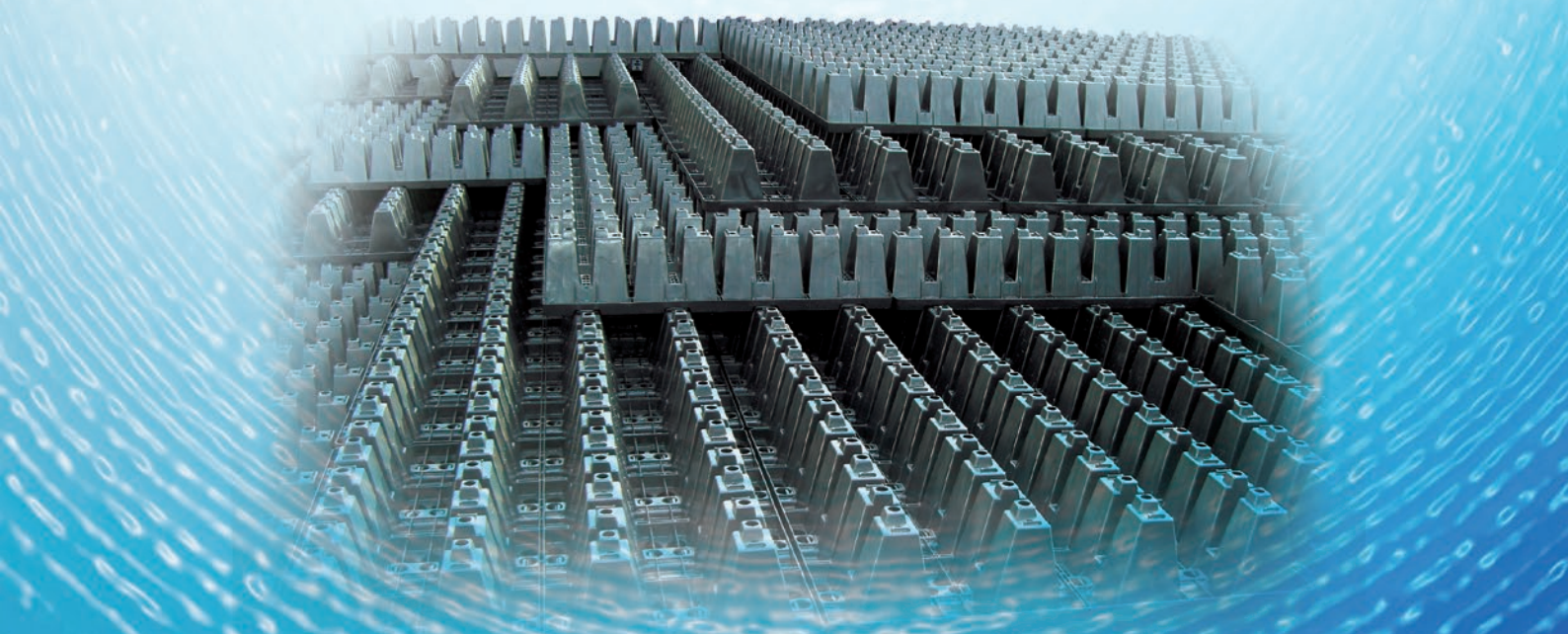
SEKISUI

April 2023 edition

Water space under the ground

Plastic material for water storage

CROSS-WAVE



SEKISUI CHEMICAL CO., LTD.

CROSS-WAVE Overview ※ As of March 2023

Cumulative total pondage in Japan

More than **3.0** million m³

Cumulative total installation in Japan

Over **13,000** cases

Prefecture penetration rate

97%

Reliable track record

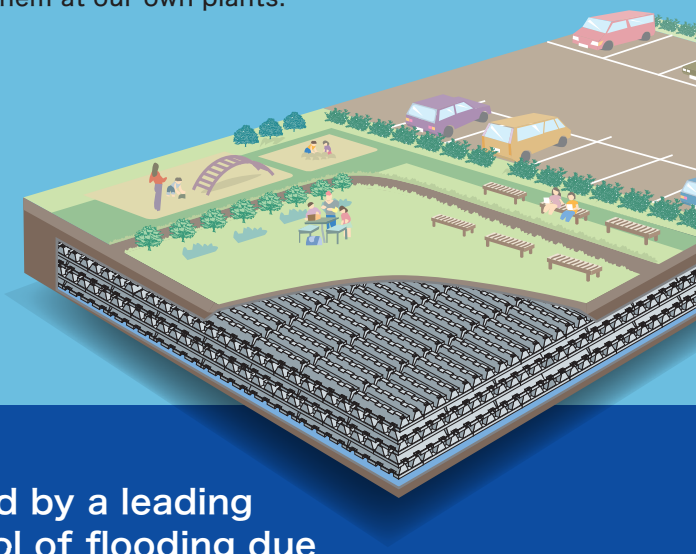
More than **25** years from release

Plastic material for water storage required now

The CROSS-WAVE series is intended to construct rainwater storage and infiltration reservoirs by burying plastic blocks(made of recycled polypropylene resin) under the ground in order to reduce rainwater runoff and use rainwater. Piling up blocks so that they intersect at right angles achieves a high void ratio, securing necessary and sufficient pondage. The completed structure is significantly stable.
SEKISUI CHEMICAL CO., LTD. launched the CROSS-WAVE series in 1998. Since then, it has been adopted at both public and private facilities, and the cumulative total of installation and the cumulative total pondage have exceeded 13,000 cases and 3,000,000 m³, respectively. Also, the prefecture penetration rate has reached 97%. As a manufacturer of plastic storage materials, we have the best track record in Japan and continue to steadily increase the number of installation cases also in overseas countries.
Furthermore, we provide high-quality products by producing them at our own plants.

