Preface

It is my great pleasure to present herein the results of the recent international activities of the Japanese Geotechnical Society (JGS). You can find here the first release of the English translation of a variety of JGS technical regulations and more will follow later. These regulations address the fundamental elements of construction practice through establishing a systematic approach from soil investigation to design analysis and performance prediction.

It is well known that the success of construction practice depends on the quality of material tests, field investigation, and design calculation that have been validated through many experiences. Those methodologies are specified by codes. In case that field investigation is carried out in a wrong way, the obtained data does not suit the design calculation. Because of the strong interdependence between practice and code, construction projects should employ both practical technologies and related codes in an assembled body. To facilitate this, JGS is now translating its codes.

As the Vice President for Asia of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), the natural conditions in Asia are very difficult as exemplified by many severe natural disasters and very thick soft clay deposits in river deltas. Typhoons/cyclones provide a huge amount of precipitation in many parts of Asia and increase the amount of river sedimentation. Thus, tens of meters of very soft deposit is encountered. It is very meaningful for Asian engineers to develop a system of construction practice that suits this difficult natural conditions. The first step toward this goal is the development of a new code in which natural conditions in Asia and even past experiences are taken into account. Because the JGS codes have been developed under the natural environment in Asia, they can provide Asian engineers a starting platform for better Asian codes.

Nothing is perfect in this world. For example, many criticisms are made against uncertainties involved in Standard Penetration Tests (SPT). However, SPT provides us with specimens of subsoils for direct inspection. Moreover, many practical formulae rely on correlation with SPT data. Therefore, it is more meaningful to improve the details of SPT practice and stablish a code for SPT rather than discarding SPT as a non-standardized penetration test. Thus, it is important for all practitioners to make efforts to establish new codes. The provided JGS code can be a good starting point for this.

I would cordially invite you all to pay attention to this code to get a better scope on soil mechanics and geotechnical engineering.

Best wishes

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Japanese Geotechnical Society Standards
－Laboratory Testing Standards of Geomaterials－

1 Procedure for Translating Standards into English

This document contains the laboratory test standards of the Japanese Geotechnical Society (JGS). The work of translating the standards into English is scheduled to take about 3 years from 2014. The English language standards are scheduled to be published in 3 separate volumes (Vol. 1 to Vol. 3) in order of priority of those standards most frequently used by practitioners. This is because we want to provide engineers with these Japanese laboratory standards as soon as possible to enable them to understand and refer to Japanese test equipment together with Japanese test standards. We feel that by translating into English the technical test standards that are used by Japanese engineers every day, the standards will be more meaningful tests.

The following tables show all of the laboratory test standards produced by JGS. This table of standards shows the order of publication according to the color of the standard. The standards shown in white characters against a colored background are standards that will be published in 2015 (Vol. 1). The standards with a shaded background will be published in the second round (Vol. 2), and the standards with no color will be published in the third round (Vol. 3). By publishing in English the JGS standards that are most frequently used by engineers, engineers will be able to easily refer to these test standards in the course of their work.

The Japanese Geotechnical Society has cultivated specialist engineers, scholars, and researchers for over more than 60 years. the laboratory test standards produced by the Society incorporate much of the know-how that has matured over this long period. By carrying out laboratory tests, design, and research with these standards by your side, the Japanese Geotechnical Society hopes that you will be able to contribute to the development of engineering and the economic development of your country.

Table 1 List of laboratory test standards part 1

Dark grey	Standards published in the first round (Vol. 1)
Light grey	Standards published in the second round (Vol. 2)
White	Standards published in the third round (Vol. 3)

Classification	Title	JGS Number	JIS Number	Vol.
Sample preparation	Practice for preparing disturbed soil samples for soil testing	JGS 0101	JIS A1201	1
	Practice for handling undisturbed samples for laboratory testing to determine mechanical properties of cohesive soils	JGS 0102		1
Classification of geomaterials	Method of classification of geomaterials for engineering purposes	JGS 0051		1
Tests for physical properties	Test method for density of soil particles	JGS 0111	JIS A1202	1
	Test method for water content of soils	JGS 0121	JIS A1203	1
	Test method for water content of soils by the microwave oven	JGS 0122		2
	Test method for water content of rocks	JGS 2134		3
	Test method for particle size distribution of soils	JGS 0131	JIS A1204	1
	Test method for particle size distribution of rock	JGS 0132		2
	Material test method for fine fraction content of soils	JGS 0135	JIS A1223	3
	Test method for liquid limit and plastic limit of soils	JGS 0141	JIS A1205	1
	Test method for liquid limit of soils by the fall cone	JGS 0142		3
	Test method for shrinkage parameters of soils	JGS 0145	JIS A1209	3
	Test method for water retentivity of soils	JGS 0151		3
	Test method for minimum and maximum densities of sands	JGS 0161	JIS A1224	1
	Test method for minimum and maximum densities of gravels	JGS 0162		3
	Test method for frost heave prediction of soils	JGS 0171		3
	Test method for frost susceptibility of soils	JGS 0172		3
	Test method for bulk density of soils	JGS 0191	JIS A1225	1
	Method for laboratory measurement of ultrasonic wave velocity of rock by pulse test	JGS 2110		3
	Test method for axial swelling strain and axial swelling stress of rocks	JGS 2121		2
	Method for rock slaking test	JGS 2124		1
	Method for accelerated rock slaking test	JGS 2125		1
	Test method for bulk density of rock	JGS 2132		2
Tests for chemical properties	Test method for ph of suspended soils	JGS 0211		3
	Test method for electric conductivity of suspended soils	JGS 0212		3
	Test method for ignition loss of soils	JGS 0221	JIS A1226	1
	Test method for organic carbon content of soils	JGS 0231		3
	Test method for water-soluble components of soils	JGS 0241		3
	Practice for preparing samples for identifying clay minerals in soils	JGS 0251		3
	Determination of cation exchange capacity	JGS 0261		3
Tests for permeability and consolidation properties	Test methods for permeability of saturated soils	JGS 0311	JIS A1218	1
	Test method for one-dimensional consolidation properties of soils using incremental loading	JGS 0411	JIS A1217	1
	Test method for one-dimensional consolidation properties of soils using constant rate of strain loading	JGS 0412	JIS A1227	3

Table 2 List of laboratory test standards part 2

(dark grey)	Standards published in the first round (Vol. 1)
(grey)	Standards published in the second round (Vol. 2)
(white)	Standards published in the third round (Vol. 3)

Classification	Title	JGS Number	JIS Number	Vol.
Tests for mechanical properties	Method for unconfined compression test of soils	JGS 0511	JIS A1216	1
	Preparation of soil specimens for triaxial tests	JGS 0520		1
	Method for unconsolidated-undrained triaxial compression test on soils	JGS 0521		1
	Method for consolidated-undrained triaxial compression test on soils	JGS 0522		1
	Method for consolidated-undrained triaxial compression test on soils with pore water pressure measurements	JGS 0523		1
	Method for consolidated-drained triaxial compression test on soils	JGS 0524		1
	Method for k0 consolidated-undrained triaxial compression test on soils with pore water pressure measurements	JGS 0525		2
	Method for k0 consolidated-undrained triaxial extension test on soils with pore water pressure measurements	JGS 0526		2
	Method for triaxial compression test on unsaturated soils	JGS 0527		2
	Preparation of specimens of coarse granular materials for triaxial tests	JGS 0530		1
	Method for cyclic undrained triaxial test on soils	JGS 0541		2
	Method for cyclic triaxial test to determine deformation properties of geomaterials	JGS 0542		2
	Method for cyclic torsional shear test on hollow cylindrical specimens to determine deformation properties of soils	JGS 0543		3
	Practice for preparing hollow cylindrical specimens of soils for torsional shear test	JGS 0550		3
	Method for torsional shear test on hollow cylindrical specimens of soils	JGS 0551		3
	Method for consolidated constant-volume direct box shear test on soils	JGS 0560		1
	Method for consolidated constant-pressure direct box shear test on soils	JGS 0561		1
	Method for unconfined compression test on rocks	JGS 2521		1
	Method for unconsolidated-undrained triaxial compression test on rocks	JGS 2531		2
	Method for consolidated-undrained triaxial compression test on soft rocks	JGS 2532		2
	Method for consolidated-undrained triaxial compression test on soft rocks with pore water pressure measurements	JGS 2533		2
	Method for consolidated-drained triaxial compression test on rocks	JGS 2534		2
	Method for direct shear test on a rock discontinuity	JGS 2541		2
	Method for splitting tensile strength test on rocks	JGS 2551		2
Tests on stabilized soils	Test method for soil compaction using a rammer	JGS 0711	JIS A1210	1
	Test method for cone index of compacted soils	JGS 0716	JIS A1228	1
	Test method for the california bearing ratio（cbr）of soils in laboratory	JGS 0721	JIS A1211	2
	Practice for making and curing compacted stabilized soil specimens using a rammer	JGS 0811		2
	Practice for making and curing statically compacted stabilized soil specimens	JGS 0812		2
	practice for making and curing stabilized soil specimens without compaction	JGS 0821		2
	practice for making and curing chemically grouted soil specimens	JGS 0831		2
Tests on geosynthetics	Procedure for characteristic opening size test of geotextiles （wet sieving）	JGS 0911		3
	Determination of water permeability characteristics normal to the plane for geotextile and related products	JGS 0931		3
	Determination of water flow capacity in their plane for geotextile and related products	JGS 0932		3
	Direct shear test for geosynthetics	JGS 0941		3
	Pull out test of geosynthetics in soil	JGS 0942		3
Proving ring for soil testing	Standard for proving ring for soil testing	JGS 0004		3

2 JGS and JIS Numbers

Each of the test standards in this list is a test standard produced by the Japanese Geotechnical Society. Each standard has JGS in front of a number. The JIS that is written with each of the JGS numbers is an abbreviation for “Japanese Industrial Standard.” Japanese Industrial Standards are recognized by the Japanese Ministry of Economy, Trade and Industry of Japan and are based on the JGS standard. In these standards, each test standard number is given a JGS number and also a matching JIS number. This means that the standard produced by the Japanese Geotechnical Society is a Japanese standard. This is sufficient for users to understand. In practice either number may be used.

