CB251
Testing of materials

Compression Test

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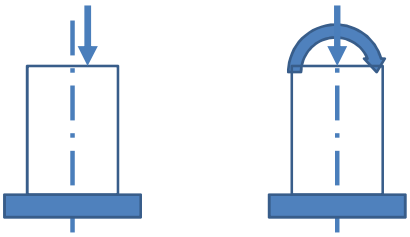
Compression Test

- Tension test is normally conducted to obtain the mechanical properties of Metals. It is the primary test used for quality control and the basis for acceptance and refusal of metallic products used in construction and other uses.
- Compression test is used to obtain the mechanical properties and is the basis acceptance and refusal of brittle non metallic and other materials that have very low strength in tension like concrete, wood, masonry, etc.

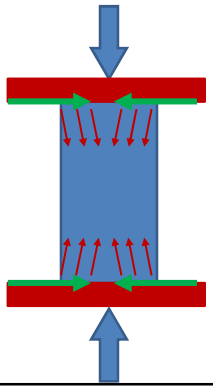
Compression Test

- Compression test could be used to obtain the mechanical properties of metals however it is not preferred due to the following;
  - It is difficult to apply a truly axial load in compression which leading to non uniform stresses



Compression Test

- Friction between the machine head and the sample effects the results causing stresses to have a small inclination



Compression Test

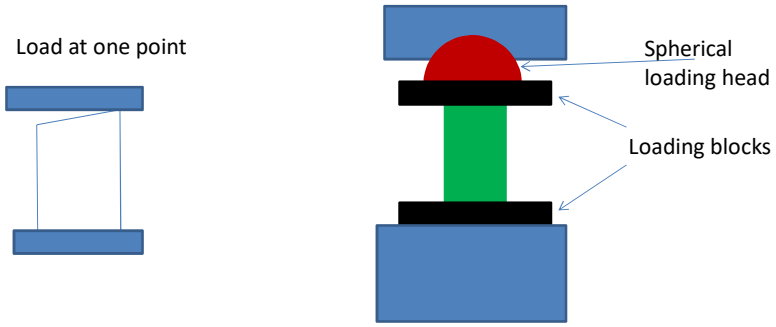
- Eccentricity may cause instability
- Long samples are prone to buckling therefore the length of the specimen must be limited
- Using small samples results in inaccuracies in results and using large samples requires testing machines with large capacities

Compression Test Setup Precautions

- Because the size of the specimen may be small compared to the size of the testing machine's head bearing blocks are used to between the specimens and the machine head to ensure proper distribution of the load

Compression Test Setup Precautions

- Spherical loading heads are used to avoid applying the load at a single point if the loading surfaces are at a small angle

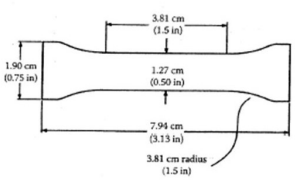


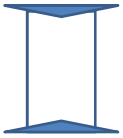
Compression Test Setup Precautions

- The specimen's length must not exceed 10 times it diameter to avoid buckling
- Both ends of the specimen must be flat and parallel
  - Metallic specimens are machined to ensure parallel level surfaces
  - For non metallic specimens like masonry and concrete a layer of mortar, gypsum or Sulphur is added on both sides to ensure parallel level surfaces

Compression Test Setup Precautions

- To reduce friction the one of the following is done
  - Lubricate friction surfaces
  - Increase diameter of specimen at ends
  - Make specimen's surface and machine head inclined with the same angle of friction





Compression Test Specimens (Metals)

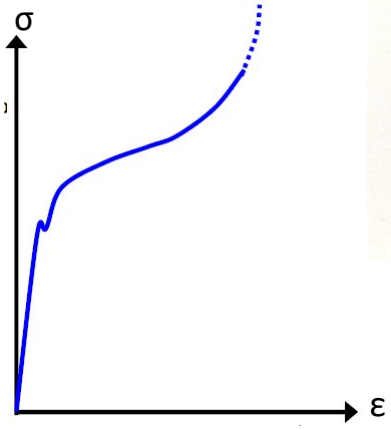
- Cylindrical specimens are preferred to ensure uniform distribution of stresses, three types of specimens are used
- $L \leq 10\ d$ to avoid buckling
- Long specimens L=8-10 d to install deformation measurement devices for obtaining the stress strain curves and other mechanical properties like the Modulus of Elasticity, Resilience, Toughness, etc.

