

**TRACE**

STRUCTURAL INVESTIGATIONS

Specialist Structural Investigations  
Consultancy

# Who We Are

## Services

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Structural Investigation and Analysis

As-Built Quality Checks

Structural Condition

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Holistic Data Collection and Analysis of Concrete Structures

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Investigation into the Cause of Known Defects

Quality Checking of Permanent Formwork for Voids

Non-intrusive Survey for Delamination Detection in Concrete Structures

# MEET THE TEAM

TRACE-SI provides specialist structural investigations and consultancy for the built world. Using the latest technology and workflows, TRACE-SI works with you to produce the information needed - we don't just pass on data. Our surveys are based on non-intrusive methods to collect large amounts of data, in combination with targeted intrusive works. This data is processed, analysed, and interpreted to extract the key information. TRACE-SI's holistic approach allows for a greater understanding of how a structure is built and its current condition.



**ANDY KITSON**  
CONSULTANT

Director and consultant with more than 15 years experience working with NDT to investigate the built world. Andy's passion and expertise are the use of non-intrusive techniques for undertaking structural investigations to determine how they are built and what defects may lie hidden beneath the surface.



**KYLE OLAJORIN**  
CONSULTANT

Director, consultant, and civil engineer with 10 years experience in GPR and non-intrusive methods for the assessment of structures. Having undertaken NDT surveys for everything from bed rock mapping, through utility locates to concrete condition Kyle has extensive experience and knowledge in NDT and its uses.





# SERVICES

TRACE-SI is a leading international consultancy firm specialising in structural investigation. Our team of experts provides tailored and bespoke services to meet the specific needs of each project and client.



## PROJECT CONSULTING

At TRACE-SI, our Project Consulting services are designed to offer comprehensive guidance and support throughout the entire process of structural investigation projects. Our team of experts collaborate closely with clients to develop customised project scopes tailored to their unique requirements, ensuring that all objectives are met efficiently and effectively. By employing innovative and holistic methods of data collection, we are able to gather an extensive amount of information in a shorter period of time, thereby reducing costs while simultaneously delivering valuable insights into the structure under investigation.

Our Project Consulting offerings also include meticulous management of investigations, as we oversee every aspect from data collection to analysis and reporting. TRACE-SI can conduct in-depth analysis of the data, producing a detailed report that outlines the construction of the structure, including key connection details. This comprehensive approach not only ensures that our clients receive an accurate and valuable understanding of their structure but also provides them with the confidence to make informed decisions based on reliable and thorough data analysis.





## STRUCTURAL INVESTIGATIONS AND ANALYSIS

TRACE-SI specialises in conducting detailed structural investigations that provide valuable insights to clients and engineers, enabling them to make informed decisions about the maintenance, repair, and rehabilitation of structures like buildings, bridges, and other concrete structures.

Our comprehensive approach to structural investigations includes a combination of cutting-edge non-destructive testing techniques, such as Ground Penetrating Radar (GPR) and ultrasonic tomography, to assess and determine construction details, identify defects, and evaluate the overall structural condition. With the data gathered, our team of experts can recreate accurate as-built drawings, allowing for a thorough analysis of the structure's current state and facilitating better decision-making for asset management.



## AS-BUILT QUALITY CHECKS

TRACE-SI are committed to delivering the highest level of quality control for our clients. Our as-built quality checks involve comparing the data obtained from our structural investigations with the original design drawings or industry standards, allowing us to identify any discrepancies or deviations from the intended design.

By evaluating the as-built quality of a structure, we can detect construction defects, assess the overall structural integrity, and provide recommendations for necessary repairs or reinforcements. Our as-built quality checks ensure that the structure meets safety and performance requirements, providing peace of mind to our clients and their engineers.





## STRUCTURAL CONDITION

Assessing the structural condition of a structure is crucial for its safety and longevity. TRACE-SI employs a range of non-destructive testing techniques to evaluate various aspects of a structure's condition, such as corrosion potential, moisture ingress, honeycombing, and voids within post-tensioning ducts. Our experts analyse the data collected to detect issues that may compromise the structural integrity, allowing for targeted maintenance and repair efforts.

This comprehensive assessment of the structural condition ensures that the necessary steps are taken to preserve the structure's performance and extend its service life.

