MINISTERUL EDUCATIEI CERCETARII SI TINERETULUI
UNIVERSITATEA TEHNICA "GH. ASACHI" IASI
FACULTATEA DE CONSTRUCTII

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STRUCTURAL DYNAMICS and EARTHQUAKE ENGINEERING

1. Which of the next equations for computing the circular frequency of vibration is correct ?

a. $\omega = \dfrac{2 \cdot \pi}{f}$ b. $\omega = \sqrt{\dfrac{g}{\delta \cdot G}}$ c. $\omega = \sqrt{k \cdot m}$

2. Conforming to P100 – 92, for a *n* DOF system, the equation for seismic forces computed through the indirect method is:

a. $S_r = \alpha \cdot k_s \cdot \beta_r \cdot \psi \cdot \varepsilon_r \cdot G$ b. $S_r = \alpha \cdot k_s \cdot \beta_r \cdot \psi \cdot \eta_r \cdot G_r$ c. $S_r = \alpha_r \cdot k_s \cdot \beta_r \cdot \psi \cdot \varepsilon_r \cdot G_r$

3. The main earthquake from March 4th, 1977, from Vrancea, had the next main characteristics:

a. magnitude (Richter) = 7.2; intensity (Mercalli) = 9 b. magnitude (Mercalli) = 6; intensity (Richter) = 6 c. magnitude (Richter) = 2.7; intensity (Mercalli) = 8

4. A multi degree of freedom system loaded by an earthquake characterized by the ground acceleration „$\ddot{u}_g(t)$" is described by the next equation ($[M]$ is the mass matrix, $[K]$ is the stiffness matrix, $[C]$ is the damping matrix and $\{u\}$ is the displacement vector):

a. $[M]\cdot\{\ddot{u}(t)\}+[C]\cdot\{\dot{u}(t)\}+[K]\cdot\{u(t)\}=-[M]\cdot\{\ddot{u}_g(t)\}$

b. $[M]\cdot\{\ddot{u}_g(t)\}+[C]\cdot\{\dot{u}_g(t)\}+[K]\cdot\{u_g(t)\}=-[M]\cdot u(t)$

c. $[M]\cdot\{u(t)\}+[C]\cdot\{\dot{u}(t)\}+[K]\cdot\{\ddot{u}(t)\}=-[M]\cdot\ddot{u}_g(t)$

5. The seismic force, defined as the maximum inertia force, is:

a. $S = m \cdot S_a$ b. $S = m \cdot \omega^2 \cdot S_a$ c. $S = m \cdot \omega \cdot S_a$

6. Conforming to P100 – 92, the nominal degree of seismic assurance R_{min} for the buildings belonging to the second importance class is:

a. $R_{min} = 0.60$ b. $R_{min} = 0.70$ c. $R_{min} = 0.50$

7. The seismic primary waves (or P - waves) are (1)……..waves
and the secondary waves (or S – waves) are (2)……waves.

a. (1) transversal (shear); (2) longitudinal (tension/compression) b. (1) parallel (bending); (2) rotational (torsional) c. (1) longitudinal (tension/compression); (2) transversal (shear)

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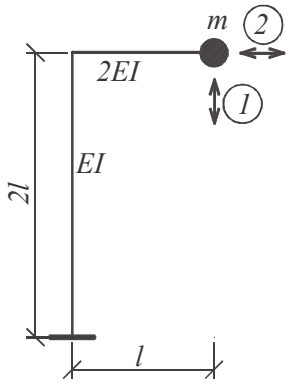
8. Which is the system of equations for obtaining the maximum and minimum conventional forces using the stiffness matrix method?