Obtained technology assessment certification from the Association for Rainwater Storage and Infiltration

Obtained certification for new technology research results from the Japan Institute of Wastewater Engineering and Technology



■ Use applications of CROSS-WAVE

Materials for rainwater storage provided by a leading plastic manufacturer, Sekisui, for control of flooding due to typhoons, torrential rain, etc.

Rainwater runoff reduction

Even in the event of heavy rain due to typhoons and torrential rain, rainwater can be stored under the ground efficiently and safely to reduce rainfall runoff, minimizing damage from flooding.

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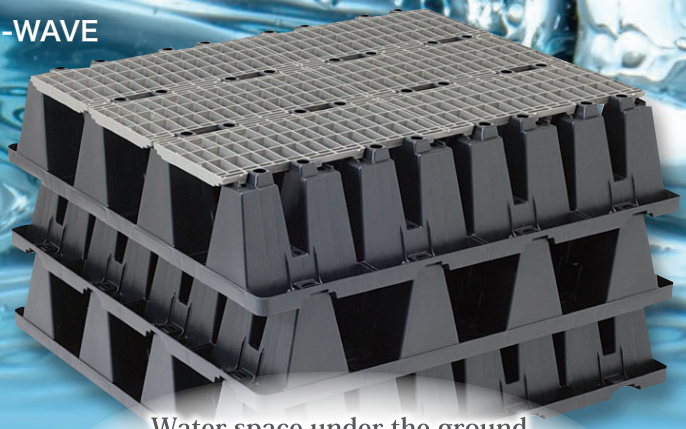
Rainwater use

Stored rainwater can be used as:

- Household non-potable water
- Industrial water
- Agricultural water

■ Five features of CROSS-WAVE



Water space under the ground

Plastic material for water storage

CROSS-WAVE

1 Void ratio

Achieving a 95% void ratio allows storage of substantial volume of water.

2 Load capacity

Can load a T-25 truck (Except for general roads)

3 Resistance against earthquakes

Resistant to level-2 seismic movements
No collapse even in the event of the Great East Japan Earthquake

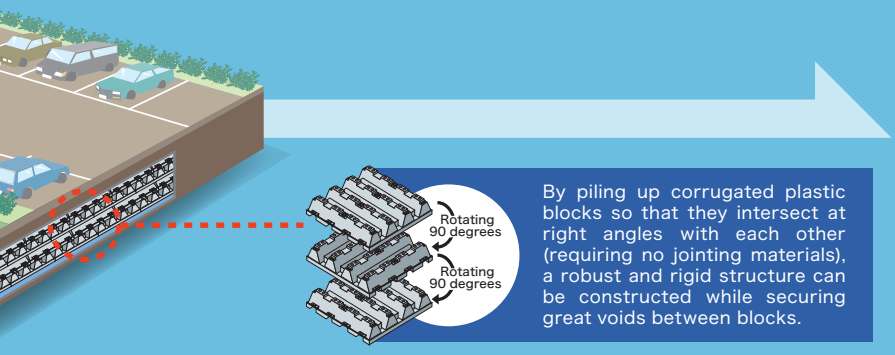
4 Easy installation

No fixing material required and can be installed manually

5 Environmental friendliness

Highly resistant to chemicals and does not pollute water

Use of recycled plastic



By piling up corrugated plastic blocks so that they intersect at right angles with each other (requiring no jointing materials), a robust and rigid structure can be constructed while securing great voids between blocks.

Since CROSS-WAVE is fully buried under the ground to store rainwater, rainwater storage and infiltration measures can be taken without impairing the scenery around the facility and in the community.

SEKISUI CHEMICAL CO., LTD. aims to produce products for achieving SDGs※ through CROSS-WAVE.

Six SDGs that CROSS-WAVE is aimed at achieving. Through initiatives to achieve these goals, Sekisui Techno Molding has declared to return more natural capital back to the planet than it uses to help to conserve the natural environment.

SUSTAINABLE DEVELOPMENT GOALS

※ Internationally shared goals from 2016 to 2030 specified in the 2030 Agenda for Sustainable Development, adopted at the United Nations Summit held in September 2015

Broad product lineup according to the purpose
Proposing the most suitable product for every environment

We offer five types of products with different earth covering and burial depth that respond to various installation conditions and burial environments of each customer's desired rainwater storage and infiltration facility. We will propose the optimum product for each customer. Please do not hesitate to contact us.

