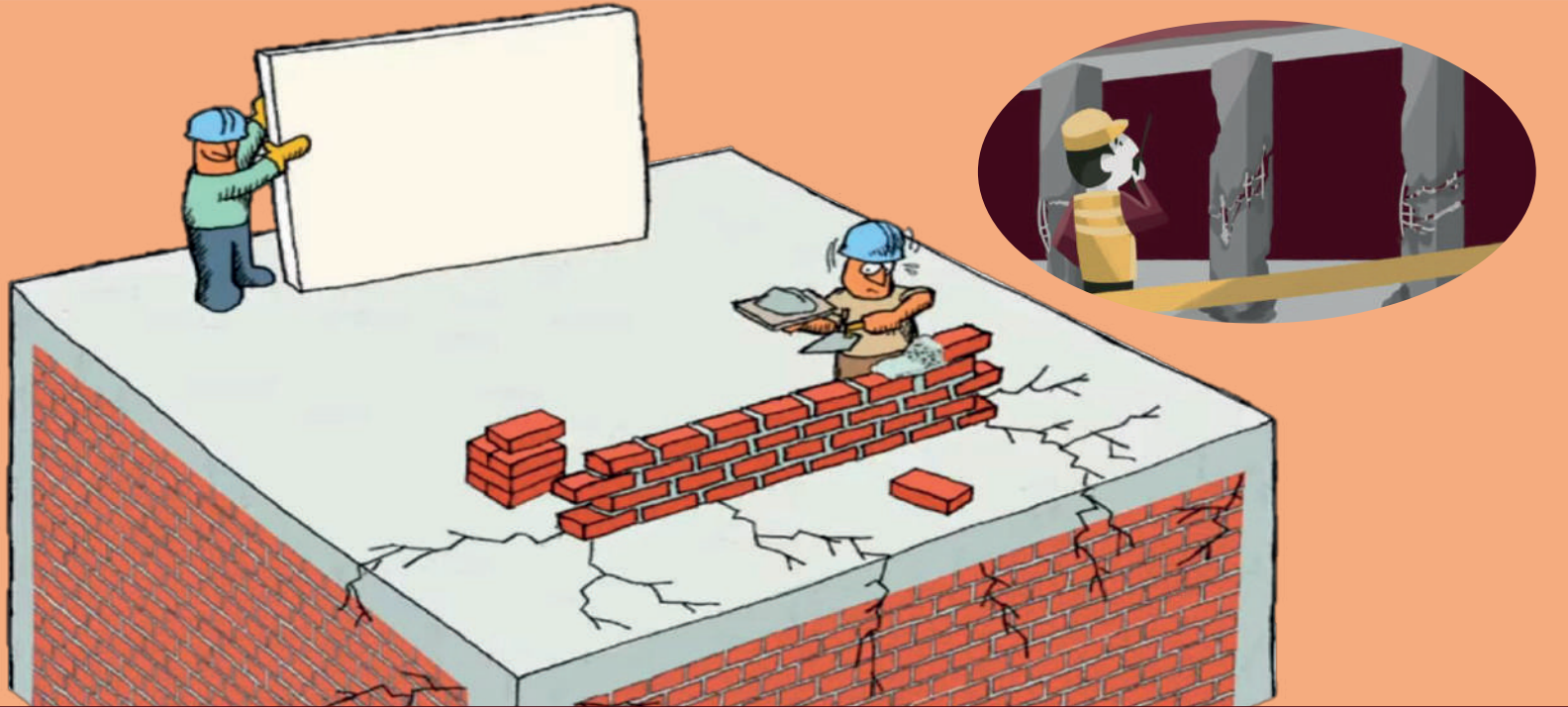


# PAMPHLET:

# STRUCTURAL DAMAGE REPAIR IN HOUSES





**GRRIPP**  
Gender Responsive  
Resilience & Intersectionality In  
Policy & Practice



**PUCP**

## **PROJECT:**

**COMMUNITY RESILIENCE WITH A GENDER APPROACH:  
GRASSROOTS WOMEN MANAGING DISASTER RISK AND THE  
IMPACT OF CLIMATE CHANGE IN PERU.**

