Alpha GeoScience

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ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Mapping of Post Tensioning (PT) Cable Ducts Within Existing Concrete Floor Slabs

Overview

A requirement of the change in use of a commercial building was an engineering assessment of the load carrying capacity of the concrete floor slabs. The planned future function of the existing building would result in high point loading of the slab in several locations.

No as-built drawings existed for the structure. It was known that the slab was reinforced with a steel anti cracking mesh and Post Tensioned (PT) cables running in ducts. As the ducts were blind at one end and the placement of the blind end blocks was unknown. Alpha Geoscience were commissioned to conduct a non invasive investigation using Ground Penetrating Radar (GPR) over selected portions of the floor slabs. The purpose of the investigation was to map the placement of the PT ducts at critical areas in the floor slabs. From the results plan view diagrams of the PT duct layouts were produced. Also produced were a number of 3 Dimensional images displaying the location of the reinforcement mesh and the PT ducts.

Equipment Choice and Methods

High frequency GPR was the method employed for this investigation. GPR can be used to locate and map reinforcement within concrete without the need to core or expose the reinforcement. Other methods that could be employed are X-Ray and Electrical Induction.

The safety issues involved with the use of X-Ray technologies requires an exclusion zone around the X-Ray source. Also there is the need to have access to both sides of the structural element being investigated.

Electrical Induction tools (Covermeters) can only be used if there is a minimum separation between the reinforcement bars. All depth and size information is only approximate and must be verified with exposure of bars.

GPR can give accurate depth information if the edges of the slabs are exposed or the thickness of the slab is known. Thus enabling an accurate estimation of the radio wave velocity to be made.

Figure 1: High Frequency GPR Antenna and Mini Cart in use on a concrete wall section

GPR profiles were collected in an orthogonal grid across the sections of the floor deemed necessary by the client. The profiles were collected at a spacing of 0.5m in each direction. Figure 2, below shows the collection pattern around a column and drop down panel.

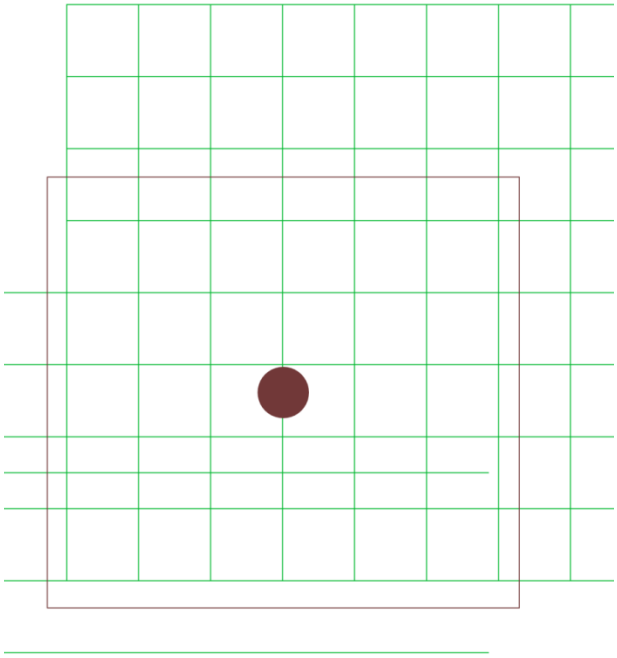

Figure 2: View of the topside of the slab showing GPR transects (green lines), results of which have been used to create the 3D drawing, line spacing is 0.5m.

All data was processed to produce images like the one shown below, see Figure 3, for final interpretation and drafting on plan view, cross section and 3D images of the reinforcement duct layout.

Results

From the topside of the slab, the reinforcing mesh and post-tensioned ducts were clearly visible. Figure 3 below shows a topside GPR profile across the slab.

