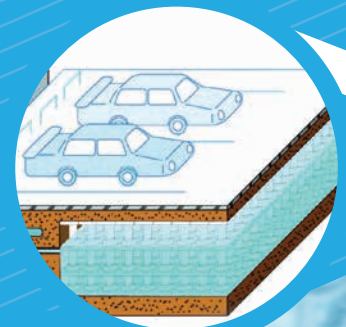
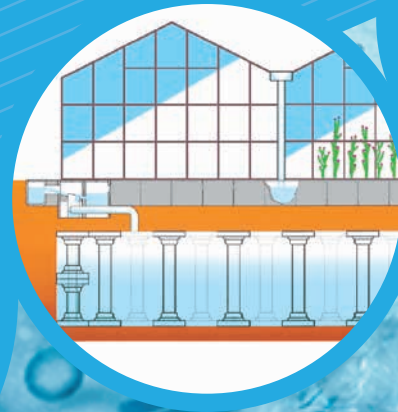


**Innovative storage parts to meet
the demands of the times**

Aqua Palace

**Plastic parts for preventing
urban-type floods and realizing
effective utilization of rainwater**



Totetsu Manufacturing, Co., Ltd.

AQUA PALACE

Characteristics

The structure can be selected.

An economically rational storage tank is realized.

Pressure resistant performance required under a parking lot is different from what is required in a greenhouse. With the Aqua Palace, the structure can be selected according to the installation site and the purpose of use.



Inspection and cleaning within the tank is possible.

Improvement in connection with maintenance and management

Underground storage tanks are affected by impact by cars, vibration during an earthquake and variation of underground water. That is why the tanks need inspection and maintenance in order to operate safely for as long as several tens of years. With the Aqua Palace, person can get inside and reliably inspect and maintain all the parts within the tank.



Porosity is high; it is higher than 92%, 95% at the highest.

Maintenance and improvement of storage efficiency

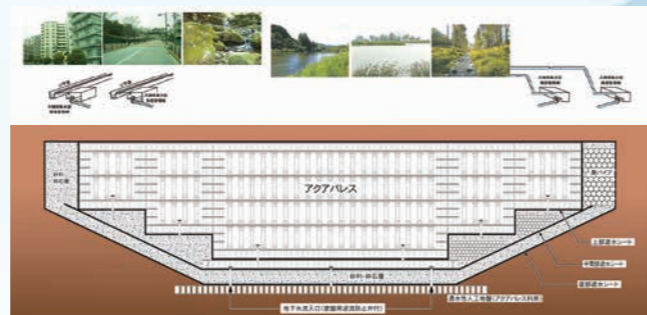
Porosity of the Aqua Palace varies according to the selected structure but, in any case, a high storage ratio exceeding 90% is possible. The larger the storage tank is, the higher the porosity is.



Ultra-large storage tanks can be constructed

Achievement of solutions for global water problems

The Aqua Palace is stable in assembly in the vertical direction. Because of this, it can be used for construction of ultra-large storage tanks to be substituted for dams and reservoirs, aided by adoption of the cell type or hybrid type structure. It is expected to spread as a system contributing to solution for global water problems in future.



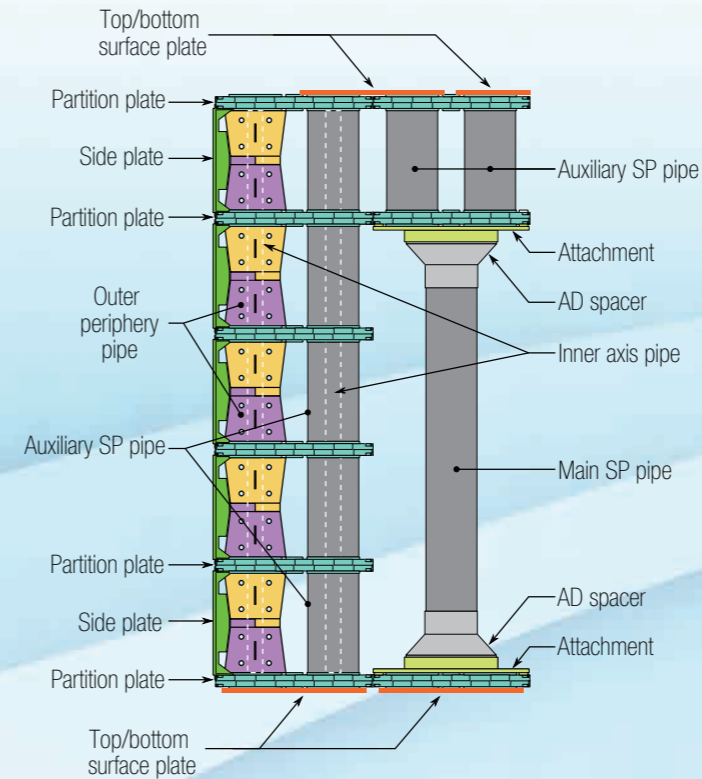
Contributing to formation of a recycling-oriented society through the effective utilization of PVC



It has been found that resin products such as polyvinyl chloride (PVC) tubes do not deteriorate, so long as they are under the ground and free from UV light. Thus, in connection with construction of the Aqua Palace tank, recycled products (including reused ones) will be proactively utilized for regions for which it is determined that the recycled products can be used "without a problem" even if safety is taken into consideration.

