

708 STONE MASONRY**708.01 GENERAL**

(A) **DESCRIPTION.** This item consists of stone masonry structures, stone masonry facing, and the stone masonry portions of structures, constructed in conformity with the lines, grades and dimensions shown in the contract documents. This item also includes, where applicable, furnishing and installing structure identification emblems.

(B) **DEFINITIONS.**

Bed – The top or bottom surface of a stone when in final position.

Depth – The dimension of the stone at right angles to the face of the masonry, measured from the pitch line (not including any rock face projection).

Rise (of a stone) – The dimension of a stone measured normal to the bed pitch line.

Rise (of a course) – The distance between the top bed of a course and the top of the next higher course.

Length – The dimension of a stone measured along the bed pitch line (including any rock face projection).

Face – The exposed surface of a stone.

708.02 MATERIALS

All stone shall be durable, sound, of uniform quality and texture, and shall be free from seams and defects which would impair its strength, durability or appearance.

Steel – [815.01\(A\) or \(B\)](#)

Galvanizing – [811.07](#)

Caulking compound – [807.02\(B\)](#)

PCC mortar mix – [806.05\(B\)](#)

708.03 WORKING DRAWINGS AND SUPPLY

(A) **Working Drawings.** The Contractor shall prepare and submit to the Chief Engineer, in accordance with [105.02](#), working drawings of all Class A (dimensioned) masonry; showing the individual stones in position, their face dimensions, designating marks, and such other detail drawings as are necessary to properly cut and set the work. The drawing shall show all anchors, cramps and dowels.

(B) **Supply.** The Contractor shall submit to the Chief Engineer for approval the names of the quarry or quarries from which the stone is to be obtained, together with evidence that sufficient stone to complete the work is obtainable from the quarry, and that adequate manpower and equipment are available to produce and complete the required amount of stone work within the contract time for completion of the project.

708.04 SAMPLES AND SAMPLE WALL

- (A) **Stone Samples.** Before proceeding with the work, the Contractor shall submit for approval by the Chief Engineer the name of the quarry and 2 samples of each kind of stone proposed for use in the work; one sample shall show the lightest color and the other shall show the darkest color of each kind of stone to be furnished. All stone in the work shall be within the color range defined by the approved samples and of the same type of stone. The samples shall have a face size of at least 6 by 6 inches.
- (B) **Sample Wall.** The Contractor will be required to construct a sample wall of the designated class or classes of stone masonry, laid up in mortar and pointed, for approval of the Chief Engineer. Each sample shall show examples of the specified stone finishes, quality of the workmanship in dressing the stone and placing them, and pointing of the beds and joints, and shall be sufficient area to illustrate the distribution of both the coloring and the stone size. The sample wall shall contain at least one edge dressed to show a representative corner. The top shall be dressed to show how the stone will abut the coping. Upon approval of such a sample by the Chief Engineer, it shall become the standard for that class or classes of stone masonry in the entire work. In general, the size of stone masonry sample wall shall not be less than 12 feet long and 6 feet high. However, for copings or other special types or shapes of dimensioned masonry, a short section showing examples of the proposed types of finish may suffice.
- (C) **Payment.** At the option of the Contractor, this wall may be constructed in place as part of the stone masonry called for in the contract documents and if approved, the sample wall shall become part of the completed work and will be paid for as specified herein for the designated class or classes of stone masonry.

708.05 CLASSES OF STONE MASONRY

The class of masonry used in each part of the work shall be that shown in the contract documents. Masonry shall be classified as follows:

Class A – Dimensioned ashlar stone masonry composed of stones each of which has two or more fixed dimensions shown on the plans. It is intended for use particularly in arch rings, quoins, pilasters, copings, facing for concrete, parapets, etc.

Class B – Ashlar stone masonry composed of stones shaped, dressed, and set in accordance with certain specified requirements given in the section which set forth the variations allowed in shaping, dressing, setting and coursing the work. It is intended for use in walls, veneer facing, parapets, etc.

Class C – Ashlar stone masonry same as for Class B stone masonry, but less exacting in the variations allowed in shaping, dressing, setting and coursing the work.

Class D – Rubble stone masonry composed of roughly dressed stones set in broken courses. It is intended for use in minor culverts and other similar structures.

