THE SLAB TRACK SOLUTION FOR THE REQUIREMENTS OF TOMORROW

LOW VIBRATION TRACK (LVT)

PPE Machtron Co.,Ltd.

Address : 99/18 Lat Phrow 31, Ratchadapisek Road
Chankasem , Jatuchak , Bangkok 10900 , Kingdom of Thailand.
www.ppemactron.com , Tel.: 66 2-513-6753.

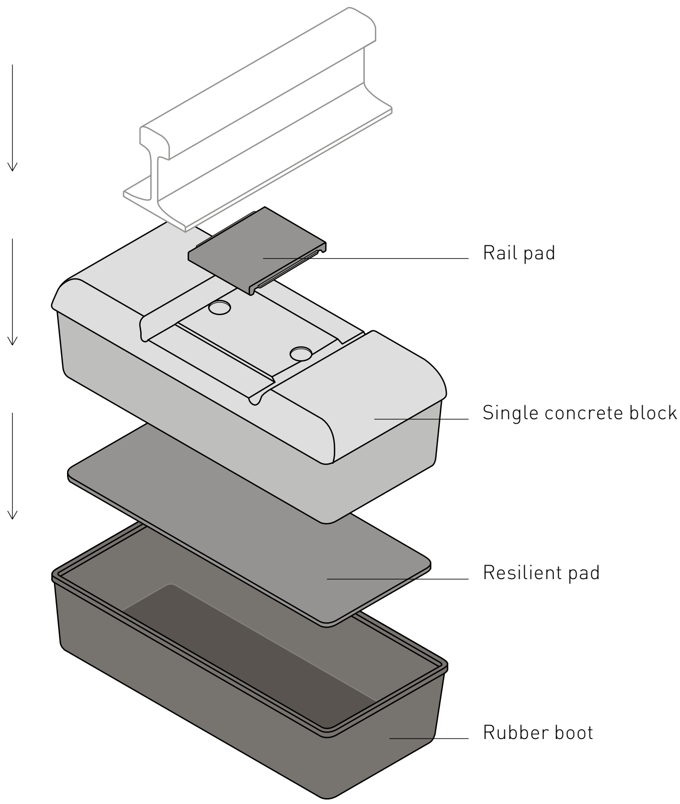
LOW VIBRATION TRACK (LVT)

THE SLAB TRACK SOLUTION FOR THE REQUIREMENTS OF TOMORROW

LVT, one of the first non-ballasted track forms in the world, has proven its worth in many famous and ambitious railway projects. Its excellent worldwide reputation is attributable to precise track geometry and to its excellent vibration protection. References from five continents bear this out.

In its present form, the system is on the idea of twin-block sleepers on a ballasted track. From this basic idea, Roger and Bernard Sonneville developed the single block system for the slab track. Not only does the Sonneville AG provide the design and quality monitoring of the system components but also technical support for different aspects of slab track technology. Engineering offices, construction companies and final clients all fall within their charge.

THE SYSTEM



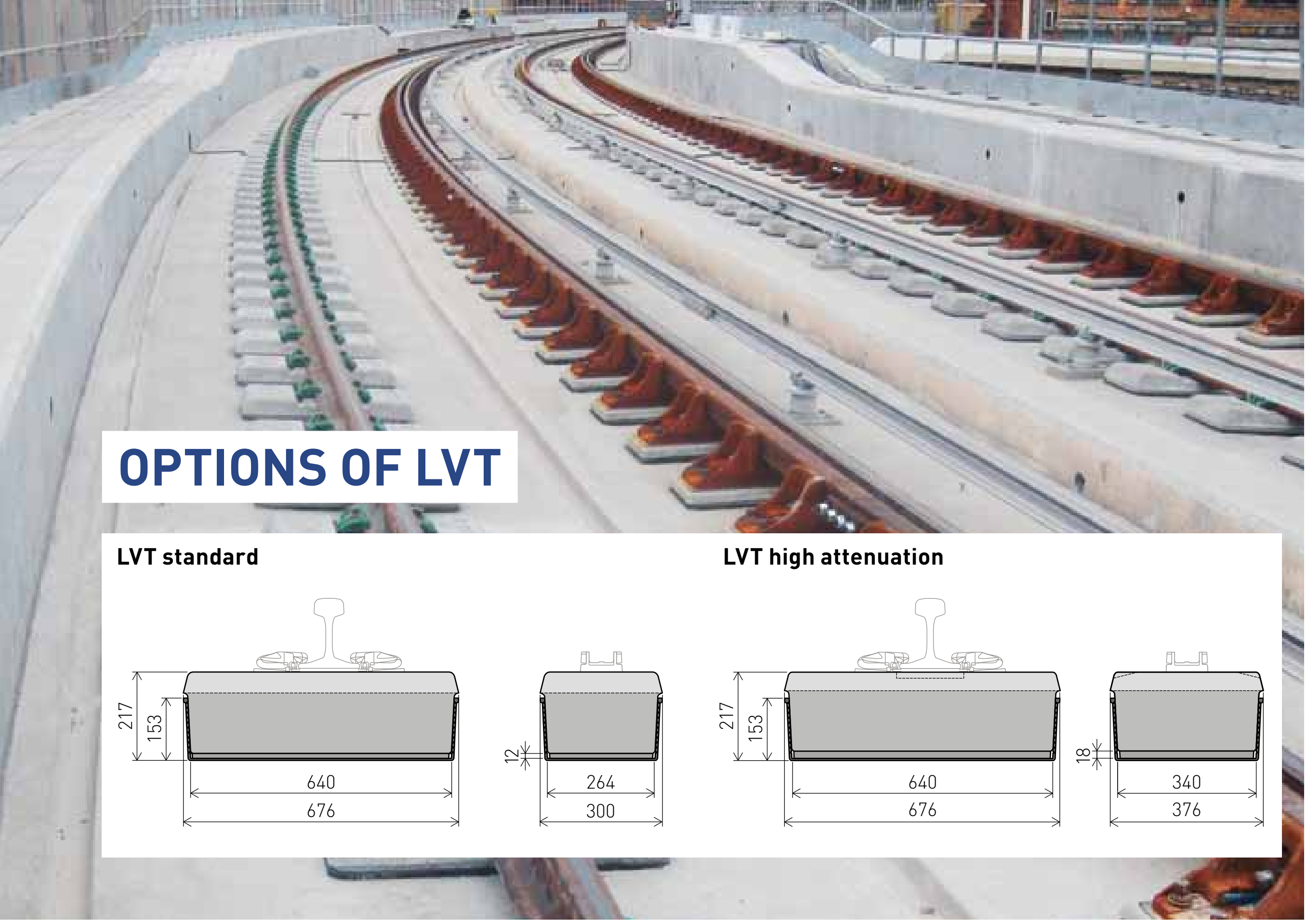
The LVT-System consists of a concrete block, a resilient pad and a rubber boot, surrounded by unreinforced concrete (2^{nd} stage concrete). No special demands on the rail fixation are made; merely an elastic rail pad is used. For each specific project, these two elastic components are matched to each other, thus bestowing upon the system the properties characteristic of dual-level elasticity.

