Maxibor moves forward with HDD methodology

Maxibor is using its experienced HDD design engineering capabilities alongside asset owners, engineering design firms and T1 contractors to help provide intelligent and creative solutions to complex pipeline project challenges.

There is an increasing appreciation in the infrastructure and mining sectors that horizontal directional drilling (HDD) can provide intelligent and creative solutions to complex problems faced by asset owners. Intelligent HDD design solutions offer significant project and whole of life asset benefits, while helping preserve the local environment and cultural heritage.

HDD solutions have relevance across many sectors including water and sewer, gas and oil, power, telecommunications, rail, mining and renewables. It is also becoming an important climate change adaptation action to mitigate the impact of fire, wind, flood, inundation and drought.

HDD Engineering Director of Special Projects Stephen Loneragan – who has records for the design and delivery of some of the longest underground pipelines in the world – says Australia is poised to take greater advantage of HDD as a solution to many challenges associated with pipeline projects.

"It is just a matter of getting the right minds together at the right stages of a project so that the full range of solutions can be considered, including HDD," says Mr Loneragan.

"The disciplined design and drilling methodology development approach used by Maxibor and its cooperative knowledge sharing attitude is something asset owners and design engineer consultancies are being very receptive to.

"First principles, foundation-based engineering is key to delivering longer, larger and more complex projects. It is about using the combined knowledge to get a better outcome for all the project stakeholders."

In the context of Maxibor, the foundation for the success of this approach is a combination of experience in engineering design and the delivery of complex and challenging pipeline projects installed by HDD. Bringing this knowledge together in a cooperative manner is the best way to optimise value for all stakeholders on a project.

Maxibor's methodology

Maxibor applies a procedure for each project that adapts accepted practices and then focuses on specifically solving the project issues through engineered design.

"Maxibor's HDD design and methodology development processes are highly iterative for the more complex bores," says Mr Loneragan.

"Each step in the design process feeds back to the previous parameters which causes an evolution in the design to get to a point that provides a pipeline installation solution which considers safety in design, constructability through engineering application and ultimately usable infrastructure."

Mr Loneragan says Maxibor's approach is developed within an integrated discipline framework, with the design and methodology development processes requiring a wide range of engineering, HDD operations and commercial knowledge to achieve successful installation.

The key steps in Maxibor's integrated discipline framework include:

- Pre-planning – project objectives.
- Build of initial bore plan – design profile, preliminary hole, casing design.
- Torque, drag and hydraulics – friction factor analysis, maximum loads, maximum torque, pipe buckling.
- Rig and equipment specification – rigs, pipes, pumps, cleaning systems.
- Case wearing – will profile cause excessive wear?
- Bore hole trajectory – objectives to minimise tortuosity, target size, ellipse or collision analysis, survey and program design, target, anti-collision.
- Bore hole stability – fracture gradient analysis, collapse, rock mechanics, clay inhibition, swab and surge pressures, geotechnical investigation.
- Product pipe design – formation type, collapse pressures, tensile loading, floatation devices, safety factors, rig limitations, pipe wall force, coating type selection.
- Bore hole assembly design – drilling tendency, bending stress state, hole size evaluation, torque reduction tools, vibration, tooling layouts, bore hole assembly (BHA) analysis, stabiliser placement.
- Fluids and hydraulics – hole cleaning, density, rheology, flow rate and regime, maximum rate of penetration (ROP), pullback capacity, back reaming, fracture gradients, drag monitoring, drill pipe rotation speeds, BHA design, bit selection, cuttings volume, fluid volume displacement, lubricity, inhibition.
- Torque and drag – friction factors, sliding limits, pick up and slack off, buckling analysis, casing wall force, fatigue endurance, yield stress, tension, rig limits.

Risk and opportunity – operational risks, corporate risks, opportunities, risk sharing. The extent of factors to consider highlights the range of knowledge required to achieve an optimised fit for purpose design and a drilling methodology. In the development of this approach, Maxibor has been able to draw upon its extensive experience of installing complex pipeline projects and its network of industry specialists, which have further facilitated the build of its internal knowledge bank. This pool of knowledge can be applied to each project and provide significant confidence to clients that using HDD will be successful.

Achieving desired outcomes for clients

Maxibor frequently puts forward alternative design solutions to clients to help achieve better outcomes and has applied its integrated design and drilling methodology development process to more complex projects, demonstrating the benefits of the disciplined and cooperative approach.

Maxibor National Business Development Manager David Turner says by investing Maxibor's expertise and resources to undertake additional work in the bidding stages, clients are able to complete an achievable project.

An early design initiative of Maxibor on a recently completed project in Logan, Queensland was to combine two shorter bores into a 1.32 km bore, which reduced the cost to the client, provided whole of life operational economies and reduced the impact on the local vegetation and noise and dust to nearby residents.

This outcome was achieved through a complete understanding of the project objectives before commencement of the detailed design and drilling methodology development activities. Mr Turner says good communication with the client and other key stakeholders is essential to ensure all HDD activity on a project is aligned with the objectives and needs of other parties.

"Our clients are increasingly appreciating the extent of our knowledge and our willingness to cooperatively share that knowledge to help achieve better outcomes," says Mr Turner.

Other examples of where the use of HDD solutions could be better utilised include hilly and undulating terrain, environmentally sensitive areas, mine and tailing dam dewatering, high bushfire prone areas and cultural heritage sites. Maxibor says, generally, HDD can be considered an "obstacle avoidance technology".

The risks of complex projects

One of the major risks on the more complex HDD projects is 'frac out'. Maxibor's engineering design process considers fracture gradient modelling as a way of predicting the annular drilling fluid pressure compared to the ability of the formation to resist a crack or fracture forming from the annular drilling fluid pressure.

There are several factors that influence this calculation, including bore hole diameter; borehole depth of cover; drill pipe diameter; drilling fluid composition; drilling fluid flow rates; formation cohesion and plasticity; and formation ground water.

Maxibor says there are two principal models that are generally applied in the HDD industry to evaluate the fracture point – the overburden density model and the DELFT model. While both models each have their place, it is important the mechanics of these complex models are fully understood since it is not a matter of simply plugging in numbers.

Maxibor sees many examples where the input values into the models is done with little understanding of the mechanics of the models or how it applies to real world drilling. It has also seen many examples of "plugging numbers" to show a desired curve on a chart.

At Maxibor, this is considered an unwise approach as clients and contractors are ultimately not provided with great outcomes. Instead, Maxibor says it believes in a cooperative approach at the design stage of a project that can help impart its collective knowledge of how to mitigate HDD project risks such as frac out and get a design that will be able to be delivered.

Maxibor has also compiled a comprehensive risk analysis for HDD operations that provides a point of reference to consider the risks associated with each project and identifies good practice actions that can be taken to mitigate those risks.

The risk analysis is relatable to the design and drilling methodology as well as broader operational areas around labour, plant, materials and HSEQ and corporate risks and opportunities. This process makes both Maxibor and the client much more informed about the project.

As a knowledge sharing business, Maxibor says it is more than happy to discuss at an early stage in a project how HDD can provide a delivery solution. **P**

For more information contact David Turner on **0499 375 511**
or visit **www.maxibor.com.au**

Background image: Maxibor used its Vermeer 330x500 maxi rig on a 1.32 km 500 mm HDD bore for Logan City Council.