A PVC tube to be disposed of.
Many PVC tubes are in such a good condition that they can be used all right, depending on the member they are used for.

Constructional elements



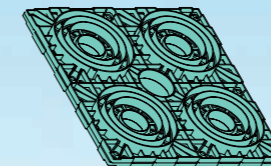
1 Top/bottom surface plate (made of polypropylene)

It can be used either as a top surface plate or as a bottom surface plate. It should be set so that a smooth surface faces downward when used as a bottom surface plate, and the smooth surface faces upward when used as a top surface plate.



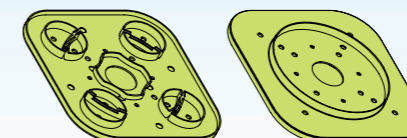
2 Partition plate (made of polypropylene)

A member constituting the main part of the Aqua Palace, along with a spacer pipe (SP pipe). These plates can be integrated with one another in the horizontal direction to form a plane.



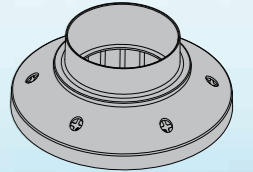
3 Attachment (made of polypropylene)

It mediates between the partition plate and the AD spacer, connecting and integrating them.



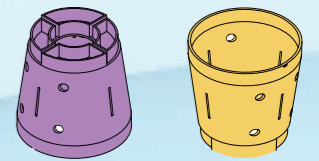
4 AD spacer (made of polypropylene)

If it is connected via a partition plate and an attachment, a slim pipe can be used as a main SP pipe. As a result, space which enables a person to conduct inspection is created within the water storage tank.



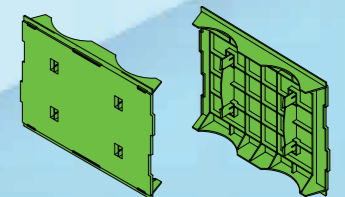
5 Outer periphery pipe (made of polypropylene)

Two pipes face and are engaged with each other when they are used. These pipes receive the soil pressure conveyed through the side plate.



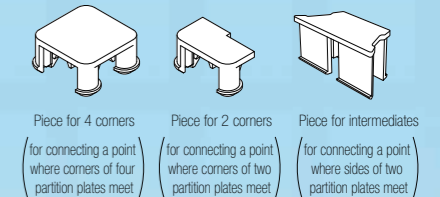
6 Side plate (made of polypropylene)

A flat plate that directly receives the soil pressure from the lateral side. Four protrusions of inside the side plate come into contact with the outer periphery pipe and the R-planes on the upper and bottom sides touch the partition plate, so that the pressure is distributed.



7 Joint piece (made of polypropylene)

This joint piece connects a plurality of partition plates with one another to form an integrated plane.



8 Main SP (spacer) pipe (made of vinyl chloride)

In principle, VU200 (JIS standard or equivalent) should be used. In the case of T-6 vehicle load or smaller, PVC-recycled (reused) pipes can be used.

9 Auxiliary SP pipe (made of vinyl chloride)

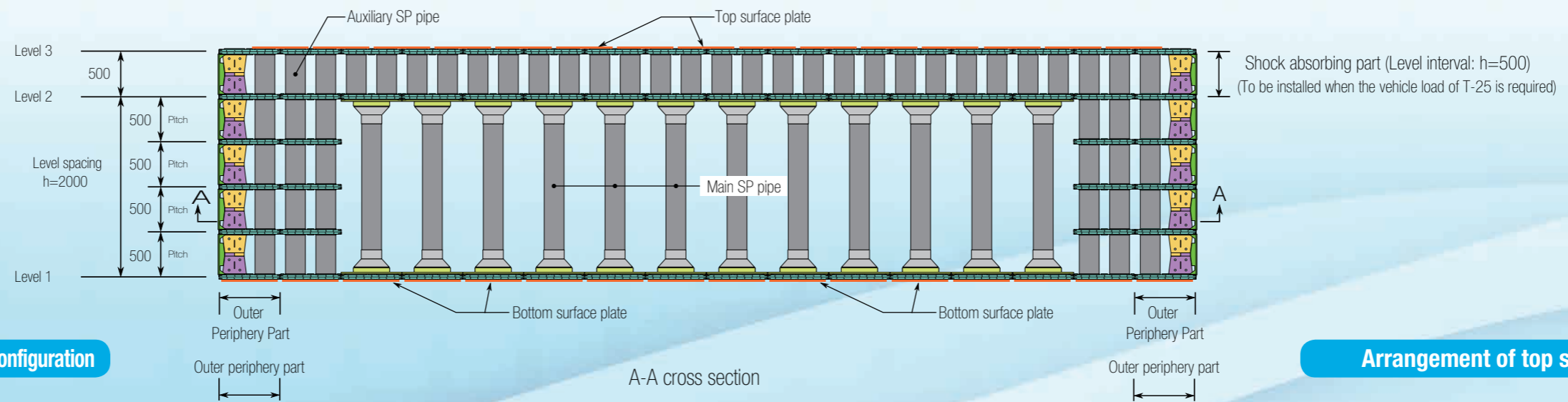
A PVC-recycled (reused) pipe with a diameter of 125 to 250 should be used.

