Code Amendment Proposal Form
For public amendments proposed to the 2018 editions of the International Codes

Instructions: Upload this form and all accompanying documentation at www.denvergov.org/BuildingCode. If you are submitting your proposal on a separate sheet, make sure it includes all information requested below.

All proposals must be received by April 26, 2019.

CONTACT INFORMATION

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Organization: Structural Engineers Association of Colorado – Denver Building Department Liaison Committee

I, Robert C. Jackson, hereby grant and assign to City and County of Denver all rights in copyright I may have in any authorship contributions I make to City and County of Denver in connection with this proposal. I understand that I will have no rights in any City and County of Denver publications that use such contributions in the form submitted by me or another similar form and certify that such contributions are not protected by the copyright of any other person or entity.

Signature: Robert C. Jackson

AMENDMENT PROPOSAL

Please use a separate form for each proposal.

1) Code(s) associated with this proposal. Please use acronym: DBC-IBC

If you submitted a separate coordination change to another code, please indicate which code:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Code Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBC-xxxx</td>
<td>Denver Building Code–xxxx (code) amendments (e.g., DBC-IBC, DBC-IEBC)</td>
</tr>
<tr>
<td>IBC</td>
<td>International Building Code</td>
</tr>
<tr>
<td>IEBC</td>
<td>International Existing Building Code</td>
</tr>
<tr>
<td>IECC</td>
<td>International Energy Conservation Code</td>
</tr>
</tbody>
</table>

2) Please check here if a separate graphic file is provided: ☐

Graphics may also be embedded within your proposal below.

3) Use this template to submit your proposal or attach a separate file, but please include all items requested below in your proposal. The only formatting needed is BOLDING, STRIKEOUT AND UNDERLINING. Please do not provide additional formatting such as tabs, columns, etc., as this will be done by CPD.

Code Sections/Tables/Figures Proposed for Revision:

DBC-IBC Section 1613.2.2 (previously Section 1613.3.2)
DBC-IBC Section 1613.2.5.3 (previously Section 1613.3.5.3)

Note: If the proposal is for a new section, indicate (new).

Proposal:
Revise as follows:

Section 1613.32.2 Site class definitions is replaced in its entirety with the following:

1613.32.2 Site class definitions. Based on the site soil properties, the site shall be classified as Site Class A, B, C, D, E, or F in accordance with Chapter 20 of ASCE 7. Any assignment of Site Class NOT based on average shear wave velocity, measured for the top 100 feet of the soil profile, shall comply with the following limitations:

a. No site shall be assigned as Site Class A, B, or C when bedrock has an overburden depth greater than 15 feet, as measured from the top of bedrock to the finished grade.

b. No site shall be assigned as Site Class A or B when bedrock has an overburden depth less than or equal to 15 feet, as measured from the top of bedrock to the finished grade.

c. Where the soil properties are not known in sufficient detail to determine the site class, Site Class D, subjected to the requirements of Section 1613.2.3, shall be used unless the building official or geotechnical data determines that Site Class E or F soils are present at the site.

Revise as follows:

Section 1613.32.5.3 Seismic design category, minimum is added:

1613.32.5.3 Seismic design category, minimum. All buildings and structures in the City and County of Denver shall satisfy the requirements of Seismic Design Category B, as a minimum.

Note: Show the proposal using strikeout _underline_ format. At the start of each section, give one of the following instructions:

- Revise as follows:
- Add new text as follows:
- Delete and substitute as follows:
- Delete without substitution:

Supporting Information:

Purpose:
The purpose of these revisions is to update the existing Denver Building Code (DBC) to align with the 2018 International Building Code (IBC).

Reasons:
These changes update the section numbers and default Site Class requirements in the DBC to be consistent with the changes adopted by the International Code Council for the 2018 IBC. Uniformity between the DBC-IBC and the IBC is essential for clarity in applying the code where language in the IBC is consistent with physical, environmental, and customary design and construction practices specific to the Denver area.

Substantiation:
These amendments with only minor changes have been in place from the first adoption of the IBC by the City and County of Denver. The following is some background for the amendments:

Section 1613.2.2 addresses local geotechnical parameters since the IBC, by reference to ASCE 7, allows the registered design professional preparing the soil investigation report to estimate the appropriate soil properties based on known geologic conditions in the absence of shear wave velocity data for the upper 100 feet at the site. The average shear wave velocity is the basic parameter for determining the Site Class, which, under the current code provisions, is an input to the determination of the Seismic Design Category. The bearing strata in the Denver Basin commonly referred to as the “Denver Blue” clay/shale does not qualify as “hard rock” (Site Class A). The strata also transmits energy to structures differently than averaged soil values given in ASCE 7. When the properties of the strata are averaged over the upper 100 feet as required by ASCE 7 in determining field measured average shear wave velocity, the averaged measurements may or may not meet Site Class B (“rock”). It is even less likely that Site Class B could be met given a greater depth of overburden soils. Therefore Site Class A or B would only be recognized in the City of Denver if actual shear wave velocity field measurements and compilations are performed. The ASCE 7 commentary indicates that there is no intended correlation between blow counts, undrained shear strength and shear wave velocity. The lack of correlation is understood to be even more prevalent in the Denver Basin. However, Table 20.3-1 of ASCE 7 does imply such a correlation for Site Class C. Therefore a more conservative design approach is taken specifically considering the depth of overburden in establishing limits on what Site Class is to be allowed in the absence of actual average shear wave velocity field measurements.

