

자연스런 모습으로 자연을 지킵니다!
Keep the nature naturally



Ecological Restoration Methods

with nature friendly materials



친환경 벤처 · 이노비즈 기업
주식회사 시내오들
SINANDLE CORPORATION



It's an honor to introduce innovative natural construction methods of Sinandle Corporation.

The company name "Sinandle" means natural river and field in Korean.

Like the company name, we have chased a basic paradigm harmonized with the water environment consistently.

Overcoming various doubts toward the fiber material, Sinandle has renovated the manufacturing systems to reform the durability and the wear resistance of Fiberstone.

Therefore, we have reached a competitive level of technical development all over items with the efforts of all the employees.

We will try our best to make ocean and river environment sustaining healthful ecological status.

Thank you.

Sinandle Corporation

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Fiber stone



Fiber stone is eco-friendly fiber net can be stuffed with specified size of stones.

It is made of high tension fiber intended to prevent the scour of riverbank, seashore, bridges and riverbed.

Specification

Item	2.0 TON Type	4.0 TON Type	8.0 TON Type	15.0 TON Type
Installation size	L2000×H400	L2400×H550	L3000×H700	L3500×H1,000
Floor space	3.00m ² (±3%)	4.50m ² (±3%)	7.07m ² (±3%)	9.60m ² (±3%)
Volume	1.16m ³ (±3%)	2.26m ³ (±3%)	4.48m ³ (±3%)	8.52m ³ (±3%)
Weight	1.8 ~ 2.3 TON	3.7 ~ 4.3 TON	7.6 ~ 8.4 TON	14.7~15.4 TON
Net spec.	Φ6 × #50~60	Φ7 × #60~70	Φ9 × #60~70	Φ10 × #60~70
Filler	Pebbles/rubbles (75~150mm)	Pebbles/rubbles (100~150mm)	Pebbles/rubbles (100~200mm)	Pebbles/rubbles (150~200mm)

● Size range : 1 TON ~ 20 TON (Customized production)

▶ Properties

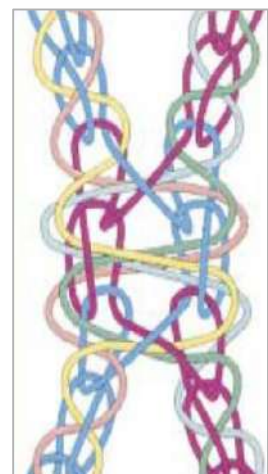
- Increase the stability, weatherability, wear resistance by weaving high strength industrial yarn with special method

- Enlarge the usage by the technology weaving the net thicker

▶ Raschel knitted net

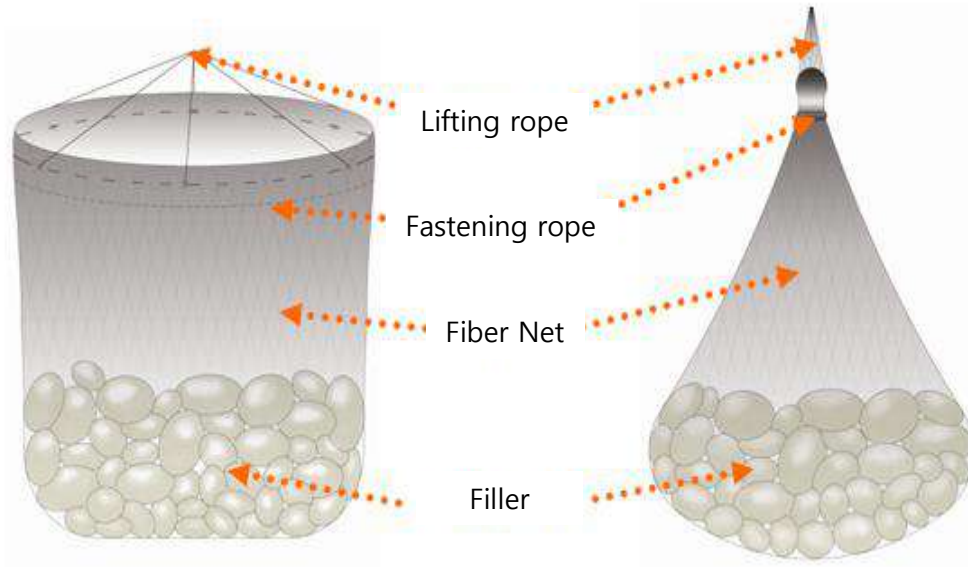
① A knotless weaved net which is tangled with numerous yarns making loops vertically

② Secure the engineering safety with no twirling off in case of net cutting



【 Raschel formation 】

Composition Diagram



Work flow



1. Putting the net over the container



2. Stone stuffing



3. Fastening the opening with rope



4. Pulling out the work container

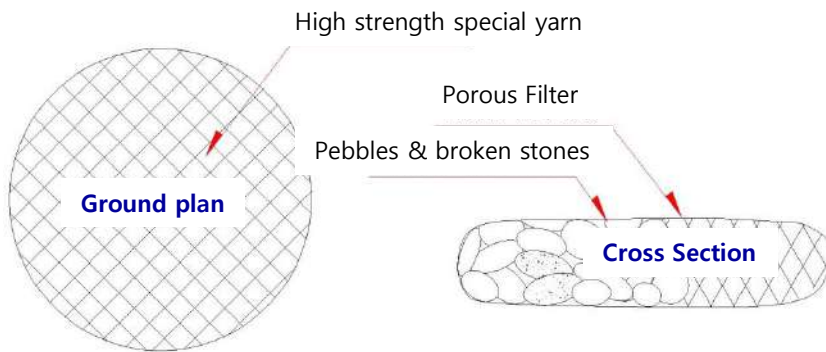
Product overview



【 Fiber Stone 2.0TON type 】



【 Fiber stone lifting 】



Installation specification		
Item	D(mm)	H(mm)
1 ton	1,600	300
2 ton	2,000	400
4 ton	2,400	550
6 ton	2,700	650
8 ton	3,000	700
10 ton	3,200	800
12 ton	3,300	900
15 ton	3,500	1,000



Smaller

Settlement / Scour depth

Larger

Smaller

- Weaker the peripheral velocity
- Smaller and slower scour depth
- Smaller and slower settlement

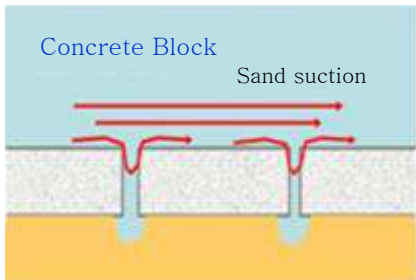
- Stronger the peripheral velocity
- Larger and faster scour depth
- Larger and faster settlement

Larger

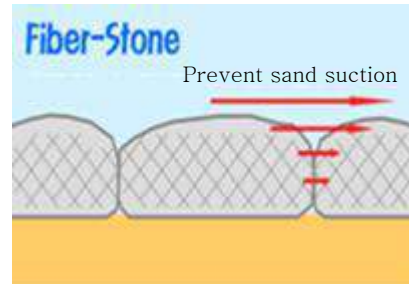
Properties (1)

1. Excellent scour protection against the flow rate with porous structure

- An structure formed with small materials characterized to prevent the suction of sand and settlement



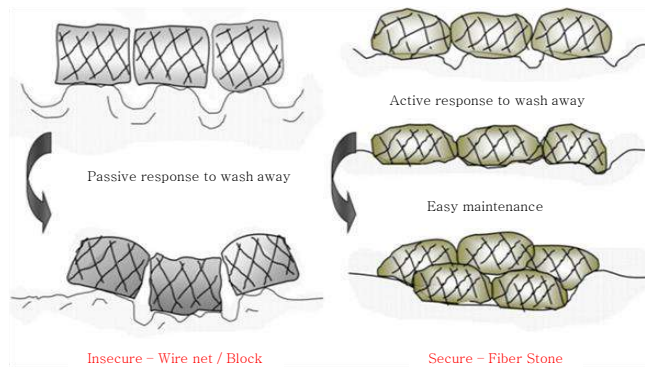
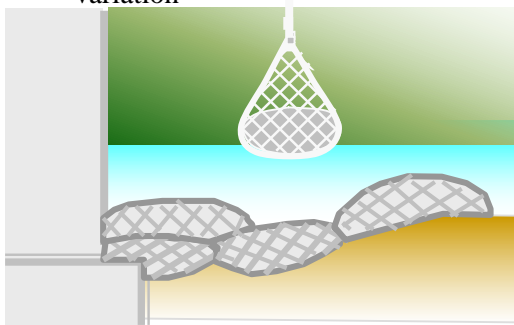
Sand suction and settlement occur when the flow rate is faster around the concrete (impermeable structure)



Prevent sand suction and settlement when the flow rate is slower around the Fiber Stone

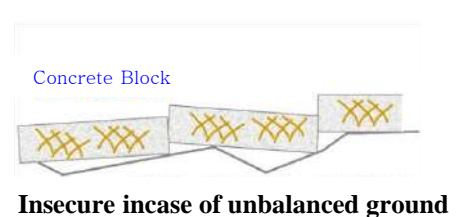
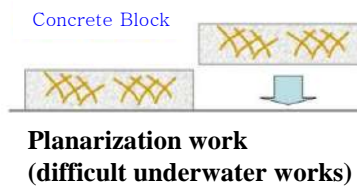
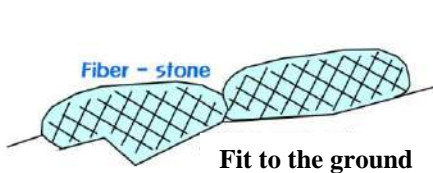
2. Secure outstanding durability and flexibility with the formation of high tensile special yarn

- Contact the ground firmly with high flexibility and respond well to the ground variation



3. Superior work performance in underwater and soft ground works

- Excellent application in sand or mud environment, and easy underwater work



4. Construction period shortening

- Able to proceed the work without appurtenant works and shorten the construction period by mechanization



5. Eco-friendly material + composition

- Made of eco-friendly material and easy to bring in aquatic, waterfront plants



6. Contribution to aquatic ecosystem

- Generate diverse space and flow rate supplying various habitat for aquatic animals



7. All-weather usage

- In harmony with various environment and other structures, Fiber Stone makes emergency recovery and maintenance easy



Summary of properties

- **Engineering stability** : Fiber based scour protection with excellent flexibility and traction
- **Hydrophile property** : Porous structure in harmony with aquatic environment and verified outstanding water purification
- **Eco-friendliness** : Fish habitat and plant introduction
- **Constructability** : Single unit structure to make the construction and precise underwater works easy

The key points of 2nd generation Fiber Stone

- **Increased durability** : Weaving high strength yarn with creative technology
- **High quality** : Increased wear resistance
- **Single unit structure** : Increased tractive force and stability against wave action
- **Pro-environment product** : Porous structure maximizing the eco-friendly property



【 Embankment protection 】



【 Submarine cable protection 】

Application of Fiber Stone

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III. Flood control

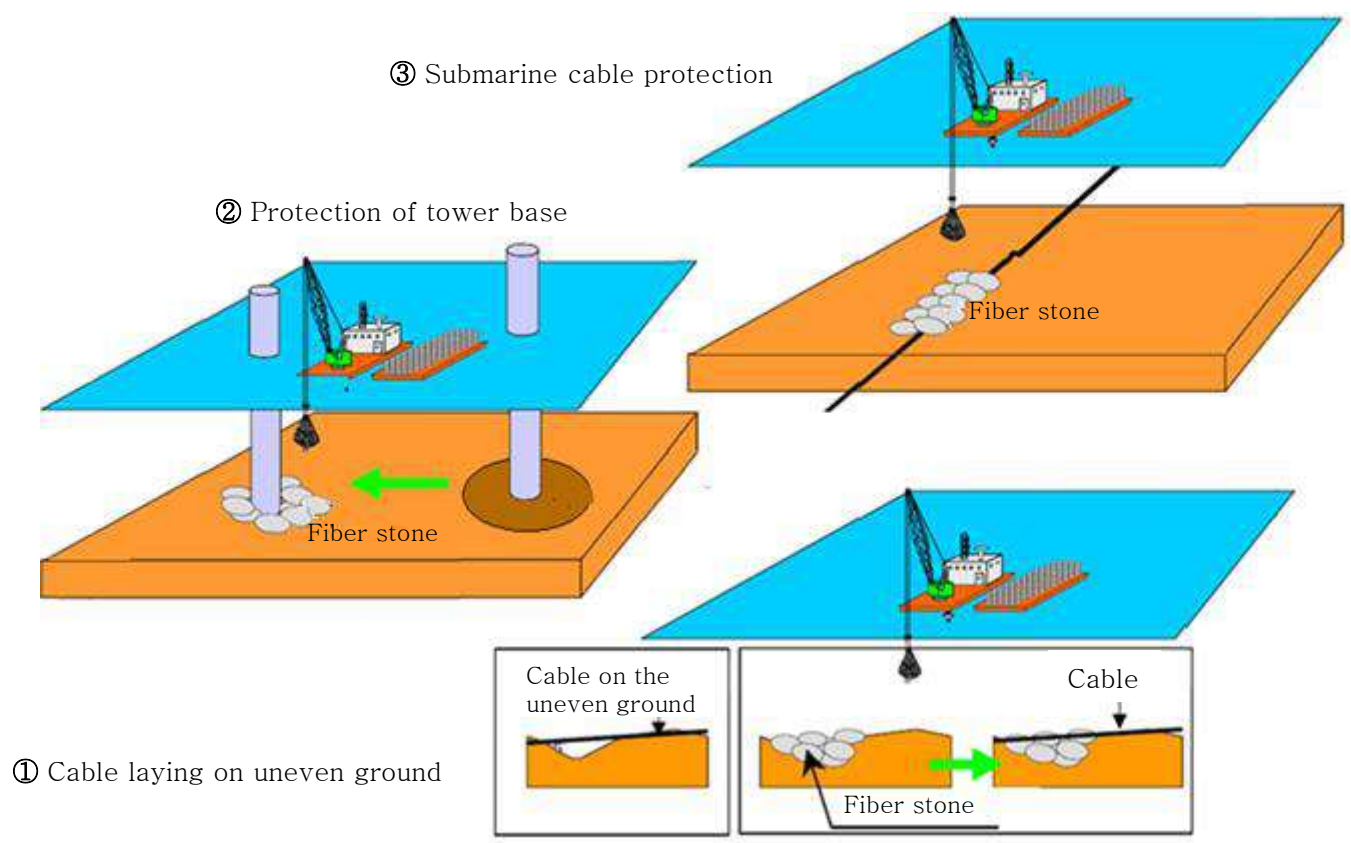
1. Prevention of floods	... 39
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The concept map of coastal application

■ Plane schematic diagram



Underwater installation diagram



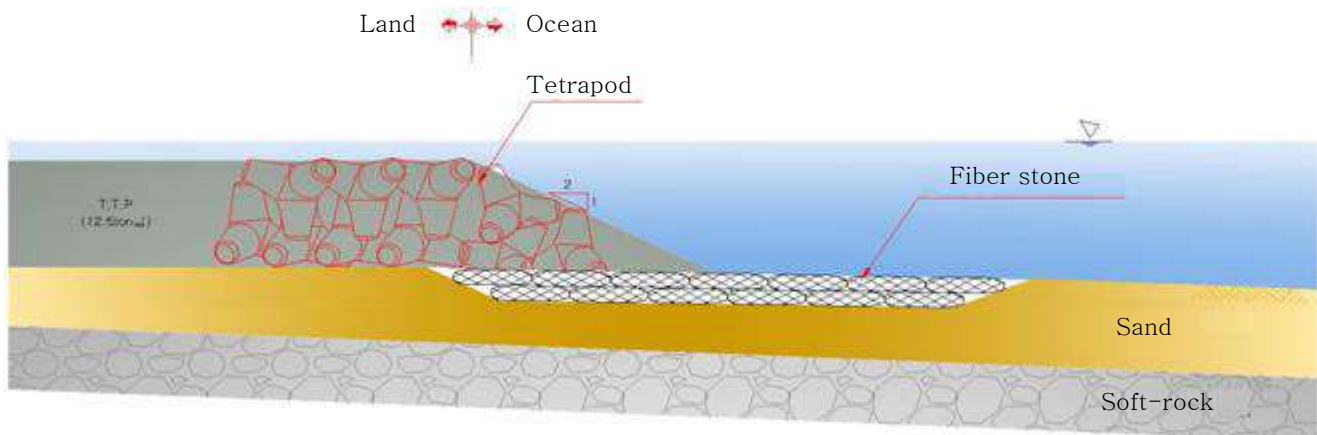
① Cable laying on uneven ground

Marine – Base protection for the submerged breakwater

■ Installation



■ Application scheme diagram



■ Features and effects

- Install as base protection structure for the submerged breakwater
- Prevent outflow of the sand flowed in between the coast and the submerged breakwater
- Complement the functions of breaking wave blocks(like T.T.P)