10 Inner axis pipe (made of vinyl chloride)

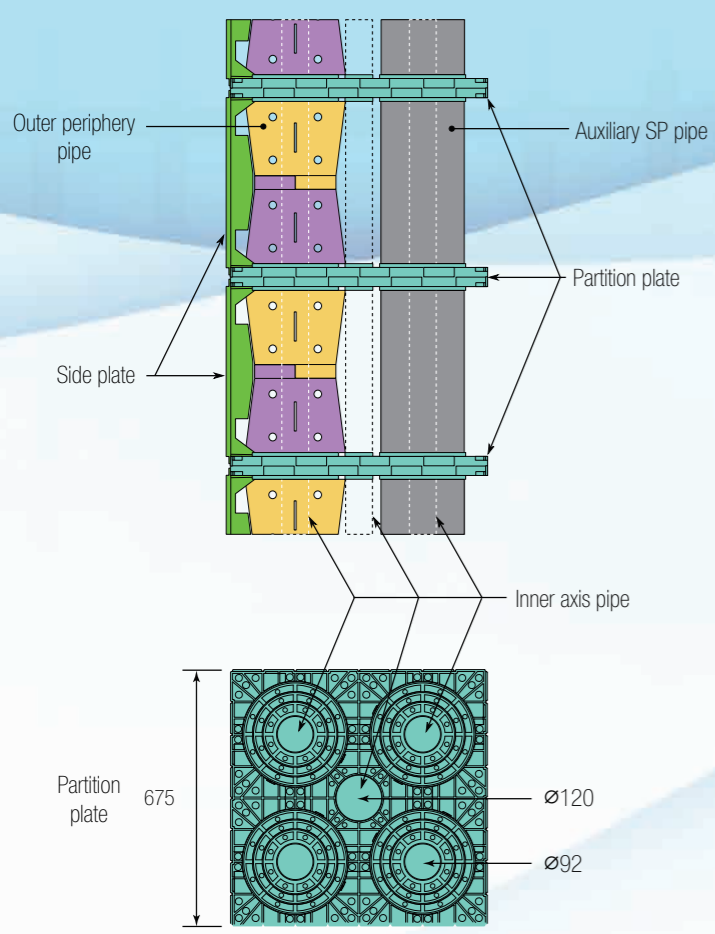
A PVC-recycled (reused) pipe with a diameter of 50 to 100 should be used.

* Colors of products in the catalog are added for the purpose of distinction, and different from the actual product colors.

