# IR 21-2.13

## CONCRETE MASONRY HIGH LIFT GROUTING METHOD: 2013 CBC

| **Disciplines:** | Structural | **History:** | Revised 03-03-16 | Revised 05-16-13 | Revised 12-17-09 |
|---|---|---|---|---|---|
| | | | Revised 10-30-14 | Revised 03-10-11 | Issued 09-01-09 |

**Purpose:** The purpose of this Interpretation of Regulations (IR) is to provide the requirements and procedure for high lift reinforced hollow-unit concrete masonry grouting when the high lift method is specified on the Division of the State Architect (DSA) approved plans and specifications.

This IR is applicable to projects submitted to DSA for review under the 2013 CBC. For projects submitted under earlier editions of the CBC, see IR 21-2 or IR 21-2.10.

**1. DESCRIPTION:** The high lift grouting method as developed for use in reinforced hollow-unit concrete masonry is intended for use on wall construction where openings, block pattern arrangements, reinforcing steel, or embedded structural steel details 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.

**1.1 Procedure:** The high lift method requires that all masonry units, reinforcing steel and embedded items are in place before grouting of the wall commences. The work shall be so arranged that, once grouting of a section of wall is started, the grouting shall proceed in lifts without stopping, except as noted below, until the full height of the prepared section is poured. The waiting period between lifts shall be limited to the time required to obtain an initial consolidation of grout. This also allows for a reduction in hydrostatic pressure of the grout on the masonry unit and reduces the possibility of “blow-outs.”

**1.2 Grout:** The grout shall be a high-slump workable mix, preferably placed by pumping to permit continuous pouring. The grout shall be worked into all voids. Mechanical vibrators shall be used for consolidation and reconsolidation. Where job conditions preclude such use, other methods may be employed if approved in advance by DSA. Because of the high water/cement ratio used in this type of grout, it is essential that the grout be reconsolidated after it has taken on a plastic consistency, but prior to taking an initial set. The reconsolidation is intended to overcome settlement shrinkage, separation from the reinforcing steel, to promote bonding to the masonry unit shells, and to minimize voids due to water loss.

**1.3 Pour:** For the purpose of this IR, a “pour” is considered as the entire height of grout fill placed in one day and is composed of a number of successively placed grout lifts. A “lift” is the layer of grout placed in a single continuous operation.

The maximum height of a pour is limited by the practical considerations of segregation of grout due to the height of free fall, the effect of dry grout deposits left on block projections, congestion due to reinforcing steel and embedded items, and the ability to effectively reconsolidate the grout. Unless specifically approved otherwise, the maximum height of pour will be 12 feet for walls with a nominal thickness of less than 12 inches, and 16 feet for walls with a nominal thickness of 12 inches or more. For height of lifts see Section 4.10.1 of this IR.

**2. QUALITY OF MATERIALS:** All materials shall conform to CBC, Section 2103A, (2103*) with the following additional requirements:

**2.1 Aggregate:** Aggregates for grout shall conform to ASTM C404.

**2.2 Admixture:** The grout shall contain an admixture of the type that reduces early water loss to the masonry units and produces an expansive action in the plastic grout sufficient to offset initial shrinkage and promote bonding of the grout to all interior surfaces of the

masonry units. Admixtures shall meet the requirements of CBC Section 2103A.15, or 2114.3* and have an evaluation report meeting the requirements of IR A-5. The approval of the architect or structural engineer and DSA is required for the use of any admixture.

**3. MORTAR AND GROUT:**

**3.1 Mortar:** Mortar shall comply with the requirements of CBC, Section 2103A.9, or 2114.2.*

**3.1.1** The total mixing time shall be 3 to 5 minutes per ASTM C270 Section 7.3.

**3.1.2** When pre-blended mortar is specified, mixing shall conform to manufacturer's instructions.

**3.2 Grout:** The grout mix shall comply with the requirements of CBC, Section 2103A.13, or 2103.13* and ASTM C476. All cells shall be solidly filled with grout in reinforced hollow unit masonry per CBC Section 2104A5.1.2.1. Coarse grout is required per CBC Section 2103A.13.3.

Sufficient water may be added to make a workable mix that will flow into all voids of the masonry without separation or segregation. The slump of the grout shall be 8 to 11 inches per TMS 602-11, Article 2.6 B.2 and ASTM C476, Section 4.2.1.2.

Grout mixes shall contain an approved admixture conforming to the requirements of Section 2.2 above. Admixture shall be used in strict accordance with the manufacturer's instructions and appropriate listing from ICC-ES or other acceptable evaluation agency per IR A-5.