The resilient pad provides for the load distribution analogous to the ballasted track and reduces the influence of low frequency vibrations. The rail pad in turn protects against the effects of higher frequencies.

The rubber boot allows an unhindered deflection that, together with the high quality of the resilient pad, leads under dynamic loads to a very low system stiffening ($c_{dyn}/c_{stat} < 1.5$).

All necessary functions for the track are taken over by the decoupled concrete block. This reduces the demands made on the 2^{nd} stage concrete.

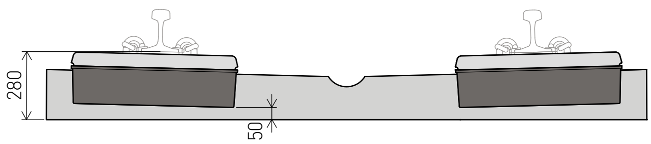
OPTIONS OF LVT



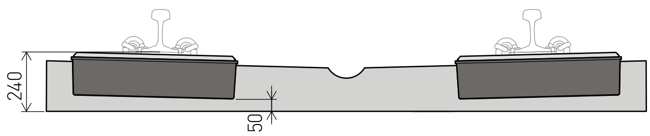
The LVT-System is tailor-made for each project. The following system options have proven themselves on the market:

LVT standard (LVT): for excellent track running performance on high-speed sections, for metro systems and for heavy haul lines.

LVT high attenuation (LVT HA): with a larger block and softer pad, for higher demands of noise and vibration attenuation. These two characteristics result in a lower natural frequency of the system that lies in the range of floating slabs.

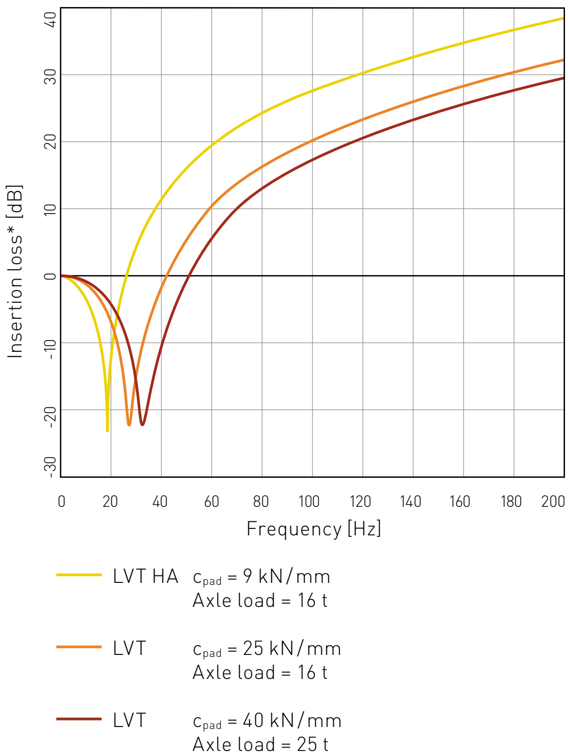


Both options are available as **LVT low profile (LVT LP)** and are especially suitable for restricted conditions of the structure gauge.

