

S-curved Microtunnel below the Swiss railway aorta and between piles



East of the City of Berne, Switzerland, a combined sewer had to be relocated to a deeper level to allow construction of an open-cut railway tunnel in the middle of the busy track field. A straight, direct alignment was not possible due to the piles of a building to be crossed and due to the hydraulic properties of the adjacent sewer structure. The solution was an S-shaped curve performed by microtunneling. Mining in soft ground, below railway tracks and between the piles of a highly frequented shopping mall, required special precautions, even more as the microtunnel was heading through the load distribution zone of the Franki piles (in-situ cast, reinforced concrete piles with pressure-injected footing) with expected sand lenses and groundwater. A tight annulus of only 10 mm (3/8 in) was chosen to minimize the effects of potential load redistribution between the piles and settlement monitoring of the rail tracks and the buildings was implemented to allow for quick reaction in case of disturbances. The Jackcontrol® Hydraulic Joint and Realtime Monitoring System were chosen not only to safely drive the curved microtunnel with regular pipe lengths, but also to monitor the development of joint rotation angles and skin friction in the high-pressure area adjacent to the piles.

AT A GLANCE

Project name	ZEB Berne Wylerfeld Entflechtung
Project location	Berne, Switzerland
Purpose	Combined Sewer
Time of completion	2017
Specialties	<ul style="list-style-type: none"> –4 railway lines in full service –Piled buildings –Shock-sensitive buildings –Soft ground
Total length	264 m / 866 ft
Pipe ID	1600 mm / 63 in
Pipe OD	1960 mm / 77.2 in
Alignment	S-curve
Min. curve radius	200 m / 656 ft
Pipe material	reinforced concrete
Pipe length	3 m / 9.8 ft
Geology & groundwater	Hard moraine (sandy gravel, dense), transitioning into backwater sediments (silty sands, clayey silt), waste deposits and rubble. Potential for quicksand. Two groundwater stories.
Hydraulic Joint	JC250 / single loop. Admissible jacking force 6'600 kN
Guidance system	VMT U.N.S. with water level
TBM	Herrenknecht AVND 1600
Owner/Client	City of Bern, Switzerland
Consultant/Designer	C + S Ingenieure AG, Switzerland
Contractor	Braumann Tiefbau GmbH, Austria,
Pipe manufacturer	HABA-Beton, Germany

Jackcontrol AG

Buchholzstrasse 50 | 8750 Glarus | Switzerland
 Phone +41 (0)55 650 20 20 | Fax +41 (0)55 650 20 30
 info@jackcontrol.com | www.jackcontrol.com