■ Product selection guide table

Maximum burial depth	Product	Earth covering					
		0.5m～	0.6m～	0.8m～1.3m	～1.6m	～2.0m	～2.2m
2.8m max.	CW-HA			○			
	CW-HD		○	○	○		
Under 4.0m	CW-S						○
	CW-N	○	○	○	○	○	
4.0 to 6.0m	CW-NS (For under 4.0m, CW-N is used.)	○	○	○	○	○	

Note 1) In the case in which the specific weight of soil is 18 kN/m³
Note 2) In the case in which a live load (when a T-25 truck passes) is considered

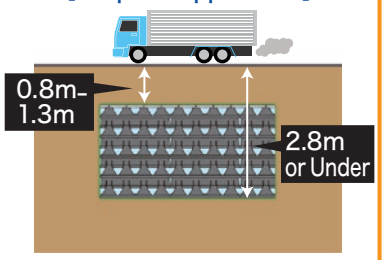
Five types of products cover a wide range of purposes and conditions.

CW-HA CROSS-WAVE HA

Void ratio 95%
(2 layers or more)

Product name		Full size	Half size	Spacer
Dimension (mm)		994×994×220	994×494×220	988×240×25
Mass (kg)		7.4	4.0 (Used in common by CW-HD)	0.8
Vertical direction	Permissible stress	67.0 kN/m²		
	Permissible stress for sustained loading	23.5 kN/m²		
Horizontal direction	Permissible stress	30.0 kN/m²		
	Permissible stress for sustained loading	18.5 kN/m²		

[Scope of application]



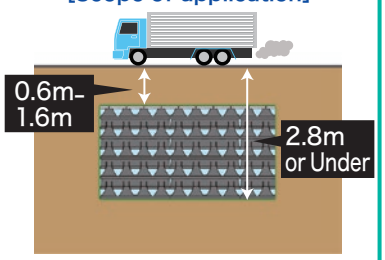
Can load a T-25 truck

CW-HD CROSS-WAVE HD

Void ratio 95%
(3 layers or more)

Product name		Full size	Half size	Spacer
Dimension (mm)		994×994×220	994×494×220	988×240×25
Mass (kg)		8.0	4.0	0.8
Vertical direction	Permissible stress	78.5 kN/m²		
	Permissible stress for sustained loading	30.0 kN/m²		
Horizontal direction	Permissible stress	30.0 kN/m²		
	Permissible stress for sustained loading	18.5 kN/m²		

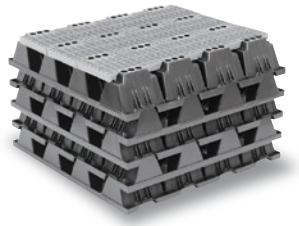
[Scope of application]



Can load a T-25 truck

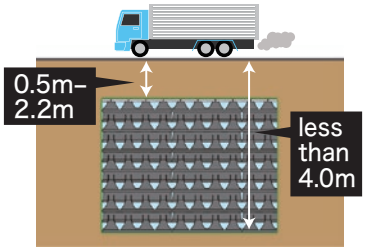
CW-S CROSS-WAVE S

Void ratio 92%



Product name		Full size	Half size	Spacer
Dimension (mm)		994×994×180	994×494×180	993×246×45
Mass (kg)		7.4	3.7	1.4
Vertical direction	Permissible stress	110.0 kN/m²		
	Permissible stress for sustained loading	40.0 kN/m²		
Horizontal direction	Permissible stress	50.0 kN/m²		
	Permissible stress for sustained loading	26.5 kN/m²		

[Scope of application]

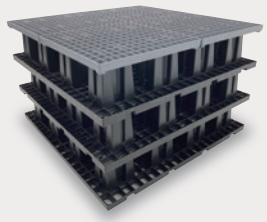


Can load a T-25 truck

CW-N

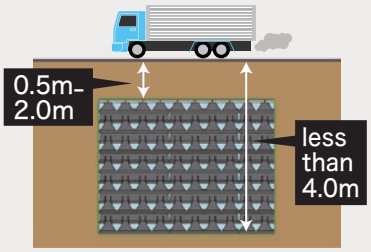
CROSS-WAVE N

Void ratio 95%
(3 layers or more)



Product name		Full size	Half size	Spacer
Dimension (mm)		994×994×220	994×494×220	490×490×40
Mass (kg)		8.0	4.0	1.1
Vertical direction	Permissible stress	110.0 kN/m²		
	Permissible stress for sustained loading	36.0 kN/m²		
Horizontal direction	Permissible stress	60.0 kN/m²		
	Permissible stress for sustained loading	26.5 kN/m²		

[Scope of application]



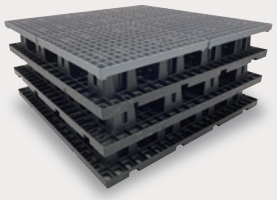
Can load a T-25 truck

CW-NS

NEW!

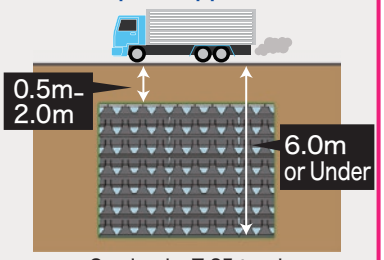
CROSS-WAVE NS

Maximum burial depth of 6.0m
(For CW-N Hybrid)