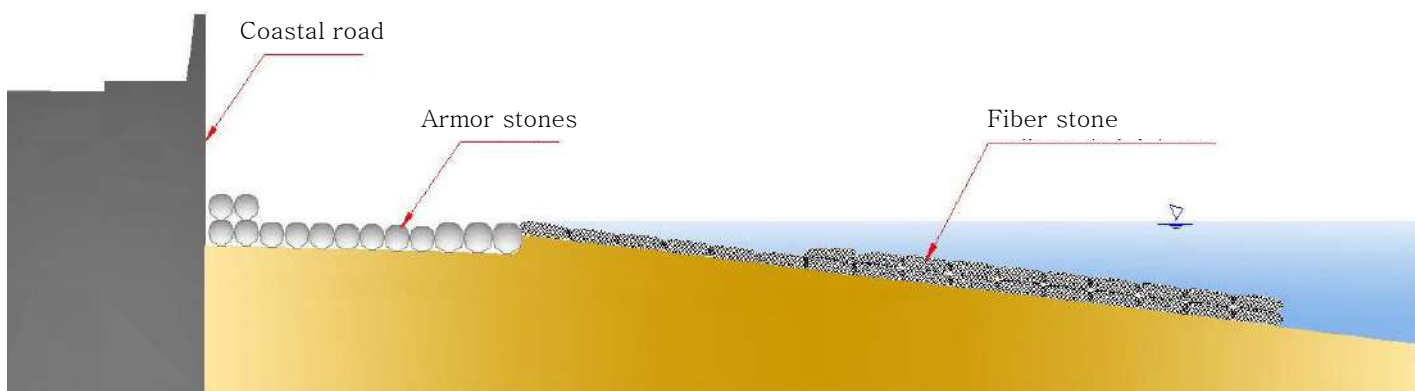
Marine – Sand outflow prevention (Jetty type)

■ Installation



- Protect newly installed coastal structures and prevent the sand outflow
- Decrease the impact of the wave and the inshore current

■ Application scheme diagram



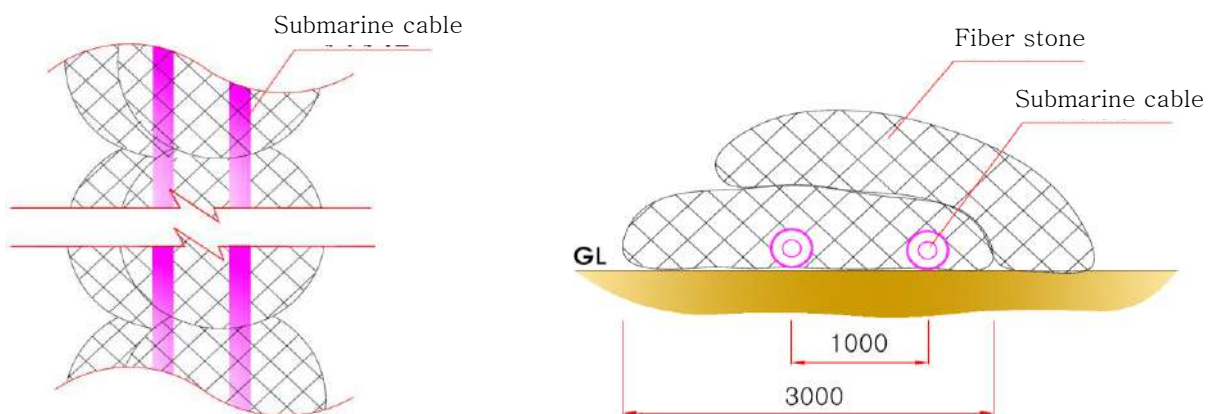
- Restrain the rapid variation of marine and costal environment to increase hydrophile property and disaster prevention fuctions
- Economic and eco-friendly method using the resilience of porous structure

Marine – Submarine cable protection

■ Installation



■ Application scheme diagram

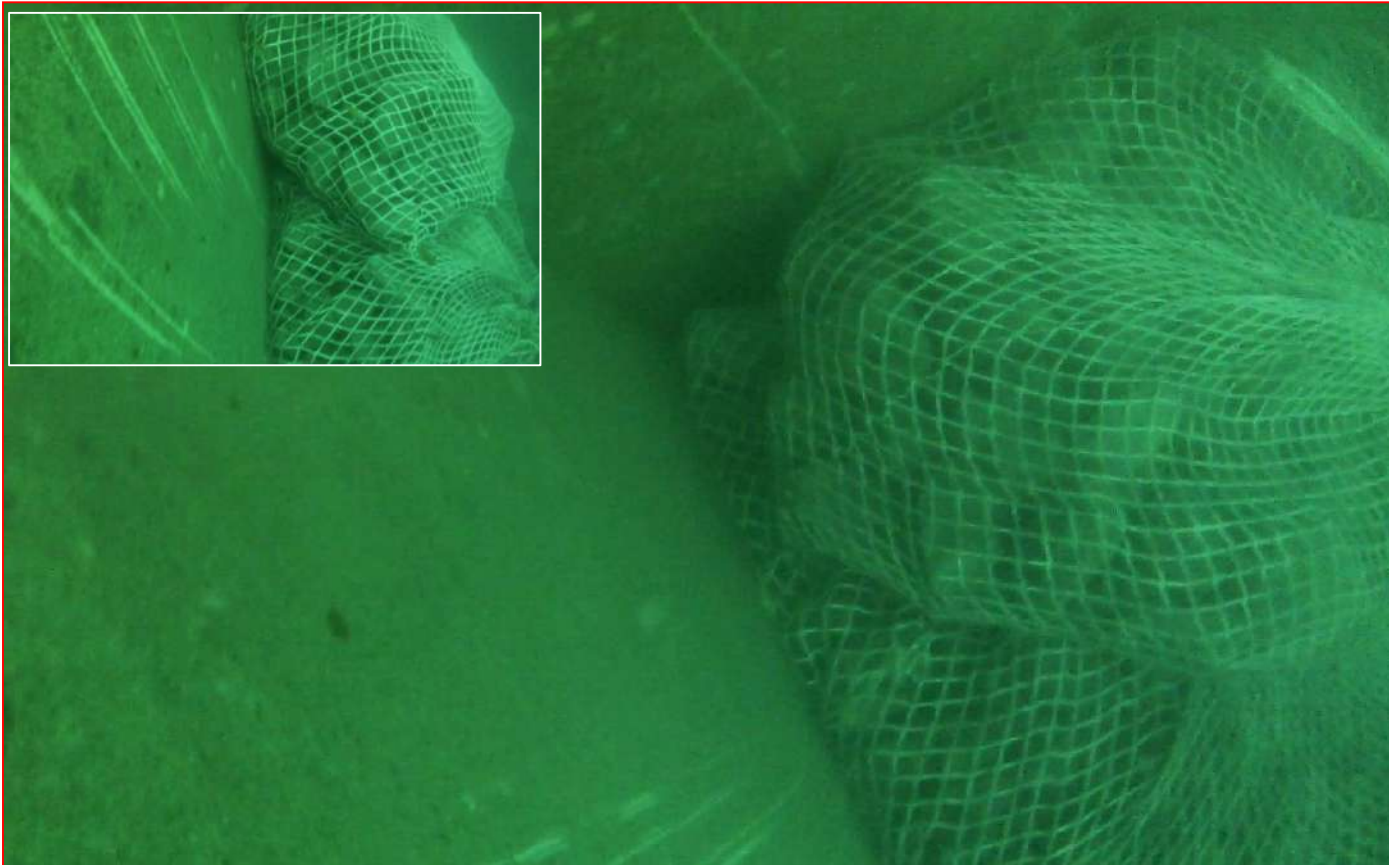


■ Features and effects

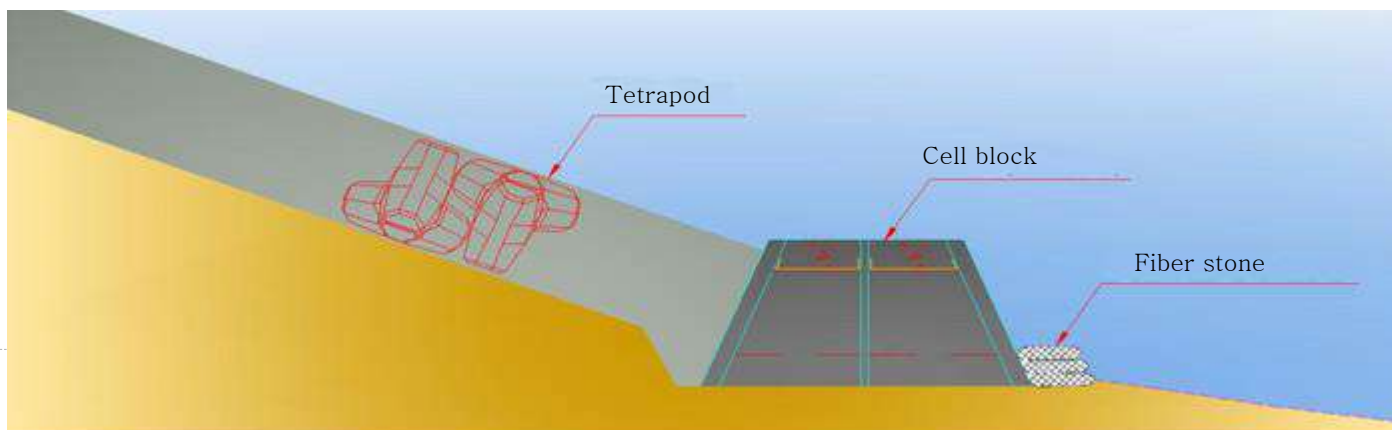
- Alternative method to solve the problems of stone protection method like stone loss and maintenance
- Capable to install the quantitative volume instead of broad range installation
- Able to install the precise installation and lessen the maintenance
- Stable even in case of un-trenching

Marine – Caisson(Cell-block) base protection

■ Installation



■ Application scheme diagram



■ Features and effects

- The filling material in cell block would be spilt out in case of uneven ground
- Install the Fiber stone in front of the cell block for sealing up effect
- Capable of precise installation by easy underwater works
- Apply large scale of Fiber stone (8ton) by reviewing the stability against wave

Marine – Coastal scour protection (Breakwater)

■ Installation



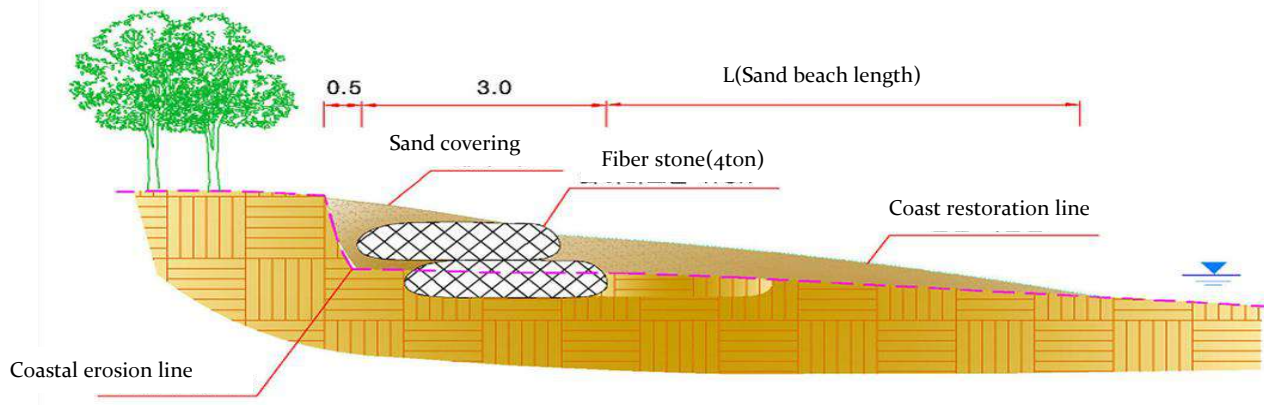
Wolsong province, Uljin, Korea

10 months after installation

Scheme diagram

- Restrain the direct coastal wave and decrease the wave energy to introduce the sand accumulation
- Breakwater function against the wave energy + sand accumulation

■ Application scheme diagram



- Works as a structure to prevent the coastal erosion by the wave
- Prevent the sand loss by the wind
- Restore the shore line (Apply to the costal erosion and the submerged sand pile)

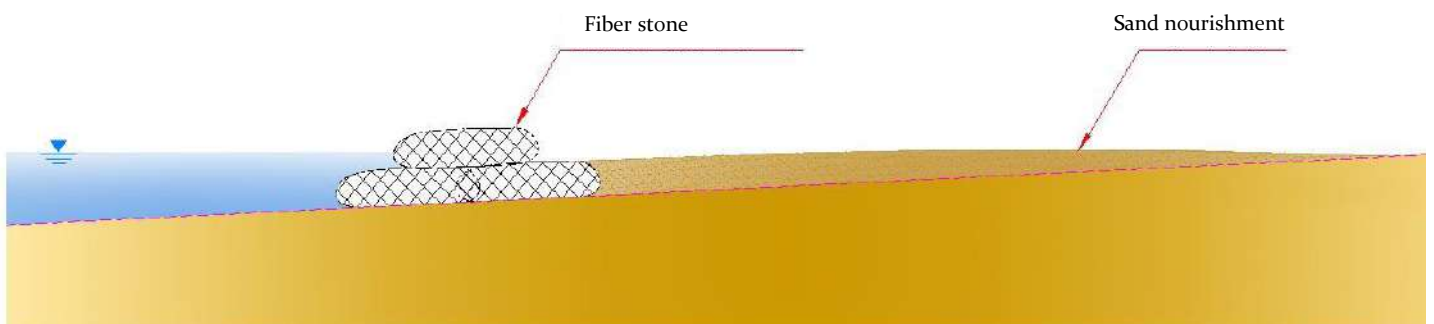
Marine – Prevention against out flow of sand nourishment (West sea)

■ Installation



- Restrain the direct coastal wave and prevent the outflow of sand nourishment
- Decrease the impact of tide and wave + Prevent the outflow of sand nourishment

■ Application scheme diagram



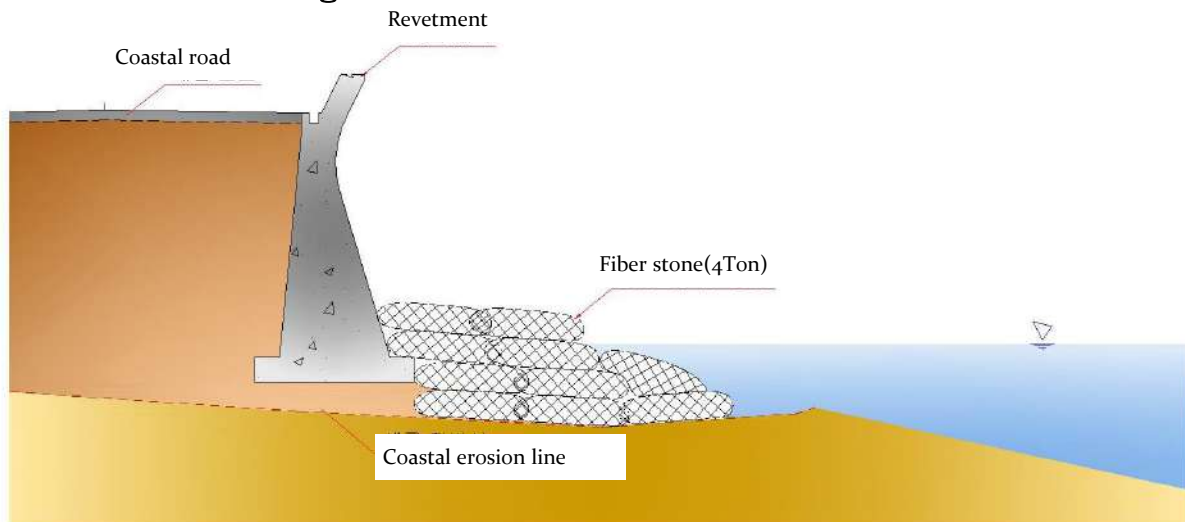
- By installing the Fiber stone at the edge of beach nourishment to prevent outflow of sand and supply breakwater function
- Work as a structure to ensure stable travel resort and economic operation
- Apply as a alternative plan to reform the inefficient beach nourishment

Marine – Emergency restoration and scour protection

■ Installation



■ Application scheme diagram



■ Features and effects

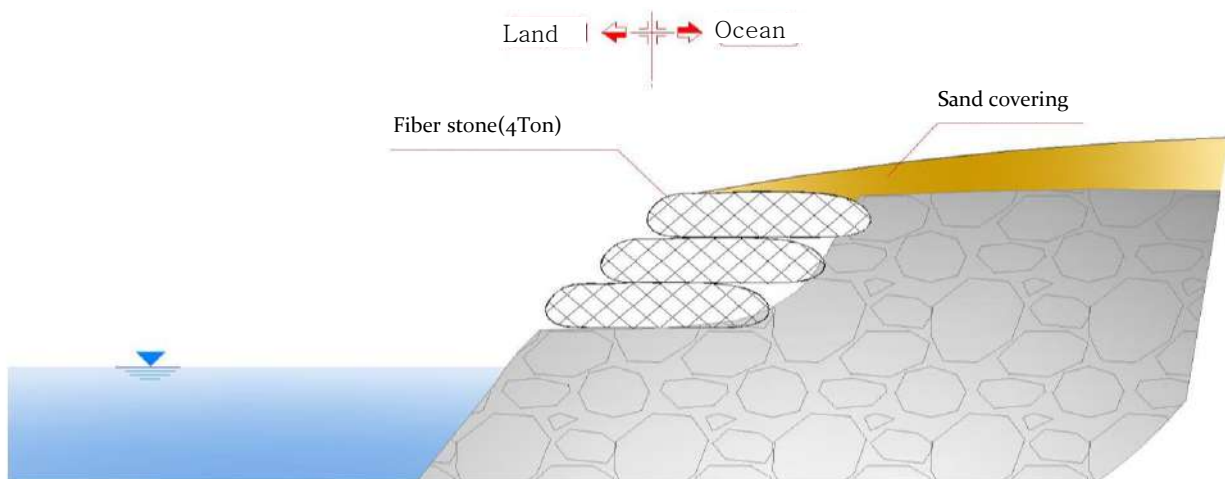
- Apply as emergency restoration for the coastal road base collapse by the scour
- A porous structure absorbs the wave energy and accumulates the sand
- Capable to use as emergency restoration and TTP base

