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MALMÖ CITYTUNNEL GROUP

January 29, 2008

Construction of tunnels, shafts and cross passages

by Johannes Truschel

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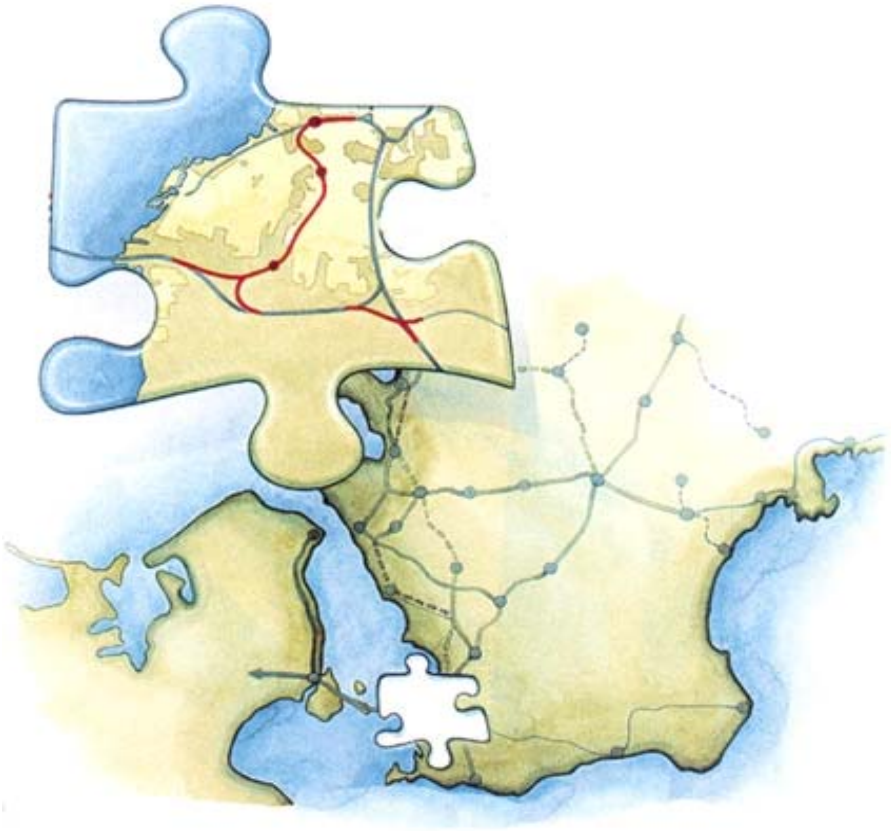
The Group

Malmö Citytunnel Group is a joint venture consisting of the German company Bilfinger Berger AG and the two Danish companies Per Aarsleff A/S and E. Phil & Søn A.S. The three contractors belong to the European elite in the field of civil construction.

BILFINGER BERGER

AARSLEFF

pihl



Malmö Citytunnel

A piece in the puzzle that will:

1. Increase the competitiveness of the railbound public transport in Skåne
2. Contribute to an improvement of the integration in the Öresund region
3. Strengthen the competitiveness of the national railroad traffic
4. Reduce the environmental problems along the Continental Line
5. Strengthen the development of localities with railroad connections in Skåne
6. Strengthen Malmö City Center as being the center of the region
7. Constitute a step towards an environmentally adjusted transportation system and a long-term lasting society

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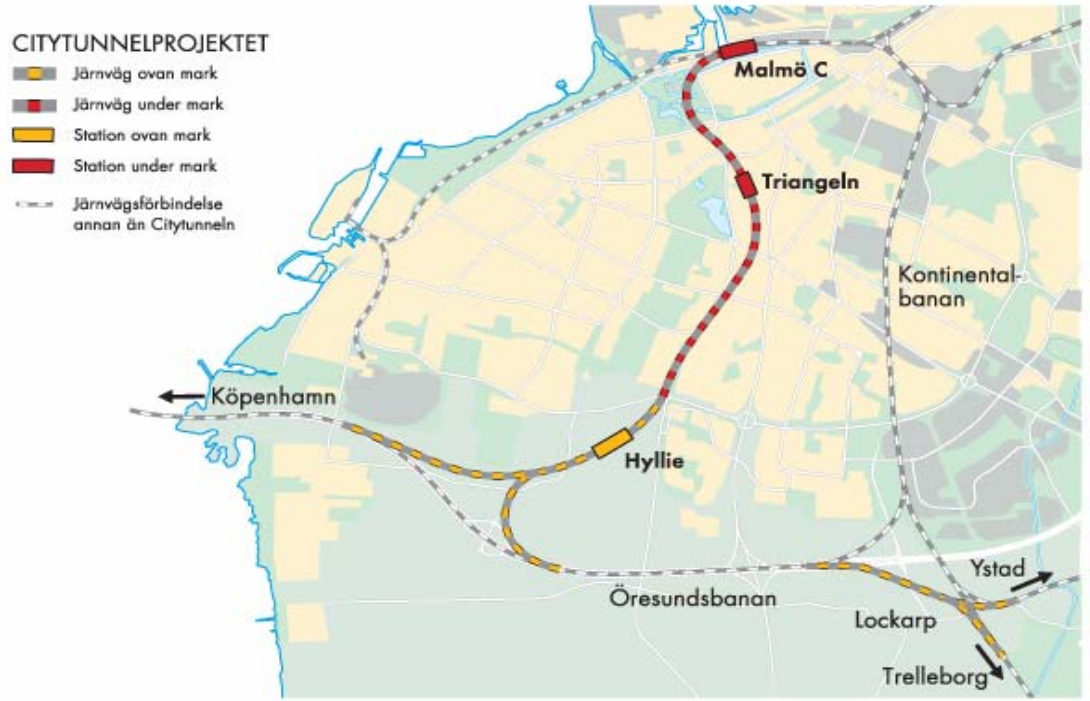


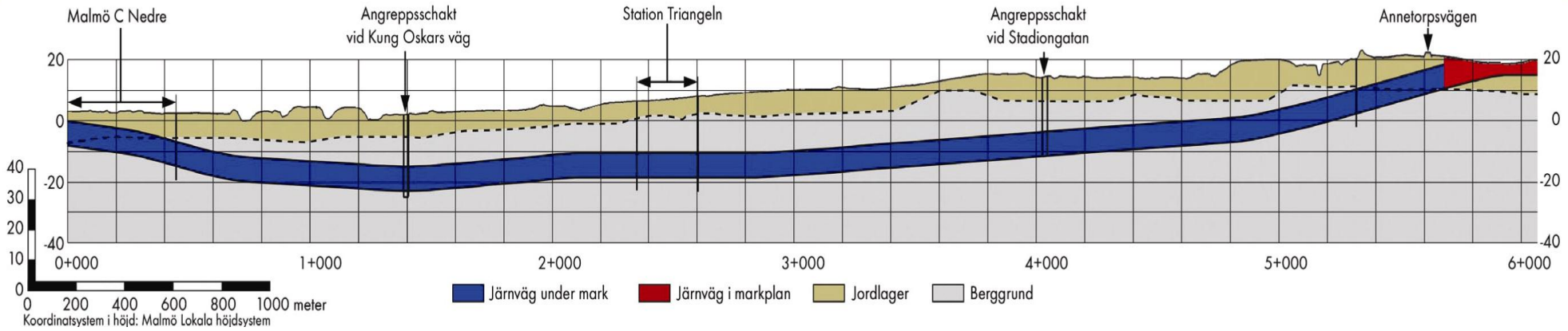
The project as a whole consists of a number of contracts, of which a dozen is procured today.