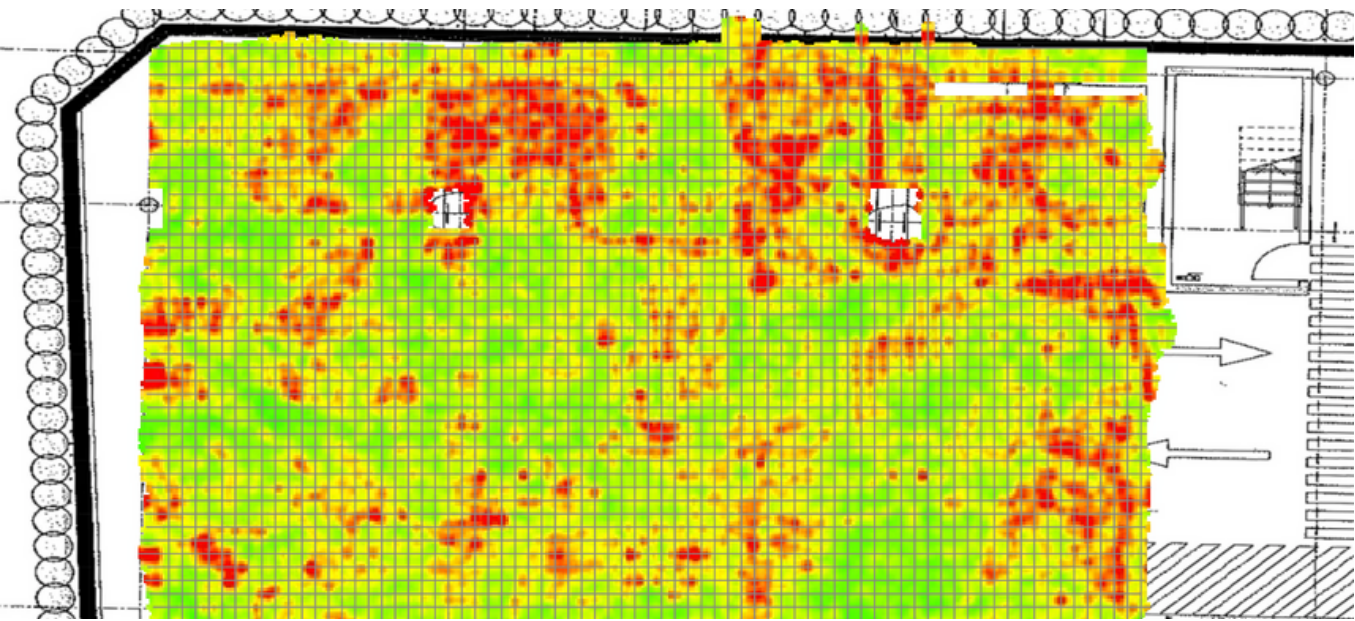


## CONDITION MONITORING

TRACE-SI offers cutting-edge condition monitoring services using non-intrusive inspection techniques that boast repeatability and consistency. Our services enable comprehensive monitoring of bridges and other infrastructure assets, allowing for more accurate assessments of their condition over time. By periodically repeating non-intrusive inspections, we help engineers acquire a wealth of data that can be compared and analysed to identify trends and changes in the structure's condition.

Our comparative analysis empowers engineers to detect subtle changes indicative of emerging issues, such as new cracks, progressing defects, or alterations in corrosion potential. This insight allows for a proactive approach to maintenance and repair, targeting areas of concern before they become critical, ultimately reducing costs and mitigating risks of catastrophic failures.





## DATA ANALYSIS AND REPORTING

TRACE-SI provides comprehensive data analysis and reporting services for clients who have collected non-destructive testing (NDT) data themselves but require support in maximising the value of the information. Our experts analyse the data, including utility mapping, and generate detailed and user-friendly reports that enable engineers to make informed decisions regarding maintenance, repair, and rehabilitation of structures.

Our enhanced reports not only detail the inspection methodology and key findings but also provide comprehensive information on construction details and the condition of the structure. By presenting the data in a clear and accessible format, we enable engineers to focus on necessary calculations and assessments, facilitating better decision-making.

To complement our written reports, TRACE-SI can create 3D models and digital twins of structures using LiDAR surveys and other non-intrusive inspection data. These digital representations serve as a single source of truth, offering a detailed and accurate view of the structure and its current condition.



