



# Midterm presentation of Numerical Modeling of Reinforcement Corrosion in Cracked Concrete

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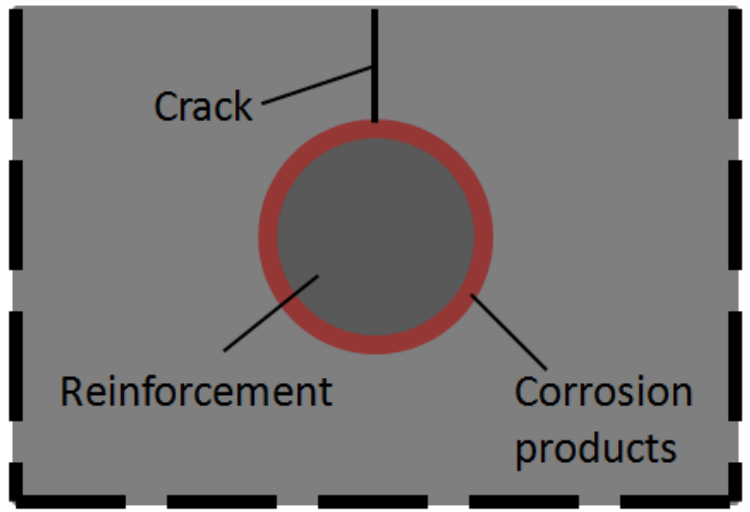
Prepared for:  
Concrete Expert Centre Reference Group Closing Meeting, November 30, 2012

- 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

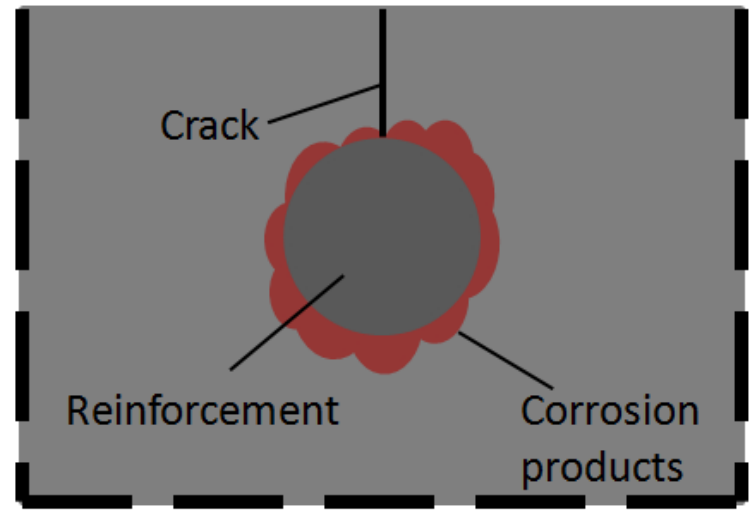
## Numerical model for the simulation of damage and cracking in concrete cover

