

CHAPTER NO. 12.

STONE MASONRY

SPECIFICATION NO. 12-1—Stone Masonry—General

1. All stones to be used shall usually comply in all respects with specification no. 3.32 for building stone. The contractor shall be responsible for the quarrying and supplying of stone. Various sizes of stones shall be stacked separately at the site of work. Stone.
2. Through and bond stone shall broadly be stacked separately from ordinary building stones and the stack shall be marked to distinguish it from the rest. Marks must be made on each bond. Bond Stones.
3. All stones for masonry in cement or lime mortar must be thoroughly wetted before being laid and the masonry work must be kept wet while in progress, care being taken to avoid washing mortar out of the joints. Wetting of stones.
4. Stones shall be laid on their natural quarry beds so that the pressure borne by them is normal to the beds. The courses shall be perpendicular to the pressure to be borne and in case of batter walls, beds of stones and the plane of courses should be at right angles to the batter. Laying stones.
5. Wherever practicable, the whole masonry in any structure must be carried up at a uniform level throughout. Where breaks are unavoidable, the joints shall be made in gradual steps. Cross walls must be carefully bonded into main wall and all junctions of walls to be formed at the time the walls are being built. Work to proceed uniformly.
6. Joints parallel to the external pressure must be staggered and should not be continuous. In other words, the stone in any course should overlap the joint in the course below. In order to obtain sufficient transverse bond, the prescribed number of headers must extend through the entire thickness of these walls or from outside face to a prescribed depth within thick walls. Such headers are termed as through or bond stones. The practice of building two thin faces of stone masonry tied with occasional through stones and filling up the space between the masonry faces with fine, small or dry stone backing shall not be permitted. To obtain proper bond at angle junction of walls, the stone at each alternate shall be carried into each of the respective walls. Bond.
7. Quoins shall be laid as header and stretcher in alternate courses. Quoins and jambs shall be dressed at a right angle the bed, to the corners being straight and vertical. In the case of masonry with hammer dressed stones, a chisel draft 1 inch wide shall be given on each external face to allow of accurate plumbing. If for architectural reasons, chisel draft is not to be allowed, the corner shall be dressed to a vertical line as best as Quoins and corners.

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possible. The cost of quoins and jambs is included in the rate for masonry.

Plumb bob and straight edges.

8. In case of vertical walls, all masonry shall be taken up truly plumb and each set of four masons shall be provided with a plumb bob and straight edges. In case of default the Sub-Divisional Officer will supply these, deducting the cost from the contractor.

Lintels and in side stones.

9. All lintels and inside stones not to be plastered over shall be of the full thickness of the wall in which they are laid, including the thickness of the plastered face or faces with a grooved joint at the junction of the plaster and stone.

Rounded corners.

10. Interior and exterior corners of walls and projecting angle shall be rounded if specified. The drawings shall also indicate the shapes and radius of rounded corners. Rounding of corners is payable separately in case of exposed masonry, but not in case of masonry to be plastered.

Cleaning work and striking joints

11. Mortar shall be confined to the joints and none should be smeared over faces of stones that are not to be plastered. If some mortar does fall on the stones during construction, it should be removed immediately and not allowed to set. Where pointing is not provided to be carried out afterwards, the joints in each days' work shall be struck by a separate mason following up the masonry work. This shall be paid for separately by superficial measurements as striking joints.

Fixtures.

12. All iron, stone, concrete or other fixtures, returns, buttresses etc. shall be built and bonded into the masonry in the correct position as work proceeds and not inserted or joggled on afterwards. Fixtures shall be built into the masonry in 1:3 cement sand mortar. The work of building these fixtures in the masonry is included in the rate of masonry irrespective of the sources of supply of these fixtures.

Bed Plates

13. Bed plates shall be provided under the end of beams, girders, roof trusses etc. Bed plates shall be either chisel dressed on top and bed, or of cement concrete, if so specified, and shall conform to the dimensions given in the drawings. Bed plates shall be carefully laid with fine joints with the necessary packing to give the correct level.

Dowels and cramps.

14. Dowels, cramps and joggles shall be supplied and used wherever specified or ordered by the Executive Engineer. Cramps may be of copper or lead and shall be in length from 6 to 12 inches (15 to 30 cms.), in thickness half to one inch (one to 3 centimetres), and one to two inches (2 to 5 cms.) in width as specified and having each end turned at right angle.

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Iron cramps shall not be used. Copper cramps shall be forged and set with neat cement; lead cramps to be formed by running molten lead into the dovetail channels in the stones. Dowels and joggles shall be of double wedged form made from copper or from slate or similar stone, and set in neat cement. Iron dowels or joggles whether galvanised or otherwise shall not be used.

15. Proper scaffolding with tightly fastened joints having two sets of vertical supports (of which they may be one) shall be provided. The scaffolding should be strong enough to bear construction loads, and if the engineer-in-charge does not consider it strong enough, he can call upon the contractor to strengthen it, but nothing in this clause shall be deemed to mean that he is responsible for the safety of either the work and scaffolding or of the workmen using the scaffolding. This responsibility shall entirely be that of the contractor. Where stone wall has to remain exposed on both faces, double scaffolding shall be provided.

Scaffolding.

16. Stone masonry laid in cement or lime mortar shall be protected during construction from the effects of rain and frost by suitable cover, if necessary. It shall be kept moist for a period of ten days. The work shall be left flooded at the end of each day with one inch (25 mm) of water. Stone masonry laid in mud mortar shall not be watered but shall be protected during construction from rain or from uneven drying.

Weather protection and watering.

17. Rate for stone masonry in the foundations and plinth includes, in the case of buildings, all work up to ground floor level and in case of other works, such work as can be done without scaffolding, i.e. up to 4½ feet (1.5 metres) from ground level. The rate for stone masonry in superstructure includes all work from the level specified above to a height of 20 feet (6 metres) in case of ashlar work and 13 ft. (4 metres) in case of other masonry, and includes the cost of scaffolding. Beyond this height an increased rate shall be paid to compensate for extra height of scaffolding and for higher lift of material, such increase being for units of 13 ft (4 metres) height. The through rate include the cost of stone, mortar, labour for dressing the stone (except where undressed stones are to be used), water arrangements, labour for laying, all tools and plant, and scaffolding. The labour rate includes the cost of tools and plant. Scaffolding, water arrangements, labour for laying and labour for dressing of stones (except where undressed stones are to be used).

Rates.

18. Stone masonry can be broadly divided into the following classes according to amount of labour spent in dressing of stones and thickness of joints :—

Classification of stone masonry.

(f) Ashlar.—It consists of work built of blocks of carefully dressed stones with narrow joints. As the cost of dressing in this

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type of work is considerable, comparatively bigger stones are used in this type of work.

(ii) **Block in Course.**—In this type also blocks of stones are used but they are not very finely dressed and thickness of joints is more than in case of ashlar, Sizes of stone is also smaller than in ashlar.

(iii) **Rubble Work.**—This consists of stones which are either irregular and undressed or very roundly dressed with hammers and laid with wide joints.

SPECIFICATION NO. 12-2—Dressing and Cutting Stones

1. Stone shall be cut and dressed as soon after quarrying as possible. Stone required for masonry shall be dressed as specified or shown on the drawings. Main types of dressing are prescribed in the following paragraphs. Stones shall be dressed accurately to the exact size shown in the drawings or according to specifications of the masonry work. All visible edges shall be free from chippings.

