

Project data – raw construction Gotthard Base Tunnel

Length, depth and distances	
Total length of tunnel system	151.840 km
Length of Gotthard Base Tunnel, north portal Erstfeld - south portal Bodio	
• East tube	57.104 km
• West tube	57.017 km
Total both tubes	114.121 km
Crow flies:	
Portal north east – portal south east	55.782 km
Portal north west – portal south west	55.704 km
Length section Erstfeld (excl. cut and cover tunnel)	
East tube	7.778 km
West tube	7.705 km
of which	
- Cut-and-cover tunnel east tube	0.600 km
- Cut-and-cover tunnel west tube	0.558 km
- Underground east tube (conventional + TBM)	7.178 km
- Underground west tube (conventional + TBM)	7.147 km
Length section Amsteg	
East tube	11.330 km
West tube	11.350 km
Length access tunnel Amsteg	2.222 km
Length section Sedrun (incl. MFS)	
East tube	8.569 km
West tube	8.738 km
Length access tunnel Sedrun	909 m
Depth shaft I Sedrun	850 m
Depth shaft II Sedrun	820 m

Length section Faido (incl. MFS)	
East tube	13.456 km
West tube	13.523 km
Length access tunnel Faido	2.646 km
Length section Bodio (excl. cut and cover tunnel)	
East tube	15.971 km
West tube	15.702 km
of which	
- Cut-and-cover tunnel and portal east tube	0.423 km
- Cut-and-cover tunnel and portal west tube	0.419 km
- Underground east tube (loose rock + TBM)	15.548 km
- Underground west tube (loose rock and + TBM)	15.283 km
Length bypass tunnel Bodio	1.336 km
Length muck transportation tunnel Bodio – Buzza di Biasca	3.162 km

Drive length total system	151.840 km (100 %)
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Conventional drive (only the tubes)	20 %
Drive by tunnel boring machine (only the tubes)	80 %

Conventional drive	54.701 km (=36 %)
Excavation by blasting (conventional drive) (Sedrun section, cross passages, access tunnels, etc.)	66.311 km = 43.7 %
Excavation diameter in tunnel section with drive by blasting (single-track tunnels only)	8.80 to 13.08 m
Excavated cross section in the tunnel sections with conventional drive (incl. MFS)	60 to 250 m ²
Daily advance rate with conventional drive (single-track tubes only)	
Blasting length	0.8 to 4 m
Average advance rate in favourable rock conditions	3.0 to 4.5 m/wd
Average advance rate in unfavourable rock conditions	Approx. 1.0 m/wd
Max. advance rate, 20.10.2004, single-track tube Sedrun South East	11.5 m/wdy
Quantity of explosive per blast (liquid explosive)	Up to 400 kg
Depth of blasting holes	Up to 4 m
Number of drilled holes per blast	Up to 250 holes
Excavated volume per blast	Up to 250 m ³
Explosive type	Pumpable emulsion explosive, e.g. Emulga

Drive by tunnel boring machine (TBM)	97.139 km (64 %)
Main sections excavated with TBM	
<ul style="list-style-type: none"> • Erstfeld east • Erstfeld west • Amsteg east • Amsteg west • Faido east • Faido west • Bodio east • Bodio west 	<p>7.151 km</p> <p>7.118 km</p> <p>10.723 km</p> <p>10.703 km</p> <p>11.134 km</p> <p>11.086 km</p> <p>13.450 km</p> <p>14.113 km</p>
Total main sections	85.477 km = 74.9 %
<ul style="list-style-type: none"> • East tube • West tube 	<p>42.458 km</p> <p>43.019 km</p>
Auxiliary structures	
<ul style="list-style-type: none"> • Piora exploration bore • Bodio spoil tunnel • Amsteg cable tunnel 	<p>5.540 km</p> <p>3.162 km</p> <p>1.884 km</p>
Shafts	
<ul style="list-style-type: none"> • Shaft II, Sedrun • Sedrun, ventilation shaft 	<p>0.820 km</p> <p>0.255 km</p>

Drive by tunnel boring machine (TBM)	97.139 km (64 %)
Number of machines	4 machines
Excavation diameter in tunnel sections with TBM drive <ul style="list-style-type: none"> • Erstfeld • Amsteg • Faido • Bodio 	9.58 m 9.58 m 9.43 m 8.83 m
Length of TBM (incl. trailer) <ul style="list-style-type: none"> • Erstfeld and Amsteg • Faido • Bodio 	441 m 450 m 377 m
Weight of TBM <ul style="list-style-type: none"> • Erstfeld and Amsteg • Faido • Bodio 	3'000 t 3'400 t 2'500 t
Driving power of TBM (10 motors)	3'500 kW
Total installed power	7'800 kVA
Feeding force	27'500 kN (at 350 bar)
Max. permissible contact pressure drilling head	15'930 kN
Drilling head revolutions	Max. 6 rpm
Number of roll chisels in the TBM cutter head <ul style="list-style-type: none"> • Erstfeld and Amsteg • Faido • Bodio 	62 roll chisels 66 roll chisels 60 roll chisels

