RESTORATION OF MASONRY STRUCTURES

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INTRODUCTION

Restoring old buildings for their historical, architectural value is becoming more and more frequent over the last decade. Structures constructed at or around the turn of the century are now in need of repairs. There is also an increase of awareness by the public as to the value of these structures as it relates to preservation of old land marks structures. As a result of this there is a demand for both mason contractors and designers with expertise in restoration work.

The most common sign of distress in these old buildings is the deterioration of the mortar caused by weathering, freeze-thaw, chemical attack, cracking of the masonry due to foundation or other movements such as wedging due to corrosion of steel inserts, deterioration of wood inserts etc.

Cleaning and enhancing the appearance of these buildings is also an area where specialized knowledge is required.

This paper looks into aspects of restoration and recommends procedures, for repainting, cleaning and enhancing of the appearance of old masonry structures and provides some guidelines which when followed are expected to produce good results. The paper also deals with the evaluation of causes of masonry distress and recommended remedial procedures.

REPOINTING MORTAR JOINTS

The wall section shown in Photos 1 and 2 derronstrates the effects of time on the mortar. Repainting of masonry structures, when properly done will restore both the visual and physical integrity of the structure. If it is not properly executed, repainting can be damaging both to the appearance and may also cause damage to the masonry units. Repainting is a process requiring removal of old deteriorated mortar from the vertical and horizontal joints and replacing it with new mortar. Because many factors contribute to deterioration repainting alone will, in most cases, not be sufficient to correct problems associated with age. The decision to repaint a structure is often the result of an inspection which points out obvious signs of deterioration such as cracks in the joints, mortar disintegration loose masonry units, areas where moisture is present etc.

Deterioration maybe the result of other factors such as water leakage from the roof or copings, water penetration from parapet walls, foundation movement, rising dampness etc.

