



ANDERSENS MEK. VERKSTED AS

Bever Control AS (control systems supplier)

Norwegian Innovative Tunnelling Equipment

Singapore Workshop 17-18 feb 2009

Norwegian Method of Tunnelling – Technologies and Practice

NORWEGIAN INNOVATIVE TUNNEL EQUIPMENT

HARD ROCK TUNNELING IN NORWAY

Presented by:

Per Gunnar Andersen, President of AMV
Thorvald Wetlesen, President of Bever Control



Control systems supplier



NORWEGIAN INNOVATIVE TUNNEL EQUIPMENT

Drilling Jumboes
Shotcrete robots
Working platforms
Grouting systems
Special products

Computer control systems
Profile scanning of excavation
Planning and reporting
systems



Control systems supplier



AMV Company

- Privately owned family company since 1860
- Main products within tunnel/mining industry and offshore industry
- ~40% of production is export
- Certified through ISO 9001 and 14001
- 11000m2 of modern production facilities including:
 - Engineering department
 - Machining shop
 - Welding and fabrication shop
 - Assembly shop
 - Electrical shop
 - Painting and sandblasting facilities
 - Warehouse and shipping



Deliveries to:

-Scandinavia, Germany, Spain, Italy, France , China, Singapore, Japan, Korea, USA



Control systems supplier





- Norwegian contractors introduced the concept of computer controlled drilling as early as 1974
- The first AMV computer controlled jumbo was set in operation in 1979
- Bever Control is the pioneer company for this technology worldwide
- We have delivered our system to more than 180 drilling jumbos and has set the standard for the performance of computer controlled drilling rigs system

AMV Total Supplier of Tunneling & Mining Equipment

Recognized Global Supplier

Drilling Jumbos

Shotcrete robots

Grouting Equipment

Working platforms

Auxilliary Equipment (Service Containers, Cable Reels)

Special Equipment for tunnel & mining industry



Control systems supplier



Our Products

AMV 21 SGBC-CC

Highlights includes:

- 3 Boom Jumbo
- Bever Control System
- Cross section up to 11,3mx17m
- Montabert HC110 Drifters
- 18" Feeders Standard (10"-22" Available)
- Low emission Deutz diesel engine
- Man basket SWL 450 Kg / 700 Kg



Control systems supplier



Our Products

AMV 2ABC-CC

Highlights includes:

- 2 Boom Jumbo
- Bever Control System
- Cross section up to 8mx13,2m
- Montabert HC110 Drifters
- 18" Feeders Standard (14"-18" Available)
- Low emission Deutz diesel engine

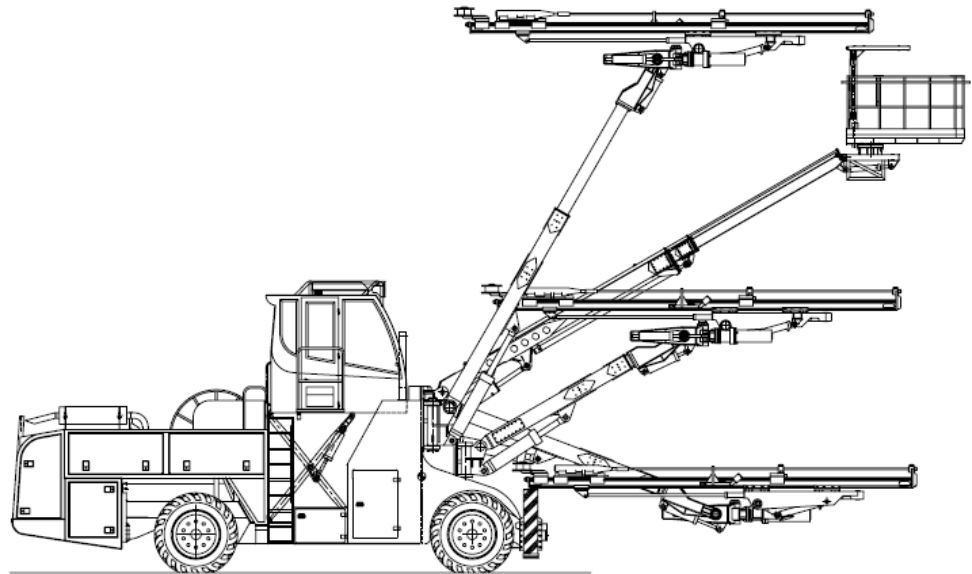


Control systems supplier



Benefits of AMV CC drilling rigs

- Efficient drilling time / Optimizing of drilling pattern
- Drillsteel usage
- Reduced overbreak
- Measurement While Drilling (MWD)
- Surveying
- OS system and benefits
- Service and maintenance
- Montabert HC110



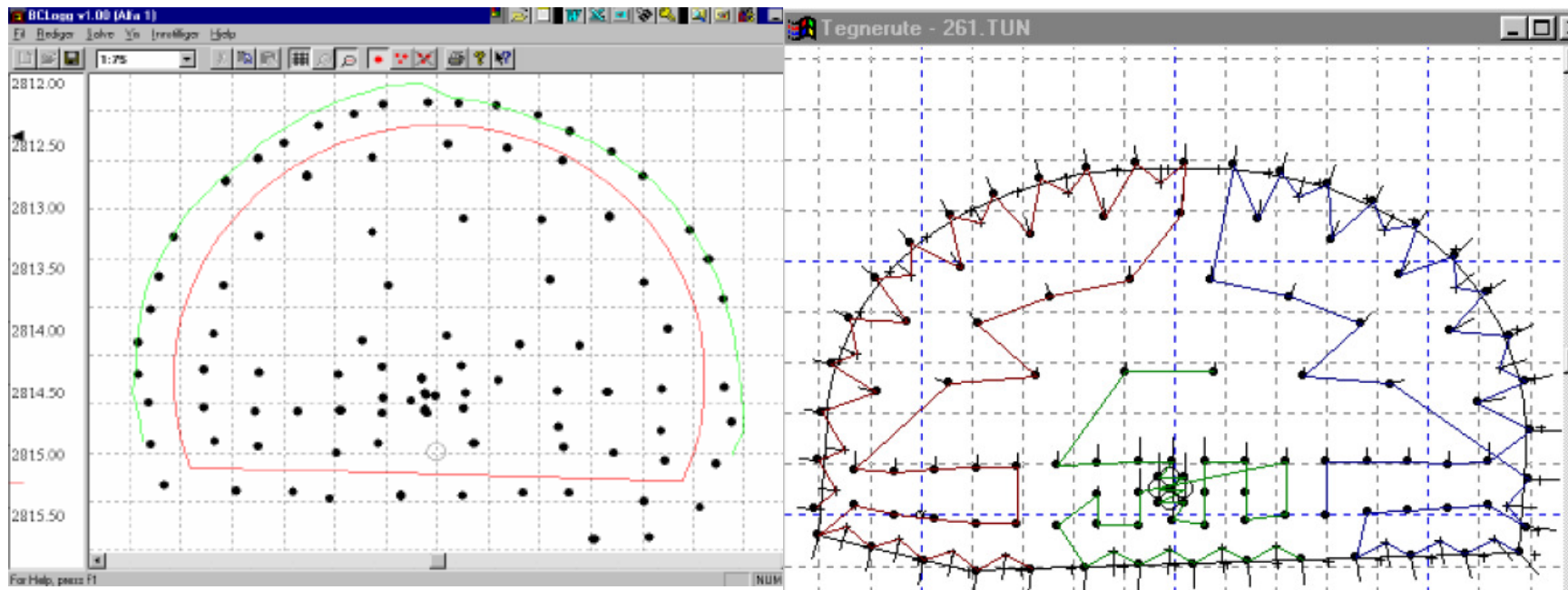
Control systems supplier



Benefits of CC drilling rigs

1. Efficient drilling time / Optimizing of drilling pattern

- Reduced no of holes by **10-15 %** due to accurate drilling and accurate distance in bottom of holes
- Longer rounds possible due to more accurate drilling
- Better blasting and direction control reduces amount of rock support



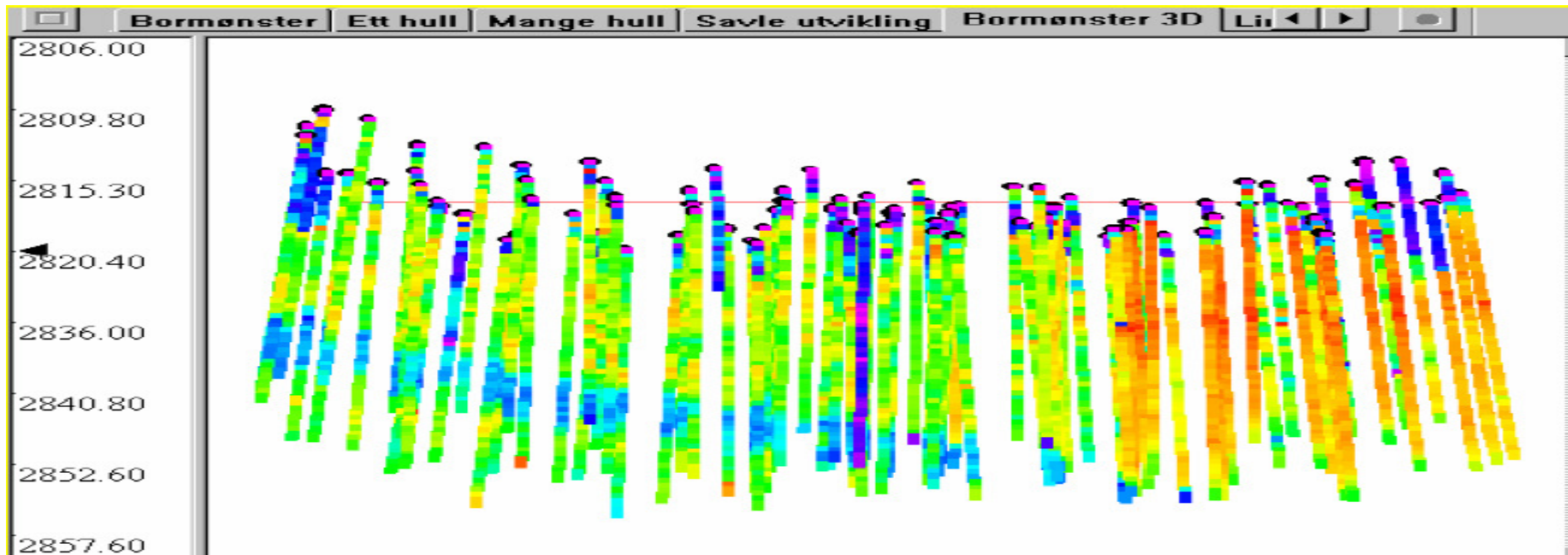
Control systems supplier



Benefits of CC drilling rigs

1. Efficient drilling time / Optimizing of drilling pattern

- Best practice and development, less dependent on human factors
- Reduced overbreak by accurate guidance, case study shows reduction from 60 to 30 cm, or typical from 25 to 11% at 35 m² and 5 m rounds



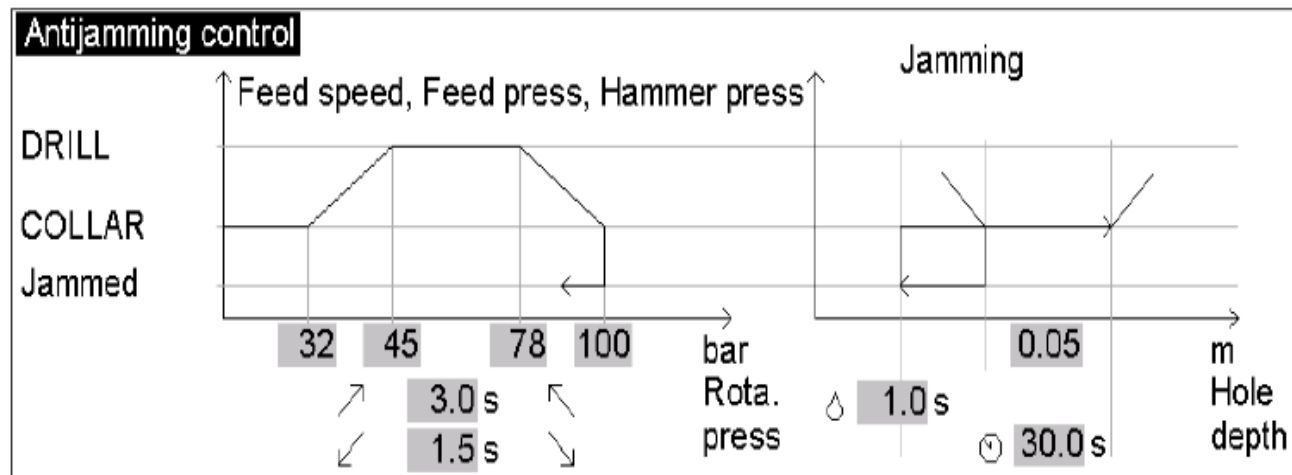
Control systems supplier



Benefits of CC drilling rigs

Drillsteel usage

- Optimized jamming and fault control, reduced steel damage and time saving
- Drifter settings optimised for actual drilling needs improves drilling capacity and reduce wear of steel and drifter, savings in maintenance and steel consumption
- Experience from Scandinavia shows that it is possible to reduce cost related to drillsteel by 10% with the use of AMV Jumbo



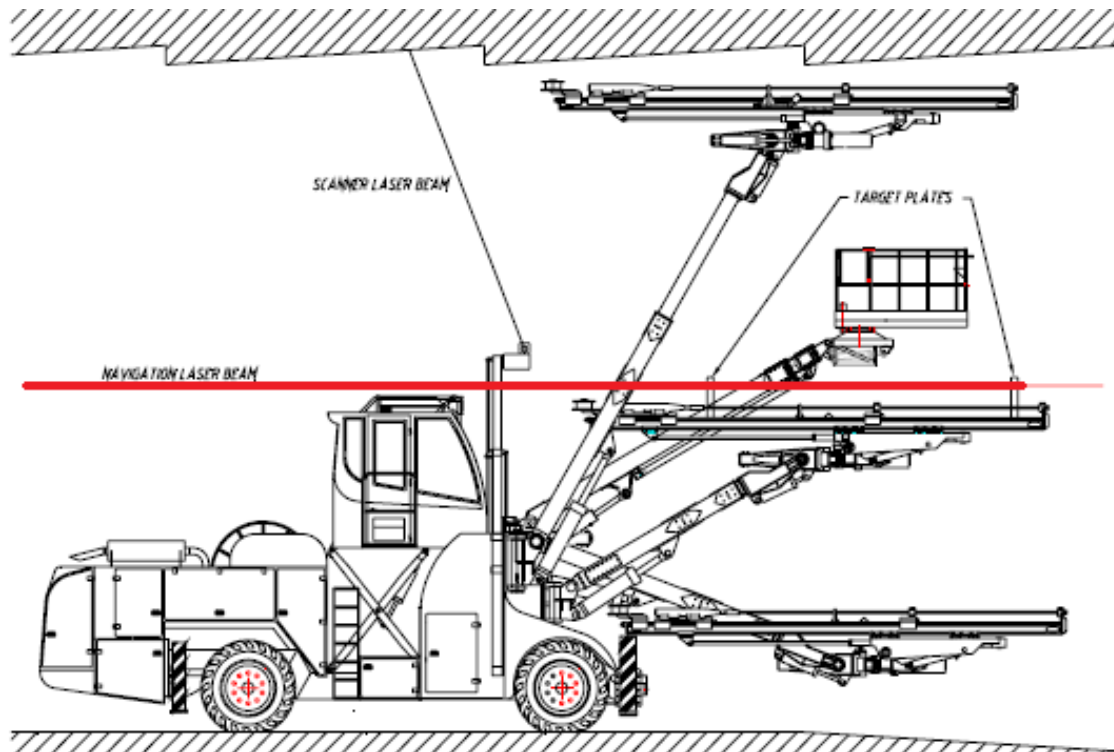
Control systems supplier



Benefits of CC drilling rigs

Navigation / Set-up of AMV Jumbo

- No marking on face
- Reduced time for positioning of jumbo
- Case study shows a typical reduction from 30 minutes to 5 minutes



Alternative Methods

- Total Station
- Profiler
- Laser



Control systems supplier



Benefits of CC drilling rigs

MWD (Measurements While Drilling) Benefits

- Reports on drilling efficiency
- Reports on rock conditions a head of face
- Reports on usage of bolts and anchors
- Drill log
- Reports on geometric position of bolts
- Reports on length and position of bolts
- Statistical reports for whole or parts of project
- Reports of overbreak statistics

TOOLS FOR QUALITY ASSURANCE AND INCREASED EFFICIENCY



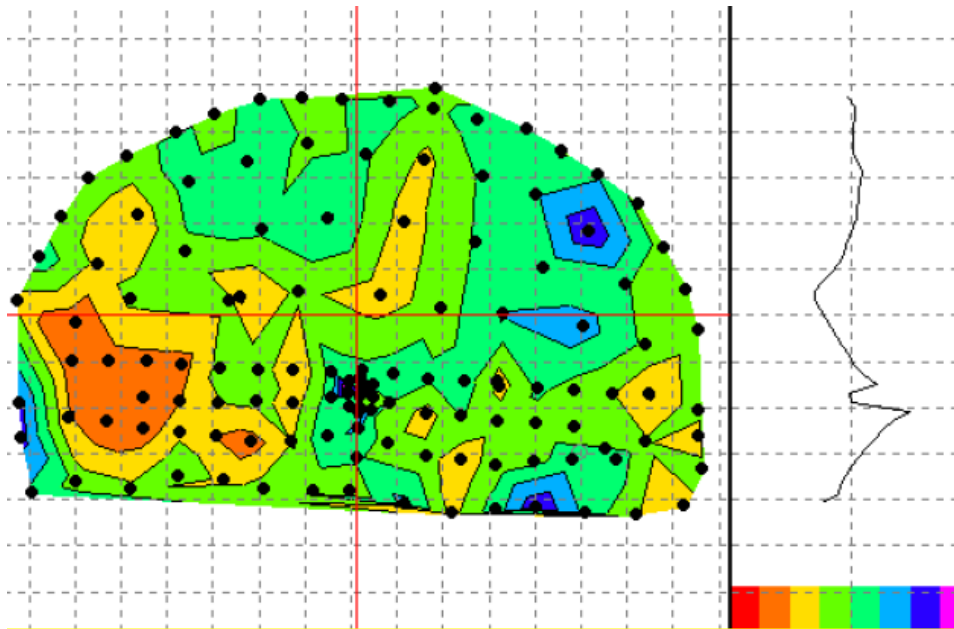
Control systems supplier



Benefits of CC drilling rigs

Planning and production efficiency

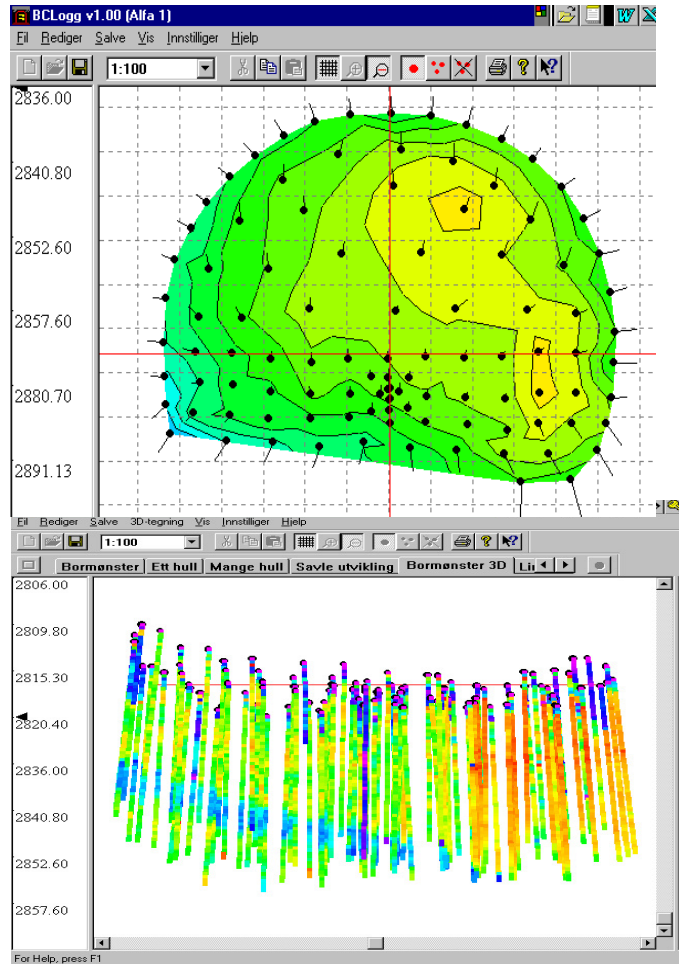
- Production planning of geometry and drillpattern gives management better control of operations
- Automatic report on drilling efficiency and settings as management tool for optimise drilling steel and drifter maintenance



