proceq
A Screening Eagle Company

Gain Clarity on Post Tension Duct Inspections

Discover the complete solution.

Multi-technology application

Layering testing methods improves the confidence level and helps to determine just how much extraction or repair is necessary.

1
Locate

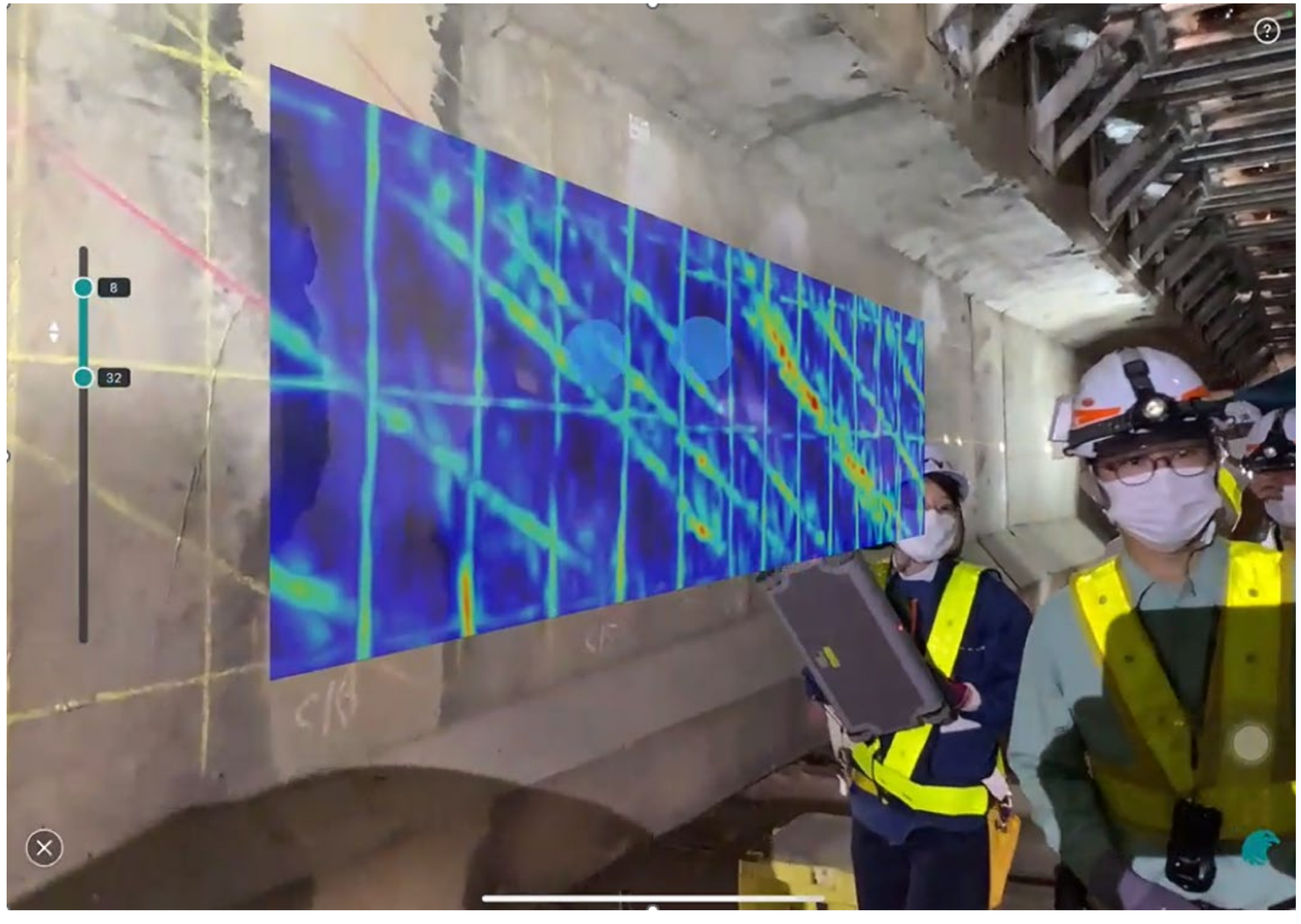
Locate tendon ducts with ground penetrating radar (GPR) for ultra-clear views of the duct layout in real-time.