708.06 SIZE OF STONE

- (A) **Stone Sizes.** Stones, not dimensioned on the plans, shall be furnished in the sizes and face areas necessary to produce the general characteristics and appearance as indicated for the

class of masonry specified. In general, stone sizes shall conform to the following limitations:

- (1) Rise of any stone – 4 inch minimum unless otherwise shown on the plans.
 - (2) Depth of any stone – 6 inch minimum, except as shown on the plans for stone veneer.
 - (3) Length of any stone – 1-1/2 times its rise, minimum; 5 times its rise, maximum; 3 times its rise, average.
- (B) **Closure Stones.** Stone sizes shall not include closure stones. A minimum number of closures, not exceeding 5 percent of the exposed surface, may be used only when absolutely necessary. Closures shall be rectangular with their longest face laid horizontal.

708.07 FINISH FOR EXPOSED FACES

The kind of finish for the exposed faces of the masonry shall be as specified in the contract documents. Face stones shall be pitched to line along all beds and joints, with no depressions below the pitch line. Each stone shall be out of wind, i.e. the four corners are in the same plane. No drill or quarry marks shall show on the face of any stone. The specified finish shall be in accordance with the following definitions:

- (A) Eight cut. Fine hammered. Interrupted parallel markings not over 3/32 inch apart. A corrugated finish. Smoother near arris lines and on small surfaces.
- (B) Six cut. Medium hammered. Interrupted parallel markings not over 1/8 inch apart. A corrugated finish. Smoother near arris lines and on small surfaces.
- (C) Four cut. Coarse hammered. Interrupted parallel markings not over 7/32 inch apart. A corrugated finish. Smoother near arris lines and on small surfaces.
- (D) Sawn. Fairly plane surface. Varying texture ranging from close approximation to sand rubbed to scorings 3/32 inch in depth. When so specified, scorings shall be vertical or horizontal as produced by gang saws. All exposed surfaces thoroughly sand blasted to remove rust stains and iron particles.
- (E) Sawn and Sanded. Fairly smooth surface. Exposed surfaces cut with a wire saw and abrasive and further treated by sand blasting with new silica sand to blend saw marks into uniform texture.
- (F) Seam Face. The surface shall present a smooth appearance, be free from tool marks, with no depressions below the pitch line and no projected plane exceeding 3/4 inch beyond the pitch line.
- (G) Rock Face. The face shall be an irregular, convex with no concave surfaces below the pitch line, and with projections beyond the pitch line, when measured in inches, not exceeding the figure preceding the symbol as used on the plans e.g., “1-1/2 inch Rock Face” means projections beyond the pitch line not exceeding 1-1/2 inches. Where a variable “rock face” is specified, stones of the same height of projection shall be well distributed.

708.08 DRESSING STONE

- (A) **GENERAL.** Stones shall be dressed to remove any thin or weak portions. Face stones shall be dressed to provide bed and joint lines with a maximum variation from true pitch lines as follows:

Class A (Dimensioned) masonry	True
Class B masonry	1/4"
Class C masonry	3/4"
Class D masonry	1-1/2"

All joints shall be vertical, except that splayed joints not greater than 45 degrees will be permitted in Class C and D masonry, with maximum of 10 percent of joints splayed in Class C. Beds shall be horizontal except under copings on a gradient.

Face stone adjoining the edges of exposed concrete work shall be accurately dressed along the edge paralleling the concrete work, allowing sufficient space for pointing.

- (B) **BED SURFACE.** Bed surfaces of face stone shall be normal to the face of the stones for about 50 mm and from this point they may depart from a normal plane not to exceed 25 mm in 300 mm for Class A (dimensioned masonry) and 50 mm in 300 mm for all other classes of masonry.

The corners at the meeting of the bed and joint lines shall not be rounded in excess of the following radii:

Class A (dimensioned) masonry	None
Class B masonry	None
Class C masonry	1"
Class D masonry	1-1/2"

- (C) **JOINT SURFACES (except ring stones).** For all classes of masonry, the joint surface of face stones shall be normal to the face of the stones for about 2 inches, and from this point they may depart from a normal plane not to exceed 2 inches in 12 inches.

- (D) **RING STONE JOINT SURFACES.** Ring stone joint surfaces shall be radial and at right angles to the front face of the stones. They shall be dressed for a distance of at least 3 inches from the front face and the soffits, from which points they may depart from a plane normal to the face not to exceed 3/4 inch in 12 inches. The back surface in contact with the concrete of the arch barrel shall be parallel to the front face and shall be dressed for a distance of 4 inches from the intrados. The top shall be cut of 4 inches from the intrados. The top shall be dressed for a distance of at least 3 inches from the front.

