

Eco-friendly rebar and construction
brand replacing steel rebar



KECO is a safer, more economic,
and sustainable construction material

Your better choice creates a
better future for the earth **KEco**

KEco refers to KCMT's brand as a new GFRP material replacing the steel rebar



Safety

- Zero on-site accident
- SM removing material

· New Eco-friendly construction material and brand replacing the steel rebar



Efficiency

- Improving the construction efficiency
- Reducing the maintenance fees



Sustainability

- Low carbon material
- Recycling discarded PET chips regardless of their color
- Corrosion-resistance and life span of 100 years

New GFRP material replacing the steel rebar

Lightweight

- Easy to handle with a weight of 25% of the steel rebar
- High-performance, costs reduction effects such as labor, equipment, and logistics costs



High strength

- 2 times stronger than SD400 steel rebar
- Improving structural stability



Corrosion resistance

- Rust-free, semi-permanent material
- Low Maintenance cost and 100 years of life span



Thermal insulation

- Improving safety in case of fire with thermal insulation properties and non-flammable characteristics



Non-magnetic, non-conductive

- Improving safety in an environment sensitive to electromagnetic



Net Zero

- Carbon emission less than 73% of the production of the steel rebar





KECO upgrading the GFRP

Excellent Quality

- Increased adhesion/constructability with integrated rib processing technology
- Prevention of process errors by establishing a closed system for each type of manufacturing process
- Quality assurance through continuous inspection and testing by accredited institutions

Green Polymer

- Contributing to resource circulation through recycling of colored PET
- Improving safety by removing the SM

Large Smart Factory

- EMS, QMS, system introduction, automation of all processes
- Annual production capacity of 80,000 tons (300,000 tons in terms of steel rebar)



KECO Bar

KECO bar includes straight-line rebar, mesh, and bending shapes that can be applied to structures and buildings. It has been developed with decades of experience in product development in the fields of construction, mining, and infrastructure and philosophy for future generations. We have already secured achievements in various construction fields.



Comparison of properties between Steel rebar vs KEco Bar

| Structure | Deformed Rebar (Sd400) | KEco-Bar |
|-----------------------------|------------------------|---|
| Density(g/cm ³) | 7.85 | 1.9~2.2 |
| Tensile Strength(Mpa) | ≥ 500 | ≥ 1000 |
| Modulus of Elasticity(Gpa) | 200 | 50~60 |
| Thermal conductivity(W/mK) | 46.00 | 0.30 |
| Adhesion Strength | 10~14 | ≥ 15 |
| Corrosion resistance | Vulnerable to chloride | Not corrosive to chlorides |
| Magnetism | Positive | Negative |
| Electrical conductivity | High | Low |
| Bending | Possible | Possible(bending is not possible on-site) |
| Welding | Possible | Not possible |

KECO G-Rebar Standard Specification

| Type No. | Nominal Diameter (mm) | Nominal Area (mm ²) | Ultimate Tensile Load (kN) | Guaranteed Tensile Strength (MPa) | Modulus of Elasticity (GPa) | Weight (g/m) | Shear Strength (MPa) |
|-----------|-----------------------|---------------------------------|----------------------------|-----------------------------------|-----------------------------|--------------|----------------------|
| VRS100-6 | 6.4 | 31.7 | 35 | 1,104 | ≥ 50 | 66.6 | ≥ 150 |
| VRS100-8 | 8.0 | 49.5 | 52 | 1,051 | ≥ 50 | 104.0 | |
| VRS100-10 | 9.5 | 71.3 | 74 | 1,038 | ≥ 50 | 149.8 | |
| VRS100-13 | 12.7 | 126.7 | 123 | 971 | ≥ 50 | 266.2 | |
| VRS100-16 | 15.9 | 198.6 | 186 | 937 | ≥ 50 | 417.3 | |
| VRS100-19 | 19.1 | 286.5 | 253 | 883 | ≥ 50 | 601.9 | |
| VRS100-22 | 22.2 | 387.1 | 333 | 860 | ≥ 50 | 813.3 | |
| VRS100-25 | 25.4 | 506.7 | 428 | 845 | ≥ 50 | 1,064.7 | |
| VRS100-29 | 28.6 | 642.4 | 529 | 823 | ≥ 50 | 1,348.3 | |
| VRS100-32 | 31.8 | 794.2 | 631 | 795 | ≥ 50 | 1,666.6 | |

KECO C-Rebar

KEco CFRP Rebar with carbon fiber as a reinforcement material has excellent specific strength and mechanical performance, making it widely used in pre-stress and high-strength structures.



