Advanced Structural Concrete

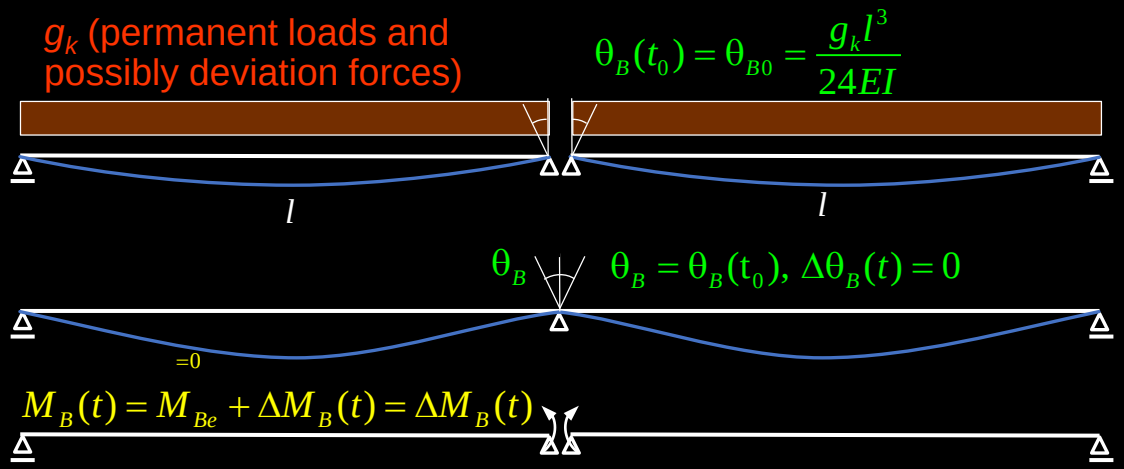
Introduction to Exercise 3

Introduction to Exercise 3

Goal of this introduction to Exercise 3:

Learn how to take the effect of creep on deformations and internal forces in reinforced concrete structures into account by applying the time-dependent force method.

Example from lecture: Influence of creep for system changes



Construction sequence:

1. Two single span girders are positioned (lifted in)
2. $t = t_0$: Monolithic connection at B

→ Over time, the internal force distribution approaches the one built in one casting due to creep.

How can we calculate this?

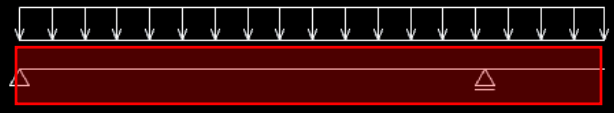
Introduction to Exercise 3

Construction in stages (system change)

t_p : Point in time after beginning of construction
t_c : Age of the concrete

t_p = 30 days t_c = 30 days

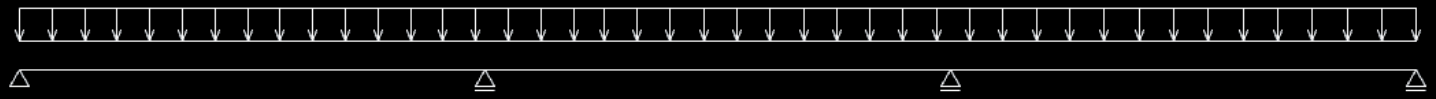
Segment 1 is constructed at time t = 0 days but temporarily supported until t_p = 30 days