**3.3 Mixing of Grout:** The mixing of grout shall conform to the requirements of ASTM C476. The procedure used and timing for adding the admixture to the grout mix shall conform to admixture manufacturer's instructions.

**3.4 Tests:** Testing of mortar and grout shall conform to the requirements of CBC, Section 2105A.2.2.1.4 (2114.9.1*).

**4. CONSTRUCTION:** The construction of high lift concrete block masonry work shall conform to the requirements of CBC, Chapter 21A (21*), with the following additional requirements:

**4.1 Foundations:** The contact surface of all foundations and floors that are to receive masonry work shall be prepared in accordance with TMS 602-11 Section 3.2B before start of block placement. Protect the prepared surface during construction to assure a good bond between the grout fill and the concrete surface.

**4.2 Cleanouts:** Provide cleanout openings for all walls at the bottom of every cell for each pour in accordance with CBC Section 2104A.5.1.2.3 (2114.6*). However, if the course at the bottom of the pour is constructed entirely of inverted open-end bond beam units, cleanout openings need only be provided in the reinforced cells.

The openings shall be made prior to the laying of masonry units and be of sufficient size and location to allow thorough removal of mortar droppings and/or debris.

After the laying of masonry units is completed, the cells cleaned, the reinforcing steel positioned, and the inspection completed, close the cleanouts by inserting face shells of masonry units or covering the openings with forms. Face shell plugs shall be adequately braced to resist the hydrostatic pressure exerted by the grout.

**4.3 Reinforcement:** All reinforcing steel shall be accurately placed in accordance with the DSA-approved construction documents. For 8-inch block 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 4.9.2 of this IR. Both horizontal and vertical bars are

to be held in position by wire ties or spacing devices near bar ends and at intervals not exceeding 192 diameters of the reinforcement. Place the horizontal bars as the placement (or laying) of the masonry units progresses. Vertical bars may be dropped into position after the completion of the laying if the bars are held in place with positioning devices near the bottom of the wall and at intervals not exceeding 192 bar diameters.

**4.4** **Masonry Units:** Use of open-end concrete masonry units is preferred, wherever possible, and is required for stacked 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 three-inch high by three-inch wide vertical opening at all cross webs.

**4.5** **Laying:** Fill all head joints solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Fill all bed joints and full-height cross webs solidly with mortar. Take care in placing the mortar to minimize its dropping into the block cells. Arrange open-end concrete masonry units used in stacked bond so that closed ends are not abutting. 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 and dirt.

**4.6** **Wall Ties and Bracing:** When stacked bond is used, or when adequate cross webs between face shells are not provided, use ties of heavy gage wire embedded in the horizontal mortar joints across continuous vertical joints or between face shells to prevent “blow-outs” due to the hydrostatic pressure exerted by the grout in its fluid phase. External ties or braces may also be used for this purpose.

During construction, adequately brace ungrouted walls to resist wind and other forces.

**4.7** **Mortar Droppings and Overhangs:** Mortar shall not project into the grout space more than ¼ inch. 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 minimum one-inch-thick 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.

**4.8** **Construction Joints:** In the high lift grouting method, intermediate horizontal construction joints are not permitted. Grouting shall be completed in one continuous pour to the top of the wall in maximum four-foot layers or lifts in the same working day. Between grout pours, or where grouting has been stopped for more than an hour, grout shall be stopped 1 ½ inch below a mortar joint. Where a bond beams occur, the grout pour shall be stopped a minimum of ½ inch below the top of the masonry with a minimum grout cover above the horizontal rebar of 1 inch. An alternate procedure may be used with the approval of the architect or structural engineer and DSA.

The section of wall to be grouted in any one pour is limited to a length in which successive lifts can be placed within one hour of the preceding lifts. Vertical control barriers shall be placed between pour sections in locations approved by the architect or structural engineer and DSA.

**4.9** **Before Grouting:** Adequate preparations shall be made prior to start of grouting operations including but not limited to:

**4.9.1** All cleanout closures, reinforcing steel and embedded items shall be properly secured in place.

**4.9.2** All cells shall be clear and unobstructed. To be considered “unobstructed” all of the following requirements must be met (also see TMS 402-11, Table 1.20.1):

- For grout pours up to and including twelve feet in height the minimum grout space dimensions of all cells shall be three inches by three inches,
- For grout pours over twelve feet in height (only permitted for walls with a nominal thickness of twelve inches or more) the minimum grout space dimensions of all cells shall be three inches by four inches,
- The minimum grout space dimensions of cells containing horizontal reinforcing steel, electrical conduits or any other obstruction shall be increased by the diameter or width of the obstruction, and
- No cell shall contain vertical reinforcing steel exceeding six percent of the cell area.