| Type No. | Size | Nominal Diameter (mm) | Nominal Area (mm ²) | Ultimate Tensile Load (kN) | Guaranteed Tensile Strength (MPa) | Modulus of Elasticity (GPa) |
|----------|------|-----------------------|---------------------------------|----------------------------|-----------------------------------|-----------------------------|
| C100-6 | 2 | 6 | 31.7 | 71 | 2241 | 124 |
| C100-10 | 3 | 10 | 71.3 | 154 | 2172 | |
| C100-13 | 4 | 13 | 126.7 | 262 | 2068 | |

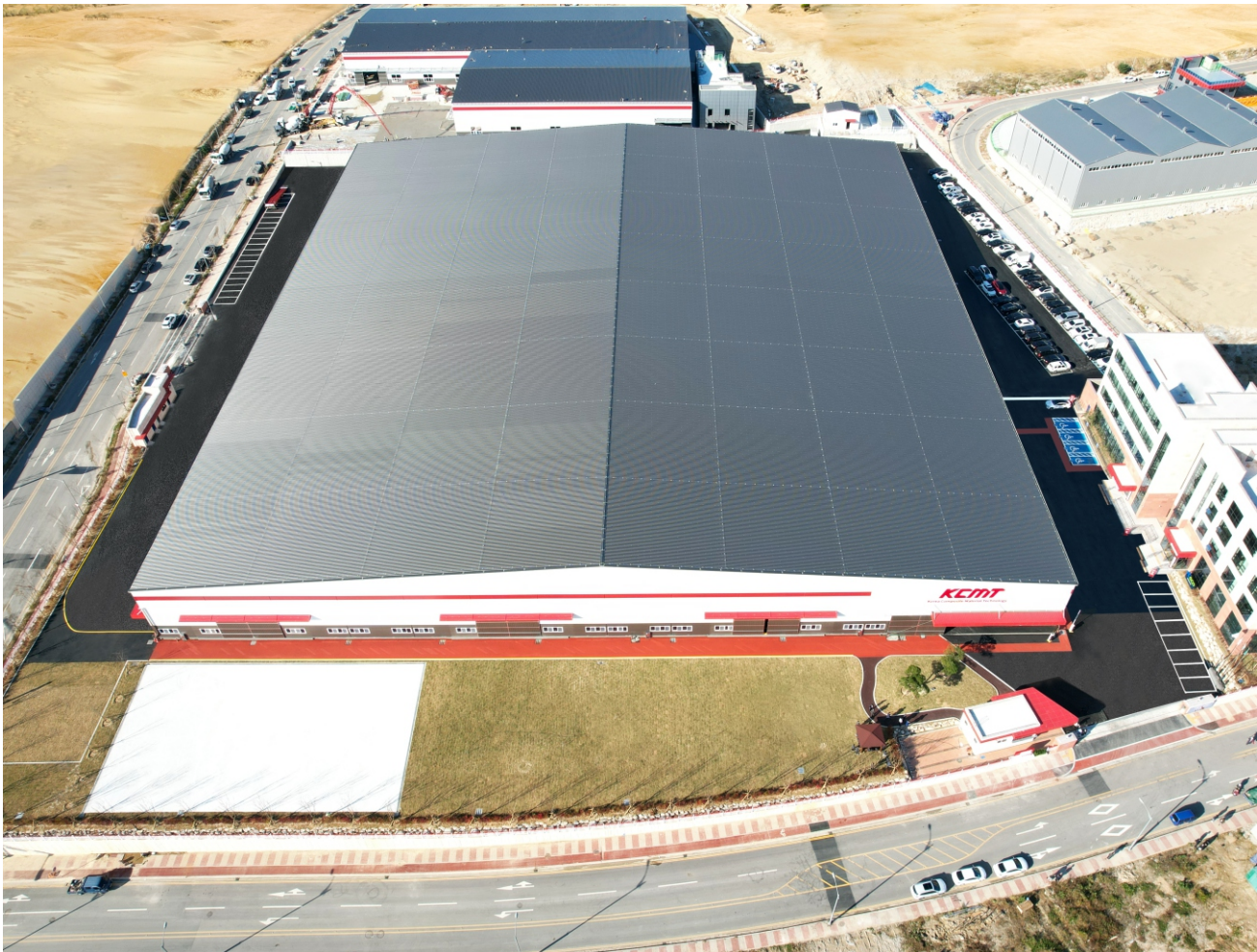
KECO B-Rebar

The KEco BFRP Rebar, which uses basalt fibers as a reinforcing material, is suitable for permanent structures due to its high strength and elastic modulus.



