

Ground Engineering



INTRAFOR

Ground Engineering Specialist

Intrafor is a leading foundations and ground engineering specialist. Our team carries out technically challenging projects in both the public and private sectors, providing sophisticated and cost-effective solutions to meet every client's needs. We perform a wide range of activities – including **geotechnical investigations, ground improvement** and the construction of **special foundations such as deep diaphragm walls**.

Our works feature specialist and innovative construction techniques, covering a variety of **building and infrastructure projects** such as deep basements, tunnels, station boxes, underground car parks, cut-off walls, land reclamation and dams.

Intrafor was originally founded in France in 1850 and became a subsidiary of **VSL International** in 2001, thus joining the **Bouygues Construction Group**. This means that we are able to offer clients - including developers, consultants and contractors - the strength of local expertise in each market backed by the support of a worldwide network.



In addition to its own permanent bases, Intrafor can call on the support of VSL International's network of 30 offices, to enable operations to be carried out around the world. Clients therefore benefit from both local expertise and global support when working with us, irrespective of the project's location.

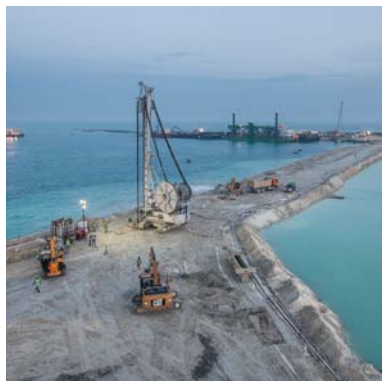
Understanding the local context and local culture is as important as bringing the most advanced solution to ensure the success of projects. By combining both a locally based subsidiary and the experience, expertise and knowledge from other entities of our Group, Intrafor delivers its internationally recognised, specialist support, with modern and cost-effective construction techniques to any location.

Our global presence also allows Intrafor to mobilise specialist staff and equipment worldwide at relative short notice. During the course of tenders and execution of projects, we have complete access to a

pool of specialist staff able to rapidly intervene and share expertise to overcome the challenges encountered.

Through our locally based Group wide network, we contributed to ground engineering projects all around the World, with projects in South Africa (Gautrain), Australia (Sydney Metro), Singapore (Fullerton Hotel) and the Corniche Hotel in Abu Dhabi (UAE).


With local solutions and global support, Intrafor provides the perfect blend of the most efficient and innovative construction techniques, delivered by talented and well-trained local teams.



The combination of Intrafor and VSL technical expertise and local knowledge brought success to numerous projects such as the New Doha Port project in Qatar, the Chinatown MRT Station in Singapore and the Perth City Link in Western Australia.

Local expertise, **global** support

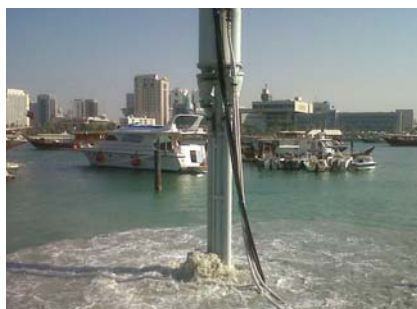




We pride ourselves on finding the right solutions to our clients' ground engineering challenges, however complex. By building close working relationships with each client, we are able to develop a tailor-made partnership geared to the successful outcome of each project.

This approach sees us create solutions together with our clients. We work with them to understand their needs before developing solutions that draw on our internal design capabilities and experience in every aspect of ground engineering. As a result, our turnkey solutions are competitive, innovative and practical. From a project's conceptual stages, we work closely with different client teams to plan the most economical and safest approach. Ongoing collaboration with estimating teams during the tender process and with technical and production teams as a project progresses ensures that plans encompass actual conditions, new challenges and changes. To service specific needs, Intrafor has the capability to act as a main contractor or a specialist sub-contractor, depending on the significance of the geotechnical component of each project.

Clients choose Intrafor for our focus on delivering results.



From marine stone columns for the extension of Doha Port (top right), to soil freezing for tunnel cross passages in Hong Kong's Lok Ma Chau Project (left) or Cutter Soil Mixing (CSM) for the Tuen Mun – Chek Lap Kok Northern Connection Project in Hong Kong (bottom right), Intrafor can offer the most advanced ground engineering solutions wherever needed.