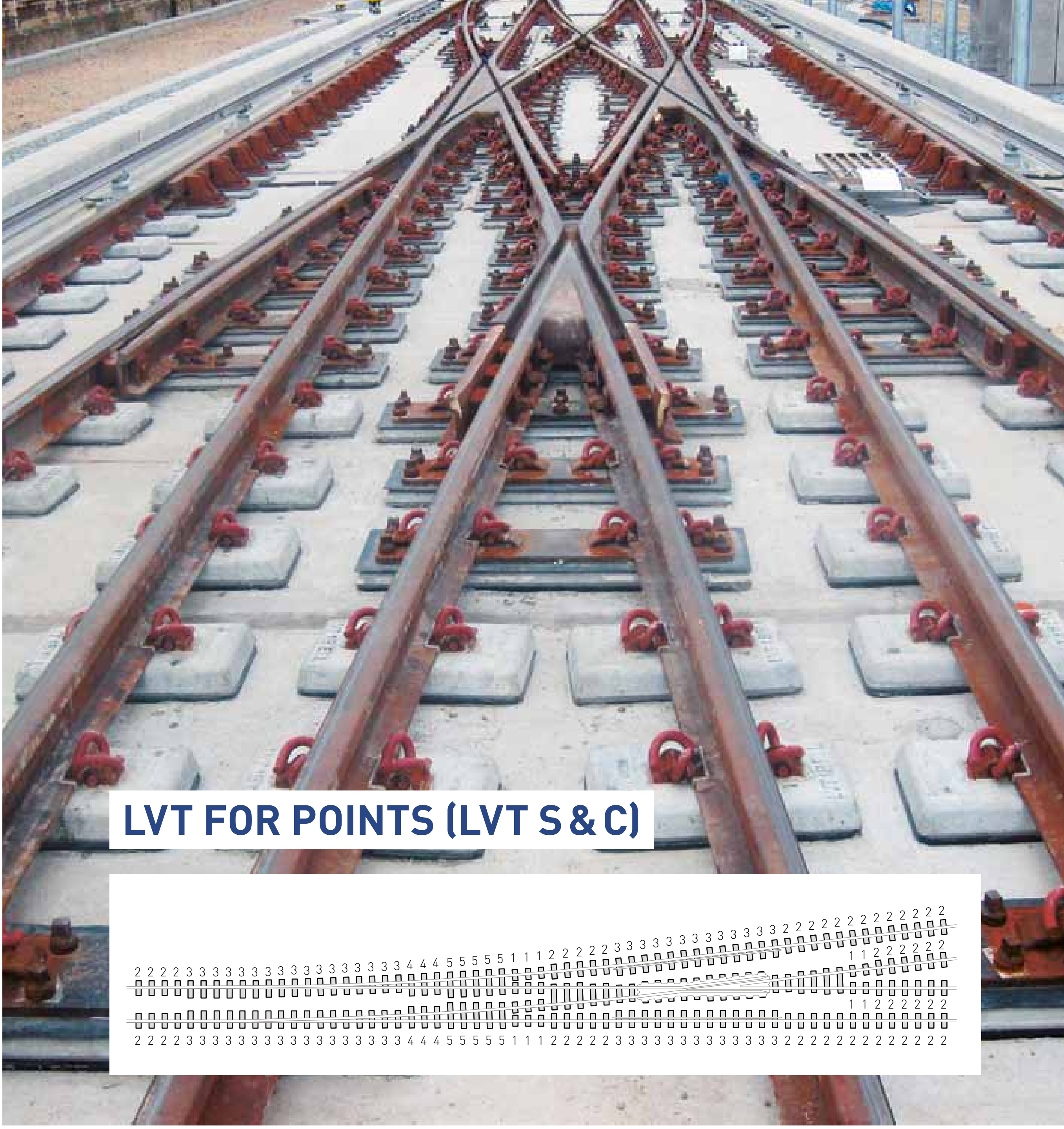


All options are exceptionally well suited for use in tunnels, at grade and for viaducts, these applications having been well confirmed by many reference objects.

An example of the effectiveness of various LVT options is illustrated by shown insertion loss:



* calculated, reference system LVT c_{pad} = 2000 kN/mm



LVT FOR POINTS (LVT S & C)

Apart from turnouts and crossings, rail expansion joints as well as fixations for guard rails and check rails are secured through LVT S & C systems on elastic bedded blocks. With five standardised LVT-supports all geometries can be represented. A uniform track-riding performance is ensured by various block pad stiffness's.

The system LVT S & C ensures also within points and junctions, a slab track having homogenous rail riding conditions. The high degree of standardization and the very frequent relinquishing of reinforcement in the 2nd stage concrete make LVT S & C a highly competitive system in all respects.

THE ADVANTAGES

More efficient vibration protection
Thanks to the two levels elasticity LVT attenuates vibrations in all frequency ranges.

High flexibility
The project-specific design of the components and the use of various fastening systems fulfil the demands of many different rail projects.

Low installation costs
The functioning mode of LVT allows one to dispense with reinforcement of the 2nd stage concrete apart from at interfaces with ballasted track and at major drainage inlets.

Highly accurate rail limits
The «top-down»-construction and the high embedment of the LVT-supports in the concrete leads to a very high gauge accuracy with values of ± 0.5 mm.

Low need for maintenance – simple access to all components
LVT is practically maintenance free. All components are easily accessible should, in the case of a derailment, individual parts need to be changed or if the track height requires adjustment.

No electric conductance
No direct connection exists between the blocks.

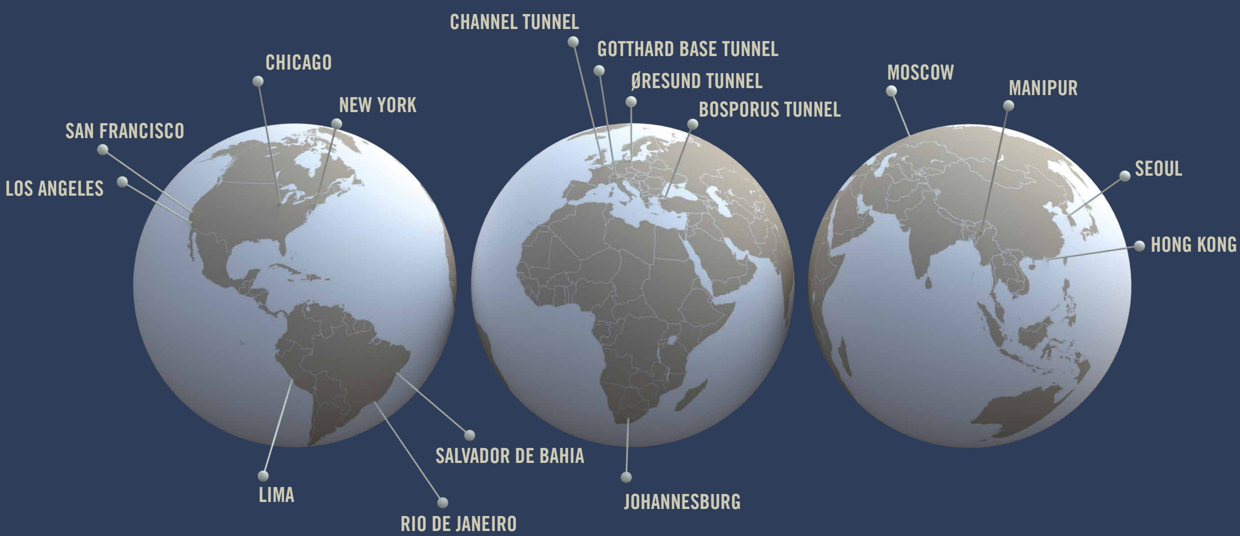
Good aerodynamics and simple access to rails
The space between the rails is unobstructed: this improves the track aerodynamics and allows unhindered access during construction work or rescue of passengers.

Flexible design of drainage system
In accordance with local conditions the water drainage system can be installed not only at the sides but also in the track centre.

Travel with work trains
During the installation phase, work can be done simultaneously on assembly sections – benefits a rapid advance in construction.

sonneville

IMPROVING RAILWAY TRACKS WORLDWIDE



IMPROVING RAILWAY TRACKS WORLDWIDE

SONNEVILLE'S EXPERTISE MEETS HIGHEST REQUIREMENTS

GLOBAL SUPPORT

Sonneville AG is the worldwide system provider of the slab track system Low Vibration Track (LVT). Railway companies, contractors and manufacturers are assisted in all stages of projects so they can carry out slab track installations based on the LVT-System on schedule and in line with the highest quality standards.

