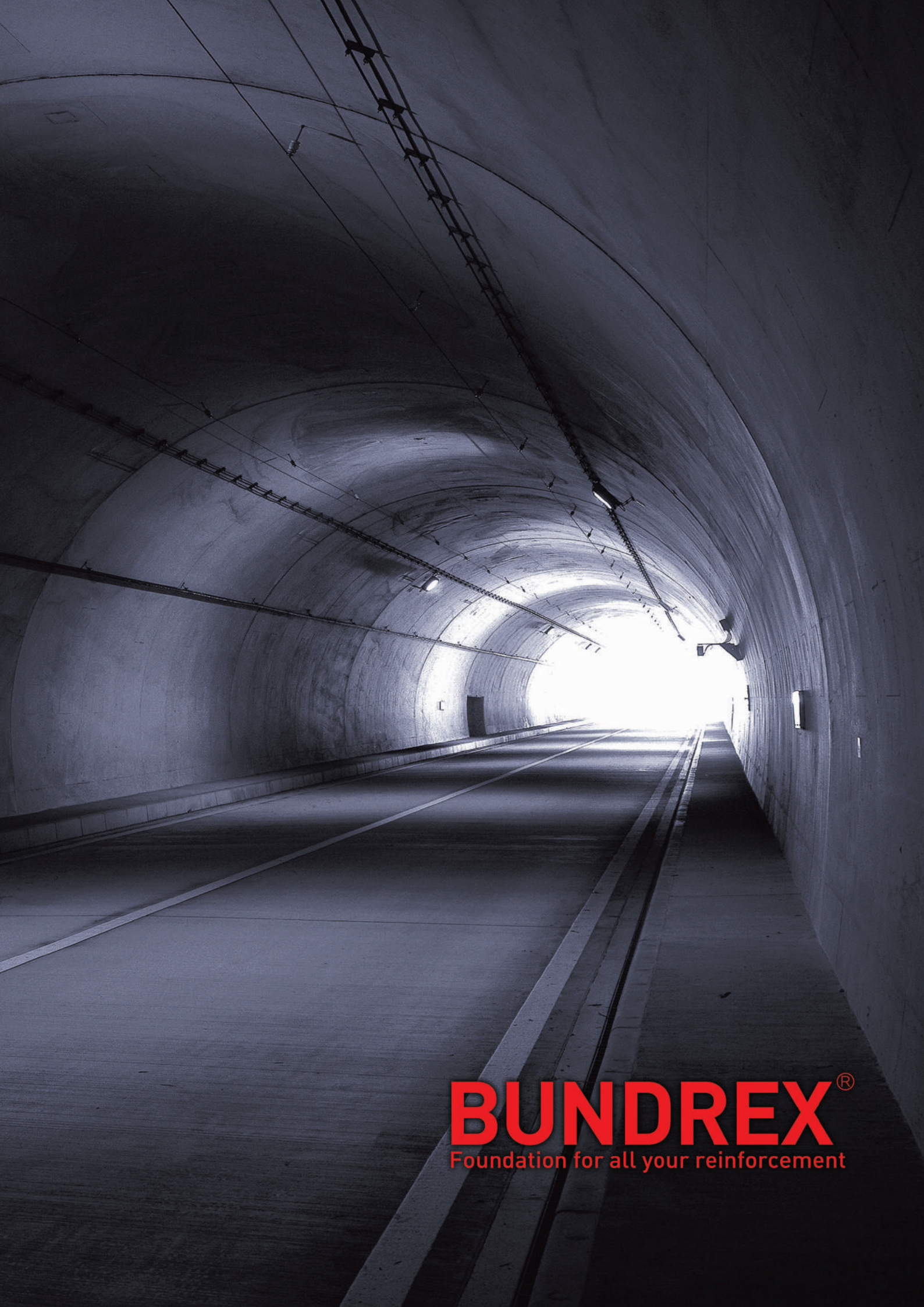
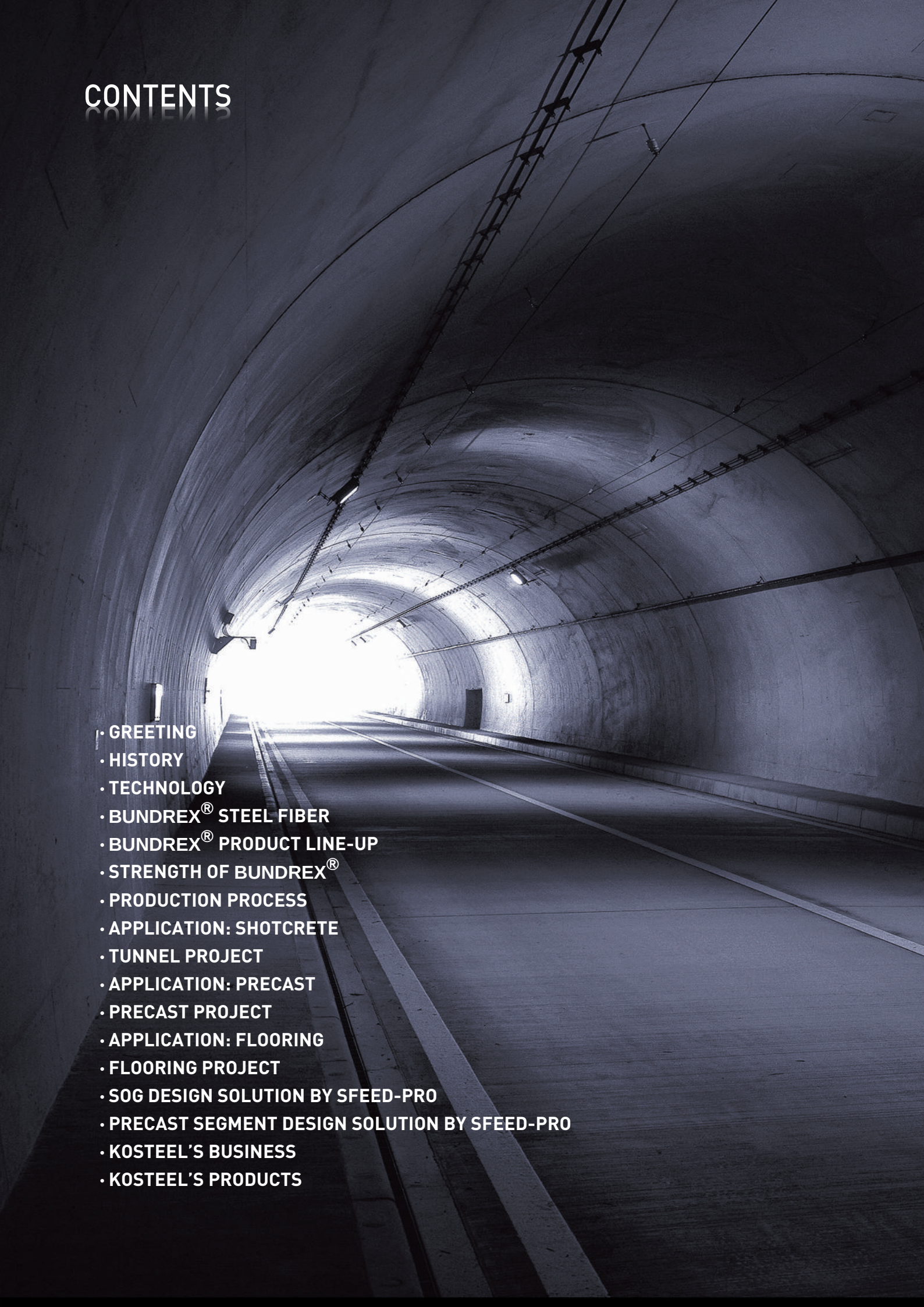


