







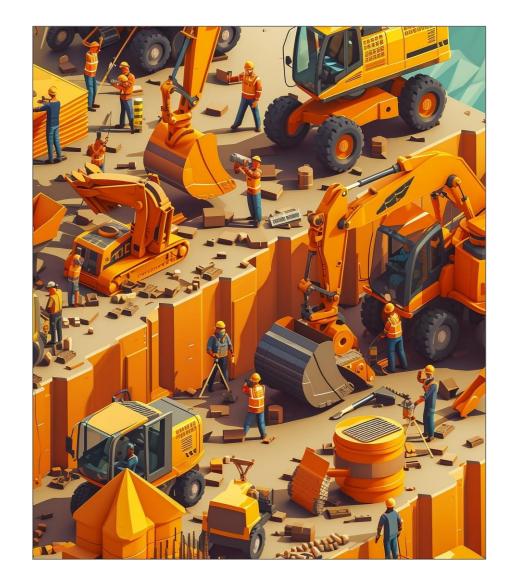
# **Eco-friendly Construction**

#### **About ET Group**

Our company leverages decades of international construction experience, combining the expertise of CM&PM engineers, scientists, and research teams. We innovate beyond traditional construction techniques, introducing the ecofriendly soil stabilization agent, "Green Soil Metrix," to the civil and architectural sectors.

Developed with a focus on environmental preservation, GSC technology addresses escalating environmental challenges. It ensures easy access to construction materials while enhancing cost-effectiveness and constructability.

Prioritizing people, the environment, economy, and safety, we integrate advanced eco-friendly techniques in road and housing construction. Our commitment to continuous research and development aims to contribute significantly to the global community.





#### Introduction to GSM Technique



**Green Soil Metrix** (GSM) utilizes soil properties to harden the subgrade and subbase, increasing both load-bearing capacity and strength over time. GSM serves as an alternative to traditional cement and concrete methods.

Compared to conventional concrete methods, GSM offers simpler construction, uses on-site materials, and eliminates the need for soil transportation, reducing construction time. The use of simple equipment further cuts costs and reduces maintenance expenses.

The eco-friendly GSM method significantly reduces carbon emissions and the use of sand and aggregates, aiding in the protection of the natural ecosystem.



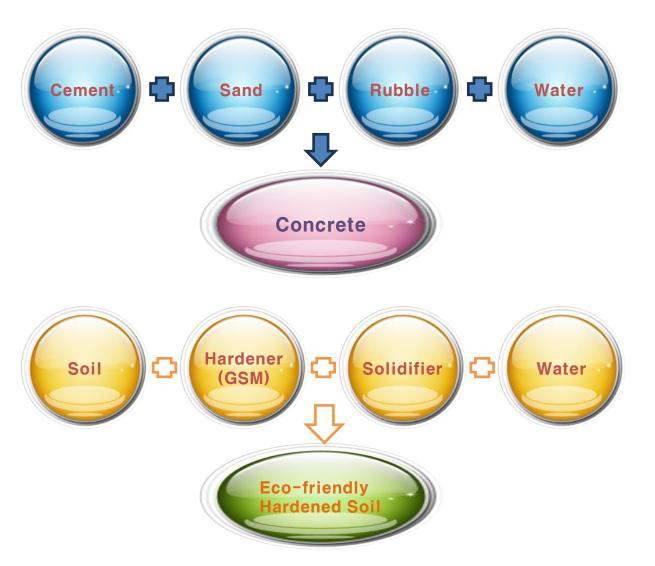
#### **Advantages of GSM Application**

- 1. Excellent insulation
- 2. Great ventilation and humidity control
- High durability: GSM bricks are stronger than regular bricks
- 4. Easy production: No need to bake bricks/blocks in kiln
- 5. Economy: Soil is the most important material
  - In order to satisfy the design strength, collect on-site soil samples to conduct indoor tests and determine the mixing ratios based on the test data.





## **Principle of GSM Solidification**



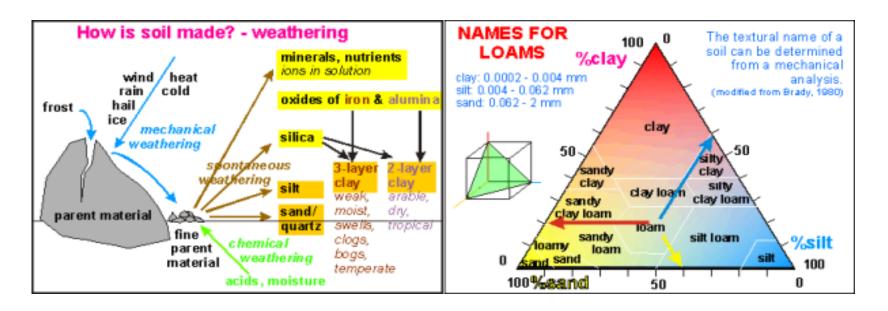
Concrete is formed by blending cement, sand, rubble, and water, but soil mixed with cement doesn't solidify due to organic matter.