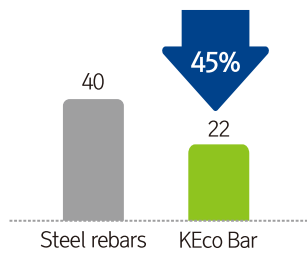
| Type No. | Diameter (mm) | Ultimate Tensile Load (kN) | Cross Section (mm ²) | Ultimate Tensile Strength (MPa) | Modulus of Elasticity (GPa) | Ultimate Shear Strength (MPa) |
|----------|---------------|----------------------------|----------------------------------|---------------------------------|-----------------------------|-------------------------------|
| B100-6 | 6 | 50 | 50.3 | 1000 | ≥ 45 | ≥150 |
| B100-10 | 10 | 79 | 78.5 | 1000 | | |
| B100-16 | 16 | 159 | 177.0 | 900 | | |
| B100-20 | 20 | 227 | 284.0 | 800 | | |
| B100-25 | 25 | 362 | 452.0 | 800 | | |

Efficiency analysis from **KECO**'s actual case, KCMT's new factory at the energy convergence general industrial complex

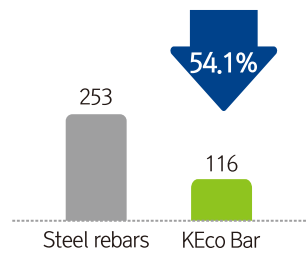


Comparative analysis of KCMT 1st factory's foundation construction costs (vs. steel rebars)

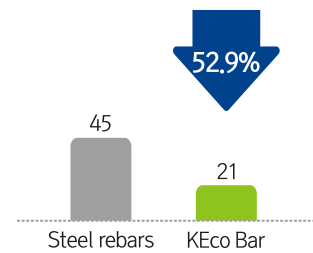
| Construction Period



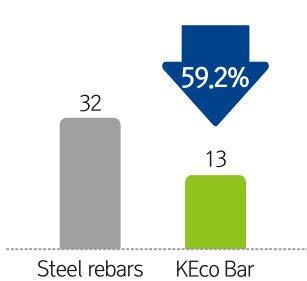
| Labor Cost



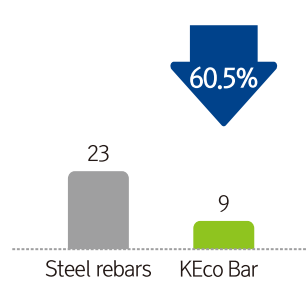
| Maintenance Cost



| Equipment Costs



| Shipping Cost



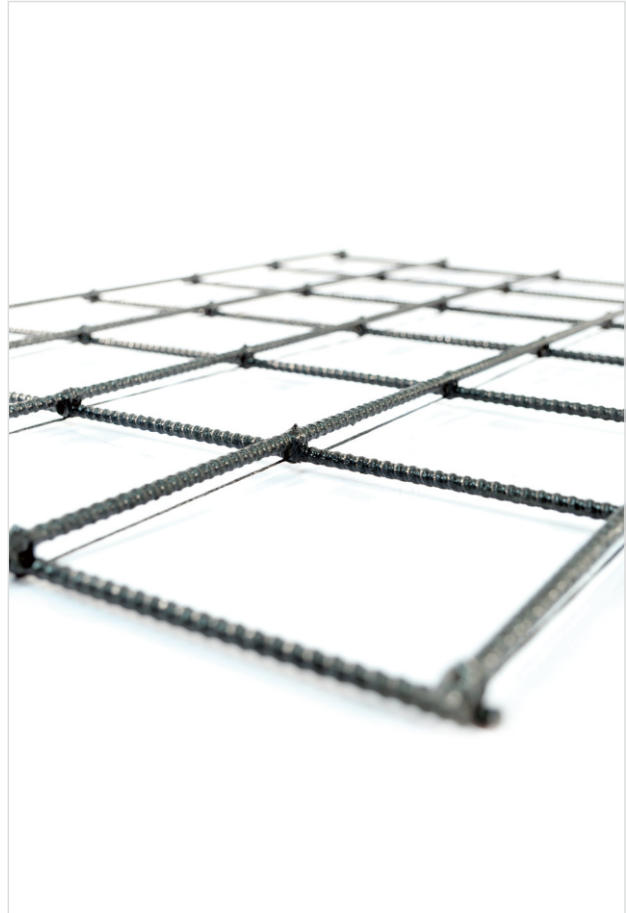
Unit : day, million won





KEco Bending Type

- Processing of foundations, columns, beams, slabs, retaining walls, etc., reinforcement of concrete in various parts required the product
- Can be customized, but difficult to process on site



KEco Mesh Type

- The mesh type is buried at horizontal joint and installed to maintain safety at the intersection of the expansion and contraction cracks and the lateral force

KECO Rebar construction



KECO Rockbolt & Soil-Nail

It is divided into Rockbolt used for bedrock and a soil-nail used for soil and sand. It is civil engineering material to secure the stability of natural slopes with high risk of collapse or artificial slopes due to excavation.



