Built on Success

Transforming Challenges into Solutions

Proceq Application Booklet (Asia Edition)

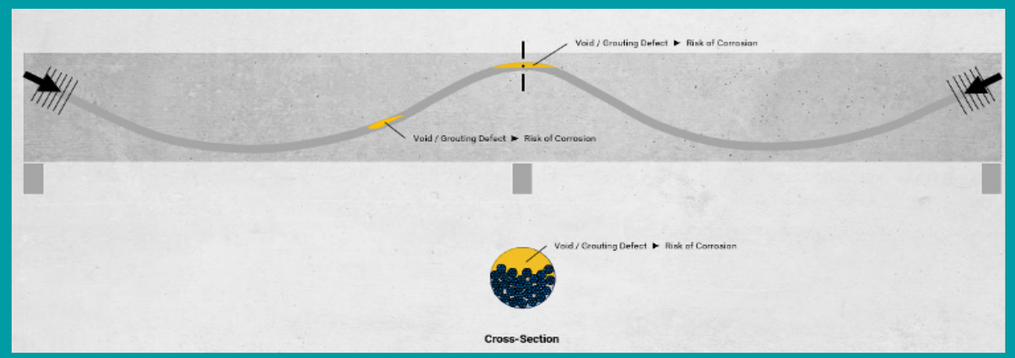
Utilising Advanced NDT Inspection Technologies

Real-World Case Studies in Asia

Overview

Post-Tension Duct Grouting Defects Inspection

Bridge post-tension (PT) ducts play a crucial role in maintaining the structural integrity of bridge girders. Ensuring these components are free from grouting defects is vital for the safety and longevity of bridges. Inspecting PT ducts for such defects presents several challenges, particularly with traditional methods.



Challenges:

Outdated Instruments:
Conventional inspection methods often use outdated instruments that lack on-site visualization capabilities and require lengthy setup and processing times.

Interpretation of results can be complex and prone to delays.

Health and Safety Risks:
Alternative methods, such as x-ray inspection, involve health risks due to hazardous radiation.

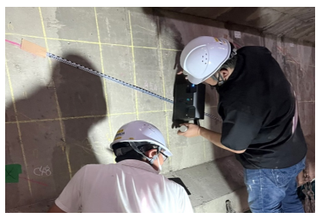
These methods require area clearance, extended setup times, and skilled personnel to manage operations.

Manual Reporting:
Traditional inspection processes rely on manual reporting without a centralized data platform, complicating real-time data sharing and collaboration among site inspection teams, project offices, and asset owners.

Solution:

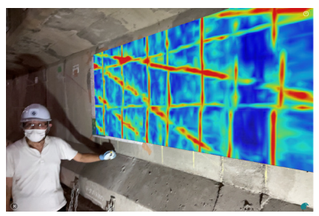
Advanced Ground Penetrating Radar (GPR):
Accurately maps rebars and PT cables in bridge girders with Proceq GP8100 GPR. Initial superline scans in X & Y, followed by detailed area scans for comprehensive analysis.

Depth slicing and 3D imaging with AR overlays ensure precise marking of locations.



Ultrasonic Pulse Echo (UPE) Inspection:

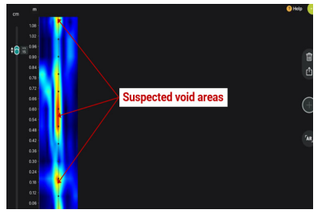
Detects air voids in suspected PT cables using Proceq PD8050. Signal reflections identify potential defects for further examination.



Digital Record & Collaboration:

Cloud-based Inspect platform consolidates photos, scan results, and drawings into a comprehensive digital record.

Enables real-time data sharing for immediate updates and collaboration.



Post-Processing & Verification:

Analyzes UPE data with Pundit Vision software for anomaly confirmation. Validates findings with targeted drilling and borescope verification.

Video Scope Inspections:

Non-invasive borescopes assess cable and grout conditions, confirming grouting defects. Standard practice in Japan and beyond, enhancing safety and longevity of post-tensioning systems.

Results:

By integrating these advanced technologies, the inspection process for PT duct grouting defects is significantly improved, offering enhanced accuracy, safety, and efficiency in bridge maintenance operations.

Water Leakage Inspection of Tunnel Linings

Tunnel linings are essential for maintaining the structural integrity and safety of tunnels, especially those situated in areas with high water tables or near significant water sources. Water leakage through tunnel linings can lead to serious issues, including deterioration of the lining material, structural weakening, and potential operational disruptions. Effective inspection and management of water leakage are crucial for preserving the longevity and functionality of tunnel infrastructure.

Challenges:

Early Detection Difficulties:

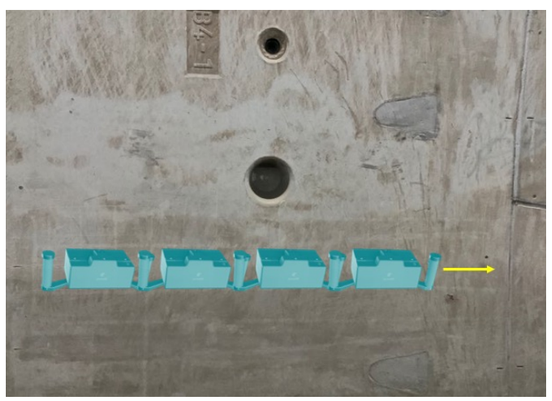
Water leakage may be subtle and not immediately visible, making early detection and accurate identification of leakage points challenging. Conventional methods might miss or inadequately assess the extent of leakage.

Structural Impact:

Persistent water leakage can damage tunnel linings by causing material degradation, corrosion of reinforcements, and erosion of surrounding soil, which may compromise the tunnel's structural integrity.

