



Masonry reinforcement by mortar injections.

IS IT:

Product

Technology

Equipment

APPLICABLE FOR:

Restoration

Rehabilitation

New Construction

APPLICABLE ON:

1. Foundations and underground structures

2. Vertical structures

3. Horizontal structures and vertical connections

4. Roof and terraces

5. Façade and building envelope

6. Finishes and completion elements

7. Integrated services

8. General strategies for building recovery

Related companies: Limepor100, LimeporIZ8 (Kimia, Italy);
MAPEWALL INIETTA & CONSOLIDA; Webertec iniezione 15;
RUREWALL B1 Iniezione; INIETTO; OPUS P.I.; CVR- fior di calce;
LEGANTE PER INIEZIONI 790.

DESCRIPTION

The reinforcement intervention by injection of structural binder mixtures consists in injecting the material inside the so-called rubble-filled walls, with the aim of filling the inner voids. These walls are often filled with recycled materials which, over time, both due to sedimentation and poor quality of the filling itself, are rich in cavities and not adequate for the structural task. The absence of consistency of the masonry is, in fact, associated with low values of resistance and stiffness. The purpose of the injection is restoring the internal continuity of the cracked or disconnected material, allowing the wall reinforcement and improving the behavior in the plane. This consolidation method is commonly referred to as "passive" as it does not require the execution of operations such as altering the external appearance of the structure. In fact, the intervention takes place inside the structure itself. The most suitable consolidating mixtures are fluid mortars based on natural hydraulic lime, capable of increasing the masonry strength, without changing too significantly the stiffness.

Limepor 100 grout can be used for the injection of rubble-filled masonry, used in the regeneration and consolidation of rubble-filled walls made of bricks or cut stone.

In the case of curtain walls including frescoes, the **Limepor IZ8** solution is preferable as this grout does not contain any water-soluble salts, avoiding the formation of salts crystals onto the surface.

Limepor 100 is an injection mixture with high resistance to sulphates and low content of water-soluble salts based on natural hydraulic lime. It is specially formulated to regenerate and consolidate, by injection, masonry and brick or freestone sack foundations. **Limepor 100** can be injected with any pump into slots or cavities with special injectors.

Mortar injections do not exclude the surface reinforcement. On the contrary, the injection intervention is often complementary to a reinforcement with fiberglass nets, if it is necessary to first restore the compactness and consistency of the masonry core, before applying further reinforcements.

The possibility of combining interventions such as injections of consolidation mixtures with surface interventions, such as reinforced plastering, allows to obtain very high-performance masonry reinforcement solutions. However, the last requires a complete covering

of the wall surface by a plaster. This condition is practicable in all those walls where there is no need to keep the facades in sight. On the contrary, when there is the constraint of the aesthetic aspect, it is necessary to adopt different solution.

WHY TO USE

Mortar injections do not exclude surface reinforcement interventions. On the contrary, this injection intervention is often complementary to a reinforcement with fiberglass nets, if it is necessary to first restore the compactness and consistency of the masonry core, before applying further reinforcements.

Limepor 100 is used for the regeneration and consolidation of ancient brick or stone sack walls, in particular for cutting, by means of low pressure injection. Among the advantages:

- High breathability.
- Physically and chemically compatibility with the original masonry.
- Very fluid mixture with low water-to-binder ratio and high penetration power; absence of segregation during injection.

HOW TO USE AND APPLY

Rehabilitation or restoration of ancient rubble-filled walls, through injections of mixture with high mechanical strength and low content of water-soluble salts.

Limepor 100 must be mixed with water respecting the quantities as specified in the technical data sheet. It must be injected into the walls with normal pumps, manual or electric, at low pressure, through injectors fixed in the drilling holes and proceeding the injections from the bottom upwards.

To prevent the leak of the mortar, proceed with re-grouting where the joints are inconsistent or provide for the sealing of any cracks.

Create a network of holes with a mesh of variable size according to the permeability and compactness of the masonry, from a minimum of 20-25 cm (solid brick type) up to a maximum of 40 cm (mixed masonry type).

The perforations for the injections must have a diameter ranging between 15 and 25 mm. The depth of the



perforations should be approximately two thirds of the wall thickness.

For thicknesses up to 60 cm it is sufficient to work on one side of the wall only; for higher thicknesses it is advisable to work on both the surfaces. The inclination of the perforations must be around 45° or, in any case, able to favour the injection.