3 Sponsors of the Translation of the Standards into English

The English language versions of these standards have been produced through donations from Japanese construction companies, design consultants, and testing organizations. The Japanese Geotechnical Society expresses its heartfelt thanks to each company that has made a donation.

An advertisement for each company that has made a donation will be published at the end of the standards. We would be pleased if you would refer to the advertisements when using these test standards and use the advertised products and services in your work.

Laboratory Testing Standards of Geomaterials

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Japanese Geotechnical Society Standard (JGS 0101-2009)
Practice for preparing disturbed soil samples for soil testing

1 Scope

This standard specifies a method for preparing disturbed soil samples with a particle size below 75 mm for soil testing.

2 Normative references

The following standards shall constitute a part of this standard by virtue of being referenced herein. The latest versions of these standards shall apply (including supplements).

JIS Z 8801-1 Test sieves – Part 1: Test sieves of metal wire cloth

JIS A 1203 Test method for water content of soils

3 Terms and definitions

The terms and definitions used in this standard are as follows:

3.1 Preparation of samples

Sample preparation includes the splitting of samples, control of the water content, and mechanical regulation of particle size.

4 Equipment

The required test apparatus is as follows:

a) Balance: capable of measuring to an accuracy of about 0.1 % relative to the mass being measured.

b) Sieves: metal wire cloth sieves as stipulated in JIS Z 8801-1.

c) Soil loosening equipment: mortar and pestle or other tool suited to loosening soil masses without damaging the soil particles.

d) Rubber spatula

e) Constant-temperature drying oven: as stipulated in JIS A 1203.

f) Desiccator: as stipulated in JIS A 1203.

5 Splitting of sample

5.1 Splitting method

To split a required amount of soil for the test from a collected sample, the quartering method shall be used in principle. The procedure of the quartering method is shown in Fig. 1.

Remark 1: A sample splitter may be used in place of the quartering method.

Remark 2: When a collected sample can be considered a representative sample in itself, the quartering method may be omitted.

5.2 Amount to split

The amount of soil split for use in testing shall be the minimum sample mass specified for each testing method plus an appropriate allowance.

Remark: The size of the soil sample required for each test depends on the purpose of the test, the number of pieces to be tested, the particle size of the soil, the water content, etc. Tables 1 (a) and (b) provide guidance for approximate sample sizes to be obtained by splitting for various tests.

Note 1 The sample amounts given above are sample masses in wet conditions or after air-drying.

Note 2 To ensure multiple tests are carried out under identical conditions, the above amounts shall be multiplied by the number of samples required for all the tests to determine the amount to be split.

Note 3 The number of sets refers the number of separate specimens required per test.

6 Control of water content of samples

6.1 General

Soil collected from site shall be controlled to prepare a sample with the appropriate water content using one of the following methods according to the soil test method and soil type.

Note: The non-drying method shall be used for soils whose properties are significantly affected by drying. These include soils consisting of fragile particles, such as weathered gravel or seashells; moist cohesive soils (particularly volcanic cohesive soils); soils containing allophane, hydrated halloysite, and other clay minerals; and organic soils. The air-drying method and oven-drying method shall be used for to soils whose properties remain almost unchanged when dried. These include coarse-grained soils with high gravel or sand fractions and cohesive soils that are very dry in-situ.

6.2 Non-drying method

Mix the soil well while maintaining the natural as-collected water content and split the required amount for the test by the quartering method described in Section 5. Mix the split soil sufficiently to ensure uniformity and store samples in a manner that ensures the water content remains unchanged.

6.3 Air-drying method

Allow the soil to dry to the required water content within the laboratory. In the case of a large soil mass, loosen it finely by hand or using a loosening tool. Mix the soil from time to time during drying. Once dried, and after mixing well, split the required amount for the test by the quartering method described in Section 5. Store samples in a manner that ensures the water content remains unchanged.

Remark 1: For air-drying, the soil shall be thinly and uniformly spread in a well-ventilated location where it is not exposed to direct sunlight until it reaches the required water content. Agitate the soil from time to time using a hand shovel. To prevent lumping of fine-grained soils, which often occurs as they are dried, loosen them from time to time by hand or with a loosening tool, or crush them with a mallet or similar tool.

Remark 2: When the soil needs to be fully air-dried, leave it at ambient temperature until the drying process has completely finished.

Remark 3: To accelerate the drying process, a constant-temperature drying oven may be used. During drying, keep the oven at 50°C or below and agitate the soil from time to time to loosen lumps until it reaches the required water content.

6.4 Oven-drying method

Mix the collected soil well and split the required amount for the test by the quartering method described in Section 5. Place the split sample in a constant-temperature drying oven at (110±5) °C to dry until a constant mass is reached. Then allow it to cool in a desiccator to approximately room temperature.

Remark: The sample may be split after oven-drying.

7 Particle size regulation

7.1 General

Soil containing particles larger than the size specified for the test shall be sieved to regulate the particle size. When the non-drying method is used and if the soil is too moist to be sieved, the soil shall be strained to regulate the particle size.

Remark 1: If the quantity of soil particles larger than the specified particle size is little and unlikely to affect the test results, no sieving or straining is necessary and the coarse particles may be removed by hand.

Remark 2: For soils consisting of fragile and breakable soil particles, such as decomposed granite soil, it is recommended that the soil be loosened by the following method before sieving to regulate the particle size: place air-dried samples of 500 g each in a plastic bag and seal with a rubber band; drop the bag from a height of 1.5 m onto a concrete surface 30 times.

7.2 Sieving

Regulate the soil particle size by using a specified test sieve of metal wire cloth, using the passed portion as a sample.

7.3 Straining

Prepare the soil such that it is soft enough for straining by kneading with distilled water or another method. Using a rubber spatula, force the prepared soil through the specified test sieve of metal wire cloth and use the passed portion as a sample.

Remark: The straining procedure is illustrated in Fig. 2.

8 Preparation of samples for soil testing

8.1 Test for density of soil particles

After controlling the water content by one of the methods stipulated in Section 6, a soil sample shall be prepared by passing the soil through a sieve with a 9.5 mm mesh.

Remark 1: If any particles of size 9.5 mm or greater are removed, the mass percentage of the removed portion to the original amount of soil shall be determined.

Remark 2: Large organic fibers shall be ground in advance.

Remark 3: The soil shall be fully loosened before oven-drying.

8.2 Test for water content of soils

An appropriate amount of soil shall be taken to be used as a sample.

8.3 Test for water content of soils by microwave oven

As in Section 8.2.

8.4 Test for particle size distribution of soils

After application of the procedure in 6.2 Non-drying method or 6.3 Air-drying method, the amount of soil required for the test shall be split and used as a sample.

Remark: When performing sedimentation analysis using soil with a maximum particle size of 2 mm or greater, ensure that the oven-dried mass of the soil that has passed through a 2 mm mesh sieve is about 115 g for sandy soils and 65 g for cohesive soils.

8.5 Test for fine fraction content of soils

As in Section 8.4.

8.6 Test for liquid limit and plastic limit of soils

After controlling the natural water content of the soil according to 6.2 Non-drying method, the soil that passes through a 425 μm mesh sieve shall be used as a sample.

Remark: If air-drying does not affect the test results, a sample controlled according to 6.3 Air-drying method may be used.

8.7 Test for liquid limit of soils by fall cone

As in Section 8.6.

8.8 Test for shrinkage parameters of soils

As in Section 8.6.

Remark: If air-drying does not affect the test results, a sample controlled according to 6.3 Air-drying method may be used.

8.9 Test for water retentivity of soils

In principle, soil that passes through a 4.75 mm mesh sieve shall be used.

Remark: When this test is carried out in connection with another soil test, sample preparation shall comply with the method used for the related soil test.

8.10 Test for minimum and maximum densities of sands

The test shall be applied to sand that passes through a 2 mm mesh sieve and of which 95 % or more remains on a 75 µm mesh. Test samples shall be well loosened after oven-drying by the procedure described in 6.4 Oven-drying method.

8.11 Test for minimum and maximum densities of gravels

The test shall be applied to coarse-grained soil that passes through a 53 mm mesh sieve, that contains gravel particles measuring 2 mm or greater, and of which 90 % or more remains on a 75 µm mesh sieve. In principle, test samples shall be oven-dried by the procedure described in 6.4 Oven-drying method and then preserved in air in the laboratory. If the particles of the dried sample are coherent, they shall be loosened before the test is conducted.

8.12 Test for frost heave prediction of soils

When compacted soil is to be tested, the sample shall consist of soil that has passed through a 19 mm mesh sieve. After controlling the water content of the soil by the procedure described in 6.2 Non-drying method or 6.3 Air-drying method, the water content of the soil shall be measured and controlled to the prescribed level before it is used as a sample.

8.13 Test for frost susceptibility of soils

As in Section 8.12.

