

Name and surname (in block letters) :

Numeric application code:

Guidelines for completion of test:

- On each page, fill in your name and your application code
 - Each question has four answers while only one answer is correct.
 - Marked correct answer means 4 points
 - Marked incorrect answer means -1 point
 - Unmarked answer means 0 points.
 - Correct answer shall be marked with a cross across the letter indicating the correct answer.
 - To undo the crossed answer, draw a circle around the crossed letter.
 - Other ways of marking the answer are considered incorrect (-1 point)
 - At least 40 points are necessary to pass the test.
 - Duration of the test is 90 minutes.
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The exam questions:

1) How many m^3 of the trench 1,2 m deep and 0,6 m wide will 1 gang of 4 workers dig out in the cohesive soil (class of excavation 1) during 1 working week (five standard shifts) by the time standard of 2 Mh/ m^3

- [A] 10
- [B] **80**
- [C] 320
- [D] no correct answer

2) Calculate the size of the step of exit between 2 processes of technological stage i and j with the same direction if you know: Duration of processes $t_i = 10$ t. u. (time units); $t_j = 5$ t. u.

Launching time $T_i = 3$ t. u.; $T_j' = 2$ t. u.

Technological pause after process i $t_p = 1$ t. u.

The processes are linked by the construction technology link with the working space index $f_{ij} = 33$ %.

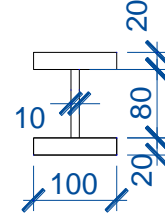
- [A] 1 time unit
- [B] **2 time units**
- [C] 3 time units
- [D] 4 time units

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3) Elastic section modulus of „I“ profile shown in the picture is:

- [A] **216 000 mm³**
- [B] 176 000 mm³
- [C] 216 000 mm⁴
- [D] 106 000 mm³

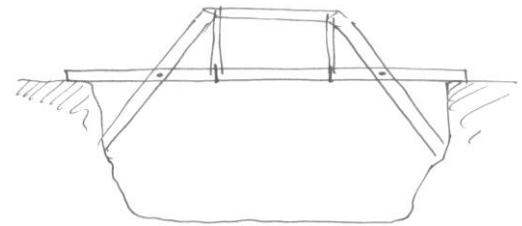


4) For timber locally loaded perpendicular to the grain has influence:

- [A] only the length on which the stress affect the timber
- [B] only the distance of the loading from the end of affected element
- [C] only the distance from the closest place where is next local load perpendicular to the grain
- [D] **everything mentioned above**

5) The structure in the picture is:

- [A] Double strut frame
- [B] Queen truss
- [C] Combination of king-post truss and strut frame
- [D] **Combination of Queen truss and strut frame**

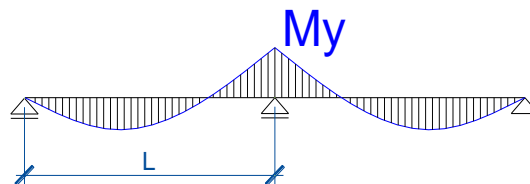


6) Timber connectors by the rigidity – choose the variant where are connectors arranged with increased rigidity (direction from left to right)

- [A] Dowell, Bolt, Toothed-plate connector, nail
- [B] nail, Bolt, Dowell, Toothed-plate connector
- [C] **Bolt, Dowell, Toothed-plate connector, Glued joint**
- [D] Dowell, Toothed-plate connector, Bolt, Glued joint

7) The value of bending moment M_y above the middle support of steel beam class 3 with uniform continual load g_d is:

- [A] $(1/12) * g_d * L^2$
- [B] **$(1/8) * g_d * L^2$**
- [C] $(1/8) * g_d * L$
- [D] $(1/4) * g_d * L^2$



8) When comparing total and effective parameters of shear strength we can say:

- [A] both ϕ_{ef} and c_{ef} are more than ϕ_u and c_u
- [B] both ϕ_{ef} and c_{ef} are less than ϕ_u and c_u
- [C] **ϕ_{ef} is more than ϕ_u , c_{ef} is less than c_u**
- [D] ϕ_{ef} is less than ϕ_u , c_{ef} is more than c_u

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9) Steel material characteristics are:

- [A] Young's modulus $E = 21\ 000\ \text{MPa}$, Shear modulus $G = 8\ 100\ \text{MPa}$ and coefficient of thermal expansion $\alpha = 0,000012\ \text{deg}^{-1}$;
- [B] Young's modulus $E = 210\ \text{GPa}$, Shear modulus $G = 8,1\ \text{MPa}$ and coefficient of thermal expansion $\alpha = 0,00012\ \text{deg}^{-1}$;
- [C] **Young's modulus $E = 210\ 000\ \text{MPa}$, Shear modulus $G = 81\ \text{GPa}$ and coefficient of thermal expansion $\alpha = 0,000012\ \text{deg}^{-1}$;**
- [D] Young's modulus $E = 210\ \text{MPa}$, Shear modulus $G = 81\ \text{MPa}$ and coefficient of thermal expansion $\alpha = 0,0012\ \text{deg}^{-1}$;

10) Which term is not used for load transfer of axial loading of pile:

- [A] toe bearing
- [B] side (skin) friction
- [C] **mobilized resistance**
- [D] end bearing

11) What is the change of vertical effective geostatic stress in saturated soil with specific weight $20\ \text{kN/m}^3$ caused by decreasing of water table level of 1,5 m?