Limitations of Traditional Methods:

Standard visual inspections and basic diagnostic tools may provide incomplete or inaccurate information about leakage, leading to delays in repairs and increased costs.



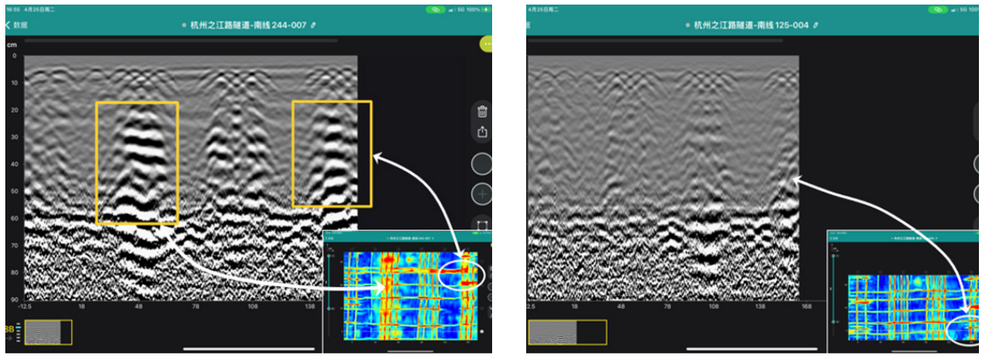
Solution:

The **Proceq GP8100** Ground Penetrating Radar (GPR) is deployed to perform high-resolution imaging of tunnel linings, providing detailed insights into potential areas of concern. Increased signal intensity in certain areas may indicate potential water saturation. These findings should be compared with radar scans from non-saturated areas to confirm the extent of the seepage.

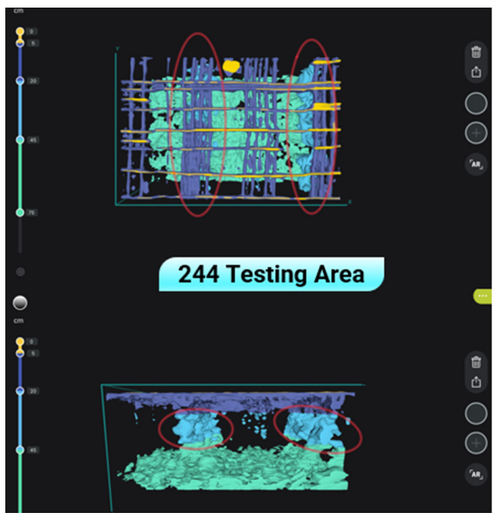
The **Proceq PD8050** can then be used to cross-verify the anomalies identified by the GPR and further investigate the voids in the affected area to assess their impact.

Results:

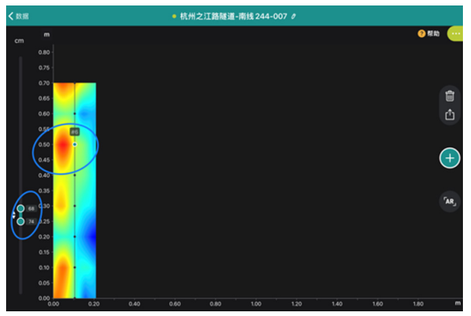
Leveraging advanced GPR and ultrasonic pulse echo technologies, along with thorough analysis and targeted repairs, helps preserve tunnel linings, minimizing water damage and ensuring long-term stability and safety.



This figure contrasts radar images from a suspected water-saturated area with those from a non-saturated area. The suspected area shows noticeable increased signal intensity between reinforcing bars and the base slab, indicating water seepage, while the non-saturated area shows no such signals.



The AR structure image highlights a noticeable water-saturated signal and potential seepage between the reinforcing bars and the base slab, as indicated by the red circle.



PD8050 scans reveal a significant void reflection in the suspected area, consistent with the GPR findings.

Water Seepage Analysis in Tunnels

Bridge post-tension (PT) ducts play a crucial role in maintaining the structural integrity of bridge girders. Ensuring these components are free from grouting defects is vital for the safety and longevity of bridges. Inspecting PT ducts for such defects presents several challenges, particularly with traditional methods.

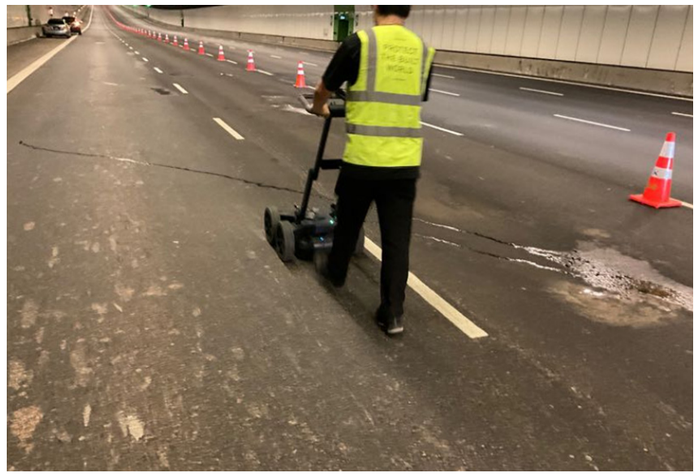
High hydrostatic pressure and saline groundwater contribute to these issues, affecting construction materials and increasing maintenance costs. Effective detection and analysis of water seepage are essential for maintaining tunnel longevity and safety.