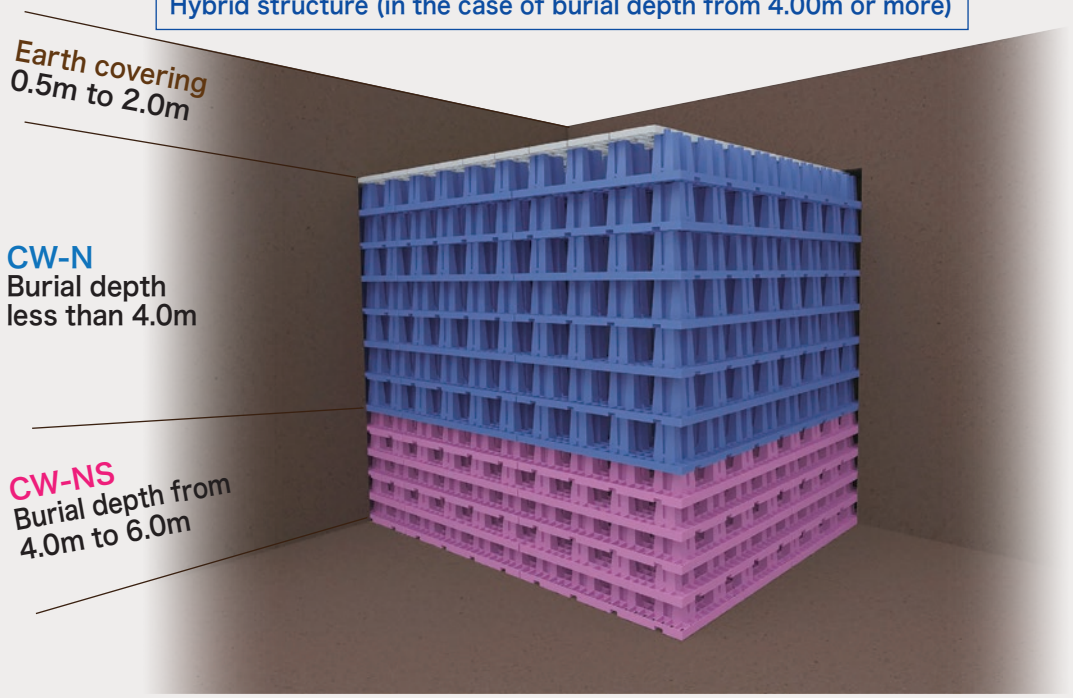
Product name		Full size	Half size	Spacer
Dimension (mm)		994×994×160	994×494×160	490×490×40
Mass (kg)		7.2	3.6	1.1
Vertical direction	Permissible stress	100.0 kN/m²		
	Permissible stress for sustained loading	36.0 kN/m²		
Horizontal direction	Permissible stress	120.0 kN/m²		
	Permissible stress for sustained loading	54.0 kN/m²		

[Scope of application]



Can load a T-25 truck

Hybrid structure (in the case of burial depth from 4.00m or more)



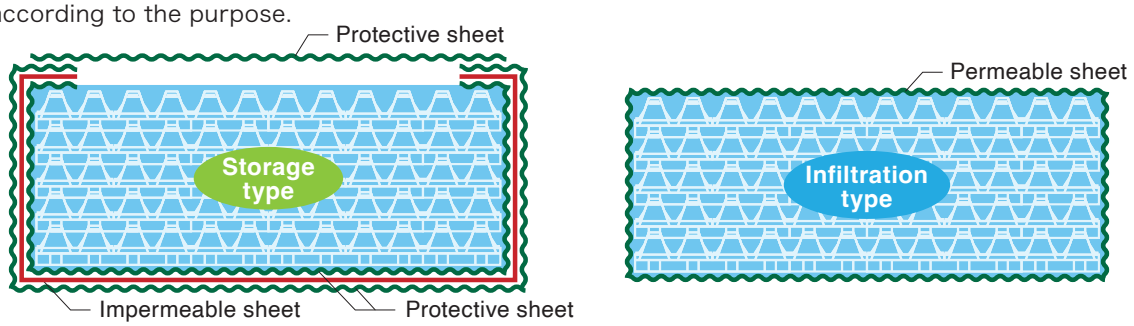
※ The hybrid structure is applicable only to CW-N and CW-NS

※ The dimensions above are figures under the temperature condition of 23±2°C.
※ The figures showing mass above are those under standard specific gravity.

Two structural patterns offered according to the purpose: storage type and infiltration type
Simple structure makes installation easy and helps to shorten the work period.

Example structural patterns for storage type and infiltration type

The following are example structural patterns of underground storage systems using CROSS-WAVE according to the purpose.



Depend on types of sheet, it can be adopted in both the storage type (left) and the infiltration type (right).

Installation procedure

Storage type

Infiltration type

Unlike concrete type, CROSS-WAVE does not require large-scale and prolonged construction work for installation, curing, etc. After the foundational construction (spreading base gravel, base concrete placing, etc.), the work that needs to be done is only laying sheets, assembling CROSS-WAVE blocks and backfilling, minimizing work using heavy equipment, a special-purpose vehicle, etc. to reduce costs.

Thoughtful design for easy maintenance to operate safely for a long time with peace of mind

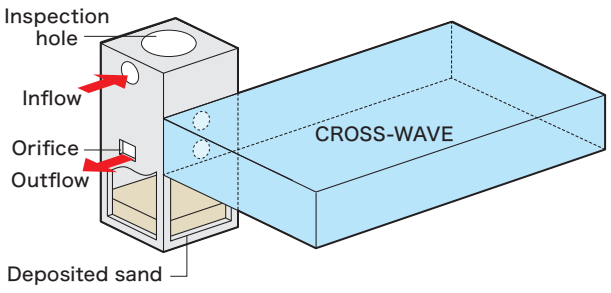
In case of a flood, Regular maintenance is needed. To prevent CROSS-WAVE's performance degradation from earth and sand accumulated inside the storage reservoir due to rainwater inflow, a concrete management basin system for maintenance and an easy cleaning system are prepared. These make periodic inspection and cleaning of deposition easy and quick, allowing full preparation for disasters.

