
CONCRETE MASONRY MULTI-LIFT GROUTING: 2022 CBC

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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 the requirements and procedures for reinforced hollow-unit concrete masonry grouting when the grout pour consists of more than one grout lift and the grout pour height exceeds 4'-0" for 8-inch nominal width units or 5'-4" for 10-inch or larger nominal width units.

SCOPE

This IR applies to reinforced hollow-unit concrete masonry construction having grout pours consisting of more than one grout lift and exceeding the pour height limits specified in the California Building Code (CBC) Section 2104A.1.3.5 and requiring DSA approval. This IR does not include requirements specific to multi-wythe masonry with pours requiring DSA approval.

BACKGROUND

The multi-lift grouting method as developed for use in reinforced hollow-unit concrete masonry wall construction is intended where openings, block pattern arrangements, reinforcing steel, or embedded structural steel elements do not prevent the free flow of grout or inhibit the use of mechanical vibration to properly consolidate, and reconsolidate, the grout in all cells or grout spaces. Masonry contractors often prefer multi-lift construction due to advantages in block placement efficiency, reduced reinforcing bar splices, scheduling and other factors. However, multi-lift construction presents additional challenges such as proper grout consolidation and blow-out prevention.

Though past CBC versions defined high-lift and low-lift grouting, neither the current CBC nor The Masonry Society (TMS) use these terms directly. The provisions herein are applicable to what historically was termed high-lift grouting and is now described as a method where one or more grout lifts occur within a grout pour, or multi-lift grouting. The multi-lift grouting method applies to grout pours using more than one lift, typically to exceed pour height limits of 4'-0" for 8-inch-wide nominal concrete masonry units and 5'-4" for 10-inch and wider concrete masonry units.

1. CONSTRUCTION DOCUMENTS

In addition to the material, test and inspection requirements of CBC Sections 2103A and 2105A, when proposing to use the multi-lift grouting method the following information shall be identified on the construction documents at the time of DSA approval. Alternatively, if this grouting method is proposed during construction, a construction change document (CCD) shall be submitted to and approved by DSA prior to proceeding with construction (refer to *IR A-6: Construction Change Document Submittal and Approval Process*).

1.1 Grout Mix Design Requirements

The grout shall be a coarse grout consisting of a high-slump, flowable mix (considering weather conditions) conforming to ASTM C476 and other requirements in TMS 602 Article 2.2 and 2.6B, with an approved admixture (used in strict accordance with the manufacturer's material installation instructions) per CBC Section 2104A.1.3.5 Item 3.b.

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1.1.1 Provide a submittal for each grout mix design, including admixtures, in accordance with TMS 602 Article 1.5 B.b and *IR 17-13: Batch Plant Inspection* Section 2. The grout mix design shall identify the admixture(s) and the required amounts and/or proportions used in the mix and, if applicable, the amounts to be added at the site by the masonry contractor. The Special Inspector (SI) shall document the addition of the admixture(s) to the grout mix that occurs at the site. Where manufacturer's material installation instructions require preconstruction testing, the results of such testing shall be included in the mix design report for review and approval prior to construction.

1.2 Reinforcement Placement Requirements

For 8-inch concrete masonry walls, all horizontal bars shall be placed in a single vertical plane in order to provide for continuous and unobstructed vertical cells as required by Section 1.3 below. Where two horizontal bars are specified at discrete locations, such as at chords or collectors, at least one bar shall align vertically with the bars below, and above where occurs.

1.3 Grout Space Requirements

All cells shall have clear "unobstructed" dimensions meeting the minimum clear grout space dimension requirements of TMS 402, Table 3.2.1 and TMS 602, Table 6, including footnote 3 of both tables. The minimum required grout space dimensions of cells, containing electrical conduits, horizontal reinforcement, or any other horizontal obstruction in the plane of the wall, shall be increased by the diameter or width of the obstruction.

1.4 Masonry Unit Type and Layup

Use of open-end concrete masonry units is preferred, wherever possible, and is required for masonry not laid in running bond. Use open-end bond beam units wherever possible to facilitate the horizontal flow of grout. Bond beam units are required at all horizontal bars to provide a minimum 3-inch-high by 3-inch-wide opening through all cross webs. This can be achieved through custom bond beam units, cutting webs of bond beam units, inverting the upper bond beam in two courses of bond beam units or other approved method.

1.5 Cleanouts

Cleanouts shall be specified in accordance with CBC Section 2104A.1.3.1.

2. WALL CONSTRUCTION

Where masonry construction uses the multi-lift grout method the construction shall be in conformance with CBC Section 2104A and the following additional provisions.

2.1 All masonry units, reinforcing steel and embedded items are to be secured and clean before grouting of the wall commences.