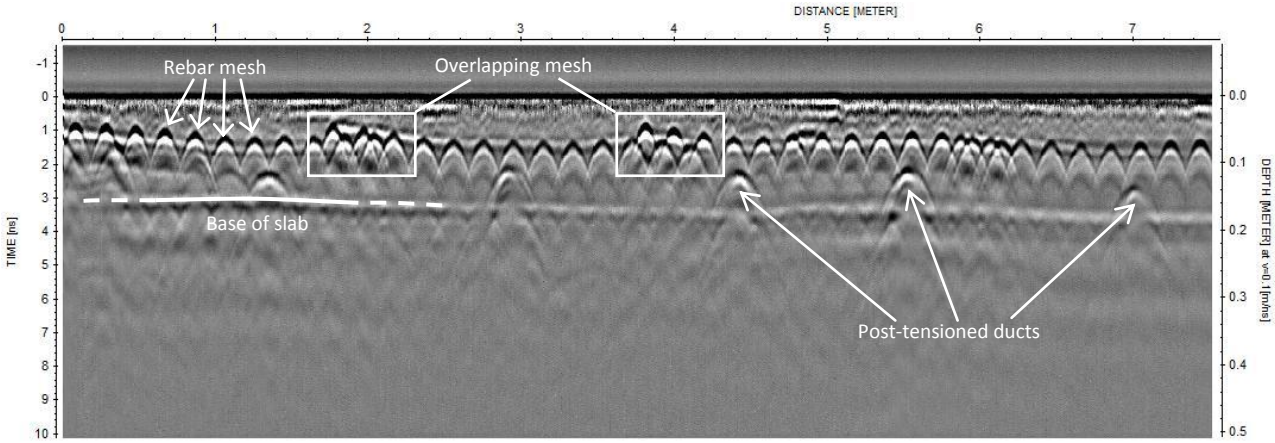

Figure 3: GPR profile showing features visible within slab

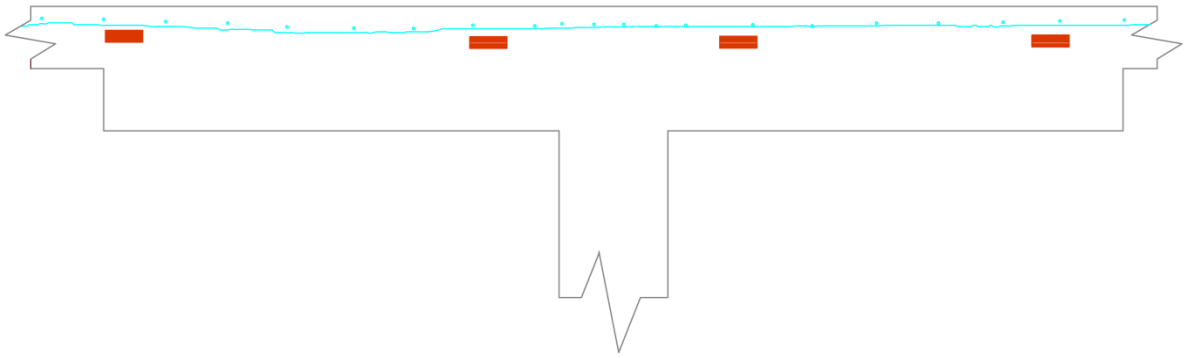

Figure 4: Cross Section through the slab and dropdown panel, showing position of PT Ducts and reinforcement

