

Repair And Retrofit of Unreinforced Masonry By Injection Grouting

Mahaalakshmi R¹, Jegidha K J², Dr. S. Suresh Babu³

^{1, 2, 3}Masters In Structural Engineering

^{1, 2, 3}Adhiyamaan College

Abstract- This paper reviews and discusses the repair technique for Injection of grout into cracks which maybe used as a form of repair following a damaging event to restore the masonry to its original structural condition. After performing initial survey and finding the causes of cracks, a suitable grout mix is formulated, in addition Admixtures such as superplasticizers is also added to the mixture which aids in the fluidity of the grout so that the grout fills more of the voids. Nondestructive and in situ tests is conducted and compared to the results of unrepaired masonry. As a result, these strengthening technique were successful in allowing the damaged specimen to recover the initial characteristics and to successfully restore their load carrying capacity.

Keywords- cracks, grout, Injection, repair, superplasticizers.

I. INTRODUCTION

Renovation, retrofit, and refurbishment of surviving buildings provides an opportunity to upgrade the energy performance of commercial building to improve their ongoing life. Existing masonry buildings often contain voids, cracks and weakness which can affect the structural capacity and safety of the building. Cracks in buildings can occur due to various reasons. Cracks maybe due to chemical reactions, changes in temperature and climate, foundation movements and settling of buildings, environmental stresses, earthquakes etc. Injection of grout into cracks maybe used as a form of repair following a damaging event to restore the masonry to its original structural condition. Injection grouting is a viable means to provide functional, durable and safe structures without physically altering the external aesthetics.

II. OBJECTIVE

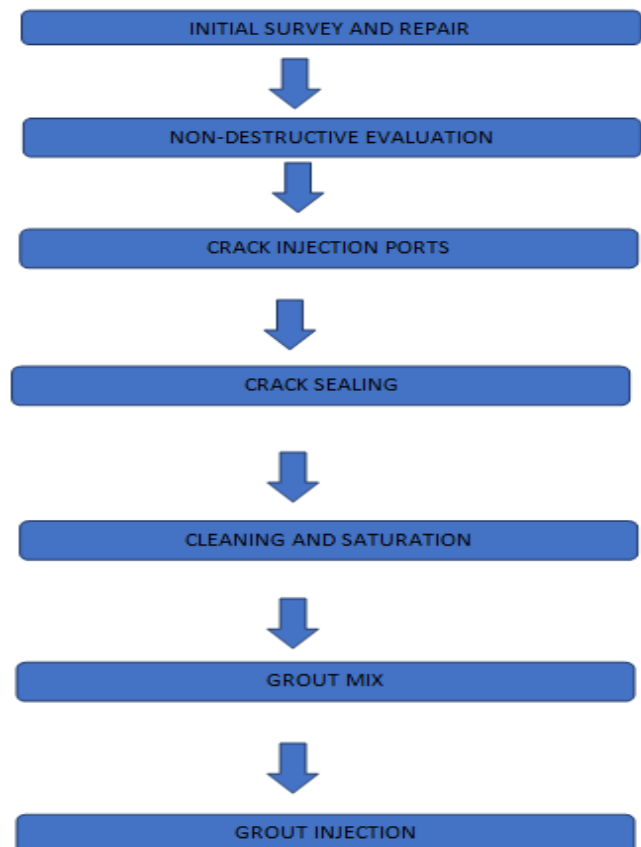
- To perform initial survey and to study the causes of cracks.
- To Carry out a nondestructive evaluation to monitor the strength of the damaged masonry using stress wave transmission method.
- To verify any insufficient grout penetration after injecting grout in cracks and a nondestructive test is carried to monitor the strength of the repaired masonry.

