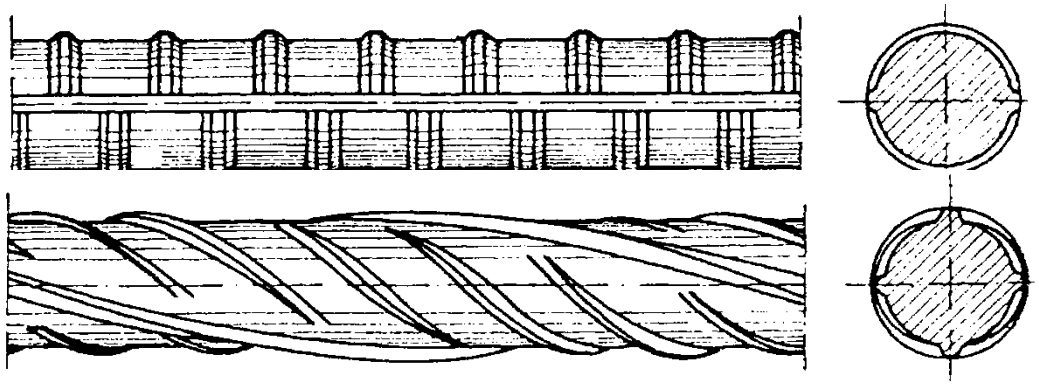
CHAPTER 1
CONCRETE AND REINFORCED CONCRETE

Material Behavior

(cont'd)

STEEL REINFORCEMENT

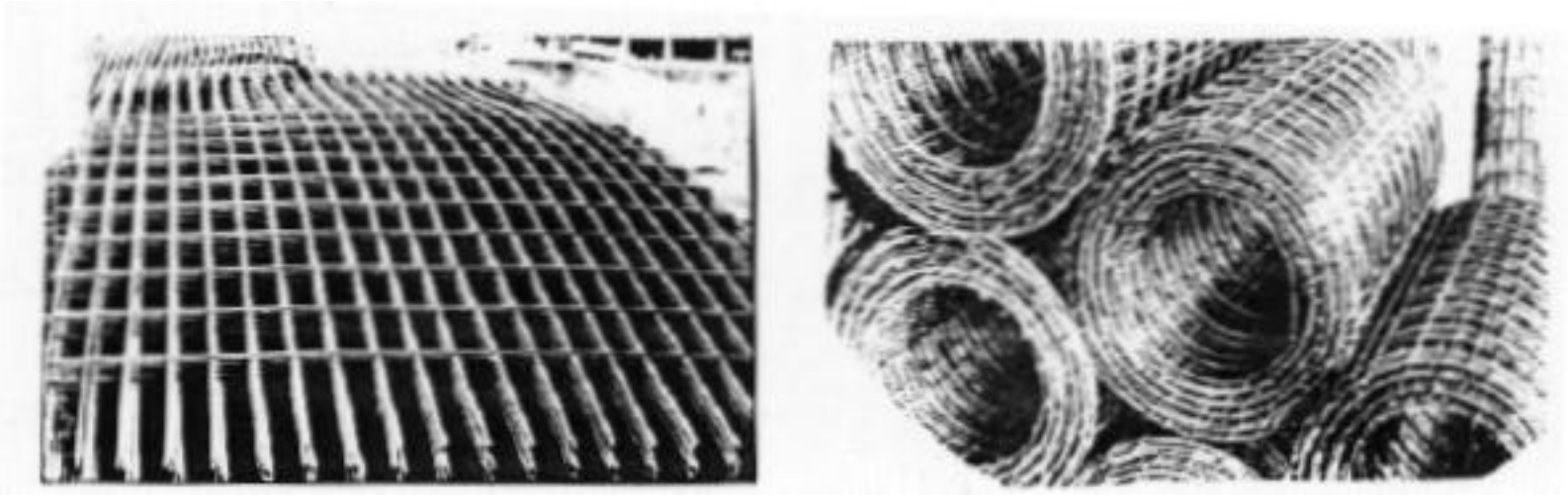
Since concrete is weak in tension, steel bars are used to take care of the tensile stresses.



