



Eleven largest earthquakes since 1900

#	Location	Date	M	#	Location	Date	M
1	Chile	1960	9.5	6	Ecuador Coast	1906	8.8
2	Alaska	1964	9.2	7	Aleutian Islands	1965	8.7
3	Aleutian Islands	1957	9.1	8	India-China	1950	8.6
4	Kamchatka	1952	9.0	9	Kamchatka	1923	8.5
5	Sumatra (Tsunami)	2004	9.0	10	Indonesia	1938	8.5
				11	Kuril Islands	1963	8.5

USGS data & map

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Seismic waves - USGS figures

Body Waves

Body waves travel through earth interior

P waves (Primary waves)
travel at very high speed (**26,000 mph**)

S waves (Secondary waves)
shake perpendicular to wave direction

Surface Waves

Surface waves travel near the earth surface

Love waves
shake perpendicular to wave direction

Rayleigh waves
shake in elliptical motion

Epicenter Location

The time difference waves of different speed arrive at seismic stations defines the earthquake distance

Distances from 3 stations define the Epicenter

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SEISMIC DESIGN ITEMS

Critical woodframe items

- A Shear wall anchor bolts
Resist wall slippage
- B Hold-down
Resist shear wall overturning
- C Shear wall nailing
Attaches panels to framing
- D Wall-to-wall hold-down
Resist shear wall overturning
- E Framing anchor clips
Transfer shear from floor to floor
- F Beam connection
Resist beam slippage
- G Shear wall width/height ratio
Minimum 1 : 3.5 for stability
- H Joist blocking
Transfers shear at panel edges

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Moment frames

Provide ductility
Require rigid beam-column joints to transfer moments

I = inflection points of zero bending stress

Steel:
Reduced beam flanges reduce joint stress

Concrete:
Extend rebars through beam & column

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Link Beam

Eccentric bracing

- Short *Link Beam* for stiffness
- Long *Link Beam* for ductility

Visco elastic bracing

- Stiff at normal load
- Ductile at large earthquakes

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