Sandstone structures
A practical guide

01 CONTEXT

01.1 Background

This guide stems from a research report prepared by the Christopher Garrand Consultancy, in July 2015, as part of a suite of documents in preparation for the Greensand Country Landscape Partnership (GCLP). Building on a partial survey that was undertaken by volunteers in 2001, the brief was to carry out the Sandstone Structures Audit across the area defined as being within the boundary of the Partnership, focusing on the location and condition of the walls and other smaller sandstone structures which are a distinctive element of the Greensand landscape. The aim was to promote a better understanding and appreciation of the subtle yet distinctive use of local sandstone in the Greensand Country and to explain how it contributes to local distinctiveness. Also, to recommend how sandstone structures could be conserved and managed, to which end a detailed Appendix (C) provided a practical outline of best practice techniques to be used in conservation. This guide is a reworking of Appendix C supplemented by information drawn from the main Audit **www.greensandcountry.com/support/landscape-partnership/**

01.2 The Area and its Geology

The area defined as the Greensand Country stretches from the fringes of Leighton Buzzard and Milton Keynes, across Bedfordshire into Cambridgeshire: some 80% of its area is in the Central Bedfordshire Council Local Government area. An attractive mix of river valley and undulating landscape with a steep north–facing scarp broken by the valley of the River Ivel, the distinctive landscape of the area reflects its underlying geology: a layer of Cretaceous sandstone described by geologists as the Woburn Sands Formation, capped in many places by an ice-deposited clay-rich glacial drift. The resultant soil pattern

is complicated and varied resulting in a mosaic of land uses including arable, plantation forestry, some ancient woodland, pasture and land set aside for conservation and leisure use. There are a number of nature reserves as well as Sites of Special Scientific Interest.

Much of the present day extractive industry (quarrying) within the Greensand Country is based on aggregates usually sand. There are also layers capable of yielding a building stone of variable quality: harder stone is preferred for buildings with friable (crumbly) stones reserved for boundary walls, etc. Iron–rich compounds lend the stone a distinctive range of rusty ochre–brown colours, which has led to the stone often being referred to as 'ironstone'. It is difficult to carve and rarely used for mouldings or other complex features. Nor can it be worked as ashlar; it is always laid as random or roughly squared rubble. Where fine detail is required, other materials are generally used, notably limestone. Sandstone can also be seen mixed with cobbles, brick, and other walling materials.

01.3 The Structures

While many of the sandstone churches that are characteristic of the Greensand Country are of ancient foundation, the majority are essentially products of 19th or early 20th century restorations; medieval stonework is rare. Except for a number of bridges, there are few examples of sandstone being used for other types of building prior to the 19th century: there are a few modest cottages; four schools; a pumping station; and one 'grand' house. Ignoring Leighton Buzzard, there are less than 50 occupied sandstone buildings within or close to the Greensand Country. There are however 43 sandstone churches — well known and prominent buildings.

While the contribution of sandstone to the character and identity of the Greensand Country is significant, its presence is not always a defining feature, it being clusters of minor structures that contribute to the overall character. The Sandstone Structures Audit identified some 500 minor structures within and around the Greensand Country, of which just over 90% are freestanding or retaining walls, including 22 churchyard walls and stretches of parkland wall. Otherwise, walls are small scale and mainly associated with residential properties; 24% are associated with statutorily listed buildings. Other minor structures include farm buildings, garden structures, a well and an icehouse.

01.4 Scope

Set out below is technical information to guide the specification of repairs to sandstone structures, including information on the supply of stone and materials for mortar. The approach is 'conservative' in that it presumes the maximum retention of original (historic) fabric, and repair methods which are compatible with traditional masonry and construction. It covers:

- Maintenance and management.
- Stone.
- Mortars.
- Repointing.
- Indent (stone replacement) repairs.
- Rebuilding.
- Restoration and new work.

Mortar repairs are not included as these are generally unsuitable for potentially friable sandstone; likewise cleaning. SPECIFICATIONS ARE PROVIDED FOR GUIDANCE ONLY AND SHOULD NOT BE USED DIRECTLY TO PROCURE ANY WORKS; THEIR PURPOSE IS TO INFORM THE SPECIFICATIONS OF OTHERS, TO WHICH END THEY SHOULD BE ADAPTED AND DEVELOPED TO SUIT THE CIRCUMSTANCES OF A PARTICULAR PROJECT. References to suppliers are current at the time of writing, but should be checked for change.