Solutions provider for complex projects

We are motivated by our passion for ground engineering and dedicated to sharing world-class expertise with all our clients.

Central reclamation Phase 3 - Hong Kong

Our people are the key to our success. Every employee contributes to the successful delivery of our ground engineering projects, and brings with them a wealth of energy, experience and expertise.



Intrafor continually recruits experienced and capable people to join our teams who then stay with us for a long time. We look for individuals excited by the opportunity to work on some of the most challenging engineering projects around the world, with some of the best teams in the business. Above all, we look for people for whom innovation is second nature.

To allow every staff member to reach their full professional potential, Intrafor actively supports continuous training and development for our people. As well as external training schemes, we offer internal training to develop management, engineering and operational skills.

We aim to make all our employees enjoy their work and be proud of being part of the Intrafor family.

A shared sense of fundamental values unites our teams at Intrafor. From our front end workers on the ground to our management, all our people reflect these core values in each of our projects, including:

RESPECT FOR PEOPLE

- Ensure safety at all levels
- Listen, care and take action
- Empower, trust and reward individuals
- Focus on training, continuous learning and knowledge sharing

PERFORMANCE

- Perform to our client's satisfaction
- Control and manage risk
- Generate positive results

RELIABILITY & TRANSPARENCY

- Act in an accountable, trustworthy and thorough way
- "Walk the talk" – put our words into practice
- Share information openly

CREATIVITY

- Create value for clients through innovative solutions
- Think differently, give new ideas a chance and reward success
- Build on people's new ideas and support them

COMPANY CULTURE

- Always act within the law, adhering to corporate guidelines and ethical standards
- Ensure that Intrafor is a company to be proud of
- Care for and contribute to the overall interests of Intrafor

Our **people**
and **core values**





High-Speed Train viaducts - Avignon / France

Shaping a **Better Life**



At Intrafor, each of our projects represents a long-term commitment. We deliver firm foundations for buildings and structures around the world, and we build with the future in mind. In doing so, our ambition is to build a sustainable environment for our staff, our clients and the local community where we are working.



employees. We walk the talk. Our performance in occupational health and safety is praised and recognised. For example, Intrafor received the award of Model Subcontractor Award from the Considerate Contractors Site Award Scheme for our works on the Central Interchange of the Central Wanchai Bypass and Island Eastern Corridor in Hong Kong.

We are committed to fostering long-term and trusted client relationships based on consideration and transparency. Successful projects are the result of openness and trust from the very early stage of projects between Intrafor and our clients. We aim to work WITH our client rather than FOR our clients.




Intrafor incorporates risk management into everyday operations, looking at the potential environmental, social and reputational impacts of our works, enhancing procedures to mitigate these risks in order to protect the reputation and image of projects, clients and owners.



We are determined to lead our sector with regards to occupational health and safety. Intrafor works with partners and subcontractors to increase prevention, improve workplace ergonomics and support the health and wellbeing of our

All these successes are only worth it if the local community surrounding us is also part of them. We are committed to supporting the communities in which we work by getting involved in local events and supporting local causes. Supporting the initiative of its sister company VSL Vietnam, VSL and Intrafor organised the collection of clothes, books and toys for the "Enfants des Rizieres" association in Vietnam which aims to feed and care for local, disadvantaged children, as well as giving them access to schooling. Intrafor also takes part when disaster strikes and contributed in the fund raising efforts for the victims of the earthquakes in Fukushima (Japan) and Nepal. On project sites, our teams act to minimise unnecessary nuisance, integrate and communicate with the local community as well as taking steps to reduce any disturbance for local residents.



Our ability to deliver safe, on time projects makes Intrafor the partner of choice in the ground engineering sector.

