



# **OPTIMAL**

FOUNDATIONS





1  
2  
3  
4  
7  
10

About Keller Group

About Keller in ASEAN

Our people and safety

Geotechnical Solutions

Our projects in ASEAN

Why Keller

# CONTENTS

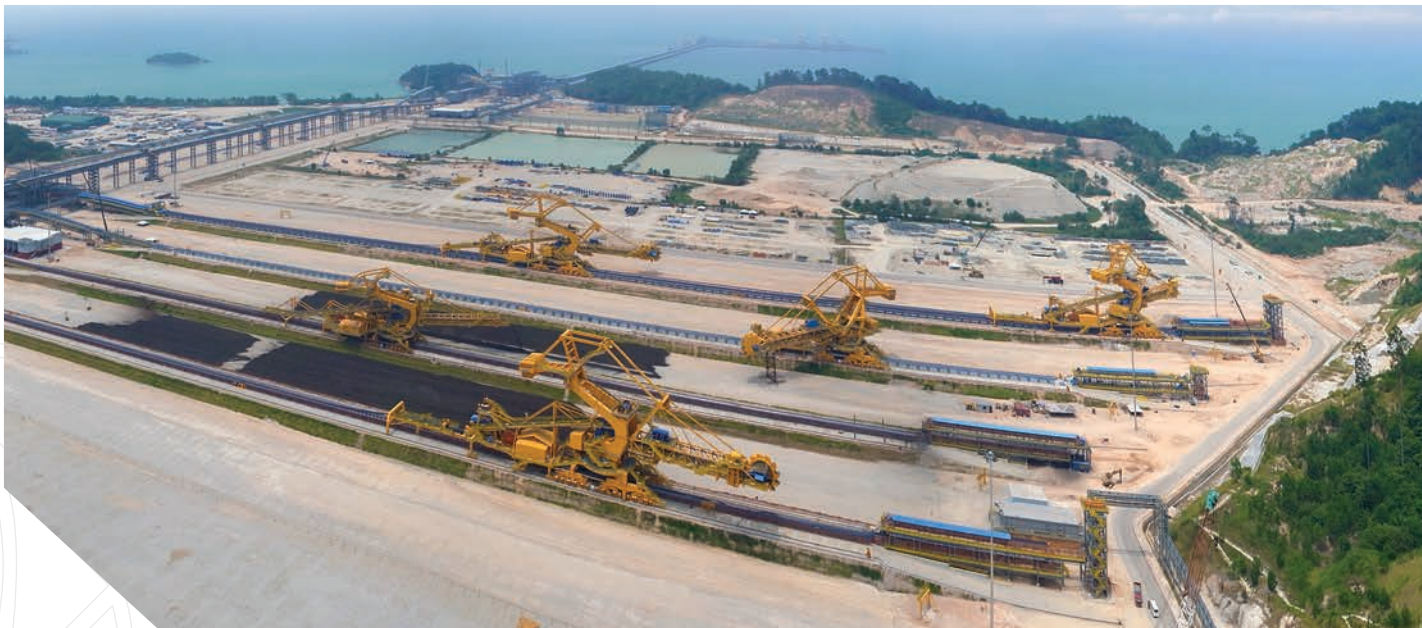
## About Keller Group

Keller Group is the world's largest independent ground engineering specialist. With 150 years of service to the construction industry, the group has around 10,000 employees worldwide and offices in over 40 countries. Keller is renowned for providing a full range of technically advanced and cost-effective foundation solutions across the entire construction spectrum. Sectors we serve include infrastructure, industrial, commercial, residential and environmental. The Keller group has a strong profile in Asia and the Middle East, unrivalled coverage in Europe, North America and Australia and a growing presence in Africa.

Keller's global scale means that we are equipped with the financial strength, know-how and capacity to handle the largest and most complex projects around the world. Keller's local focus means that we can also respond quickly to our many customers and can handle smaller projects with ease.



