VAN ELLE
TOTAL FOUNDATION SOLUTIONS

CASE STUDY
Air Traffic Control Tower, Manchester Airport

Project: The development of the second tallest air traffic control tower in the UK, at Manchester Airport.
Van Elle Involvement: New bearing pile foundation design and installation.
Client: Manchester Airport
Principal Contractor: Morgan Sindall
Engineer: URS Scott Wilson

Project:
The project aim was to replace the current Air Traffic Control (ATC) facilities. The new tower, which is to be located adjacent to the north fire station, is expected to be completed in 2013.

Standing at approx. 60m high, it will become an iconic building for the region rivalling the most innovative designs and tallest buildings at any UK airport. The current, 40-year-old Air Traffic Control centre on top of existing tower block, will be reviewed at a later date as part of the renovation process.

The new Llamada P140TT CFA Piling Rig and a Cathay Pacific Cargo Boeing 747.

With a 360-degree panoramic outlook, it will provide unrivalled views of the entire airfield negating the requirement for camera assistance as used to view the extremities of the runway at present.

The tower will house a new panoramic control room, an approach radar & navigation section and surveillance & communication equipment to ensure Air Traffic Control can effectively service the long-term investment and future growth of the airport.


Site team preparing the Dywidag bars for the cages.

The new tower will be a stand alone, purpose built building, with the base of the building housing a new equipment centre and offices for ATC, which is carried out at Manchester by Air Traffic Control company, National Air Traffic Services (NATS).

Geotechnical:
Although a high-profile project, it wasn't a large scheme as piling projects go but there were a number of challenges to overcome in both the ground conditions and programme.

The Llamada piling machine model P-140TT is designed for the execution of continuous flight auger piles (CFA) and displacement piles up to 26.5m deep without Kelly bar extension and diameters between 400mm and 1000mm.

The machine differs from its competitors by its reduced weight, high stability and 360°, working range as well as by its compact transport and easy set up. Its compact design, robustness and power make this machine unique in the market. Thanks to its features this machine reaches performance levels that even larger machines fail to achieve.

Based on the given ground investigation report and loadings & forces applied by the structure, we designed 25No. 750mm diameter bearing piles to a depth of 21.25m or rig refusal. As they were fairly large diameter for CFA (Continuous Flight Auger) piles and were expected to be deep too, we opted to use our brand new Llamada P140TT rig having recently been delivered from Spain.

There were to be a combination of loads applied to each pile as per the engineer's spec; 2500kN compression, 400kN tension and 75kN shear and in this greatly varying strata, meant that one size didn't fit all, hence drilling to a design depth or rig refusal.

The ground conditions, according to the site investigation report, were:

- Made Ground from 0 to -4m
- Medium Dense Sand from -4m to -11m
- Very Dense Sand from -11m to -15m
- Mudstone from -15m

We did, however, find that the Mudstone started anywhere from -11m to -12m. Our calc to determine the pile depth was simply based on a worst case scenario and the design, having been completed by our project engineer, Chris Bosworth, was checked by our senior design engineer, Abid Adekunte.

The design required a 6.25m rock socket (or prior rig refusal), a 9m long cage of 6No H16 bars with a 36mm Dywidag to 14.5m to resist the tension.

We installed a sacrificial test pile which was tested to 1.5 times the working load i.e. 3750kN and it only settled 4.3mm compared to the engineer's specification of 15mm allowance and at working load it settled 2.83mm compared to the allowed 10mm. We used a sacrificial pile rather a working pile due to the programme pressures and the access restrictions at the end of the site closest to the Restricted Zone (RZ) fence.

Upon arrival on site on the agreed start date, due to complications which had arisen working in such close proximity to a fully-functional airport, we were delayed for a couple of days which further increased the pressure on the programme as the platform was not ready and the required paperwork to begin the piling had not yet been received by our client, Morgan Sindall.

Once we began installing the piles then all went fine and the only difficulty, again, arose from the position of the tower in relation to the Restricted Zone (RZ) fence and the fact that this came to a point as can be seen in the above image, although we knew about this prior to beginning the contract so were able to work around it.

Had the loadings not been so great then we could have looked at using a smaller rig to carry out the piling, however, we were limited due to the required depth and diameter of the piles so opted to use the Llamada which is extremely powerful and helped to keep us on schedule despite the initial hold-up.

Left: Pile cages stacked and ready to be inserted into the piles with the Llamada tracking towards the narrowest part of the site to begin piling.

Below: TWO NEW GIANTS - The back of the new Llamada P-140TT with the new Emirates Airbus A380 ultra-efficient twin-deck, four-aisle aircraft landing in the background.

We may have considered a rotary pile early on, however, as the ground investigation report showed the water table (-2m) to be so high, it meant that we would have had to have used casing and de-watered the site. This would have taken a lot longer and cost a lot more.

Results:
We successfully designed, installed and tested the sacrificial test pile which performed well and proved our design for the working piles.

We have worked on many projects before for Morgan Sindall including the Birmingham International Airport control tower so, with good communication from day one and an understanding of their programme requirements, we were able to design and plan to meet our targets and help them to produce another successful high-profile build.

Through working closely with both Morgan Sindall and URS/Scott Wilson, we achieved the desired results and look forward to working with them on more challenging schemes in the future.

Van Elle's Project Value: £60,000.00