RCM-Rainfall Conservation Module

Stormwater Retention and Drainage System

Design and Installation technical information

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RCM-Design and Installation technical information

A. RCM-Promote water infiltration of Stormwater in Site Description

A-1. RCM - The main purpose

It is a facility that collects rainwater to accelerate the infiltration of stormwater into the surface, and contains groundwater to prevent excessive surface runoff.

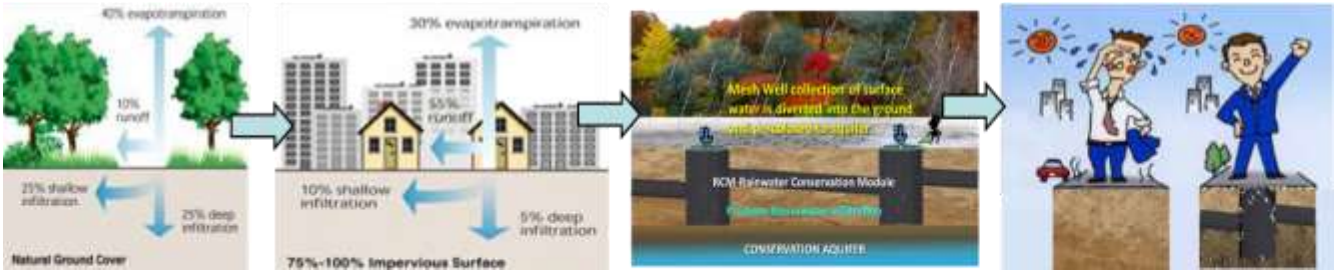
RCM is a vertical "Mesh Drainage Wells" collecting rainfall on the surface of the ground. Through the horizontal "Arched Mesh Pipe", the two sides cooperate with each other to remove the precipitation that cannot be naturally infiltrated in the base, and try to concentrate on the inside of the pipe and quickly infiltrate the groundwater layer to achieve the effect of its auxiliary infiltration, to make up for the lack of natural infiltration.

A-2. RCM Promote stormwater infiltration - land conservation

In urban high-density development areas, surface impervious areas, including roofs, streets, sidewalks, and parking lots, often fail to provide sufficient exposed ground infiltration of stormwater. The increase in surface runoff is proportional to the amount of impervious pavement, impervious to water. The increase in the area will reduce the chance of stormwater infiltration into the soil. As a result, not only will the groundwater replenishment be reduced, but also the peak flow and runoff volume will increase, and the river base flow will also decrease. The function of conservation and sluggish rainfall in urban areas is declining due to the increase of impervious areas, and the increase in water consumption and displacement due to the increase in population and the negative impacts of various urban constructions will adversely affect the hydrological environment in urban areas. The impact. Therefore, artificial facilities RCM are needed to help the precipitation to penetrate into the surface as much as possible. This method is called “manual assisted infiltration”.

 *Before the city is undeveloped, enough bare ground allows Stormwater to infiltrate and balance the ecology.*	→	 *Urban high-density development areas cannot provide enough exposed ground to allow rainwater to infiltrate and cause floods*

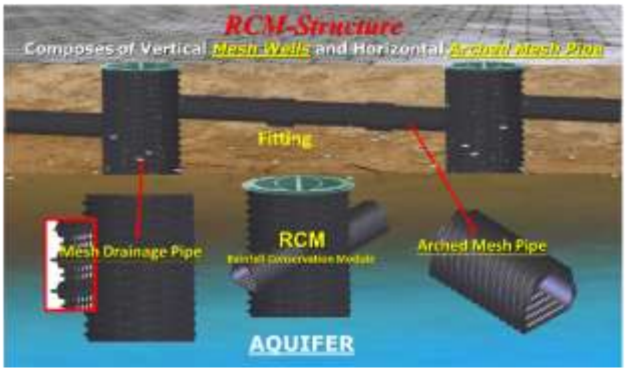
As can be seen from the results in the figure below, when the original natural surface coverage changes to 75% to 100% of the impermeable surface, the original natural surface runoff mechanism also changes significantly with the expansion of the impermeable area. The runoff, which originally only accounted for 10% of the total rainfall, surged to 55% of the total rainfall due to the result of urbanization, while the infiltration rate was reduced from 50% of the original total rainfall to only 15%, and the evaporation was It also decreases. As a result of the changes in the urbanization of a region, we can clearly see the changes in the urban and rural water environment caused by the relationship between surface runoff, evaporation and infiltration in the hydrological cycle caused by urbanization.



Schematic diagram of the impact of urbanization on the water environment

A-3. RCM – Structure

RCM is the vertical "Mesh Drainage Well" collecting rainfall on the surface, through the horizontal "Arched Mesh Pipe" to cooperate with each other, the precipitation in the base can not be naturally infiltrated, try to concentrate in the pipe and then quickly infiltrate into the groundwater In the layer, the effect of artificial assisted infiltration is achieved to compensate for the lack of natural infiltration.



「DMW-Drainage Mesh Well」

It is a vertical auxiliary infiltration facility, which not only has a better effect of reservoir infiltration, but also can be used as a joint between the " Drainage Mesh Well " to accommodate the sludge and debris generated during the drainage process. It is convenient to remove regularly to keep the drainage smooth. Normally, " Mesh Drainage Well " and "Arched Mesh Pipe" are combined with "RCM" to collect saturated stormwater from the surface and formation to cover the groundwater layer.	

「AMP-Arched Mesh Pipe」

The half moon type is an impermeable layer, and the flat part is a mesh permeable layer.

Most of the traditional water-permeable pipes are provided with slots in the upper part. They need to be covered with filter materials such as gravel and non-woven fabric to prevent the pipe from being blocked. The infiltration pipe is designed with a half-moon design. The half-moon type is an impermeable layer and the flat part is a net. The permeable layer is immersed, and the flat part is a network-like permeable layer downward. As a result, the soil particles naturally sink into the water pipe due to gravity, so that the water does not need to be filtered by the gravel and the non-woven fabric. Material, non-blocking, ecological engineering construction, is the best permeable drainage material to solve the problem of underground drainage pipe blocking.	

A-4. RCM - Feature

RCM collects rainwater, accelerates the infiltration of rainwater into the artificial auxiliary facilities under the surface, and conserves the groundwater layer to prevent excessive surface runoff.

* Water retention, promote stormwater infiltration, and replenish groundwater.
* Effectively supplement the conservation of groundwater, Restoring river flow, improve environmental and ecological conditions, and promote bio-organic survival space.
* Regulate the microclimate and ease the warming of the urban climate.
* Alleviate land subsidence, reduce waterlogging and seawater backflow.
* Slow down the chances of urban flooding.
* Stormwater recycling measures can save precious tap water sources and reduce water charges, and can truly fulfill the goal of effective use of water resources.
* Small footprint and required space, easy construction, low investment cost, high efficiency, and reduced drainage facilities.
* Promote rainwater infiltration - create an ecologically balanced environment.

A-5. RCM - Specifications

DMW-Drainage Mesh Wells Specifications

Mesh Drainage Well Size	Mesh Drainage Well Code	ID*OD ±3.0%mm	Pitch ±3.0%mm
6"	NSO-150A	148*165	14.0mm
8"	NSO-200A	193*216	14.5mm
10"	NSO-250A	239*267	14.5mm
12"	NSO-300A	290*318	15.0mm
16"	NSO-400A	390*420	15.5mm

Winding pipe well specification

Winding pipe

Code	ID*OD mm±3%
WP200P4B	200*220
WP250P4B	250*270
WP300P4B	300*330
WP400P4B	400*440
WP500P4B	500*540
WP600P4B	600*650
WP700P4B	700*750
WP800P4B	800*862
WP900P4B	900*978
WP1000P4B	1000*1088
WP1200P4B	1200*1300

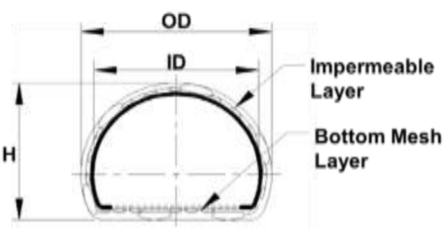
Spiral pipe well specifications

Spiral pipe

Code	ID*OD mm±3%
SPC-150 SPO-150	150*173
SPC-200 SPO-200	200*234
SPC-250 SPO-250	250*285
SPC-300 SPO-300	300*340
SPC-400 SPO-400	400*450
SPC-500 SPO-500	500*566
SPC-600 SPO-600	600*676

AMP-Arched Mesh Pipe Specifications

Size	Code	ID*OD*H ±3.0%mm	Pitch ±3.0%mm	Length m
2"	HPT-50A	50*62*54	11.5mm	5m
2½"	HPT-65A	63*76*70	12.5mm	5m
3"	HPT-75A	79*92*82	12.5mm	5m
4"	HPT-100A	96*114*94	12.5mm	5m
6"	HPT-150A	149*167*136	14.0mm	5m
8"	HPT-200A	193*216*170	14.5mm	5m
10"	HPT-250A	239*267*197	15.0mm	5m
12"	HPT-300A	290*318*223	15.5mm	5m