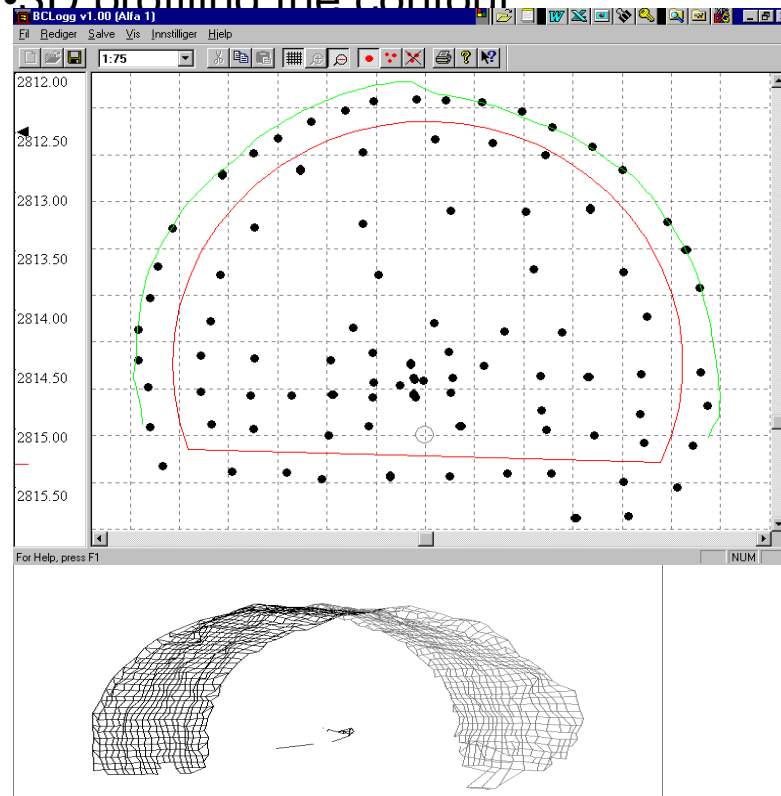
		Element	Low Peg No	High Peg No
SUMMARY ROUND REPORT		10	1151,89	1385,15
Parsell:	Koppstad - Solerød	Round length (m)	284,2	
Sign:	0	Jumbo id	21SGBC-CC (11-2404) (11218 BCA 20.1	
Date:	15.12.2004			
Comment:	0			
Comment:				
Sign:				
	Total	Boom 1	Boom 2	Boom 3
Started	29.10.04 20:44	01.01.00 0:00	01.01.00 0:00	01.01.00 0:00
Ended	15.12.04 18:51	15.12.04 18:51	15.12.04 18:26	15.12.04 18:44
Round Time (hours:min)	206:28	200:08	174:17	206:28
Periode length (days:hours)		14:18:51	14:18:26	14:18:44
Normal drilling (hours)		74:06	65:06	71:35
Slow/jammed drilling		12:50	17:38	15:41
Insert rods		0:00	0:00	0:00
Clean/other time		26:00	19:44	27:49
Move		87:10	71:48	91:21
No of holes	6644	2242	2231	2171
Drilled (meter)	30460,7	10683,2	9160,9	10616,6
Penetration rate (m/min)	2,27	2,21	2,14	2,30
Hammer pressure (bar)		124	125	119
Feed pressure (bar)		60	57	56
Rotation pressure (bar)		70	68	74

Benefits of CC drilling rigs

Bever Team Reporting



- Mapping the face
- Compare blasted contour and drill log
- Penetration rate logging
- 3D profiling the contour



Control systems supplier



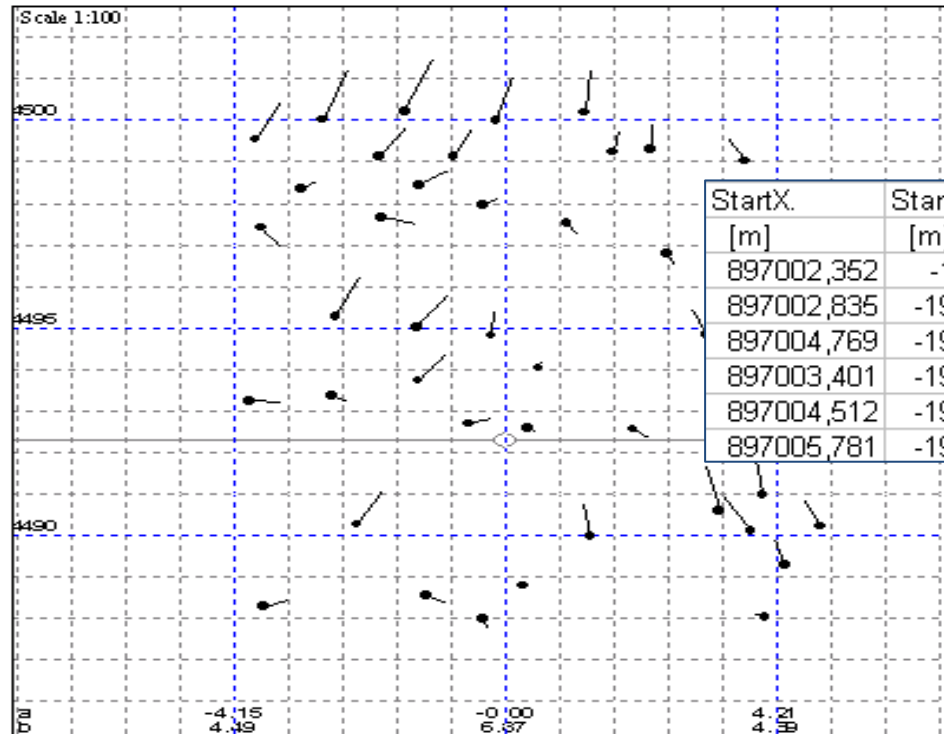
Benefits of CC drilling rigs

Bever Team Reporting

Printing date: 20030623 14:52

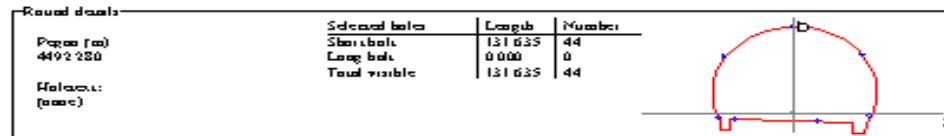
Bolt log

Production date: 20021026 08:28



StartX. [m]	StartY [m]	StartZ [m]	EndX. [m]	EndY [m]	EndZ [m]
897002,352	-19029,35	231,923	897000,411	-19031,2	233,127
897002,835	-19029,422	232,938	897001,197	-19031,196	234,619
897004,769	-19028,616	235,425	897003,817	-19030,089	237,778
897003,401	-19026,604	234,81	897001,966	-19027,513	237,212
897004,512	-19026,037	235,482	897003,787	-19026,534	238,298
897005,781	-19025,469	235,5	897005,166	-19025,642	238,42

Automatic record from
drilling of bolt holes



Control systems supplier



Benefits of CC drilling rigs

Survey / Profile Scanning

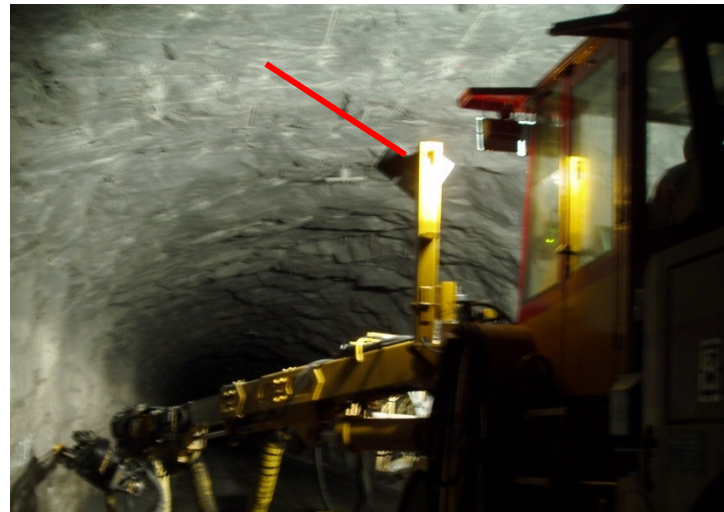


Computer Win XP

Scanning Time 5 minutes on a 90m2 5m length



Joystick controller



Scanner with Win CE realtime controller inside

Control systems supplier

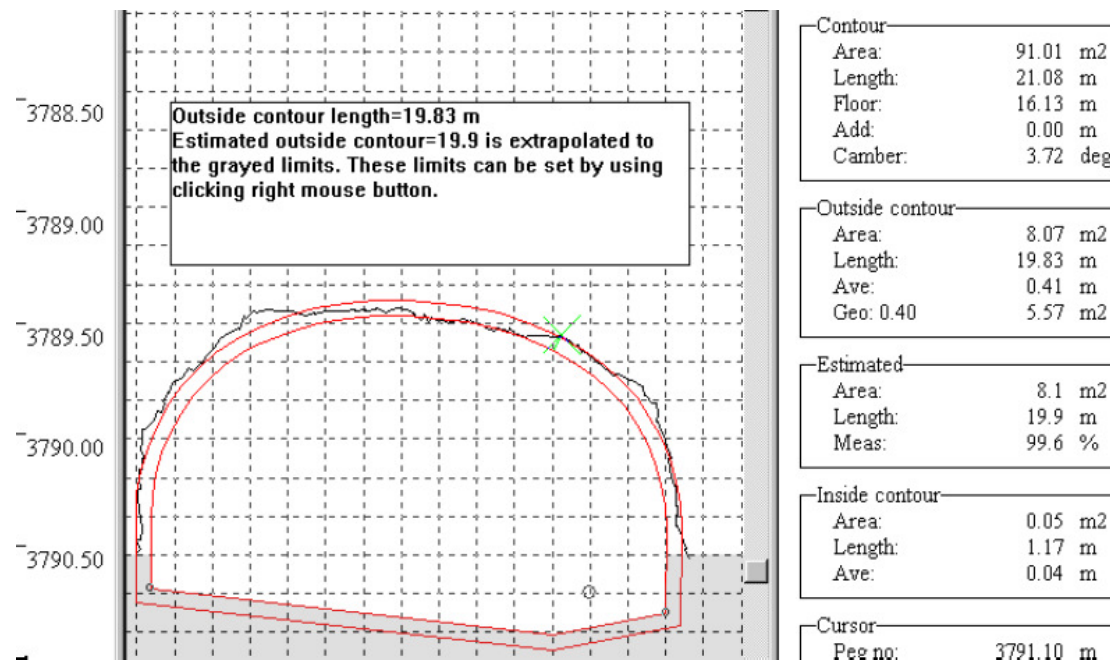


**Bever
Control**

Benefits of CC drilling rigs

Survey / Profile Scanning

- Operator will get direct control of overbreak
- Can be used for marking on the face
- Contour documentation with no surveyor presence
- Accurate underbreak control-scan grid c/c 25cm (select by operator)



Control systems supplier



Benefits of CC drilling rigs

AMV- Bever Control Advantages

- Well proven computer system, Ms Windows Embedded XP/CE operating systems used since 2000 – Mobile 15 inch touch screen computer, easy to upgrade and is a platform for the future
- Project planning system, integrated design and reporting system
- Several navigation methods (laser, profiler, total station)
- Many features beyond competitors (operation, complex geometry, logging)
- Failure detection system
- USB stick or LAN transfer of rig data
- Can be delivered with any desired language (Spanish, English, Korean, Chinese etc..)



Control systems supplier



Benefits of CC drilling rigs

Competitor Advantages of AMV

- Best component quality selected
- Stable boom design, with several features which enhances accuracy
- Well protected, easy maintenance of components
- High power capacity is standard
- Montabert drifters-excellent performance low cost pr drillmeter
- Small companies dedicated to top support and customer attention
- Low total cost with regards to maintenance and use of drillsteel
- Availability ~95 % experience from national and international projects

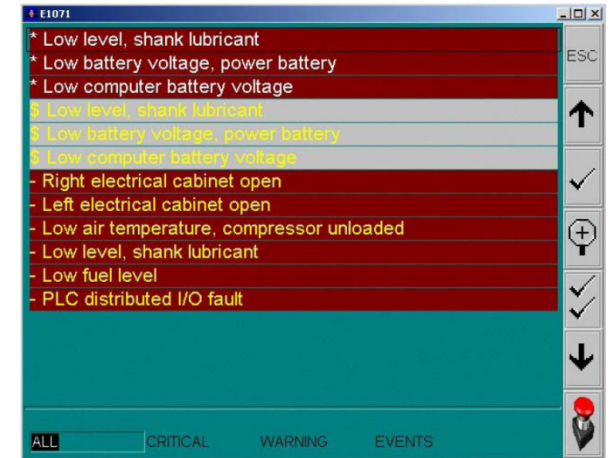


Control systems supplier



Maintenance

- Easy accessible for maintenance
- All Planned Maintenance Schedules, Maintenance Manuals and Spare Parts Manuals can be called up on the Service P.C. touch screen. Extensive equipment logs and fault finding facilities are available



Montabert HCl 10

Hi Frequent Drifter 32Kw (~70 Hz)

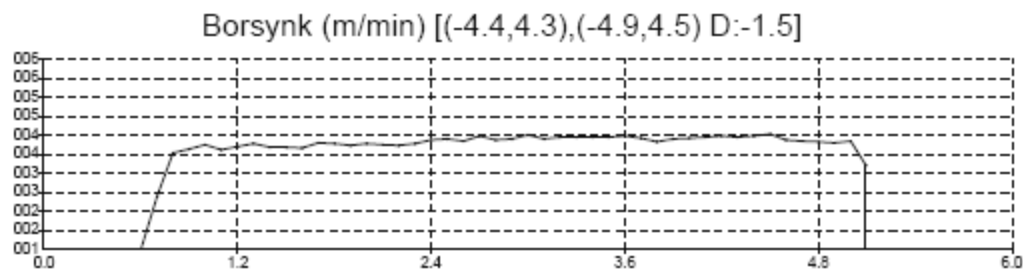
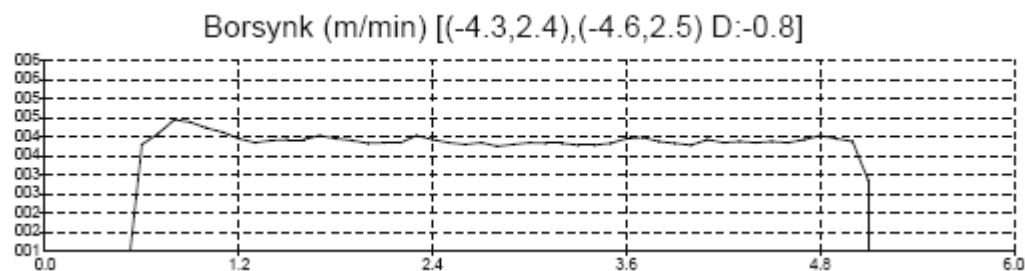
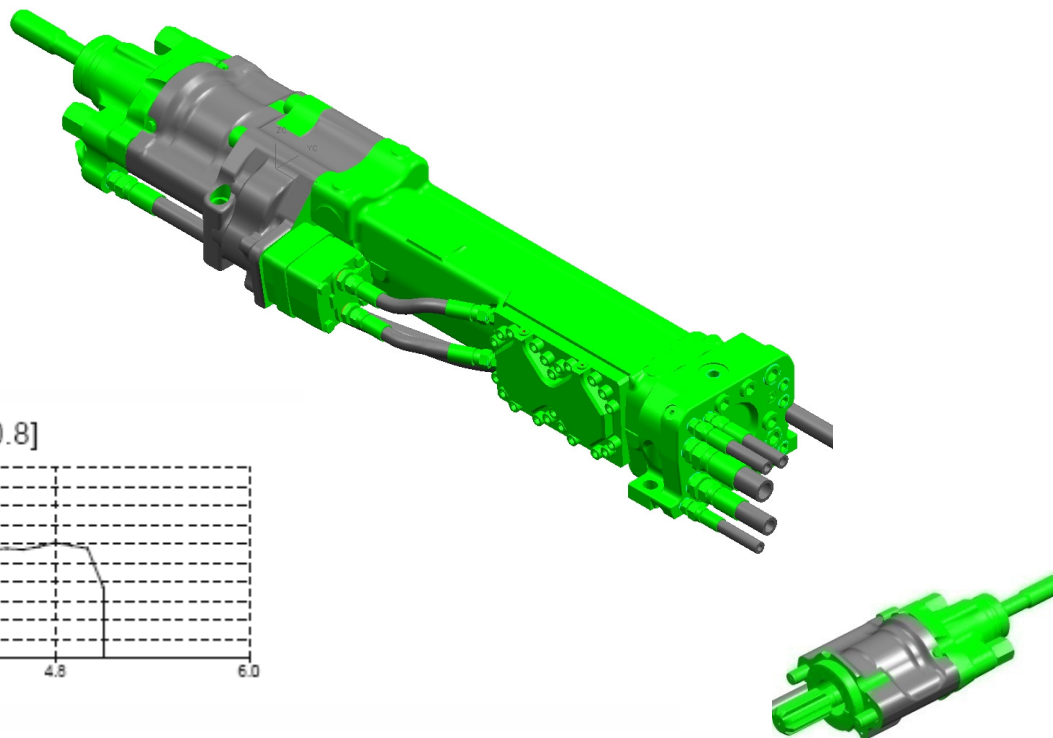
Only drifter with hydraulic reversed percussion

Average penetration rate between 3,5-5 m/min

No maintenance intervals

Test machine run 700Hrs with no maintenance

Low cost on total drill steel consumption



Control systems supplier



Our Products

Shotcrete robots

Highlights includes:

- Shotcreting capacity up to 25m² pr/hour
- Max height of spraying 18 m
- Max side reach of 16m
- Handles all types of shotcrete incl steel fibre addition
- Fully enclosed air conditioned operators cabin
- Can be delivered as:
 - Electrical driven
 - Diesel driven
 - Combination diesel/electric
- Low rebound rate < 7 %
- RC Controlled
- High Quality Compressor
- Auto- add system
- Takes into account the highest HSE regulations



Control systems supplier



Our Products

AMV 6400 Shotcrete robot



Control systems supplier



Our Products

AMV 7450 Shotcrete Robot



Our Products

AMV Working platforms

Highlights includes:

- High mobility
- Easy maintenance on chassis world wide
- Possibility for electric/diesel driven
- Can-Bus System
- Radio Control of chassis/work platform

Wide range of alternatives

- 8,5m Working platform
- 10,5m Working platform
- 17,5m Working platform
- Multi purpose working platforms with drilling equipment



Control systems supplier



Our Products

AMV Working platforms



Control systems supplier



Our Products

AMV Grouting Rig

Highlights:

- High Capacity Injection Unit
- Two separate mixing lines
- Three simultaneous injection pumps
- Complete logging functionality (Vc Number, Quantity, Hole)
- Coverage area of tunnels between T8 to T12,5
- Radio Controlled Palfinger Crane
- Mixer Equipped with weigh cells for accurate recipe
- Designed for easy cleaning and maintenance



Control systems supplier

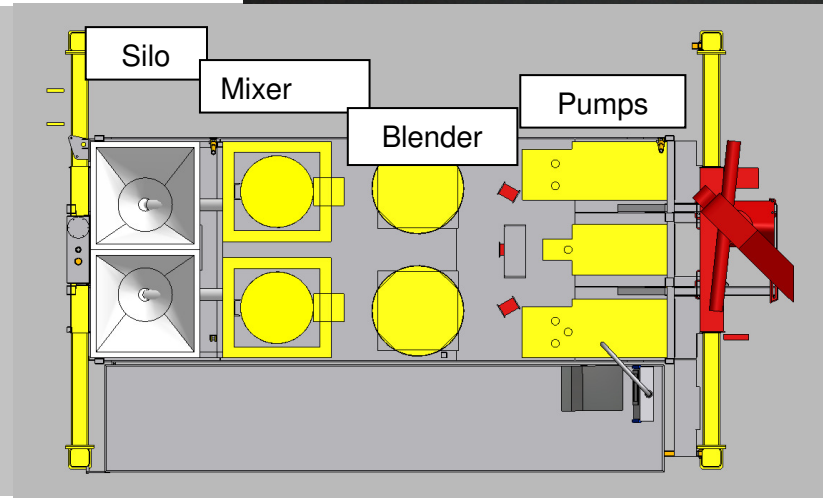
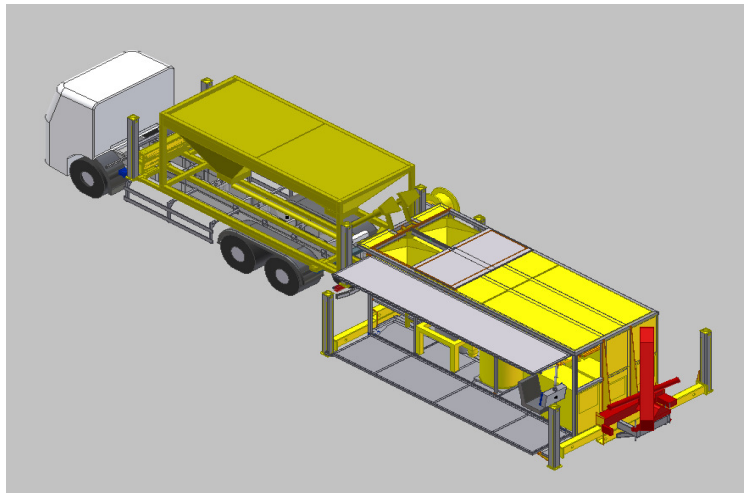


