



European
Commission

Horizon 2020
European Union funding
for Research & Innovation



**Rethinking coastal defence and Green-energy Service infrastructures
through enHancEd-durAbiLiTy high-performance cement-based materials**

WP5. Quantification of UHDC improved long-term durability performance

CSIC (Leader)

María Cruz Alonso

Partners participating: POLIMI, EPG, ANF DEVELOPMENT, API EUROPE MEPE, PENETRON IT, UPV, TUD, BGU, UOM

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WP objectives

- Verification of the enhanced durability performance at laboratory level of the novel UHDCs (WP4) in XS and XA scenarios. *Input to WP4 (Contribution to GO1 and GO2)*
- Provide data for modelling long-term durability of UHDCs *Input to WP6 (Contribution to GO2)*
- Evaluation of the reliability of monitoring techniques and sensors for validation and demonstration of scalability. *Input to WP8 (Contribution to GO3)*

WP objectives

Strategy

- Feedback system with WP4:
 - To contribute the development of UHDC mix-design concept and formulation.
 - To improve UHDC design by using accelerated durability and aging tests.
- Verification of the sensitivity and reliability of non-destructive monitoring technologies and sensors for each aggressive environment and the evaluation of the functionalities of durability enhancers.
- Contribution to the improvement of theoretical understanding of performance through non accelerated test in representative scenarios for validation of the models and service life evaluation.

WP 5 timeline: M4-M40

TASKS	year 1				year 2				year 3				year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
5.1 "Feedback" of durability performance and UHDCs design	M4							M18								
5.2 verification of sensivity and reliability of in-situ non-destructive methods and sensors		M6								M24						
5.3 characterisation of UHDC material performance in simulated XS and XA operating conditions by a multimethod approach using advanced laboratory strategies			M8													M40
5.4 criteria for durability performance assessment of UHDC in XS and XA environments to reduce maintenance						M19				M24						

WP5 effort: 138 PM

POLIMI (9), EGP (1), ANF DEVELOPMENT (3), API EUROPE MEPE (2),
 PENETRON IT (1), UPV (21), TUD (12), CSIC (44), BGU (29) UOM (16)



WP tasks and partners

Task 5.1: “Feedback” of durability performance and UHDCs design
(lead: **BGU**) [M4-M18]

Task 5.2: verification of sensivity and reliability of in-situ non-destructive methods and sensors
(lead: **UPV**) [M6-M24]

Task 5.3: Characterisation of UHDC material performance in simulated XS and XA operating conditions by a multi-method approach using advanced laboratory strategies
(lead: **CSIC**) [M8-M40]

Task 5.4: Criteria for durability performance assessment of UHDC in XS and XA environments to reduce maintenance
(lead: **CSIC/UPV**) [M19-M24]

Expected interactions within WPs

➤ Input:

- Definition of scenarios and of durability demands and performance parameter, such as preliminary criteria for DAD from **WP3**.
- Characterisation of UHDC from **WP4**.

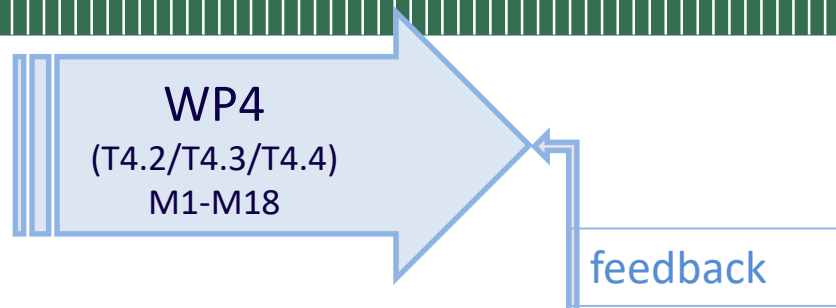
➤ Output:

- Results from standardized or adapted tests to XS and XA exposure conditions and tailored functionalities to feed **WP4**.
- Verification of sensitivity and reliability of in-situ non-destructive methods and sensors to feed **WP8**
- Results from characterisation of UHDC performance in XS and XA exposures to feed **WP6**, **WP8** and “close-loop” to T4.1 in **WP4**.