Low headroom cutter at Hung Hom Station - Hong Kong

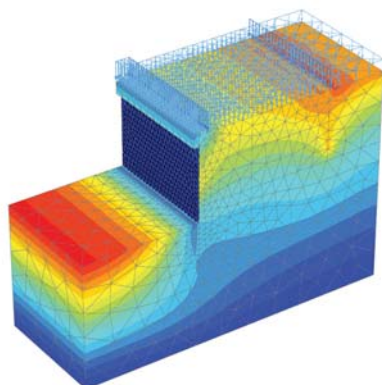
Specialist **knowledge** and **experience**

Intrafor's specialist knowledge sets us apart from other ground engineering contractors. We combine in-house design capabilities with the expertise of a specialist operational team, supported by the most advanced equipment in the industry.

This unique, specialist solution delivers a high quality service to clients. Our willingness to innovate and our commitment to new technologies allow us to develop cost-effective solutions to client challenges, while evaluating risk appropriately.

Every member of our senior design team has contract management site experience, making them familiar with relevant construction processes. Because our staff know the inherent risks, they prepare detailed design alternatives for each project as part of our standard tendering process, giving our offers a competitive edge.

Intrafor also invests heavily in R&D to maintain our technological edge. This has resulted in a host of patented technique and equipment, and allows Intrafor to always offer clients the most cost-effective and practical solution for each project.



Left | 3D Finite Element Analysis

Top | In house development of specialised equipment

Center | Diaphragm wall and strutting works

Bottom | Grouting plant computerised control system



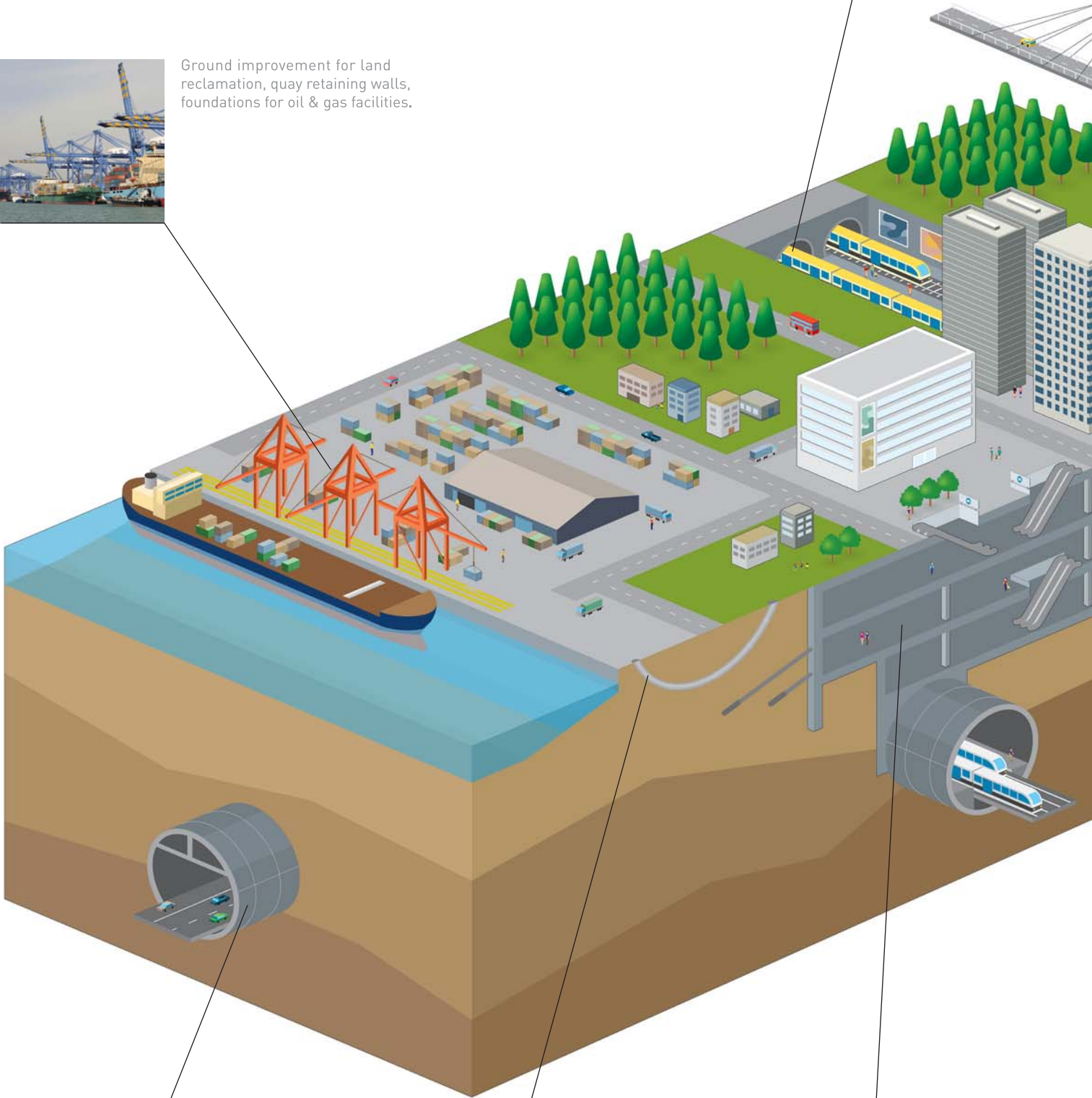
We master all ground engineering techniques to serve all types of projects.



