Scanning office floor slab for safe drilling and renovations

Using GPR to find double-layer rebar and buried pipes under office floor

A civil building needs to drill the office floor slab due to the needs of maintenance and improvement. The traditional detection method has technical limitations. Only single-layer steel bars can be detected. When the strong reflection of the steel bar mesh is encountered, the detection signal is difficult to penetrate under the steel bar, resulting in the inability to grasp the pipeline layout under the steel bar.

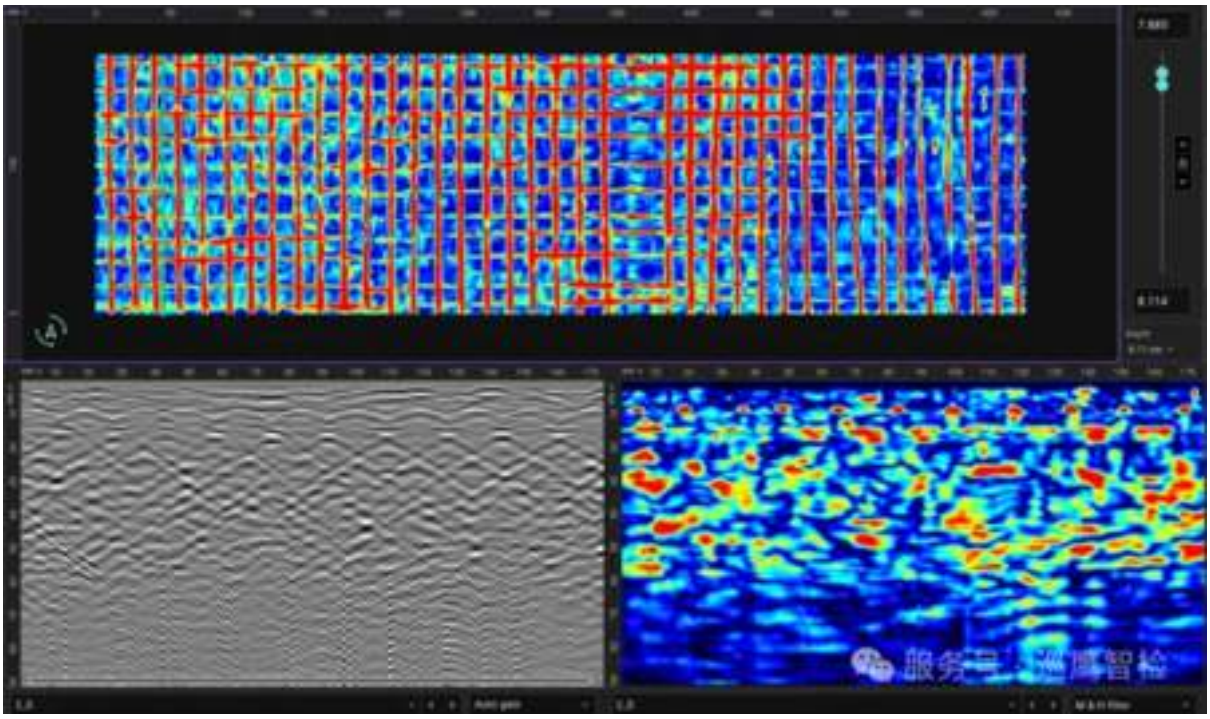
This lack of information makes drilling operations extremely high-risk, which may accidentally touch pipelines or damage deep structures, which not only affects the maintenance progress, but also may cause safety accidents and additional maintenance costs. Therefore, a detection solution with strong penetration and high-precision analysis ability is urgently needed to provide safe location guidance for drilling operations.

Equipment selection

Based on the requirements of the project for detection depth, accuracy and analysis ability, the construction team chose the Proceq GP8100 multichannel GPR for testing. Its working principle relies on advanced stepped frequency continuous wave radar technology, with a broadband working range of 400-4000 MHz, a 6-channel design, and a detection depth of up to 80 cm under excellent conditions (dry concrete and low rebar density).