Verified Material

Civil engineering materials used since the 1990s after the development of GFRP in the 1950s (40% share of the domestic rock bolt market)

Long Life of facilities and reduced resource consumption due to strong corrosion resistance

Eco-friendly Materials

Produce Production resource less than 45% comparison of steel rebar

Carbon emission less than 73% of the production of the steel rebar

Safe Materials

1/4 weight ratio of steel rebar address increasing worker safety

4 time many loads can be transported in comparison with the steel reinforcement

Increased convenience of construction management by allowing coloring

GFRP Rockbolt Quality Standards

2016. Apr Established GFRP Rockbolt specification by Korea Highway Corporation

2017. Aug Establishment of GFRP Rockbolt quality standard by Korea Rail Network Authority and Ministry of Land, Infrastructure and Transport

| Division | Unit | Quality Standards | Remarks |
|---------------------|------|-------------------|---------|
| Tensile Strength | MPa | ≥ 850 | |
| Shear Strength | MPa | ≥ 150 | |
| Glass Fiber Content | % | ≥ 75 | |
| Minimum Diameter | mm | ≥ 20 | |

KECO Rockbolt / Soil-Nail Standard Specification

Solid Type

| Type No. | Outer Diameter (mm) | Ultimate Tensile Strength (Mpa) | Shear Strength (Mpa) | Glass Fiber Content (%) |
|----------|---------------------|---------------------------------|----------------------|-------------------------|
| SS-25 | 25 | 850 | ≥ 150 | ≥ 75 |
| SS-32 | 32 | 850 | ≥ 150 | ≥ 75 |

Hollow Type

| Type No. | Outer Diameter (mm) | Hole Diameter (mm) | Ultimate Tensile Strength (Mpa) | Shear Strength (Mpa) | Glass Fiber Content (%) |
|----------|---------------------|--------------------|---------------------------------|----------------------|-------------------------|
| HS-25 | 25 | 12 | 850 | ≥ 150 | ≥ 75 |
| HS-27 | 27 | 12 | 850 | | |
| HS-32 | 32 | 15 | 850 | | |

KECO vs Steel Bar

KECO Rockbolt

| | Steel Rockbolt | KEco Solid Rockbolt | KEco Hollow Rockbolt |
|-----------------------|--|---|---|
| Materials | SD35 | GFRP | GFRP |
| Nominal Diameter | D=25.4mm | D=23.5mm | D=27/12(Holo)mm |
| Weight(4m) | 15.92kg | 3.88kg | 3.88kg |
| The tensile strength | More than 490 MPa | More than 850 MPa | More than 850 MPa |
| Ultimate | 25.3 t/unit | 37.0 t/unit | 32.0 t/unit |
| Electrical conduction | ○ | × | × |
| Durability | Poor durability | Approximately 100 years (corrosion resistance) | Approximately 100 years (corrosion resistance) |
| Constructability | <ul style="list-style-type: none"> · The heavy weight of steel rock bolt can caused fatal accidents during the operation · Two or more people are required to install the steel rock bolt · Drop-out frequently occurs in the ceiling rock bolt installation due to the heavy weight of the steel rock bolt · A separate process is required for connecting the injection pipe · Difficulty in inserting the steel rock bolt connected to the injection pipe · Difficulty working in the water section | <ul style="list-style-type: none"> · Lightweight (4kg/4m) for easy to handle · KEco solid rock bolt can be installed by one person · A separate process is required for connecting the injection pipe · There is almost no dropout due to its own weight when working on the end of the ceiling · Easy to insert KEco solid rock bolt compared to steel rebar · Difficulty working in the water section | <ul style="list-style-type: none"> · Lightweight (4kg/4m) for easy to handle · KEco solid rock bolt can be installed by one person · It can be injected through a hollow hole without connecting a separate injection tube · It is possible to shorten the construction time and to fill it by 100% · Excellent effect in the work of the water section |
| Stability | <ul style="list-style-type: none"> · Increased risk of using equipment when transporting with high weight (2 people can carry it) · Use of equipment when inserting steel rock bolts (A number of safety accidents occur) | <ul style="list-style-type: none"> · KEco solid rock bolt can be installed by humanpower · Secure structural stability by using high strength rock bolt · It is a non-conductive product, it can be used safely even in high-moisture and high-pressure sites | <ul style="list-style-type: none"> · Reduced risk factors with lightweight materials and excellent workability · Stable excavation cycle management is possible by reducing worker fatigue and increasing work efficiency · Workers can check the mortar filling status by themselves · 100% filling possible(prevention of falling accidents) · Zero safety accidents by ensuring quality and minimizing risky work |