Ground improvement for land reclamation, quay retaining walls, foundations for oil & gas facilities.



Retaining wall solutions for cut & cover structures, temporary and permanent earth retaining systems.



Ground improvement for protection of surroundings during tunnelling works, Horizontal Directional Coring (HDC).



Horizontal Directional Drilling (HDD), Horizontal Directional Coring (HDC) and soil investigation.



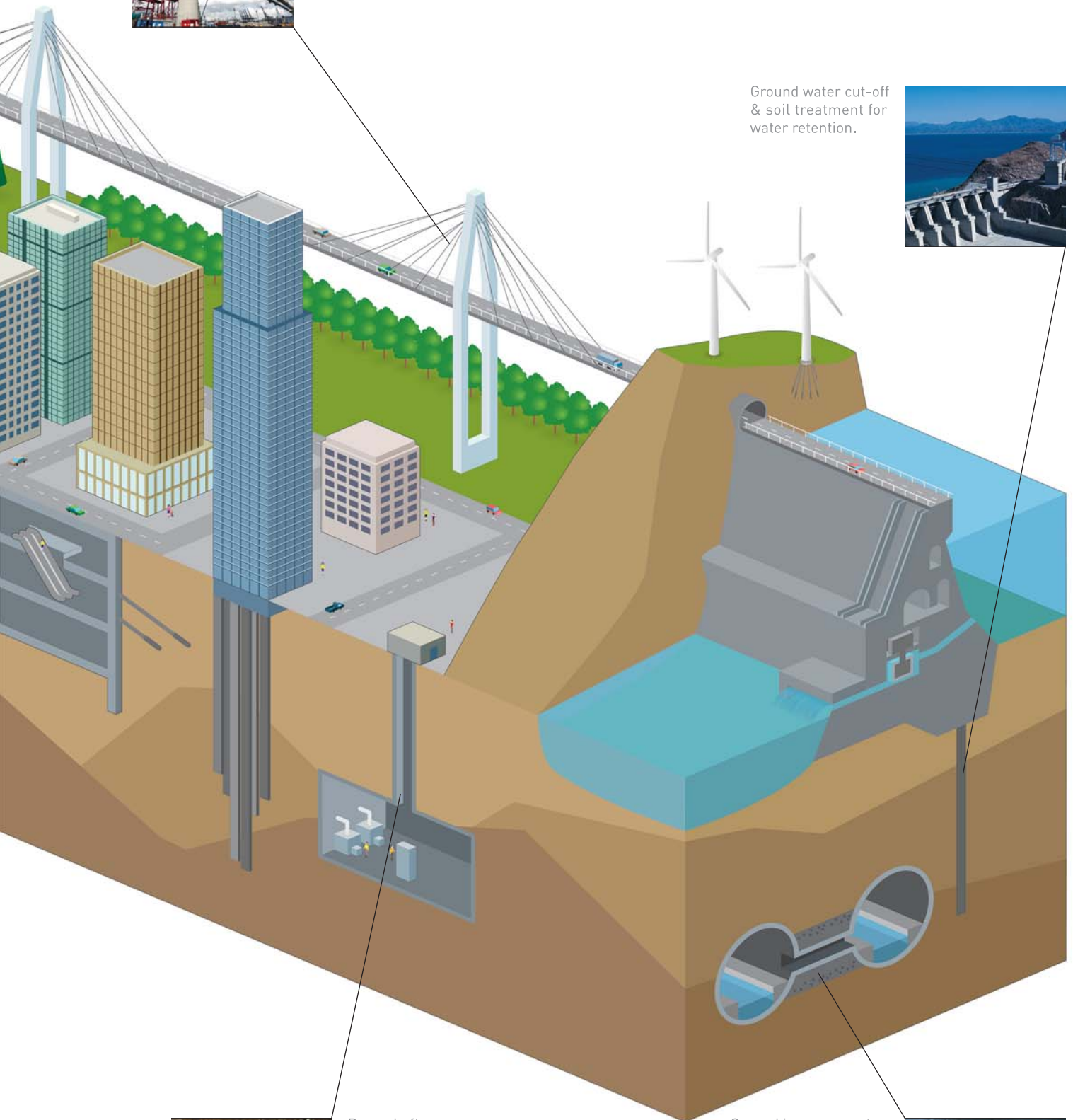
Retaining walls, ground improvement and foundations for basement and underground structures.

