IR EB-5

REHABILITATION REQUIRED BY SCOPE: 2019 CAC

Disciplines: Structural **History:** Issued 03/10/22

Division of the State Architect (DSA) documents referenced within this publication are available on the DSA Forms or DSA Publications webpages.

PURPOSE

This Interpretation of Regulations (IR) clarifies how DSA determines when a rehabilitation, as defined in California Administrative Code (CAC) Section 4-314, is required to an existing certified school building in accordance with CAC Sections 4-306 and 4-309(c), Item 2 or 3. CAC Section 4-309(c), addresses cases when the scope of a reconstruction, alteration, or addition results in changes to the existing building that impact the performance of the lateral-force-resisting system (Item 2) or its Risk Category classification (Item 3). The degree of impact is measured by thresholds defined by the regulation. This clarification is intended to promote consistent implementation and enforcement of these thresholds requiring rehabilitation, often referred to as “rehabilitation triggers”.

SCOPE

This IR is applicable to projects with scope including reconstruction, alteration, addition, or any combination thereof to one or more existing certified school buildings.

This IR is not applicable to reconstruction projects for the repair of fire damage in accordance with the Exception listed in CAC Section 4-309(a). This IR does not address the local strengthening requirements of CAC Section 4-309(a) for reconstruction, alteration, and/or addition projects when a rehabilitation is not required.

This IR does not address conditions requiring rehabilitation per CAC Section 4-309(c), Item 1, which is addressed in *IR EB-4: Rehabilitation Required by Cost*. Similarly, this IR does not address voluntary upgrades to the lateral-force-resisting system of an existing building as defined in CAC Section 4-309(d).

BACKGROUND

The CAC contains numerous provisions addressing new construction work in existing certified school buildings, which is generally categorized as reconstruction, alteration, or addition. When certain characteristics of such projects exceed the thresholds defined in CAC Section 4-309(c), a rehabilitation of the existing building is required.

CAC Section 4-306 defines the requirements of rehabilitation projects of existing certified school buildings. CAC Section 4-307 defines the requirements of rehabilitation projects for nonconforming buildings being converted into school buildings; the thresholds discussed in this IR are not applicable to the conversion of nonconforming buildings.

The rehabilitation requirement of CAC Section 4-309(c), Items 2 and 3 intends to ensure that when significant changes impact the lateral-force-resisting system or raise the Risk Category classification, the building is evaluated holistically and brought into conformance with the safety standards of the current regulations.

Frequently used terms defined in the Glossary of IR EB-4 also apply to this IR.

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1. GENERAL REQUIREMENTS

1.1 System Level Assessment

The thresholds established by CAC Section 4-309(c), Item 2 measure the degree of impact proposed changes have to an existing building's overall structure and lateral-force-resisting systems. These global measures identify changes to the existing building that require a rehabilitation. A rehabilitation is defined in CAC Section 4-314 and generally consists of an evaluation and resulting construction work to "bring the building, or portion thereof, into conformance with the safety standards of the currently effective regulations". Similar to the threshold measures, a rehabilitation applies globally to the entire building. Refer to *IR EB-3: Evaluation and Design Criteria Report* for additional details of rehabilitation scope.

1.1.1 When the scope of the proposed reconstruction, alteration, and/or addition project does not require a rehabilitation by CAC Section 4-309(c), local evaluation and strengthening may still be required. Refer to CAC Section 4-309(a) for evaluation and strengthening requirements applicable to local elements impacted by the proposed changes. Determination that the thresholds of CAC Section 4-309(c), Item 2 are not exceeded does not preclude the requirements pertinent to local strengthening.

1.1.2 Although the thresholds established by CAC Section 4-309(c), Item 2 pertain to the existing building's lateral-force-resisting system (i.e., the system resisting seismic and wind loads), when a limit is exceeded the required rehabilitation is not limited to the lateral-force-resisting system. The rehabilitation applies to all building systems governed by the Parts of Title 24, California Code of Regulations (C.C.R.) listed in the definition in CAC Section 4-314. Furthermore, the following aspects of a required rehabilitation are sometimes misunderstood:

1.1.2.1 The scope of a rehabilitation is not limited to the loading condition associated with the exceeded threshold. For example, when a rehabilitation is required due to exceedance of a wind force threshold, the rehabilitation requires compliance of the lateral force resisting system with the current code for wind and seismic loads.

1.1.2.2 The scope of a rehabilitation is not limited to the principal axis associated with the exceeded threshold. As noted in the following sections, some threshold criteria are considered separately in each of the orthogonal principal axes of the building in plan. In these cases, when the criteria is met in one but not both principal axes, the rehabilitation applies to the entire building, including the systems on both axes.

1.1.3 In accordance with CAC Section 4-306, a rehabilitation project requires the advance development, submission, and DSA approval of an Evaluation and Design Criteria Report (EDCR). Refer to IR EB-3 for additional information.

1.1.4 Existing buildings on many school campuses have historically been constructed with interconnecting exterior covered walkways. Such existing covered walkways commonly consist of light frame construction with or without columns and often do not include building separation details as required by current seismic code provisions. Existing covered walkways of this nature shall not be used to combine otherwise separate buildings for the purpose of assessing the scope thresholds established by CAC Section 4-309(c), Item 2. When there is doubt concerning the destinction of separate buildings, the district and/or design team shall meet with the DSA regional office to which the project will be submitted to obtain concurrence.

1.2 Cumulative Changes

Changes to the existing building assessed by the thresholds defined in CAC Section 4-309(c), Item 2 are "cumulative since the original construction".

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1.2.1 Except as permitted by Section 1.2.4 below, the baseline to which all changes are compared shall be the existing building as first designed and delineated on the original construction drawings. This is not necessarily the current state of the building, as changes made during the life of the building are not included in the baseline except as permitted by Section 3.1.1.2 below.