*Punggol Waterway, Singapore*



*Vale Iron Ore Facility, Malaysia*

## Keller in ASEAN

*Innovative . Experienced . Full Service . Safe*



*Biodiesel Plant, Singapore*

In ASEAN, Keller has local offices with experienced design and construction personnel on board. We have a wide range of specialized rigs, equipment and tools. As part of the Keller Group, we have access to global expertise and resources. These capabilities enable us to provide cost effective, fit-for-purpose geotechnical solutions across different market sectors.



*Over the years, we provided geotechnical solutions for various projects across Asia including:*

- Bored Piles for Singapore's Gardens by the Bay
- Vibro Compaction and Prefabricated Vertical Drains for a ship hull block facility in Tuas, Singapore
- Soil Nailing, Bored Piles and Ground Anchors for Mediapolis business park, Singapore
- Driven Piles, Deep Soil Mixing, Jet Grouting and Vibro Stone Columns for a power plant in Port Dickson, Malaysia
- EPC & Project Management for a dockyard expansion in Sarawak, Malaysia
- Driven Piles and Civil Works for a petrochemical complex in Johor, Malaysia
- Vibro Stone Columns for a petrochemical refinery complex in Than Hoa province, Vietnam
- Bored Piles for Ciputra World Surabaya in Indonesia
- Vibro Stone Columns for Hong Kong Link Road

In ASEAN, Keller combines geotechnical design and construction experience with our core products in ground improvement and heavy foundations. Since the 1970's we have built a strong presence in Singapore, Malaysia and Indonesia providing heavy foundations, ground improvement, specialist grouting and earth retention systems. We also have a growing presence in Vietnam, Hong Kong and the Philippines.

Over the years, targeted acquisitions have added capability and experience to the Keller Group.

In 1998, Frankipile Indonesia, a reputed bored and driven piling contractor joined the Group.

In 2009, Keller Group acquired Resource Piling, a premier bored piling contractor in Singapore.

In 2014, one of Malaysia's most experienced driven piling contractors AnsaH, became part of the Keller Group.

**Keller** has proved to be **a vital partner** in solving geotechnical problems for large and small projects



## Our People

Keller has over 800 skilled and experienced people in ASEAN. They are individuals from different nationalities, ethnicities, cultures and backgrounds. We are committed to delivering excellent foundation solutions and services for our customers, where safety is the highest priority.

We encourage pooling of expertise and transfer of best practices in order to broaden our experiences and strengthen our skills. Our connection with the rest of the Keller group enables us to provide our customers the best possible solutions.

We are committed to the development and the growth of our people. We provide training and consistently support them in developing their potential. We recognise and respond to the needs of their jobs.

People are the fundamental asset of our organization. Through them, Keller has established a reputation of innovation and reliability.



*Keller civil works team for a large petrochemical project, Malaysia*

## Safety

Safety is a significant part of how we work. At Keller, we hold our managers and supervisors accountable for the safety of our people. We expect them to demonstrate effective leadership in safety. However, all employees are responsible for preventing and correcting unsafe behaviour or work conditions. We are also committed to comply with local regulations where we operate, and to international practices wherever practicable.

We firmly believe that all accidents are preventable. Therefore, we endeavour to identify, assess and manage risks prior to starting work. Our workplaces are regularly checked to better understand work practices and come up with more effective ways of managing risks. Accidents and potential near misses are investigated to determine root causes and we take necessary steps to prevent recurrence.

Our aim is to create permanent behaviour change through awareness building. We want to develop a proactive approach towards safety.

We are committed to the group's "Think Safe" program. We strive to maintain and continually improve our health and safety standards to reach our ultimate safety goal of Zero Injuries in all our operations.



*Singapore Safety Day*



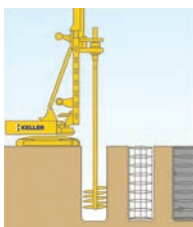
## Geotechnical Solutions

Keller delivers a broad range of cost-effective and fit-for-purpose geotechnical solutions across the construction spectrum.



### Soil Investigation

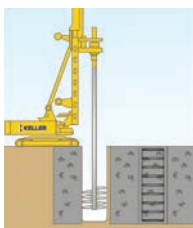
Soil investigation is a crucial step in all construction activity. Two popular soil investigation techniques are the drilling of boreholes and conducting cone penetration tests. Boreholes allow a variety of in-situ tests to be performed (for example standard penetration tests and vane shear tests) and for samples to be retrieved and sent for laboratory testing. Cone penetration tests involve pushing an instrumented cone into the ground for classifying soil and determining engineering parameters.