Project **capabilities**



Deep foundations for major civil infrastructures.

Ground water cut-off & soil treatment for water retention.



Deep shafts including small diameters.

Ground improvement by grouting or soil freezing techniques for the construction of cross passages and tunnel adits.





Tunnel for Sydney Metro

Civil works & infrastructure

The experience and innovation in ground engineering solutions that our team brings to major infrastructure projects means that Intrafor is widely recognised as an industry leader.

We have the resources and expertise necessary to design and construct even the most ambitious civil works or infrastructure projects, including **underground railway systems, train stations, bridges, dams, tunnels, roads, ports and power stations.**

Intrafor specialises in the development of retaining structures using diaphragm walls, the construction of deep foundations, and ground improvement works using grouting, soil freezing or compaction techniques.

Intrafor has worked on major transport and infrastructure projects including: the Perth City Link in Australia, Chinatown Station in Singapore, the Express Rail Link in Hong Kong and the MRTA in Bangkok.

In recent years, we have also carried out a variety of ground engineering works including constructing **storm water storage tanks, diaphragm walls and foundations for sewers, pumping stations and electricity power stations.** Previous projects include: Harbour Area Treatment Scheme (HATS) and Castle Peak Cable Tunnel in Hong Kong. Intrafor has also provided ground engineering solutions to many major infrastructure projects in the Middle East and Africa including: BurJuman and Saeediya stations on the Dubai Metro, Park and Sandton stations for the Gautrain Railway project in Johannesburg and Attaba station on the Cairo Metro. We have also undertaken extensive cut-off wall construction works for the New Doha Port in Qatar and the Midlands Dam project in Mauritius.



Top left | Hang Hau Station - Hong Kong
Top right | Park Station, Gautrain Railway Project in Johannesburg - South Africa
Bottom | Attaba Station, Cairo Metro Line 3 - Egypt



Intrafor offers a range of foundation solutions to provide support for new building construction, or underpinning to strengthen existing ones.

Using in-house design capabilities, we are able to develop site-specific solutions for all types of building projects, from the smallest residential development to the tallest high-rise commercial building. We use a many of techniques and a vast range of specialised equipment to deliver foundation solutions to specific budgets, on programme and to the required quality standards in a safe and efficient manner. Our range of techniques include: **Bored Piling; Prebored H Piling; Restricted access mini piling; Anchors; Diaphragm Walls and Friction Barrettes.** Whether you are building a commercial or residential tower, or are digging underground to create a basement or car park, our experience in construction techniques is unmatched, and will

provide the most effective support for your building project.

Intrafor also works directly with property developers as main contractor to undertake all their ground engineering work. We believe this to be beneficial, as appointing one contractor to handle all substructure packages reduces the risk factor on the project. Once all ground engineering and basement works are completed, the property developer can hand over the site to a building contractor, ready for construction works to begin without any potential risk to the client. This process can also fast-track development as the start of works can be delinked from detailed superstructure design and planning.