2.2 The maximum grout lift height in all circumstances is 4'-0" for 8-inch nominal concrete masonry and 5'-4" for 10-inch and larger nominal concrete masonry per CBC Section 2104A.1.3.6. Unless specifically approved otherwise, the maximum grout pour height will be 12'-8" for walls with a nominal thickness of less than 12 inches, and 16'-0" for walls with a 12-inch or larger nominal thickness.

2.3 Fill all head joints, bed joints, and full-height cross webs solidly with mortar and in accordance with the requirements of TMS 602 Article 3.3B as modified by CBC Section 2104A.1.3.2. At masonry not laid in running bond, arrange open-end concrete masonry units so that closed ends are not abutting, except at control joints. Consolidate mortar adequately by tooling to form a tight bond with the concrete masonry unit, and to enhance the water resistance of the assemblage. At the time of laying, masonry units shall be free of dust, dirt, and any other substance deleterious to mortar and grout bonding.

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2.4 The work shall be arranged so that once grouting of a section of wall is started, the grouting shall proceed in grout lifts without stopping until the full height of the prepared wall section is poured. See Section 3 below for additional requirements.

2.5 Remove mortar droppings from the foundation or bearing surface, cell walls and reinforcing steel. An acceptable method is to cover the exposed surface of the foundation with a thin layer of dry sand, and then dislodge any hardened mortar from the cell walls and reinforcement with a pole or rod. Remove the mortar debris and the sand cover prior to closing up of cleanouts and grouting.

2.6 Vertical grout barriers shall be placed between pour sections in locations approved by either the design professional in general responsible charge (DPGRC) or the structural engineer of record (SEoR), and by DSA. Control joints, shown on the construction documents, where grout is discontinuous across the joint, may act as a vertical grout barrier.

2.7 In the multi-lift grouting method, intermediate horizontal construction joints are not permitted. An alternate procedure may be used with the approval by either the DPGRC or SEoR, and by DSA.

2.8 Place the horizontal bars as the masonry unit placement (or laying) progresses. Both horizontal and vertical bars must be secured in accordance with CBC Section 2104A.1.3.3 Item 1, (e.g., by wire ties or spacing devices) near bar ends and at intervals to prevent movement beyond tolerances during grouting. Vertical bars may be dropped into position after completing laying of masonry units provided the bars are secured near the bottom of the wall, near bar ends, and at intervals not exceeding the movement limitations above.

3. GROUT PLACEMENT

3.1 Transport grout from the mixer to the point of deposit in the grout space, as rapidly as practical, by pumping in accordance with CBC 2104A.1.3.9 to permit continuous grout placement.

3.2 Grout placement means and methods shall be utilized which prevent segregation of the mix and minimize grout splatter on reinforcing steel and masonry unit surfaces not being encased in the grout lift. Depending on weather conditions and absorption rates of the masonry units, the grout lift heights and waiting periods between grout lifts may vary but shall not exceed limits specified herein.

3.3 Place the first grout lift to a uniform height within the pour section and mechanically vibrate thoroughly to fill all voids. Vibration shall follow closely behind grout placement and at the same pace as the grouting operation.

3.4 Because multi-lift grout has a high water/cement ratio, it is essential that the grout be reconsolidated after it has taken on a plastic consistency, but prior to taking an initial set. When the grout of the preceding grout lift is still of plastic consistency, pour the next grout lift. Consolidate the current grout lift and reconsolidate the preceding grout lift by vibrating each cell the full depth of the preceding grout lift. Alternatively, if the preceding grout lift was reconsolidated throughout its full height, pour the next grout lift and, while consolidating every cell the full height of the grout lift, vibrate alternate cells 12 to 18 inches into the preceding grout lift.

3.5 In order to allow proper reconsolidation, the waiting period between grout lifts shall be after initial water loss and settlement, but before loss of grout plasticity.

3.6 If, because of unavoidable job conditions, it is anticipated that the placement of the succeeding grout lift is going to be delayed beyond the period of workability of the preceding grout lift, reconsolidate each grout lift by reworking with the mechanical vibrator as soon as the grout has achieved its settlement shrinkage.

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3.7 The waiting, pouring and reconsolidation steps shall be repeated to the top of the pour. The top grout lift shall be reconsolidated after the required waiting period and then filled with grout to replace any voids left by settlement shrinkage.

3.8 To reduce the possibility of blow-outs, do not pour grout until the mortar has adequately cured. In mild weather, it is reasonable to assume sufficient mortar curing occurs after four hours, but longer curing periods may be required during cold weather. Grout the walls as soon as possible after mortar has cured to reduce shrinkage and cracking.