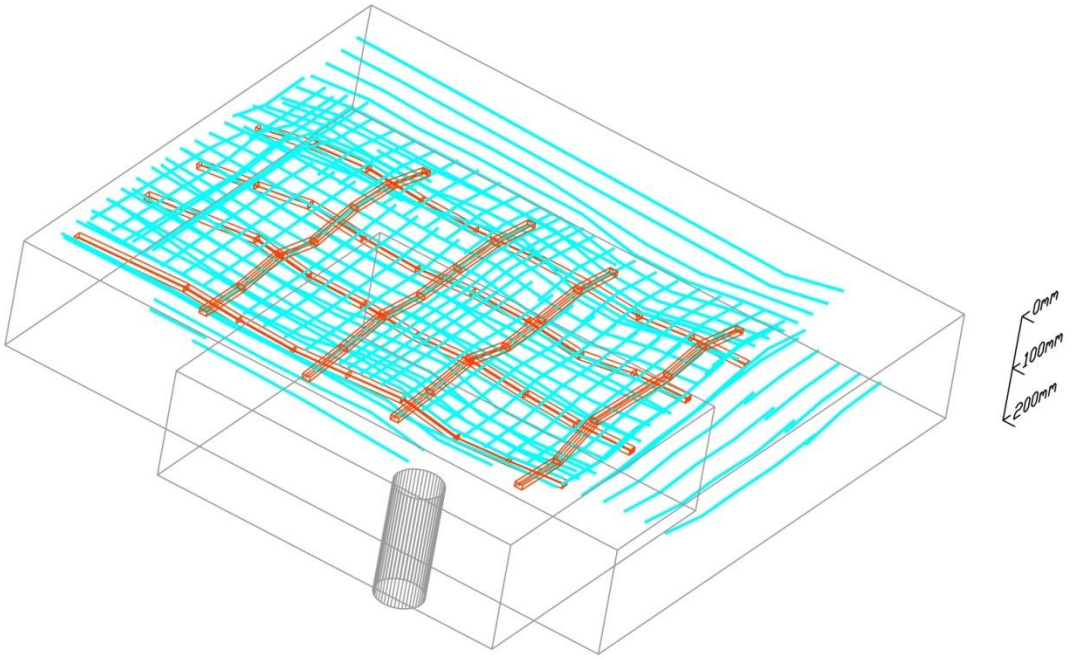

Figure 5: 3D view from downward perspective view showing PT duct layout and reinforcement detail

