

bmcs course

brittle/matrix cementitious
composite structures

roadmap, organization

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Abedulgader Baktheer
Institute of Structural Concrete



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

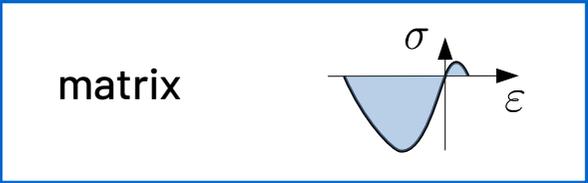
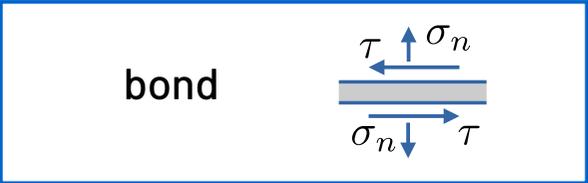


*Jena, Germany, Dyckerhoff-Widmann
(1922-1923)*

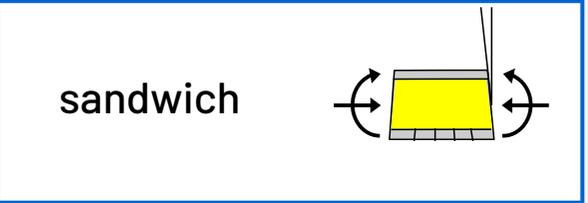
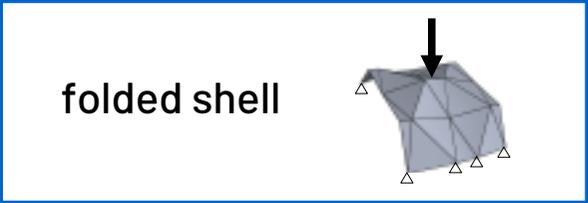
the roadmap

local - global

material

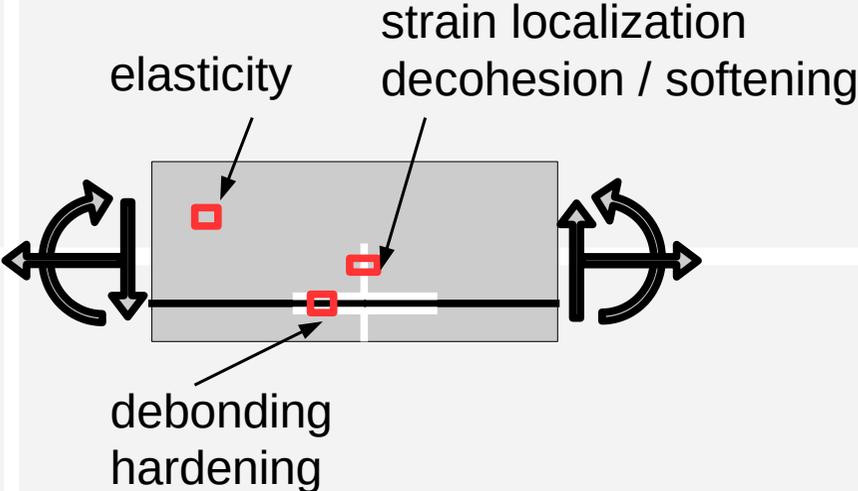
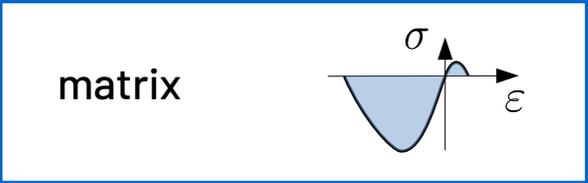
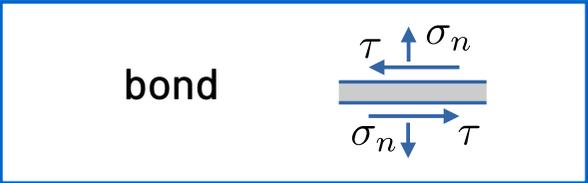


