

# bmcs course

brittle/matrix cementitious  
composite structures

roadmap, organization

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Institute of Structural Concrete



*oricrete: Yoshimura vault, RWTH Aachen  
(2015)*



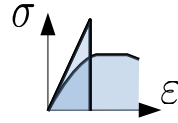
*Jena, Germany, Dyckerhoff-Widmann  
(1922-1923)*

*the roadmap*

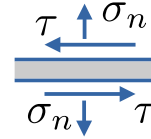
# local - global

material

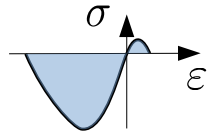
reinforcement



bond



matrix

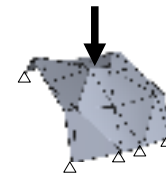


form

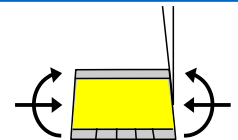
slab



folded shell

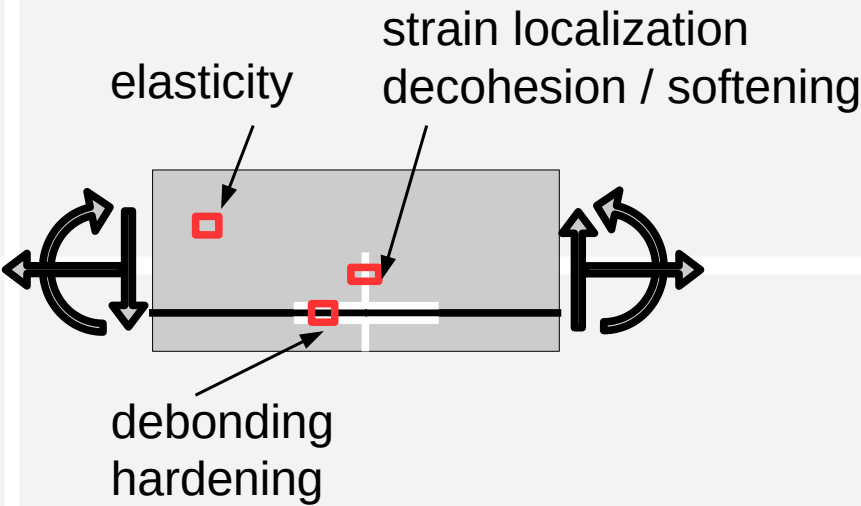
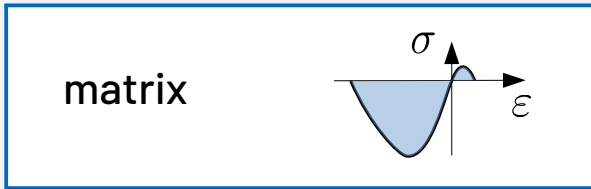
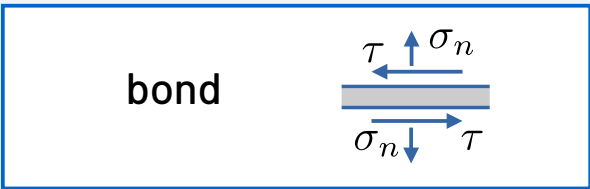
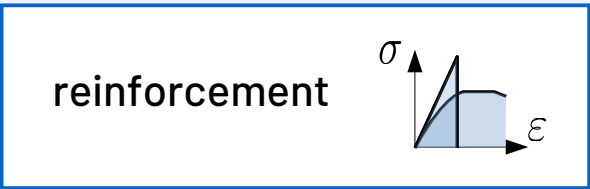


sandwich

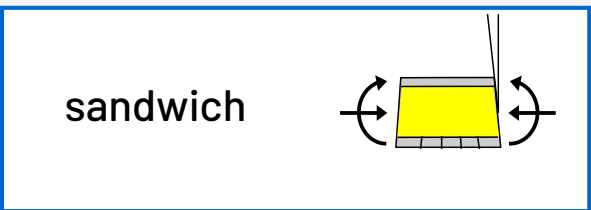
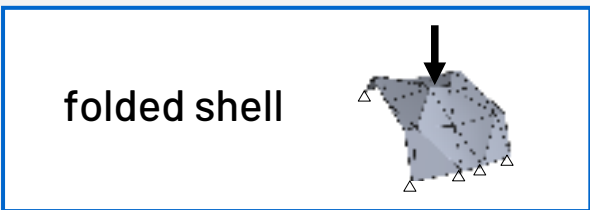