Uniform corrosion



$$\text{mean}(i_{\text{corr\_uniform}})$$

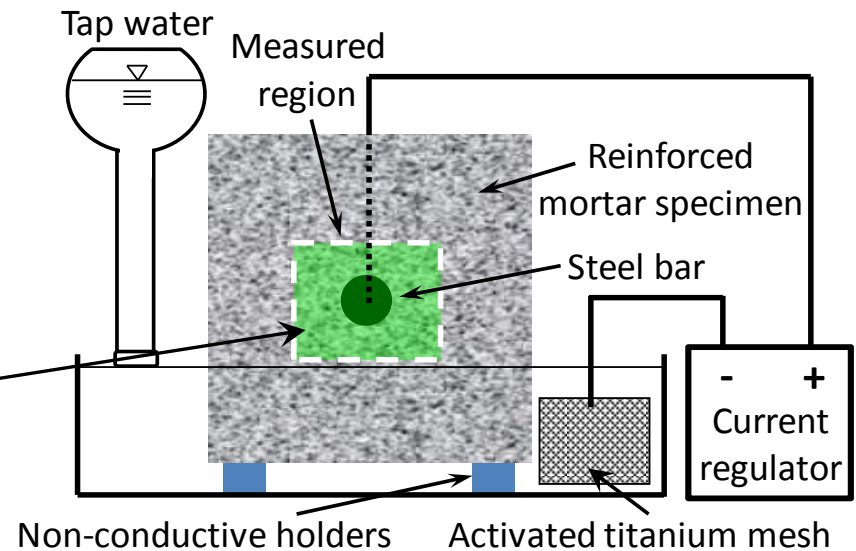
Non-uniform corrosion



$$\text{mean}(i_{\text{corr\_nonuniform}})$$

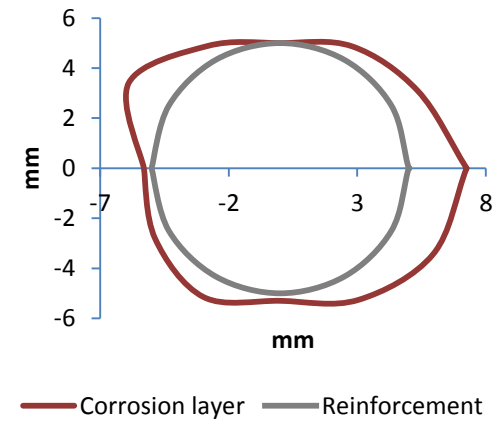
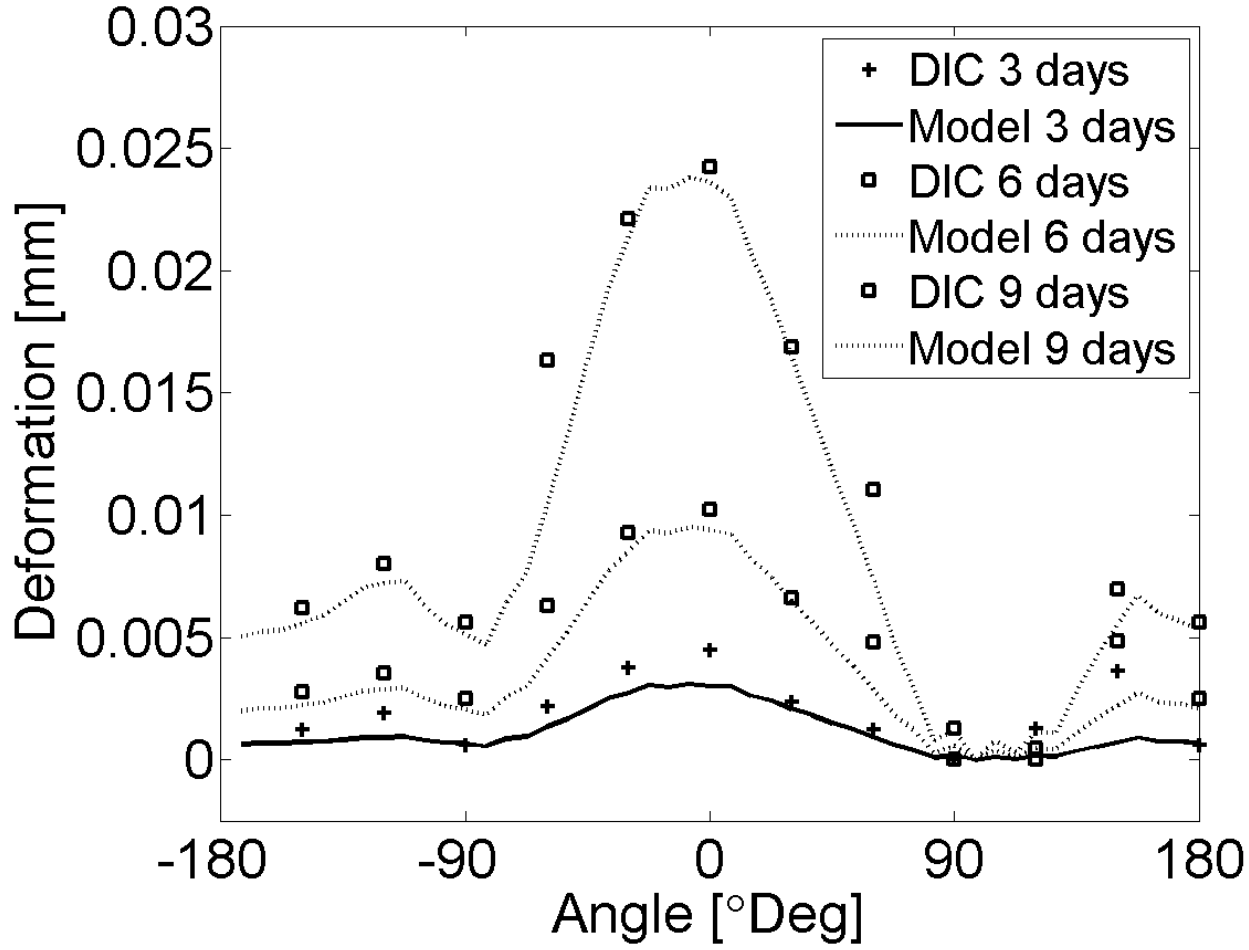
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- Digital image correlation (DIC)
  - 24.5 megapixel camera used for DIC during accelerated corrosion testing
  - Each pixel corresponds to  $7.8 \times 7.8 \mu\text{m}^2$  of specimen surface