BUNDREX®

Foundation for all your reinforcement

CONTENTS



GREETING

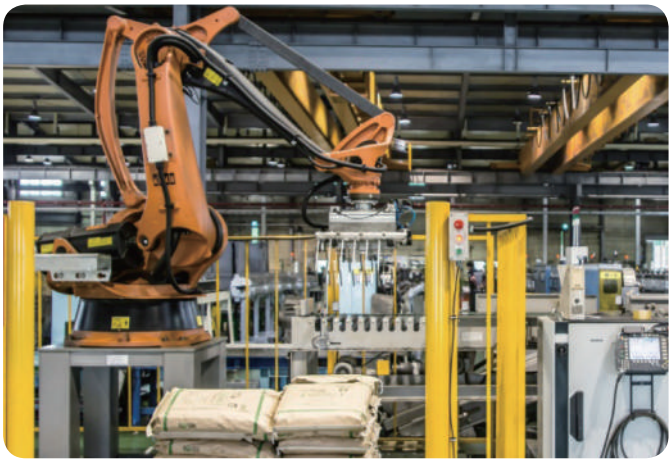
Since the launching of our fiber business in 2011, KOSTEEL's BUNDREX Division has set the Vision of "Providing total concrete reinforcing solution that customers desire" and the Mission of "**Working as a pioneer for KOSTEEL at global market**" to expand our business.

Now we are at the stage of making a new leap forward to be export-oriented business based on the wire rod manufacturing technology which makes us different and more competitive from other companies.

We will measure up to our customers by becoming global partner to provide customized fiber with stand-alone fiber solution for all your needs by continuously investing on R&D and reducing the cost of our products.

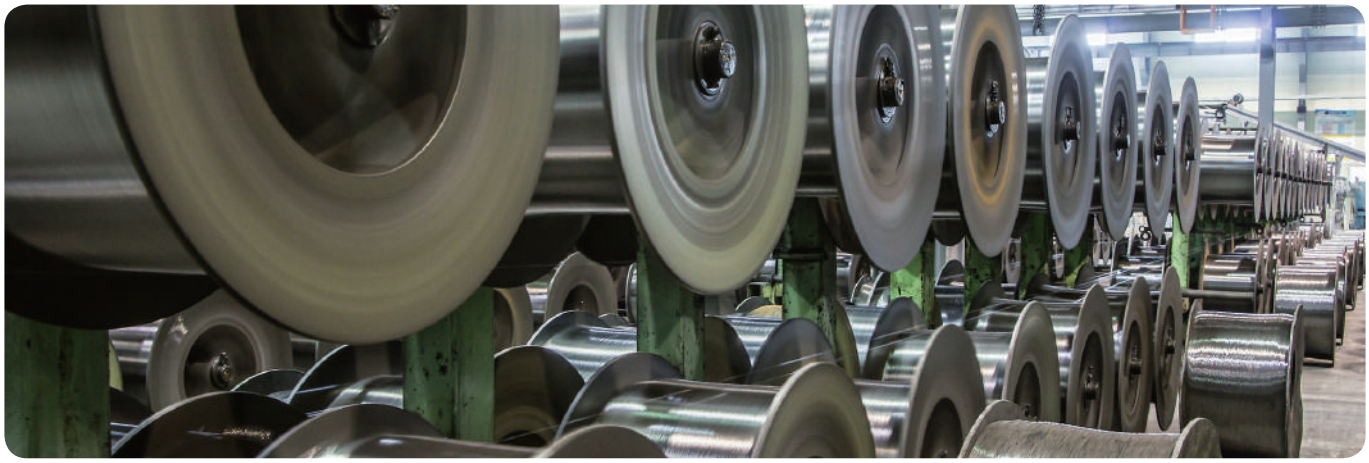
We will continue to move forward together with you as a new leading company in the global market to be total solution provider of reinforced concrete.

New era for steel fiber, Starts with KOSTEEL's BUNDREX®



2001	October	Establishment of Steel Fiber Korea
2002	April	Industrial design registration of concrete reinforced steel fiber
2003	February	Completion of laboratory and 2nd factory building
	June	Registered trademark for **BUNDREX®**
	November	Registered trademark for Steel Fiber Korea
2004	June	Acquired utility model registration for steel fiber forming roller, dice and built-up capstan
2005	February	Acquired patent for rigid/ductile wire production equipment
	December	Completion of 2nd factory for Steel Fiber Korea
2006	February	Acquired patent for steel fiber glue and its method of production
	April	Acquired utility model registration for steel fiber dozing machine
	November	Obtained patent for Cement Material Containing Reinforced Fiber and its Composite
	December	Obtained Certificate of Technology Innovation (SME type) from SMBA
2008	October	Registered trademark for SFK Hybrid fiber
2009	March	Started exporting to Japan
	April	Hybrid fiber development seminar
	May	Steel fiber reinforced SOG development seminar
2010	June	Obtained CE certification
	July	Obtained ISO 9001 certification
	August	Conducted refractory test on prototype of hybrid fiber reinforced segment
2011	December	Merge of Steel Fiber Korea to KOSTEEL
2012	June	Obtained CE certification with grade "R"
2013	October	Development of Steel fiber reinforced concrete slab on grade design program (SFEED-PRO)
2014	January	Participated World of Concrete (Las vegas, USA)
2015	February	Participated World of Concrete (Las vegas, USA)
	May	Obtained ISO 9001 certification
		Participated World Tunnel Congress (Dubrovnik, Croatia)

Through continuous research and development, KOSTEEL has been upgrading its technology and techniques for steel fiber.
Our goal is to provide satisfaction and trust to our customers by producing best quality steel fiber through our top-notch steel wire techniques.
We will keep trying our best to develop new technologies to be the top steel fiber manufacturing company in the world.



	Registration Number	Registration Date	Title
PATENT	0442415	2004/07/20	Glue device of a rigid and ductile wire for the reinforcement of concrete
	0445533	2004/08/12	Cold and warm air circulator for a manufacturing of a rigid and ductile wire
	0471675	2002/03/22	Manufacture of a rigid and ductile wire for the reinforcement of concrete
	10-0558282	2006/02/28	Adhesives for steel fiber and manufacture method
UTILITY MODEL	0306696	2002/11/26	A auto supply apparatus of steel fiber
	0360213	2004/04/26	Bobbin apparatus for supplying wire
	0355146	2004/04/09	Assembly type of capstan in wire drawing machine
	0355148	2004/04/09	Dies unit wire drawing machine
	0394571	2005/06/01	Guide device for removal of steel wire
	20-0413920	2006/01/17	A supply apparatus steel fiber
DESIGN	0296619	2001/07/23	Concrete reinforced steel fiber
	0322613	2002/04/13	Concrete reinforced steel fiber
NAME	0587731	2003/02/20	**BUNDREX®**
	0008702	2002/04/11	Steel Fiber Korea
DESIGN REGISTRATION	30-0412891	2005/05/31	Steel fiber guide apparatus