Concrete management basin system

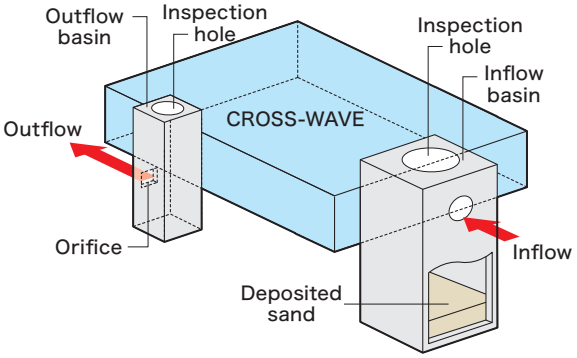
A maintenance-focused storage reservoir structure adopted Responding to small to large areas

Installing a sand basin, etc. at the inflow portion separates sand and earth flowing in, thereby letting only rainwater enter the CROSS-WAVE storage reservoir. Maintenance can be performed by removing deposition in the sand basin with a vacuum cleaner, etc.

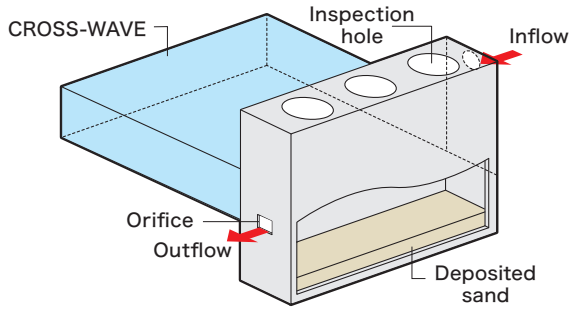
Example of integrated inflow and outflow basins



Example of separately locating inflow and outflow basins



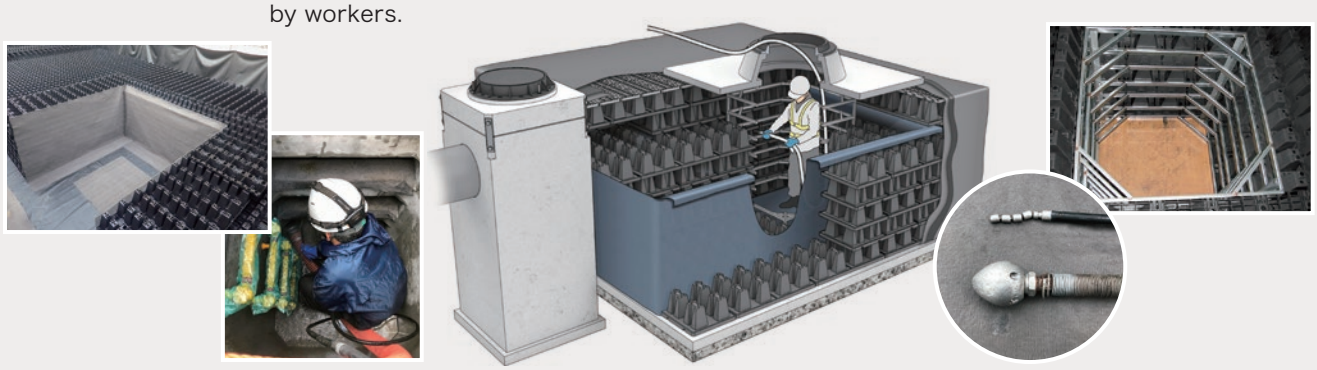
Example of integrated inflow and outflow basins (large-scale regulating pondage)



Easy cleaning system

Thoughtfully designed for workers to enter through the inspection hole and do the cleaning easily

Workers can enter the CROSS-WAVE storage reservoir through the inspection hole to check the status of deposition in it. The easy cleaning system allows concentration of sand and earth flowing in from the inflow pipe to deposit inside the basin, which can be checked by workers.



Installation cases show CROSS-WAVE's capabilities. Small- to large-scale facilities installed almost everywhere in Japan

CROSS-WAVE has been used in more than 97% of prefectures in Japan.
In other words, CROSS-WAVE has penetrated into almost all areas of the country.
Below are installation cases by architecture type, such as plant, shopping center, warehouse, school, hospital and residential area, that respond to various site environments and installation conditions.

School | Hospital | Plant and warehouse | Public facility | Commercial facility | Others

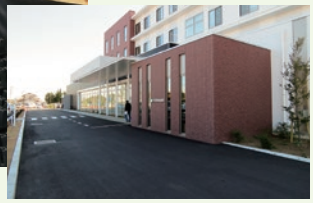
Installation cases

Rainwater regulating reservoir
in Ishikawa Prefecture
9,200m³

Farm in Shizuoka Prefecture
16,500m³

Cemetery in Tokyo
1,000m³

Land development in
Okinawa Prefecture
400m³



Hospital in Saitama
Prefecture
110m³

□ Related products

Material for temporary roads “Plaroad”

NETIS registration
Registration No.
KT-100053-VR

In the case of electric transmission-related construction work and civil engineering work at paddies and fields, temporary roads are traditionally constructed by using a combination of mountain sand, broken stones, crossties, etc. and steel plates; however, this method makes the construction period longer and causes a problem with restoration to the original state and material waste disposal. The material for temporary roads named “Plaroad” enables effective construction and removal of temporary roads.

