RUHR-UNIVERSITÄT BOCHUM

TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

DLR Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

RUB

Development of a modular concrete heliostat prototype

Funded by
DFG Deutsche Forschungsgemeinschaft
German Research Foundation

Motivation

Mission statement

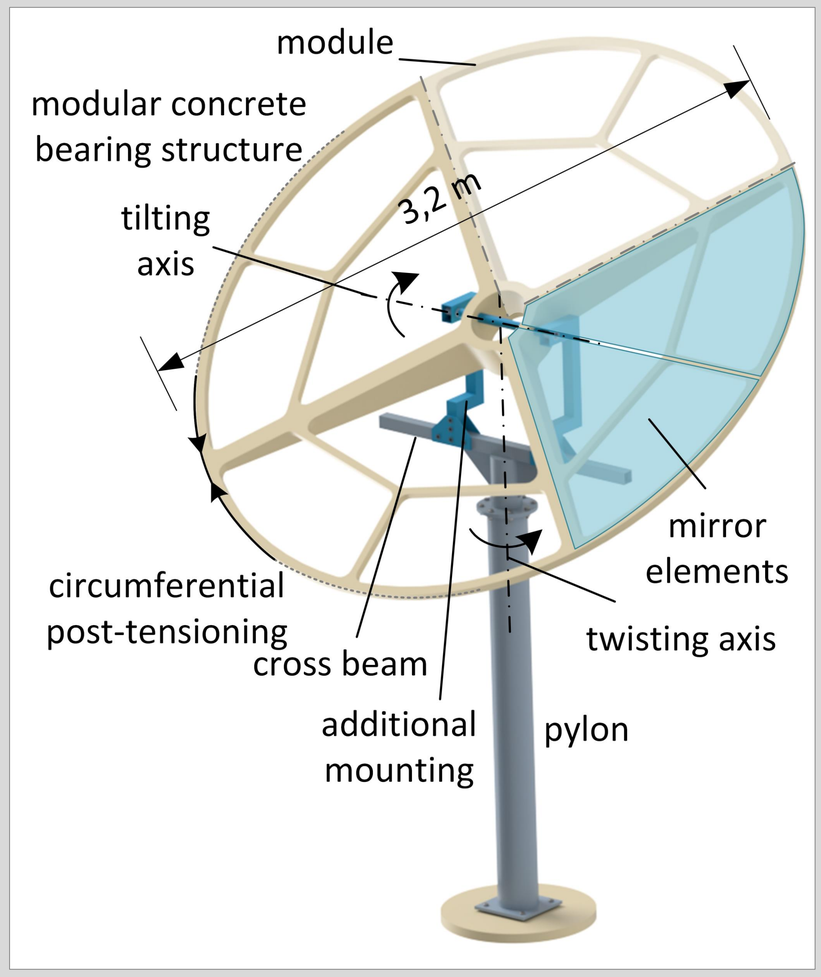
The main idea of this ‘knowledge transfer’ project is to replace typical steel structures for heliostats by means of concrete due to its low costs. With respect to accuracy demands a high-performance concrete is used that possesses high compressive and tensile strength. The collector is designed as a 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

