Development of a modular concrete heliostat prototype

Mission statement
The main idea of this ‘knowledge transfer’ project is to replace typical steel structures for heliostats by means of concrete due to its low costs. With respect to accuracy demands a high-performance concrete is used that possesses high compressive and tensile strength. The collector is designed as a strut-like structure with main radial beams and a central mount to ensure high stiffness. The design exhibits a circular shape to reduce shading. For construction, the concrete collector is dissolved into equal modules derived from symmetry reduction methods enabling serial production. The modules are subsequently post-tensioned to form a heliostat. To show the feasibility, a small-scale prototype is developed that will be built up and qualified at the solar tower Jülich, Germany.

High-performance concrete (NANODUR®)
- Young’s modulus 50,000 MPa
- Compressive strength 116 MPa
- Flexural tensile strength 20 MPa
- Design tensile strength 6.2 MPa
- Bulk density 25 kN/m³

Dimensions
- Diameter 3.2 m
- Mirror area 8 m²
- Weight 744 kg
- Modules 4

System reduction method
- Derivation of segmental modules with equivalent stiffness
- Restrictions:
  - Slope deviation SD rms ≤ 1.25 mrad
  - 1st principle stress $\sigma_1 \leq 6.2$ MPa

Accuracy analysis
- Numerical analysis of deformations
- Derivation of slope deviations SD
- SD rms = 1.20 mrad (numerically)

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