TECHNICAL BULLETIN 4

REPOINTING MORTAR JOINTS

INTRODUCTION

This bulletin is intended to provide a guideline for the conditions relevant to repointing of mortar joints between masonry units.

DEFINITIONS

Pointing: To fill or refill and finish the joints

Repointing: The process of removing deteriorated mortar from the joints of a masonry and replacing with new mortar.

Tuckpointing: A special kind of joint used to make wide, irregular joints resemble thinner and more regular joints.

APPLICATION CONSIDERATIONS

1. When to repoint

A. Missing, void or deteriorated mortar joints between masonry units. Missing or deteriorated to the extent moisture penetration and/ or facade integrity has been compromised.

B. Debonded or cracked mortar joints: When bondline separation occurs between masonry and mortar has separated to a degree that allows moisture penetration. Typically this is 1/52 inch or greater.

C. Powdering mortar joints: When mortar has deficient integral characteristics, resulting in component separation or loss of aggregate typically caused by freezing or extreme weathering of mortar.

D. Loss of inappropriate jolnt profile: When joint profile has eroded or otherwise lost its weatherproofing capabilities or desired aesthetics.

E. Inappropriate mix/material: When existing joint composition has an inappropriate mix design or incompatible replacement materials (i.e. sealant, too high compressive strength, etc.)

2. VERIFICATION OF EXISTING CONDITIONS

A. Visual: Visually inspect ¡oint for original profile, color, fooling and texture characteristics.

B. Physical: Physical analysis of mortar is compiled by removing existing sample that can be tested using sieve analysis to identify size, type and color of aggregate. Compression strength testing should also be completed on existing mortar sample to determine hardness of original mortar. n no case should replacement mortar be harder (higher cement content) than original mortar. Testing of the substrate to be pointed should be performed to determine the compatibility of the repointing mortar chosen.

C. Chemical: Chemical analysis of modern cements can be performed to determine the binder (cement/lime) content. Placing a crushed mortar sample into diluted hydrochloric acid does this. If a reaction (bubbling) occurs, most of the binder was lime. Cement will leave a murky liquid that dissolves over a few days. By rinsing remaining aggregate, examination is possible to visually determine size, range of color and overall granulation of aggregate. The most accurate testing requires laboratory analysis.

D. Proposition: By a combination of the physical and chemical analysis results, the proportional mix of materials in a mortar can be calculated.

E. Petrographic Visual analysis (using a high—powered microscope) by specially trained technicians of prepared mortar samples can assist in determining or confirming the composition and proportions of mortar materials in a sample. This is particularly helpful when evaluating samples from historic properties.

Mortar Joint Removal (Refer to *SWRI Technical Bulletin #3 Mortar Joint Removal*)

DESIGN CONSIDERATIONS

Mortar Mix

After determining original composition of mortar by methods described above, the appropriate mortar mix can be designed. Mix ingredients typically consists of lime, cement,

aggregate, water and possibly pigments. The relative proportion of lime to cement to aggregate will determine the compressive strength, workability, bonding strength, joint texture, elasticity and color characteristics of the mortar.

See Figure 1 for standard modern mortar mix designs

See Figure 2 for historic mortar mix designs.

Consideration should be given not only to existing mortar conditions (hardness, color, porosity, texture) but also to existing substrate; building location relative to elevation exposure (N, W, S, N), extraneous (adjacent structures, pollutants, etc.) and climate conditions. In all applications, the replacement mortar should not be harder than the adjacent substrate or original mortar. Testing of the original substrate to determine existing physical properties is recommended to verify compatibility.

Cement: Portland cement has been used since the mid 1800s. It is a combination i›f lime, silica, alumna and iron oxide tha is ground up, burned in a kiln and mixed with gypsum to form a fine powder. Ilamra1 cement, consisting of high-clay-content limestone burned in a 1‹ih and ground into a fine powder, was used widely between 1850 and 1920.Masonry Cement consists of a mixture of Portland cement or blended hydraulic cement and plasticizing materials such as limestone, hydrated or hydraulic lime together with other materials introduced to enhance one or more properties. Masonry Cements are primarily used for the laying or relaying of masonry units.