# CASE STUDIES



# CONFINED SPACE SEWER VOID MAPPING AND STRUCTURAL INVESTIGATION

TRACE-SI was contacted by a client concerned about possible voids around a section of brick sewer pipe, as well as the unknown structural details of the pipe. These issues posed potential risks to the sewer infrastructure.

## OBJECTIVES

The client needed to understand the presence and locations of voids or significant subsurface anomalies around the sewer pipe. TRACE-SI offered a comprehensive solution, using their expertise in structural investigations and void mapping to provide accurate and reliable results.

## SOLUTIONS

TRACE-SI designed and conducted a confined space ground-penetrating radar (GPR) survey of the full accessible length of the sewer tunnel and chamber. The GPR system provided the appropriate penetration depth and resolution to identify ground conditions, voids, and significant subsurface anomalies. TRACE-SI's team of confined space trained personnel ensured the safety and effectiveness of the survey.

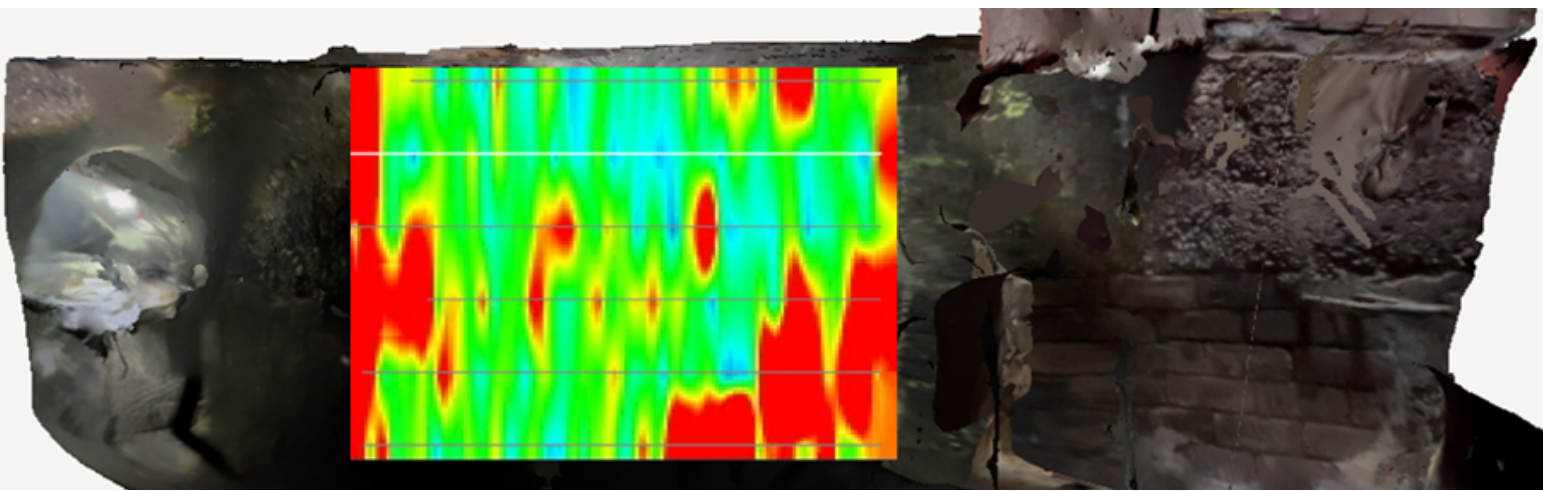
Data processing and analysis were carried out using specialist software, and experienced TRACE-SI personnel manually analysed the data. The survey identified areas of increased reflection amplitudes indicative of voiding, as well as areas of significantly increased noise, which suggested poorly consolidated ground or increased moisture content.

## BENEFITS

The client can now make informed decisions regarding the safety and maintenance of their sewer infrastructure based on the accurate and reliable data provided by TRACE-SI.

TRACE-SI's non-intrusive survey eliminated the need for costly and disruptive excavation, reducing overall project costs and minimizing downtime.

The detailed report provided by TRACE-SI gave the client a comprehensive understanding of the sewer pipe's structure and the surrounding ground conditions.



# HOLISTIC DATA COLLECTION AND ANALYSIS OF CONCRETE STRUCTURES

TRACE-SI innovative survey workflow and holistic approach to data collection and analysis enabled the client to gain a more comprehensive understanding of the construction details and quality of their pool structures.