- [A] 15 kPa lower
- [B] **15 kPa higher**
- [C] 30 kPa lower
- [D] 30 kPa higher

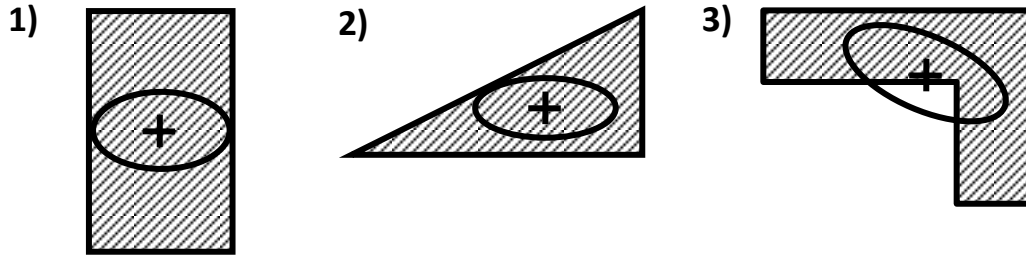
12) Coefficient of earth pressure at rest is computed as:

- [A] **$1 - \sin\phi$**
- [B] $\text{tg}(45^\circ + \phi/2)$
- [C] $(1 - \sin\phi)/(1 + \sin\phi)$
- [D] $\text{tg}^2(45^\circ - \phi/2)$

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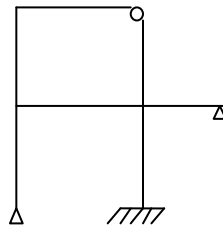
13) The next figure shows the centre of gravity and the size and orientation of the ellipse of inertia for three types of cross sections (plane shapes). Which of them are correct?



- [A] correct 1) a 2)
- [B] correct 2) a 3)
- [C] **correct 3)**
- [D] no cross sections are correct

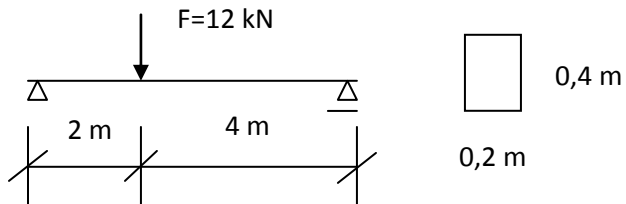
14) What is the degree of static indeterminacy?

- [A] 4
- [B] 8
- [C] **6**
- [D] 1



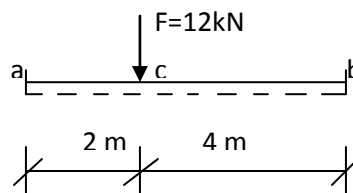
15) Determine the maximum shear stress τ_{xz} in the most stressed cross section of the beam.

- [A] 100 kPa
- [B] **150 kPa**
- [C] 225 kPa
- [D] -75 kPa



16) On a beam loaded by a pin force 12 kN (see figure), the end moments were determined by the slope deflection method $M_{ab} = 9 \text{ kNm}$, $M_{ba} = -3 \text{ kNm}$. (End moments are positive turning counter-clockwise.) Compute the bending moment at cross section c (beneath the force). The result is:

- [A] - 9 kNm
- [B] **+ 9 kNm**
- [C] - 7 kNm
- [D] - 5 kNm

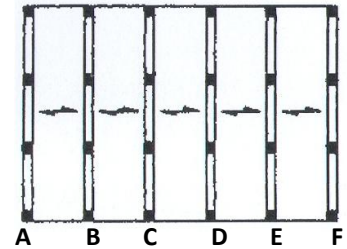


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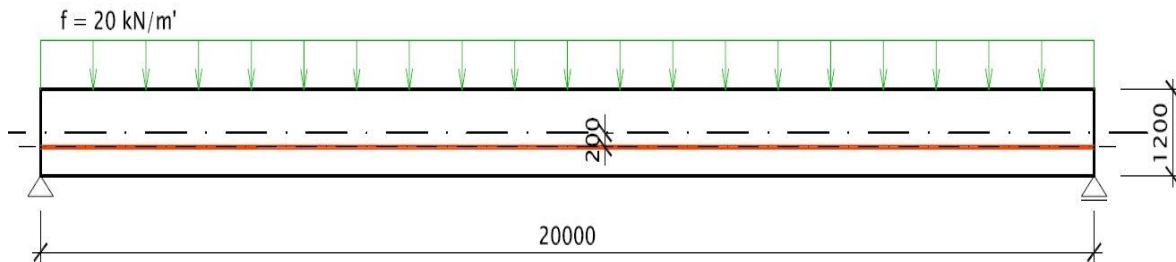
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17) 4-storey RC in-situ frame system (uniformly distributed load in all spans + wind load parallel to the frames' plane); spacing of frames is even, columns and beams have constant sections. Compare values of loading for edge frame A and inner frame B:

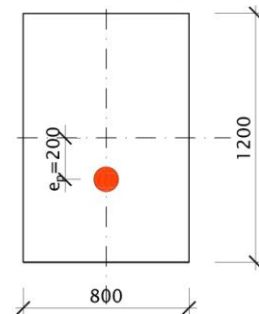
- [A] Both vertical load and wind load are bigger for frame B than for frame A
- [B] Both vertical and horizontal load are the same for both frames
- [C] Vertical load is same for frame A and B, wind load is bigger for frame B
- [D] **Vertical load is bigger for frame B, wind load is the same for both frames**



18) Define the minimal value of the pre-stressing force P to eliminate tension stress caused by loading f (f including self-weight) at bottom fibres in midspan cross section.



- [A] $P = 5000 \text{ kN}$
- [B] $P = 10000 \text{ kN}$
- [C] **$P = 2500 \text{ kN}$**
- [D] $P = 1250 \text{ kN}$



19) Monolithic reinforced concrete beam with a cantilever supported on masonry pillars, uniformly distributed load, moments calculated according to linear-elastic theory. For the reinforcement design a modification of the bending moment can be used:

- [A] redistribution only, reduction is not allowed
- [B] **reduction of the bending moment with respect to the width of supports, redistribution is not allowed**
- [C] reduction of bending moments with respect to the support width and redistribution of bending moments and shear forces
- [D] both reduction of the bending moment with respect to the width of supports and redistribution are not possible

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20) What is a partially pre-stressed concrete section?

- [A] The compression stress is distributed along the entire section
- [B] The tensile stress is distributed only along the area between the centroidal axis and the edge under the tension
- [C] The tensile stress is lower than the tensile strength of concrete
- [D] **The tensile stress may be higher than the tensile strength of concrete**

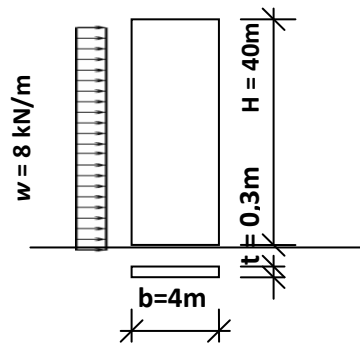
21) A cantilever beam from a plain concrete has a square section 0,3x0,3m. Calculate the critical length (span) L for which the beam fails due to the self-weight (the first crack occurs and subsequently the beam collapses).

Concrete parameters: density 2400kg/m³, compressive strength 21,6MPa, tensile strength 2,16MPa.
The length L is:

- [A] 9,5m
- [B] 12m
- [C] **3m**
- [D] 0,9m

22) For the reinforced concrete shear wall fixed in a basement calculate the maximum tensile stress σ_w at the bottom section of the wall due to the wind load w.

- [A] **8,0 MPa**
- [B] 26,7 MPa
- [C] 6,0 kPa
- [D] 2,0 MPa



23) Which of the following methods can be used for assessment of consistency of concrete:

- [A] test of concrete hardness
- [B] **flow test**
- [C] uniaxial compression test on cubes
- [D] aggregate grading test

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24) The water-cement ratio for concrete composition is defined as its minimum value is:

- [A] the ratio between the volume of water and the volume of concrete; $v_{\min} \cong 0,12$
- [B] the ratio between the volume of water and the volume of cement; $v_{\min} \cong 0,25$
- [C] the ratio between the weight of water and the weight of cement; $v_{\min} \cong 0,12$
- [D] **the ratio between the weight of water and the weight of cement; $v_{\min} \cong 0,25$**

25) The recommended maximum length between two expansion joints, when two identical cast-in-place reinforced concrete structural blocks are considered, is:

- [A] the same for indoor and outdoor structure
- [B] **greater for the indoor structure than for the outdoor structure**
- [C] greater for the outdoor structure than for the indoor structure
- [D] in the case of pre-stressed structures, the same for indoor and outdoor structure