form

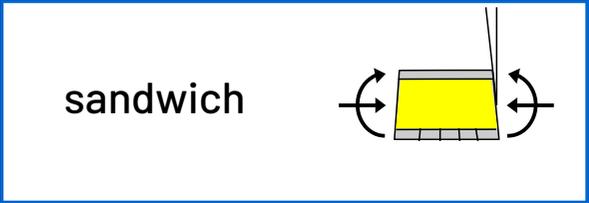


interaction of mechanisms

material



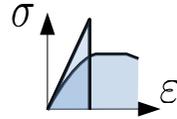
form



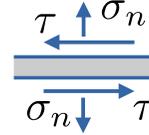
elementary - complex

material

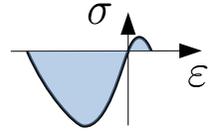
reinforcement



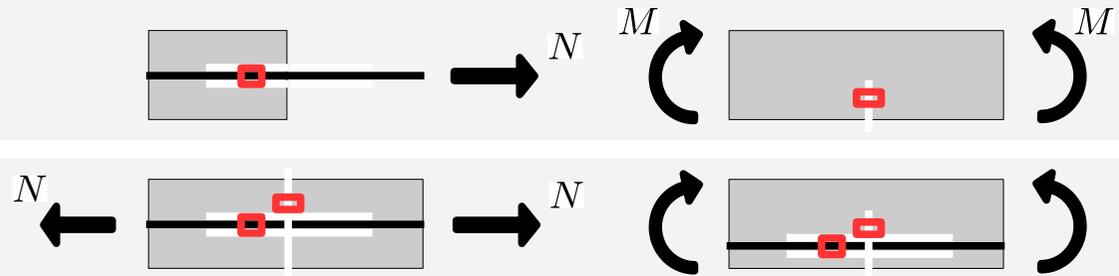
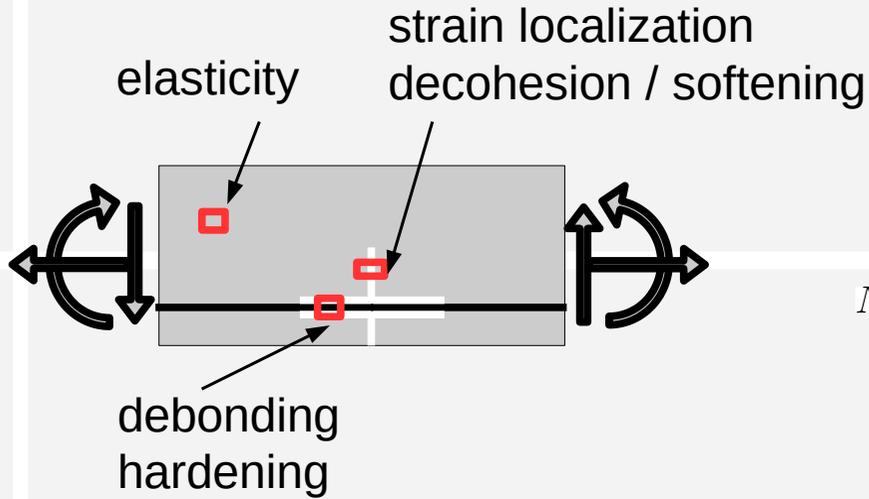
bond



matrix



cross section

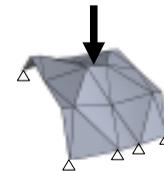


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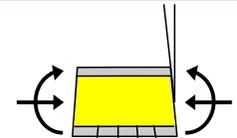
slab



folded shell



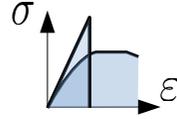
sandwich



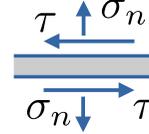
local - global

material

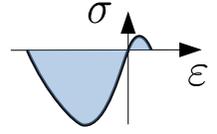
reinforcement



bond



matrix

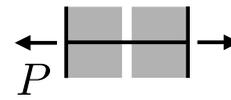


cross section

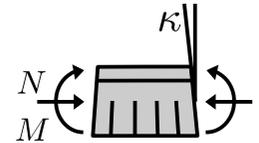
pullout



crack-bridge



moment-curvature

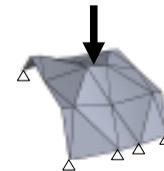


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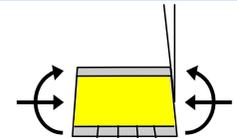
slab