2
Assess

Assess PT duct grout and detect defects rapidly with an ultrasonic pulse echo method (UPE). Expand your analysis of UPE data with Pundit Vision.

3
Verify

Verify the results and view the interior of the PT duct in high resolution photos and videos using a videoscope.



Step 1 - Locate Tendon Ducts with Ground Penetrating Radar (GPR)

Measurements

Scan perpendicular to the direction of the tendon duct and mark the location on the concrete surface.

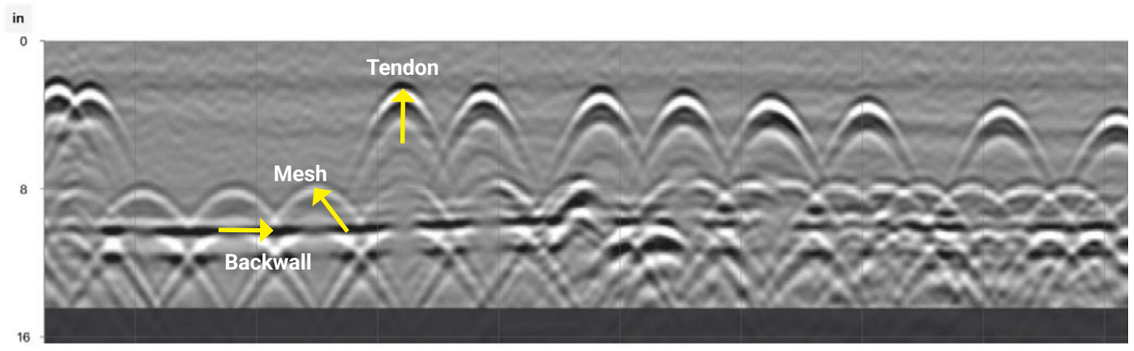
PT ducts can be difficult to distinguish from rebar using just a single GPR scan. A trick is to scan several locations along a suspected tendon and note any change in depth. PT ducts tend to drape and/or curve through a structure depending on locations of critical stress while reinforcement bars tend to remain a straight line.

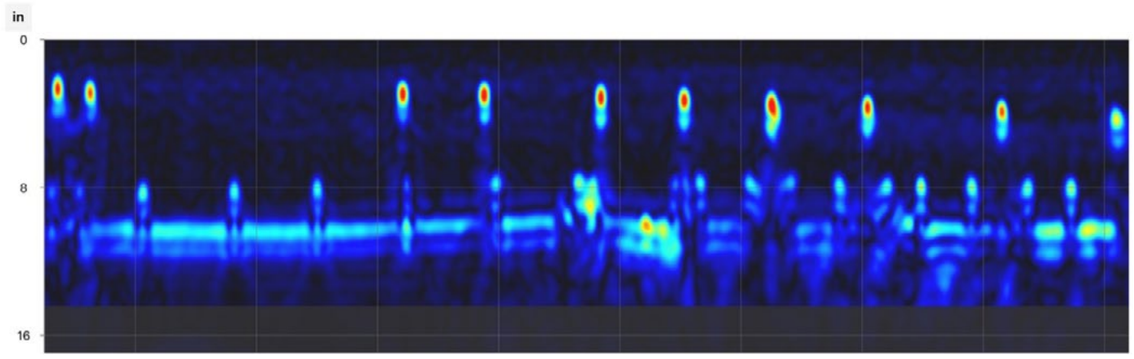
GPR Results

GPR results are a cross-sectional image of objects underneath the scanned concrete surface shown in what is called a B-scan. This can be displayed as a classic radargram view (top) or a migrated view (bottom). In this example of a suspended concrete slab, there is concrete mesh on the bottom and a row of PT cables around halfway below the surface.

If an area scan is performed, the scan can be superimposed onto the surface using augmented reality to improve visualization for reports and to confirm markings.

