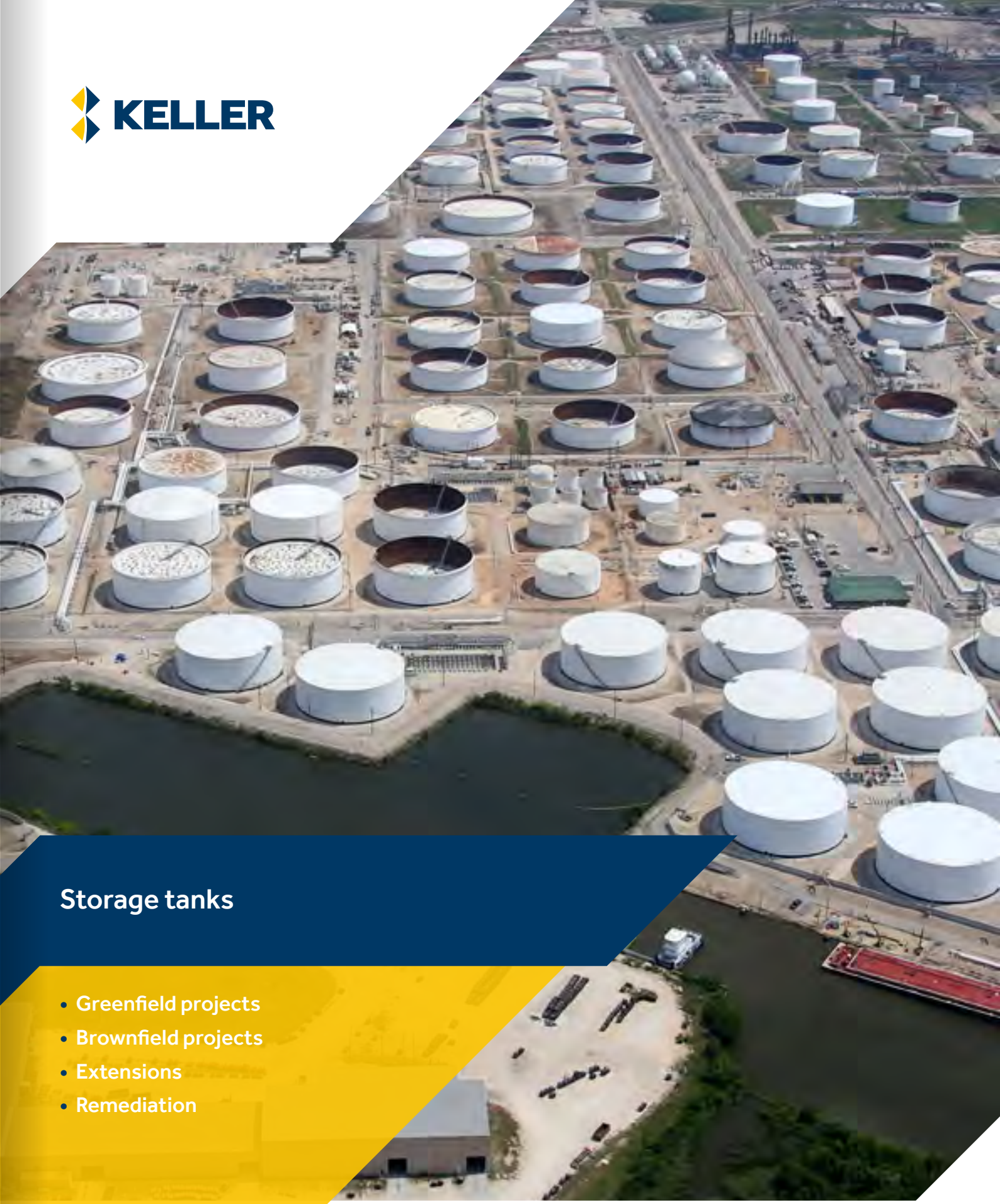
KELLER



Storage tanks

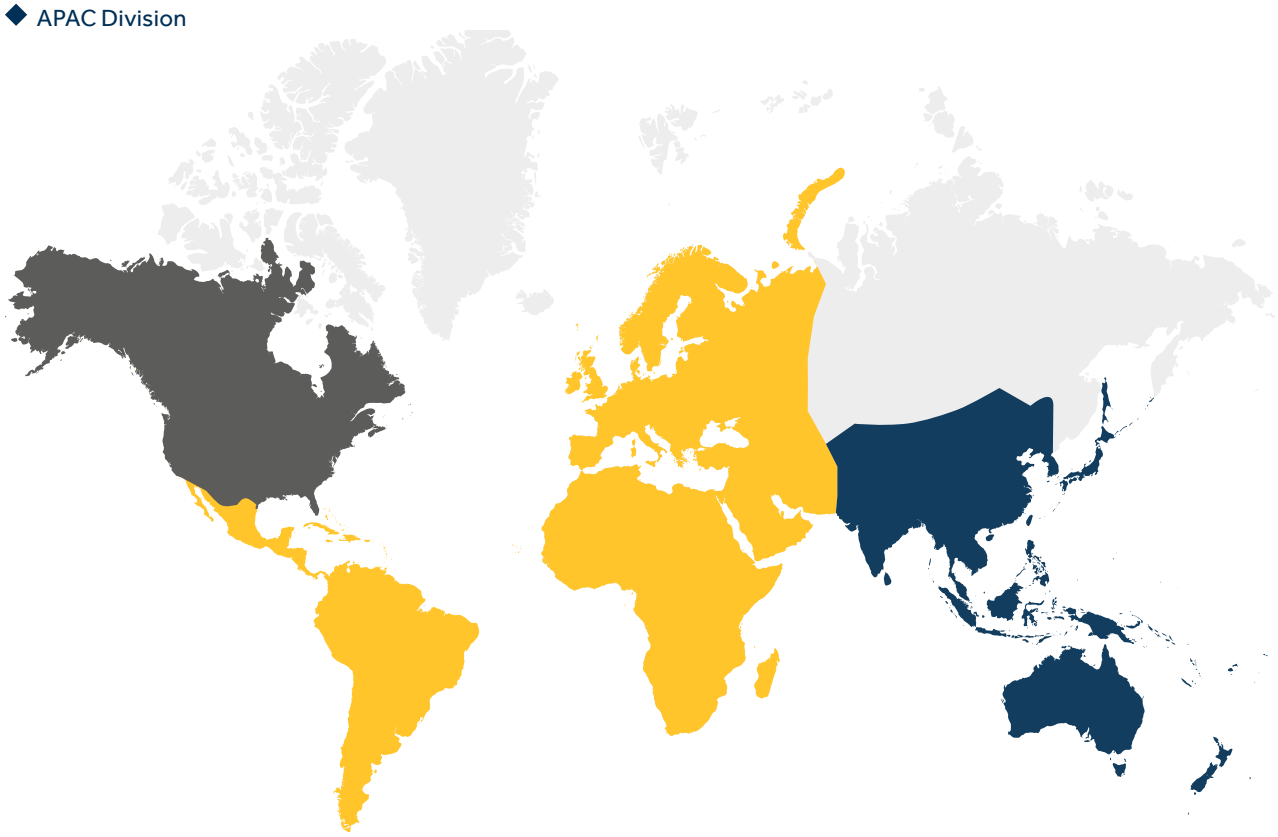
- Greenfield projects
- Brownfield projects
- Extensions
- Remediation

Geotechnical solutions for the construction industry

Keller Group plc - Who we are

Every day, people around the world live and work on ground prepared by Keller, the world's largest geotechnical specialist contractor.

- North America Division
- EMEA Division
- APAC Division



Solutions specialist

Used individually or in combination, our technologies solve a wide range of challenges across the entire construction sector – from industrial, commercial and housing projects to infrastructure construction.

Global strength and local focus

Global strength and local focus are what makes us unique. Our knowledge of local markets and ground conditions means we're ideally placed to understand and respond to a particular local engineering challenge. Our global knowledge base then allows us to tap into a wealth of experience, and the best minds in the industry, to find the optimum solution. With 10,000 employees and operations in more than 40 countries, we have the people, expertise, experience and financial stability to respond quickly, get the job done and see it through safely.