### Piling

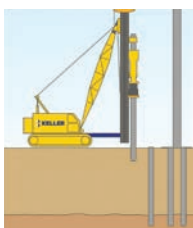
#### Bored Piling

Bored Piling is a method that involves boring a circular hole into the ground, installing steel reinforcement and filling the bored circular hole with concrete to form a pile. Bored pile foundations are suitable for all types of soil conditions and compared with conventional driven piling methods, bored piling activities generate less noise and vibration.



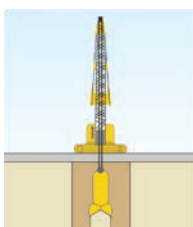
#### Contiguous Bored Piles and Secant Piles

A Contiguous Bored Pile wall is an earth retention system formed by installing closely spaced Bored piles, with a small gap between adjacent piles. In contrast, a Secant Pile wall is an earth retention system formed by installing overlapping Bored piles. These walls are cantilevered or with a variety of supports (ground anchors, walers & struts, etc.). Secant Piles are usually selected where there are particular concerns about groundwater inflow, i.e. where there is a high groundwater table and permeable soils.



#### Driven Piles

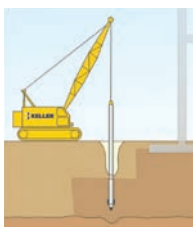
Driven Piles include precast concrete piles, steel piles, high strength concrete spun piles and "mini" triangular concrete piles. A special type of driven pile is the iconic Franki pile, an enlarged base, driven cast in-situ pile.



### Diaphragm Walls (D Walls)

D Walls are constructed using grabs or cutters to create a narrow trench excavation into the ground. The trench is supported by an engineered slurry. Many D Walls use reinforced concrete, though unreinforced walls are also used. Joints in adjacent panels are formed using either an over-cut technique or via temporary stop-ends.

### Deep Vibro Techniques



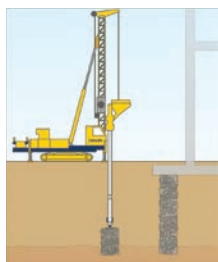
Deep Vibro Techniques is the name given to a versatile group of ground improvement solutions. These methods are mainly used to increase bearing capacity, reduce settlements, stabilise slopes, and mitigate liquefaction. Powerful depth vibrators are used for these techniques.

#### Vibro Compaction

Vibro Compaction is a technique that compacts granular soils and rearranges the soil particles into a denser state. It is often used for land reclamation projects or natural sandy deposits.

### **Vibro Stone Columns (Vibro Replacement)**

Vibro Stone Columns (Vibro Replacement) are load bearing columns made from gravel or crushed stones, constructed in cohesive soils or granular soils with high fines content. The stone columns improve the shear strength and stiffness of the soil mass. This highly versatile method is often used for embankments, tanks, buildings, materials stockpiles, highway or railway constructions.



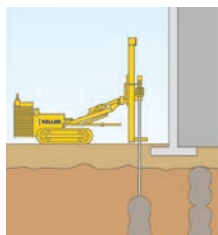
### **Vibro Concrete Columns**

Vibro Concrete Columns are high modulus concrete columns that transfer loads through weak strata. This technique is usually applied if the fine grained subsoil does not provide sufficient lateral support for conventional stone columns. Vibro concrete columns increase allowable bearing pressure and decrease settlements for buildings, embankments, tanks and other similar structures.

## **Specialist Grouting**

### **Compaction Grouting**

Compaction Grouting is a solution that can be applied in various fields such as soil improvement, stabilisation and rehabilitation of foundations, and cavity grouting. It can be used to improve both coarse-grained and fine-grained soils.



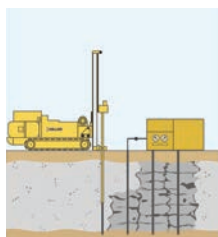
### **Soilcrete® Jet Grouting**

The Jet Grouting process, Soilcrete®, is used for stabilisation and sealing of all kinds of soils ranging from loose sediments to clay. The Soilcrete® process is often applied for tunnel protection, foundation restoration, dam sealing and groundwater barriers.