General.

TOOL FOR STONE MASONRY

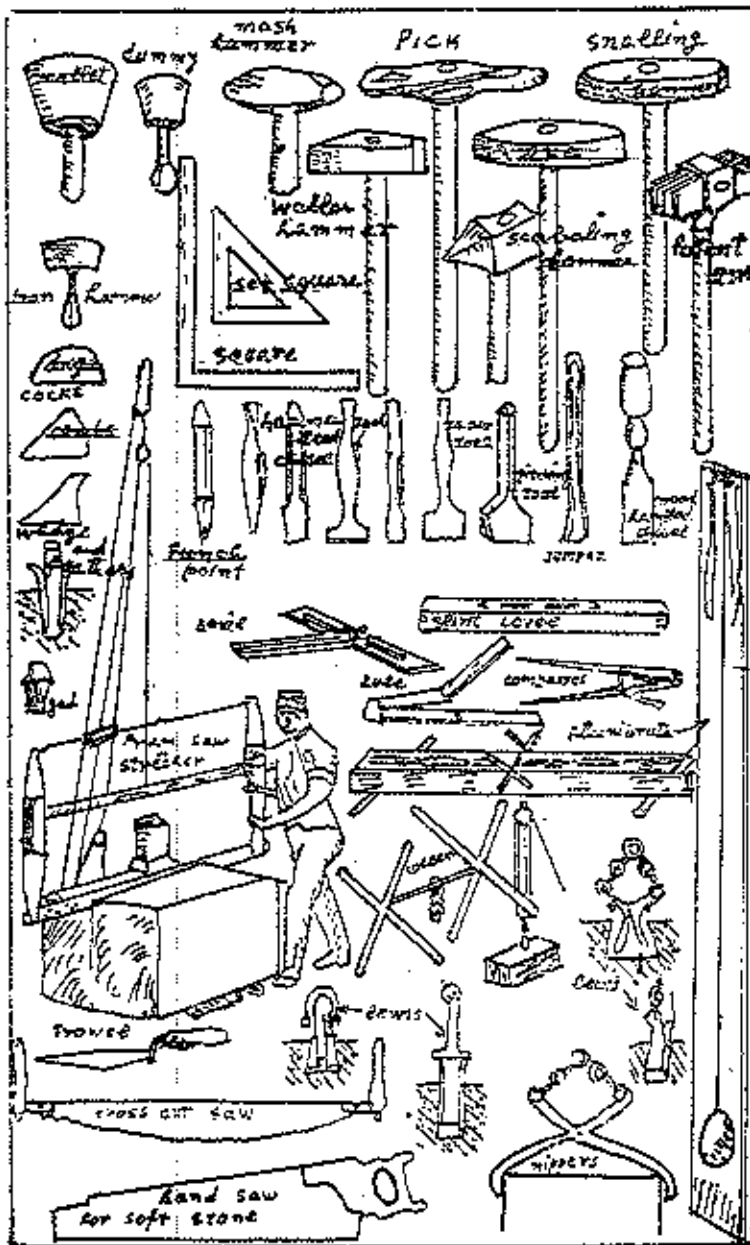


FIG. 12-2 (a)

SPECIFICATION NO. 12.2—Dressing and Cutting Stones

Scabbled stones.

2. Scabbled stone means quarried stone in which irregular angles have been taken off with the scabbling hammer, usually done at quarry. Scabbling hammer weights about 15 lbs. (6.8 kg.) and is shown in Fig. 12.2 (a).

Hammer dressed stone.

3. When the scabbled stone is dressed with mason's hammer or waller's hammer to make the faces square and to remove unnecessary bushing, it is called hammer dressed stones. No picking or chiseling is used in this type of dressing.

Rough tooled stone.

4. The rough tooled stone is also called one line dressed stone. It is dressed with a chisel, or sparrow picked until no portion of the dressed surface is more than $\frac{1}{4}$ inch (6 mm.) from a straight edge placed on it.

Chisel dressed stone.

5. Chisel dressed stone is also called "two-line dressed" stone. It is dressed with chisel or sparrow picked until no portion of the surface dressed is more than $\frac{1}{8}$ inch (3 mm.) from straight edge placed on it.

Fine dressed stone.

6. This is also called "three-line dressed" stone. By fine dressing or three line dressing is meant, the best surface which can be given to a stone with chisel, and without rubbing. The straight edge laid along the face of the stone so dressed must be in contact with the stone at every point.

Finely punched stone.

7. This type of stone means stone having face work to an approximately true surface by means of pointed tools or punch giving a dotted appearance usually specified to give architectural effect.

Cut stone work.

8. Every stone for cut stone work shall be fine-tooled on all faces to exact shape specified in design. Templates made of zinc sheets shall be used to dress to correct shapes.

Sawing and polishing.

9. Certain building stones like marbles shall be sawn in blocks wherever so specified and certain stones like granite and marble shall be polished with a stone polishing machine, if so specified. Sand blasting may sometimes be prescribed as a finishing process for building stones.

SPECIFICATION NO. 12-3—Ashlar Masonry

1. Ashlar masonry shall be laid in the specified mortar and in regular courses not less than 12 inches (30 cm.) in height. All the courses shall be of the same height unless otherwise specified. Where courses of different heights are specified, no course shall normally be thicker than any course below it unless otherwise specified to give architectural effect. The stones shall be laid in cement sand mortar in accordance with the architectural detail shown in the drawings or as ordered by the Executive Engineer. Unless otherwise specified, no stone may be less in breadth than in height or less in length than twice its height.

General specifications.

2. All joints and beds will be perfectly vertical and horizontal respectively. All visible edges must be free from chippings. Each stone will be well set up and flushed with mortar as specified and will be stuck with a wooden maul when laid to being it to a solid bearing both as to bed and joint.

Beds and joints.

3. The face stone will be laid in flemish bond with headers and stretchers alternatively in the same course (unless otherwise ordered). The headers should be arranged so as to come as nearly as possible in the middle of the stretchers above and below; the stones must break joint on the face by at least half the height of the course; the bond must be carefully maintained throughout the wall. In walls $2\frac{1}{2}$ ft. (75 cm.) thick and under, the headers shall run right through the wall.

Bond.

4. Jambs for door and window openings shall be formed with quoins of the full height of the course. Unless otherwise specified, the twice the depth, and at least 3 quoins in the case of doors and 2 in the case of windows shall be stones of the full thickness of the wall.

Jambs.

5. All stones shall be wetted before laying. They will then be floated on mortar and bedded solid with wooden mallets without the use of chips or underpinning of any sort. Wherever, necessary, jib cranes or other mechanical appliances shall be used to hoist the heavier pieces into correct position.

Laying.

6. The ashlar masonry can be divided into three classes:—

Classification.

