

| Leading Enterprise of Railroad Culture |

CHUNWOON RAILROAD



 Chunwoon Railroad Co., Ltd.

Introduction of Company



02



CEO Kang-Hoon

(Chairman of Railroad & Track Works Council in Korea Professional Construction Association)

Chunwon Railroad has become third best company in Railroad and Track Industry in Korea since its first railroad track construction in April 1996, in spite of a short company history. This success has been possible because of the company's clear objective and strong philosophy. Chunwon Railroad has always strived to execute railroad and track construction projects ensuring quality, safety, and transparency as top priorities. Kang Hoon, a founder and CEO, always emphasizes that we must perform railroad and track construction projects as efficiently and precisely as possible because railroads are most used public transportation method that directly influences on people's lives. For achieving better performance and enhancing working capacity, Chunwon Railroad has also provided employees safe and pleasant working environments.

Through promoting the company's objective and philosophy, Chunwon Railroad has been contributing to the public providing reliable public transportation system as well as to national economic growths performing as a responsible taxpayer since its foundation.

In order to provide top quality services to clients, Chunwon Railroad has constantly been making efforts and improvements in internalizing existing technologies and developing new technologies.

Therefore, Chunwon Railroad has successfully performed over many railroad and track construction projects, applying top lines of technologies.

After the Technology Agreement regarding ZUBLIN high-speed rail construction, and the Technology Agreement with TOTEUT, Japanese Construction Company in 1999, Chunwon Railroad could develop the utility model on "Track Vibration Absorber" and could apply to the construction project for Youngdong maintenance depot of Kyungbu high-speed railroad in 2001.

Also, Chunwon Railroad perfectly performed light-structure track construction projects for the Korean Light Rail Transit such as Kyungchun Subway Line and Busan Subway Line 3, using the rubber-wheeled "AGT (Automated Guideway Transit)" system. "Method for constructing paved concrete track by using high-flowability and high-early-strength mortar" was designated as an official new technology in 2009. As these achievements and contributions to Korean Railroad development have been recognized, Chunwon Railroad received awards from Korean governmental organizations including Ministry of Construction and Transportation and Ministry of Land, Transport, and Maritime Affairs.

Chunwon Railroad strongly believes that investing on research and development for innovative technologies ultimately maximize company's future value. In 2012, Chunwon Railroad opened its own technology research center to constantly enhance its technological power at work sites.

As a result, Chunwon has already obtained 14 patents related to rubber-wheeled AGT system. In January 2013, "Method for constructing a railroad by using a guideway for a rubber-wheeled automated guideway transit system" was officially designated as a new transport technology by Korean government.

Most recently, for the first time in the world, Chunwon Railroad has introduced an innovative track construction technology, "3D curved precast slab track", which can take care of sharp-curved area and underground section of railroad. With this technology, Chunwon Railroad can perform any track construction project with its own technology independently.

Brief history

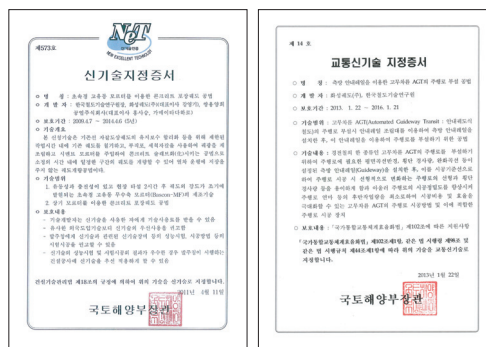
- 1996. 5 Acquired Railroad Construction Licence(Daegu Line 15-3)
- 1999. 9 Establishment of Domestic and Foreign Corporation by Chunwon Railroad co.,Ltd.
- 1999. 10 Technology Agreement on ZUBLIN rapid-transit railroad and railroad construction
- 1999. 12 Technology Agreement with japanese TOTEUT Construction Company
- 2000. 12 M&A of Chunil Co.,Ltd. by Chunwon Railroad Co.,Ltd.
- 2005. 3 Citation by Commissioner of Deagu Regional Tax Office.
- 2005. 11 Citation by Minister of Construction and Transportation
- 2007. 8 M&A of Jooham Industry Co.,Ltd. by Chunwon Railroad Co.,Ltd.
- 2009. 9 Citation by Minister of Land, Transport and Maritime Affairs
- 2011. 3 Awarded by Commissioner of Eastern Daegu Tax Office
- 2011. 3 Awarded by Minister of Land, Transport and Maritime Affairs

