

Non destructive tests for Refractories

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AGC



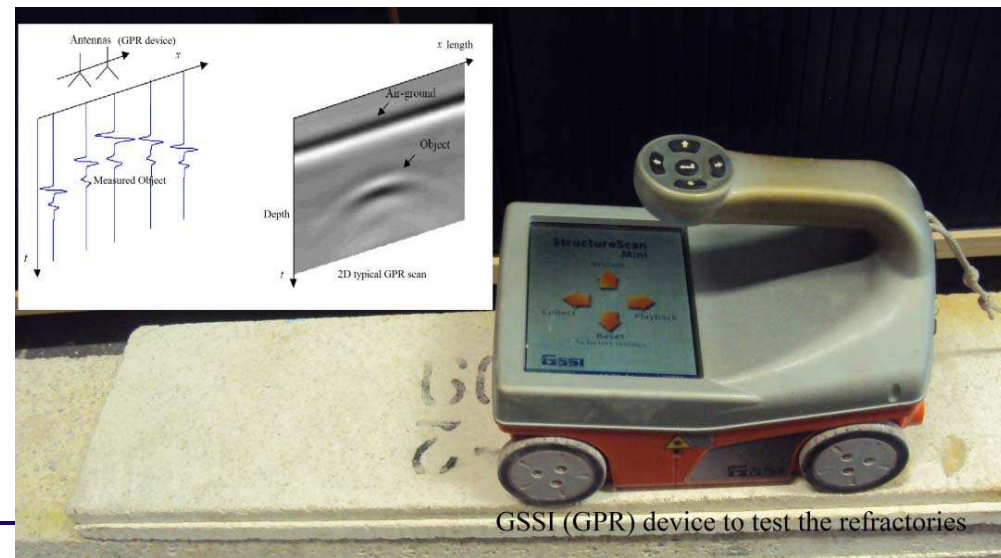
Your Dreams, Our Challenge

GPR - Principle and device

The Ground Penetrating Radar is a Non-Destructive Testing used mainly for the concretes survey or soils analyses. It consists into the use of **electromagnetic pulses** to determine the structure of **nonconductive material**.

2 physical properties of the material impact the GPR response:

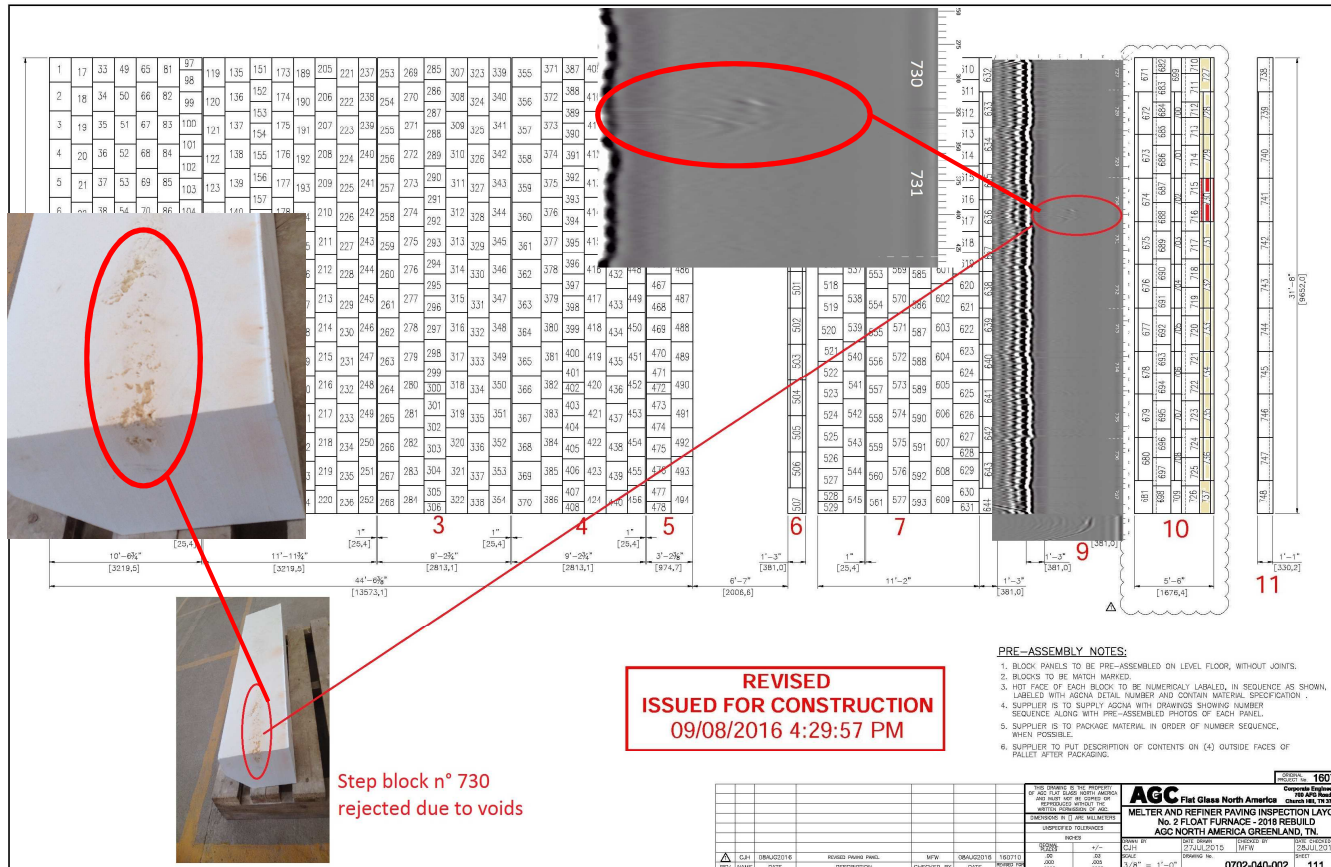
1. **Electrical conductivity**: The Radar is suitable for inspection of any material with low electrical conductivity.
2. **Dielectric constant**: Descriptive number that indicates how fast radar energy travels through a specific material. ($v = \frac{c}{\sqrt{Di\epsilon l\ cst}}$)