## OBJECTIVES

TRACE-SI, a specialist structural investigations consultancy, was approached by a client to conduct data processing and analysis of concrete walls and floors of their swimming pool, spa pool, and infinity pool. The client needed to understand the construction details and the quality of the concrete used in these structures. Traditional targeted grids might not have provided enough information on the construction details, so TRACE-SI offered a different, more holistic method of data collection and analysis

## SOLUTIONS

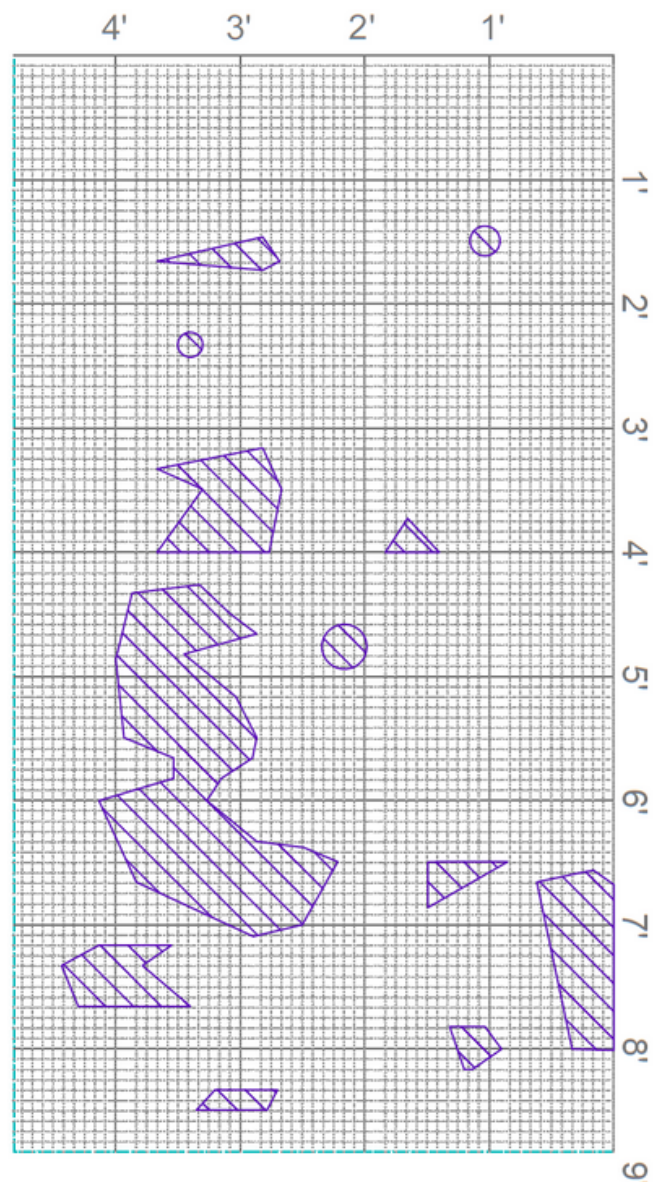
TRACE-SI collaborated with the client's on-site team to collect data using ground penetrating radar (GPR), which was then processed and analysed. The data was subjected to several filters to improve visualization, and features were picked through manual interpretation. The survey identified significant areas of potential honeycombing and voiding within the scanned areas. Some pool elements showed little to no noise, indicative of good concrete compaction, while others exhibited poor concrete compaction.

## BENEFITS

The holistic approach that TRACE-SI implemented provided a more detailed report than traditional targeted methods.

The client received valuable insights into the construction quality of their pool structures.

The comprehensive analysis allowed for informed decision-making regarding potential remedial actions or improvements



# ACCURATE MAPPING OF FOUNDATIONS

Foundations were mapped in order to safely install new drainage below the basement slab

## OBJECTIVES

The client was undertaking extensive refurbishments of a central London building. As part of these works, new drainage runs were required below the basement. Given the unknown foundation construction, and concern over damaging potential ground beams, TRACE-SI was contracted in to map the foundation details.

## SOLUTIONS

Ground penetrating radar (GPR) was used to determine the presence and location of the foundations and resolve their details. The system was set up to work with a robotic total station.