8.14 Test for pH of suspended soils

To prepare a sample, the water content of the soil shall be controlled by the procedure described in 6.2 Non-drying method and then soil particles measuring about 10 mm or greater in particle size shall be removed using tweezers or other tools.

Remark: The soil shall be loosened if consolidated.

8.15 Test for electric conductivity of suspended soils

As in Section 8.11.

Remark: The soil shall be loosened if consolidated.

8.16 Test for ignition loss of soils

Soil that has been air-dried and become easily loosened by the procedure described in 6.3 Air-drying method shall be loosened or ground in a mortar and passed through a 2 mm mesh sieve. The portion that passes the sieve shall be oven-dried to a constant mass at (110±5) °C for use as a sample. In the case of highly organic soil, coarse inorganic particles (measuring about 2 mm or greater) shall be removed wherever possible. In the case of soils other than highly organic soil, any particles measuring 2 mm or greater that cannot be ground may be removed.

8.17 Test for organic carbon content of soils

Soil that has been air-dried and become easily loosened by the procedure described in 6.3 Air-drying method shall be loosened or ground in a mortar and passed through a 2 mm mesh sieve. The portion that passes the sieve shall be ground into finer particles using a mortar. It shall then be oven-dried to a constant mass at (110±5) °C for use as a sample. Coarse organic matter (plant remnants, etc.) shall be removed before air-drying. Any particles measuring 2 mm or greater that cannot be ground may be removed.

8.18 Test for water-soluble components of soils

After controlling the natural water content of the soil according to 6.2 Non-drying method, soil particles 10 mm or greater in size shall be removed using tweezers or other tools.

8.19 Preparation of samples for identifying clay minerals in soils

After controlling the water content according to the procedure in 6.2 Non-drying method or 6.3 Air-drying method, the soil shall be loosened in a mortar or using other tools and coarse particles shall be removed before it is used as a sample.

Remark: Wood chips, leaves, plant roots, etc., shall be removed.

8.20 Test for cation exchange capacity (CEC)

After controlling the water content by the procedure described in 6.3 Air-drying method, the soil shall be loosened in a mortar or using other tools. Alternatively, after removing plant roots and other coarse inorganic particles that cannot be ground to the degree possible, the soil shall be loosened in a mortar. To obtain a sample, the soil shall then be passed through a 2 mm mesh sieve.

8.21 Test for soil compaction using rammer

If drying of the sample could affect the compaction test results, the water content of the soil shall be controlled by the procedure described in 6.2 Non-drying method. If not, it shall be controlled by the procedure described in 6.3 Air-drying method. After one of these methods of controlling the water content, the soil shall be passed through a test sieve of metal wire cloth matching the allowable maximum particle size for a sample.

Remark 1: The wet method and dry method specified in JIS A 1210 “Test method for soil compaction using a rammer” correspond to the methods stipulated in 6.2 Non-drying method and 6.3 Air-drying method, respectively. In the wet method, a sample is dried or water is added to bring the water content of the sample from the natural content to the required content. In the dry method, the whole sample is air-dried to the optimum water content. Then in the compaction process, water is added to control the sample to required water content levels.

Remark 2: In the non-drying method, if a sample is too wet to pass through a sieve matching the allowable maximum particle size, it is allowable to simply remove coarse particles by hand.

8.22 Test for cone index of compacted soils

After controlling the natural water content of the soil according to 6.2 Non-drying method, soil that passes through a 4.75 mm mesh sieve shall be used as a sample.

Remark: If a sample is too wet to pass through a sieve, it is allowable to simply remove coarse particles by hand.

8.23 Test for California Bearing Ratio (CBR) of soils

As in Section 8.21.

Remark: The water content of a sample shall usually be the natural or optimum water content.

8.24 Test for permeability of saturated soils

As in Section 8.17.

8.25 Preparation of compacted stabilized soil specimens using rammer

After controlling the water content according to the procedure in 6.2 Non-drying method or 6.3 Air-drying method, soil that passes through a test sieve of metal wire cloth matching the allowable maximum particle size shall be used as a sample.

Remark 1: The water content of a sample shall usually be the natural or optimum water content.

Remark 2: The allowable maximum particle size is 19 mm when using a 10 cm mold and 37.5 mm when using a 15 cm mold.

Remark 3: If a sample is too wet to pass through a sieve, it is allowable to simply remove coarse particles by hand.

8.26 Preparation of statically compacted stabilized soil specimens

After controlling the water content according to the procedure in 6.2 Non-drying method or 6.3 Air-drying method, soil shall be used as a sample after removing gravel larger than 9.5 mm in particle size.

Remark: The water content of a sample shall usually be the natural or optimum water content.

8.27 Preparation of stabilized soil specimens without compaction

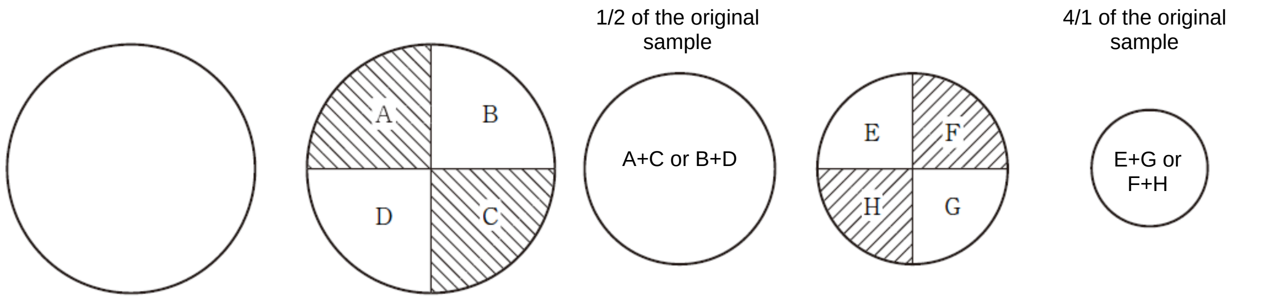
After controlling the water content according to the procedure in 6.2 Non-drying method, soil shall be used as a sample after removing gravel larger than 9.5 mm in particle size.

Remark 1: The water content of a sample shall usually be the natural water content.

Remark 2: If the soil contains much gravel or humus content, adoption of a larger-diameter mold and a correspondingly larger maximum particle size is acceptable.

8.28 Preparation of chemically grouted soil specimens

As in Section 8.27.



a) Spread a sample uniformly.

b) Divide it into four portions and select two portions that are not adjacent to each other.

c) Put together, mix well, and spread uniformly the selected two portions.

d) Again, divide them into four portions and select two portions that are not adjacent to each other.

e) Put together and mix the selected two portions. If the amount of the sample is too great, repeat the previous steps.

Fig. 1 Quartering method

Table 1 (a) Sample splitting guidance for testing

Category	JGS Standard	Test method and variations			Maximum particle size of sample (mm) 0.425	2	4.75	9.5	19	26.5	37.5	53	75
Tests for physical properties of soil	JGS 0111	Test Method for density of soil particles			20 g (nominal capacity of pycnometer: 100 ml or less 40 g (nominal capacity of pycnometer: above 100 ml)				-				
	JGS 0121	Test method for water content of soils			5 g - 10 g	10 g - 30 g	30 g - 100 g	150 g - 300 g		1 kg - 5 kg		5 kg - 30 kg	
	JGS 0122	Test method for water content of soils by the microwave oven			5 - 30 g		30 -100 g	100 - 200 g	-				
	JGS 0131	Test method for particle size distribution of soils			200 g		400 g	1.5 kg		6 kg		30 kg	
	JGS 0135	Material test method for fine fraction content of soils			200 g		400 g	1.5 kg		6 kg		30 kg	
	JGS 0141	Test method for liquid limit and plastic limit of soils			230 g	-							
	JGS 0142	Test method for liquid limit of soils by the fall cone			200 g	-							
	JGS 0145	Test method for shrinkage parameters of soils			30 g	-							
	JGS 0151	Test method for water retentivity of soils			To be determined according to size of container, etc.								
	JGS 0161	Test method for minimum and maximum densities of sands			500 g		-						
	JGS 0162	Test method for minimum and maximum densities of gravels	Inner diameter of mold: 200 mm	Mold A	15 kg							-	
			Inner diameter of mold: 300 mm	Mold B	50 kg								-
	JGS 0171	Test method for frost heave prediction of soils			1.2 kg (reconstituted sample)					-			
	JGS 0172	Test method for frost susceptibility of soils											
Tests for soil stability	JGS 0711	Test method for soil compaction using a rammer	Inner diameter of mold: 15 cm	a) Dry and cyclic method	5 kg					-			
				b) Dry and non-cyclic method	3 kg x number of sets[4)]								
				c) Wet and non-cyclic method	3 kg x number of sets[4)]								
			Inner diameter of mold: 15 cm	a) Dry and cyclic method	8 kg								
				a) Dry and cyclic method	15 kg							-	
				b) Dry and non-cyclic method	6 kg x number of sets[4)]								
				c) Wet and non-cyclic method	6 kg x number of sets[4)]								
	JGS 0716	Test method for cone Index of compacted soils			3 kg x number of sets[4)]			-					
	JGS 0721	Test method for the california bearing ratio (CBR) of soils in laboratory			5 kg x number of sets[4)]							-	
Test for soil permeability	JGS 0311	Test methods for permeability of saturated soils			3 kg (standard specimen)					-			
Methods of preparing stabilized soil specimens	JGS 0811	Practice for making and curing compacted stabilized soil specimens using a rammer	Inner diameter of mold: 10 cm		3 kg					-			
			Inner diameter of mold: 15 cm		6 kg							-	
	JGS 0812	Practice for making and curing statically compacted stabilized soil specimens			500 g				-				
	JGS 0821	Practice for making and curing stabilized soil specimens without compaction			500 g								
	JGS 0831	Practice for making and curing chemically grouted soil specimens			500 g								