3.9 Provisions, such as dry packing, shall be made to provide solid bedding for nailers at the tops of walls. These provisions shall not be used as a substitute for proper and complete grout placement.

3.10 Immediately after the wall has been fully grouted, clean grout overspill or grout bleeds through the wall using methods that do not damage the masonry. Avoid undiluted cleaning products, acids, and excessive chemicals.

4. BLOW OUTS

If a blow-out occurs during or after grouting and the contractor immediately patches or shores the wall while the grout is still in a fluid state, the contractor shall reconsolidate the grout by mechanical vibration. If the grout achieves its initial set prior to this reconsolidation, the zone of damage shall be delineated for removal. The special inspector shall immediately report the extent of the blow-out damage to the project inspector, DPGRC, SEoR and DSA, and shall keep records of the blow-out damage and any repair procedures for review by the DSA field engineer.

5. EQUIPMENT BREAKDOWN OR EMERGENCY

If equipment breaks down, or any other unforeseen circumstance prevents the grouting operation from proceeding in accordance with these requirements, stop the grout pour until repairs can be made. If any grout does not receive consolidation, or reconsolidation, as required above, the areas in question shall be clearly delineated and reported to DSA. If "cold joints" or noncompliant construction joints result from an emergency interruption of the placing sequence, clearly delineate and report these areas. The DPGRC or SEoR shall either propose methods for repair, replacement, additional testing or propose acceptance of the delineated areas. The proposal shall be submitted to DSA for review and approval.

6. ALTERNATE GROUT PLACEMENT METHOD

With prior DSA approval, and prior to the start of masonry construction, a grout demonstration panel may be used to demonstrate equivalence to requirements in this IR and the CBC, where grouting procedures, admixtures, or grout space geometry do not conform to the code requirements. The acceptance of the alternate method is subject to the following requirements.

6.1 The DPGRC or SEoR shall submit forms *DSA 1-AMM: Request for Alternate Design, Materials & Methods for Construction* and *DSA 140: Application for Submittal of Post-Approval Document* (see *IR A-6: Construction Change Document Submittal and Approval Process*) to DSA for review and approval. The DSA 1-AMM shall include detailed documentation for the construction of the grout demonstration panel and shall define the required tests and inspections with corresponding acceptance criteria. Provisional approval of the DSA 1-AMM, thereby allowing construction of the grout demonstration panel, will be communicated by DSA to the design professional submitting the DSA 1-AMM. Final approval will be based on the results of the inspections and tests of the grout demonstration panel.

6.2 The project inspector and the special inspector shall document and be present during the construction of the demonstration panel.

6.3 The grout demonstration panel shall be a stand-alone panel.

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6.4 The demonstration panel shall be of adequate size to replicate the proposed alternate wall construction and construction methods. The wall shall be a minimum of 4'-0" long and no less than the maximum proposed grout pour height.

6.5 The demonstration panel shall be constructed in the same manner and constitute the same restrictions and materials as the proposed alternate wall. The most restrictive conditions (e.g., reinforcement congestion, construction access given other adjacent structural elements, etc.) are to be used to demonstrate compliance. If there are multiple conditions with substantially differing restrictions, a second demonstration panel may be required.

6.6 Tests and inspections shall be of a quantity and type to adequately demonstrate compliance with the CBC and this IR. At a minimum, two core samples and two viewing windows shall be provided for each panel.

6.6.1 The viewing windows shall be placed in lieu of the face shell and at locations aligning with the intersections of vertical and horizontal reinforcement. There shall be one viewing window on each side of the wall.

6.6.2 Cores samples shall be taken, inspected, and tested in accordance with CBC Section 2105A.4.

6.7 Results of the inspections and tests shall be submitted to the DPGRC, SEoR, Project Inspector, contractor, school district, and DSA. The SEoR shall notify DSA of acceptance or rejection of the grout demonstration panel results based on the provisionally approved and previously submitted acceptance criteria. DSA will document concurrence with or objection to the findings of the SEoR by completing the review of the submitted form DSA 1-AMM.

REFERENCES:

2022 California Code of Regulations (CCR) Title 24

Part 2: California Building Code (CBC) Sections 2104A.1.3.1 through 2104A.1.3.9, 2104A.1.3.11

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.

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GLOSSARY

Blow out

The condition where one or more face shells of masonry separate from the wall during grouting causing grout to flow outside of the intended placement cell.

Grout Lift

The incremental height of grout placed in one continuous operation and within a total grout pour.

Grout Pour

The total height of masonry to be grouted in one day prior to erection of additional masonry and composed of a one or more successively placed grout lifts.

Plastic consistency

The condition of masonry grout such that deformation will be sustained continuously in any direction without rupture.