02 MAINTENANCE & MANAGEMENT

The basis of all conservation (of buildings and structures) is good maintenance and management as 'prevention' is always better than 'cure', i.e. the prioritisation of simple repairs and anticipating problems can avoid the need for potentially major works sometime in the future. Key issues for minor sandstone structures are:

- **Day-to-day checks and inspection:** to identify at an early stage concerns such as invasive vegetation, the need for repointing and resetting loose copings, and — if necessary — specialist advice. Simple records should be kept, including photos (the same picture taken at intervals can be useful).
- **Vegetation control:** while lichens, mosses, creepers, etc. are in most cases benign and part of the character of historic structures, there are instances where vegetation can cause damage and hence should be removed. While not always a problem, ivy will need to be removed if woody, secondary growths are penetrating mortar joints, though it should never be pulled from a wall; the plant must be killed first, which may mean having to temporarily remove then reset stones in the same way as the indent (stone replacement) repairs described in Section 06. Other penetrating, woody growths should be similarly treated. Attention should also be paid to self-sown trees and other shrubs which may encroach on the stonework and cause displacement or collapse.

For larger structures, a formal maintenance regime should be considered, especially if piecemeal repairs are to be carried out over a period of time (all repairs should be recorded in a way that can easily be retrieved by others).

Ivy penetrating joints

Holly tree damaging wall

03 STONE

03.1 Supply

New stone for the repair of sandstone structures within the Greensand County can be obtained from two operating quarries:

- Cainhoe Quarry on the A507 southeast of Clophill (TL102375), owned by **Thomas Brothers Excavations (Luton) Ltd.**

  Cainhoe Road
  Beadlow
  Bedfordshire MK45 4HH

  Telephone: 01582 594111

- The large sandpits east of Heath & Reach (SP927287), owned by **L. B. Silica Sand Ltd.**

  Byrants Lane
  Heath & Reach
  Bedfordshire LU7 0AL

  Telephone: 01525 372000

Both quarries are primarily worked for aggregates (sands) but will supply building stone on request. Details are correct as of March 2019. Other quarries may be able to provide small quantities of stone locally; enquiries should be made direct.

03.2 Preparation

New stone must be carefully selected so as to ensure that it is free from any defects that could adversely affect its integrity in use or the appearance of the completed work, e.g. unconsolidated (soft) pockets or hidden shakes (fissures); a proportion of wastage should always be presumed. Stones must be:

- Properly seasoned (stone freshly split from the rock contains salts and other quarry 'sap' which must be allowed to stabilise before the stone is used).
- Brought to the proper condition for use, meaning that stone should not be placed when saturated or — most importantly — frozen (in cold and wet weather, stones should be kept under cover until usage).
- Hand dressed. While machine cutting and shaping is a sensible and economical way of working stone, final dressing (finishing) must be carried out using hand tools, with particular attention paid to replicating the shape, surface texture, tool marks, etc. of existing stone to be repaired or restored.
- Marked with the natural bed following working, allowing for placing all walling stone 'on bed' and for the 'edge bedding' of copings.
- Handled with tackle or other suitable mechanical aids, noting the requirements of the *Manual Handling Operations Regulations 1992*.
- As far as possible worked in the quarry or workshop due to the health and safety issues associated with silica dust which — as it may cause silicosis and other respiratory illnesses including lung cancer — is a controlled substance.

Recycled stone arising from demolitions, fallen walls and the like may also be used provided it meets the above criteria. Damaged stones can be cut down and redressed for use where smaller stones are needed, provided they can still be correctly bedded, though this may be difficult with random rubble.

Horizontal bedding planes

Edge bedded stone

04 MORTARS

The repair of sandstone structures should be based on mortars bound with lime (obtained by burning limestones or chalks at 900˚C to 1,000˚C so as to drive off carbon dioxide and leave calcium oxide), not modern Portland cements which — due to their high salt (sulphate) content and 'strength' (low porosity and permeability) — are generally harmful to traditional masonry.