Hong Kong landmarks founded on Intrafor’s expertise include Asia World Expo and the International Commerce Centre (ICC), a 118-storey commercial skyscraper and the tallest building in Hong Kong.

We have completed a wide variety of works for the leisure, residential and commercial sectors. Previous projects include, Corniche Hotel and Eastern Mangrove in Abu Dhabi, St Theresa Hospital and One Pacific Centre in Hong Kong.



Top | Asia World Expo - Hong Kong
Bottom left | Friction barrettes and diaphragm wall at ICC Tower - Hong Kong
Bottom right | Underground car park

Buildings



Hong Kong ICC Tower



Port of Pusan - South Korea

Ground Improvement

Intrafor has many years of experience in ground improvement techniques for all applications. We can provide solutions to soil improvement or grouting problems in almost any situation, regardless of the size of the project or the ground conditions.

From sinkhole remediation to the mitigation of liquefaction potential, the field of grouting and ground improvement encompasses a diverse range of subsurface conditions and an equally diverse range of treatment methodology. Our expertise spans a wide variety of techniques including **Vibro Compaction; Stone Columns; Jet Grouting; Ground Freezing; Permeation or Rock Grouting** to name a few.

Intrafor's innovative ground improvement techniques not only deliver a more optimal engineering design, but can also provide a more cost-effective solution.

These techniques are used to form a variety of structures including:
Power Stations / Oil and Gas tanks or processing plants / Residential and Industrial developments / Ports and Harbours / Reclamation sites / Tunneling.

With state-of-the-art equipment and in-depth expertise, Intrafor has the capability to handle any ground improvement project from emergency response water control grouting to large-scale foundation soil treatment.

In recent years, Intrafor has worked on major ground improvement projects in the Middle East including Ghantoot Naval base, Integrated Gas development DAS island or Marina Power Station in U.A.E. We have also carried out extensive grouting and ground freezing works on various tunneling projects in Hong Kong such as Express Rail Link, Lok Ma Chau Spur Lines tunnels and West Island Lines Tunnels.



Top left | Penny's Bay reclamation - Hong Kong
Top right | Automated grouting plant
Bottom right | Vibro compaction works on DAS Island - Abu Dhabi





Intrafor is a leading directional drilling and geotechnical specialist. We are masters of a wide range of techniques in fields such as ground investigation, soil improvement and trenchless construction, meaning that we can bring our expertise to all stages of a project.

Besides the more traditional soil investigation carried out vertically, Intrafor is now also leader in the field of directional coring. Intrafor has developed its own drilling tools through its research and development programme allowing sub-horizontal directional coring to be carried out in order to extract high quality soil information all along the entire planned route of a tunnel.

This innovative technology ensures that geological conditions are fully understood before the tunnelling process begins, and that problems can be anticipated before they hinder the project.

Intrafor has contributed to Geotechnical Investigation for projects such as in Hong Kong: Eagle Nest Route 9, Drainage Service Department West Drainage Tunnel and the CLP Castle Peak Cable Tunnel. Our ground investigation capabilities also encompass land and marine Cone Penetration Tests (CPTs), downhole in-situ testing including impression packer, water inflow, water absorption and Goodman Jack techniques, Standard Penetration Tests (SPT), vibro-coring and the installation of geotechnical instrumentation.

Using our specialist drilling techniques, we have also taken part in a wide variety of projects, such as underwater pipeline construction for the installation of electrical cables; installation of UPVC pipes to allow ground improvement by soil freezing for infrastructure works; and carrying out horizontal directional pipe piling for the construction of box jacked tunnels.