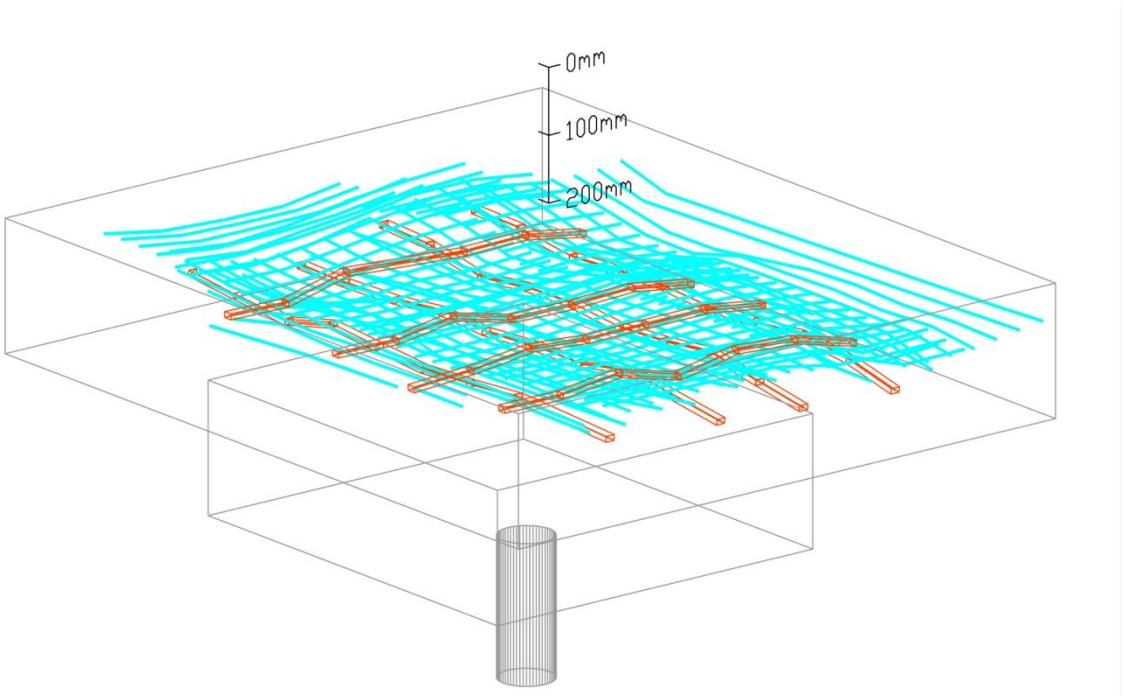

Figure 6: 3D view of PT duct layout and reinforcement detail

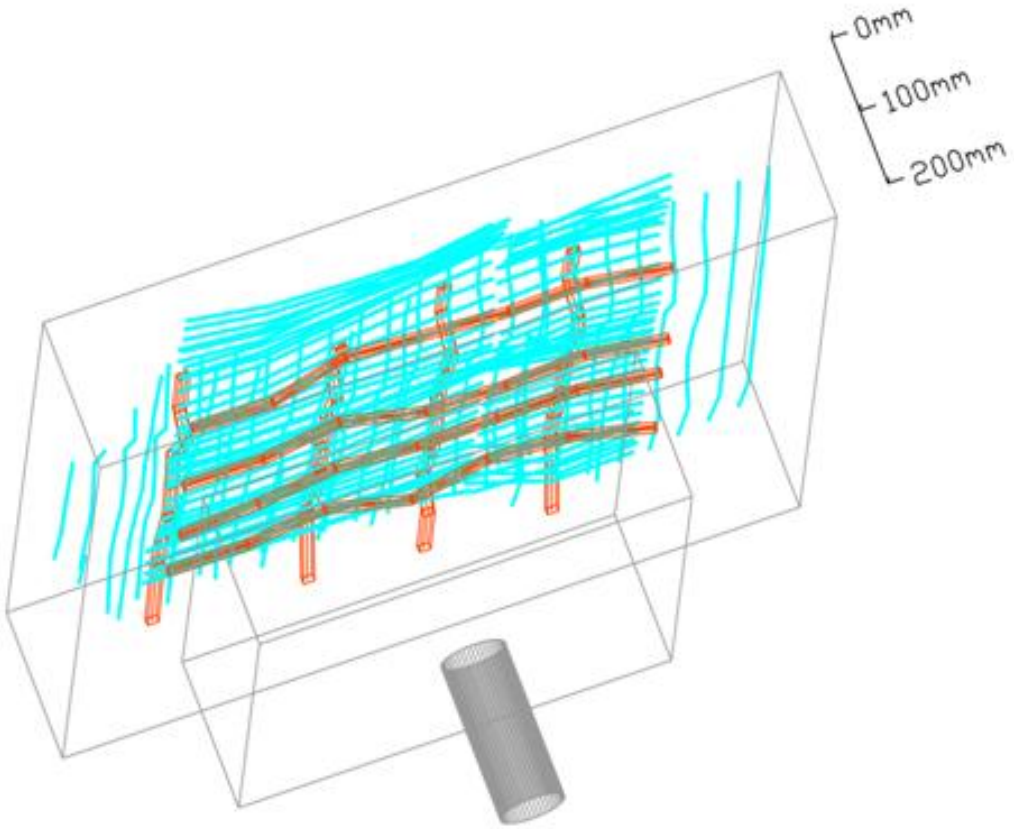

Figure 7: 3D view from upward perspective view, showing PT duct layout and reinforcement detail

Conclusions

The use of GPR in this investigation enabled the successful mapping of the location and depth of the PT ducts within the floor slabs.

Production of plan, section and 3D images enabled visualisation of the layout of the reinforcement mesh in relation to the PT ducts.

The results of this investigation gained information that assisted in an engineering evaluation of the building for a change in usage, without the need for expensive exclusion zones implementation or exposure, and consequent repairs, of large portions of the reinforcement and PT ducts.