Table 1 (b) Sample splitting guidance for testing

Category	JGS Standard	Test method	Particle size of sample (mm)			Remarks
			2 mm or less	5 mm or less	10 mm or less	
Tests for chemical properties of soil	JGS 0211	Test method for pH of suspended soils	30 g	100 g	150 g	Oven-dried mass (to be used in wet conditions)
	JGS 0212	Test method for electric conductivity of suspended soils	30 g	100 g	150 g	Oven-dried mass (to be used in wet conditions)
	JGS 0221	Test method for ignition loss of soils	2 - 10 g	-		Oven-dried mass
	JGS 0231	Test method for organic carbon content of soils	0.1 - 1 g	-		Oven-dried mass
	JGS 0241	Test method for water-soluble components of soils	50 g			Oven-dried mass (to be used in wet conditions)
	JGS 0251	Practice for preparing samples for identifying clay minerals in soils	100 g (after removing coarse soil particles)			Mass of soil with natural water content or soil that is air-dried until the soil can be easily loosened
	JGS 0261	Determination of cation exchange capacity (CEC)	2.5 g			Mass of sample by the air-dry method

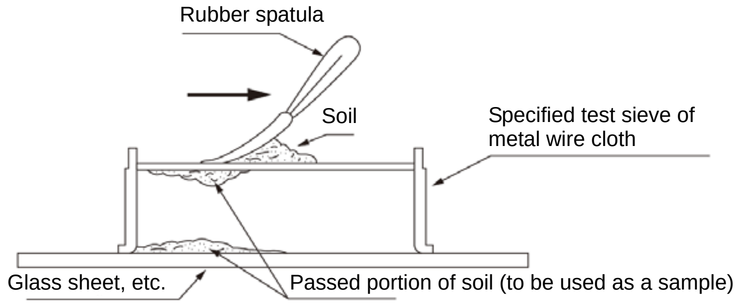


Fig. 2 Example of straining procedure

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THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN (OCDI)
PENTA-OCEAN CONSTRUCTION CO., LTD.
SCOPE（SERVICE CENTER OF PORT ENGINEERING）
TOA CORPORATION
WESCO CO., LTD.

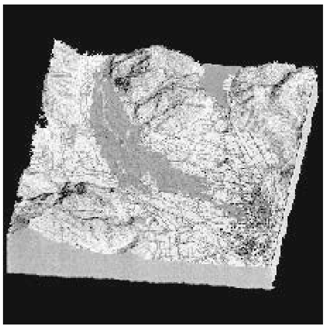
One Stop Service

Our company provides one stop service for a client starting from the investigation until the maintenance service after completion of a construction.

Subsurface Exploration

Civil Engineering Structural Design

Structural Maintenance



Numerical Analysis

Technology

Soft ground investigation

The seismic earthquake shall be considered to the construction design over soft ground area such as landfill and reclaimed land.
Our company utilizes the latest technology of soft ground investigation and proposes the best solution and method of a construction work.
In addition, we are developing the advanced subsurface investigation method closely with industrial, academic and government sector.

Active fault investigation

The construction of civil engineering structural shall be considered the effect of the earthquake.
The earthquake caused by the fault movement is increasing and can be roughly predicted the damage scale by examining the active faults in a vicinity of construction site.
Our company offers a high degree of reliable data by the advanced investigation technology over half a century.

DIA CONSULTANTS

Head Office
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Tel:+813 5835 1711,Fax:+813 5835 1720

Unique Technologies and Know-How Playing a Major Part in the Construction of Social Infrastructure

CIVIL ENGINEERING

With our wealth of technical expertise and experience we are building the social fabric of the future in the following fields:

- Roads, railways, dams and waterways, water supply and sewerage systems, energy infrastructure and other land-based civil engineering
- Port and airport installations, fishing facilities, coast defenses, man-made islands and other coastal and offshore civil engineering

Main technologies:

Mountain tunneling; shield tunnel boring; dam construction; earthworks; offshore engineering; earthquake resistance strengthening and replacement;
waste disposal plant construction; dismantling of incineration facilities; water treatment; soil decontamination

SOIL IMPROVEMENT

In 1956 we were first in the world to develop the sand compaction pile method (SCP), which is so effective for mitigation liquefaction during earthquake. We continue to build on our R&D record, and as experts in soil improvement we have a comprehensive range of design and implementation technologies and a portfolio of project implementation.

Main technologies:

Compaction, de-watering, drainage, solidification and water cut-off methods; lightweight soil; anti-vibration technologies

ENVIRONMENT-USE BLOCKS

We lease forms for concrete blocks including tetrapods and other wave-dissipating blocks, and for waterfronts we offer various technologies and design services, and also products designed to protect coastal aspects and ecosystems.

Main products:

Shaped concrete blocks of tetrapod, tetraneo, pelmex and other designs; filtering units; ion culture components; etc.

FUDO TETRA

Fudo Tetra Corporation

For a better society

Japan is located in one of the most active seismic zones in the world. After the 2011 Great East Japan Earthquake, our society seeks safety and people are hoping to have a more stable life.
In this age, Geo-Labo Chubu is contributing to developments for a better society with laboratory tests of geomaterials.

Nagoya Castle and buildings

Value creation

We pursue improvments of customer satisfaction in every aspect and are always creating new values.

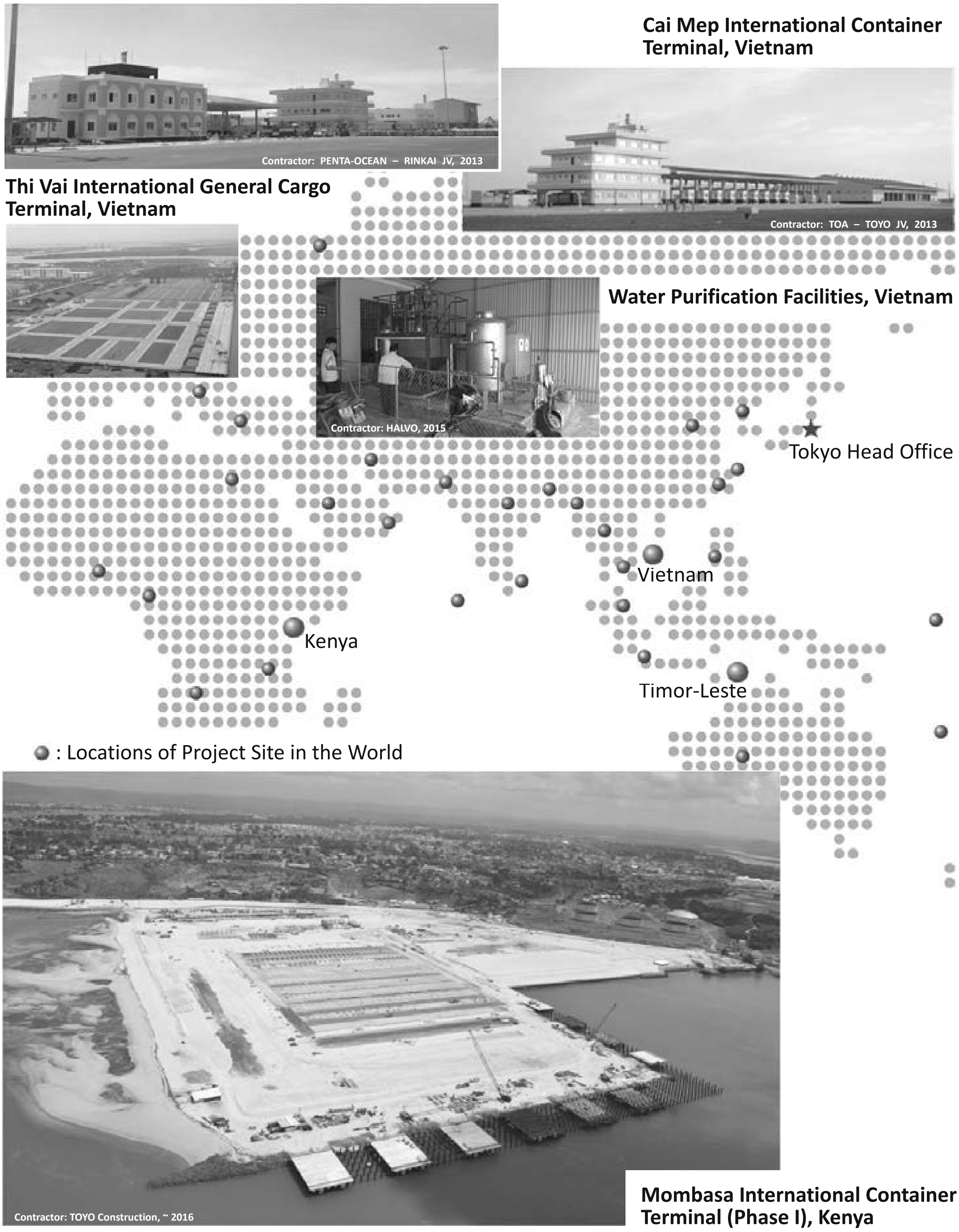
Our mission

Contribution to society

We aim for the realization of a safe and secure society for all via laboratory tests of geomaterials.