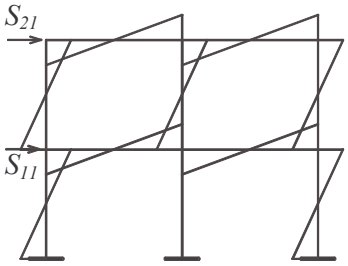
a. $([k]_L - \theta^2 \cdot [m]) \cdot \{U_{0i}\} + \{D_{0i}\} = \{0\}$ b. $([k]_L - \theta^2 \cdot [m]) \cdot \{U_{0i}\} = \{F_{0i}\}$ c. $([k]_L - \omega^2 \cdot [m]) \cdot \{U_{0i}\} = \{F_{0i}\}$

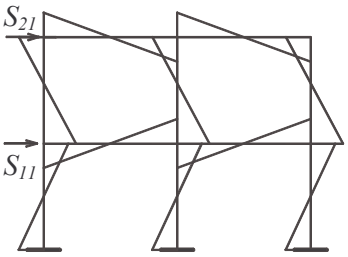
9. For the system shown by the adjoining figure, the flexibility matrix is:

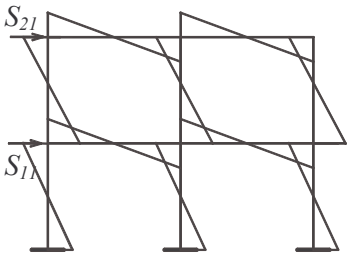


a. $[\Delta]_L = \frac{l^2}{3 \cdot E \cdot I} \cdot \begin{bmatrix} 13 & 12 \\ 12 & 16 \end{bmatrix}$ b. $[\Delta]_L = \frac{l^3}{6 \cdot E \cdot I} \cdot \begin{bmatrix} 13 & 12 \\ 12 & 16 \end{bmatrix}$ c. $[\Delta]_L = \frac{l}{E \cdot I} \cdot \begin{bmatrix} 13 & -12 \\ -12 & 16 \end{bmatrix}$

10. Which of the next bending moment diagrams produced by seismic action is correct?

a. 

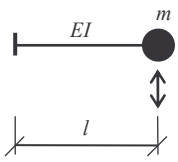
b. 

c. 

11. Conforming to P100 – 92, for an 1 DOF system, the equation for seismic force is:

a. $S = \alpha \cdot k_s \cdot \beta \cdot \psi \cdot G$ b. $S_r = \alpha \cdot k_s \cdot \beta_r \cdot \psi \cdot G_r$ c. $S_i = \alpha_i \cdot k_s \cdot \beta_i \cdot \psi \cdot G_i$

12. For the cantilever from the adjoining figure the period of vibration is:



a. $T = 2\pi\sqrt{\frac{l^2}{3 \cdot E \cdot I}}$ b. $T = 2\pi\sqrt{\frac{l^3 \cdot m}{3 \cdot E \cdot I}}$ c. $T = 2\pi\sqrt{\frac{l^2 \cdot m \cdot g}{6 \cdot E \cdot I}}$

13. Which seismic waves are the most dangerous for civil engineering structures?

a. primary waves (longitudinal) b. secondary waves (transversal) c. surface waves

14. Conforming to P100 – 92, the nominal degree of seismic assurance "R" is:

a. $R = S_{capable} / S_{\max im}$ b. $R = S_{capable} / S_{neccesary}$ c. $R = S_{neccesary} / S_{capable}$

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15. The maximum response of a structure to seismic load, obtained by modal superposition is given by („R_r" is the response for the „r" mode of vibration):

a. $R_{\max} = \dfrac{\sum_{r=1}^{m} R_r}{\sqrt{\sum_{r=1}^{m} R_r^2}}$ b. $R_{\max} = \sqrt{\sum_{r=1}^{m} R_r^2}$ c. $R_{\max} = \dfrac{1}{\sqrt{\sum_{r=1}^{m} R_r^2}}$

16. The Richter Scale is a (1)……. scale, also named (2)……scale:

a. (1) objective; (2) seismic intensity b. (1) objective; (2) magnitude c. (1) subjective; (2) MSK

