# Midas Intro Session

## Evaluating Creep Response Using Time-Step Analysis

Midas North American Office
Thursday, Jan 27th, 2021
3:00 PM – 4:00 PM EST

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- Concrete Crack Analysis
- Static Analysis
- Construction Stage Analysis
- Reinforcement Analysis
- Buckling Analysis
- Eigenvalue Analysis
- Response Spectrum Analysis
- Time History Analysis(Linear/Nonlinear)
- Static Contact Analysis
- Interface Nonlinearity Analysis
- Nonlinear Analysis(Material/Geometric)
- Heat of Hydration Analysis
- Heat Transfer Analysis
- Slope Stability Analysis
- Seepage Analysis
- Consolidation Analysis
- Coupled Analysis(Fully/Semi)

# Creep and Shrinkage of Concrete and Relaxation of Steel

The stress and strain in a reinforced or prestressed concrete structure are subject to change for a long period of time, during which creep and shrinkage of concrete and relaxation of the steel used for prestressing develop gradually.

For analysis of the time-dependent stresses and deformations, it is necessary to employ time functions for strain or stress in the materials involved. (Ghali et al., 2012)

# Creep and Shrinkage of Concrete

**Creep** – It is the effect due to which concrete undergoes continuous deformation under sustained loading applied for a considerable time

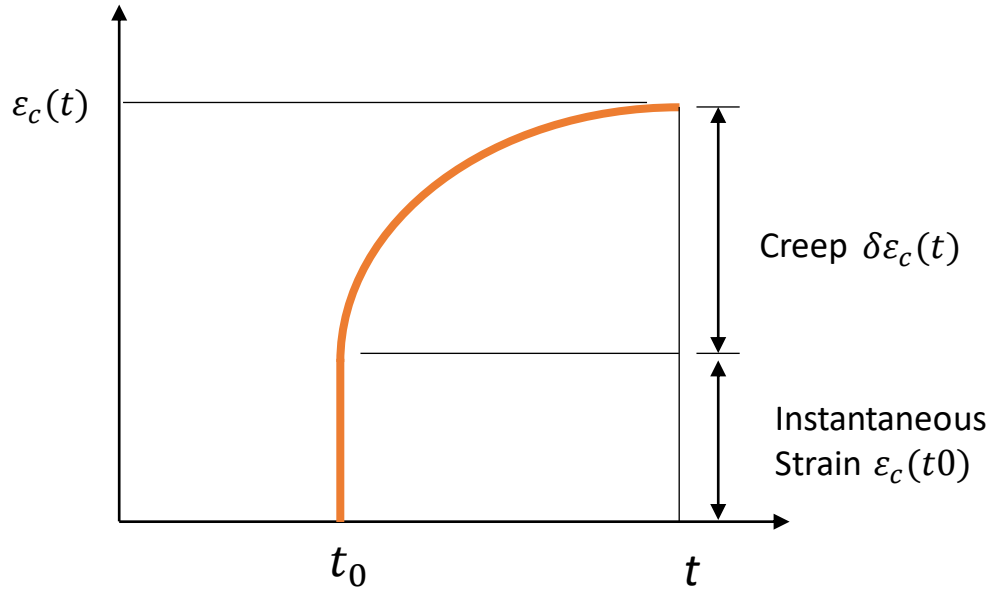
**Shrinkage** – Contraction in the concrete due to the drying of concrete and is independent of applied loads. Tensile loads will develop if the contraction is constrained, which will cause the cracking of concrete.