1.2.2 Changes to the existing building after its original design and construction shall be cataloged as accumulated changes. This includes changes made as part of past DSA certified reconstruction, alteration, or addition projects. Determination of whether a rehabilitation is required, therefore, necessitates that the design professional collect data from all past projects for inclusion in the various threshold comparisons.

1.2.3 In some cases, the original construction drawings for an existing building may be lost, incomplete, or otherwise illegible to such an extent that uncertainty of the original construction renders the comparisons required by the regulation difficult to perform. In such cases, the district and/or design team shall make an assessment based on field investigation and meet with the DSA regional office to which the project will be submitted to obtain concurrence on critical assumptions concerning the original construction.

1.2.4 After a rehabilitation project has been constructed and certified by DSA, the rehabilitated building is considered to be in conformance with the structural safety standards of the edition of Title 24, C.C.R. under which the rehabilitation was approved and resets the baseline building configuration for future rehabilitation threshold comparisons. Future reconstruction, alteration, or addition projects need not include changes made before the rehabilitation in assessing the thresholds defined by CAC Section 4-309(c), Item 2. Neither local strengthening required by CAC Section 4-309(a) nor voluntary strengthening to a lesser standard than a full rehabilitation in accordance with CAC Section 4-309(d) resets the baseline for the comparison of future projects as a rehabilitation does.

1.3 Combined Effect

Where the proposed reconstruction, alteration, and/or addition project both increases demand to and reduces capacity of an existing building's lateral-force-resisting system, the percentage change values determined in Part A and B of CAC Section 4-309(c), Item 2 shall be summed.

1.3.1 For example, the alteration of a single-story building may propose changes that result in an increase of the seismic roof weight by 8 percent in combination with changes that reduce the capacity of the original shear walls by 9 percent. While neither change taken independently exceeds 10 percent, the combined effect of these changes results in a 17 percent (8 percent plus 9 percent) increase in the demand-to-capacity ratio of the story. Because the combined effect exceeds the 10 percent threshold a rehabilitation is required. Refer to Figure 4 below for an additional example.

1.3.2 When considering combined effects, a reduction in seismic weight or wind tributary area at any story is not permitted to offset a reduction in the lateral-force-resisting system for the purposes of evaluating the thresholds requiring rehabilitation.

1.4 Application Submission

In accordance with form *DSA 3: Project Submittal Checklist*, Part 4, Section B, the submission of the reconstruction, alteration, and/or addition project shall include comparisons of each threshold required by the regulation and applicable to the project. The design professional shall prepare and present each comparison and provide all supporting information and documents upon which the comparisons are based.

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2. INCREASE IN LATERAL FORCE

Part A of CAC Section 4-309(c), Item 2 addresses conditions whereby the reconstruction, alteration, and/or addition scope of work causes an increase in the overall seismic or wind force demand on the building's lateral-force-resisting system at any given story level. Revisions to the regulations since the time of the existing building's design and construction are likely to have changed the code-prescribed seismic and wind forces. However, this provision is constructed to identify changes in the lateral force demand resulting from the proposed scope of work, not changes to the building code and/or its adopted standards. For example, a decrease or increase in the code-prescribed seismic or wind parameters is not considered in the evaluation of thresholds requiring rehabilitation.

2.1 Seismic Weight

An increase in the effective seismic weight in any story by more than 10 percent shall require a rehabilitation of the existing building.

2.1.1 As described in Section 1.2 above, changes to the seismic weight shall be taken as cumulative since the original construction.

2.1.1.1 Any existing seismic weight added during the life of the building shall be included as a portion of the cumulative increase in weight and shall not be included in the baseline seismic weight.

2.1.1.2 Similarly, the story weight comparison is permitted to consider reductions in the original seismic weight over the life of the building, including the proposed project, to offset past and proposed increases.

2.1.1.3 The following examples illustrate the determination of net cumulative change in seismic weight:

2.1.1.3.1 When a proposed alteration project scope includes the replacement of existing rooftop mechanical units that were included on the original construction drawings, the change in seismic weight of this work may be taken as the difference in unit weights.

2.1.1.3.2 When a proposed alteration project scope includes the replacement of existing rooftop mechanical units that were added during a previous modernization project (and did not exist on the original construction drawings), the full weight of the new units shall be counted as increased seismic weight.

2.2 Wind Force

An increase in the wind load surface area for any story by more than 10 percent shall require a rehabilitation of the existing building.

2.2.1 As described in Section 1.2 above, changes to the wind load surface area shall be taken as cumulative since the original construction.

2.2.1.1 Any existing surface area collecting wind loads that was added during the life of the building shall be included as a portion of the cumulative increase in surface area and shall not be included in the baseline surface area.

2.2.1.2 Similarly, the wind load surface area comparison is permitted to consider reductions in the original surface area over the life of the building, including the proposed project, to offset past and proposed increases.

2.2.2 The wind load surface area comparison shall be considered separately in each of the orthogonal principal axes of the building in plan. If a surface area(s) collecting wind loads is not parallel to the principal axes, the contribution of the nonparallel area(s) to the story surface area in each direction shall be taken as its trigonometric projection onto each respective principal axis.

2.2.3 Either of the following methods are permitted to evaluate the change in surface area exposed to wind:

2.2.3.1 The profile of the original baseline building is projected onto a vertical plane in each orthogonal direction. The projected area is distributed to each story (i.e., floor or roof level) by creating dividing lines corresponding to the framing system of the exterior walls. For typical floor-to-floor or floor-to-roof framed walls, the dividing lines occur at the midpoint between floor/roof levels (spandrel framed systems vary). The process is repeated for the existing building with cumulative reconstruction, alteration, and/or additions, including those currently proposed. The resulting surface areas at each story level are compared and evaluated according to the threshold.