t_p = 60 days t_c = 60 days t_c = 30 days

t_p = 90 days t_c = 90 days t_c = 60 days t_c = 30 days

One cast system



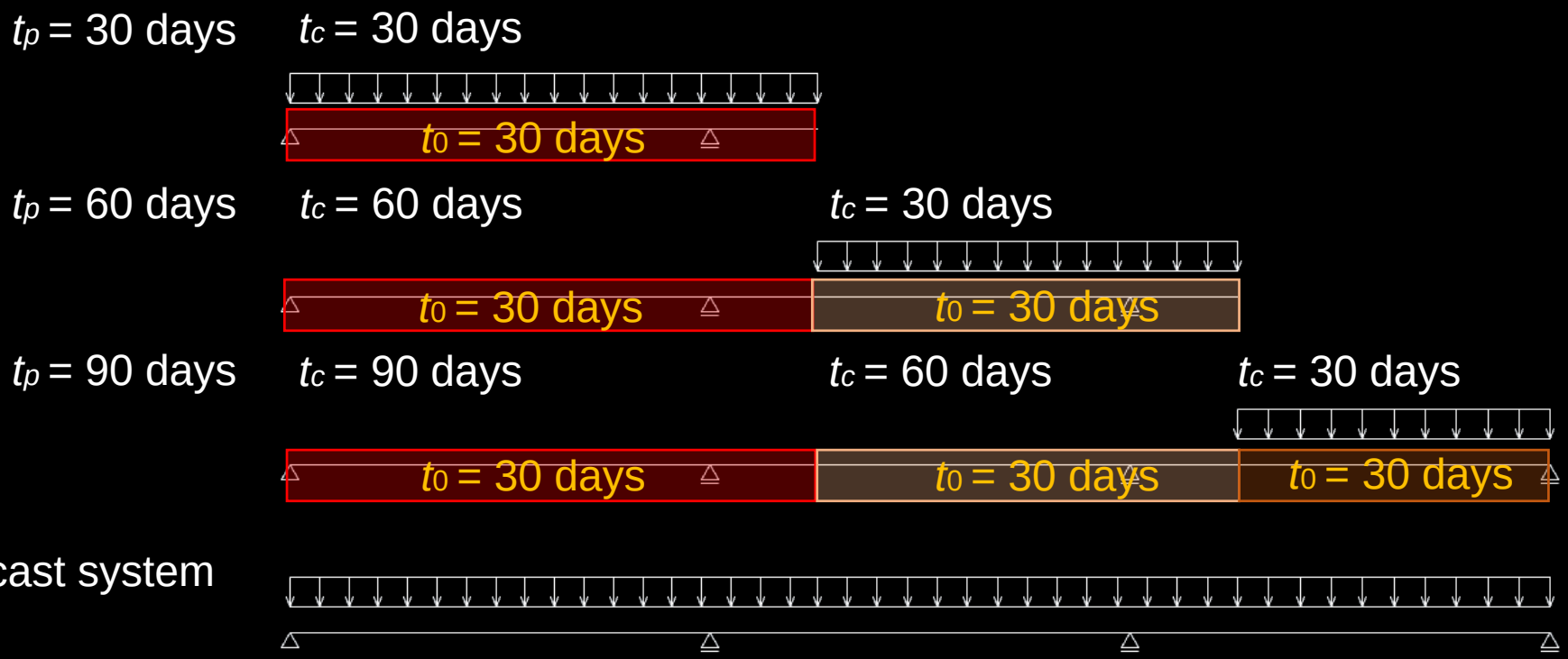
Introduction to Exercise 3

Construction in stages (system change)

Creep coefficient

$$\varphi(t,t_0) = \varphi_{RH} \cdot \beta_{\sigma c} \cdot \beta_{fc} \cdot \beta(t_0) \cdot \beta(t - t_0)$$