Marine – Prevention against collapse of the coastal base line

■ Installation



■ Application scheme diagram

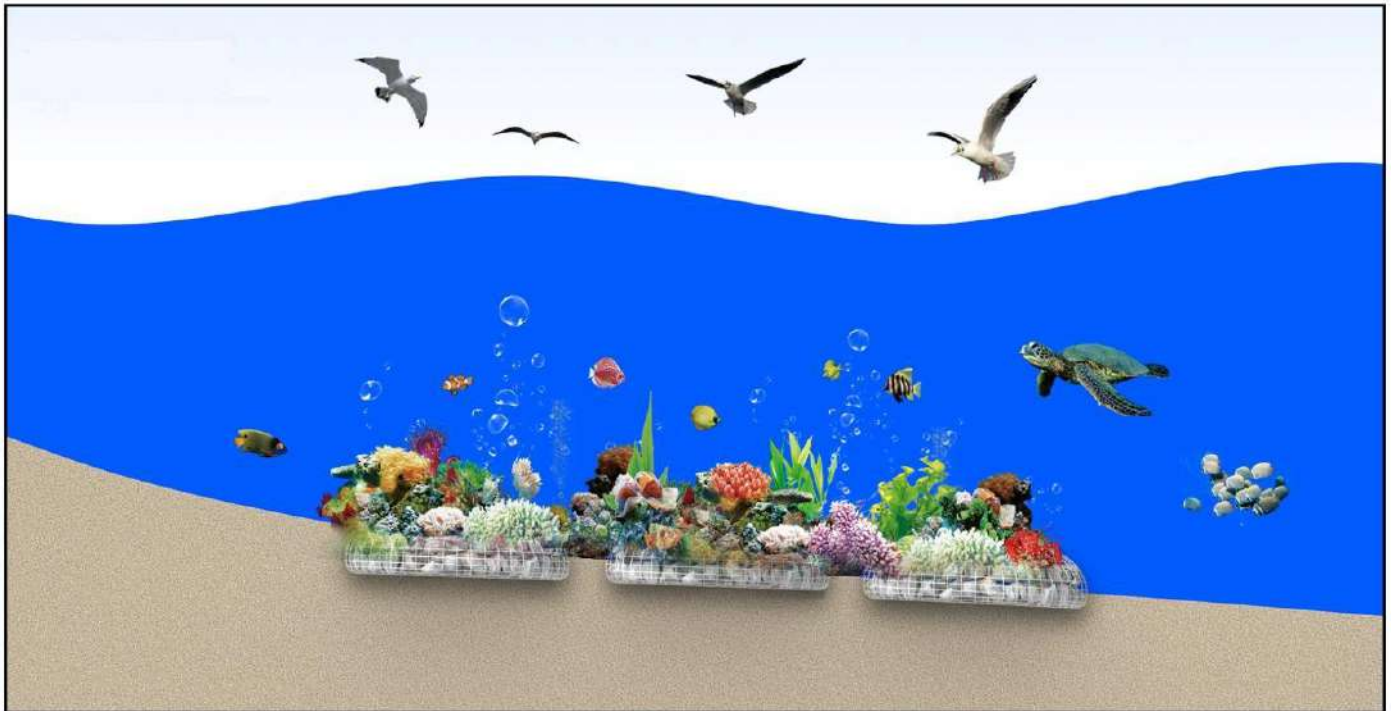


■ Features and effects

- Prevent the coastal erosion and restrain the collapse of beach sand from the land
- Suppress the constant collapse and scour of the base line from the land
- Prevent the scour of adjacent coastal road and protect the coastal structures

Marine – Marine ranch

■ Installation scheme diagram



Excellent efficiency	Aqua biotope function and outstanding application
Structural stability	Flexible porous structure with constant stability
Simplified Installation	Fast and simple all-weather installation
Eco-friendly structure	Eco-friendly structure without toxic substance emission
Harmonization	Introduction of marine various aqua creatures

■ Installation monitoring



Sea slug island, Yangyang, Korea



Haeundae, Busan, Korea

Marine – Silt protector anchor

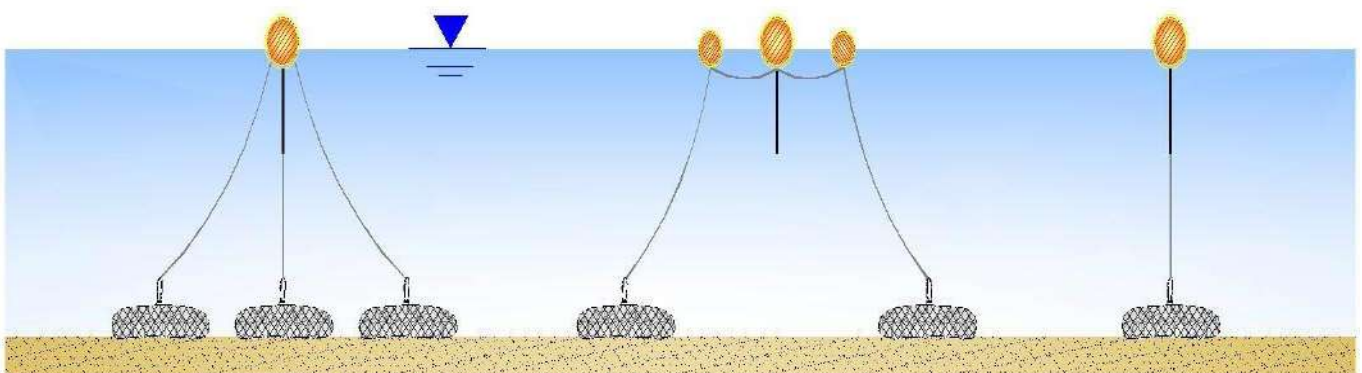
■ Installation



■ Comparison table

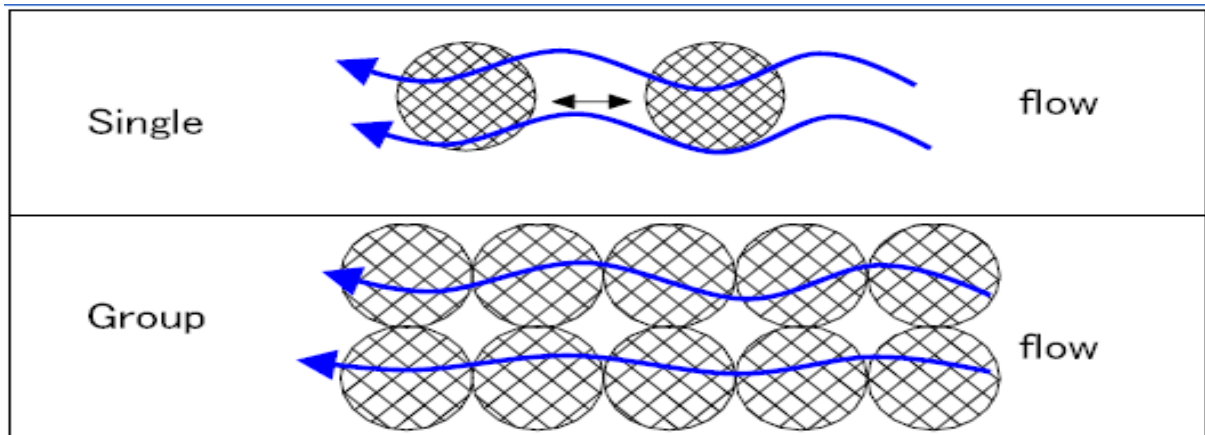
	Fiber stone	Sandbag	Concrete block
Diagram			
Outline	<ul style="list-style-type: none"> • Connect Fiber stone to membrane part • Fixed by the weight of Fiber stone itself 	<ul style="list-style-type: none"> • Connect the sand stuffed sandbag to floating part • Fixed by the weight of sand bag itself 	<ul style="list-style-type: none"> • Connect the concrete block to floating part • Fixed by the weight of concrete block itself
Features	<ul style="list-style-type: none"> • Reduce the construction time with easy assembling • Easy removal and reuse • Easy reuse of stuffed stones • All-weather application • Superior adhesion • Easy submarine works 	<ul style="list-style-type: none"> • Reduce the construction time with easy assembling • Easy removal, but comes with floating matters • Costs disposal expense because of non-reusable • Difficult to use on the soft ground • Short life span 	<ul style="list-style-type: none"> • Broad manufacturing site needed • Disposal expense needed after completion • Difficult removal on the soft ground and move management

■ Application scheme diagram



Stability to the velocity of moving fluid and the wave

1) Stability to the velocity of moving fluid



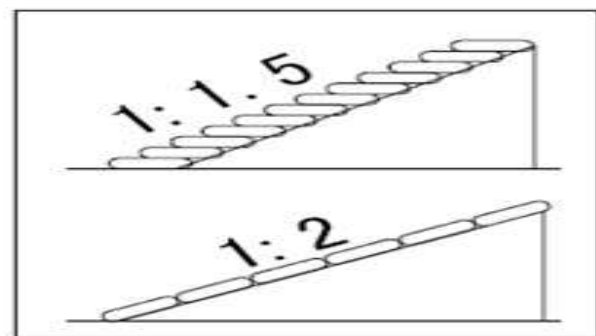
구 분	Applicable velocity to the single type (m/s)	Applicable velocity to the group type(m/s)
2Ton type	4.6	6.9
4Ton type	5.0	7.5
6Ton type	5.5	8.4
8Ton type	5.8	8.7
10Ton type	6.0	9.0

2) Stability to the velocity of wave (Breakwater)

Implemented tests with different cross-sections for the validation of stability against wave



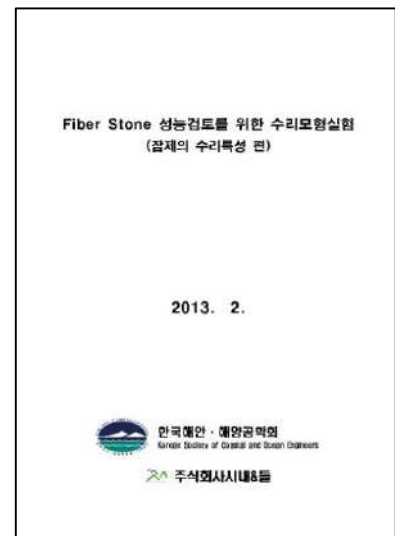
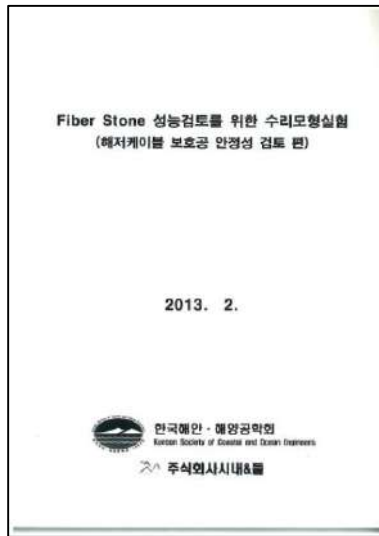
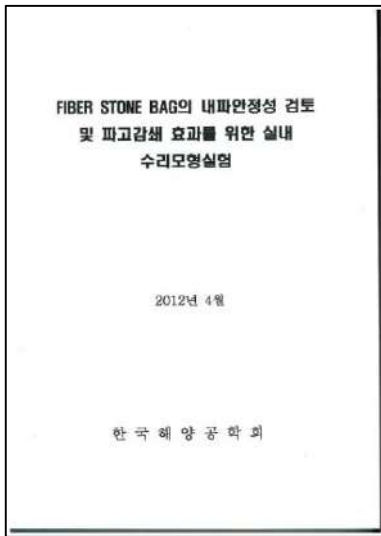
【 Comparison of Fiber stone with rockberm 】



【 Transmissibility observation 】

【 Wave resistance experiment on inclines 】

Theses of Fiber stone



【 Fiber Stone theses 】

< Hydraulic model experiments for the study of Fiber Stone stability against wave >

- The Korean society of ocean engineers
- Un-Trenching (Open type)
 - 1 row installation : Need to install the Fiber Stone heavier than 8 ton type
 - 2 rows installation : All type are stable
- Trenching (Channel type)
 - Regardless of the depth of water, all types are stable with only 1 row
- Stability comparison of Fiber stone with rock berm
 - Fiber stone is more stable than rock berm with only 30% volume of rock berm, therefore it has excellent stability, economical efficiency and constructability

< Hydraulic model experiments for the performance of Fiber Stone (Submarine cable) >

- The Korean society of ocean engineers
- Un-Trenching
 - 1 row installation : 10 tons at 9 sec/cycle, more than 12 tons at 14 sec/cycle
 - 2 rows installation : All types are stable
- Trenching
 - Regardless of the depth of water, all types are stable with only 1 row

< Hydraulic model experiments for the performance of Fiber Stone (Breakwater) >

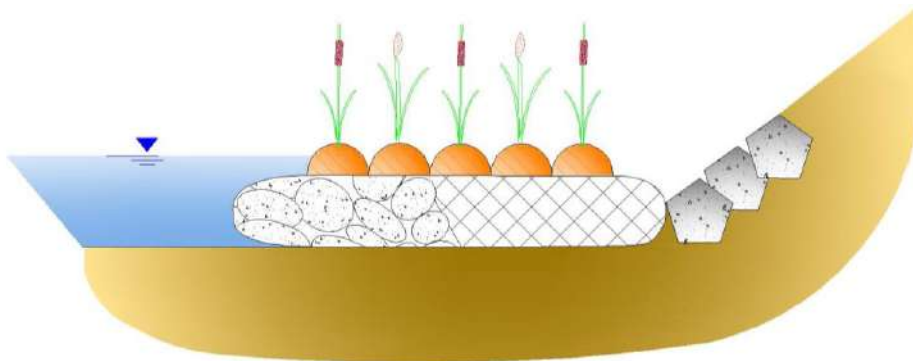
- The Korean society of ocean engineers
- When we compared the transmissibility of two types of the artificial reefs, tetrapods and Fiber stones, the Fiber stone showed superior transmissibility reduction.