Most PT ducts are made of steel which means that GPR is excellent at locating, however, the steel is impenetrable for radar waves so grout condition cannot be determined. Other non-destructive testing is required to pass through the steel.





If the duct is made of plastic, GPR is able to locate the metal cables but still may not be sensitive enough to detect the air voids. Other methods are suggested to improve the analysis.

Step 2 – Assess the ducts and grouting condition with Ultrasonic Pulse Echo (UPE)

Assess the grout, reduce the doubt.

**Full grout =
Corrosion protection**

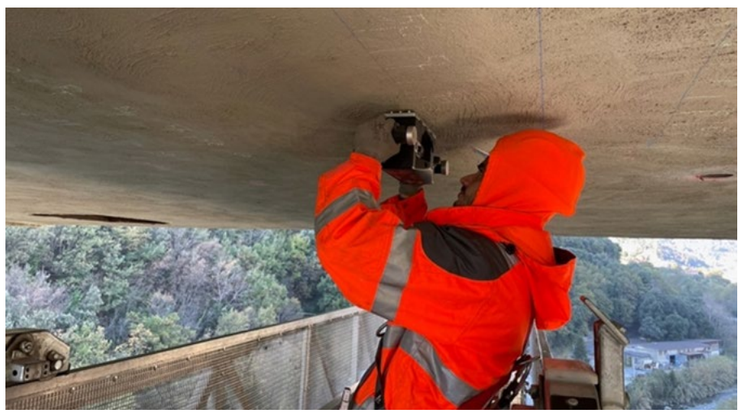
**Grout defects =
Future corrosion risk**

**Defects + Corrosion =
Possible structural failure**

Measurements

A UPE device like the PD8050 is used to assess the grout condition because ultrasonic waves have a strong reflection from air voids. The scan can be collected using a line or matrix scan depending on the resolution desired.

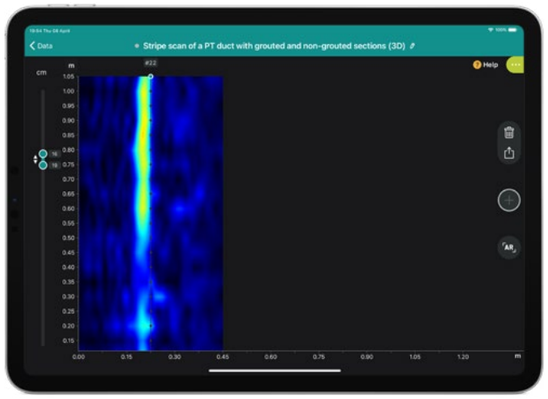
Interpret results onsite for initial conclusions on grout conditions and mark the surface for potential further testing.



UPE Results

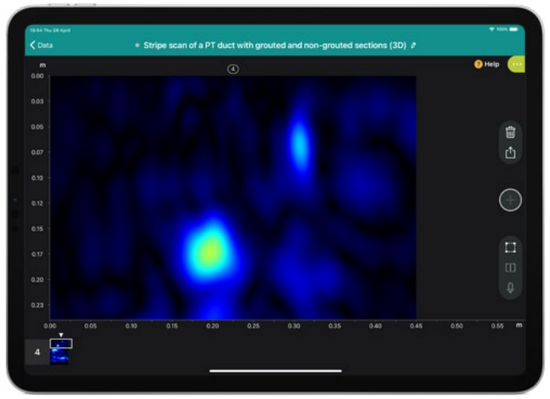
UPE Amplitude Analysis C-Scan

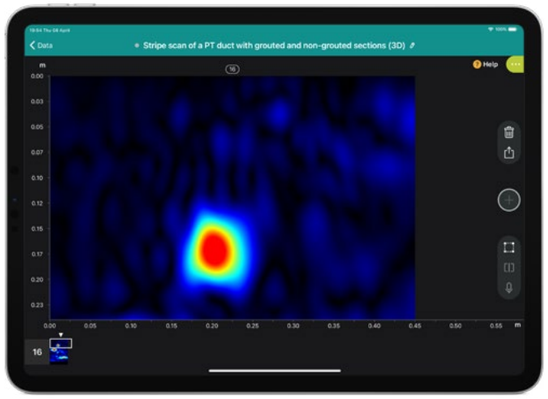
Air boundaries have a strong reflective surface for UPE so the greatest amplitude reflection likely indicates the presence of a void. Fully grouted areas will generally produce weaker reflections.