Our Products

AMV Grouting Rig System Overview

Automatic control of:

- Weighing and blending
- Mixer Start/Stop
- Blender start stop
- Injection pump stop
- Dosing accelerator fluid

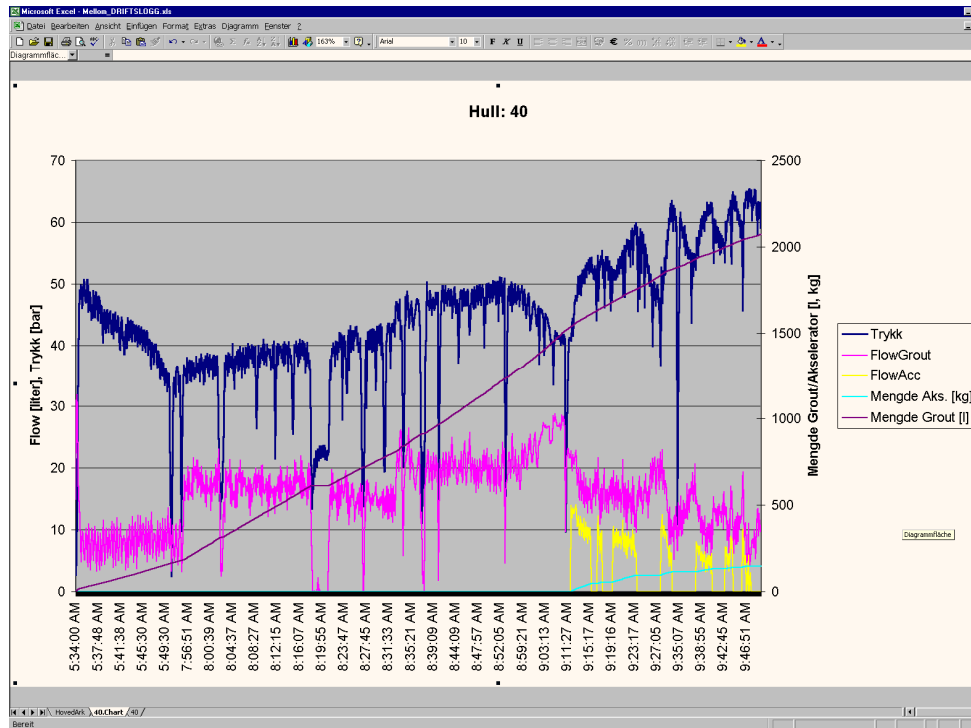


Control systems supplier



AMV Grouting Rig

Complete logging functionality (Vc Number, Quantity,



<

Our Products

AMV Guardrail Installation Rig

Highlights:

- Built on standard chassis
- High mobility
- High Efficiency Montabert HC90
- Can-Bus
- RC Controlled for one man operation



Control systems supplier



Our Products

AMV Other Tunnel/Mining Equipment

Cable Reel

Service Container



Control systems supplier



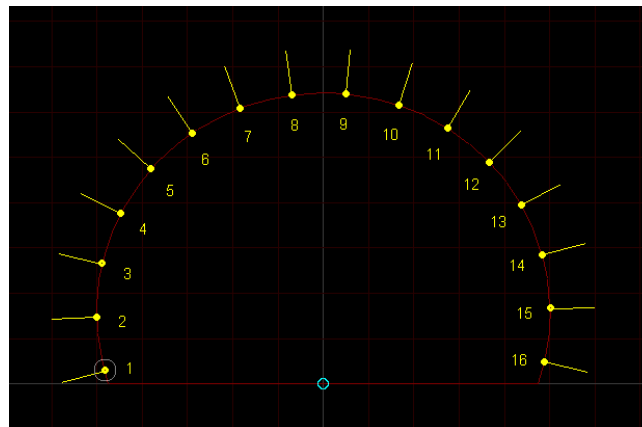
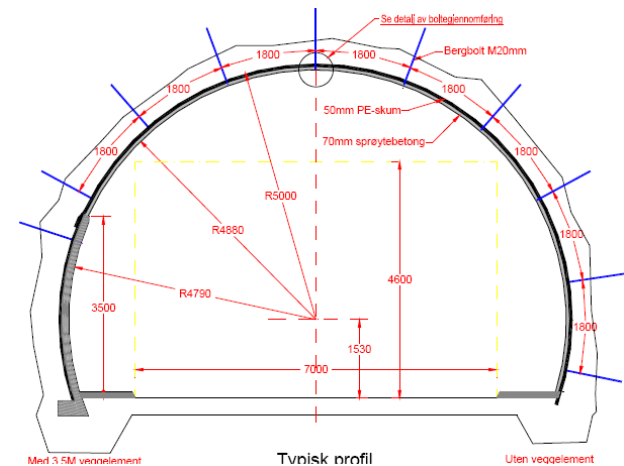
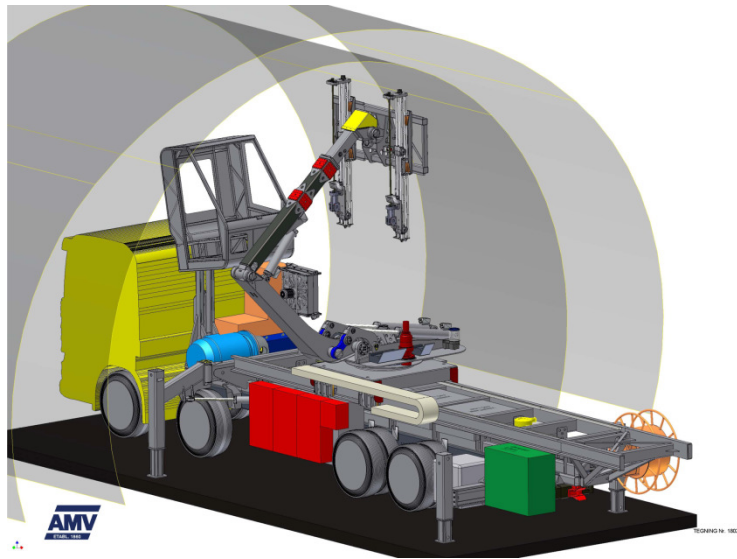
Special Products



Control systems supplier



Computer controlled
installation of bolting for roof
support, accuracy 3-5 cm



Control systems supplier





AMV Bolting rig for roof support

Control systems supplier



Mobile scanner, selfcontained unit



More details on:

Machine control systems

Planning and reporting systems

Project management



Control systems supplier



Bever machine control

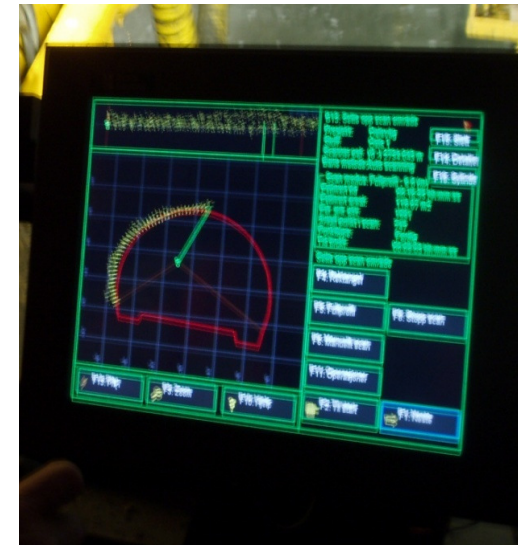
3. generation computer controlled drilling and scanning



Drill guidance system and Profile scanning from drilling rig



Bever Win 3D Profiler in operation



Navigation – setup of drilling machine alternative methods



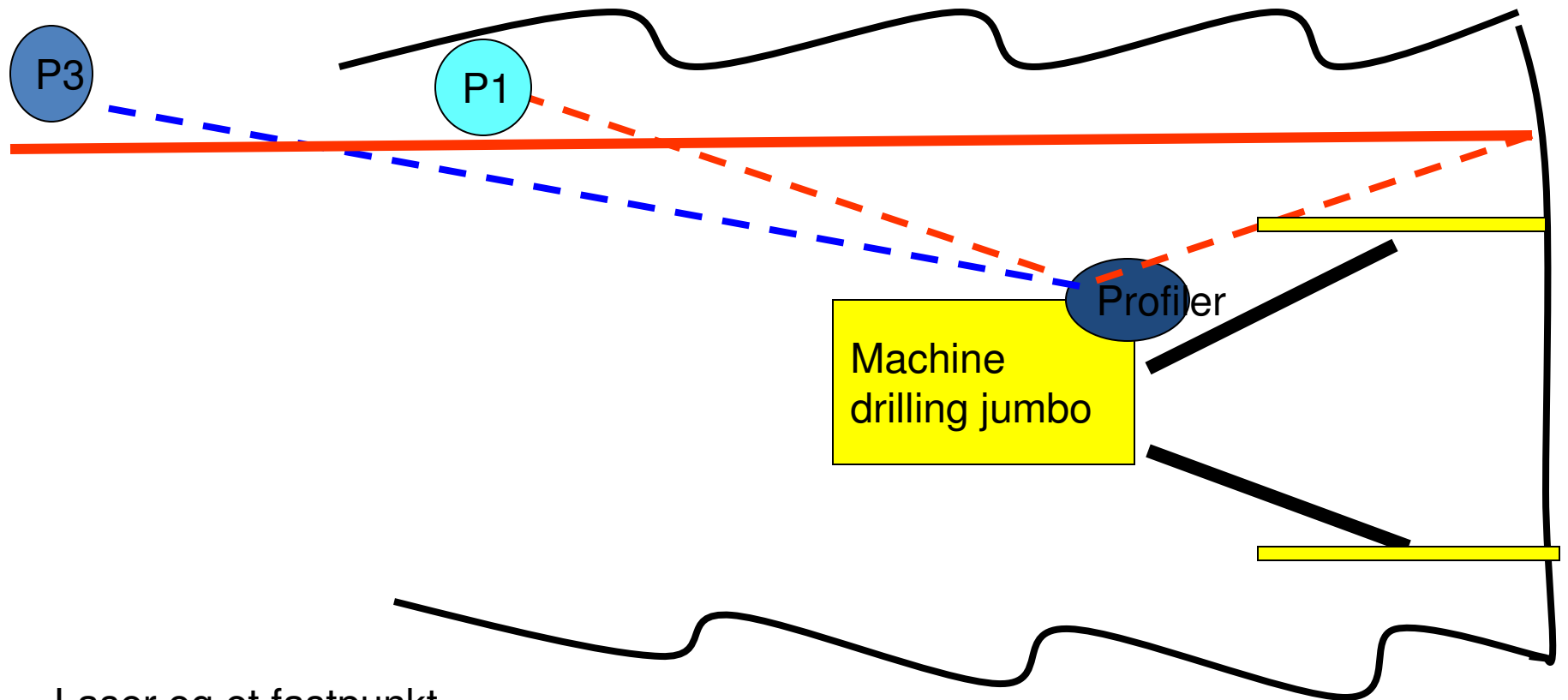
Tunnel laser

Totalstasjon (Trimble)

Profiler (Bever)