The total station embedded coordinates directly into the GPR data, at the point of collection.

This greatly increased the positional accuracy of detected features, thereby removing positional errors typically encountered due to obstructions or uneven floor levels.

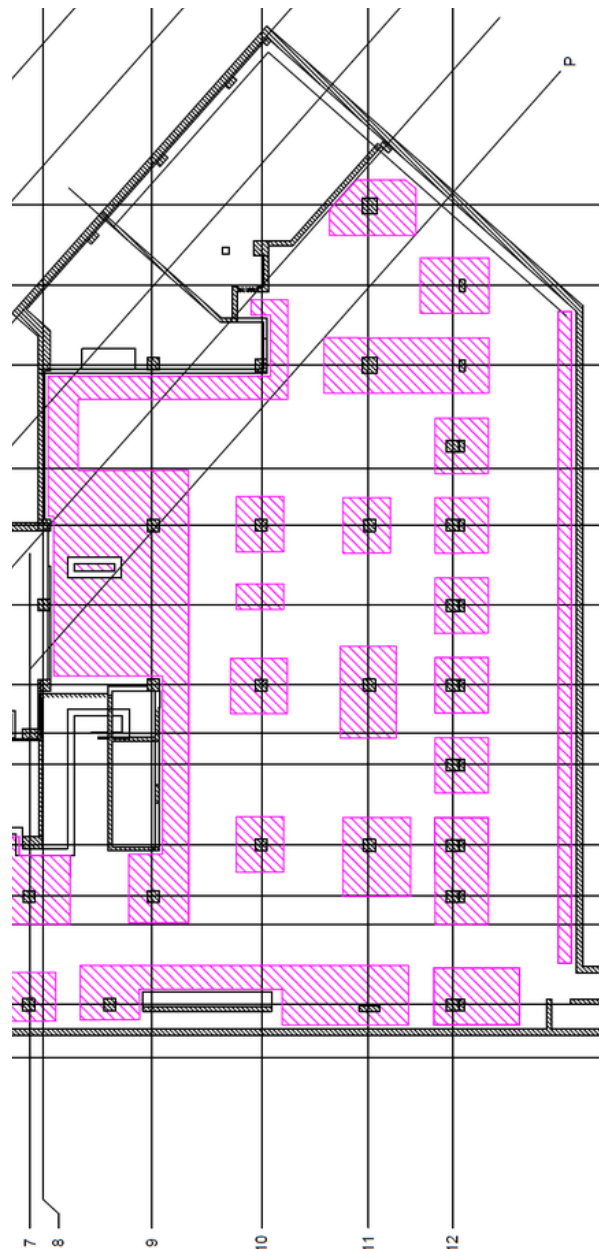
The entire floor slab was scanned and all collected data was analysed by TRACE-SI using specialised software. The identified foundation details were determined and their position and extents were presented on a CAD drawing ready to be utilised by the Engineer.

## BENEFITS

Site works were fast, non-destructive and comprehensive; avoiding disruption to the project schedule.

TRACE-SI produced accurate and detailed CAD drawings with foundations mapped to a high accuracy.

Due to the level of detail provided the client was able to design their drainage scheme without costly intrusive works.





# MAPPING THE CORROSION POTENTIAL OF DOWEL BARS

To allow for targeted repairs mapping of key affected areas was essential.

## OBJECTIVES

A main A-Road in the east of England was constructed with unreinforced concrete slabs joined with dowel bars. Visual deterioration to the surface caused concern about the condition of the dowel bars.

## SOLUTIONS

The client brought in TRACE-SI to investigate the key areas of concern using non-intrusive investigation methods. TRACE-SI undertook extensive scanning to map the areas of increased corrosion potential.

A system, connected to an RTK GPS that embeds coordinate data directly into the GPR data as it is being collected, greatly increasing the positional accuracy of detected features.

The data was collected on site and TRACE-SI analysed and interpreted the data off site.

TRACE-SI have developed bespoke workflows to increase the accuracy of corrosion potential mapping by combining automatic analysis with manual interpretation by experienced consultants. This ensured that the areas suspected of corrosion were accurate and not anomalies in the data

All results were geospatially accurate and plotted onto CAD or Google Earth, as required.