BUNDREX®

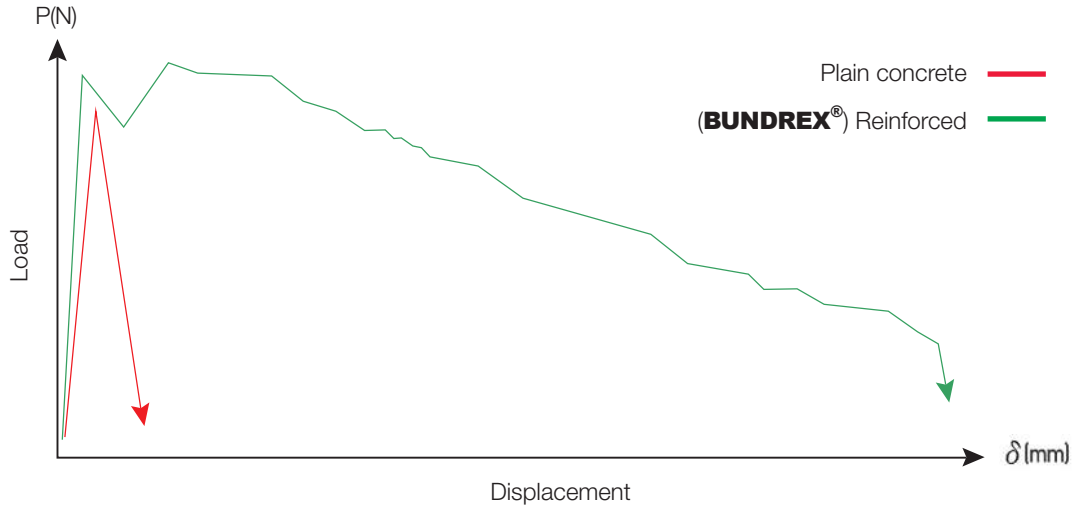
BUNDREX®, KOSTEEL's steel fiber produced by best drawing process is ideal for concrete reinforcement.

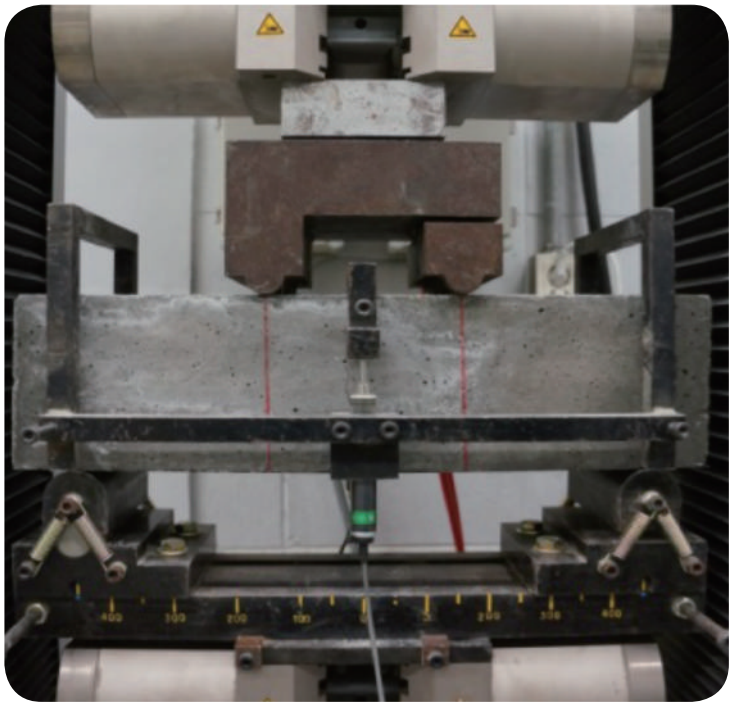
BUNDREX® is widely used in shotcrete, floor slab and precast areas as substitute for rebar or wire-mesh and also have several examples of its use in structures.

Characteristics of BUNDREX® reinforced concrete

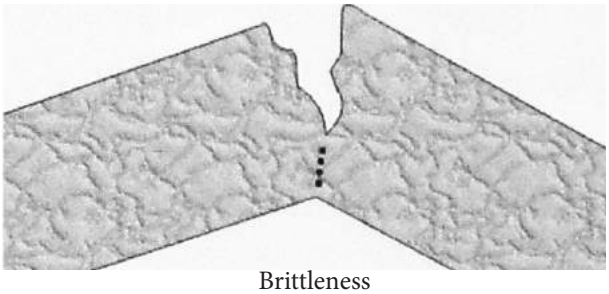
- **Increase** flexural toughness, shear, impact, fracture, fatigue resistance and flexibility of concrete
- **Suppress** drying shrinkage and plastic shrinkage cracking of concrete
- **Minimize maintenance cost** by improving abrasion, erosion and durability of concrete
- **Reduce thickness of concrete** by improving physical properties of concrete
- **Improve physical cohesion** of concrete by uniform dispersion of steel fiber
- **Increase safety** by multi-dimensional reinf orcement effect in concrete
- **Improve economical efficiency and workability** by elimination of wire-mesh or rebar installation

Physical Property Change of **BUNDREX®** Reinforced Concrete

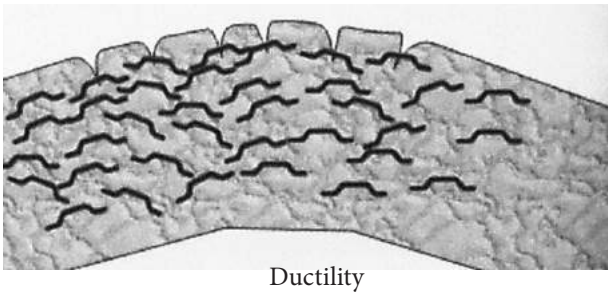




Beam Test



Brittleness

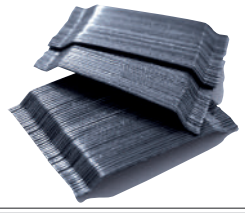


Ductility

Physical Properties of Concrete	**BUNDREX®** Performance
Modulus of Rupture	Increase up to 3 times
Shear Strength	Increase up to 2 times
Torsional Strength	Increase up to 2 times
Fatigue Resistance	Increase up to 1.8 times
Abrasion and Corrosion	Increase up to 1.4 times
Impact Absorption	Increase up to 15 times