**STRUCTURAL DAMAGE  
REPAIR IN HOUSES**

**GROOTS PERÚ NETWORK  
PROJECT SPONSORED BY GRRIPP AND PUCP  
Perú, june 2023**



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**Perú, June 2023**

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## PRESENTATION

*A family's greatest desire is to have a safe and comfortable home that improves their quality of life. However, many families who opt for self-construction do not achieve a safe home in the event of earthquakes, often due to a lack of technical guidance. Civil construction works are carried out by construction companies with professional personnel; however, there are many small construction works that are managed and/or built by their owners.*

*Some structural damage in houses can cause substantial consequences if not repaired in a timely manner. Our house must have a safe and well-built structure. Aware of the effort put to build a safe home, GROOTS PERÚ, in cooperation with GRRIPP, SEA, and the PUCP, wishes to support families so that their investment of a lifetime is lasting and beneficial. To this end, we have produced this pamphlet on STRUCTURAL DAMAGE REPAIR IN HOUSES.*

## I.- HOUSE REPAIR

We always have questions about when a house should be repaired and when it should be reinforced. Occasionally we end up reinforcing the structure of a house that may have just needed to be repaired.

### WHEN TO REINFORCE A HOUSE

1. When there are cracks, settling, or deterioration due to overstressing of the structure in any part of the house as a result of bad structural design.
2. When more floors than initially planned need to be built.
3. When an external agent weakens the structure of the house (earthquake, fire, flood, etc.).

### WHEN TO REPAIR A HOUSE

1. When the structure is damaged due to an inadequate construction process:
  - cracks in columns, beams, and roofs
  - settling of columns and walls
  - saltpeter in foundations and walls

## II.- DIFFERENCE BETWEEN REPAIRING AND REINFORCING A HOUSE

**REINFORCING:** A house is reinforced when its structure is not adequate to resist stress caused by seismic activity or the use of the house.

For example, a building that was initially built to be used as a house and is now required to be used as a gym. Another common example would be a house that was built for a 2-floor structure and is now required to have 4 floors. Whatever the reason, it is important to note that it is a civil engineer who must draw up the reinforcement plans. All reinforcement must be designed, modeled, and calculated.

**REPAIRING:** A house is repaired when its structure is adequate, but it is damaged due to a poor construction process.

For example, the presence of saltpeter on the walls because adequate concrete was not used or columns with oxides lacking the proper coating.

## PROCEDURE FOR REINFORCING A HOUSE WHEN IDENTIFYING DEFICIENCIES OR DETERIORATION IN THE STRUCTURE

1. Inspection by a civil engineer.
2. Survey of structural elements of the house: walls, columns, beams, ceilings, etc.
3. Structural design proposal compatible with the architecture.
4. Structural seismic-resistant assessment aided by calculation software.
5. Drafting of reinforcement plans.
6. Works by a qualified and experienced master builder.





### III.- REPAIR PROCEDURE FOR A WALL WITH SALTPETER

The repair procedure for a wall with saltpeter will be carried out based on the degree of damage to the wall, for which we will establish three levels.

- A. Slightly salty wall.
- B. Moderately salty wall.
- C. Highly salty wall.

#### A. SLIGHTLY SALTY WALL

Wall with slight presence of saltpeter, in the form of foam without humidity, so that there is damage in the paint and very slightly in the rendering. They can be classified in 02 levels.

#### B. MODERATELY SALTY WALL

Wall where the saltpeter has affected not only the paint, but also the rendering to the point of destroying, fissuring, or cracking it.

#### C. HIGHLY SALTY WALL

Wall where saltpeter has affected not only the rendering, but also the brick or base to the point of reducing the width of the wall.

## A.1.- SLIGHTLY SALTY WALL - LEVEL 01

Wall showing saltpeter efflorescence only on the paint and no humidity (dry surface).

### Solution:

- Remove the paint from the affected area.
- Clean the dust and excess paint on the surface.
- Apply an additive directly on the affected area; it can be Sika Imper mur or similar. This product is delivered ready to use (mono-component); the surface must be dry according to this product.
- Method of application: paintbrush.
- Yield: 16 m<sup>2</sup> to 20 m<sup>2</sup>



Sika Imper mur x 4L



## A.2.- Slightly salty wall - Level 02

Wall showing saltpeter efflorescence on the paint and showing humidity.