MCG's part consists of:

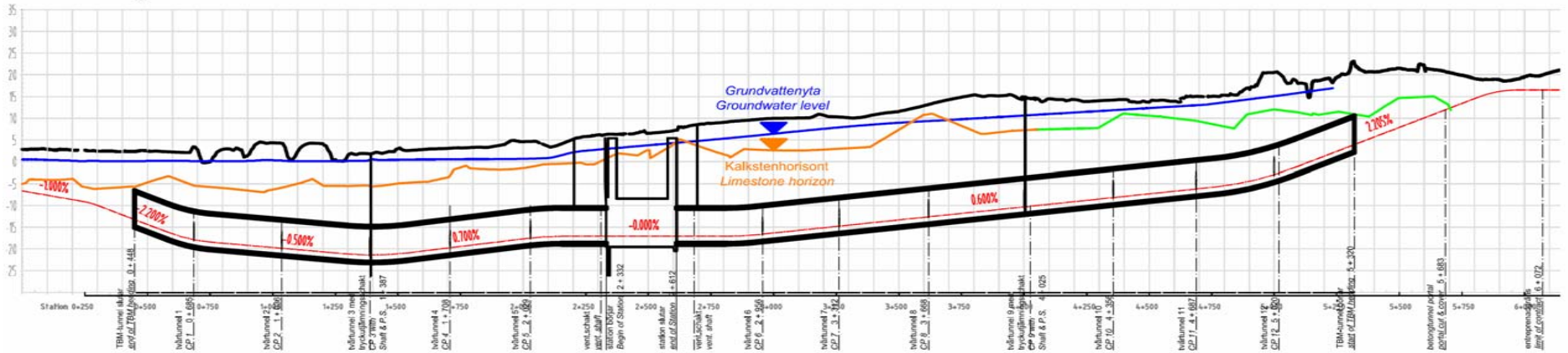
- two 4,6 kilometre bored tunnels
- ramp and excavated tunnel section in Hyllie
- the rock cavity at Triangeln, where Triangeln station is located
- 13 cross tunnels between the main tunnels
- two access shafts
- four pressure equilization shafts
- road bridge over ramp

MCG are boring the two 4,6 km long tunnels that will run below Malmö.

The tunnels are part of the 17 km electrified railway which connects Malmö Central Station and the Öresund bridge



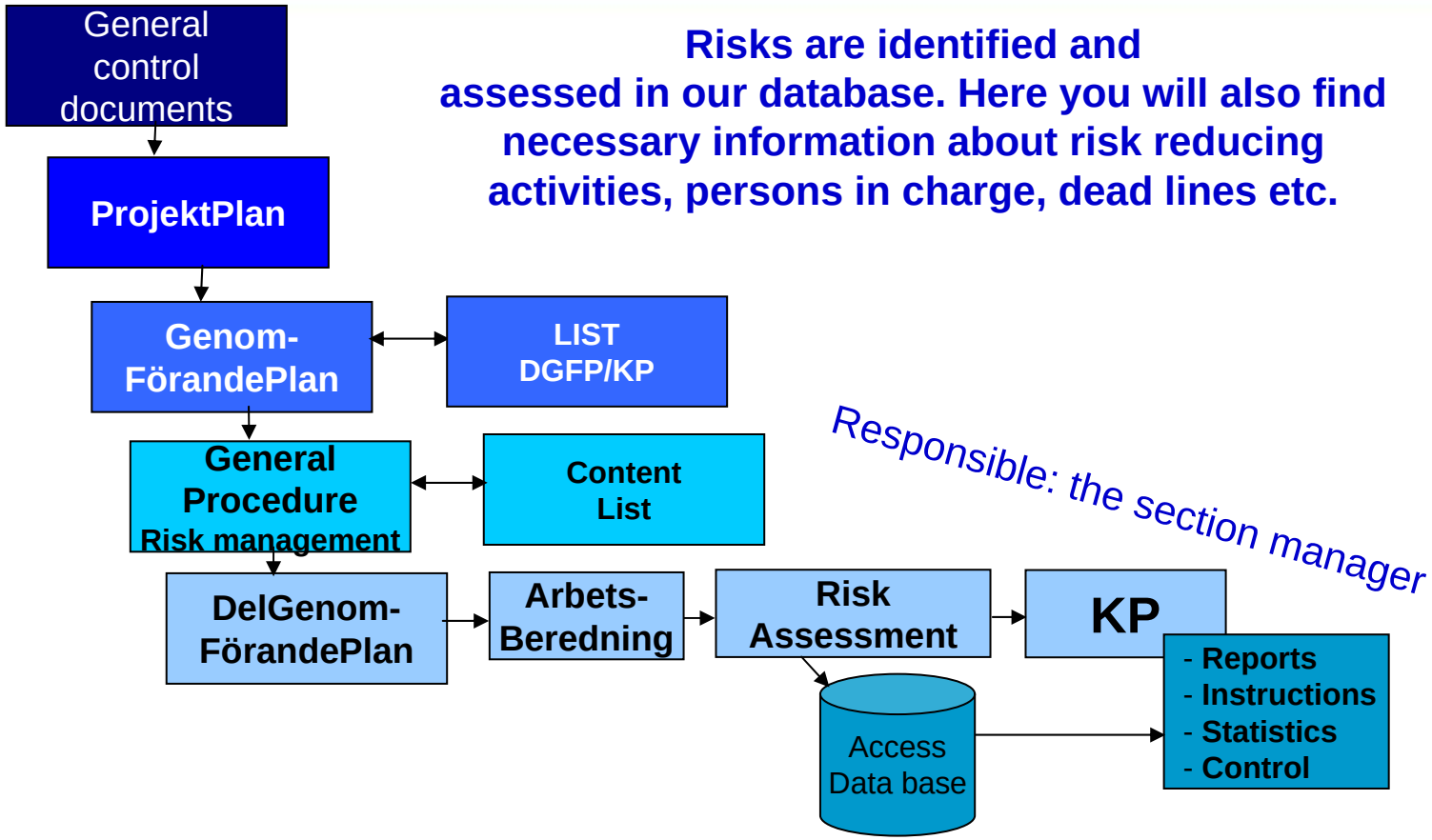
longitudinal section track No. 74



Tender bid evaluation

- Price 60%
- Cooperation capacity, management and organisation 20%
  - in connection with evaluation cooperation capacity, management and organisation the builder will attach great importance to:
    - systems and routines for establishing and maintaining cooperation forms
    - organisation structure with short decision channels and clear distribution for responsibility and competence for decision makers,
    - relevant experience and education for key staff,
    - structure, contents and connection of project plans to the execution of the works contract
    - system and routines for risk management documented in the project plan
- Environment and work environment 10%
- Technique 10%

Risks are identified and assessed in our database. Here you will also find necessary information about risk reducing activities, persons in charge, dead lines etc.