By connecting global resources and local knowledge, we can tackle some of the largest and most demanding projects around the world but the everyday work we do is just as important and, in total, we handle an unrivalled 7,000 projects every year.

Keller at a glance

1860 established

10k employees

40 countries

7k projects pa

We are
the world's largest geotechnical specialist contractor

Helping create infrastructure that improves the world's communities

- Ground improvement
- Grouting
- Deep foundations
- Earth retention
- Instrumentation and monitoring

KELLER

Storage tanks

Planned tank storage facilities may require ground improvement to increase soil bearing capacity and control settlement, deep foundations to transfer loads to competent bearing strata, or drainage to accelerate consolidation of saturated soils before construction.

Keller offers a wide range of solutions for supporting tanks, always selecting the best approach for the soil characteristics.

Our engineers will work out the most suitable technical solution for meeting the API (American Petroleum Institute) or any other required standard. If simple, grade-supported tanks are not possible, we have an extensive variety of ground improvement solutions which avoid employing expensive deep foundations when there is a cheaper option.

Challenges we can solve

Bulk liquid storage is often located in sea or river ports, where the soils are weak and compressible. Bearing heavy loads is always a challenge and, if shallow foundations result in settlement and damage over time, can be costly. Tailored solutions are often needed to mitigate excessive deformations and avoid future problems.

We provide services to the tank storage sector for new construction and renovation. If there are unacceptable deformations during or after construction, we can also design and implement appropriate remediation work to stabilise the tanks.

What makes us different

Keller is more than a foundation contractor: we partner with our clients from the early stage of their project and our engineers work closely with the technical team to define and design the most suitable and cost-efficient ground engineering technology. We follow-up each project with a Hydrotest survey.

Our broad experience and wide range of technologies ensure our clients the best value for money solution.

Health and safety

Health and safety is a priority for Keller and we have a proven track record of one of the lowest accident frequency rates in our industry. The commitment of leaders and employees to our Think Safe programme has earned us awards and recognition from industry bodies as well as our clients.

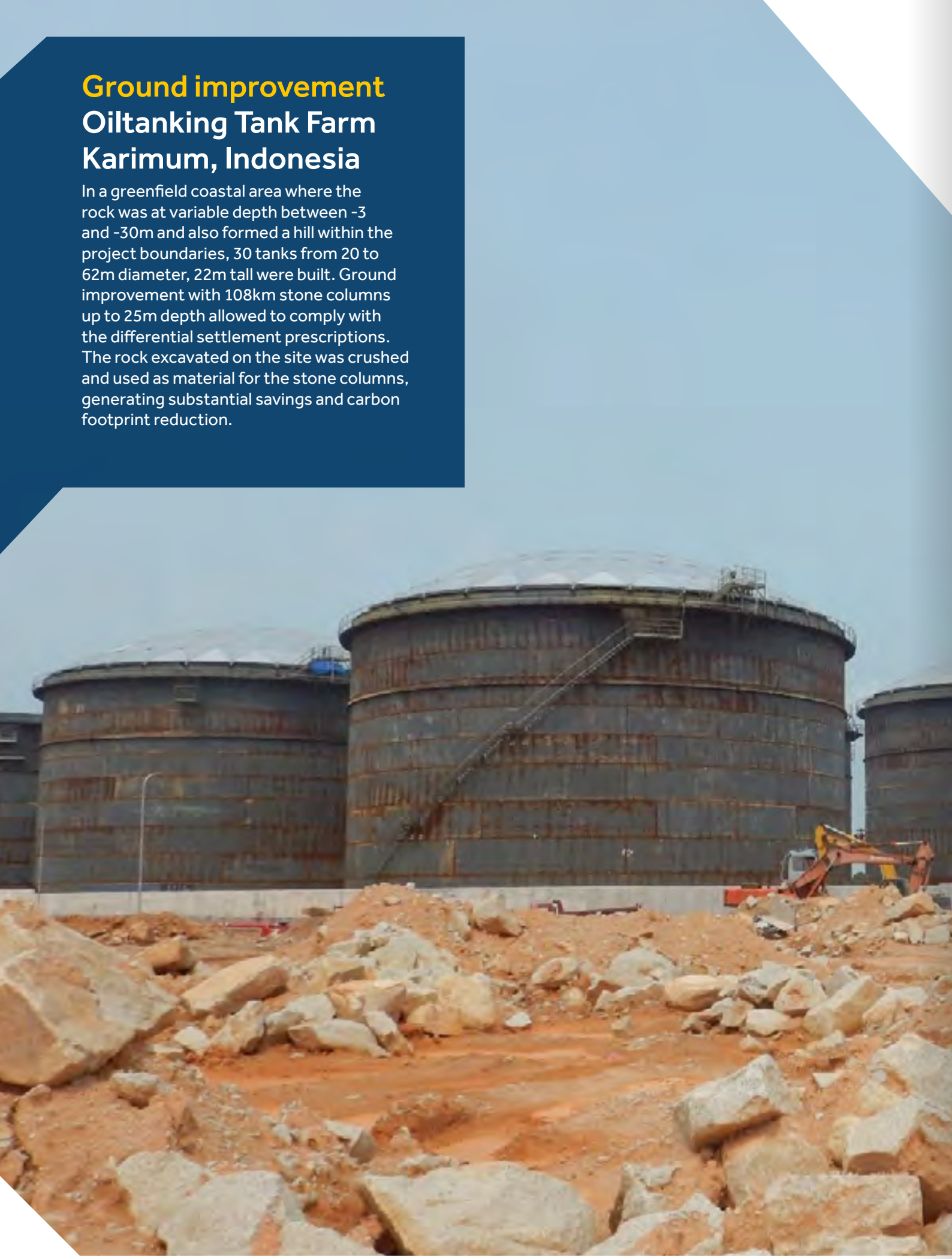
We believe no one should be harmed as a result of any work we do and our ultimate goal is zero incidents.