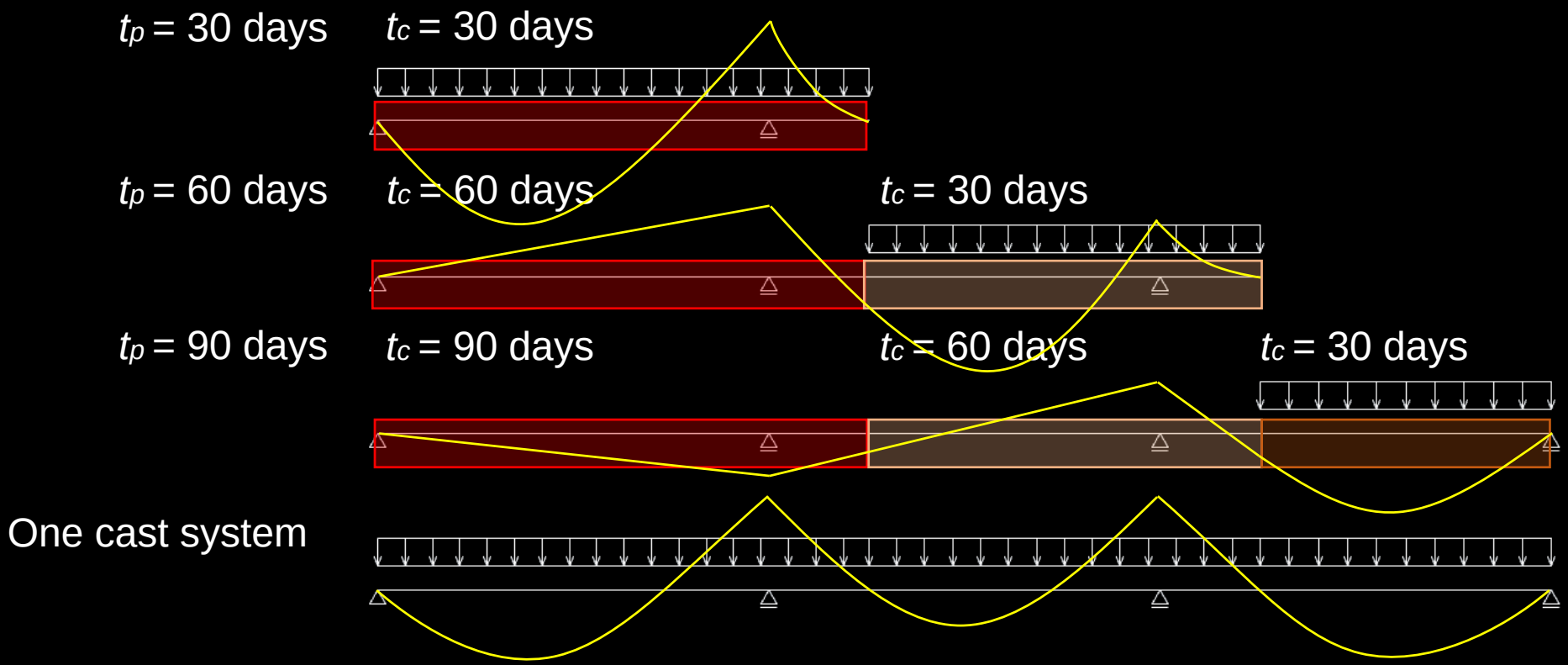
t_p : Point in time after beginning of construction
t_c : Age of the concrete
t_0 : Age of the concrete at beginning of loading



Introduction to Exercise 3

Construction in stages (system change)

t_p : Point in time after beginning of construction
t_c : Age of the concrete
In yellow: moment distribution from additional load

