

bmcs course

brittle/matrix cementitious
composite structures

roadmap, organization

Rostislav Chudoba
Abedulgader Baktheer
Institute of Structural Concrete



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



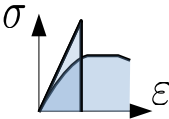
*Jena, Germany, Dyckerhoff-Widmann
(1922-1923)*

the roadmap

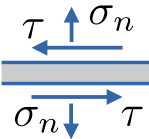
local - global

material

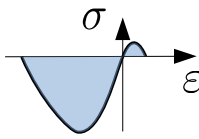
reinforcement



bond

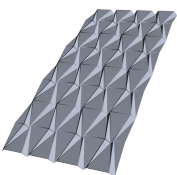


matrix

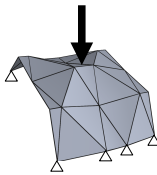


form

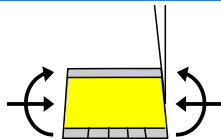
slab



folded shell

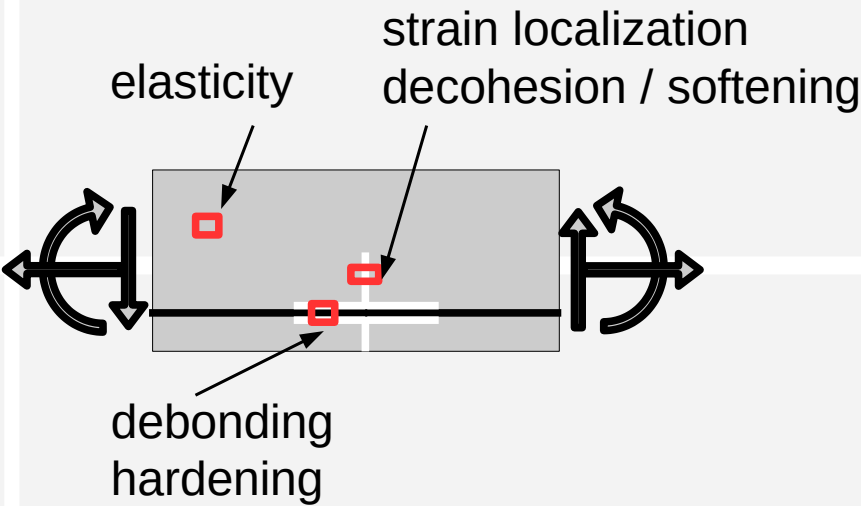
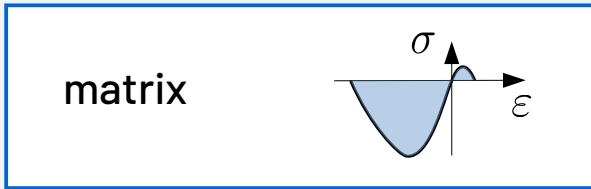
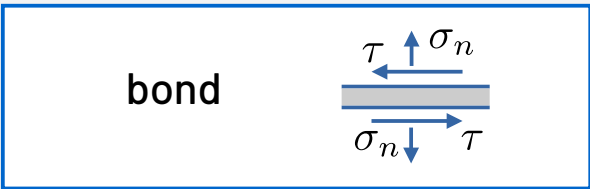
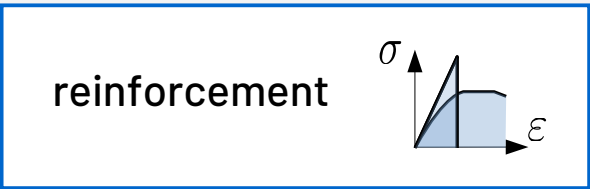