Rivers – Vegetation on inland water revetment

■ Installation



■ Application scheme diagram



■ Features and effects

- Flood control + Vegetation + Fish habitat
- Create natural vegetation revetment
- Build natural riparian vegetation line
- Purification of water in the downtown

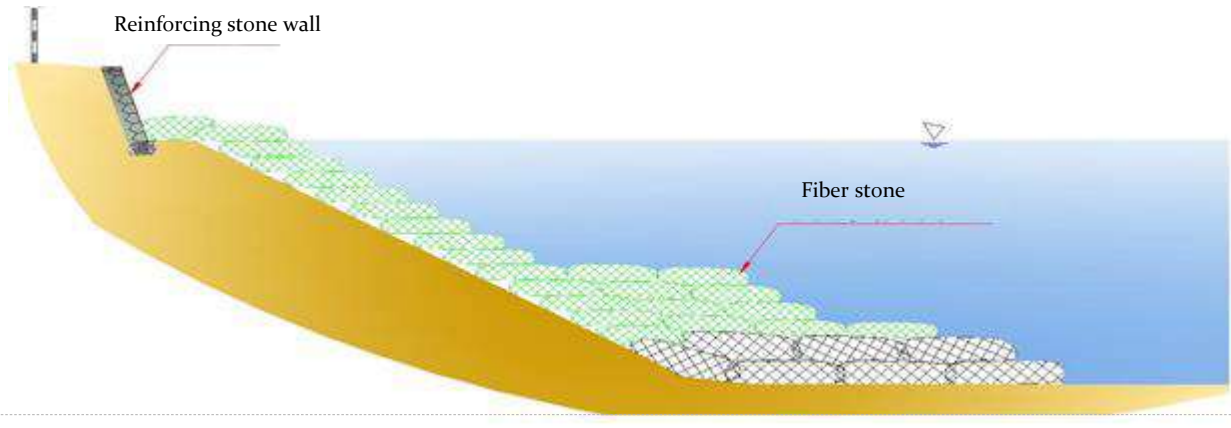


Rivers – Soft ground slope protection

■ Installation



■ Application scheme diagram



■ Features and effects

- Excellent applicability on the soft ground
- Anti-settlement + flexibility + superior tractive force
- Easy precise underwater works
- Short construction period
- Stable slope and compulsory replacement effect

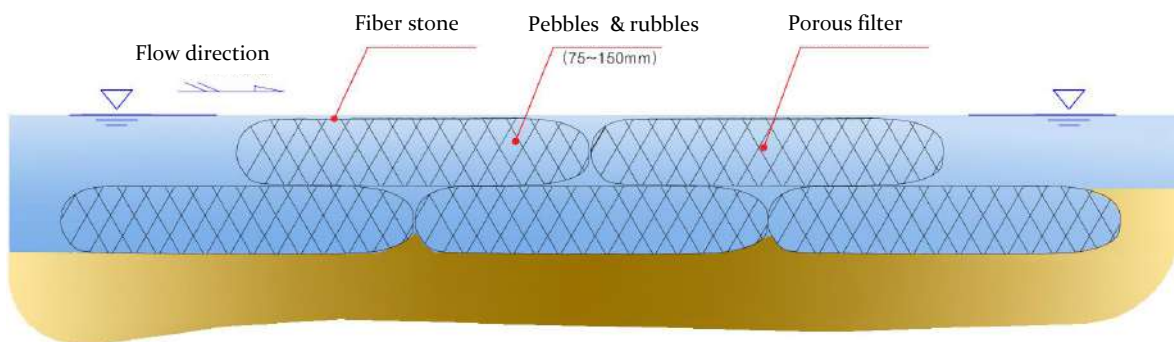


Rivers – Bed protection work

■ Installation



■ Application scheme diagram



■ Features and effects

- Steep stream and fast flow rate
- Water purification and easy vegetation influx
- Superior response to bed variation



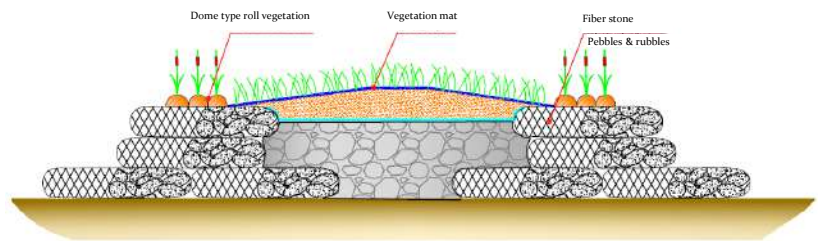
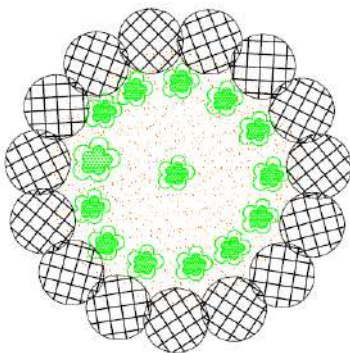
Rivers – River islands development

■ Installation



Reinforcing existing river island – Gyungan stream, Yongin, Korea

■ Application scheme diagram



■ Features and effects

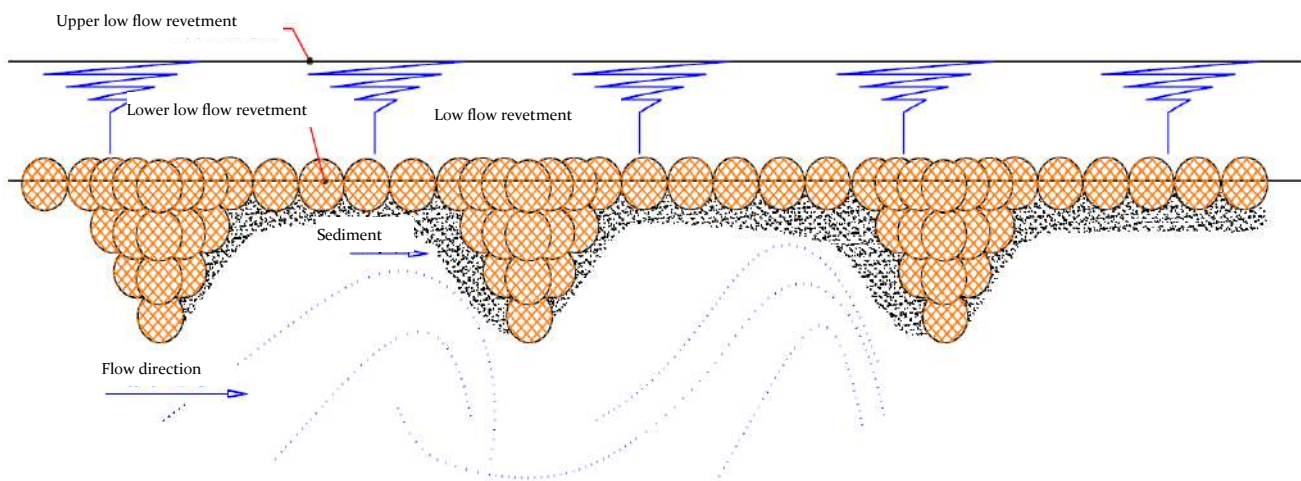
- Repair and reinforce of existing river islands
- Build up the outskirts of new river islands
- Easy application to velocity and stream flow
- Create ecosystem with porous structure



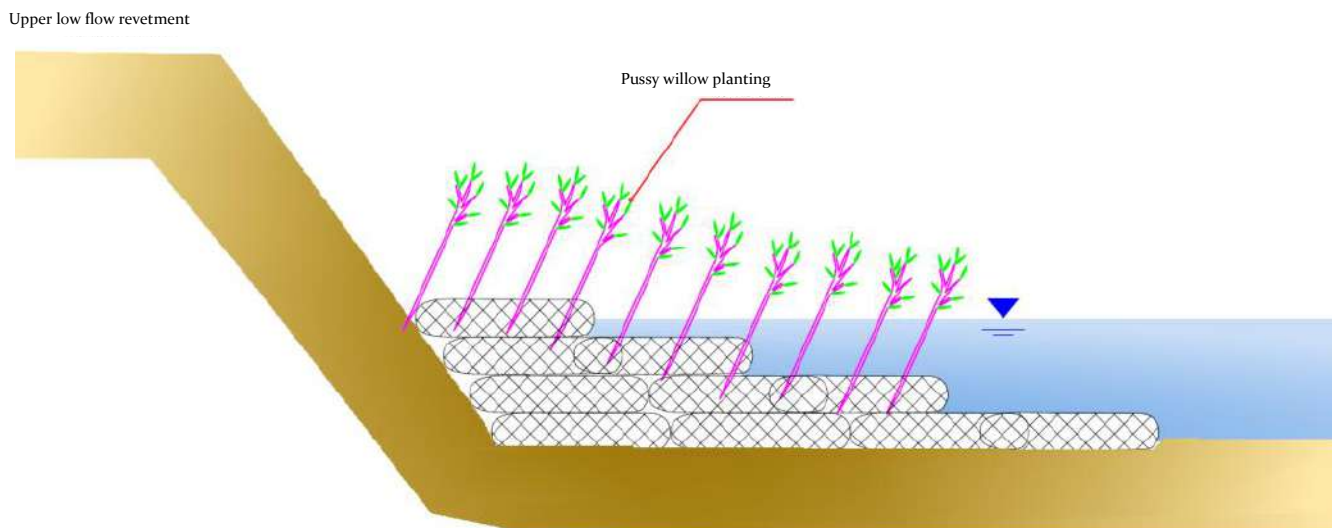
New river island – Gyungan stream, Yongin, Korea

Rivers - Groyne

■ Ground plan



■ Side cross section



■ Features and effects

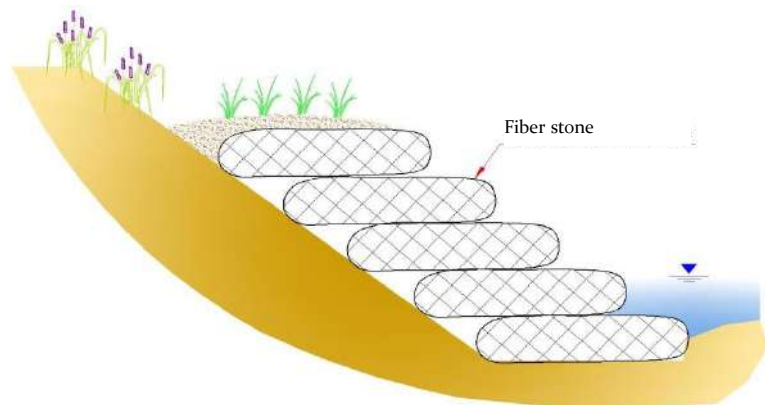
- Easy to control the flow rate with porous structure
- Site of rapid flow rate : Change or control the flow
- Site of severe scour : Control the sand flow to create stable revetment
- Bank on soft ground : Excellent bank protection
- Earth and sand sediment : Lead the flow in water attacking point to central part of stream

Rivers – Scour protection of low flow revetment

■ Installation



■ Application scheme diagram



■ Features and effects

- Site of rapid velocity – Rigid revetment protection
- Ecological protection site – Reduce muddy water
- Fish habitat, vegetation introduction
- Create natural line of revetment

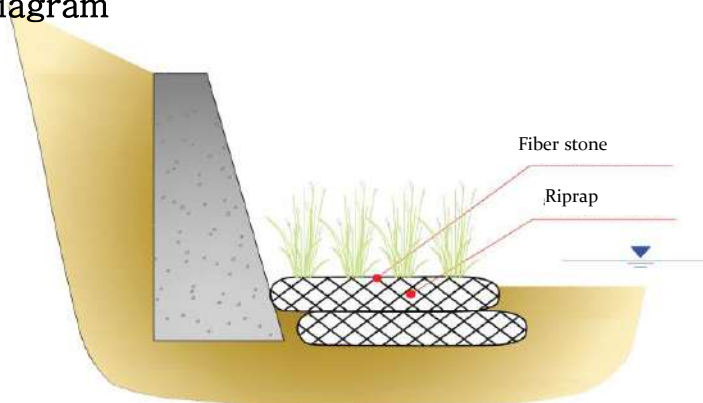


Rivers – Scour protection for the base of revetment

■ Installation

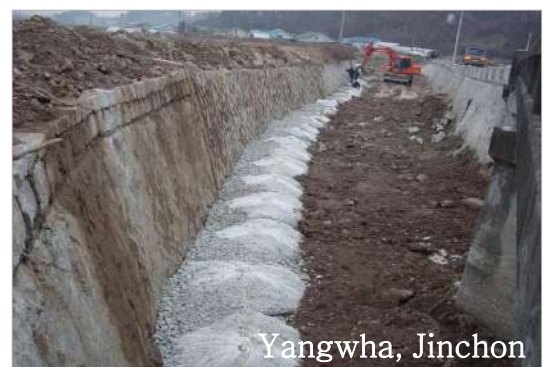


■ Application scheme diagram



■ Features and effects

- Scour protection for the base of revetment
- Repair and reinforcing of existing revetment
- Fish habitat, vegetation introduction site
- Easy underwater works and control the suction of sand
- Easy vegetation introduction

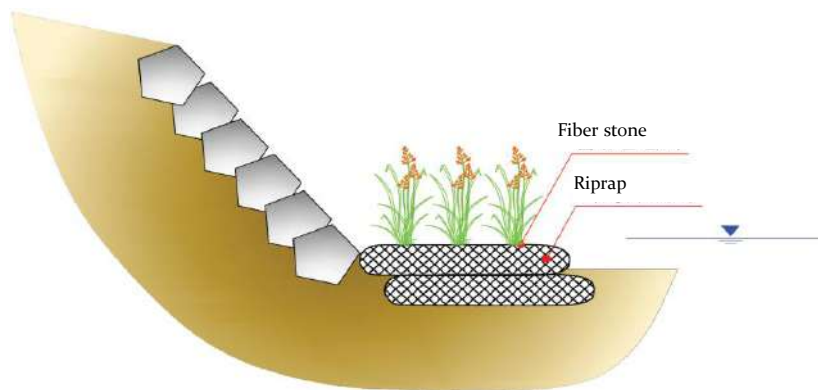


Rivers – Scour protection for the base of stonework

■ Installation



■ Application scheme diagram



■ Features and effects

- Scour protection for the base of stonework
- Repair and reinforcing of existing stonework
- Fish habitat
- Natural vegetation revetment

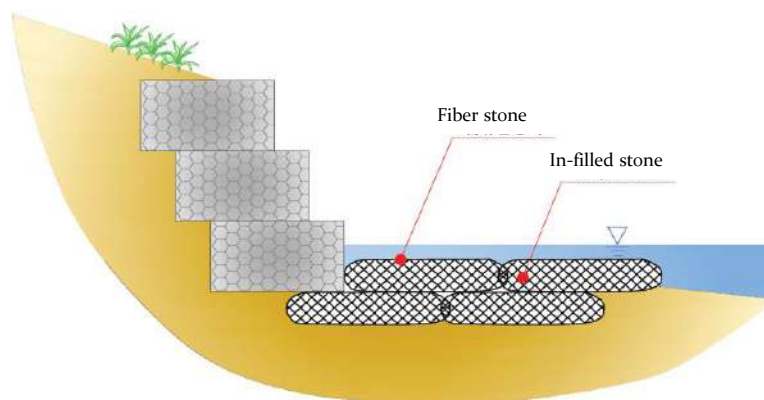


Rivers – Scour protection for the base of gabion

■ Installation



■ Application scheme diagram



■ Features and effects

- Scour protection for the base of gabion
- Repair and reinforcing of existing gabion revetment
- Fish habitat, vegetation introduction site
- Reinforcing the scour section of round type gabion

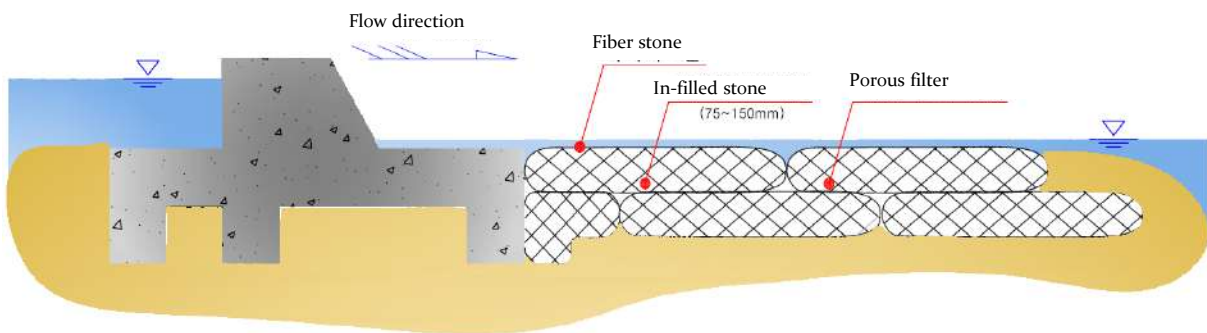


Rivers – Bed protection for falling crest weir

■ Installation



■ Application scheme diagram



■ Features and effects

- Severely scoured site
- Heavily polluted site
- Unsuitable site to build the cofferdam
- Fish habitat – Fish way function
- Induce nature friendly water flow

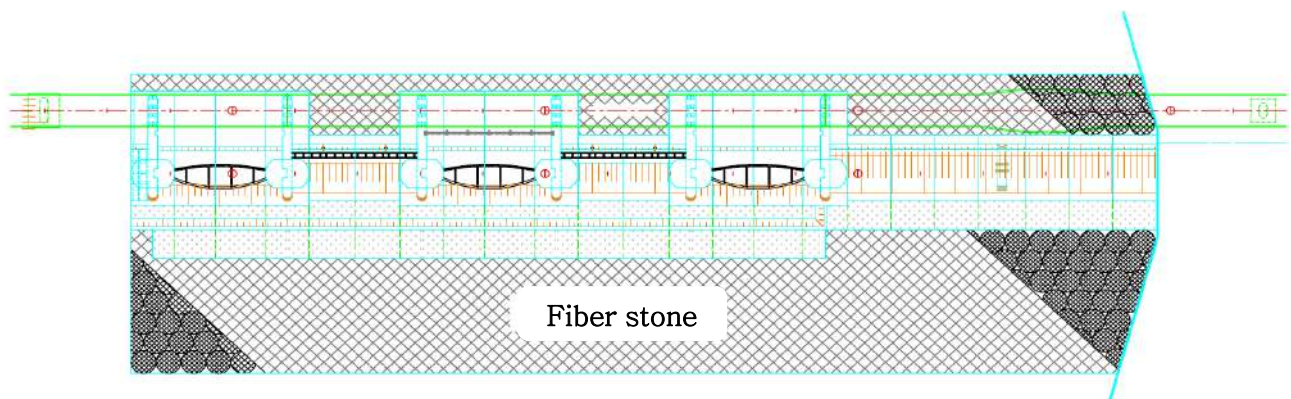


Rivers – Scour protection for falling crest weir

■ Installation



■ Application scheme diagram



■ Features and effects

- Bed scour protection for falling crest weir
- Flowrate reduction & buffer effect
- Water purification
- Environment friendly method

