

**Berlin Subway, Germany**

Subway tunnel below a hospital

Completion 1994

Mini ballast troughs (2.5 m), spring elements underneath

Total length: 2 x 200 m

Axle load: 9 t

Velocity: 70 km/h

System natural frequency: 7.5 Hz

Cologne Tramway, Germany

Tunnel below residential buildings

Completion 1997

Long slabs in tunnel, GSI-elements

Total length: 2 x 900 m

Axle load: 10 t

Velocity: 70 km/h

System natural frequency: 6.5 Hz

Tramway Bielefeld, Germany

Tramway passing a hotel building, slab used by trams and vehicles

Completion 1995

Turnout slab at grade, GSI-elements

Slab length: 65 m

Axle load: 10 t

Velocity: 50 km/h

System natural frequency: 5.0 Hz

Frankfurt/M., Germany**Passenger-Transfer-System**

International Airport; fully automatic elevated train system with rubber wheels passing partially through and on top of buildings

Completion 1997

Spring supported, elevated steel girders and concrete troughs, spring units partially combined with sliding elements

Total length: 1200 m, different sections

Axle load: 7 t

Velocity: 60 km/h

System natural frequency: 5.0 Hz

Puchon Station, Korea

Railway station within shopping mall building, passenger and freight trains

Completion 1997

Long ballast troughs (46 m), KY-elements

Total length: 6 x 225 m

Axle load: 22 t

Velocity: 120 km/h

System natural frequency: 6.1 Hz

Cheonan Station, Korea

High Speed Track (TGV) on top of station building

Completion 1999

Ballasted track on concrete slab supported on prestressable type GP spring elements and Viscodampers®

Total length: 4 x 1200 m

Axle load: 22 t

Velocity: 350 km/h

System natural frequency: 6 Hz

Sao Paulo Metro, Brazil**Line 3**

Subway tunnel underneath residential buildings

Completion 2000

Long slabs in tunnel, GSI-elements

Total length: 2 x 300 m

Axle load: 20 t

System natural frequency: 7 Hz

London, UK**DLR Lewisham Extension,**

Tunnel underneath residential buildings

Completion 1999

Long slabs in tunnel, GSI-elements

Total length: 2 x 430 m

Axle load: 10 t

Velocity: 80 km/h

System natural frequency: 6.5 Hz

**Stuttgart-Ruit, Germany****Tramway Station**

Tunnel close to residential buildings

Completion 2000

Long slabs (45 m), GSI-elements

Total length: 2 x 135 m

Axle load: 10 t

System natural frequency: 5.7 Hz

Frechen/Cologne, Germany

Tramway

Completion 1999

2 turnout slabs at grade, GSI-elements

Dimensions: 115 m² / 120 m²

Axle load: 9 t

System natural frequency: 6.5 Hz

Brasilia Metro, Brazil**Line 3**

Completion 2000

Long slabs in tunnel, GSI-elements

Total length: 2 x 195 m + switches

Axle load: 16 t

Velocity: 85 km/h

System natural frequency: 6.9 Hz

Tokyo, Japan**Waterfront Area Rapid Transit,****Rinkai Fukutoshin Line**

Test slab in subway tunnel

Completion 2000

Long slabs in tunnel, GSI-elements

Total length: 20 m

Axle load: 10 t

Velocity: 100 km/h

System natural frequency: 10.2 Hz

Tokyo, Japan**Waterfront Area Rapid Transit,****Rinkai Fukutoshin Line**

Subway tunnel underneath residential buildings

Completion 2002

Long slabs in tunnel, GSI-elements

Total length: 180 m

Axle load: 10 t

Velocity: 50 km/h

System natural frequency: 9.5 Hz

Beijing Metro, China**Line 13, Xizhimen Station**

Completion 2002

Long slabs, KY-elements

Total length: 3 x 126 m

Axle load: 14 t

Velocity: 40 km/h

System natural frequency: 6.5 Hz

Charlotte NC, USA,

LRT Line passing through Convention Centre

Completion 2002

Long twin-track slabs at grade, GSI-elements

Total length: 221 m

Design axle load: 12.5 t

Velocity: 25 km/h

System natural frequency: 6.5 Hz

Beijing Metro, China**Line 13, Xizhimen Station**

Completion 2002

3-span bridge girders on GP-elements

Total length: 3 x 75 m

Axle load: 14 t

Velocity: 40 km/h

System natural frequency: 5 Hz



Beijing Metro, China
Line 13, Hepingli Section

Completion 2002

Long slabs in tunnel, GSI-elements
Total length: 2 x 120 m
Axle load: 14 t
Velocity: 80 km/h
System natural frequency: 5 Hz