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Manhole cover specifications

Plastic manhole cover specifications

Size	A	B	C	D	E
12"	390	342	323	60	26
16"	494	446	426	60	26

Material : PP

Cast iron manhole cover specifications

Size	A	B	C	D	E
10"	323	293	277	60	27
12"	374	344	328	60	27
16"	476	446	430	60	27

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RCM-Specifications

DMW-Drainage Mesh Well +AMP- Arched Mesh Pipe

Drainage Mesh Well		H	Arched Mesh Pipe		Manhole Cover
Size	**Code**	**mm**	**Size**	**Code**	
10"	NSO-250A	**500**	**4"F**	HPT-100A	Cast iron manhole cover
		600	**6"F**	HPT-150A	
		800	**8"F**	HPT-200A	
		1000	**10"F**	HPT-250A	
12"	NSO-300A	**500**	**4"F**	HPT-100A	Cast iron manhole cover Plastic manhole cover
		600	**6"F**	HPT-100A	Cast iron manhole cover Plastic manhole cover
		800	**8"F**	HPT-150A	Cast iron manhole cover Plastic manhole cover
		1000	**10"F**	HPT-200A	Cast iron manhole cover Plastic manhole cover
		1200	**12"F**	HPT-250A	Cast iron manhole cover Plastic manhole cover
16"	NSO-400A	**500**	**4"F**	HPT-100A	Cast iron manhole cover Plastic manhole cover
		600	**6"F**	HPT-150A	Cast iron manhole cover Plastic manhole cover
		800	**8"F**	HPT-200A	Cast iron manhole cover Plastic manhole cover
		1000	**10"F**	HPT-250A	Cast iron manhole cover Plastic manhole cover
		1200	**12"F**	HPT-300A	Cast iron manhole cover Plastic manhole cover

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RCM-Specifications

WP-Winding pipe well + AMP-Arched Mesh Pipe

Winding pipe well		H	Arched Mesh Pipe		Manhole Cover
Size	Code	mm	Size	Code	
250mm	WP250-4	500	4"F	HPT-100A	Cast iron manhole cover
		600	6"F	HPT-150A	
		800	8"F	HPT-200A	
		1000	10"F	HPT-250A	
300mm	WP300-4	500	4"F	HPT-100A	Cast iron manhole cover Plastic manhole cover
		600	6"F	HPT-100A	Cast iron manhole cover Plastic manhole cover
		800	8"F	HPT-150A	Cast iron manhole cover Plastic manhole cover
		1000	10"F	HPT-200A	Cast iron manhole cover Plastic manhole cover
		1200	12"F	HPT-250A	Cast iron manhole cover Plastic manhole cover
400mm	WP400-4	500	4"F	HPT-100A	Cast iron manhole cover Plastic manhole cover
		600	6"F	HPT-150A	Cast iron manhole cover Plastic manhole cover
		800	8"F	HPT-200A	Cast iron manhole cover Plastic manhole cover
		1000	10"F	HPT-250A	Cast iron manhole cover Plastic manhole cover
		1200	12"F	HPT-300A	Cast iron manhole cover Plastic manhole cover
500mm	WP500-4	500	4"F	HPT-100A	Grille manhole cover
		600	6"F	HPT-150A	Grille manhole cover
		800	8"F	HPT-200A	Grille manhole cover
		1000	10"F	HPT-250A	Grille manhole cover
		1200	12"F	HPT-300A	Grille manhole cover
600mm	WP600-4	500	4"F	HPT-100A	Grille manhole cover
		600	6"F	HPT-150A	Grille manhole cover
		800	8"F	HPT-200A	Grille manhole cover
		1000	10"F	HPT-250A	Grille manhole cover
		1200	12"F	HPT-300A	Grille manhole cover

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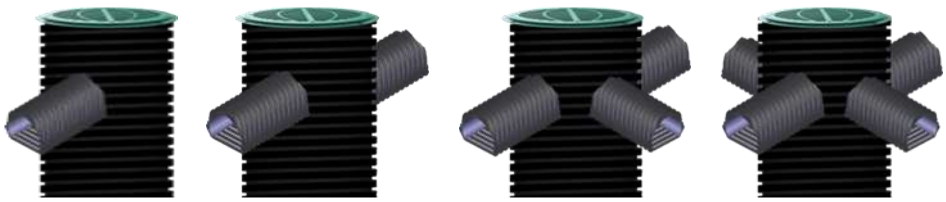
RCM-Specifications



SP-Spiral pipe well + AMP-Arched Mesh Pipe

Spiral pipe well		H	Arched Mesh Pipe		manhole cover
Size	**Code**	**mm**	**Size**	**Code**	
250mm	SP250	**500**	**4"F**	HPT-100A	Cast iron manhole cover
		600	**6"F**	HPT-150A	
		800	**8"F**	HPT-200A	
		1000	**10"F**	HPT-250A	
300mm	SP300	**500**	**4"F**	HPT-100A	Cast iron manhole cover Plastic manhole cover
		600	**6"F**	HPT-100A	Cast iron manhole cover Plastic manhole cover
		800	**8"F**	HPT-150A	Cast iron manhole cover Plastic manhole cover
		1000	**10"F**	HPT-200A	Cast iron manhole cover Plastic manhole cover
		1200	**12"F**	HPT-250A	Cast iron manhole cover Plastic manhole cover
400mm	SP400	**500**	**4"F**	HPT-100A	Cast iron manhole cover Plastic manhole cover
		600	**6"F**	HPT-150A	Cast iron manhole cover Plastic manhole cover
		800	**8"F**	HPT-200A	Cast iron manhole cover Plastic manhole cover
		1000	**10"F**	HPT-250A	Cast iron manhole cover Plastic manhole cover
		1200	**12"F**	HPT-300A	Cast iron manhole cover Plastic manhole cover
500mm	SP500	**500**	**4"F**	HPT-100A	Grille manhole cover
		600	**6"F**	HPT-150A	Grille manhole cover
		800	**8"F**	HPT-200A	Grille manhole cover
		1000	**10"F**	HPT-250A	Grille manhole cover
		1200	**12"F**	HPT-300A	Grille manhole cover
600mm	SP600	**500**	**4"F**	HPT-100A	Grille manhole cover
		600	**6"F**	HPT-150A	Grille manhole cover
		800	**8"F**	HPT-200A	Grille manhole cover
		1000	**10"F**	HPT-250A	Grille manhole cover
		1200	**12"F**	HPT-300A	Grille manhole cover

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A-6. RCM-Drainage Mesh Well and Arched Mesh Pipe Physical Properties

Drainage Mesh Well is made of high-density polyethylene (HDPE). It is light, tough, acid and alkali resistant, non-corrosive, non-toxic, and soil and water are completely free from pollution. It is the best permeable material for underground drainage.

Physical properties	Chemical properties
High-density polyethylene (HDPE) integrated extrusion molding Light weight: (specific gravity 0.936 ~ 0.965) Operating temperature range: -30 ° C ~ 80 ° C Impact resistance Durability Shockproof	Good resistance: In general soils, polyethylene is completely free of chemicals. Non-toxic: Polyethylene plastic (PE) is environmentally friendly and the land and water quality are completely free from pollution.

DMW-Drainage Well Pipe Physical Property Specifications

Inspection project	unit	Test method	Standard
Density	g/cm^3	ASTM 0792-13	﹥0.940
Elongation	%	ASTM D638-14	﹥300
Tensile strength	Kgf/cm^2	ASTM D638-14	﹥180

AMP-Arched Mesh Pipe Physical indicators

Inspection project	unit	Test method	Standard
Density	g/cm^3	ASTM 0792-13	﹥0.940
Elongation	%	ASTM D638-14	﹥300
Tensile strength	Kgf/cm^2	ASTM D638-14	﹥180
Compressive strength (10% deformation)	Kgf/m	ASTM D2412	﹥180

B. RCM-Design

B-1. RCM Design Description

RCM purpose

The RCM project is designed to accelerate the infiltration of Stormwater into the surface, to contain groundwater, to prevent excessive surface runoff, and to take into account the original drainage function and environmental quality.

RCM planning

In the areas where there are rainwater and underwater waterways, RCM can divert the flood control and drainage of the sewers, so that some of the rainwater can be directly infiltrated under the ground as an auxiliary system for flood and waterway flood control. In the area where the rainwater and underwater waterway system is planned, drainage planning should be made first, and RCM should be set up in conjunction with the planning, saving the construction cost of the sewer, and achieving the goal of water retention and flood prevention.