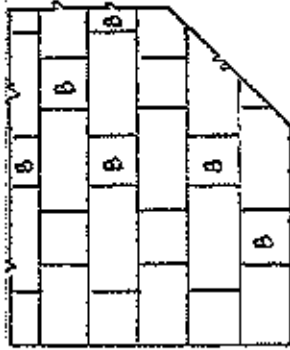
(a) **Fine Ashlar:**—In fine ashlar every stone shall be fine dressed (three line dressing) on all beds, joints and faces, full true and out of winding, if the surfaces are plane, or to uniform curves or twists if required by the design. All stones shall be laid in cement mortar and the beds and joints must not exceed $\frac{1}{8}$ th inch (3 mm.) in thickness.

(b) **Ashlar rough tooled (or Bastard Ashlar):**—In this type of ashlar masonry, the faces exposed to view shall have a fine dressed.

SPECIFICATION NO. 12-3—Ashlar Masonry

STONE MASONRY

'B' DENOTES BOND OR THROUGH STONE (MINIMUM SIZE ON FACE 6x6)

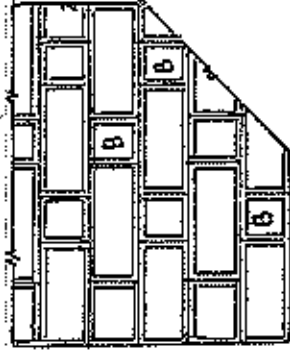


ELEVATION

FIG. 12-3 (d)
FINE ASHLAR



SECTION



ELEVATION

FIG. 12-3 (c)

BASTARD ASHLAR WITH BRICK BACKING



SECTION

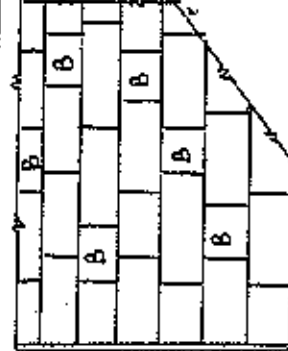


ELEVATION

FIG. 12-3 (b)
RUSTIC ASHLAR WITH BOULDER BACKING

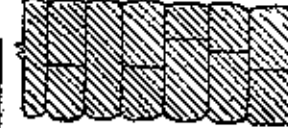


SECTION



ELEVATION

FIG. 12-3 (d)
BLOCK COURSE (WITHOUT CHISEL-DRAFT)



SECTION

SPECIFICATION NO. 12.3—Ashlar Masonry

chisel draft 1 inch (25 mm.) wide around the edges, and be rough tooled (one line dressed) between the drafts, and on all beds and joints. The thickness of joints and beds must not exceed $\frac{1}{4}$ inch (6 mm.). The stones will be set in cement mortar which is specified.

- (c) **Rock Ashlar, Rustic Ashlar or Quarry faced Ashlar:**—This type of masonry is similar to Bastard Ashlar, except that the exposed faces of the stone between the drafts shall be left rough as the stone comes from the quarry. No rock face or bushing may project more than 3 inches (7.5 cm.) from plane or drafts. If required for architectural reasons, the drafts may be omitted, altogether except on quoins. All the beds and sides of stones shall be rough tooled (one line dressed). The cement mortar shall be as specified. The beds and joints shall not exceed $\frac{1}{4}$ inch (6 mm.) in thickness. Where only ashlar masonry is specified, without indications on the drawings or otherwise, the types of ashlar required will be taken as fine ashlar. As regards size of stones, bond, etc., there is no difference in the three types of ashlar masonry.

7. In all other respects the work shall conform to general specification no. 12.1 for stone masonry.

Other respects.

8. The rate for ashlar work includes the cutting of rebates for door and window frames cutting and dowelling of holes for fixing railings, crestings, bars, anchors and similar fixtures. The through rate and labour rate include the cost of items as mentioned in paragraph 17 of specification no. 12.1 for stone masonry.

Rate.

9. Ashlar masonry is generally used for masonry, construction, where great strength, stability and durability are required as in canal headworks, piers, abutments, arches and parapets of bridges and for small hydraulic works. It is also used for architectural effect and durability in prestige and monumental buildings.

Uses.

SPECIFICATION NO. 12.4—Ashlar facing

General.

1. As it is too costly to have walls built entirely of ashlar, they are constructed to have ashlar facing and rubble backing or ashlar facing and brick backing specially in case of thick walls. In case of piers and abutments backing or hearting is built in cement concrete of suitable strength. Ashlar facing for this type of masonry will comply with specification no. 12.3 for ashlar masonry with the difference as explained in the following paragraphs.

Height of courses.

2. No course shall be less than 8 inches (20 cm.) in height. Subject to this the height of the course shall be equal to an exact number of courses of brick work or rubble back-fill with intermediate mortar joints. The backing must be carried up simultaneously with the face work.

Size of stones.

3. Unless otherwise specified, no stone shall be less than 18 inches (45 cm.) long. One-third of the entire length of each course must be in headers. Depth of facing shall be as specified in the drawings. Normally it should not be less than 4 inches (10 cm.) and 8 inches (20 cm.) in alternate courses.

Beds and joints.

4. The beds and joints will be rough-tooled one line dressed true and square for at least the same distance as the thickness of facing specified in drawings. In case of rubble or concrete backing, the backs of facing stones may not be dressed and may be left rough in the state in which they leave the quarry. The faces of the stones shall be dressed according to the specifications of the fine ashlar, bastard ashlar or rustic ashlar as the case may be. The beds and joints will not exceed $\frac{1}{8}$ inch (3 mm.) in thickness where fine ashlar facing has been specified and $\frac{1}{4}$ inch (6 mm.) in thickness in case of bastard ashlar and rustic ashlar.

Bond stones.

5. Special care should be taken to secure a good bond between the facing and the backing. Bond stones shall be inserted with a clear distance of 5 to 6 feet (2 metres) apart in every course. If the thickness of walls is less than $2\frac{1}{2}$ Feet (75 mm.), the bond stones must run right through the backing while in case of thicker walls they must overlap at least 7 inches (15 cm.), care being taken not to place the bond stones of successive course over each other.

Rate.

6. In a work of this kind the face work alone will be paid for as ashlar, and thickness to be measured shall be only so much as is dressed back true and square on the beds and joints plus $\frac{1}{3}$ rd more allowed for headers (for example, in case of 12 inches thick ashlar facing a thickness of 16 inches from the face would be paid for as ashlar masonry), the remainder to be paid for according to the character of backing. The rate for ashlar facing includes all such items as detailed in para of specification no. 12.3 for Ashlar Masonry.

SPECIFICATION NO. 12.5—Cut Stone Work

1. General specification of the fine ashlar masonry will apply in case of cut stone work. **General.**
2. Every stone shall be cut to the required size and shall be chisel dressed on all beds and joints so as to be free from any winding, and to give perfectly vertical and horizontal joints with the adjoining stones etc. The faces shall be gauzed, cut, chamfered, grooved, rebated, sunk or plain-moulded and fine tooled as shown on the working drawings. For this purpose full size lay out of the mouldings etc., shall be prepared on a platform from which sheet templates shall be cut and the stones dressed to templates to a uniform and fine finish. All visible angles and edges shall be true, square and free from unsightly chippings. The corner stones shall be dressed at true right angles, the corners being straight and vertical. **Dressing.**
3. A sample of dressed stone shall be prepared for approval and it will be kept on work after being passed and initialled by the engineer-in-charge. **Sample to be approved.**
4. The measurement of all cut stones moulded or ornamental work shall be taken over all projections, i.e. the volume of least rhombohedron in which the cut or moulded stone can be contained. The volume of each stone, but excluding its tailing shall be worked out separately. **Measurements.**
5. All cut stone work fixed in place shall be protected from injury during construction, by wooden casing, strawmats or padded gunny bags until construction is finished and the site cleared. The rate allows for such protection after fixing and during construction. **Protection during construction**

SPECIFICATION NO. 12.6—Block in Course Masonry

Description.