RISK MANAGEMENT AT MCG

- Not only contractual requirement but actively used
- Fully integrated from design phase to completion
- Risks discussed and shared with the Client
- Risk sessions (discussions) involving all disciplines as well as Client representatives for each major work activitiy

These risk areas must be considered…

- Health and Safety
- Environment
- Finance
- Time
- Confidence/Public Opinion
- Property
- Third party injury
- Third party property

Risk rating

		S - Severity				
		1	2	3	4	5
L - Likelihood	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

A-Acceptable for all areas	A-Acceptable for all areas except HS + IP3 + E	R-to be Reduced if possible	U-Unacceptable

The Risk database, start page

Start page
Log out
Register
- Add new risk
- Risk list
- My risk list

Follow up
- Follow up mitigating actions
- My mitigating actions
- Implementation date passed
- Implementation date within one week

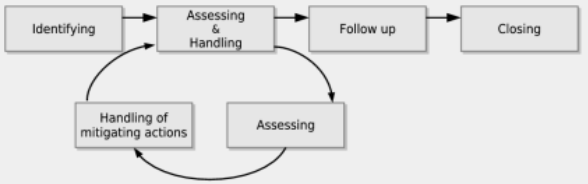
Search
- Rapid Searching
- My Searchings

Reports
- Standard Reports
- My Reports
- WBS Reports
- Formatted Reports

Basic data
- Users
- WBS
- Phases
- Risk Groups
- Risk Areas
- Damage Groups
- Damage Events
- Consequences
- Frequencies
- Status
- Risk Levels

Admin functions
- Copy risk
- Move risk
- WBS functions
- Upload WBS file
- Import risks
- Export risks

Risk Management



Not assessed risks

Risk ID	Phase	Risk name	Responsible
201.F.A-01	Project	Settling	skjold
201.F.A-02	Project	Landslide	skjold
201.F.A-03	Project	Noise	skjold
201.F.A-04	Project	Fall down of limestone	skjold
201.F.A-05	Project	Collision between vehicles	skjold
201.F.A-06	Project	Collision with pedestrian	skjold
201.F.A-08	Project	Increased volume of grout	skjold
201.F.A-09	Project	Boring of rock anchors-Personal Injury	skjold
201.F.A-10	Project	Collapse of anchor	skjold
201.F.A-11	Project	Spraying of concrete-Personal Injury	skjold

Latest

Risk ID	Risk name
201.TEST-03	Underground test
201.G.C-01	Cross Passages - Pumped water
201.G.D-04	Formworks
201.G.D-03	Placing of reinforcement
201.G.D-02	Hot works
201.G.D-01	Concrete-works
201.G-58	TBM-shield rotation
201.G-57	TBM dives
201.G-56	Clogging of wells
201.G-55	Clogging of wells
201.TEST-02	Testing

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SITE HOLMA

- Site establishment, workshop, warehouse, office
- 440 m ramp / 360 m cut-and-cover tunnel
- TBM start area
- Conveyor belt station with storage for mucking
- Batching plant
- Segment factory with segment storage

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- 2 SKAKO plants (2,0 m^3 and 1,5 m^3 mixers)
- 10 000 m^3 monthly
- 240 000 m^3 total
- Microsilica and PP-fibres dosing
- Delivery by mixer tracks and conveyor bucket


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MUHLHAUSER


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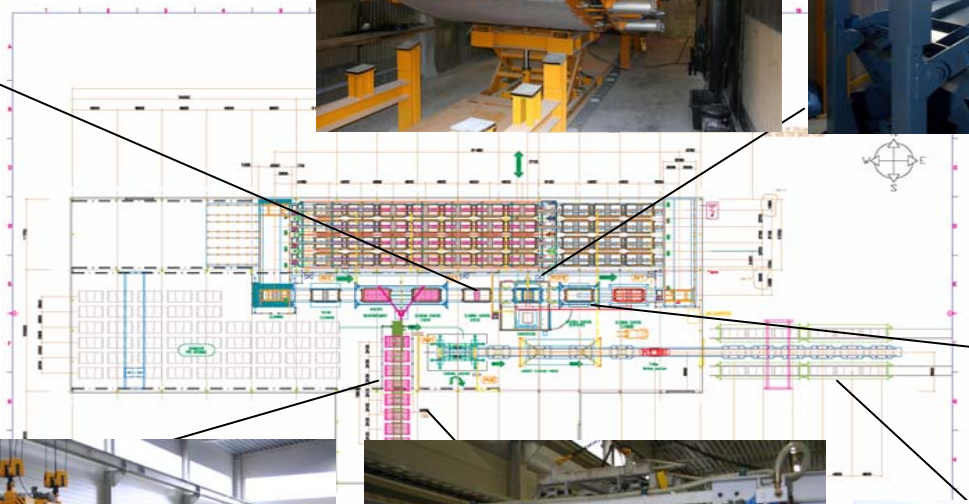
Details segment lining

- Number of segments: 7+1
- Length of segments: 1 800 mm (in middle)
- Tapering: 50 mm
- Diameter (outside/inside): 8 600 mm / 7 900 mm
- Thickness: 350 mm
- Weight per ring: 42 ton
- Number of segments: 40 960
- Number of rings: 5 120
- Concrete volume per ring / total: 16,33 m^3 / ~ 84 000 m^3



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September 2005

April 2006

October 2007

TBM Data

• Supplier	Herrenknecht, Germany
• Type	EPB – Shield Earth Pressure Balance
• Lenght	10 m shield + 110 m backup
• Diameter	8.90 m
• Power	4MW
• Groundwater	max. 25 m above base
• Excavation	580.000 m^3 (solid)

