



A Position Statement on the Seismic Safety of New Colorado Buildings
by the Seismic Committee of the
Structural Engineers Association of Colorado

Date:
 December 3, 2021

Position Statement:

Design and construction of new Colorado buildings should use the Seismic Design Categories required by the International Building Code (IBC) tables as modified below. The modified cells are highlighted. The tables are based on the 2018 IBC. Corresponding tables in previous versions of the IBC have used “Occupancy Category” or “Seismic Use Group” rather than the current “Risk Category.”

TABLE 1613.2.5(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT PERIOD (0.2 second) RESPONSE ACCELERATION

	RISK CATEGORY			
	I	II	III	IV
$S_{DS} < 0.167g$	A	B	B	B
$0.167g \leq S_{DS} < 0.33g$	B	B	B	C
$0.33g \leq S_{DS} < 0.50g$	C	C	C	D
$0.50g \leq S_{DS}$	D	D	D	D

TABLE 1613.2.5(2)
SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

	RISK CATEGORY			
	I	II	III	IV
$S_{DI} < 0.067g$	A	B	B	B
$0.067g \leq S_{DI} < 0.133g$	B	B	B	C
$0.133g \leq S_{DI} < 0.20g$	C	C	C	D
$0.20g \leq S_{DI}$	D	D	D	D

Background:

Colorado has a long history of seismic activity including the 1882 earthquake that shook the ground over a large portion of the state. The use of Seismic Design Category A (SDC A), which does not require design for earthquakes is inappropriate for buildings of significant occupancy.

The International Building Code (IBC) is intended to allow SDC A for the design of buildings only in areas deemed to be of lowest seismic hazard. It provides a false economy: small savings in first cost and potentially large future loss when a damaging earthquake occurs. For SDC A, a lateral force of only 1% of the total gravity force is required at each level. Earthquake shaking as indicated by the seismic hazard maps in the IBC seismic provisions could be 10 times larger. The earthquake hazard in Colorado has a high uncertainty because of the relatively short time of recorded earthquake history in



the state. On-going changes in the national hazard maps combined with the IBC criteria for Seismic Design Category can result in a “yoyo” effect in seismic design requirements. These changes in the maps are usually related to judgments about the most appropriate models to use for propagation of ground motions, and the data to choose a model for Colorado is very sparse. Currently most of the Front Range cities are on the borderline between SDC A and B for Site Class C. The 2024 IBC will broaden the Front Range area for SDC A such that, even for the default Site Class D, the design for SDC A will be possible by code in many more locations.

Colorado’s largest historical earthquake occurred on November 7, 1882, when the population was very sparse. No instruments existed then as are in use today to estimate earthquake magnitudes. Based on felt reports, the magnitude has been estimated at 6.6 ± 0.6 . The location of this event appears to have been in the northern Front Range west of Fort Collins. The shaking was so great in Denver that equipment bolts at the electric light plant were sheared off and bent causing power and lighting to go out in the city. The earthquake was apparently felt as far east as Salina, Kansas and as far west as Salt Lake City. Although included in the USGS maps as a contributing earthquake, the methodology used to include the 1882 earthquake has resulted in no significant effect on the hazard maps for Colorado as a result of its inclusion. Colorado is one of only 14 states with documented historical earthquakes of magnitude 6.0 or greater. There are over 90 potentially active faults in Colorado. Only six have been individually included in the USGS maps that guide the building code seismic provisions.

Creating an inventory of buildings in which seismic design is included in some editions of the code and ignored in others is a poor public policy. There is a precedent for SEAC making a policy statement similar to this one to avoid building code “yoyo” effects. The 1997 Uniform Building Code would have increased the design ground motions in the Front Range area substantially over what was in the 1994 and prior editions of the UBC. At the time the 1997 UBC was being considered for local adoption, it was already known that the upcoming 2000 IBC would use the ground motions in the 1998 edition of ASCE 7, which were about the same as in the 1994 UBC. Structural engineers then recommended that local building code amendments refer to ASCE 7-98 for the ground motions, and a “yoyo” was avoided.

This Position Statement has negligible impact on construction cost yet provides a substantial enhancement to life-safety.