



## CASE 4.9 NDT & Strength Evaluation of an Industrial Warehouse, Mexico



A Graphite Electrodes’ manufacturing company requested a full structural condition assessment of one of their industrial warehouses in Monterrey, Mexico. After the evaluation, decision would be taken regarding the demolition or repair of the structure. The 50-year-old structure was fully built with cast-in-place reinforced concrete elements. The structure consisted of regular rectangular columns and beams, and a large semi-circular vaulted roof. The longest dimension of the roof from edge to edge was 124 meters. Since the owner of the structure didn’t allow coring, a full NDT evaluation program was conducted..

### COMPRESSIVE STRENGTH ESTIMATION

The warehouse was composed of a total of 81 structural elements among columns, beams and vaulted roof sections. In order to obtain a representative sample of compressive strength values, ASTM 122 was used to determine the number of elements that should be tested. As a result, CAPO-TEST was conducted at 24 structural elements. And, using the statistical method suggested by ACI 228, an equivalent compressive strength was calculated for the whole structure.

CAPO-TEST COMPRESSIVE STRENGTH SUMMARY	
Tested Elements	24
No of CAPO-TEST’s	
Strength Range (MPa)	20 to 32
Mean Strength (MPa)	25
St. Dev. (MPa)	4
C.V.	16%
Equivalent $f_c$ (MPa)	19

### REBAR SCANNING

Ground Penetrating Radar with a 2600 MHz antenna was used to scan the structural elements and Cover Meter was used to estimate the rebar diameter. It was found that the average cover layer of all columns and beams was 20 mm.



GPR for rebar depth      Covermeter for size of bar



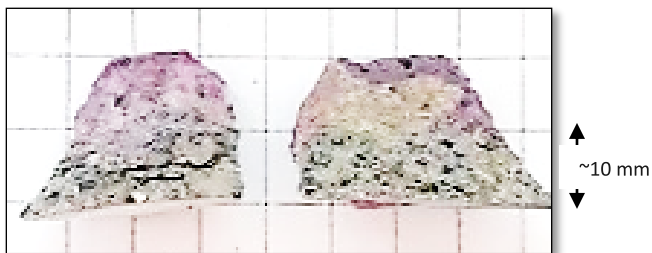
CAPO-TEST

# NDTitans in action



s'MASH Impulse Responce on the vaulted roof

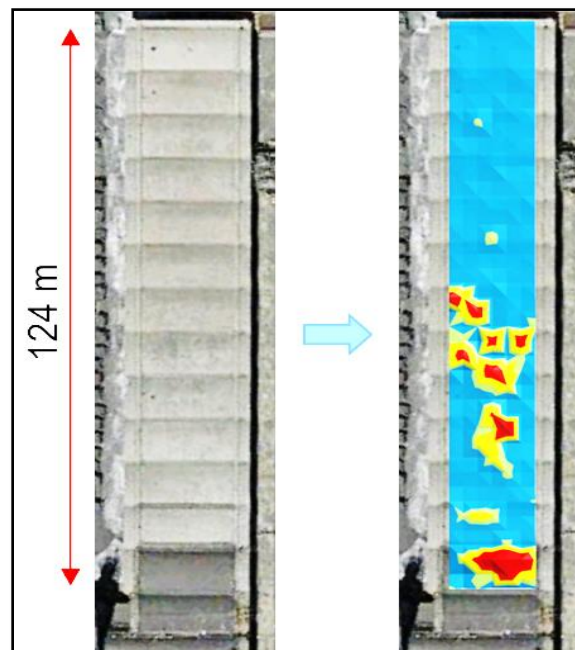
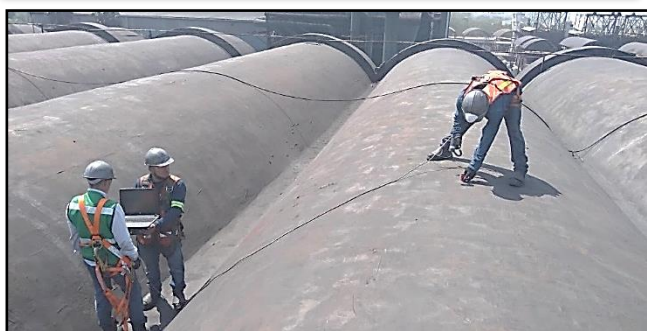
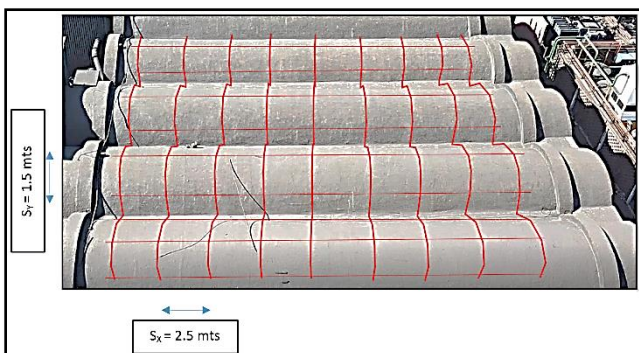
## CARBONATION



The CAPO test conical pullout cones were tested for carbonation with a pH indicator. It was found that the depth of carbonation on columns was ~10 mm and the beams and roof ranged between 15 to 30 mm. the average coverlayer was 20 mm, the reinforcement of beams and roof was at high risk of corrosion.

## STRUCTURAL INTEGRITY ASSESMENT OF VAULTED ROOF

s'MASH Impulse-Response was conducted to quickly evaluate the structural integrity of the large concrete roof. 8,600 m<sup>2</sup> of roof were tested with around 1,200 points in 1 a full day.



s'MASH contour plot of average mobility

The “average mobility” value of each point was used to compute a statistically modified contour plot as shown with the “sound” areas (blue) vs “unsound” areas (red / yellow) It was found that the areas where high “average mobility” (red / yellow) coincided with heavy corrosion induced damage from carbonation.

## CONCLUSION

Using the calculated equivalent compressive strength as suggested by ACI 228 and the on-site rebar configuration, it was found that the structure was appropriately designed and built. However, after 50 years of service, the structure had developed localized carbonation induced corrosion deterioration on beams and especially the roof, and needed repair. Columns were suffering from mechanical impact due to negligent driving of tractors within the warehouse. A concrete rehabilitation manual was provided to the structure owner.

## NDTitans in action

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