sandwich

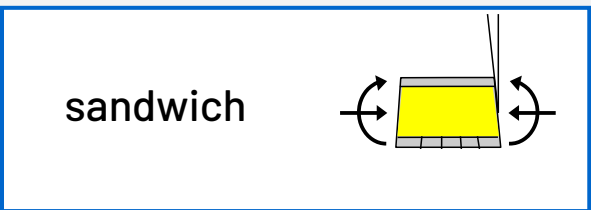
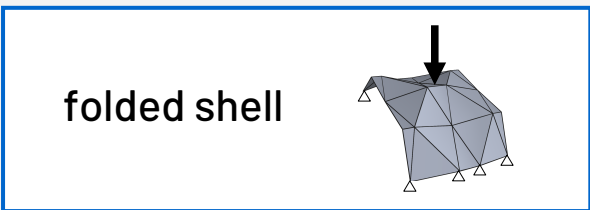
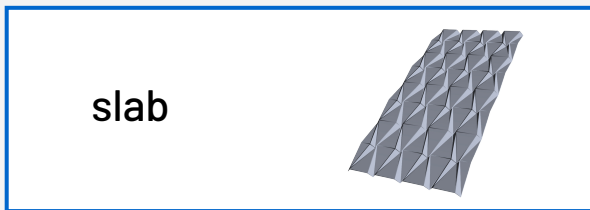


interaction of mechanisms

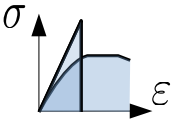
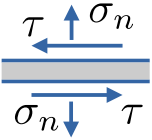
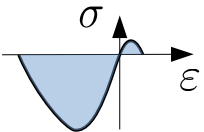
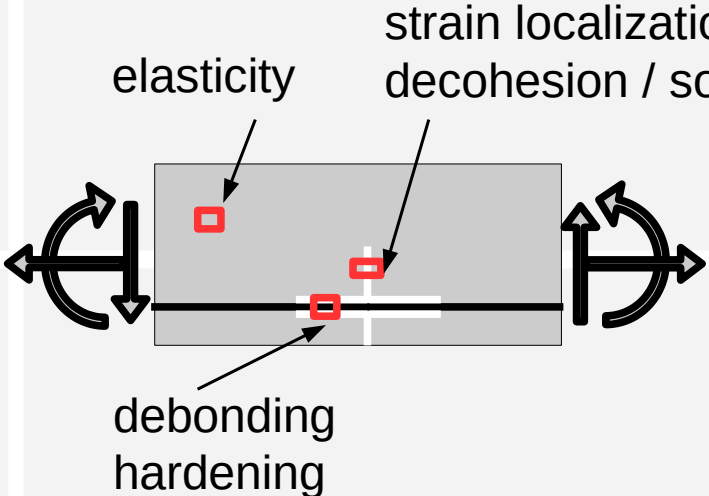
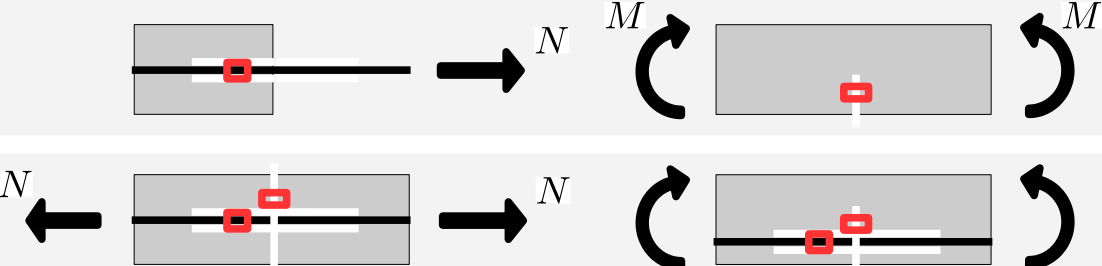
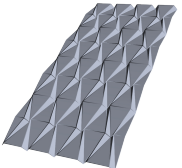
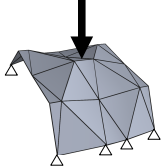
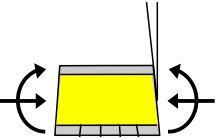
material



form



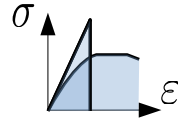
elementary - complex

material	<div>reinforcement</div>	<div>bond</div>	<div>matrix</div>
cross section	<div></div> <div></div>		
form	<div>slab</div>	<div>folded shell</div>	<div>sandwich</div>

