Midterm presentation of Numerical Modeling of Reinforcement Corrosion in Cracked Concrete

Prepared by:
Anna Emilie A. Thybo

Prepared for:
Concrete Expert Centre Reference Group Closing Meeting, November 30, 2012
• Modeling non-uniform corrosion
• Comparison of model, experimental data
• Influence of modeling non-uniform corrosion on surface crackning
• Input/output
• Future work
Modeling non-uniform corrosion

Numerical model for the simulation of damage and cracking in concrete cover

\[ \text{mean}(i_{corr\_uniform}) = \text{mean}(i_{corr\_nonuniform}) \]
• Digital image correlation (DIC)
  – 24.5 megapixel camera used for DIC during accelerated corrosion testing
  – Each pixel corresponds to 7.8×7.8 μm² of specimen surface

(Pease et al., 2012)
Comparison of model, experimental data - deformations
Comparison of model, experimental data – crack width 1.4 mm from reinforcement

![Graph showing comparison of crack width data from DIC and model over time.](image-url)
Influence of modeling non-uniform corrosion on surface crackling

Scenario 1

Scenario 2

Scenario 3

Scenario 4
Influence of modeling non-uniform corrosion on surface crackling
Input/output

• INPUT
  – Material parameters (concrete, steel and corrosion products)
  – Geometrical parameters (incl location of corrosion products)
  – Corrosion current density
  – Time

• OUTPUT
  – Thickness of corrosion layer/reduction of steel area
  – Crack width in concrete cover
• Probabilistic modeling of non-uniform corrosion – quantifying uncertainty
• Multiple cracking in the cross section
• Implementing penetration of corrosion products into cracks
• Mechanical modeling
  – initial defects
  – debonding

*Moisture, temperature, oxygen, chloride, carbon dioxide*

(Michel et al., 2009)
Future work

- Coupling with other models

(Material and transport models)

Service life prediction

(Michel et al., 2010)
Thank you for your attention
Concrete body
Corrosion layer
Reinforcement