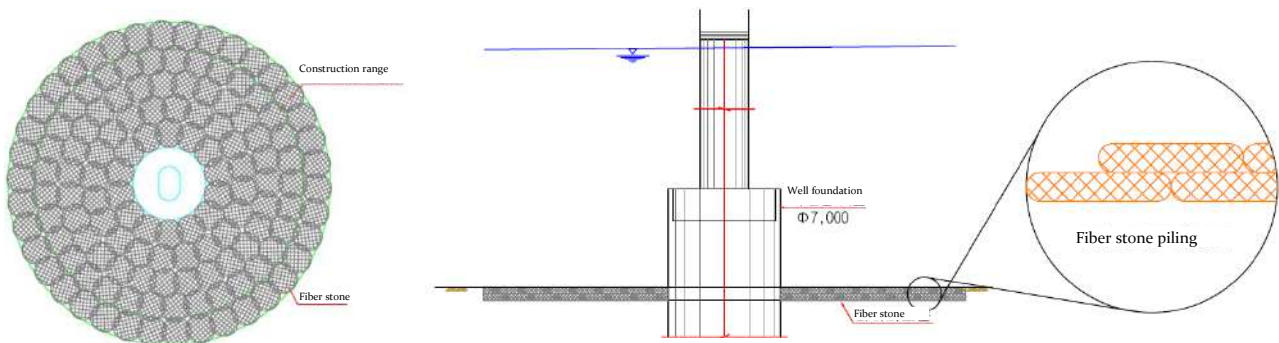


Rivers – Pier scour protection

■ Installation



■ Application scheme diagram



■ Features and effects

- Scour protection for well foundation
- Easy maintenance & reinforcement
- Possible to skip the cofferdam construction
- Reduce the flow rate around the pier
- Restrain the sand suction & protect the pier base

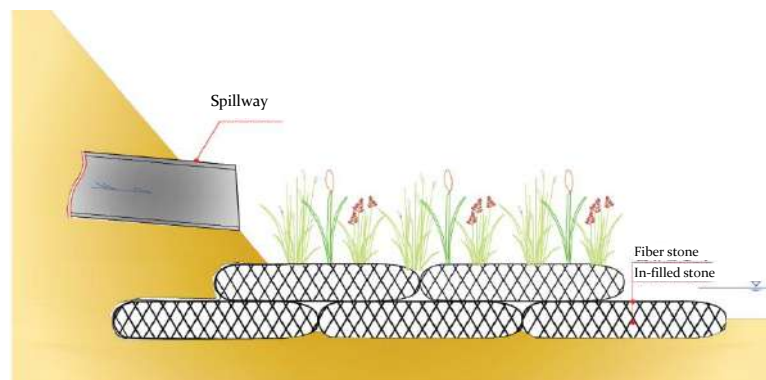


Rivers – Spillway protection

■ Installation



■ Application scheme diagram



■ Features and effects

- Scour protection for the spillway base
- Purification of rainwater and dirty water
- Scour protection around the spillway
- Ground protection of forest road slope

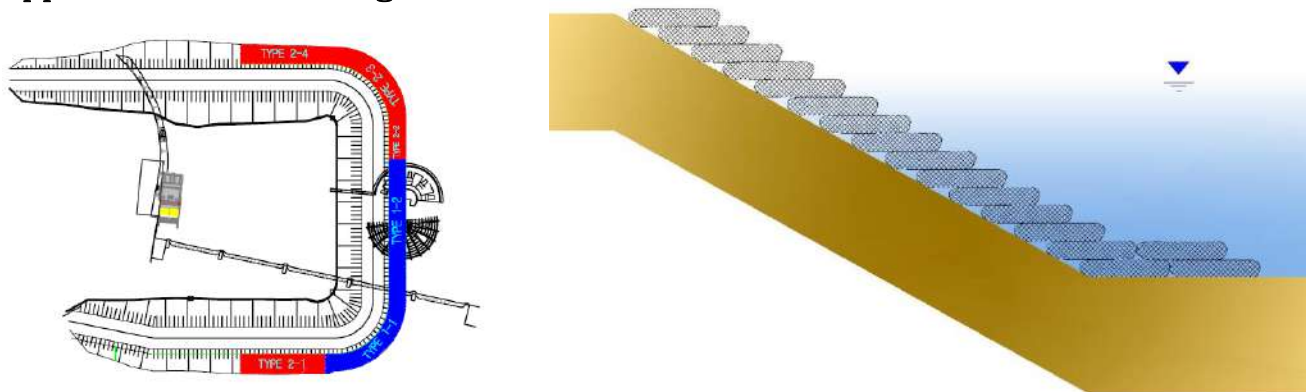


Rivers – Scour protection of cofferdam

■ Installation



■ Application scheme diagram



■ Features and effects

- Last section of cofferdam in plentiful stream flow and rapid flow river
- Capable of reuse after cofferdam use
- Applicable to various usage
- Superior application to rapid flow

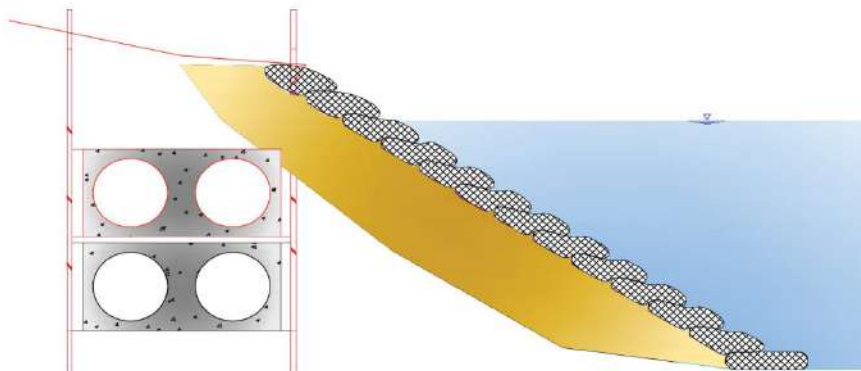


Rivers – Water intake conduit protection

■ Installation



■ Specification and drawing



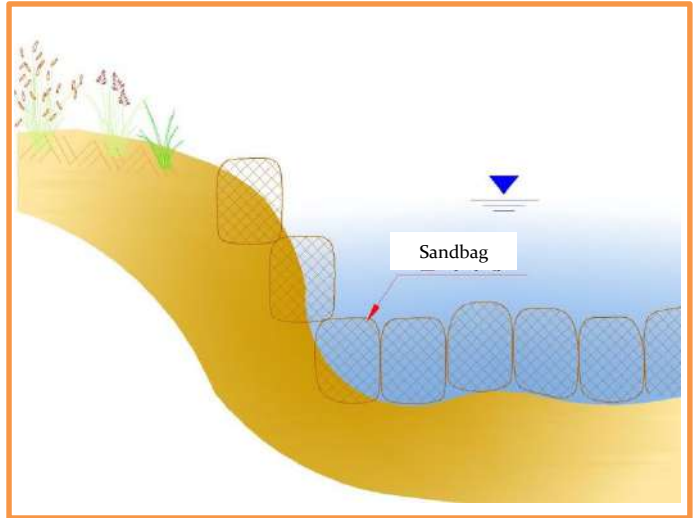
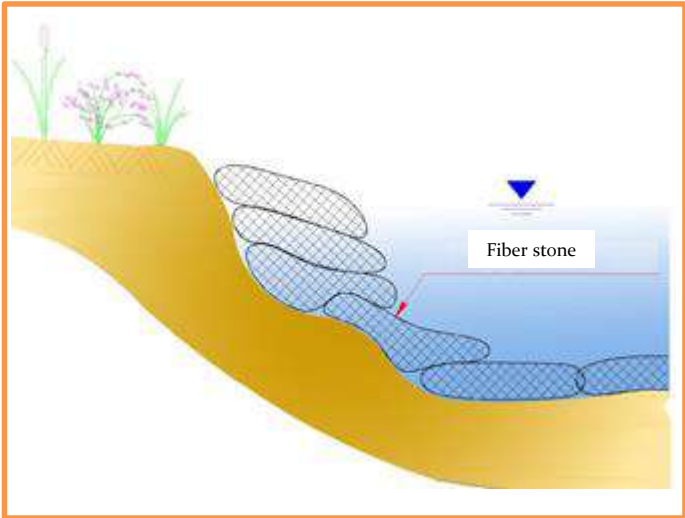
■ Features and effects

- Excellent protection for underwater structures
- Precise installation according to drawings
- Safer and easier construction design
- Accurate inspection by underwater scanning



Prevention of floods

- Porous structure stuffed with specified size of stones which is made of high tension fiber net
- Restrain the sand and earth outflow by flow rate and the rear earth pressure to protect the base and sustain the stability
 ⇒ Applicable to use as flood control material



Application 1. Restoration of marine structure loss



Application 2. Emergency restoration of farm road beside the reservoir



1



2



3



4

Farm road, Jeonju, Korea

Application 3. Prevention of cutting area loss



1



2



3



4

Junggeum, Hoengseong, Korea

Application 4. Emergency restoration of falling crest weir loss



Application 5. Emergency restoration of underwater structure loss



Geumjeonggu stream

Stone roll



Stone roll is a round type Fiber stone which is composed of high tension fiber net crossing at right angles.

It is suitable for water attacking points and artificial swampy land.

STONE ROLL specification

Section	Ø 300 Type	Ø 500 Type	Remarks
Size	L 2000×Ø300 Round type	L 2000×Ø500 Round type	± 2%
Area	About 0.6m ² (± 2%)	About 1.0m ² (± 2%)	
Volume	About 0.141m ³ (± 2%)	About 0.393m ³ (± 2%)	
Weight	About 280kg (± 5%)	About 600kg (± 5%)	Minimum
Net	Φ4 × #40~45	Φ4 × #40~45	
Fastening rope	6 mm rope	6 mm rope	
Filler materials	Pebbles/Broken stones (50~100mm)	Pebbles/Broken stones (50~100mm)	

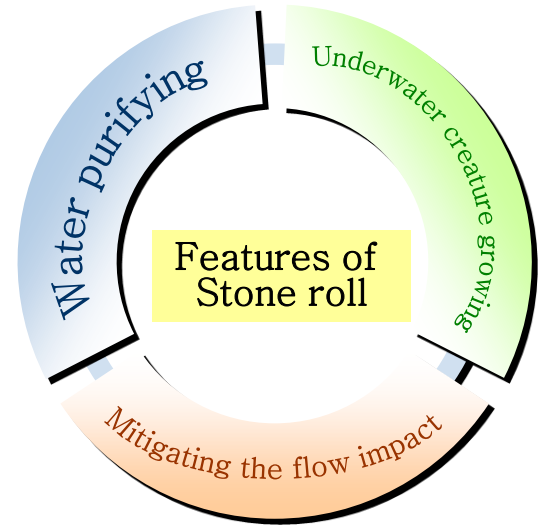
Application

- Weak water attack points revetment ⇒ Protect revetment from the running water
- Create habitat for underwater creatures ⇒ Improve ecological diversity
- Create artificial swampy land ⇒ Make the swampy outskirts and inner vegetation barrier
- Waterside vegetation creation ⇒ Easy introduction of emerged plants and pussy willows
- Areas in need of water purification ⇒ With contact oxidation and microorganism
- Substitute for coir roll ⇒ Reform the flaws, corrosion and damage of coir roll

Features of STONE ROLL

Ecological health of low flow revetment + Structural stability

- Porous water purifying filter made of ecofriendly materials
- Low flow revetment with slow flow rate
- Create habitat for underwater creatures
- Structural stability + Vegetation



Installation flow



1. Install work frame 2. Mechanized in-filling work 3. Fastening the opening

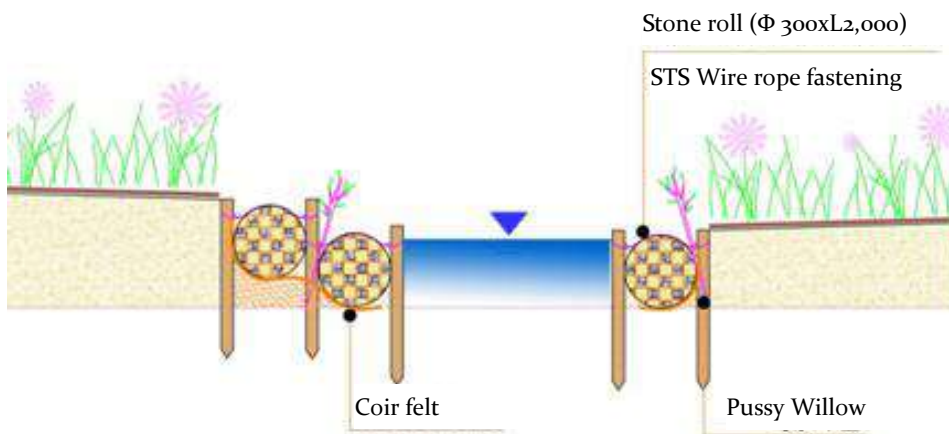


4. Installation : Pulling up, laying & fixing with antiseptic stakes(or fixing steel bar)

■ Installation

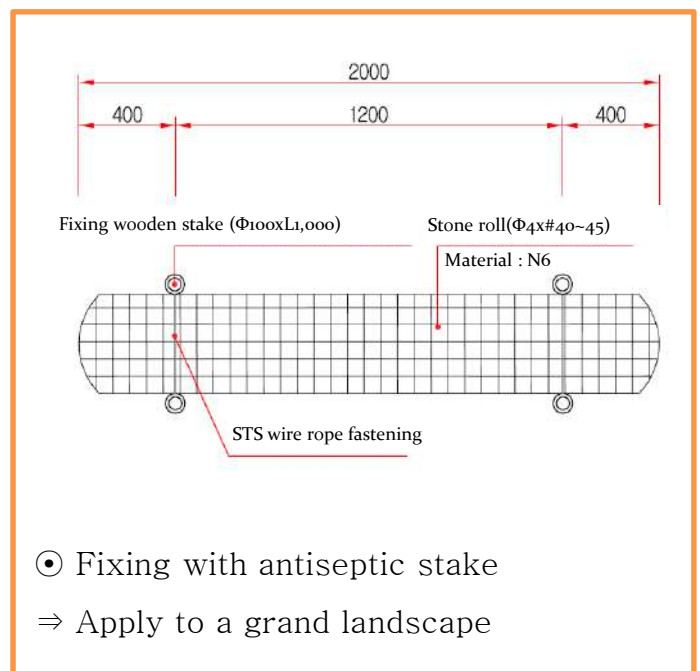
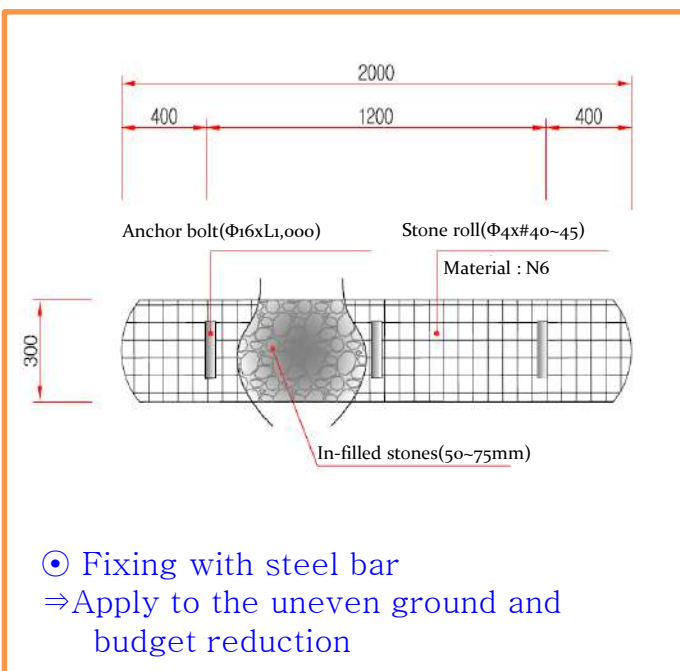


■ Application scheme diagram

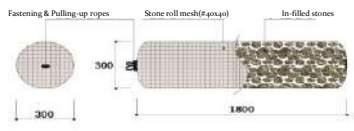
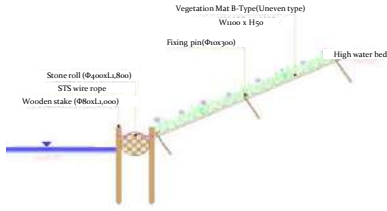
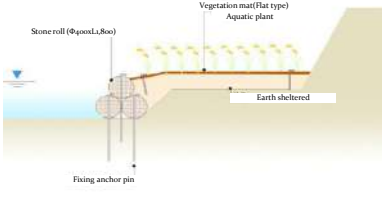


Stone roll (Φ 300xL2,000)

■ Detailed Drawing (Ø300 type)



Application examples of STONE ROLL

<p>Compo- sition</p>	<p>Fiber Net + Fastening rope + In-filled material</p>	<p>Stone roll + In-filled material + Antiseptic stake</p>	<p>Stone roll + In-filled material + Fixing steel rod + Pussy willow etc.</p>
<p>Cross section</p>			
<p>Review points</p>	<ul style="list-style-type: none"> - Individual work efficiency <ul style="list-style-type: none"> - L 2000 × H 300 - Work area : 0.6m² - Work volume : 0.141m³ - Weight : 280kg - Fixing methods <ul style="list-style-type: none"> - Antiseptic stake/ Fixing steel rod 	<ul style="list-style-type: none"> - Ordinary & flood water level - Slope - Vegetation introduction 	<ul style="list-style-type: none"> - Difficult to apply at water attacking point - Slope - Ordinary & flood water level - Water purification + landscape improvement – Creatures habitat - Natural bank creation
<p>Features & Effects</p>	<ul style="list-style-type: none"> - Use high-strength special fiber - Porous structure - Harmony with river - Outstanding application - Water purification and fishery habitat - Easy underwater work - Easy vegetation introduction 	<ul style="list-style-type: none"> - Superior civil engineering stability - Maintain reasonable roughness coefficient - Easy underwater work - Water purification - Fishery habitat - Easy vegetation introduction 	<ul style="list-style-type: none"> - Superior civil engineering stability - Roughness coefficient improvement - Water purification - Create natural revet - Fishery habitat - Low cost and high efficiency - Landscape improvement
<p>Applica- tion Points</p>	<ul style="list-style-type: none"> ⦿ Base of soft revetment ⦿ Place of slow flow ⦿ Scoured area ⦿ Vegetation needed place ⦿ Underwater work ⦿ Spillway needed place ⦿ Water purification place ⦿ Underwater creatures habitat 	<ul style="list-style-type: none"> ⦿ Base of soft revetment ⦿ Waterway development in swamp ⦿ Build river island boundary ⦿ Water purifying waterway ⦿ Scour protection ⦿ Underwater creatures habitat ⦿ Difficult underwater work 	<ul style="list-style-type: none"> ⦿ Poor ground and cost reduction needed work ⦿ Underwater creatures habitat ⦿ Civil engineering stability ⦿ Water purification ⦿ Build waterfront space ⦿ Create small purifying waterway

Natural river maintenance business –Samyul river, Korea



Other applications



Gongneung river ①



Gongneung river ②



Waterway – Uiseonggun ①



Waterway – Uiseonggun ②

Fiber stone net



A product assembling fiber net with stones which is composed of high tension fiber net crossing at right angles.