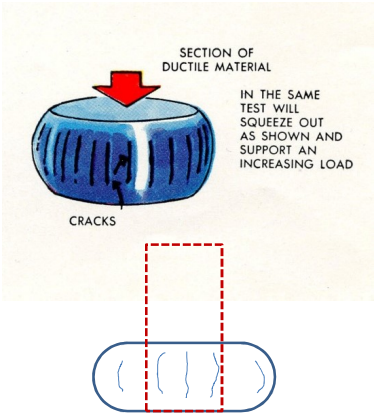
Compression Test Specimens (Metals)

- Medium specimens L= 3 d to obtain compression strength of metals
- Short specimens L= 0.9 d to test metals used as bearings since the friction induced in testing will resemble bearing conditions

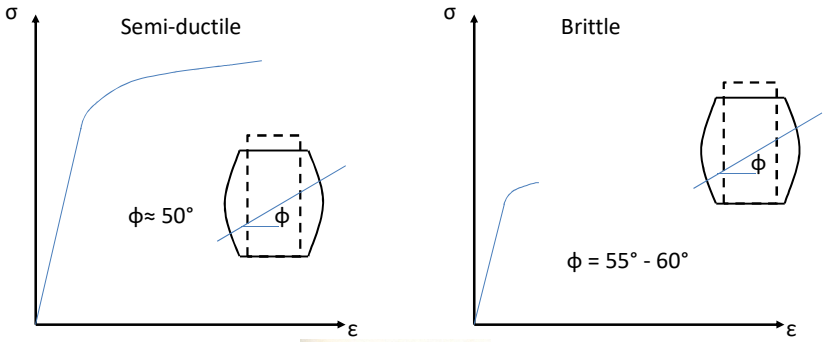
Behavior of Metals in Compression

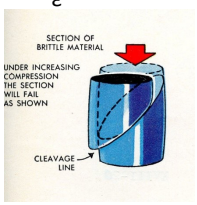
- Ductile metals





Behavior of Metals in Compression





Failure shapes of metallic specimens

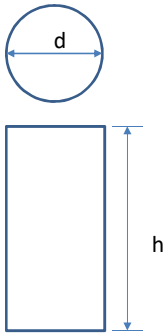
In the following Figure are the compression test specimens of metals (left to right): untested specimen, and tested specimens of gray cast iron, aluminum alloy 7075-T651, and hot-rolled AISI 1020 steel.

1) With the help of the Mohr's circle, explain why both gray cast iron and aluminum alloy have the classic 45 degree fracture surface;

2) How the AISI 1020 steel is deformed. _____)

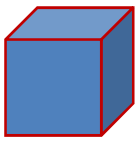
Compression Test Specimens (Concrete)

Cylinder (American Standards)



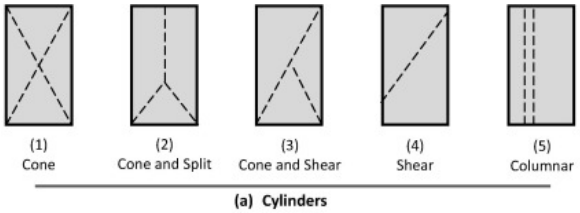
Large d=150 mm (6 inch)
h=300 mm (12 inch)
Small d=100 mm (4 inch)
h=200 mm(8 inch)

Cube (Egyptian Standards)

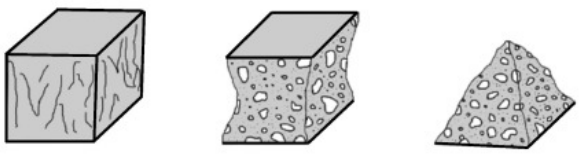


Large (150 x 150 x 150 mm)
Small (100 x 100 x 100 mm)

Concrete Failure Shapes



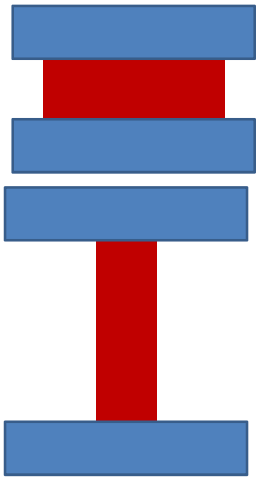
(a) Cylinders



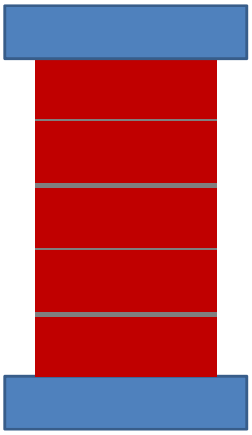
(b) Cubes

Masonry

1 Block
To obtain brick properties



5 Block
To obtain brick-mortar assembly properties



Column