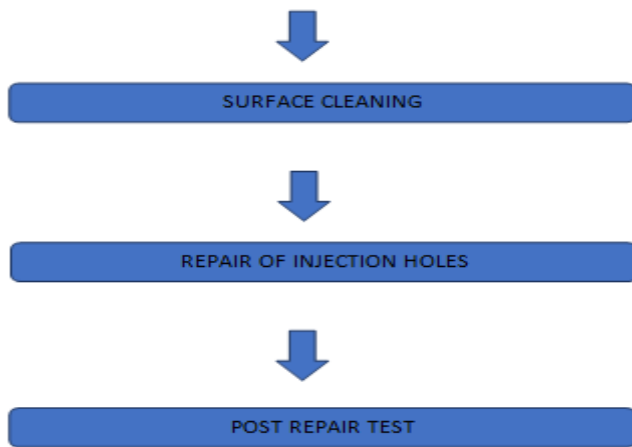
- To Compare the strength of the repaired masonry with that of the damaged masonry to indicate the effect of injection grouting as a repair technique.

III. GROUT FORMULATIONS

Grout mixing is an important step since a grout with superior injectability properties must be achieved. Tests are performed to determine the relative fluidity, injectability and bond strength. The grout is made using cement, sandy soil and fine sand mix in the proportions in 1:1:3 with enough water and a superplasticizer to make it into slurry. Superplasticizers allow reduction in water content by 30% and used in making high strength concrete.

IV. GROUTING PROCEDURES





1. Initial Survey and Repair

A thorough assessment must be conducted in the area of repair before proceeding with any repair procedure. This survey also serves as a post repair quality verification. This step helps in determining the extent and size of visible cracks and the presence of voids.

2. Non-Destructive Evaluation

This step is an important part of the repair procedure, since the subsurface cracks, voids and grout penetration can be determined by performing a non-destructive test. Any method working based on pulse wave transmission can be used (ultrasonic pulse velocity).

3. Crack Injection Ports

Injection holes measuring 6 to 12 mm diameter are drilled for cracks less than 1mm wide and the ports are placed in the drilled holes. The placement of these ports is dependent upon the width and the roughness of the cracks. Using the sealant used for sealing the surface cracks the ports can also be sealed.

4. Crack Sealing

In order to avoid grout leakage during the injection procedure the surface breaking cracks are sealed. The sealant used to seal the cracks must be able to withstand the injection pressure and also aid in rapid setting on the surface of the cracks. These sealants are removed after the injection procedure to make sure that the appearance does not get altered. Care must be taken to prevent the sealant from penetrating deep into the cracks.

5. Cleaning and Saturation

The surface is flushed with water to remove the dirt present, the surface is saturated 24 hours prior to the injection and 30 minutes before injection of grouts which avoids the problem of grout stiffening.

6. Grout Mix

The grout mix is prepared as discussed above in the grout formulations. A suitable grout mix is prepared to fill the fine cracks with excellent bond strength. The properties of the grout prepared must be similar to the masonry of the repairing surface. The addition of a superplasticizer helps in reducing the water level and also allows the grout to flow evenly along the cracks and the smaller voids.

7. Grout Injection

For injecting these cementitious grouts, a low-pressure injection is used. The grout is injected from lower nipple to upper till it comes out to the next higher nipple and then move to next higher nipple. This procedure is followed to fill the entire cracks. The injection pressure is always kept as low as possible to avoid any additional damages due to pressure during injection. The injecting process must be continuous without any time lapse during the injection of grout.

8. Surface Cleaning

Surface cleaning is carried out immediately after the injection to remove any spilled grout during the injection. A stiff brush or water is used to remove the extras on the surface.

9. Repair of Injection Holes

After cleaning the surface, the grout is allowed to cure for 24 hours. After the curing period the sealants can be removed using a hard brush or water and the ports are now removed and a suitable mortar similar to the masonry is prepared and is packed firmly into the injection holes, prior to the placement of the mortar the holes must be saturated.

10. Post Repair Test

The post repair test is the final step in this procedure and is carried out to find the effect of the grout penetration. Non destructive test is carried to find the improvement in strength of the mortar and any insufficient penetration of the grout. In case of insufficient penetration additional injection is required.

V. CONCLUSION

Based on the assessment the injection grouting had some economical features like it requires Minimal costs as such products are readily available and can be easily applied. This method required Minimal amount of material and very 'light' application made this method sustainable. This method had some advantages like No added mass, Available materials, Low disturbance, Low cost, can restore initial stiffness, Improves shear and compressive behavior up to 80 percent of the original strength.

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