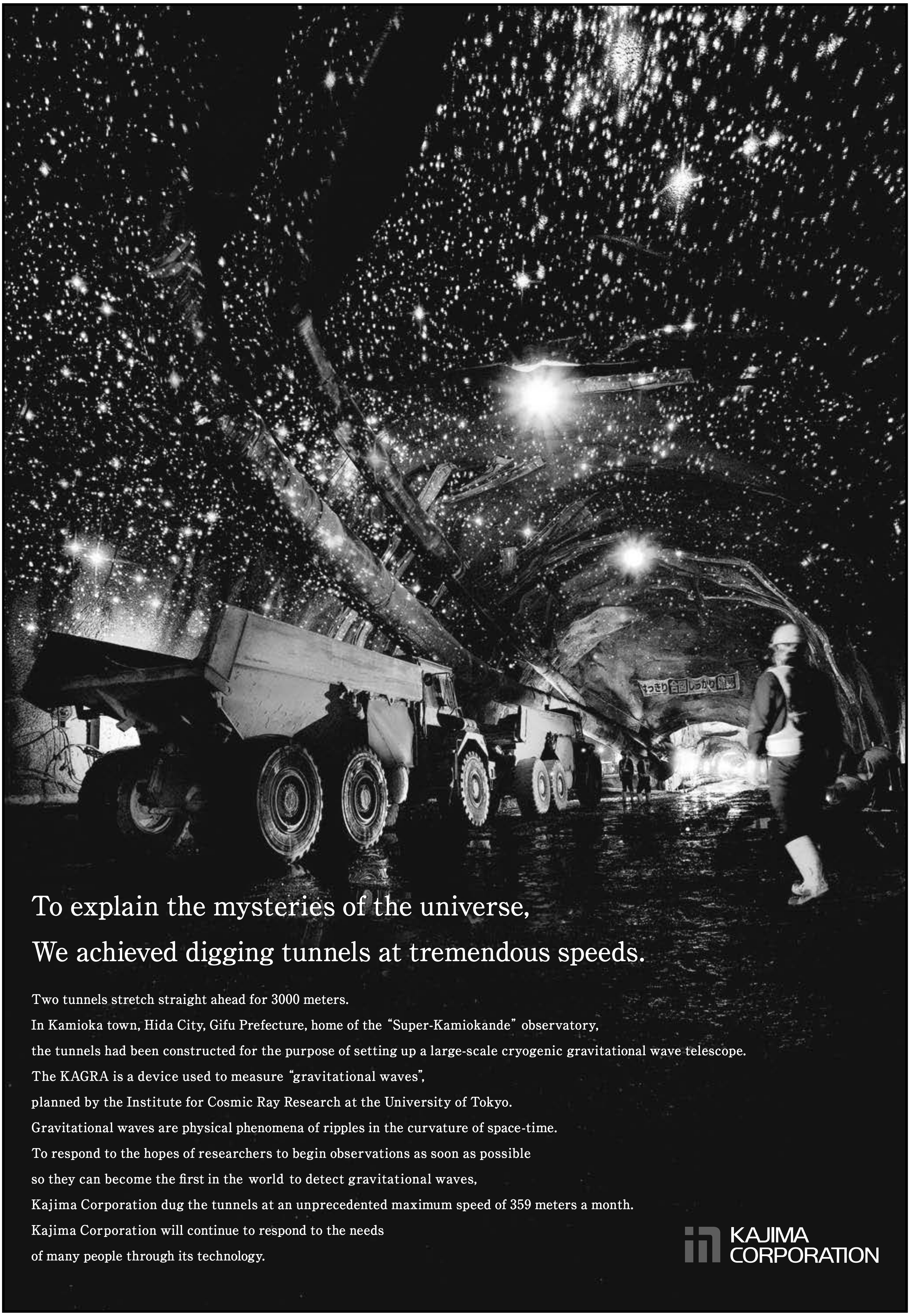
Technological strength

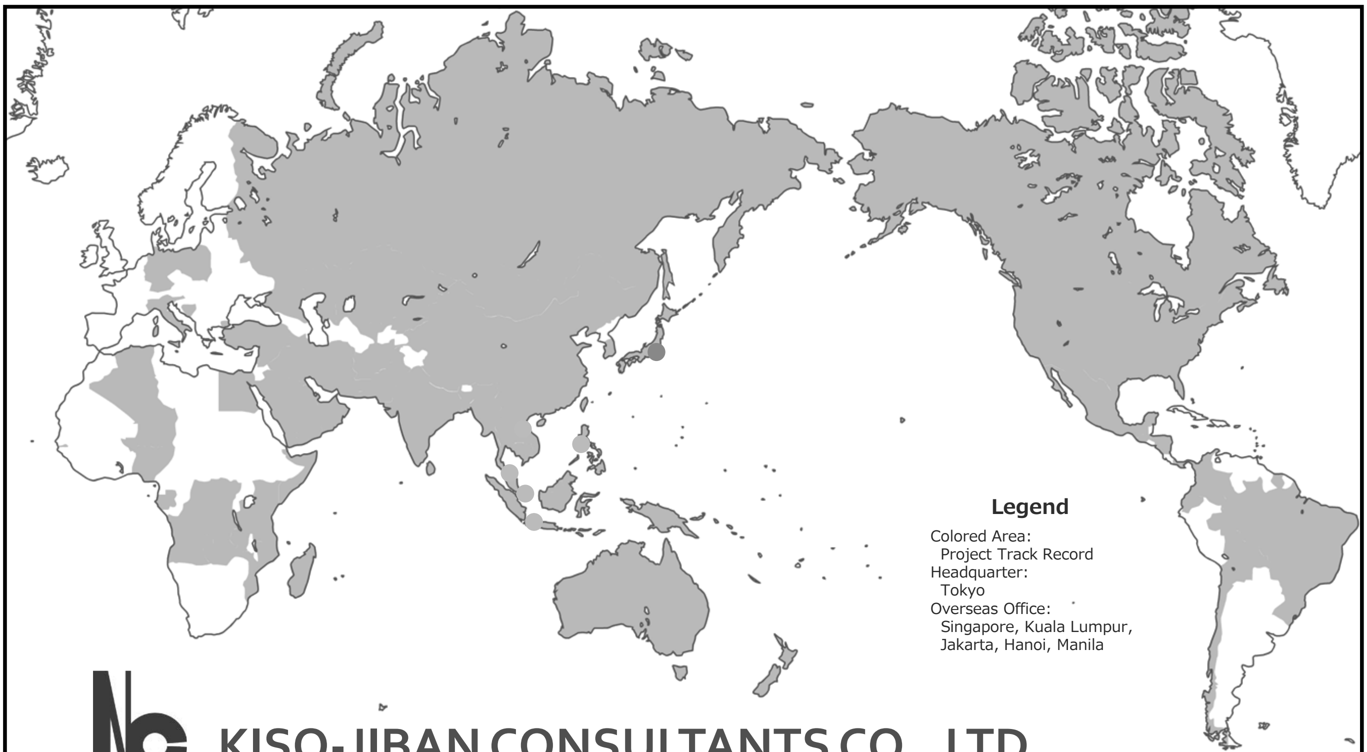
We offer information of reliable geomaterials with ample facilities and skills that meet the demands of the present age.


Contractor: PENTA-OCEAN – RINKAI JV, 2013
Thi Vai International General Cargo Terminal, Vietnam
Cai Mep International Container Terminal, Vietnam
Contractor: TOA – TOYO JV, 2013
Water Purification Facilities, Vietnam
Contractor: HALVO, 2015
Tokyo Head Office
Vietnam
Kenya
Timor-Leste
: Locations of Project Site in the World
Contractor: TOYO Construction, ~ 2016
Mombasa International Container Terminal (Phase I), Kenya


Contractor: TOA – TOYO JV (Crane: IHI - MES JV), 2013


Contractor: TOBISIMA Corporation, 2013


To explain the mysteries of the universe,
We achieved digging tunnels at tremendous speeds.
Two tunnels stretch straight ahead for 3000 meters.
In Kamioka town, Hida City, Gifu Prefecture, home of the "Super-Kamiokande" observatory,
the tunnels had been constructed for the purpose of setting up a large-scale cryogenic gravitational wave telescope.
The KAGRA is a device used to measure "gravitational waves",
planned by the Institute for Cosmic Ray Research at the University of Tokyo.
Gravitational waves are physical phenomena of ripples in the curvature of space-time.
To respond to the hopes of researchers to begin observations as soon as possible
so they can become the first in the world to detect gravitational waves,
Kajima Corporation dug the tunnels at an unprecedented maximum speed of 359 meters a month.
Kajima Corporation will continue to respond to the needs
of many people through its technology.
KAJIMA CORPORATION



KISO-JIBAN CONSULTANTS CO., LTD.

KISO-JIBAN is an engineering consulting firm experienced in all phases of civil engineering project. Established in 1953, we have participated in over 6000 overseas projects in more than 80 countries worldwide and have been leading the industry with our innovative technology as a pioneer.