The basic principle

First, the design of RCM, based on the principle of immediate drainage, according to the selected frequency of rainfall intensity, soil type, regional rainfall characteristics, drainage structures, risk loss and other factors, using a reasonable formula method.
Second, the layout of RCM is based on the principle of not invading sewage, preventing the safety of buildings and being easy to clean and maintain.
Third, RCM layout scale, K value (10^{-8}m / s) or more in areas with poor soil permeability, such as clay layer, should be based on water retention design. The K value (10^{-7}m/s) below the soil permeability is better than sand and silt, and the soil permeability is mainly based on flood control design.

B-2. RCM Design Key Points

1. The rainfall conditions

The amount of rainfall and intensity, rainfall delay, spacing of rainfall events, sunshine intensity and evaporation will affect surface hydrology, and therefore will affect the infiltration performance of RCM. In the planning of RCM, it is assumed that the runoff generated after rainfall immediately flows into the RCM, and the infiltration phenomenon occurs at the same time, and the infiltration phenomenon will continue until the end of the rainfall event, that is, the pre-flood conditions are assumed to be saturated; therefore, from the design point of view. It can be seen that the decision to design the rainfall delay not only affects the planned RCM scale, but also affects the performance of the RCM. Therefore, careful selection of the design rainfall delay at the beginning of the planning period will contribute to RCM performance improvement and efficiency.

2. Soil types

The runoff regulation efficiency of RCM has a great relationship with soil seedlings. High-permeability soil can quickly infiltrate the retained rainwater into the soil in a short time to increase the use efficiency of RCM storage space. The penetration energy affects the performance of the facility. Therefore, in order to obtain the correct soil infiltration rate, the field test should be the main one. If the field test cannot be carried out, it should be replaced by the laboratory test.

The infiltration rate is better when the surface soil particles are larger, and the choice of RCM setting position often takes into account the soil drainage rate. Therefore, soil properties are an important factor in the site selection of RCM.

3. Storage pool time

Another factor affecting the performance of RCM is the maximum storage time that it can tolerate. The so-called pool storage time is the time required to completely infiltrate the runoff stored in the facility during heavy rain to the underground. The storage time is RCM setting. An important flaw in the relationship is closely related to the design depth of the RCM.

Since the soil is formed by the weathering of rocks, its physical properties such as texture, depth of topsoil, profile structure, and organic matter content all affect the infiltration capacity of the soil.

In design, in order to consider the impact of rainwater retention on the environment, it is usually 24 to 72 hours; the infiltration rate is often affected by the water depth, and the higher depth of the facility can provide greater water pressure to increase the infiltration of rainwater. Speed, and the side wall can still provide opportunities for infiltration when the bottom is blocked. Therefore, it is necessary to consider the maximum design depth in the design practice.

4. Topography and geology

The topography of the base affects the flow of water. The higher the slope, the faster the water flows, the faster the water is discharged, and the less water is infiltrated into the soil. Therefore, the RCM has better infiltration efficiency. Terrain is an important indicator of evaluation; in general, RCM cannot exceed 20%. In terms of geology, detailed geological surveys such as geological drilling should be carried out before installation. In order to obtain better infiltration efficiency, the bottom of the infiltration facility should be at least 1 m away from the shale disk.

5. The water table

The level of the groundwater level will affect the infiltration efficiency of the RCM. The higher groundwater level is not suitable for Stormwater infiltration, while the low-lying area is prone to increase the groundwater level due to the accumulation of water and reduce the infiltration. Therefore, it is necessary to set up the area for the infiltration facilities during planning. The groundwater level is surveyed on site. It is generally recommended that the bottom of the infiltration facility be at least 1 m above the seasonal groundwater level. If there is no groundwater level information in the area, it is recommended that the bottom of the RCM be at least 1.5 m away from the groundwater level.

6. Vegetative Buffer

Generally, in the planning of the infiltration facility, a vegetation buffer zone should be arranged around it to prevent the drooping or debris blocking facilities in the runoff from reducing the infiltration efficiency, and the vegetation buffer zone also has the functions of reducing the flow rate, increasing the collecting time and infiltration. RCM may inject groundwater pollution into the groundwater layer through infiltration, causing groundwater pollution. This phenomenon can also reduce the risk by pre-treatment facilities such as phytosanitary buffers. The choice of vegetative plants is more resistant to water and more soluble. Contaminants are preferred, and plants have seasonal ability to adsorb pollutants that gradually decrease over time, so plants should be replaced periodically according to the season and its adsorption capacity.

7. Land use plans and restrictions

The location of the RCM is often closely integrated with the city and the community. Therefore, the use of the land will affect the amount of water and water quality intercepted by the RCM. Therefore, the land use of the urban plan should be further understood, such as the site of the factory and the landfill. Because the soil has been contaminated, the RCM will spread the pollution source to cause groundwater pollution, so it is not suitable to set it; if there is a pumping well nearby, at least 30m above the distance can be set RCM.

For areas with large slopes and risk of collapse, it is necessary to investigate in detail. It is strictly forbidden to set up RCM in this area. For areas where the land is prohibited or not to be developed according to law, it should be excluded and not included in the site selection; The choice of RCM setting location may also affect the use of the facility. Therefore, different management methods should be set according to the purpose of RCM to avoid danger.

8. Pollution control

Contaminants contained in surface runoff can cause RCM blockage and may contaminate groundwater quality. Therefore, water quality and soil must be investigated to see if it has been contaminated. In particular, RCM is distributed throughout the catchment in a decentralized configuration. If a single facility is contaminated and may spread throughout the catchment area, it should be fully investigated before planning and extensive collection of design information.

B-3. Design Rainfall Runoff

The calculation of the runoff area, the surface characteristics, the rainfall intensity, etc. by calculating the rainwater runoff, the runoff calculation formula is as follows.

$Q=\frac{C\times I\times A}{360}$	Formula： Q : Runoff (m^3 / sec) C : Runoff coefficient I : Rainfall duration, average rainfall rate in t minutes (mm/hour) A : The drainage area (hectare)

Estimated rainfall

1. **Storm intensity formula**

   The intensity of heavy rain should be determined by reference to the local rainwater and underwater waterway system or by past data from each region.

2. **Stormwater collection time**

   The RCM facility's collection time includes the start time and the flow time in the pipe, which takes 10 minutes to 15 minutes.

   The collection time is the time from the farthest point of the water flow to the project site, including the inflow time and the flow arrival time. The calculation formula is as follows:

   Tc=t1+t2

   In the formula:

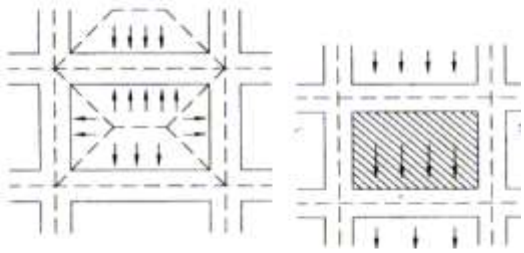
   Tc: collection time (hours)

   T1: Inflow time (hours) refers to the time required for precipitation to flow through the surface of the ground or from the boundary of the catchment to the waterway. Through woodland and grassland

   The inflow time is usually calculated at a flow rate of 0.3 to 0.6 m/s.

   T2: The arrival time (hours) refers to the time required for the path to flow through the waterway to the project location.

3. Drainage area

In the calculation of the drainage area, the central area should consider the ground slope as the watershed line in principle, and should consider the drainage demand of the adjacent street profile, as shown in the figure. In other areas, the drainage area is estimated based on the terrain.	 Drainage area division method

B-4. RCM Design Concept

Although infiltration is a simple concept, the RCM infiltration facility must be carefully designed and maintained. Poor design or improper construction is prone to problems. Rainfall and soil saturated permeability coefficient are the main considerations for RCM treatment design, and system maintenance is also necessary, including regular inspection, removal of water inlet to prevent blockage, weeding and cleaning, and penetration of silt. Sundries.

RCM occupies a small area, and permeate wells or infiltration nets can also be used separately to collect rainfall from the roof or other surface.

The RCM setting is approximately 1 meter above groundwater to prevent groundwater contamination.

In order to make full use of the RCM space, the top of the permeate well is provided with a cover and the permeate well is provided at an appropriate distance.

The hydraulic calculation uses the Manning formula.

RCM hydraulic calculation

The hydraulic calculation uses the Manning formula and the continuous equation:

$Q = A \cdot V$ $V = \frac{1}{n} R^{\frac{2}{3}} \cdot S^{\frac{1}{2}}$	Formula： Q: Flow volume (m^3 / sec) A: water area (m^2) V: flow rate (meters / sec) N: roughness coefficient R: hydraulic radius (meter) S: hydraulic slope

Roughness coefficient

Arched Mesh Pipe roughness coefficient (n) value: 0.015

Design flow rate limit

The minimum flow rate of the Mesh pipe at the design flow rate should not be less than 0.8 m/s, and should not be greater than 5 m/s.