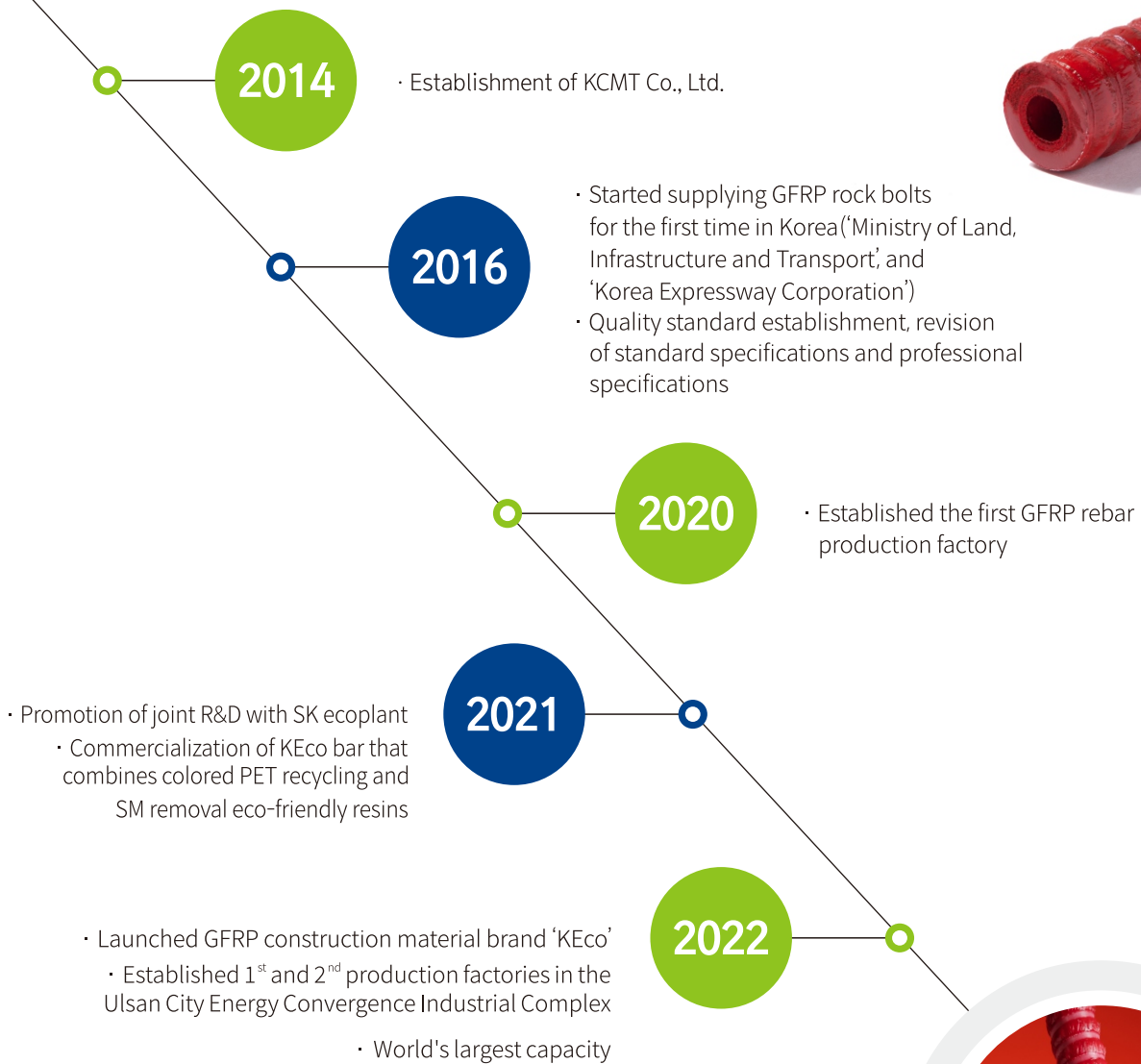
KEco Rockbolt has widely used in tunnel and slope supporting, and provide a very beneficial substitution for traditional steel Rockbolt system

Rockbolt Application field





KCMT is a company specializing in the production of GFRP construction materials, a new material that replaces steel rebars. Since supplying GFRP Rockbolt to the ministry of land, infrastructure, and transport also Korea expressway corporation for the first time in Korea in 2016, we have been leading the quality standards for GFRP construction materials in Korea.



