Left column: new 1,200mm-diameter steel casing being installed to 13m depth

Centre column: Massenza MI4 lowering a specially designed cutting tool to 106m

Right column: the MI45, with its 16m mast, during the extraction of the columns of the existing well

Back to full flow

Old water wells in the urban environment of Milan, Italy, are being restored back to full functionality

The city of Milan features numerous non-functioning or disused water wells, which are seen as part of the city's heritage.

In order to preserve them, the company in charge of the city aqueduct, Milan Underground Integrated Water Service, has assigned drilling company Idrogeo, based in Fiorenzuola in Piacenza, to completely restore them. As a result, the wells will be fully functioning once again and maintained to the highest standard.

Many of the wells are currently blocked, and the water cannot permeate from the aquifer into the well pipe. The contractor has to remove the entire pipe column and replace it. The new water-producing area of the column is then reactivated and all other areas are sealed.

The advantages of the project can be summarised as follows:

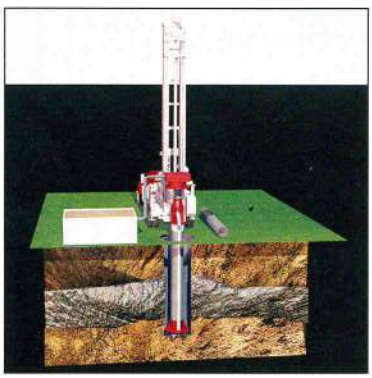
- Reactivation of a well that is not in use, which is exactly aligned with the old well, without having to set up the new administration of concession procedures;
- Integral renewal of pipes with more resilient material (304 stainless steel);
- Reuse of existing structures; and
- Reuse of the existing water connections.

CHALLENGING WELL

One of the wells presented the drillers with technical challenges and the method of replacement had to be well planned. Previous attempts to refurbish it have proven unsuccessful.

The initial step was to inspect the entire column with a video camera to determine the exact depth and structural situation of the well, which is 450/400mm in diameter.

With the support of a Massenza MI4 drilling rig, a specially designed cutting tool was lowered to 106m, and an accurate horizontal release cut was made through the wall of the 219mm steel casing.



Idrogeo's graphic of the restoration operation with the MI45

The next phase was to establish the construction site to accommodate all the material to be removed and introduced during the refurbishment.

The top section surrounding the well pipe was removed with an auger system, and a new 1,200mm-diameter steel casing was installed to a depth of 13m. The casing ensures the stability of the top section and the following operational phases. This part of the operation was completed using a Geax EK110 drilling machine.

The reverse-circulation (RC) method was used to drill over the old well casing and remove all the debris from the hole.

The remaining operations were completed with a Massenza MI45 drilling rig. The drill pipes and 1,200mm-diameter tungsten carbide insert (TCI) RC bit were designed and manufactured specifically for this application.

Quick-connection steel pipes (620mm in diameter) were transformed into RC drill pipes by incorporating separate flow lines for the compressed air and circulation fluid.

The viscosity and density of the bentonite mud was carefully monitored and calibrated throughout the entire operation to maintain the integrity of the borehole, as it had to remain open for several days.

Drilling returns were continually ►

"The wells will be fully functioning once again and maintained to the highest standard"

Installation of stainless steel casings from 66m to 93m depth

Drill pipes and 1,200mm-diameter TCI RC bit being lowered into the well

examined to determine the stratigraphy of the original well, and these also revealed the presence of a gravel screen and cement fragments, confirming that this was a column constructed during the previous intervention in the 1990s.

The drilling programme proceeded without hindrance, progressing 4m to 7m per day. The drilling continued to a depth of 105m, and then the drill string and bit were removed, which revealed the TCI RC bit to be in excellent condition.

A specific 'fishing tool' was lowered to approximately 9m inside the 219mm-diameter well casings, and the previous release cut meant that the casings were now detached from the redundant lower section.

The pull effort required during this phase was well within the capabilities of the drilling rig; however, it was still substantial as the cementing carried out in the 1990s resulted in the casings being securely fixed both internally and externally.

The column was removed in sections, and the height of the drill-rig mast allowed this to be completed in 16m sections.

"The recorded data has shown good results with almost zero sand content for the whole duration of the tests"

RECONSTRUCTION PHASES

After the extraction of the columns, normal RC drill techniques were employed with standard phases as summarised below:

- Circulation and reconditioning of the drilling mud with properties suitable for the well's subsequent completion.
- Supply and installation of 304 stainless steel casings with continuous spiral screens with robust structure, placed from 66m to 93m. Drainage gravel was placed outside the screens.
- Saturation up to ground level of the remaining hole with clay and cement injection.
- Start of well-activation operations with airlift and simultaneous production and Hydropuls development. The operations were carried out for several days with continual testing of the well output, which improved constantly until the well stabilised itself.
- Successful completion of the works with payload tests in steps from 10 to 64L/sec with a submerged pump of 60Cv placed at 36m from ground level.
- Payload measurements were made with a Woltmann DN 150 meter, and sand content was monitored and assessed in the settlement tanks. The recorded data has shown good results with almost zero sand content for the duration of the tests.
- When 40L/sec was reached, the specific payload reached was 8.49L/sec/m, which complies with the conditions of the project design.

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