

What are Seismic Design Principles?

Worksheet

Seismic design principles size a structure's lateral force-resisting system (walls, frames, bracing) to survive earthquake shaking, most simply expressed through the base shear equation $V = C_s W$, where C_s is the seismic response coefficient and W is the building's effective weight.

Questions

1. A building has $C_s = 0.15$ and $W = 4000$ kN. What is the base shear?
A) 600 kN
B) 266.7 kN
C) 4000.15 kN
D) 60 kN
2. What does the seismic response coefficient C_s primarily depend on?
A) Paint color
B) Ground acceleration, soil type and building period
C) Number of windows
D) Floor area only
3. Why is ductility desirable in seismic design?
A) It makes the building lighter
B) It lets elements yield and absorb energy instead of fracturing
C) It reduces cost only
D) It increases stiffness only
4. An irregular building (asymmetric mass/stiffness) during an earthquake tends to
A) Behave identically to a regular one
B) Experience unpredictable torsion and concentrated damage
C) Never need seismic design
D) Have lower base shear automatically
5. A building has effective seismic weight $W = 8000$ kN and seismic response coefficient $C_s = 0.10$. Find the base shear.
6. A stiffer, heavier building has $W = 15000$ kN with $C_s = 0.08$ (lower due to a longer period). Find V .
7. A code requires a minimum C_s of 0.05 for a hospital (essential facility, $W = 20000$ kN). What is the minimum base shear it must be designed for?
8. Define: What is base shear?
9. Define: What does C_s represent?
10. Define: What is a lateral force-resisting system?

Answer Key

1. A) $600 \text{ kN} - V = C_s W = 0.154000 = 600 \text{ kN}$.
2. B) Ground acceleration, soil type and building period - C_s is derived from site seismicity, soil conditions, structural period and importance factor.
3. B) It lets elements yield and absorb energy instead of fracturing - Ductile behavior dissipates seismic energy safely, preventing sudden collapse.
4. B) Experience unpredictable torsion and concentrated damage - Irregularities cause torsional effects and stress concentrations that are hard to predict.
5. $V = C_s W = 0.10 \ 8000 = 800 \text{ kN}$ base shear.
6. $V = C_s W = 0.08 \ 15000 = 1200 \text{ kN}$ base shear.
7. $V = C_s W = 0.05 \ 20000 = 1000 \text{ kN}$ minimum base shear.
8. The total horizontal force at the base of a structure caused by earthquake ground motion, $V = C_s W$.
9. The seismic response coefficient - a factor combining ground acceleration, soil type, structure period and importance.
10. The structural elements (shear walls, braced or moment frames) specifically designed to resist horizontal earthquake and wind forces.

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