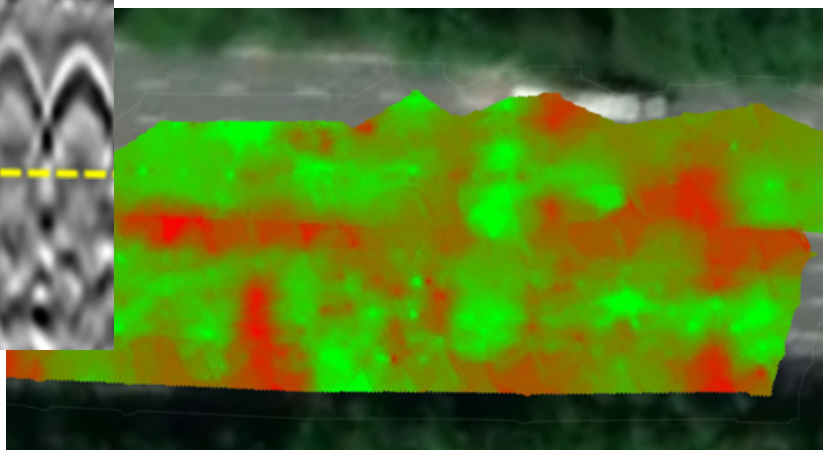
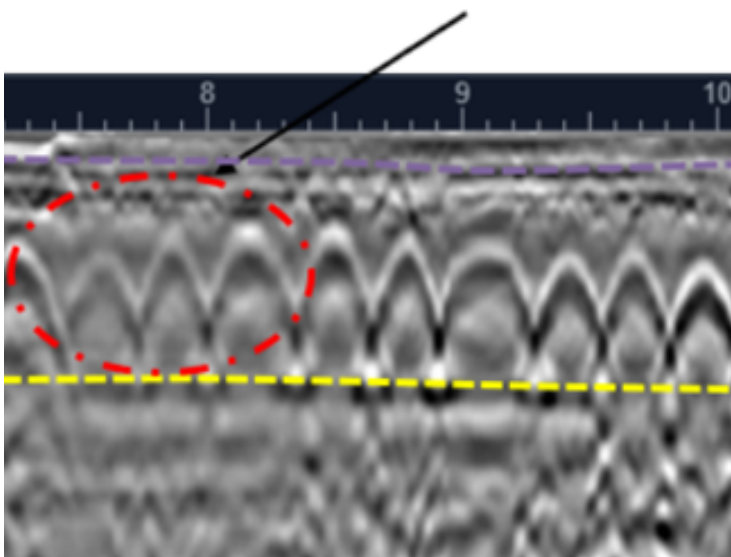
## BENEFITS

Site works were fast, non-destructive and could be undertaken through existing pavement layers - with no drilling required

Data was collected at high-way speeds, without traffic management

Through repeat scanning, any changes of the bars could be mapped and future repairs predicted.

Area of low amplitude reflection responses from the dowel bars, indicative of potential corrosion.



# INVESTIGATION INTO THE CAUSE OF KNOWN DEFECTS

A section of the slab was presenting with significant heave, the cause of which was unknown

## OBJECTIVES

The client had a section of slab that had raised up within their asset. The construction details of the slab were unknown, as was the extent of the damage; was the whole slab lifting or was it only surface finishes. The likely cause of the lifting was also unknown.

## SOLUTIONS

The client brought in TRACE-SI to investigate the affected area using non-intrusive investigation methods.

TRACE-SI scanned the defective area extensively, as well as the surrounding areas, to determine the typical construction details.

TRACE-SI analysed the data off site and were able to determine the typical construction details of the slab and where they varied around the defect. It was found that,

while voiding was detected below the slab, only the surface finishes were rising up.

Furthermore, the gap between the slab and the surface finishes was filled with water. Water had penetrated through the surface finishes and likely caused corrosion to the steel within the concrete slab, resulting in expansion of material

## BENEFITS

Site works were non-destructive, completed quickly and comprehensive allowing for no disruption to the project

