WG 2 - Modelling of CBM and the behaviour of structures

Strategic view

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WG 2 motivation and objectives

Motivation:

- Variety of parameters to be described
- Long time-span considered (service life predictions)

Objectives:

- to support unified approaches for conducting **numerical experiments for material properties of CBM**

- to support unified approaches for **macroscopic modelling of CBM behaviour during the life cycle**. For such purpose, multi-physics models will be deployed, framed in the context of the thermodynamics of porous reactive media.

- to **integrate the conclusions from different modelling scales** (cement paste, mortar, concrete, structural level) to create a set of general instructions to be used in designing software for CBM and reinforced concrete structures.

Scope of the WG2

- The Action has a special focus on predicting behaviour of CBM over ist service life, starting from the phenomena occuring at early ages
- Modelling at different scale levels:
  - Micro-meso level ➔ prediction of material properties (porosity, transport, mechanical) based on composition
  - Macroscopic level ➔ multi-physics modeling of transport, deformations + stresses and damage at a structural level
- Models at different complexity levels (from simple empirical predictions to complex multi-scale, multi-physics models)

Workgroup structure

Group priorities:

- GP2.1 – Micro-mesoscopic approach
- GP2.2 – Macroscopic approach
- GP2.3 – Benchmarking
  a) Simple examples (in cooperation with WG1)
  b) Case studies

Group priorities (1)

GP2.1 – Micro – mesoscopic approach

Microstructural and meso-structural approaches:

- Transport and microstructure
  - Simulate microstructure evolution due to hydration
  - Relate microstructure evolution to transport, sorptivity
  - Describe material degradation due to leaching, carbonation, microcracking, etc.
  - CEMHYD3D, HYMOSTRUC, µic, Meso-level FEM models …
- Mechanical properties
  - Simulate mechanical properties, stress and creep evolution and damage (cracking)
  - Meso-level FEM models, lattice models, analytical/numerical homogenization

Group priorities (2)

GP2.2 – Macroscopic approach

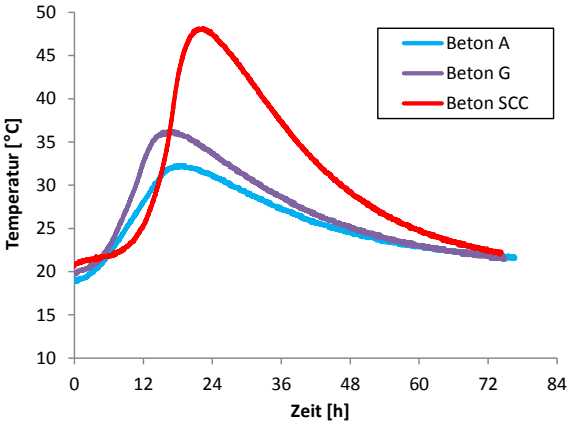
- Thermo-hygro-mechanical modeling of concrete at a structural level
  - Poromechanical models (commercial, e.g. COMSOL, or home-made modeling platforms)
  - …
- Constitutive relationships for transport, deformations, stresses, creep, damage
  - Empirical approach
  - Analytical/numerical homogenization (up-scalling from micro-meso level models)
- Effect of hygro-thermal behaviour and damage on structural performance
  - coupling of multi-physics macroscopic models with traditional RC design tools ➔ cooperate with commercial tools developers (Robot, DIANA, etc.)
  - development of simple design approaches

Group priorities (3)

GP2.3 – Benchmarking

a) Simple benchmarking based on WG1 data

- Micro-meso approaches
  - Predict evolution of porosity, transport properties, mechanical properties based on the input characteristics
- Macroscopic modeling
  - Boundary value problem: predict evolution of e.g. temperature, drying, water or CO_2 ingress, thermal expansion and drying shrinkage, stress development



Group priorities (4)

GP2.3 – Benchmarking

b) Case studies

- EDF Vercors project (early age behaviour data should be available from 2015) – contact by Farid Benboudjema
- CEOS.FR project – contact by Farid Benboudjema
- Slab casting (concrete producers or construction companies to be contacted)
- Case studies provided by the participants…

Gantt chart

	Year 1				Year 2				Year 3				Year 4			
Activity /month	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
Meetings	K	1		2		3		4		5		6		7		End
Workshops				2a				4a				6a				C
Accept GP structure																
Assign GP members, collect the relevant models, plan benchmarking																
Micro-meso level modeling based on WG1 data																
Macro-level modeling based on WG1 data (Boundary vaue problems)																
Case studies (micro-meso-macro modeling)																
Recommendations for modeling at the structural level																
Dissemination																

K - Kick-off meeting 18 November 2014, Paris
C - conference

Meetings:
1 - discuss necessary input from WG1 (at start of WG1 Round-Robin test)
2 and 2a - present recent developments and the results of the micro-meso level modelling, review (recent developments of the models) and plan simulations at macro-level (Boundary value problems from WG1)
3 - plan the case studies, contact companies for incorporation of the models in RC design
4 and 4a - present data on micro-meso level and macro-level benchmark
5 - discuss the progress of case studies, launch preparation of reccomendations for modelling (in cooperation with WG3)
6 and 6a - present recent achievements and results of case studies
7 - discuss the progress of recommendations, finalize macro-level modeling of boundary value problems (exchange informations with WG1)
End and C - present the final results

Thank you for your attention.

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