1. It is also called 'ashlar block in course masonry'. It is similar to rough-tooled (bastard) ashlar except that may not be chisel draft, the minimum height of courses may be 6 inches (15 cm.) and the face stones are not laid strictly in headers and stretchers. In external appearance, it is more like coursed rubble masonry except for finer dressing and chisel draft.

Dressing.

2. The stone shall be rough-tooled (one line dressed) on all beds and joints so as to give rectangular shaped stones. No face joints shall be thicker than $\frac{1}{2}$ inch (6 mm.).

Size of stone

3. Each course shall consist of stones of even thickness, no course being less than 6 inches (15 cm.) height. Stones shall break joint on the face by at least half the height of the course and no course shall be greater in height than the ones below it unless specified otherwise. No face stone except closers shall have less breadth than height. No stone tail into the wall less than its height. At least one third of the face stones shall be headers tailing into the wall twice their height, and shall be evenly distributed over the entire face.

Laying.

4. All courses shall be laid with beds truly horizontal and joints truly vertical, each bed and joint being full of the mortar specified, and each stone being struck with wooden maul to bring it to a solid bearing.

Bond stones

5. In walls less than 2 feet (60 cm) thick, through stones shall be inserted in every course at 5 feet (2 metres) intervals. In walls more than 2 feet (60 cm.) thick, a line of two or more headers or stones shall be laid from face to back, which shall overlap each other by at least 6 inches (15 cm.), care being taken not to place the through stones of successive courses over each other.

Uses.

6. Block in course masonry is used for hydraulic structures like harbour walls, abutment walls, piers etc.

Other respects.

7. In all other respects the work must comply with the general specifications no. 12.1 for stone masonry.

SPECIFICATION NO. 12.7--Block-in-Course Facing

1. Block in course facing may be used for walls in brick work, concrete or rubble masonry. This kind of facing is generally specified for brick work and rubble masonry structures subjected to submergence under water. The work will comply with specification no. 12.6 for block in course masonry with difference as explained in the following paragraphs.

General.

2. No course shall be less than 6 inch (15 cm) in height and it will be fixed so as to be equal to exact number of courses of brick work or rubble masonry backing including intermediate mortar joints. The backing must be carried up simultaneous with the face work.

Height of courses.

3. No stone shall be less than 15 inches (39 cm.) long. The depth of facing shall not be less than 6 inches (15 cm.) and no header shall tail less than 10½ inches (25 cm.) into the backing. One third of the entire length of each course must be in headers, which shall be distributed evenly over the other.

Size of stones.

4. Bond stones shall be inserted at a clear distance of 5 to 6 feet (2 metres) in every course. Up to 2 feet (60 cm.) thick walls, the bond stones must run right through the backing. In case of thicker walls, the bond stones must overlap at least 6 inches (15 cm.) care being taken not to place bond stones of successive courses over each other.

Bond stones.

5. Payment will be made for the actual thickness of face work plus an allowance of 1/3rd more for headers, the remaining thickness to be paid for according to the character of the backing.

Rate.

SPECIFICATION NO. 12.8—Squared Rubble Masonry Coursed

- Height of course.** 1. The stones shall be laid in horizontal courses not less than 6 inches (15 cm.) in height. All the stones in each course shall be of equal height and all courses of the same height unless otherwise specified, in which case no course shall be thicker than any course beneath it. All stones to be set full in mortar in all bed or vertical joints.
- Dressing.** 2. The face stone shall be squared on all joints and beds by hammer dressing with the help of a mason or waller's hammer. The face of the stone to be hammer-dressed, and 'bushing' not to project more than $1\frac{1}{2}$ inches (38 mm.) on an exposed face, nor more than half an inch (12 mm.) on a face that is to be plastered. The beds of stones shall be rough dressed (one line dressed) or hammer dressed true and square for at least 2 inches (50 mm.) back from the face, and the joints for at least $1\frac{1}{2}$ inches (38 mm.) from the face.
- Joints.** 3. All stones shall be set full in mortar along all beds and vertical joints. All beds shall be horizontal and joints vertical. No pinnings will be allowed on the face. The beds and joints shall not be more than $\frac{3}{8}$ inch (10 mm) in thickness. Along all course stones shall break joint by at least half the height of the course.
- Size of stones.** 4. No face stone shall be less in breadth than its height, nor shall it tail in to the work to a length less than its height. At least one third of the stones shall tail into the work at least twice their height, or, in walls thicker than 2 feet (60 cm.) three times their height. No stone should tail into a point.
- Through stones.** 5. Through stones shall be inserted between 5 and 6 feet (one metre) through stone apart in every course and shall run right through walls not more than 2 feet (60 cm.) thick. Where the thickness of wall is more than 2 feet (6 cm.) a line of two or more headers or stones shall be laid from face to back, which shall overlap each other by at least 6 inches (15 cm.). Care should be taken not to place the through stones of successive courses over each other.
- Quoins.** 6. The quoins, which shall be of the same height as the course in which they occur, shall be formed of header stones at least $1\frac{1}{2}$ feet (45 cm.) along, laid lengthwise alternatively along each face. The quoins shall be selected stones more carefully dressed, squared and bedded to a depth of at least 4 inches (10 cm.) and laid square on their beds.
- Internal face.** 7. The work on the internal face shall be precisely the same as on the exterior face, unless the work is to be plastered in which case, the side joints need not be vertical.

SPECIFICATION NO. 12-8—Squared Rubble Masonry Coursed

STONE MASONRY

SQUARED RUBBLE COURSED

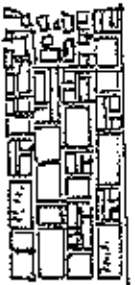
SQUARED RUBBLE BUILT TO COURSES

SQUARED RUBBLE UNCOURSED

ELEVATION



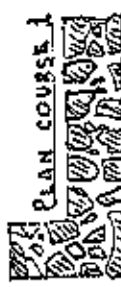
ELEVATION



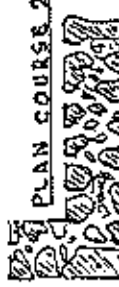
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PLAN COURSE 1



PLAN COURSE 2



PLAN COURSE 1



PLAN COURSE 2



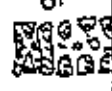
PLAN COURSE 1



PLAN COURSE 2



CROSS SECTION



CROSS SECTION



CROSS SECTION

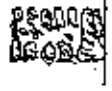


FIG:- 12-8(a)

FIG:- 12-9 (a)

FIG:- 12-10(a)

SPECIFICATION NO. 12-8—Squared Rubble Masonry Coursed

Interior filling of
wall or hearing.

8. The interior of the wall shall consist of flat bedded stones carefully laid on their proper beds and solidly bedded in mortar, chips and spalls of stones being wedged in wherever necessary, so as to avoid thick beds or joints of mortar, care being taken that no dry work or hollow spaces shall be left anywhere in the masonry. The external and internal face work shall be brought up evenly, but the hearing should not be levelled up at each course by the use of chips.

