

Knox Metropolitan Church Bell Tower Conservation Project 2016

Masonry Procedures, Mix and Scope of Work

Masonry Testing

ASTM C1324: Standard testing method for examination and analysis of hardened masonry mortar

ASTM C67: Sampling and testing brick and structural clay tile

ASTM C136: Test method for sieve analysis of fine and coarse aggregate

CSA A179: Mortar and grout for unit masonry

Knox Met masonry testing consisted of 2 samples of mortar, (bedding and pointing) and compressive strength testing of 1 brick. A petrographic study was undertaken on both mortar samples as well the mix ratio and composition was determined. The study indicated that the mortar was a Portland cement based mortar which was strongly carbonated. Carbonation is the uptake of CO₂ from the ambient air and its subsequent reaction with the lime contained in the mortar.

The brick was being tested for compressive strength as it relates to the compressive strength of the mortar. The mortar must always be softer than the brick that it is being used to bind. This makes the mortar sacrificial which helps prevent damage to the masonry units.

All samples were being tested by Clifton Associates Ltd. which is a CSA/CCIC accredited testing laboratory. The mortar composition will be determined at a later date and will include the amount of Portland cement, lime and sand.

The compressive strength of the brick was 29 MPa or 4206 psi which is an extremely hard fired brick. Based on the mix ration of the mortar, its tensile strength will need to be estimated to ensure it is less than that of the brick. The mortar being recommended for this project will be recommended at a later date, but will need to have a compressive strength which is less than that of the test brick making it an acceptable mortar for the use in this project.

Key points when choosing the repointing mortar are:

- 1) It must be compatible with the original masonry units and similar to the original mortar in composition
- 2) It should be able to resist freeze thaw cycles and,
- 3) It should be compatible with the character defining elements of the building.

The repointing mortars compressive strength must be lower than the compressive strength of the masonry unit to prevent spalling and damage to the masonry units.

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It is preferable to have pre-bagged mortars prepared to meet the mortar mix ratios noted during the testing phase as this type of mortar will help minimize and eliminate the possibilities of inconsistent mortar mix preparation and batching.

Scope of Proposed Work

The scope of work being proposed for Knox Met will include selective repointing of areas noted on all faces of the bell tower and will stop at the string course located below the louvers. Inappropriate mortar will be removed, poorly installed Dutchman repairs using mortar will be removed and redone. The parging installed over the bricks at the base of the tower along the north elevation will be removed. Lime runs and organic staining will be removed to prevent further deterioration of the stone. In locations where the drip edge has ceased to function, it will be cleaned to ensure that the water is being properly shed away from the face of the building. Sealants that have been installed improperly will be removed to ensure that water does not penetrate into the wall cavity. It is not anticipated that there will be a requirement to replace any of the Indiana Limestone, however this will be confirmed once the scaffolding is in place so that a detailed examination of the stone condition can take place.

Mixing Procedures

Mortar batching will consist of mixing no more mortar than what can be used within 1 hour of original preparation. Pre-bagged mortar will limit the possibilities of error when combining the ingredients as there will only be the requirement to add water. The mortar can be mixed using a standard paddle mixer or a mortar mill or hand drill with a whip attachment. The mortar is to be mixed thoroughly for no more than 5 minutes then it must be allowed to sit for 1 minute. A final mix of the mortar is to be completed adding any extra necessary water and ensuring that all the dry material is thoroughly mixed. The volume of water will be as per manufacturer's recommendations.

Joint Preparation

The joint sizes around the bell tower are fairly consistent in size at approximately 3/8". While performing various site inspections it was observed that there appeared to be no joints less than 3/8" in width.

Typically a mortar joint is prepared for repointing by removing twice the thickness of the joint or 25mm. All joint preparation work will be following this standard. It is preferred not to allow the use of power tools on thin bedding joints however because of the consistent size of the bedding joint grinders will be allowed to be used to prepare only the horizontal joints. A 1/8" cut through the center of the bedding joint can be made to the specified depth noted above. The balance of the mortar removal process within the horizontal joints will be completed using hand tools. All vertical joints will have the mortar removed using hand or pneumatic tools with a diameter smaller than the 3/8" bedding joint. Any pneumatic tools proposed by the contractor will be approved by the conservator or the architect prior to use. Also the joint preparation and cut out procedure will be demonstrated as a mock up and approved prior to being implemented on the

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entire project. This demonstration is important in ensuring proper techniques are utilized to ensure that there is no damage to the areas of the brick.

Once the joints have been cut out it is important to ensure that joints are cleaned of all debris that may be left inside the joint space. The joints must be vacuumed or brushed out prior to any pointing work beginning. The joint is then to be flushed out with water working from the top down.

Pointing

This project involves selective repointing where only areas requiring mortar repairs will take place. This includes areas where the mortar is missing completely or so deteriorated it is allowing moisture to enter the building envelope which may result in spalling of the masonry units or accelerated deterioration of the building envelope.

Since the repointing depth is twice the thickness of the bedding joint or 25mm deep the repointing work will take place in 2 lifts. The joints will be wetted to assist with keeping the joint wet while the pointing takes place and will assist with the curing of the mortar. There should not be any standing water within the joint when the pointing begins.

The first lift is applied ensuring that it is well packed into the joint to its full depth. The mortar is to be left with a rough surface to allow the second lift to bond to the first. The first lift is to be left for 1 day for curing to take place. Prior to the application of the second and final lift the joint must be rewetted ensuring there is no standing water within the joint. Care in ensuring that the correct volume of mortar is applied to the final lift is critical. Overfilling the joint will result in staining on the faces of the masonry units. The joint will be tooled to match the existing ensuring that the mortar is slightly recessed back from the face of the masonry unit to ensure proper shedding of water.

Before the full repointing of the building is allowed to proceed a mock-up following the above procedure will be performed on the same area where the cutting out and joint preparation procedure were undertaken. This wall section will become the reference area for quality control and finish that is to be maintained as the work proceeds around the bell tower.

Curing and Protection

Throughout the entire masonry conservation process it is important to protect all the masonry work from wind, rain and direct sunlight. Since the work will be performed from an engineered scaffold, netting can be installed to protect the masonry from the elements.

The mortar is to be kept damp for 3-7 days. The preference will be for burlap to be hung over the areas where the mortar work has been completed while ensuring that the burlap is not in contact with the masonry units. Direct misting is a possibility but so much care must be taken to ensure the new mortar is not saturated and washed away that this method will not be accepted.

The burlap should be continually wetted over a 3 day period. A plastic sheet is placed over the burlap to ensure that a relatively high humidity is maintained. The frequency of wetting the burlap will be dependent on the outside temperature and rate of evaporation. However the

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temperature within the scaffolding must be maintained at 10°C to a maximum of 27°C throughout this process.

Over the following 4 days the new masonry must be protected from wind, rain and direct sunlight. The burlap and plastic sheet may be removed after the initial 3 day and the temperature must be maintained above 0°C.

Once the new mortar has undergone the 7 day procedure for curing all of the protective screening can be removed. The new mortar will develop a patina that will match the original as it is exposed to the environment and time passes.

Conclusion

The drawings will highlight areas of work around the bell tower exterior and the specifications will detail the work requirements that are to be followed while performing all work outlined for this project. The processes described will be maintained throughout the conservation project with multiple inspections taking place every week to ensure quality is maintained.

Appendix A

Tower Photographs indicating various existing conditions



Improper use of sealants



Poorly executed Dutchman repair



Parging



Lime runs & improper sealants



Organic staining



Selective repointing & organic staining