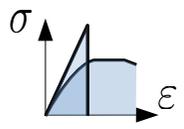
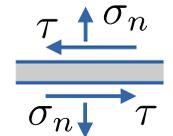
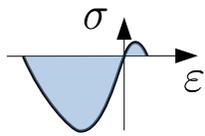
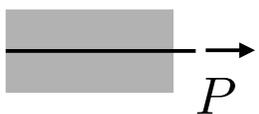
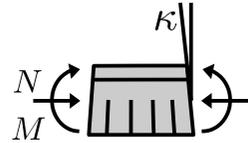
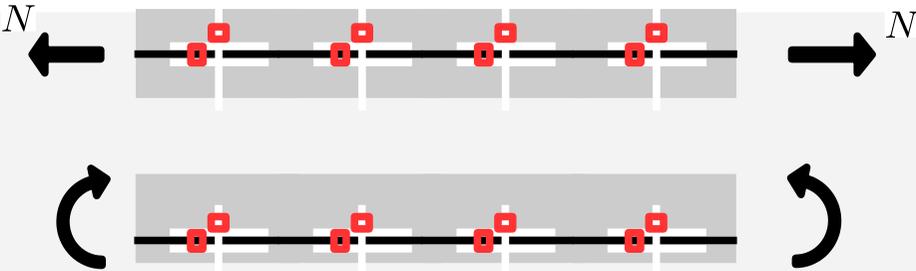
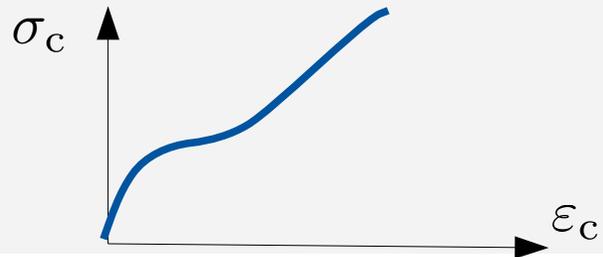
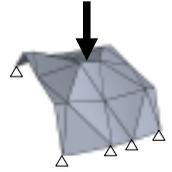
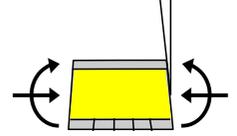
folded shell



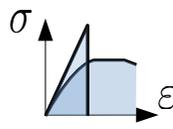
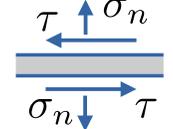
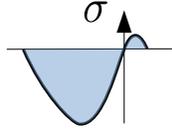
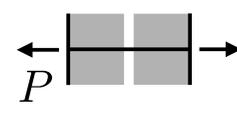
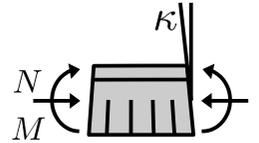
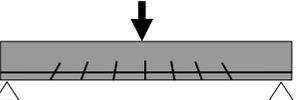
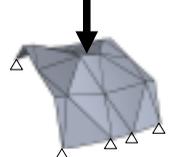
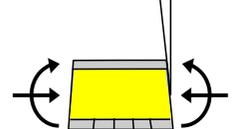
sandwich

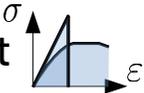
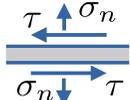
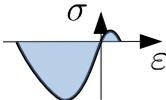
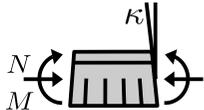
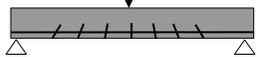


interaction of mechanisms

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

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

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

9 Lectures, 3 seminars, 8 guided tours

04/14/23	Lecture	Prof. Chudoba
04/21/23	Lecture	Prof. Chudoba
04/28/23	Lecture	Prof. Chudoba
05/05/23	Lecture	Prof. Chudoba
05/12/23	Exercise	Dr. Baktheer
05/19/23	Lecture	Prof. Chudoba
05/26/23	Lecture	Prof. Chudoba
06/09/23	Lecture	Prof. Chudoba
06/16/23	Lecture	Prof. Chudoba
06/23/23	Exercise	Dr. Baktheer
06/30/23	Lecture	Prof. Chudoba
07/07/23	Exercise	Dr. Baktheer
07/14/23	Exam	Dr. Baktheer

- **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: Energy supply, storage and dissipation**
- **Tour 7: Concrete cracking and yielding**
bending of a cross section
- **Tour 8: Beam deflection**
comparison with EC2 and Model Code

Explain → Observe → Exercise

- **Explain:** lectures, 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