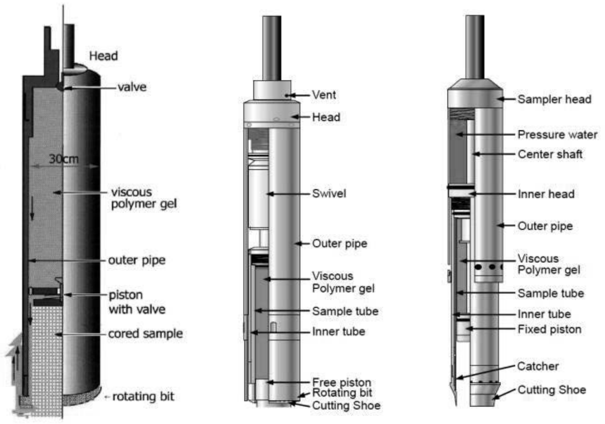
Comprehensive Service Areas

Geological and Geotechnical Survey
Geotechnical Design and Analysis
Disaster Prevention and Management
GIS (Geographic Information Systems)
Soil and Rock Laboratory Tests
Instrumentation and Monitoring
Geophysical Exploration & Development
Distribution of Geosynthetics Products

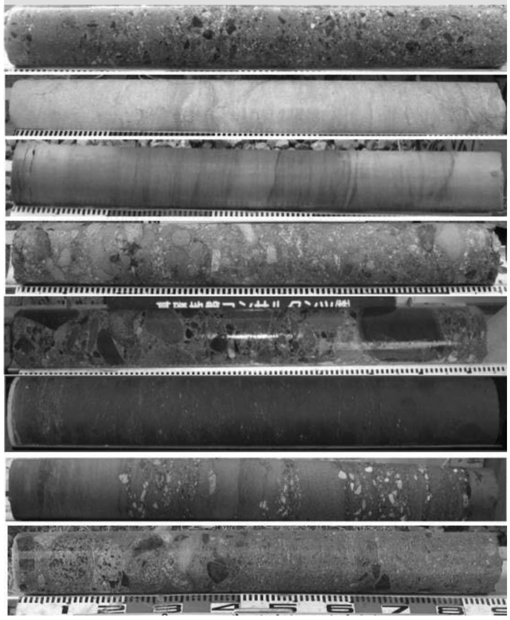
Soil Investigation

Among existing sampling technologies, the most noteworthy technology should be Gel-Push Sampler which was developed by KISO-JIBAN. Gel-Push Samplers enable to obtain undisturbed soil samples on fragile soft ground.

GP-D type (Single Tube Sampler Type)	GP-Tr type (Triple Tube Sampler type)	GP-S type (Thinwall Sampler type)



Undisturbed Samples Obtained with GP Sampler



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Jakarta 12780, Indonesia
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Philippines

KISO-JIBAN Representative Office
Unit 2105, 88 Corporate Center,
Sedeno Street Corner Valero Street,
Salcedo Village, Makati City 1200, Philippines
TEL:+63-2-552-8238

Geophysical Survey & Analysis

KISO-JIBAN has developed and innovated a number of geophysical survey technologies as well as analysis software.

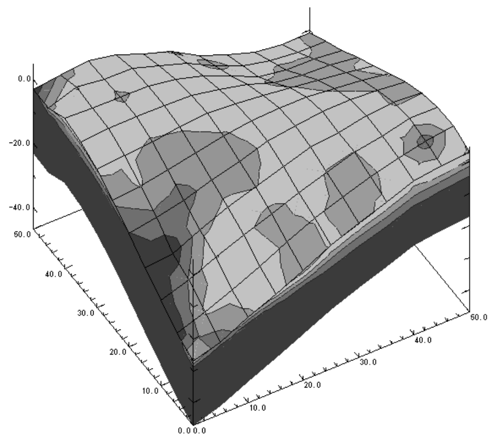
One of our notable geophysical survey method, 3D seismic refraction survey, enables the visualization of elastic wave velocity for underground structure.

For geotechnical analysis, we leverage our technical expertise and our experience in choosing method and forming judgment.

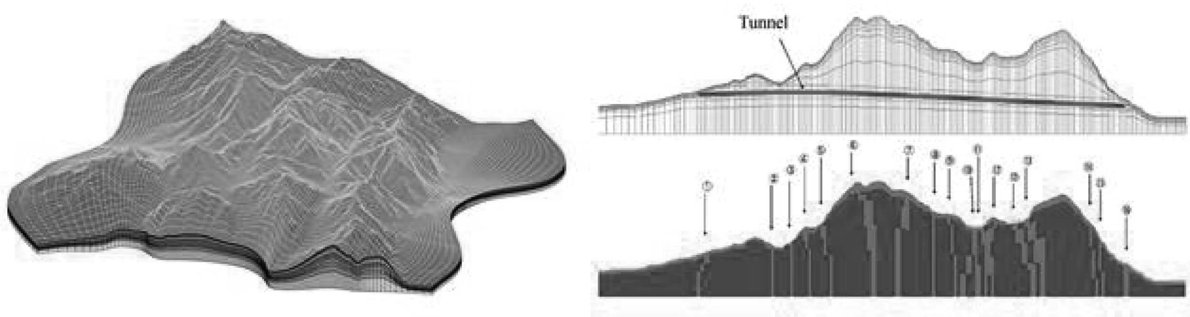
Being an international company, we are capable to work with all major international standards such as ASTM (American), BS (British), EN (European), DIN (German), and GOST (Russian).

As a pioneer, we are committed to keep listening to our clients and to move forward to the future.

3D Seismic Refraction Survey



3D Terrestrial Fluid Analysis by “GETFLOWS”



Multi Water Quality Meter

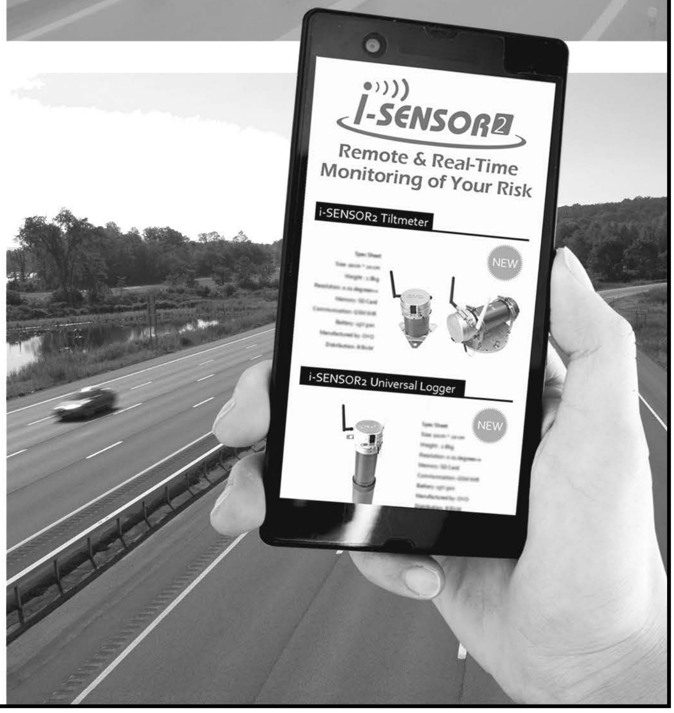
i-SENSOR

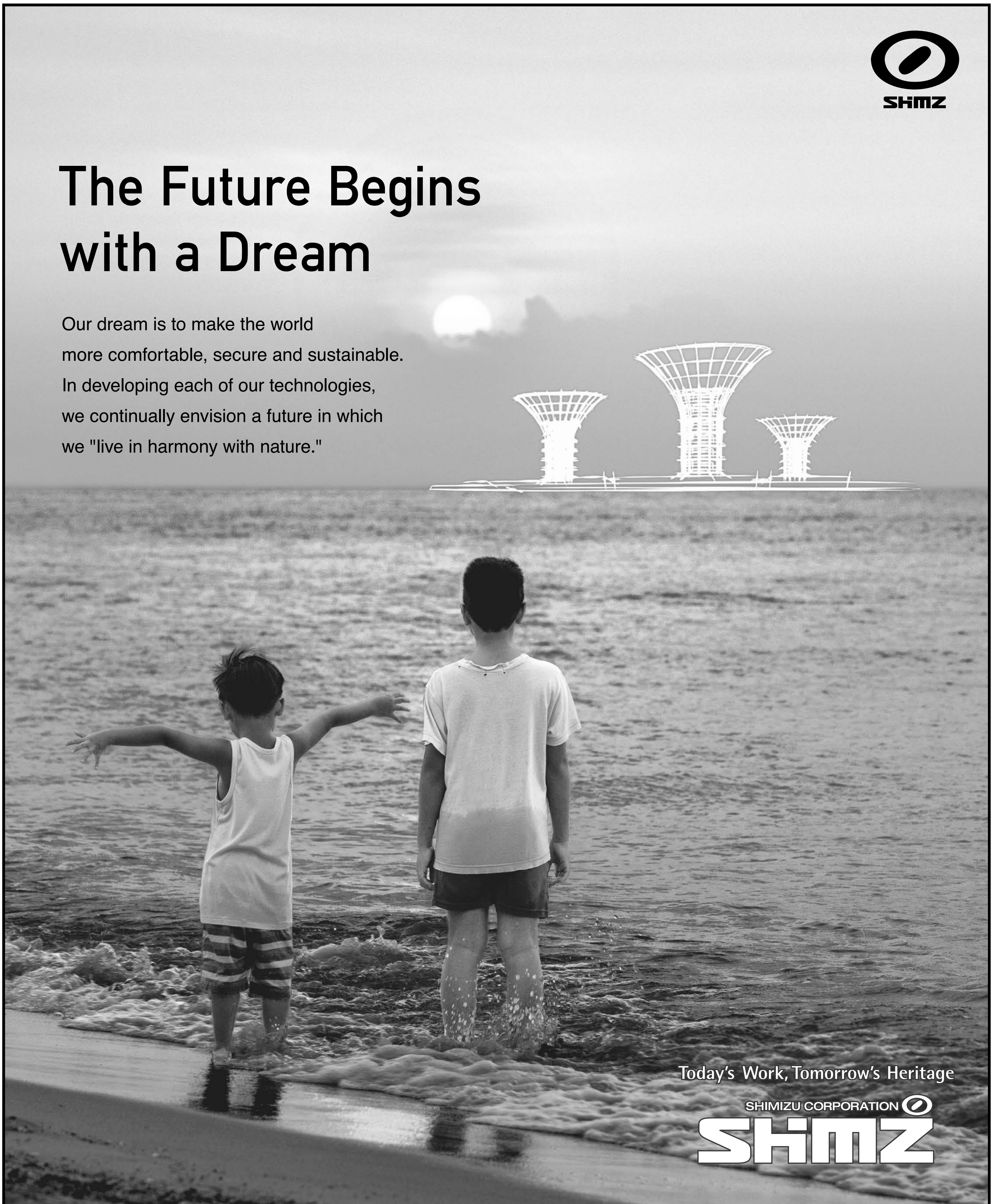
How do you secure safe operation of your projects which are always exposed to risks of geohazards and environmental pollution? Land subsidence in tunnel construction, environmental pollution in dams, rock fall in roadside slopes... There are so many risks you have to monitor. How do you watch them when you cannot keep your eyes on them?