Reinforcing bars are either hot rolled or cold worked. Hot rolled steel is manufactured in the plant and its properties depend largely on the chemical composition. In cold working process, steel is drawn or twisted under normal temperatures.

STEEL REINFORCEMENT

In welded wire fabric, used in slabs and walls, the reinforcing bars are placed orthogonal to each other forming either rectangular or square grids. These bars are usually welded at each joint.

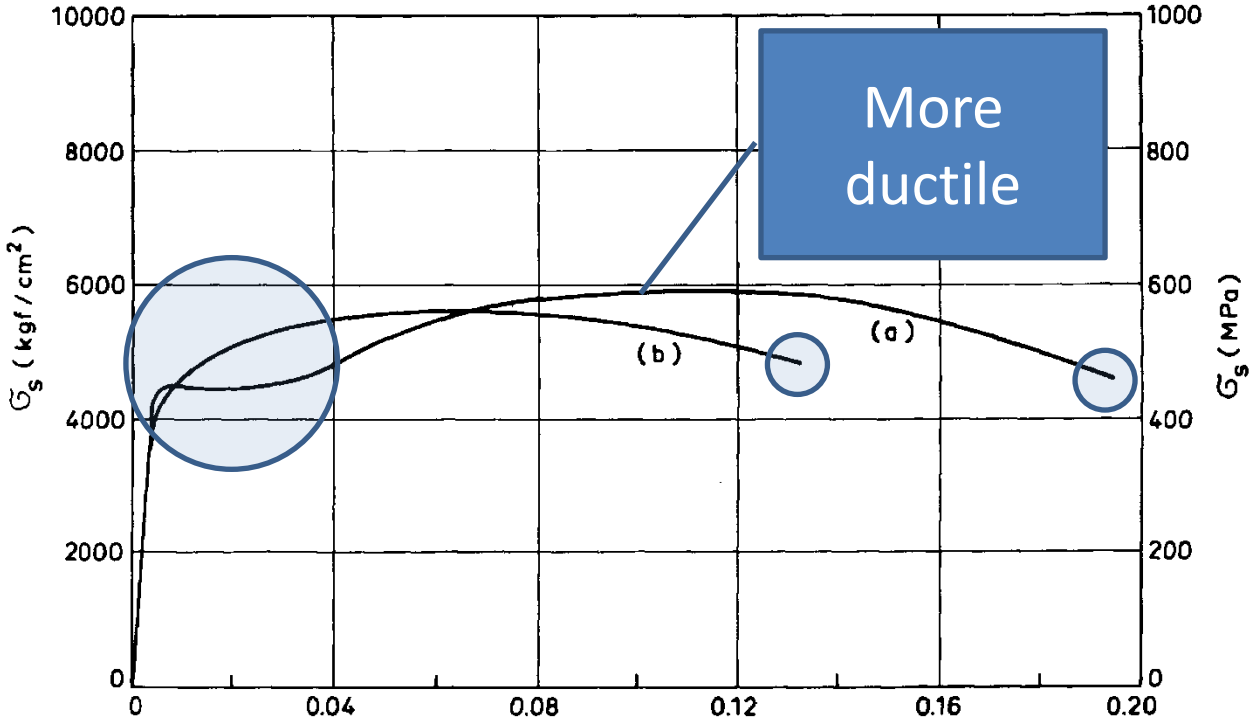


STEEL REINFORCEMENT

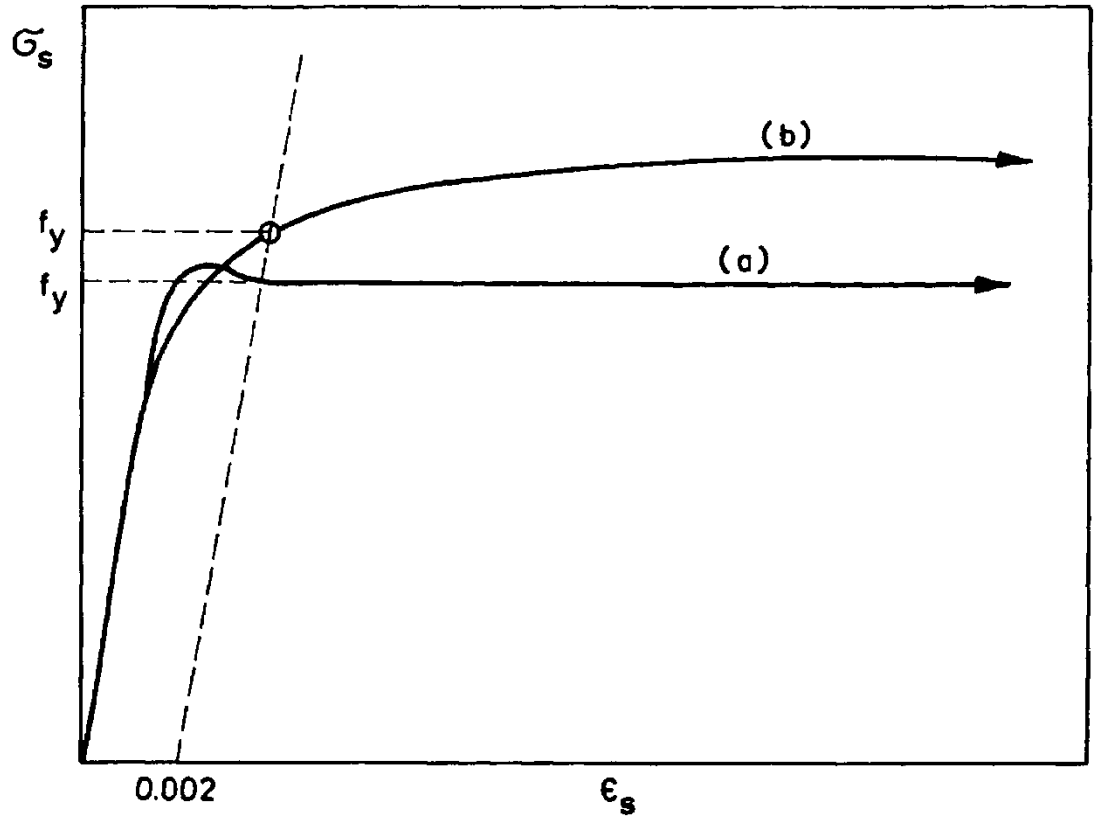
In Europe and in Turkey, bars are designated with their sizes in mm. For example ∅12 means a bar having a diameter of 12 mm.

In North America, the bar number is related to the diameter which is expressed in inches. For example, #5 bar means a bar with a diameter of 5/8 inches.