The flow rate of the Mesh pipe (0.2 m/s) can remove deposits inside the pipe.

Arched Mesh Pipe Slope

In order to meet the drainage capacity of each route, and to play the network drainage function and the most economical waterway section, the minimum longitudinal slope is 1/1000, and the longitudinal slope is generally parallel to the road surface. If the longitudinal slope of the road is flat, it is not parallel to the road surface.

Infiltration well inlet design

For the inlet of the infiltration well, it is advisable to consider setting the vertical drop inlet of the grille. Intake inlet size and type depending on water characteristics, floating object blocking possibility, safety and economy, etc., choose edge stone inlet or grill inlet or double inlet

Infiltration well inlet location and spacing

The spacing of the inlet of the infiltration well is determined by conditions such as topography, catchment area, longitudinal slope of the road, lateral slope, flow direction, RCM, and inlet size. At the intersection of the base and the lowest point of the base, the lowest point of the vertical curve and about 3 meters before or after the entrance to the underground tunnel should be set, and the spacing is between 5 and 30 meters.

Inlet flow volume

$Q = KCA(\sqrt{2gh})$	Formula： *Q*：Manhole cover inlet flow volume (m^3 / sec) *K*：The safety factor of the blockage is generally 0.5 *C*：Hole coefficient，0.5~0.6 *A*：Gate hole net area（m2） *g*：Gravity acceleration (9.8 m / s 2) *h*：Shallow ditch water flow average water depth（m）

Infiltration well manhole

At the appropriate distance or direction of the RCM or at the junction of more than two pipes, a manhole is provided for cleaning and connection.

Infiltration well spacing

The spacing of the manholes depends on the size of the rainwater channel and the number of floating objects and sediments in the waterway. The spacing of the manholes is not more than 30 meters.

Infiltration well manhole layout

The manhole should have sufficient space for personnel to clean up and its shape and construction should not seriously interfere with the flow of water.

B-5. RCM Permeate Drainage Capacity

1. Runoff volume

Expected rainfall calculation formula

$Q_f = C \times I \times A$	Q_f : expected rainfall (m^3/hr) C : runoff coefficient I : rainfall intensity <mm/hr> A : Base area <m^2>

Design rainfall runoff volume

The calculation of the runoff area, the surface characteristics, the rainfall intensity, etc. by calculating the rainwater runoff, the runoff calculation formula is as follows.

$Q = \frac{C \times I \times A}{360}$	Formula： Q : Runoff (m^3 / sec) C : Runoff coefficient I : Rainfall duration, average rainfall rate in t minutes (mm/hour) A : The drainage area (hectare)

Runoff coefficient reference value

The surface runoff coefficient C is worth reference to the table below, but the C value in development is calculated as 1.0.

Catchment status	Runoff coefficient without development area	Development of runoff coefficient after land preparation in the whole region
Steep mountain	0.75~0.90	0.95
Mountain area	0.70~0.8	0.90
Hilly land or woodland	0.5~0.75	0.90
Flat cultivated land	0.45~0.6	0.85
Non-agricultural use	0.75~0.95	0.95~1.0
Mountain river	0.75~0.85	
Flat river	0.45~0.75	
Most of the rivers are flat	0.5~0.75	

Runoff coefficient runoff coefficient (C), according to the classification of water permeability or not, as shown in Table 20.1, according to the regional type classification provisions as shown in Table 20.2

Table 20. 1 Runoff coefficient table (based on permeable or not)

Rainfall duration (min)	Runoff coefficient C	
	Impervious ground	Permeable ground
5	0.50	0.10
10	0.60	0.20
20	0.80	0.34
30	0.85	0.40
45	0.90	0.45
60	0.94	0.50

Note: The runoff coefficient of asphalt pavement adopts a fixed value of 0.8.

Table 20. 2 Runoff coefficient table (based on regional type)

Regional type	Business district	Residential area	park	industrial area
Runoff coefficient *C*	0.7-0.8	0.5	0.1	0.2

2. Rainfall collection time

Segment estimation method:

The Rainfall collection time is tc=to+ts

To: The runoff generated by rainwater, the time required from the boundary of the catchment area to the side of the river (the time of slope runoff).

Ts: The time required for the runoff of the slope to flow through the waterway from the upstream to the outlet (the time of the runoff of the watercourse).

The flow velocity (V) of the slope runoff is generally around 0.3~0.6m/sec, so the runoff time to of the slope can be estimated by dividing the slope length (L) by V. The speed of the runoff from the slope of the river channel should be calculated according to the section of the section, slope, roughness and other data.

Design value calculation for promoting RCM penetration capacity of rainfall infiltration

Arched Mesh Pipe theoretical water permeability	Infiltration well theoretical water permeability
$Q_{hp} = A_{id} x\ k\ x\ t$	$Q_w = A_b x\ kx\ t + 0.5\ x\ A_s x\ kx\ t$
Q_{hp} ：Arched Mesh Pipe theoretical water permeability	Q_w ：Infiltration well theoretical water permeability
A_{id} ：Arched Mesh Pipe area	A_b ：Infiltration well bottom area
K：soil permeability coefficient or final infiltration rate	A_s ：Infiltration of the side area of the well
t ：rainfall delay reference value	K ：soil permeability coefficient or final infiltration rate
	T ：rainfall delay reference value

Soil permeability coefficient k_{Soil}

k：The soil permeability coefficient (m/s) is determined by the soil within 2 m of the surface layer. Drilling investigation shall be carried out according to the provisions of Article 64 of the Building Construction Regulations, and the “uniform classification” of the soil within 2 m of the surface of the drilling results shall be substituted into Table 13 to obtain the k value; If you do not need to do a drilling survey, you can judge the possible soil quality of the topsoil by experience and substitute it into Table 14 to obtain the k value.

Base final infiltration rate f

f：The final infiltration rate (m/s) of the base, the final infiltration rate refers to the value when the rainwater is absorbed by the soil at the time of rainfall. It should be infiltrated in the field or determined by the soil within 2m of the surface. . Drilling investigation shall be carried out according to the provisions of Article 64 of the Building Construction Regulations, and the “uniform classification” of the soil within 2 m of the surface of the drilling shall be substituted into Table 13 to obtain the f value; If you do not need to do a drilling survey, you can judge the possible soil quality of the topsoil by experience and substitute it into Table 14 to obtain the f value.

Table 13: Unified soil classification and soil final infiltration rate f and permeability coefficient k

Soil classification	Particle size D10 (mm)	Unified soil classification	Final infiltration rate*f*(m/s)	Soil permeability coefficient*k* (m/s)
Bad grade gravel	0.4	GP	10^{-3}	10^{-3}
Good grade gravel		GW	10^{-4}	10^{-4}
Mud gravel		GM		
Clay gravel		GC		
Bad grade sand		SP	10^{-5}	10^{-5}
Good grade sand	0.1	SW		
Muddy sand	0.01	SM	10^{-6}	10^{-7}
Clay sand		SC		
Mud clay	0.005	ML	10^{-7}	10^{-8}
clay	0.001	CL		10^{-9}
High plastic clay	0.00001	CH		10^{-11}

Note: Different soils belonging to the same soil uniform classification will have errors due to the tightness and composition. This table is based on the objective of the assessment, but its minimum value, which makes the assessment results more conservative and credible.

Table 14 Soil final infiltration rate f and permeability coefficient k simple comparison table

Soil quality	sandy soil	Silt Soil	Clay Soil	High plastic clay
Final infiltration ratef (m/s)	10^{-5}	10^{-6}	10^{-7}	10^{-7}
Soil permeability coefficientK(m/s)	10^{-5}	10^{-7}	10^{-9}	10^{-11}

Table 15 Arched Mesh Pipe each meter of water permeate theory

Coefficient k	DIA.	The bottom is not covered with sand	Laying sand on the bottom (Increase in area 20cm)
Final infiltration rate (10^{-6} m/s)	2"	0.1793 L/hr·m	0.8993 L/hr·m
	3"	0.2592 L/hr·m	0.9792 L/hr·m
	4"	0.3420 L/hr·m	1.0620 L/hr·m
	6"	0.5173 L/hr·m	1.2373 L/hr·m
	8"	0.6851 L/hr·m	1.4051 L/hr·m
Soil permeability coefficient (10^{-7} m/s)	2"	0.0179 L/hr·m	0.0899 L/hr·m
	3"	0.0259 L/hr·m	0.0979 L/hr·m
	4"	0.0342 L/hr·m	0.1062 L/hr·m
	6"	0.0517 L/hr·m	0.1237 L/hr·m
	8"	0.0685 L/hr·m	0.1405 L/hr·m

