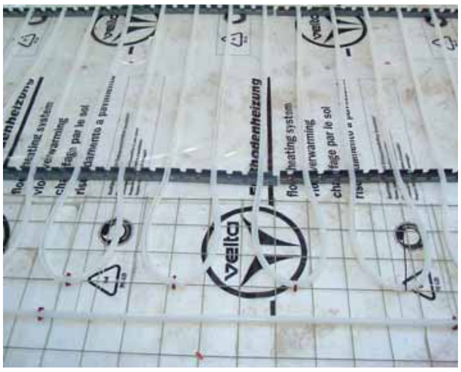
Detection of plastic pipes in a concrete floor

Description of problem



This application note describes the construction of a new building with the heating system made up of a water-heating pipe work inside the concrete floor. The plastic pipes (25 mm in diameter) are fixated to an insulation material prior to poring the concrete.

However, after the concrete were cast, pipes were seen on top of the concrete in a certain part of the floor. This led to the need of inspection of the status of the rest of the floor, as a certain amount of concrete (at least 100 mm) was needed to ensure an efficient and even heating distribution. Further on, interior walls are to be constructed on the floor, and these are nailed directly on the floor, so again there is a need for sufficient amount of concrete above the plastic pipes, to avoid puncture and leakage.

Equipment used

The Malå Geoscience CX Main unit (including control unit and monitor for data acquisition and storage) with a 1,6 GHz high frequency antenna (4 m measurement cable) were used.

Investigation method

The area to be surveyed (40 m x 25 m) was divided into several 5 m x 5 m blocks. Each block was surveyed in turn and any findings marked directly on the concrete surface. The client requested that any findings where the concrete was less than 110 mm above the plastic pipes were to be documented.

The investigation was made in parallel profiles within the smaller areas, and to get a good coverage a distance of 30 cm between the profiles were kept.

During the investigation water was present in the plastic pipe work.

Measurement settings

As the maximum range required in this survey was 200 mm the following settings were used:

Point distance: 0.005 cm
Time window: 8 ns
Stacks: Auto
Velocity: 60 m/µs,

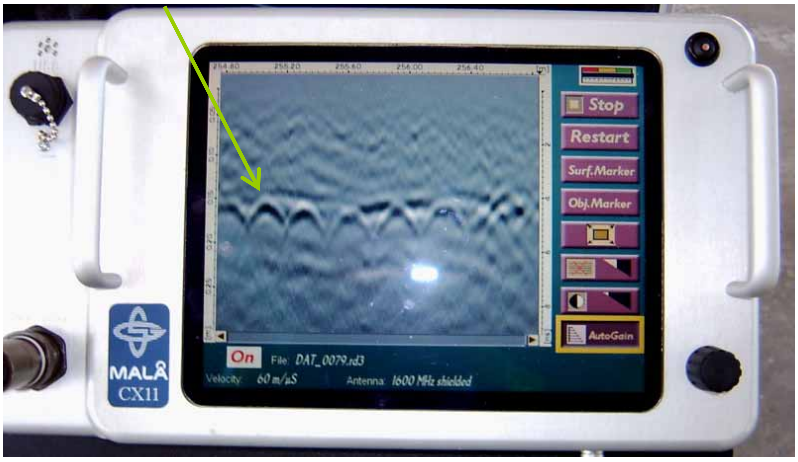
Critical elements

The most critical element was to set the correct velocity for the radar wave, which in turn is used to give the correct depth of the objects mapped on the radargram. As the investigation depth needed to be at most 200 mm in the fibrous type of concrete, a misjudgement of the velocity can lead to noticeable errors. The velocity of radar waves in concrete varies lot, due to type of concrete and due to the extent of moisture. Most often velocities are found between 50 and 150 m/μs, where the lowest velocities are found in wet concrete. In this case the velocity was set to 60 m/μs, estimated with the help of a known object and its depth in the same concrete environment.

Occasionally during the investigation, dust and debris affected the encoder wheel on the small wheel carriage of the antenna. The wheels didn't always turn, especially when the antenna was pulled back, giving a wrong length measurement. These profiles were repeated to obtain the correct position of the pipes.

Results

The CX together with the 1.6 GHz antenna gave good results (see picture below), the plastic pipes showed well (as clear hyperbolas, one marked with an arrow) on the radargram and the resolution was extremely good.



It was found that the majority of the pipe work system was buried at a depth exceeding 110 mm; only minor areas were found to rise to 100 mm. These areas were not of concern as they were relatively small and infrequent and did not coincide with the construction of the partitioned interior walls. However, two areas were found to have pipe work at less than 100 mm depth and in one case a reading as low as of 30 mm was found. These areas were clearly marked directly on the concrete surface.

Conclusions

This investigation gave immediate results, and it was possible to identify the areas directly onsite during the operation were the plastic pipe work was located too shallow. This was sufficient information for the constructor to avoid certain areas for further construction work, and to know where the pipe work has to be improved. The investigation area of 40 m x 25 m (densely profiled) was easily covered within one day, and no further reporting was necessary. To increase the pace of work the whole area could have been measured as a continuous long profile with a direct interpretation along the measurement.

As conclusion, the chosen equipment together with the investigation method used, did solve the customer's problem.

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