17. For a 1 DOF system described by the equation $\ddot{u}(t) + 2 \cdot \xi \cdot \omega \cdot \dot{u}(t) + \omega^2 \cdot u(t) = -\ddot{u}_g(t)$, the spectral value of the displacement is defined by:

a. $S_d(\xi, \omega) = |u(t)|_{\max}$ b. $S_\omega(\xi, \omega) = \left|\ddot{u}(t)\right|_{\min}$ c. $S_a(\xi, \omega) = \left|u(t)\right|^2$

18. The tectonic plates are floating on the mantle of the Earth determining:

a. the continental drift b. the Earth internal structure c. the behavior of civil engineering structures

19. Which of the next orthogonality equations is correct?

a. $\sum_{i=1}^{n} m_i \cdot U_{ir} \cdot U_{is} = 0,\ r \neq s$ b. $\sum_{r=1}^{n} m_i \cdot U_{ir} \cdot U_{is} = 0,\ r \neq s$ c. $\sum_{i=1}^{n} m_r \cdot U_{ir} \cdot U_{is} = 0,\ r \neq s$

20. A system with cu 1 DOF, „u(t)", has the mass „m", the stiffness „k" and the damping „c". If the external, unidirectional earthquake action is „$\ddot{u}_g(t)$", then the equation of motion for this system under the earthquake actions is:

a. $m \cdot \ddot{u}(t) + c \cdot \dot{u}(t) + k \cdot u(t) = -m \cdot \ddot{u}_g(t)$

b. $m \cdot \ddot{u}_g(t) + c \cdot \dot{u}_g(t) + k \cdot u_g(t) = -m \cdot u\ \ (t)$

c. $m \cdot \ddot{u}_g(t) + c \cdot \dot{u}(t) + k \cdot u(t) = -m \cdot u\ \ (t)$

21. Conforming to P100 – 92, for a n DOF system, the equation of seismic forces computed through the direct method is:

a. $S_{ir} = \alpha \cdot k_s \cdot \beta_r \cdot \psi \cdot \varepsilon_r \cdot G_i$ b. $S_{ir} = \alpha \cdot k_s \cdot \beta_r \cdot \psi \cdot \eta_{ir} \cdot G_i$ c. $S_{ir} = \alpha \cdot k_s \cdot \beta_r \cdot \psi_i \cdot \eta_{ir} \cdot G_i$

22. Conforming to P100 – 92, for the "A" seismic intensity zone, the k_s coefficient has the value:

a. $k_s = 0.32$ b. $k_s = 0.26$ c. $k_s = 0.20$

23. Which of the next versions represents the system of equation for obtaining the modes of vibrations for the a n DOF system in undamped free vibrations using stiffness matrix method:

a. $([k]_L - \omega_r^2 \cdot [m]) \cdot \{U_{ir}\} = \{0\}$ b. $([k]_L - \theta^2 \cdot [m]) \cdot \{U_{ir}\} = \{0\}$ c. $([\Delta]_L - \omega_r^2 \cdot [m]) \cdot \{U_{0i}\} = \{0\}$

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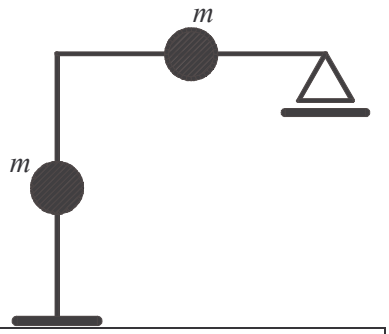
24. How many dynamic degrees of freedom has the system from the figure?



a. *1 GLD* b. *2 GLD* c. *3 GLD*

25. Which of the next versions represents the system of equation for determining the modes of vibrations for the *n* DOF system in undamped free vibrations using flexibility matrix method?