2.2.3.2 The wind load demands prescribed for the main wind force reisting system by the current California Building Code (CBC) are determined for the original baseline building in each orthogonal direction. The overall wind load is distributed to each story (i.e., floor or roof level) in accordance with the CBC. The process is repeated for the existing building with cumulative reconstruction, alteration, and/or additions, including those currently proposed. The resulting story-level wind forces are compared and evaluated according to the threshold.

3. LATERAL-FORCE-RESISTING SYSTEM REDUCTION

Part B of CAC Section 4-309(c), Item 2 addresses conditions whereby the reconstruction, alteration, and/or addition scope of work causes a reduction in the overall strength or stiffness of the building's lateral-force-resisting system at any given story level.

3.1 Strength Reduction

A reduction in the strength of the existing lateral-force-resisting system at any story by more than 10 percent shall require a rehabilitation of the existing building. For the purposes of evaluating the strength reduction, any new strengthening as part of the proposed project shall not be considered. Refer to Figures 1 through 4 below.

3.1.1 As described in Section 1.2 above, reduction to the story strengths of the lateral-force-resisting system shall be taken as cumulative since the original construction.

3.1.1.1 Any past reductions in the strength of the lateral-force-resisting system during the life of the building shall be included as a portion of the cumulative reduction in story strength and shall not be included in the baseline story strength(s).

3.1.1.2 In accordance with CAC Section 4-309(c), Item 2, any past increases in the strength of the lateral-force-resisting system made through projects approved and certified by DSA are permitted to be included as part of the baseline story strength(s). Past strengthening shall not be used to offset past and/or proposed (i.e., cumulative) story strength reductions. Refer to Figure 3 below for an example of this condition.

3.1.2 The story strength comparison shall not consider the net change in story strength(s) proposed in the scope of the reconstruction, alteration, and/or addition project. While voluntary strengthening of the lateral-force-resisting system in accordance with CAC Section 4-309(d) is permitted, any strengthening included in the proposed project shall be neglected in the story strength comparison. Refer to Figures 2 and 3 below for examples of this condition.

3.1.3 The story strength shall be determined from the primary components of the lateral-force-resisting system whose original design intent was the resistance of lateral wind and seismic forces. Existing secondary components (e.g., columns of the gravity-load-resisting system, partial height masonry or concrete infill walls, etc.) may have inherent lateral stiffness and, in a rehabilitation, will be required to demonstrate adequate deformation compatibility, but shall be neglected for the purpose of the story strength comparison.

3.1.4 The story strength comparison shall be considered separately in each of the orthogonal principal axes of the building in plan. If the existing lateral-force-resisting system includes a line(s) of lateral resistance that is not parallel to the principal axes, the strength of the nonparallel line(s) contributory to the story strength in each direction shall be taken as no more than the trigonometric projection of the in-plane strength onto each respective principal axis.

3.1.5 Story strength shall consider all the lines of resistance in the direction of a given principal axis regardless of the relative stiffness of the diaphragm for the purpose of the story strength comparison.

3.2 Stiffness Reduction

A reduction in the stiffness of the lateral-force-resisting system at any story by more than 10 percent shall require a rehabilitation of the existing building. For the purposes of evaluating the stiffness reduction, any new strengthening as part of the proposed project shall not be included.

3.2.1 The story stiffness comparison shall be based on the same lateral-force-resisting system configurations used for the story strength comparison as defined in Sections 3.1.1 through 3.1.4 above.

3.2.2 Where the diaphragm of the story under consideration is classified as rigid or semi-rigid in accordance with American Society of Civil Engineers Standard 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7), Section 12.3 and a torsional irregularity per ASCE 7 Table 12.3-1 (Type 1a or 1b) does not exist, the story stiffness comparison shall be based on the drift at the diaphragm's center of mass.

3.2.3 Where the diaphragm of the story under consideration is classified as rigid or semi-rigid in accordance with ASCE 7 Section 12.3 and a torsional irregularity per ASCE 7 Table 12.3-1 (Type 1a or 1b) does exist, the story stiffness comparison shall be based on the drift at the edge of the diaphragm where the most severe stiffness reduction occurs.

3.2.4 Where the diaphragm of the story under consideration is classified as flexible in accordance with ASCE 7 Section 12.3, the story stiffness comparison is permitted to be based on a simple sum of the stiffnesses of the vertical lateral force resisting elements at each story in each of the principal axes. Section 3.1.5 above applies to this comparison.

3.3 Shear Wall Systems

The following provisions apply to lateral-force-resisting systems consisting of shear walls.

3.3.1 When determining the story shear of the lateral-force-resisting system (and any corresponding reductions), shear walls shall be determined to be either shear-controlled or flexural-controlled. Flexural-controlled shear walls will not develop their full shear strength before yielding, and therefore only the shear force corresponding to flexural yielding is contributory to the story shear strength. It is permitted to treat all light-frame sheathed shear walls as shear-controlled.

3.3.2 When a new opening is introduced into an existing shear wall at a location that renders a remaining portion(s) of the wall noncompliant with the aspect ratio requirement of the current regulations, the portion of wall made noncompliant by the proposed work ceases to contribute to the strength and stiffness of the story. Both the new opening and the noncompliant length of wall shall be considered reductions in the story strength and stiffness. Refer to Figure 4 below. This consideration is specific to code prescribed aspect ratio requirements and in light-frame sheathed shear walls does not preclude achieving compliance through the addition of new holddown hardware or straps in conjunction with the new wall opening.

3.3.3 When light-frame wood shear walls require local repair of damage caused by water or moisture, DSA may allow sheathing replacement solely in accordance with the local structural component assessment requirements of CAC Section 4-309(a). In such cases the district should provide a full inventory of the extent of known water damage and the design team should meet with the DSA regional office to which the project will be submitted to review this information and establish the evaluation criteria. The rehabilitation requirements of CAC Section 4-309(c), Item 1 will not be waived, and all new construction shall comply with the current CBC.