Certificate

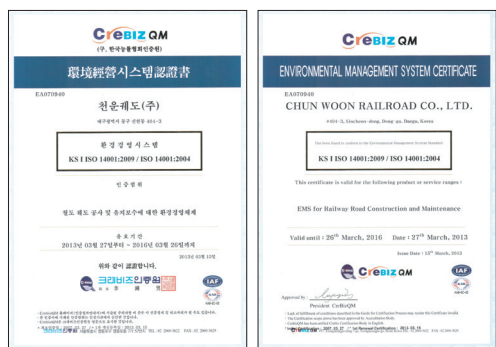
ISO Quality Management System Standard



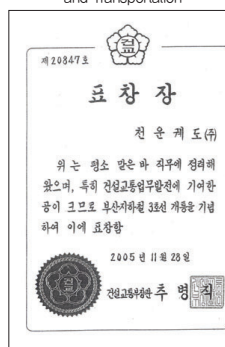
New Excellent Technology



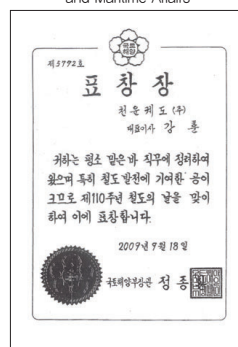
ISO Environmental Management System Standard



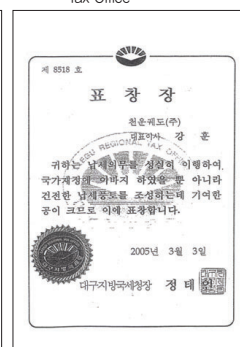
Citation—Ministry of Construction and Transportation



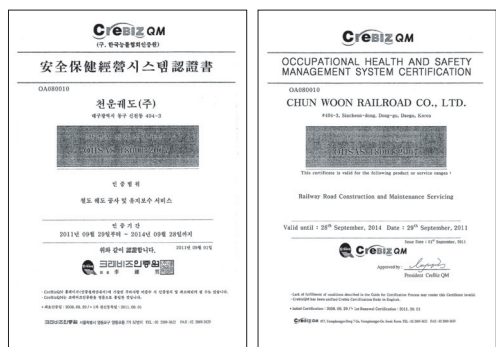
Citation—Ministry of Land, Transport and Maritime Affairs



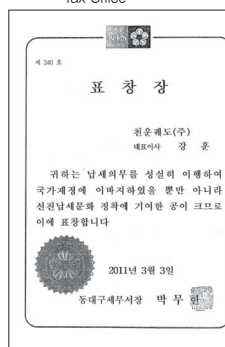
Citation—Daegu Regional Tax Office



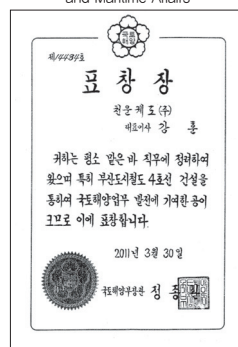
ISO Occupational Health & Safety Management System Standard