Other respects.

9. In all respects the work must comply with the general specification no. 12-1 for stone masonry.

**SPECIFICATION NO. 12-9—Squared Rubble Masonry Built
to Courses**

1. This type of stone masonry is similar to squared rubble coursed in all respects except that stones in each course need not be all of the same height. Two or three stones may be used in a course depending upon the height of the course. However, all quoins, bond stones and through stones must be of the full height of the course as illustrated in fig. No. 12-9 (a). This type of masonry is normally used in areas where quarried stones of highly stratified formation are available, which can be easily squared but are available mostly in small thicknesses.

Face work.

2. The backing shall consist of uncoursed rubble masonry which shall be carried up simultaneously with the faces. The face stones being backed as soon as laid, but each course need not be completely levelled off.

Hearting or
Backing.

In all respects other than those specified above, the facing and backing shall correspond with the specifications for squared rubble coursed and uncoursed rubble respectively.

**SPECIFICATION NO. 12·10—Squared Rubble Uncoursed or
snecked Rubble**

- Description.** 1. In this type of work all the stones are dressed as in case of squared rubble coursed but stones of different heights are used so as not to have any horizontal courses, but to break joints as much as possible, long vertical lines of joints shall be avoided.
- Sneck stones.** 2. Small size stones have to be used at certain places to facilitate breaking of vertical and horizontal joints as illustrated in Fig. No. 12·10 (a) These stones are called sneck stones and the masonry is also termed as snecked rubble sometime.
- Through stones.** 3. Bond or through stones shall be provided at the rate of one per 9 sft. (one sq. metre) of superficial area.
- Other respects.** 4. In all other respects, work must confine to specification no. 12·8 for squared rubble coursed and no. 12·1 for stone masonry.

SPECIFICATION NO. 12-11—Random Rubble Masonry

1. Random rubble masonry consists of stones which are not squared but are of irregular shapes and are laid in specified mortar according to a random arrangement as shown in Fig. No. 12-11 (a).

General.

2. In this type of work scabbled or quarry dressed stones are used and no further dressing is done except to knock off weak or angular corners. In case of stones obtained from boulders, heavy pieces are split nearly at right angles to the natural bed into smaller pieces. These stones are then laid with the split surface to form the face. No dressing is done except removing superfluous material or weak corners. Care is taken to select stones of as uniform a shape as possible. Each stone will be laid on its quarry bed and will be wedged or pinned strongly into position in the walls by spalls or chips which may show on the face.

Dressing of stones.

3. The stones will be arranged to break joints as much as possible; long vertical lines of joints shall be avoided. No stone is to rail into a point. The height of any face stones shall not be greater than the breadth at the face. It shall rail into the wall not less than $1\frac{1}{2}$ times its height. The thickness of joints shall normally be $\frac{1}{2}$ inch (13 mm.) but it should not exceed $\frac{3}{4}$ inch (20mm.) in any case.

Joints.

4. Bond or through stones running right through the walls shall be provided in walls up to 2 feet (60 cm.) thickness and if the wall is more than 2 feet (60 cm.) thick, a line of these shall be laid from face to back which shall overlap each other at least 6 inches (15 cm.). Bond or through stones shall evenly be distributed over the whole face of the wall in such a way that for every 5 sq. ft. of the face, there shall be at least one through or bond stone (or for every square meter of the face there shall be at least two bond or through stones).

Through stones.

5. The hearting or filling between the exterior and interior face work shall consist of rubble stones, carefully laid, hammered down with a wooden mallet into place and solidly bedded in mortar, chips and spalls of stones being used wherever necessary to avoid thick beds or joints of mortar, care being taken that no dry work or hollow spaces are left anywhere in the masonry. The work of hearting must proceed side by side with the face work and backing.

Hearting.

6. In all other respects, the work must comply with the general specification No. 12-1 for stone masonry.

Other respects.

7. Random rubble masonry is generally used for residential buildings and for un-important low revetment walls etc. where these structures do not come in contact with water.

Uses.

**SPECIFICATION NO. 12-12—Random Rubble Brought
to Course**

General.

1. This type of stone masonry will conform in every respect to the specifications for random rubble stone masonry except that the beds may be brought to level after every 18 inches or 24 inches (45 cm. or 60 cm.) vertical interval as shown in Fig. No. 12-12 (a).

Heating.

2. Heating shall be laid as specified in case of specification No. 12-11 for random rubble masonry. Heating shall be laid nearly level with each course, except that at about 3 feet (one metre) intervals, vertical "plums" projecting 6 to 9 inches (15 to 23 cm.) shall be firmly embedded to form a bond between successive courses.

SPECIFICATION NO. 12-12—Stone Masonry

STONE MASONRY

B DENOTES BOND OR THROUGH STONE. (MINIMUM SIZE ON FACE 6"X6")



ELEVATION
FIG. 12-11(d)



SECTION

RANDOM RUBBLE



ELEVATION



SECTION

FIG. 12-12 (d)

RANDOM RUBBLE BROUGHT TO COURSES



ELEVATION

FIG. 12-14 (d)

BOULDER MASONRY



SECTION

**SPECIFICATION NO. 12-13—Polygonal Random
Rubble Masonry (Kentish Rag)**

General.

1. In this type of random rubble masonry the face stones are of very irregular shape most of them forming polygons. The stones are used as they come out of the quarry and if sufficient stones with polygonal faces are not forthcoming some of the stones are hammer-dressed to give polygonal faces.

Laying

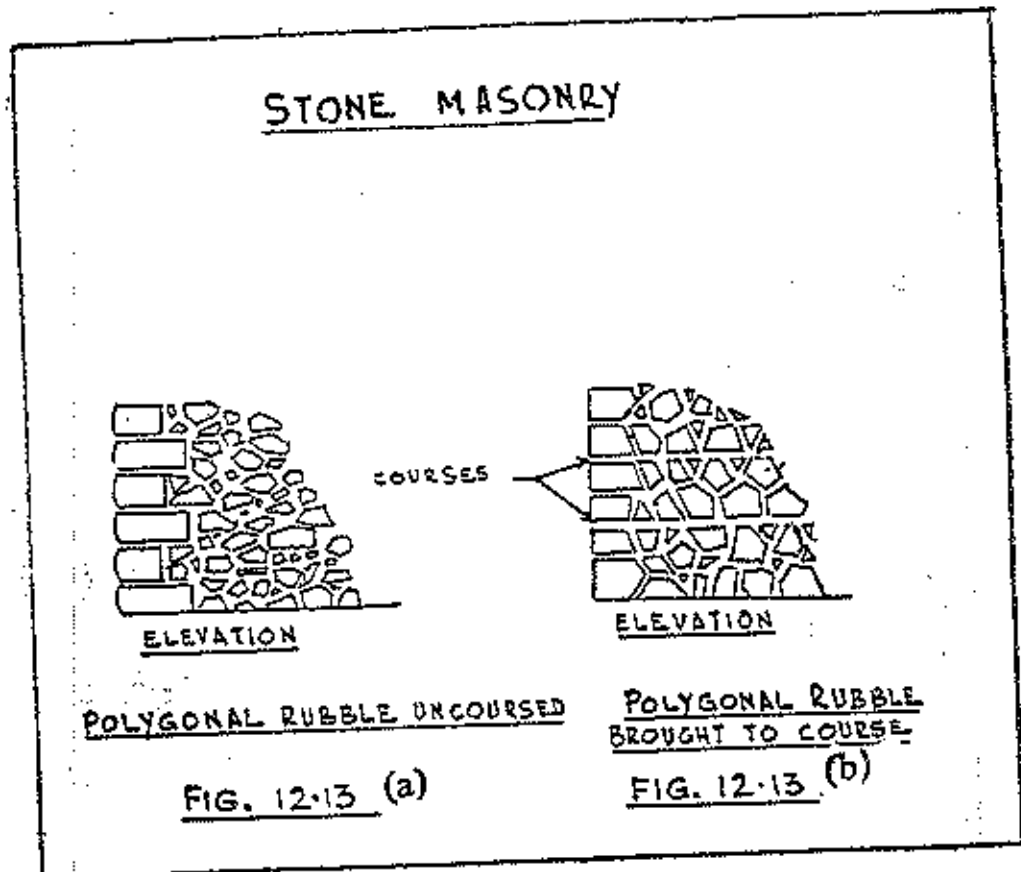
2. Stones are laid to a random arrangement as shown in sketch Nos. 12-13 (a); care being taken to lay them as close to each other as possible.