708.09 ANCHORS

- (A) **GENERAL.** The Contractor shall furnish and set all anchors, cramps, dovetail slots, dowels, bolts and any other work to the concrete backing. All anchors, cramps,

dowels, bolts, etc. shall be galvanized steel. Any bending shall be done before galvanizing.

- (B) FOR CLASS A MASONRY.** Anchors shall be of 3/8 inch by 1-1/2 inch material and shall extend at least 9 inches into the concrete backing, except where limited by the thickness of the backing, with ends extending not less than 1-1/2 inches vertically into the stone and into the concrete. Cramps for tying stones together shall be of 3/8 inch by 1-1/2 inch material, turned down at least 1-1/2 inches at each end, and shall span at least 12 inches on the flat. In general, 2 anchors shall be used for each stone 1 meter or over in length, and 1 anchor for each smaller stone. Corner stones shall have 1 anchor and shall be cramped to adjoining stones. Special cramps, anchors and/or dowels shall be provided for cap stones, coping stones and other special stones. Each arch ring stone shall be tied to the concrete backing with side anchors, the type and location of which shall be shown in the contract documents.

Holes for anchors, cramps, bolts or dowels shall be at least 150 mm from any face of the stone, except that for stones less than 12 inches in depth, the holes shall be placed at the center of the depth.

Where necessary, stones shall be grooved for cramps and anchors so as to allow at least 1/8 inch for mortar between the cramps or anchors and the adjoining stone.

(C) FOR CLASS B, C AND D MASONRY

(1) MASONRY CONSTRUCTED BEFORE PLACING CONCRETE BACKING.

Anchors shall be of not less than 8 gage by 1-inch material embedded in the bed joints, spaced 2 feet on centers both horizontally and vertically and shall extend at least 9 inches into the concrete backing and to within 75 mm of the face of the stone. Each end of the anchors shall be of such approved shape and design as to mechanically engage the stone and the concrete backing. The anchor and the methods of anchorage shall be approved by the Chief Engineer before any stone is erected.

(2) MASONRY CONSTRUCTED AFTER PLACING CONCRETE BACKING.

Anchors shall be of not less than 8 gage by 1-inch material, embedded in the bed joints and engaging 24 gage dovetail anchor slots in the previously placed concrete. Anchor spacing shall be 2 feet on center, both vertically and horizontally. The end of each anchor embedded in the masonry joint shall be of such approved shape in design as to mechanically engage the stone and shall extend to within 3 inches of the face of the stone. The dovetail anchor slots shall have a temporary filling of felt or other material to prevent the slots from being filled with concrete as the concrete is placed.

During the setting of the stone, the temporary filling shall be removed from the anchor slots and the voids in the anchor slots between the anchors shall be filled with setting mortar. No voids in any part of the wall will be permitted.

708.10 CONSTRUCTION REQUIREMENTS

- (A) WEATHER LIMITATIONS.** Stone masonry shall not be placed when the temperature of the air or the stone is below 40°F except by written permission from the Chief

Engineer, and then only by the use of such methods as he may prescribe for preparing the materials and protecting the work after it has been laid. Such permission and the use of the methods prescribed shall not, however, release the Contractor from his obligation to build a satisfactory structure. All work damaged by cold weather shall be removed and replaced.

In hot or dry weather the masonry shall be satisfactorily protected from the sun, and shall be kept wet for a period of at least 3 days after completion.