# interaction of mechanisms

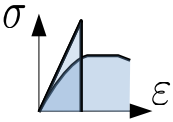
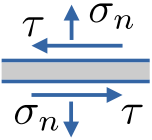
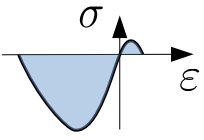
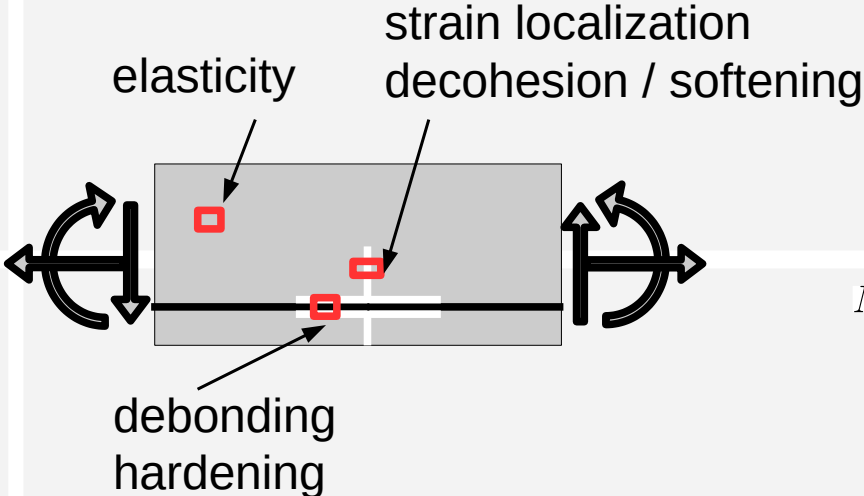

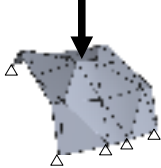
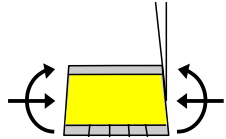
material



form



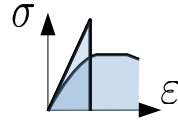
# elementary - complex

material	<div>reinforcement</div>	<div>bond</div>	<div>matrix</div>
cross section	<div><p>elasticity</p><p>strain localization</p><p>decohesion / softening</p><p>debonding</p><p>hardening</p></div>		
form	<div>slab</div>	<div>folded shell</div>	<div>sandwich</div>

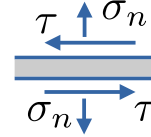
# local - global

material

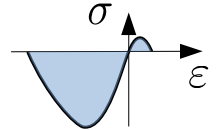
reinforcement



bond



matrix

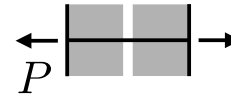


cross  
section

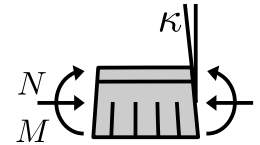
pullout



crack-bridge



moment-  
curvature

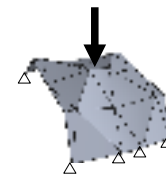


form

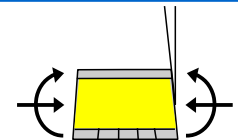
slab



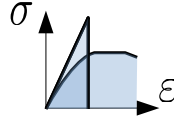
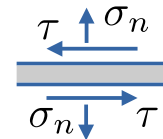
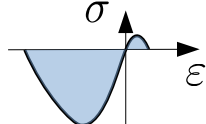

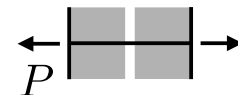
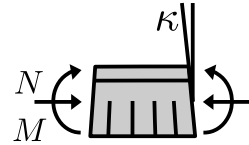
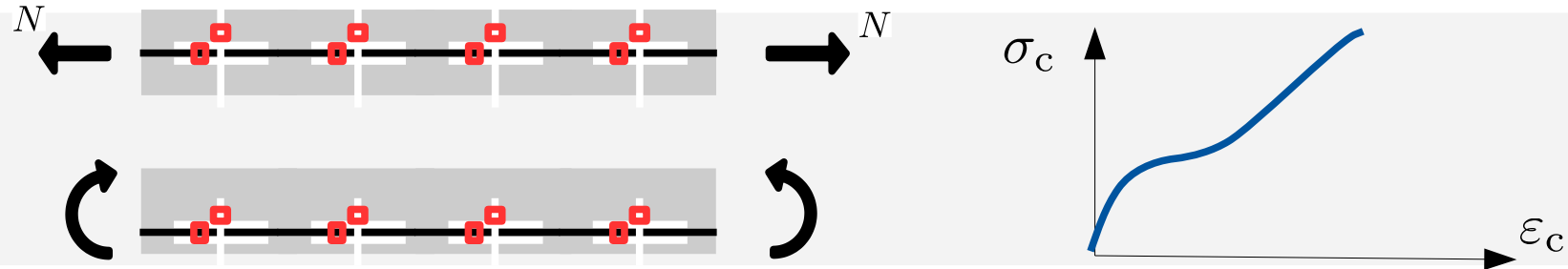