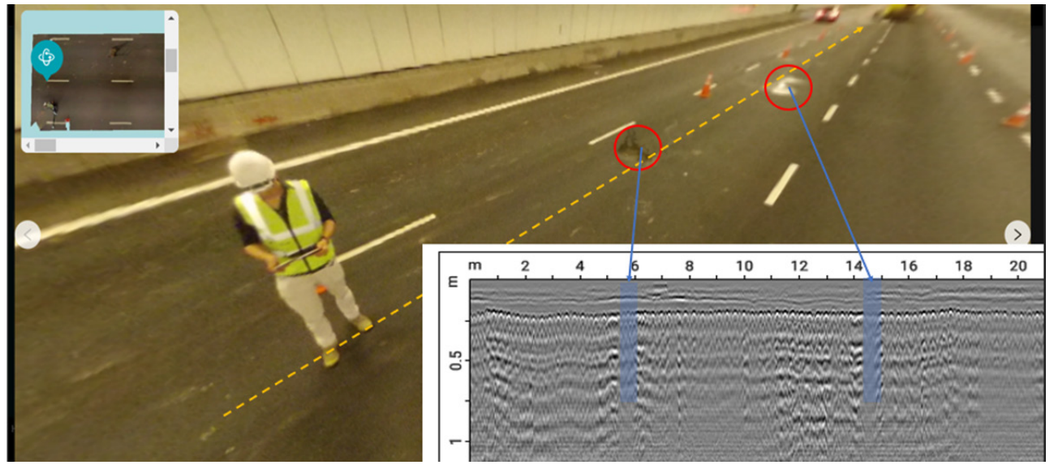
Challenges:

Inadequate Traditional Methods:
Visual inspections and localized repairs may not fully detect the extent or source of water seepage.

Structural Damage Risks:
Water seepage can weaken pavement, increase pothole risks, and pose safety Conventional GPR Limitations: High conductivity of water-saturated materials can distort traditional Ground Penetrating Radar (GPR) signals, complicating accurate seepage assessment.

Non-Destructive Needs:
There is a need for non-destructive methods that can accurately map and analyse water infiltration without disrupting tunnel operations.



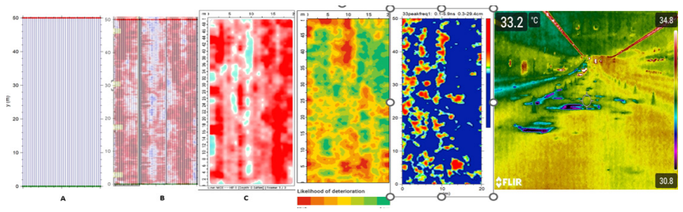


Solutions:

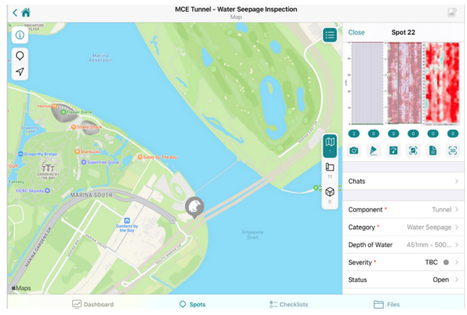
Advanced Ground Penetrating Radar (GPR):

- The Proceq GS8000 and GS9000 deliver high-resolution imaging to detect water seepage, enabling accurate detection even in challenging conditions such as high material conductivity and saline environments.
- Augmented Reality overlays for direct visualization of seepage on tunnel surfaces.

Data Post-Processing and Enhancement:
GPR Insights Software enhances the radar data with advanced processing techniques, producing high-quality 2D and 3D visualizations for a comprehensive view of the seepage extent.



Digital inspection platform, Inspect was used to document the visual inspection data and to streamline the inspection workflow.



3D GPR Insights results indicating material deterioration and heatmap of the reinforced concrete structure below the asphalt, highlighting areas of varying condition.

Results:

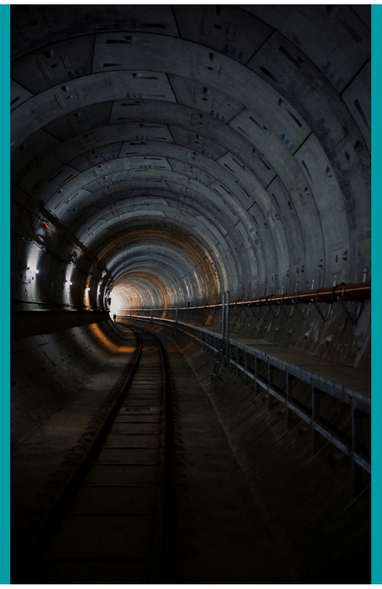
Leveraging these technologies enables engineers and maintenance teams to proactively address water seepage issues, ensuring the structural integrity and safety of tunnel infrastructure while reducing maintenance costs and operational disruptions.

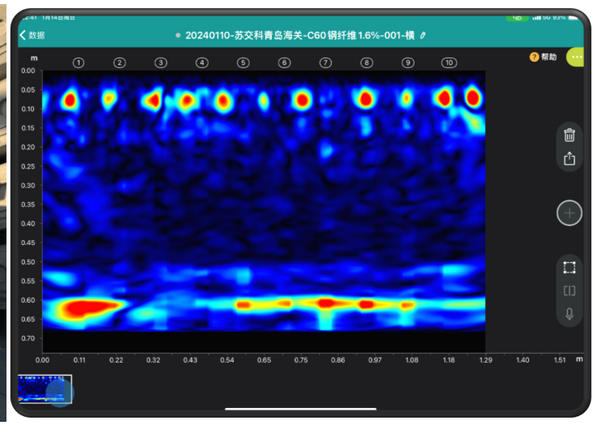
Accurate Rebar Cover Measurement in Steel Fiber-Reinforced Concrete Structures

In construction projects involving reinforced concrete structures, ensuring the correct cover thickness of reinforcing bars is crucial for the durability and safety of the structure. This is especially true in environments where concrete is exposed to aggressive conditions, such as undersea tunnels, bridges, and high-performance structures.