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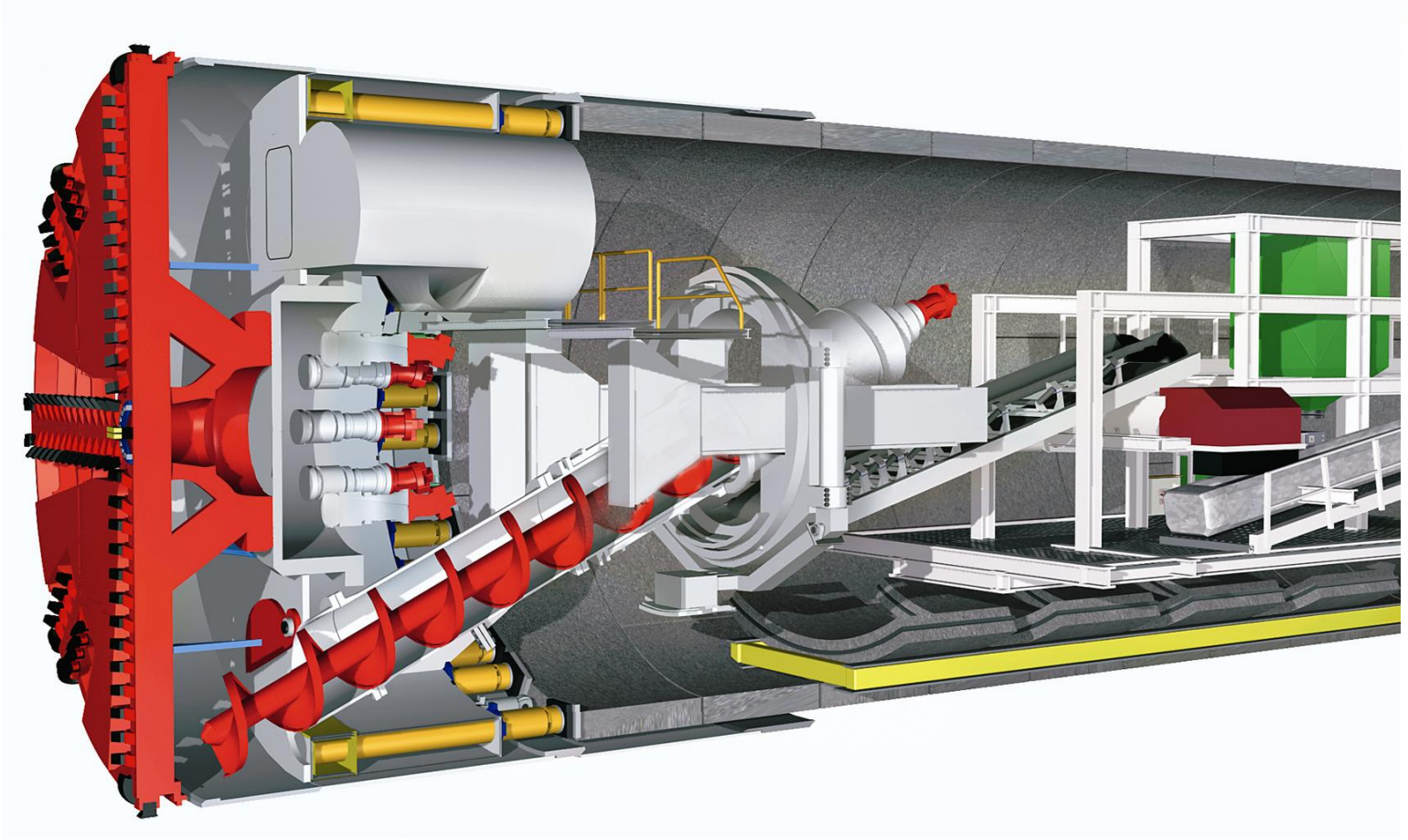
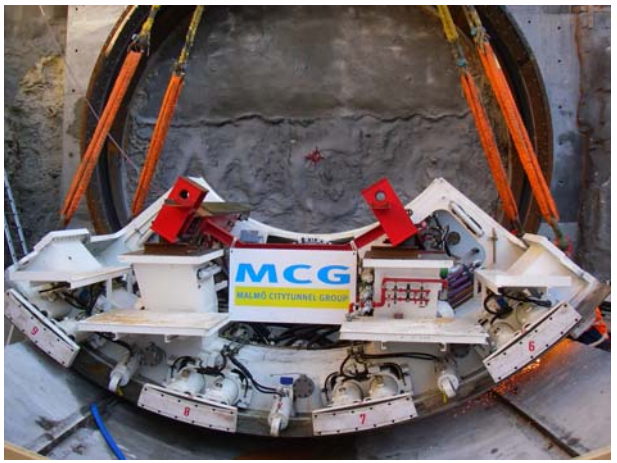
14
1
2
3

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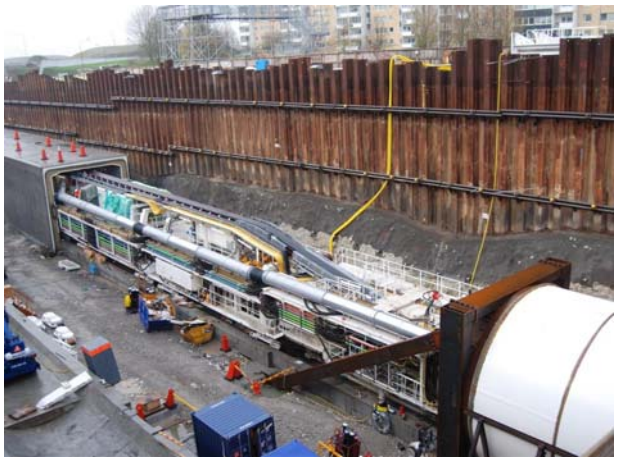
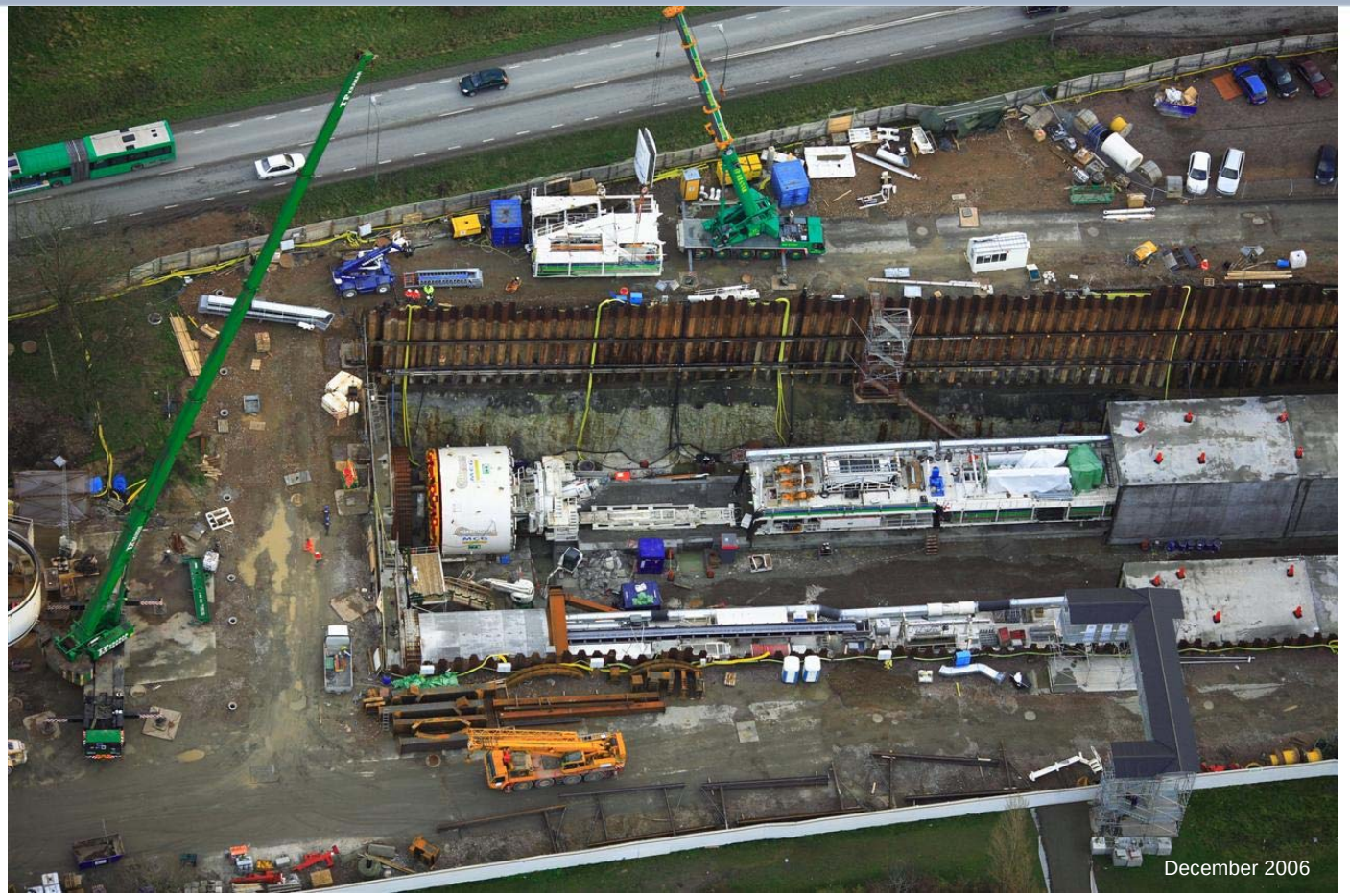
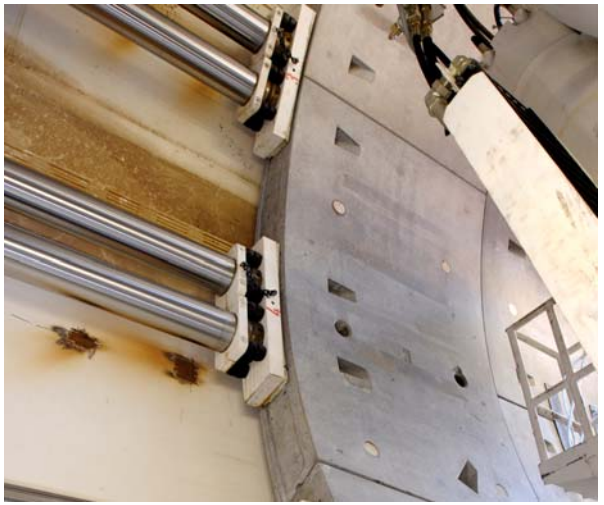




