating a structural element.	1	 2		ED

Part IV: Strain Hardening cementitious composites						
8	05.11.2024	Ultra-high-performance fiber-reinforced concrete (UHPFRC), structure and properties - 1 History, bases of mix-design and mechanical behavior Exercise 6: Comparative analysis and classification of UHPFRC performance.	2	 1		ED ED
9	12.11.2024	Mixing test demonstration: SCC + UHPFRC - lab and video presentation Exercise 7: analysis of mixing tests, performance prediction (SCC, UHPFRC).		 1.5	1.5	ED
10	19.11.2024	Ultra-high-performance fiber-reinforced concrete (UHPFRC), structure and properties - 2 Tensile and flexural mechanical behavior: modeling and testing. Exercise 8: inverse analysis of a bending test on UHPFRC plates, calculation of a structural element.	2	 1		ED
11	26.11.2024	Ultra-high-performance fiber-reinforced concrete (UHPFRC), structure and properties - 3 Delayed effects (viscoelasticity, shrinkage), heat of hydration, protective properties. Exercise 9: dimensioning a UHPFRC element.	2	 1		ED
12	03.12.2024	Structure and properties of hardening cementitious composites - 4 Presentation from Prof. Dr. Viktor Mechtcherine – TU Dresden (Zoom) and discussion Synthetic fiber materials (ECC/SHCC), slurry infiltrated materials (SIFCON, SIMCON), principles, properties and applications. Specification and application of concretes and UHPFRC: requirements, selection parameters (performance and composition), fiber orientation effects, performance characterization	 1.5 0.5 1			 VM ED

		Part V: Outlook, synthesis and conclusions				
13	10.12.2024	Exercise 10: Specification of materials for applications (normal concretes, SCC, FRC, UHPFRC, etc.) - group work - preparation for presentation. Solution of exercise 10 - group presentation - discussion (oral exam simulation).	 	1.5 1.5	 	ED
14	17.12.2024	Presentation of UHPFRC applications The future - tension-hardening UHPFRC with synthetic fibers + environmental impact assessment Synthesis and conclusions: material-structure synergies, summary and answers to questions.	1.5 1 0.5	 	 	ED ED ED

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