# Concrete Creep

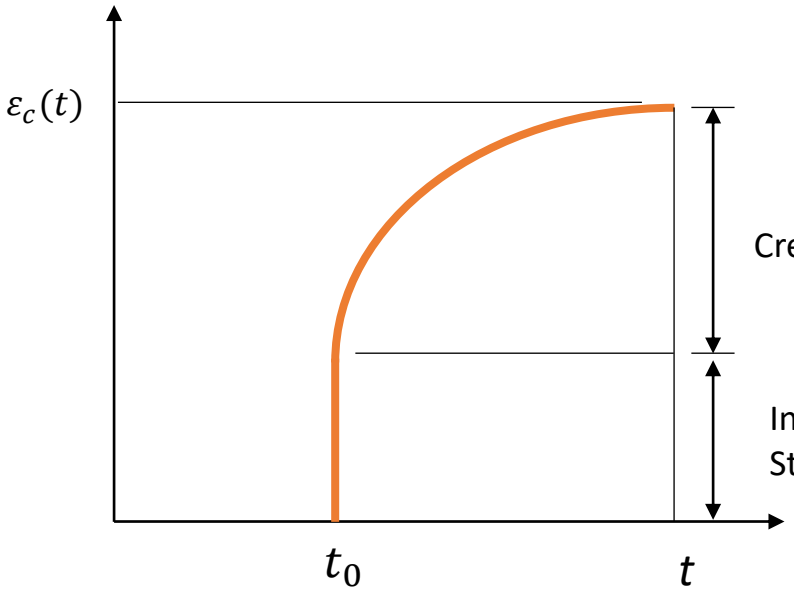
The modulus of elasticity of concrete increases with its age. A stress applied on concrete produces instantaneous stain; if the stress is sustained the strain will progressively increase with time due to creep. (Ghali et al., 2012)

The parameters affecting the magnitude of creep (as well as shrinkage) include the following:

- Ambient relative humidity
- Average thickness of the member
- Volume-to-surface ratio
- Temperature