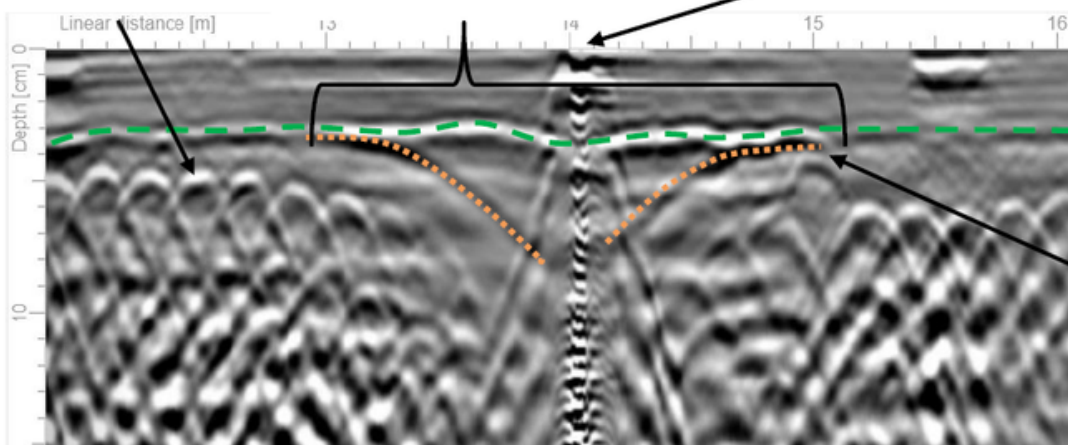
Accurate and detailed interpretation of the collected data allowed for detailed analysis of potential causes for the problem.

Follow up intrusive works and repairs could be better planned with the knowledge of what would be found upon exposure..

Slab reinforcement at 200mm centres at ~150mm depth

Strong reflection amplitude, indicative of a water filled cavity.

Gully



Underside of screed/surface finishes at ~80mm depth.

Apparent top of the structural slab, thought to be level but visually increasing in depth due to the presence of a cavity above.

# QUALITY CHECKING OF PERMANENT FORMWORK FOR VOIDS

Permanent formwork is a highly efficient construction method but can lead to hidden honeycombing and voids.

## OBJECTIVES

The client was constructing a multi-storey building using a concrete permanent formwork system. This consisted of two precast leaves, infilled with concrete. However, if the concrete was not correctly vibrated it can lead to hidden voids or honeycombing within the wall.

## SOLUTIONS

TRACE-SI advised on a fully non-intrusive survey method that allowed for complete coverage of the walls. The works were completed by a consultant covering two floors of the building in less than a week, all while other works continued on site.

The data was analysed offsite and detailed CAD drawings were created showing the size and locations of areas of honeycombing and voiding present within the walls.

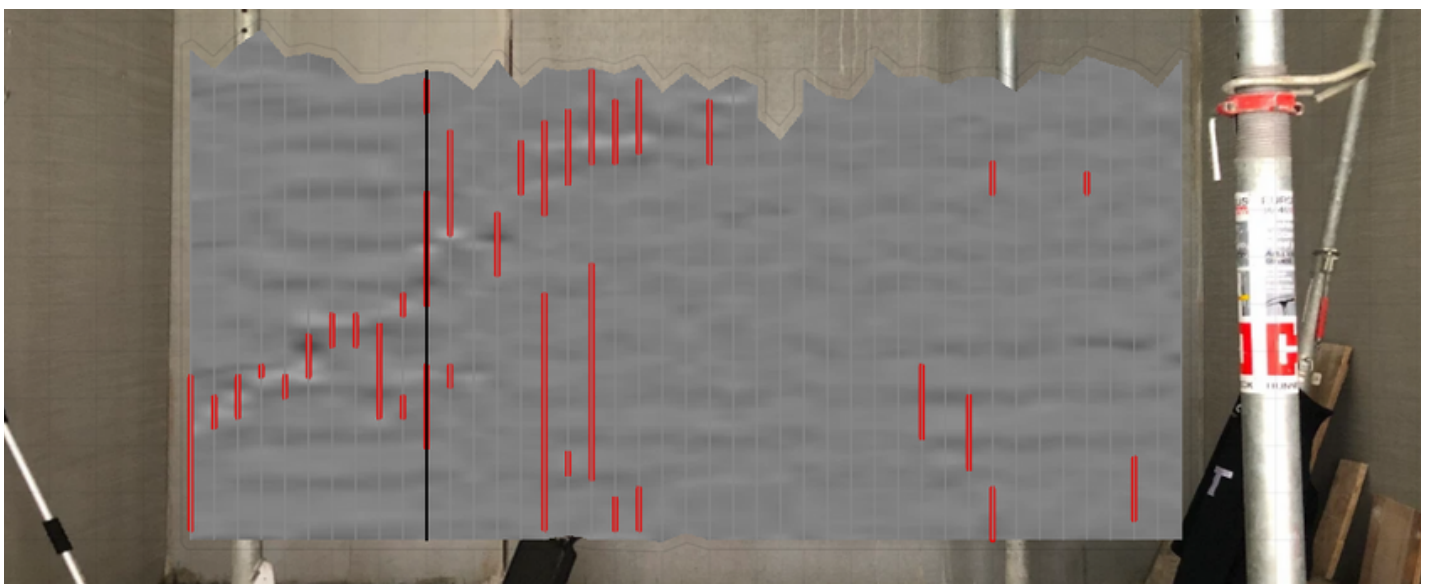
This allowed the client to drill and grout the defects. Once grouted, TRACE-SI returned to site to check the effectiveness of the grouting and map remaining voids. With this, the client was able to confirm the compliance of the walls to the asset owners