**4.9.3** All equipment used for grouting shall be functional, appropriate and adequate for the intended task.

**4.9.4** An adequate number of vibrators (including at least one spare vibrator to be available if a vibrator breaks down or gets stuck in the wall cavity) shall be available. Vibrators shall be suitable for vibrating the masonry (e.g. small diameter, with a shaft long enough to penetrate into the previous lift as required).

**4.10 During Grouting:**

**4.10.1** Transport grout from the mixer to the point of deposit in the grout space as rapidly as practical by means and methods which will prevent segregation of the mix and minimize grout splatter on reinforcing steel and masonry unit surfaces not being encased in the grout pour. Depending on weather conditions and absorption rates of the masonry units, the lift heights and waiting periods may be varied. Individual lifts of grout shall be limited to five feet four inches (Section 3.5D in TMS 602-11) in height.

**4.10.2** Place the first lift of grout 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.

**4.10.3** When the grout is still plastic, pour the succeeding lift and vibrate alternate cells twelve to eighteen inches into the preceding lift to reconsolidate the preceding lift and close any plastic shrinkage cracks or separations from the cell walls.

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

**4.10.5** The waiting, pouring and reconsolidation steps shall be repeated to the top of the pour. The top lift shall be reconsolidated after the required waiting period to fill any space left by settlement shrinkage.

**4.10.6** To reduce the possibility of “blow-outs,” do not pour grout until the mortar has adequately cured. Grout the walls as soon as possible after mortar has cured to reduce shrinkage and cracking of the vertical joints.

**4.10.7** **Blow Outs:** If a “blow-out” occurs 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 tothis reconsolidation (see Section 4.11 of this IR) 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, architect, structural engineer, and DSA, and shall

keep records of the blow-out damage and any repair procedures for review by the DSA field engineer.

**4.10.8** Provisions, such as drypacking, shall be made to provide solid bedding for nailers at the tops of walls.

**4.11** **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, in a timely manner, the areas in question shall be clearly delineated and reported. If "cold joints" or noncompliant construction joints result from an emergency interruption of the placing sequence, clearly delineate and report these areas. The architect or engineer in general responsible charge of the project will 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.

**4.12** **Curing:** Attention shall be given to proper curing of the mortar and grout.

**4.13** **Cleaning Wall:** Immediately after the wall has been fully grouted, water pressurized through a jet nozzle shall be used to remove stains which have percolated through the blocks and joints. Water pressure shall be controlled to preclude damage to the wall.

## 5. INSPECTION AND CORE TESTS:

**5.1** **Inspection:** All masonry work is required to be continuously inspected during the laying of masonry, placing of reinforcing steel and grouting by an inspector specially approved for that purpose by DSA. A qualified individual acceptable to the testing laboratory shall make test samples and perform such field tests as are required.

The special masonry inspector shall check the materials, details of construction and construction procedure. The special inspector, who contracts individually and directly with the school board, shall furnish a verified report on Form DSA 292 certifying that of his or her own personal knowledge the work covered by the report has, in every material respect, been performed in compliance with the DSA-approved construction documents. The laboratory of record that employs a special inspector shall furnish a verified report on Form DSA 291 certifying these special inspections.

**5.2** **Core Tests:** Core samples of the completed masonry construction shall be taken in accordance with CBC, Section 2105A.5, (2114.9.3*). Cores shall be a minimum of 3 3/4 inches in diameter and shall be taken in a manner as to exclude masonry unit webs and reinforcing steel. All core samples shall be submitted to the testing laboratory for examination and testing.

A representative of the testing laboratory shall inspect the coring of the masonry walls and prepare a report of the coring operations. The report shall include the following:

- Number, location and condition of all cores cut on the project.
- Detailed description of the bond between the grout fill and the cell walls of the masonry unit.
- Any difficulties encountered in the coring operation which might impair the shear strength of the sample.
- Report results on form DSA 207.

# CONCRETE MASONRY HIGH LIFT GROUT METHOD: 2013 CBC

## REFERENCES:

2013 CBC, Section 2104A.5, 2114.6*

*Indicates alternative 2013 CBC sections that may be used by community colleges, per 2013 Title 24, Part 1, Section 1.9.2.2.

This Interpretation of Regulations (IR) is intended for use by the Division of the State Architect (DSA) staff, and as a resource for design professionals, to promote more uniform statewide criteria for plan review and construction inspection of projects within the jurisdiction of DSA which includes State of California public elementary and secondary schools (grades K-12 and 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 reviewed on a regular basis and is subject to revision at any time. Please check the DSA website for currently effective IRs. Only IRs listed in the document at http://www.dgs.ca.gov/dsa/Resources/IRManual.aspx at the time of plan submittal to DSA are considered applicable.