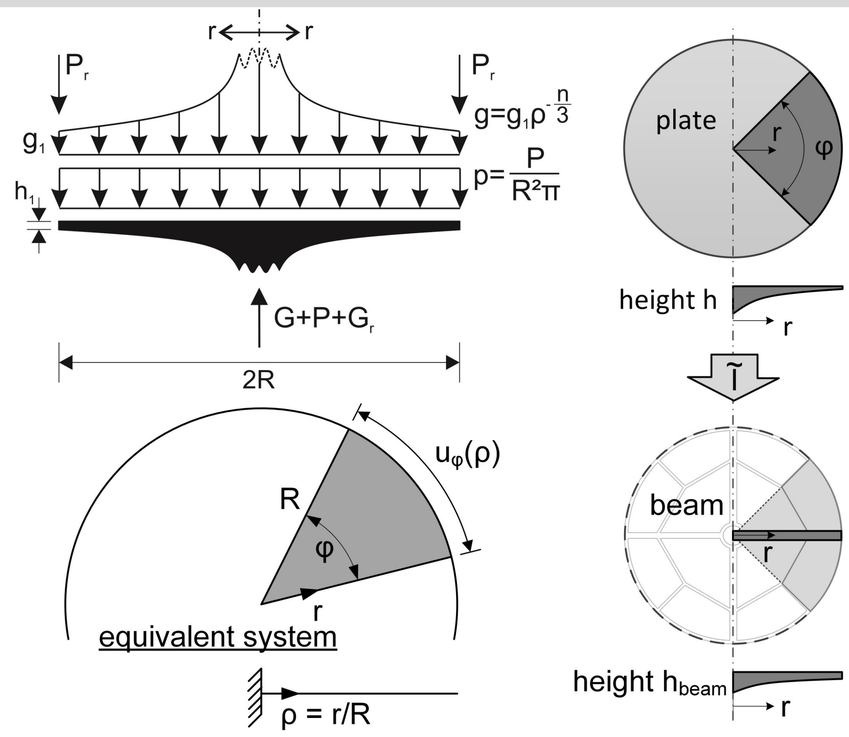
• Diameter	3.2 m
• Mirror area	8 m²
• Weight	744 kg
• Modules	4



Design and construction

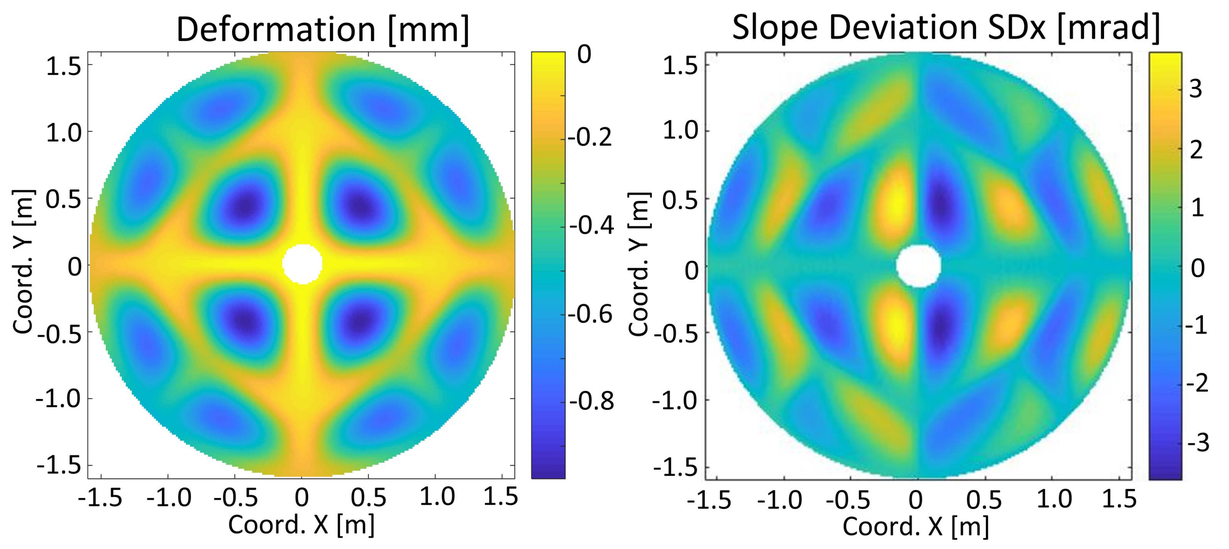
System reduction method

- Derivation of segmental modules with equivalent stiffness
- Restrictions:
  Slope deviation SDrms ≤ 1.25 mrad
  1st principle stress $\sigma_I \leq 6.2$ MPa



Accuracy analysis

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



Construction

- Polystyrene formwork with adhesive foil covering
- External post-tensioning of the modules to form a heliostat
- Additional mounting on the already existing T-type pylon for the central mount at the solar tower plant Jülich, Germany
- Mirroring by means of composite mirror elements “vegaprime” (aluminum layer with plastic core)

Modular polystyrene formwork of a test segment

Concreting

Project partner: ALMECO GROUP · durcrete · innovativ INNOgration integriert