THINK SAFE
WORK SAFE, GO HOME SAFE

Ground improvement

Oiltanking Tank Farm Karimum, Indonesia

In a greenfield coastal area where the rock was at variable depth between -3 and -30m and also formed a hill within the project boundaries, 30 tanks from 20 to 62m diameter, 22m tall were built. Ground improvement with 108km stone columns up to 25m depth allowed to comply with the differential settlement prescriptions. The rock excavated on the site was crushed and used as material for the stone columns, generating substantial savings and carbon footprint reduction.



Project examples

Ground improvement

GPS Terminal extension

Amsterdam, Netherlands

In the port area of Amsterdam, GPS has extended the storage capacity of its tank terminal with six new tanks at 25m in height and between 29 and 36m in diameter.

To overcome weak soil and insufficient bearing capacity, as well as a soft clay layer between five and 15m down, causing significant settlement, Keller Funderingstechnieken designed a tailored ground improvement solution using CMM®. This solution was implemented to achieve long-term performance and reduce settlement to 2cm during tank operation.

Ground improvement
Project PERN
Gdansk, Poland

In the port area of Gdansk, the extension of the PERN terminal included six new 62-metre-diameter storage tanks and four 17-metre-diameter water tanks. The local soil conditions are unsuitable for heavy structures, with high organic content down to 21m-deep leading to unacceptable settlement. Keller Polska implemented CMM® ground improvement technology to meet the challenging settlement criteria of 5cm between the centre and edge of the tanks.