Other respects.

3. In all other respects, the work will conform to specification No. 12-11 for random rubble masonry.

Two types of works.

4. Polygonal random rubble masonry of this type can either be uncoursed [as shown in sketch No. 12-13 (a)] or it can be brought up to course by levelling after every 18 to 24 inches (45 to 60 cm.) vertical interval [as shown in sketch No. 12-13 (b)].



SPECIFICATION NO. 12-14—Boulder Masonry

1. Boulder masonry shall consist of natural and untrimmed boulders selected for soundness and as flat and rectangular in shape as possible.

General.

2. For this type of construction, the stones of various sizes shall be so selected and arranged that minimum thickness of joints is obtained and the stones are brought as near each other as possible. The interstices between stones being carefully wedged up by the packing with pieces and spalls. Efforts should be made to use small, undressed rounded or flat stones instead of spalls and broken pieces for wedging. There shall not be regular courses but the work will be built as random rubble. The vertical joints shall be broken from course to course and long vertical joints shall be avoided. Thickness of joints shall normally be $\frac{3}{4}$ inch (20 mm.) but will not exceed one inch (25 mm.).

Laying.

3. Through or bond stones shall be provided as in case of random rubble masonry specification No. 12-11; care being taken to select such bond or through stones which can be used in the face work without dressing.

Through stones.

4. In all other respects the work will conform to specification No. 12-11 for Random Rubble Masonry.

Other respects.

5. Boulder masonry is generally used in single storeyed buildings and residential houses for architectural appearances and where walls are not subjected to heavy loads. This type of masonry is also used for ghat revetments, slope, pitching, boundary walls or low retaining walls in which case the interior face and hearting may also be built of undressed boulders.

Uses.

SPECIFICATION NO. 12.15—Dry Rubble Masonry

General.

1. Dry Rubble masonry or dry stone walling shall be used in constructing breast and retaining walls, revetments walls and parapets.

Bond and dressing.

2. In appearance dry rubble masonry will be like squared rubble built to courses. Each course shall be built through the entire thickness of the wall without mortar but with chips and spalls. The stones shall be roughly dressed to secure the maximum bedding surface without unduly reducing the size of stones. The largest stones shall be used in such construction, the larger being used in the lower courses.

Batter.

3. Dry stone walling should not have a face batter steeper than 1:12 and until otherwise specified, batter shall be 1:4. The back of the wall shall be vertical; foundations as well as the courses must run at right angles to the face batter and not horizontally.

Bond stones.

4. Through or bond stones shall be provided in each course at intervals of 5 feet (2 metres). Bond or through stones shall be of the full height of the course in which they are used and shall be as broad as possible and of the greatest length procurable. No bond or through stone shall be less than 2 feet (60 cm.) in length and when the length is less than the thickness of the wall two or more shall be used overlapping by at least 6 inches (15cm.) to provide a through bond from front to back through or bond stones will be staggered in consecutive courses. All bond or through stones shall be separately stacked before use and the face marked with paint so that they can be identified after having been built into the wall.

High walls.

5. Dry stone wall higher than 20 feet (6 metres) should be strengthened by laying three consecutive courses of squared rubble masonry coursed in lime or cement mortar at every 10 feet (3 metres) interval.

Long walls.

6. Where ordered by Executive Engineer, long lengths of dry rubble walls should be divided into panels separated from one another by short lengths of walls 5 feet to 7 feet (2 metres) long built with squared rubble courses in lime or cement mortar at intervals of say 20 to 30 feet (6 to 9 metres), in order to confine damage, if any, only to the panels affected and thereby to minimise the repairs required.

Weep holes.

7. Weep holes shall be provided in dry stone walling when built against earth or hill slopes subject to saturation by surface or ground water flow. Weep holes shall be backed by coarse gravel and important walls by graded filters composed of coarse sand and gravel.

SPECIFICATION No. 12.15—Dry Rubble Masonry

8. Filling immediately behind dry stone wall must, wherever possible consist of stone refuse or chips or coarse gravel clayey and silty soil should not be used where stone refuse or gravel is available. Filling.

9. For purposes of payments the portions built in squared rubble masonry in cement or lime mortar shall be measured and paid for separately. The remaining work shall be paid for as dry rubble masonry. Rate.

SPECIFICATION NO. 12.16—Arch Work in Stone Masonry

- General.** 1. Masonry in arches shall follow general specification no. 12.1 for stone masonry; specification no. 12.2 for dressing and cutting stone as well as the detailed specifications for the class of masonry in which the arch work is to be executed.
- Dressing and joints.** 2. The stones shall be dressed on the face and on the beds and joints in accordance with the specifications for the class of masonry in which the arch is to be built, the ultimate thickness of the joint being governed by the same corresponding specifications.
- Erection.** 3. The full number of stones required for completion of an arch are to be cut or dressed and the arch laid dry on the ground before commencement of work on the arch. No voussoir is to be cut or dressed after it has been laid *in situ* in mortar.
- Breaking joints.** 4. All joints must break joint with each other and no stone shall overlie a circumferential joint by less than half of the width of the extrados.
- Centring.** 5. Arches shall be built on proper centring approved by the engineer-in-charge and the centring shall not be eased or struck without his permission.
- Pointing** 6. Mortar of the joints on face and soffit of arch to be raked out as soon as the centring is removed, and the joints neatly pointed with good specified lime or cement mortar.
- Other details.** 7. In all other respects with work in masonry shall follow specification no 11.7 for arch work in bricks.
- Measurements.** 8. For measurements of arch work, the mean of the lengths of the extrados and intrados is multiplied by full breadth of the arch and by the full depth of the stones in arch ring.
- Rate.** 9. The through rate for arch work includes the cost of stone and mortar, labour for dressing and laying and cost of tools and plant and scaffolding, centring, shuttering and water. The labour rate includes the labour for dressing and laying and cost of tools and plant scaffolding, centring, shuttering and water.