### Solution:

- Remove the paint from the affected area.
- Clean dust and excess paint on the surface.
- Apply additive to the affected area: it can be Sika Top 1 or similar. This product is mixed with water to form a paste, which is applied as if it were a filling on the damaged surface. It comes in gray and white tones.
- Moisten the surface before applying the product.
- Method of application: trowel.
- Yield: 10 m<sup>2</sup> to 12 m<sup>2</sup>



Sika Top 1 x 4L (white/gray)

## B.- Moderately salty wall

Wall showing humidity and saltpeter where the rendering shows significant damage (the damage is no longer superficial).

### Solution:

- Remove the rendering from the salty area and an additional 30 cm all around.
- Once the rendering has been removed, the excess saltpeter on the brick or concrete must be washed off with water, then an additive (Sika Top 1 or similar) should be applied to form a resistant base.
- Re-render using preferably Type V cement.



## C.- Highly salty wall

Wall showing humidity and saltpeter and the rendering is destroyed; the damage has also affected the brick or concrete wall (internal damage)

### Solution:

- Remove the rendering from the salty area and an additional 30 cm all around and mark the area where the brick or wall is also damaged to be demolished and replaced.
- For example, if it is a 3 m-long brick wall, it can be repaired every 0.75 m. Another method would be to make a concrete pour as a replacement of the brick with the same methodology (similar procedure to the one used in wall footings).
- Once the damaged brick wall has been replaced by a new wall, it should be rendered, preferably using type V cement for the mortar.



### III.- REPAIR PROCEDURE FOR A WALL WITH SALTPETER



Repaired wall

Repaired column



## IV.- REPAIR PROCEDURE FOR A COLUMN

A family's greatest desire is to have a safe and comfortable home that improves their quality of life. Nevertheless, many families who opt for self-construction do not achieve a safe home in the event of earthquakes, often due to a lack of technical guidance. Civil construction works are carried out by construction companies with professional personnel; however, there are many small construction sites that are managed and/or built by their owners.



**CASE I:** The steel has not yet reduced its cross-section. The repair involves treating the steel; the damage is slight.



**CASE II:** The steel has reduced its cross section affecting the strength of the column. The repair involves changing the rusted steel in the damaged



## IV.- REPAIR PROCEDURE FOR A COLUMN

When the steel initiates the corrosion process, it does so by reacting chemically, increasing its volume so that, at an advanced stage, it manages to destroy the concrete, presenting itself in the form of a fissure in the longitudinal direction of the steel.

The repair can be such that the rust in the steel can be treated with rust removers, provided that the structural steel is not damaged and has not reduced its cross-section. If the rust on the steel is such that the damage has reduced the cross-section of the steel, it should be replaced with new steel with appropriate splices.

Next, we will present a mild case of rust repair in column steel (CASE I) and another case where the rust in the steel is more damaged and the steel must be replaced (CASE II).



## IV.- REPAIR PROCEDURE FOR A COLUMN

### CASE I : Repair of lightly rusted steel



#### **STEP 01: INSPECTION**

A column presents a fissure, where upon striking it, it sounds like a box, which is an indicator that the steel has increased its volume as the corrosion process begins.



#### **STEP 02: EVALUATION**

The corrosion process has started, a reddish coloration is observed in the steel and the beginning of very thin scales under 0.1 mm thick can be seen. In this case, rust is removed with a rust remover additive.

## IV.- REPAIR PROCEDURE FOR A COLUMN

### CASE I : Repair of lightly rusted steel



#### STEP 03: RUST CLEANING

Clean mechanically with a wire brush and rag, then brush on rust remover as many times as necessary until the structural steel is completely clean.

#### STEP 04: APPLY ADHESION BRIDGE

Once the steel is free of rust, an epoxy glue should be applied to the concrete surface to be repaired (e.g., Sika Dur 32 or similar); after that a repair mortar should be placed



Epoxy glue, mix 2 parts of component A with 1 part of component B.

Rust remover, applied directly with a brush.