Project examples

Ground improvement

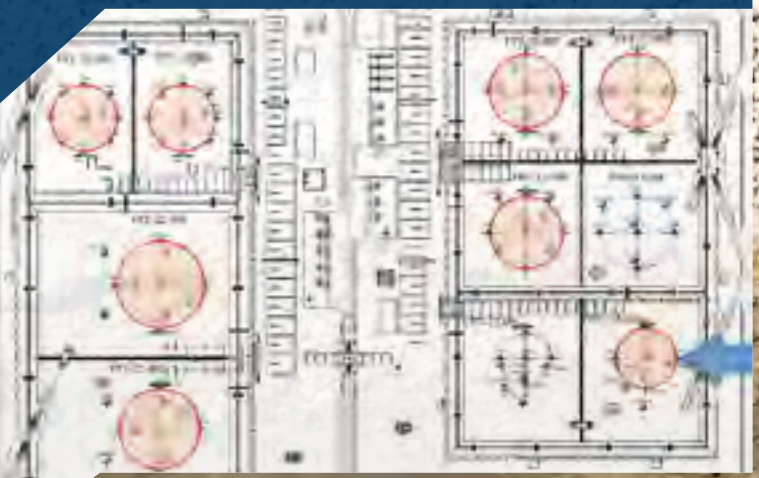
Burgan Cape Terminals

Cape Town, South Africa

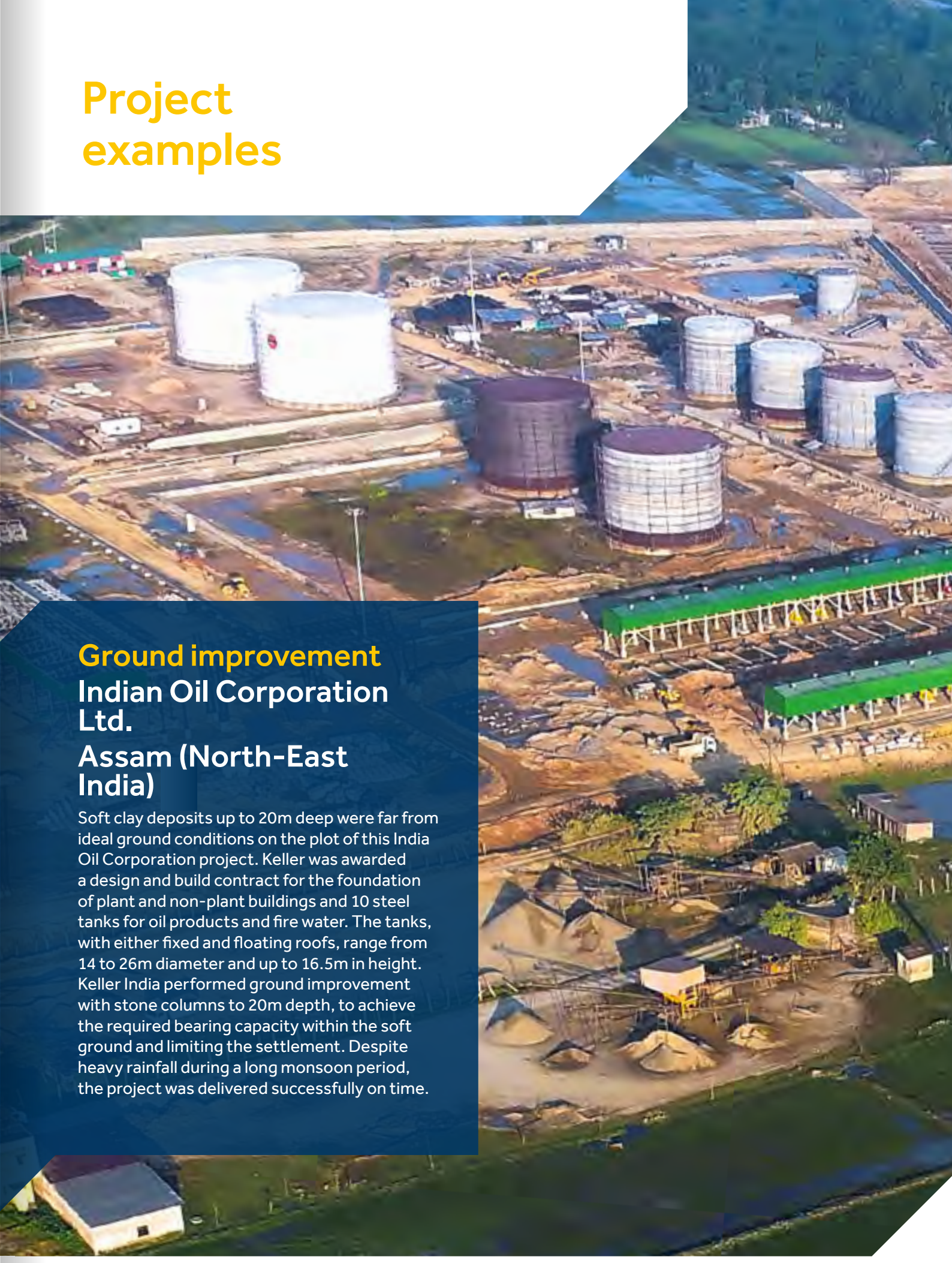
The ground at the Burgan Cape terminal in Cape Town is made up of heterogeneous fill of varying conditions including concrete blocks and debris. For the extension of the storage capacity at the terminal, 13 tanks at up to 31m diameter were built, covering an area of 15,100 m². Keller company Franki Africa designed and implemented a dynamic compaction solution for settlement control and improvement of bearing capacity.