This method improves the flaws, flexibility and durability, of wire type of stone net.

Application

- Revetment slope protection
- Vegetation introduction of the natural river
- Revetment heat protection
- Swift current, spur dyke

Fiber stone net types



H300 Type



H500 Type

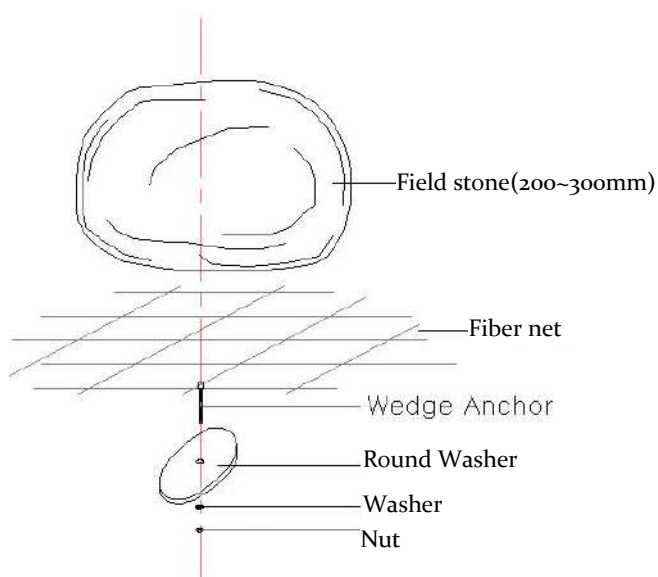
Features of Fiber stone net

- Has high tractive force that prevents the scour of slopes and leads long term stability of slopes
- High stability to the flood due to flexible high strength fiber and stones
- Outstanding hydrophile property than the wire net and easy vegetation introduction
- Superb ground stability and sand outflow prevention due to outstanding flexibility

Specification

Section	Riprap type	Pebble type	Boulder type	Notes
Installation Size	1,000×1,000	1,000×1,000	1,000×1,000	± 15%
	1,000×2,000	1,000×2,000	1,000×2,000	± 15%
	1,000×3,000	1,000×3,000	1,000×3,000	± 15%
	2,000×2,000	2,000×2,000	2,000×2,000	± 15%
Fiber net	Φ8 × #35~40	Φ8 × #35~40	Φ8 × #35~40	
Material	Riprap (300type/500type)	Pebble (300type/500type)	Boulder (300type/500type)	

Composition



When apply the special fiber net -

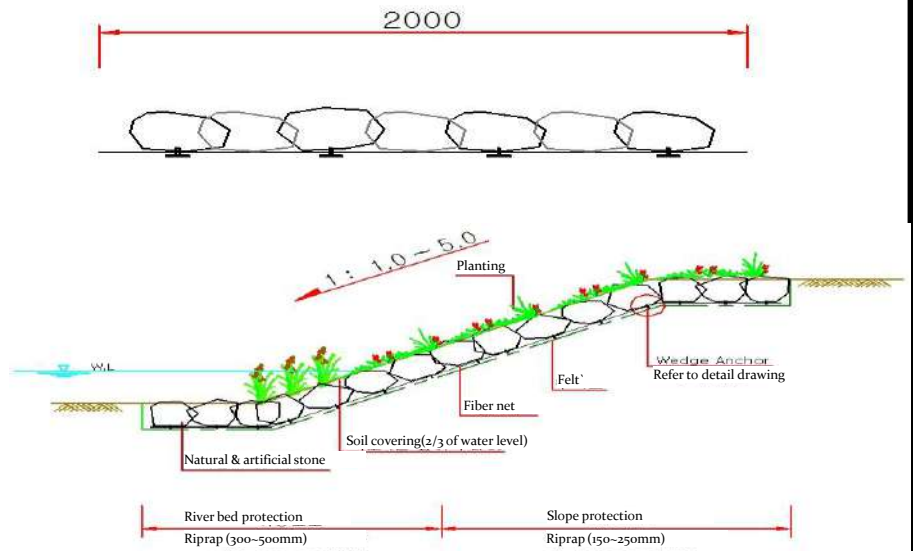
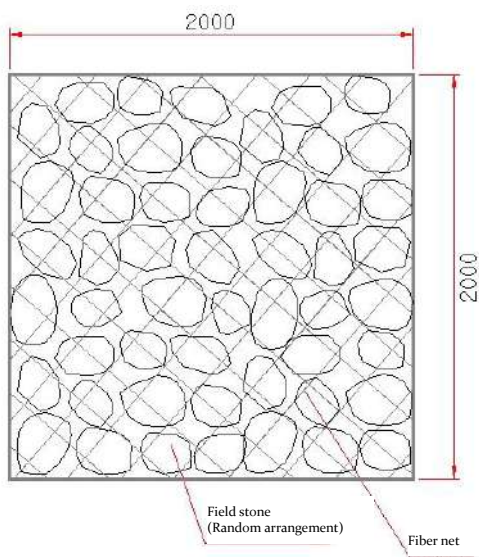
- Need Superb endurance against the flow than the galvanized wire net
- Improve the ground stability with its superior flexibility
- Control the sand outflow and introduce easy vegetation
- Solve the corrosion and risk of injury caused by wire stone net

Design points

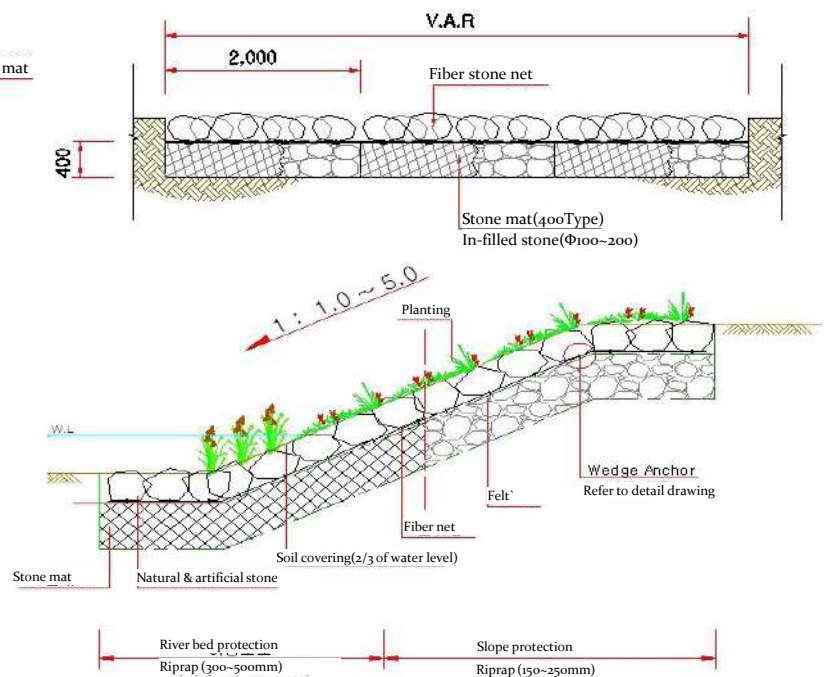
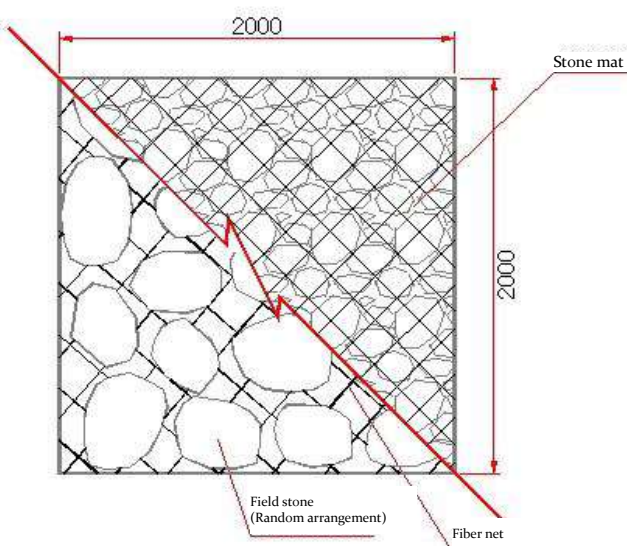
- Creating natural river area under water attack point ⇒ Good covering and flexibility
- An area in need of hydrophile property ⇒ Fiber material
- Newly built revetment slope ⇒ Outstanding flexibility and vegetation introduction

Fiber stone Net/Mat drawings

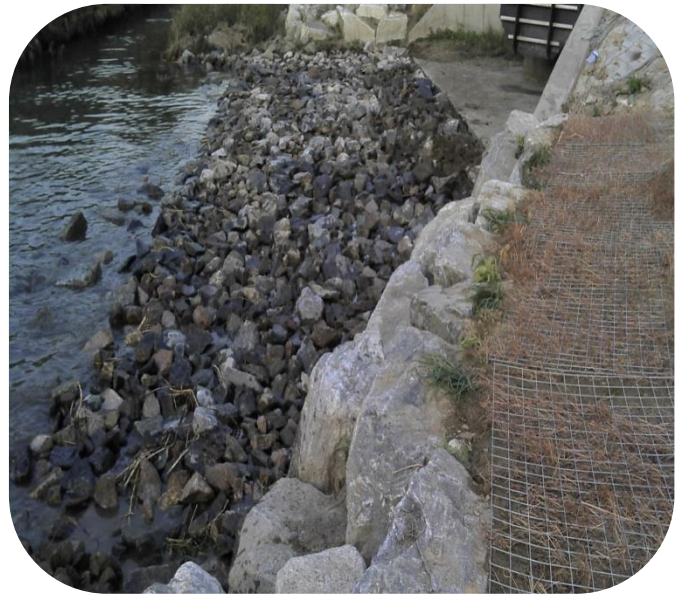
■ Fiber stone -Net



■ Fiber stone -Mat



Fiber stone -net Installation



Crib work

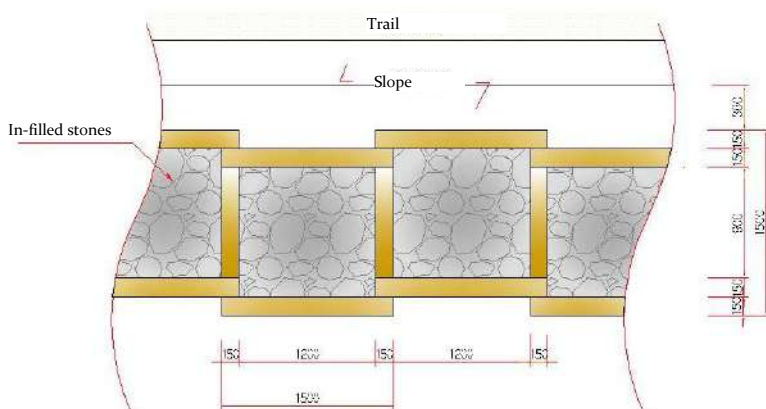


A crib work is Korean traditional construction method which stacks the antiseptic rectangular timbers at right angles with open up-and down. After the stacking, it is filled with riprap and used for revetment protection and ecologic stream.

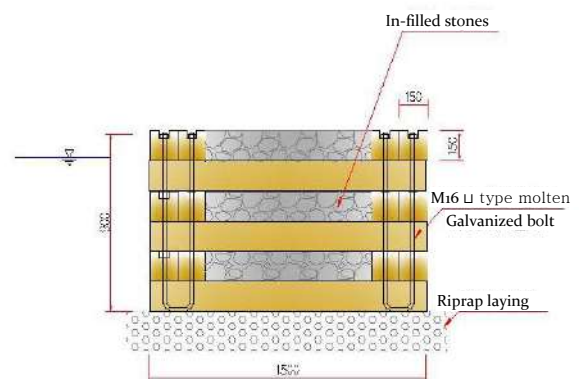
Specification and drawings

Specification	Unit	Composition
<ul style="list-style-type: none"> Standard timber <ul style="list-style-type: none"> - 1500 × 1500 Height of types (H) <ul style="list-style-type: none"> - 600 Type - 900 Type - 1200 Type - Customized 	mm	<ul style="list-style-type: none"> Square box type with integrally connected formation Capable to produce customized and step types Tighten “⊥” bolts from bottom to top <ul style="list-style-type: none"> - Rigid structure with integrally connected formation - Restrain the deformation by lateral pressure of the flowing water - Facilitate the underwater works and minimize the defects Improve landscape and reduce the flow rate Capable of installing curved type smoothly

■ Ground plan



■ Sectional plan



Types of crib work

• Standard types



• Step types



Vegetation space of crib work

• Direct vegetation – Shrub, cuttage

- Cuttage method of cutting of the pussy willow or winnow willow in drastic water level deviation
- Plant the plants at the edge of frame (4 plants / frame)
- Plant and fix roots protected with jute fabric
- Favorable to plant roots under the ordinary water level

• Planting with the vegetation mats – Aquatic plants

- Install the vegetation mats at upper part of the frame (about 1.2 m² of vegetation space)
- Install the top of frame at -150mm of ordinary water level
- Fix the vegetation roll or the pot coir roll adjusted to specification
- Plant aqua plants like reeds, cattails, flag iris to purify the water and make natural landscape