a. $\left(\omega_r \cdot [\Delta]_L \cdot [m] - [1]\right) \cdot \{U_{ir}\} = \{0\}$ b. $\left(\omega_r^2 \cdot [\Delta]_L \cdot [m] - [1]\right) \cdot \{U_{ir}\} = \{0\}$ c. $\left([\Delta]_L \cdot [m] - \omega_r^2 \cdot [1]\right) \cdot \{U_{ir}\} = \{0\}$

26. Conforming P100 – 92, the dynamic coefficient β has the next maximum and minimum values:

a. $\beta_{\max} = 2.5$, $\beta_{\min} = 1$ b. $\beta_{\max} = 2.0$, $\beta_{\min} = 0.7$ c. $\beta_{\max} = 2.5$, $\beta_{\min} = 0.7$

27. A particular solution of the equation of motion $\ddot{u}(t) + 2 \cdot \xi \cdot \omega \cdot \dot{u}(t) + \omega^2 \cdot u(t) = -\ddot{u}_g(t)$ is:

a. $u(t) = 2 \cdot \xi \cdot \omega + \frac{1}{\omega^2} \cdot \int_0^t \ddot{u}_g(\tau) \cdot e^{-\xi \cdot \tau} \cdot \sin \frac{1}{\sqrt{1-\xi^2}} \cdot d \cdot \tau$

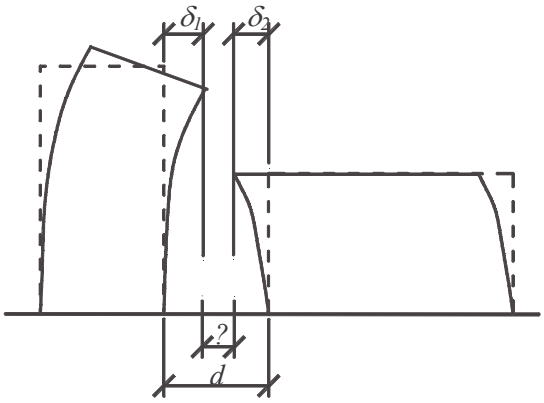
b. $u(t) = -\frac{1}{m} \cdot \int_0^t \ddot{u}_g(\tau) \cdot \sin \frac{\omega^2}{1-\xi^2} \cdot d \cdot \tau$

c. $u(t) = -\frac{1}{\omega \cdot \sqrt{1-\xi^2}} \cdot \int_0^t \ddot{u}_g(\tau) \cdot e^{-\xi \cdot \omega \cdot (t-\tau)} \cdot \sin\left[\omega \cdot \sqrt{1-\xi^2} \cdot (t-\tau)\right] \cdot d \cdot \tau$

28. A design spectra refers to the maximum probabilistic response of 1 DOF system acted by:

a. the Vrancea earthquake, from March 4th, 1977 b. many earthquake records scaled at the same intensity c. one earthquake specified by designer

29.



Conforming P100 – 92 the anti-seismic joint is:

a. $d \geq \delta_1 + \delta_2 + 20mm$ b. $d \geq \delta_1 + \delta_2 + 20cm$ c. $d \geq \delta_1 + \delta_2 + 10cm$

30. The process in which a tectonic plate is moving against and under another plate is named:

a.	subduction	b.	substitution	c.	substructure

31. The Rayleigh waves şi Love waves are generated:

a.	at the Crust surface	b.	in the Mantle	c.	in the Core

32. Where is the Moho (Mohorovicic) discontinuity placed?

a.	between the Mantle and Core	b.	between the Mantle and Crust	c.	under the Crust

33. Where is an earthquake epicenter located?

a.	at the Crust surface	b.	at the place of earthquake generation	c.	under the Crust

34. The exogenous earthquakes are generated:

a.	in the Crust	b.	at the Crust surface	c.	in the Mantle

35. Who have firstly develop the Continental Drift Theory?

a.	Wegener	b.	Richter	c.	Beethoven

36. What was the name of the super-continent from 200 millions years ago?

a.	Panagaea	b.	Panthalassa	c.	Eurasia

37. Which are the main tectonic plates?

a.	Nazca, Cocos, Somali, Caribbean, Philippine and Arabian	b.	Pacific, Australian-Indian, Antarctic, American, African and Euroasian	c.	Antarctic, American, Somali, Caribbean, Philippine and Euroasian