Material exclusive for roads “AQUAROAD”

▲Flooding-prone roads, underpasses

Measures against soft ground/buoyant force, lightweight mounding ▶

Construction Technology Review and Certification No.1012 Public Works Research Center

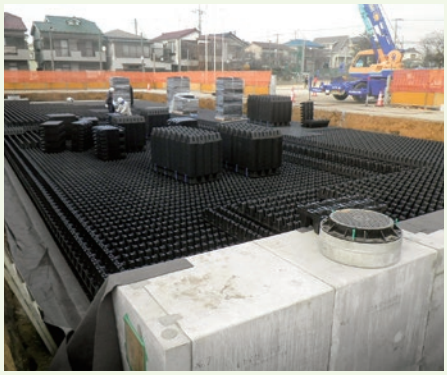
“AQUAROAD” is effective for load alleviation and as a measure against flooding in the event of concentrated heavy rain and buoyant force when using earth pressure-relieving mounding and lightweight mounding. As a structural part of resin rainwater storage/infiltration reservoirs that can be constructed under roads, AQUAROAD has been certificated by Construction Technology Review and Public Works Research Center.

Commercial complex in Saitama Prefecture 500m³

Elementary school in Fukuoka Prefecture 800m³

Commercial complex in Chiba Prefecture 100m³

Housing land development in Saitama Prefecture 5m³



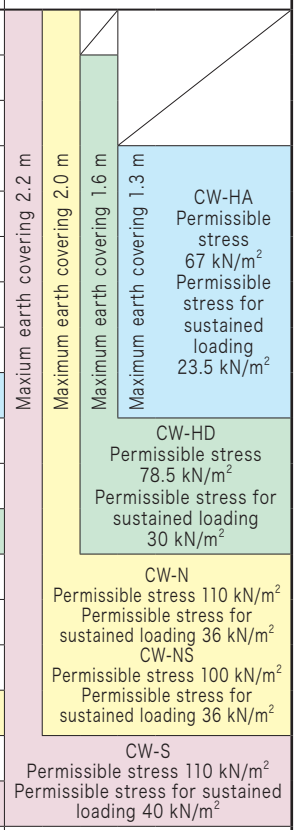
Elementary school in Chiba Prefecture 460m³

Town development in Saitama Prefecture 15m³×140 subdivisions

Calculated load for the vertical direction and scope of application

Earth covering (m)	Vertical earth load (kN/m²)	Live load (kN/m²)			Total (kN/m²)		
		T-25	T-20	T-14	T-25	T-20	T-14
0.5	9.0	78.8	63.1	44.2	87.8	72.1	53.2
0.6	10.8	67.6	54.1	37.9	78.4	64.9	48.7
0.7	12.6	59.1	47.3	33.1	71.7	59.9	45.7
0.8	14.4	52.6	42.1	29.5	67.0	56.5	43.9
0.9	16.2	47.3	37.9	26.5	63.5	54.1	42.7
1.0	18.0	43.0	34.4	24.1	61.0	52.4	42.1
1.1	19.8	39.4	31.6	22.1	59.2	51.4	41.9
1.2	21.6	36.4	29.1	20.4	58.0	50.7	42.0
1.3	23.4	33.8	27.1	19.0	57.2	50.5	42.4
1.4	25.2	31.6	25.3	17.7	56.8	50.5	42.9
1.5	27.0	29.6	23.7	16.6	56.6	50.7	43.6
1.6	28.8	27.9	22.3	15.6	56.7	51.1	44.4
1.7	30.6	26.3	21.1	14.8	56.9	51.7	45.4
1.8	32.4	24.9	20.0	14.0	57.3	52.4	46.4
1.9	34.2	29.6	23.7	16.6	63.8	57.9	50.8
2.0	36.0	28.2	22.6	15.8	64.2	58.6	51.8
2.1	37.8	26.9	21.5	15.1	64.7	59.3	52.9
2.2	39.6	25.7	20.6	14.4	65.3	60.2	54.0
2.3	41.4	24.7	19.7	13.8	66.1	61.1	55.2
2.4	43.2	23.7	19.0	13.3	66.9	62.2	56.5
2.5	45.0	22.8	18.2	12.8	67.8	63.2	57.8
2.6	46.8	21.9	17.6	12.3	68.7	64.4	59.1
2.7	48.6	21.2	16.9	11.9	69.8	65.5	60.5
2.8	50.4	20.4	16.4	11.5	70.8	66.8	61.9
2.9	52.2	19.7	15.8	11.1	71.9	68.0	63.3
3.0	54.0	19.1	15.3	10.7	73.1	69.3	64.7
3.1	55.8	18.5	14.8	10.4	74.3	70.6	66.2
3.2	57.6	18.0	14.4	10.1	75.6	72.0	67.7
3.3	59.4	17.4	14.0	9.8	76.8	73.4	69.2

Scope of application (in the case of T-25)