### **Permeation Grouting**

Permeation Grouting involves the low-pressure, controlled injection of a suspension into the soil mass, usually to reduce permeability. Depending on the soil, a variety of materials are injected, often through tube-a-manchettes (TAMs). For finer grained silts and sands, chemical grouts are used, while for sands and gravels, cement grouts are used.



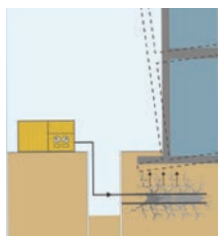
### **Rock Grouting**

Rock Grouting refers to the injection of a suspension (usually a cement grout) to seal fissures and channels within a rock mass. The borehole is often drilled into the rock using a down-the-hole hammer, with the grout delivered through a tube with a single packer. Grouting may be carried out "bottom up" (which is generally quicker) or "top down" (usually for fractured rock).



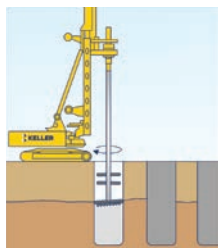
### **Soilfrac® Compensation Grouting**

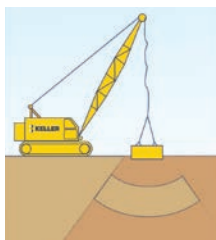
Soilfrac® is a process of controlled fracturing and grouting. Firstly, tube-a-manchettes (TAMs) are installed in the soil layer to be treated. A grout hose equipped with a double packer at the tip is then inserted into the TAM to allow the injection of the Soilfrac® suspension. Fractures in the soil are created which are filled with grout. This method is usually applied in foundation restoration and protection of structures against settlements.



## **Deep Soil Mixing**

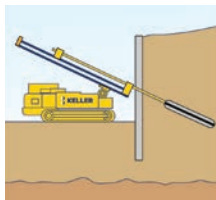
Deep Soil Mixing (DSM) is a method that achieves significant improvement of mechanical properties of the existing soil by mechanically mixing it with cement or compound binders. It is typically used for embankments on soft soils, foundation support, protection of excavation pits, stabilisation of slopes, and reduction of liquefaction potential.





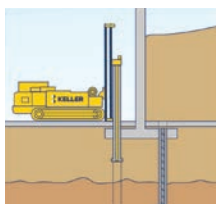
## Dynamic Compaction & Dynamic Replacement

Dynamic Compaction and Dynamic Replacement are ground improvement techniques that involve systematically dropping heavy pounders, typically 10 to 25 tons, from specially fitted crawler cranes. Dynamic compaction is applied to granular soils and for typical applications is effective to depths of 6 to 10 m. Dynamic replacement is a process of forming large diameter columns in clayey or silty soils, typically to depths of 5 to 6 m.

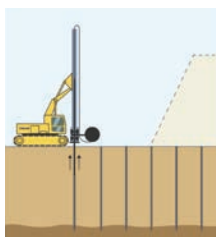


## Ground Anchors & Micropiles

Anchors are stabilization and support elements that transfer tension loads using high-strength steel bars or steel strand tendons. Ground anchors are typically used in deep excavation support systems, for dam stabilization or to resist uplift forces.

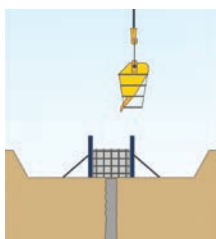


Micropiles are small diameter piles, up to 300 mm. These piles are usually heavily reinforced and carry high loads in spite of their small diameters. Typical applications include underpinning of existing structures and construction very close to existing buildings. Ground anchors and micropiles are installed with similar drill rigs.



## Prefabricated Vertical Drains

Prefabricated vertical drains (PVDs) are thin elements, typically 100 mm x 5 mm, made of a plastic core and geotextile filter. Using specialized rigs, PVDs are pushed deep into soft soils to aid in the dissipation of pore water pressures and hence acceleration of consolidation settlements. After installation of the PVDs, usually a soil surcharge (called preload) is placed over the area, and consolidation settlements monitored. It is also possible to apply a vacuum pressure to draw pore water out of the soil through the PVDs, in a method called vacuum consolidation.