3.4 Braced Frame Systems

The following provisions apply to lateral-force-resisting systems consisting of braced frames.

3.4.1 The story strength of the lateral-force-resisting system (and any corresponding reductions) for a braced frame system is permitted to be determined by a plastic mechanism analysis. The plastic mechanism analysis shall be based on expected brace strengths in tension and compression.

3.4.2 When a single brace is removed as part of the reconstruction, alteration, and/or addition project the story strength shall be considered in the direction that results in the most severe reduction of strength. For existing buildings with conventional concentrically braced frames in balanced configurations (i.e., equal number of braces in tension and compression), this will mean considering the removed brace as acting in tension.

3.5 Moment Frame Systems

The following provisions apply to lateral-force-resisting systems consisting of moment frames.

3.5.1 The story strength of the lateral-force-resisting system (and any corresponding reductions) for a moment frame system is permitted to be determined by a plastic mechanism analysis. The portal method may be used to determine story strengths associated with the plastic mechanism. Other analysis methods may be utilized, provided they are applied consistently to both the existing and proposed structures.

3.5.1.1 Where a strong-column/weak-beam configuration is verified, the plastic mechanism analysis shall assume the plastic hinge formation at each end of each moment frame beam.

3.5.1.2 Where the existing construction does not provide a strong-column/weak-beam configuration the plastic mechanism analysis must determine the sequence of yielding to establish the story strength.

4. STRUCTURAL IRREGULARITY

Part C of CAC Section 4-309(c), Item 2 addresses conditions whereby the reconstruction, alteration, and/or addition scope of work results in a structural irregularity that is prohibited by the California Building Code (CBC) regulations for new building design.

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4.1 Proposed Changes

4.1.1 The assessment for prohibited structural irregularities is based on an analysis of the structure including the proposed reconstruction, alteration, and/or addition project. Proposed voluntary strengthening of the lateral-force-resisting system as part of the project, including those designed to remediate prohibited irregularities, are permitted to be included in this analysis.

4.1.2 When a prohibited irregularity occurs in an existing building in the absence of (i.e., prior to) the proposed reconstruction, alteration, and/or addition, the structure shall be evaluated to determine if the proposed work worsens the existing irregularity. If the proposed work makes an existing prohibited irregularity more severe, a rehabilitation is required.

4.2 Extreme Torsional Irregularity (Horizontal Type 1b)

A resultant extreme torsional irregularity may be affected by proposed work that changes either the center or mass or the center of rigidity of any given floor. The presence of this prohibited irregularity, therefore, could be influenced directly by changes to the lateral force-resisting-system, indirectly by other building changes effecting the mass distribution, or a combination of these two.

4.2.1 If the lateral-force-resisting system is modified or mass is added in a nonuniform manner such that the torsional evaluation could be significantly impacted, an analysis is required to determine if the proposed work results in an extreme torsional irregularity or worsens an preexisting extreme torsional irregularity.

4.2.2 The Exception of CBC Section 1617A.1.10 that permits an extreme torsional irregularity under specified conditions also applies to this CAC regulation. A rehabilitation is not required due to an extreme torsional irregularity when the specified conditions of the Exception are met by the existing building including the work of the proposed project.

4.2.3 The extreme torsional irregularity shall be considered separately in each of the orthogonal principal axes of the building in plan.

4.3 Extreme Soft Story Irregularity (Vertical Type 1b)

A resultant extreme soft story irregularity may be affected by proposed work that changes the stiffness of the lateral-force-resisting system. The presence of this prohibited irregularity could be influenced by a decrease in lateral stiffness at the story under consideration or an increase in lateral stiffness at the story (or stories) above.

4.3.1 When the lateral story stiffness is altered, it shall be evaluated to determine if an extreme soft story irregularity is created or made worse.

4.3.2 The extreme soft story irregularity shall be considered separately in each of the orthogonal principal axes of the building in plan.

4.4 Weak Story Irregularities (Vertical Type 5a or 5b)

A resultant weak story irregularity may be affected by proposed work that changes the strength of the lateral-force-resisting system. The presence of this prohibited irregularity could be influenced by a decrease in lateral strength at the story under consideration or an increase in lateral strength at the story (or stories) above.

4.4.1 When the lateral story strength is altered, it shall be evaluated to determine if a weak story irregularity is created or made worse.

4.4.2 The weak story irregularity shall be considered separately in each of the orthogonal principal axes of the building in plan.

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5. CHANGE IN OCCUPANCY

CAC Section 4-309(c), Item 3 addresses conditions whereby the reconstruction, alteration, and/or addition scope of work results in the structure being classified in a higher Risk Category as defined by CBC Table 1604A.5.

5.1 Risk Category of Existing Building

The Risk Category of Table 1604A.5 was first defined in the 2013 edition of the CBC in coordination with the 2010 edition of the adopted standard, ASCE 7. The 2007 and 2010 editions of the CBC in coordination with the 2005 edition of ASCE 7 defined Occupancy Categories in Table 1604A.5 using the same designators and definitions as later used for Risk Categories. The 2001 and 1998 editions of the CBC defined Occupancy Categories by name in Table 16A-K.

For the purpose of this regulation and determining whether Item 3 requires a rehabilitation, the baseline Risk Category of the existing building shall be determined as follows:

5.1.1 For buildings designed and constructed prior to the 1998 CBC, the Risk Category shall be taken as that determined from the requirements of the current CBC based on the occupancy and use of the original design.