If possible, saturate the entire masonry with water, using the same holes created for the injection. Wait one day to allow the elimination of stagnant water into the masonry.

For weakly degraded masonry, it is possible to proceed with pressure injections. The injections will always start from the bottom up and from the sides towards the center with an injection pressure between 1 and 4 atm. Subject to direct verification. For very degraded masonry such as not to be able to withstand over-pressure, it is possible to proceed with injections by gravity. The application of the product from the bottom upwards allows the air to escape, favoring a greater filling of the voids.

TECHNICAL CHARACTERISTICS

The product, in powder and with light gray, hazelnut shades, supports designers in the realization of:

- LEED certified works, in accordance with the U.S. Green Building Council;
- GBC HOME and HISTORIC BUILDING certified works.

RECOMMENDATIONS AND OTHER INFORMATION

It is essential to choose the most adequate grout for injections, compatible with the physical-chemical characteristics of the masonry.

- Consequently, the following factors must be taken into account:
 - resistance of the masonry to salts;
 - comparable thermal expansion;
 - non-freezing behavior of the product;
 - modulus of elasticity approximately equal to that of the masonry;
 - adequate fluidity to penetrate and saturate the cavities;
 - resistance to excessive shrinkage phenomena.

The injections of fluid mortar aim to eliminate the chaotic local disintegration of a masonry, reducing the voids and strengthening the link between the existing parts of the masonry, thus making it more cohesive and resistant in the event of an earthquake. Furthermore, the consolidation intervention by injection must be used where the degradation of the masonry is attributable to the binder and also in the presence of widespread cracks.

The adoption of injections of binders in the consolidation works of stone, brick and sack masonry aims to improve the mechanical characteristics of the masonry. For this reason, the consolidation of stone walls after injections is not sufficient on its own to ensure a better behavior of an entire structure as a whole. Or, to put it in technical jargon, the injections into the masonry guarantee greater stability to the single wall, but do not have the task of ensuring also an effective clamping.

If the damage and/or deterioration of the masonry can be attributed only to the binder (mortar), while the inserts (natural or artificial) show satisfactory characteristics of resistance and texture, it is possible to reinforce the masonry using the technique of injection of mixtures of binders (in pressure or per color) so as to restore, or improve, the mechanical characteristics of the masonry, without changing the original structural scheme

EXAMPLES

Limepor IZ8 is an injection mixture with high resistance to sulphates and a zero water-soluble salt content based on natural hydraulic lime, reinforced with metakaolin with high pozzolanic reactivity. Limepor IZ8 can be injected with any pump in slots and cavities with special injectors.

Limepor IZ8 is used for the regeneration and pre-consolidation of wall structures, including frescoes, by injection.

The advantages are:

- High breathability and chemical compatibility with the materials used in historic buildings.
- Product that does not give rise to efflorescence.
- Fluid mixture with low water / binder ratio and high penetration power.



REFERENCES / SOURCES AND LITERATURE

Michele Vinci, Metodi di calcolo e tecniche di consolidamento per edifici in muratura - III edizione; Dario Flaccovio editore, 2019.

<https://edificiinmuratura.it/Pagina/355/11-consolidamento-di-edifici-in-muratura-elevazione>

<https://www.kimia.it/it/blog/rinforzo-murature-iniezioni-stilature>

<http://www.benedettiandpartners.it/opera14.asp>

WEBSITE OF THE COMPANY

<https://www.kimia.it/it/prodotti/limepor-100>

<https://www.kimia.it/it/blog/rinforzo-murature-iniezioni-stilature>

<https://www.mapei.com/it/it/prodotti-e-soluzioni/prodotti/dettaglio/mapewall-inietta-e-consolida>

www.vimark.com

https://www.vimark.com/wp-content/uploads/2016/02/INIETTO_1016_ITA.pdf

<https://www.chryso.it/p/8781/rurewall-b1-iniezione>

<https://www.calceforte.it/prodotto/opus-p-malta-iniezione/>

<https://www.cvr-italy.com/it/fior-di-calce-iniezioni.html>

<https://www.it.weber/impermeabilizzanti-malte-da-ripristino-clc-e-consolidamento-murature/come-incrementare-la-resistenza-della-muratura-iniezione-di-miscele-leganti>