KECO Smart Factory

Inside and outside view of the factory

KEco 1st factory



KEco 2nd factory



It is a smart and automated system factory with a production capacity of 80,000 tons per year, or 300,000 tons when converted to steel rebar.

We produce the best products by introducing a manufacturing logistics automation system, an automated warehouse system, and an in-house quality inspection system.



Quality/Environmental Management Optimization System

KECO Smart Factory

- ✓ We have established a closed system that prevents artificial errors in principle in each manufacture
- ✓ Ring process for the production of high-quality products.
And we have implemented an ICT system for QM(Quality Control System) and EM(Environment management)



The entire process has been automated to avoid defections



High-quality products



Automated production system for a more effective production



The world's largest single-process GFRP manufacturing facility



KECO Application (Rebar)

| Client | Application | Supplied products |
|--|--|--------------------------------------|
| Structural Laboratory of Civil Engineering, Kyungnam National University of Science and Technology | Freecast Rebar | GFRP Rebar (RS Ø13mm) |
| TB Block | Prevent Thermal Bridging in Architecture | GFRP Rebar (VRS Ø16mm) |
| Incheon Port International Passenger Pier (Stage 1) Site Construction Corporation | Handrail Rebar | GFRP Rebar (RS Ø10mm, Ø14mm) |
| Ecosite | Micro-pile | GFRP Rebar (RS Ø25mm, Ø28mm) |
| Sampyo P&C Cheongju Factory | Precast Steel in Architecture | GFRP Rebar (RS Ø14mm, VRS Ø16mm) |
| Chungnam National Univ. Sejong Hospital | Foundation rebar in MRI suite | GFRP Rebar (RS Ø19mm) |
| Hyosung LB-DECK | Deck Rebar | GFRP Rebar (RS Ø13mm) |
| Pyeongtaek, Godeok Area Infrastructure Construction | Slurry wall Rebar | GFRP Rebar (RS Ø25mm) |
| Kepeco Research Institute | Construction of an Empirical Test Site for Reducing Transmission and Magnetic Fields | GFRP Rebar (VRS Ø10mm) |
| The Expressway Construction works between Anseong and Gu-ri (Section No. 14) | Bridge Slab rebar | GFRP Rebar Ø16, 19, 22, 25mm |
| West coast railway construction | Precast concrete for soundproof walls | GFRP Rebar Ø13mm |
| Manufacturing Factory, Janglim, Busan | Foundation work, Retaining wall | GFRP Rebar Ø19mm |
| West coast railway construction | Soundproof walls (cast in site) | GFRP Rebar Ø13mm |
| Pyeongtaek P3 PROJECT | Tunneling Construction | GFRP Rebar Ø25mm |
| Jungyang SG | Prevent Thermal Bridging in Architecture | VRS Ø16mm , Ø19mm |
| KCMT | Foundation for ManuFacturing Factory | VRS Ø19mm , Ø25mm |
| JMG Tech | Foundation for ManuFacturing Factory | GFRP Rebar Ø19mm |
| The Expressway Construction works between Changnyeong and Milyang (Section No. 1) | Foundation rebar in CRCP | VRS Ø19mm , Ø22mm |
| Yongin Industrial Complex | Freecast culvert structure | VRS Ø10mm, Ø13mm, Ø16mm |
| The Expressway Construction works between Pohang and Yeongdeok (Section No. 1) | Bridge Slab rebar | VRS Ø13, 22mm |
| Gyeongseo Heavy Industries Co., Ltd, Hampyeong | Foundation work | GFRP Rebar Ø19mm |
| Ecopolymer Factory, Gyeongju | Foundation work | GFRP Rebar Ø10, 13, 16, 19, 22, 25mm |
| Construction of a Waste Landfill Facility in the General Industrial Complex of Myeonggye 3 | Foundation work | VRS Ø19mm |