Basic configuration of the Aqua Palace

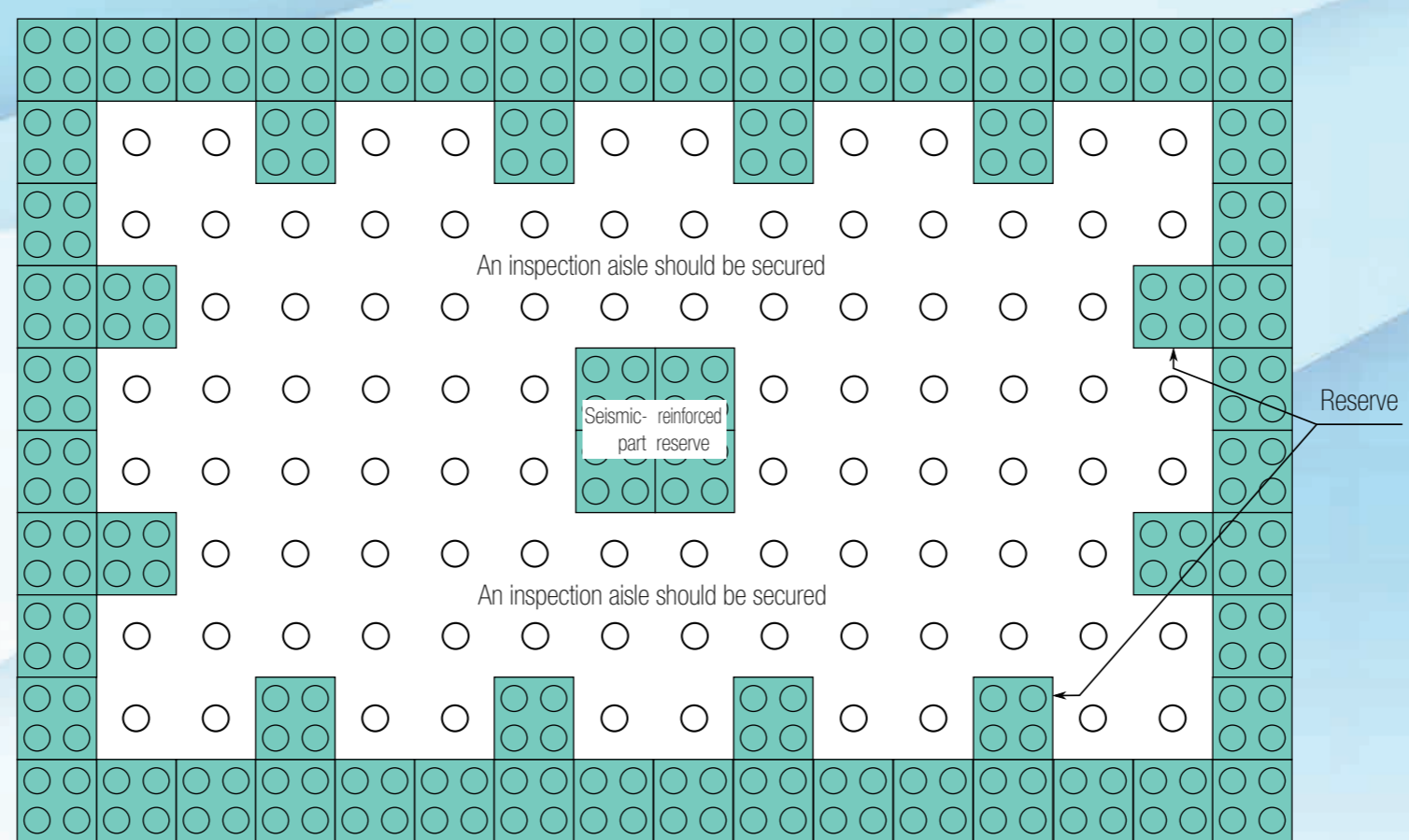


Configuration of the outer periphery part configuration

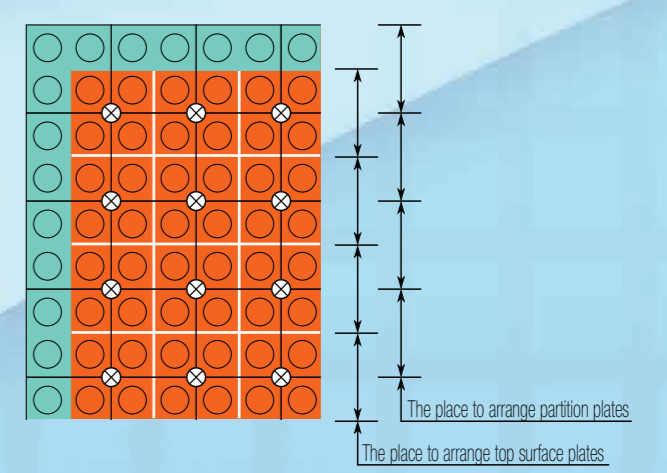


For reinforcement, 1 to 5 inner axis pipes (PVC pipes) can be inserted from five holes in the partition plate into the outer periphery part.

A-A cross section



Arrangement of top surface plates



In order to prevent the place marked ⊗, where corners of partition plates meet, from becoming a weak point of the structure, the top surface plate should be arranged as shown in the figure above.

Pressure resistance reinforcement by reserves

More "reserves", which are installed within outer periphery parts, should be installed so as to respond to the lateral soil pressure increasing as the depth of the storage tank increases. In addition, inner axis pipes are inserted into the partition plate and the auxiliary SP pipe here, just like the outer periphery part.

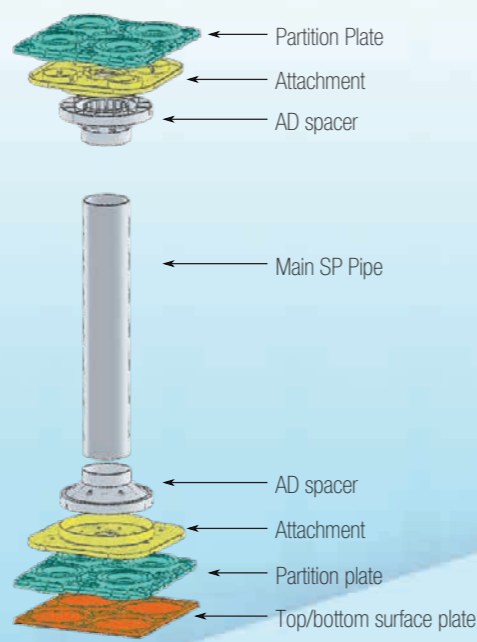
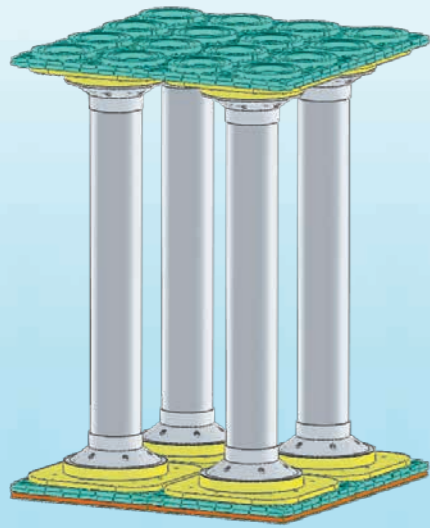
Seismic-reinforced parts

In order to ensure 100% earthquake resistance, one seismic-reinforced part per approximately 50 square meters of the surface area within the tank (except for outer periphery parts) is provided. Inner axis pipes are inserted into the partition plate and the auxiliary SP pipe here, just like the outer periphery part.

* Colors of products in the catalog are added for the purpose of distinction, and different from the actual product colors.