The use of fiber-reinforced concrete, particularly those incorporating steel fibers, enhances structural performance but introduces additional complexity in accurately measuring rebar cover.

Traditional methods often face challenges due to the dense and heterogeneous nature of the material, requiring advanced inspection techniques to ensure compliance with safety and design specifications.





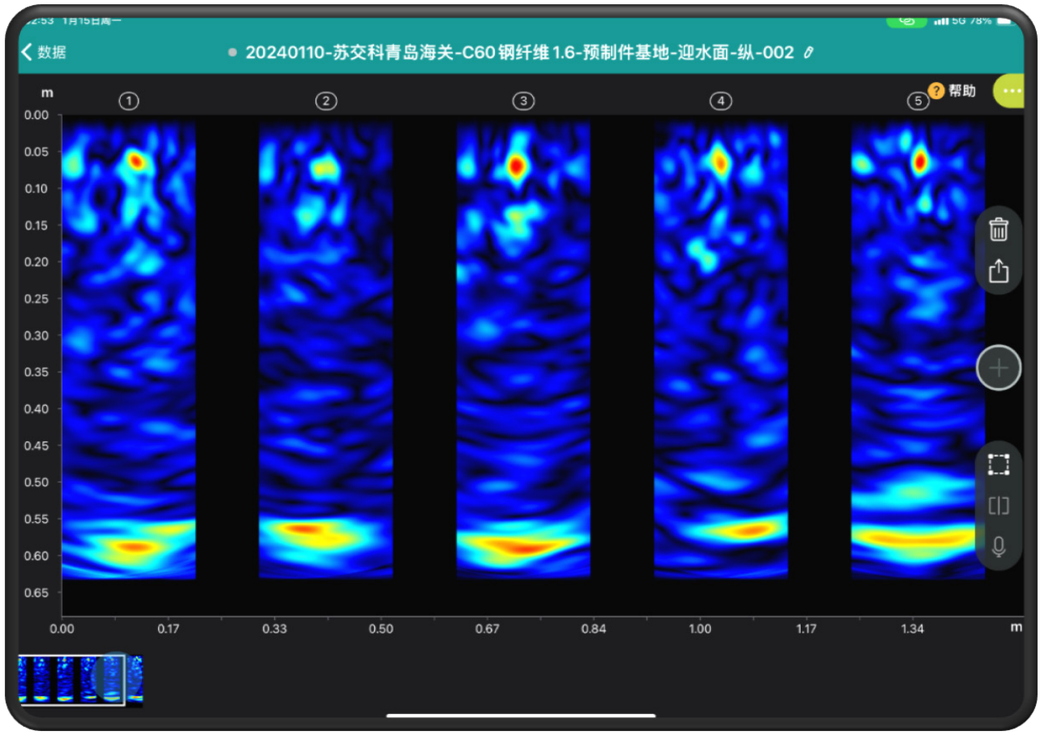
Challenges:

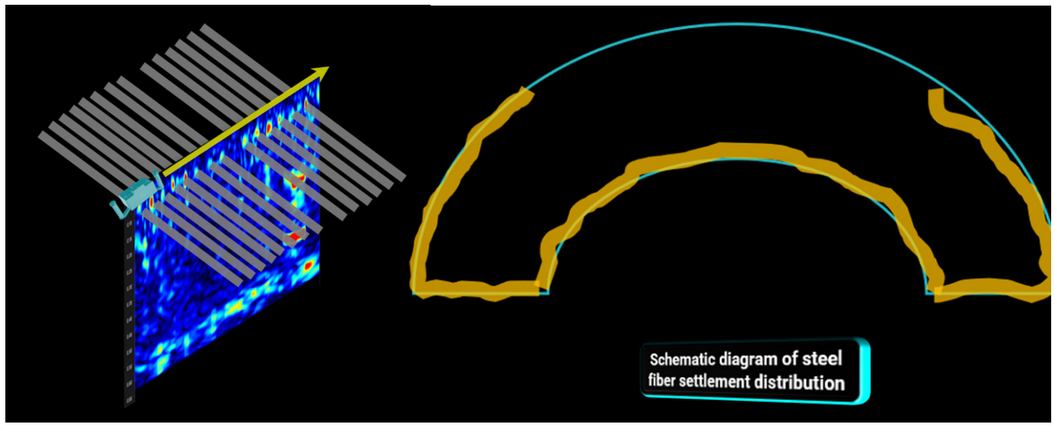
Fiber-reinforced concrete often contains steel or other metallic fibers, which can interfere with traditional non-destructive testing (NDT) methods, such as ground-penetrating radar (GPR) or magnetic cover meters.

These fibers, along with variations in concrete composition, can cause signal scattering and attenuation, making it difficult to accurately differentiate between the steel fibers and the rebar. This interference leads to reduced accuracy in detecting the rebar's position and cover thickness, posing significant challenges for obtaining reliable data using conventional inspection methods.

Solution:

Utilizing advanced ultrasonic pulse echo array, PD8050, enables clear detection of reinforcing bars even in fiber-reinforced concrete.





Results:

By analyzing ultrasonic signals, this technology provides accurate measurements of rebar cover thickness, overcoming the limitations posed by traditional NDT methods in fiber-laden concrete environments.

Large-Scale Concrete Dams: Assessment of Rebar Integrity and Void Detection

In large-scale infrastructure projects like dams, assessing the condition of rebar and concrete is essential for ensuring long-term safety and structural integrity.

For dams built in varying conditions and with complex structural elements, it is crucial to conduct detailed surveys to evaluate rebar placement, concrete strength, and potential issues such as voids or corrosion. These assessments are key to planning maintenance and ensuring the continued safety and performance of the structure.