38. Which are the micro-plates that intersect on the Romanian territory?

a.	Interalpine, Russian, Eurasian, Black See Micro-plate	b.	Arabian, Moesian, Eurasian, Black See Micro-plate	c.	Interalpine, Moesian, Eurasian, Black See Micro-plate

39. Which is the nature of the most weighting earthquakes?

a.	exogenous	b.	endogenous	c.	xenophobes

40. Which seismic waves are longitudinally propagating?

a.	Love	b.	Rayleigh	c.	P

41. How can seismic waves be recorded?

a.	with micrometers	b.	with seismometers	c.	with accelerometers

42. Where was firstly done a seismic record?

a.	El Centro	b.	Long Beach	c.	Pasadena

43. Who had firstly conceived a scale for evaluation of seismic action?

a.	Medvedev	b.	Mercalli	c.	Rossi and Forel

44. With the help of which scale can quantitatively be appreciated an earthquake?

a.	Richter	b.	MM	c.	MSK

45. The dominant characteristics of an earthquake recorded at the surface of the Earth are generated by the …. waves.

a.	P and S	b.	PP	c.	Rayleigh and Love

46. How many grades has the seismic intensity scale (MSK) used in Romania?

a.	12	b.	10	c.	9

47. How is also named the Richter scale?

a.	quantitative scale	b.	subjective scale	c.	magnitude scale

48. What an accelerogram is?

a.	ground acceleration's variation with time	b.	ground acceleration's variation with frequency	c.	ground displacement's variation with time

49. Which from the scales of evaluation of seismic action is important for the civil engineer?

a.	Richter	b.	MSK	c.	MM

50. Where the subduction phenomenon can be produced?

a.	in the epicentral zone	b.	at the level of oceanic crust	c.	in the rifts' zones

51. A Fourier spectrum is a representation of the relation:

a.	acceleration – time	b.	oscillation amplitude – frequency	c.	oscillation amplitude – period

52. What a spectral value is?

a.	maximum acceleration of the response of a system with one DOF to a given action	b.	maximum displacement of the response of a system with one DOF to a given action	c.	maximum velocity of the response of a system with one DOF to a given action

53. A seismic response spectrum is the representation of relation:

a.	spectral values – time	b.	spectral values – frequency	c.	spectral values – period

54. How the damping of a system affects the response to seismic action?

a.	by reducing it	b.	by amplifying it	c.	not at all

55. How the waves generated by earthquakes at the level of oceanic crust are named?

a.	Seiche	b.	Tsunami	c.	Beniof

56. Which is the rigid body frequency?

a.	15 Hz	b.	100 Hz	c.	33 Hz

57. The relation between the seismic response spectra is:

a.	$S_a = \omega^2 \cdot S_d = \omega \cdot S_v$	b.	$S_a = \omega^2 \cdot S_v = \omega \cdot S_d$	c.	$S_a = -\omega^2 \cdot S_d = -\omega \cdot S_v$

58. The seismic magnitude is define as:

a. the base 10 logarithm of the maximum amplitude, measured in micrometres (10^{-6}m), of the earthquake result obtained by Wood – Anderson seismograph with magnification 2800, the natural period T=0.8s, damping coefficient 0.8, and corrected to a distance of 100 km from epicenter

b. the natural logarithm of the minimum amplitude, measured in nanometers (10^{-9}m), of the earthquake result obtained by Woody – Alen, seismograph with magnification 8200, the natural period T=8.0s, damping coefficient 8.0, and corrected to a distance of 90 km from epicenter

c. the natural logarithm of the average amplitude, measured in centimeters (10^{-2}m), of the earthquake result obtained by Wood – Angel seismograph with magnification 28, the natural period T=8.08s, damping coefficient 0.8, and corrected to a distance of 10 m from epicenter