From the early stages of project design through manufacturing of the LVT supports to the successful implementation in railway tracks, Sonneville offers consultancy services in design and quality control, machinery for local block production as well as track installation tools around the world.

PHILOSOPHY

Sonneville is committed to providing enduring and sustainable modern track technology. In close cooperation with clients and contractors, Sonneville develops project-specific solutions. Experience and know-how, combined with state-of-the-art technologies, result in high quality slab track systems with outstanding durability and cost efficiency as well as vibration attenuation and structure-borne noise reduction.

HISTORY

Sonneville was incorporated in 1981 as Sonneville International Corporation (S.I.C.) to pursue the worldwide development of the track system originally designed by Roger Sonneville. Starting in the 1960s, Roger Sonneville together with SBB developed one of the first slab track systems in the world based on a bi-block tie design for ballasted track and equipped with elastic components to achieve the necessary resiliency in the concrete track. Since then, this system has evolved from the original dual block to today's booted single block system LVT.

By virtue of a new management team and the company's integration in the Swiss Vigier group in 2009, Sonneville AG has further increased its worldwide activities in the slab track business. A highly experienced team of railway engineers develops innovative and sustainable designs for the LVT-System to meet any environmental and technical requirement at the most economical solution.

CHANNEL TUNNEL

ENGLAND – FRANCE

PIONEER

Line: London – Paris
Length of LVT slab track: 100 km / approx. 310'000 supports
Design axle load: 22.5 t
Design speed: 200 km/h
Traffic: Passenger and freight trains

The Channel Tunnel between England and France is the first large-scale project using the LVT slab track technology. After the start of revenue service in 1994, the LVT-System has accumulated more than 2 billion gross tonnes so far. With up to 453 trains per day and 110 – 120 million gross tonnes per year, the Channel Tunnel is one of the most frequented railway tunnels in the world. The LVT-System meets the requirements even under heavy loads and in the severe tunnel environment.

CORE COMPETENCIES

CUSTOMISED DESIGN OF THE LVT-SYSTEM

SONNEVILLE'S SERVICES

- Long-standing experience in the slab track industry
- Detailed design of LVT slab track
- Development of customised solutions
- Rental of local production machinery and equipment
- QM / QA
- Supervision of LVT installation
- Experience in working on large-scale projects in different cultural environments
- Worldwide network of partners and agents providing a high level of flexibility and direct contacts to meet the customer's requirements
- Vibration analysis
- ISO 9001 and ISO 14001 certified

PRODUCTS

Sonneville AG is known for its innovative solutions, which are easy to implement and fully adaptable to the customer's demands. Due to the technology used, the LVT-System stands for effective vibration attenuation and a very economical installation procedure. Different designs and support variations are available to satisfy all requirements within the different projects, no matter if a tunnel requires a trafficable slab track system for rubber tyred rescue vehicles or a sophisticated turnout construction needs to be equipped with the LVT-System.

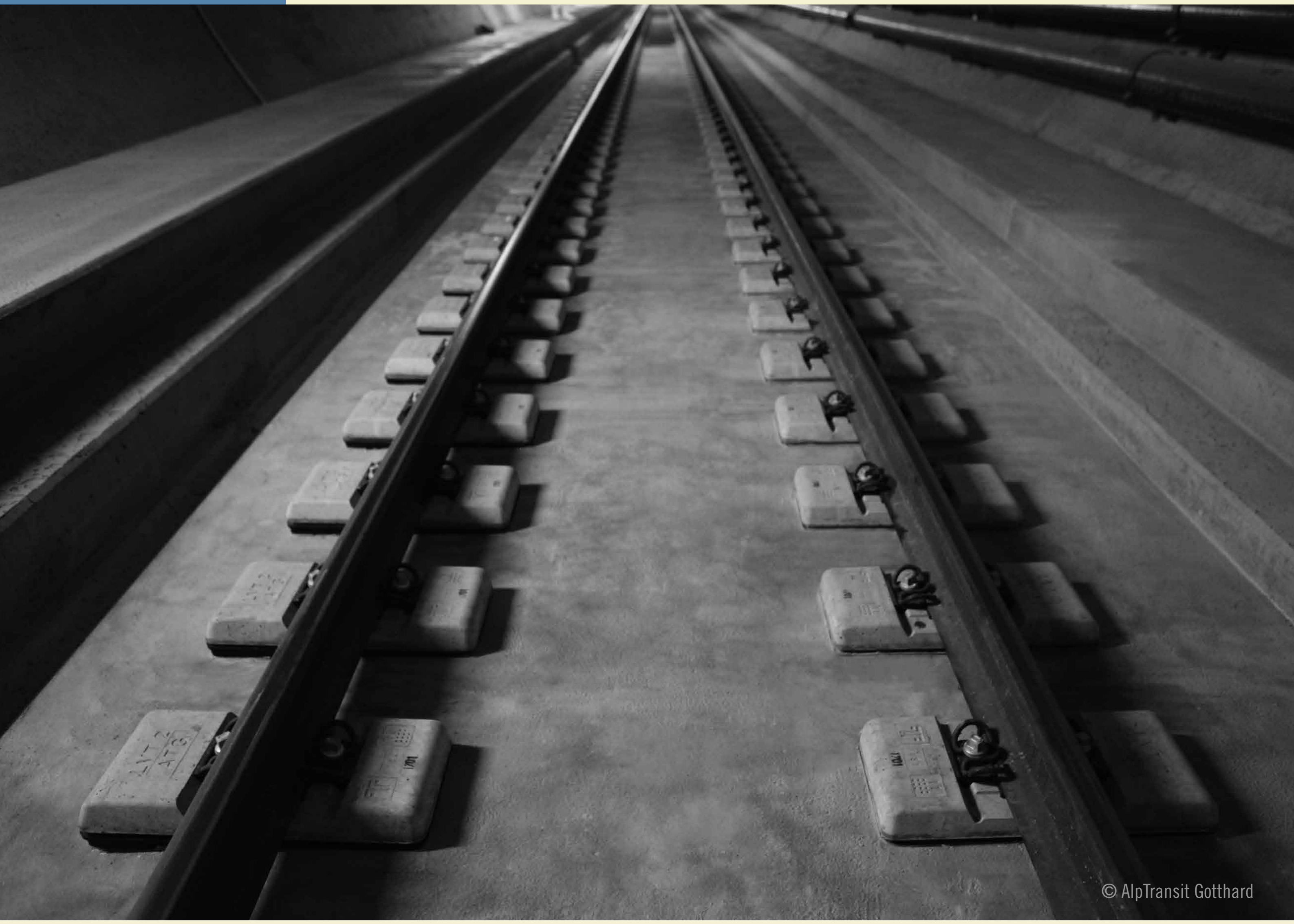
The LVT-System has proven to be the perfect application for slab tracks with various demands, irrespective of whether it is a high-speed track where highly accurate track geometry is needed or a railway line in an urban area, where vibration attenuation is of primary importance. Whether it is heavy haulage, high speed or metro lines – the system's low need for maintenance is always decisive.