Our innovation, Green Soil Metrix (GSM), introduces an eco-friendly Soil Metrix Binder to eliminate these organics and achieve solidification.



#### **Soil Solidification**

- Soil is formed from weathered rocks and consists of decayed organic materials, living organisms, and minerals. The organic material includes plant matter like banana peels and leaves.
- Soil particles have dissolved organic acids with strong electric forces due to absorbed moisture. These acids hinder the chemical reactions necessary for proper solidification.
- The GSM Binder removes organic acids through ion-exchange, promoting the reaction between soil, cement, and water to stabilize and solidify the soil as a structural material.





#### **Soil Solidification Process**

Schematic of Reaction	Reaction Principle	Remark
	Soil particles     Humin acid that contains strong electronic power dissolves in the water molecule attached to the surface of soil particle	Soil Particles
	Without soil stabilization     : The Humin acid in the water molecule hinders cement's hydration	Humin Acid
	3. Add soil stabilizer     : The base metals and Humin acid creates ION exchange reaction and separates them causing reaction to speed up	Cement
	4. Hydration caused by CaSio4  : Hydration accelerates formation of Etteringite (acicular structure)	Soil Stabilizer
	5. Rapid formation of Etteringite  : Rapid expansion of Etterngite fixes the soil particle within the Etteringite structure	Etteringite
	6. Soil stabilization(solidify)  : Pozzolan reaction forms structure	J



#### **GSM vs. AASHTO**

No.	Item	GSM	AASHTO
1	Road Structure	Comprises an ascon surface layer, ascon ATB layer, soil-stabilized base course, soil-stabilized sub-base course, and a selective layer	Comprises an ascon surface layer, ascon ATB layer, ascon rubble mixed base course, rubble sub-base course, and a selective layer.
2	Constructability	The process uses on-site soil mixed with GSM, covering 2,000m² to 2,500m² per day. An aggregate finisher ensures a uniform surface layer at a specified thickness, delivering excellent pavement quality	Mixing rubble and ascon involves transportation from a designated plant and extensive time for installation and rubble selection, taking a day to construct $1,000\text{m}^2\sim 1,200\text{m}^2$ , leading to civil complaints due to mining activities.
3	Economy	Utilizing on-site soil and an aggregate finisher for uniform installation reduces both construction time and costs	Construction costs soar due to mining on rocky mountains, transportation of broken stones for base course, sub-base course, and selective layers, escalating expenses significantly.
4	Construction Cost	85% on average	100%
<b>4</b> 5		85% on average  Uses eco-friendly inorganic ingredients and limits cement usage to below 15%, maintaining an alkaline degree of pH 7.6 with no detectable levels of the 11 major heavy metals	Tar and heavy metal elements in asphalt result in adverse environmental effects.
<b>4</b> 5	Cost	Uses eco-friendly inorganic ingredients and limits cement usage to below 15%, maintaining an alkaline degree of pH 7.6 with no detectable levels of the 11	



## **Application of GSM**

#### **Eco-friendly Roads and Applications**

 Unpaved roads (sidewalk), parks (walking trails), hiking trails

 Rural and countryside road networks, agricultural waterways

School (fields), public facilities (parking lots)

Urban roads, dust reduction, industrial complex (factories)

Highways, coastal roads, mountain roads

Special purpose roads (military roads)

Environmentally protected areas (cultural heritage sites)

Airport runways



- Eco-friendly housing (no cement needed)
- Affordable housing construction for lowincome families
- Reduced carbon emission in brick production (no firing required)
- Affordable construction with ecofriendly paving blocks
- Compatible blocks, slope (soil erosion) stabilization
- Housing ground reinforcement
- Eco-friendly natural fish farms

**Eco-friendly Housing and Applications** 



## **Applications of GSM Method**



**Eco-friendly Construction** 



Urban construction



**Paving** 

- Road construction and improvement works (Upper and lower subgrade improvement works)
- Simple, temporary road paving and repair works
- Construction works within school/park and stadium grounds



Soft Ground Strengthening

- Marsh ground improvement
- Soft subgrade improvement
- Slope stabilization for collapsed roads and dam sites



## **Applications of GSM Method**



**Foundation Works** 

- Embankment stabilization
- Ground foundation works
- Civil structure foundation works



**Submarine Ground Works** 

- Submarine ground improvement works (Deep mixing)
- Dredging and port reclamation
- Breakwater foundation works