UPE Amplitude Analysis B-Scan

Similar analysis can also be carried out using B-scans

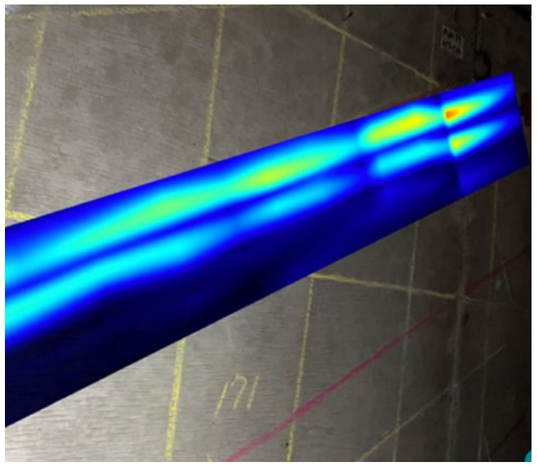




UPE Amplitude analysis C-Scan

The scan can be superimposed onto the surface using augmented reality to highlight the suspected void areas for clear reporting.

Amplitude is a localized comparison and can be misinterpreted in some circumstances. For example, a smooth steel PT duct could have the same amplitude as a rough air boundary. Performing a phase analysis can add confidence because it considers the reflected wave shape. Combining amplitude and phase increases confidence in the analysis before destructive testing begins.



Increase confidence with Phase Analysis

Increased confidence in defect detection can be obtained by performing phase analysis of the UPE data with the Pundit Vision post-processing software.

Pundit Vision is a collection of software modules for advanced postprocessing of ultrasonic data. Phase evaluation is a module that assigns a color to the signal phases to highlight the different material boundaries.

A phase analysis further improves an ultrasonic tomography analysis by considering the reflection coefficient of the wave. It is no longer limited to an amplitude analysis but also the physical shape of the wave reflection. This increases the confidence that reflections from PT ducts are voids in the grout.

Figure 1 shows a PT tendon example with several matrix scans assembled into a single plan and 3D view using Pundit Vision.

Figure 2 shows a Bscan of the same data set after a phase analysis. The known backwall and the tendons have a similar phase color indicating voids in the grout. The disappearance of the backwall below the tendons also indicates a grouting defect as the wave is unable to get through the air void to reach the back wall. There are also several reflectors near the surface with the pattern and phase of steel reinforcement. The Ascan at the bottom of the image helps highlight the change in phase where the blue colors highlight a positive amplitude at the void and backwall location and where the red has a negative amplitude at the steel reinforcement location.