December 2006

Naming cermony

December 4, 2006 and 2007

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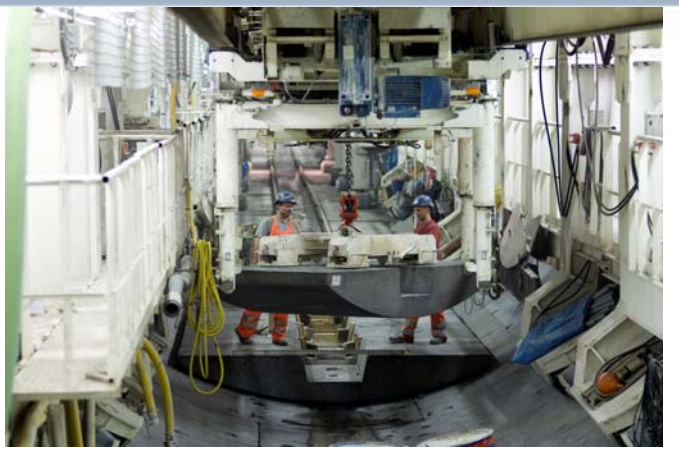

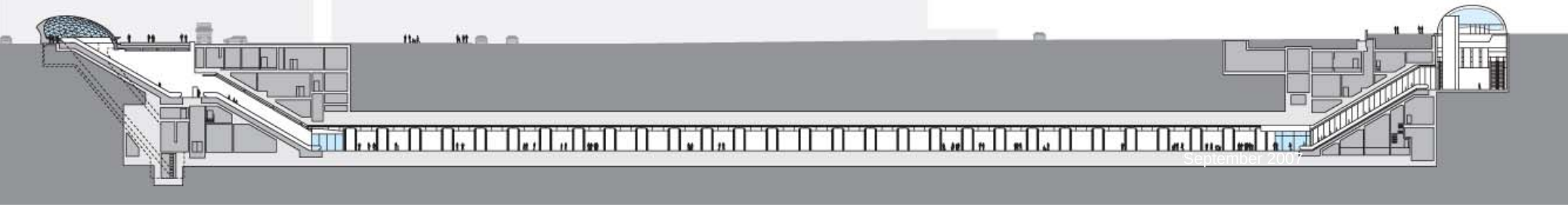

September 2007

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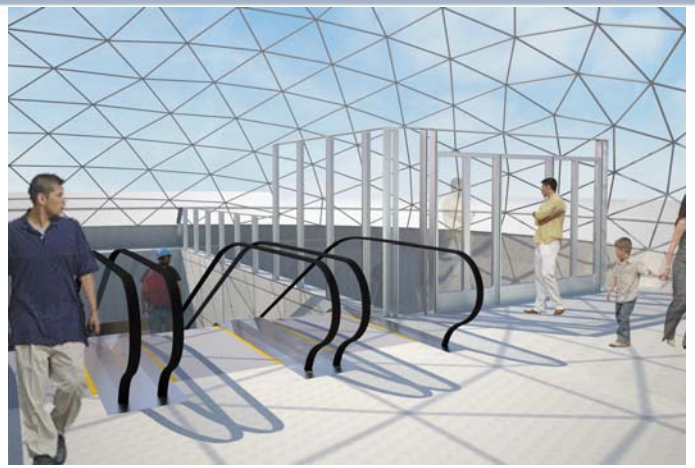
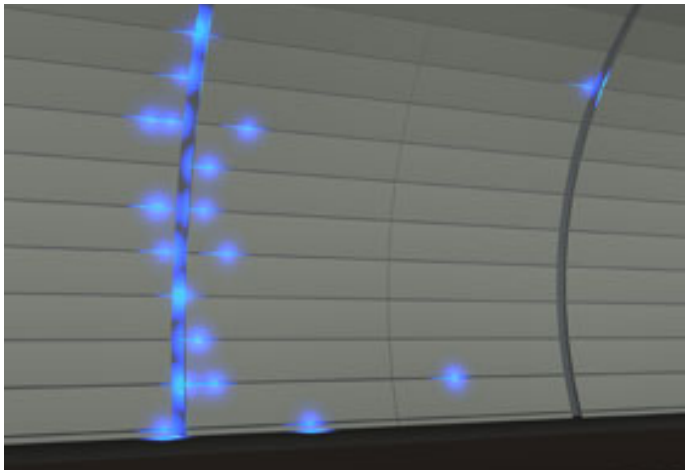
FFNS/KHRAS joint venture





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SITE TRIANGELN

Rock cavern builds the new underground station

- Lenght 285 m
- Widht 26 m
- Invert level about 25 m below ground level
- Excavated by mechanical excavation in sequences
- One pillar tunnel
- Two side tunnels, lenght 197 m