Section 1613.2.5.3 requires that design seismic forces be distributed through the structure consistent with Seismic Design Category B using the actual ground motion response accelerations given by the National Seismic Hazard Maps as included in the IBC. The use of Seismic Design Category A (SDC A) is allowed by the IBC for the design of buildings only in areas of lowest seismic hazard. The IBC does not differentiate among Risk Categories for SDC A. Where SDC A is allowed, ordinary structures are treated the same as essential facilities.
such as hospitals, fire stations, emergency shelters, etc. There is also no seismic limitation on the height of a building if the site qualifies for SDC A. For SDC A there is no requirement for a linear or exponential increase in the vertical distribution of the seismic forces with increasing height. A lateral force of only 1% of gravity is applied at each level. Equivalent lateral forces used in the Uniform Building Code for Zone 1 (applicable for Denver prior to the IBC) generally correspond to those for Seismic Design Category B, approximately 3 to 8% of gravity depending on the Risk Category and lateral seismic force resisting system. The emphasis on soils type, the variability of the attenuation functions, and the impact of steeper gradients in the mapped values can result in highly variable and changing seismic design requirements for areas such as the Front Range Urban Corridor of Colorado. The break point acceleration contours at which SDC A is allowed for Site Class C have varied from IBC code edition to code edition for Denver. The IBC would have otherwise allowed SDC A first for about half of Denver, then for most of Denver and now, under the latest 2014 hazard maps, mainly only for the eastern portions of Denver. The earthquake hazard in Colorado has a high uncertainty due to the relatively short time of recorded earthquake history in the state. Also, the on-going changes in the national hazard maps combined with the IBC criteria for Seismic Design Category determination can result in a “yo-yo” effect in seismic design requirements for Denver which is detrimental to design and construction quality and consistency. Therefore Seismic Design Category B is required as a minimum for purposes of seismic resistance and consistency of code requirements.

Colorado is one of only fourteen States that have documented historical earthquakes of magnitude 6.0 or greater. (Stover and Coffman, 1993).

There are over 90 potentially active faults in Colorado (Widmann, et al) but only six have been individually included in the USGS maps. Colorado’s largest historical earthquake was the November 7, 1882 event which occurred when the population was very sparse. No instruments were then in use to develop magnitudes. Based on felt reports and correlation to Modified Mercalli intensities, the magnitude has been estimated at 6.6 ± 0.6 (Spence, et al). The location of this event appears to be in the northern Front Range west of Fort Collins (Kirkham and Rogers, 1986 and Spence, et al). 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. The shaking was so great in Denver that it broke the electrical generators loose from their mounts and knocked out power. The earthquake was apparently felt as far east as Salina, Kansas and as far west as Salt Lake City. The strongest shaking in Denver was reported in the downtown, northern, and western parts of the city. Most of this area is underlain by water-saturated alluvial deposits.

The 1960’s Rocky Mountain Arsenal earthquakes, just northeast of Denver, are not included in the earthquakes contributing to the USGS hazard maps. They were probably induced by the deep injection of waste fluids at the Arsenal. These events included the Front Range’s largest instrumented earthquake, a 5.3M in August 1967 that caused over $1 million dollars (1967) in damage. A 4.1M earthquake occurred in the Arsenal area in April 1981. Those earthquakes that occurred near the Arsenal between 1962 and 1970 are considered to have been induced by fluid injection (Charlie, et al, 2002) and are therefore not included in the hazard maps.

Bibliography:

Note: This section MUST include these items:
- **Purpose**: State the purpose of the proposed amendment to physical, environmental and customary characteristics that are specific to the City and County of Denver (e.g., clarify the code; revise outdated material; substitute new or revised material
for physical, environmental and customary characteristics; add new requirements to the code; delete current requirements, etc. to reflect physical, environmental and customary characteristics that are specific to the City and County of Denver)

- **Reasons:** Clearly justify the change to current code provisions, stating why the proposal is necessary to reflect physical, environmental and customary characteristics that are specific to the City and County of Denver. Proposals that add or delete requirements shall be supported by a logical explanation that clearly shows why the current code does not reflect physical, environmental and customary characteristics that are specific to the City and County of Denver and explains how such proposal will improve the code.

- **Substantiation:** Substantiate the proposed amendment based on technical information and substantiation. Substantiation provided which is reviewed and determined as not germane to the technical issues addressed in the proposed amendment shall be identified as such.

- **Bibliography:** Include a bibliography when substantiating material is associated with the amendment proposal. The proponent shall make the substantiating materials available for review.

### Referenced Standards:

N/A

**Note:** List any new referenced standards that are proposed to be referenced in the code.

### Impact:

These changes update the existing DBC-IBC to align with the 2018 IBC. The language in the updated sections is largely unchanged from the existing DBC-IBC, and therefore will have no impact on the cost of design or construction of projects.

**Note:** Discuss the impact of this proposal in this section AND indicate the impact of this amendment proposal for each of the following:

- The effect of the proposal on the cost of construction:  ☐ Increase  ☐ Reduce  ☒ No Effect
- The effect of the proposal on the cost of design:  ☐ Increase  ☐ Reduce  ☒ No Effect
- Is the proposal more or less restrictive than the I-codes:  ☐ More  ☐ Less  ☒ Same

### Departmental Impact: (To be filled out by CPD staff)

**Note:** CITY STAFF ONLY. Discuss the impact of this proposal in this section AND indicate the impact of this amendment proposal for each of the following:

- The effect of the proposal on the cost of review:  ☐ Increase  ☐ Reduce  ☐ No Effect
- The effect of the proposal on the cost of enforcement/inspection:  ☐ Increase  ☐ Reduce  ☐ No Effect