04.1 Materials

Building mortars comprise a mix of binders, aggregates and water (which reacts with the binder as the mortar 'sets'). There are various types of lime:

- **Calcium lime putty:** CL90 to EN 459–1:2015. Matured for 3 months or longer and supplied in plastic tubs. A very pure lime made by 'slaking' quicklime in water and removing (sieving out) lumps so as to leave a smooth, consistent mass of gelatinous binder that sets by reaction with carbon dioxide in the air, a process known as carbonation. A number of firms produce CL90 putty. For reasons of health, safety and quality control, site slaking is discouraged.
- **Natural hydraulic lime:** NHL 2.0 or 3.5 to EN 459–1:2001. Made by the burning of limestones that contain clay and other impurities, and which when mixed with water have a 'chemical' set, i.e. air is not essential for carbonation though all NHLs contain a proportion of 'free' (pure) lime. Supplied in bags as a powder, NHL is branded either by manufacture or importer (NHL production in the UK ceased some years ago).
- **Quick lime:** unslaked calcium oxide supplied bagged in 'lump' (typically 40 mm), granular (e.g. 15 mm) or powdered form. Large scale production by firms that also supply limes for iron and steel production, and industrial, agricultural and environmental purposes. The basis of making lime putty (see above) though increasingly used for 'hot' lime mortars.

Earth may also be used as a binder (refer 05.3), though the nature and properties of this highly localised material are beyond the scope of this Appendix.

The principal **aggregate** for use with sandstones is a sharp sand, well washed and graded: Type S to BS 1200:1976 (replaced by BS EN 13139:2002 but still current) with clay content not exceeding 1–2% and with particle size restricted to the range 2.36mm to 150 microns. Leighton Buzzard sands are typical of the Greensand Country and available from local builders merchants. SOFT SANDS SHOULD NOT BE USED. Water should be clean and free from harmful matter.

Additives known as pozzolans are used to lend CL90 mortars a degree of chemical set where cold or damp might limit or compromise performance. A simple form of pozzolan is finely crushed brick albeit the particles may influence the colour of the mortar. Trass is natural pozzolan derived from volcanic rocks, used in northern Europe for many centuries. Metakaolin (a form of the clay mineral kaolinite sold under proprietary names), ground granulated blast furnace slag (GGBS) and low sulphur pulverised fuel ash (PFA) are also effective pozzolans.

04.2 Suppliers

Limes, aggregates and additives are available from a number of specialist suppliers operating regionally and nationally. The Building Limes Forum provides an up–to–date list (https://www.buildinglimesforum.org.uk/about-lime/lime-suppliers/). Many suppliers have informative websites and highly knowledgeable advisors.

04.3 Storage and handling

Calcium lime putty: Provide adequate dry, safe and secure storage of tubs in cool, frost free conditions. Party used tubs should have surface water returned and the lids tightly sealed to prevent carbonation.

Natural hydraulic lime: Provide adequate dry, safe and secure storage on site for bags of natural hydraulic lime. Store unopened bags of hydraulic lime in a dry, well ventilated place. Avoid wetting of lime before mixing. Open bags must be folded over, put into a dry store overnight and not used after the recommended shelf life.

Quicklime: Store as for natural hydraulic lime, noting that quick lime has a limited shelf life — usually three months — and will start to slake (convert to calcium hydroxide) if left in contact with the air.

Aggregates: To be protected from the weather but may be stored outside provided they pose no safety hazard and do not risk becoming contaminated. Aggregate must also be covered and protected from moisture, to prevent the washing out of fines and the 'separating out' of the graded material. Avoid intermixing and cross–contamination with other materials.

Additives: Store internally so as to ensure absolutely no cross–contamination. Check on delivery and reject any split or otherwise open bags. After opening, keep bags or containers sealed and covered.

04.4 Mixes

It is important to appreciate at the outset that when specifying and using lime (or any other) mortar there is no 'correct' mix. The 'design' of a mortar must start from an understanding of what is it intended to achieve and the conditions under which it will have to perform. Account must also be taken of the skills and experience of those who are to work with and 'place' the mortar, be they highly skilled stonemasons or perhaps general contractors wanting to 'do the right thing'. The key factors to consider at the outset are:

- **Durability:** the natural resistance of the masonry to weathering and decay, which in the case of the sandstones of the Greensand Country can generally be taken as 'moderate' though some of the more friable stones may have to be considered as 'weak'.
- **Condition:** little evidence of decay or surface erosion indicates stone in 'good' condition; 'moderate' means some surface loss or scaling, etc; and extensive loss of surface, and weak and powdery surfaces should be taken as 'poor'.
- **Exposure:** freestanding walls are subject to wetting both sides and — subject to the degree of shelter from driving rain provided by trees, buildings, etc. and proximity to roads and pavements (splashback and de-icing salts intensify exposure) — are best treated as being 'very exposed', with retaining walls perhaps considered as being in 'wet' conditions.