Advance rates achieved			
Average advance rate (per theoretical driving day, i.e. incl. downtime)			
• Erstfeld east / west		14.27 / 14.21 m/wd	
• Amsteg east / west		11.05 / 10.60 m/wd	
• Faido		10.50 / 9.92 m/wd	
• Bodio		10.83 / 11.76 m/wd	
Advance rate excl. downtime (per actual driving day = TBM performance)			
• Erstfeld east / west		18.06 / 17.57 m/wd	
• Amsteg east / west		14.07 / 15.83 m/wd	
• Faido		12.41 / 12.50 m/wd	
• Bodio		12.47 / 14.04 m/wd	
Maximum performance			
• Erstfeld (18.07.2009 TBM West) on 18/19.7.2009 in 24 h		39.0 m/wd 56.0 m/wd	
• Amsteg (09.07.2004 TBM West)		40.1 m/wd	
• Faido (09.11.2008 TBM West)		36.0 m/wd	
• Bodio (10.12.2005 TBM East)		38.4 m/wd	
Breakthrough			
Bodio – Faido east	(15 km)	Sissi	11.2002 – 06.09.2006
Bodio – Faido west	(15 km)	Heidi	12.2002 – 26.10.2006
Amsteg – Sedrun east	(11,4 km)	Gabi I	05.2003 – 29.11.2007
Amsteg – Sedrun west	(11,4 km)	Gabi II	10. 2003 – 17.10.2007
Erstfeld – Amsteg east	(7,1 km)	Gabi I	12.2007 – 16.06.2009
Erstfeld – Amsteg west	(7,1 km)	Gabi II	04.2008 – 16.09.2009
Final Breakthrough			
Faido – Sedrun east	(12 km)	Sissi	07.2007 – 15.10.2010
Faido – Sedrun west	(12 km)	Heidi	09.2007 – 23.03.2011

Heights above sea level and height differences	
Rail upper edge at north portal Erstfeld	460 m
Rail upper edge at south portal Bodio	312 m
Culmination point	
East tube	Tkm 121.733
• from north portal	22.006 km
• from south portal	35.098 km
• height	549.37 m asl
West tube	Tkm 221.760
• from north portal	21.960 km
• from south portal	35.057 km
• height	549.36 m asl
Maximum gradient north of culmination point	4.055 ‰
Maximum gradient south of culmination point	6.76 ‰
Difference in height from north portal at Erstfeld to apex	89 m
Difference in height from south portal at Bodio to apex	237 m
Geometrical parameters of the track inside the tunnel	
Horizontal radius	Rh, min. 5'000 m
Vertical radius	Rv, min. 25'000 m
Travel speed inside the tunnel	Max. 250 km/h
Geometrical parameters of the track outside the tunnel	
Horizontal radius	
• Newly constructed section Gotthard North	Rh, min. 5'000 m
• Newly constructed section Gotthard South	Rh, min. 3'200 m
Vertical radius	
Min. Gotthard North	Rv, min. 25'000 m
Min. Gotthard South	Rv, min. 6'000 m
Maximum gradient north ramp	7 ‰
Maximum gradient south ramp	15 ‰
Travel speed outside tunnel	Max. 250 km/h

Various facts and figures	
Standard distance between tunnel axes	40 m
Maximum distance between tunnel axes	70 m
Multifunction stations (Sedrun and Faido)	2 MFS
- each with one emergency stop station per direction of travel	4 emergency stops
- each with two track crossovers (tube interchanges)	4 crossovers
Total number of cross passages	178 cross passages
Standard distance between cross passages	325 m
Number of fixed points for surveying the Gotthard Base Tunnel (incl. overground section, surface area and tunnel)	670 fixed points
Maximum rock overlay	2'450 m
Maximum rock temperature	Approx. 46° C
Maximum work temperature	28° C
Persons employed, including engineers, geologists, owner, etc.	2'600 persons
Bench on non-rescue side, height above upper edge of rail	0.15 m
Bench on rescue side, height above upper edge of rail	0.35 m
Bench in multifunction station, height above upper edge of rail	0.55 m
Height of overhead conductor above upper edge of rail on overground section	5.4 m
Height of overhead conductor above upper edge of rail in tunnel	5.20 m

Spoil management	
Total volume of excavated rock	28.2 mil. t (100 %)
Quality A material → suitable as aggregate for concrete	9.3 mil. t (33 %)
Quality B material → for embankments, deposits and recultivation	18.7 mil. t (66.3 %)
Quality C material → hazardous waste landfill	0.2 mil. t (0.7 %)
Length of the conveyor belts for transporting the excavated rock	Around 70 km

Material consumption	
Concrete	4.0 mil. m ³
Cement	1.4 mil. t
Steel rings	125'000 t
Steel mesh	3 mil. m ²
Rock anchors	4'800 km
Reinforcement	16'000 t
Sealing and drainage foil, vault	2.85 mil. m ²

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