<https://www.fassabortolo.it/it/prodotti/-/p/6/19/ex-novo-restauro-storico/legante-per-iniezioni-790-bio-legante-per-iniezioni-resistente-ai-solfati-a-base-di-calce-idraulica-naturale-nhl-3-5-per-murature-storiche>



IMAGES AND CAPTIONS



Fig.1: Masonry with evident deterioration and instability. © <https://www.casapratca.net/materiale-fai-da-te/lavori-di-muratura/muri-a-sacco.asp>

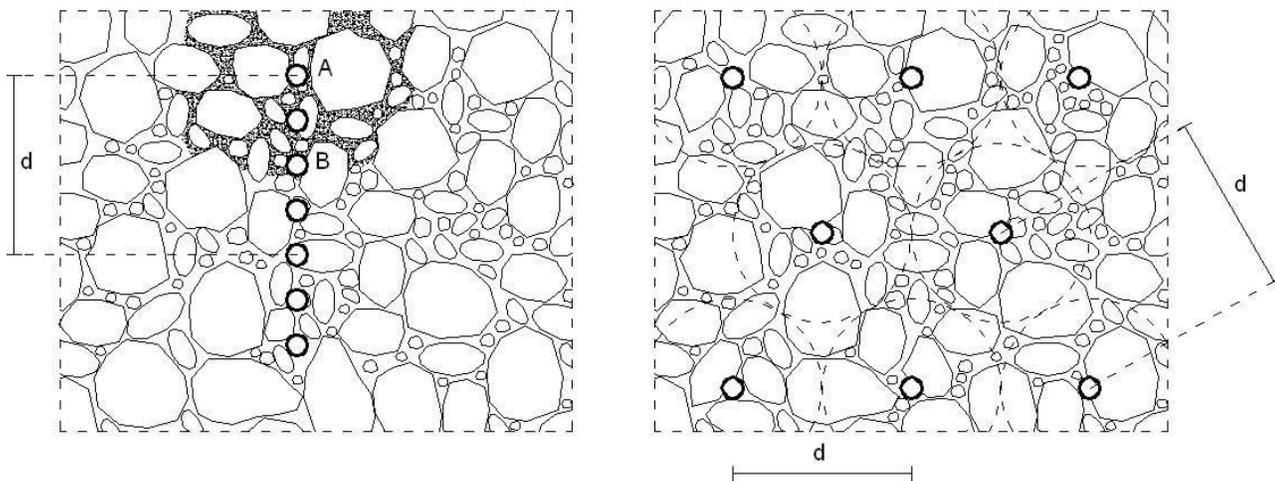


Fig.2: How made the holes into the masonry for the rehabilitation intervention. © <https://www.edificiinmuratura.it/Pagina/93/11-consolidamento-elevazione-iniezioni-di-malta-immagini>