5.1.2 For buildings designed and constructed under the 1998 or 2001 editions of the CBC, the Risk Category may be determined in accordance with Section 5.1.1 above. Alternately, the Risk Category is permitted to be determined from the Occupancy Category of the original design code as follows:

5.1.2.1 Essential facilities are considered Risk Category IV.

5.1.2.2 Hazardous facilities are considered Risk Category IV.

5.1.2.3 Special occupancy structures are considered Risk Category III.

5.1.2.4 Standard occupancy structures are considered Risk Category II.

5.1.2.5 Miscellaneous occupancy structures are considered Risk Category I.

5.1.3 For buildings designed and constructed under the 2007 or 2010 editions of the CBC, the Risk Category shall be taken as the Occupancy Category defined by the design code and listed on the DSA approved construction drawings.

5.1.4 For buildings designed and constructed under the 2013 CBC or later, the Risk Category shall be as defined by the design code and listed on the DSA approved construction drawings.

5.2 Examples of Risk Category Reclassification

Multiple scenarios exist in which a change in occupancy may result in the reclassification of a structure to a higher Risk Category, including but not limited to the following:

5.2.1 When a reconstruction or alteration project changes the use of an existing building to an occupancy with a more concentrated occupant load factor, the resulting increased occupant load may result in a higher Risk Category classification. Occupant load factors shall be as defined in CBC Table 1004.5. For example, an existing building designed with 10,000 net square feet of shop space may have originally been designated a Risk Category II structure based on an occupant load of 200 (10,000 net square feet / 50 net square feet per occupant). When repurposed to use as regular classrooms, however, the occupant load will increase to 500 (10,000 net square feet / 20 net square feet per occupant), exceed 250, and result in a Risk Category III classification.

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5.2.2 When an addition increases the square footage of a building, the resulting increased occupant load may result in a higher Risk Category classification. In accordance with the requirements of CBC Section 1604A.5.1, this condition can occur in structurally detached additions as well as structurally attached additions.

5.2.3 When an existing building is designated as an essential facility where such designation did not previously exist, the building becomes subject to the higher Risk Category IV classification. This could occur when a Community College district repurposes a classroom building for use by the campus police department.

REFERENCES:

2019 California Code of Regulations (CCR) Title 24
Part 1: California Administrative Code (CAC), Sections 4-306, 4-307, 4-309, 4-314, 4-322, 4-339
Part 2: California Building Code (CBC), Tables 1004.6, 1604A.5

This IR is intended for use by DSA staff and by design professionals to promote statewide consistency for review and approval of plans and specifications as well as construction oversight of projects within the jurisdiction of DSA, which includes State of California public schools (K–12), community colleges and state-owned or state-leased essential services buildings. This IR indicates an acceptable method for achieving compliance with applicable codes and regulations, although other methods proposed by design professionals may be considered by DSA.

This IR is subject to revision at any time. Please check DSA's website for currently effective IRs. Only IRs listed on the webpage at www.dgs.ca.gov/dsa/publications at the time of project application submittal to DSA are considered applicable.

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Basis of Evaluation

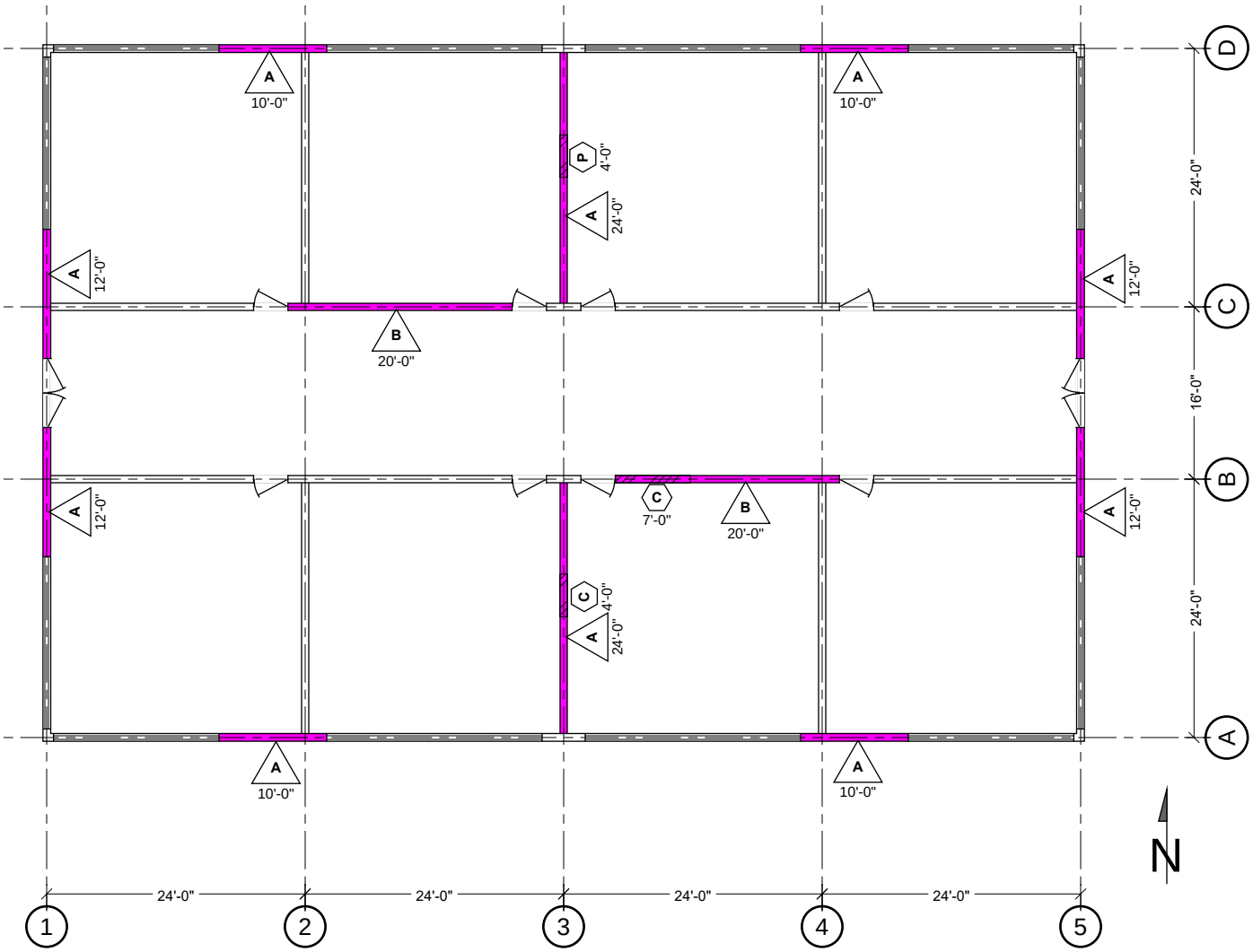
1) Original and all prior alteration projects were approved and certified by DSA.
2) Single story building with a flexible roof diaphragm. Seismic mass not changed.
3) All shear walls are shear-controlled.
4) Shear capacity of shear walls in pounds per linear foot (plf) is as follows:
   - Type A: 500 plf
   - Type B: 750 plf
5) Stiffness check not performed here.