Ground improvement
SUMED Product Hud Ain Sukhna, Egypt

As part of the extensive 'Ain Sukhna Product Hub ASPH' development (including onshore and offshore facilities for storage, loading/unloading and sending out fuel oil, LPG and natural gas) Arab Petroleum Pipeline Co. SUMED erected a storage tank farm. The diameter of the tanks varied from 38 to 55m and the height from 21.5 to 28m, for individual capacities ranging from 25,000 up to 50,000 m^3. The particularly challenging sensitive soil conditions led Keller engineers to design a vibro replacement solution, reaching depths of 38m – a first in Middle East. This solution will also prevent soil liquefaction and any damages should there be a seismic event.



Project examples



Ground improvement

Indian Oil Corporation Ltd.

Assam (North-East India)

Soft clay deposits up to 20m deep were far from ideal ground conditions on the plot of this India Oil Corporation project. Keller was awarded a design and build contract for the foundation of plant and non-plant buildings and 10 steel tanks for oil products and fire water. The tanks, with either fixed and floating roofs, range from 14 to 26m diameter and up to 16.5m in height. Keller India performed ground improvement with stone columns to 20m depth, to achieve the required bearing capacity within the soft ground and limiting the settlement. Despite heavy rainfall during a long monsoon period, the project was delivered successfully on time.

Ground improvement

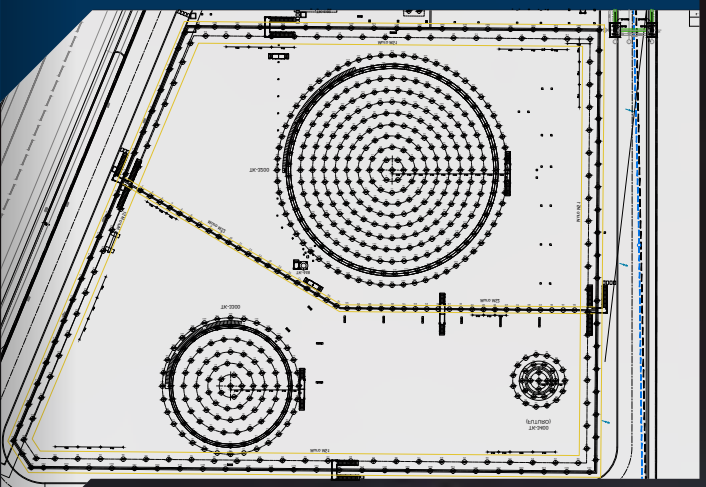
Fiagril Ethanol tanks Mato Grosso, Brazil

F&S Agri Solutions Ind. E Biocombustiveis LTDA is building one of the world's most advanced production plants dedicated to biofuels and animal food. In this region, soft collapsible soils make it difficult to install heavy storage units. To ensure a safe and effective foundation for the five ethanol tanks, each with 31m diameter, Keller Tecnogeo designed and built an innovative stone column ground improvement concept 16m deep with a cement seal on top of each column. This method accelerates the consolidation of the soil beneath the tanks, stops any liquid from penetrating into the sensitive soil and prevents any future damage.

Project examples

Ground improvement
PRIO tanks
Aveiro, Portugal

Keller Geo-Fundações had been treating the soft soils of this area for more than a decade before building production facilities and storage tanks. The latest project involved the implementation of vibro replacement to enable the construction of three new tanks with diameters up to 36m and up to 18m high.



