CONCRETE TECHNOLOGY
تكنلوجيا الخرسانة 2

المرحلة الثالثة
الفصل الثاني

Asst. Lec. Nora AL-Anssari

Syllabus

	Topic
Lectures Outline:	**Modulus of elasticity**
	Creep of Concrete
	Shrinkage of Concrete
	Durability of concrete
	Special Concrete
	Site Investigation
	Non-Destructive tests (In site tests)

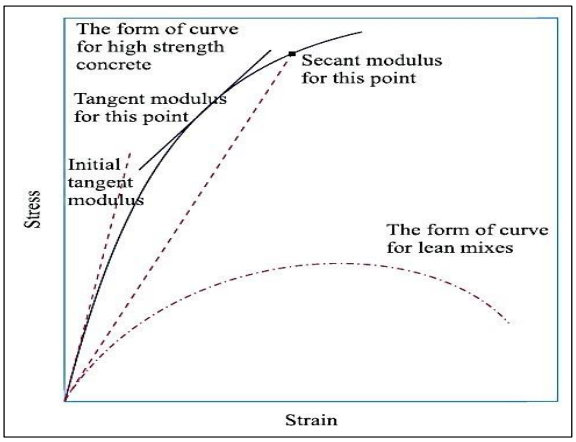
nora.fawzi.abdah@uomus.edu.iq

• *Modulus of elasticity*

The modulus of elasticity of a material is defined by the slope of the stress-strain curve. The higher the elastic modulus, the more resistant the material is to deformation. Concrete is not a perfectly elastic material and therefore the stress-strain curve indicates a varying elastic modulus (the slope of the tangent). .

Due to the nonlinearity of the σ-ε diagram, E is the defined by:

1. Initial Tangent Method
2. Tangent Method
3. Secant Method



Stress - Strain curve

• Types of modulus of elasticity

1.**Young's modulus:-** This is called the initial tangent modulus can be applied only to the linear portion of the stress-strain curve.

2.**Tangent modulus:-** The slope of the tangent at an arbitrary strain.

3.**Secant modulus or static modulus of elasticity:-** It is the common elastic modulus of concrete. It is given by the slope of the line drawn connecting a specified point on the curve to the origin of the curve. The value depends on the rate of load application.

4.**Dynamic modulus:-** Dynamic modulus of elasticity of concrete represents the progressive changes in the state of a concrete specimen. The change can be observed by determining the fundamental resonant frequency of the specimen at appropriate stages of the investigation.

The dynamic modulus is roughly equal to the initial tangent modulus, and is therefore higher than the static modulus of elasticity.

The approximate relationship between static and dynamic modulus are given in BS 8110-2 as: **Ec = 1.25 Ecq – 19**

However the relationship may vary depending on the aggregate type used in the concrete.

• Factors influencing modulus of elasticity

1.**Strength of concrete:-** Concrete's modulus elasticity increases roughly in proportion to the square root of its resilience.

2.**Cement paste:-** The hydrated cement's elastic modulus influences concrete's elastic modulus. The elastic modulus of concrete increases when porosity decreases due to an increase in the elastic modulus of cement paste. Cement paste's porosity is regulated by air scope, degree of cement hydration, cement to-water ratio, and admixture dosage.

3.**Aggregates:-** The porosity substantially impacts the elastic modulus of aggregate; aggregate with low porosity has a high elastic modulus. The proportion of coarse aggregate leads to a high value of elastic modulus.

4.**Concrete wetness condition:-** It is shown that the wet specimen's modulus of elasticity is 15% higher than the dry specimen's modulus of elasticity. The attribute demonstrates that drying builds more microcracks, generating more microcracks in the transition zone under dry conditions.