BUNDREX® PRODUCT LINE-UP

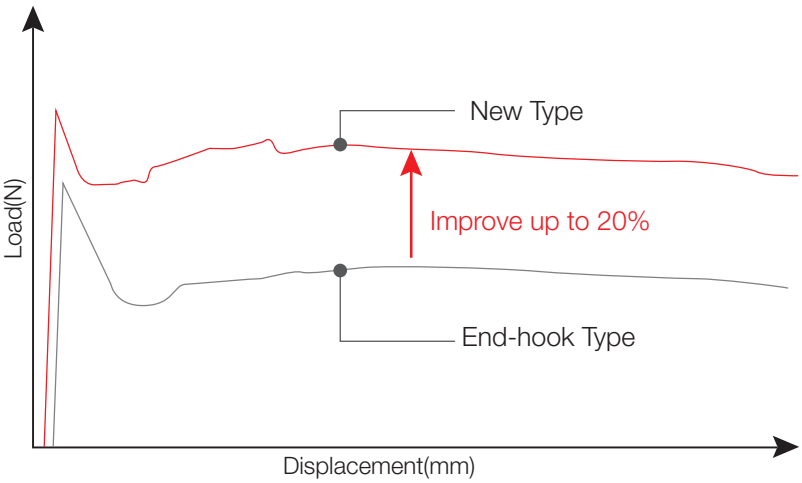
BUNDREX®

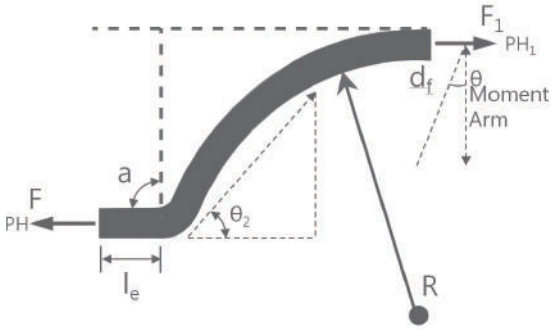


Product Code	D (mm)	L (mm)	L/D
KF 60/30 CH	0.50	30	60
KF 65/35 CH	0.55	35	64
KF 50/30 CH	0.60	30	50
KF 71/50 CH	0.70	50	71
KF 80/60 CH	0.75	60	80
KF 67/60 CH	0.90	60	67

- Tensile Strength : 900 ~ 2,200 MPa
- Customized products are available upon request

Optimum formation maximizes the performance of steel fiber in concrete through the technology of micro-mechanics





- Patent application No. : 10-2014-0127460

Product Code	D (mm)	L (mm)	Aspect Ratio	R (mm)
Arched 73/55 High	0.75	55	73	35

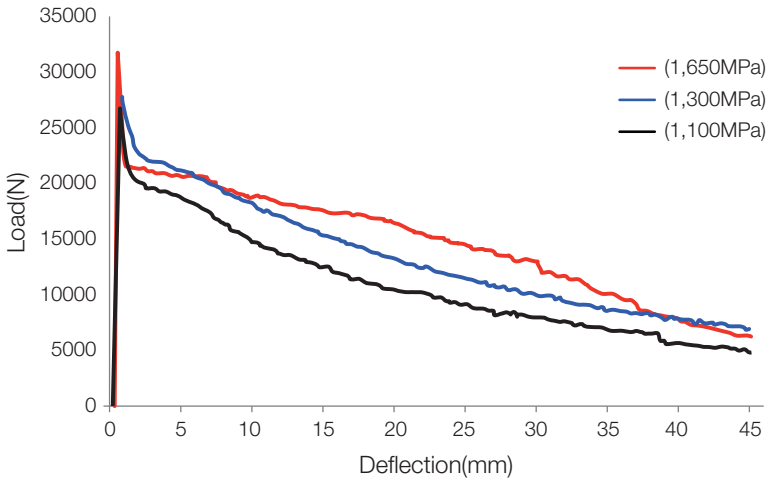
BUNDREX® High Strength Steel Fiber

Product Code	D (mm)	L (mm)	Aspect Ratio	T/S (MPa)
KF 66/35 Ultra	0.55	35	64	1,650
KF 80/60 High	0.75	60	80	1,500
KF 67/60 Ultra	0.90	60	67	1,800
KF 67/60 Super	0.90	60	67	2,100

Product Code	D (mm)	L (mm)	Aspect Ratio	R (mm)	T/S (MPa)
Arched 73/55 High	0.75	55	73	35	1,350

KF 66/35 Ultra

Load-Deflection Curve(Round Panel)



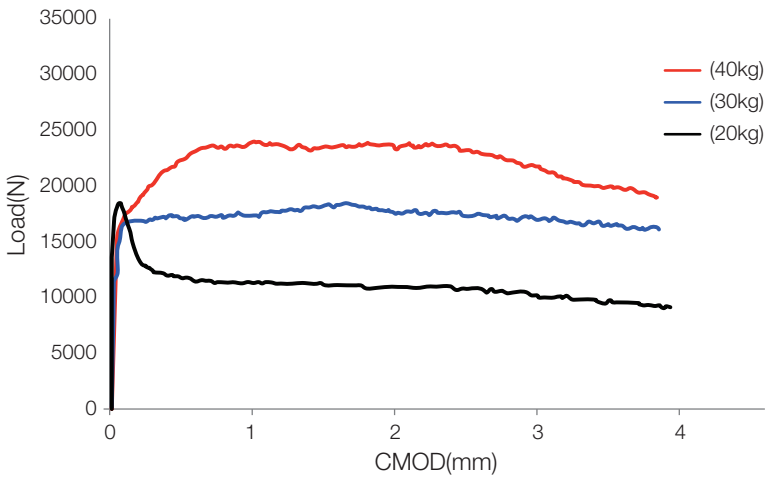
Round Panel Test(ASTM C 1550-05)

Dosage : 40 Kg/m^3

Test Result	Energy Absorption (Joule)
(1,650MPa)	625.46
(1,300MPa)	565.17
(1,100MPa)	465.96

KF 80/60 High

Load-CMOD Curve(Notched-Beam)

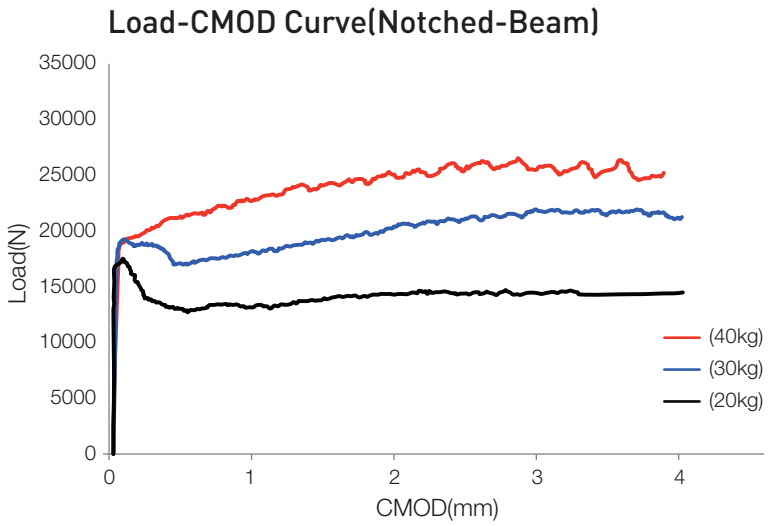


CMOD Beam Test (EN 14651:2005)

Tensile Strength: 1,500 MPa

Test Result	Residual Flexural Tensile Strength (MPa)			
	f_R1	f_R2	f_R3	f_R4
(40kg)	6.74	7.13	6.97	6.04
(30kg)	5.21	5.55	5.25	5.00
(20kg)	3.55	3.38	3.23	2.90

KF 67/60 Ultra

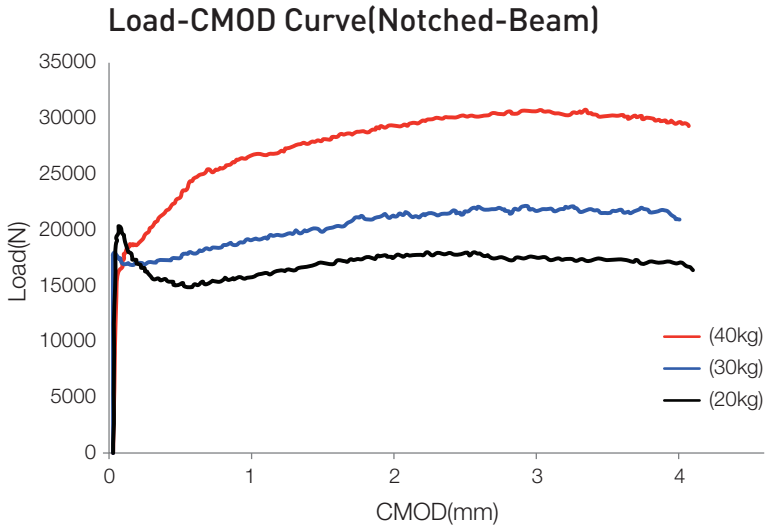


CMOD Beam Test(EN 14651:2005)