INNOVATION

GOTTHARD BASE TUNNEL

SWITZERLAND

EUROPE



Line: Zurich – Milan
Length of LVT slab track: 114 km / approx. 380'000 supports
Design axle load: 25 t
Design speed: 250 km/h
Traffic: High-speed and freight trains

In the Gotthard Base Tunnel, the longest railway tunnel in the world, the tracks are equipped with the LVT-System to meet the demanding requirements of the project. Due to the dense geology around the tunnel and the over 2'000 m high mountains, the temperature in the tunnel stays above 40 °C with high humidity. The LVT-System is designed to withstand these conditions as well as daily loads of 0.5 million gross tonnes. The tracks in the Gotthard Base Tunnel are the most precise in the world, used by high-speed trains of up to 250 km/h and freight trains, ensuring maximum durability and availability.

LINE 7 EXTENSION NEW YORK

USA

AMERICAS

Line: Flushing Line New York
Length of LVT slab track: 4.8 km / approx. 13'000 supports
Design axle load: 19 t
Design speed: 90 km/h
Traffic: Metro

LVT is installed in almost all major metro networks throughout the Americas. Besides the above project in New York, where LVT has been selected as the preferred system for plain tracks and special trackwork, the LVT-System is extensively used in Chicago, San Francisco and Los Angeles. Also Brazil and Peru have recognised the benefits of the LVT-System, which is in service in the metros of Rio de Janeiro, Salvador de Bahia, Porto Alegre and Lima.

INCHEON METRO LINE 1

SOUTH KOREA

ASIA

Line: Line 1 Incheon
Length of LVT slab track: 61 km / approx. 195'000 supports
Design axle load: 17 t
Design speed: 80 km/h
Traffic: Metro

Nearly 50% of all LVT slab track installations are found in Asia, especially in Korea and Hong Kong. As the sizes of cities are rising so does the demand for an economical slab track system that effectively reduces noise and vibration. With the LVT-System these requirements can be met perfectly.
The LVT HA system even allows a replacement of light mass-spring systems resulting in significant cost reduction and higher installation rates.

sonneville

Sonneville AG
Industriezone 2 | 3225 Müntschemier | Switzerland
Tel. +41 32 312 98 50 | Fax +41 32 312 98 88

mail@sonneville.com www.sonneville.com

LVT REFERENCE LIST - METRIC VERSION (November 2019)