## Foundation Civil Works

After the completion of pile installation or ground improvement, other foundation elements such as pile caps, base slabs, ground beams and load transfer platforms need to be constructed. These elements are needed to properly transmit the load from the superstructure to the foundations.



## Testing

Various tests are performed on piles and improved ground to ensure quality. On piles, static load tests, dynamic tests and pile integrity tests are often performed. For ground improvement an array of tests such as cone penetration tests, coring and unconfined compressive strength testing, plate load tests and water pressure tests are performed, depending on the ground improvement method employed.



## Monitoring

After the foundation is completed, the superstructure can be monitored during construction and during service life. Settlements, tilts, excess pore water pressures, soil movements and other parameters are often measured. This data is then meaningfully plotted and interpreted. In some cases such as Soilfrac® compensation grouting, real-time monitoring of the settlements is crucial to the success of the technique.



## Our Projects

Over the years, Keller has provided geotechnical solutions for large and small projects across Asia. Our global connections give us a broad knowledge base and access to specialized equipment, and our local presence enables us to respond quickly to our customers' needs.

*This page features projects performed by Keller companies in ASEAN in recent years.*

### Coal-Fired Power Plant, Malaysia Deep Soil Mixing, Vibro Stone Columns, Jet Grouting, Driven Piling



At Port Dickson, Malaysia, a 2x1000MW coal-fired power plant is being developed to increase the power supply in Malaysia by 2020. Keller, in collaboration with Ansh Asia, delivered a range of geotechnical solutions- Driven Piling, Deep Soil Mixing, Jet Grouting and Vibro Stone Columns to support various structures of the power plant.

### Ship Hull Block, Singapore Vibro Compaction, Prefabricated Vertical Drain



Working directly for the owner, Keller designed and executed a ground improvement scheme for a hull block workshop in Tuas, Singapore. Vibro Compaction was carried out and Prefabricated Vertical Drains were installed to improve the subsoil for a 126,000 square meter ship hull block fabrication facility.

### Business Park, Singapore Piling, Ground Anchors, Soil Nailing, Shotcrete



Keller, working together with Resource Piling, installed Foundation Bored Piles, Secant Bored Piles and Ground Anchors and carried out Soil Nailing and Shotcrete works for the foundations of an 11-storey commercial building in Singapore. Close collaboration and communication with our client enabled us to respond quickly to different site challenges and complete the work ahead of project schedule.

### Land Preparation for Airport Expansion, Singapore Vibro Compaction



Keller is involved in the expansion project of Singapore Changi Airport Terminal Five, compacting 33 million cubic meters of sand. A telescopic Vibro compaction rig was used in areas with air height restriction. This project once again proves Keller's strength in innovative technologies and our extensive experience working in an active airport environment.

### Retaining System for Mass Rapid Transit Station, Malaysia Deep Soil Mixing, Curtain Grouting, Secant Bored Pile



Keller is involved in the development of an underground Mass Rapid Transit Station at Chan Sow Lin, Malaysia. We provided a Geotechnical solution package for a retaining system consisting of Deep Soil Mixing, Curtain Grouting and Secant Bored Piles. In spite of the complexity of the job, our skillful project management enabled us to deliver the work efficiently and safely.

### Petrochemical Complex, Malaysia Driven Piling, Civil Works



Keller, in collaboration with Ansh Asia installed over 36,700 pre cast Spun Piles of various diameters and performed various foundation civil works for the development of a large petrochemical project in South East Johor, Malaysia. This was also Keller's largest Civil Works contract by far. We brought together a multi-national and a multi-skilled team, to deliver the project to the satisfaction of the customer and the owner.

**Ground Improvement for  
Expressway, Malaysia**  
Vibro Stone Columns



On a very deep, soft alluvium soil, Keller installed Vibro Stone Columns for a road embankment in Klang, Malaysia. In spite of challenging ground condition, our team completed the work with an excellent safety performance.