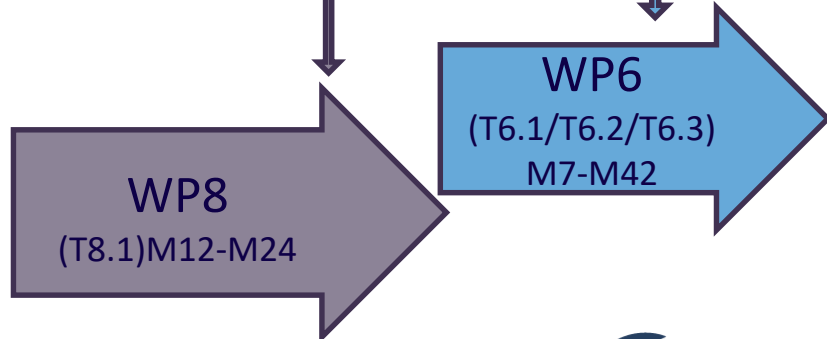
Deliverables and Milestones

DELIVERABLE	year 1				year 2				year 3				year 3				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
MS6 selection of suitable monitoring systems for assessment of UHDCs operating in EAE XS and XA (CSIC)																	Month24
D5.1 verification of durability of UHDCs under XS and XA accelerated tests (BGU)																	
D5.2 verification of sensivity and reliability of ND methods and sensors (UPV)																	
D5.4 understanding the durability performance of UHDC-XS and UHDC-XA (CSIC)																	Month40
D5.3 Particularisation of durability criteria for design of UHDCs to extend the service life of infrastructures in XS and XA environments (CSIC/UPV))																	Month24

Deliverables and Milestones



DELIVERABLE	year 1				year 2				year 3				year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
MS6 selection of suitable monitoring systems for asesment of UHDCs operating in EAE XS and XA (CSIC)									Month24							
D5.1 verification of durability of UHDCs under XS and XA accelerated tests (BGU)								Month18								
D5.2 verification of sensivity and reliability of ND methods and sensors (UPV)								Month22								
D5.4 understanding the durability performance of UHDC-XS and UHDC-XA (CSIC)																Month40
D5.3 Particularisation of durability criteria for design of UHDCs to extend the service life of infrastructures in XS and XA environments (CSIC/UPV)								Month24								



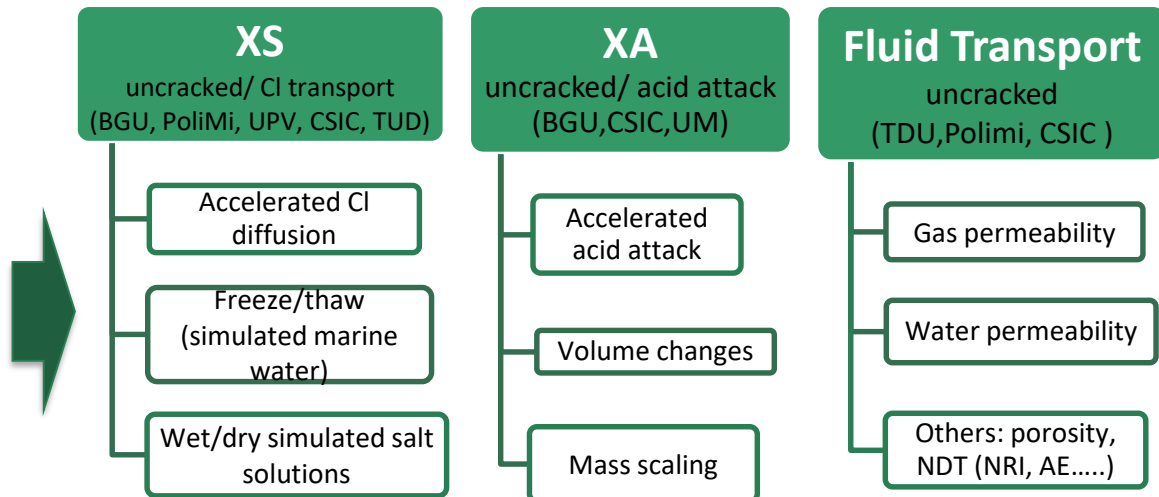
Strategy to reach the objectives

Output from T5.1: (leader: BGU) [M4-M18]

- **D5.1 Verification of durability of UHDCs under XS and XA accelerated tests [M18]:** “Feedback” of durability performance and UHDCs design. Results and guidelines to check the durability of UHDC through accelerated exposure tests to the designed aggressive environments. Measurement of the change of chemical composition and microstructures.