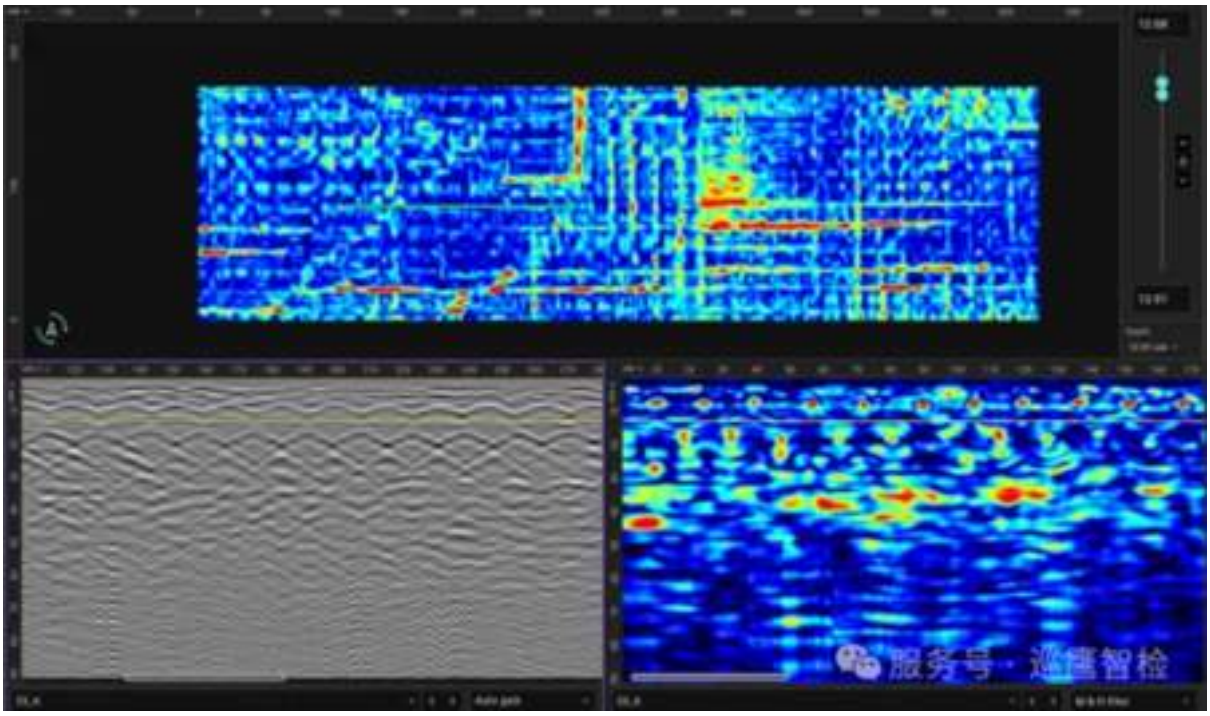
Key test results

Rebar detection: Through GP8100 radar depth slicing and B-scan image analysis, the distribution of double-layer steel bars inside the floor slab can be clearly identified. Among them, the first layer of steel bar is located at a depth of about 8 cm, and its signal is continuous and regular in the depth slice, and the corresponding B-scan image presents a distinctive hyperbolic radar signal at the same depth;