- (B) LAYING STONE.** All masonry shall be constructed by experienced workmen. Face stones shall be set so as to produce the effect indicated herein for the class of masonry specified and to correspond with the sample wall section approved by the Chief Engineer.
- (1) **Beds and Joints.** Beds and joints for Class A masonry shall average 3/8 inch, plus or minus 1/8 inch. For Class B Masonry, the nominal size of beds and joints shall be 3/4 inch; for Class C masonry 3/4 to 1 inch; for Class D masonry 1 inch to 1-1/2 inches. All joints shall be vertical and shall not extend in an unbroken line through more than 2 stones, except that splayed joints not greater than 45 degrees will be permitted in Class C and D masonry, with maximum of 10 percent of joints splayed in Class C. Beds shall be horizontal except under copings on a gradient, and shall not extend in an unbroken line through more than 4 stones, unless otherwise shown in the contract documents. In no case shall the 4 corners of adjacent stones be contiguous.
 - (2) **Bunching.** Care shall be taken to prevent the bunching of small stones or stones of the same size. When weathered or colored stones, or stones of varying texture, are being used, care shall be exercised to distribute the various kinds of stones uniformly throughout the exposed faces of the work. Large stones shall be used for the bottom courses. In general, the stones shall decrease in size from the bottom to the top of the work.
 - (3) **Arch Ring Stone.** Arch ring stone shall be carefully thoroughly and wetted immediately before being set, and the bed which is to receive them shall be cleaned and moistened before the mortar is spread.
 - (4) **Bedding.** The stone shall be kept free from dirt, oil or any other injurious material which may prevent the proper adhesion of the mortar or detract from the appearance of the exposed surface. Stones shall be laid on their natural beds in full beds of mortar, and the other joints shall be flushed with mortar. The Chief Engineer may direct the lifting and resetting of stones to assure proper bedding.
 - (5) **Placement.** The exposed faces of individual stones shall be parallel to the faces of the walls in which the stones are set. The stones shall be so handled as not to jar or displace the stones already set. Suitable equipment shall be provided for setting stones larger than those that can be handled by two men. The rolling or turning of stones on the walls will not be permitted. If a stone is loosened after the mortar has taken initial set, it shall be removed, the mortar cleaned off, and the stone relaid with fresh mortar. All voids between back of stone veneer facing and face of concrete wall, including the voids of anchor slots after removal of the filler material, shall be filled solid with setting mortar. All shaping and dressing of stone shall be done

before the stone is placed, and no dressing or heavy hammering will be permitted after it is placed.

- (6) Spalls. No spalls shall be used in the face of the wall.
 - (7) Cleaning. Immediately after being laid, and while mortar is fresh, all face stone shall be thoroughly cleaned of mortar stains and shall be kept clean until the work is completed. Before final acceptance, if ordered by the Chief Engineer, the surfaces of the masonry shall be cleaned using wire brushes and, if necessary, muriatic acid.
- (C) **MIXING MORTAR.** Before adding water, materials, as described in [806.05\(B\)](#) shall be mixed, either in a tight box or in an approved mortar mixing machine, until the dry mixture assumes a uniform color. Then the water shall be added as mixing continues. Sufficient water shall be added to produce a mortar of such consistency that it can be handled easily and spread with a trowel. Mortar that is not used within one hour after water has been added shall be discarded. Re-tempering of mortar will not be permitted.
- (D) **POINTING AND FINISHING.**
- (1) Pointing. All beds and joints shall be raked out, before mortar is set, to a depth of not less than 3/4 inch deeper than the surface of the finished joint, then cleaned and pointed with pointing mortar as and when directed by the Chief Engineer. The pointing mortar shall be well driven into the joints with hardwood ramming wedges or other approved method and finished with an approved pointing tool. The stone masonry shall be kept wet while pointing is being done, and in hot or dry weather, the pointed masonry shall be protected from the sun, and kept wet for 24 hours.
 - (2) Finishing. The finishing of all points, beds and joints shall be as shown in the contract documents. For Class B masonry finished beds and joints shall be raked back 3/8 inch from pitch line. When raked beds and joints specified, the mortar shall be raked out squarely to the depth specified. Stone faces in the joint shall be cleaned free of mortar. When weather joints are called for, they shall be weather-struck.
- (E) **BONDING.** Bonding for Class A (dimensioned) masonry shall be as shown on the plans.
- (1) Breaks. All stone, except as shown on the plans, shall be so placed as to break joints at least 4 inches and beds at least 3 inches in order to secure firm bond.
 - (2) Bond with Concrete Surface. Stone surface against which concrete is to be placed shall be thoroughly cleaned to remove all loose materials. Immediately before placing concrete against the masonry, the stone surfaces shall be blown free of dust by compressed air and then thoroughly wetted. The stone surface shall be kept wet at all times at points of spading concrete against them. Spading and vibrating the concrete along the stone surface shall be such as to flush the stone surface with mortar and to completely fill all interstices, securing a firm bond with the stone.
- (F) **BRACING.** When in the opinion of the Chief Engineer the placing of concrete against stone masonry might create pressure sufficient to cause deflection or displacement, the Contractor shall brace the stone masonry in a manner satisfactory to the Chief Engineer.
- (G) **FALSEWORK.** Arch centering shall be designed, submitted for approval and constructed in accordance with [703.16](#), or as outlined in the contract documents.