Challenges:

Accurate Rebar Detection:

Identifying the precise location and condition of rebar embedded deep within concrete can be challenging, especially when dealing with multi-layered reinforcement and varying cover depths. Traditional methods such as visual inspections or basic magnetic tools may struggle to detect rebar accurately, especially when it is buried deep within concrete or when dealing with multi-layered reinforcement. These methods often lack the precision needed to fully assess rebar placement and condition.

Void and Compaction Identification:

Detecting voids and areas of poor compaction within the concrete is critical, as these issues can affect the structural stability and durability of the dam. Conventional techniques like hammer tests or core drilling are invasive and can be disruptive. They may provide limited information about voids or areas of poor compaction, potentially missing critical areas or causing damage to the structure.

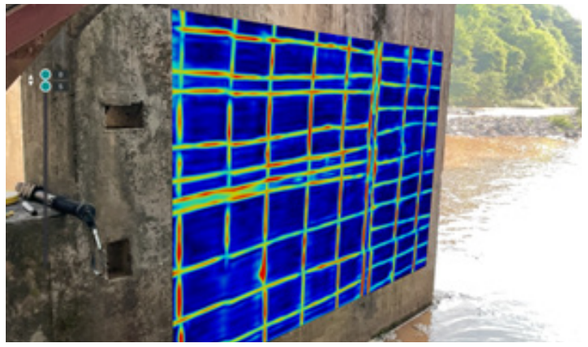
Corrosion Impact:

Corroded rebar can complicate detection efforts and potentially lead to inaccurate readings, which may affect the reliability of the survey results. Traditional inspection methods may not effectively detect or evaluate the impact of rebar corrosion. Corrosion can affect the accuracy of rebar detection and lead to incomplete assessments, resulting in potential underestimation of the structure's condition.

Standard inspection methods often require multiple test points and significant time to gather comprehensive data, which can be inefficient and may not provide a complete picture of the structural health.

Solutions:

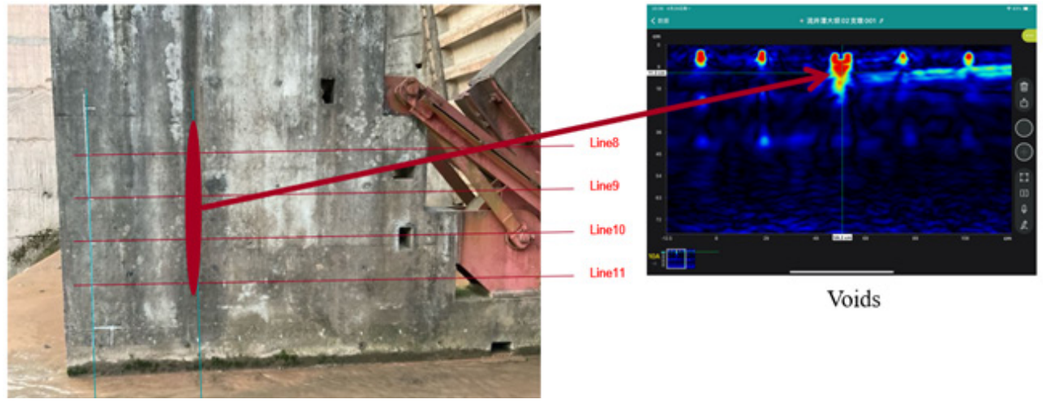
The use of GP8100 allows for detailed superline imaging and insights into rebar and concrete conditions in large-scale infrastructures. Its high-resolution scanning provides clear data on rebar distribution, and helps identify any voids or areas of concern within the concrete. This ensures that potential issues are addressed effectively to maintain structural integrity. Additionally, radar imaging can also identify potential corrosion by detecting signal anomalies that reflect changes in the rebar's condition. These anomalies can be accurately mapped and analysed to determine the extent and severity of deterioration.



Employing both area scanning and super linear scanning methods enables a comprehensive evaluation of the structure. Area scanning is ideal for assessing the overall distribution of reinforcement, while super linear scanning efficiently detects the presence of rebar and highlights potential issues.

Results:

By leveraging advanced GPR technology, similar infrastructure projects can achieve precise and efficient assessments of rebar and concrete conditions. This approach ensures that infrastructure projects remain safe and operational over the long term.



In the measurement lines 8-11 shown in the above figure, signals of voids and poor compaction (marked in red) were also detected, with a depth of 7 to 20 cm, and traces of water seepage can also be seen on the surface of the structure.

Road Pavement: Assessing Subsurface Cavities and Voids

Road pavements form a critical part of our infrastructure, serving as vital pathways for daily transportation and economic activities. Ensuring their integrity is crucial, yet beneath their surfaces lie hidden threats. Subsurface defects, such as cavities and voids, pose serious risks to structural stability, often going unnoticed until significant damage occurs.

Road pavement cavities can form due to various factors, including poor drainage, environmental wear, and subsurface utility failures. When surface water isn't properly drained, it accumulates and gradually infiltrates the layers beneath, weakening the road foundation. Additionally, natural processes like the dissolution of soluble rock or underground mining activities can create voids beneath the pavement. These cavities can lead to surface collapses, sinkholes, and other infrastructural failures, compromising road safety and functionality.

Challenges:

Invasiveness and Disruption:
Techniques like core drilling or ground probing with metal rods are highly invasive, causing damage to the road surface and disrupting traffic.

Limited Coverage:
Most traditional techniques only provide data for specific points, missing potential defects in other parts of the road. This limited coverage makes it harder to fully assess subsurface conditions.

Surface-Level Focus:
Visual inspections and sounding techniques only detect visible or near-surface damage. By the time surface defects like cracks or sinkholes appear, the underlying issues may have already progressed. These methods often fail to reveal the full extent of subsurface issues, leaving potential hazards unaddressed until they worsen.