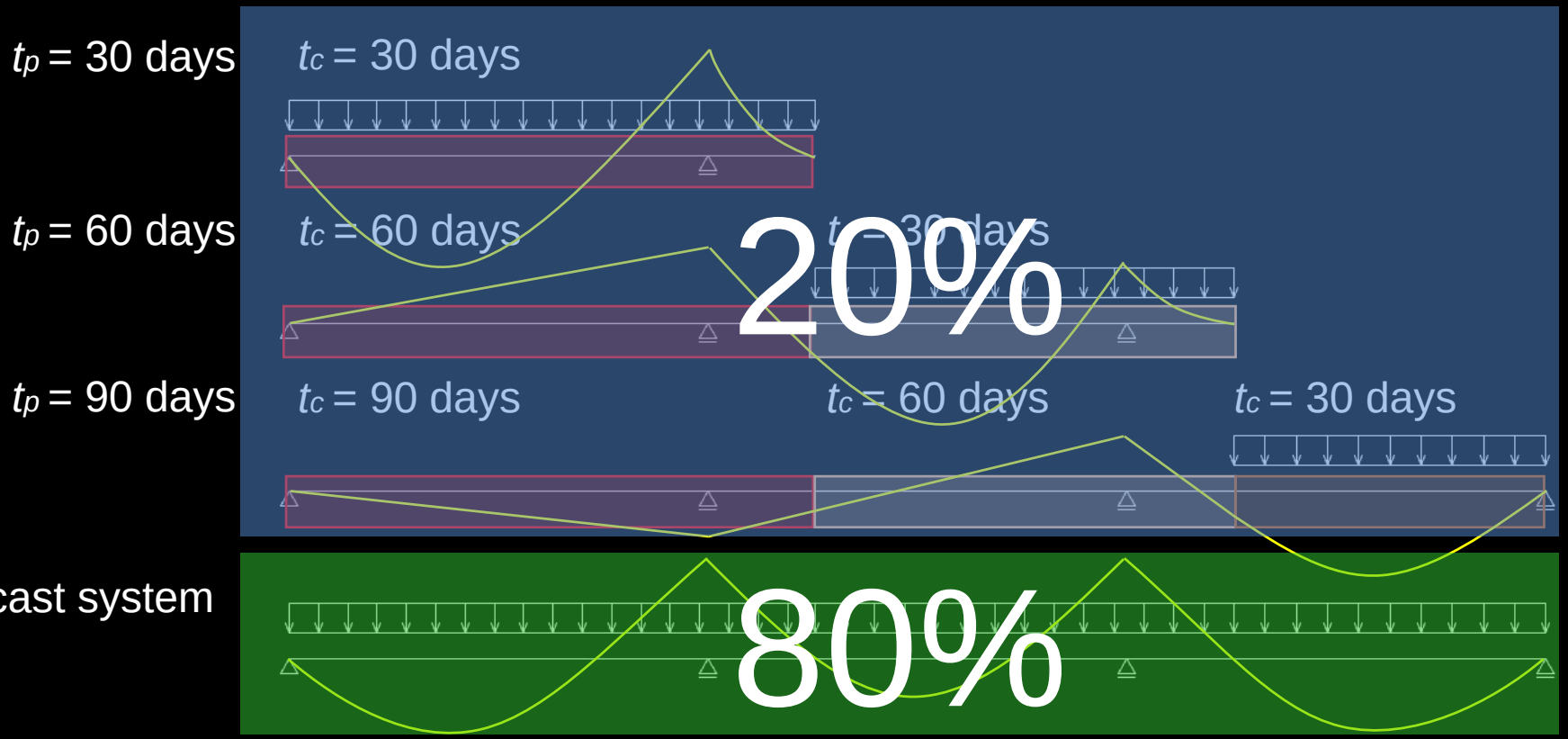


Introduction to Exercise 3

Construction in stages (system change)

t_p : Point in time after beginning of construction
t_c : Age of the concrete

After some time, the internal distribution approaches the one cast system.



Introduction to Exercise 3

Construction in stages (system change)

- Simple approximation of the bending moment curve for $t \rightarrow \infty$ with:
  - 80% of the bending moment distribution of what would occur for a monolithic structure at $t = 0$.
  - 20% of the sum of the bending moments (from each stage) neglecting creep effects.
- Additional task: Determining the bending moment curve at $t_p = 120$ days and $t_p = 5$ years with the Trost method (Formula according to slides 24ff of the lecture).

$$M_t(x) = \sum_{i=1}^{n} \left[M_{0,i}(x) \cdot \left(1 - \frac{\varphi(t_i, t_0)}{1 + \mu \cdot \varphi(t_i, t_0)} \right) \right] + M_{mono}(x) \cdot \frac{\varphi(t, t_0)}{1 + \mu \cdot \varphi(t, t_0)}$$

Introduction to Exercise 3

Exercise 3: Organisation

Handout: 30.11.2023

Voluntary submission for correction: 13.12.2023

Publication solution: 14.12.2023