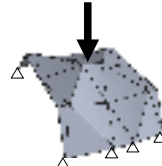
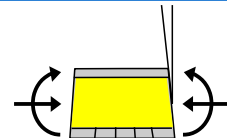
folded shell



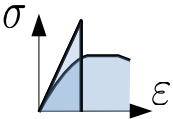
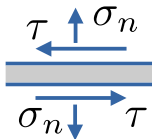
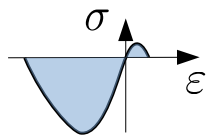


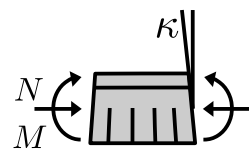

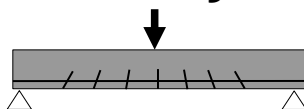


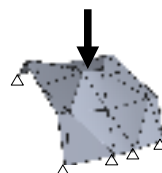
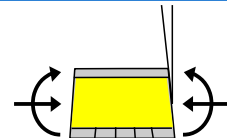
sandwich



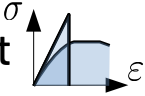
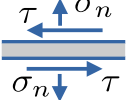
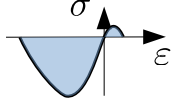


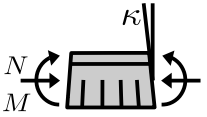

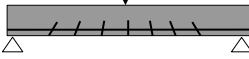

# interaction of mechanisms

material	<p>reinforcement </p>	<p>bond </p>	<p>matrix </p>
cross section	<p>pullout </p>	<p>crack-bridge </p>	<p>moment-curvature </p>
zone			
form	<p>slab </p>	<p>folded shell </p>	<p>sandwich </p>

# elementary - complex

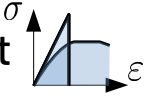
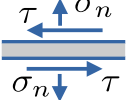
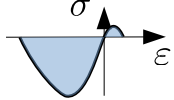


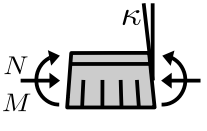

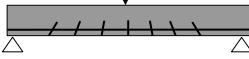

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cross section	<div>pullout</div>	<div>crack-bridge</div>	<div>moment-curvature</div>
zone	<div>tension - fragmentation</div>	<div>bending</div>	<div>compression - stability</div>
form	<div>slab</div>	<div>folded shell</div>	<div>sandwich</div>



material	<div>reinforcement </div>	<div>bond </div>	<div>matrix </div>
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zone	<div>tension - fragmentation </div>	<div>bending </div>	<div>compression - stability </div>

# guided tours

- Tour 1:** Mixture rule (effective composite stiffness)
- Tour 2:** Constant bond (friction, pull-out, crack-bridge, multiple cracking)
- Tour 3:** Nonlinear bond (hardening, softening -> failure modes: anchorage, cracking) |
- Tour 4:** Plastic bond behavior (irreversibility -> energy dissipation)
- Tour 5:** Damage bond behavior (2D sheet debonding)
- Tour 6:** Concrete cracking and yielding (bending of a cross section)
- Tour 7:** Beam deflection - comparison with EC2 and Model Code

material	reinforcement 	bond 	matrix 
cross section	pullout 	crack-bridge 	moment-curvature 
zone	tension - fragmentation 	bending 	compression - stability 

## Explain → Observe → Exercise

- **Explain:** videos with slides
- **Observe:** virtual experiments
  - what happens if you change something?
  - what is the model validity = quality?
- **Exercise:** book of examples [relevant for exam]

# Organization

- 3 SWS – 8 CP
  - homework assignment and colloquium – 2 CP
  - exam – 6 CP
- Hybrid lectures
  - Meeting every week with explanation of video content
  - Individual study using videos / jupyter notebook
- Consulting hours to exercise videos on a weekly basis

# What counts

## Seminar work

- read a scientific paper related to BMCS
- examine/validate/discuss particular issues described in the paper
- seminar work will be launched after the fifth lecture (6 weeks)
- reports either written or as a video presentation

## Exam

- written exam at the last date of the course