Tensile Strength: 1,800 MPa

Test Result	Residual Flexural Tensile Strength (MPa)			
	f_R1	f_R2	f_R3	f_R4
(40kg)	6.49	7.38	7.79	7.80
(30kg)	5.18	5.86	6.42	6.58
(20kg)	4.00	4.31	4.48	4.46

KF 67/60 Super

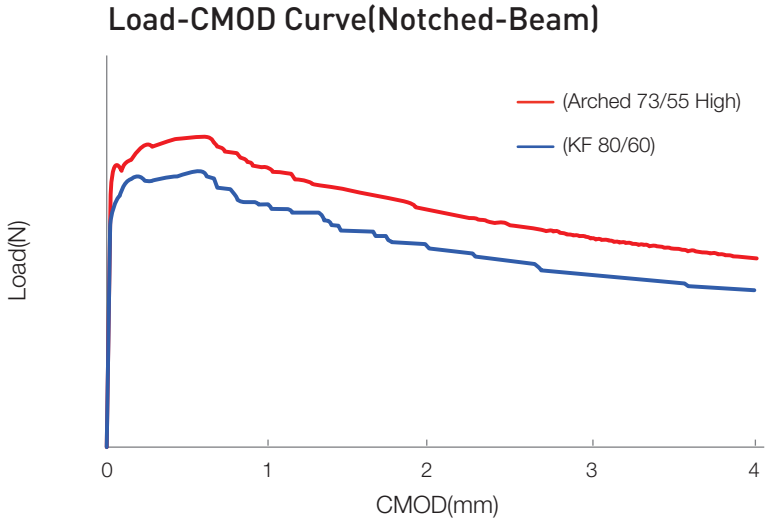


CMOD Beam Test(EN 14651:2005)

Tensile Strength: 2,100 MPa

Test Result	Residual Flexural Tensile Strength (MPa)			
	f_R1	f_R2	f_R3	f_R4
(40kg)	7.19	8.74	9.35	9.35
(30kg)	5.49	6.28	6.81	6.80
(20kg)	4.77	5.38	5.66	5.50

Arched 73/55 High



CMOD Beam Test(EN 14651:2005)

Tensile Strength: 1,350 MPa

Dosage: 40 kg/m^3

Test Result	Residual Flexural Tensile Strength (MPa)			
	f_R1	f_R2	f_R3	f_R4
	0.5mm	1.5mm	2.5mm	3.5mm
Improvement(%)	13.16	18.86	18.97	21.86

BUNDREX® Synthetic Fiber

KSF-100MA

Synthetic Macro Reinforcing Fiber

100% virgin polypropylene (homopolymer/monofilament)

Benefits

- Increases flexural toughness
- Improves impact resistance
- Reduces dry shrinkage cracking

Application

- Industrial floor, mining, tunnel lining, slope or ground stabilization

KSF-100MI

Synthetic Micro Reinforcing Fiber

100% virgin polypropylene (homopolymer/multifilament)

Benefits

- Reduces plastic shrinkage cracking
- Improves resistance explosive spalling
- Reduces permeability

Application

- Tunnel lining, precast concrete, curbs, metal decks, indoor/outdoor floors

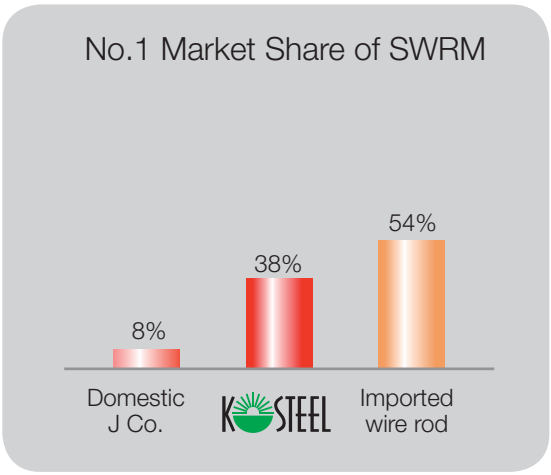
STRENGTH OF **BUNDREX®**

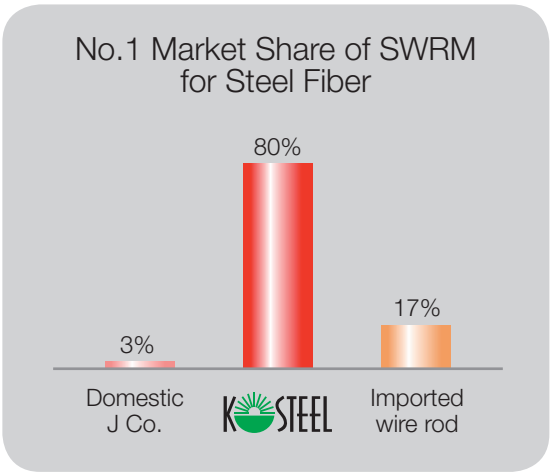
We are the biggest manufacturer of steel wire rod in Korea which is the main raw material of steel fiber.
By manufacturing specialized wire rod designed for steel fiber, we can produce high quality product with competitive price.
We integrate the production from wire rod to steel fiber in-house which makes us the most competitive steel fiber supplier.