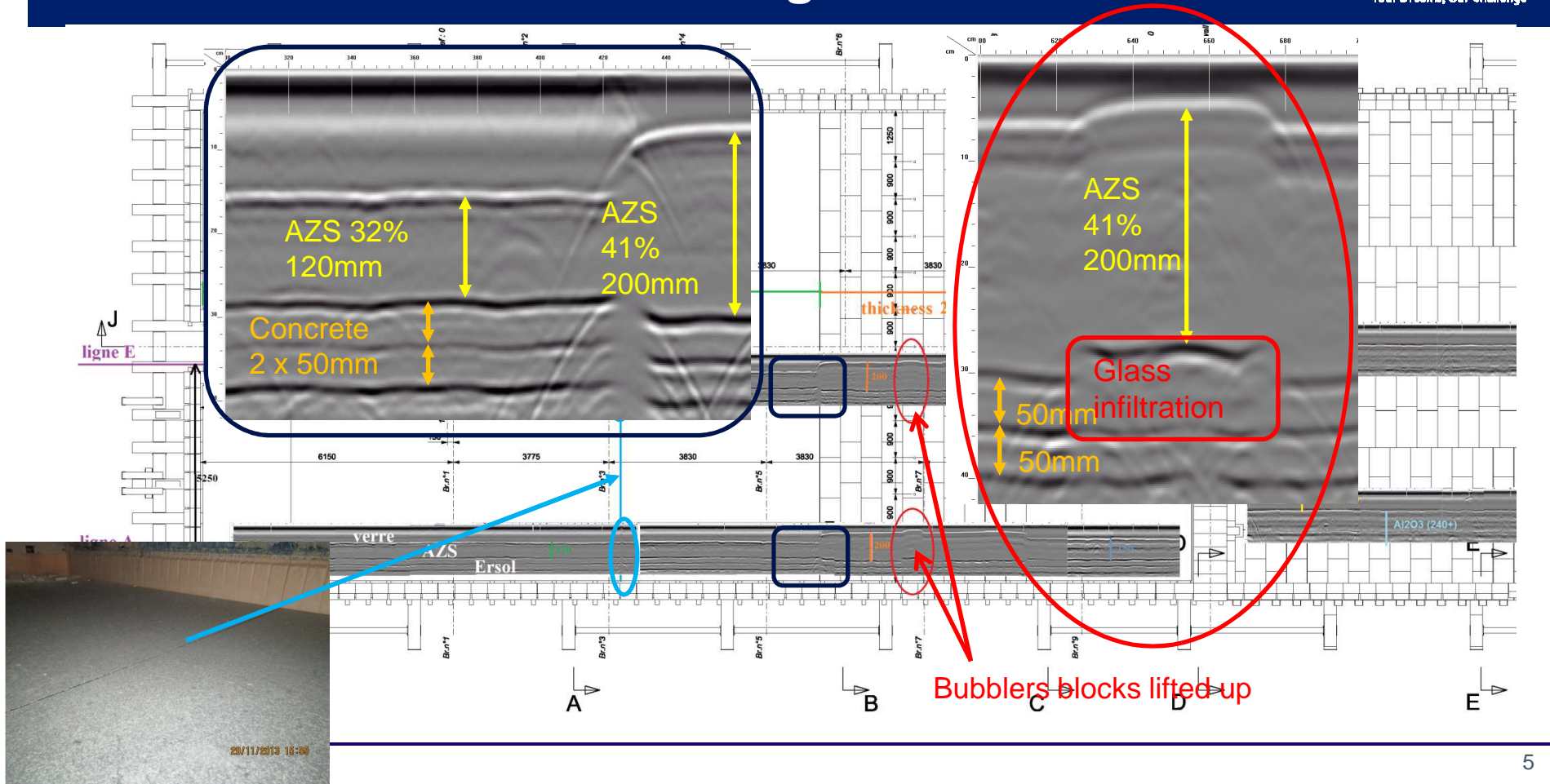
Refractory quality by NDT (Ground Penetrating Radar)