Configuration and assembly of each part

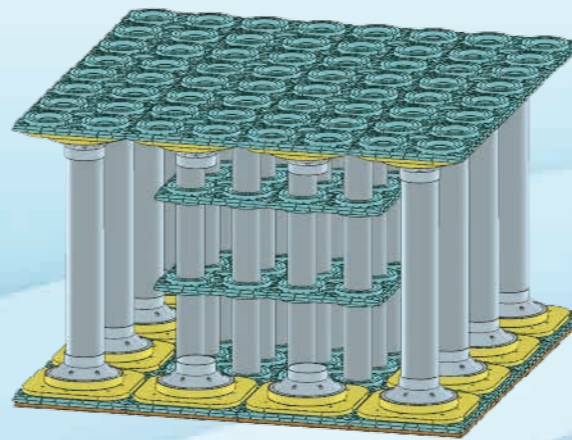
The center of the main body



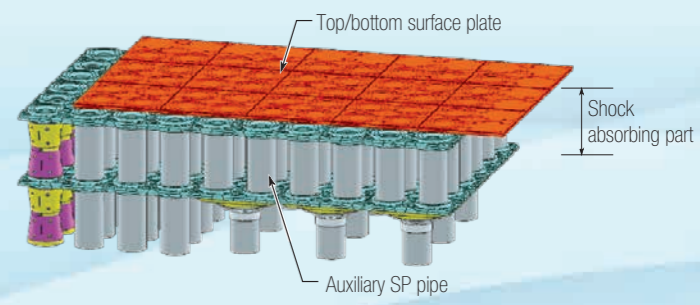
The top/bottom surface plate is placed at bottom first, and the partition plate is engaged onto the top/bottom surface plate and is connected by a joint piece. Then parts are assembled in order from the bottom, as shown in the figure above, to form a three-dimensional object.

If the strength of T-25 is required, a shock absorbing part is provided on this. If the strength of T-14 or smaller is acceptable, the top/bottom surface plate is provided on the top and assembly is completed.

Seismic-reinforced part

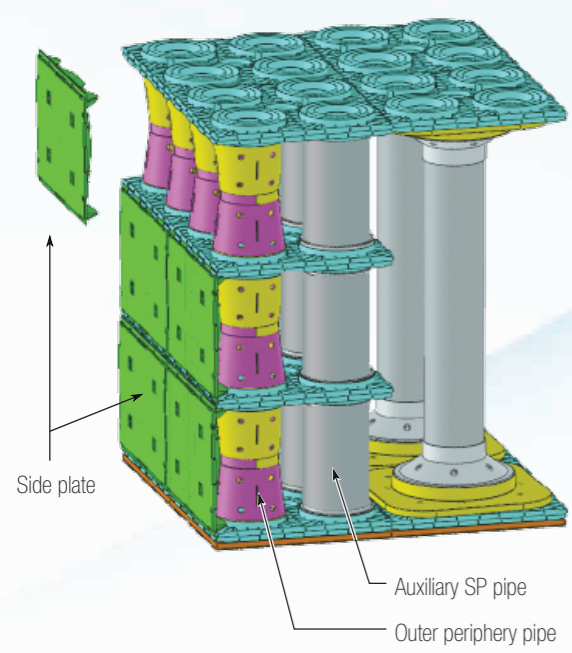


Shock absorbing part



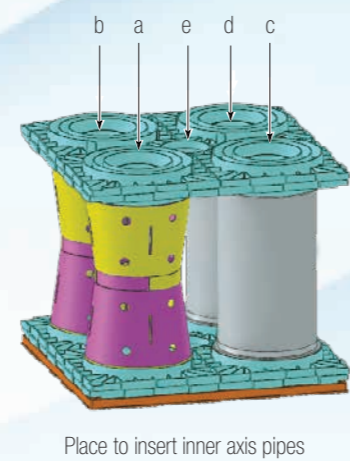
Outer periphery part

Outer periphery pipes and auxiliary SP pipes are directly set to partition plates, without using any attachments or AD spacers.



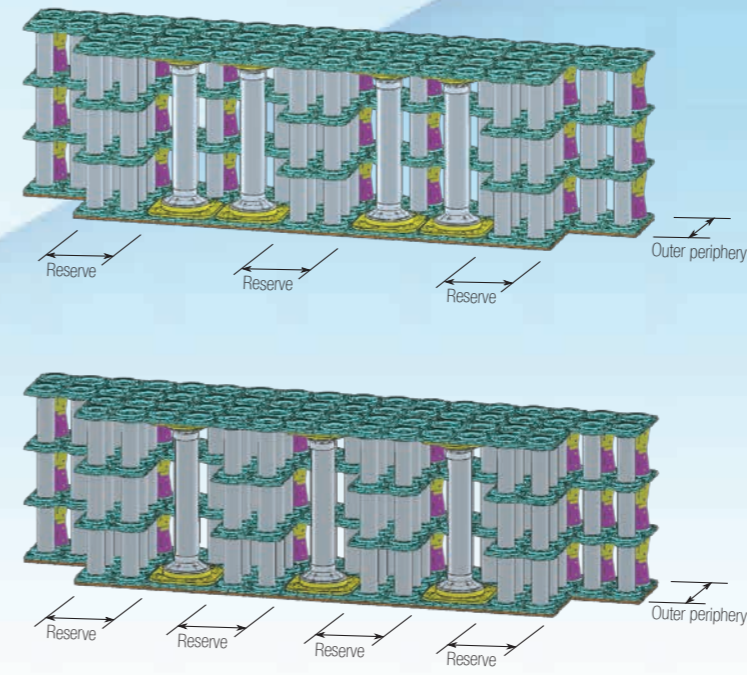
Inner axis pipes are usually inserted from holes in the uppermost partition plate (See the figure below). There are five insert holes, and more pipes are inserted as the tank height is larger. The relation should be as follows:

- Tank height 1.0m --- 2 points (b and c)
- Tank height 1.5m --- 3 points (a, b and c)
- Tank height 2.0m or higher --- all points (a, b, c, d and e)



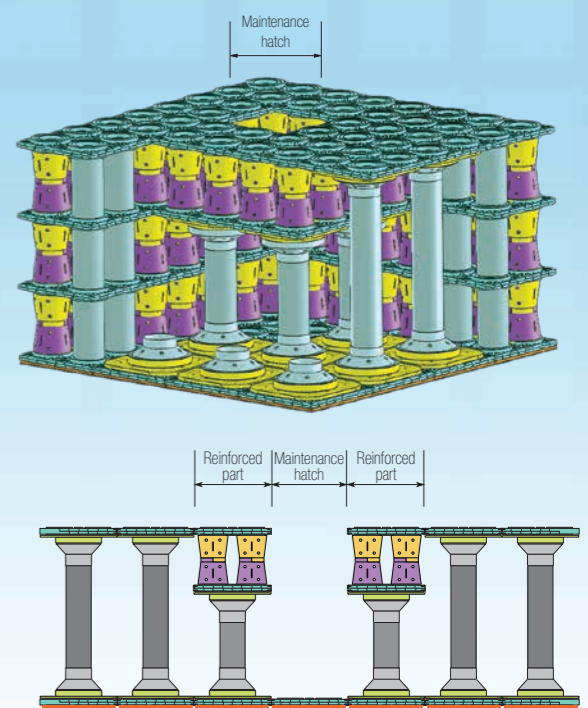
Lateral pressure resistance reinforcement by reserves

Reserves are provided when the tank height is 2m or higher (including the shock absorbing part). The number of reserves is increased according to the lateral pressure.



Place to provide a hatch

The place to provide a maintenance hatch is firmly reinforced by outer periphery pipes located immediately below, and around the place.

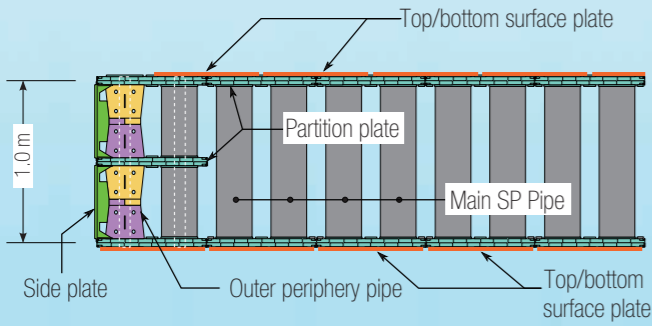


Standard structure of the Aqua Palace

1 T-25-compatible standard structure

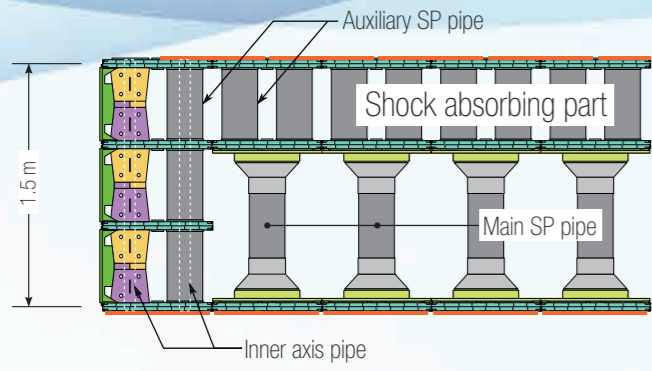
T-25 is the load capacity required where heavy-duty vehicles weighing up to 25 tons are expected to enter. To be concrete, T-25 is required below public parking lots or in the underground space of vacant land in cities.

NO.1 H (height) = 1.0m



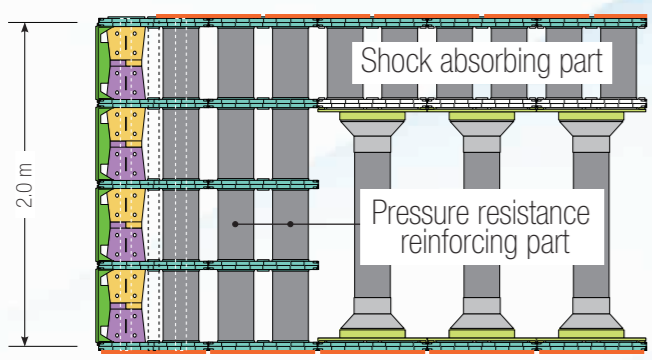
- Specification**
- As main SP pipes, PVC pipes (including recycled/reused products) of at least VU 150 or equivalent are used.
 - Inspection holes are properly arranged so that the inside of the tank can be inspected and cleaned from the top of the tank.
 - Normally, pressure resistance reinforcement with the use of "reserves" is not used.

