

SECTION 153

BRICKWORK AND MASONRY REPAIRS

Materials & workmanship

- 1** Materials and workmanship for repairs to brickwork and masonry shall be in accordance with Section 150: Brickwork, Blockwork and Masonry unless modified by this Section.

(153.001)

Definitions

- 2** The following definitions shall apply:
- (i) patch repairs shall mean the replacement of a portion of existing defective brickwork or masonry with new brickwork or masonry of similar construction such that all edges are bonded into the original brickwork or masonry,
 - (ii) re-facing shall mean either the complete removal and subsequent replacement of a skin of brickwork or masonry, or the addition of a skin of brickwork or masonry on to an existing brickwork or masonry “core”,
 - (iii) stitching shall mean the process of inserting steel bars to bridge fractures, and grouting in such bars such that the grout penetrates the fractures,
 - (iv) pinning shall mean the securing of new brickwork or masonry to existing brickwork or masonry below or behind, using bars which are anchored using “adhesives” so that the existing and new brickwork or masonry is anchored to the bar. No voids or fractures are filled by pinning,
 - (v) grouting shall mean insertion of cementitious (or other) material into a structure through drilled holes to fill fractures and/or voids with suitable material to improve the structural performance,
 - (vi) injection shall mean the insertion of cementitious (or other) material into a structure directly into the fracture.

(153.002)

Deterioration and defects to be identified

- 3** The factual report in accordance with Section 23: Structural Repair Survey shall detail the apparent deterioration of elements of the structure and identify defects which may be pertinent to the performance or durability of the structure. Deterioration to be detailed and defects to be identified shall include but not be limited to the following:
- (i) cracks including, orientation, shape, size, depth, and any evidence suggesting new or long standing cracks,
 - (ii) spalling including location, shape, size, and depth, and any evidence suggesting new or long standing spalling,
 - (iii) drumminess (including arch ring separation), when struck with a suitable hammer, areas which sound “drummy” shall be identified, where visible, the amount of arch ring separation occurring,

- (iv) water seepage including rate of seepage, source of water, any evidence suggesting new or long standing water seepage, leachate, stone or brick slurry, and whether the area is wet, damp, dry or subject to wetting or drying,
- (v) insufficient mortar to joints including depth and joint width, and condition of mortar,
- (vi) misalignment of brickwork or masonry, (such as bulging, tilting and rotation) including dimensions of misalignment, degree of misalignment over a gauged length, and where practical a contour plot of any bulging,
- (vii) loose brickwork or masonry including the depth of such brickwork or masonry,
- (viii) apparent loss of strength (including crushing and softness) including an evaluation of the loss of section or strength of the material.

All defects shall be logged and shown on dimensioned sketches, to show the location, extent, and degree of deterioration and to detail the defect on the structure. Photographs, in accordance with Section 23: Structural Repair Survey for each defect shall be included, but shall not be used as a substitute for dimensioned sketches.

(153.003)

Tests

- 4** Details of the Contractor's proposed testing regime shall be submitted for the agreement of the Employer's Representative.

The following tests shall be included in the Contractor's proposed testing regime:

- (i) compressive strengths of bricks and mortar,
- (ii) elastic modulus of repair area,
- (iii) water absorption of bricks,
- (iv) **(INSERT)**.

(153.004)

Design of brickwork and masonry repairs

- 5** Unless detailed on the Contract Drawings, the design of brickwork and masonry repairs shall be carried out by the Contractor.

Designs of brickwork and masonry repairs shall be in accordance with BS 5628 or BS 5390 as applicable to the material of the structure, and shall satisfy the load capacity, serviceability limits, durability and life expectancy and other design requirements of Section 23: Structural Repair Survey.

Repairs to brickwork and masonry and the method of carrying out the repairs shall not adversely affect the performance of the structure by the introduction of local stiffening or adversely affecting the load path through the structure.

Where the design of the repair is carried out by the Contractor, proposals for the repair shall be submitted in accordance with Section 23: Structural Repair Survey.

Cleaning and superficial surface repairs to brickwork and masonry shall be in accordance with Clause 153.040.

(153.005)

**Surface condition
of existing
brickwork and
masonry**

- 6** Where new brickwork is to be bonded to existing brickwork, the surface condition of the existing brickwork shall be controlled, as far as is reasonably practicable, so as to comply with the suction rate requirements of Section 150: Brickwork, Blockwork and Masonry. Reduction of excessive suction rates may be achieved by wetting the existing brickwork with clean water. The existing brickwork shall not be soaked.