Cost and Time Constraints especially for large areas.

Delayed Decision-Making:
Insufficient information can delay repairs, increasing the risk of road collapse and higher repair costs.

These challenges have traditionally led to a reactive approach in road maintenance, where defects were often only detected once they caused visible damage, leading to costly repairs or even hazardous road failures.

Solution:

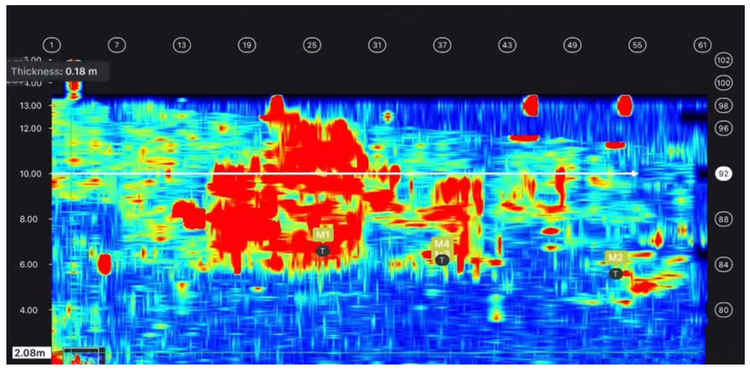
With advancements in Ground Penetrating Radar (GPR) technology, we can now move towards proactive maintenance. GPR provides real-time, non-invasive subsurface imaging, allowing us to detect and map subsurface cavities, identify potential issues early and address them before they escalate into significant safety concerns.

Advanced Ground Penetrating Radar (GPR) Proceq GS8000 and GS9000 provide:

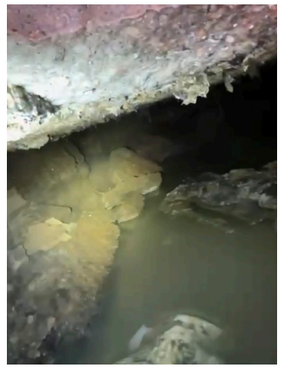
- Versatile frequency ranges for various scanning depths, with the GS8000 suitable for medium-depth imaging at 40–3440 MHz, and the GS9000 offering deeper scans at 30–750 MHz and higher-resolution shallow scans at 500–3000 MHz.
- GPR systems paired with GNSS can operate without traditional survey grids, making the process faster and more flexible. This allows teams to scan areas based on specific conditions, improving the accuracy of data collection.
- Real-time 2D and 3D data processing for immediate anomaly detection and enhanced understanding of subsurface structures, improving field efficiency and safety.

Results:

By integrating advanced GPR technology into routine inspections, infrastructure managers can proactively address potential hazards, reduce the risk of road collapse, and minimize emergency repair costs. This enhances road safety and durability, supporting better urban infrastructure management.



Scanned data showing possible cavity location



Cavity confirmed via verification with borescope

Identifying and Mapping Structural Damage for Bridge Deck

Structural damage beneath road pavements can lead to significant issues, including:

- Pavement Deformation: Subsurface voids and anomalies can cause pavement cracks, settlement, and uneven surfaces, posing risks to vehicles and pedestrians.
- Safety Concerns: Structural weaknesses can result in road collapse, creating hazards for motorists and potentially leading to serious accidents.
- Infrastructure Damage: Subsurface issues can affect the integrity of nearby utilities and infrastructure, leading to costly repairs and disruptions.

Challenges:

Pavement Deformation:
Subsurface voids and anomalies can cause pavement cracks, settlement, and uneven surfaces, posing risks to vehicles and pedestrians.

Safety Concerns:
Structural weaknesses can result in road collapse, creating hazards for motorists and potentially leading to serious accidents.

Infrastructure Damage:
Subsurface issues can affect the integrity of nearby utilities and infrastructure, leading to costly repairs and disruptions.

Solution:

The advanced GPR system Proceq GS8000 and GS9000 offer cutting-edge capabilities for non-destructive detection and mapping of subsurface structural damage.

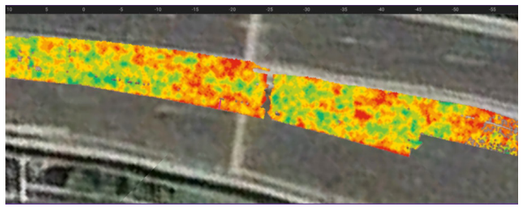
High-Resolution Imaging:
Provides detailed imaging of subsurface conditions, accurately detecting voids, cracks, and other anomalies.

Multi-Channel GPR:
The GS9000 features multi-channel capabilities, allowing for comprehensive coverage and precise mapping of structural damage, even in complex environments.

Real-Time Data Visualization:
Both systems offer real-time data visualization, enabling immediate assessment and verification of subsurface conditions, facilitating quick decision-making and action.

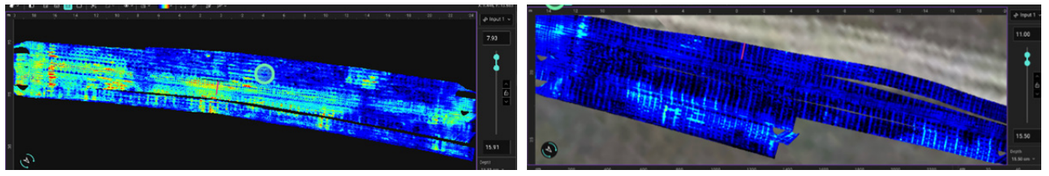
Results:

By utilizing these advanced GPR systems, infrastructure managers and engineers can efficiently identify and address structural issues beneath road pavements, mitigating risks and avoiding costly repairs. The integration of GPR Insights software further enhances the accuracy and reliability of the data, supporting informed decision-making and ensuring the safety and longevity of road infrastructure.