	Project Name	Country	Owner	Traffic start	Environment	LVT Type	Fastening	Rail	Axle load (t)	Spacing (mm)	Annual traffic (MGT)	Speed (km/h)	Length (m)
1	New York / New Jersey	USA	PATH	1991	Tunnel	Project specific	Sonneville S.75	100 lb	13	572			200
2	Channel Tunnel	England - France	EUROTUNNEL	1993	Tunnel	Standard	Sonneville S.75	UIC 60	23	600	150 projected / 120 actual	200 design / 160 actual	100'000
3	St Louis, MO	USA	METRO LINK	1993	Tunnel / @Grade	Low Profile	Pandrol e-clip	132 lb	13	762			2'800
4	Grauholz Tunnel	Switzerland	SBB	1995	Tunnel	Standard	Vossloh W14	UIC 60	23	600	30 actual	200 design / 160 actual	800
5	San Francisco, CA	USA	BART	1995	Tunnel	Standard	Pandrol e-clip	119 lb	13	762			400
6	Atlanta, GA	USA	MARTA	1996	Tunnel / @Grade	Low Profile	Sonneville S.75	115 lb	14	762			600
7	Dallas, TX	USA	DART	1997	Tunnel / Bridge	Standard	Pandrol e-clip	115 lb	14	762			9'900
8	Rio Metro	Brazil	RIO TRILHOS	1998	Tunnel / Viaduct	Standard	Sonneville S.75	TR 57	17	750	19 actual	85 actual	2'500
9	Lantau And Airport Railway, Hong Kong	China	MTRC	1998	Tunnel / @Grade / Viaduct	Standard	Pandrol e-clip	UIC 60	17	650	75 projected	140 actual	30'000
10	Portland, OR	USA	TRI-MET	1998	Tunnel / @Grade	Low Profile	Sonneville S.75	115 lb	11	762			10'200
11	Incheon Metro Line 1	South Korea	IRTC	1999	Tunnel	Standard	Pandrol e-clip	KS 60	17	625	17 actual	80 actual	49'000
12	Red Line, Los Angeles, CA	USA	LACMTA	1999	Tunnel	Project specific	Pandrol e-clip	115 lb	12	762			200
13	Connecticut	USA	DOT	1999	@Grade	Low Profile	Pandrol e-clip	132 lb	30	610			100
14	Oresund Tunnel	Denmark	ØK	2000	Tunnel	Low Profile	Pandrol Fastclip	UIC 60	25	600	10 actual	200 design / 200 actual	7'400
15	Porto Alegre	Brazil	TRENSURB	2000	Viaduct	Standard	Sonneville S.75	TR 57	21	650	20 actual	90 actual	5'000
16	Atlanta, GA	USA	MARTA	2000	Tunnel / @Grade	Low Profile	Sonneville S.75	115 lb	14	762			800
17	Quarry Bay, Hong Kong	China	MTRC	2001	Tunnel	Standard	Pandrol e-clip	UIC 60	17	650			3'400
18	Tseung Kwan O, Hong Kong	China	MTRC	2002	Tunnel	Standard	Pandrol e-clip	UIC 60	17	700			13'900
19	Copenhagen Metro	Denmark	METRO	2003	Tunnel / @Grade	Standard	Vossloh W14	UIC 54	12	700			19'000
20	West Rail, Hong Kong	China	KCRC	2003	Tunnel	Standard & Turnout	Pandrol e-clip	UIC 60	18	610			29'400
21	1st Bundang Line Installation	South Korea	KRC	2003	Tunnel	Standard	Pandrol e-clip	KS 60	18	625		80 actual	10'000
22	San Francisco, CA	USA	BART	2003	Tunnel	Standard	Pandrol e-clip	119 lb	13	762			5'600
23	Philadelphia, PA	USA	SEPTA	2003	Tunnel	Project specific	Pandrol e-clip	100 lb	9	610			300
24	Newark, NJ	USA	AMTRAK	2003	@Grade	Special Cavity	Pandrol e-clip	136 lb	33	560			200
25	Pueblo, CO High Tonnage Loop	USA	TTCI	2003	@Grade	Standard	Sonneville STL	136 lb	36	610	100 actual	65 actual	80
26	Zimmerberg Tunnel	Switzerland	SBB	2004	Tunnel	Standard	Vossloh W14	UIC 60	23	600	23 actual	200 design / 160 actual	18'000
27	East Rail MOS & TST, Hong Kong	China	KCRC	2004	Tunnel / Viaduct	Standard & Turnout	Pandrol e-clip	UIC 60	18	700			2'500
28	1st Cholla Line Installation	South Korea	KRC	2004	Tunnel	Standard	Pandrol e-clip	KS 60	22	625	20 actual	100 actual	9'000
29	Minneapolis, MN	USA	HIAWATHA	2004	Tunnel / @Grade	Low Profile	Pandrol Fastclip	115 lb	14	762			5'950
30	New York, NY	USA	MTA	2004	Tunnel	Project specific	Pandrol e-clip	100 lb	19	572			100
31	Daegu Metro Line 2	South Korea	DRTC	2005	Tunnel	Standard & Turnout	Pandrol e-clip	KS 60	17	625	14 actual	80 actual	45'000
32	Busan Metro Line 3	South Korea	BUTA	2005	Tunnel	Standard & Turnout	Pandrol e-clip	KS 60	17	625	15 actual		22'300
33	St Louis, MO	USA	METRO LINK	2007	Tunnel / @Grade	Standard	Pandrol Fastclip	115 lb	13	762			5'900
34	Lötschberg Tunnel	Switzerland	BLS	2007	Tunnel	Standard	Vossloh W14	UIC 60	25 design	600		250 design / 200 actual	51'300
35	Trupo Tunnel	Taiwan	THSRC	2007	Tunnel	Standard	Vossloh W14	JIS 60	14 / 18 / 25	650			26'200
36	LMC, Hong Kong	China	KCRC	2007	Tunnel / Viaduct	Standard & Turnout	Pandrol e-clip	UIC 60	18	700			10'200
37	Incheon Airport Phase 1	South Korea	AREX	2008	Tunnel	Standard	Pandrol e-clip	KS 60	17	625	25 projected	100 projected	28'000
38	Ocean Parkway, New York	USA	MTA	2007	Tunnel	Project specific	Pandrol e-clip	100 lb	19	572			160
39	Rio Metro Copacabana Ext.	Brazil	RIO TRILHOS	2007/09	Tunnel	Standard	Sonneville S.75	TR 57	17	750		90 actual	4'100
40	Taebaek Line	South Korea	KRNA	2014	Tunnel	Standard	Pandrol e-clip	KS 60	22	625		150 design	27'000

sonneville

Sonneville AG
Industriezone 2 | 3225 Müntschemier | Switzerland
Tel. +41 32 312 98 50 | Fax +41 32 312 98 88
mail@sonneville.com www.sonneville.com

LVT REFERENCE LIST - METRIC VERSION (November 2019)