**Intervention Shaft 2, Malaysia**  
Deep Soil Mixing, Rock Fissure Grouting



For Malaysia's Klang Valley Mass Rapid Transit 2 project, Keller provided a more efficient alternative solution using Deep Soil Mixing for the retaining wall of intervention shaft 2. Rock Fissure Grouting work was also carried out in this project.

**Gardens by the Bay, Singapore**  
Piling



A one of a kind attraction in Singapore, Gardens by the Bay is made up of 50m tall illuminated supertrees, skywalks, water features, and conservatory domes. Resource Piling, installed over 1,500 piles with diameters up to 1,800mm for various structures of this attraction. These include the supertrees, the conservatories and the waterfront promenade.

**Link Road, Hong Kong**  
Vibro Stone Columns



The Hong Kong Link Road project comprises of sea viaducts in the Western waters of Hong Kong, tunnels through scenic hills and underneath the Airport Road and Airport Express Line, and at-grade roads on reclamation along the East-coast of airport island. 200,000 linear meters of Vibro Stone Columns were installed in this project, some under air height restrictions because of the nearby airport.

**Petrochemical Refinery Complex,  
Vietnam**  
Vibro Stone Columns



Nghi Son petrochemical refinery complex situated in Thanh Hoa province is the country's second refinery and the largest project so far. Keller constructed Stone Columns to treat the area approximately 50,000 square meters. Using Keller's bottom-feed method, over 100,000 linear meters of Vibro Stone Columns were installed to depths of 18m, supporting 12 tanks up to 90m in diameter and 19.9m in height.

**Commercial Building, Indonesia**  
Piling



Strategically located at the new central business district in Surabaya, Indonesia, Ciputra World Surabaya is a premier workplace and a lifestyle centre. Frankipile Indonesia installed Foundation Bored Piles and Secant Pile Walls at the 1 hectare site.

## Why Keller?

### RELIABILITY

Keller possesses decades of experience building foundations for different types of structures, in various ground conditions, all over the world. This helps us to deliver safe and reliable geotechnical solutions to our customers today, no matter how challenging the conditions.



*Vibro Compaction works for an airfield development, Singapore*

### INNOVATION

We invest in the development of new techniques, equipment and design methods in order to come up with innovative geotechnical solutions. We are able to transfer this know-how across the world to deliver the best possible solutions for our customers.

### PROJECT DELIVERY

Our global scale gives us the financial strength, know-how and capacity to tackle the largest and most complex of projects. Yet our regional focus means that we are familiar with local conditions and are able to deliver smaller projects efficiently.



*Diaphragm Wall for the intervention shaft and the crossover of Mass Rapid Transit 2 project, Malaysia*

### COST

Our design and build capabilities, local knowledge and broad range of techniques enable us to offer cost-effective, full-packaged solutions in different market sectors.

### SAFETY

The safety of the workforce is a priority for us and for our customers. Keller seeks to deliver projects safely, using the "Think Safe" framework as our guide. We recognise that safety is a continuing journey, and endeavour to improve our safety standards to reach our ultimate goal of Zero Injuries.

### Headquarters

#### **Keller Group plc**

5th Floor, 1 Sheldon Square,  
London W26TT  
Tel: +44 020 7616 7575  
Email: [info@keller.com](mailto:info@keller.com)  
Web: [www.keller.com](http://www.keller.com)

#### **Keller AsiaPacific Limited**

72 Anson Road #11-03  
Anson House, Singapore 079911  
Tel: +65 6443 6730  
Web: [www.keller.com](http://www.keller.com)

### Singapore

#### **Keller Foundations (S E Asia) Pte Ltd**

18 Boon Lay Way, #04-104 Tradehub 21  
Singapore 609966  
Tel: +65 6316 8500  
Fax: +65 6316 8652  
Email: [info@kellersing.com.sg](mailto:info@kellersing.com.sg)  
Web: [www.kellerasean.com](http://www.kellerasean.com)

#### **Resource Piling Pte Ltd**

18 Boon Lay Way #04-113 Tradehub 21  
Singapore 609966  
Tel: +65 6382 3400  
Fax: +65 6281 7720  
Email: [info@resource-piling.com.sg](mailto:info@resource-piling.com.sg)  
Web: [www.resource-piling.com.sg](http://www.resource-piling.com.sg)