Table 16 Permeable well theoretical water permeability (L/hr)

size	Coefficient k	L 80cm	L 90cm	L 100cm	L 110cm	L 120cm
10"	Final infiltration rate (10^{-6} m/s)	1.243 L/hr	1.378 L/hr	1.513 L/hr	1.648 L/hr	1.783 L/hr
	Soil permeability coefficient (10^{-7} m/s)	0.124 L/hr	0.138 L/hr	0.151 L/hr	0.165 L/hr	0.178 L/hr
12"	Final infiltration rate (10^{-6} m/s)	1.550 L/hr	1.714 L/hr	1.878 L/hr	2.042 L/hr	2.206 L/hr
	Soil permeability coefficient (10^{-7} m/s)	0.155 L/hr	0.171 L/hr	0.188 L/hr	0.204 L/hr	0.221 L/hr

Table 17 Comparison of infiltration well and arched mesh pipe and PVC pipe（Rainfall：50mm/hr)

PVC pipe size（mm）	Roof area（m^2）	Runoff m^3/hr	Infiltration Well Size	Arched Mesh Pipe Size
50	67	3.35	8’’ 10’’ 12’’	2’’ 3’’ 4’’
65	135	6.75	8’’ 10’’ 12’’	3’’ 4’’
75	197	9.85	10’’ 12’’	4’’ 6’’
100	425	21.25	10’’ 12’’	6’’ 8’’
125	770	38.5	10’’ 12’’	8’’
150	1250	62.5	12’’ 16’’	8’’ 10’’
200	2700	135	16’’	10’’

B-6. RCM Installation Specifications

RCM Installation Specifications

A. RCM – Feature

RCM is a facility for collecting rainwater to accelerate the infiltration of rainwater into the surface. The function is to conserve groundwater and reduce surface runoff. RCM is the vertical "Mesh Drainage Well" collecting rainfall on the surface. Through the horizontal "Arched Mesh Pipe", the two sides can cooperate with each other to remove the precipitation that cannot be naturally infiltrated in the base. In the groundwater layer, the effect of its auxiliary infiltration is achieved to make up for the lack of natural infiltration.

The Arched Mesh Pipe adopts a half-moon type infiltration network tube design. The half-moon type is an impermeable layer, and the flat part is a mesh-shaped permeable layer. When the burial, the network permeable layer is downward, and the water flows from bottom to top into the water conduit, so that the soil The granules naturally sink the temple due to gravity, so that they do not flow into the water conduit along with the water, and at the same time, they will not accumulate in the vicinity of the network tube, and the permeable layer facing downwards can both enter the water and also disperse water. When the moisture enters, the capillary phenomenon will occur. Naturally, it has the effect of pumping water in the soil and discharging it outward by gravity flow. When the water reaches the outlet, it will siphon due to the drop, further generating negative pressure inside the soil, greatly increasing the efficiency of water absorption and drainage. When the soil moisture is insufficient. Water can penetrate into the soil to achieve water retention irrigation. The infiltrated network pipe is made of high-density polyethylene (HDPE), and the three-dimensional thread is extruded around the whole body. The pressure resistance is high and it is not easy to slide. The thread is not easy to block around the mesh structure. The spiral mesh structure is light, tough and acid resistant. Excellent characteristics such as alkali, non-corrosive, and not easily broken.

B. RCM – Materials

DMW-Drainage Mesh Well Physical Property Specifications

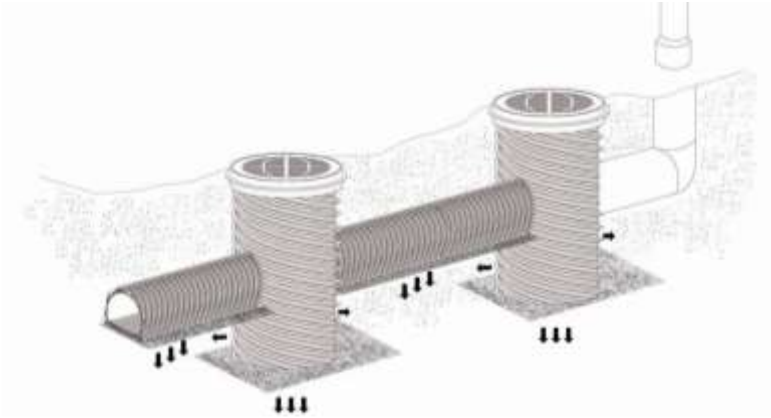
Inspection project	unit	Test method	Standard
Density	g/cm^3	ASTM 0792-13	＞ 0.940
Elongation	%	ASTM D638-14	＞ 300
Tensile strength	Kgf/cm^2	ASTM D638-14	＞ 180

AMP-Arched Mesh Pipe Physical indicators

Inspection project	unit	Test method	Standard
Density	g/cm^3	ASTM 0792-13	＞ 0.940
Elongation	%	ASTM D638-14	＞ 300
Tensile strength	Kgf/cm^2	ASTM D638-14	＞ 180
Compressive strength (10% deformation)	Kgf/m	ASTM D2412	＞ 180

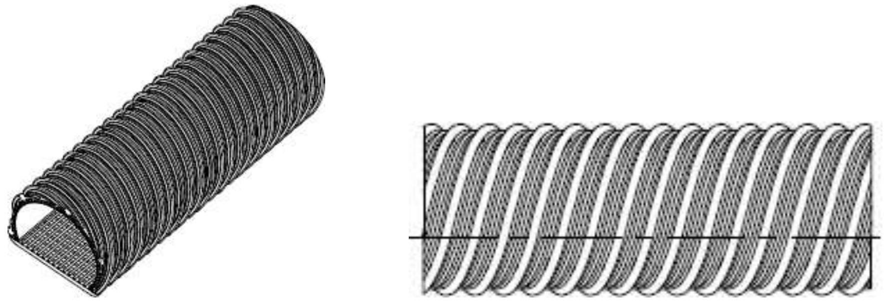
C. RCM Structure :

RCM is the vertical " Drainage Mesh Well" collecting rainfall on the surface. Through the horizontal "Arched Mesh Pipe", the two sides can cooperate with each other to remove the precipitation that cannot be naturally infiltrated in the base. In the groundwater layer, the effect of artificially assisted infiltration is achieved to compensate for the lack of natural infiltration.



RCM FIG Stereogram

The three-dimensional thread of the infiltration mesh tube is integrally formed by extrusion, and the thread is surrounded by a mesh structure. The half moon type is an impermeable layer, and the flat part is a mesh-shaped water-permeable layer. When the layer is buried, the mesh-shaped water-permeable layer is downward, and the water flows from bottom to top.

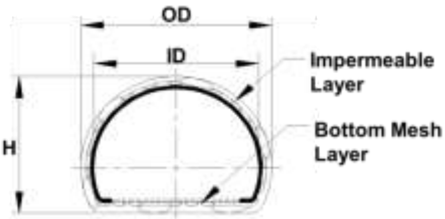


Arched Mesh Pipe FIG Stereogram

D. AMP-Arched Mesh Pipe Specifications :

AMP-Arched Mesh Pipe Specifications

Size	Code	ID*OD*H ±3.0%mm	Pitch ±3.0%mm	Length m
2"	HPT-50A	50*62*54	11.5mm	5m
2½"	HPT-65A	63*76*70	12.5mm	5m
3"	HPT-75A	79*92*82	12.5mm	5m
4"	HPT-100A	96*114*94	12.5mm	5m
6"	HPT-150A	149*167*136	14.0mm	5m
8"	HPT-200A	193*216*170	14.5mm	5m
10"	HPT-250A	239*267*197	15.0mm	5m
12"	HPT-300A	290*318*223	15.5mm	5m



E. AMP-Arched Mesh Pipe Connect：

Arched Mesh Pipe with standard fittings, construction faster and easier.

F. General provisions：

1. Before the construction, the contractor shall prepare the samples and the original catalogue together with the project plan submitted to the architect or engineering consultant for approval before construction.
2. After the completion of this project, the original manufacturer's factory certificate shall be issued by the contractor to be submitted to the architect or engineering consultant for verification.