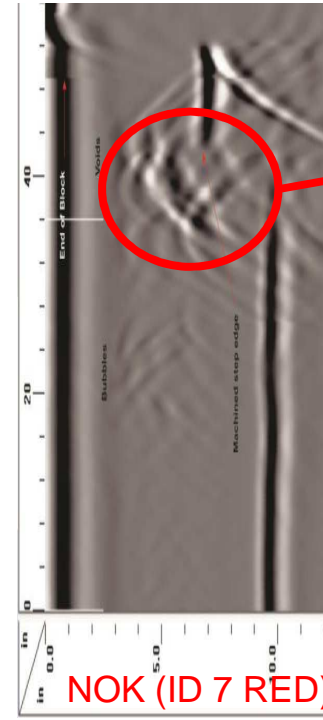
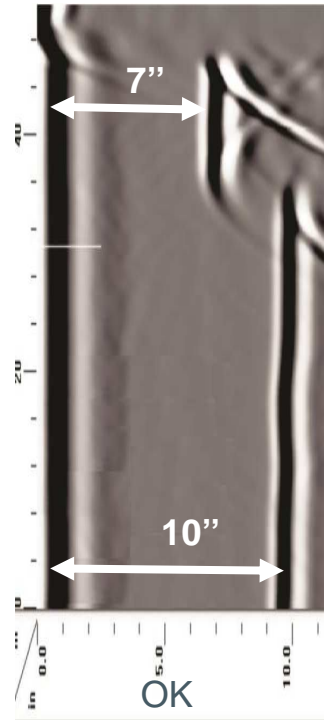
Voids detected in step bottom paving (inspection at supplier)



GPR – bottom structure – longitudinal scans



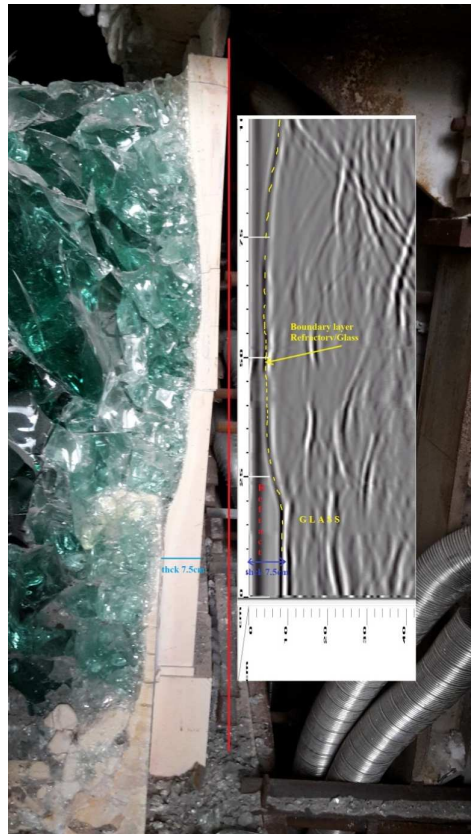
Refractories inner structure - GPR in workshop