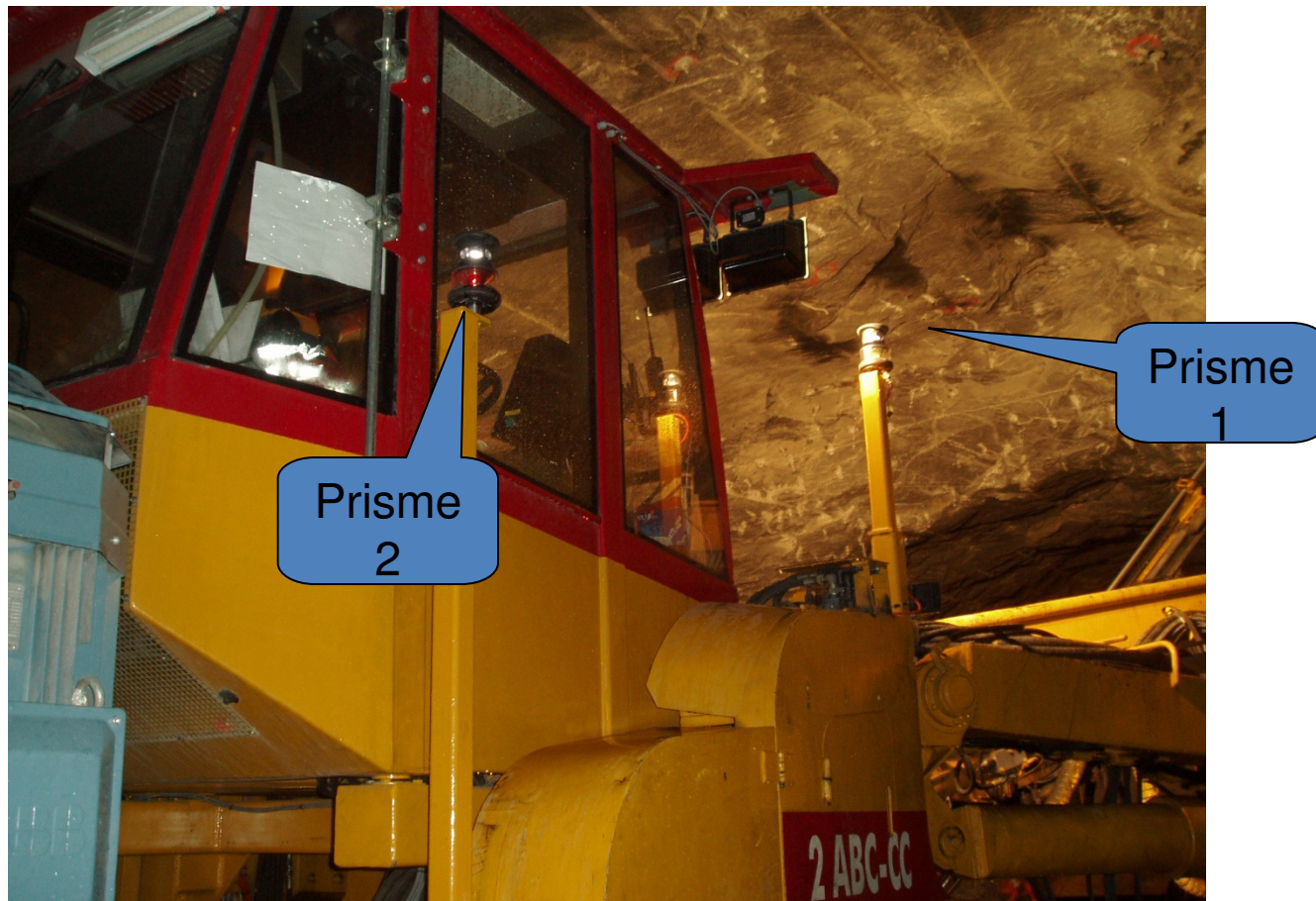


Jumbo navigation with Bever Profiler 2000



Laser og et fastpunkt,
kontrollpunkt

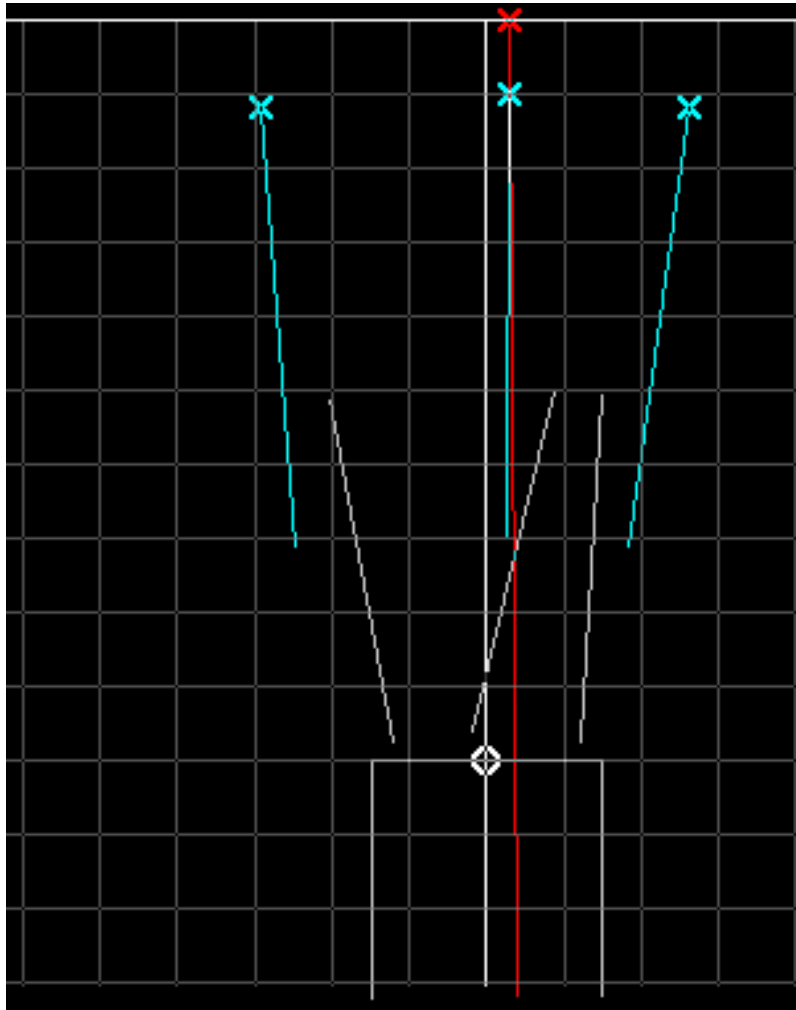
Trimble Navigation – New method



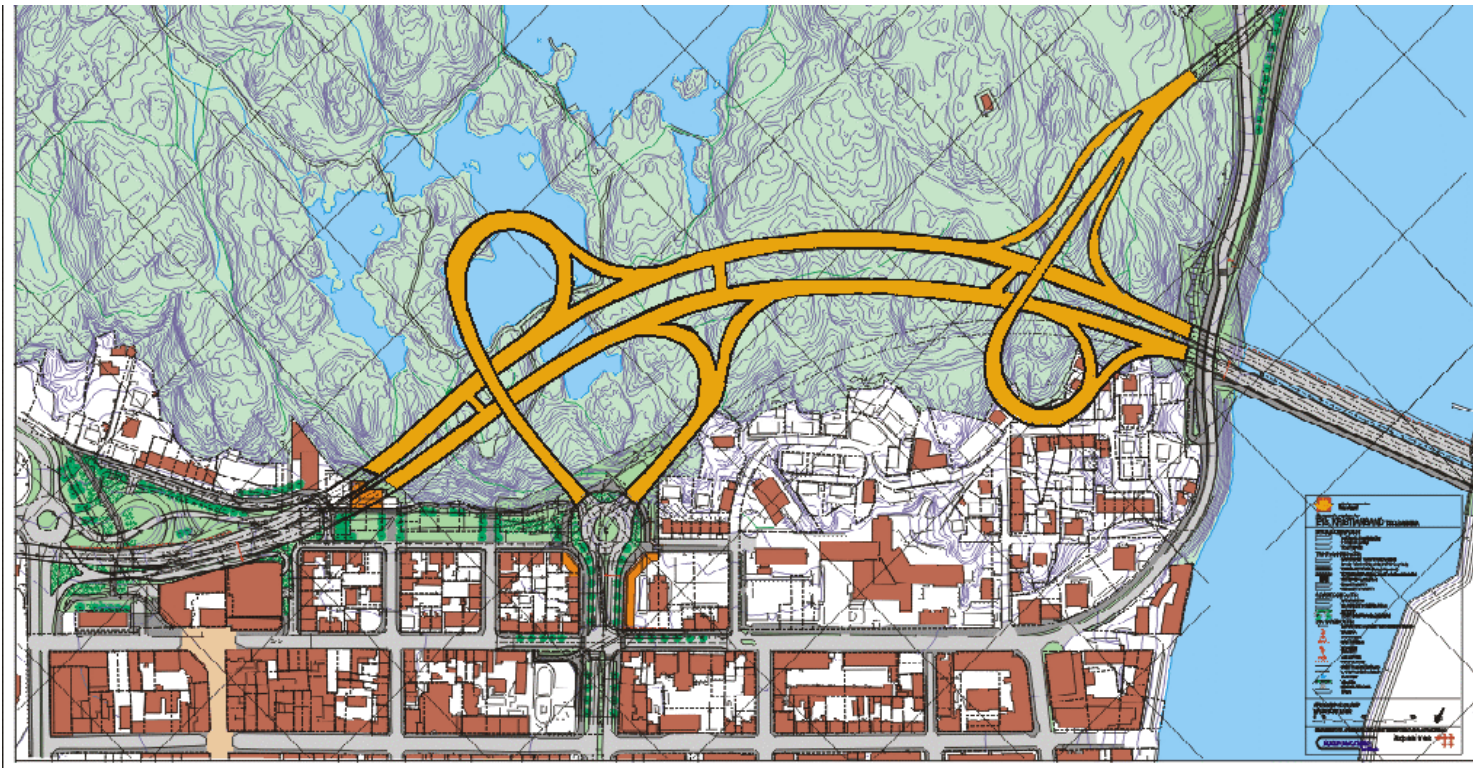
Trimble totalstasjon



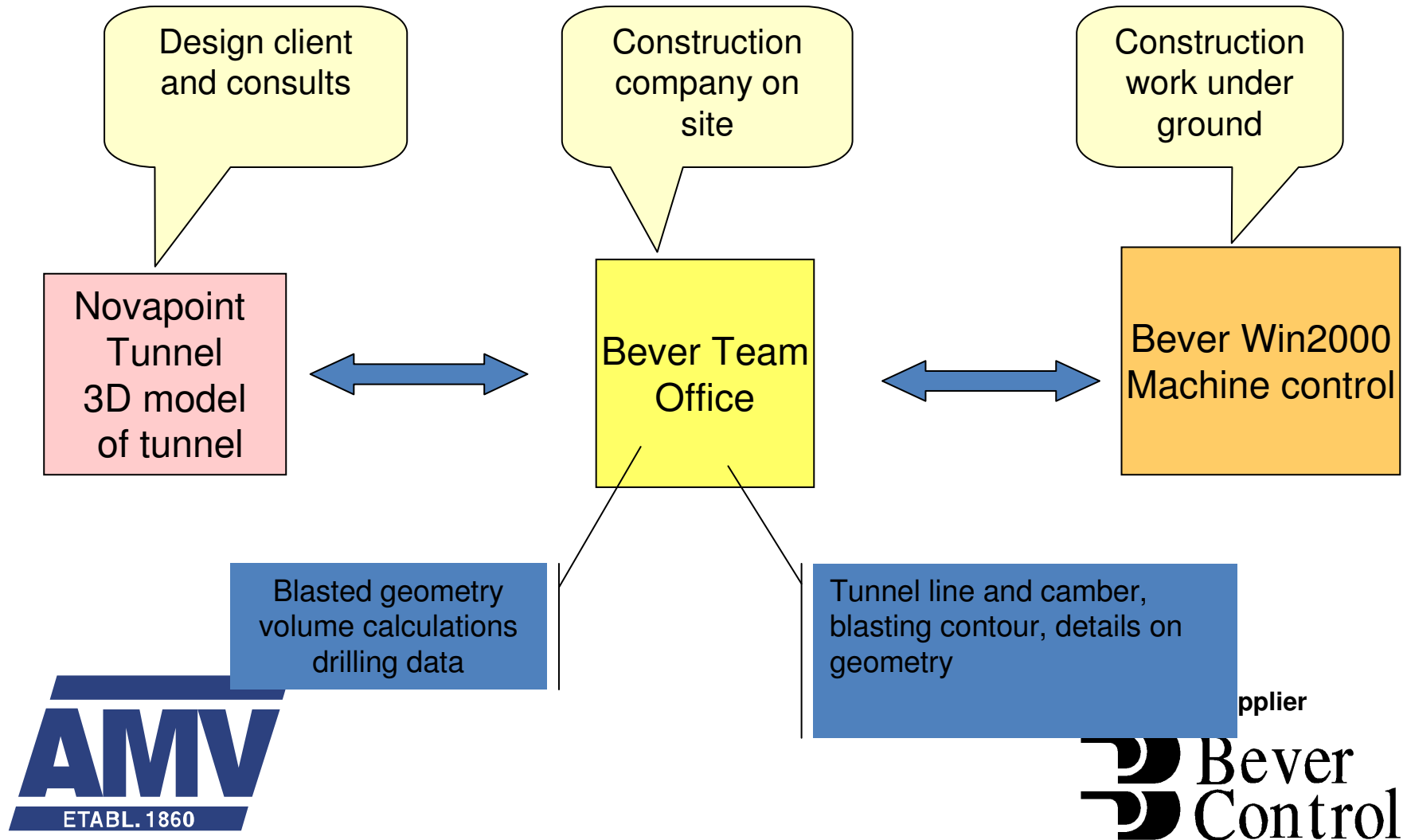
Navigation on operators display shows feed and jumbo position



Bever Control – machine control tunneling and mining complex projects



Novapoint Tunnel – Bever dataflow from design to construction



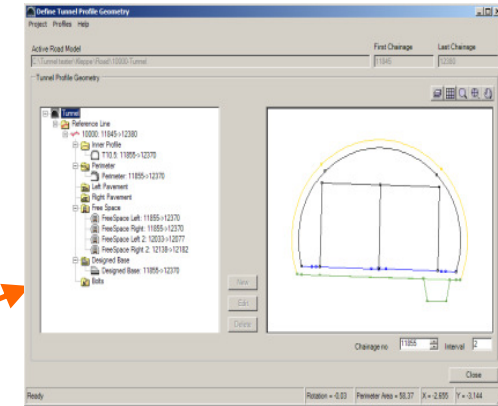
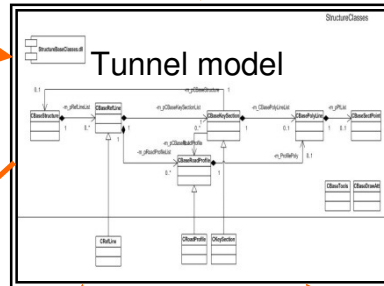
Nova Point Tunnel (CAD system for road design)



Registration of geology



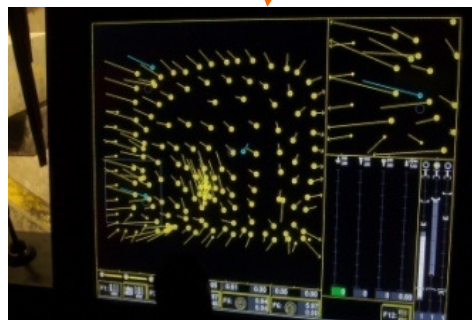
Storage for maintenance
(NVDB)



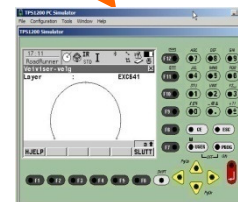
Design program



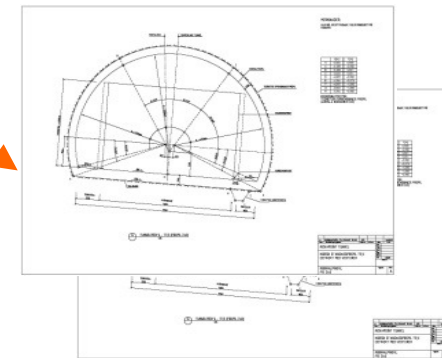
3D-visualization (VR)



Drilling machine control systems
Registration, Scanner data



Survey equipment



Drawings

Control systems supplier

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Control**



Nova Point Tunnel (CAD system for road design)

These companies and institutions have contributed to the project:



Statens vegvesen



In addition to the companies/institutions above the following companies participate in the reference group:

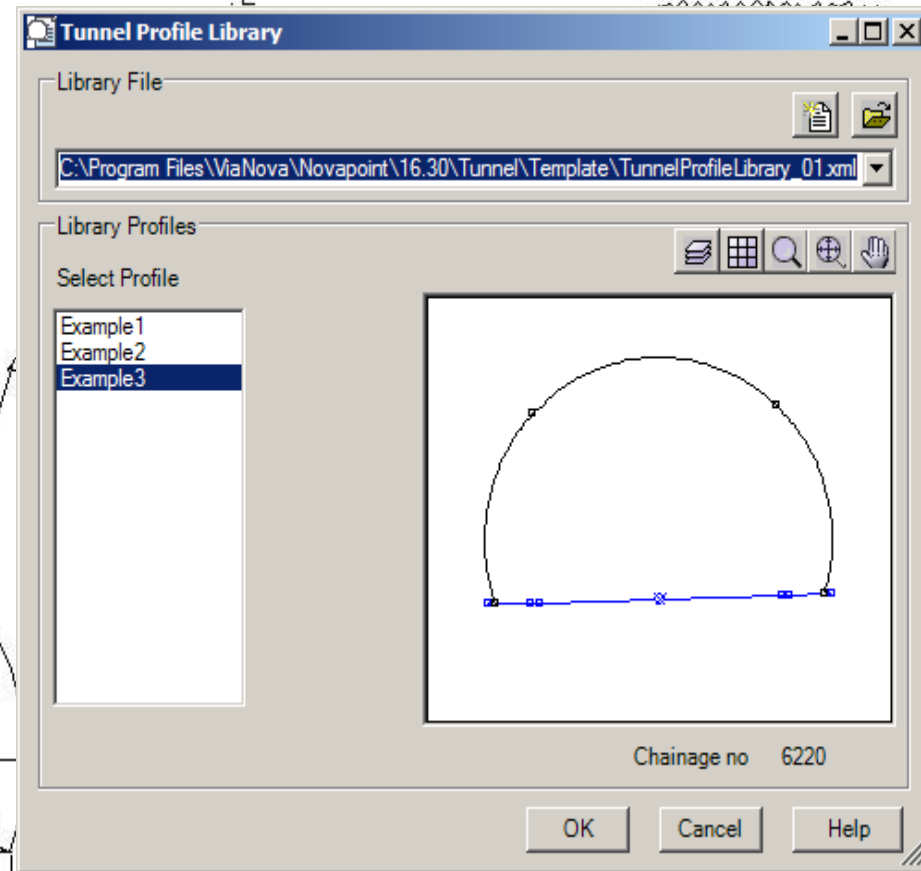
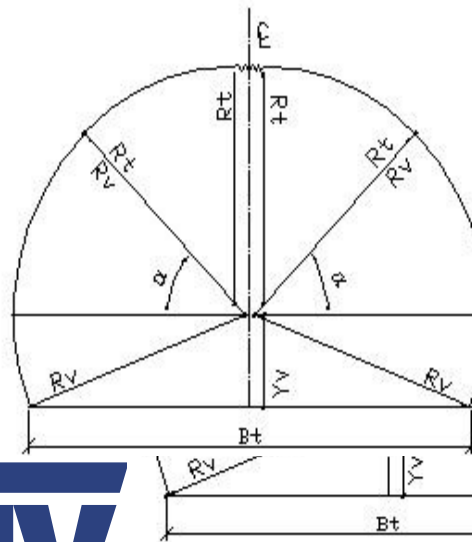


Control systems supplier



Nova Point Tunnel (CAD system for road design)

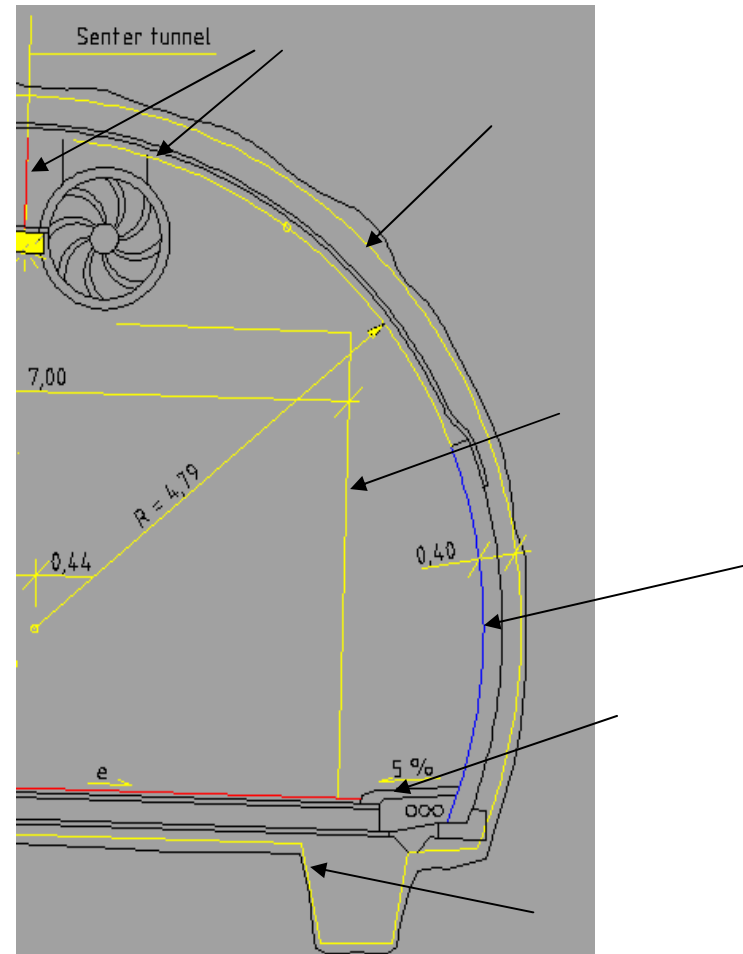
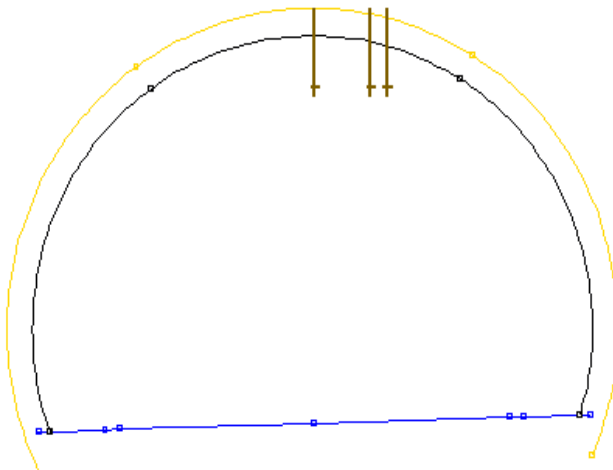
T4
T5.5, T8.5, T11.5
T7, T9.5, T12.9
Train tunnel
General parametric profile
Cross section library



Nova Point Tunnel (CAD system for road design)

The following tunnel elements can be modelled by Novapoint Tunnel v. 1.0

- Inner profile
- Perimeter
- Free vehicle clearance
- Pavements
- Theoretical base and designed base
- Attachment bolts



Control systems supplier



Nova Point Tunnel (CAD system for road design)

Perimeter

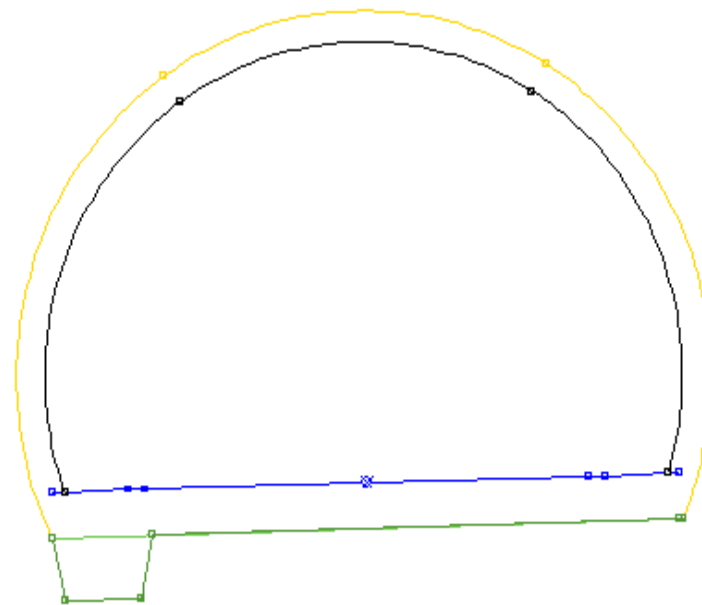
The perimeter is defined by:

User specified offset from the inner profile

Parametric section connected to road surface edge lines

Theoretical and designed base

Perimeter Type	
<input checked="" type="radio"/>	Distance from inner tunnel profile
<input type="radio"/>	Parametric perimeter
Parameters	
Distance to Inner Profile [m]	<input type="text" value="0.4"/>



Nova Point Tunnel (CAD system for road design)

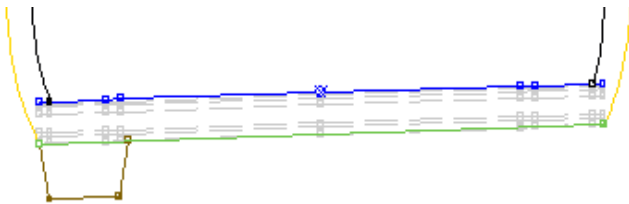
Base

There are two different base definitions:

Theoretical base (the contractual base)

Designed base (the contractors operational plan)

Theoretical base always follows the road bed from the road model

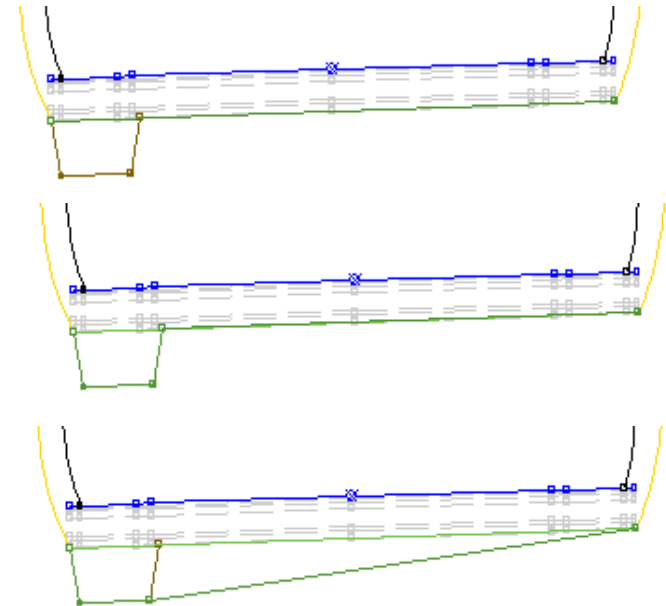


There are three different methods to define the design base:

As theoretical base

Follows closed drainage from the road model

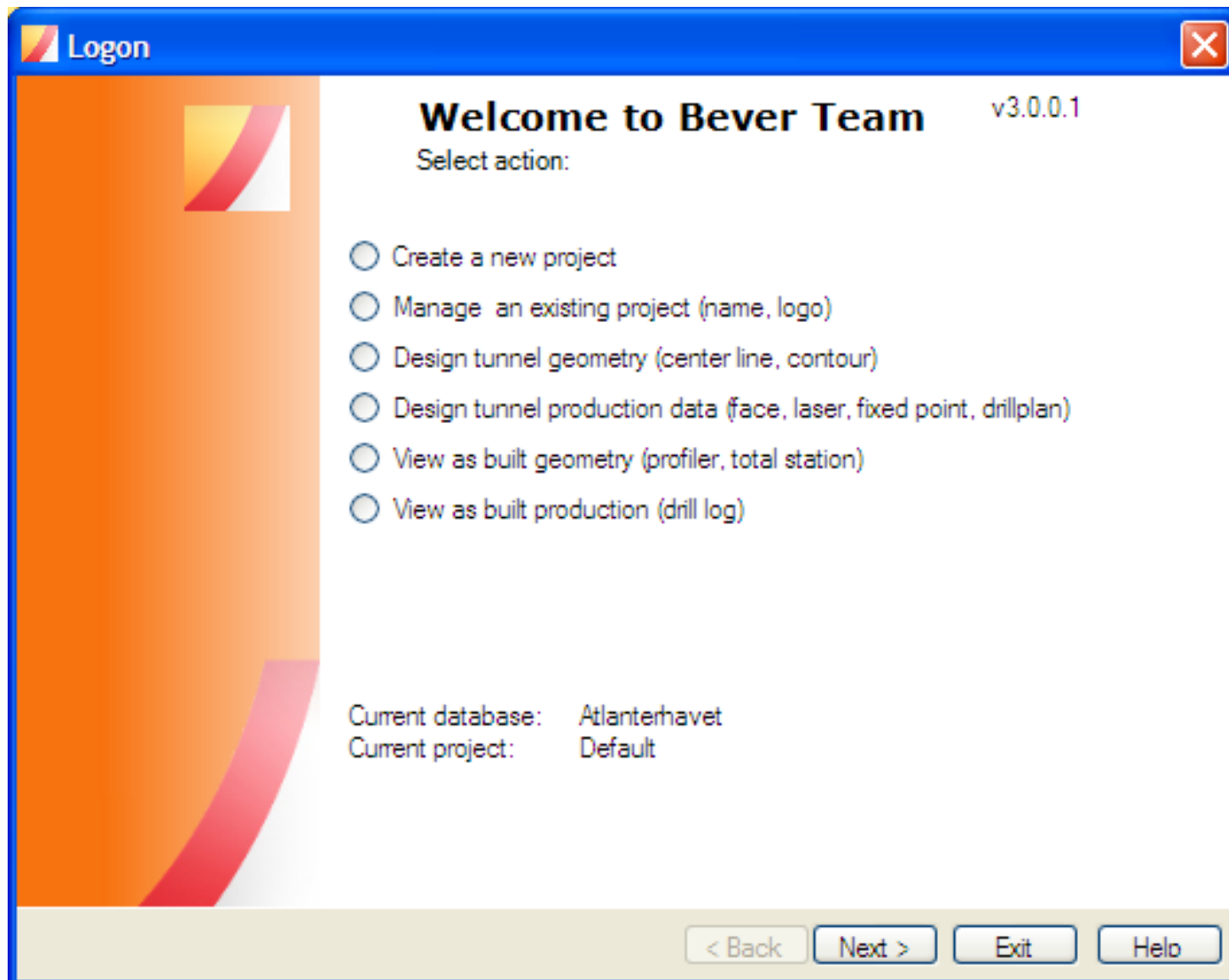
User defined



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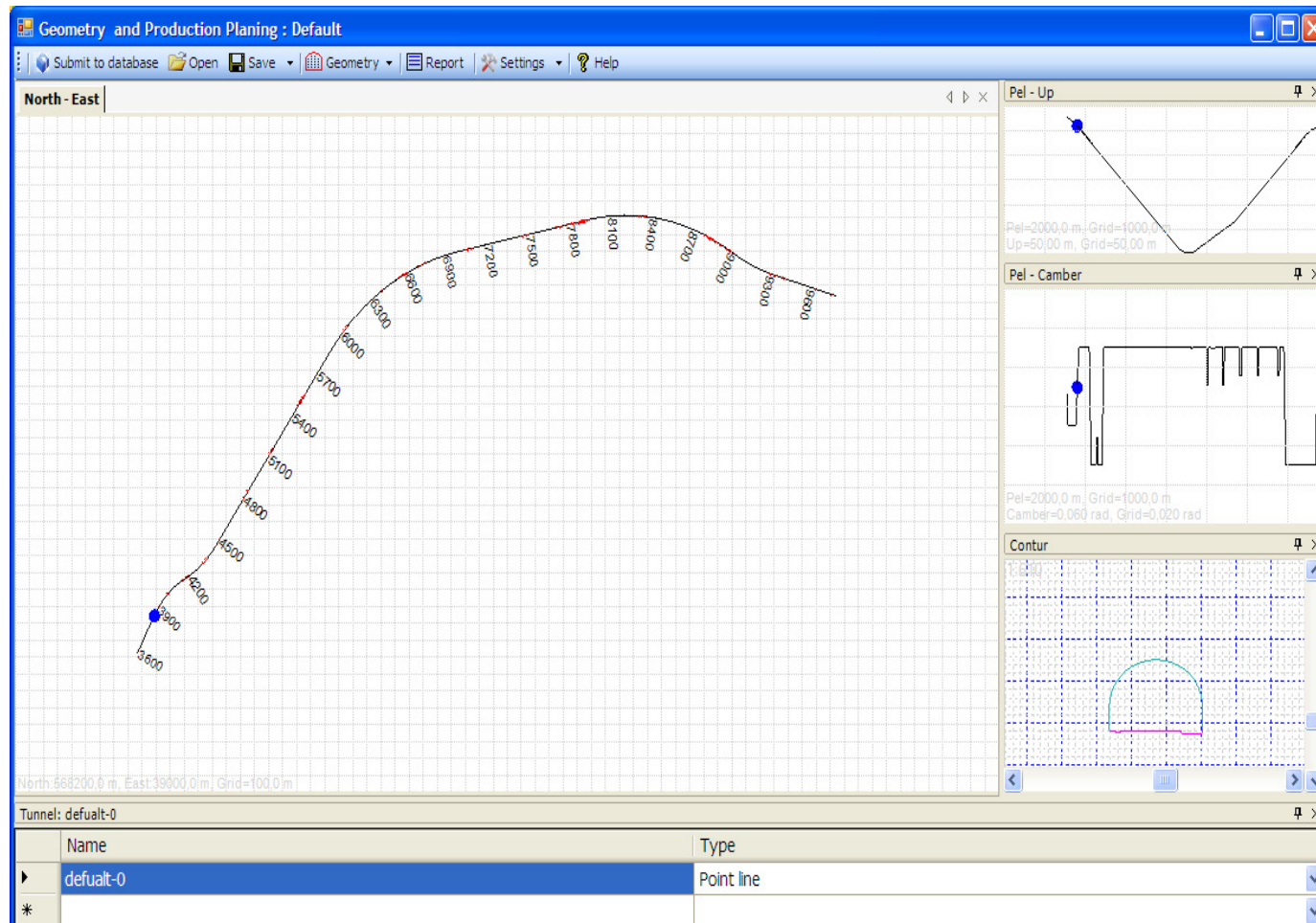
Bever Team Office 3



Systems supplier

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Planning of geometry

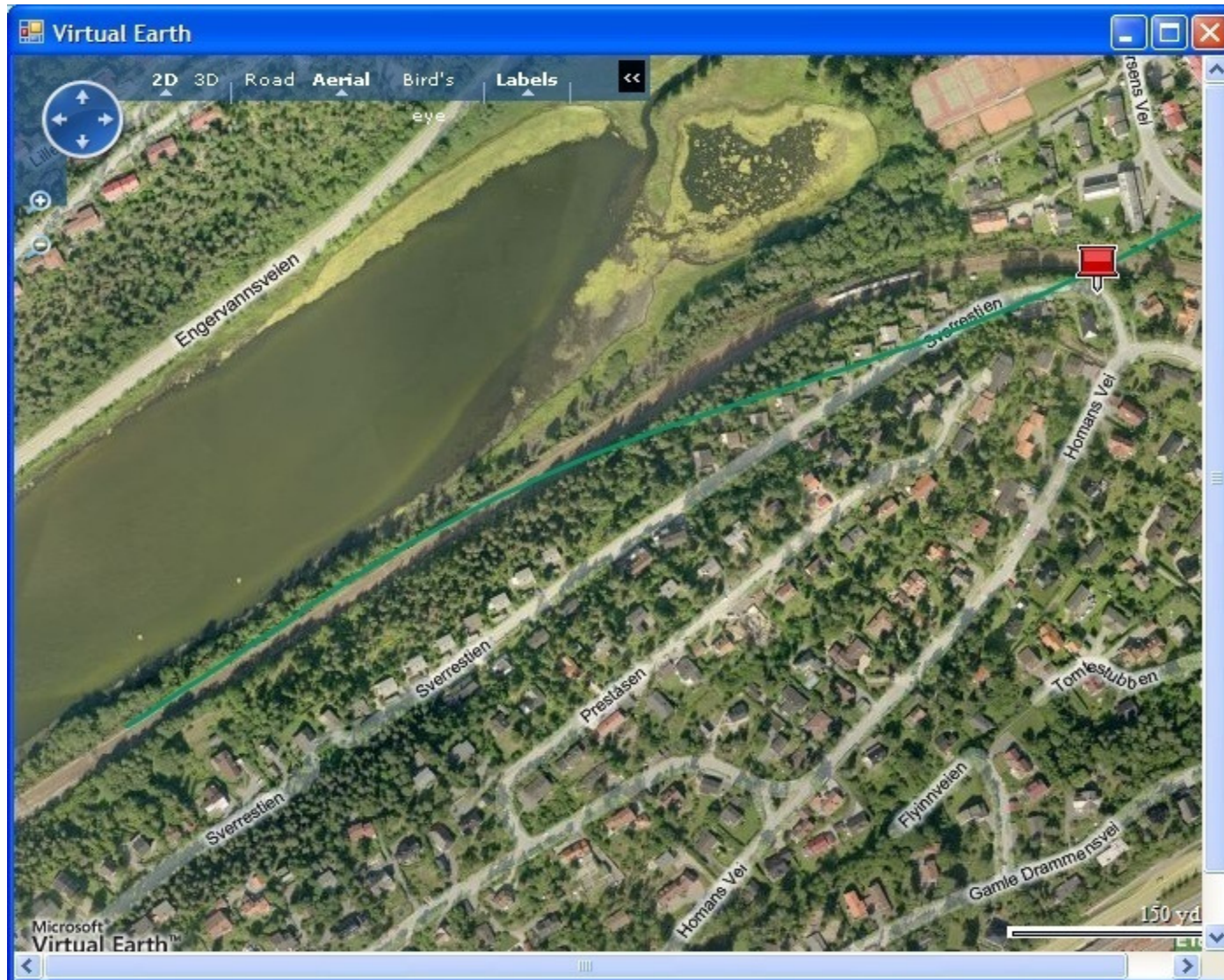


Center line
-Points
-VIPS

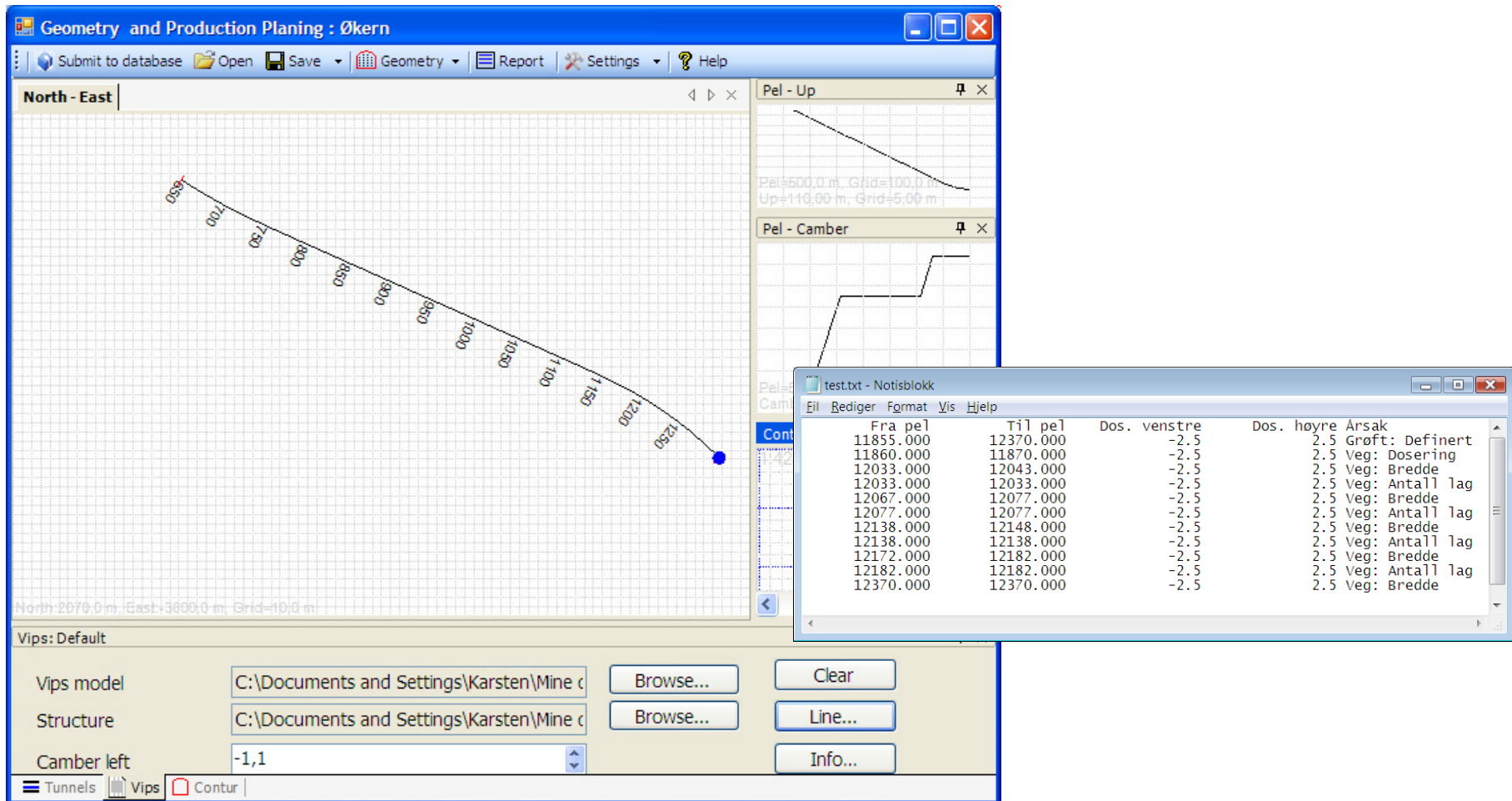
Cross
section/contour:

-Points
-NPT
-From file
-From HB
21
-CAD
-Angles
-XML

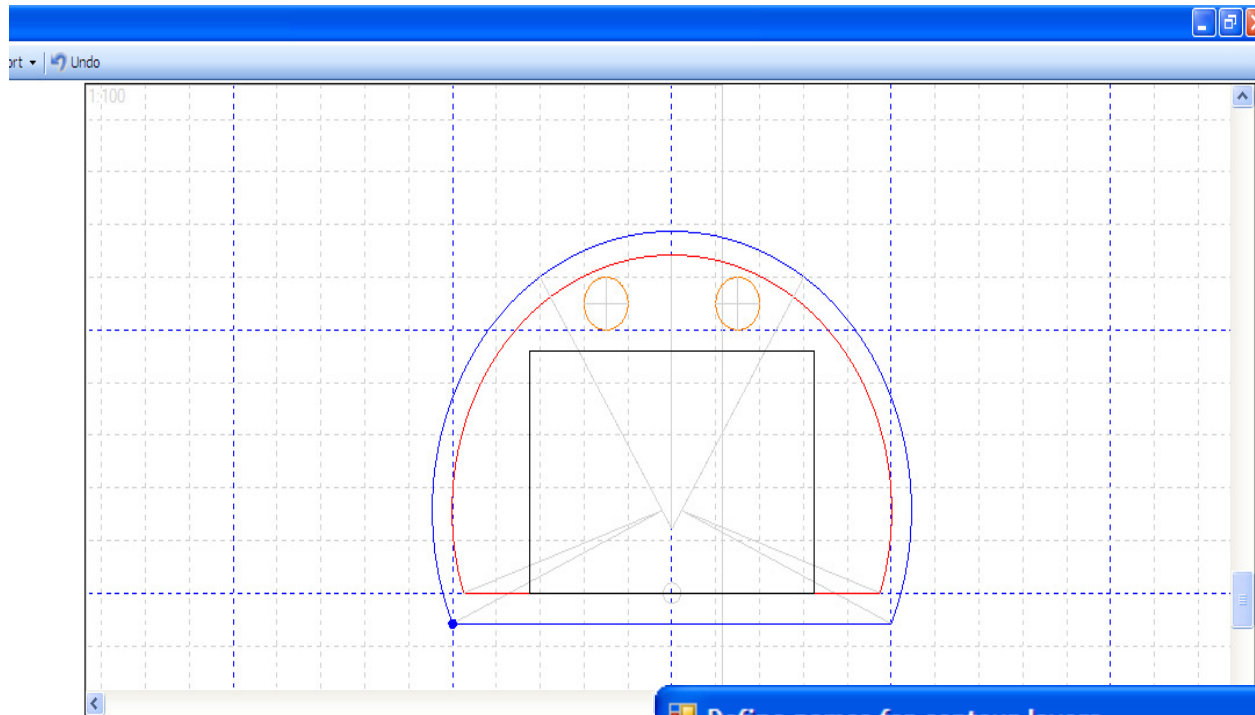
Line show in Google Earth



Line and contours from NPT



Define a contour

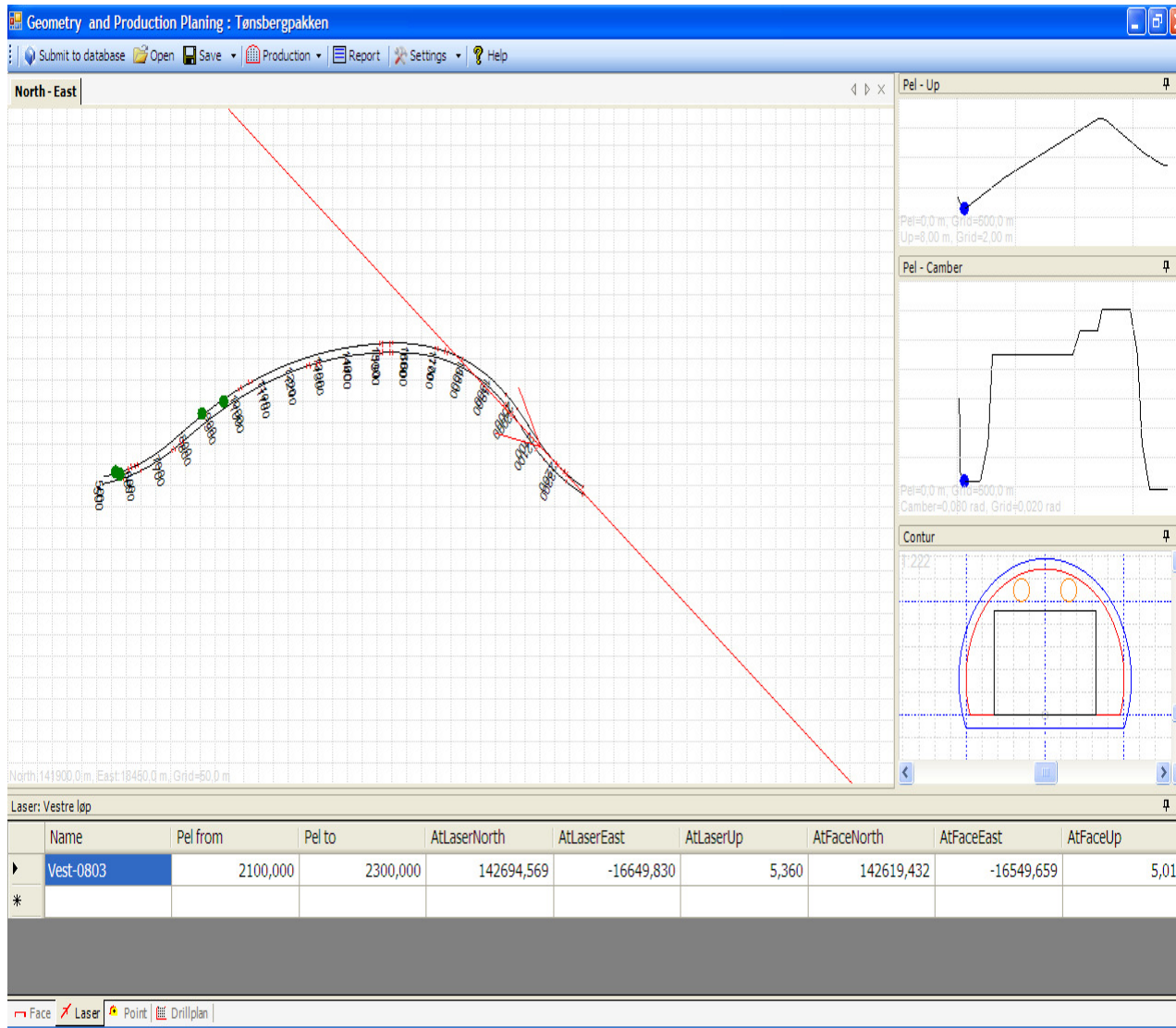


- Name on layers
- Several types of input
- Camber on/off
- Colour

	Right (m)	Up (m)
0	-4.999	
1	-3.009	
2	3.009	
3	4.999	

Define names for contour layers					
	Layer index	Name	Use camber	Vault color	Floor color
▶	1	Teoretisk spreng...	<input checked="" type="checkbox"/>		
	2	Veggelement	<input checked="" type="checkbox"/>		
	3	Vifte	<input checked="" type="checkbox"/>		
	4	Kjøreboks	<input checked="" type="checkbox"/>		
	5	Vifte	<input checked="" type="checkbox"/>		
*			<input type="checkbox"/>		

Tunnel lasers



- Control point
- Peg definition

Laser control

Enter a point in the laser line (m)

North: 142647,577

East: -16587,194

Up: 5,150

Deviation (m)