Strategy:

- Focused on UHDCs mix designs under accelerated and/or standard degradation tests:
 - 1) XS: Chlorine rebar corrosion
 - 2) XA: Chemical acid attack
- Input from and towards WP4



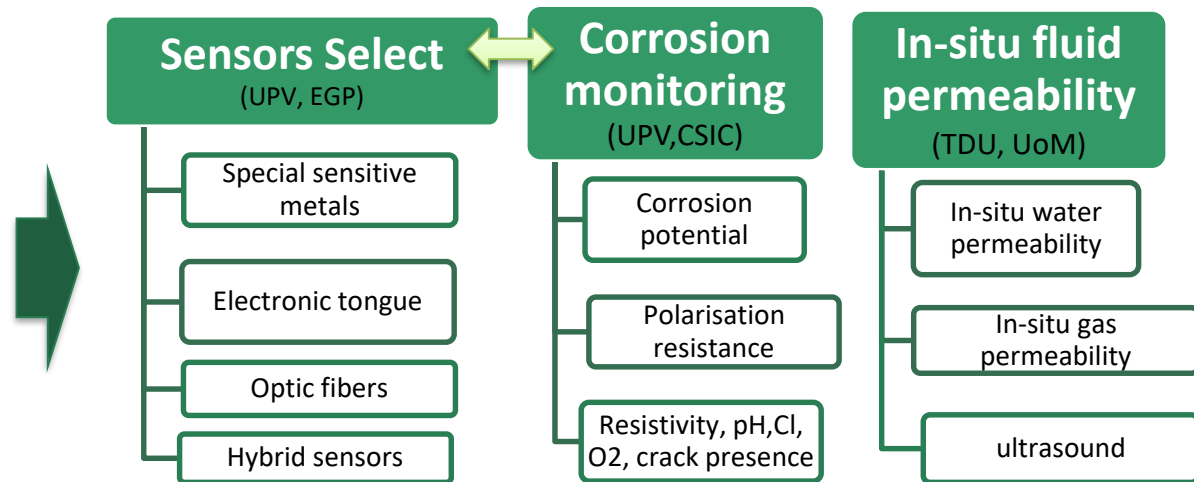
Strategy to reach the objectives

Output from T5.2: (Leader:UPV) [M6-M24]

- **D5.2 Verification of sensivity and reliability of ND methods and sensors [M22]:** *For lab and in-situ.* Results of the verification of sensivity and reliability of non-destructive sensors employed in measuring on-site the durability of UHDC for XS and XA exposure conditions. Choices for the use in the pilot (WP8)
- **MS6 Selection of suitable monitoring systems for assessment of UHDCs operating in EAE XS and XA [M24]**

Strategy:

- Comparative evaluation of degradation monitoring with NDT and sensors
- Input to WP8