# Concrete Creep

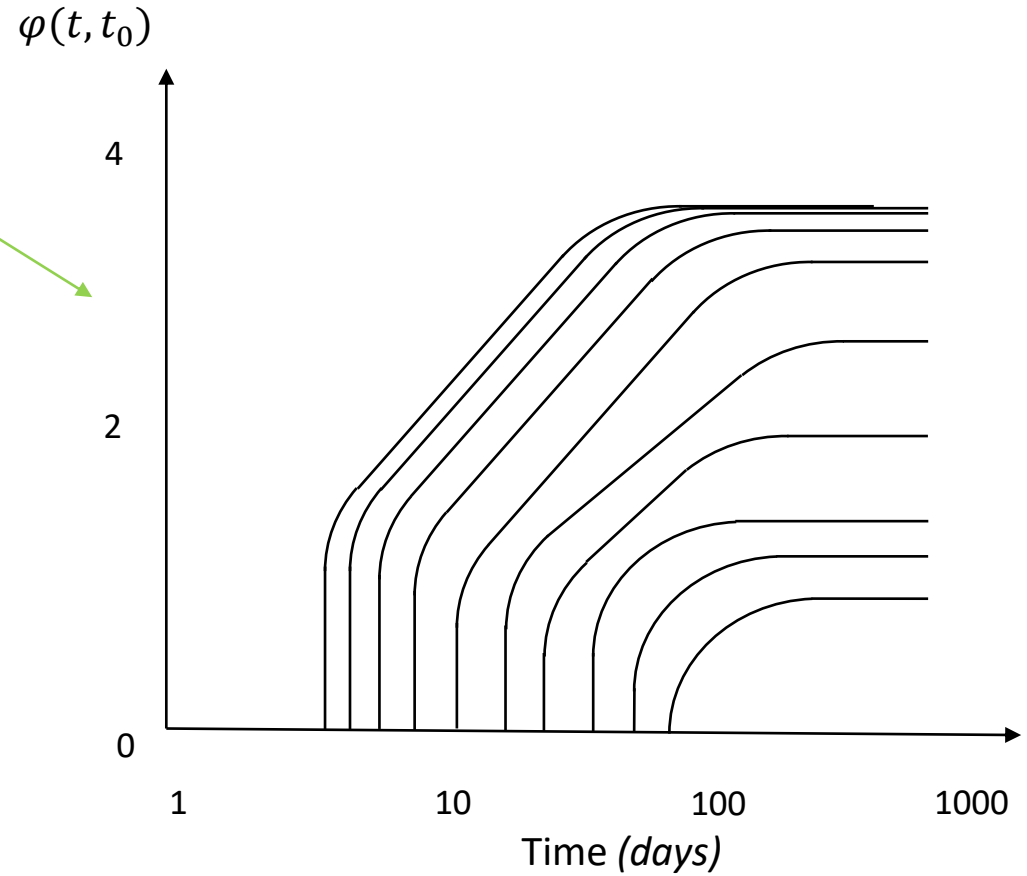



Creep $\delta\varepsilon_c(t_0)$

$$\delta\varepsilon_c(t) = \frac{\sigma_c(t_0)}{E_c(t_0)}\,\varphi(t,t_0)$$

Instantaneous Strain $\varepsilon_c(t_0)$

$$\varepsilon_c(t) = \frac{\sigma_c(t_0)}{E_c(t_0)}$$

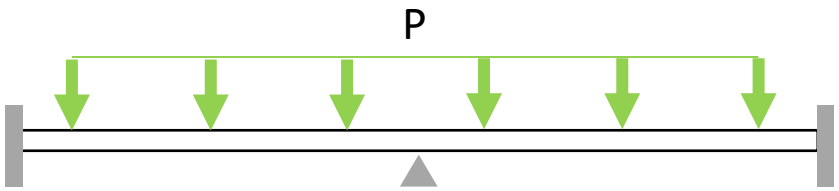


# Concrete Creep

The creep effects can be categorized in two ways:

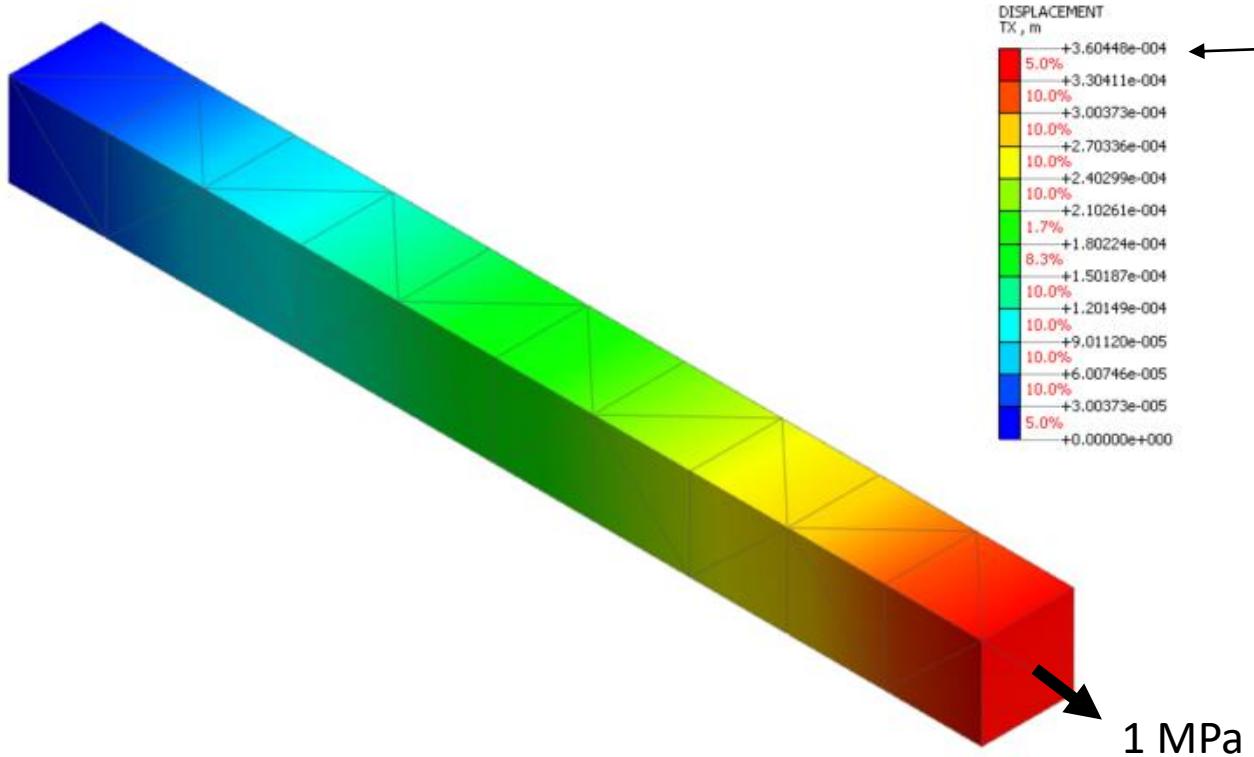
- Primary effects
  - The primary effects are independent of boundary conditions of the structure and an be calculated based on the formulations given in various design codes.


- Secondary effects
  - The secondary effects are dependent on the boundary conditions of the structure



# Concrete Creep

Fully Constrained




1 MPa

E=2.7771e+010

$\delta l = 0.00036$

For a stage duration (t) of 97 days, where the element is loaded at the age of 5 days (t0), $\varphi(t, t_0)$ = 0.895

$\delta l$total = 0.00036 (1+0.895)
= 0.0006824

# Concrete Creep