	Project Name	Country	Owner	Traffic start	Environment	LVT Type	Fastening	Rail	Axle load (t)	Spacing (mm)	Annual traffic (MGT)	Speed (km/h)	Length (m)
41	New South Ferry, New York	USA	MTA	2009	Tunnel	Project specific & Turnout	Pandrol e-clip	115 lb	19	572			900
42	Janghang Line	South Korea	KRNA	2007	Tunnel	Standard	Pandrol e-clip	KS 60	22	625		150 design	1'200
43	Gold Line, Los Angeles, CA	USA	LACMTA	2009	Tunnel	Low Profile & HA	Pandrol e-clip	115 lb	12	762			5'500
44	KyungJeon Line 3	South Korea	KRNA	2010	Tunnel	Standard	Pandrol e-clip	KS 60	22	625		150 design	12'000
45	RearRailway, New Busan Port 2	South Korea	KRNA	2010	Tunnel	Standard	Pandrol e-clip	KS 60	22	625		150 design	5'000
46	Seoul Metro Line 9	South Korea	SMG	2009	Tunnel	Standard	Pandrol e-clip	KS 60	16	625		80 actual	48'000
47	2nd Cholla Line Installation	South Korea	KRNA	2009	Tunnel	Standard	Pandrol e-clip	KS 60	22	625		150 design	9'000
48	Gautrain	South Africa	Gauteng Province	2010	Tunnel	Low Profile & Turnout	Pandrol Fastclip	NR60E2	16	700		160 design	21'200
49	East London Line	England	TfL	2010	Tunnel / Viaduct / @Grade	HA, Standard & Turnout	Vossloh/Pandrol	CEN56E1	15	650			10'600
50	Dong (East) Gwangyang Line	South Korea	KRNA	2010	Tunnel	Standard	Pandrol e-clip	KS 60	22	625		150 design	7'000
51	3rd Cholla Line	South Korea	KRNA	2010	Tunnel	Standard	Pandrol e-clip	KS 60	22	625		150 design	9'000
52	Incheon Line 1 Extension	South Korea	IRTC	2010	Tunnel	Standard	Pandrol e-clip	KS 60	17	625	17 actual	80 actual	12'000
53	Citytunnel Malmö	Sweden	Banverket	2010	Tunnel	HA, Standard & Turnout	Pandrol/Vossloh	UIC 60	19	650		160 design	12'000
54	Incheon Airport Phase 2	South Korea	AREX	2010	Tunnel	Standard	Pandrol e-clip	KS 60	17	625	25 projected	120 projected	28'000
55	Daegu Line 2 Extension	South Korea	DRTC	2012	Tunnel	Standard	Pandrol e-clip	KS 60	17	625	14 projected	80 design	6'600
56	2nd Bundang Line Installation	South Korea	KRNA	2015	Tunnel	Standard	Pandrol e-clip	KS 60	18	625		110 design	13'600
57	Alptransit Gotthard	Switzerland	SBB	2016	Tunnel	Standard	Vossloh W14	UIC 60	25	600		250 design	114'000
58	Manises - Riba-Roja	Spain	GVA-CIT	2013	Tunnel	HA	Vossloh W3	UIC 54	14	720		80 design	1'800
59	KyungJeon Line 4	South Korea	KRNA	2010	Tunnel	Standard	Pandrol e-clip	KS 60	22	625		150 design	3'000
60	RearRailway, New Busan Port 3	South Korea	KRNA	2011	Tunnel	Standard	Pandrol e-clip	KS 60	22	625		150 design	4'000
61	New Bundang Line Ext. (Yongsan-Gangnam)	South Korea	KRNA	Expected 2022	Tunnel	Standard	Pandrol e-clip	KS 60		625		150 design	16'000
62	38th Street Yard New York	USA	MTA	Expected 2020	@Grade	Standard & Turnout	Pandrol e-clip	115 lb	19	572			260
63	Culver Viaduct New York	USA	MTA	2013	Viaduct	Standard	Pandrol e-clip	115 lb	19	572			5'020
64	Porto Alegre	Brazil	TRENSURB	2012	Viaduct	Standard	Sonneville S.75	TR 57	21	650	20 projected	90 design	18'850
65	Barcelona Metro Line 9	Spain	Metro Barcelona	2016	@Grade	Standard, HA, Turnout	Vossloh W3	UIC 54	16	750		80 design	600
66	Canal Tunnel London	England	Network Rail	Expected 2018	Tunnel	HA, Turnout	Pandrol Fastclip	UIC 60	15	650			1'000
67	Marmaray BC1	Turkey	TCCD	2013	Tunnel	Standard, HA, Projectspecific, Turnout	Vossloh	UIC 60	25	630		100 design	25'200
68	Daegu Line 1 Extension	South Korea	DRTC	2012	Tunnel	Standard	Pandrol e-clip	KS 60	17	625			6'300
69	New Bundang Line Ext. (Jeongja - Kwangyo)	South Korea	KRNA	2016	Tunnel	Standard	Pandrol e-clip	KS 60		625			25'000
70	Suin Line (Songdo-Incheon)	South Korea	KRNA	2016	Tunnel	Standard	Pandrol e-clip	KS 60		625			60'000
71	Tren Eléctrico Lima, Line 1	Peru	Tren Eléctrico Lima	2012	Viaduct	Standard	Pandrol e-clip	115 lb	17	650	14 projected	80 design	320
72	Seoul Metro Line 9, stage 2	South Korea	SMG	2014	Tunnel	Standard	Pandrol e-clip	KS 60	16	625		80 actual	18'000
73	Cityringen Copenhagen Metro	Denmark	Metroselskabet	Expected 2019	Tunnel	Standard, HA	Vossloh W14	UIC 54	12	700	11.7 projected	90 design	32'700
74	Durchmesserlinie Zürich	Switzerland	SBB	2014	Tunnel	Standard, HA, Turnout	Vossloh W14	UIC 60	22	600			13'300
75	Sagrera-Mollet	Spain	ADIF	2013	Tunnel	Standard, HA	Vossloh W14	UIC 60	17	650		250 design	400
76	Line 7 Extension	USA	MTA	2015	Tunnel	Standard, Turnout	Pandrol e-clip	115 lb	19	572			4'400
77	2nd Avenue Subway, Phase I	USA	MTA	2017	Tunnel	Standard, Turnout	Pandrol e-clip	115 lb	19	572			6'000
78	Tunnel 6, Moscow - Adler	Russia	RZD	2013	Tunnel	Standard	Vossloh W14	R65	27	595		60	780
79	Tunnel 7, Moscow - Adler	Russia	RZD	2013	Tunnel	Standard	Vossloh W14	R65	27	595		60	1'007
80	Nangang Extension	Taiwan	THSRC	2016	Tunnel	Standard	Vossloh W14	JIS 60	18	650			13'000

sonneville

Sonneville AG
Industriezone 2 | 3225 Müntschemier | Switzerland
Tel. +41 32 312 98 50 | Fax +41 32 312 98 88
mail@sonneville.com www.sonneville.com

LVT REFERENCE LIST - METRIC VERSION (November 2019)