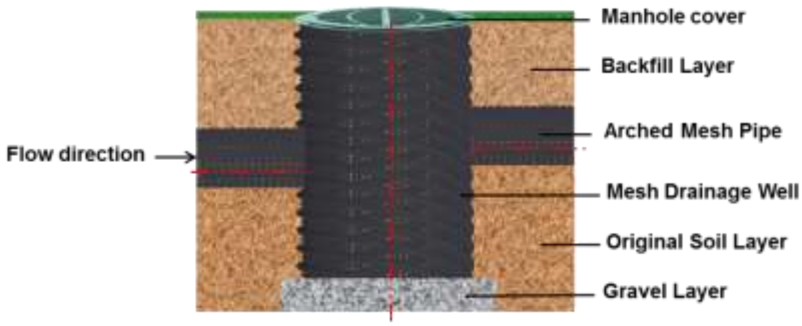
G. Installation Steps：

1. Site preparation: Mark the construction scope clearly and properly level. The height is based on the drawing and is compacted.
2. Stakeout: Measure the exact location of the site and mark it according to the piping plan.
3. Mechanical trenching:
   - I. First excavate the position of the main pipe according to the set slope.
   - II. Re-excavate the branch pipe position and the pipe end depth is based on the dry pipe depth.
   - III. When digging trenches, if there are any debris in the square or the trench, it must be removed by manual excavation.
4. Gravel laying: After the trenching project is completed, the 5cm~10cm clear gravel is evenly laid on the bottom of the ditch. The thickness is subject to the illustration.
5. Buried permeable arched mesh pipe and shallow well construction:
   - I. Firstly, the main pipe is buried in the ditch and fixed by gravel. During the construction, the pipe will be laid flat, the halfmoon type will be upward, and the plane part will be downward.
   - II. The intersection of the main pipe and the branch pipe are connected by two-way, three-way and four-way joints respectively.
   - III. When constructing the well, please make a reserved hole so that the main pipe can be inserted into the well, and then the surrounding space will be sealed with cement mortar.
6. Backfilling: The overall configuration of the main pipe and the branch pipe is completed, and the backfill is layered and is compacted.

H. DMW-Drainage Mesh Well Reference Map

The width of the trench is designed to add 10cm to both sides of the diameter of the well.

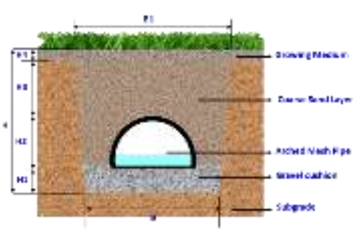
The inclination of the infiltration arched mesh pipe is 1:100~1:500.



DMW-Drainage Mesh Well schematic diagram

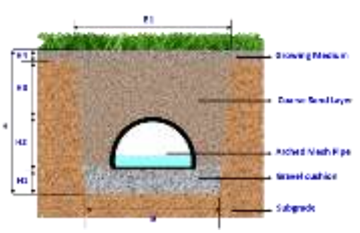
AMP-Arched Mesh Pipe Design and Installation Reference

Arched Mesh Pipe Design Reference**-** Pedestrian lane



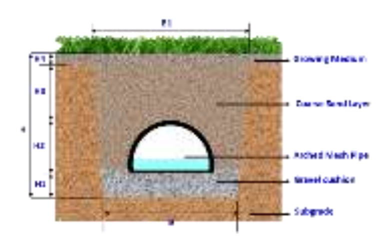
Size	B (cm)	B1 (cm)	H (cm)	H1 (cm)	H2 (cm)	H3 (cm)	H4 (cm)
2"	25	30	41	5	6	25	5
3"	25	30	43	5	8	25	5
4"	25	30	44	5	9	25	5
6"	30	35	49	5	14	25	5
8"	37	42	62	5	17	35	5
10"	45	50	65	5	20	35	5
12"	50	55	68	5	23	35	5

Arched Mesh Pipe Design Reference**-** Light load lane **(**T-20*1)



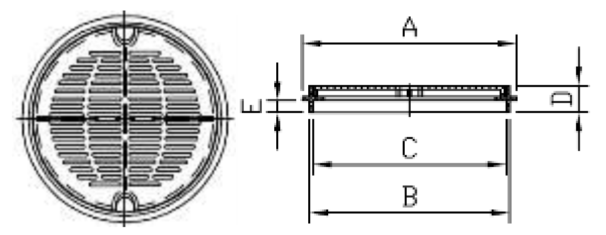
Size	B (cm)	B1 (cm)	H (cm)	H1 (cm)	H2 (cm)	H3 (cm)	H4 (cm)
2"	25	30	41	5	6	25	5
3"	25	30	53	5	8	35	5
4"	25	30	54	5	9	35	5
6"	30	35	69	5	14	45	5
8"	37	42	72	5	17	45	5
10"	45	50	85	5	20	55	5
12"	50	55	88	5	23	55	5

Arched Mesh Pipe Design Reference**-** Heavy load lane **(**T-20*2)



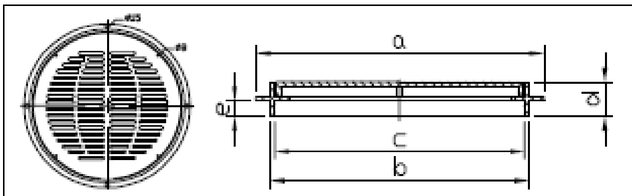
Size	B (cm)	B1 (cm)	H (cm)	H1 (cm)	H2 (cm)	H3 (cm)	H4 (cm)
2"	25	30	49	5	4	35	5
3"	25	30	63	5	8	45	5
4"	25	30	74	5	9	55	5
6"	30	35	89	5	14	65	5
8"	37	42	102	5	17	75	5
10"	45	50	115	5	20	85	5
12"	50	55	128	5	23	95	5

Cast iron manhole cover reference data



manhole cover	A	B	C	D	F
10"	323	293	277	60	26
12"	374	344	328	60	26
16"	476	446	434	60	26

Plastic manhole cover reference data



manhole cover	A	B	C	D	F
12"(318)	390	342	323	60	26
16"(420)	494	446	426	60	26

B-7. RCM-Promotes Rainfall Infiltration and slows down surface runoff design

The expected rainfall will use RCM to enable rainwater to infiltrate rapidly and reduce surface runoff for flood control purposes

Flood control design condition calculation

Expected rainfall calculation formula

$Q_f = C \times I \times A$

Q_f : Expected rainfall（m^3/hr）

C：Outflow coefficient

I：Rainfall intensity〈mm/hr〉

A：Base area〈m^2〉

RCM Permeability

$Q_s = \Sigma Q_s = Q_{hp} + Q_w$

Q_s :RCM Permeability

Q_{hp}: Arched Mesh Pipe Permeability

Q_w : Mesh Drainage Well Permeability

Arched Mesh Pipe Permeability	Mesh Drainage Well Permeability
$Q_{hp} : A_{hp} x\ k\ x\ t$	$Q_w : A_w x\ k\ x\ t$
Q_{hp} : Arched Mesh Pipe Permeability (m^3/hr)	Q_w : Mesh Drainage Well Permeability (m^3/hr)
A_{hp}：Arched Mesh Pipe water permeable area（m^2）	A_w：Unit well permeable area（m^2）
k ：soil saturated permeability coefficient (m/s)	k ：soil saturated permeability coefficient (m/s)
t ：Rainfall delay reference value (s)。	t ：Rainfall delay reference value (s)。

Soil saturation coefficient k value simple comparison table

Soil quality	Sand	Loam	Clay	Plastic Clay
Soil permeability coefficient K(m/s)	10^{-5}(m/s)	10^{-7}(m/s)	10^{-9}(m/s)	10^{-11}(m/s)

"**RCM Design permeability**" The amount of penetration, plus the following various infiltration capabilities

$Q_s=αX\ (Q_{hp}+Q_w)$

Q_s : RCM unit design permeability 〈m^3/hr〉

$Q_{hp}+Q_w$: RCM theory permeability 〈m^3/hr〉

α : Various influence factors 〈0.9〉

α Calculation method: calculated by various influence factors$α=α_1 Xα_2 Xα_3 Xα_4$

$α_1$= Groundwater level 〈0.9〉

$α_2$= Mesh blocking 〈1〉

$α_3$= Water temperature of water injection 〈1〉

$α_4$= Before rainfall 〈1〉

B-8. Case Study : RCM Underground Drainage

Name : OO park

Land area : $10000m^2$

1. **Land permeability coefficient k judgment**

   There is no drilling investigation report in this case. Referring to the data of the neighboring points of the geological database, the soil layer distribution is between the poor grade sand and the argillaceous sand, and the permeability coefficient k is 10^{-7}cm/s.

