



ACN 129 296 957

Capiphon™

Draintube & Drainbelt

Product Information Pack (PIP)

Australian Road & Rail Infrastructure

Type Approval of Products

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Committed to sustainable and cost-effective water Management

Introduction

Capiphon is a relatively new technology that drains water from saturated soil but, unlike perforated pipe, does not rely on gravity

alone. Capiphon uses surface tension, capillarity and syphonic action to move more water than through gravity alone. Additionally, it does not rely on geotextile fabric to avoid blockage by soil particles. Thus, the system permeability (flow) is not progressively impeded by the fabric as it traps the fine soil particles.

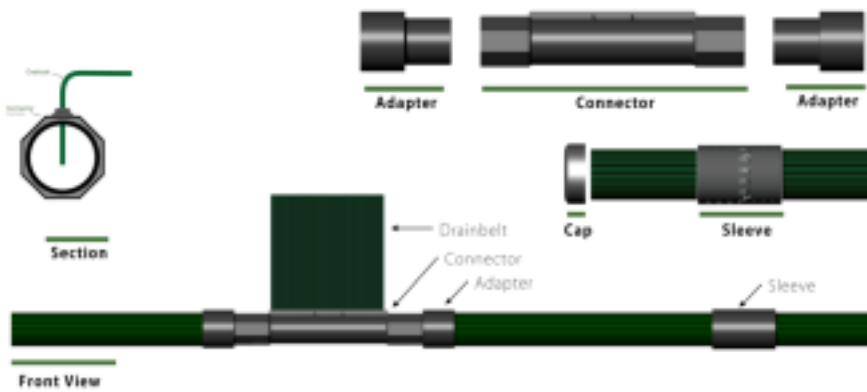
Capiphon can be used as a cost-effective substitute wherever perforated drainage is employed – beside and under roads and rail tracks, for instance, as well as in embankments.

Similarly, it is used behind retaining walls, in tunnels, around buildings and other infrastructure, rooftop gardens and, of course, in agriculture. It has been successfully employed in Taiwan and China for over 20 years without diminution of flow.

This submission is for approval of Capiphon, in the first instance, as an underdrain for stormwater pipes alongside roads. This “like for-like” application is simple, low-risk and low cost.

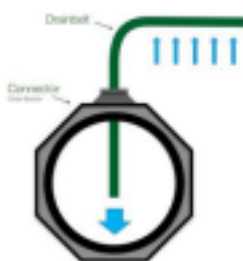
Draintube System

Components

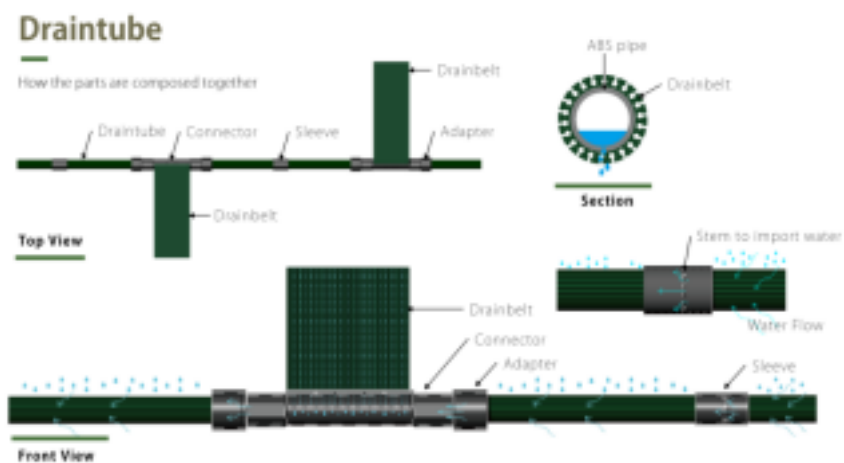


In

saturated soil, water moves into the Capiphon belt. If the belt is on a 1% slope, or there is a 5-10mm head, the capillary straw moves along the belt. The drop into the Draintube creates an additional head which increase flow rate and draws water from below.