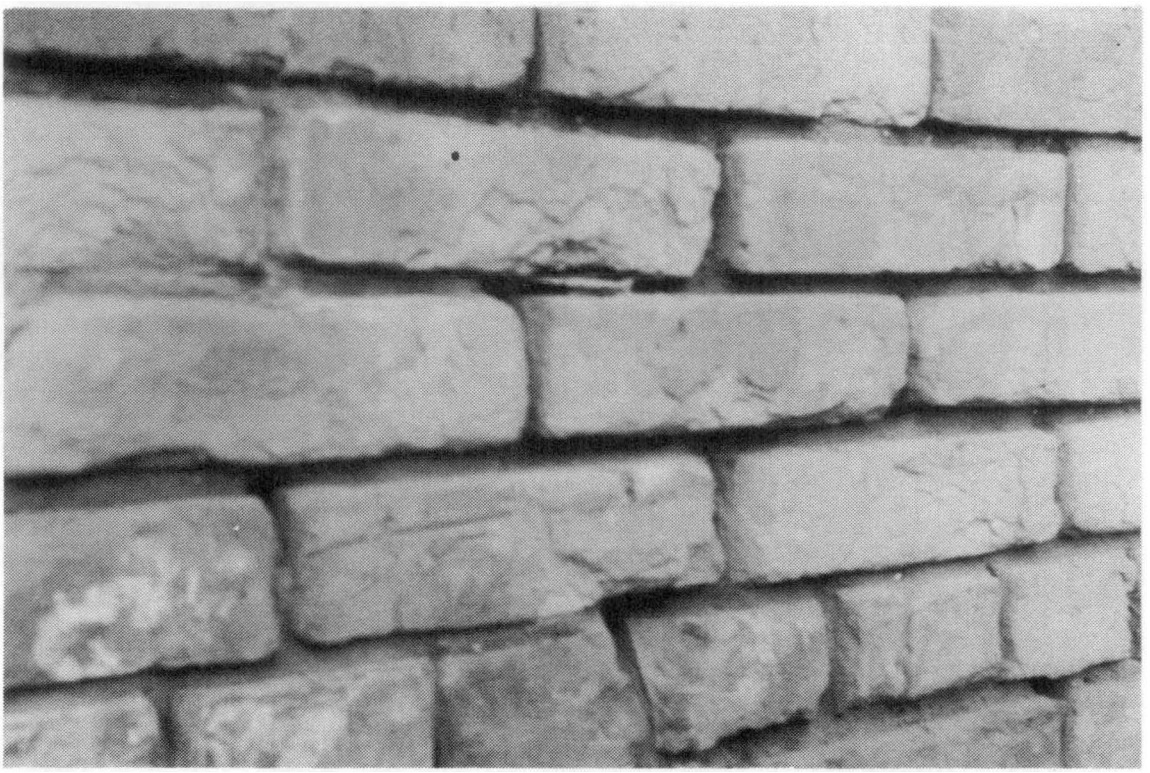

Photo 2. Old Brick wall showing mortar deterioration.

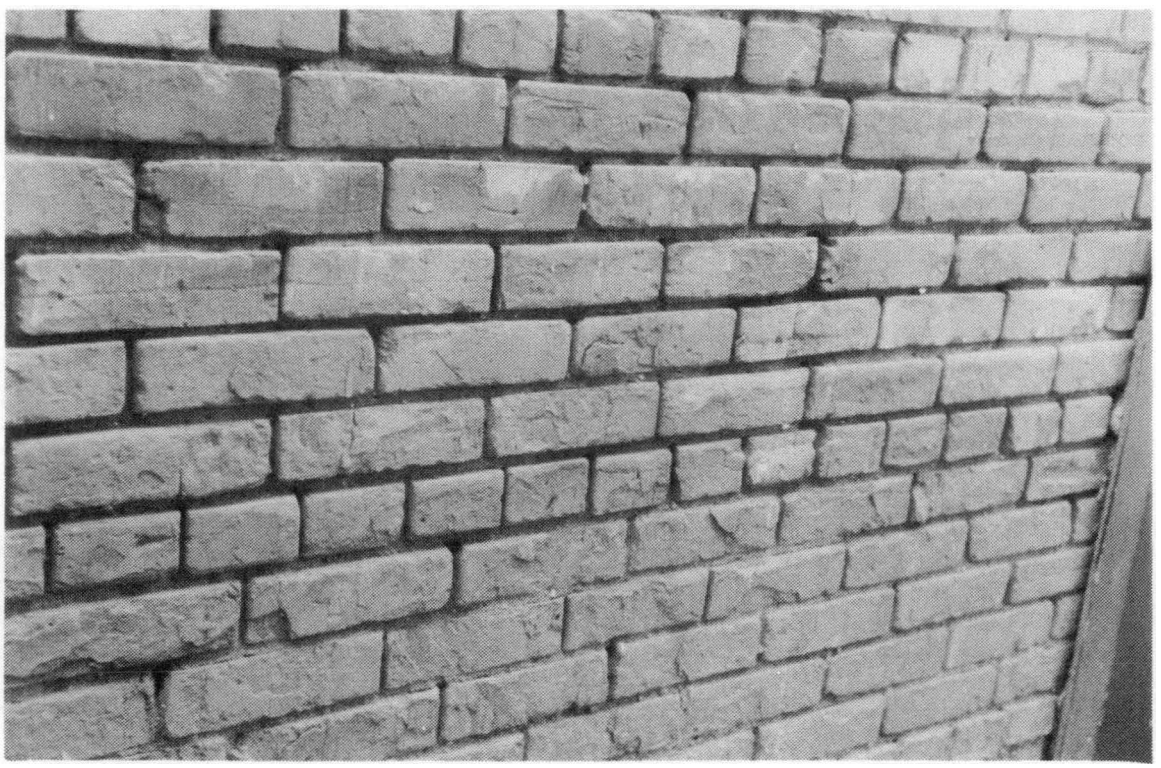

Photo 3. Weathering of mortar in old brickwork.

All the above sources of deterioration must be recognized and acted upon. Failure to correct these factors will result in deterioration of the repainted masonry, or reductions of the life expectancy of the remedial work. Once the factors contributing to deterioration are recognized and dealt with, repainting of the structure can proceed.