In-house Production Integration from wire rod to steel fiber

Wire Rod

Steel wire rod mild Market in Korea

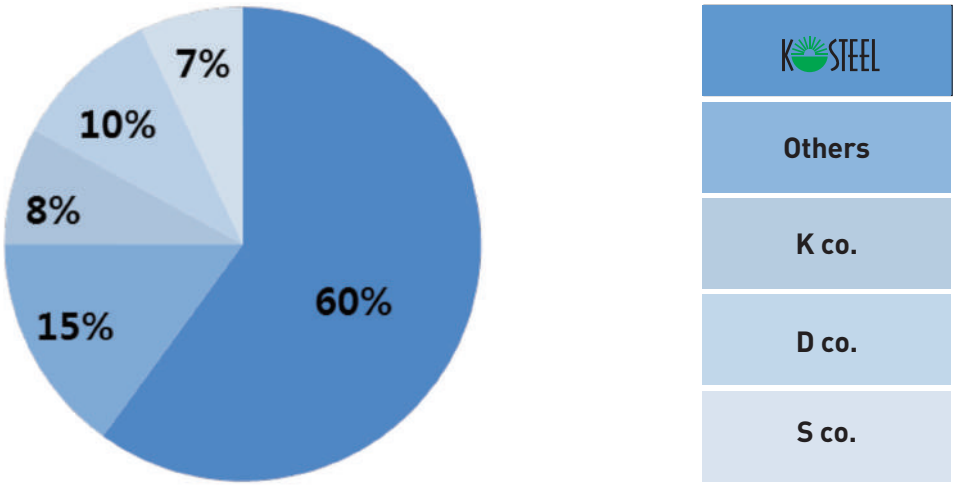




*SWRM: Steel Wire Rod Mild

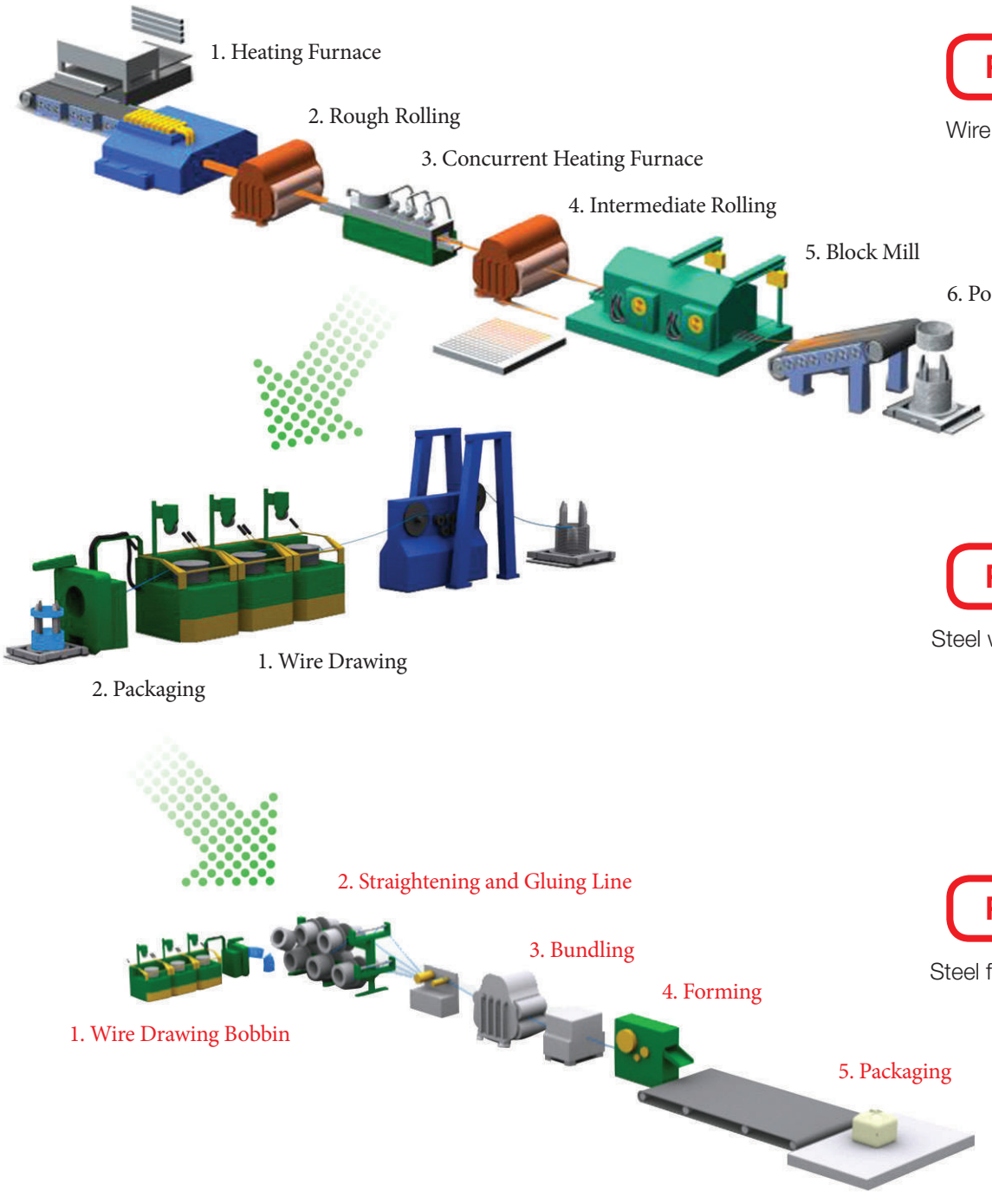
Steel Fiber

Steel fiber Market share in Korea



PRODUCTION PROCESS

Due to integrated process from raw material to steel fiber, **BUNDREX®** is favored by steel fiber users for our technical strength and cost competitiveness.



Process 1

Wire rod (Φ 6.5~5.5mm)

Process 2

Steel wire (Φ 2.3~2.2mm)

Process 3

Steel fiber (Φ 0.9~0.5mm)

Product Certifications

USA EUROPE JAPAN ISO KOREA

APPLICATION : SHOTCRETE

Advantages of SFRS (Steel Fiber Reinforced Shotcrete) for Tunnel

- **Reduces thickness of wall**
- Reduces risk of cave-in accidents due to fast workability after excavation
- **Less labor** is required
- **Less construction time** is required

Steel fiber vs.
Traditional Wire-mesh

Advantages of BUNDREX® SFRS

- Numerous number of construction experiences **(over 100 on-going construction sites as of end of 2014)**
- Provides **optimum solution** for each construction site based on professional work forces and experience
- Responds with optimum solution by carrying **full product line-up** for shotcrete application



Product Line-up for Shotcrete

Product Code	D (mm)	L (mm)	Aspect Ratio
KF 60/30 CH	0.50	30	60
KF 65/35 CH	0.55	35	65
KF 50/30 CH	0.60	30	50

Tensile Strength : 900 MPa ~ 1,650 MPa

Completed Projects

Clients	Construction Sites
Korea Expressway	Daejeon-Dangjin Expressway
Korea Railway	Middle-Line
K-Water	Shihwa dam
Korea Electric Power	Chungsong dam
Seoul Metropolitan Gov.	Seoul-Metro 7 line (702)
Nippon Expressway (Japan)	Minoh Project
Ministry of Land, Infrastructure, Transport & Tourism (Japan)	Yujawa city rock-support project

Other Application of SFRS


Emergency Gallery


Slope Stabilization


Ground & Rock Support


Water Tunnel

Seocheon Tunnel

Yeongam Tunnel No. 1

Gochang Tunnel

Kangjin Tunnel

Gochang Tunnel No. 1

Nokmun Tunnel

Munju Tunnel

Osan Tunnel

Ojeong Tunnel

Chimgok Tunnel

Yulchi Tunnel

Jeongok Tunnel No. 2

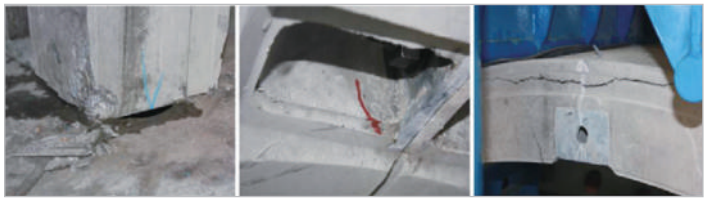
APPLICATION : PRECAST

Advantages of SFRC (Steel Fiber Reinforced Concrete) for Precast

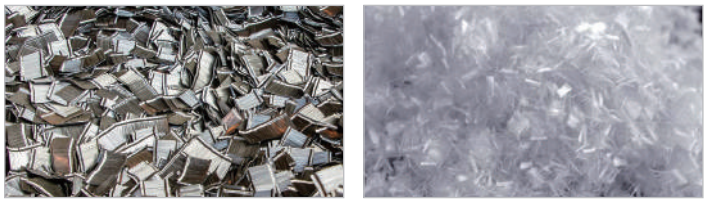
- **Improves productivity by reducing part/all of rebar**
  - **Reduces time, space and labor** used for installing rebar
  - Gives effects of smooth dispersion of concrete and **multi-directional reinforcement** of steel fiber
- **Increases crack control, impact resistance and durability**
  - **Increases crack control** by even dispersion of steel fiber within concrete
  - **Reduces crack or breakage** of joint between the segments cause by jack thrust
- **Secures refractory performance by combining with synthetic fiber**
  - **Prevents spalling** of high-strength concrete
  - **Increases residual strength** after fire exposure
- **Increases economic efficiency**
  - **Reduces cost of material and labor** to install rebar
  - **Reduces maintenance cost** by better durability