## IV. - REPAIR PROCEDURE FOR A COLUMN

### CASE I : Repair of lightly rusted steel



### Step 05: COLUMN CONCRETE REPAIR

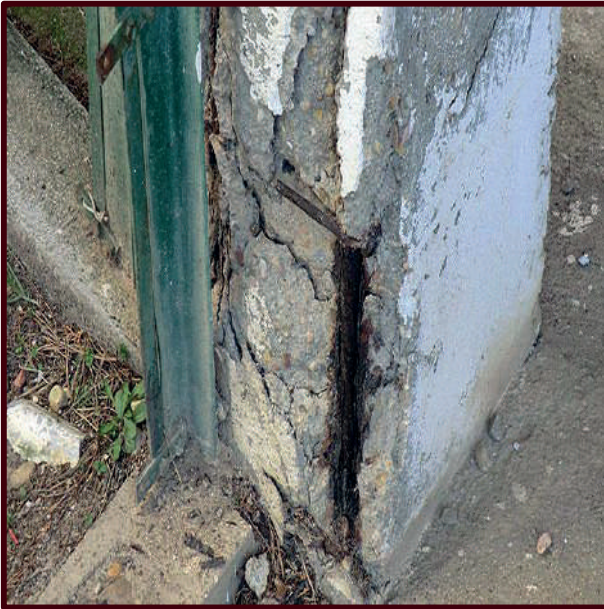
Immediately after placing the adhesion bridge, it should be patched with a repair mortar, which can be Sika Rep 500 or similar, shaping it to the column's initial volume.



High-strength repair mortar. It is prepared only by mixing with water.

## IV.- REPAIR PROCEDURE FOR A COLUMN

**CASE II** : Column repair by replacing the damaged steel.



### STEP 01: INSPECTION

The cracked area of the column should be punctured to analyze the condition of the steel. In our case, the steel will be replaced because of the rust in the lower part of the column.

## IV. - REPAIR PROCEDURE FOR A COLUMN

### CASE II: Column repair by replacing the damaged



#### STEP 02: COLUMN DEMOLITION

The column should be demolished to the extent of the rust damaged steel, leaving a suitable splice to receive the new steel column structure. In this case, the column did not have a footing.

## IV. - REPAIR PROCEDURE FOR A COLUMN

CASE II: Column repair by replacing the damaged steel.



### STEP 03: ASSEMBLY OF NEW COLUMN

In this case, a new grill for the footing has been created and a new column has been structured with new steel.

## **IV. - REPAIR PROCEDURE FOR A COLUMN**

**CASE II: Column repair by replacing damaged steel.**



### **STEP 04: POURING OF CONCRETE IN FOOTING AND COLUMN**

Before pouring the concrete, all traces of rust must be removed from the existing steel that will be spliced; this cleaning should be done with a wire brush and rust remover. Then, epoxy glue should be applied between the old and new concrete joints to give monolithic properties to the column.

## IV.- REPAIR PROCEDURE FOR A COLUMN

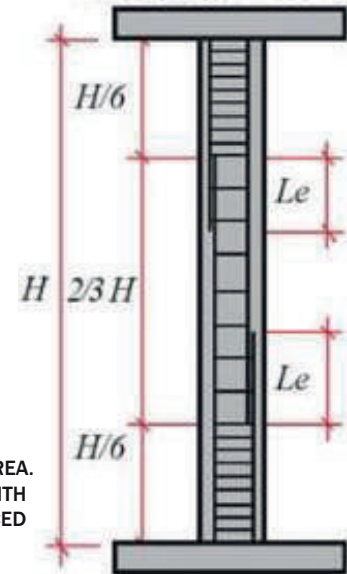
### BUILDING STEEL SPLICE FOR COLUMNS.

It is important to note that steel splices must be created in low-effort areas of the column. For that matter, the following table is presented.

Longitud de Empalme	
1"	1.20 m
3/4"	0.70 m
5/8"	0.60 m
1/2"	0.50 m
3/8"	0.50 m

#### NOTE:

- MAKE THE SPLICES IN THE CENTRAL THIRD OF THE COLUMN HEIGHT.
- DO NOT SPLICE MORE THAN 60% OF THE TOTAL AREA.
- IF IT IS NOT SPLICED IN THE INDICATED AREA OR WITH THE SPECIFIED PERCENTAGE, FEED THE SPLICED LENGTH AT 100% OR CONTACT THE DESIGNER.



### DETAIL OF SPLICING IN COLUMNS AND PLATES





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