Construction sequence



1. Delivering the timbers and distribution

2. Stack the timber at right angles



3. Filling the regular with riprap



4. Installing vegetation mats

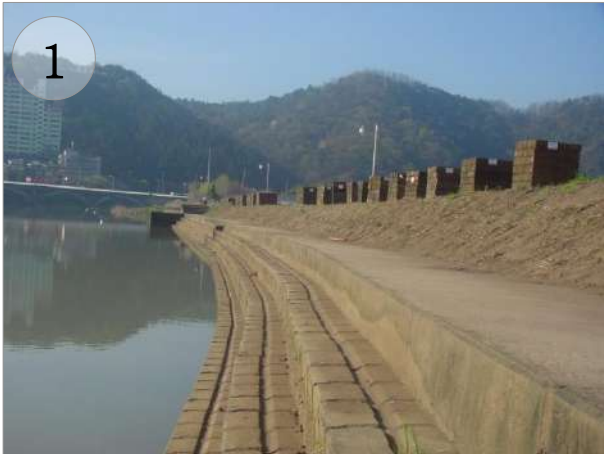


5. Planting aquatic vegetation



6. 10 months after the construction

Application 1. Monitoring in Taewha river, Korea



- Before the construction -



- Under construction -



- 2 months after the construction -



- 4 months after the construction -



- 1 year after the construction -



- 1 year after the construction -

Application 2. Natural river of Gyeongan river



Application 3. Natural river of Mapo Bulgwang river



Application 4. Natural river of Tanchon river

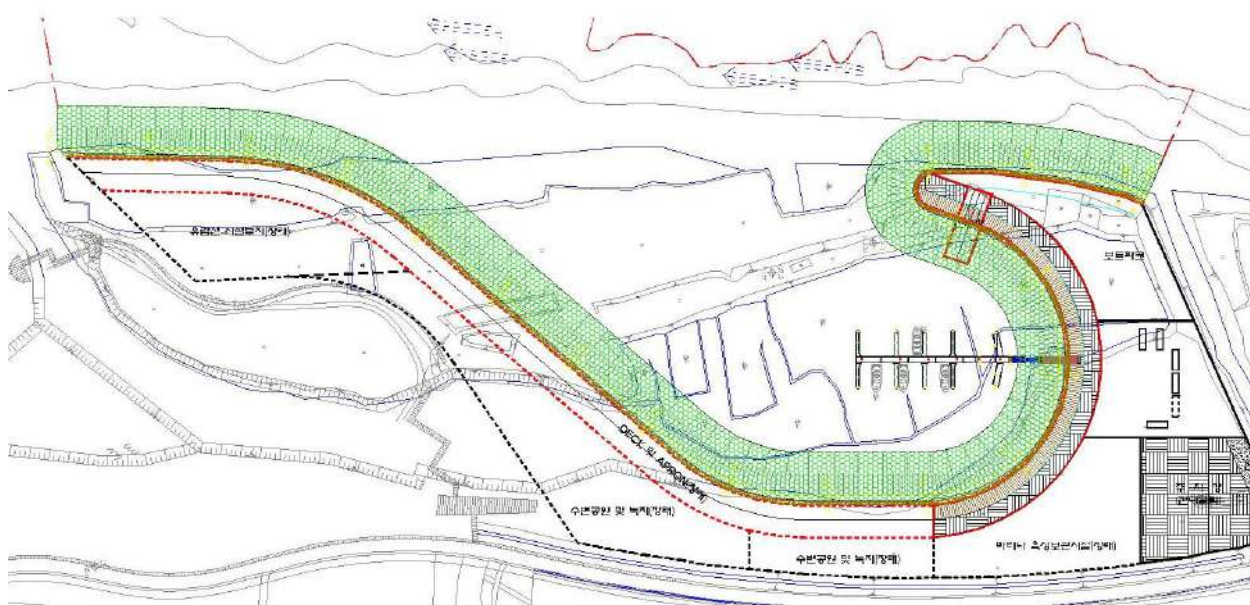


Application 5. Natural river of Gunwi Wichon



Application 6. Natural river of Yacht mooring in Whamyong park, Busan

■ Ground plan



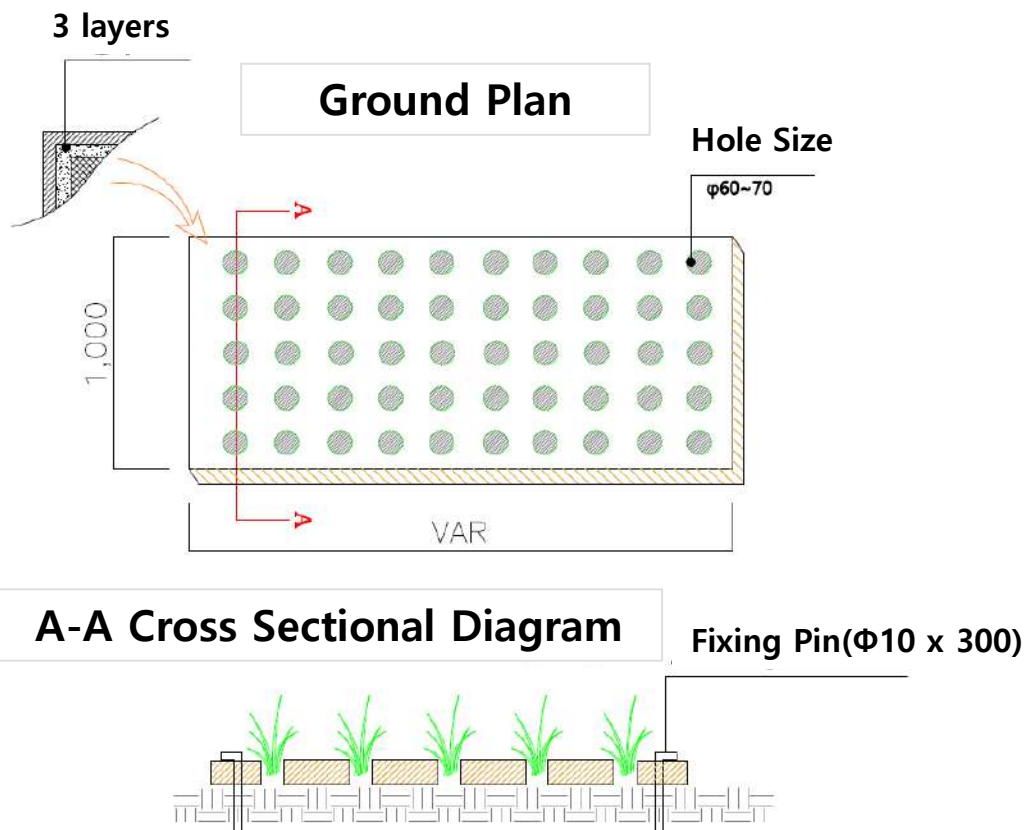
Fiber Stone
Stone Roll
Fiber Stone Net
Cribwork
Mulching Mat
Walking Mat
V/B Roll
A.P Island
Coir Mat
Halophyte
Hemispheric roll

Mulching mat



A kind of coir mat which has holes on the mat to help early rooting of plants and formation of specified plant group.

Specification



Item	Size	Unit	Structure
Mulching Mat (25holes)	1.0 X VAR	m ²	<ul style="list-style-type: none"> Natural material mat with 25 holes, 36 holes per m² each 3 layers of cross section backstitched Change the hole number according to field condition and specified species
Mulching Mat (36holes)			

Features

Structure	Considerations	Features and effects	Application points	Notes
Flat 3 Layers Coir mat + Coir fiber	<ul style="list-style-type: none"> - Use pot seeding - Area difficult to manage after the installation - Flow rate impact - Installation time (March ~ October) - Weed control and formation of colony 	<ul style="list-style-type: none"> - Natural material - Flat 3 layer - Weed control - Lagging function - Easy installation - Symmetrical vegetation 	<ul style="list-style-type: none"> ○ Colony formation needed area ○ Weed occurrence area ○ Soil outflow area ○ Soil improving area ○ Dry land ○ Non-point pollutant source improving area 	<ul style="list-style-type: none"> - 25 holes - 36 holes - Customized holes

Construction sequence



1. Flattening the land



2. Installing the mulching mat



3. Vegetation



4. After vegetation

Natural river – Anyang river



Natural river – Samyul river



Other provinces



Hyoje river, Uiseong



Cheongsuk park

Walking mat



A kind of coir mat made of natural fiber from coconut which improves the walking sense of people and restrains the soil outflow.

Applications

- Prevent the soil outflow of steep slope
- Stamping region of park
- Regions needed walking sense
- Non slip on the concrete road

Specification

Product name	Models	Specification	Notes
Walking mat	SWM-100	1000×1000×T 32mm	
	SWM-120	1000×1200×T 32mm	

Structure



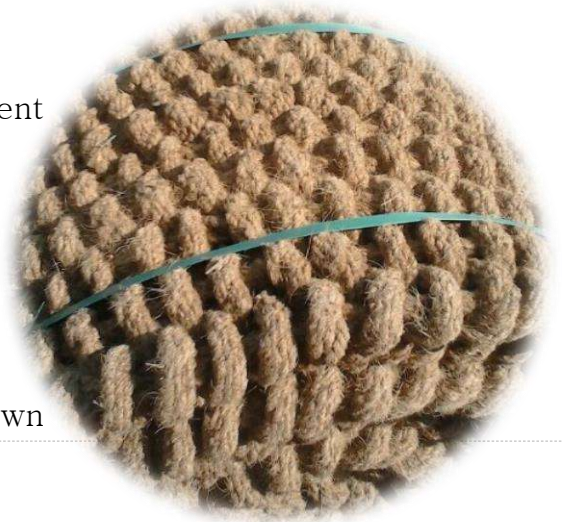
2 same thickness of ropes cross at right angles repeatedly to form 24 knots



2 x 2 (Thickness 32mm)

Features

- Use 100% of coconut fiber for natural environment
- Easy installation and convenient maintenance
- Natural decaying after the installation
- Possible to make customized products
- Capable of creating natural landscape in downtown



Walking mat installation



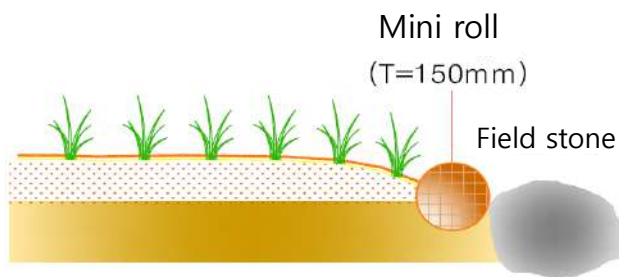
Vegetation boundary roll



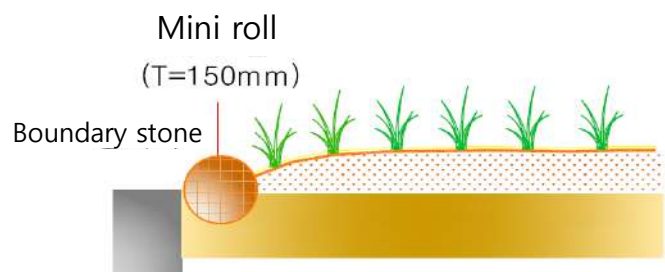
A kind of coir roll made of natural coconut fiber which is used to build the vegetation boundary lines on high water bed, roadside greenbelts

Specification

Product name	Specification	Structure
Vegetation boundary roll	$\Phi 100 \sim \Phi 300 \text{mm} \times 1 \sim 4 \text{m}$ (Length - Customized)	<ul style="list-style-type: none"> - Use coir rope weaving machine to make more than $\Phi 5 \text{mm}$ of net diameter, 10 twists of coir roll - Form rectangular net with a power loom ($\#20 \times 20, \pm 5\%$) - Filling material : Refined 100% coconut fiber



Type 1. Field stone + mini roll

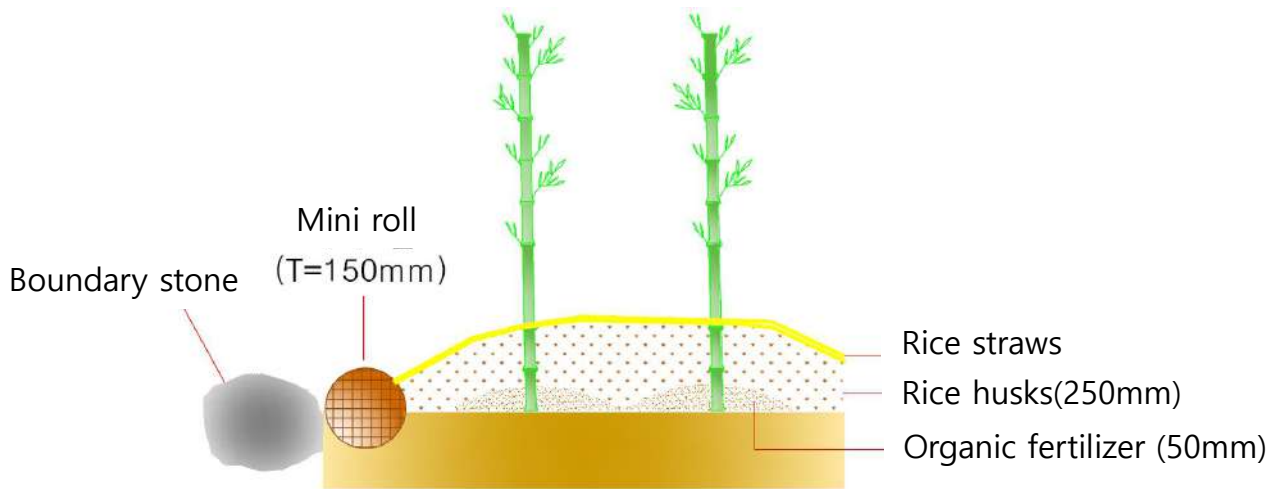


Type 2. Boundary stone + mini roll

Features

Structure	Considerations	Features and effects	Application points	Notes
Cylindrical mini Coir roll	<ul style="list-style-type: none"> - Project purpose - Harmony with environment - Flow rate impact 	<ul style="list-style-type: none"> - Natural material - Various usages - Esthetic effect - Easy installation - Customized formation 	<ul style="list-style-type: none"> • Vegetation boundary line forming • Stamping region • Overwintering work • Muddy water splash prevention 	Improve landscape

Application 1. Anyang river



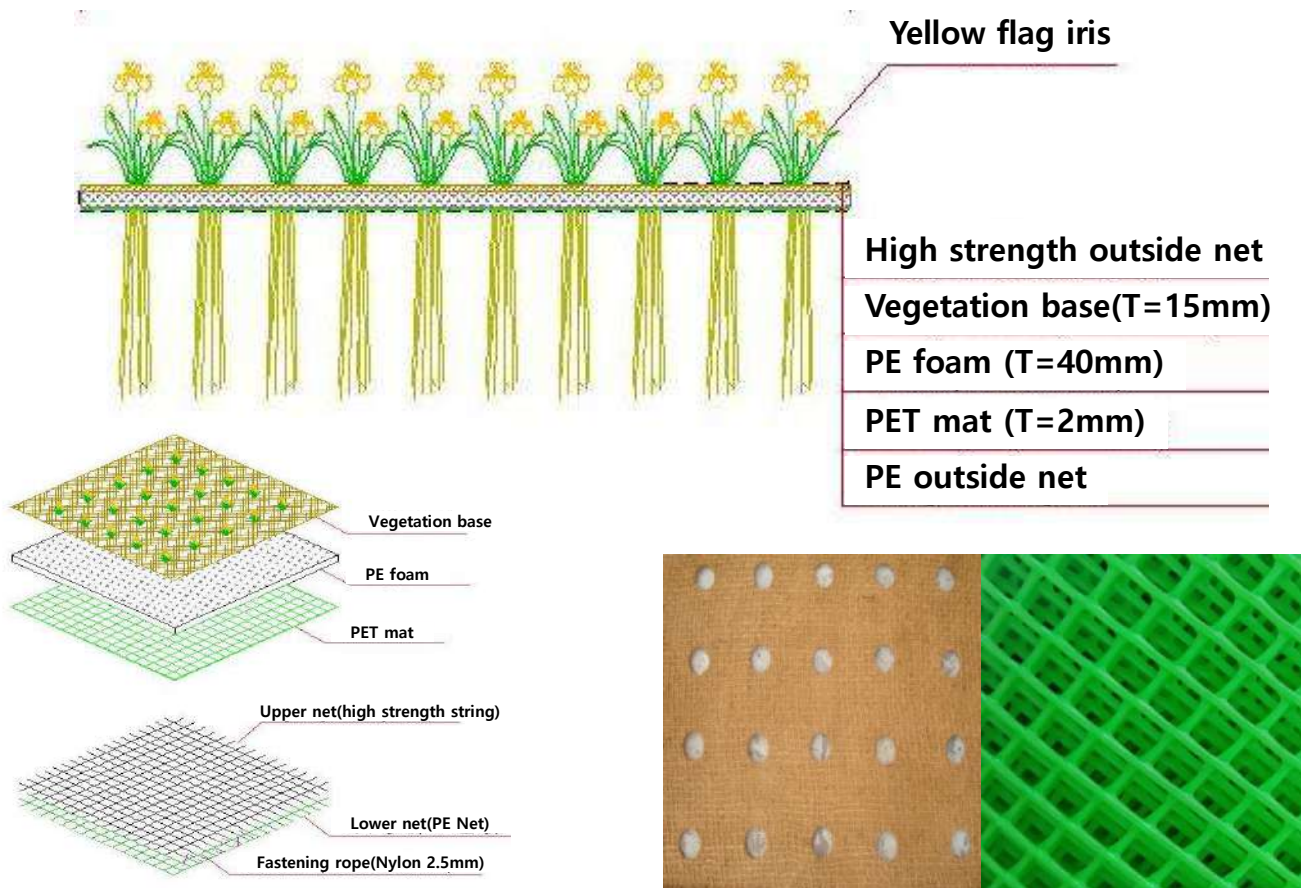
- Form vegetation boundary lines and build the landscape
- Prevent the muddy water splash in case of rain and control soil erosion

Aquatic planting island



A kind of ecological environment creation method installed on a floating type of artificial plant island which can plant and grow the aquatic plants providing purification and landscape effects.

