

# Tables explaining the JMA Seismic Intensity Scale

## Notes

- (1) As a rule, seismic intensities announced by JMA are values observed using seismic intensity meters installed on the ground or on the first floor of low-rise buildings. This document describes the phenomena and damage that may be observed for individual seismic intensity levels. Seismic intensities are not determined from the observed phenomena described here.
- (2) Seismic ground motion is significantly influenced by underground conditions and topography. Seismic intensity is the value observed at a site where a seismic intensity meter is installed, and may vary even within the same city. In addition, the amplitude of seismic motion generally differs by floor and location within the same building, as shaking on upper floors may be considerably amplified.
- (3) Sites with the same level of seismic intensity will not necessarily suffer the same degree of damage, as the effect of tremors depends on the nature of the seismic motion (such as amplitude, period and duration), the type of construction and underground conditions.
- (4) This document describes typical phenomena that may be seen at individual levels of seismic intensity. In some cases, the level of damage may be greater or less than specified. Not all phenomena described for each intensity level may necessarily occur.
- (5) The information outlined here is regularly checked at intervals of about five years, and is updated in line with actual phenomena observed in new cases or improvements in the earthquake resistance of buildings and structures.

## ● Human perception and reaction, indoor situation, outdoor situation

Seismic intensity	Human perception and reaction	Indoor situation	Outdoor situation
0	Imperceptible to people, but recorded by seismometers.	—	—
1	Felt slightly by some people keeping quiet in buildings.	—	—
2	Felt by many people keeping quiet in buildings. Some people may be awoken.	Hanging objects such as lamps swing slightly.	—
3	Felt by most people in buildings. Felt by some people walking. Many people are awoken.	Dishes in cupboards may rattle.	Electric wires swing slightly.

Seismic intensity	Human perception and reaction	Indoor situation	Outdoor situation
4	Most people are startled. Felt by most people walking. Most people are awoken.	Hanging objects such as lamps swing significantly, and dishes in cupboards rattle. Unstable ornaments may fall.	Electric wires swing significantly. Those driving vehicles may notice the tremor.
5 Lower	Many people are frightened and feel the need to hold onto something stable.	Hanging objects such as lamps swing violently. Dishes in cupboards and items on bookshelves may fall. Many unstable ornaments fall. Unsecured furniture may move, and unstable furniture may topple over.	In some cases, windows may break and fall. People notice electricity poles moving. Roads may sustain damage.
5 Upper	Many people find it hard to move; walking is difficult without holding onto something stable.	Dishes in cupboards and items on bookshelves are more likely to fall. TVs may fall from their stands, and unsecured furniture may topple over.	Windows may break and fall, unreinforced concrete-block walls may collapse, poorly installed vending machines may topple over, automobiles may stop due to the difficulty of continued movement.
6 Lower	It is difficult to remain standing.	Many unsecured furniture moves and may topple over. Doors may become wedged shut.	Wall tiles and windows may sustain damage and fall.
6 Upper	It is impossible to remain standing or move without crawling. People may be thrown through the air.	Most unsecured furniture moves, and is more likely to topple over.	Wall tiles and windows are more likely to break and fall. Most unreinforced concrete-block walls collapse.
7		Most unsecured furniture moves and topples over, or may even be thrown through the air.	Wall tiles and windows are even more likely to break and fall. Reinforced concrete-block walls may collapse.

## ● Wooden houses

Seismic intensity	Wooden houses	
	High earthquake resistance	Low earthquake resistance
5 Lower	—	Slight cracks may form in walls.
5 Upper	—	Cracks may form in walls.
6 Lower	Slight cracks may form in walls.	Cracks are more likely to form in walls. Large cracks may form in walls. Tiles may fall, and buildings may lean or collapse.
6 Upper	Cracks may form in walls.	Large cracks are more likely to form in walls. Buildings are more likely to lean or collapse.
7	Cracks are more likely to form in walls. Buildings may lean in some cases.	Buildings are even more likely to lean or collapse.

(Note 1) Wooden houses are classified into two categories according to their earthquake resistance, which tends to be higher for newer foundations. Earthquake resistance tends to be low for structures built up to 1981, and high for those built since 1982. However, to maintain a certain range of earthquake resistance according to differences in structure and wall arrangement, resistance is not necessarily determined only by foundation age. The earthquake resistance of existing buildings can be ascertained through quakeproofing diagnosis.

(Note 2) The walls in this table are assumed to be made of mud and/or mortar. Mortar in a wall with a weak base can easily break off and fall, even under conditions of low deformation.

(Note 3) Damage to wooden houses depends on the period and duration of seismic waves. In some cases (such as the Iwate-Miyagi Nairiku Earthquake of 2008), few buildings sustain damage in relation to the level of seismic intensity observed.