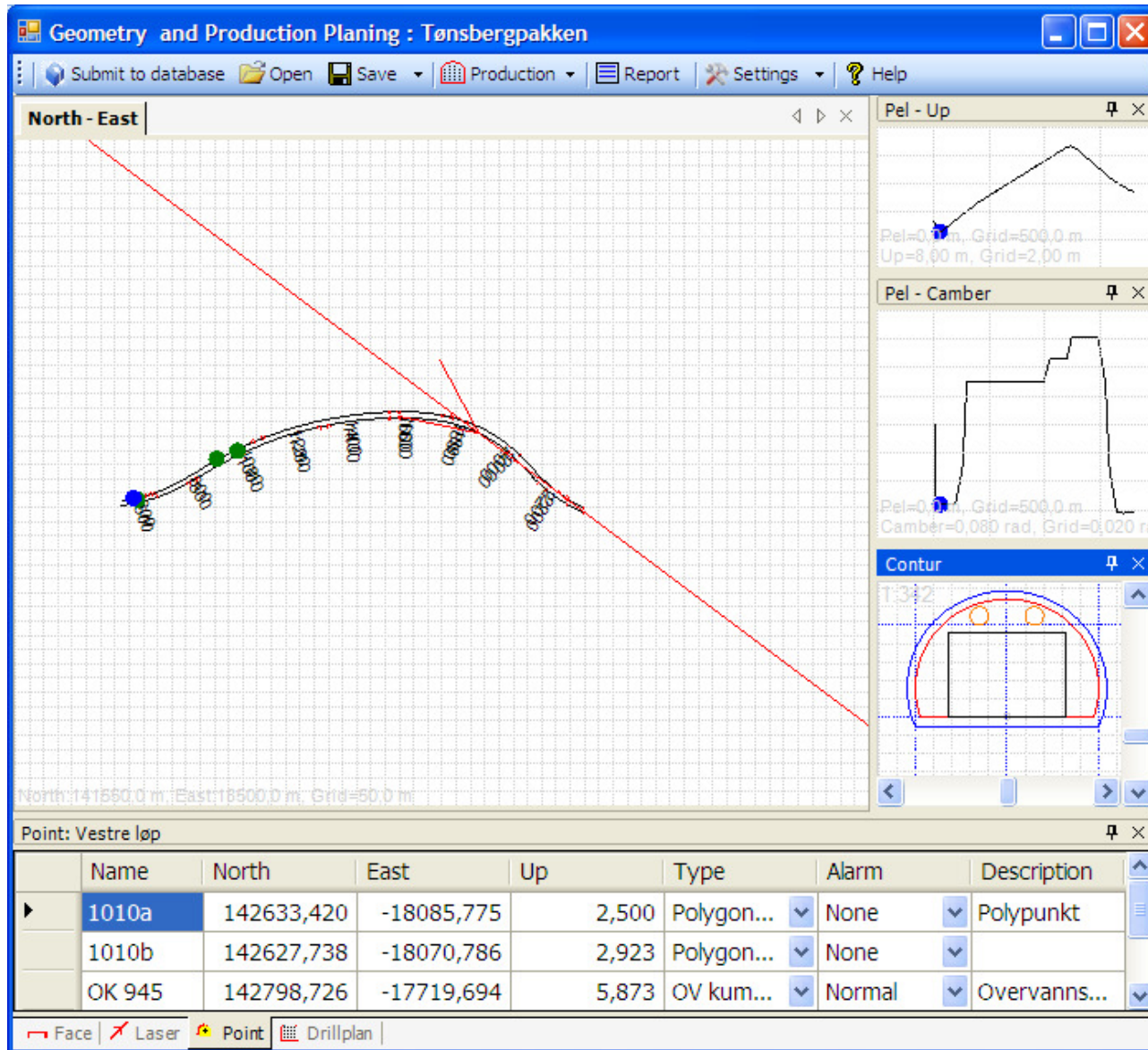
North: -0,006

East: -0,005

Up: 0,006

Control

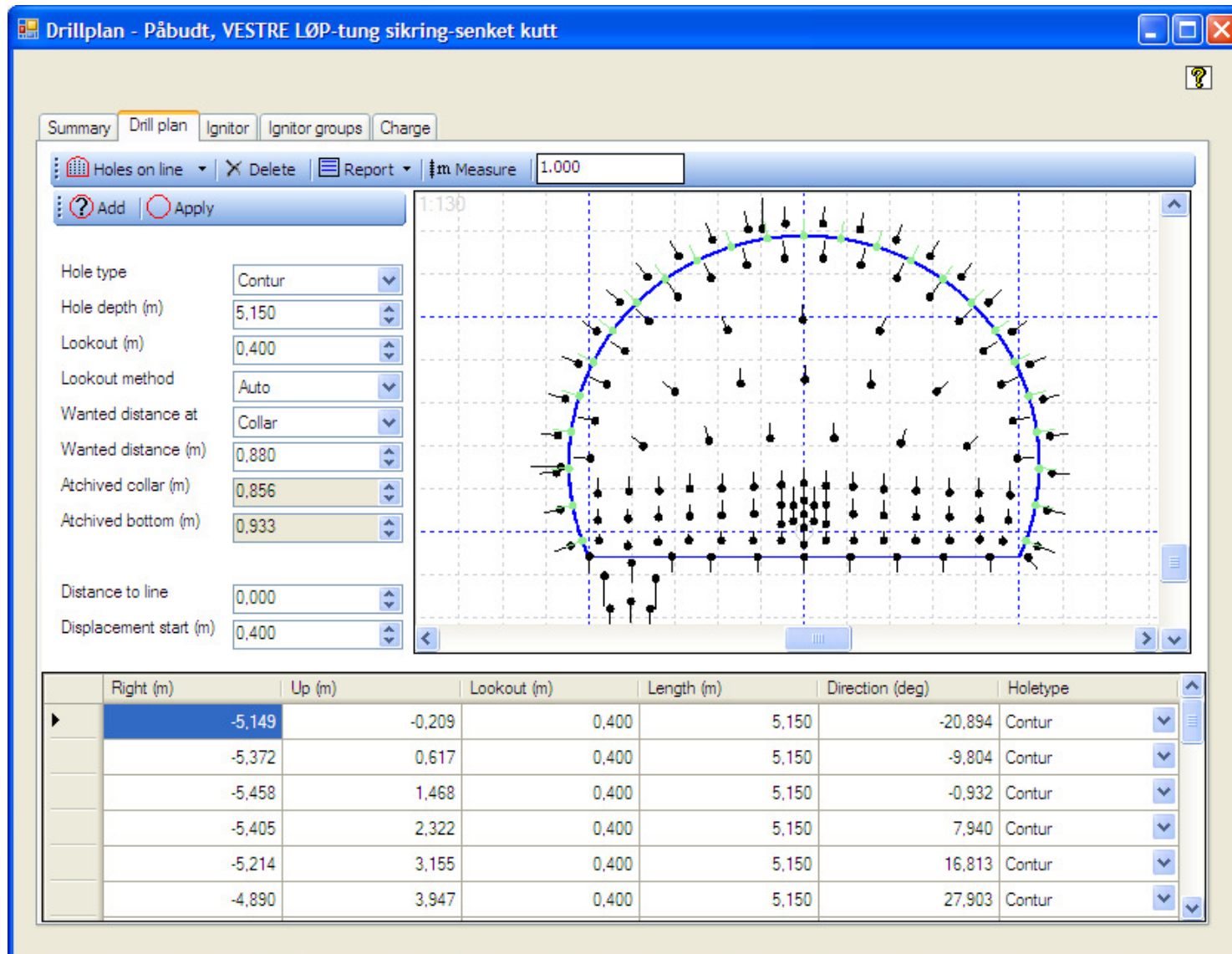
Fixed points



New:

- Type
- Alarm
- Description
- Pegnr. / distance from CL

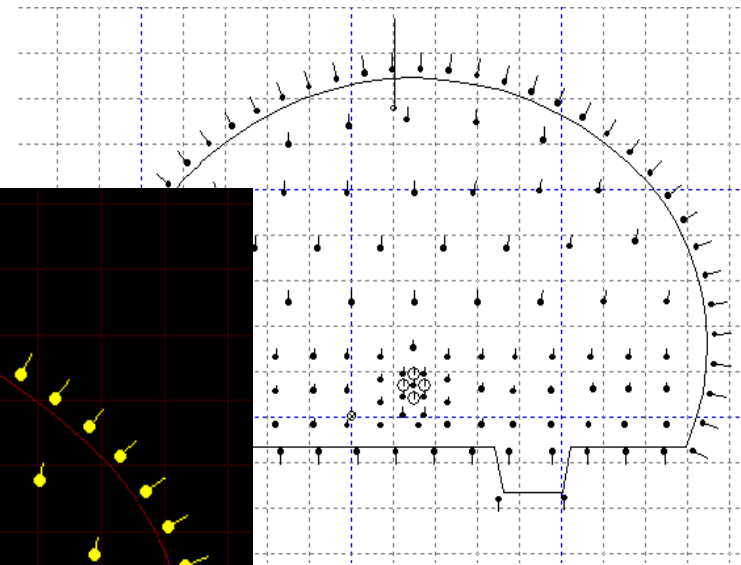
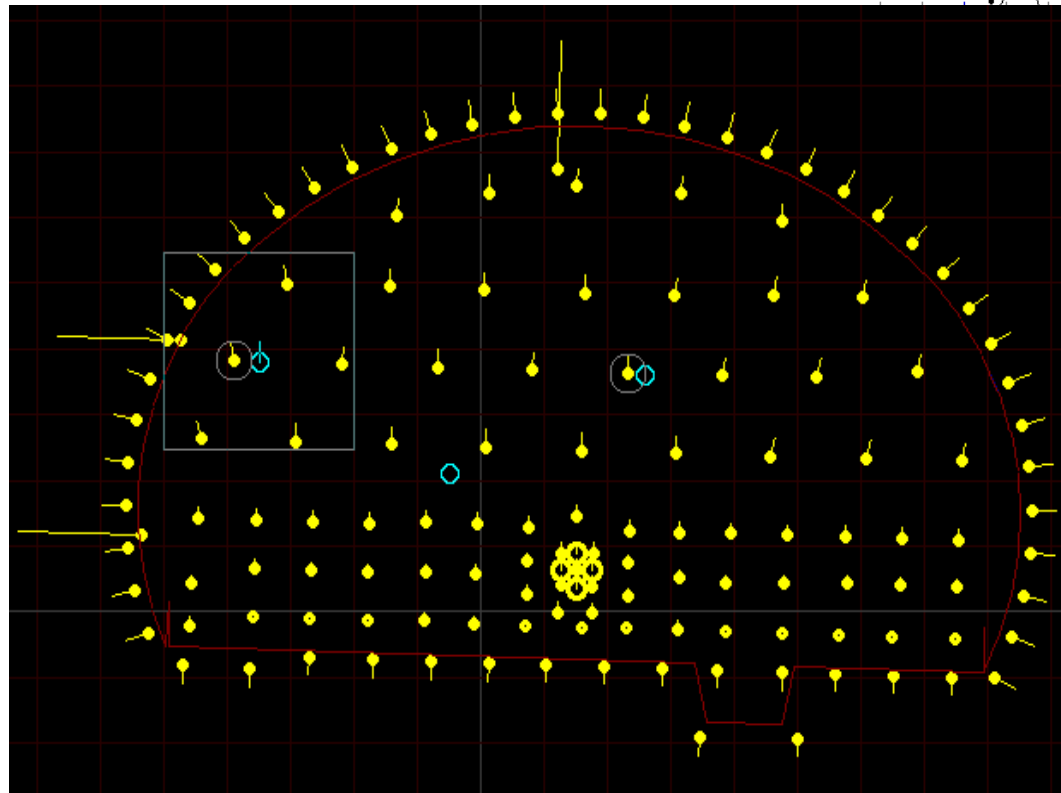
Drill Pattern design



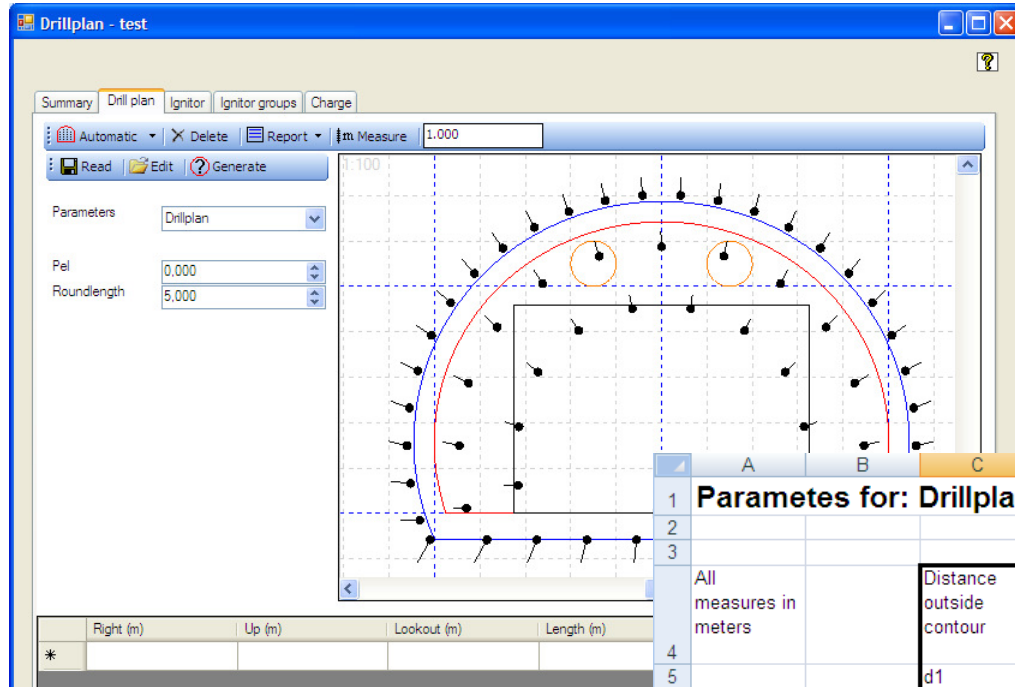
ms supplier

Bever
Control

Drillplan –at peg no 20/6668

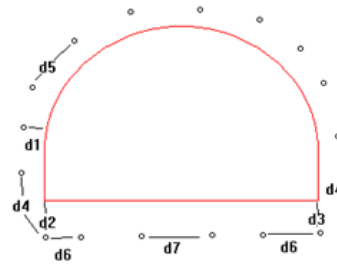


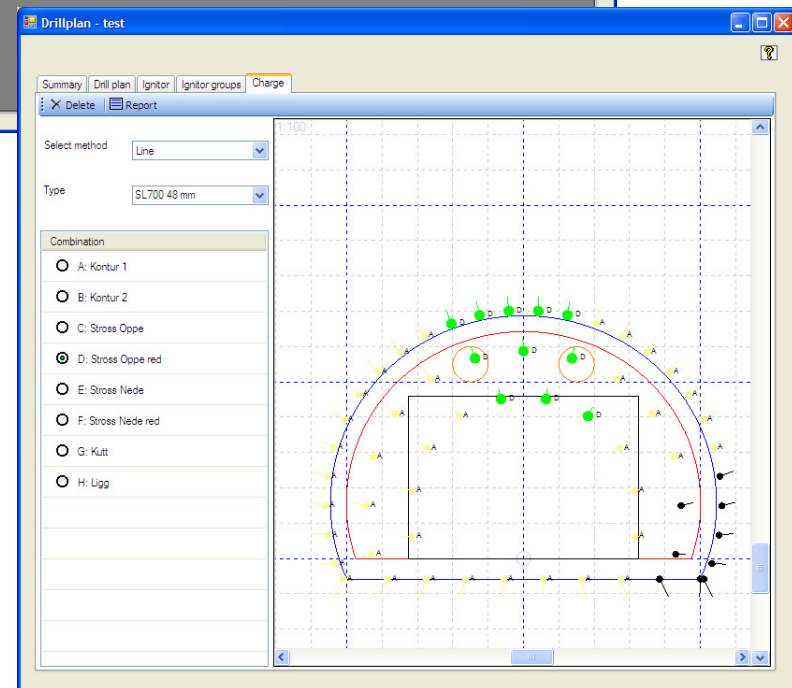
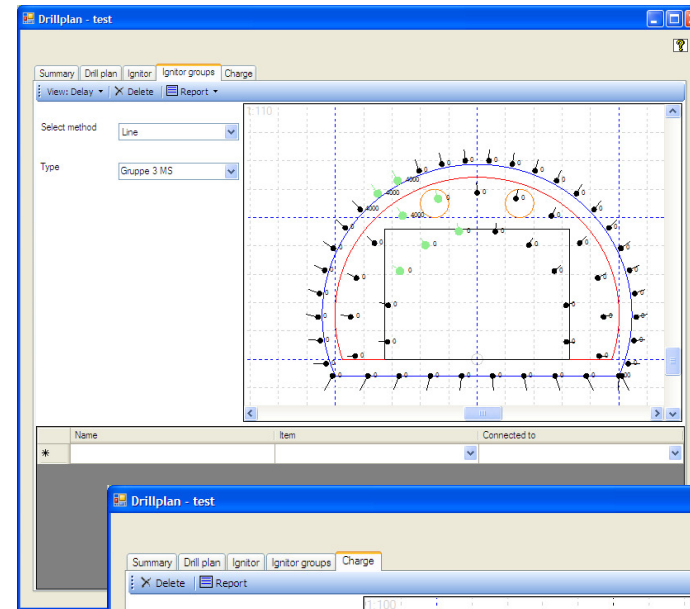
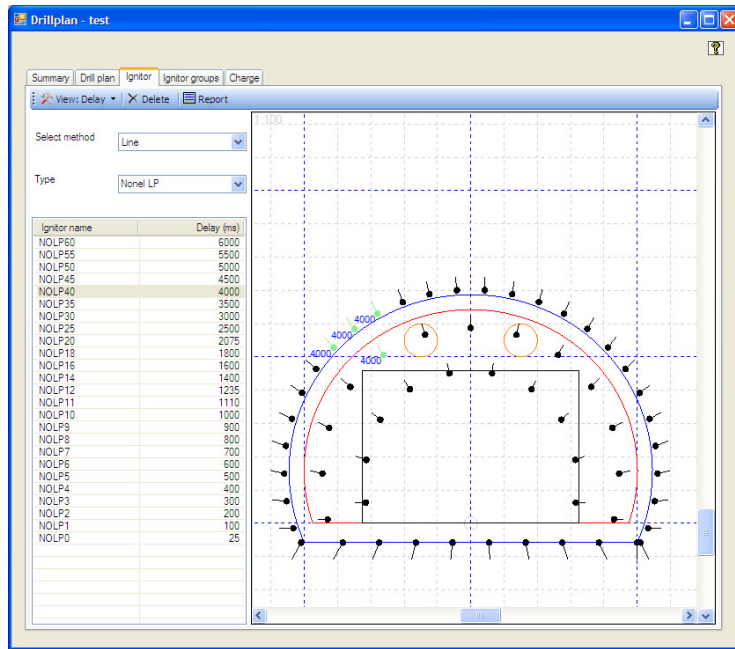
Automatic drill pattern



Parameters for: Drillplan

All measures in meters		Distance outside contour	Down left corner	Down right corner	High first hole on contour over bottom	Hole distance contour	Distance from wall to first hole in bottom	Hole distance bottom	Comments
		d1	d2	d3	d4	d5	d6	d7	
Start of hole	Row 1	0.15	0.00	0.00	0.50	0.90	1.25	1.25	Contour 1
	Row 2	-1.00	0.00	0.00	0.70	1.50	0.00	0.00	Contour 2
	Row 3	-2.30	-0.50	-0.50	0.70	1.50	0.00	0.00	Contour 3
End of hole	Row 1	0.55	0.50	0.50	1.00	0.90	1.25	1.25	Contour 1
	Row 2	-0.65	0.00	0.00	0.70	1.50	0.00	0.00	Contour 2
	Row 3	-2.00	-0.50	-0.50	0.70	1.50	0.00	0.00	Contour 3





- Ignitor
- Ignitor groups
- Charge planning

Project transferred to drilling machine



Tlf: +4732858960
Fax: +4732858961
mail@bevercontrol.com
www.bevercontrol.com

AMV (11045 BCA 22.10)
Bulid: Oct 21 2005 11:06:15
Plan til Drill status: Ok
Plan til profiler Ok

2005.11.17 18:42:13

F25: Stuff Default
F26: Laser O:Laser 1 (12100 -)(3005.000)
F27: Naviger
F28: Borrplan
F29: Logg

F13: Profiler F54: Borring F3: Zoom F10: Hjelp

B01: Velg prosjekt / delprosjekt

Aktivt prosjekt :