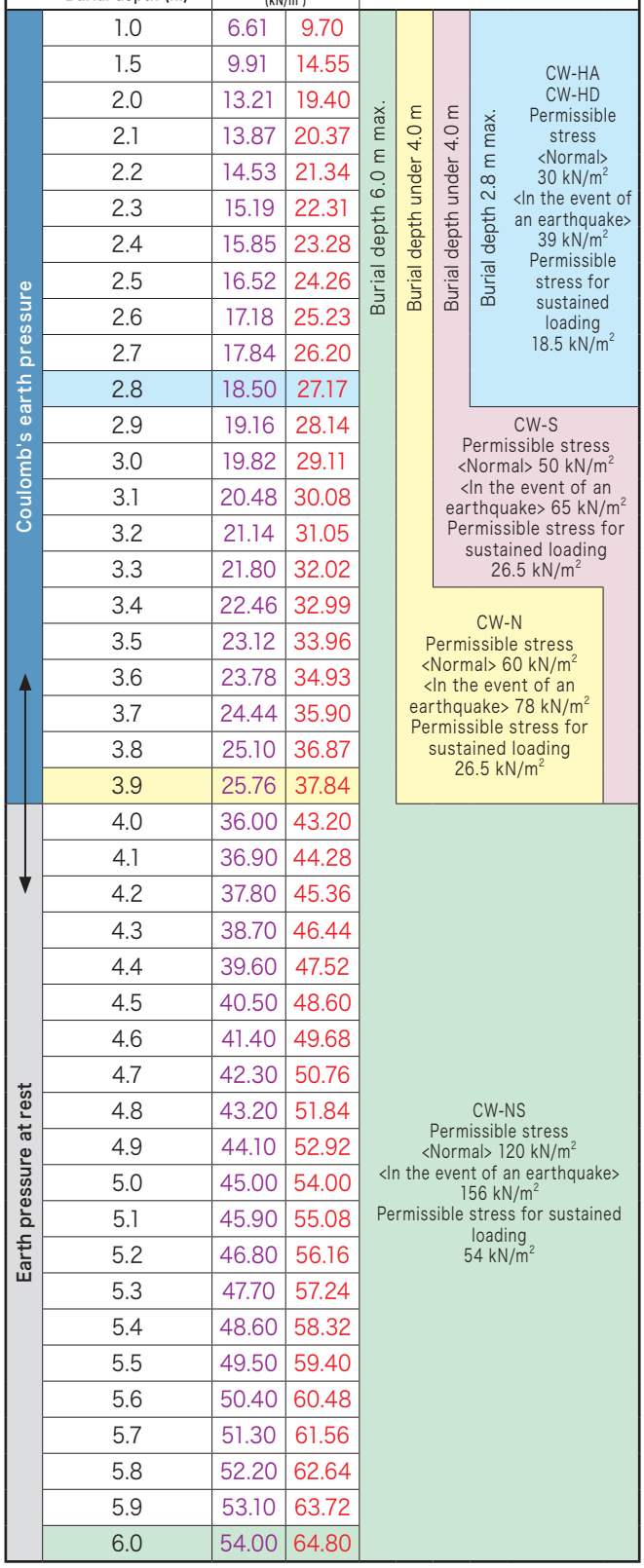


* The maximum earth covering is determined based on the long-term vertical load performance test.

Calculated load for the horizontal direction and scope of application of each product

Item		Normal	In the event of an earthquake*
Soil texture		Cohesive soil	Cohesive soil
Mass per unit volume (kN/m³)		18	18
Coefficient of Coulomb's earth pressure (Under 4.0 m)		0.367	0.539
Coefficient of earth pressure at rest (4 m min.)		0.5	0.6
Surcharge load (kN/m²)		None	0
Burial depth (m)		Horizontal earth pressure (kN/m²)	
Coulomb's earth pressure	1.0	6.61	9.70
	1.5	9.91	14.55
	2.0	13.21	19.40
	2.1	13.87	20.37
	2.2	14.53	21.34
	2.3	15.19	22.31
	2.4	15.85	23.28
	2.5	16.52	24.26
	2.6	17.18	25.23
	2.7	17.84	26.20
	2.8	18.50	27.17
	2.9	19.16	28.14
	3.0	19.82	29.11
	3.1	20.48	30.08
	3.2	21.14	31.05
	3.3	21.80	32.02
	3.4	22.46	32.99
	3.5	23.12	33.96
	3.6	23.78	34.93
	3.7	24.44	35.90
	3.8	25.10	36.87
	3.9	25.76	37.84
Earth pressure at rest	4.0	36.00	43.20
	4.1	36.90	44.28
	4.2	37.80	45.36
	4.3	38.70	46.44
	4.4	39.60	47.52
	4.5	40.50	48.60
	4.6	41.40	49.68
	4.7	42.30	50.76
	4.8	43.20	51.84
	4.9	44.10	52.92
	5.0	45.00	54.00
	5.1	45.90	55.08
	5.2	46.80	56.16
	5.3	47.70	57.24
	5.4	48.60	58.32
	5.5	49.50	59.40
	5.6	50.40	60.48
	5.7	51.30	61.56
	5.8	52.20	62.64
	5.9	53.10	63.72
	6.0	54.00	64.80

CROSS-WAVE
Scope of application
(in the case of cohesive soil)