Calculation

North-south direction:
Baseline = 500plf[12'(4)+24'(2)] = 48,000#
Reduction = 500plf(4'+4') = 4,000#
Ratio = 4,000/48,000 = 0.083 = 8.3% < 10%

East-west direction:
Baseline = 500plf(10')(4)+750plf(20')(2) = 50,000#
Reduction = 750plf(7') = 5,250#
Ratio = 5,250/50,000 = 0.105 = 10.5% > 10%

Rehabilitation IS Required



Legend

Existing shear wall from original construction (A, 12'-0")

Existing shear wall added in previous strengthening (A, 12'-0")

Demolished shear wall (C, 6'-0")
C = current project
P = previous project

New shear wall proposed as part of the current project (A, 12'-0")

Figure 1: Shear Wall Removal

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Basis of Evaluation

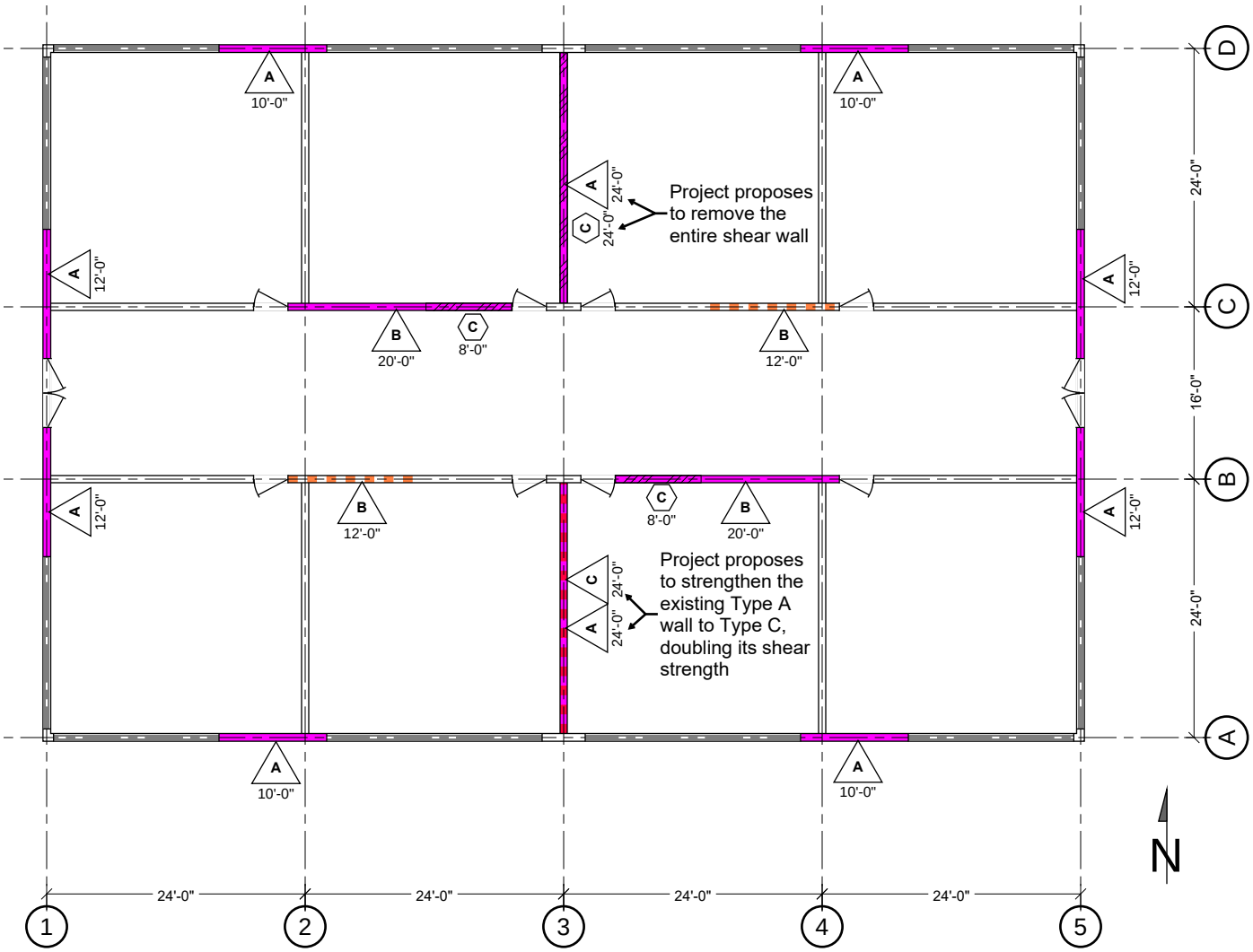
1) Original and all prior alteration projects were approved and certified by DSA.
2) Single story building with a flexible roof diaphragm. Seismic mass not changed.
3) All shear walls are shear-controlled.
4) Shear capacity of shear walls in pounds per linear foot (plf) is as follows:
   - Type A: 500 plf
   - Type B: 750 plf
   - Type C: 1,000 plf
5) Stiffness check not performed here.