For a repainting project to be successful the most important factor is that of establishing the type of mortar to be used. The mortar must be of the same colour as the one used in the original construction. Since the materials used in the original structure are of different qualities and consistency than the materials is use at present it may be necessary to establish the techniques, mortar and masonry units used in the original construction of the wall.

The colour of the mortar depends to a large degree on the colour of the sand. In order to establish the type of sand employed, remove mortar samples from areas where no weathering has occurred. Break these samples using a wooden mallet until they are separated into their constituent parts. With due care blow away the cementitious, powdery materials, and examine the sand with a low power magnifying glass.

Since it is more than likely that the original sand was not screened or grated it may be necessary to obtain samples from a number of locations in order to establish the source of materials used.

Repainting mortars should be softer than the masonry units in the structure and no harder than the historic mortar. Hard mortar is not necessarily more durable than soft mortar.

In most cases lime mortar is the most suitable for repainting, however, the additions of small percentage of cement (white cement) will improve workability.

To ensure that the new mortar will match the old one, a sample panel must be constructed and allowed to cure for at least 30 days. The panel should be combined with un-weathered interior wall section where the mortar is cut back to expose interior colour and texture.

Prior to repainting the joints must be prepared to receive the new mortar, by removing old mortar to a depth of 2½ to 3 times the thickness of the old joint they also must be free of dust to ensure that adequate new bond will develop and to prevent mortar "popout".

If the joints to be filled are more than 25 mm deep, repainting must be in layers, to limit shrinkage and to ensure proper filling. The second application can be made when the placed mortar is allowed to gain strength (hardens). Tooling of the joints should be carried out when the mortar is thumb print hard. Tooling the joints when too soft will yield a lighter colour and when the joints are tooled when the mortar is to hard there may be dark streaks appearing.

Prior to cooling it is important to examine existing vertical and horizontal joints to determine the order in which they were tooled and whether they were the same style.

CLEANING OF THE OLD BRICKWORK

Prior to commencing with cleaning of brickwork it is important to know what is expected of the cleaned surface. In some cases the beauty of the material is achieved with the age and weathering. Unique colour and texture of the surfaces are the result of many years of exposure to the elements. It is possible that under this weathered surface there are old repairs which may be visable after cleaning. In such instances cleaning may not be desirable or it can be a mistake.

There are however cases where the original design by means of different colours and textures of masonry units created certain appearances effect which may be significant enough to warrant restoration. In such cases cleaning may be the only means of exposing the hidden features and restore the original intentions. Photo 3 shows brickwork when cleaning is required. For structures in urban areas rerroval of soot and grime enhance the appearance drastically.

Methods for cleaning brickwork are devited in two categories:

a. Wet Process and

b. Dry Process.

Wet process should start by evaluating the performance of drinking water assisted by liquid brushing with a bristle (not wire) brush. Warm water and steam should be tried next with detergents or weak acids as a last resort. In all cases the walls should be saturated with