Water is also collected by the grooves on the outside of the Draintube and flows through a special adapter into the inside of the next section of Draintube.



Not all of the component parts need to be used in all applications. A common configuration, for instance, is in draining turf playing fields or under a concrete slab. In these cases, the major component is the Capiphon Drainbelt which is laid flat. The end of the belt dipping into a collector pipe creating a siphon head which increases the flow rate.

[Capiphon Drainage Laboratory Demo](#)

The siphon effect is demonstrated in this video showing the capillary and siphon action of Capiphon belt.

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It also shows that, because the PVC used in Capiphon is slightly hydrophobic, water moves out of the grooves when the soil starts to dry out. As a result, any remaining silt and/or colloidal material is removed. There is also no water left in the grooves

to attract tree roots.

Capiphon Product Information

The Capiphon belt (“**Capiphon**”) is manufactured from high quality virgin PVC.

- There may be some variation in width of the belt which arises from the manufacturing process and/or from subsequent splitting. This will be no more than 5% variation and will not affect the performance of the belt other than a marginal increase or decrease in capacity.
- The flexibility of the Capiphon belt is temperature dependent. It becomes less flexible in cold weather and will, under those conditions, often revert to its original coiled configuration. This is normal. Prior to installation we recommend laying the belt in the sunlight or a warm area to enable easier handling.
- Extreme temperature (over 100° Centigrade) together with extreme pressure may distort the PVC and occlude some of the grooves.
- The Capiphon belt is slightly hydrophobic – that is, it appears to repel water. This is normal and contributes to its performance, in that water will move out of the grooves when the surrounding soil dries out. The apparent water resistance of the Capiphon is only temporary and disappears when in the soil, due to the decrease in surface tension when in contact with the soil particles.

Benefits of Capiphon

When installed in accordance with the most current Installation Guidelines published by Capiphon Drainage Australia Pty Limited, Capiphon is claimed:

1. **To be more effective** than other commonly used sub-surface drainage systems such as slotted pipe and “French Drains”.

By “more effective”, we mean that, in the trials we have undertaken:

- a. Capiphon starts to flow earlier than other sub-surface drains;
- b. Capiphon flows for longer than other sub-surface drains; and
- c. Capiphon lowers the water table further than other sub-surface drains.

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2. **To Never Block.**

By “never block”, we mean:

- a. Soil particles larger than approximately 0.3mm will not enter into the grooves; and

- b. Soil particles less than approximately 0.3mm may pass into one or more grooves but will either be flushed out over time or will remain in the groove without adversely affecting the ability of Capiphon to drain.
3. **To Cost** less than conventional slotted pipe drainage. By “cost less”, we mean we anticipate you will enjoy savings from one or more of the following:
 - a. By using a narrower trench;
 - b. By using a shallower trench;
 - c. By not requiring a geotextile cloth to prevent soil particles from entering into the system; and
 - d. By backfilling with washed coarse sand instead of gravel which, although the price per cubic metre is similar, is easier to transport and handle.

Capiphon Life Expectancy

PVC in general has an extremely long life, especially if kept out of the sunlight and away from extreme heat (over 100° Centigrade).

PVC pipes have been approved for use for drinking water as well as for sewerage in most countries, with lifetimes expected to be in the hundreds of years.

Capiphon is soft PVC that contains plasticizers to make it more flexible. Generally, soft PVC will not last as long as hard, un plasticized PVC, however it is still anticipated to last at least 25 years underground, and probably much longer.

Capiphon was first installed in Taiwan in 1999. It is still functional almost 20 years later.

For 3 years Capiphon was left outside on the surface in direct sunlight in Windsor, NSW, and in that time would have experienced air temperatures in the high 30s, as well as frosts. When examined after that period, there was no apparent detriment, and the belt was subsequently used in trials with no identified drop in functionality or performance.