The different exposures and demands of mortars for pointing (exposed to air and the elements) and bedding (less exposed and hence less air for carbonation of free lime) should also be taken into account.

In general terms, the following mortar mixes are recommended generally:

- 1:2.5–3.0 CL90:sand + a pozzolan (10% PFA or Trass, or 5% Metakaolin or GGBS as a proportion of the volume of the lime:sand mix).
- 1:2:1 CL90:sand:crushed brick.
- 1:2.5–3.0 NHL2:sand (best avoided if the stone is weak).

Straight CL90 lime and 'hot' mixes may also be acceptable — the former for weak, friable stone and the latter (especially) for the bedding replaced or rebuilt stonework — subject to specification and placing by experienced persons. Pre-mixed mortars are available and can also be used. For retaining walls and copings in good condition, a 1:2.5–3.0 NHL3.5:sand mix can be considered.

Mixes are given for general guidance. Final proportions within the specified ranges should be adjusted to suit the size of aggregate (the smaller the aggregate the greater the proportion of lime) and weather conditions, aiming always to achieve the most permeable mortar within the given constraints of the joint width and exposure. FINAL SPECIFICATION SHOULD BE DETERMINED FOLLOWING TRIALS.

04.5 Batching

Measure materials for mortar into separate buckets or gauging boxes to suit the specified proportions. Completely fill and empty buckets or boxes at each batching, keeping dry at all times. Avoider gauging by shovel. Do not batch damp aggregates.

04.6 Mixing

CL90 lime mortars: By hand (small quantities) or using a pan mixer. A normal rotary cement mixer may be used if two or three smooth stones (cobbles) are placed in the drum, and its inclination reduced. In either case, do not add water.

NHL mortars: A normal cement mixer may be used. While in a dry state, mix half the sand with all of the lime to achieve a uniform colour. Add the remaining sand and mix well again. Continue mixing whilst slowly adding the least amount of water necessary to achieve a workable mix. Follow manufacturer's instructions for mixing large quantities. To improve workability, reduce the mixing time and soften the initial set 10% of CL90 putty — as a proportion of the weight of the NHL binder — may be added provided this is done before the optimal level of water is added and strictly in accordance with the supplier's instructions.

Hot lime mortars: Water is added to quicklime and dry aggregate (the quicklime is usually placed in a well in the sand) and thoroughly combined with a shovel, the slaking and mixing effectively taking place at the same time. The process generates a lot of heat, and the mixed mortar may have to be sieved to remove unslaked lumps or other impurities.

Pozzolans (additives): Do not add to mortar until immediately before use. Mix with water to form a slurry before thoroughly blending into binder–aggregate mixture (coarse stuff) using a plaster mixer drill or rotary drum mixer. POZZOLANS MUST NOT BE ADDED TO NHL MORTARS.

04.7 Usage

Calcium lime mortars: can be stored and reworks ('knocked–up') provided isolated from contact with air, i.e. in sealed containers. MORTAR TO WHICH POZZOLANS HAVE BEEN ADDED MUST BE USED WITHIN TWO HOURS OF BLENDING.

NHL mortars: can be knocked–up within 12 hours of mixing, provided they are covered and protected to minimise water loss. Reworking should entail adding only the absolute minimum of water. If significant quantities of water are needed then the mortar must be discarded.

Hot lime mortars: can be used hot or cold, and stored as calcium lime mortars.

04.8 Working temperature

Do not mix mortars unless precautions are taken to ensure that the air temperature *at time of placing* will be above 5°C and below 30°C, taking account of the wind chill factor on exposed sites. Cease work when the air temperature is at or below 5°C (or likely to fall below 5°C before the surface set of the mortar) unless precautions are taken to ensure that the mortar is 8°C min. when laid and is protected from freezing until the mortar has hardened. Do not place during a continuous cold spell.