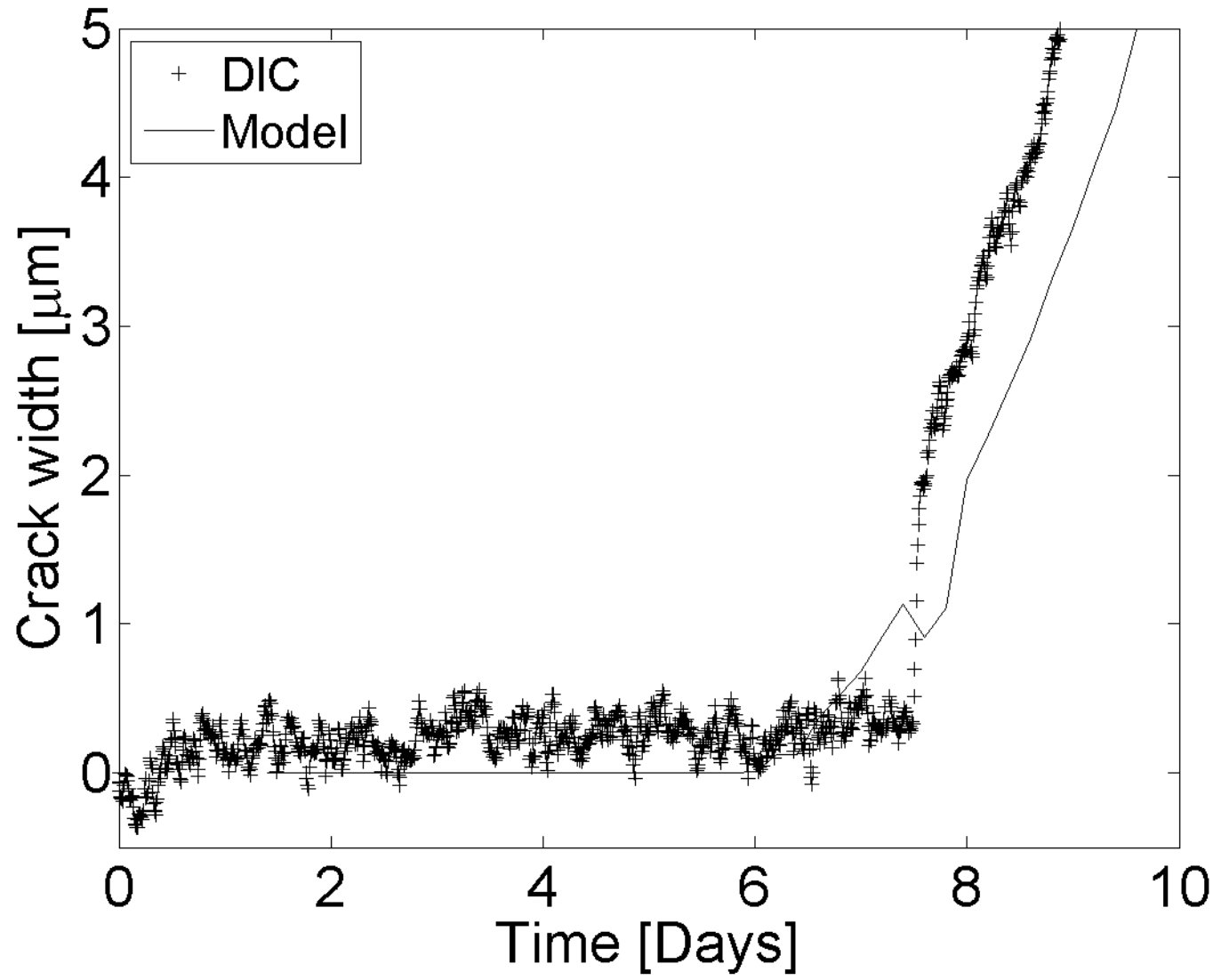


(Pease et al., 2012)

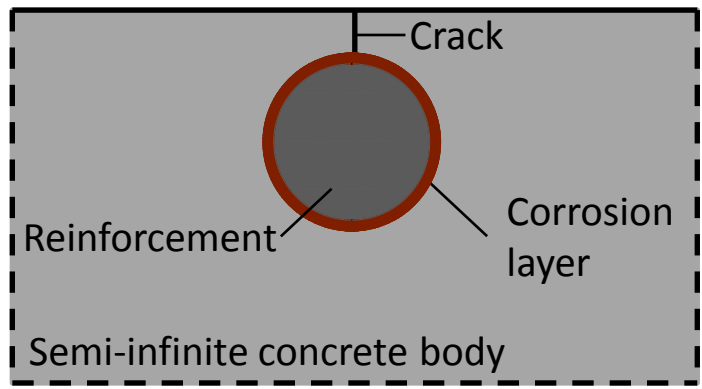
# Comparison of model, experimental data - deformations



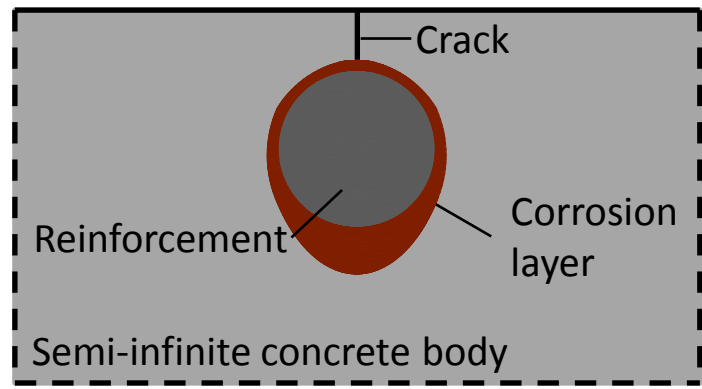
# Comparison of model, experimental data – crack width 1.4 mm from reinforcement



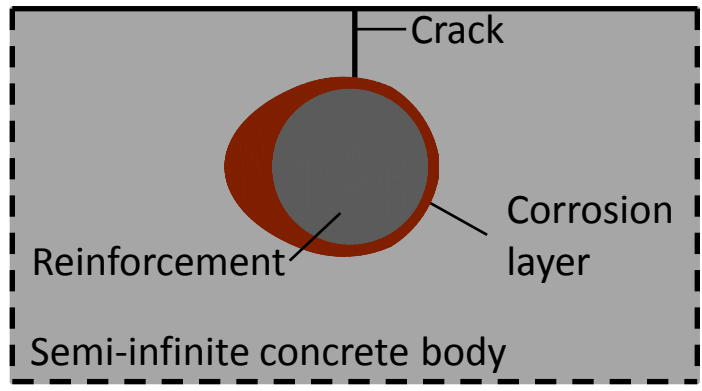
# Influence of modeling non-uniform corrosion on surface crackning