59. What a deterministic spectrum is?

a. design spectrum b. result of processing an in situ recorded action c. result of processing a random action

60. In what range the spectral peaks for actions recorded until now on Earth are found?

a. 0-0.3s b. 0.3-1.8s c. 0-2.5s

61. The Fourier spectrum and the seismic spectrum are the same thing.

a. yes b. no c. almost the same

62. What is the d'Alambert's Principle useful for?

a. for writing the differential equation of motion b. for writing the fictitious statical equilibrium for a dynamical system c. for obtaining spectra

63. Which are the forces participating to seismic response?

a. damping, elastic and seismic forces b. damping, inertia seismic forces c. damping, elastic, seismic and inertia forces

64. In a conservative system the damping force is:

a. different from 0 b. equal to 0 c. equal to or different from 0

65. What is the relation between the kinetic energy (E_c) and potential energy (E_p) during the oscillation of a conservative system?

a. $E_c + E_p = 0$ b. $E_c + E_p$ = constant c. $E_c + E_p > 0$

66. Corresponding to the maximum amplitude of a system being in oscillation, kinetic energy (E_c) and potential energy (E_p) are:

a. E_c - maximum; E_p - 0 b. E_c - 0; E_p - maximum c. E_c - maximum; E_p - maximum

67. Which is the relation between period, frequency and circular frequency for a system with one DOF?

a. $T = \frac{1}{\omega} = \frac{2 \cdot \pi}{f}$ b. $T = \frac{1}{f} = \frac{2 \cdot \pi}{\omega}$ c. $T = (f)^{-1} = \frac{2 \cdot \pi^2}{\omega}$

68. What is a response of the type "time history"?

a. the response obtained through the integration of the differential equation of motion b. the response obtained through the help of seismic response spectrum c. the response obtained through modal analysis

69. Which degrees of freedom of a mass are usually taken into consideration in dimensioning structures to seismic actions?

a. those of horizontal translation
b. those of rotation
c. those of horizontal translation, vertical translation and rotation

70. For common systems with *n* DOF used in civil engineering the inertia matrix is:

a. diagonal
b. full
c. main diagonal symmetrical and also secondary diagonal symmetrical

71. For systems with *n* DOF the stiffness matrix can be:

a. diagonal
b. tri-diagonal
c. full and main diagonal symmetrical

72. For non-conservative systems with *n* DOF the damping matrix can be:

a. 0
b. diagonal
c. full and main diagonal symmetrical

73. The spectral matrix is:

a. diagonal
b. full
c. formed from the square of circular frequencies placed on main diagonal

74. The modal matrix is:

a. symmetrical
b. anti-symmetrical
c. random

75. The displacement vector corresponding to the fundamental mode of vibration of a system is formed from terms:

a. null
b. with same sign
c. positives and negatives

76. Which of the next expressions gives the generalized mass?

a. $M_i = \{x_k\}_i^T \cdot [\backslash m_k \backslash] \cdot \{x_k\}_j$
b. $M_i = \{x_k\}_i \cdot [\backslash m_k \backslash] \cdot \{x_k\}_i^T$
c. $M_i = \{x_k\}_j^T \cdot [\backslash m_k \backslash] \cdot \{x_k\}_j$

77. Which is the correct form for the shape factor?

a. $\eta_{ki} = x_{ki} \dfrac{\{x_k\}_i \cdot [\backslash m_{k\backslash}] \cdot \{1\}}{\{x_k\}_i^T \cdot [\backslash m_{k\backslash}] \cdot \{x_k\}_i}$
b. $\eta_{ki} = x_{ki} \dfrac{\sum_{i=1}^{n} x_{ki} \cdot m_k}{\sum_{i=1}^{n} x_{ki}^2 \cdot m_k}$
c. $\eta_{ki} = x_{ki} \dfrac{\{x_k\}_i \cdot [\backslash m_{k\backslash}] \cdot \{x_k\}}{\{x_k\}_i^T \cdot [\backslash m_{k\backslash}] \cdot \{x_k\}_i}$