04.9 General protection

Protect mortar from direct sunlight, wind and rain for at least one week after placing. In hot weather, prevent rapid drying out by wetting with a fine mist spray two or three times a day. Netting to scaffolding will provide adequate protection generally, though exposed work will need to be protected with plastic sheeting or similar in close contact.

05 REPOINTING

05.1 Purpose

The purpose of repointing selected joints and areas of the walling is to ensure that open bed joints or perpends which compromise the weathering function of the walls are filled with mortar which is more permeable than the adjacent masonry, and that — where practical and appropriate — damaging cement-rich pointing is replaced.

Open joints & failing cement mortar in need of renewal

05.2 Mortar analysis

Before finalising any decision to repoint, the nature and composition of the existing mortar should be established, and if necessary adjustments made to the mixes given in 04.4. Simple visual analysis of a sample using a 10x lens will usually suffice, though for important walls laboratory analysis of samples may be considered. Firms who are able to carry out analysis are listed in *The Building Conservation Directory* published annually by Cathedral Communications Ltd.

05.3 Earth mortars and dry bedding

Some walls — particularly retaining walls — may be bedded in earth–lime mortar or just earth; if so, the walls should be repointed in a similar mortar, using where necessary local deposits of clay and accepting the need to experiment with samples and trials. Where stonework laid in earth mortars has been subsequently repointed, in cement, the pointing should be removed, noting that the repointing is quite likely to have failed or be failing. Other walls may simply be laid 'dry', in which case no attempt should be made to point any joints; previous attempts at pointing may also need to be removed.

05.4 Removal of existing pointing

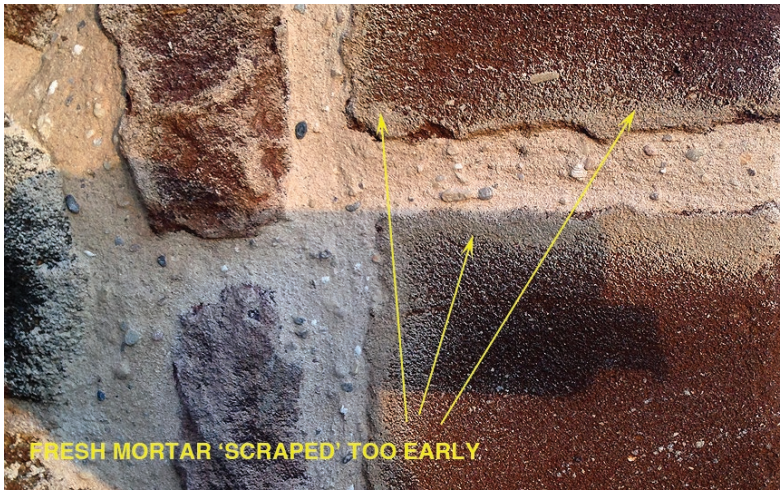
Carefully cut out defective pointing, breaking hard cement mortar along the line of the joint with a flat bladed chisel or quirk held parallel to the joint, always working away from the arises of the stones, which must not be chipped. Softer mortars can be removed by hand using a small tool or — with careful use — a hammer and a chisel or quirk which is *narrower* than the width of the joints being cleared. Mortar should be removed to a depth of 30mm from the arises of the masonry and cut back to a square, clean face. DO NOT USE ANGLE GRINDERS OR OTHER POWER TOOLS TO REMOVE MORTAR; ALL JOINTS MUST BE CLEARED BY HAND.

05.5 Preparation of joints

Fully clean open joints using a bristle brush and compressed air, and if necessary an industrial vacuum cleaner. Rinse debris from joints and wall surface using a hand sprayer with a fine jet until the water runs clear.

05.6 Pointing and finishing

Dampen joints immediately prior to filling. Fill joints with mortar, pressing well (hard) into the back of the joint with a pointing iron of the correct size (i.e. narrower than the joint), bringing joints flush or slightly proud of the surface of the surrounding stone or brickwork ready for finishing. Protect as necessary until finishing. DO NOT ATTEMPT TO CLEAN FRESH, SURPLUS MORTAR FROM THE FACES OF THE STONEWORK.