Ground improvement

Kinder Morgan Oil Storage

Edmonton, Canada

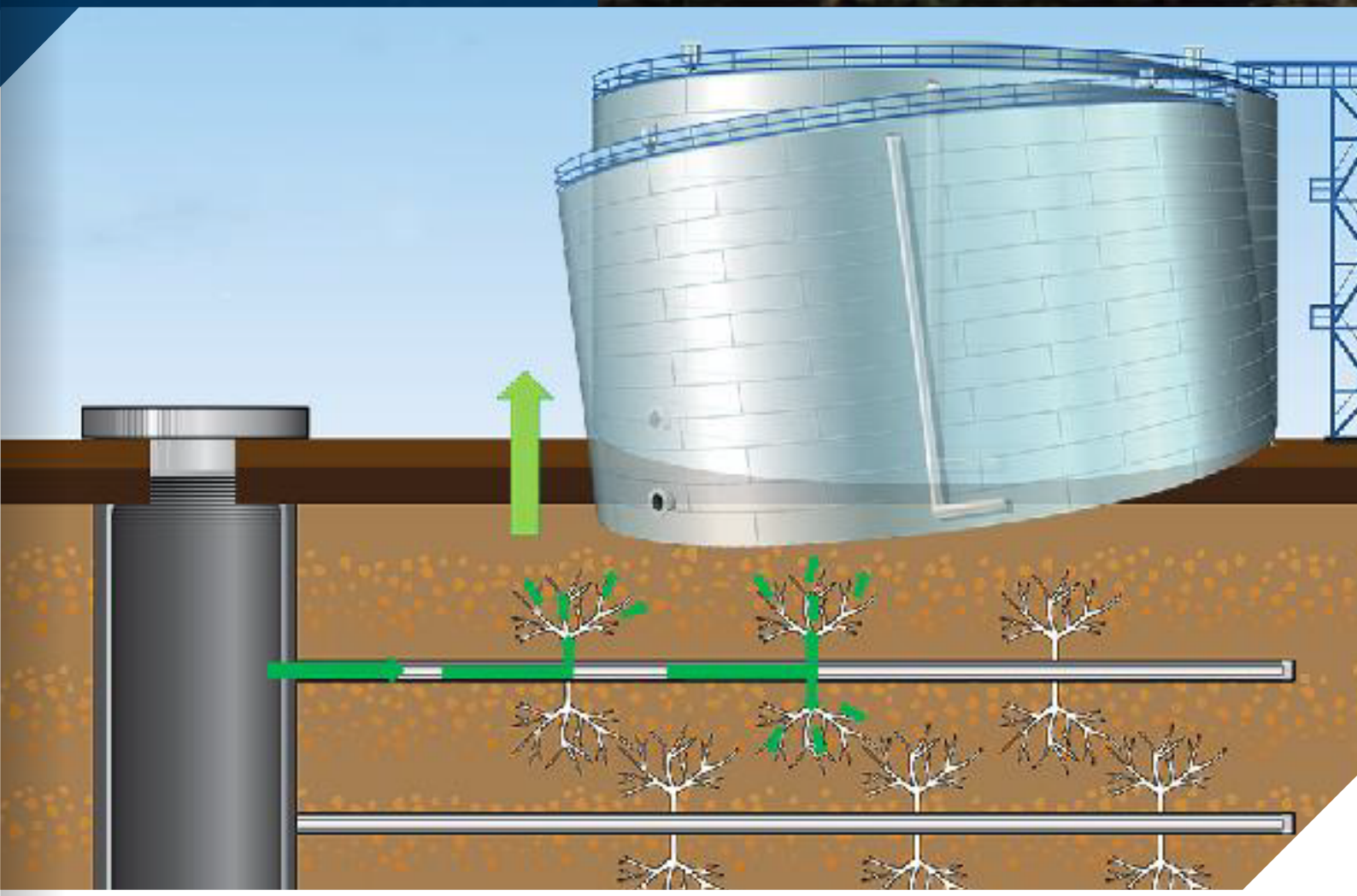
To allow for the addition of an extra 16 tanks (each with diameters between 45 and 60m) at the Kinder Morgan oil storage plant, Keller implemented a ground improvement solution using soil mixing, across an area of over 35,000m². Using high-powered machines, cement was mixed in 2.44m diameter columns with the silty-sandy soil to prevent settlement and ensure bearing capacity.

