METHODS OF CONCRETE MIX DESIGN

SAND POINT METHOD

1) Bolomey equation

$$f_{cm} = A_i \cdot (C/W + a)\ [MPa]$$

$f_{cm} = (1{,}3 - 1{,}4) \cdot f_{ck}$

A_i – coefficient from the table below

A_1 dla $1{,}2 < C/W \leq 2{,}5$
A_2 dla $2{,}5 < C/W < 3{,}0$

$$a = \begin{cases} 0{,}5 & \text{if } C/W > 2{,}5 \\ -0{,}5 & \text{if } C/W \leq 2{,}5 \end{cases}$$

2) Water requirement equation

$$W = C \cdot w_C + K_1 \cdot w_{K1} + K_2 \cdot w_{K2}$$

K_1 = coarse aggregate
K_2 = fine aggregate
w_C = cement water demand coefficient
w_k = aggregate water demand coefficient

3) Volume equation

$$C/\rho_C + K_1/\rho_{K_1} + K_2/\rho_{K_2} + W = 1000$$

$\rho_C = 3{,}1\ kg/dm^3$
$\rho_K = 2{,}65\ kg/dm^3$ (sand, gravel, granite aggregate)
$\rho_K = 3{,}0\ kg/dm^3$ (basalt aggregate)

4) Equation characteristic for the sand point method

$$K_1/K_2 = (p_{K2} - p_i)/(p_i - p_{K1})$$

p_{K2} = sand point of the fine aggregate
p_{K1} = sand point of the coarse aggregate
p_i = total sand point $(35 \div 45)$

ONE-LEVEL ENCAPSULATION METHOD OF PASZKOWSKI

Equation 1 – 3 like in sand point method

4) Equation characteristic for the method

$$K_1 = (\rho_{nzK1}/m_{K1}) \cdot 1000$$

ρ_{nzK1} – tapped bulk density of the coaarse aggregate
m_{K1} – softening coefficient of the coaarse aggregate

TWO-LEVEL ENCAPSULATION METHOD OF PASZKOWSKI

1) Water requirement equation

$$W = C \cdot w_C + K_1 \cdot w_{K1} + K_2 \cdot w_{K2}$$

2) Volume equation

$$C/\rho_C + K_1/\rho_{K_1} + K_2/\rho_{K_2} + W = 1$$

3) Equation characteristic for the method

$$K_1 = (\rho_{nzK1}/m_{K1})$$

4) Equation characteristic for the method

$$K_2 = z \cdot (\rho_{nzK2}/m_{K2}) \qquad \text{where} \quad z = (1 - K_1/\rho_{K1})$$

ρ_{nzK2} – tapped bulk density of the fine aggregate
m_{K2} – softening coefficient of the fine aggregate
ρ_{K1} – density of the coarse aggregate

Verification of the strength class: $f_{cm} = A \cdot (C/W + a)$ – Bolomey equation
$f_{ck} = f_{cm}/(1{,}3 - 1{,}4)$

ITERATION METHOD

K_1 – crushed coarse aggregate (chippings)
K_2 – natural coarse aggregate (gravel)
K_3 – fine aggregate

1) Bolomey equation

$$f_{cm} = A \cdot (C/W + a)\ [MPa]$$

$$a = \begin{cases} 0{,}5 & \text{if } C/W > 2{,}5 \\ -0{,}5 & \text{if } C/W \leq 2{,}5 \end{cases}$$

$f_{cm} = (1{,}3 - 1{,}4) \cdot f_{ck}$

2) Water requirement equation

$$W = C \cdot w_C + K_1 \cdot w_{K1} + K_2 \cdot w_{K2} + K_3 \cdot w_{K3}$$

3) Volume equation

$$C/\rho_C + K_1/\rho_{K_1} + K_2/\rho_{K_2} + K_3/\rho_{K_3} + W = 1000$$

$\rho_C = 3{,}1\ kg/dm^3$
$\rho_K = 2{,}65\ kg/dm^3$ (sand, gravel, granite aggreagate)
$\rho_K = 3{,}0\ kg/dm^3$ (basalt aggregate)

4) Equation characteristic for the method

$$K_1/K_2 = x$$

5) Equation characteristic for the method

$$K_2/K_3 = y$$

The proportion of the aggregates (equation 4 and 5) is based on the maximum tightness of the aggregates.