Citation—Eastern Daegu Tax Office



Citation—Ministry of Land, Transport and Maritime Affairs

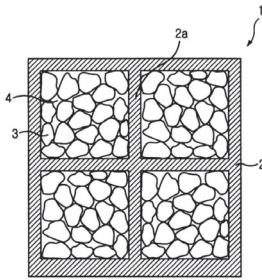




Utility New Idea

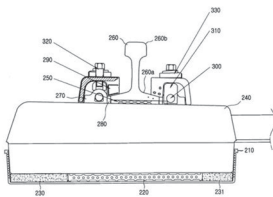
Sound Absorption Block

- ① The Track Sound Absorption Block, 'Field of Technical Art', written on the claim
- ② Technical Substance the Invention Tries to Solve – The invention has its purpose to provide the track sound absorption block that reliably absorbs the vicious noise from the vehicle itself and friction between wheel and rail through integrating recyclable rubber from wasted tire, gravel, or hard slag which has excellent ability on buffer and sound absorption with the railroad or the substructure of rail on the subway section.
- ③ Substance of Solution from the Invention – The invention is being installed on the both sides of track which creates fixed storage space inside. Sound absorption material storage box is formed with many drainage holes on the bottom; is inherent in the above sound absorption material storage box, and is a sound absorbing material which absorbs the noise transferred from the track with fixed size gap; is a supporting method to attach it to the roadbed while equipped on the bottom of above sound absorbing material storage box; is being installed on the substructure of rail on above track, and it is a rail sound absorption method to absorb the vibration from above track; as well as it provides the track absorption block covering the sleeper sound absorption method to absorb the vibration transferred to it while installed on the outside of sleeper which supports above track.
- ④ Major Use of the Invention – The invention is being installed on the bottom of roadbed to reduce noise and vibration transferred from upper structure.



Vibration Absorber

This invention is in regard to the track vibration absorber which increases the vibration absorption and minimizes the track destruction through absorbing the impact load from each direction effectively by installation of sleeper and roadbed concrete facility in unfixed way while using the existing sleeper and roadbed concrete facility. It is being inserted between the inside bottom of vibration absorber box equipped on the roadbed concrete and bottom of sleeper block, it is formed with elastic material, and it is the first load absorption method which is being transformed through absorbing the vertical directional load transferred from the sleeper block; it is being inserted between top of the sleeper block and bottom of the rail, it is formed with elastic material, and it is the second load absorption method which is being transformed through absorbing the vertical directional load transferred from the rail; it is being inserted between both ends of horizontal extension part on the substructure of rail and each clip holder, it is formed with elastic material, and it is the third load absorption method which is being transformed through absorbing the horizontal load transferred from the rail; The bottom of one side is attached with the top of above sleeper block, and the bottom of block is combined with the above clip holder to pressurize the top of horizontal extension of rail for supporting the rail; It is a rail supporting method and formed with elastic material to displace the rail to vertical and horizontal directions from the vertical and horizontal directional load of railroading; as well as it provides the track vibration absorber including combination method to combine above rail supporting method with the clip holder, and it is used for reducing vibration and noise from the track.



〈No. 14〉 New Transport Technology

Method for constructing a railroad by using a guideway for a rubber-wheeled automated guideway transit system

- Inventors: Korean Railroad Technology Institute, Hwasung Railroad Co., Ltd (Chunwoon Railroad Co., Ltd is a subsidiary of Hwasung Railroad Co., Ltd.)
- Address: 374-1, Wolam-dong, Uiwang-si, Gyunggi-do (Tel. 031-460-5326)
482-33, Yachonri, Gayagok-myeon, Nonsan-si, Choongchungnam-do (Tel. 041-742-5037)
- Protection period: 2013. 1. ○○ ~ 20○○. ○○. ○○ (○ years)

1. Description of the new transport technology

(1) Brief description

(a) The present technology relates to a method for constructing a railroad for a rubber-wheeled automated guideway transit (AGT) system by using lateral guideway preinstalled by using a guideway-assembling device.

(b) The present technology relates to a method and apparatus for constructing a railroad for a rubber-wheeled automated guideway transit system by installing and using a guideway with predetermined plane curve radius, amount of cross gradients, and transition curves before constructing a driveway, which results in minimizing construction costs and maximizing construction efficiency by eliminating post processes such as a grinding process and the like and improving construction precision by using the guideway as a standard to construct a railroad that linearly varies.