Rebar reinforced segment cage

Steel fiber reinforced segment cage



Cracks and damages of rebar reinforced segment



Hybrid fiber products (steel fiber + synthetic fiber)

Advantages of BUNDREX® SFRC

- **SFEED-PRO**
  - Steel Fiber Enhanced Engineering Design PROgram for Precast Segment
  - Independently developed design program for SFEED-PRO provides optimum solution with safety for Precast Segment application

SFEED PRO

Steel Fiber Enhanced Engineering Design PROgram

Product Line-up for Precast

Product Code	D(mm)	L(mm)	Aspect Ratio
KF 80/60 CH	0.75	60	80
KF 67/60 CH	0.90	60	67

- Tensile Strength : 900 MPa ~ 2,200 MPa

Completed Projects

Clients	Construction Sites
Tokyo Expressway	Yokohama Circle North Line
Hanshin Expressway	Yamato River Shield Tunnel
TEPCO(Tokyo ElectricPower Corporation)	Oi/Ariake Shield Tunnel
Japan Sewage Works Agency	Toyama Shield Tunnel
KEPCO(korea Electric Power Corporation)	Power Line Shield Tunnel

Other Application of SFRC Precast

Waterway Culvert

Railroad Sleeper

Tunnel Lining Support

Residential

Segment at Curing Stage

Segment Delivery

Precast Segments for Tunnel

Precast Segment

Precast Segments for Tunnel

Shield Tunnel

APPLICATION : FLOORING

Advantages of SFRC (Steel Fiber Reinforced Concrete) for Flooring

- **Reduces construction time** with outstanding constructability
- Increases load dispersion & surface strength with 3-dimensional reinforcement (reduces thickness of concrete slab)
- **Increases cracking resistance, shock resistance and abrasion**
- **Increases life cycle of structure**

Steel fiber vs. Traditional rebar or Wire-mesh

Advantages of **BUNDREX®** SFRC

- **SFEED-PRO**
  - Steel Fiber Enhanced Engineering Design PROgram for SOG
  - Independently developed design program for SFEED-PRO provides optimum solution for SOG application

SFEED PRO
Steel Fiber Enhanced Engineering Design PROgram

Newly Launched Product

- **Improve 10~20% of overall performance** compared with usual type
- Provide **high quality product** for SOG & SOP application

Product Line-up for Flooring

Product Code	D(mm)	L(mm)	Aspect Ratio
KF 71/50 CH	0.70	50	71
KF 80/60 CH	0.75	60	80
KF 67/60 CH	0.90	60	67
Arched 73/55 High	0.75	55	73

- Tensile Strength : 900 MPa ~ 2,200 MPa

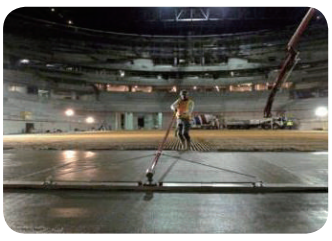
Completed Projects

- **Solar Power Station (20-megawatt)**
  - Project: Solar power station on Samsung-Renault Motors- Busan factory (The world's biggest of its kind built at a factory site)
  - Site size: 260,000 m^2
  - Period: August~November, 2013
  - Dosage: **BUNDREX®** KF 80/60 CH (0.75x60mm), 700 MT
- **Office Depot Distribution Center**
  - Project: Office Depot Distr. Center near Bogota, Colombia
  - Site size: 20,000 m^2
  - Period: July~October, 2013
  - Dosage: **BUNDREX®** KF 80/60 CH (0.75x60mm), 60 MT

Other Application of SFRC Flooring

Warehouse

Container Yard



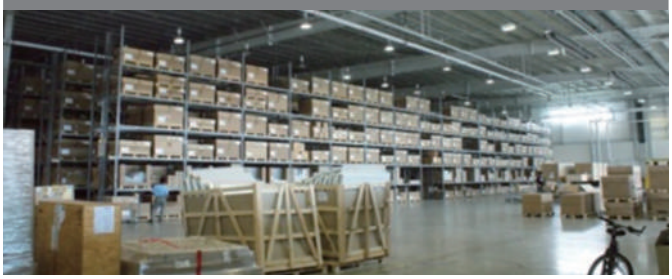
Arena

Taxiway

Factory

- Applied Load : Machinery, Forklift
- Concrete Strength : 21~30 MPa
- Slab Thickness : 180mm~300mm
- Dosage : 15~20 kg/m^3

Warehouse

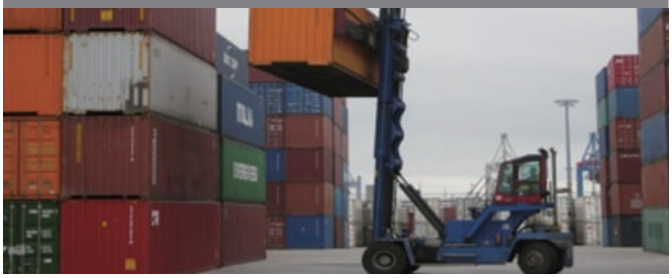


- Applied Load : Rack, Mezzanine, Truck, Forklift
- Concrete Strength : 24~33 MPa
- Slab Thickness : 200mm~300mm
- Dosage : 20~30 kg/m^3

Gas Station

- Applied Load : Car, Fuel Truck
- Concrete Strength : 18~24 MPa
- Slab Thickness : 150mm~200mm
- Dosage : 10~15 kg/m^3

Container Yard



- Applied Load : Uniform, Truck, Forklift, Crane
- Concrete Strength : 24~40 MPa
- Slab Thickness : 300mm~500mm
- Dosage : 30~40 kg/m^3

Residential Slab

- Applied Load : Dry Shrinkage and Plastic Shrinkage Stress
- Concrete Strength : 18~21 MPa
- Slab Thickness : 150mm~200mm
- Dosage : 10 kg/m^3

Taxiway

- Applied Load : Airplane, Truck
- Concrete Strength : 27~35 MPa
- Slab Thickness : 300mm~400mm
- Dosage : 30~40 kg/m^3

SOG DESIGN SOLUTION BY SFEED-PRO

BUNDREX® Design Program for SOG: SFEED-PRO

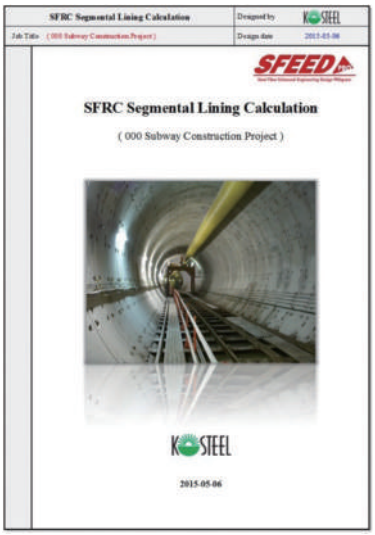
SFEED-PRO is a design program based on UK's Technical Report 34(TR-34), a guide to design and construction of SFRC SOG, which performs simulation of various cases for slab thicknesses, concrete strengths, and size and dosage of steel fiber to provide the safest and most economical solution