F4: ASSURTJERN

F5: Synkroniser media F6: Løs ut media

Aktivt prosjekt

F4: ASSURTJERN

F5: Synkroniser media F6: Løs ut media

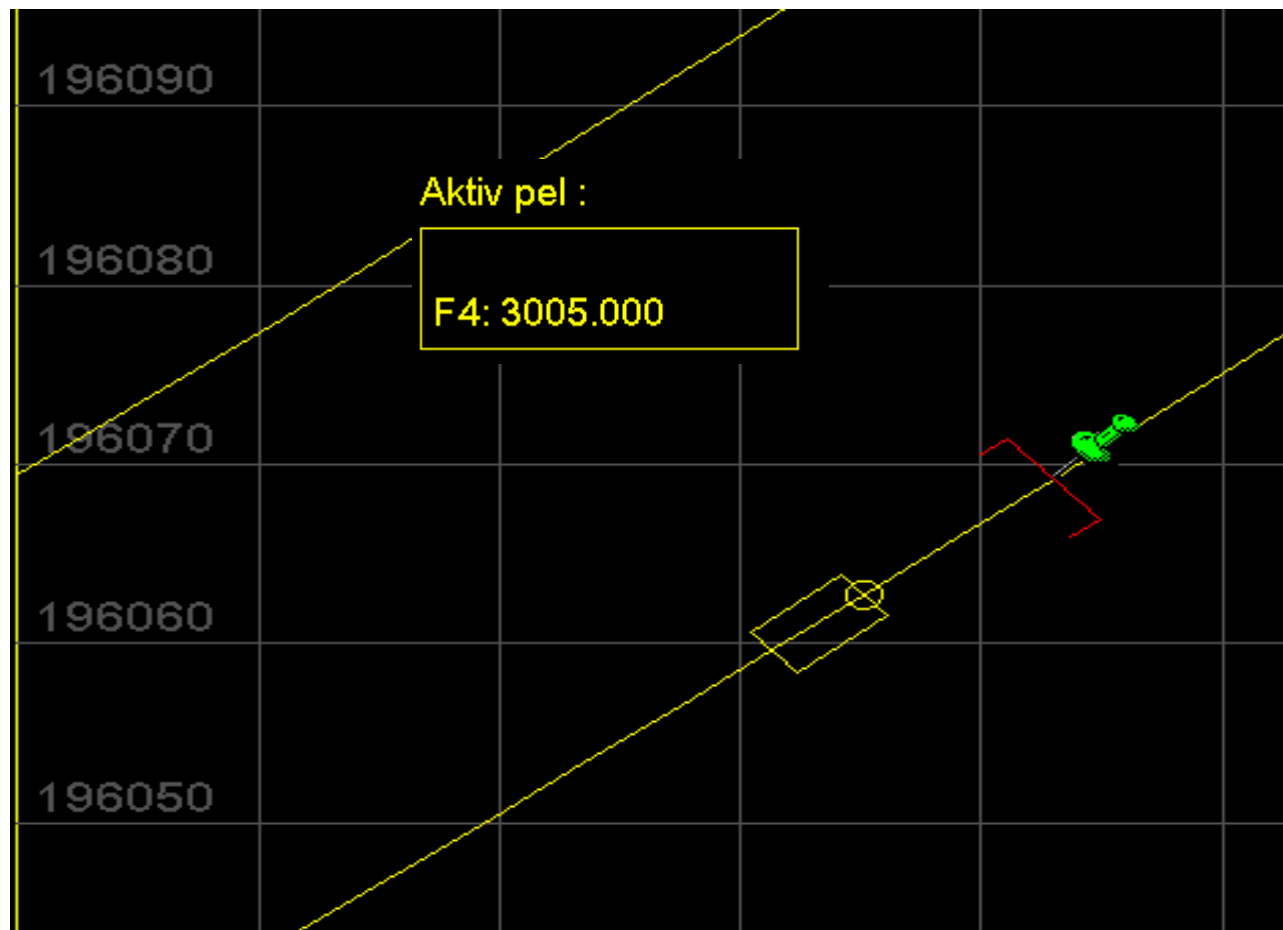
F11: Operasjoner

F2: Til start F1: Neste

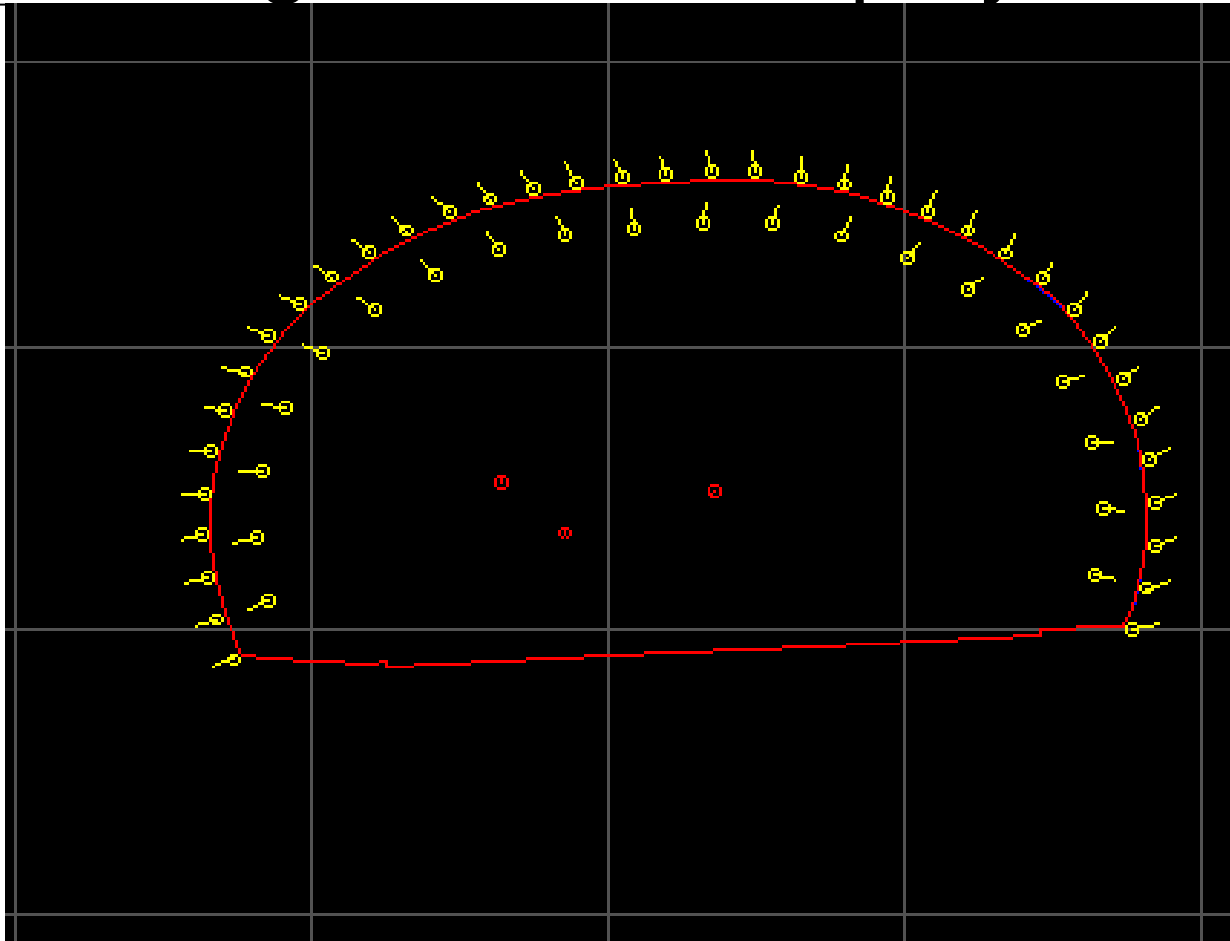
Start

2 Windows ... Demo ViaBev... Bever_Profiler Bever_Drill Bever_Plan Microsoft Po... NC 18:42

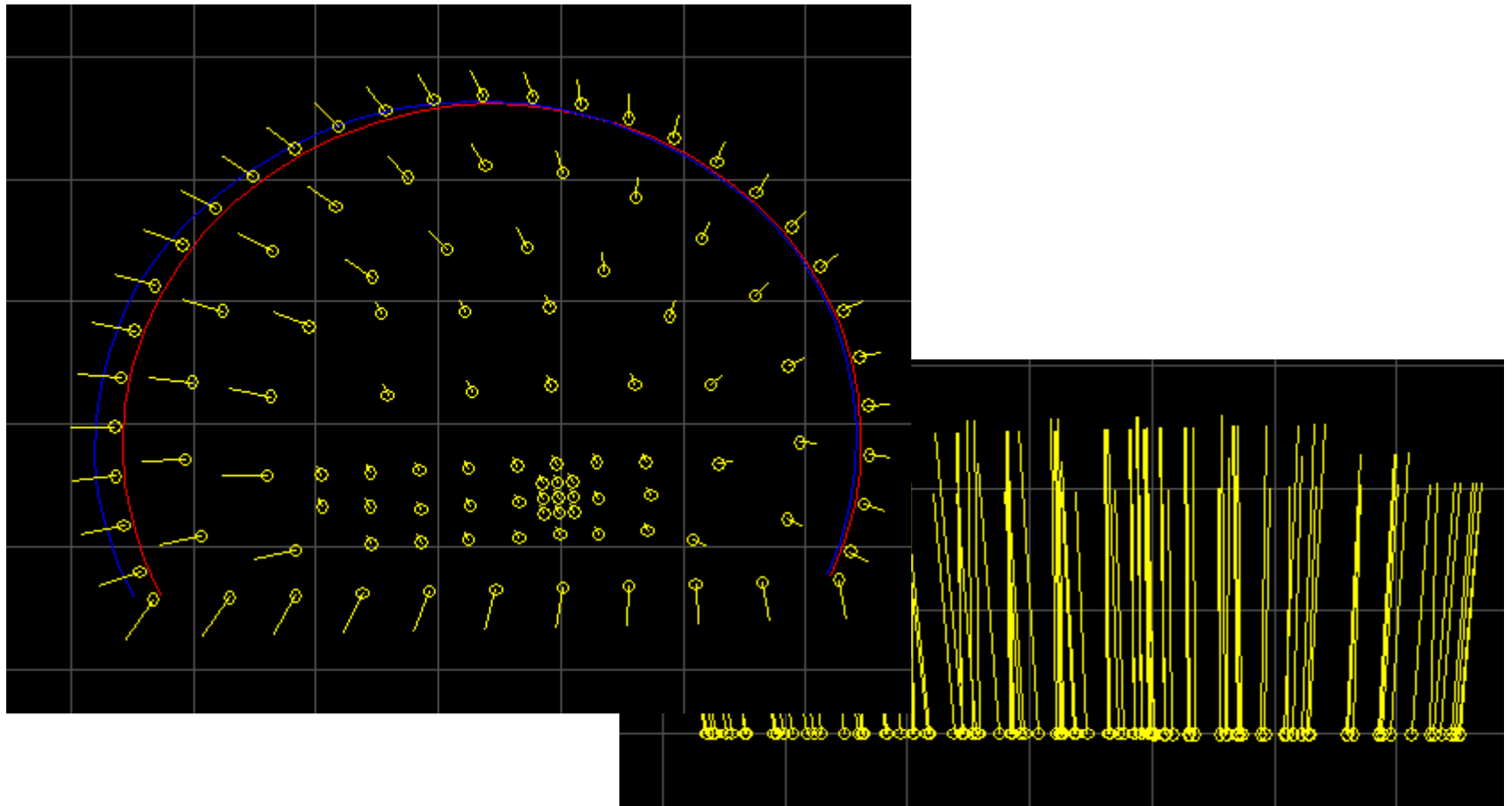
Drilling machine setup at peg no 3005 in a twin tube highway



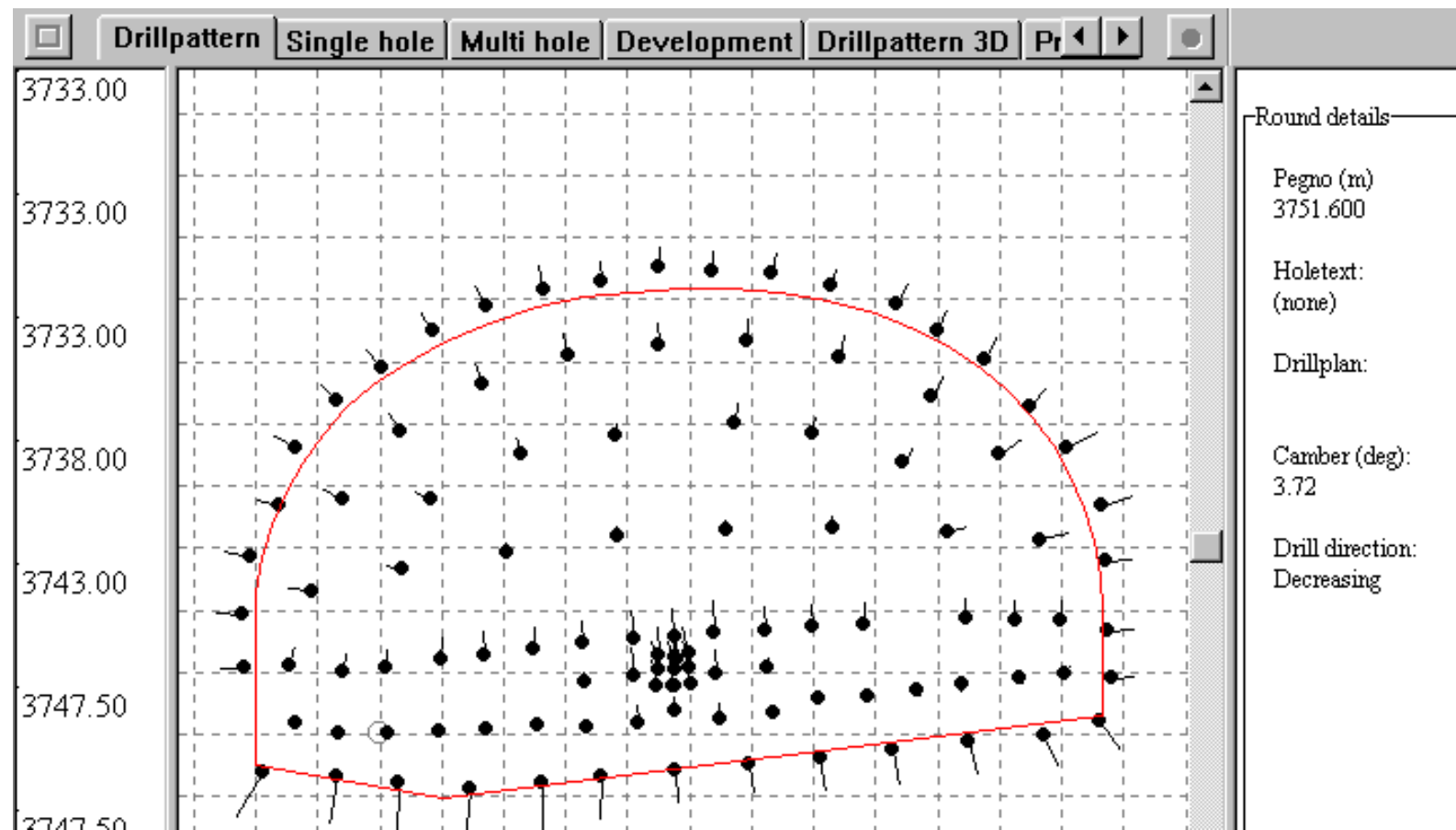
Contour at peg no 3005 shows up on the drilling machine display and contour



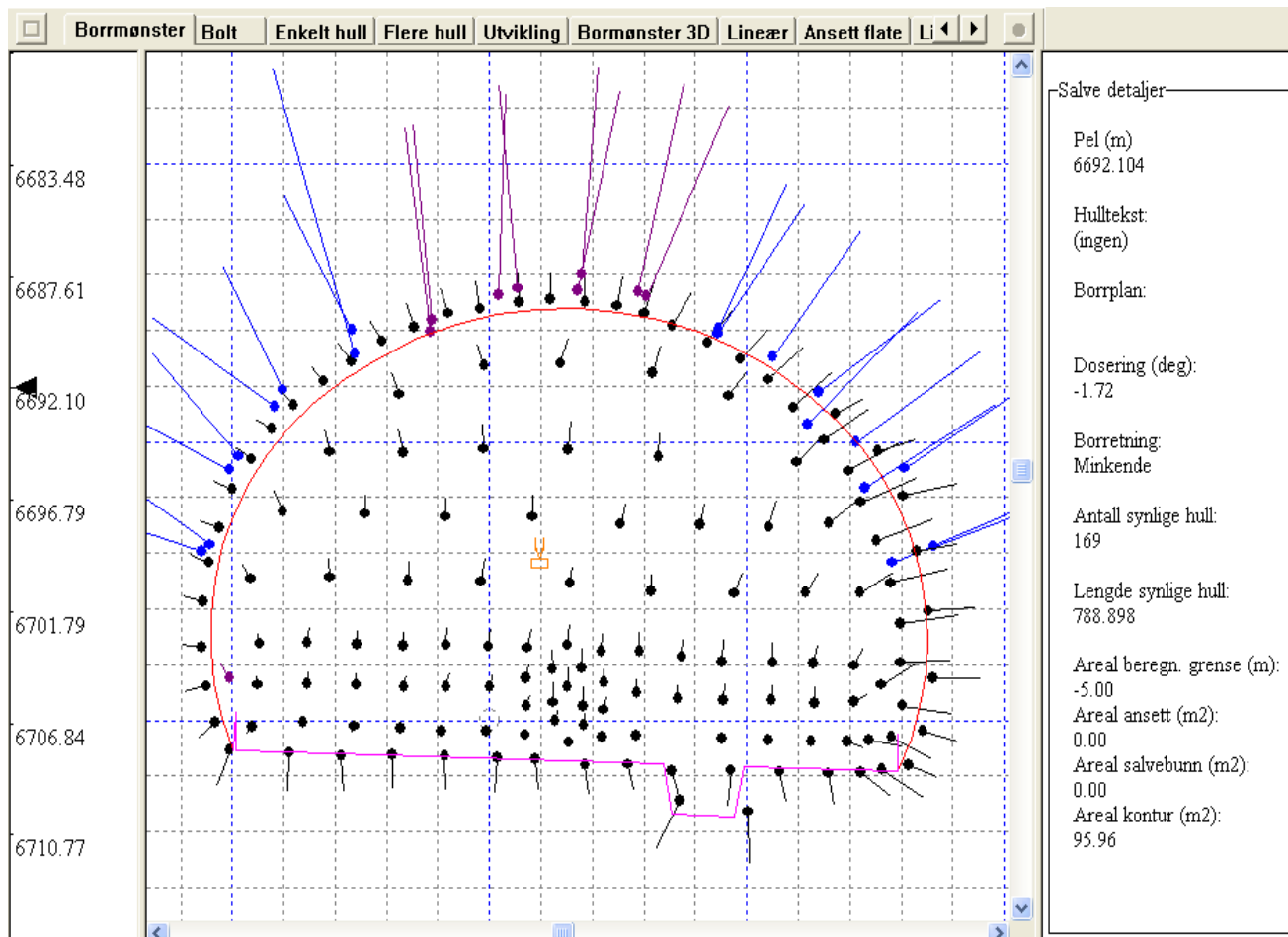
Drillplan is automatic created to adapt to expansion and curve in the tunnel