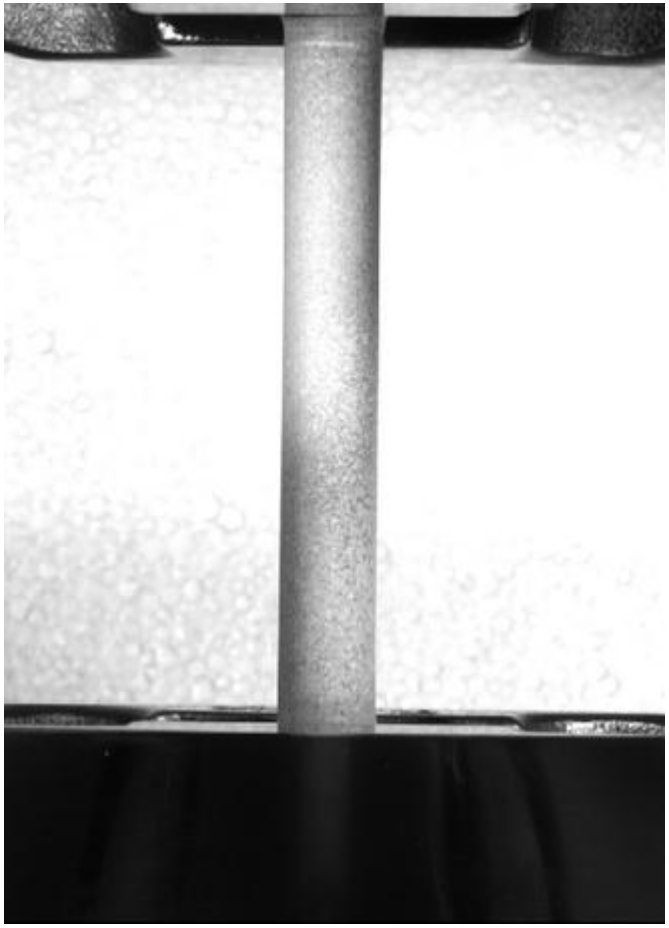
Behavior under Monotonic Loading

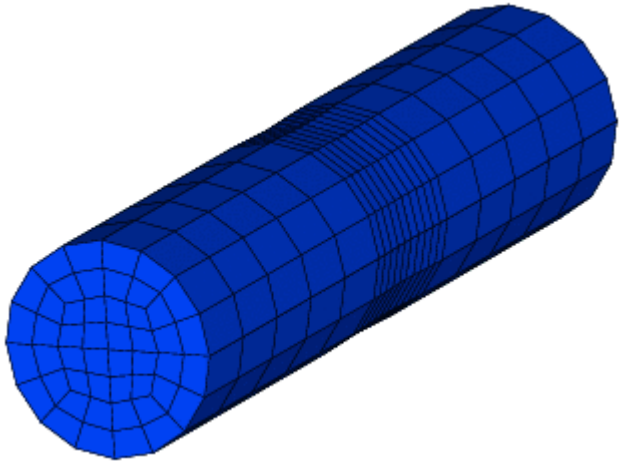


Behavior under Monotonic Loading



Behavior under Monotonic Loading



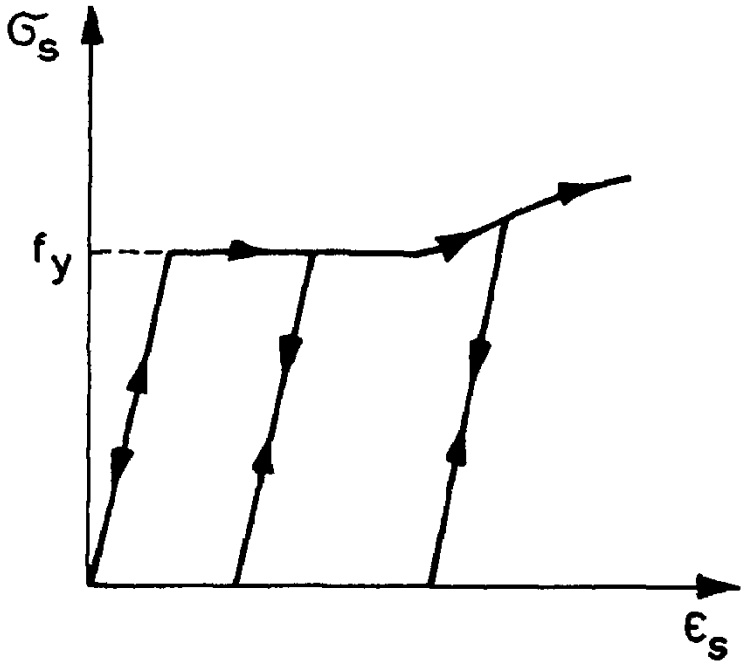


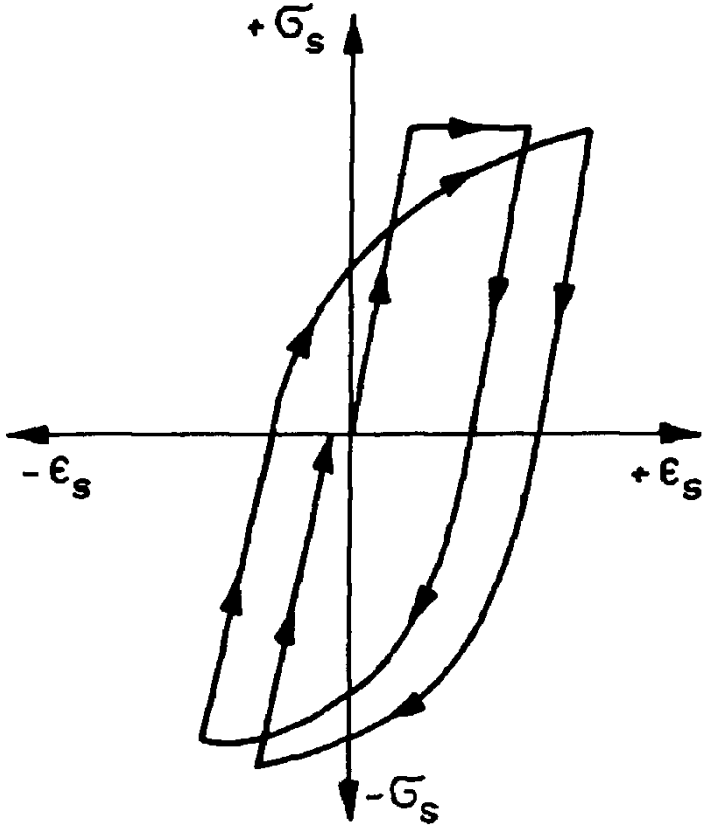
Behavior under Monotonic Loading

The most important properties of the σ–ε diagram of the reinforcing steel are (a) the yield strength, (b) the ultimate strength, (c) strain capacity, and (d) its elasticity modulus.

The modulus of elasticity of steel (slope of the initial portion) should be taken as 2×10^5 MPa (or 2×10^6 kgf/cm^2).

Behavior under Repeated and Reversed Loading





CONCRETE AND STEEL GRADES

Concrete

Concrete is classified according to its 28-day compressive strength. In TS500(2000) is classified as C16, C20, ……., C50.

The number following letter **“C”** indicates the cylinder compressive strength in terms of MPa. For example, C25 means concrete with a compressive strength of 25 MPa.

CONCRETE AND STEEL GRADES

Concrete Class	28-Day Strength (MPa)			
	150×300 mm Cylinder Compressive Strength f_{ck}	Equivalent Compressive Strength (150 mm cube)	Tensile Str. (Uniaxial) f_{ctk}	Modulus of Elasticity E_{c28}
C16	16.0	20.0	1.4	27 000
C18	18.0	22.0	1.5	27 500
C20	20.0	25.0	1.6	28 000
C25	25.0	30.0	1.8	30 000
C30	30.0	37.0	1.9	32 000
C35	35.0	45.0	2.1	33 000
C40	40.0	50.0	2.2	34 000
C45	45.0	55.0	2.3	36 000
C50	50.0	60.0	2.5	37 000

CONCRETE AND STEEL GRADES

Steel

In Europe and in Turkey, steel grades are designated with the letter **“S”** and the number following the letter “S” indicates the yield strength (minimum). For example, **S420** means steel with yield strength of 420 MPa. The commonly used steel grades are S220, S420 and S500.

The letter (a) or (b) following the yield strength indicates whether the steel is hot rolled or cold worked.

For example, S420(a) and S420 (b) are hot rolled and cold worked respectively.