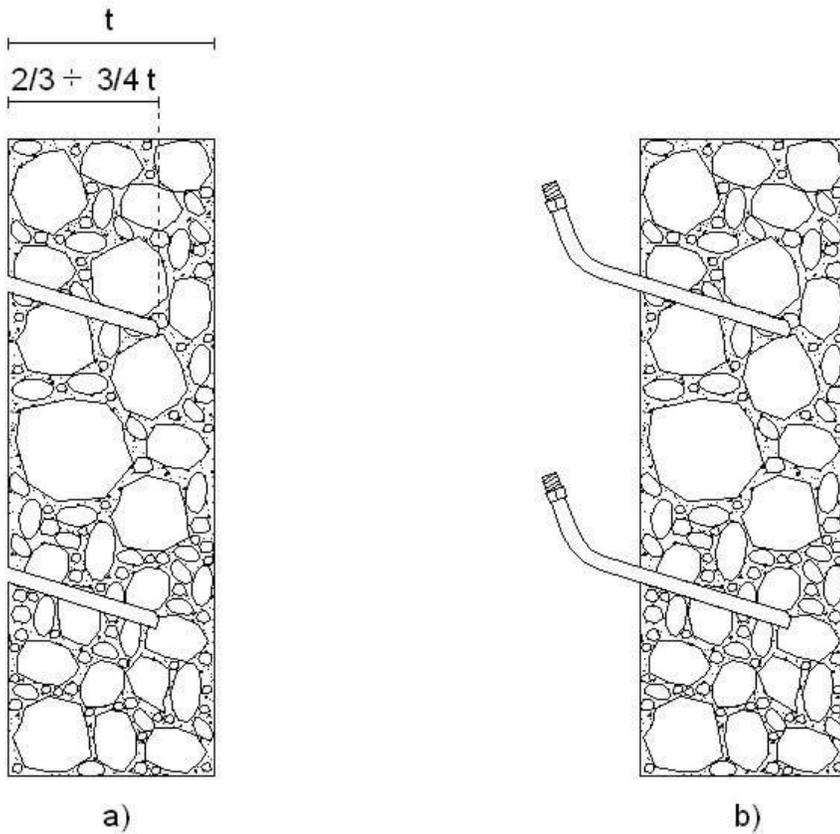


Fig.3: Realisation of the holes and positioning the top-up tubes. © <https://www.edificiimuratura.it/Pagina/93/11-consolidamento-elevazione-iniezioni-di-malta-immagini>

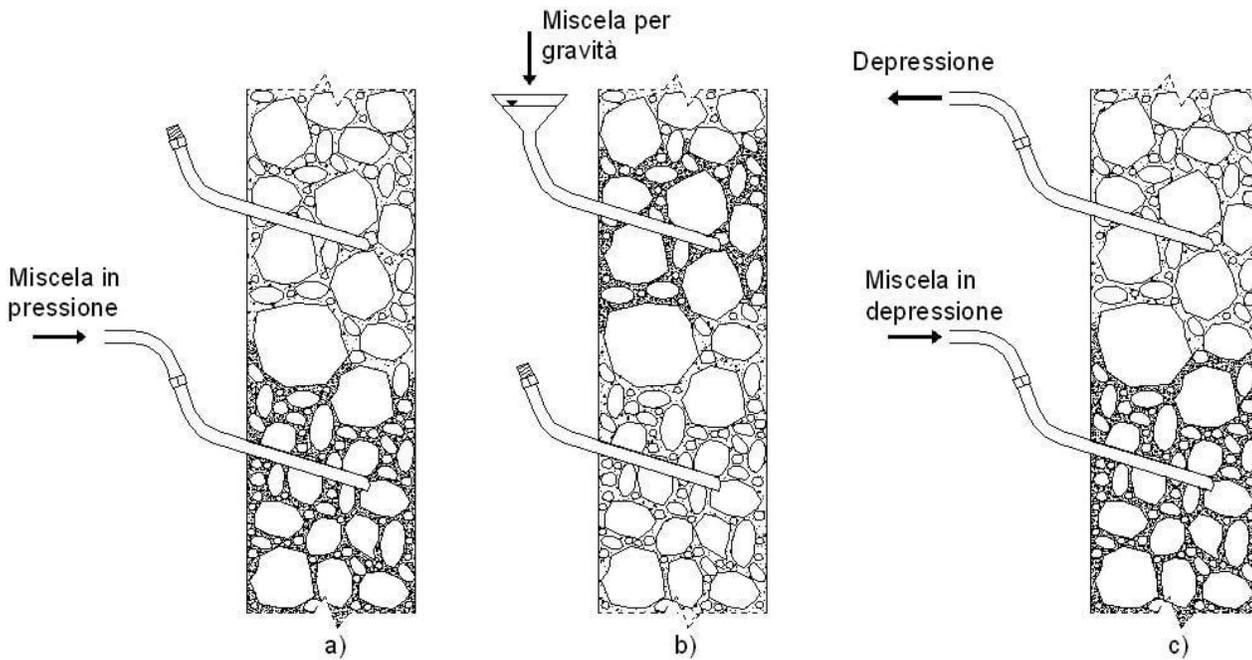


Fig.4: Intervention phases.. © <https://www.edificiimuratura.it/Pagina/93/11-consolidamento-elevazione-iniezioni-di-malta-immagini>



Fig.5: Intervention phases. © <https://www.kimia.it/blog/rinforzo-murature-iniezioni-stilature>



Fig.6: Intervention phases. © <https://iton.it/iniezioni-resine-cementi-malte-colloidali/>



Fig.7: Intervention phases on foundation masonry. © https://www.archiproducts.com/it/prodotti/master-builders-solutions/boiacca-di-calce-pozzolonica-per-consolidamento-di-murature-masterinject-222_51885