NO.2 H (height) = 1.5m



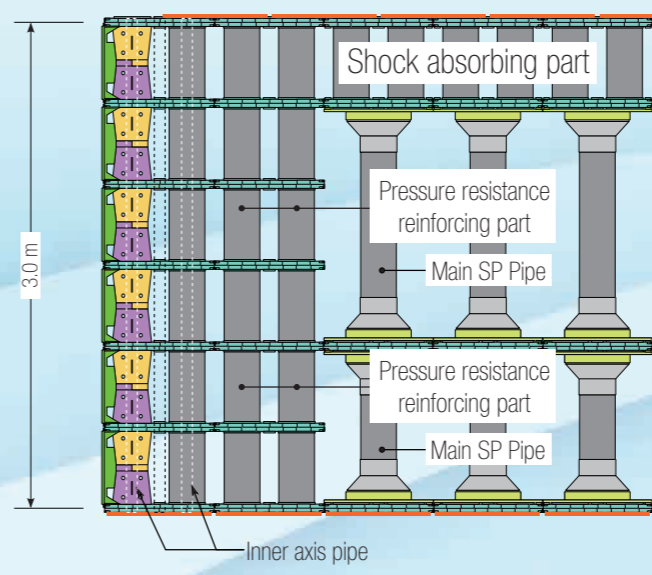
- Specification**
- As main SP pipes, PVC pipes of VU 200 or equivalent are used.
 - A maintenance hatch is provided, and a person goes into the tank to inspect and clean the inside of the tank.
 - Normally, pressure resistance reinforcement with the use of "reserves" is not used.

NO.3 H (height) = 2.0m



- Specification**
- As main SP pipes, PVC pipes of VU 200 or equivalent are used.
 - A maintenance hatch is provided, and a person goes into the tank to inspect and clean the inside of the tank.
 - Normally, pressure resistance reinforcement with the use of "reserves" is used.
- *4 pitches, 2.0m under the shock absorbing part when H (height) =2.5m.
Specification is the same as in the case of H=2.0m.

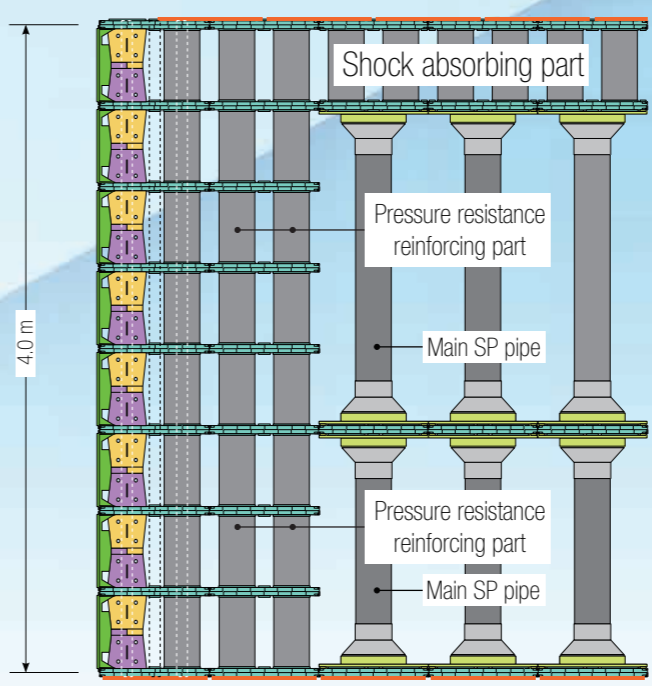
NO.4 H (height) = 3.0m



- Specification**
- As main SP pipes, PVC pipes of VU 200 or equivalent are used.
 - A maintenance hatch is provided, and a person goes into the tank to inspect and clean the inside of the tank.
 - Normally, pressure resistance reinforcement with the use of "reserves" is used.

**2 pitches, 1.0m" changes into "3 pitches, 1.5m" at the lowest step when H (height) =3.5m.
Specification is the same as in the case of H=3.0m.

NO.5 H (height) = 4.0m



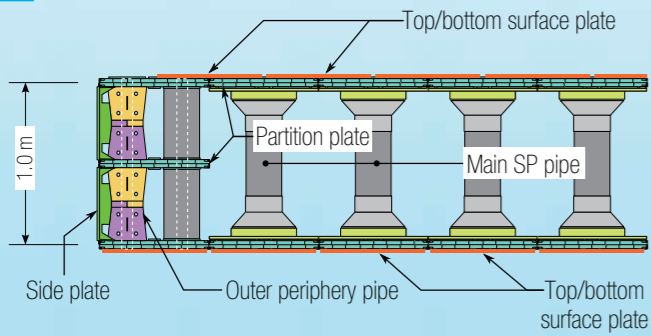
- Specification**
- As main SP pipes, PVC pipes of VU 200 or equivalent are used.
 - A maintenance hatch is provided, and a person goes into the tank to inspect and clean the inside of the tank.
 - Normally, pressure resistance reinforcement with the use of "reserves" is used.

Examples of construction of the Aqua Palace

2 T-6-compatible standard structure

T-6 is the load capacity required where only passengers pass and sometimes up to medium-sized vehicles are expected to enter. This structure is used in the underground space of gardens of collective housing and houses, parking space of ordinary households, farmland and greenhouses.

NO.1 H (height) = 1.0m



Specification

- As main SP pipes, PVC pipes (including recycled/reused products) of VU 200 or equivalent are used. In some cases, however, two PVC pipes with a smaller diameter (100 to 150) can be used instead. (See below)
- A maintenance hatch is provided, and a person goes into the tank to inspect and clean the inside of the tank.
- Pressure resistance reinforcement with the use of "reserves" is used only when H (height)=2.0m.