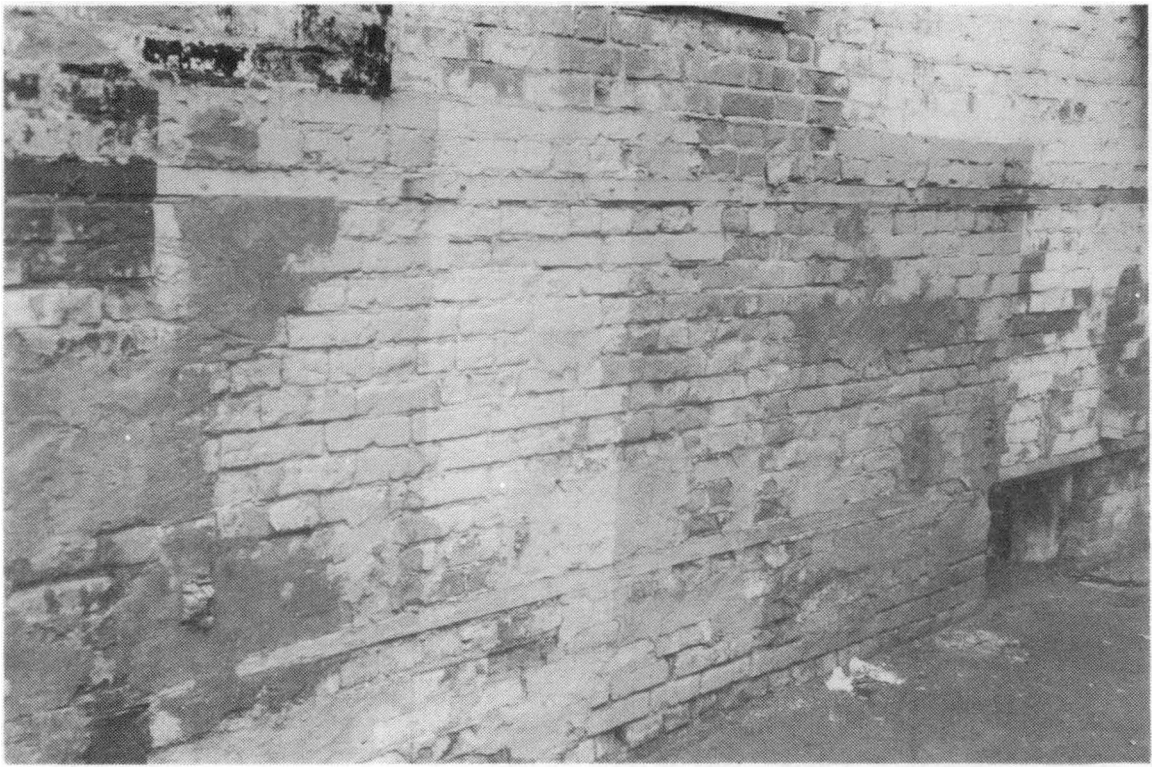

Photo 3. Brickwork requiring cleaning.

clean water and should be rinsed immediately after the treatment, especially when acid solutions are applied. It should also be mentioned here that the walls to be cleaned should be structurally sound prior to commencing with the cleaning.

Dry processes are the ones utilizing abrasive materials applied with or without a fine water mist.

These processes require careful preparation as for the wet processes in the protection of windows, doors, attachments, etc.

Both processes require special care and the choice of processes will depend on a number of parameters, which include the type of brick, the extent and chemical composition of the material to be removed etc.

While the wet process does not darrage the skin of the masonry unit, it can result in brick saturation with the possibility of the risk of efflorescence.

The dry process on the other hand although it can be fine tuned to remove the skin of grime and not the face of the masonry units, is very dependent on the skills of the applicator and may change the texture of the surface.

RISKING DAMP

Water drawn up by capillary action from the ground up can result in deterioration of masonry especially in areas where freezing and thawing

is a factory. Normally this dampness does not reach higher than 15 mm from the ground and it can be corrected by inserting a damp proof core. Photo 4 shows damage to old brickwork caused by rising damp.

The following methods can be employed to provide dampproof course prior to carrying out repairs.

Removal of a section of brickwork no more than 400 mm in length at a time, and incorporation of rigid dampproof material. Although some settlement can be expected with this method the results are usually excellent.

b. Evaporation holes drilled upwards into masonry at an angle of 45° will increase the evaporation surfaces than decreasing the capillary action. Inserting porous ceramic tubes into the holes will contribute to an increase in the area for water to evaporate and slight temperature variations within the tubes will encourage rroisture to collect in the tubes from where it is discharged into the air.

c. Cause of chemicals to create a dampproof course. This can be allowed by injecting a line of predrilled holes in the masonry of a chemical which will inhibit the capillary action. The chemical depending on the way the holes are drilled can be either injected or gravity placed into the masonry. Chemicals for this purpose can include silicone solutions, latex mixtures, setting resine, etc. Providing a continuous dampproof course can be a problem with this method.

Photo 4. Deterioration of brickwork attributed to rising damp.