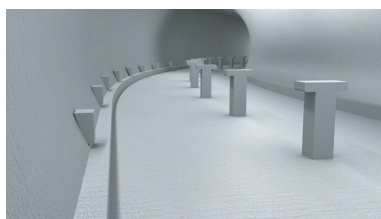
(2) Principle and Construction Method

(a) Principle

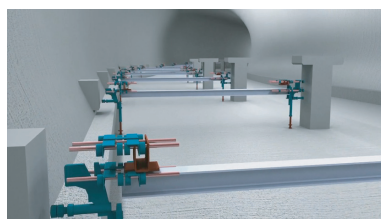
Acknowledging that a guideway and a driveway are aligned each other, a railroad should have the same trace as the guideway in terms of horizontal alignment, longitudinal alignment, and amount of cross gradients. The railroad is constructed by moving a finisher along the guideway to form top surface of a concrete driveway based on predetermined horizontal alignment, longitudinal alignment, amount of cross gradients of the preinstalled guideway.

(b) Construction method

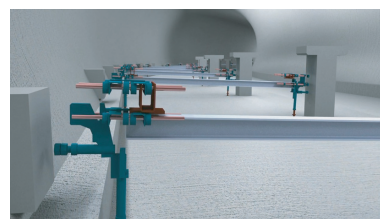
The method for constructing a railroad for a rubber-wheeled AGT system, comprising: installing guideway assembling devices; constructing a guideway after measuring the horizontal alignment and amount of cross gradients by using the guideway assembling device; arranging steel bars at a precise place where the railroad will be formed; installing molds around the arranged steel bars; pouring concrete into the molds; forming the driveway by moving a finisher along the guideway to form top surface of the concrete driveway in accordance with the guideway; measuring flatness test after the concrete is flattened; and polishing the concrete driveway based on the flatness data.



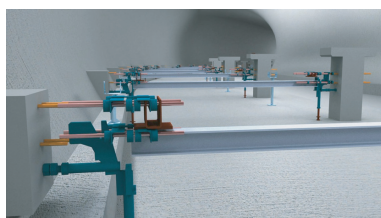
Tunnel



Installing guideway assembling device



Measuring horizontal alignment and amount of cross gradients



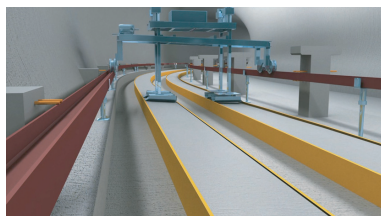
Attaching scaffold & burying bolts



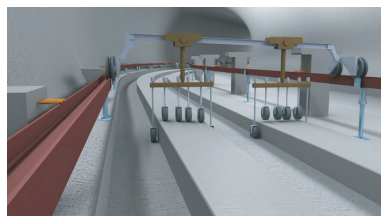
Constructing guideway



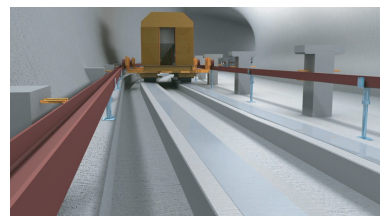
Arranging steel bars and installing molds



Forming concrete driveway



Measuring flatness test



Polishing surface of concrete driveway

2. Use of the new transport technology

(1) Applied construction projects

This method has been developed since 2008 and applied to the below construction projects, resulting in reducing construction costs and maximizing construction efficiency by shortening construction period and improving construction precision. Currently, Busan Subway Line 3 is successfully being operated.

Project	Construction cost	Contractor	Construction Period
Railroad 2nd stage construction & Pillar installation on Busan Subway Line 3, Section 321	1,450,000,000	Daelim Corporation	2009.8~2011.3
Railroad 2nd stage construction & escape way pillar installation on Busan Subway Line 3, Section 322	730,000,000	Daewoo E&C	2009.8~2011.3
Railroad 2nd stage construction on Busan Subway Line 3, Section 4	450,000,000	Samhwan Corporation	2009.8~2011.3
Railroad 2nd stage construction on Busan Subway Line 3, Section 4	110,000,000	Hyeopsung Corporation	2009.8~2011.3

(2) Applicable areas and perspectives on application

A rubber-wheeled AGT system is more capable for curves and steep gradients than a steel-wheeled AGT or magnetic levitation AGT. Thus line of railroad for a rubber-wheeled AGT system is shorter than other types of AGT system. Accordingly, a rubber-wheeled AGT system is often preferred as it reduces construction cost and attracts more passengers who live in curvy urban areas.