SPECIFICATION NO. 12.17—Ashlar Arch Work

1. Ashlar arching is normally used for bridges over 60 feet (120 metres) span. It conforms to the general specifications for arch work in stone masonry with the differences as mentioned in the following paragraphs,

General.

2. All stones required for ashlar arching shall be carefully and accurately wrought, giving the proper radiating joints i.e. the arch stones shall be dressed full and true to their proper shapes with the necessary summering, twist or winding. For this purpose the stones will be cut to a zinc sheet template made against a full sized elevation of the arch drawn on lime or cement plaster. The voussoirs sides shall be truly radial and the upper and lower surface truly concentric.

Work to template.

3. The face stones may be tooled or rock-faced according to type of ashlar masonry specified.

Face stones.

4. The arch stones shall not be less than 10 inches (25 cm.) on their least dimension, and shall break joint by atleast 9 inches (23 cm.) in arches up to 2 feet (60 cm.) in depth, the height of each shall be equal to cm. the full depth of the ring. In arches greater in depth than 2 feet (60 cm.) the stones shall be laid header and stretchers alternatively, all the headers being of full depth of the ring and not more than two stretchers making up the full depth of the ring.

Size of stones.

In arches over 3 feet (one metre) in depth the height of quoins and key-stones alone need be equal to the full depth of the ring. The rest of the stones shall be laid in such bond as may be directed but not more than two stones shall make up the full depth of the ring. Exact uniformity will be required in the thickness of each course of arch stones, and in oblique or skew arches, great care is to be taken to dress the beds to the required winding.

5. In case of the ashlar wall less than 2 feet (60 cm.) thick, all stones shall be through stones unless otherwise specified.

Through stones.

6. The stones in arch work shall be carefully set in good fine mortar normally cement mortar 1:2. Thickness of joints shall not exceed 3/16 inches (5mm.). The key-stones and the keying course if any, shall be accurately fitted and driven into place with heavy wooden beaters.

Laying.

SPECIFICATION NO. 12.18—Block-In-Course Arch Work

General.

1. Block-in-course arching shall be precisely similar to that of ashlar arching, except that the stones shall not be less than 6 inches (15cm.) on their least dimension and shall only be rough-tooled (one line dressing) on beds and joints which shall not exceed $\frac{1}{4}$ inches (6 mm.) in thickness. This type of arching is used for bridges from 30 feet to 60 feet (10 metres to 20 metres) span.

Other respects.

2. In all other respects, block-in-course arch-work shall conform to the specification no. 12.16—Arch work in Stone Masonry and specification no. 12.6 for Block-in-course Stone Masonry.

SPECIFICATION NO. 12.19—Rubble Arch Work

1. General specifications of arch work in masonry shall apply in case of rubble arching. In addition, the specification as given in the following paragraphs shall also apply.

General.

2. Each stone shall be hammer-dressed approximately to the proper shape with necessary summering, so that arch stones may bear fairly one upon the other for the full thickness of arch. Should parts of the backs of the stones be open, they shall be solidly wedged up with spalls and chips of stones set in mortar. The face joints of the stones shall be dressed truly radiating and the bed joints shall be properly summered. The ends of the face stones shall also be dressed. The joints on the face and soffit shall not exceed $\frac{1}{2}$ inch (13mm.) in thickness. In case of small spans, the thickness of joints may be allowed up to $\frac{3}{4}$ inch (20mm.)

Dressing.

Note.—The mortar used should be of very good quality as the strength of rubble arches depends very much upon the strength of mortar used.

3. Unless otherwise specified, the height of each stone shall be equal to the depth of the arch up to 15 inches (38 cm); above this, two stones may be used, but no stones shall be less than 6 inches (15 cm.) in height. The intrados of all stones be rectangular (rhomboid in skew arches) no side being less than 4 inches (10 cm.)

Size of stones.

4. In case of rubble arches in walls, the two springers and key-stones shall be through stones as well as every third stone in between.

Through stones.

5. In all other respects, rubble arch work shall conform to specification no 12.16—arch work in stone Masonry (general) and specification no. 12.8 for Square Rubble Masonry coursed.

Other respects.

SPECIFICATION NO. 12.20—Copings, Cornices,
Columns, etc.

- Stone. 1. Stone cornices, copings, pillars, string courses, chajjas, brackets, corbels and similar work will be made from stone of uniform colour and texture and of the kind specified for each detail.
- Dressing. 2. The stone shall be dressed full or to template (which shall be made of zinc sheet) as shown in the drawings. Unless otherwise specified, the exposed faces shall be fine chisel (three line) dressed. All visible angles and edges shall be free from chippings.
- Details of size. 3. No stone shall be less than 18 inches (45 cm.) in length nor less in height than the height of the coping. In cornices and string courses which do not extend right through the wall, every stone shall tail into the wall by at least as much the projection beyond the face of the wall, and in no case less than 6 inches (15 cm.). Coping stones shall extend the entire depth of the coping unless otherwise permitted in writing by the Executive Engineer.
- Chajjas. 4. Chajjas, in the case of isolated windows, will consist of a single stone; in continuous chajjas all joints must come over the brackets.
- Mortar. 5. Cornices, string course, corbels and pillars shall be set in lime mortar, or if the rest of the masonry is cement mortar, in similar cement mortar. Copings and chajjas shall always be set in 1:3 cement mortar.
- Joints. 6. No joints shall be more than 1/8th of an inch (3 m. m.) in thickness.
- Weather and throating. 7. All outside cornices, copings, corbels and similar projecting courses are to be weathered on top and throated underneath.
- Measurement. 8. Cornices, string courses and chajjas shall be paid for by the running foot (metres) while coping will be paid for by the cubic foot (cubic metre).
- Dowels. 9. Coping stones and other similar work are to be cramped or dowelled and courses of pillars, skew-backs and similar work to be joggled wherever specified or ordered.

SPECIFICATION NO. 12.21—'Dhajji' Walls

1. The timber used in the framing shall comply with the general specifications for timber and wood work (specification no. 3.15 and 17.1) if kail or similar wood has been used in the frame work, all exposed timbers subject to wear, such as the sills of doors and windows shall be made from deodar. Timber.
2. The frame shall usually consist of a sill at the bottom and a bressumer on top each 5 inches X 5 inches (125mm. X125mm.) in section and of the longest lengths procurable. Vertical posts shall be tenoned into these at all corners and junctions of walls, and elsewhere about 4 feet (one metre) apart, but so spaced as to form the door and window openings. All posts shall be single pieces, and 5 inches X5 inches (125mm X 125mm.) in section. Frame work sills
Bressumers posts.
3. Into these posts shall be notched horizontal pieces, 5 inches 3X inches (125mm. X75mm.) in section, one line being at the level required to form the lintel of the doors and windows and the rest so spaced along the height of the wall that no panel shall be more than 4½ feet (1.5 metres) in height. Horizontal pieces.
4. The panels shall be strutted diagonally by 5 inches X1½ inches (125mm. X 38mm.) boards fitting tightly into the corners and halved into one another at the point of intersection. The diagonal bracing will be omitted if brick nogging is provided in the panels. In that case first class burnt bricks must be used. Diagonal bracing.
5. The framing shall be so constructed with reference to the door and window openings that the chowkats can be fixed to the timber forming the framework. When doors and windows, are hung on chowkats, they shall be measured over the chowkat in the customary manner. Doors and windows
separate chowkas.
6. Where required, the framing shall be so constructed, that no separate chowkats are required but the leaves hung on the frame timbers which shall be made with the necessary rebates to take the leaves. The doors and windows will be paid in that case on the net area of the opening, the depth of the frame or chowkat being excluded from the measurement. Without Chowkats.
7. The framing of dhajji walls shall be erected on a plinth of brick or stone not less than 12 inches (30cm.) high from the ground. The sill shall be laid on an adequate damp proof course, and at such a level that its top is not more than 2 inches (5 cm.) above the floor. Protection from
damp ground.