CORROSION OF METAL INSERTS

The effects of corrosion of metal inserts inserted into masonry are shown in Photos 5 and 6. Repairing the brickwork without taking the necessary measures to ensure that no further corrosion will take place is not recommended. Usually once corrosion has started it will continue even if the source of moisture is removed. It is therefore desirable to replace corroded iron with galvanized steel prior to repairing the brickwork. Usually corrosion of metals in brickwork results in stress build up which eventually causes the masonry to fail. This type of failure is shown in Photo 7.

LOSS OF SUPPORT

Loss of support can result from a number of factors. The most common ones being: overloading on the foundation of the structure, and ground movement.

Excavation, changes in the water table and vibration may also contribute to loss of support.

The result of loss of support can give rise to two types of failures:

The walls may crack, lean or exhibit a combination of the two. Photo 8 shows cracking of brickwork resulting from loss of support.

Photo 5. Corrosion of metal inserts in brickwork

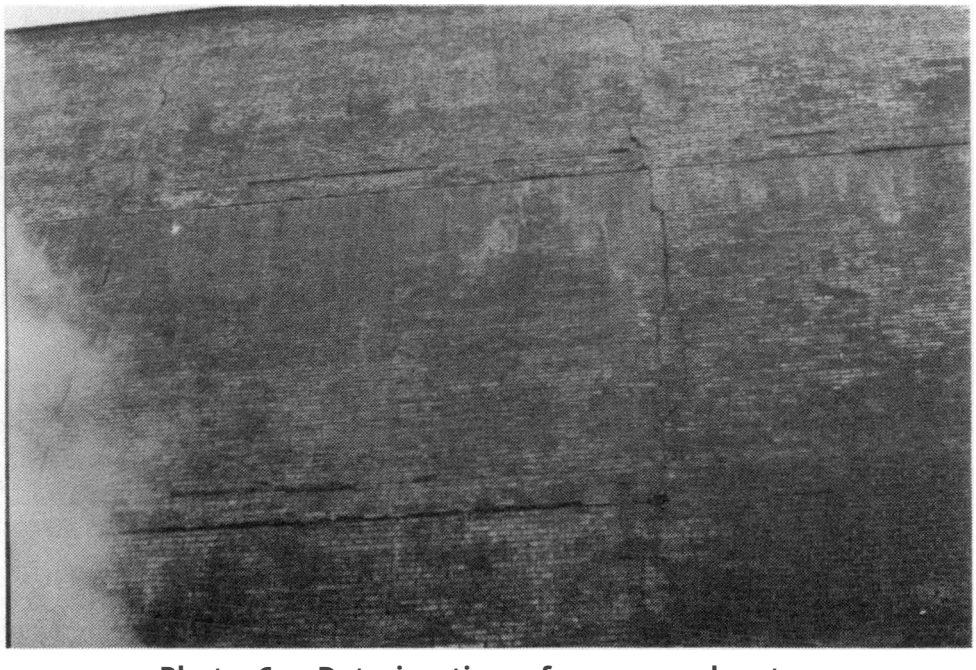

Photo 6. Deterioration of masonry due to corrosion of metal

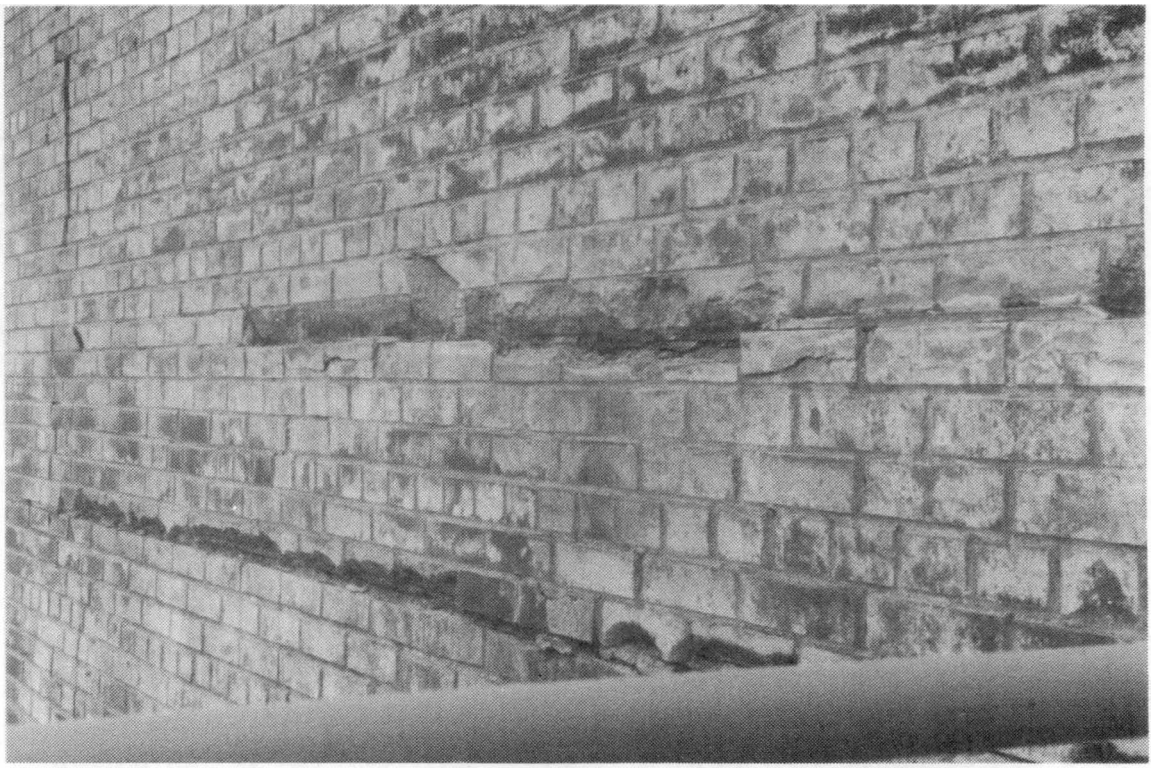

Photo 7. Brick failure due to rust wedging action.

Photo 8. Cracking due to loss of support.

When cracking has stopped and where cracking is not excessive, rebuilding the affected wall sections and taping the two sections may be an acceptable solution.

However, if in addition to vertical movement there is also horizontal movement rebuilding of the whole wall may be required.

If the movement is severe, underpinning of the foundation should be considered. For cases where the movement is the result of overloading, load re-distribution is the solution.

MOSSES, ALGAE AND OTHER GROWTHS