Currently, many local governments and railroad companies are strongly interested in adopting a driverless rubber-wheeled AGT system because it is economical and environmentally friendly compared to a conventional subway.

Currently, Seoul (Dongbook Line, Shinlim Line), Gwangmyeong LRT, Choongnam (1st & 2nd stages of Cheonan Line), Busan (Choeup Line between Sasang and Hadan) are considering adopting a rubber-wheeled AGT system. In this case, the present technology will be more practically applied.

3. Technological and economical effects

(1) Technological effects

- ▶ Obtaining technological independence and capability for constructing a rubber wheeled AGT system
- ▶ Capable to export the new method and apparatus for overseas railroad construction projects (e.g., a guideway assembling device, a concrete finisher, a flatness tester, and concrete surface polisher etc.)
- ▶ Applicable for railroad sections under the ground
- ▶ Increasing construction management efficiency by constructing a guideway and a driveway at the same time

(2) Economical effects

- ▶ Reducing about 7% of construction period by constructing a guideway and a driveway at the same time
- ▶ Reducing construction cost, especially when installing molds and planarizing concrete driveway and by using a finisher riding on preinstalled lateral guideway

Work	Apparatus	Amount	Unit	Old Method (a)		New Method (b)		Cost Difference (b-a)
				Unit price	Cost	Unit price	Cost	
Driveway		1	km					-43,678,400
Forming concrete	Finisher+Leveler	2,300	m ²			21,369	49,148,700	49,148,700
Forming concrete	Machine	2,300	m ²	32,191	74,039,300			-74,039,300
Installing molds	Plywood (4 times of use)	600	m ²			28,973	17,383,800	17,383,800
Installing molds	Steel molds	600	m ²	60,286	36,171,600			-36,171,600

〈No. 573〉 New Technology

Method for constructing paved concrete track by using high-flowability and high-early-strength mortar

- Inventors: Korean Railroad Technology Institute, Hwasung Railroad Co., Ltd, and SsangYong Cement (Chunwoon Railroad Co., Ltd is a subsidiary of Hwasung Railroad Co., Ltd.)
- Address: 374-1, Wolam-dong, Uiwang-si, Gyunggi-do
- Protection period: 2009. 4. 7 ~ 2012. 4. 6 (3 years)

1. Description of the new technology

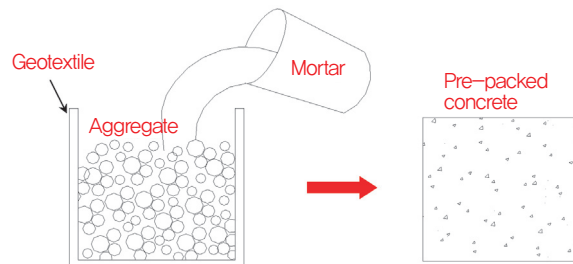
(1) Brief description

- (a) The present technology relates to a method for using mortar that has characteristics including high flowability, recyclability, and high-early-strength (Bacon-MF).
- (b) The present technology relates to a method for constructing paved concrete track by using Bacon-MF.
- (c) The present technology relates to a method for reconstructing track by process of making concrete slab for a purpose of track maintenance within limited working time. The process involves in eliminating ballast track; reconstructing track panel using nonwoven cloth and cleaned ballast; and pouring concrete mortar. The process does not take much time, thereby can avoid interfering train operation.

(2) Principle and construction method

(a) Principle

The method is an application of a pre-packed concrete technique, which involves in making concrete slab by filling layers of ballast with Bacon-MF. Wide sleeper, low elastic fastening, geotextile, and cleaned ballast are used for paved concrete track. The method makes the construction process simple. Thus, maximum 30 meters of track structure can be reconstructed within 3-4 hours, which can avoid interfering train operation.