	Project Name	Country	Owner	Traffic start	Environment	LVT Type	Fastening	Rail	Axle load (t)	Spacing (mm)	Annual traffic (MGT)	Speed (km/h)	Length (m)
81	WSB Aarau - Binzenhof	Switzerland	AAR	2014	Tunnel	Low profile	Vossloh W14	SBB I (46 E1)	12	600			390
82	Sokolnicheskaya line extension	Russia	Metro Moscow	2015	Tunnel	Special Cavity	ARS	R65	17	610		70	6'500
83	Lyublinsko-Dmitrovskaya line extension	Russia	Metro Moscow	2015	Tunnel	Special Cavity	ARS	R65	17	610		70	10'300
84	Cleveland Tunnel rehabilitation	USA	GCRTA	2013	Tunnel	Standard, Turnout	Pandrol e-clip	115 lb	17	610			1'100
85	Metro Rio Line 4	Brazil	RIO TRILHOS	2016	Tunnel	Standard	Sonneville S.75	TR 57	17	750		80 design	30'000
86	Salvador Bahia Line 1	Brazil	CCR Metro	2014	Viaduct / @Grade	Standard, Turnout	Pandrol e-clip	UIC 60	17	750		100 design	11'250
87	Double-Tracked Electric Railroad (Seongnam-Yeoju)	South Korea	KRNA	2016	Tunnel	Standard	Pandrol e-clip	KS 60					50'000
88	Busan Metro Line 1 Ext. (Dadea line)	South Korea	BUTA	2017	Tunnel	Standard	Pandrol e-clip	KS 60	17				13'600
89	Incheon Line 1 Extension	South Korea	IRTC	Expected 2020	Tunnel	Standard	Pandrol e-clip	KS 60	17				3'000
90	Salvador Bahia Line 2	Brazil	CCR Metro	2017	Viaduct / @Grade	Standard, Turnout	Pandrol e-clip	UIC 60	17	750		100 design	42'000
91	Durchmesserlinie Zürich Viaduct	Switzerland	SBB	2015	Viaduct	Standard	Vossloh W14	UIC 60	22	600			1'550
92	Sha Tin - Central	China	MTRC	Expected 2020	Tunnel	HA	Pandrol e-clip	UIC 60	18	600-700		130 design	2'770
93	Ceneri Base Tunnel	Switzerland	SBB	2020	Tunnel	Standard, Turnout	Vossloh W14	UIC 60	22.5	600		250 design	30'800
94	Heitersberg Tunnel	Switzerland	SBB	2015	Tunnel	Turnout	Vossloh	UIC 60	22.5	600		160 design	300
95	Crossing Walthamstow	England	London Undergr.	2015	Tunnel	Turnout	Pandrol e-clip	54E1 / 56E1	12	700			240
96	Wilson Station Chicago	USA	CTA	2018	Viaduct	Standard	Pandrol e-clip	115 lb	19	762			2'000
97	Queen Street Tunnel	Scotland	Network Rail	2016	Tunnel	Turnout	Vossloh	56E1	22.5	700		80	245
98	Glasgow Subway Modernisation	Scotland	Glasgow Subway	2016	Tunnel	Standard, Turnout	Vossloh	39E1 (BS80A)	9	650	5 projected	60	800
99	Tower City Station, Cleveland	USA	GCRTA	2016	Tunnel	Standard	Pandrol e-clip	115 lb	17	610			213
100	Extension Nordhavnen	Denmark	Metroselskabet	Expected 2020	Tunnel	HA	Vossloh W14	UIC 54	12	700		90 design	4'700
101	Blackburn Depot	England	Network Rail	2017	@Grade	Standard SE	Pandrol e-clip	56E1	10	650			250
102	Myrtle Avenue restoration, New York	USA	MTA	2017	Viaduct	Standard	Pandrol e-clip	100-8	19	572			800
103	Northern Line Extension	England	London Undergr.	Expected 2019	Tunnel	Standard, Turnout	Pandrol e-clip	56E1	12	685			5'700
104	Mariina Roscha - Petrovsko-Razumovskaya	Russia	Metro Moscow	2016	Tunnel	Special Cavity	ARS	R65	17	610		70	1'220
105	Rechnoy Vokzal - Hovrino	Russia	Metro Moscow	2016	Tunnel	Special Cavity	ARS	R65	17	610		70	1'659
106	Delovoy centr - Nizhnaya Maslovka	Russia	Metro Moscow	2016	Tunnel	Special Cavity	ARS	R65	17	610		70	4'779
107	Park Pobedy - Ramenki	Russia	Metro Moscow	2016	Tunnel	Special Cavity	ARS	R65	17	610		70	4'157
108	Ramenki - Rasskazovka	Russia	Metro Moscow	2016	Tunnel	Special Cavity	ARS	R65	17	610		70	923
109	CEVA F	France	SNCF	2017	Tunnel	Standard, HA	Vossloh W14	UIC 60	22	600			2'100
110	CEVA CH	Switzerland	SBB	Expected 2019	Tunnel	Standard, HA	Vossloh W14	UIC 60	22	600			17'500
111	Severomuysky Tunnel	Russia	Metro St. Petersburg	2017	Tunnel	Special Cavity	ARS	R65	17	610			2'700
112	Jiribam – Tupul (Imphal) Project, Section 1	India	NF Railways	Expected 2020	Tunnel	Standard	Mark V	UIC 60	25	600		160 design	15'112
113	Loetschberg crest tunnel	Switzerland	BLS	Expected 2022	Tunnel	Standard SE, Turnout	W14 Nirotec	UIC 60	22.5	600	35	125	28'800
114	Wigan Depot	England	Network Rail	Expected 2019	@Grade	Standard SE	Pandrol Fastclip	36E1	10	650			250
115	Ruckhaldetunnel (DML St. Gallen)	Switzerland	Appenzeller Bahn	2018	Tunnel	Standard, HA	Vossloh W14	SBB I (46 E1)	9	600		60	700
116	Incheon Airport Termianl 2	South Korea	KRNA	2017	Tunnel	Standard	Pandrol e-clip	KS 60	17	650		150 design	1'000
117	Seoul Metro Line 9, stage 3	South Korea	SMG	2018	Tunnel	Standard	Pandrol e-clip	KS 60	17	650		120 design	21'000
118	Hanam Line(Line 5 extension)	South Korea	SMG	Expected 2020	Tunnel	Standard	Pandrol e-clip	KS 60	17	650		120 design	15'000
119	Suin Line (Suwon~Handae)	South Korea	KRNA	Expected 2020	Tunnel	Standard	Pandrol e-clip	KS 60	17	650		150 design	14'500
120	Seoul Metro Line 7 Seoknam extension	South Korea	IRTC	Expected 2021	Tunnel	Standard	Pandrol e-clip	KS 60	17	650		120 design	8'500
121	Axenline	Switzerland	SBB	2019	Tunnel	Standard, HA, Panel, Traffic	Vossloh W14	UIC 60	22.5	600		80	5'850
122	Eppenberg Tunnel	Switzerland	SBB	2020	Tunnel	Standard, HA, traffic	Vossloh W14	UIC 60	22.5	600		200	5'920
123	Bözberg Tunnel	Switzerland	SBB	2020	Tunnel	Standard, Standard special	Vossloh W14	UIC 60	22.5	600		200	4'100
												Total length	**1'504'305**