* Calculated assuming that the design horizontal seismic coefficient is 0.2

Height and void ratio chart

Product name	CW-HA		CW-HD		CW-S		CW-N	
No. of layers	Height (m)	Void ratio (%)	Height (m)	Void ratio (%)	Height (m)	Void ratio (%)	Height (m)	Void ratio (%)
1	0.220	94	0.220	94	0.1800	92	0.230	94
2	0.405	95	0.405	94	0.2925	92	0.430	94
3	0.590	95	0.590	95	0.4050	92	0.630	95
4	0.775	95	0.775	95	0.5175	92	0.830	95
5	0.960	95	0.960	95	0.6300	92	1.030	95
6	1.145	95	1.145	95	0.7425	92	1.230	95
7	1.330	95	1.330	95	0.8550	92	1.430	95
8	1.515	95	1.515	95	0.9675	92	1.630	95
9	1.700	95	1.700	95	1.0800	92	1.830	95
10	1.885	95	1.885	95	1.1925	92	2.030	95
11	2.070	95	2.070	95	1.3050	92	2.230	95
12	2.255	95	2.255	95	1.4175	92	2.430	95
13	2.440	95	2.440	95	1.5300	92	2.630	95
14	2.625	95	2.625	95	1.6425	92	2.830	95
15					1.7550	92	3.030	95
16					1.8675	92	3.230	95
17					1.9800	92	3.430	95
18					2.0925	92	3.630	95
19					2.2050	92	3.830	95
20					2.3175	92		
21					2.4300	92		
22					2.5425	92		
23					2.6550	92		
24					2.7675	92		
25					2.8800	92		
26					2.9925	92		
27					3.1050	92		
28					3.2175	92		
29					3.3300	92		
30					3.4425	92		
31					3.5550	92		
32					3.6675	92		
33					3.7800	92		
34					3.8925	92		

		CW-N + NS (in the case of hybrid)	
		Height (m)	Void ratio (%)
Range with a burial depth under 4.0 m CW-N is used.	1	0.230	94
	2	0.430	
	3	0.630	95
	4	0.830	
	5	1.030	
	6	1.230	
	7	1.430	
	8	1.630	
	9	1.830	
	10	2.030	
	11	2.230	
	12	2.430	
	13	2.630	
	14	2.830	
	15	3.030	
	16	3.230	
	17	3.430	
Range with a burial depth from 4.0 to 6.0 m CW-NS is used.	1	0.140	94
	2	0.280	
	3	0.420	
	4	0.560	
	5	0.700	
	6	0.840	
	7	0.980	
	8	1.120	
	9	1.260	
	10	1.400	
	11	1.540	
	12	1.680	
	13	1.820	
	14	1.960	
	15	2.100	

Hybrid structure examples (CW-N + CW-NS)

Burial depth (m)	Product name	Plane area (m^2)	No. of layers	Height (m)	Void ratio (%)	Storage volume (m^3)
Under 4 m	Earth covering			0.500		
	CW-N	1,000	17	3.430	95	3,258*1
4 m min.	CW-NS		14	1.960	94	1,842*1
	Total		31	5.890		5,100

*1: Figure after being rounded down to the nearest integer

Our partner companies across Japan provide support for design and installation throughout Japan.

Our partner company will provide support about the desired rainwater storage reservoir (rainwater storage and infiltration facility), from design consultation to after-sales service.

Inquiry → Design consultation → Drawing creation with CAD → Confirmation before installation → Assembly and installation → Installation completion

※ The support described above is provided upon request.

[To use CROSS-WAVE safely]

Below are important instructions regarding safety. Please be sure to follow them.

Prohibition

The following acts are prohibited as they may cause an accident or damage to a facility.

- **Use of broken products**
  Never use broken products.
- **Use near fire**
  The products are flammable. Keep away from flames during storage and installation.
- **Modification of products**
  Do not make modifications (boring, cutting, etc.) to the products. Doing so will reduce strength.
- **Violation of law**
  Observe related laws, regulations, etc. for installation.
- **Use outside the applicable scope**
  When using the products, observe the applicable loading condition by product.(If the products are used with an earth covering, burial depth, etc. outside the scope of application, the products may break.)
- **Crane operation**
  Do not operate a crane or remove sheet piles on the storage reservoir.
- **Installation during stormy weather**
  Do not lay sheets during the rain or snow.
- **Pouring of hot water**
  Pouring hot water will cause deformation and reduce strength. Contact us before doing so.

Caution

To install products safely, caution should be exercised regarding the following matters.

- **Handling products**
  Do not throw away the products. Doing so will cause breakage.
- **Storing products**
  When the products are in storage for a long time, cover them with sheets to keep from direct sunlight.
- **Laying sheets**
  Sheets shall be laid by professionals so as not to cause leakage of water, etc. due to imperfect bonding of sheets.
- **Installation**
  When getting on the upper surfaces of the products or spacers during installation, watch your step.
- **Backfill**
  After completing installation of the storage reservoir, backfill the hole as soon as possible. Backfill the area around the storage reservoir evenly so as not to cause uneven load.
- **Oil resistance**
  If organic solvents, oil, etc. stick to the products, deformation and strength reduction are caused. Be sure to keep them away.

※ SEKISUI CHEMICAL CO., LTD. makes a proposal pursuant to the Technical Guidelines for Plastic Underground Storage and Infiltration Facilities (Draft).

SEKISUI CHEMICAL CO., LTD.

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