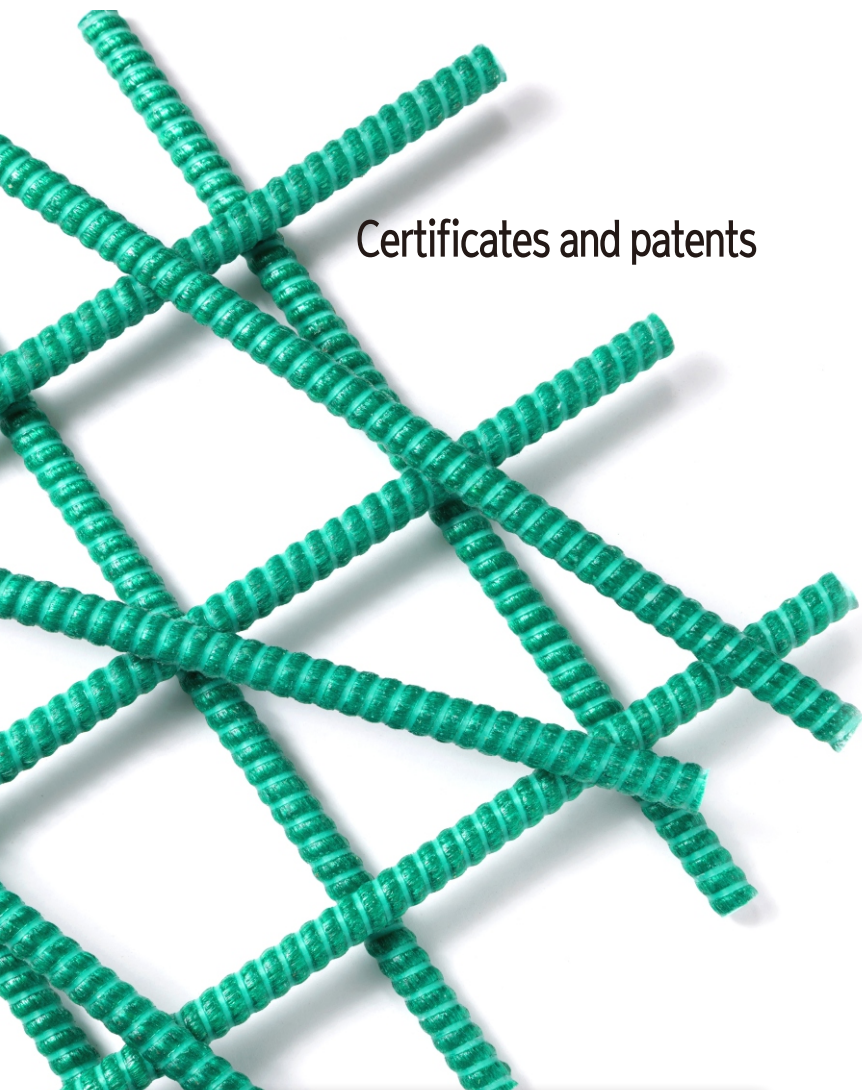
KECO Application (Rockbolt)

| Client | Project | Supplied products |
|------------------------------|--|---------------------------------|
| Korea Expressway Corporation | The Construction works between Gimpo and Paju of Expressway No. 400(Section No. 2) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| | The Construction works between Gimpo and Paju of Expressway No. 400(Section No. 2) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | The Construction works between Miryang and Ulsan of Expressway No. 14(Section No. 2,3,4,5,6,9) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | The Expressway Construction works between Busan Ring Expressway No.600 (Section No. 2,4) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | The Construction works between Saemangeum and Jeonju(Section No. 5,6,7,8) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| | The Construction works between Sejong and Anseong of Expressway No. 29(Section No. 9) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| | The Expressway Construction works between An-seong and Gu-ri (Section No. 11,13) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | The Expressway Construction works between An-seong and Gu-ri (Section No. 11) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| | The Construction works between Anseong and Seongnam of Expressway No. 29(Section No. 7) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | The Construction works between Anseong and Seongnam of Expressway No. 29(Section No. 4,9) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| | The Expressway Construction works between Hwa-do and Yang-pyeong (Section No. 2) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | The Expressway Construction works between Yang-pyeong and Hwoado (Section No. 2,3) | GFRP RockBolt (KCMT HS27 Ø27mm) |

KECO Application (Rockbolt)