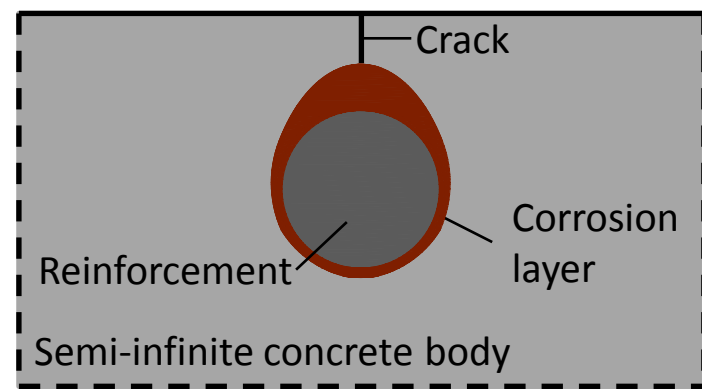
Scenario 1



Scenario 2

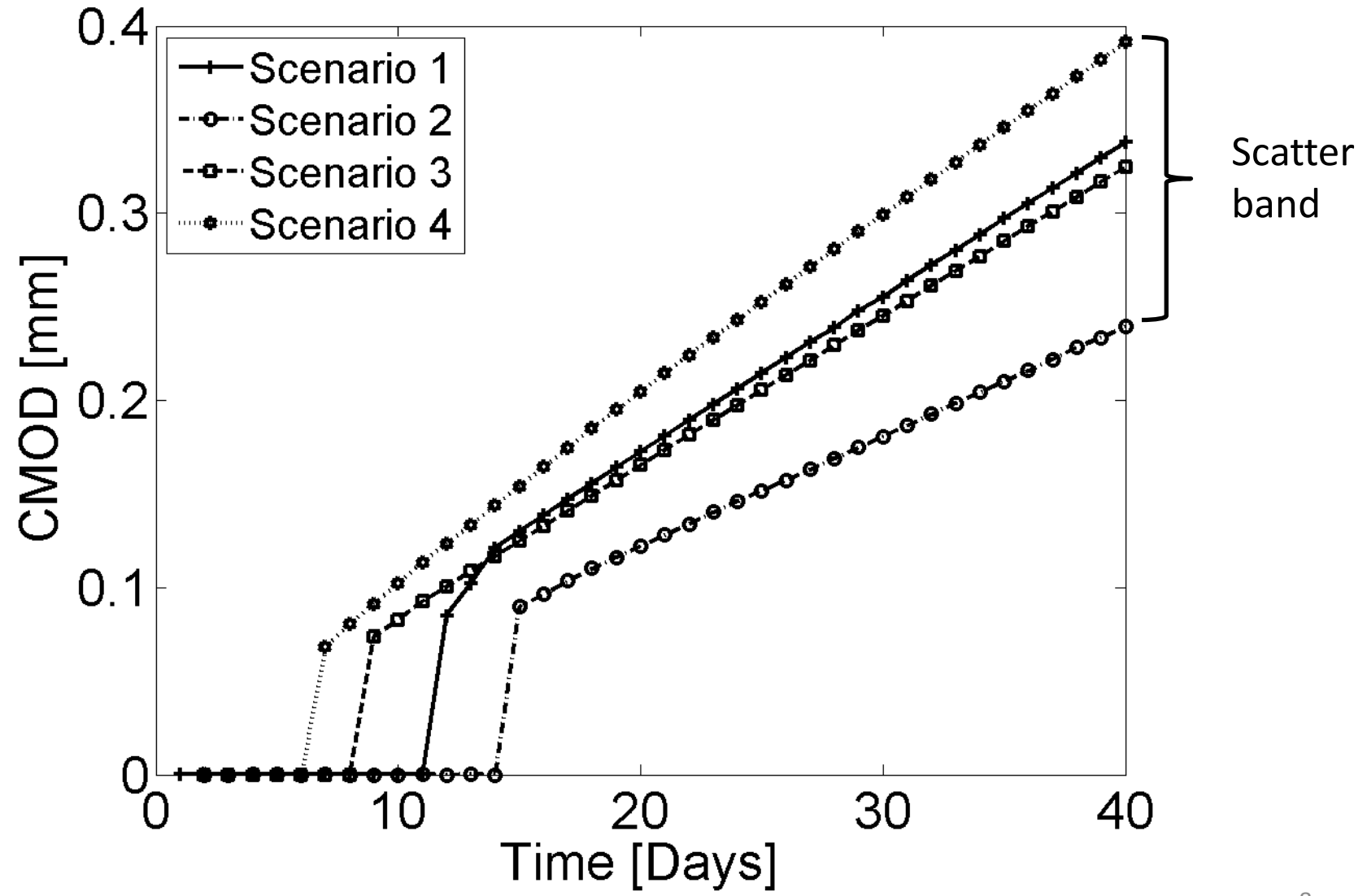


Scenario 3



Scenario 4

# Influence of modeling non-uniform corrosion on surface crackning





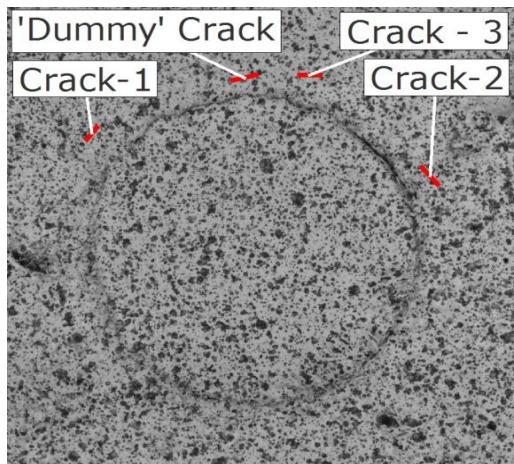
- INPUT