SPECIFICATION NO. 12.21—"Dhajji" Walls

Paint with a wood Preservative.

8. Before finally fitting the framing together, all the timbers including the shaped ends, scafs and mortices shall be given two coats of hot solignum, creosote or other approved wood preservative.

Iron fastening.

9. Having erected the framing the vertical and horizontal members shall be firmly fastened together on both sides of all junctions with $\frac{3}{4}$ inch (10 mm.) diameter spikes, and the diagonal braces secured with 4 inches (10 mm.) wire nails.

Filling.

10. The frame work shall then be filled with one or more of the following classes of brick work or masonry as specified :—

- (i) First class brickwork in lime (Specification No. 11.1).
- (ii) First class brickwork in mud (Specification No. 11.1).
- (iii) Second class brickwork in mud (Specification No. 11.2).
- (iv) Sun-dried brickwork (Specification No. 11.5).
- (v) Random rubble masonry in lime (Specification No. 12.11).
- (vi) Random rubble masonry in mud (Specification No. 12.11).

In each case the brickwork or masonry shall comply with the detailed specifications for each type of work.

Filling to be tight.

11. All joints in the filling shall be as fine as practicable with the stones of bricks breaking joint in every course and firmly wedged against the framing to hold the panel in place against any lateral thrust. In the case of stone filling, all stones must be through stones with flat beds, and laid to fit close against the diagonal bracing.

Inner walls to be plastered.

12. Inner walls shall be plastered over the filling as well as the framework, which shall be covered with $\frac{1}{2}$ inch (12 mm.) mesh wire netting kept $\frac{1}{4}$ inch (6mm.) away from the wood work or have nails driven into it, to form a key for the plaster. The rate for dhajji walling includes treating the framework suitably for plastering.

Rate finish of outer walls.

13. Outer wall shall be finished with (a) the plaster over all, (b) the plaster over the brick or masonry filling only, the plaster being stopped against the frame, or (c) pointing. If plastered all over, the instructions in paragraph (12) above shall apply. If the filling only is to be plastered or if it is to be pointed, the filling shall be so laid in the framework that the framework will project $\frac{1}{2}$ inch (3mm.) beyond the finished plastered or pointed surface.

Rate.

14. The rate for dhajji walling includes the provision and erection of the timber framing and filling with brickwork or masonry

SPECIFICATION NO. 12.21—"Dhajji" Walls

as specified. The rate does not include the plastering and/or pointing of the face of the wall dhajji walls shall be paid for by superficial measure.

Note.—Wherever the work of dhajji walling occurs in an estimate, the item for it shall clearly specify :—

- (i) the timber from which framing is to be made ; and
- (ii) the nature of the filling.

SPECIFICATION NO. 12.22--Precast Block Masonry

- General.** 1. Sometimes walls in buildings or piers and abutments in bridges etc. are made of precast concrete blocks which may be either hollow or solid. When solid blocks are used, the work is termed as "artificial stone masonry" or "cast stone masonry".
- Material.** 2. Portland cement shall comply with specification no. 3-12. Coarse and fine aggregates from natural sources for concrete shall comply with specification No. 3-29 and 3-30 respectively. Cement sand and cement lime sand mortars shall conform to specification Nos. 2.2 and 2.3, respectively.
- Manufacture.** 3. Concrete blocks or cast stones are normally manufactured by block making machines of various capacities. Blocks manufactured by any process or machinery shall be acceptable provided they satisfy all the specifications regarding materials sizes, etc. The blocks shall be manufactured from portland cement and suitable aggregates such as sand, gravel, crushed stone, bituminous or anthracite cinders, burnt clay or shale, and blast-furnace slag. The aggregates used shall be durable quality and the same shall be got approved from the engineer-in-charge before starting manufacture. Unless otherwise specified in particular cases, the concrete used for casting of blocks shall be mixed in the proportion of 6 parts of aggregates, 3 parts of sand and one part of cement in conformity with specification No. 10.4 for "Cement concrete for Ordinary Structure". The sides of the mould may be removed from the base plates for 36 hours after casting. The blocks shall be kept continuously wet for 14 days after casting and shall not be built into the work for atleast 4 weeks after casting. All blocks shall be exactly of same shape, perfect and uniform in every respect. Blocks that are cracked or are deformed in any way shall be rejected.
- Size of the Blocks.** 4. In case of blocks used in building work, the sizes should be so chosen that the length, height and breadth are suitable multiples of bricks plus thickness of joints. While fixing sizes, it should be seen that each block is light enough to be lifted and laid easily. The blocks which are to be used for facing, should have suitable texture and colour, those required for backing should be rough, so as to provide good key for rendering of plastering. In case of hollow blocks, no skin or web should be less than 2 inches (5 cm.) or more than 3 inches (7.5cm.) in thickness. The net volume of the material in the block shall not be less than 60 per cent of its gross volume.
- Water absorption.** 5. The precast blocks (excepting those of cinder or clinker aggregate) shall be tested by the engineer-in-charge for water absorption. Blocks selected at random will be placed up to half of their height

SPECIFICATION NO. 12.22—Precast Block Masonry

in water for 6 hours. The capillary rise shall not be more than 2½ inches (8cm.) Alternatively, the blocks shall be immersed in water and absorption of water found in lbs. per cft. (kilograms per cubic metre) of net volume of block. This should not be more than 15 lbs. per cft. (240 kilograms per cubic metre). The absorption shall be computed as under :—

$$\frac{(\text{Wet weight minus dry weight}) \times 62.4}{\text{wet weight minus weight while suspended in water.}}$$

6. Special quoin blocks with a return face equal in length to half the normal face should be cast for all building blocks for external work. Proper half length closers are to be cast and not cut.

Quoins and closers

7. All parts of work such as cornices, coping and lintels which can not be made in a machine, must be moulded in pucca teak wood moulds lined with zinc or steel plates or they may be made in situ. In any case the work when finished must be absolutely true in line and level, and finished off smooth.

Cornices, coping
lintel.

8. All precast concrete blocks slabs etc. shall be set in cement sand mortar 1 : 3 or cement lime sand mortar . 1 : 1 : 6 as ordered by the engineer-in-charge the blocks being wetted with water before they are used in work. The external face work except in case of breeze blocks, when set, are to be finished with neat struck weathered joints on internal faces are to be raked back for plastering unless otherwise specified. A systematic bond must be maintained throughout the work. Vertical joint must be staggered and all masonry must be uniform and true in line and plumb.

Laying and jointing