FIGURE 1

Mortar Type	Parts by volume of portland cement, cement, or portland blast-furnace slag cement	Parts by volume of masonry cement	Parts by volume of hydrated lime or lime putty	Aggregate, measured in a damp, loose condition
M	1 1	1 –	– ¼	Not less than 2 ¼ and not more than 3 times the sum of the volumes of the cements and lime used
S	½ 1	1 –	– Over ¼ to ½	
N	– 1	1 –	– Over ½ to 1 ¼	
O	– 1	1 –	– Over 1 ¼ to 2 ½	

Lime: lime is a burned form of lime derived from the calcificafion of sedimentary limestone. Lime is an essential ingredient in mortar because it adds plasticity, improves workability, and provides water retention attributes for effective bonding, decreases shrinkage In mortar and reduces efflorescence potential due to its purity. Hydrated lime, type S, is typically used for mortar mixes. Lime putty, or fully slaked and screened dolomitic lime in putty form, is also available today.

Aggregate: Aggregate typically consists of clean sand obtained naturally from quarries and riverbeds. Aggregate acts as filler and helps in the workability of the mortar. A siltation test should be performed on aggregates to ensure aggregates are suitable for mortar mix – (refer to technical manual to be sent separately).

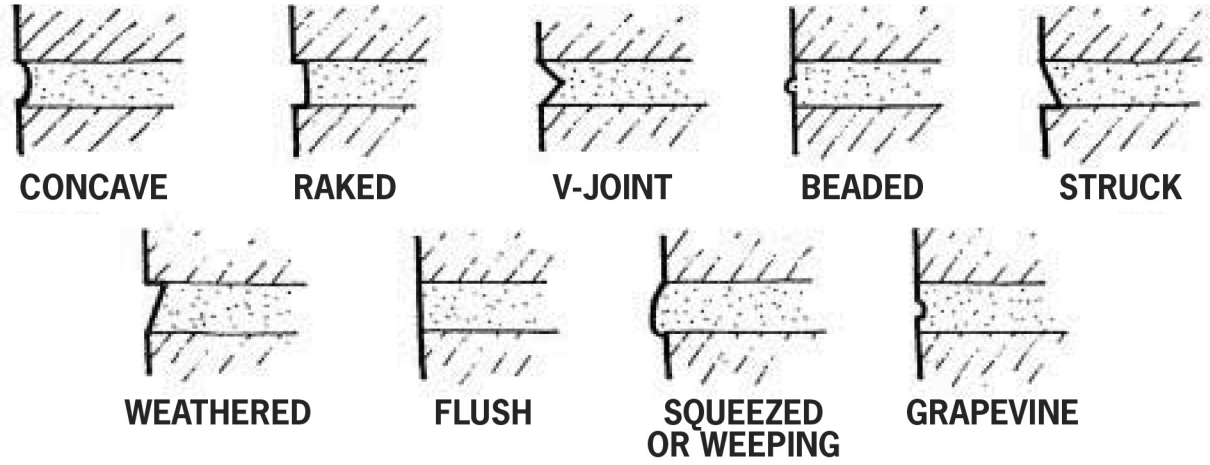
Water: Water should be clean, potable water.

FIGURE 2 **HISTORIC MORTAR TYPES**

Designation	Cement	Hydrated Lime or Lime Putty	Sand
M	1	1/4	3 - 3 3/4
S	1	1/2	4–4 1/2
N	1	1	5–6
O	1	2	8–9
K	1	3	10–12
“L”	0	1	2 1/4–3

Color: Mortar pigments are typically inorganic mineral oxides mom specific materials that, when added to the dry aggregate portion of the mix, provide a range of colors for the mortar. Pigments should not exceed 10 percent of the weight of the portland cement to avoid excessive strength reduction of the mortar. Pigments should be used in the smallest amounts possible to

FIGURE 3



provide the desired color. Color should match original joint color, not the soiled existing color. It should be noted that the proper use of local aggregates in the mortar mix could be another successful method to controlling color, especially when attempting to match older historic mortars.

Mixing Procedure

All components (lime, cement, aggregate and coloring) should be volume measured for precise mix ratios. Measuring devices should consist of scales or appropriate volume containers and not used soda cans, coffee cups, W Mix proportions should be available at jobsite for production control purposes.