Calculation

North-south direction:
Baseline = 500plf[12'(4)+24'(2)] = 48,000#
Reduction = 500plf(24') = 12,000#
Ratio = 12,000/48,000 = 0.25 = 25% > 10%

East-west direction:
Baseline = 500plf(10')(4)+750plf(20')(2) = 50,000#
Reduction = 750plf[8'(2)] = 12,000#
Ratio = 12,000/50,000 = 0.24 = 24% > 10%

Rehabilitation IS Required



Legend

- Existing shear wall from original construction (A 12'-0")
- Existing shear wall added in previous strengthening (A 12'-0")
- Demolished shear wall (C 6'-0") C = current project P = previous project
- New shear wall proposed as part of the current project (A 12'-0")

Figure 2: Shear Wall Removal and Proposed New Shear Walls

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Basis of Evaluation

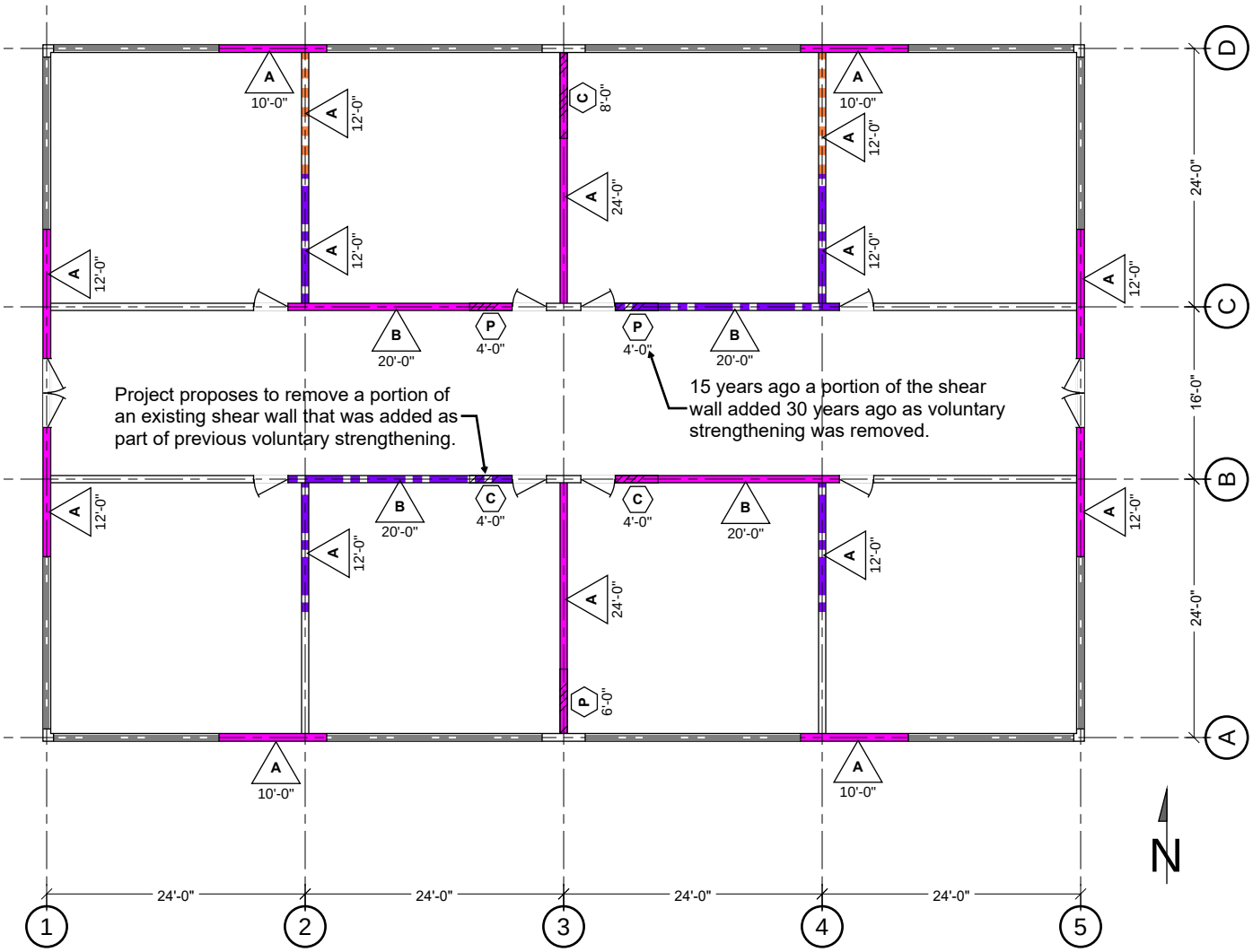
1) Original and all prior alteration projects were approved and certified by DSA.
2) Single story building with a flexible roof diaphragm. Seismic mass not changed.
3) All shear walls are shear-controlled.
4) Shear capacity of shear walls in pounds per linear foot (plf) is as follows:
   - Type A: 500 plf
   - Type B: 750 plf
5) Stiffness check not performed here.