78. Applying the calculated seismic forces on a system, the analysis is:

a. dynamic
b. static
c. pseudo-dynamic

79. „Time history" is an analysis of the type:

a. dynamic
b. static
c. pseudo-dynamic

80. Which of the next coefficients make the link with the spectrum?

a. ψ
b. β_r
c. k_s

81. Through which coefficient the structural capacity for dissipation the energy is taken into account?

a. α b. ψ c. ε_r

82. Which is the correct expression for the equivalence coefficient?

a. $\varepsilon_i = \dfrac{\left(\sum_{k=1}^{n} m_k \eta_{ki} x_{ki}\right)^2}{\left(\sum_{k=1}^{n} m_k\right)\left(\sum_{k=1}^{n} m_k x_{ki}^2\right)}$ b. $\varepsilon_i = \dfrac{\left(\sum_{k=1}^{n} m_k x_{ki}\right)^2}{\left(\sum_{k=1}^{n} m_k\right)\left(\sum_{k=1}^{n} m_k x_{ki}^2\right)}$ c. $\varepsilon_i = \dfrac{\sum_{k=1}^{n} m_k x_{ki}}{\left(\sum_{k=1}^{n} m_k\right)\left(\sum_{k=1}^{n} m_k x_{ki}^2\right)}$

83. Is there any difference between the seismic forces' distribution coefficient and the shape factor?

a. yes b. no c. they are the same thing

84. The contribution of the fundamental mode of vibration to the response of a common system with *n* DOF is:

a. the most important b. insignificant c. relative

85. Through what can be appreciated the contribution of a mode of vibration to the total response of a system?

a. shape factor b. modal participation factor c. distribution factor

86. Surface earthquakes mostly affects:

a. low-rise and stiff constructions b. tall flexible constructions c. all constructions

87. Seismic isolation is realized through:

a. increase of structural ductility b. introduction of a bearing between foundation and superstructure c. introduction of energy dissipating elements into the structure

88. Which is the concept standing at the base of common seismic design norms?

a. Elastic concept b. ductility concept c. elastic-ductility concept

89. Through the ductility of a construction element the next is assured:

a. increase of the strength b. increase of the energy dissipation capacity c. possibility of plastic hinges formation

90. What are the seismic forces?

a. inertia forces b. forces from external actions c. link forces

91. Which are the units the acceleration can be appreciated with?

a. cm/s^2 b. m/s^2 c. mm/s^2

92. The fundamental period of vibration of a system corresponds to:

a. any mode of vibration b. the last mode of vibration c. the first mode of vibration

93. Which are the units that can express the mass?

a. Kg b. $N/(m/s^2)$ c. daN

94. The gravity acceleration, g (m/s^2) is:

a. 9,81 b. 8,81 c. 10,0 0

95. For an uncoupled dynamic system with *n* DOF the mass matrix is:

a.	full	b.	diagonal	c.	triangular

96. The modal matrix is:

a.	the matrix of the mode shapes of vibration	b.	the circular frequencies matrix	c.	the square of circular frequencies matrix

97. The floor's relative stiffness is:

a.	ratio between the share force and the floor's relative displacement	b.	ratio between the share force and the total displacement	c.	ratio between the total displacement and the floor's relative displacement

98. The spectral matrix is:

a.	the matrix of the square of circular frequencies	b.	the matrix of mode shapes	c.	the matrix of the modes of vibration

99. The epicentral distance is:

a.	the distance between the focus and the epicenter	b.	the distance between the epicenter and the seismic station	c.	the distance between the focus and the seismic recording station

100. The fundamental mode of vibration is the assemble between:

a.	T_i, ω_i	b.	$\omega_1, \{U_{i1}\}$	c.	T_1, ω_r