Advantages of SFEED-PRO

- Various variable input for specific needs
  - Material (Concrete, Steel fiber)
  - Slab (Region, Thickness)
  - Load (Rack, Mezzanine, Wall, Fork lift, Truck, Uniform)
  - Dowel at the construction joint
  - Safety & Environmental factors
  - Unit cost and others

- Case simulation for various slab thicknesses and concrete strengths
- Safety verification and economic analysis for each simulation cases

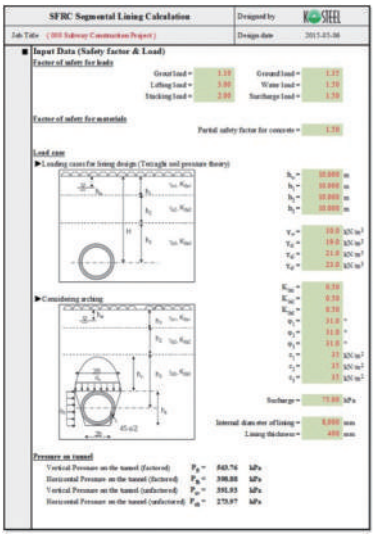
BUNDREX® Design Program for Precast Segment: SFEED-PRO



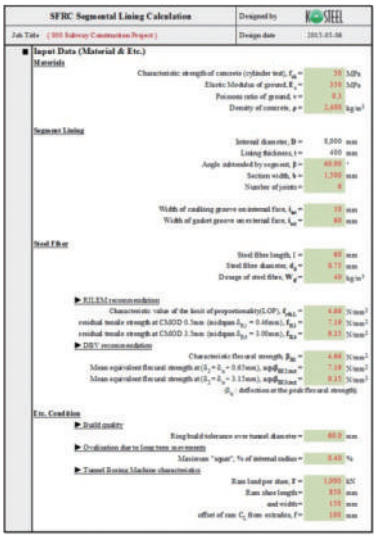
SFEED-PRO also can calculate the SFRC segment based on RILEM & DBV recommendations. According to various input datum such as load, material and steel fiber reinforced conditions, this program can check the safety of SFRC segment

- **Recommendation**
  - **RILEM TC 162-TDF** : Test and design methods for steel fibre reinforced concrete
  - **DBV-Merkblatt** : Guideline for steel fiber reinforcement in tunnel linings

Input Values for SFRC Segment Design

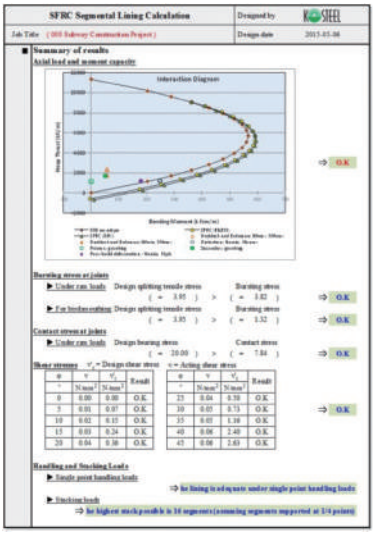


- **Safety factor & Load condition**
  - → Safety factor for load
  - → Safety factor for material
  - → Load condition



- **Material & Etc. condition**
  - Concrete & ground ←
  - Segment lining dimension ←
  - SFRC performance (CMOD) ←
  - TBM characteristic ←

Output Result of SFEED-PRO



Check

- **Axial load and moment capacity**
- **Bursting stress at joints**
- **Contact stress at joints**
- **Shear stresses**
- **Handling load**
- **Stacking load**

KOSTEEL'S BUSINESS

Kosteel is established in 1977

Head Office (Seoul)

- Strategic planning, Marketing, Domestic & overseas sales, HRM, Accounting, Finance, IT, and Sales support, etc.
- No. of employees : 80

Pohang Plant 1

- Product : **Wire-Rod**
- Production : **420,000 MT/year**

Pohang Plant 2

- Product : **Annealed Wire, Nails, Flat Coil**
- Production : **130,000 MT/year**

Eumseong Plant 3

- Product : **Deck-Plate**
- Production : **2,400,000 m^2/year (25.8 million ft^2/year)**

Gwangju Plant 4

- Product : **Steel Fiber**
- Production : **50,000 MT/year**

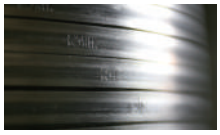
Wire Rod

Low carbon steel wire rod is **KOSTEEL's main product** which is used in various ways from common households to industries and construction.

In addition, we have developed **low carbon steel wire rod** specially for steel fiber that can be drawn up to 0.4 mm.

This is why many of our customers prefer to use our steel fiber products.

Application


Flat coil


Steel Fiber

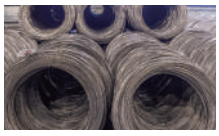

Stationery


Steel Wire Crafts


Hanger


Bolts


Round Wire Nail


Annealed Wire


Binding Wire


Deck Plate

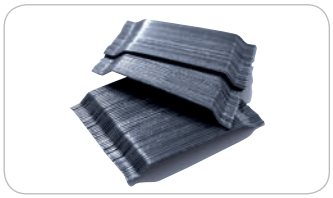

Coated Wire for Packaging


Low Carbon Steel Wire

Code	Chimical Composition (%)					Tensile Strength (N/mm^2)
	C	Si	Mn	P	S	
SWRM 6A	0.01 >	0.05 >	0.20 >	0.030 >	0.015 >	271.3
SWRM 6M	0.011~0.03	0.03 >	0.101~0.25	0.030 >	0.030 >	326.1
SWRM 6L	0.041~0.05	0.04 >	0.30 >	0.030 >	0.030 >	350.4
SWRM 8A	0.051~0.07	0.04 >	0.201~0.40	0.030 >	0.030 >	382.8
SWRM 12L	0.071~0.15	0.05 >	0.301~0.60	0.040 >	0.040>	436.5
SWRM 17L	0.151~0.18	0.05 >	0.601~0.90	0.045 >	0.045 >	472.6
SWRM 20L	0.181~0.23	0.05 >	0.601~1.20	0.045 >	0.045 >	501.1

Other Products

KOSTEEL also produces application products with our own wire rod.

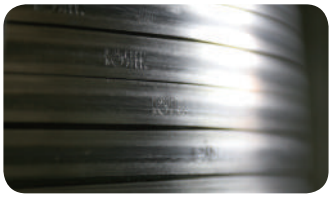

Steel Fiber


Deck Plate


Nails


Rebar


Cold-drawn Steel Wire


Flat Coil


Deformed Steel Wire


Annealed Wire

Head office (International Business)
4F Haustory, 122 Sagajeong-ro, Dongdaemun-gu, Seoul, Korea
Tel: +82 2 2106 0135, Fax: +82 2 2106 0240
E-mail : steelfiber@kosteel.co.kr
Homepage : www.kosteel.co.kr

Factory
669-2, Yong-dong, Gwangsan-gu, Gwangju, Korea
Tel: +82 62 944 3771, Fax: +82 62 944 3770