

## SE 110.16 *Parabolic Arch*



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

- \* **Statically determinate or statically indeterminate parabolic arch under load**
- \* **Deformations of the arch under load**
- \* **Support reactions of the arch**

The complete experiment setup is arranged in the frame SE 112.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

### Technical Description

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 bearings. 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.

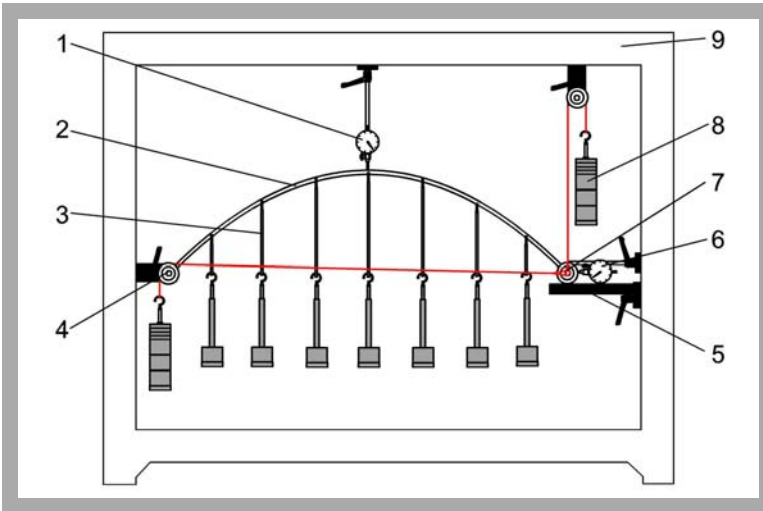
SE 110.16 includes a pre-shaped parabolic arch. It can be subjected to point or distributed loads. One of the arch's supports is fixed, the other is on a roller bearing. Weight sets are used to cancel this movement. The movable support thus becomes a fixed support. Additional weight sets compensate for the vertical support reaction.

Dial gauges record the deflection of the arch under load and the horizontal displacement of the movable bearing. As long as the roller bearing is movable, the arch is statically determinate, though it is substantially deformed under load. As soon as the roller bearing becomes immovable, the arch is no longer statically determinate and is deformed only to a minor degree. The various elements of the experiment are clearly laid-out and housed securely in a storage system.

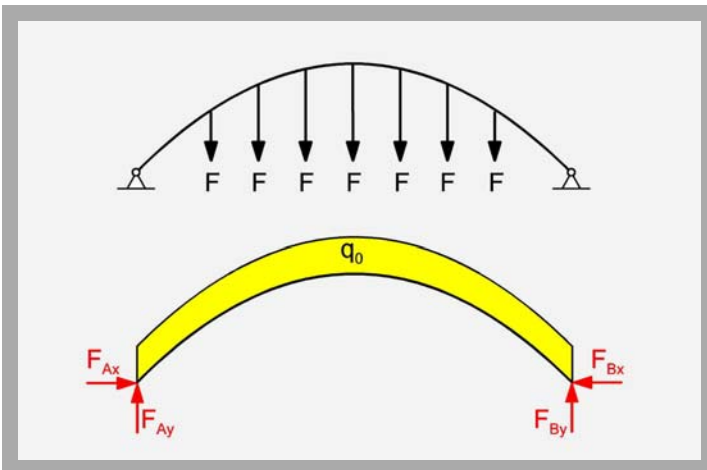
### Learning Objectives / Experiments

- 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 point load or distributed load on reaction forces and deformation of the arch

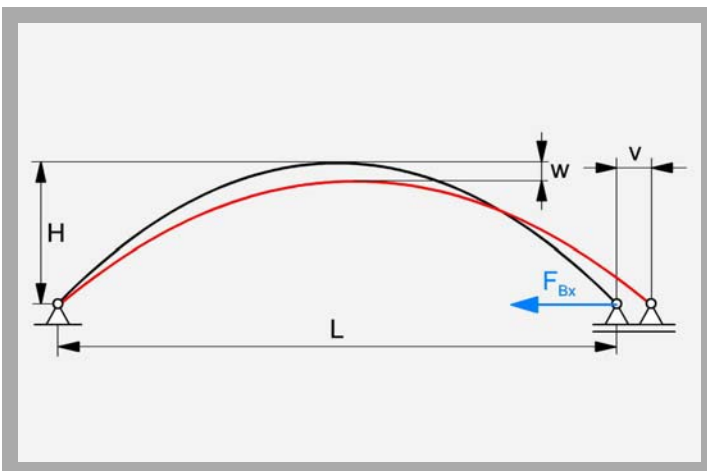
## SE 110.16 Parabolic Arch



1 dial gauge for deflection of arch, 2 arch, 3 shackle, 4 deflection roller with fixture, 5 roller bearing, 6 dial gauge for horizontal displacement of support, 7 movable or fixed support, 8 weight, 9 frame SE 112, red: cable



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

### 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 weights or by point loads
- [3] Dial gauges record the deformation of the arch under load
- [4] 4 sets of weights to compensate for the reactions of a fixed support
- [5] Storage system to house the components
- [6] Experiment setup in frame SE 112

### Technical Data

- Parabolically pre-shaped steel arch
- length: 960mm
  - height: 262mm
  - cross-section: 20x6mm
- Dial gauges
- Measuring range: 0...25mm, graduations: 0.01mm
- Weights
- 11x 1N (7+4 hangers)
  - 16x 1N
  - 19x 5N

### Dimensions and Weight

Weight: approx. 23 kg

### Scope of Delivery

- 1 arch with 7 shackles + 7 weight hangers
- 4 sets of weights
- 2 deflection rollers with fixture
- 1 bearing
- 2 dial gauges
- 1 storage system
- 1 set of instructional material

### Order Details

022.11016 SE 110.16 Parabolic Arch