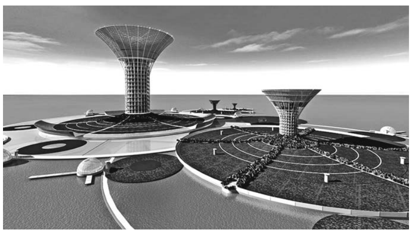
i-SENSOR will keep its eyes instead.

Water Level Gauge S&DL mini

Stationary Borehole Inclinometer




SHMZ
The Future Begins
with a Dream
Our dream is to make the world
more comfortable, secure and sustainable.
In developing each of our technologies,
we continually envision a future in which
we "live in harmony with nature."
Today's Work, Tomorrow's Heritage
SHIMIZU CORPORATION
SHMZ

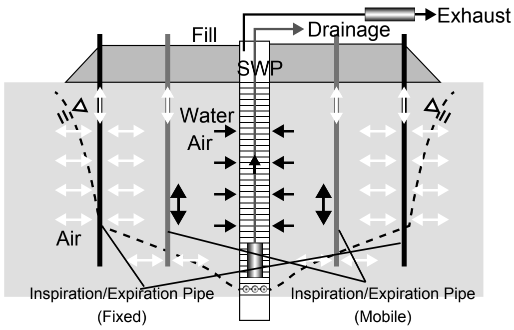


A&S Soil Improvement Method (Absorption and Subsidence Soil Improvement Method)

Summary

This method is able to improve soil property in a short term by 3 points.

①Suctioning pore water by Super Well Point Method(SWP)
②Improve permeability by inspiration and expiration in the ground
③Promote consolidation settlement by loading fill



Diagrammatical view: A&S Soil Improvement Method

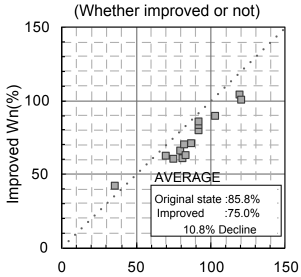
Feature

①Subsidence convergence in only 3months
②The cost will be half or less than deep mixing method
③The applicable depth is around 50m (Experience:30m)
④It controls residual settlement surely
⑤Compact construction facilities
⑥Only the pipe of the SWP is left

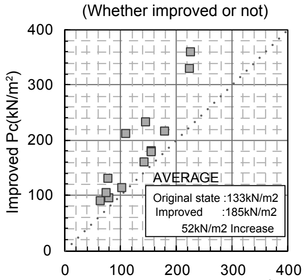
Cunstruction

Result

Comparing naturarl water content
(Whether improved or not)



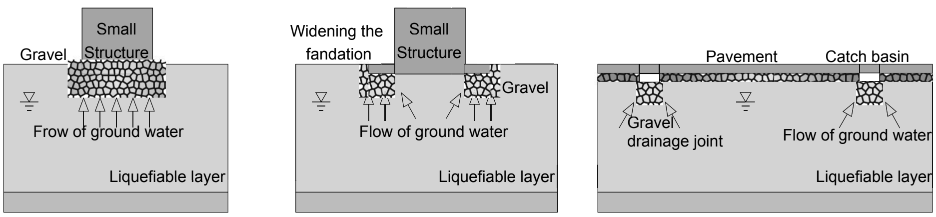
Comparing Consoilidation yield stress
(Whether improved or not)



Gravel Support Method

Summary

The gravel support method reduces liquefaction-induced damage of small structures or outdoor facilities by improving only the ground surface with highly permeable gravel layer.



newly-constructed structures (Gravel layer) | pre-existing structures (Gravel layer+ Widening the foundation) | outdoor facilities (Gravel drainage joint)

Applicability

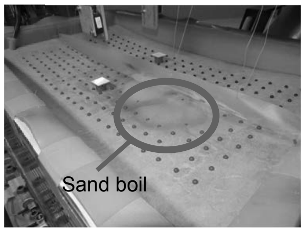
(1)Structures which meets all four conditions below
①Weight : less than 5t/m²
②Short side length : less than 15m
③Thickness of the foundation (pre-existing structures only) : larger than 50cm
④No habitable room
(2)Outdoor facilities

Advantage

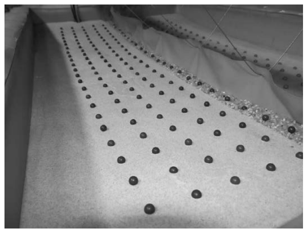
①Liquefaction-induced damages can be largely reduced by improving only the surface layer
②Can significantly reduce the cost in compare with other existing methods
③Is application to wide variety of construction conditions
④Can be constructed without stopping the operation of facilities