- (H) **HEADERS.** When headers are required, they shall be distributed uniformly throughout the wall of structures so as to form at least 1/5 of the faces. Headers shall extend not less than 12 inches into the core or backing, unless otherwise indicated. Headers in walls 2 feet or less in thickness shall extend entirely through the walls.
- (I) **BACKING.** The backing for gravity type walls shall be built primarily with large stones. The individual stones composing the backing and hearting shall be well bonded with the stones in the face wall and with each other. All openings and interstices in the backing shall be completely filled with mortar or with spalls completely surrounded by mortar.
- (J) **PARAPETS.** Selected stone, squared and pitched to line and with heads dressed, shall be used in ends of walls and in all exposed angles and corners. Headers shall be well interlocked and as many as possible shall extend entirely through the wall. Both the headers and stretchers in the two faces of the wall shall be well interlocked in the heart and shall comprise practically the whole volume of the wall. All interstices in the wall shall be completely filled with mortar or spalls completely surrounded with mortar.
- (K) **WEEP HOLES.** All stone walls and abutments shall be provided with weep holes, unless otherwise shown or directed by the Chief Engineer. The weep holes shall be placed at the lowest points where free outlets can be obtained and shall be spaced not more than 10 feet apart. The inlet end of weep holes shall be protected by placing a wire basket 1 foot by 1 foot by 1 foot, filled with coarse aggregate, size 7, 8, 57 or 68 immediately over or behind the holes as directed.
- (L) **EXPANSION OR CONTRACTION JOINTS.** Expansion or contraction joints shall be placed as shown in the contract documents. When caulking is required it shall be applied in accordance with the manufacturer's specifications. The color shall be approved by the Chief Engineer.
- Stone surfaces in contact with expansion or contractions joints shall be neatly squared back from the face of the wall for the full depth of the joints. Preformed joint material shall be anchored to joints by concrete nails at approximately 2 foot intervals.
- (M) **COPINGS, TOP WALLS, BRIDGE SEATS, BACK WALLS, Etc.** Copings, top walls, bridge seats, back walls, etc. shall be constructed to the lines, grades, and cross sections, and of the material, indicated on the contract drawings or as directed by the Chief Engineer.
- (1) **Concrete Copings.** Concrete copings shall be constructed in sections from 5 to 10 feet long and shall be of such width and thickness as indicated on the contract drawings.
 - (2) **Stone Copings.** Stone copings shall consist of carefully selected stones of the length, width, and thickness indicated on the contract drawings. They shall have a uniform surface and pitched to line along the top and bottom edge.
- (N) **FOUNDATION PREPARATION.** Structure excavation, foundation preparation, and backfill shall be performed and paid for in accordance with the provisions set out in [Division 200](#). The foundation for this type of construction shall present a uniform bearing surface, and if a reinforced foundation is necessary, it shall be constructed and paid for in accordance with the contract drawings or as directed by the Chief Engineer.

708.11 REJECTION OF STONE

Any stone not conforming to the approved sample or not in accordance with the contract documents shall be rejected and removed from the site.

708.12 MEASURE AND PAYMENT

The unit of measure for the various classes of Stone Masonry will be the cubic foot. The number of cubic feet of Class A (dimensioned) masonry will be the actual volume of the individual stones determined from the dimensions shown on the approved working drawings. No measurement will be made of mortar backings or mortar joints between the Class A masonry. The number of cubic feet of Class B, C or D stone masonry will be determined from the actual measured length and height of the stone structure and the average depth as indicated in the contract documents.

The volume of joints and beds between Class B, C or D stone masonry and either Class A stone masonry or PCC structures shall be included in the measurement for Classes B, C or D stone masonry. No deductions will be made for openings of less than 2 square feet in area.

The number of cubic feet of Stone Masonry measured will be paid for at the contract unit price per cubic foot for the various classes of Stone Masonry listed in the Schedule of Prices, which payment will include furnishing, cutting and setting of stone, mortar, anchoring devices, furnishing and setting of structure identification emblems, cleaning and pointing, and all labor, materials, tools, equipment and incidentals necessary to complete the work as specified herein.