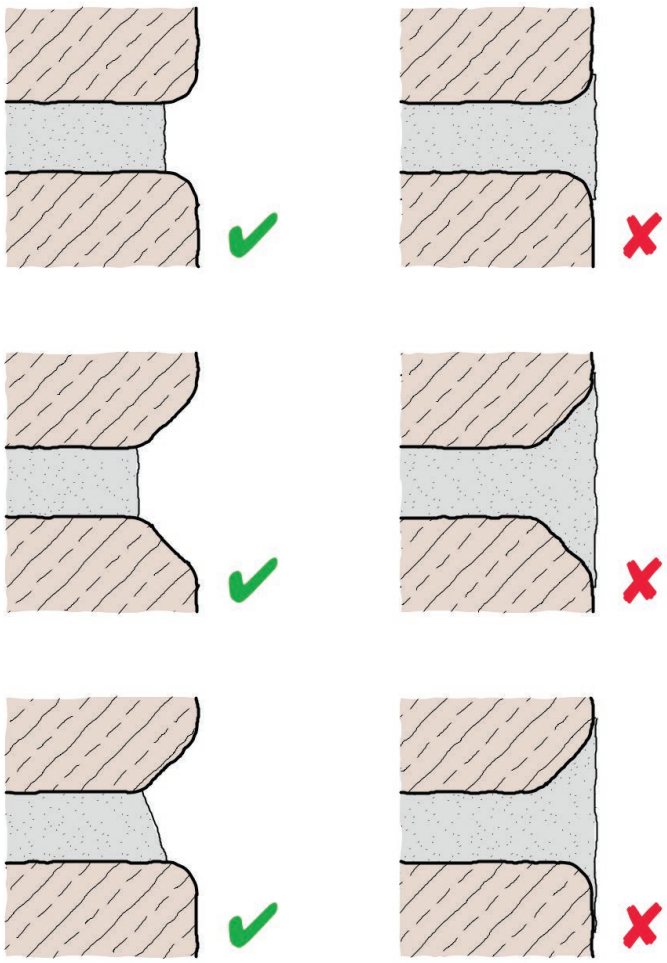
Permanent discolouration of stonework due to attempt to remove surplus mortar while placing (i.e. when fresh)

05.7 Deep tamping

Where joints are deep or have voids behind which need packing out (e.g. after raking out friable mortar), it may be necessary to point–up in more than one application (to avoid slumping or excessive shrinkage), pushing a 'dry' mortar hard back into the joint with a tamping iron or other suitable tool. Build–up deep tamping in layers, allowing each application to dry (dewater) before applying more mortar.

05.8 Finishing

Allow the mortar to go off. Tidy up and compact any loose or friable edges using a spatula or other fine tool, 'contouring' the mortar to ensure the avoidance of any vulnerable feathered edges, i.e. faces of joints to be at between 45° and 90° to the beds of the stonework. Stipple with a stiff bristle (churn) brush so as to break (open) the surface of the joint, which should finish flush or just back from the rounded or weathered arises of the masonry. SPONGING (SMOOTHING) OF JOINTS AND RAISED (RIBBON) POINTING ARE IN NO CIRCUMSTANCES ACCEPTABLE.



Correct & incorrect treatment of pointed joints

05.9 Protection

Protect mortar — placed and finished — from direct sunlight, wind and rain using polythene sheet or hessian in close contact. In hot weather, prevent rapid drying out by wetting with a fine mist spray two or three times a day (if used, hessian to be kept damp regardless). If temperatures are expected to drop below 5°C at night, provide additional layers of insulation, e.g. bubble–wrap separated from the masonry by a layer of hessian, overlain by a second layer of hessian held firmly in place. Protection to remain in place for at least one week after finishing of mortar.

Good quality repointing of a squared rubble wall

06 INDENT REPAIRS

06.1 Purpose

The purpose of indent repairs is to replace deeply eroded stones that threaten the stability or weathering function of a wall or structure using new (or reclaimed) stone that matches as closely the existing in terms of colour, texture, etc.

06.2 Sequencing

Cutting out of stones (individually or in groups) must be planned so as to ensure the stability of the structure is not compromised, taking account of both size and position of stone, with stonework renewed in short, discontinuous lengths. Allow if necessary for needling, propping and pinning.