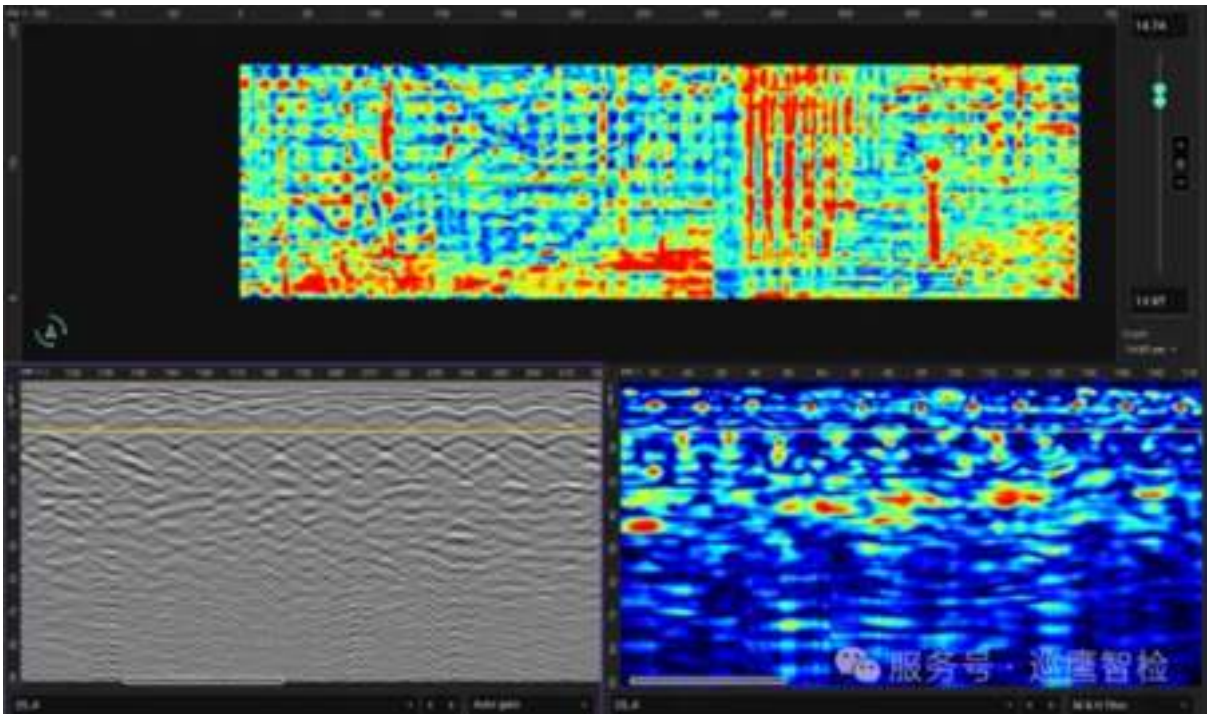


Signal diagram of the first layer of steel bar

The position of the second-layer steel bar is about 13 cm, and the bottom plate is about 15 cm. Although affected by the signal blocking of the first layer of steel bar, the signal of the second layer of steel bar does not reach the clarity of the first layer of steel bar, it can still effectively identify its position, breaking the limitation that traditional equipment can only detect single-layer steel bar.