Growths of any kind at times are considered as attractive and often are considered to produce a pleasant decoration to old buildings. In most cases they are usually harmful to the wall. Mosses and algae can interfere with the function of gutters and down pipes, and can also stain and disfigure brickwork. Mosses and algae indicate the presence of moisture usually in considerable quantities, the source of which must be eliminated prior to applying an alga-side or moss killer.

Where large growths of vegetation have to be removed, care must be taken to avoid damage to the walls. It is preferable to kill the growth to facilitate removal of the dead and brittle remains. The removal must be carried out in small sections, and in a methodical manner, safe-guarding against possible fall of loose bricks.

PRESERVATION

Upon completion of the masonry repairs, wetting of the brickwork will ensure proper curing.

Surface coatings and applications, such as water repellent are not recommended for old masonry structures.

When such repellents have been used in old buildings, there is evidence of an accelerated deterioration in the form of spalling of the exterior surfaces. The need for masonry walls to breath and to be free from coatings or other deposits is well documented.

Surface coatings will interfere with the movement of soluble salts to the exterior surfaces during the evaporation process.

SUMMARY

Restoration of old masonry structures requires careful evaluation of the forces that contribute to the deterioration. Once the cause is eliminated procedures for remedial work are established and the structure is prepared to accept the remedial work.

It is recommended that a sample area is chosen to evaluate the materials and procedures. Careful planning will ensure best results. The work should be carried out when weather conditions are not expected to affect the curring of the repaired walls.