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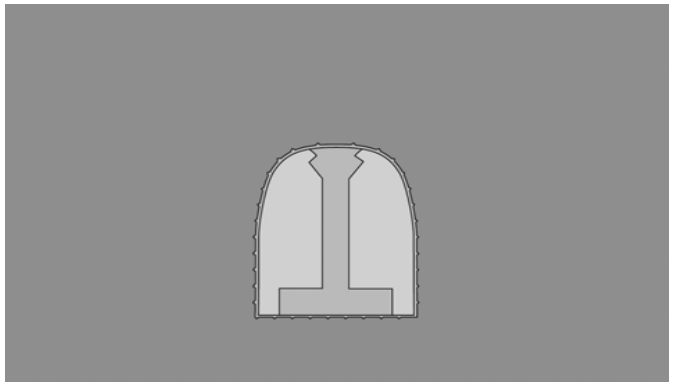
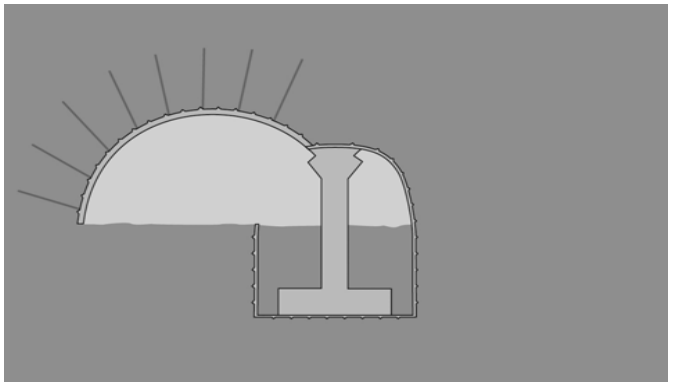
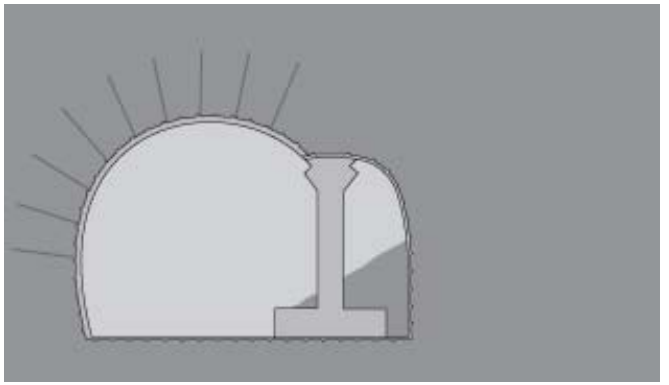
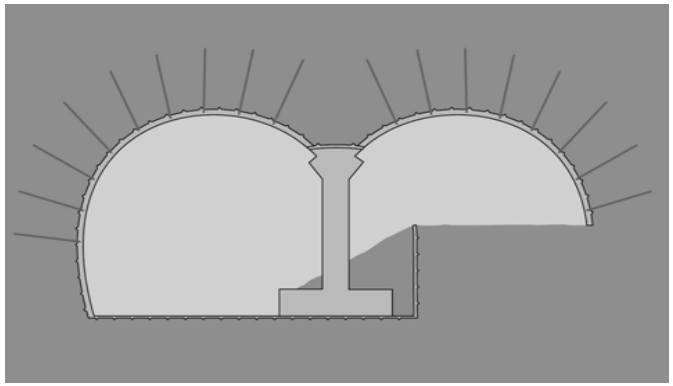
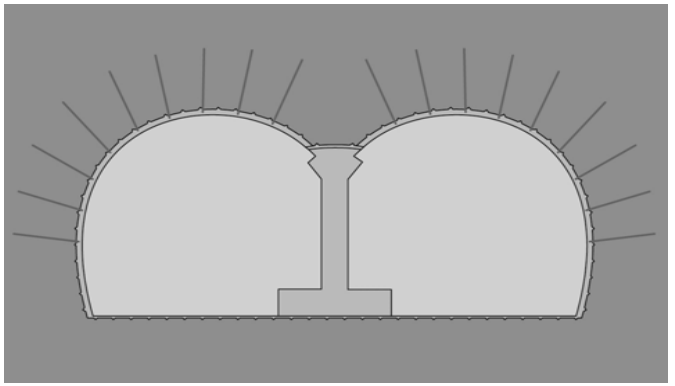
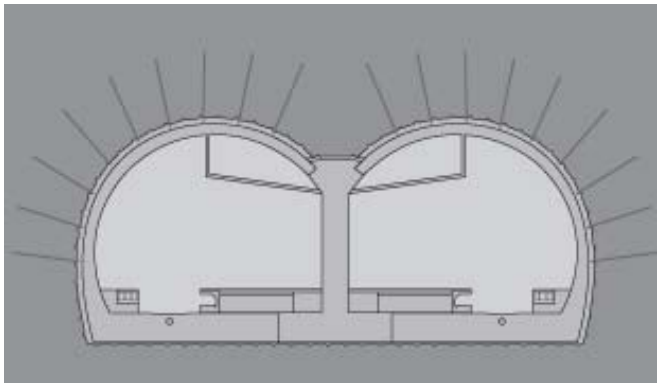