| Client | Project | Supplied products |
|--|---|---------------------------------|
| Korea Expressway Corporation | The Construction works between Paju and Yangju · Pocheon of Expressway No. 400(Section No. 2) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | The Construction works between Pohang and Yeongdeok of Expressway No. 65(Section No. 3) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| | The Construction works between Pohang and Yeomchi of Expressway No. 65(Section No. 2) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| | The Construction works between Hamyang and Changnyeong of Expressway No. 14(Section No. 3,9,11) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | The Construction works between Hamyang and Changnyeong of Expressway No. 14(Section No. 1,2,4,6) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| | The Construction works between Hamyang and Hapcheon of Expressway No. 14(Section No. 2) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| Korea National Railway | Gimpo Metro Area 1,3 | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | Subway Line NO.4 Extension Project (Jinjeop Line), Section 1 | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Gyeonggi Province/Korea National Railway | Subway Line NO.8 Extension Project (Byelnae Line), Section 4 | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Busan Transportation Corporation | Busan urban rail Sasang-Hadan 5th Section Construction | GFRP RockBolt (KCMT HS25 Ø25mm) |
| Busan Regional Office of Construction Management | National Road Construction of Geoje-Masan(3) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | National Road Construction of Seomyeon-Geunnam(1) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| | Goseong~Tongyeong national road construction project | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Busan Regional Construction and Management Administration | Alternative Bypass Construction Project of National Highway in Changwon-si (2nd Anmin Tunnel) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Seoul Regional Construction and Management Administration | The Construction works between Icheon and Osan of Expressway No. 400 (Section No. 1-1,1-2) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Wonju Regional Construction and Management Administration | National Road Construction of Dogye-Singi | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Daejeon Regional Construction and Management Administration | Cheongju national road bypass(Bukil~Namil2) construction project | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Incheon Metropolitan Urban Railroad Construction Headquarters | Construction of Seoknam Line Extension of Seoul Metro No.7 Section 2 | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Seoul Metropolitan Infrastructure Headquarters | The Road Construction Works for Sillim-Bongcheon Tunnel(Section No. 1,2) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Construction Headquarters, Busan Metropolitan City | The Construction Management for inner circulation(Mandeok-Centum) urban expressway Zone1-1, 2(Private-Public Partnership Project) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| Ministry of the Interior and Safety | Construction work of National Computing & Information Agency(Gongju) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Gangneung Eco Power | Construction of Plant Facilities for Gangneung Anin Thermal Power Plant | GFRP RockBolt (KCMT HS27 Ø27mm) |
| Kangwon-do Youngwol-gun | Gundo Line 9 Linear Improvement Project (Bundeokjae Tunnel) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Gyeonggi Province | HANAM lines(Sangil~Geomdansan) Construction of Double Track Railway Section 5 | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Nextrain Co., Ltd | Railway Double-tracking and Electrification Project of the Sinansan Line(Section No. 1-2,2) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Nextrain Co., Ltd | Railway Double-tracking and Electrification Project of the Sinansan Line (Section No. 1-1,4-2,5-2) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| Comprehensive Construction Headquarters of Ulsan Metropolitan City | Infrastructure maintain business around Ulsan Station complex transfer center | GFRP RockBolt (KCMT HS27 Ø27mm) |
| Busan Transportation Corporation | Yongsan Metro Line(Nopo~Bukjeong) 1th Section Construction | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Busan Metropolitan Corporation | International Industrial Logistics City (1-2 Phase) After Busan New Port (Section 9) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Busan regional office of aviation | The Construction works of UI-leung airport | GFRP RockBolt (KCMT SS25 Ø25mm) |
| WESTERN Metro Co., Ltd | Daeguk-Sosa Railway Area 2 // double-track electrification projects Daegok-Sosa(Section No. 2) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| Smart-rail Co., Ltd | Double-track electrification project for Bujeon-Masan section 1 | GFRP RockBolt (KCMT SS25 Ø25mm) |
| West Seoul Expressway | The Construction for Seobu Expressway Tunnel construction Project (Private-Public Partnership Project)Zone 2-1 | GFRP RockBolt (KCMT SS25 Ø25mm) |
| SG Rail Co., Ltd | The Seoul Metropolitan Aera Express Railway A Line (Section No. 1,2,3,4,5,6) | GFRP RockBolt (KCMT SS25 Ø25mm) |
| SG Rail Co., Ltd | The Seoul Metropolitan Aera Express Railway A Line (Section No. 1,6) | GFRP RockBolt (KCMT HS27 Ø27mm) |
| Korea Southern Power Co., Ltd | Construction of Namjeju Combined Cycle Power Plant | GFRP RockBolt (KCMT SS25 Ø25mm) |

Certificates and patents



특허증
CERTIFICATE OF PATENT

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Patent Number

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Registration Date

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위의 발명은 「특허법」에 따라 특허원부에 등록되었음을 증명합니다.
This is to certify that, in accordance with the Patent Act, a patent for the invention has been registered at the Korean Intellectual Property Office.

2023년 04월 13일

특허청장
COMMISSIONER
KOREAN INTELLECTUAL PROPERTY OFFICE

이인신

특허증
CERTIFICATE OF PATENT

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Patent Number

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This is to certify that, in accordance with the Patent Act, a patent for the invention has been registered at the Korean Intellectual Property Office.

2016년 12월 21일

특허청장
COMMISSIONER
KOREAN INTELLECTUAL PROPERTY OFFICE

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품질경영시스템인증서

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인증범위:
GFRP확폭트, GFRP Rebar, GFRP Mesh의 설계 및 제조

적용제외요구사항 [8.5.3 고객 또는 외부공급자의 재산]

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