## ● Reinforced-concrete buildings

Seismic intensity	Reinforced-concrete buildings	
	High earthquake resistance	Low earthquake resistance
5 Upper	—	Cracks may form in walls, crossbeams and pillars.
6 Lower	Cracks may form in walls, crossbeams and pillars.	Cracks are more likely to form in walls, crossbeams and pillars.
6 Upper	Cracks are more likely to form in walls, crossbeams and pillars.	Slippage and X-shaped cracks may be seen in walls, crossbeams and pillars. Pillars at ground level or on intermediate floors may disintegrate, and buildings may collapse.
7	Cracks are even more likely to form in walls, crossbeams and pillars. Ground level or intermediate floors may sustain significant damage. Buildings may lean in some cases.	Slippage and X-shaped cracks are more likely to be seen in walls, crossbeams and pillars. Pillars at ground level or on intermediate floors are more likely to disintegrate, and buildings are more likely to collapse.

(Note 1) Earthquake resistance tends to be higher for newer foundations. The value tends to be low for structures built up to 1981, and high for those built since 1982. However, to maintain a certain range of earthquake resistance according to differences in structure and 2D/3D arrangement of reinforced walls, resistance is not necessarily determined only by foundation age. The earthquake resistance of existing buildings can be ascertained through quakeproofing diagnosis.

(Note 2) Slight cracks may form in reinforced-concrete buildings without their core structure being affected.

## ● Situation of ground and slopes, etc.

Seismic intensity	Situation of ground	Situation of slopes, etc.
5 Lower	Small cracks may form and liquefaction <sup>※1</sup> may occur.	Rock falls and landslips may occur.
5 Upper		
6 Lower	Cracks may form.	Landslips and landslides may occur.
6 Upper	Large cracks may form.	Landslips are more likely to occur; large landslides and massif collapses may be seen <sup>※2</sup> .
7		

※1 Liquefaction may be seen in areas with a high groundwater level and loose sand deposits. Damage observed as a result of liquefaction includes spouts of muddy water from the ground, outbreaks of subsidence in riverbanks and quays, elevation of sewage pipes and manholes, and leaning or destruction of building foundations.

※2 When large landslides and massif collapses occur, dams may form depending on geographical features, and debris flow may occur due to the large quantities of sediment produced.

## ● Influence on utilities and infrastructure, etc.

Suspension of gas supply	In the event of shaking with a seismic intensity of about 5 Lower or more, gas meter with safety devices are tripped, stopping the supply of gas. In the event of stronger shaking, the gas supply may stop for entire local blocks <sup>※</sup> .
Suspension of water supply, electrical blackouts	Suspension of water supply and electrical blackouts may occur in regions experiencing shaking with a seismic intensity of about 5 Lower or more <sup>※</sup> .
Suspension of railroad services, regulation of highways, etc.	In the event of shaking with a seismic intensity of about 4 or more, services on railroads or highways may be stopped for safety confirmation. Speed control and traffic regulations are performed according the judgment of the relevant bodies. (Standards for safety confirmation differ by organization and area.)
Disruption to lines of communication such as telephones	In the event of an earthquake, telephone line congestion may occur as a result of increased use related to safety confirmation around regions of strong shaking. To combat this, telecommunications providers offer message boards and message dial services for use in disasters resulting from earthquakes with a seismic intensity of about 6 Lower or more.
Suspension of elevator services	In the event of shaking with a seismic intensity of about 5 Lower or more, elevators with earthquake control devices will stop automatically for safety reasons. Resumption of service may be delayed until safety is confirmed.

※ In the event of shaking with a seismic intensity of 6 Upper or more, gas, water and electric supplies may stop over wide areas.

## ● Effects on large-scale structures

Shaking of skyscrapers from long-period ground motion <sup>※</sup>	Due to their longer characteristic period, skyscrapers react less to earthquakes than general reinforced-concrete buildings, which have a shorter characteristic period. However, they exhibit slow shaking over a long time in response to long-period ground motion. If motion is strong, poorly fixed office appliances may move significantly, and people may have to hold onto stable objects to maintain their position.
Sloshing of oil tanks	Sloshing of oil tanks occurs in response to long-period ground motion. As a result, oil outflows or fires may occur.
Damage or collapse of ceilings etc. at institutions covering large spaces	In institutions covering large spaces such as gymnasiums or indoor pools, ceilings may shake significantly and sustain damage or collapse, even in cases where ground motion is not severe enough to cause other structural damage.

※ Occasionally, when a large earthquake occurs, long-period seismic waves reach locations far from the hypocenter; such waves may be amplified over plains depending on the characteristic period of the ground, thus extending their duration.