BIW4-01 Tragwerkssicherheit Beleg 3

Philipp Göbel
4607083

Aufgabe a)

$$\sigma_u = \sqrt{\ln\left[1 + \left(\frac{\sigma_{X2}}{\mu_{X2} - x_{0,2}}\right)^2\right]} = 0{,}234$$

$$\mu_u = \ln\frac{\mu_{X2} - x_{0,2}}{\sqrt{1 + \left(\frac{\sigma_{X2}}{\mu_{X2} - x_{0,2}}\right)^2}} = 5{,}559$$

$$c_j = -\left|\frac{N_j(G=1)}{A}\right|$$

$c_1 = 0$ $\quad c_4 = -331{,}56$ $\quad c_7 = -265{,}25$ $\quad c_{10} = -264{,}7$

$c_2 = -265{,}25$ $\quad c_5 = -198{,}94$ $\quad c_8 = -198{,}94$

$c_3 = 0$ $\quad c_6 = -300{,}85$ $\quad c_9 = 0$

$$f_1(x_1) = a \cdot \exp\left[-a(x_1 - b) - \exp(-a(x_1 - b))\right]$$

$$a = \frac{1}{\sqrt{6}\,\sigma_{X1}} = 0{,}018$$

$$b = \mu_{X1} - \frac{0{,}5772}{a} = 378{,}50$$

$$F_{X2}(x_2) = \Phi^{SNV}(y) \quad \text{mit} \quad y = \frac{\ln(x_2 - x_{0,2}) - \mu_u}{\sigma_u}$$

$$P_f = 1 - \int_{x_1=-\infty}^{\infty}\left[\prod_{j=1}^{n}\left(1 - F_{min,zj}(-c_j \cdot x_1)\right)\right] f_1(x_1)\,dx_1 = 1 - \prod_j \int_{\frac{-x_{0,2}}{c_j}}^{\infty} F_{min,zj}(-c_j x)\, f_1(x_1)\,dx$$

→ numerisch integriert: $P_f = 0.032$

Aufgabe 5)

$$P_f = \max_{j=1..n} (P_{fj}) = \max_{j=1..n} \left(\int_{x_1 = -\frac{x_{01}}{c_j}}^{x_1 = \infty} F_{win,zj}(-c_j \cdot x_1) \cdot f_1(x_1) \, dx_1 \right)$$

num. integriert:

$P_{f1} = 0$ $\quad P_{f5} = 0.0057$ $\quad P_{f9} = 0$

$P_{f2} = 0.0043$ $\quad P_{f6} = 0.0037$ $\quad P_{f10} = 0.0056$

$P_{f3} = 0$ $\quad P_{f7} = 0.0043$

$P_{f4} = 0.0032$ $\quad P_{f8} = 0.0057$

$\max P_{fj} = P_{f5} = P_{f8} = 0.0057$

Aufgabe c)

$$c_{jk} = -|N_j(G=1)|$$

$c_{1,k} = 0$ $\quad c_{4,k} = -1.25$ $\quad c_{7,k} = -1.0$ $\quad c_{10} = -1.1775$

$c_{2,k} = -1$ $\quad c_{5,k} = -0.75$ $\quad c_{8,k} = -0.75$

$c_{3,k} = 0$ $\quad c_{6,k} = -1.414$ $\quad c_{9,k} = 0$

$$k_j = \frac{E \cdot I \cdot \bar{q}^2}{c_j^2}$$

$k_1 = 964.93$ $\quad k_4 = 617.56$ $\quad k_7 = 964.93$ $\quad k_{10} = 2467.40$

$k_2 = 1715.43$ $\quad k_5 = 1715.43$ $\quad k_8 = 1715.43$

$k_3 = 1715.43$ $\quad k_6 = 1045.71$ $\quad k_9 = 617.56$

⇒ Nur Druckstäbe relevant, d.h. 5, 6, 7, 10

Fall I

$$P_{fk} = 1 - \Phi^{Ni}\left(-\frac{1}{\sigma_{x_1}}\left(-\frac{k_j}{c_{jk}} - \mu_{x_1}\right)\right)$$

$P_{f5k} = 2.69 \cdot 10^{-157}$

$P_{f6k} = 6.14 \cdot 10^{-6}$

$P_{f7k} = 8.98 \cdot 10^{-14}$

$P_{f10k} = 1.10 \cdot 10^{-127}$

$\max P_{fk} = P_{f6} = 6.14 \cdot 10^{-6}$

→ a) $\max_{j=E_1^+, E_2^+} P_{fj} = 6.14 \cdot 10^{-6} \leq P_f \leq 0.032$

→ b) $\max_{j=E_1^*, E_2^*} P_{fj} = 6.14 \cdot 10^{-6} \leq P_f \leq 0.0057$

Fall II

$$P_{fik} = 1 - \exp\left(-\exp\left(\frac{0.0321 \cdot k_i}{c_{ik}} - 10.6\right)\right)$$

$P_{f5k} = 0$

$P_{f6k} = 1.97 \cdot 10^{-6}$

$P_{f7k} = 1.42 \cdot 10^{-3}$

$P_{f10k} = 0$

→ a) $1.97 \cdot 10^{-6} \leq P_f \leq 0.032$

→ b) $1.97 \cdot 10^{-6} \leq P_f \leq 0.057$