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

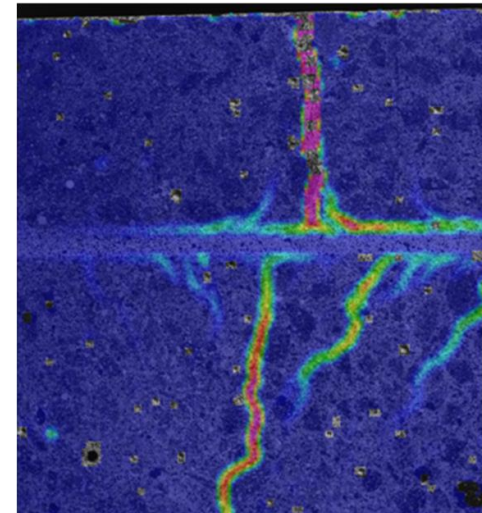
- OUTPUT

- 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



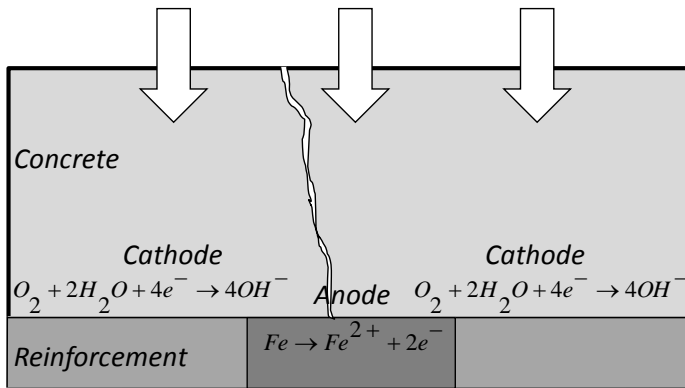
(Pease et al., 2012)



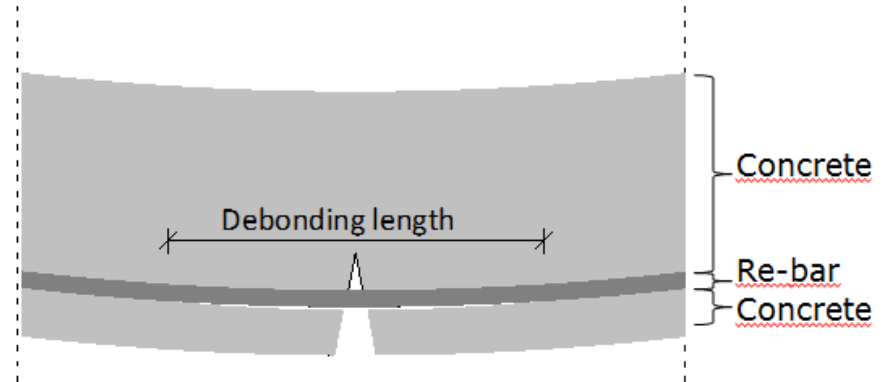
(Pease et al., 2006)