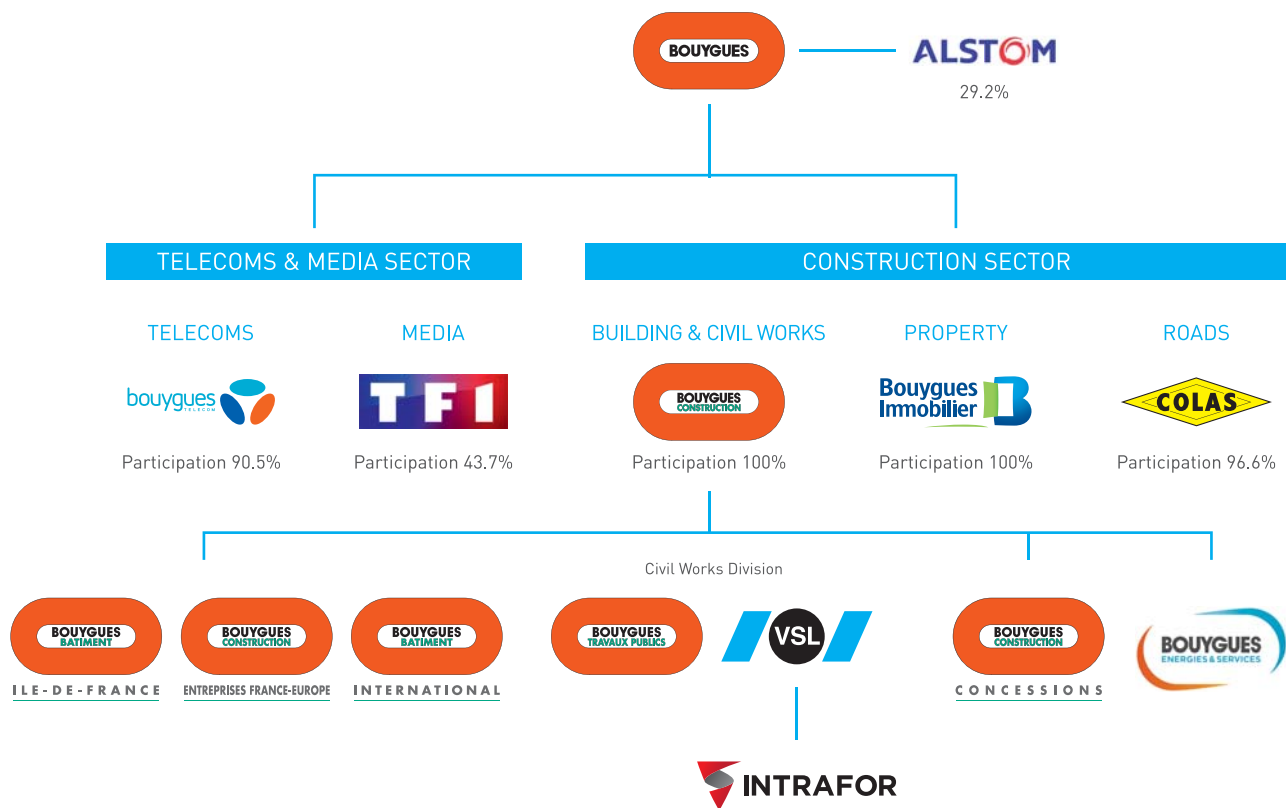
Intrafor has extensive experience in directional coring and directional drilling. Most recently we have completed the installation of 900m long, 600mm diameter outfalls underneath the seabed at Hong Kong's Lamma Island (bottom left).



Drilling & Geotechnical Services



Express Rail Link Project – Hong Kong



Headquarters

Intrafor Hong Kong Ltd
20/F., Eight Commercial Tower
8 Sun Yip Street, Chai Wan,
Hong Kong
Tel: +852 2590 2288
Fax: +852 2590 0290
Email: northasia@vsl-intrafor.com

Principal Offices

VSL International Limited
Wankdorfallee 5
CH - 3014 Bern
Switzerland
Tel: +41 58456 3000
Fax: +41 58456 3055

South East Asia
VSL Singapore Pte Ltd
Tel: +65 6559 1222
Fax: +65 6257 7751

Middle East
Intrafor Hong Kong Limited
(Dubai Branch)
Tel: +971 4 885 7225
Fax: +971 4 885 7226

Australia & New Zealand
VSL – Intrafor Australia – NZ
Tel: +61 2 9484 5944
Fax: +61 2 9875 3894

Also present around the world through VSL local offices.
See websites for details.

www.vsl.com
www.intrafor.com

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