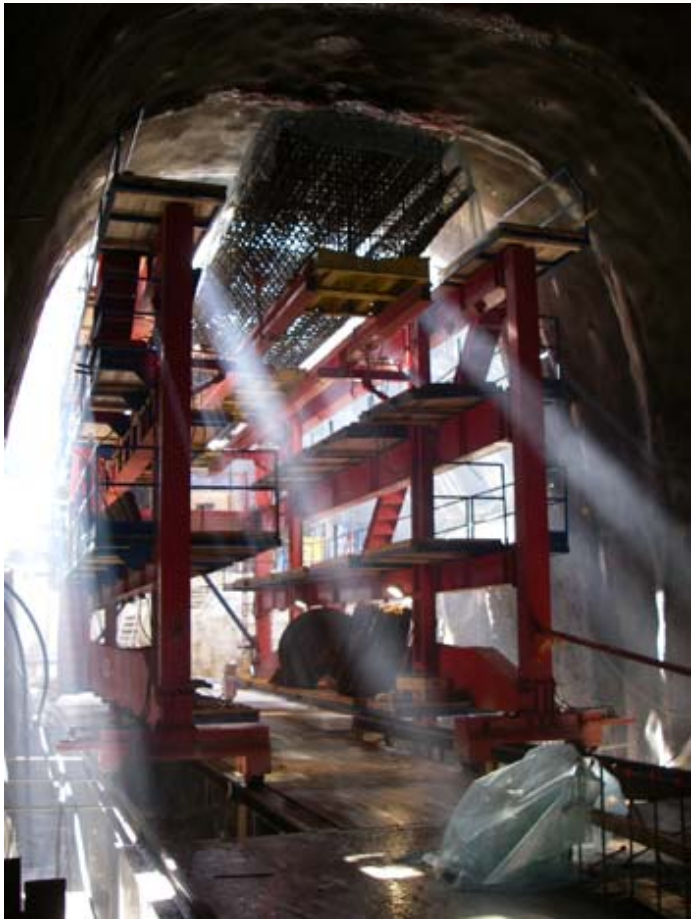


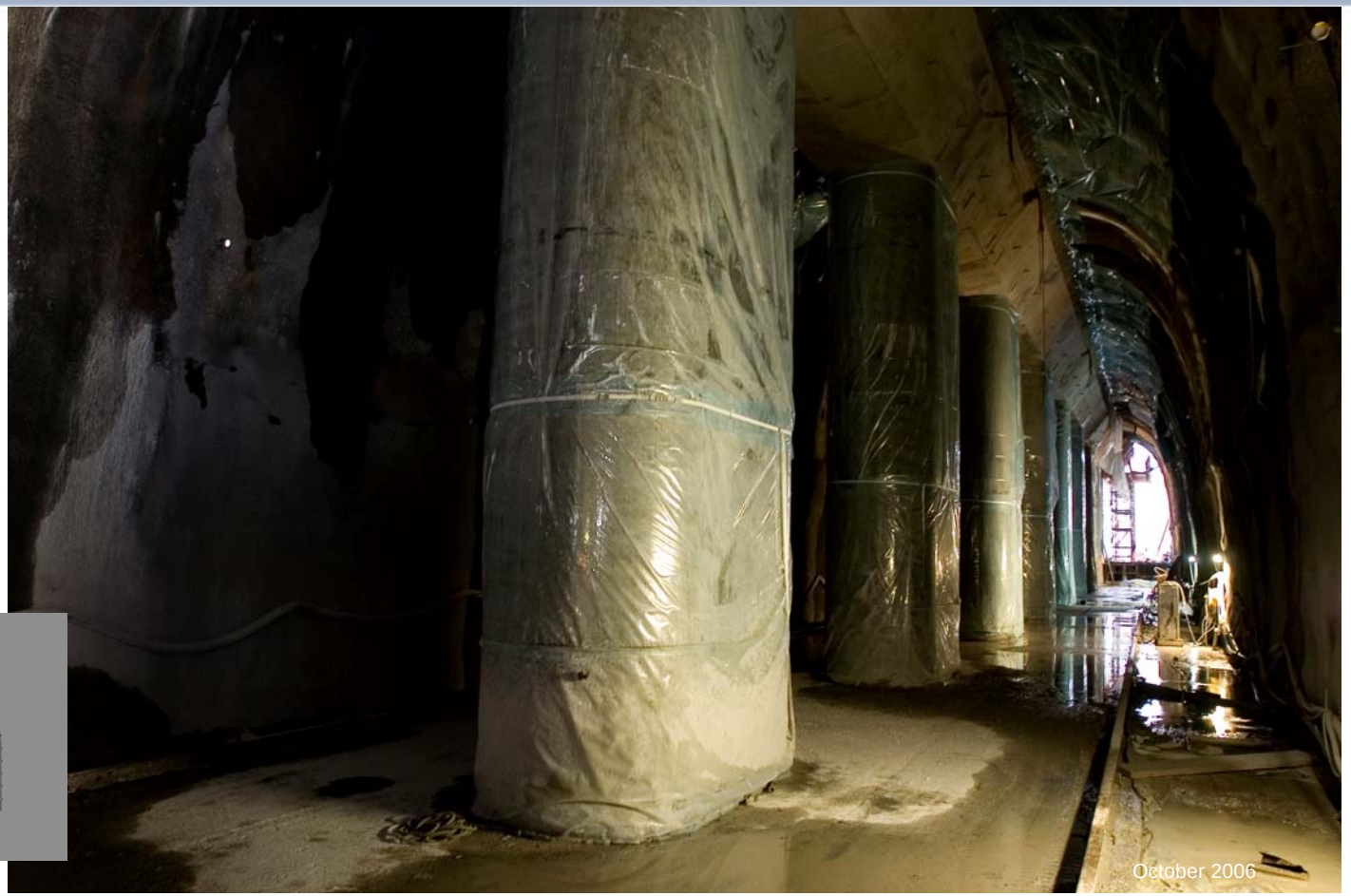




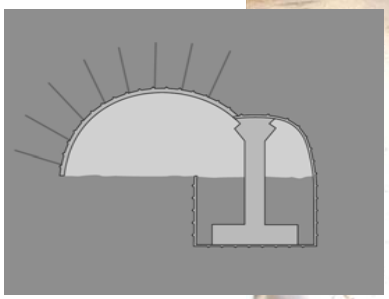




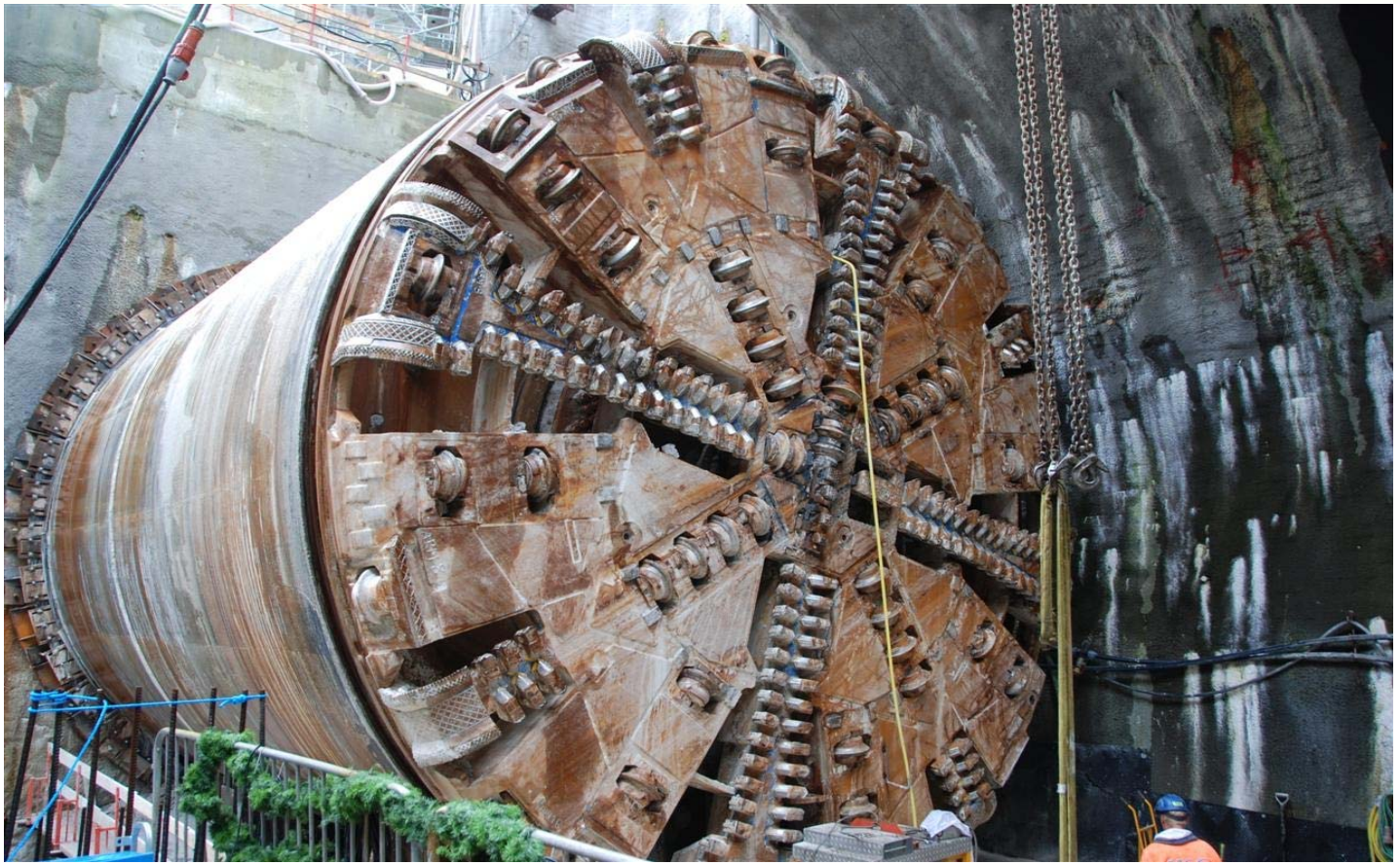


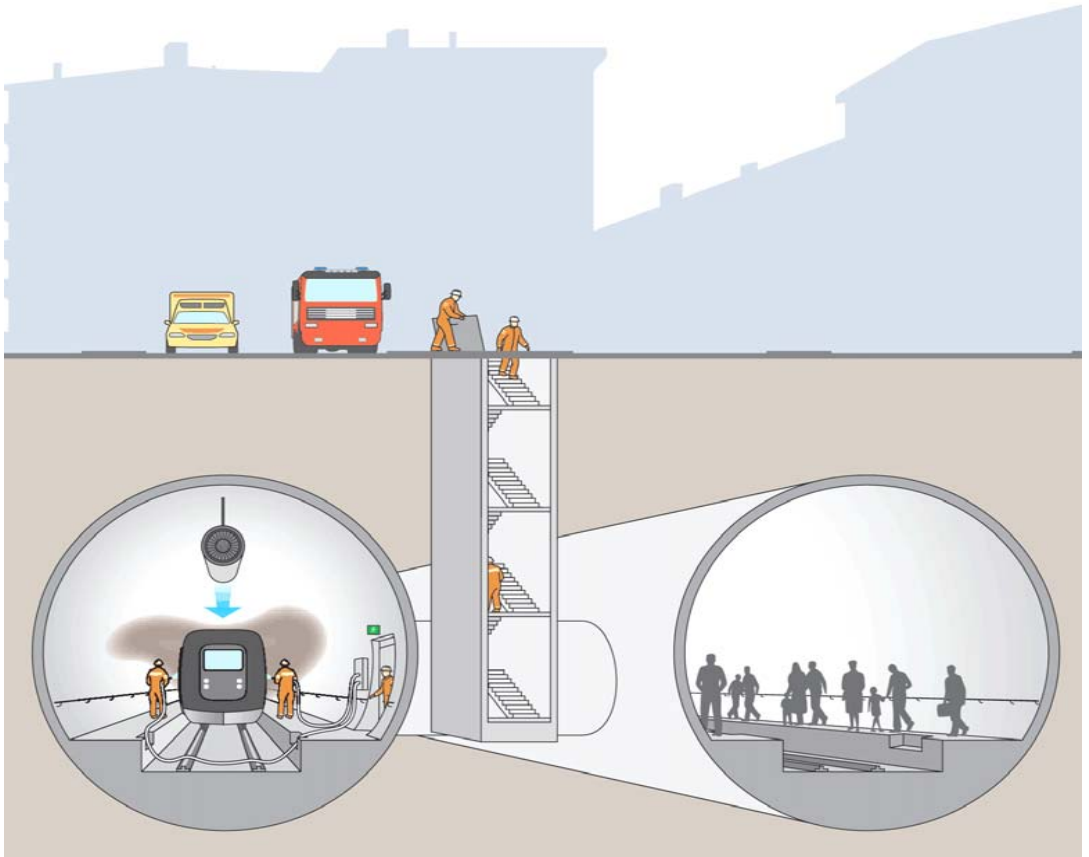


October 2006



February 2007





ACCESS SHAFT STADIONGATAN AND KUNG OSCARS VÄG

Access for the fire fighters…
….to the tunnel in case of a fire
.....in each quarter of the tunnel lining

September 2006

May 2007

December 2007