### Indonesia

#### **Keller Foundations (S E Asia) Pte Ltd**

Pusat Perkantoran Graha Kencana Blok EK  
Jalan Raya Perjuangan No. 88, Kebon Jeruk  
Jakarta Barat 11530, Indonesia  
Tel: +62 21 5325 986  
Email: [info@kellersing.com.sg](mailto:info@kellersing.com.sg)  
Web: [www.kellerasean.com](http://www.kellerasean.com)

#### **PT. Frankipile Indonesia**

Pusat Perkantoran Graha Kencana Blok EK  
Jalan Raya Perjuangan No. 88, Kebon Jeruk  
Jakarta Barat 11530, Indonesia  
Tel: +62 21 5366 0778  
Fax: +62 21 5366 0779  
Email: [franki@indo.net.id](mailto:franki@indo.net.id)  
Web: [www.frankipile.co.id](http://www.frankipile.co.id)

### Vietnam

#### **Keller Foundations Vietnam Co., Ltd**

2nd Floor, Van Loi Building  
24 Dang Thai Mai  
Phu Nhuan District  
Ho Chi Minh City, Vietnam  
Tel: + 84 28 3551 5022  
Fax: + 84 28 3551 5023  
Email: [loi.cao@keller.com.vn](mailto:loi.cao@keller.com.vn)  
Web: [www.kellerasean.com](http://www.kellerasean.com)

### Malaysia

#### **Keller (M) Sdn. Bhd.**

Kuala Lumpur  
B5-10 Block B Plaza Dwtasik  
Bandar Sri Permaisuri  
56000, Kuala Lumpur, Malaysia  
Tel: +60 3 9173 3196  
Fax: +60 3 9173 3196  
Email: [info@keller.com.my](mailto:info@keller.com.my)  
Web: [www.kellerasean.com](http://www.kellerasean.com)

#### Johor Bahru

Wisma SP Setia, No. 05-23, Jalan Indah 15  
Taman Bukit Indah 81200, Johor Bahru  
Malaysia  
Tel: +60 7 239 5294 or +60 7 239 5284  
Fax: +60 7 239 5354  
Email: [info@keller.com.my](mailto:info@keller.com.my)  
Web: [www.kellerasean.com](http://www.kellerasean.com)

#### Kuching

No. 437, 1st Floor, Lot 14659  
Height Drive Commercial Centre  
Jalan Stutong, 93350 Kuching  
Sarawak  
Tel: +60 82 450 231  
Fax: +60 82 456 006  
Email: [info@keller.com.my](mailto:info@keller.com.my)  
Web: [www.kellerasean.com](http://www.kellerasean.com)

#### **Resource Piling (M) Sdn. Bhd.**

Wisma SP Setia, No. 05-23, Jalan Indah 15  
Taman Bukit Indah 81200 Johor Bahru  
Malaysia  
Tel: +60 7 239 5294 or +60 7 239 5284  
Fax: +60 7 239 5354  
Email: [info@resource-piling.com.sg](mailto:info@resource-piling.com.sg)  
Web: [www.resource-piling.com.sg](http://www.resource-piling.com.sg)

#### **Ansah Asia Sdn. Bhd.**

B5-10 Block B Plaza Dwtasik  
Bandar Sri Permaisuri  
56000, Kuala Lumpur, Malaysia  
Tel: +60 3 9171 2058  
Fax: +60 3 9173 4727  
Email: [info@ansahasia.com.my](mailto:info@ansahasia.com.my)  
Web: [www.kellerasean.com](http://www.kellerasean.com)

### Hong Kong

#### **Keller Foundations (S E Asia) Pte Ltd**

Unit A, 27/F Billion Plaza II  
10 Cheung Yue Street, Cheung Sha Wan  
Kowloon, Hong Kong  
Tel: +852 3959 3353  
Fax: +852 3584 7990  
Email: [info\\_hk@kellersing.com.sg](mailto:info_hk@kellersing.com.sg)  
Web: [www.kellerasean.com](http://www.kellerasean.com)