Deterioration Map based on the amplitude degradation of the top rebar.

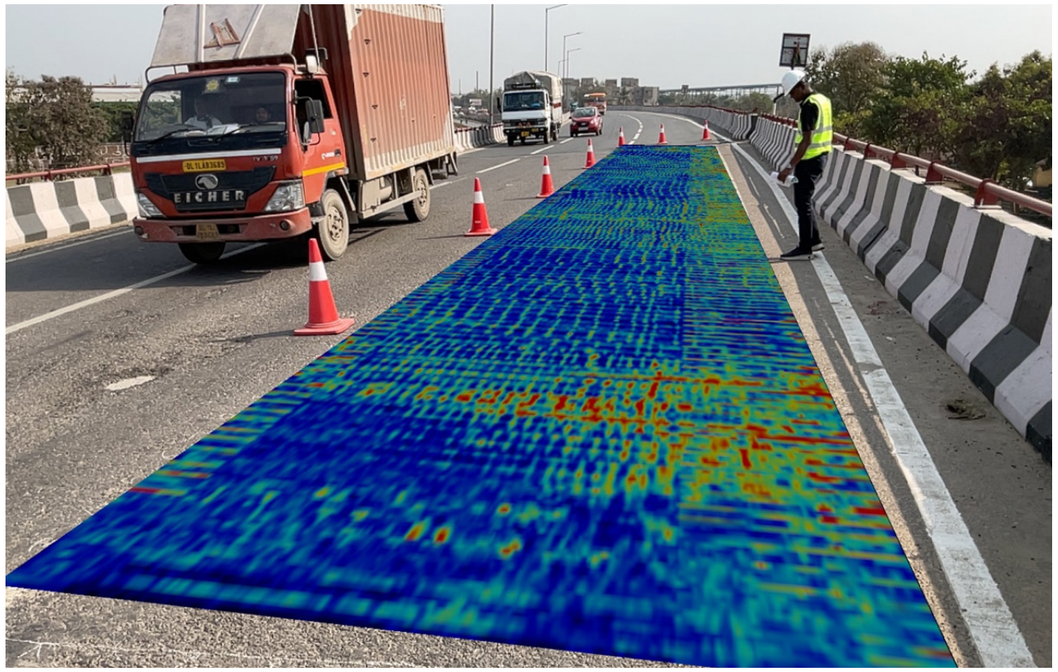
Interface defects between Asphalt-to-Concrete (A/C) layers (Delamination.)



Live-Slice view of the first layer rebar mesh.

Utilizing Advanced Non-Destructive Testing for Bridge Condition Assessment

Infrastructure management companies responsible for highways, bridges, and tunnels face the ongoing challenge of maintaining and inspecting these assets over their operational life span. Effective management of these infrastructure components requires advanced technologies to enhance inspection accuracy, streamline maintenance processes, and ensure long-term structural integrity.



Challenges:

Comprehensive Condition Assessment:
Reliable subsurface defect detection methods are vital for bridges, especially those with complex structures. Traditional techniques lack detail and accuracy.

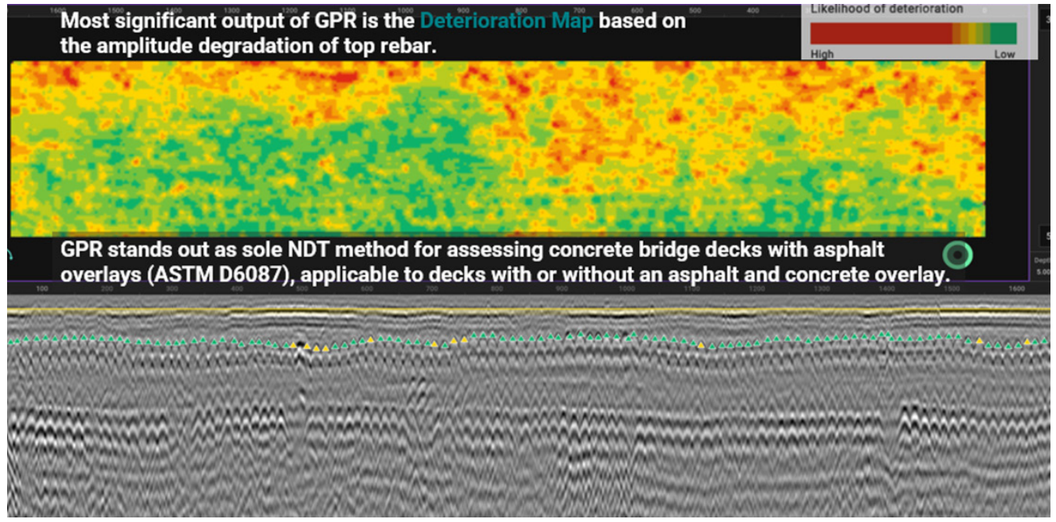
Efficient Data Management:
Managing inspection data across sites and ensuring compliance is challenging without centralized systems.

Hidden Defect Detection:
Subsurface issues like voids, delamination, and reinforcement corrosion are hard to spot visually, necessitating advanced detection.

Safety & Efficiency:
Traditional methods disrupt traffic and increase costs. Faster, safer techniques are needed.

Solution:

Recent NDT advancements offer powerful tools. By adopting these, firms can optimize inspection workflows, enhance data accuracy, and ensure compliance.