No repairs shall be carried out to brickwork which is subjected to running water or seepage which causes continuous wetting unless instructed to do so, in writing, by the Employer's Representative.

(153.006)

Bricks

- 7** Permanently exposed bricks to be used in the repair of **(INSERT)** shall comply with BS 3921, Type FL (Frost resistant and low salt content). Bricks shall have a compressive strength, elastic modulus, and water absorption characteristics compatible with the existing bricks in the structure. The nominal size and appearance shall match the bricks in the structure.

Should the Contractor propose to reuse bricks from other redundant structures, such bricks shall be tested to confirm the compressive strength, elastic modulus and water absorption characteristics. Samples shall be provided to the Employer's Representative for agreement to the inclusion of such bricks in the repair.

Bricks from redundant structures shall be in good condition with all old mortar removed.

Non-standard bricks shall comply with BS 4729.

(153.007)

Stonework

- 8** Stonework shall match the existing masonry and shall be in accordance with Section 150: Brickwork, Blockwork and Masonry.

(153.008)

Grout

- 9** Further to Section 150: Brickwork, Blockwork and Masonry grout shall have a low heat of hydration and plastic shrinkage, high resistance to sulphate and other chemical attack and capable of developing the performance specified when large volumes of water are present. The grout shall comply with the following performance specification at 5°C:

- (i) minimum compressive strength of 5 N/mm² at three days, 7 N/mm² at seven days, and 11 N/mm² at 28 days,
- (ii) maximum compressive strength at 28 days of **(INSERT)** N/mm² compatible with the strength of the existing brickwork or masonry,

- (iii) initial set at 1 hour maximum, final set at seven hours maximum,
- (iv) pourable consistency with flow channel figure not less than 380 mm,
- (v) maximum water / solids ratio: 0.4.

Admixtures including chlorides shall not be used.

(153.009)

Mortar

- I0** Except where mechanical pointing is to be used, mortar shall be in accordance with Section 150: Brickwork, Blockwork and Masonry and shall be compatible with the existing construction. The colour of the mortar shall match the existing.

Where coloured mortar is to be used, ready-mixed coloured mortar shall be used. Shovel gauging shall not be used. Coloured mortars shall not be trowelled excessively such that the colour is affected.

(153.010)

Mortar for mechanical pointing

- II** Mortar for mechanical pointing shall be a factory blend of sulphate resisting Portland cement to BS 4027, kiln dried sand and pulverised fuel ash to BS 3892: Part 2.

The mix proportions to obtain the design strength required shall be determined by the Contractor.

The mortar mix shall have low heat hydration and low plastic shrinkage properties, with a minimum 28 day compressive strength compatible with the strength of the adjacent brickwork.

In wet areas of tunnel-lining repair, sodium silicate shall be introduced, when required, into the mortar flow at the applicator nozzle.

The optimum silica content in relation to its viscosity shall be as advised by the mechanical pointing mortar mix supplier to give an initial set suitable for the conditions at application.

(153.011)

Curing of grout and mortar

- I2** Details of the hardening and curing characteristics of the proposed grout or mortar including details of the effects on temperature or other environmental and weather factors on the hardening and curing of the grout or mortar shall be submitted to the Employer's Representative.

During the hardening and curing of the grout or mortar, adequate precautions shall be taken to ensure that the temperature, environmental and weather factors do not cause any adverse effect on the performance of the grout or mortar. These factors shall be monitored and recorded so that an assessment can be made of the actual strength gain of the grout or mortar in situ.

Testing of samples of the grout or mortar, cured under identical conditions as the repair, shall be carried out to verify the setting, hardening and strength to be achieved on the resumption of dynamic loading.

Adequate precautions shall be taken to ensure that dynamic loading of the repair or element of the structure does not adversely affect the integrity of the completed repair.

(153.012)

Stitching and pinning bars and holes

- 13** Stitching and pinning bars shall be stainless steel high yield deformed reinforcing bar (grade 460) complying with BS 6744.

Holes shall be drilled in accordance with Clause 153.036.

Unless shown otherwise on the Contract Drawings, the nominal bar diameter and drilled hole size shall be in accordance with Table 153/I as applicable to usage.

Table 153/I		
Usage	Nominal bar diameter	Nominal hole diameter
Cross pinning of new facing or patch repairs	12	16
Stitching cracks	16	20
	20	25
Cross stitching for grouting of brick arch rings	16	20

The bar and hole length shall be determined by the Contractor to ensure a minimum of 100 mm solid brickwork or masonry remains intact beyond the end of the hole.