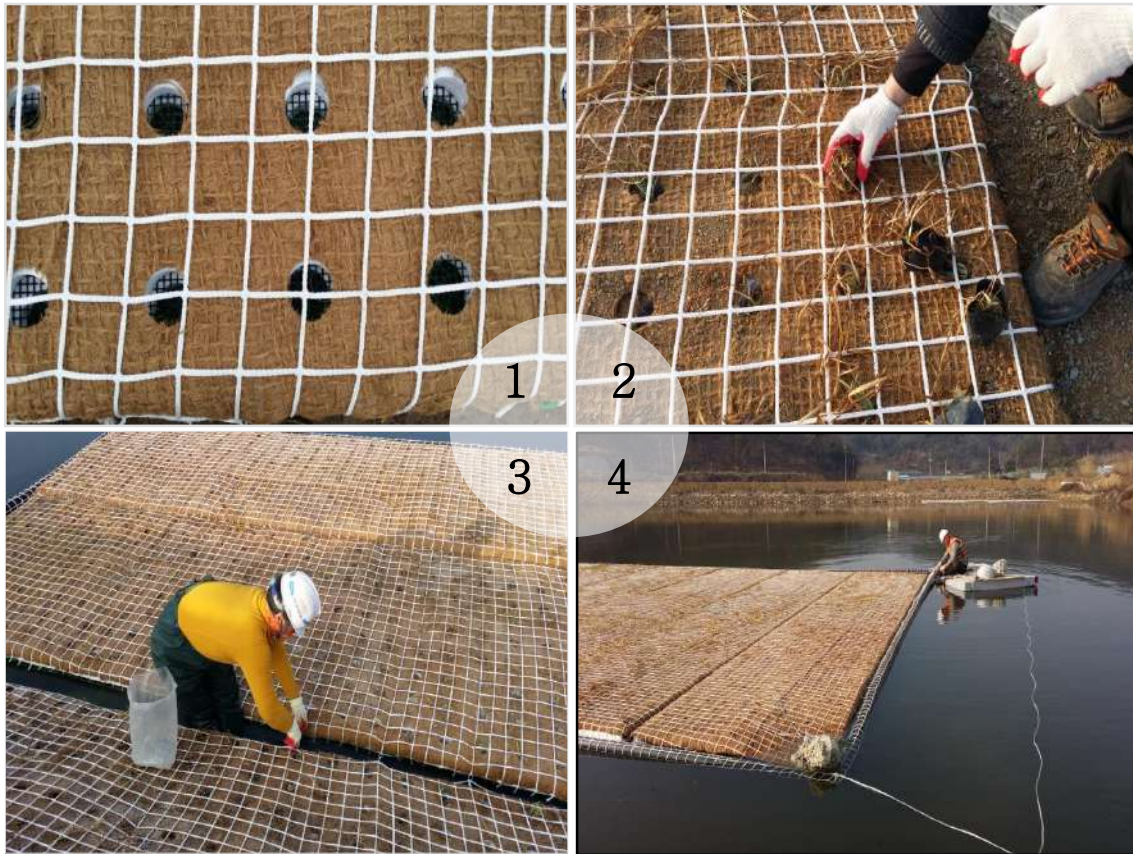
Schematic diagram



Features

- Create stable growth space for the aquatic plants ⇒ With integral structure
- Implement plant mechanism for water purification ⇒ Improve root viability
- Apply customized vegetation base ⇒ Use natural material to create colony easily
- Provide birds and amphibians shelter ⇒ Compose additional formation easily

Aquatic planting island – Habin district



Other province

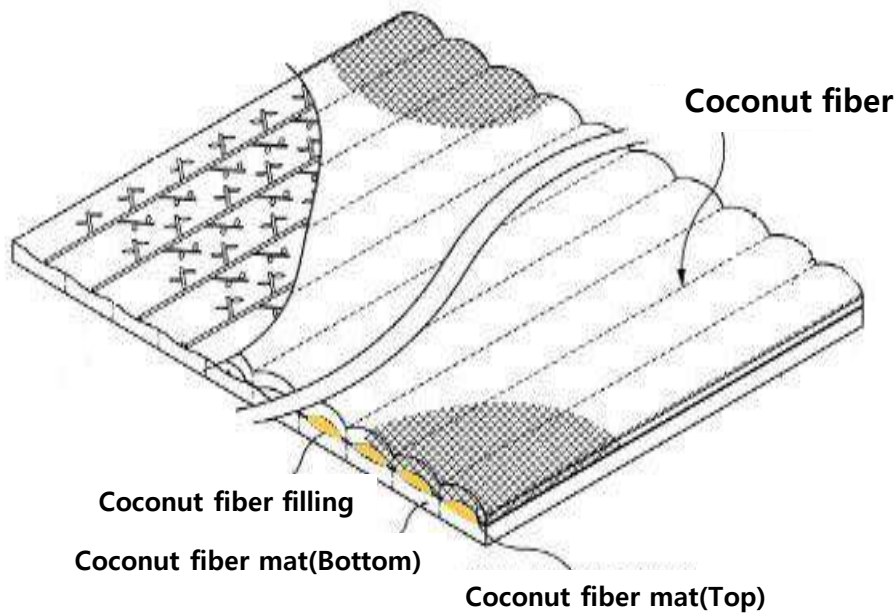


Coir mat



A construction method to grow seeds of aimed plants on the revetment slope by installing vegetation mats and prevent the slope scour and soil outflow

Specification

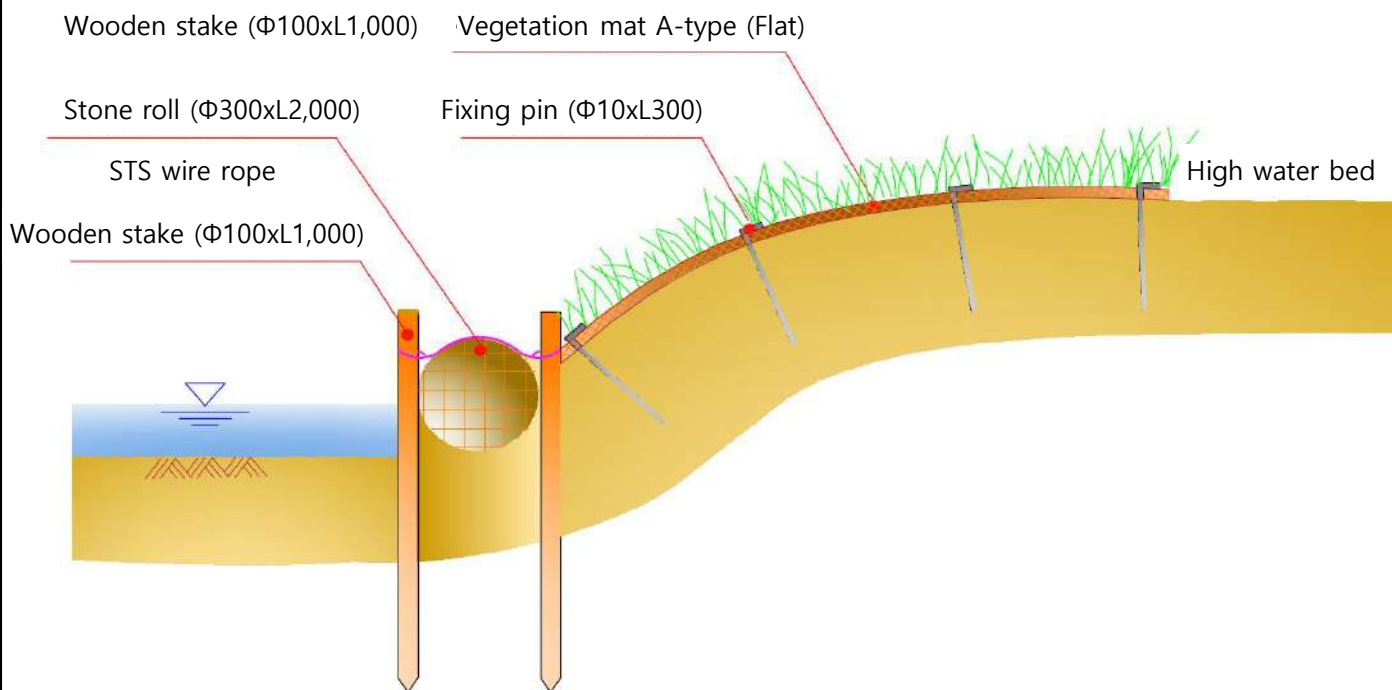


■ Specification

Product name	Width (m)	Thickness (mm)	Length (m)	Notes
Vegetation mat	1.1	10~30	10	11m ² /Roll

- Able to produce customized

Schematic diagram



Features

Structure	Considerations	Features and effects	Application points
Flat 3 Layers Coir mat + Coir fiber	<ul style="list-style-type: none"> - Flow rate impact - Installation time (March ~ October) - Selection of species - Weeds prevention and formation of colony 	<ul style="list-style-type: none"> - Natural material - Flat VAR structure - Prevent the invasion of denizens - Control slope scour - Early rooting - 3 layer structure and outstanding stability 	<ul style="list-style-type: none"> ● Stability + Vegetation ● Early rooting of plants ● Various applications ● Weeds prevention ● Early colony formation ● Improving non-point pollutant area



【 Rooting monitoring of vegetation mat 】

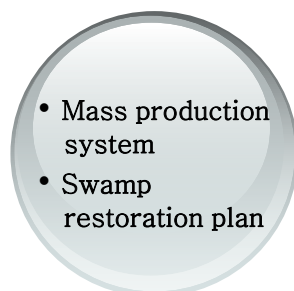
Halophyte



A revegetation measure implemented in brackish zone or the coast which is growing plants in the salty land with pretreatment process

Features of salt plants

Principles	Considerations	Features and effects	Application Points	Notes
<p>Salty environment</p> <p>↓</p> <p>Plant Adaptation</p> <p>↓</p> <p>Salt plants (Pot seeding) (Mat seeding)</p>	<ul style="list-style-type: none"> - Pre-inspection of salt concentration - Select applicable plants - Select appropriate vegetation methods - River mouth(Brackish zone) - Mud flat, coast - Reclaimed land 	<ul style="list-style-type: none"> - Use natural force - Vegetation in salty land - Ecological restoration - Pot & mat seeding - Excellent salty environment adaptation 	<ul style="list-style-type: none"> ○ Vegetation incapable area ○ Shore eroded area ○ Purification needed points ○ Key ecological position ○ Calcium chloride damaged area 	<ul style="list-style-type: none"> - Salty plants - Mat raising seeding - Reed, cattail
<p>5-10% Adaptation</p> <p>↓</p> <p>10-20% Adaptation</p> <p>↓</p> <p>20-30% Adaptation</p>				

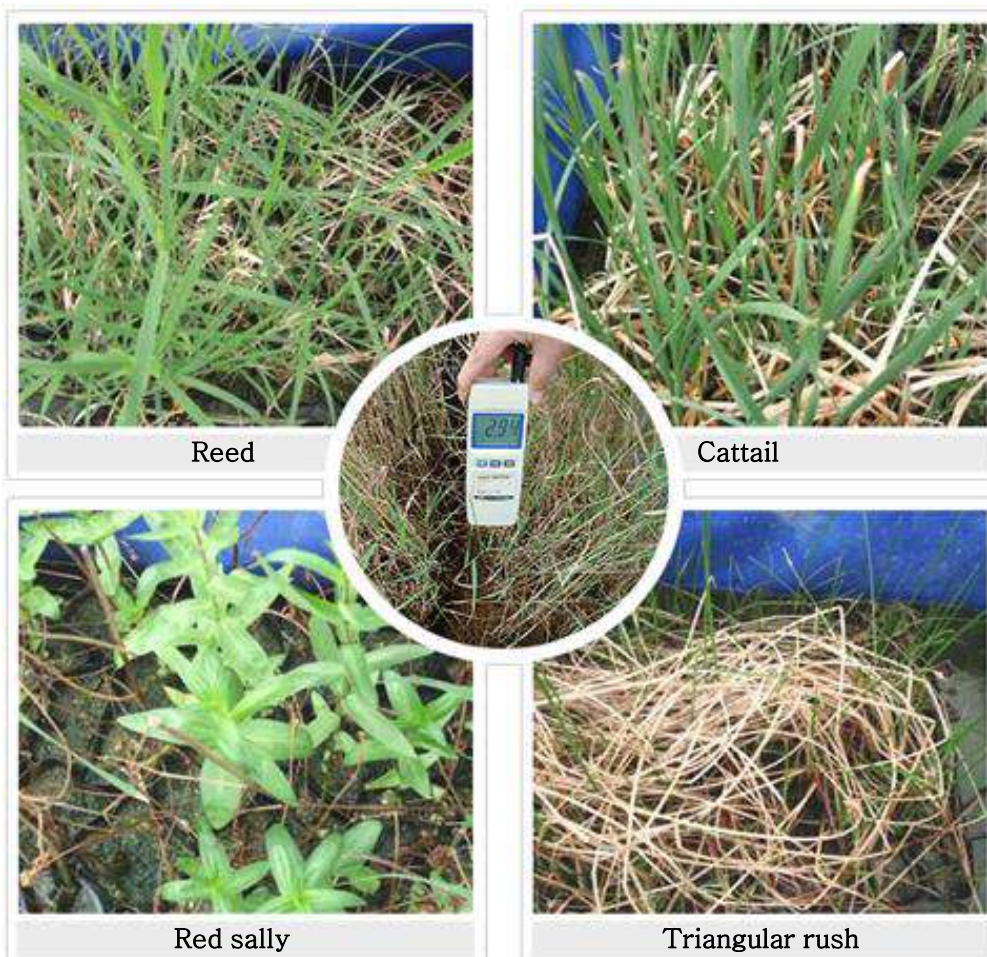


Study of salt plants

Minimize the loss factors during the preprocessing and salt adaptation processes of salt plants growing and manage comprehensive system from planting, growth management to monitoring.

- **Excellent technology**
 - Develop the salt adapted plants through adaptation experiments
 - Develop new vegetation methods for vegetation belt restoration
- **Originality**
 - Develop the invisible potential force of plants
 - Research plan focused on practical use of food production in the salty land
 - Ecological restoration business in river mouth linked with the natural river development
 - Improve accessibility to new method of construction of riverside erosion in brackish

■ Salinity measurement



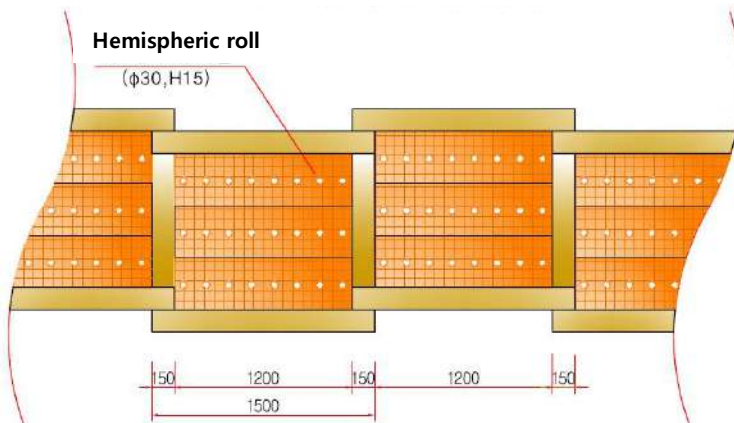
Hemispheric roll



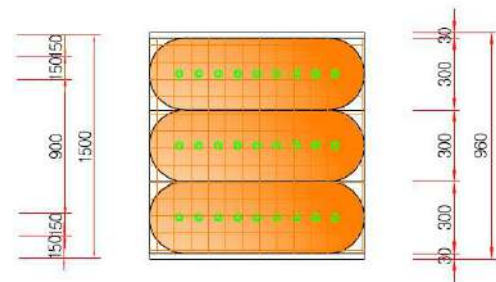
A dome type of vegetation base material made of 100% natural material considering the growth properties of aquatic plants and installation on the crib works or Fiberstone to create the natural vegetation revetment of riverside

Specification and schematic diagram

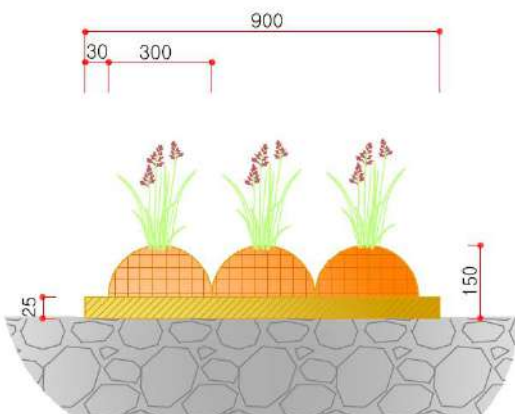
Ground plan of dome type roll on the crib works



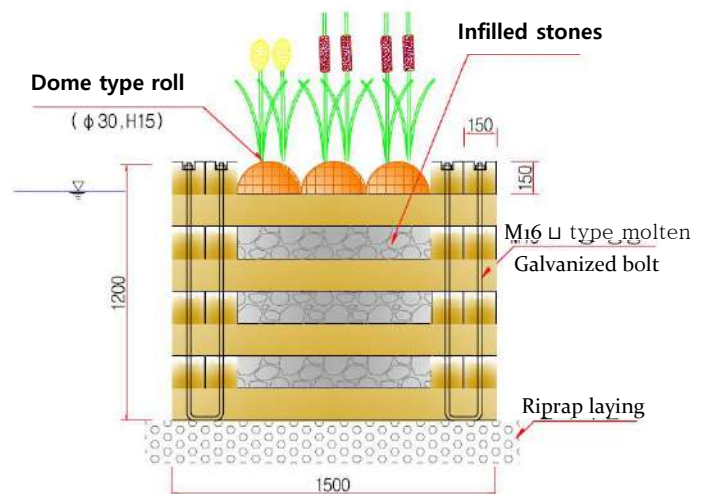
Ground plan of hemispheric roll



Cross section of hemispheric roll



Cross section of hemispheric roll installed on crib work



Features

Composition	Considerations	Features and effects	Application Points
Coir mat + Coir fiber + Vegetation holes	<ul style="list-style-type: none"> - Planting purification plants - Secure ordinary water level(5cm submerged) - Pot vegetation - Introduction of customized materials 	<ul style="list-style-type: none"> - Use natural materials - Connected dome type - Excellent stability - soil sedimentation - Reduce the tiredness of plant roots - Able to select in-filled materials 	<ul style="list-style-type: none"> • Continuous vegetation base • Create Vegetation • River in downtown • Area affected by water flow • Purification needed • Substitute the coir roll effect