2. **The base rainfall assessment**

   $Q_f=C\ x\ I\ x\ A$

   Q_f : Expected rainfall（m^3/hr）

   C : Outflow coefficient

   I : Rainfall intensity 〈50mm/hr〉

   A : Base area 〈$10000m^2$〉

   $Q_f=0.9\ x\ (50/1000)*10000 =$ **450.0m^3/hr**

3. **Water retention RCM configuration design value calculation**

   Arched Mesh Pipe permeability(m)

   $Q_{hp} = A_{id} x\ k\ x\ t$

   Q_{hp} : Arched Mesh Pipe theoretical water permeability

   A_{id} : Arched Mesh Pipe(ID)

   k : Soil permeability coefficient or final infiltration rate

   t : Rainfall delay reference value (s)

Arched Mesh Pipe permeability α/m Model test

Arched Mesh Pipe actual permeability α/m :

Model test data sand soil permeability coefficient $K=3.124*10^{-5}$m/s

Estimating soil permeability coefficient $1.0*10^{-7}$m/s

Size	ID mm	Soil permeability coefficient K		
		$3.124*10^{-5}$m/s Sand	$1.0*10^{-7}$m/s Loam	$1.0*10^{-9}$m/s Clay
4"	96	62.76m^3/hr	0.20m^3/hr	0.0020m^3/hr

Arched Mesh Pipe permeability Design : 4" x 2000m

$Q_{hp} = A_{id} x\ k\ x\ t$

Q_{hp} =(0.2m^3/hr) *2000m=400.0m^3/hr

Mesh Drainage Well permeability

$Q_w : A_w x\ k\ x\ t$

Q_w: Mesh Drainage Well permeability(m^3/hr)

A_w：Unit well permeable area（m^2）

k ：Soil permeability coefficient or final infiltration rate (m/s)

t ：Rainfall delay reference value (s)

Unit well permeable area (A_w)

Pipe area + bottom area = water permeable surface area (m2)

Code	Size	ID m	$2\pi R$ x (Well Length) $+\pi R^2$= Water permeable surface area (m^2)							
			L 60cm	L 80cm	L 90cm	L 100cm	L 120cm	L 150cm	L 180cm	L 200cm
NSO-200	8"	0.193	0.3929	0.5141	0.5747	0.6353	0.7565	0.9383	1.1201	1.2413
NSO-250	10"	0.239	0.4951	0.6452	0.7203	0.7953	0.9454	1.1705	1.3957	1.5458
NSO-300	12"	0.290	0.6124	0.7945	0.8856	0.9766	1.1587	1.4319	1.7051	1.8872

Q_w Mesh Drainage Well permeability (Soil permeability coefficient K：10^{-7}m/s)

Code	Size	ID m	$Q_0 : A_o x\ k\ x\ t$							
			L 60cm	L 80cm	L 90cm	L 100cm	L 120cm	L 150cm	L 180cm	L 200cm
NSO-200	8"	0.193	0.5091	0.6662	0.7448	0.8233	0.9804	1.2160	1.4516	1.6087
NSO-250	10"	0.239	0.6417	0.8362	0.9334	1.0307	1.2252	1.5170	1.8088	2.0033
NSO-300	12"	0.290	0.7936	1.0297	1.1477	1.2657	1.5017	1.8558	2.2098	2.4458

Drainage Mesh Well permeability

12" diameter x 1.2m Length x 50pcs

$Q_w = A_{id} \times k \times t$

Q_w= *1.5017*m^3/hr x 0.9 x 50=67.58m^3/hr

4. **RCM permeability design：**

$Q_s = \Sigma Q_s = Q_{hp}$ x (m) + Q_w x (n)

$Q_s = \Sigma Q_s$=400.0m^3/hr +67.58m^3/hr =467.58(m^3/hr)

5. Valuation

The designed treatment capacity is 467.58 (m3/hr) greater than the expected amount of rainfall 450.0m3/hr.

The design throughput of the RCM facility is the combination of Arched Mesh Pipe permeability and permeability.

Please confirm that the design process results are greater than the sum of the expected rainfall Qf = C X I X A.

If it is small, the facility size must be processed.

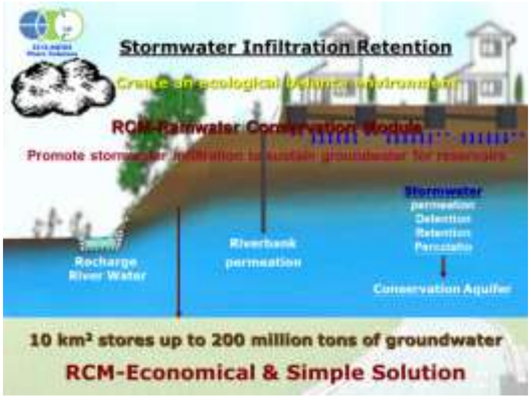
C. RCM-The main function

C-1. RCM promotes rainfall infiltration

Collecting saturated rainfall from the surface and strata, and infiltrating the groundwater layer, it is a water-retaining design with a function of slowing the surface flow to promote the water circulation capacity of the earth, improve the ecological environment, regulate the microclimate, and alleviate the urban climate. phenomenon.

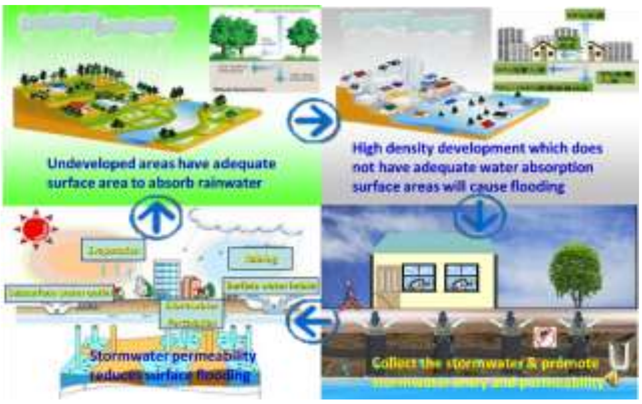
With an area of 200 square kilometers of 200 million tons of groundwater, RCM offers the most economical and simple method.

Promote the infiltration of rainwater into the soil, try to keep the rainwater temporarily placed on the base, and then allow the water to permeate and circulate to the earth at a certain flow rate. When the base retains the better water retention performance, the base has the ability to conserve rainfall, which is beneficial to the microorganisms in the soil. Activities to improve the activity of the soil and maintain the balance of the natural ecological environment within the building base. Restoration of river base flow, improvement of environmental and ecological conditions, as well as various benefits such as mitigating land subsidence, reducing waterlogging and seawater inversion.



C-2. RCM promotes rainfall infiltration - Land protection

In urban high-density development areas, surface impervious areas, including roofs, streets, sidewalks, and parking lots, often fail to provide sufficient exposed ground infiltration of rainfall. The increase in surface runoff is proportional to the amount of impervious pavement, impervious to water. The increase in the area will reduce the chance of rainwater infiltration into the soil. As a result, not only will the groundwater replenishment be reduced, but also the peak flow and runoff volume will increase, and the river base flow will also decrease. The function of conservation and sluggish rainfall in urban areas is declining due to the increase of impervious areas, and the increase in water consumption and displacement due to the increase in population and the negative impacts of various urban constructions will adversely affect the hydrological environment in urban areas. The impact. Therefore, the artificial facility Arched Mesh Pipe is needed to help the precipitation to penetrate into the surface as much as possible. This method is called "manual assisted infiltration".



D-3. Prevent land subsidence

The main reason for the subsidence of the stratum is that people extract excessive groundwater and cause subsidence.

RCM promotes the cultivation of groundwater layers under rain and water, and replenishes groundwater to prevent subsidence.

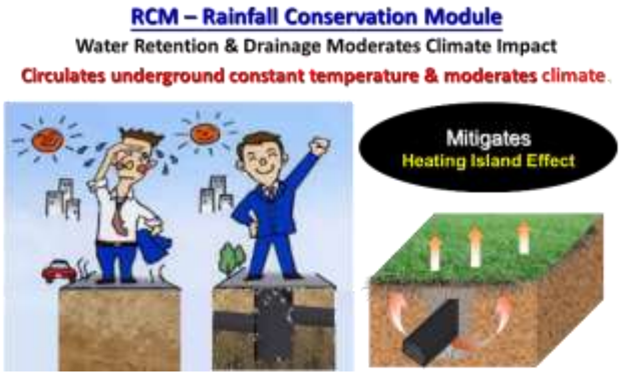
RCM is a manually assisted infiltration facility that helps precipitation infiltrate into the groundwater layer as much as possible.

D-4. RCM-Mitigates Heating Island Effect

RCM collects saturated water from the surface and the groundwater in the groundwater layer. It is a water retention design that has the function of slowing the surface runoff to promote the water circulation capacity of the earth, improve the ecological environment, regulate the microclimate, and alleviate the urban climate. Slow down the heat island effect.

The formation temperature of 70 cm below the surface is mostly the average annual temperature and does not change with changes in atmospheric temperature.

Use normal temperature underground temperature, cycle in RCM, mediate surface temperature, reduce city temperature, control greenhouse temperature, maintain road temperature, etc.



C-5. RCM-Advantage

1. Stormwater retention, promotes stormwater infiltration, and replenishes groundwater.
2. Effectively supplement the conservation of groundwater, restore the river flow, improve environmental and ecological conditions, and promote bio-organic survival space.
3. Regulate regional microclimate and ease urban climate warming.
4. Alleviate land subsidence, reduce waterlogging and seawater backflow.
5. Reduce the chance of urban flooding.
6. Recycling of rainwater can save precious water resources, reduce water fees, and truly realize the goal of effective use of water resources.
7. The floor space and required space are small, the construction is easy, the investment cost is low, the benefit is high, and the drainage channel facilities can be reduced.