Shenzhen Metro, China
Line 1

Completion 2003

Long slabs in tunnel, GSI-elements
Total length: 2 x 253 m
Axle load: 16 t
Velocity: 80 km/h
System natural frequency: 5 Hz

Shanghai Metro, China
Line 4

Completion 2003

Long slabs in tunnel, GSI-elements
Total length: 2 x 120 m
Axle load: 16 t
Velocity: 80 km/h
System natural frequency*: 8 Hz

Tokyo, Japan
Metropolitan Intercity Railway
Tsukuba Express
Minami-Nagareyoma Section
Completion 2004

Long slabs in tunnel, GSI-elements
Total length: 2 x 154 m + 2 x 140 m
Design axle load: 15 t
Velocity: 160 km/h
System natural frequency*: 8.7 Hz

Shanghai Metro, China
Line 4, Pu Dong
underneath Medicine Institute

Completion 2005

Long slabs in tunnel, GSI-elements
Total length: 2 x 120 m
Axle load: 16 t
Velocity: 80 km/h
System natural frequency*: 8 Hz

Shanghai Metro, China
Line 4

Completion 2005

Long slabs on bridge
Total length: 2 x 97 m
Axle load: 16 t
Velocity: 80 km/h
System natural frequency*: 9 Hz

Guangzhou Metro, China
Line 3
underneath Film Studios

Completion 2005

Long slabs in tunnel, incl. for turnouts, GSI-elements
Total length: 890 m
Thickness of slabs: approx. 550 mm
Design axle load: 16 t
Velocity: 80 km/h
System natural frequency: 6 - 7 Hz

Nanjing Metro, China
underneath Golou Hospital

Completion 2004

Long slabs in tunnel, GSI-elements
Total length: 2 x 120 m
Thickness of slabs: approx. 460 mm
Design axle load: 14 t
Velocity: 80 km/h
System natural frequency*: 8 Hz



Bochum, Germany
Tramway

Completion 2005

Long ballast troughs in tunnel, GSI-elements
 Total length: 90 m
 Dead load: 7.8 t/m
 Design axle load: 10 t
 Velocity: 80 km/h
 System natural frequency: 6.4 Hz

Tokyo, Japan
Metropolitan Intercity Railway
Tsukuba Express
Nishi Ayase Tunnel
Completion 2004

Long slabs in tunnel, GSI-elements
 Total length: 2 x 272 m
 Design axle load: 15 t
 Velocity: 85 km/h
 System natural frequency*: 10 Hz

Tokyo, Japan
Metropolitan Intercity Railway
Tsukuba Express
Oosone Tunnel
Completion 2004

Long slabs in tunnel, GSI-elements
 Total length: 2 x 140 m
 Design axle load: 15 t
 Velocity: 130 km/h
 System natural frequency*: 10 Hz

Oslo, Norway
Wessels Plass

Completion 2004

Twin-track slab at grade above public building,
 KY-elements
 Total slab length: 25 m
 Design axle load: 10 t
 System natural frequency: 5 Hz

Beijing Metro, China
Line 5

Completion 2006

Long slabs in tunnel, GSI-elements
 Total length: 640 m
 Axle load: 14 t
 Velocity: 60 km/h
 System natural frequency*: 8 Hz

Moscow Subway, Russia

Completion 2006

Long slabs in tunnel, incl. for 4 turnouts & 1 diamond
 crossing
 Total length: 800 m
 Axle load: 15 t
 Velocity: 100 km/h
 System natural frequency*: 6.5 Hz