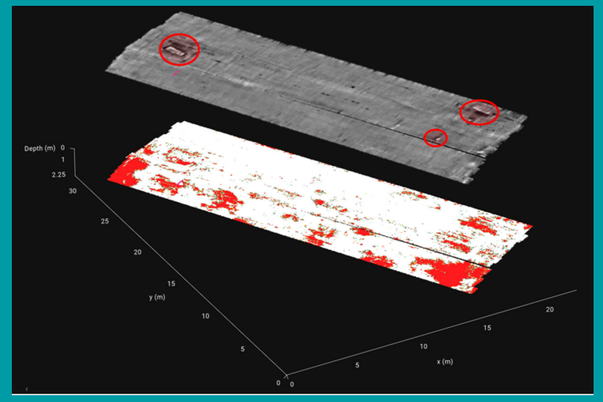


Multi-Channel GPR Push Cart (GS9000):
Ideal for bridge deck mapping, offering high-resolution data for pavement thickness, defect detection, and structural analysis.

Handheld GPR (GP8100):
A portable alternative for detailed scans, though slower than the push cart for large areas.

Digital Inspection Platform:
Streamlines data management and collaboration, ensuring up-to-date information and compliance.

AI-Enhanced Post-Processing:
Analyzes GPR data, generating condition maps and identifying deterioration areas for proactive maintenance.



Road markings and potholes identified, and red zone indicating high amplitude from A/C layer interface

Results:

By integrating GPR technology, digital platforms, and AI tools, infrastructure managers can conduct thorough, accurate bridge assessments, improving defect detection, data management, and compliance, leading to safer, more efficient bridge maintenance.

proceq

Advanced Preventive Inspection of an Aging Jetty

Essential for maritime transport, concrete jetties endure harsh marine conditions and heavy loads, leading to corrosion and weakening. Preventive inspections are vital for safety and function, enabling early detection of damage and maintenance to prolong their life and reduce operational disruptions.

Challenges:

Structural Degradation:
Corrosion of reinforcing steel and delamination of concrete surfaces compromise the jetty's structural integrity.

Surface Damage:
Cracks and delaminations on deck slabs and columns can lead to serious structural issues if left unaddressed.

Inspection Difficulties:
Traditional inspection methods may not fully reveal subsurface conditions, leading to overlooked defects and increased risks. Some traditional methods involve invasive testing, which can further damage the structure and lead to costly repairs.

Visible surface cracks on the slabs and some columns.

Solution:

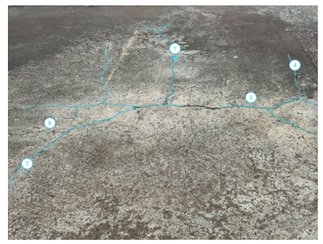
Advanced GPR Systems:

Internal Assessment: GP8100 GPR evaluates subsurface conditions, detects voids, corrosion, and deterioration in delaminated areas.

Detailed Analysis: GPR Insights software confirms air pockets, generates a 3D Condition Map overlaying surface delamination data for clear visualization of areas needing attention.

Ultrasonic Pulse Velocity (UPV):

Crack Depth Measurement: The Pundit-200 can be employed to measure the depth of surface cracks on the deck, providing critical insights into the extent of cracking and guiding effective repair strategies.

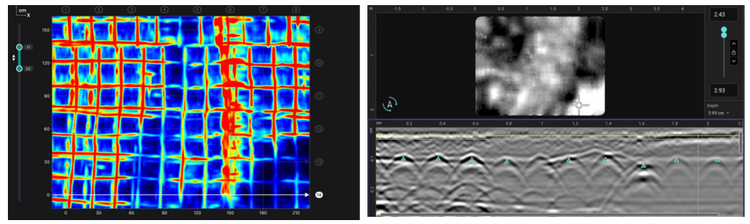


Cloud-based Digital Inspection Platform:

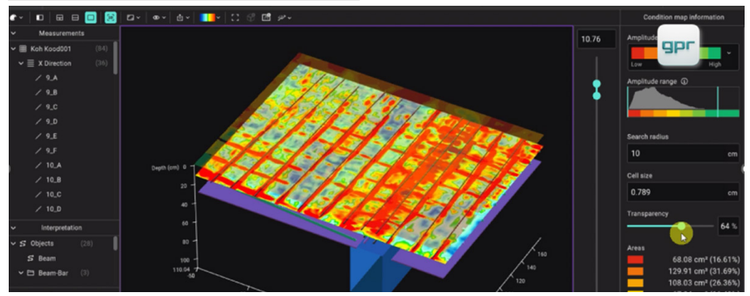
The Screening Eagle Inspect digital inspection platform can be used to document and record all visual inspection photos and findings. Sensor data from on-site testing can also be seamlessly linked to the software and attached to the exact Spots of identified issues, ensuring comprehensive documentation and accurate record-keeping.

Results:

By integrating advanced GPR and UPV technologies with the Inspect digital inspection platform, stakeholders can gain a comprehensive, real-time understanding of the jetty's condition, enabling informed decision-making and proactive maintenance. These solutions also enhance collaboration among teams, helping to mitigate structural risks, ensure the longevity and safety of the jetty, and minimize operational disruptions and repair costs.



A close-up analysis of the surface delamination confirms that the signal above the first layer of steel reinforcement in the concerned area indicates the presence of air.



Condition mapping

proceq

Proceq Full Stack Solutions

Company

Proceq, part of Screening Eagle Technologies, is a global leader in non-destructive testing (NDT) solutions. Our advanced concrete, road, and metal testing technologies deliver real-time insights, enhancing safety and efficiency. Committed to innovation and quality, we empower industries with smart inspection solutions for reliable, data-driven decision-making.

ScreeningEagle.com

Screening Eagle Singapore Pte. Ltd.
1 Fusionopolis Way
Connexis South Tower #20-03
138632 Singapore
Singapore
T +65 6331 4151

Proceq Trading Shanghai Co. Ltd.
Room 3A, No. 315
Guangyuan West Road
Xuhui District, Shanghai
China, 200030
T +86 21 6317 7479
M +86 152 2162 8766