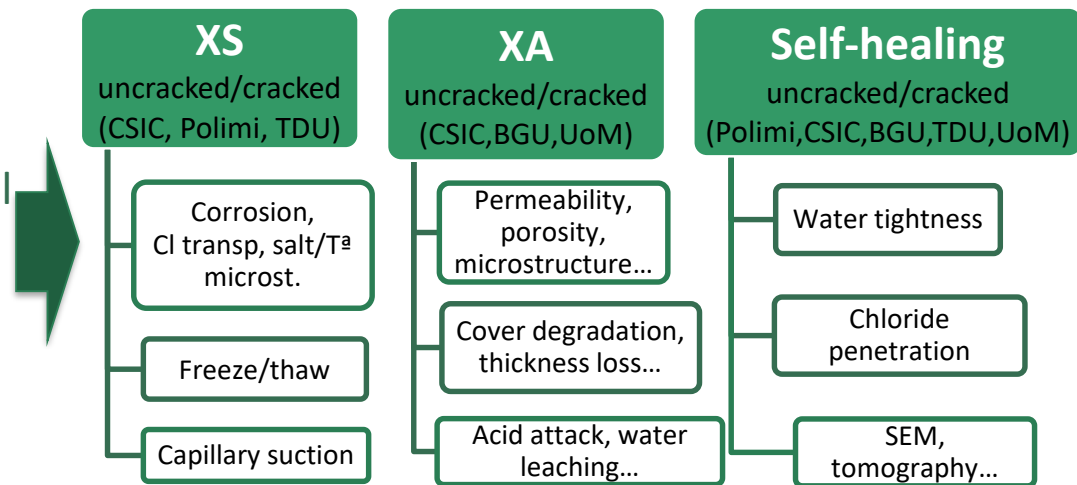
Strategy to reach the objectives

Output from T5.3 (Leader: CSIC) [M8-M40]

- **D5.4 understanding the durability performance of UHDC-XS and UHDC-XA [M40]:**
Characterisation of UHDC material performance in simulated XS and XA operating conditions by a multi-method approach using advanced laboratory strategies. Durability performance and processes of UHDC exposed to simulated XS and XA environments. Analyses of critical durability properties evolution from different characterization techniques

Strategy:

- Long-term degradation mechanisms understanding: through experimental tests in simulated natural conditions at laboratory level
- Collect parameters for WP6, WP8



Strategy to reach the objectives

Output from T5.4 (Leader: CSIC/UPV) [M19-M24]

- **D5.3 understanding the durability performance of UHDC-XS and UHDC-XA (CSIC/UPV)**
[M24]: *Joint analyses of the knowledge on the UHDC development and durability criteria for design of UHDC to extend service life of structures in XS and XA conditions in uncrack and cracked state*

Strategy:

- Close collaboration and contributions from experiences gained from WP4/WP5
(CSIC, UPV, Polimi, BGU, TUD, UOM, EGP, ANF Develp., API Eurp, Penetron It)
- Input to WP8

Risks affecting the WP5

TASKS	year 1				year 2				year 3				year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
5.1 "Feedback" of durability performance and UHDCs design		█	█	█	█	█										
5.2 verification of sensivity and reliability of in-situ non-destructive methods and sensors		█	█	█	█	█	█									
5.3 characterisation of UHDC material performance in simulated XS and XA operating conditions by a multimethod approach using advanced laboratory strategies			█	█	█	█	█	█	█	█	█	█	█			
5.4 criteria for durability performance assessment of UHDC in XS and XA environments to reduce maintenance						█	█									

1. Underestimation of task duration. Likelihood: *low*. Consequences: *medium*, WP2, WP3, WP4, **WP5**, WP6, WP7, WP8, WP9. Mitigation: *continuously monitoring of the project evolution by WP leaders and mutual feedback through common workspace*
2. Delays in supply of materials. Likelihood: *low*. Consequences: *medium*, WP2, WP3, WP4, **WP5**, WP6, WP7, WP8, WP9. Mitigation: *industrial partners of the project will supply needed materials, with priority time delivery requirements alternative suppliers will be contacted if necessary*
3. Test methods not able to evaluate durability differences. Likelihood: *medium*. Consequences: *medium*, WP4, **WP5**, WP8. Mitigation: *several methods will be used to minimize the risks sensors will be tested at lab scale previously to their use in the pilots.*

Coordination in WP5

- Mailing list with all task leaders and WP partners
- **Coordination meeting to start activities to launch at M4** . All partners
- **Coordination with *Task Leaders***: T5.1 (BGU), T5.2 (UPV), T5.3 (CSIC), T5.4(CSIC/UPV (WP4)
- ***Interaction with WP4***: through BGU/Polimi/UPV
- **Bussiness Skype meetings every 1 Month**: progress work review and contingencies respect WP5 (all partners)

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