D. RCM-Applications

D-1. RCM- Roof & Garden Drainage

1. RCM can replace traditional cement drainage facilities and save installation costs up to 30%.
2. Using ecological engineering construction method, it is quick and easy.
3. To keep land completeness.
4. To reinforce rainwater permeation and reduce the burden of storm sewer.
5. To provide soil with ventilation for keeping plant growth and health fast.
6. The invisible permeation drainage system circulates water through the stack effect resulting in stable climate.
7. Because of rainwater permeation, there is no stagnant water through the drainage. Thus there is no mosquito breeding environment.

Therefore RCM is the best approach for prevention and treatment of dengue fever through the drainage system.

D-2. RCM-Pavement Stormwater Drainage

Trail bricks and asphalt pavement, rainwater can not be infiltrated into the ground is the main cause of urban runoff, RCM collects rainwater quickly infiltrated underground, construction and maintenance is easy, low construction cost, is the best trail base water retention system.

Permeable bricks, permeable asphalt asphalt materials and installation costs are higher than RCM, and the maintenance cost is high. The pavement should be cleaned with a strong water column. The water retention efficiency of the base is affected by the permeable bricks. The permeability coefficient of the permeable asphalt tarmac affects the water permeable efficiency, and the dust and debris obstruct the water permeable holes, which cannot be removed. The water permeable effect is slowly lost, so there is a certain life.

Setting RCM in the paving brick can not only solve the drainage problem of impervious pavement, but also conserve groundwater. Therefore, RCM is the best material for water retention and drainage in the sidewalk base.

C-3. Road Water Retention and Drainage

The damage to the roadbed and pavement structure is largely due to the presence of water. Water is one of the main causes of road failure. Good road drainage can extend the life of the road. To maintain adequate road support and extend the life of the road, a good drainage system is required. Modern highways with good drainage systems have a design life of two to three times higher than those without drainage.

Water in the asphalt pavement causes moisture damage to the asphalt material, reduced modulus, and reduced tensile strength. Water saturation reduces the modulus of the asphalt by 30% or more compared to the dry state. The dense grading base layer has a low permeability, a long drainage path to the edge of the road, and a very slow drainage.

RCM quickly eliminates road surface water and saturated rainwater in the soil, prolonging the service life of modern highways by 2~3 times

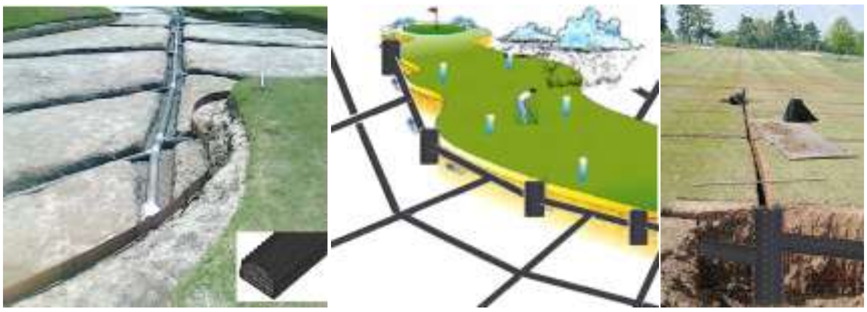
C-4. RCM-Golf Course Drainage

Directly buried by RCM, there is no problem of waste soil removal, the drainage system is not blocked, saving construction costs and filter material costs. It is the best material for water retention in bunkers, fairways and greens.

Arched Mesh Pipe, when the permeable layer is laid down, the water flows from bottom to top into the water conduit, and the natural gravity phenomenon is directly used to generate the soil water separation effect. Thus, the soil particles naturally sink the temple due to gravity, and will not block the drainage layer. It will not block and lose drainage.

There is no water filtration layer filter material to hinder the base water retention phenomenon, and the base water retention function is particularly good.

Quickly eliminate rainfall, store and infiltrate, conserve groundwater layers, and promote turf growth.



D-5. RCM-Stormwater Retention Tunnel System

The metropolis of the modern metropolis is concentrated, the industry and commerce are prosperous, and the traffic is developed. Therefore, an impervious layer, such as houses and roads, is laid over a large area. When heavy rain came, the rainwater previously absorbed by soil and vegetation was now concentrated in the drainage ditch. These metropolises are often built in flat areas, and unless there is a perfect sewer system, these rainwaters are not easily removed, thus causing urban flooding. At the same time, because the sewer is not enough, the rainwater is mixed with untreated sewage and is often discharged directly into nearby rivers and lakes, which causes pollution problems.

Basic concept

When heavy rain comes, although there is a drainage channel, it is not easy to discharge, so there is often water accumulation. It is also forced to put untreated sewage into nearby lakes and rivers.
To solve this problem, rainwater can be treated separately from sewage, and large-capacity sewers can be used to discharge rainwater into nearby rivers. However, due to the concentration of the population, the narrow roadway and the difficulty in obtaining the land, the cost of completing such a complete system is more expensive than the new concept mentioned below, and the problem of pollution has not been completely solved.
Therefore, it is proposed to set up the flood discharge method of the infiltration well base water retention network system to form an underground rainwater infiltration tunnel to drain a large amount of rainwater and store it in the groundwater layer. After the heavy rain, the rainwater is pumped back to use and then placed. The tap water purification plant handles the problem that the turbidity caused by heavy rain is difficult to handle. Groundwater in the groundwater layer can also be used during drought and water shortage. The water intake needs to be determined by the groundwater level of the groundwater observation well. Such rainwater recycling measures can save precious tap water sources and truly realize the goal of effective utilization of water resources.

Tunnel RCM system setup costs and future maintenance costs are low

The water retention RCM system of the penetrating well base is located between 30 and 100 cm below the ground. The main advantage is that the floor space and required space are small, the integrity of the building base is maintained, the construction is easy, the land is not used, the investment cost is low, and the benefit is low. High, and can be deep into the lanes, so that some rain and water infiltration, excess rainwater and then discharged into the sewer through RCM, solve the problem of flooding difficulties in the community drainage, and can reduce drainage facilities.
RCM collects rainfall from the roof or other surface.
Rainwater recycling measures can save precious water resources and reduce water charges, and can truly fulfill the goal of effective use of water resources.

Tunnel RCM system High economic efficiency

Due to the easy construction of the water retention RCM system (underground drainage tunnel) of the infiltration well base, the installation cost is low, and there is no land acquisition problem. The system does not have to be connected to each other, and can be used in a small area of a community or in a large area. It can also solve the problem of drainage and flooding caused by insufficient capacity of rainwater and underwater waterways.
Solve the surface runoff caused by heavy rain (flood protection).
Solve the problem of water accumulation caused by heavy rain.
Effectively supplement the conservation of groundwater, restore the river base flow, improve environmental and ecological conditions, and promote bio-organic survival space.
Regulate the microclimate and alleviate the urban climate.

Tunnel RCM system Planning

The preliminary investigation includes hydrological investigation and geological exploration. The hydrological survey is a detailed study of the rainfall and its distribution over the years to determine the scale of the water retention RCM system at the percolation well. At present, the design is based on heavy rains with a statistical frequency of 100 years.

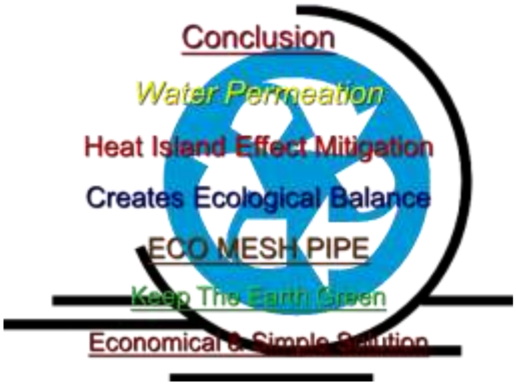
Geological exploration can obtain a variety of important geological data, such as the appropriate location for the construction of underground flood drainage tunnels, soil permeable filtration, groundwater level and various factors affecting the infiltration of rain and water, in order to solve the following problems.

1. Rainfall condition
2. Soil species
3. Extension of time
4. Topography and geology
5. Groundwater level
6. Planting buffer zone
7. Land use plans and restrictions
8. Pollution control

Conclusion

The above is a very brief introduction that describes the steps taken in a new project plan and the issues that must be considered. As for the detailed plan and the resolution of various issues, it is beyond the scope of this article. However, as can be seen from the above, it can be seen that the infiltration well base water retention network system plan is a one-size-fits-all solution to fundamentally solve the problem of flooding and flooding in the area.

RCM facilities have low cost and do not need to be connected to each other. When considering the rainwater drainage facilities, the government should mainly use RCM, supplemented by rainwater drainage channels, which not only saves a lot of construction funds, but also achieves water retention and rainwater recycling. Precious water resources and lower water bills can better fulfill the goal of effective use of water resources.



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