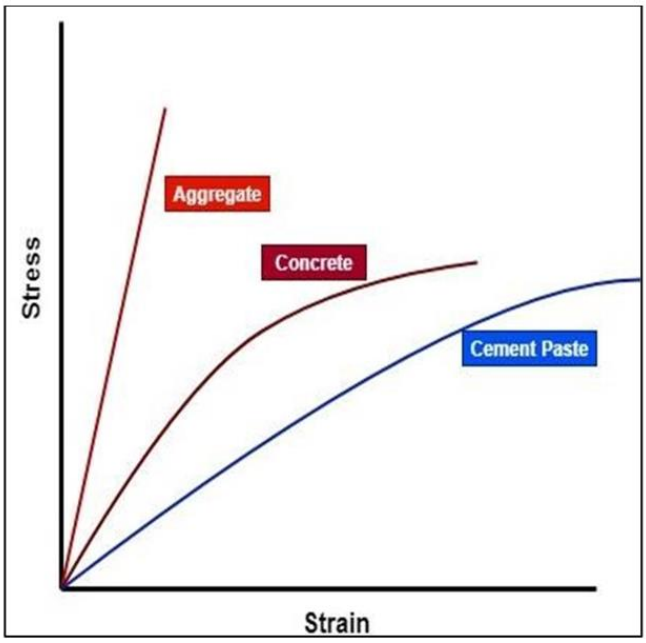
5. **Transition zone:-** As the transition phase weakens due to the C-H crystal cracks and empty spaces already existing, the modulus of elasticity decreases. The interface between solidified cement paste and coarse aggregate particles is the transition zone.
6. **Mix proportion:-** The modulus of elasticity increases with the increase in the quantity of cement.
7. **Concrete age:-** As the concrete becomes old, the elasticity modulus increases.
8. **Curing regime:-** The steam-cured concrete's modulus of elasticity is somewhat less than water-cured concrete for the same strength.

• Is concrete an elastic material?

Elasticity is the property of a material by which the material regains its original shape when the load is withdrawn.

Yes. Concrete is an elastic material to a certain extent i.e. at low stresses.

Concrete is a heterogeneous, multi-phase material, whose behaviour is influenced by the elastic properties and morphology of its component materials. So, the stress-strain curve does not exactly does not follow Hooke's law. The components of concrete i.e. cement paste and aggregates, when individually subjected to loading, they show almost linear stress-strain relation. The cement paste has lower elastic modulus than the aggregate. The concrete behavior is somewhere in the middle of both.



Stress-strain Relations for Cement paste, aggregate and Concrete

• Types of elastic behavior in engineering materials

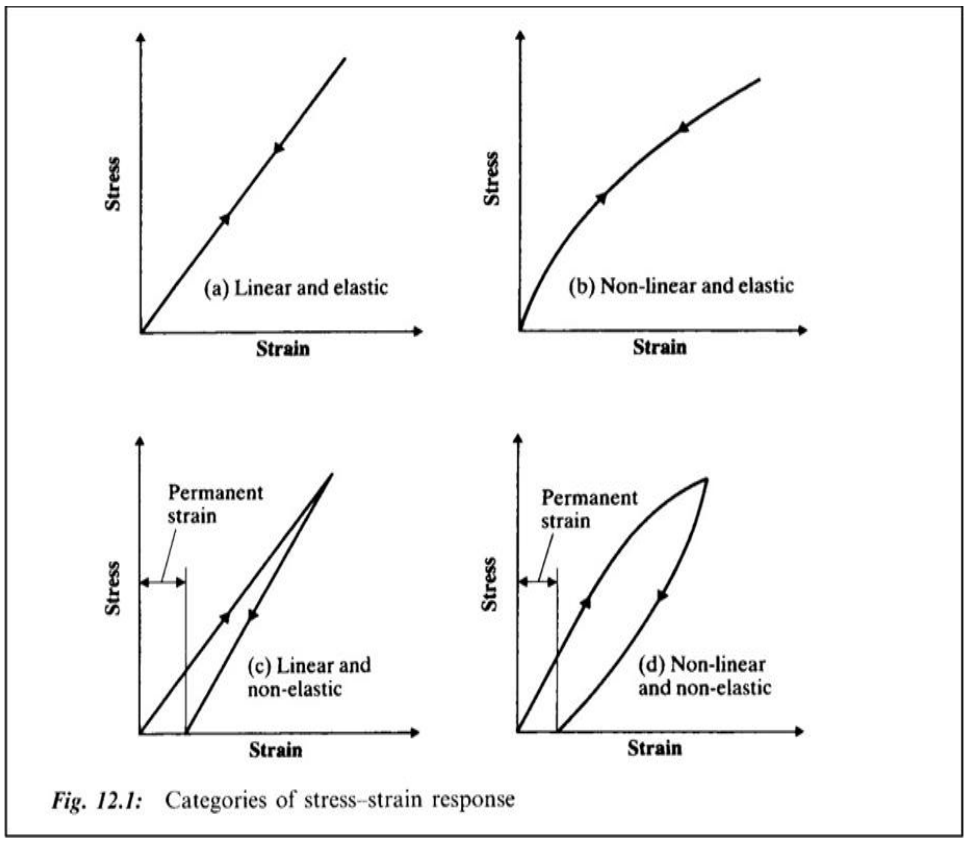


Fig. 12.1: Categories of stress–strain response

a) such as steel

b) such as plastics and timber

c) such as glass

d) such as concrete