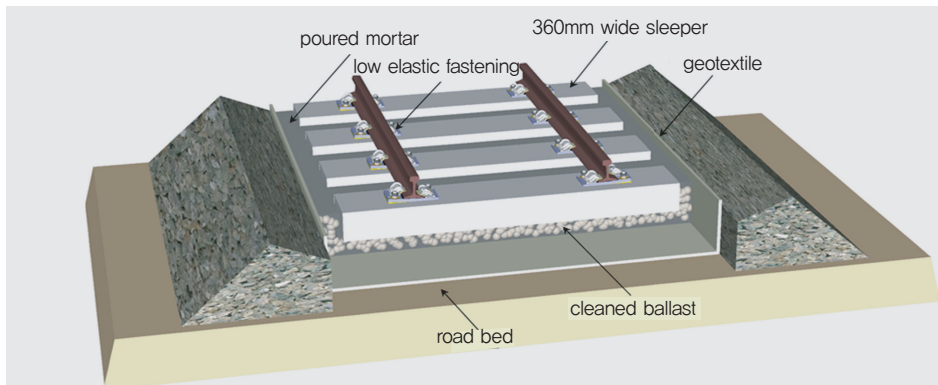


〈Concept of pouring mortar for paved concrete track〉

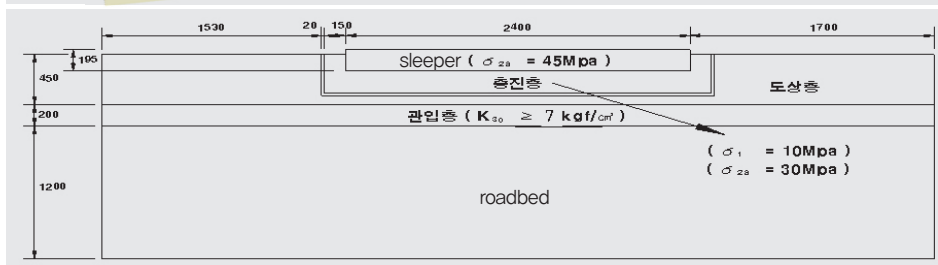
(b) Construction method

The method for constructing paved concrete track, comprising: replacing old ballast and track panel with cleaned ballast and wide sleeper; pouring mortar to fill layers of aggregate wrapped by nonwoven cloth to prevent irregularity of track; using wide sleeper to decentralize ballast pressure; and using adjustable fastening for making maintenance easy. The whole process can be completed during non-traffic hours (2-3 hours per day).

The unique feature of the method is recycling old ballast by using dry-washing technology that has been developed for the first time in the world.



〈Conceptual Diagram〉



〈Roadway digraph for paved concrete track〉

2. Use of the new technology

(1) Applied construction Projects

1. Testing construction for track system development			
Construction Period	2007. 11. 21 ~ 12. 20	Construction Cost	95,000,000원
Organization	Seoul Metro	Department	Railroad & Civil Team
Content	Testing construction for performance evaluation for Seoul Metro Line 1 between Seoul and Namyoung station		
2. Testing construction for track system development			
Construction Period	2007. 5. 29 ~ 5. 30	Construction Cost	31,000,000원
Organization	Busan Transportation Corporation	Department	Civil Team
Content	Testing construction for processing method for paved track		
3. Construction for third rail			
Construction Period	2009. 4. 15 ~ 2009. 7. 14	Construction Cost	498,000,000원
Organization	Korea Rail Network Authority	Department	Track Structure R&D Team
Content	Paved track construction for constructing third rail (410m)		

(2) Applicable areas

- ▶ For more efficient maintenance for old ballast track
- ▶ For difficult sections for reconstructing track structure such as bridge concrete track or nose turnout
- ▶ For sections that are difficult to have long working hours for maintenance

3. Technological and economical effects

(1) Technological effects

- ▶ Obtaining own technological capability for reconstructing ballast track of tunnel section and urban railroad.
- ▶ Promoting use of the new technology for various types of tracks by designation as a new technology by the government.
- ▶ Obtaining technological grounds to expand domestic/overseas track reconstruction markets through making the new method for Korean model of paved track practical
- ▶ Immediately applicable for current or planned projects for reconstructing old ballast track of urban railroad (Gwacheon)