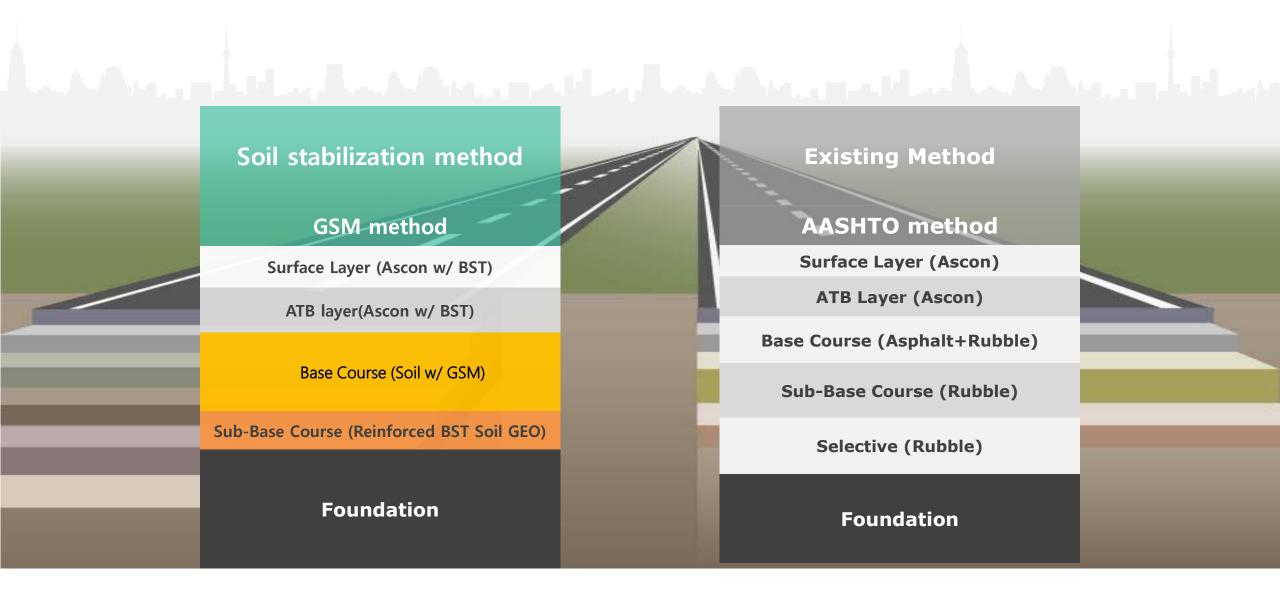


Other Improvement Works

- Anti-freezing, water barrier, erosion control
- Agricultural waterway and reservoir water supply improvement
- Earthen (soil) brick production

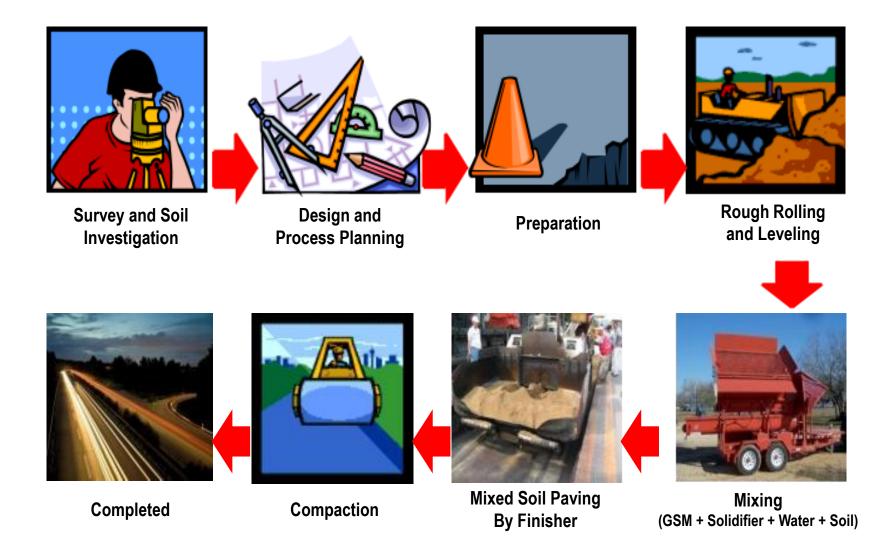


#### **Concept of GSM Construction**





#### **GSM Construction Flow**





#### **GSM Road Construction**









- 1. Mixed soil by Soil Stabilizer(GSM)
- 2. GSM spray & Compactinon
- 3. Mixed soil paving by finisher
- 4. Mixed Soil by Agricultural rotary