## BENEFITS

Site works were fast, non-destructive and comprehensive, preventing disruption to the project

Accurate and detailed CAD drawings showed the areas of concern allowing for efficient remediation

TRACE-SI undertook a return visit to quality check the repair works and ensure all voids were sufficiently grouted.



# NON-INTRUSIVE SURVEY FOR DELAMINATION DETECTION IN CONCRETE STRUCTURES

TRACE-SI's innovative non-intrusive survey techniques provided an objective assessment of concrete delamination for a client, surpassing the limitations of traditional tap testing methods.

## OBJECTIVES

The client approached TRACE-SI after conducting a tap test investigation on down stand beams in a major infrastructure site. The tap test revealed hollow sounding areas, suggesting the presence of voids or fractures in the concrete. To confirm these findings, TRACE-SI was asked to objectively determine the extents and depth of delamination within the hollow sounding areas without causing further damage to the structures.

## SOLUTIONS

TRACE-SI designed and undertook a non-intrusive survey using Ground Penetrating Radar (GPR) and ultrasonic pulse echo system technology. The survey identified the presence of voiding and delamination within the beams, typically at depths of 15-45mm from the scanned surface.

To further validate the results, the client performed breakouts, which confirmed the accuracy of TRACE-SI's findings.

## BENEFITS

NDT offered an objective evaluation of the delamination, in contrast to the subjective tap test method.

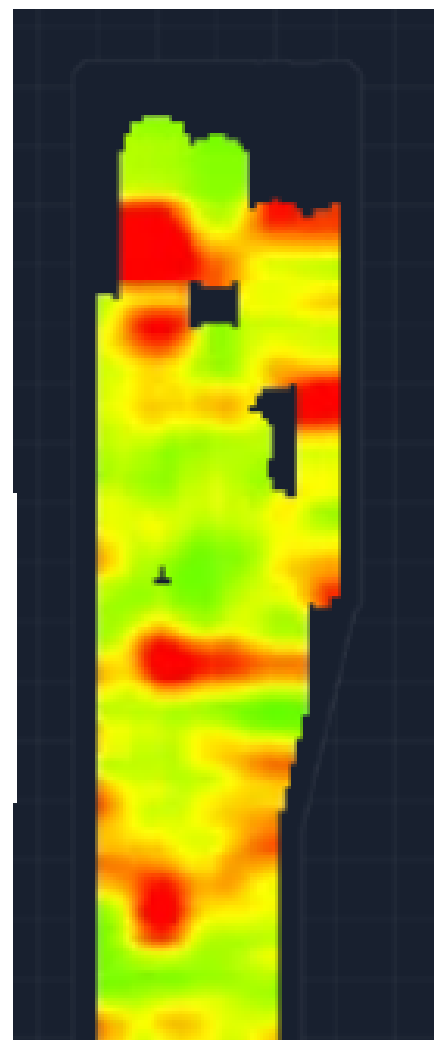
The survey accurately detected the presence, extent, and depth of voids and delamination within the concrete structures.

The detailed information obtained from the survey allowed the client to make informed decisions on potential remedial actions or improvements.

Low negative amplitude reflections, indicative of minor honeycombing

Medium negative amplitude reflections, indicative of honeycombing

High negative amplitude reflections, indicative of voiding or delamination





# CONTACT US

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