Dry mix should be thoroughly mixed to ensure proper blending of lime and cement and complete coating of aggregate. Acceptable means of mixing are manual (hoc and mortar box) or mechanical (mortar mixer or paddle mixer) Most mixers cannot dry mix the components prior to adding water. The mixers will bind and not run if this procedure is followed. . enough water should be added to mix to produce a damp mix, which will retain its form when compressed into a ball.

Fully mixed mortar should be used v4thin 50 minutes and should not be retempered. Percentage of wafer used in the mortar depends on the composition of the dry ingredients, moisture content of the aggregate, types of masonry units being installed and desired consistency for the technician.

Joint Profile

There are a variety of joint profiles common today. Figure 2 illustrates typical mortar joint profiles.

'the most elective and watertight joints are the concave and "v" tooled joints. £lush Joints are used when other finish materials (stucco or coatings) are to be applied over masonry. Existing joint profile should determine the appropriate replacement joint used in historic projects.

APPLICATION CONSIDERATIONS

1. Mock-up panel

An important consideration for a successful repointing project and mutual understanding between contractor and owner/architect is the installation of a mock-up panel Usually a 5- foot-by-5-foot panel is sufficient to demonstrate the joint profile, mortar color and overall appearance within the surrounding masonry. Typically, the contractor would install a panel at an inconspicuous but representative area of the building. Once approved, the panel should serve as the standard for the balance of the work on the rest of the building.

2. Mortar Installation

Climate conditions: Repointing should be performed only when the outside air temperature and substrate temperature meets or exceeds 40 degrees and the wall is given proper protection from the elements. Masonry shall be protected from freezing for 72 hours after placement. High Lime content mixes require extended protection from freezing conditions. Straight lime mixes may need protection up to 90 days.

Joint condition: The prepared mortar joint (as per Technical Bulletin #3 - Mortar Joint Removal) should be flushed clean with potable inter, resulting in a damp condition free of standing water often referred to as SSD (saturated surface dry)

Joint placement: Pack mortar into the prepared joint in three equal, successive layers (1/4 inch thick). Each layer should be fully compacted and thumbprint hard prior to the installation of the next layer. the final layer is to be tooled to match the prepared mock up panel. If the joint is more than 1 inch deep, placements of first and second layers should be 2/5 each of joint depth with final layer the remaining 1/3 inch (not to exceed 3& inch).

A. Curing of mortar: Upon completion of installation of fresh mortar, area should be mist cured periodically to maintain a damp condition for approximately 72 hours. This promotes desired bonding between mortar and masonry and ensures consistent full-depth curing of mortar.

B. Clean up: Alter mortar is fully hardened, thoroughly clean exposed masonry sufaces of excess mortar failings, smear stains and efflorescence using still nylon bristle brushes or wet burlap. the surface should be rinsed down with dean, potable inter applied at1‹zv pressure.

C. Environmental impact: Consideration must be given to the Impact that mixing mortar joints have on the health and safety of the workers and the environment of the surrounding project site. Workers must wear and be properly trained in the use of respirators and other personal protective equipment, such as face shields, eye and hearing protection. It is also incumbent on the contractor to ensure that pedestrians and building occupants are protected from the dust created by the operation Protective tarping and mesh have proven to be effective in controlling the dust to the work area directly. The use of vacuum attachments to the equipment housing is also effective in collecting dust. Some attachments prevent workers from having a clear view of the mortar joint and should not be used.

D. References: The able guidelines are developed primarily for reprinting of brick masonry units. Repointing for stone, terra cotta, concrete block, etc., will vary due to substrate materials and conditions. Refer also to USIM Standards C144 (Aggregate for Masonry Mortar), C150 (Portland Cement), G2o7 (Hydrated Lime), C270 (Mortar for Unit Masonry) for additional information

Other valuable resources available from the Sealant, Waterproofing & Restoration Institute

SWR Institute *Applicator,* a technical journal

Applying Liquid Sealants: An Applicator Training Program

Below Grade Waterproofing Manual

Clear Water Repellent Handbook

A Practical Guide to Waterproofing Exterior Walls

Sealants: The Professional's Guide