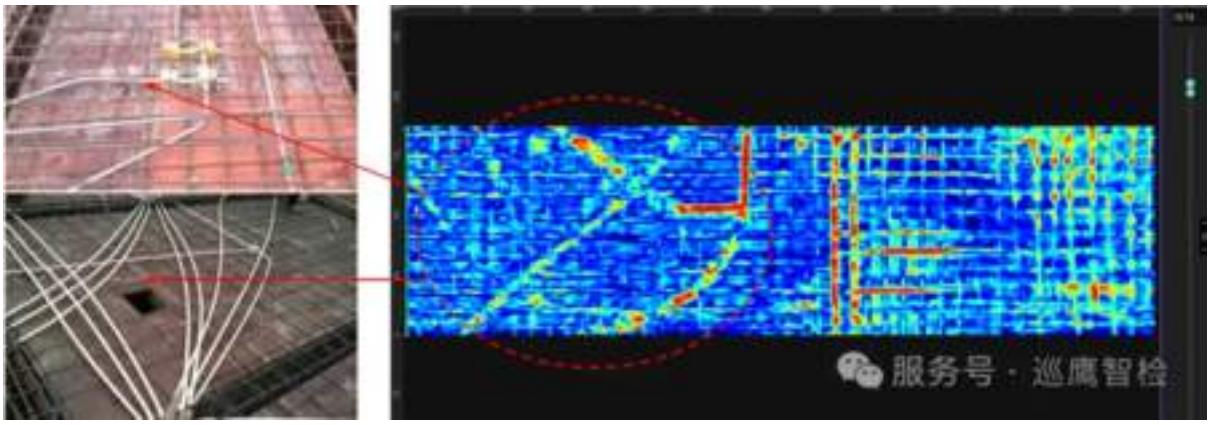


Signal diagram of the second-layer steel bar



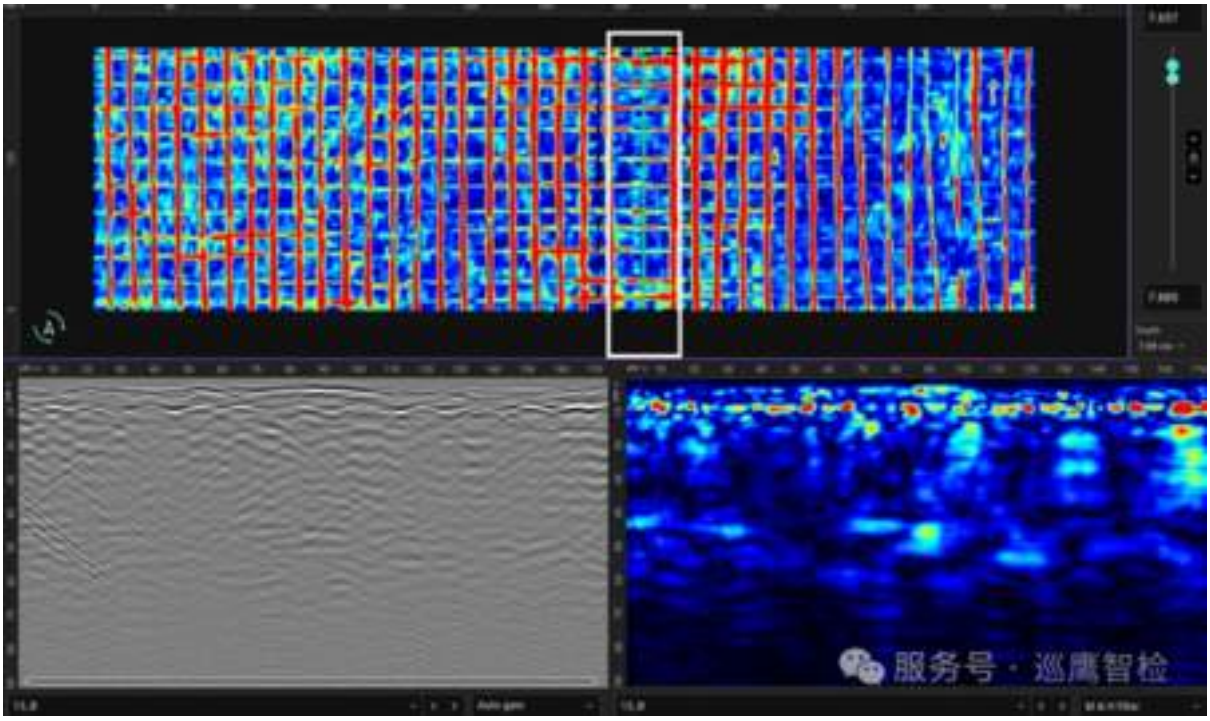
Signal diagram of the floor board

Pipeline detection: The radar depth slice shows several continuous strip signals at a depth of about 11 cm. According to the corresponding B scan, there is a clear hyperbolic signal (typical feature of the pipeline) at this depth, and it is determined that the pipeline is located between the first and second layers of steel bars.



In order to further verify the accuracy, the test results are compared with the real photos of the pre-buried pipeline at the construction site, and the distribution form of the two is highly similar. At the same time, according to Article 9.6.8 of the "12SG121-1-General Description of Structural Design of Construction Drawing", "The pre-buried pipeline in the plate should be arranged between the bottom of the plate and the steel bar on the top of the plate". According to the regulations, it is finally confirmed that the signal is a pre-buried pipeline signal.

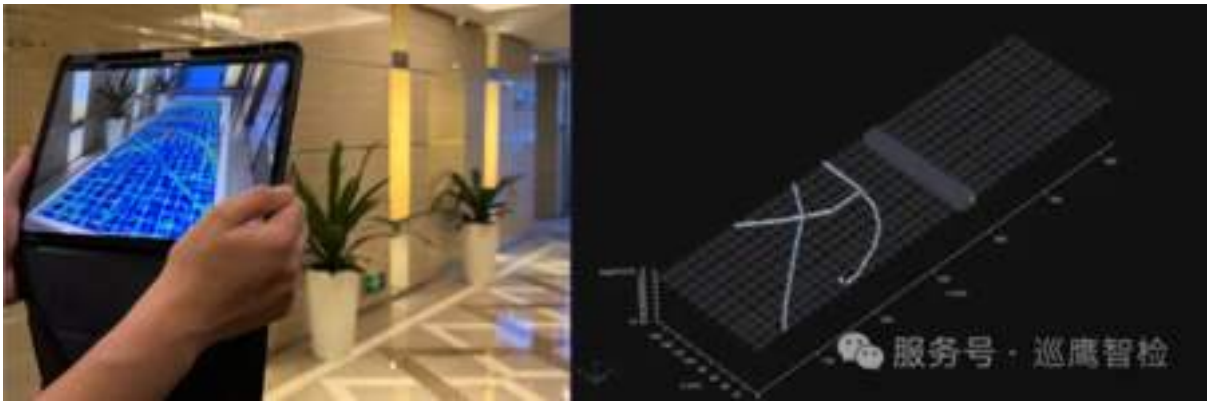
Beam detection: At the specific marking position of the deep slice, by analyzing the corresponding radar B scanning, it is found that only the reflection signal of a layer of steel bar can be seen, and there is no characteristic signal below. Combined with the on-site floor slab structure judgment, there are dense steel bars here, and the radar waves cannot penetrate, resulting in signal shielding, and then determine the existence of the beam at this position to avoid the drilling operation from accidentally touching the beam structure.



Beam body signal diagram

Visualization and 3D reconstruction

After the area scanning is completed, with the help of the AR projection function of the software, the real-time and intuitive visualization of the trend of double-layer steel bars and pipelines inside the floor slabs can be realized, which is convenient for on-site staff to quickly grasp the structural distribution. In the later stage, the inspection data is imported into the post-processing software, and their distribution is drawn with the software drawing function. The intention is to provide an intuitive and detailed technical basis for the safe location planning of drilling.



Left side: AR projection Right: Internal structure diagram drawn by post-processing software

In this application, the Proceq GP8100 GPR has been unanimously praised by the construction unit for its strong penetration and high-precision analysis. It makes up for the traditional detection of short plates, accurately locates the double-layer steel bars, and clearly shows the distribution of pipelines and beams under the steel bars.

This enables the staff to accurately plan the safe location of floor slab drilling, avoid the risk of accidental contact, ensure the smooth progress of residential building maintenance, and reduce structural damage and cost waste.