

## SE 110.16

### Parabolic arch



The illustration shows SE 110.16 in a frame similar to SE 112.

#### Description

- **statically determinate or statically indeterminate parabolic arch under load**
- **deformations of the arch under load**
- **support reactions of the arch**

Parabolic arches are popular elements in construction engineering. They can be employed as bridges or beams for example. Normally these bridges are statically indeterminate. The special feature of the parabolic arch is that in the arch only normal forces and bending moments occur, but no shear forces. That is the case when the arch is subjected to a uniform distributed load and both ends are mounted in fixed supports. This enables arches to be constructed from loosely set stones – a construction technique which has been in existence for many centuries. Loads acting upon the inner of the arch are primarily compressive forces in the direction of the normal force at every point of the arch.

SE 110.16 includes a pre-shaped parabolic arch. It can be subjected to point or distributed loads. It is possible to suspend an elastic roadway and load it.

One of the arch's supports is fixed, the other is horizontally movable. Weights are used to undo this movement. The movable support thus becomes a fixed support. Additional weights compensate for the vertical support reaction.

Dial gauges record the deflection of the arch under load and the horizontal displacement of the movable support. As long as the movable support is movable, the arch is statically determinate, though it is substantially deformed under load. As soon as the movable support becomes immovable, the arch is no longer statically determinate and is deformed only to a minor degree.

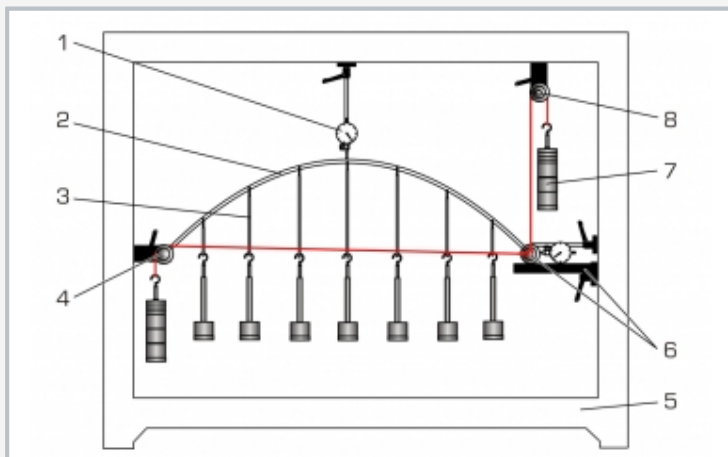
All the component elements of the experiment are clearly laid-out and housed securely in a storage system. The complete experimental setup is arranged in the frame SE 112.

#### Learning objectives/experiments

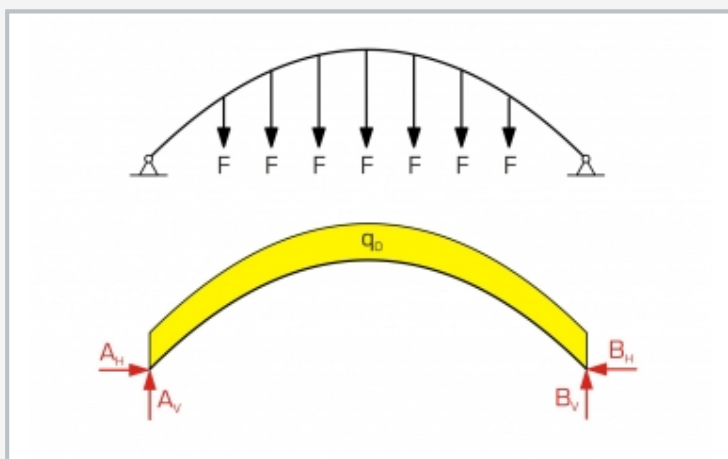
- mechanical principles of the parabolic arch
- differences between statically determinate and statically indeterminate arches
- measurement of the deformations of the arch under load
- measurement of the support reactions on the statically indeterminate arch under load
- calculation of the support reactions
- influence of load on reaction forces and deformation of the arch
  - ▶ point load
  - ▶ distributed load
  - ▶ suspended elastic roadway under load

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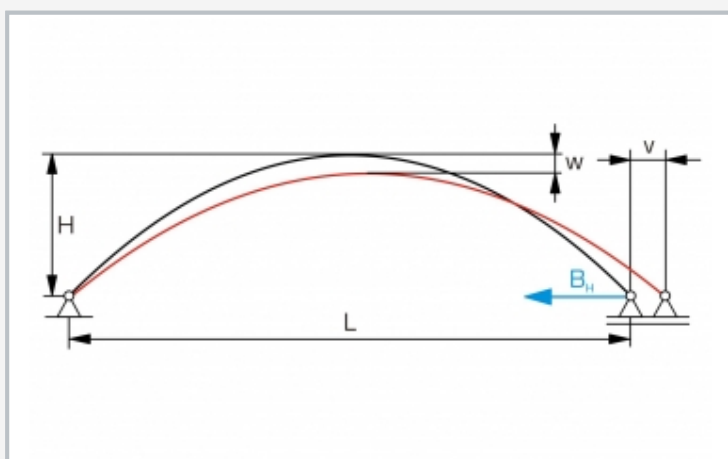
## Parabolic arch



1 dial gauge, 2 arch, 3 shackle, 4 fixed support, 5 frame SE 112, 6 movable support with support plate, 7 weight, 8 deflection roller, red: cable; not shown: elastic roadway



Top: forces on the statically indeterminate parabolic arch, bottom: free-body diagram with distributed load  $q_0$  in yellow (generated from evenly distributed point loads  $F$ ) and support reactions  $F_A + F_B$  in red



Deformation of the statically determinate arch under distributed load: L length, H height, w deflection, v horizontal displacement on the movable support; black arch without load

### Specification

- [1] investigation of a parabolic arch, optionally statically determinate (1 fixed support, 1 movable support) or indeterminate (2 fixed supports)
- [2] loading of the arch with a distributed load by way of 7 evenly distributed loads or by point loads or by suspended roadway with loads
- [3] 2 dial gauges record the deformation of the arch under load
- [4] weights to compensate for the reactions of a fixed support
- [5] roadway with 1 set of shackles to be suspended into the arch; shackles in graduated length
- [6] storage system to house the components
- [7] experimental setup in frame SE 112

### Technical data

Parabolically pre-shaped steel arch

- length: 1000mm
- height: 280mm
- cross-section: 20x6mm

Roadway made of PVC

- dead-weight: approx. 2,6N
- LxWxH: 900x70x3mm

Dial gauge

- measuring range: 0...25mm
- graduation: 0,01mm

Weights

- 11x 1N (7+4 hanger)
- 7x 1N (shackle)
- 36x 1N
- 19x 5N

LxWxH: 1170x480x178mm (storage system)

Weight: approx. 38kg (total)

### Scope of delivery

- 1 arch with 7 shackles + 7 hangers
- 1 roadway with shackles
- 1 set of weights
- 2 deflection rollers with fixture
- 1 support
- 2 dial gauges
- 1 storage system with foam inlay
- 1 set of instructional material

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Required accessories

022.11200      SE 112      Mounting frame