- Mechanical modeling
  - initial defects
  - debonding

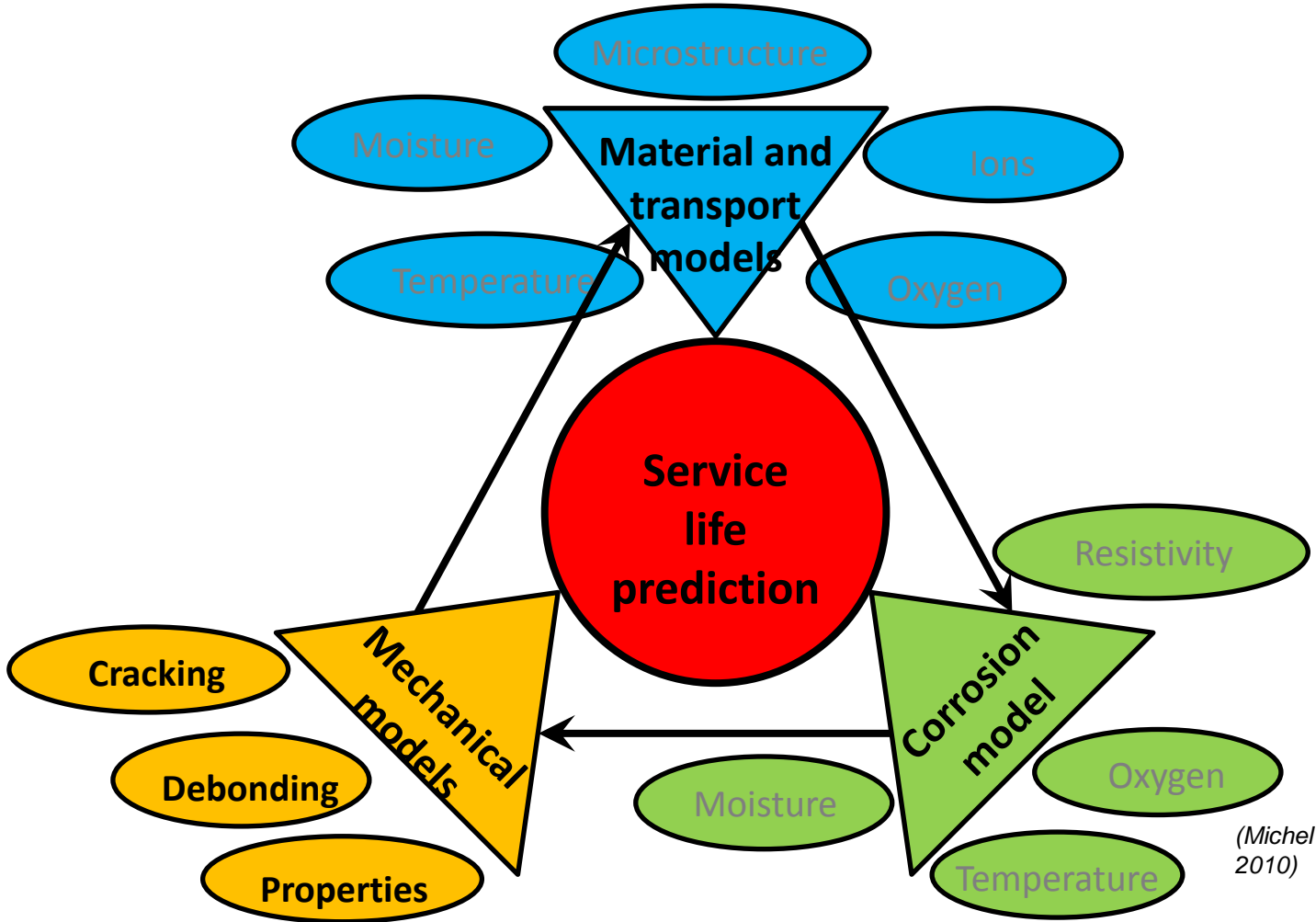
*Moisture, temperature, oxygen, chloride, carbon dioxide*



*(Michel et al., 2009)*



- Coupling with other models



(Michel et al., 2010)

Thank you for your attention