Effect of the measures

Verification of the effect of the measures by centrifugal model tests



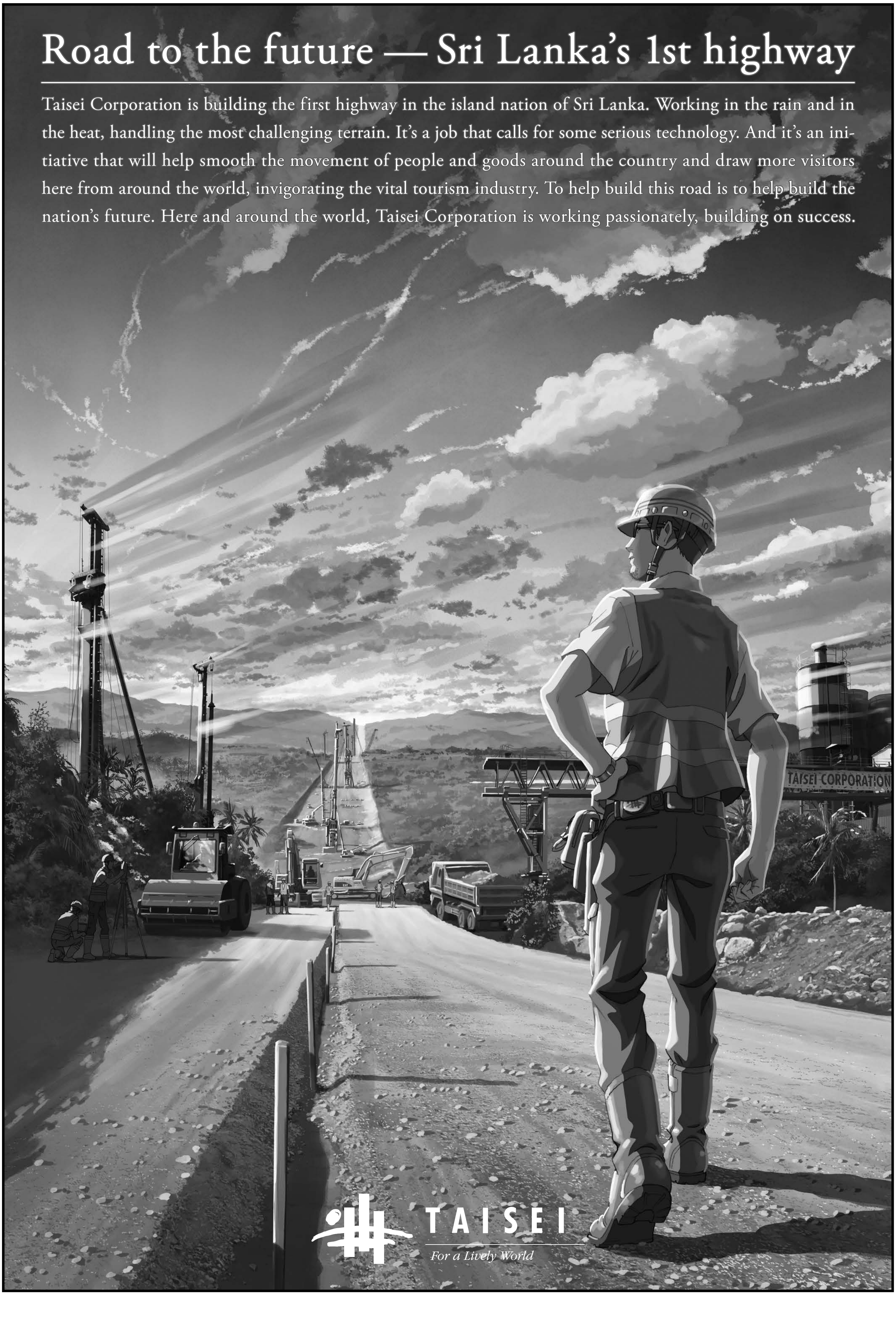
No measures



Gravel Support Method

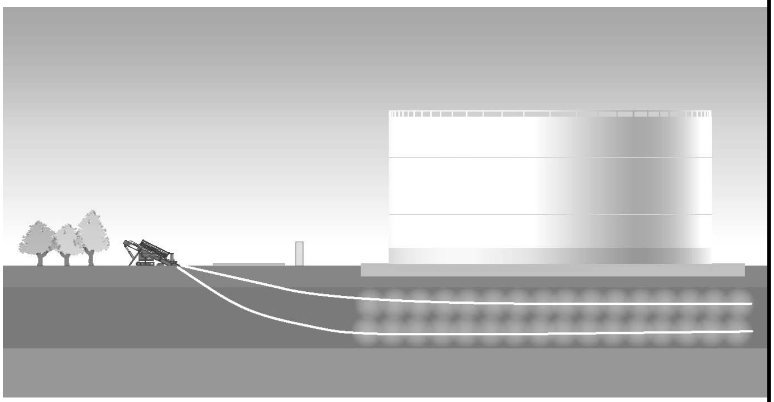
Today's Work,
Tomorrow's Heritage

SHIMIZU CORPORATION
SHIMZ


Road to the future — Sri Lanka's 1st highway
Taisei Corporation is building the first highway in the island nation of Sri Lanka. Working in the rain and in the heat, handling the most challenging terrain. It's a job that calls for some serious technology. And it's an initiative that will help smooth the movement of people and goods around the country and draw more visitors here from around the world, invigorating the vital tourism industry. To help build this road is to help build the nation's future. Here and around the world, Taisei Corporation is working passionately, building on success.
TAISEI CORPORATION
TAISEI
For a Lively World

Ground Flex Mole®

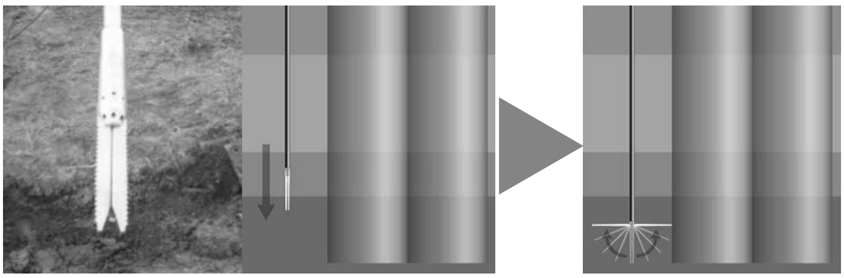
Permeation grouting, void filling and soil remediation beneath existing structures using directional drilling technology



The drilling machine occupies a small area; applicable in narrow spaces
Temporary work pits are not required; low cost and short construction period
The method allows operation of existing structures during soil improvement works

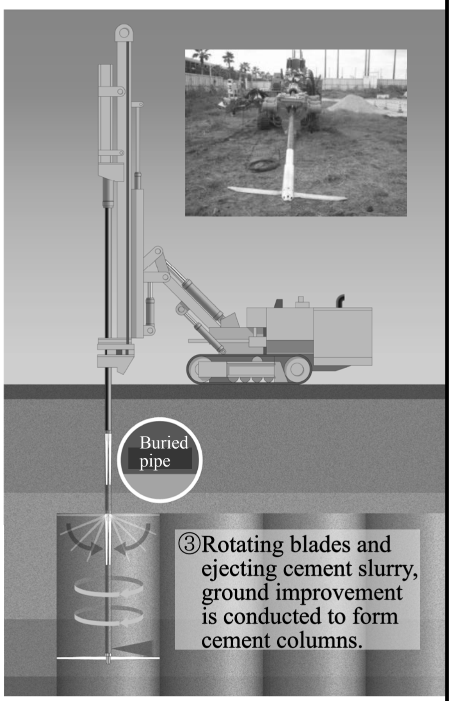
WinBLADE®

In-situ soil mixing method at narrow spaces adjacent to existing structures using expandable/collapsible mixing blades



①Mixing blades in collapsed state are inserted into ground through casing

②The mixing blades are expanded at the tip of the improvement area

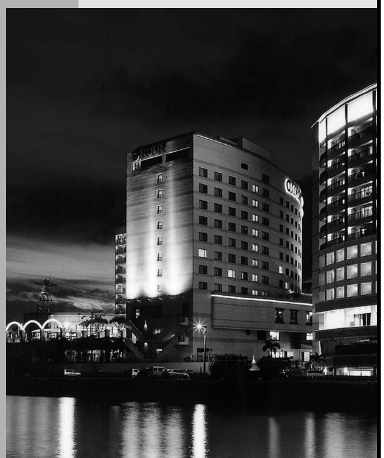


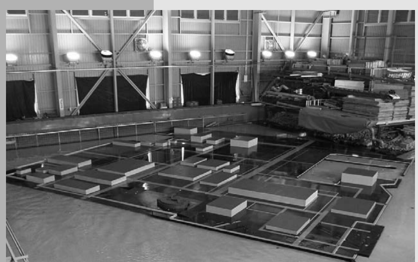
③Rotating blades and ejecting cement slurry, ground improvement is conducted to form cement columns.

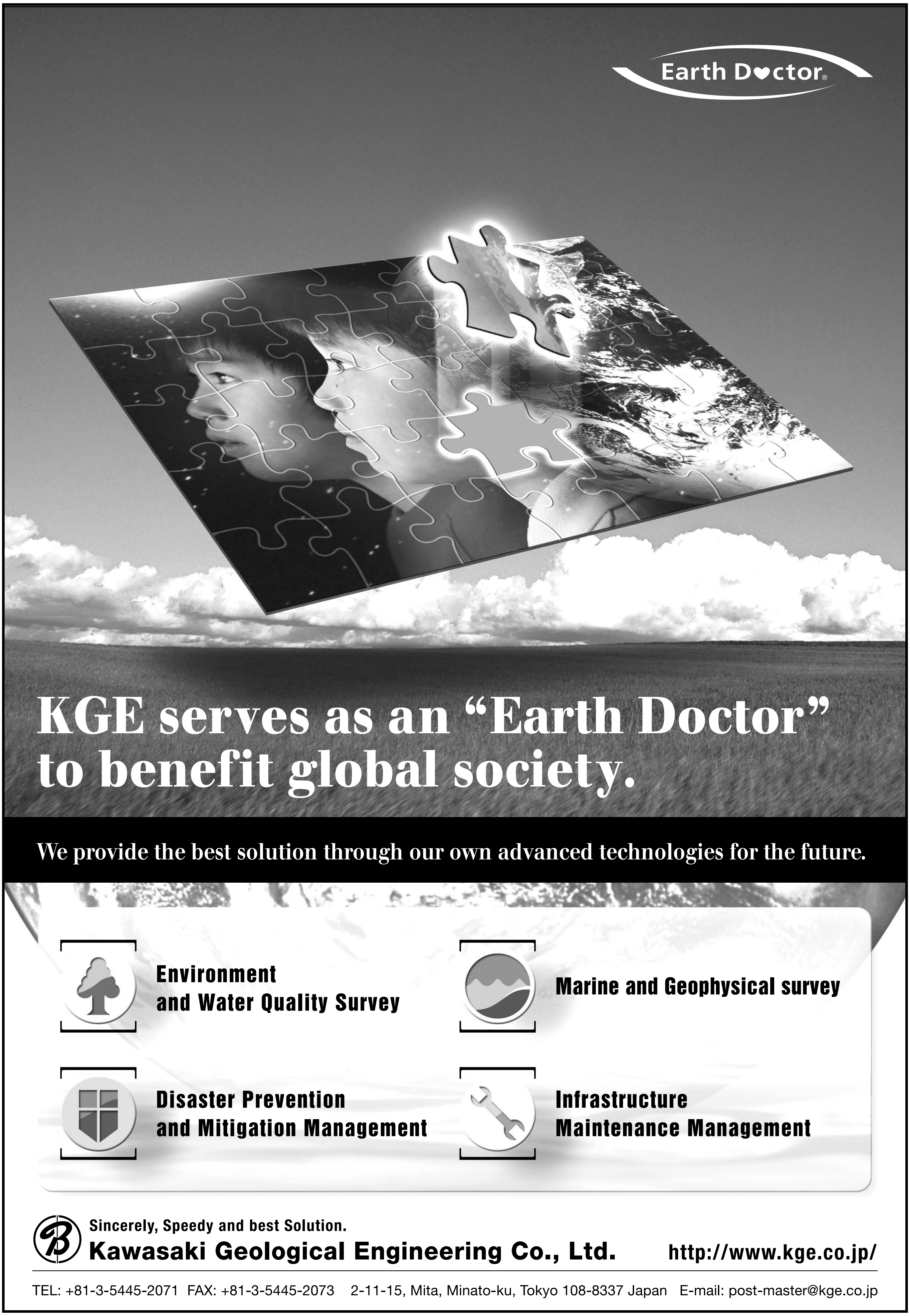
High applicability by vertical and diagonal mixing
Less removal work of pavement and buried obstacles
Reliable execution using monitoring and auto control system

TAISEI
For a Lively World

Giving Shape



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Marine and Geophysical survey
Disaster Prevention and Mitigation Management
Infrastructure Maintenance Management
Sincerely, Speedy and best Solution.
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http://www.kge.co.jp/
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