06.3 Cutting out existing stone

Cut out around each stone — or area of stone — to be replaced using a fine-toothed masonry saw or other tool that is narrower than the width of the surrounding joints, and to the full depth of the stone; coping stones to be cut out full depth and height. NO ANGLE GRINDERS OR OTHER POWER TOOLS ARE TO BE USED. The utmost care is to be taken to ensure that adjacent stones are not in any way damaged (e.g. chipped, nicked or cut). Stone to be wasted may be removed by any reasonable means following loosening.

06.4 Preparation of cavity

Clear all dust and debris from the whole of the cavity by flushing with clean water, and allow to dry. If necessary, retain samples of mortar for analysis.

06.5 Preparation of new stones

Ensure all stones are dressed and sized to suite the cavity allowing for mortar joints to match existing width, and for the correct bedding of each stone, which should follow the pattern of the existing (unless already incorrectly bedded).

06.6 Laying

Wet the existing stone and spread to the base and rear of the cavity a mortar bed of a thickness to suit the final joint width and the line of the face of the stonework (new stone). Dampen and carefully place the new stone, working it back into the cavity until it is in the correct position.

06.7 Jointing and pointing

Allow for the bed joints to dry and the new stone to settle. Fill all remaining joints with mortar, deep tamping to ensure compaction right to the back of the joint before pointing and finishing in accordance with Section 05, noting the requirements for finishing and protection.

07 REBUILDING

07.1 Purpose

The purpose of rebuilding is — on the basis of understanding and justification (rebuilding should always be a last resort) to — carefully take down and reconstruct unstable or falling stonework, using as much original material as possible, following and where necessary recreating the existing pattern, coursing and detailing.

07.2 Recording

Before taking down, record in detail the wall or structure as it stands, assigning a unique number to each stone. Positions of stones in elevation (both sides of walls) can be recorded on marked-up, rectified photos or heavy gauge clear polythene held in a tracing frame. Pay special attention to unique or characterful details.

07.3 Taking down

Carefully take down masonry stone–by–stone, working sequentially from the coping or top course one layer of stone at a time, numbering the top of each stone with chalk prior to removal, and marking clearly both face and tail, i.e. the direction of the stone in the wall. Store stones in a systematic manner, laid out in sequence. Clear all stones of mortar, dust and debris.

07.4 Rebuilding

Wetting stonework as work proceeds, rebuild walling in the reverse sequence of taking down, working in horizontal layers (courses) placing each numbered stone back in its original location and in the correct orientation. Bed stones in lime mortar as Section 04, accounting for the possibility of earth mortars, etc. as 05.3. For walls, do not raise more than approximately 900mm of stonework in any day.

07.5 Finishing

Leaving bedding mortar as laid for approximately 24 hours before removing surplus material and finishing as specified for repointing in 05.6.

07.6 Protection

Cover rebuilt stonework at the end of each day, and provide on–going protection generally as for repointing (05.9), though allowing for the stonework being wetter and hence the possible need to remove protection earlier (to allow the free lime component of the mortar to dewater and carbonate).

08 RESTORATION & NEW WORK

Where stonework that has — for whatever reason — been lost and is on the basis of evidence and justification to be restored, new building should be on the basis of the specifications provided in Sections 03 to 07. Particular care should be taken to match the type of stonework (random or squared rubble, uncoursed or coursed, etc.) and the pattern and heights of any coursing, which may be:

- **Random:** Uncoursed, brought to courses, polygonal, diagonal or herringbone.
- **Squared:** Uncoursed, snecked, brought to courses or regularly coursed.

New walls and other minor structures (especially walls) should only be introduced in areas where sandstone contributes to local distinctiveness (refer Subsection 04.2 of main body of Sandstone Structures Audit report).

Local traditions in terms of usage, stone size and coursing should always be noted and generally followed.

Types of rubble walling

Random — uncoursed

Random brought to courses

Random — polygonal

Random — diagonal

Squared — uncoursed

Squared — snecked

Squared brought to courses

Squared — regular courses

09 OTHER REPAIRS

Individual circumstances may require other forms of repair to minor sandstone structures, examples of which include grouting, crack–stitching, buttressing, pinning and other engineering–type interventions. These must be justified and developed on a case–by–case basis, combined with a thorough understanding of the issues involved and if appropriate the advice of a structural engineer experienced in the conservation of historic buildings and structures.

10 FURTHER INFORMATION

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