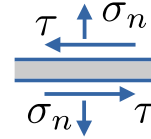
local - global

material

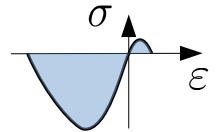
reinforcement



bond



matrix

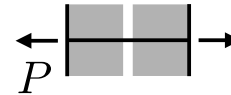


cross
section

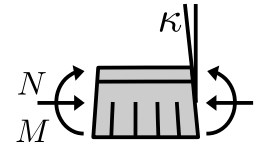
pullout



crack-bridge

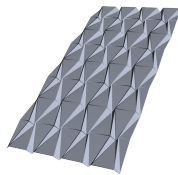


moment-
curvature

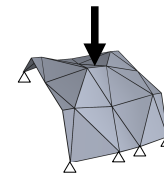


form

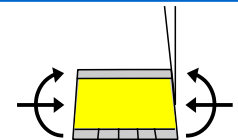
slab



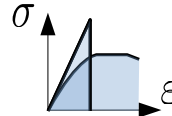
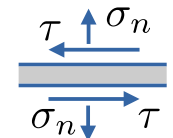
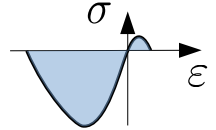


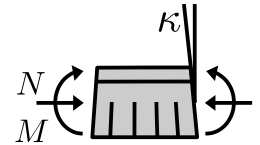
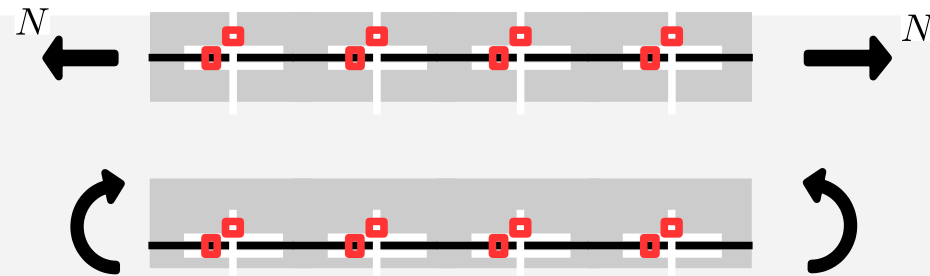
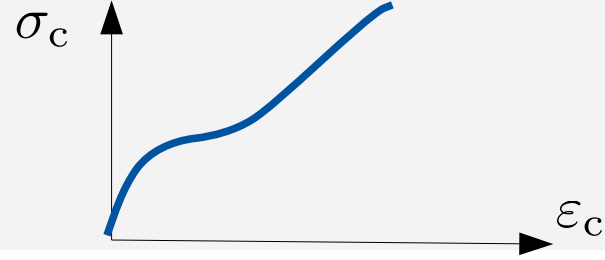
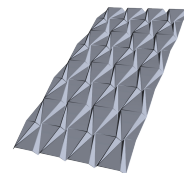
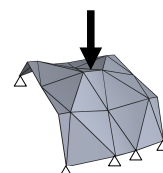
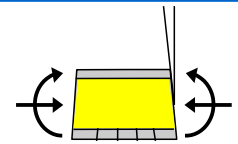
folded shell



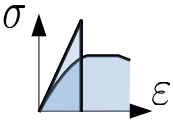
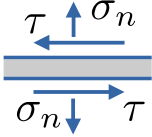
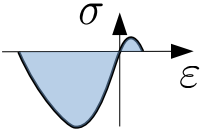


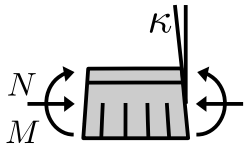

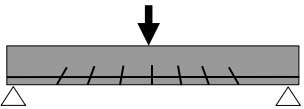
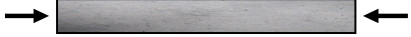
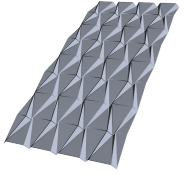
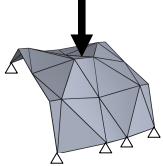
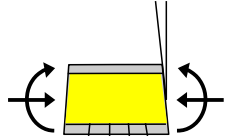
sandwich

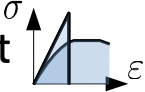
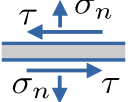
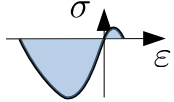


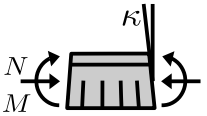

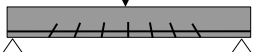



interaction of mechanisms

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

elementary - complex

material	<div>reinforcement</div>	<div>bond</div>	<div>matrix</div>
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	<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> 

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