WORK AREA NORTHERN HARBOUR

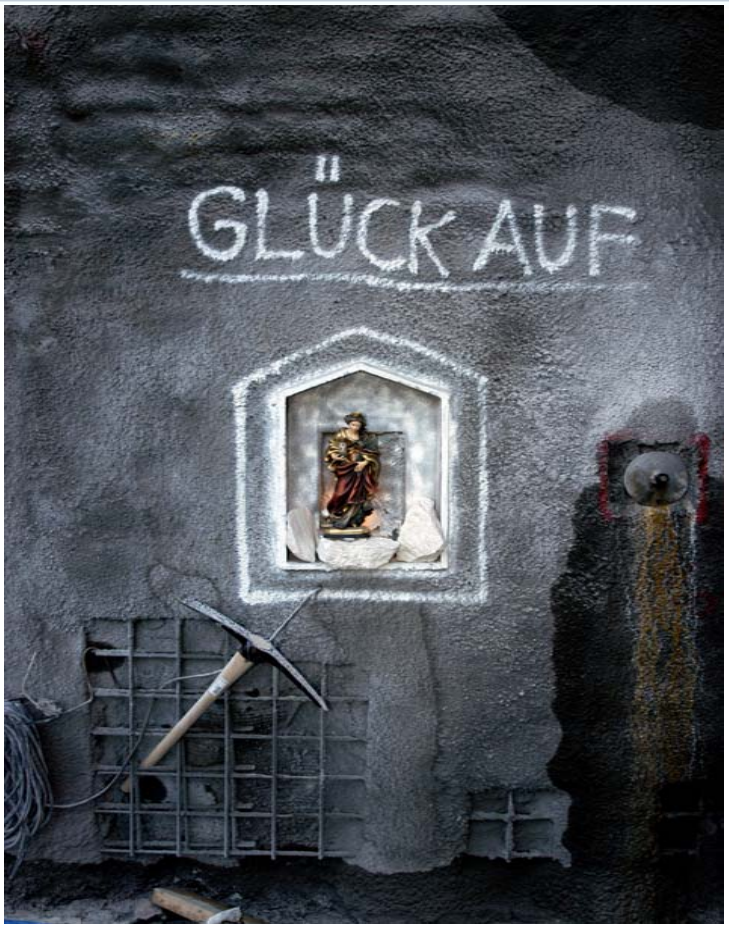
September 2005

November 2007

Here we are now

Timetable

• December 2003	-	Submission
• November 2004	-	Signing of contract E201
• April 2005	-	Construction start
• December 2006	-	TBM handling
• April 2007	-	Completion of rock chamber Triangeln
• Spring 2008	-	Completion of TBM-drives
• Summer 2009	-	Completion of Contract E201
• 2011	-	Inauguration of Citytunnel


GLÜCK AUF