Capiphon Technical Features & Performance

Product Capiphon™ is a drainage material made from a special formulation of PVC that remains flexible and is long lasting. Capiphon™ has a series of grooves running down its length. The grooves are omega shaped with an internal diameter of one millimetre. The opening to the grooves is approximately 0.3 mm.

General Brochure

Drainage Brochure showing the many applications in which Capiphon Drainage is being used.

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Initial risk assessment

Safety Data Sheet

Capiphon Safety Data Sheet

Physical, chemical, environmental, and other factors involved in using and being exposed to Capiphon. The information set forth herein has been gathered from standard reference materials and/or supplier test data and is, to the best knowledge and belief of Capiphon Drainage Pty Ltd, accurate and reliable.

Blockage

Capiphon (Draintube) has been widely installed in China and Taiwan for over 20 years. [This video \(in Chinese with English subtitles\)](#) is of Capiphon Draintube installed into an embankment showing that it is still draining well after 20 years.

[Examining The Clogging Potential of Underdrain Material For Stormwater Biofilter \(Redahegn Sileshi\)](#)

This paper refers to the blockage risk for Capiphon when used as an underdrain for a bioretention swale where the blockage risk is associated with turbid water in which algae would be expected and encouraged to grow.

[Capiphon Product Warranty](#)

Capiphon Drainage Australia Pty Limited ACN 129 296 957 (Capiphon) warrants to the purchaser of the Capiphon Drainage Belt (and Capiphon Drain Tube/Pipe from Capiphon and to the last purchaser of the Product prior to its installation that, subject to the Conditions of Warranty set out, the Product is as described, is without defects, and will not block.

[Why Capiphon Does Not Block](#)

This video shows why perforated pipe blocks. Water remains in the perforated pipe when it has stopped flowing. Any soil particles suspended in this water settles, and over time and many rain events, builds up and blocks the pipe. Additionally, it is this water that attracts tree roots which also block the pipe.

Incorrect installation as a potential risk

Given that Capiphon is somewhat counter-intuitive, especially for installers long-practising installers, detailed installation instructions are available online, and a training program is being developed for the many different applications. Given the siphoning characteristic of Capiphon, it is less prone to incorrect installation than traditional perforated pipe.

Requirements verification traceability matrix (To be addressed later)

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Comparison of material properties to main competitors

There are two main competitors to Capiphon in sub-surface drainage, both of which usually have geotextile cloth around them:

a) Standard PVC perforated pipe

b) HDPE perforated pipe.

Product	Capiphon DRAINTUBE	PVC perforated pipe	HDPE perforated pipe
Opening rate	20%	1.50%	6.30%
Geotextile cloth?	No	Yes	Yes
Filter material?	No, but washed coarse sand recommended.	Yes	Yes
Drainage efficiency	Great, especially at low head	Bad	Good
Drainage depth to bottom	0 to -7cm, as long as the capillary connection is maintained. ¥¥	25mm	0mm horizontal 20mm vertical
Clogged condition	Not easily blocked	Easy to be blocked including Geotextile cloth.	Easy to be blocked including Geotextile cloth.
Prone to complete failure?	The Capiphon DRAINTUBE has 132 capillaries. Even if some capillaries are blocked, the system as a whole will not collapse.	PVC pipes require an annual budget for maintenance and cleaning. Average 3-5 years PVC drainage system will be completely disabled. **	HDPE pipes require an annual budget for maintenance and cleaning. Average 3-5 years PVC drainage system will be completely disabled. **
Construction difficulty	Simple Click to Collect. Only 3 screws.	Hard. Heavy rolls to handle.	Hard. Heavier rolls to handle.
Trench width	Narrow trench 70-100mm	Wide trench 250-300mm+	Medium trench 100-200mm
Transport and storage	Easy and light. One meter long, pack of 20, 15kg. Easy to transport to or within the site. No special vehicles/machines.	Heavy and large pack.	Heavy and large pack.