Challenge: define specification for GPR

Residual thickness

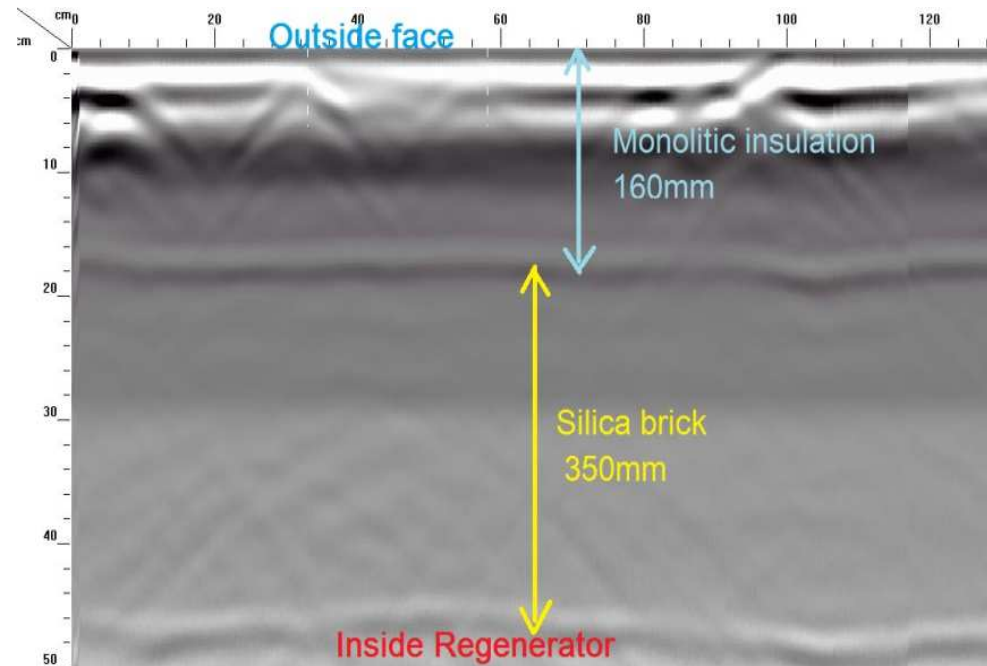
Glass/Refractory interface can be detected by GPR at room temperature



Residual thickness (hot)

Silica crown
(regenerator +/- 1490°)

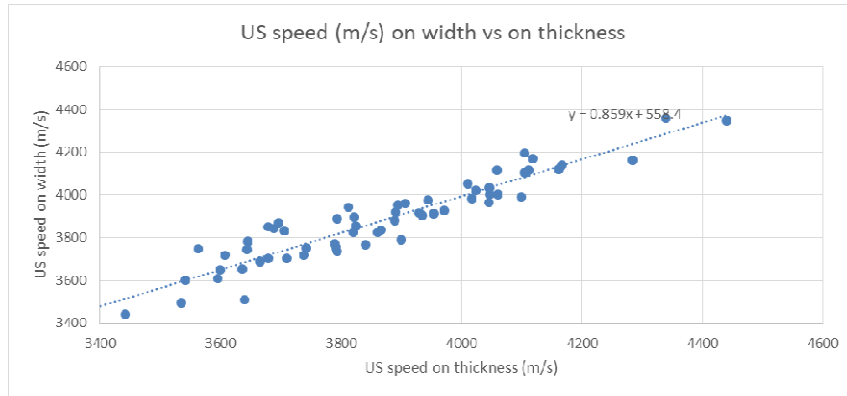
Clear visibility of the
refractories thicknesses
(insulating & silica)



Ultrasonic tests



Typical results & discussions



	On Thickness	On width
AVERAGE	3861	3875
STDEV	226	205
MAX	4440	4360
MIN	3262	3323
QYT	61	61

US on silico aluminous TBB

All blocks

shape 1

shape 2

AVERAGE	5,412
STDEV	174
QTY	208
MAX	5,787
MIN	4,420
Format	15.0196
AVERAGE	5,410
STDEV	192
QTY	156
MAX	5,787
MIN	4,420
Format	15.0285
AVERAGE	5,420
STDEV	106
QTY	52
MAX	5,690
MIN	5,241

US on CA TBB

US comments

- US is used to evaluate the consistency of the production
- US depends not only upon the material but other parameters must be taken into account :
 - Press type (hydraulic, friction...)
 - Process (uniaxial – isostatic – casting...)
 - Firing conditions
 - Room temperature (specifically if below 0°C) , however not recommended to inspect the refractories at this T°C range

Temperature	Dry concrete	Wet concrete
10°C – 30°C	1.0 (No correction)	1.0 (No correction)
60°C	1.05	1.04
40°C	1.02	1.02
0°C	0.99	0.99
-4°C	0.98	0.92

Table by Proceq