NO.2 H (height) = 1.5m

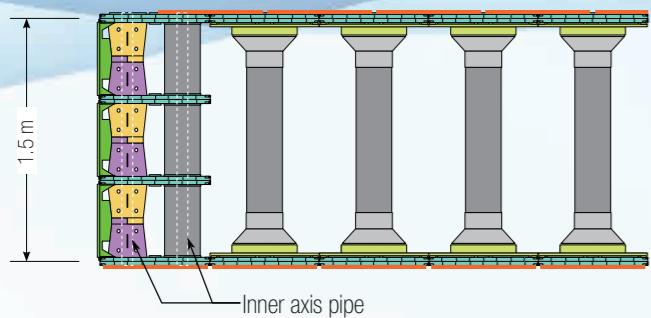
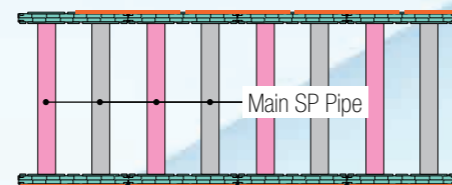
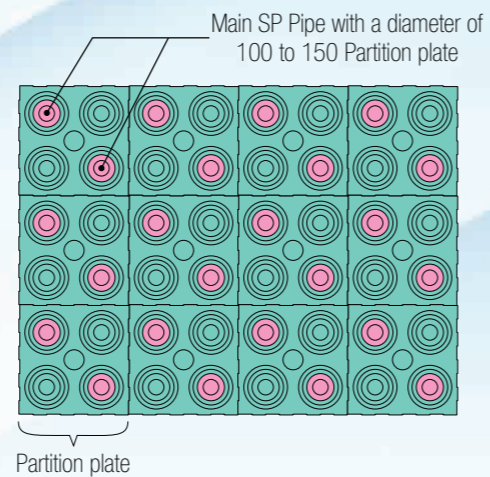
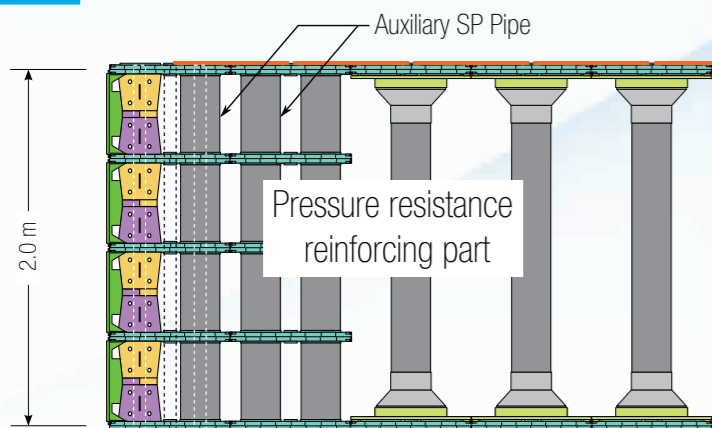


Figure: An example of arrangement when two PVC pipes are used per partition plate



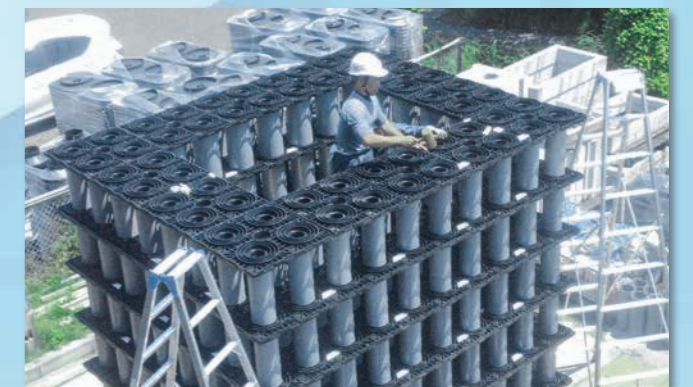
NO.3 H (height) = 2.0m



▲ Aqua Palace assembled to have a capacity of about 100m³.



▲ Assembly work 1



▲ Assembly work 2



▲ Medium-sized underground water storage tank under construction: with a water storage capacity of 95 m³.



▲ Small parts are assembled in the plant, transferred to the construction site and lifted by a crane.



Notes



- **The Aqua Palace should be assembled correctly.**

Tasks including engagement of partition plates, or of a partition plate and a spacer, should be conducted properly and correctly. Incorrect engagement may lead to structural breakdown or workers' falls.

- **Please beware of fall accidents.**

Workers stepping on a partition plate of the outer periphery part should beware of fall accidents.

- **Open flame is strictly prohibited in the Aqua Palace.**

Do not put flame or a heat source near the Aqua Palace. A fire or softening deterioration may be caused.

- **Please beware of the lack of oxygen when entering the inside of the completed storage tank.**

Workers entering the Aqua Palace tank in use for the purpose of inside inspection should take adequate measures against the lack of oxygen, toxic gases and bacterial infections.

- **Please take care during the design or construction work at a place where the underground water level is high.**

Plastic storage parts are easily affected by the buoyancy because of their specific gravity is small. Please take adequate measures against levitation when a storage tank is installed at a place where the underground water level is high. Please beware of intrusion of rainwater into the surrounding areas or a rise in the level of underground water during the construction work, and take measures such as drainage as necessary.



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Agency