(2) Economical effects

- ▶ Additional source of increasing revenue expanding track reconstruction market
 - Construction cost for paved concrete track: 1,400,000,000 KRW/km
 - Current status of old ballast tracks in Korea: urban railroads (370km), general railroad (1,000km)
 - Reconstruction of 200km: earnings of 280,000,000,000 KRW

Equipment Status

Track Equipment

Name	Type	Measure	Number	Remark
Motorcar	182PS/2500r.p.m	Unit	2	-
Trolley	5TON and others	Unit	8	-
Hand Tie-Tamper	220V/60HZ/3PH	Unit	10	-
Power Wrench	8HP	Unit	8	-
Engine Impact	1,030Nm	Unit	14	-
Track Lifter	10TON	Unit	2	-
Generator	7kw and others	Unit	15	-
Rail Cutter	5HP/16"	Unit	21	-
Rail Carrier	-	Unit	6	-
Portal Crane	-	Group	42	-
Rail Drilling Machine	3HP	Unit	12	-
Rail Jack	15Ton	Unit	48	-

*Filled with only major equipments.

Welding Equipment

Name	Type	Measure	Number	Remark
Gas Pressure Welding Machine	TGP-5/KGP-6	SET	2	-
Thermit Machine	-	SET	4	-
Shearing Machine	EME-1 and others	Unit	4	-
Grinding Machine	-	Unit	4	-
Face Grinding Machine	-	Unit	8	-
Generator	30KW	Unit	2	-
Winch	2.1KW	Unit	2	-

*Filled with only major equipments.

Inspection & Measurement Equipment

Name	Type	Measure	Number	Remark
Ultrasonic Flow Detector	AND	SET	1	-
Hardness Tester	-	SET	1	-
Magnetic Particle Tester	MP-3	SET	1	-
Track Master	RCS	SET	4	-
Compression Tester	-	SET	2	-
Airometer	-	SET	2	-
Total Station	DTM-520	SET	3	-
Auto Level Instrument	AC-2	SET	3	-

*Filled with only major equipments.



Business Records

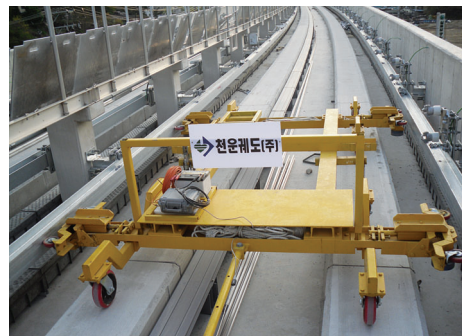
Contract Name	Client	Contract Period	Contract Amount	Remark
Railroad 1st Stage Construction on Busan Subway Line 2 Section 3	Busan Transportation Corporation	1996.10~1998.08	1,583,352,000	-
Railroad Car Depot Construction on Incheon Urban Railroad Line1	Incheon Subway Construction	1997.09~2000.02	3,217,530,000	-
Railroad Construction on Seoul Subway Line 7 Section 7~6	Seoul Subway Construction	1997.12~2000.07	2,446,674,300	-
Railroad 1st stage Construction on Busan Subway Line 3 Section 1	Busan Transportation Corporation	2003.10~2005.05	8,390,135,200	-
Railroad 1st Stage Construction on Busan Subway Line 3 Section 2	Busan Transportation Corporation	2003.10~2005.05	9,167,839,000	-
Railroad Construction on Janghang Line between Sinjanghang and Daeya	Korea Rail Network Authority	2006.11~2008.06	9,398,863,000	-
Other Construction on 3 points with 53.136km Section of Kyungbu Line between Byungjum and Osan (Southbound Lane 2)	Korea Railroad	2008.12~2009.05	226,333,000	-
Railroad Construction on Janghang Line between Joopo and Sinjanghang	Korea Rail Network Authority	2006.11~2008.12	14,489,800,000	-
Railroad 2st Stage Construction on Busan Subway Line 3 Bansong Line	Busan Transportation Corporation	2008.04~2011.03	17,388,300,000	-
Wheel Turning Station Construction and Other Improvement Work (Field of Railroad)of Gunja Car Depot	Seoul Metro	2008.12~2009.09	286,117,000	-
Railroad Construction on Jurisdiction of Busan, Daegu, and Gyeongnam branches of the Korea Railroad under Yearly Unit cost Contract(4th group)	Korea Railroad	2009.02~2010.02	1,191,333,000	-
Railroad Facility Maintenance Construction on 3rd Technology Office in 2009	Seoul Metro	2009.03~2010.04	864,444,000	-
Railroad Construction on Kyungchun Line Section 1 (Mangwoo ~ Geumgok)	Korea Rail Network Authority	2009.08~2011.08	16,238,400,000	-
Rail-biking Double Track Railroad Project (1st and 2nd)	Mungyeong City	2009.11~2011.10	1,682,440,000	-
Railroad Construction on Double Track Railroad (Jookjun ~ Giheung) between Ori to Suwon	Korea Rail Network Authority	2010.09~2011.07	7,344,440,000	-
Railroad Construction on Honam Line 5, Section 3	Korea Rail Network Authority	2010.06~2014.01	17,075,850,000	-
Railroad Construction on Daegu & Busan branches under Yearly Unit cost Contract [4th group]	Korea Railroad	2012.03~2013.03	2,978,550,030	-
Railroad Construction on Honam Line, Section 2 between Iksan and Gwangju	Korea Rail Network Authority	2012.07~2014.11	34,332,980,000	-