Yokohama, Japan
City Loop Line, Line 4

Completion 2006

Long slabs in tunnel, GSI-elements
 Total length: 2 x 520 m
 Axle load: 15 t
 Velocity: 80 km/h
 System natural frequency*: 9 Hz

Guangzhou Metro, China
Line 4

Completion 2006

Long slabs in tunnel, GSI-elements
 Total length: 2 x 350 m
 Axle load: 15 t
 Velocity: 80 km/h
 System natural frequency: 7 Hz



Metro Sao Paulo, Brazil
Line 2 Extension

Completion 2006

Long slabs in tunnel, GSI-elements

Total length: 953m
Axle load: 17.5 t
Velocity: 100 km/h
System natural frequency: 7 Hz

Heidelberg – Kirchheim, Germany
City Tram Line

Completion 2007

2 turnout slabs at grade, GSI-elements

Total length: 2 x 26 m
Axle load: 10 t
System natural frequency*: 7.5 Hz

Basle, Switzerland
Tram T-Crossing close to Concert Hall

Completion 2006

Long turnout slabs at grade, GSI-elements

Total length: 200 m
Axle load: 10t
System natural frequency: 5 Hz

Shanghai Metro, China
Line 1, North Ext.

Completion 2007

Long slabs on bridge, incl. turnout

Total length: 450 m
Axle load: 16t
System natural frequency: 9.3 Hz

Shanghai Metro, China
Line 2

Completion 2007

Long slabs in tunnel, GSI-elements

Total length: 360 m
Axle load: 16t
System natural frequency: 8.5 Hz

Beijing Metro, China
Line 10

Completion 2007

Long slabs in tunnel, GSI-elements

Total length: 2,740 m
Axle load: 14t
Velocity: 80 km/h
System natural frequency: 6.5 – 8 Hz

Beijing Metro, China
Line 4

Completion 2008

Long slabs in tunnel, GSI-elements

Total length: 3,824 m
Axle load: 14t
Velocity: 80 km/h
System natural frequency*: 6.5 – 8 Hz

London DLR, U.K.
Woolwich-Arsenal Extension

Completion 2009

Long slabs in tunnel, GSI-elements

Total length: 2 x 330 m
Axle load: 10 t
System natural frequency*: 7 Hz
Slab dead load: 3.25 t/m

Fukuoka, Japan
Hakata Station,
Railway station within shopping mall building
Completion 2009

Prefabricated ballast troughs, KY-elements

Total length: 8 x 96 m
Axle load: 17 t
System natural frequency: 7.5 Hz



**Chengdu Metro
Line 1**

Completion 2010

Long slabs in tunnel, GSI-elements

Total length: 1,340 m

Axle load: 14t

Velocity: 80 km/h

System natural frequency*: 8.4 Hz

**Shenzhen Metro, China
Line 1, Ext.**

Completion 2010

Long slabs in tunnel, GSI-elements

Total length: 4,387 m

Axle load: 16 t

Velocity: 80 km/h

System natural frequency: 6 + 8 Hz

**Shenzhen Metro, China
Line 2**

Completion 2010

Long slabs in tunnel, GSI-elements

Total length: 3,860 m

Axle load: 16 t

Velocity: 80 km/h

System natural frequency: 8.5*/7.6 Hz

**Shenzhen Metro, China
Line 3**

Completion 2010

Long slabs in tunnel, GSI-elements

Total length: 2,573 m

Axle load: 16 t

Velocity: 80 km/h

System natural frequency: 8.5*/7.7 Hz

**Metro São Paulo, Brazil
Line 2, 2nd Ext.**

Completion 2009

Long slabs in tunnel, GSI-elements, single track and
turnouts

Total length: 1,875 m

Axle load: 175 kN

Velocity: 100 km/h

System natural frequency: 5.9 Hz + 7 Hz

**Metro São Paulo, Brazil
Line 4**

Completion 2009

Long slabs in tunnel, GSI-elements

Total length: 1,145 m

Axle load: 175 kN

Velocity: 100 km/h

System natural frequency: 6.8 Hz

* dead load only

04/2009