Calculation

North-south direction:
Baseline = 500plf[12'(8)+24'(2)] = 72,000#
Reduction = 500plf(8'+6') = 7,000#
Ratio = 7,000/72,000 = 0.097 = 9.7% < 10%

East-west direction:
Baseline = 500plf(10')(4)+750plf(20')(4) = 80,000#
Reduction = 750plf[4'(4)] = 12,000#
Ratio = 12,000/80,000 = 0.15 = 15% > 10%

Rehabilitation IS Required



Legend

- Existing shear wall from original construction
- Existing shear wall added in previous strengthening
- Demolished shear wall
  C = current project
  P = previous project
- New shear wall proposed as part of the current project

Figure 3: Shear Wall Removal, Previous Strengthening and Proposed New Shear Walls

REHABILITATION REQUIRED BY SCOPE: 2019 CAC

Basis of Evaluation

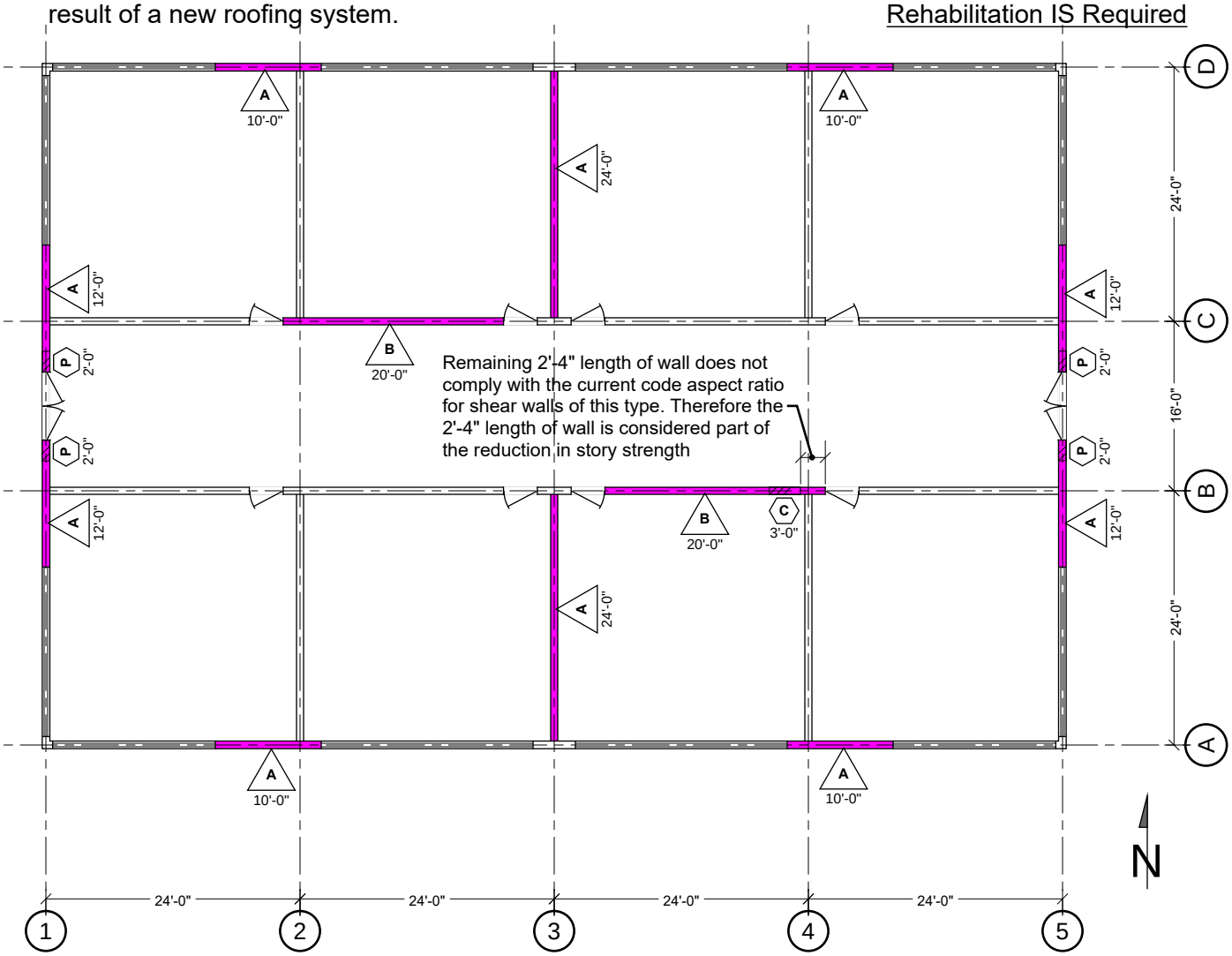
1) Original and all prior alteration projects were approved and certified by DSA.
2) Single story building with a flexible roof diaphragm.
3) All shear walls are shear-controlled.
4) Shear capacity of shear walls in pounds per linear foot (plf) is as follows:
   - Type A: 500 plf
   - Type B: 750 plf
5) Stiffness check not performed here.
6) Seismic mass increased by 3.8% as a result of a new roofing system.

Calculation

North-south direction:
Baseline = 500plf[12'(4)+24'(2)] = 48,000#
Reduction = 500plf[2'(4)] = 4,000#
Ratio = 4,000/48,000 = 0.083 = 8.3% < 10%
Σ Ratio = 3.8% + 8.3% = 12.1% > 10%

East-west direction:
Baseline = 500plf(10')(4)+750plf(20')(2) = 50,000#
Reduction = 750plf(3'+2.33') = 4,000#
Ratio = 4,000/50,000 = 0.08 = 8% < 10%
Σ Ratio = 3.8% + 8% = 11.8% > 10%

Rehabilitation IS Required



Legend

- Existing shear wall from original construction (A 12'-0")
- Existing shear wall added in previous strengthening (A 12'-0")
- Demolished shear wall (C 6'-0") C = current project P = previous project
- New shear wall proposed as part of the current project (A 12'-0")

Figure 4: Combined Effect