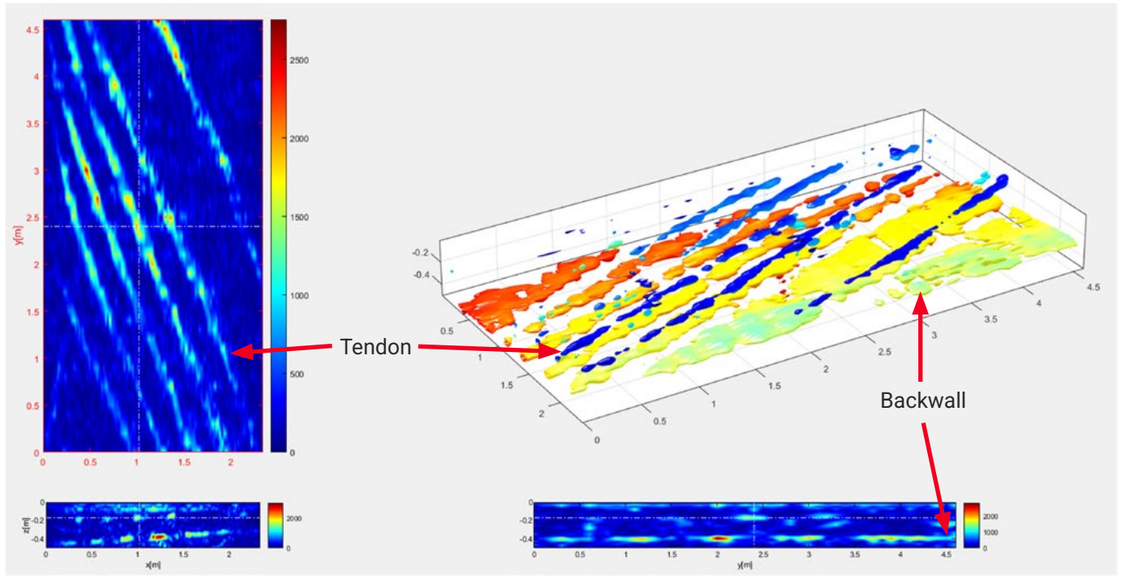


Figure 1: Several PT tendons shown in each plane and in 3D

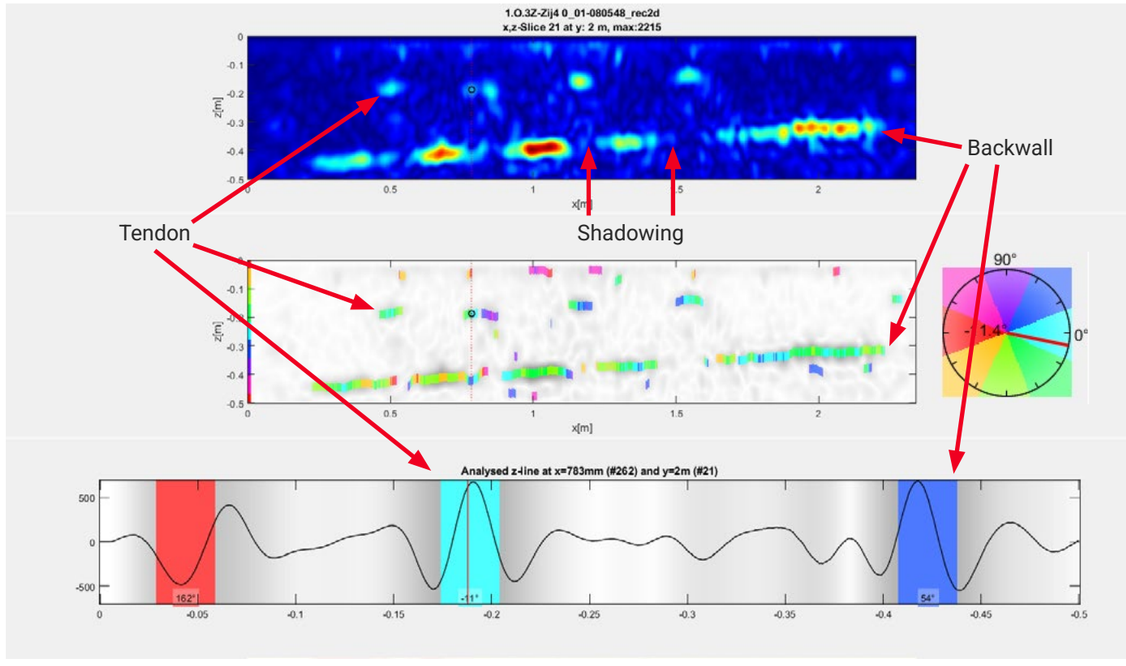


Figure 2: The same PT tendons as above undergoing a phase evaluation

Step 3 – Verify your results with the Videoscope

Until the grout condition can be seen with the human eye or a videoscope through a destructive investigation, one can never be 100% sure where voids are located no matter how many nondestructive tests are performed. However, these preliminarily tests can reduce the required damage and focus an investigation.

Measurements

Use a drill bit of at least ∅ 25mm into the duct wall to create an entry point for the videoscope.

Videoscope results

Gain visual verification of your results in high resolution images and videos.

Get Pundit Vision software + the Videoscope FREE

When you purchase selected items!

Scan to register your interest & receive more info

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