



Empa

Materials Science and Technology

Application of externally bonded reinforcement on concrete

ETH Lecture 101-0167-01L

Fibre Composite Materials in Structural Engineering

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Safety

- Adhesive and solvent are dangerous for persons and environment
- See safety instructions of the provider of the materials
- Protection of hands, eyes, head etc.

- Attention with dust of CFRP

Characteristic bond strength of concrete f_{hk} (SIA166 Ziffer 6.2)

- Pull-off test according to SN EN 1542
 - drilling of a circular groove with a depth of min. 5 mm
 - disc with \varnothing 50 mm
- $f_{hk} = 0.7 f_{hm}$
- If a minimum of 8 single testing values exists, then the characteristic value can be determined with $f_{hk} = f_{hm} - k_n s$ (with s being the standard deviation)
- Each single value has to be larger as 1.5 N/mm² (strips) or 1.0 N/mm² (fabrics)

- Comparison with value taken for design

Surface preparation

- grinding
- sand blasting
- etc.

- remove any fat, oil and dirt
- remove dust!

- Furthermore, check evenness of concrete surface
 - for 2 m measurement length (Messlatte): max. 5 mm tolerance
 - for 0.3 m measurement length (Messlatte): max. 1 mm tolerance

- repair mortar → speak with specialized companies

- Only qualified persons
- Check of correct working temperatures according to the specifications of the adhesive (should be measured!)
- Check of dew point ("Taupunkt")
- Cleaning of strip surface
- Good and proper mixing of the adhesive, application of adhesive on strip and concrete surface
- Ev. contact pressure
- Ev. test samples of adhesive

- Manufacturer shall deliver information on
 - product type
 - product components
 - name and address manufacturer
 - batch number
 - expiry date
 - material tests
 - information on handling, transportation, storage (pot life, storage conditions, etc.)
 - safety data

Quality control

- Check if material delivered in proper packaging and information about what it is
- Check for damage due to transport
- Correct type of FRP? Correct adhesive?
- Protocol of the execution procedure (temperature etc.)
- After finishing: adhesive thickness, unevenness of glued FRP
- Test samples of the materials (adhesive, FRP)

Bond quality control after practical execution

- Partially destructive techniques:
 - Pull-off test
 - Lap-shear test (e.g. by using prestressing equipment)
- Non destructive techniques
 - Tapping
 - Thermography (heating of FRP, defects are visible due to different thermal properties)
- Load tests on the strengthened structure before and after the strengthening
- Long-term monitoring systems