¥¥ Water is drawn up from below the pipe by siphon action.

** According to the feedback of the Taiwan Highway Administration.

Material properties pertaining to longevity and the environment.

Capiphon DRAINTUBE is made of two separate materials: · the grooved belt wrapped which absorbs water from the soil matrix is made of PVC (CNS1298); and

· the pipe around which the Capiphon belt is wrapped for support, and which collects the water from it is made of

ABS (CNS13474).

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- While PVC has sometimes been regarded as an environmentally unfriendly material, its poor reputation comes from the earlier use of heavy metals and other environmentally toxic substances in its formulation. Capiphon does not have toxic substances in the formulation. It complies with the Restriction of Hazardous Substances Directive (ROHS) & Registration, Evaluation and Authorization of Chemicals (REACH) standards.
- It is not biodegradable and, because it is buried underground, it does not degrade by exposure to light.
- The PVC used in Capiphon is not made from recycled material. It is “virgin” PVC formulated to provide a degree of surface tension that makes the grooves slightly hydrophobic such that water in the grooves will readily move out into the soil as the soil dries out. ([video of water moving out of the grooves](#)). The result is:
 - there is no deposition of suspended and/or colloidal material.
 - There is no water left in the grooves to attract plant roots.

ABS (Acrylonitrile butadiene styrene) provides favorable mechanical properties such as impact resistance, toughness, and rigidity when compared with other common polymers. ABS's light weight and ability to be injection molded and extruded make it useful in manufacturing products such as drain-waste-vent (DWV) pipe systems. ABS material has high strength and toughness. A pipe manufactured from ABS may be deformed after external pressure, but it is not easy to break and cause water to flow out of the pipe.

Of course, the durability of PVC and ABS can be predicted in the laboratory, but because the data of the laboratory and the actual application environment are not the same thing, we do not think that this data is related to the actual drainage functional life of DRAINTUBE in the field. Therefore, we prefer to use actual data to prove that the life cycle of DRAINTUBE so far is higher than that of most other drainage materials, that is, the longest case so far is 22 years and is still being calculated ([this video was recorded 2 years ago](#)).

Other PTA Assessments and Approvals

[American Association of State Highway and Transportation Officials \(AASHTO\)](#)

Capiphon has been approved by AASHTO (the American Association of State Highways and Transportation Officials) use on their roads and highways.

The list of tests for the product included: thickness: width: hardness: impact resistance: tensile properties: brittleness: cellular

plastic compressive properties: and water permeability in 3 different conditions

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Some tests have no relevance for everyday use – breaking strain and brittleness at minus 29 degrees Centigrade, for example – but others showed some important characteristics such as

- There was no distortion of the Capiphon under pressure.
- There was no evidence of intrusion into the drain system by the soil (a sandy clay) even under load.
- The flow rate is proportional to hydraulic gradient indicating the added stress does not significantly change the transmissivity of the material.

In all, the Capiphon Drain belt is recommended for highway subsurface drainage as part of a multidisciplinary approach to solving groundwater problems responsible for pavement failures and slope failures.

Minghsin University of Science and Technology Disaster Prevention Technology

The Taiwan Government recently commissioned a report ([Performance Evaluation Results Report of Drainbelt and Draintube](#)) in which Capiphon was re-tested prior to inclusion in a number of construction processes.

Other relevant product information Overseas Road/Rail Installations and Client List

Capiphon Draintube system has been used by the following road or rail-related government agencies:

1. Taiwan High Speed Rail (THSR)
2. Taiwan Railways Administration (TRA)
3. Mass Rapid Transit Bureau, Kaohsiung City (KMTB)
4. Taiwan Freeway Bureau, MOTC
5. Directorate General of Highways, MOTC
6. Civil Aeronautics Administration, MOTC
7. China Jinan Railway Bureau

Taiwan High Speed Rail installations (PowerPoint presentation)

Capiphon has been used for drainage and remediation in a number of incidences under the auspices of **Dr. Hanwei Yang** as the Engineering Director at Taiwan High Speed Rail Corporation. Dr Yang's profile is attached. (Note: Dr Yang has since retired from THSRC, and is currently adjunct Professor at the National University of Taiwan. He is available for consultation in the use of Capiphon in a variety of situations.