Trial drilling of the existing brickwork or masonry shall be carried out to ascertain the overall thickness of the brickwork or masonry.

The dimension between the end of the bar and the front face of new brickwork or masonry, projected along the centreline of the hole, shall be in the range:

- (i) 20 mm to 30 mm for cross pinning of new facing and patch repairs and for pinning new single brick arch rings,
- (ii) 40 mm to 50 mm for stitching of cracks.

(153.013)

Re-facing and patch repairs: general

- 14** Bricks for facing shall be in accordance with Clause 153.007.

Mortar shall be in accordance with Clause 153.010.

The maximum area of defective brickwork or masonry removed at any one time shall be agreed with the Employer's Representative and shall take account of the following factors:

- (i) whether the element supports static or dynamic loading,

- (ii) the condition of the brickwork or masonry to be removed and surrounding brickwork or masonry,
- (iii) the thickness of the remaining brickwork or masonry,
- (iv) Temporary Works used to relieve the element of load,
- (v) the time available for removal of dynamic and/or dead load, the amount of work which may be completed during the time available and the strength of the repair when traffic is planned to be re-introduced,
- (vi) the location and effectiveness of any repair,
- (vii) **(INSERT)**.

At all times the structure shall be capable of carrying the loads detailed in Section 23: Structural Repair Survey unless measures are taken to reduce the loading.

Unless shown otherwise on the Contract Drawing, the maximum area of defective brickwork to be removed shall be 1.0 m² by a half brick thick. Headers shall only be replaced where a key to the next course is required, or when agreed by the Employer's Representative. Care shall be taken to minimise disturbance to adjoining brickwork.

Details of the areas of brickwork or masonry to be removed at any one time, including supporting calculations and details of any Temporary Works shall be included in the detailed method statement for the repair.

Removal of existing brickwork and new facing or patch repairs to brickwork shall not be carried out until pinning or stitching and grouting operations have been completed.

New brickwork to patch repairs shall match the existing bond.

Mortar joints to patch repairs to arch rings shall be struck flush. Mortar joints to other patch repairs shall be struck flush, and finished to give a 'bucket handle' or struck and weathered joint as applicable to match the existing finish.

(153.014)

**Re-facing and
patch repairs:
general excluding
arch rings**

- 15** New brickwork for patch repairs or facing shall be built up in lifts which do not compress new laid mortar beds or preclude the installation and inspection of the grout infill between the existing and the new brickwork. The maximum single lift of new brickwork shall be 1.0 metre.

The gap between the existing or exposed brickwork and the new face shall be filled in lifts not exceeding three courses of brickwork. Subsequent grout filling shall only proceed after the previous filling has attained an initial set. Grout filling shall not progress until the brickwork mortar has achieved an adequate strength.

Grout infill shall be monitored using the method specified in accordance with Clause 153.037.

(153.015)

**Re-facing method
for major repairs
excluding arch
rings**

- 16** Complete or large scale re-facing shall be carried out in accordance with the principles shown on Standard Drawing RT/CED/436-001.

Totally new facing skins of brickwork shall be founded on the existing foundations, subject to adequate foundation capacity. If this is not practical new foundations shall be constructed at the same depth as the existing foundations. New foundations shall be designed to prevent differential settlement between the existing and new brickwork.

The interface between the original and new skin at the top of totally new facing skins of brickwork, shall be capped or sealed against the ingress of water. Details of the proposed shall be included in the Contractor's method statement.

Details of the materials to be used and the proposed method of installation shall be provided in the detailed method statement.

Channels shall be manufactured from stainless steel complying with BS 1449: Part 2. Holes shall be drilled in the channel to suit the reinforcement bar fixings.

Channel fixings shall be manufactured from stainless steel complying with BS 6105. The length of the fixing shall depend on the condition of the underlying brickwork. The depth of the channel and fixing arrangement shall be nominally 32 mm.

Brick ties shall be heavy duty channel ties made from stainless steel. Ties shall fit the channel section.

Following removal of existing defective facing, holes to receive channel fixings shall be drilled into the existing brickwork in accordance with Clause 153.036. Channels shall be installed at 450 mm centres (horizontal dimension) with channels fixings at 600 mm centres to suit brickwork coursing and avoid clashing with brick ties. Channels may be fixed to the face of the existing or exposed brickwork or recessed such that the fixing is flush with the face of the existing or exposed brickwork.

Channel fixings shall be grouted using a polyester resin grout. Details of the proposed grout shall be submitted to the Employer's Representative for agreement.

Brick ties shall be installed as work proceeds in every third course vertically, and ties in adjacent channels staggered by two courses.