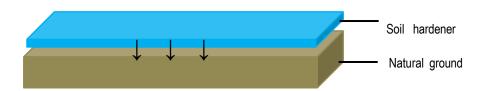


#### **GSM Road Construction** – Paving

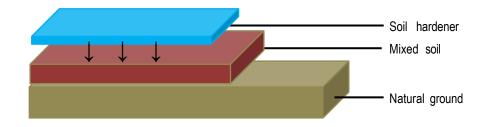


Sectional view of soil pavement and soil concrete pavement

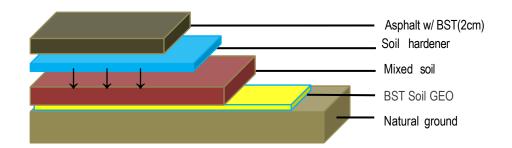
Soil pavement



- \* Change based on site conditions
- > Spray soil hardener(GSM) after consolidation work of the natural ground
- Soil concrete pavement (Paving roads and grounds for light vehicles weighing 20tons and less)



- Consolidation work of the natural ground
- Laying mixed soil (soil + solidifier or cement)
- Spraying soil hardener (GSM)
- Reinforced BST Soil GEO work or not, depending on the kinds of soil in a local area
- Soil concrete pavement (Paving roads and grounds for heavy vehicles weighing 20tons and more)



- Consolidation work of natural ground
- Laying mixed soil (soil + solidifier or cement)
- Spraying soil hardener (GSM)
- Paving asphalt (thickness 2 cm)
- Reinforced BST Soil GEO work or not, depending on the kinds of soli in a local area
- Recommending asphalt pavement in accordance with construction-related laws of a country or to improve the flexural strength of pavement



#### **GSM Road Construction** – Detailed Process

-CBR test

#### **START** ▶

Analysis of Soil Properties

Collecting
Testing Sample

Mixing Test

Planning/ Testing

Construction Plan

- Sweden Test
- Con-Penetrometer
  Penetration Test

Processing Procedure

strength test

-pressure/compression

- -residential land development Test
- -road improvement Test
- -building foundation improvement Test
- -temporary road construction Test
- -pond, river, muddy land Test

Construction Preparation

Construction

Construction Report

Construction Management

Curing

compaction

Laying/Leveling

Conveyance

Mixing Soil + GSM + Cement + Water

Leveling

Excavation

- -Construction plane testing -Road plane testing
- -Onsite CBR testing



-Roller(each kind)

-Finisher

-Dump Truck

-Soil Mixer





#### **GSM Housing Construction**

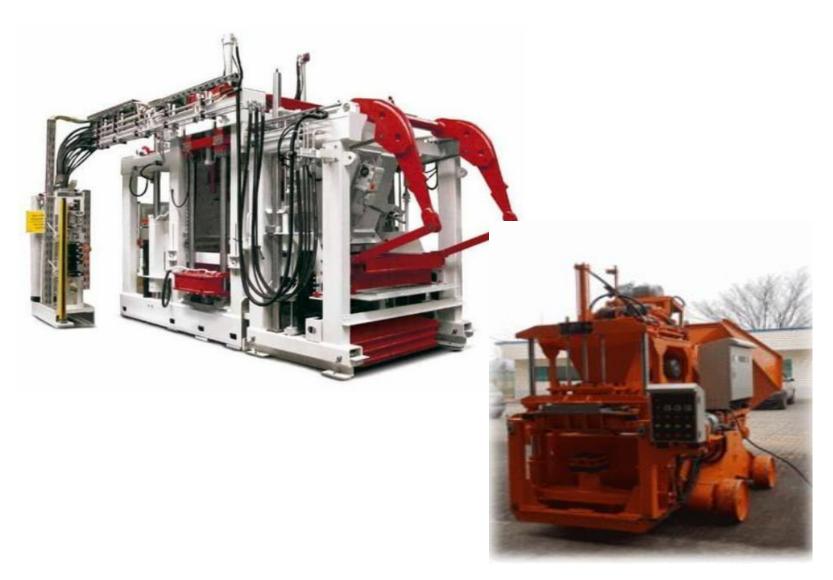
#### Advantages of block / brick with GSM

- Affordable : On-the-spot soil
- Ventilation
- No need to fire blocks/bricks in kiln
- Strength: 3 times stronger than concrete (Adjustable strength)





## **GSM Housing Construction** – Brick & Block Machine







# **GSM Housing Construction** – Brick House











#### **Other GSM Constructions**





# **Project Images** – Cambodia







# **Project Images** – Highway in Brunei













# **Project Images** – Indonesia











# Project Images – China











## **Project Images** – Military Road, South Korea







## **GSM Road Construction** – Core Sampling after Construction





# **Application Images (Others)**



Boardwalk



School Fields



Farm Road



**Slope Protection** 



#### **Patents**



Patent Certificate (Korea)



Patent Certificate (Korea)



Patent Certificate (PCT)



#### **Test Reports**









Heavy Metal Leak Test (Korea)

Heavy Metal Leak Test (Chile Road Institute)

Test Report (China National Laboratory)

Test Report
(National Research
Center of Testing
Techniques for
Building Materials)





# THANK YOU

**Eco-friendly Construction** 