1

Business Records

Railroad 2 Stage Construction on Busan Subway Line 3 Bansong Line

Contract Name	Client	Contract Period	Contract Amount	Remark
Railroad 2st Stage Construction on Busan Subway Line 3 Bansong Line	Busan Transportation corporation	2008.04~2011.03	17,388,300,000	-

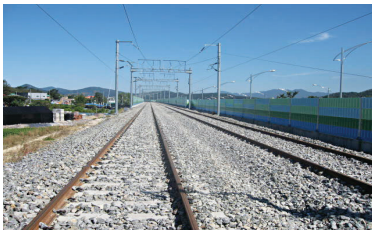


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Business Records

Railroad Construction on kyungchun Line Section 1 (Mangwoo ~ Geumgok)

Contract Name	Client	Contract Period	Contract Amount	Remark
Railroad Construction on kyungchun Line Section 1(Mangwoo ~ Geumgok)	Korea Rail Network Authority	2009.08~2011.08	16,238,400,000	-



3

Business Records

Railroad Construction on kyungchun Line Section 2 (Geumgok ~ Daesung-ri)

Contract Name	Client	Contract Period	Contract Amount	Remark
Railroad Construction on kyungchun Line Section 2(Geumgok ~ Daesung-ri)	Korea Rail Network Authority	2005.12~2011.04	14,258,146,000	-

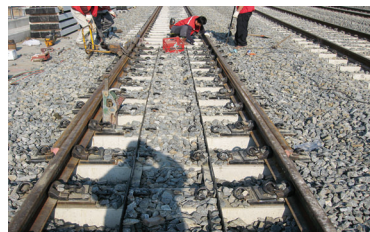


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Business Records

Railroad Construction on Janghang Line between Joopo and Sinjanghang

Contract Name	Client	Contract Period	Contract Amount	Remark
Railroad Construction on Janghang Line between Joopo and Sinjanghang	Korea Rail Network Authority	2006.11~2008.12	14,489,800,000	-



5

Business Records

Railroad Construction on Janghang Line Section 3 between Sinjanghang and Daeya

Contract Name	Client	Contract Period	Contract Amount	Remark
Railroad Construction on Janghang Line Section 3 between Sinjanghang and Daeya	Korea Rail Network Authority	2006.11~2008.06	9,398,863,000	-



Leading Enterprise of Railroad Culture



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