A List of Some Other Major Sites In Taiwan And China.

Installation Guidelines

Capiphon Installation Guidelines

General Drainage There are two main ways in which to install Capiphon™ for general drainage: laid horizontally or laid vertically ...

How To Use Capiphon as an Intercept Drain

The naming of drains is a difficult matter! There are many slight variations and some differences geographically. An intercept drain is simply a drain designed to intercept water flowing across the surface.

How To Use Capiphon Behind a Retaining or Basement Wall A basement wall and a retaining wall are essentially the same. Both need to be drained properly to protect the building not only from leaks but from moisture compromising the structural integrity.

How To Use Capiphon in Roadside Drainage

Installing Capiphon/Draintube installation instead of the usual perforated PVC pipe or rigid strip filter drain, is simple. The major difference is that:

- Geotextile sock is not needed,
- The trench can be backfilled, not with gravel or no fines concrete, but with washed, coarse sand. The drainage layer, in this case, is the Capiphon in combination with the washed coarse sand.

Comparative Performance

Comparison of Capiphon Draintube, Capiphon Belt and other common drainage materials - laboratory tests

Drainage Characteristics of Capiphon Belt and Pipe - Some Comparisons With Slotted Pipe With Sock

Paper presented to the International Commission on Irrigation & Drainage (Adelaide June 2012): Initial studies showed that Capiphon drainage technology outperforms slotted pipe with sock (Drain Coil) in soil. It also had a higher flowrate in free water at low hydraulic head. In soil when flooded, Capiphon commenced flow before, and continued to drain long after Drain Coil had ceased. Its capillary and syphonic action resulted in drawing water upwards, pulling the water table down to at least 70mm in a loam soil (approximately 15% fines).

[Drainage Characteristics of Capiphon Belt and Pipe](#)

Slide presentation of the ICID paper.

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[Capiphon Drawing Water Up in Tank Test](#)

This snapshot from a video shows the water level in a test tank dropping below the outlet through which the belt passes.

[Capiphon Drawing Water Up In Tank Test Full Of Soil](#) This snapshot from a video shows the water level in a test tank of soil (approximately 15% fines) dropping below the outlet through which the belt passes.

[Flow Reports for Capiphon Drain Belt](#)

Translation from the original Chinese report, conducted by the Chinese Research Institute of Water Resources and Hydroelectric Power.

[Capiphon Flow Rates](#)

Flow rates quoted for agricultural (slotted) pipe are the capacity of the pipe to move water that enters it. There is no direct performance standard for sub-surface drainage, however the minimum requirement for the Australian Standard AS2439.1 for clear water opening is 1,500mm²/m. Capiphon's clear water opening (20,000mm²/m for 10cm belt) clearly exceeds that.

Comparison of the performance of Capiphon Draintube, Capiphon Belt in the field

[A New and More Cost Effective Drainage System For Turf - A Comparative Trial In A Racetrack](#)

Report to Irrigation Australia and International Commission on Irrigation & Drainage (Adelaide 2022) on a trial in which detailed measurements showed that Capiphon Drainage flowed sooner and with greater volume than standard ag pipe in a racetrack.

While this paper is not directly applicable to roadside drainage, it describes a scientifically designed comparison of the performance of Capiphon against the standard system in a real-world example.

[A New and More Cost Effective Drainage System For Turf - Slide Deck For IAL-ICID Conference 2022](#)

Slide Deck for the above presentation.

Comparative Permeability in Like-for-Like Installation of