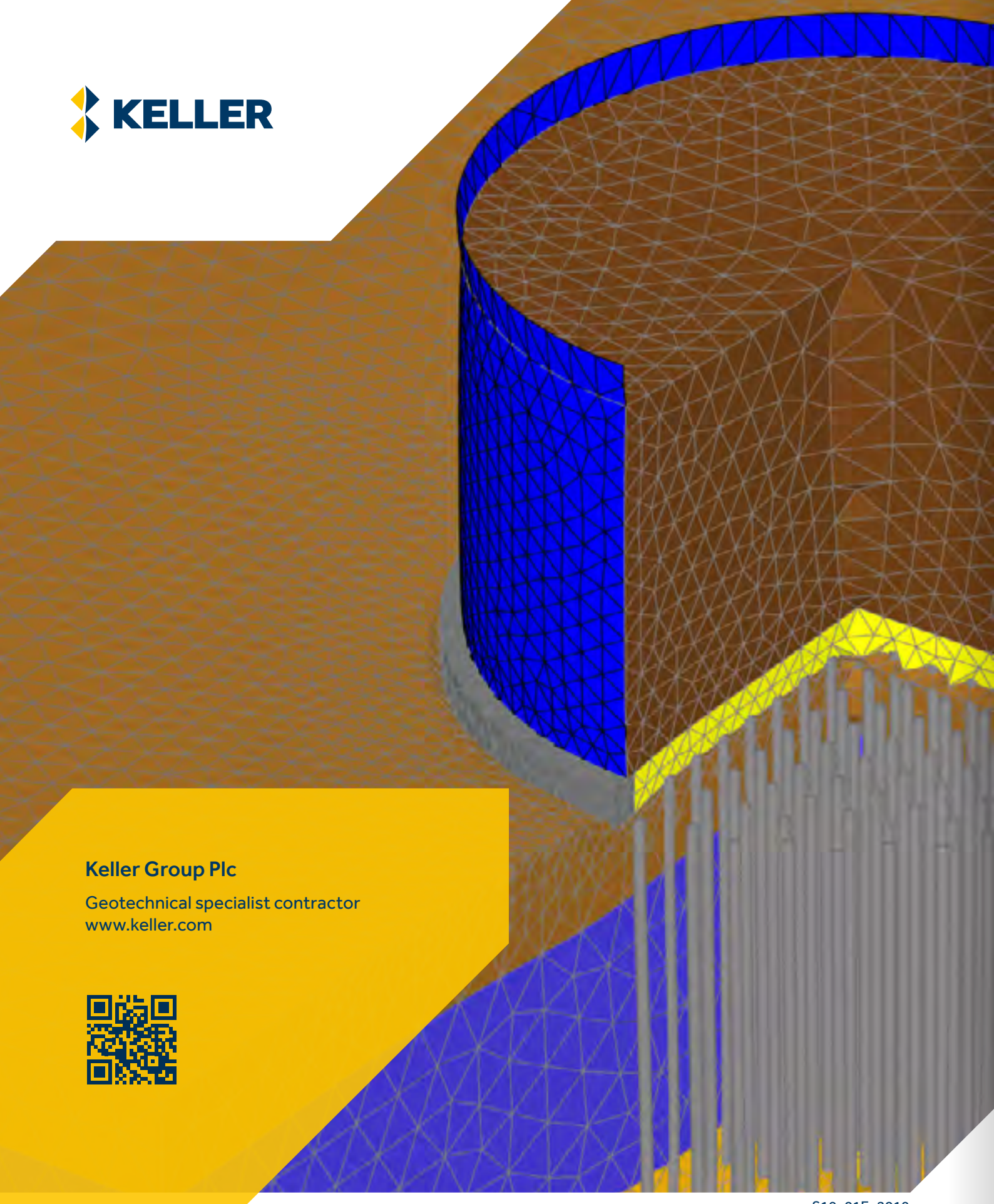
Project examples

Ground improvement

Settlement remediation, Italy

At this site, due to the heterogeneous nature of the soil, depression in the tank bottom and differential settlement of the steel shell had damaged two crude oil tanks putting their use at risk. Keller implemented its Soilfrac® technology alongside sophisticated monitoring to lift the tank base without any interruption to service.





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