Drill logs includes all detailed information about the drilling process



Profil Drill-logs nitche at peg no 20/6692

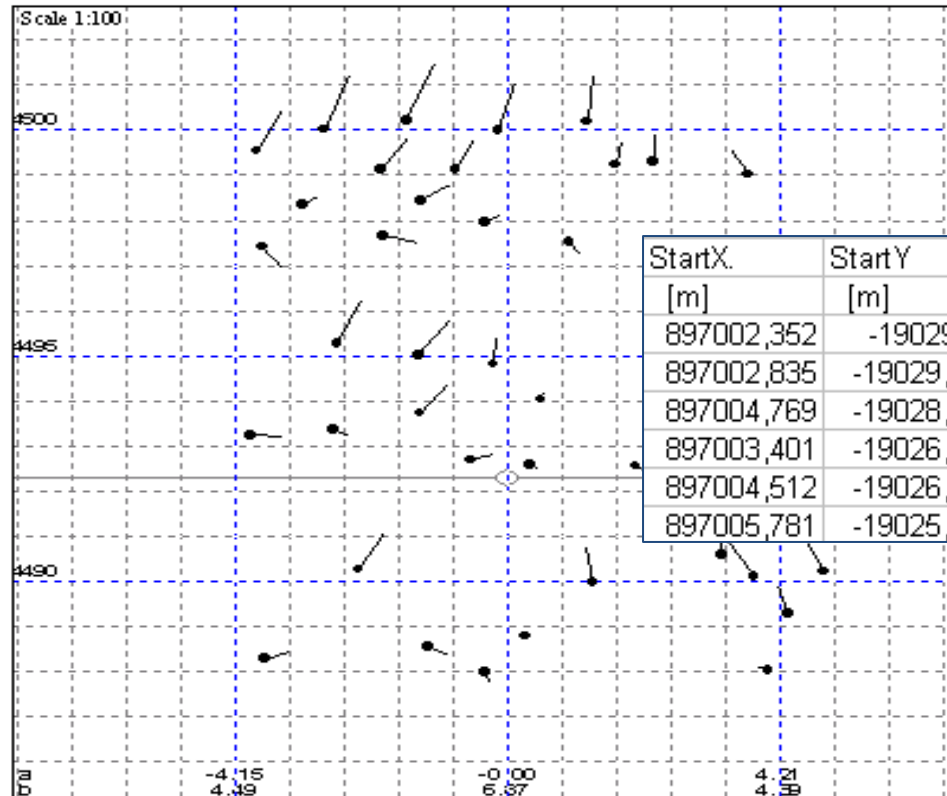


Bolting recording from drilling

Printing date: 20030623 14:52

Bolt log

Production date: 20021026 08:28

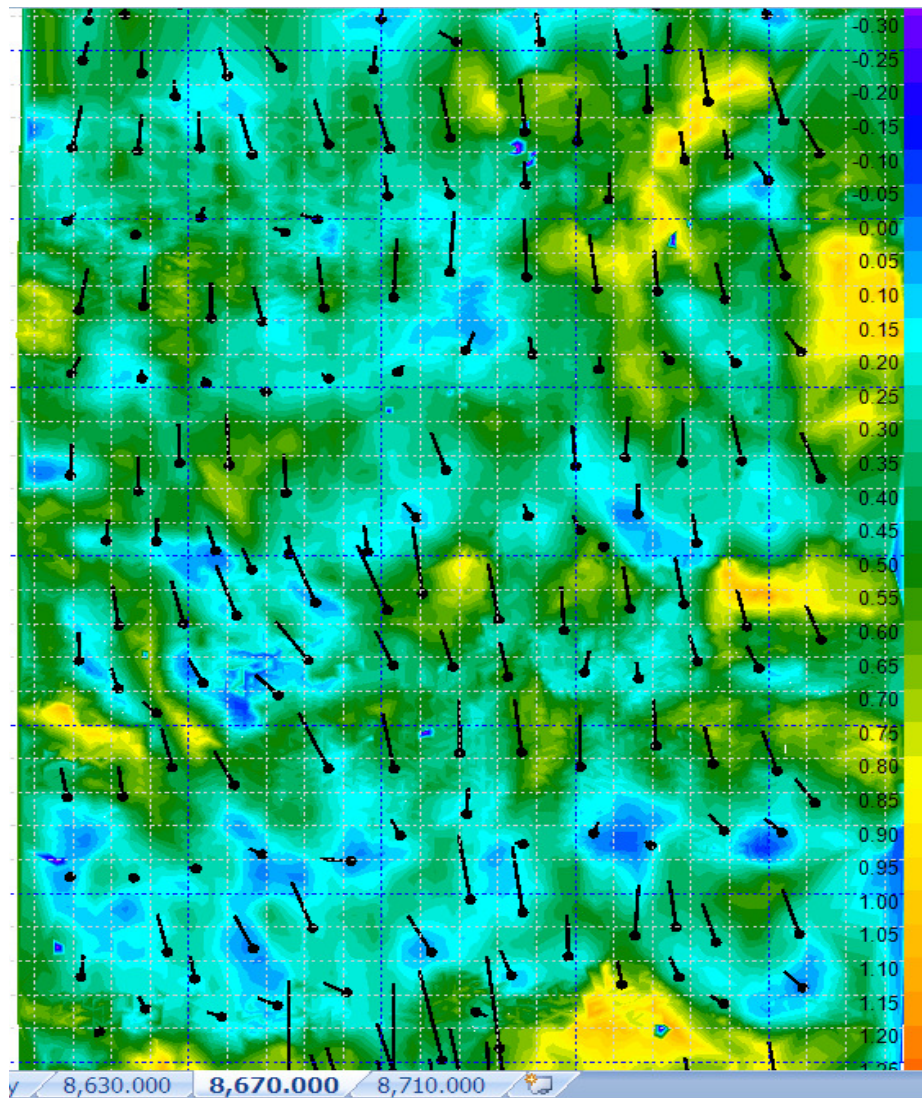


StartX. [m]	StartY [m]	StartZ [m]	EndX. [m]	EndY [m]	EndZ [m]
897002,352	-19029,35	231,923	897000,411	-19031,2	233,127
897002,835	-19029,422	232,938	897001,197	-19031,196	234,619
897004,769	-19028,616	235,425	897003,817	-19030,089	237,778
897003,401	-19026,604	234,81	897001,966	-19027,513	237,212
897004,512	-19026,037	235,482	897003,787	-19026,534	238,298
897005,781	-19025,469	235,5	897005,166	-19025,642	238,42

Automatic record from
drilling of bolt holes

Round data:			
Pages (no)	Selected holes	Length	Number
4492 220	Short hole	131 635	44
	Long hole	0 000	0
Relax.: (mm)	Total visible	131 635	44

Surface map
shows overbreak
and bolting
pattern on a 30
meters tunnel
section



Drill report from standard blast round drilling

SUMMARY ROUND REPORT

Element	Low Peg Ilo	High Peg Ilo
	10	1151,89 1385,15

Parsell: Koppstad - Solerod
 Sign: 0
 Date: 15.12.2004
 Comment: 0

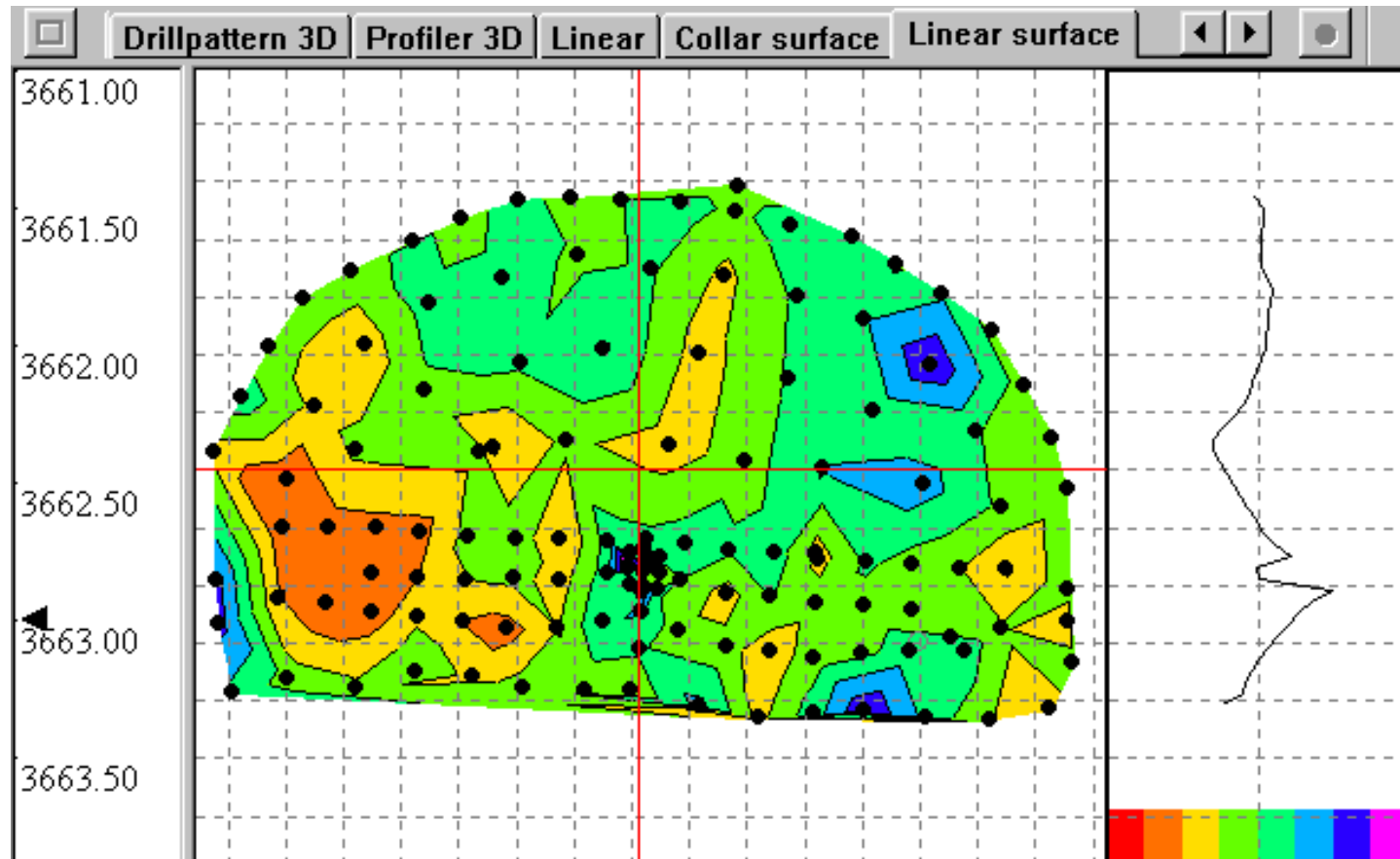
Round length (m) 284,2
 Jumbo id 21SGBC-CC (11-2404) (11218 BCA 20.1

Comment:
 Sign:

	<i>Total</i>	<i>Boom 1</i>	<i>Boom 2</i>	<i>Boom 3</i>
<i>Started</i>	29.10.04 20:44	01.01.00 0:00	01.01.00 0:00	01.01.00 0:00
<i>Ended</i>	15.12.04 18:51	15.12.04 18:51	15.12.04 18:26	15.12.04 18:44
Round Time (hours:min)	206:28	200:08	174:17	206:28
Periode length (days:hours)		14.18:51	14.18:26	14.18:44
Normal drilling (hours)		74:06	65:06	71:35
Slow/jammed drilling		12:50	17:38	15:41
Insert rods		0:00	0:00	0:00
Clean/other time		26:00	19:44	27:49
Move		87:10	71:48	91:21
Ilo of holes	6644	2242	2231	2171
Drilled (meter)	30460,7	10683,2	9160,9	10616,6
Penetration rate (m/min)	2,27	2,21	2,14	2,30
Hammer pressure (bar)		124	125	119
Feed pressure (bar)		60	57	56
Rotation pressure (bar)		70	68	74

Drilling speed at peg no 3663

Indicates variations in geology – for

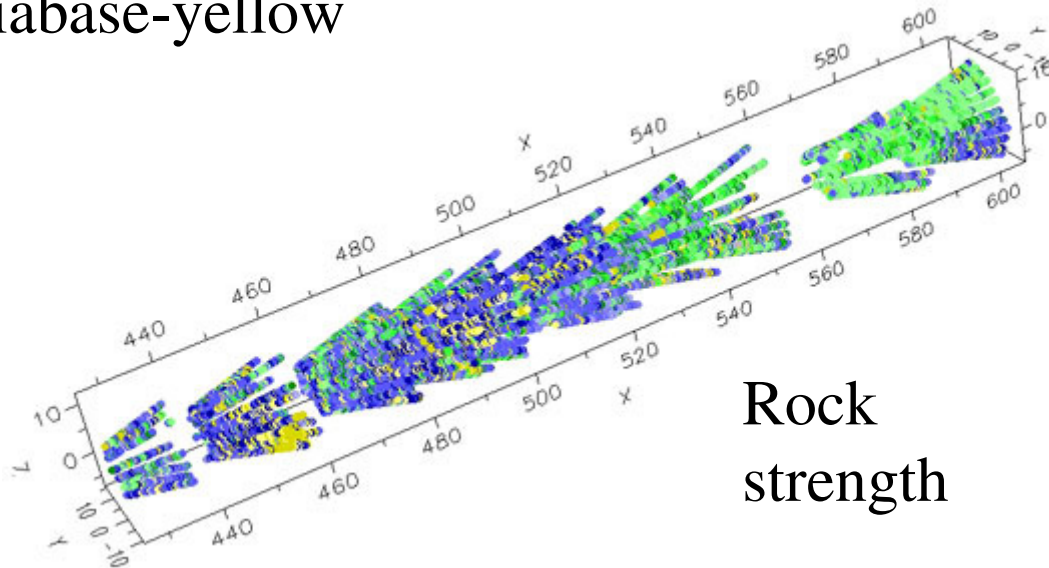
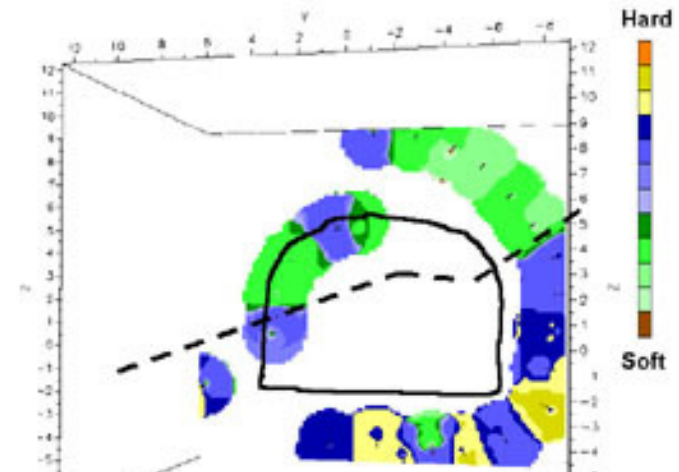


Drill parameters logger (drilling speed)



Geology interpretation from drilling log (Rockma analysys)

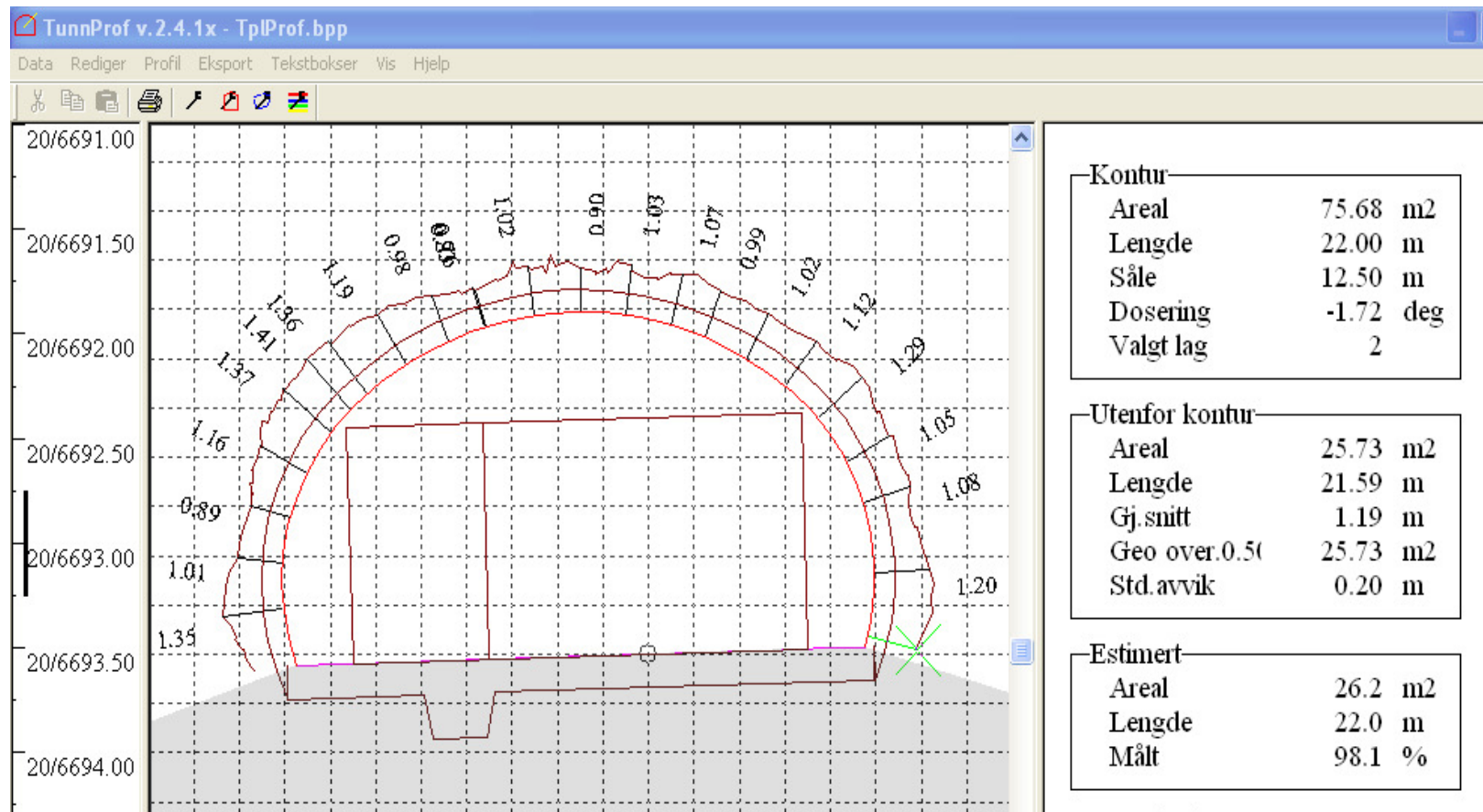
Rock strength
Rockma Analysis
limeston-blue
slate-green
diabase-yellow



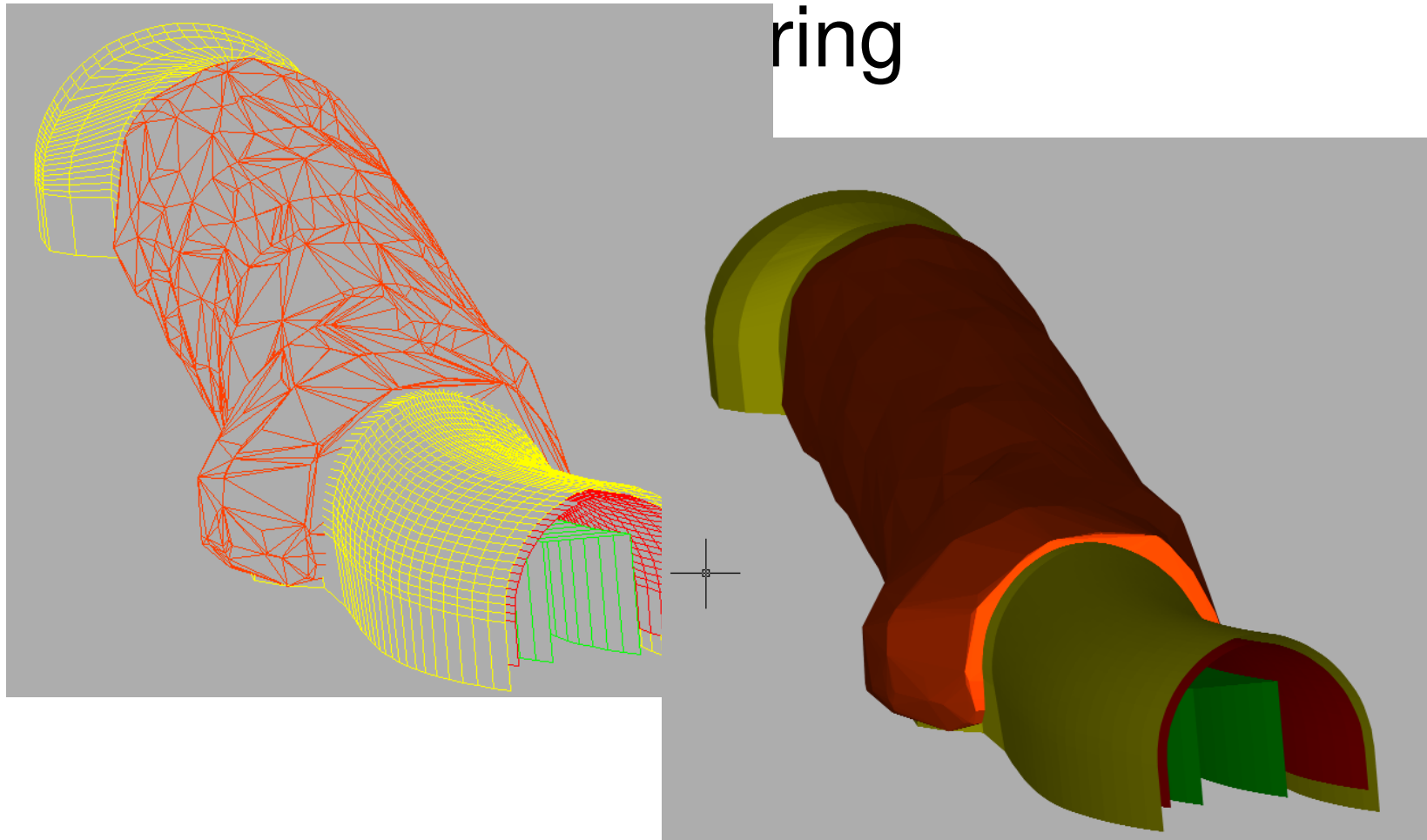
Rock
strength



Profil scanning – at peg no 20/6675

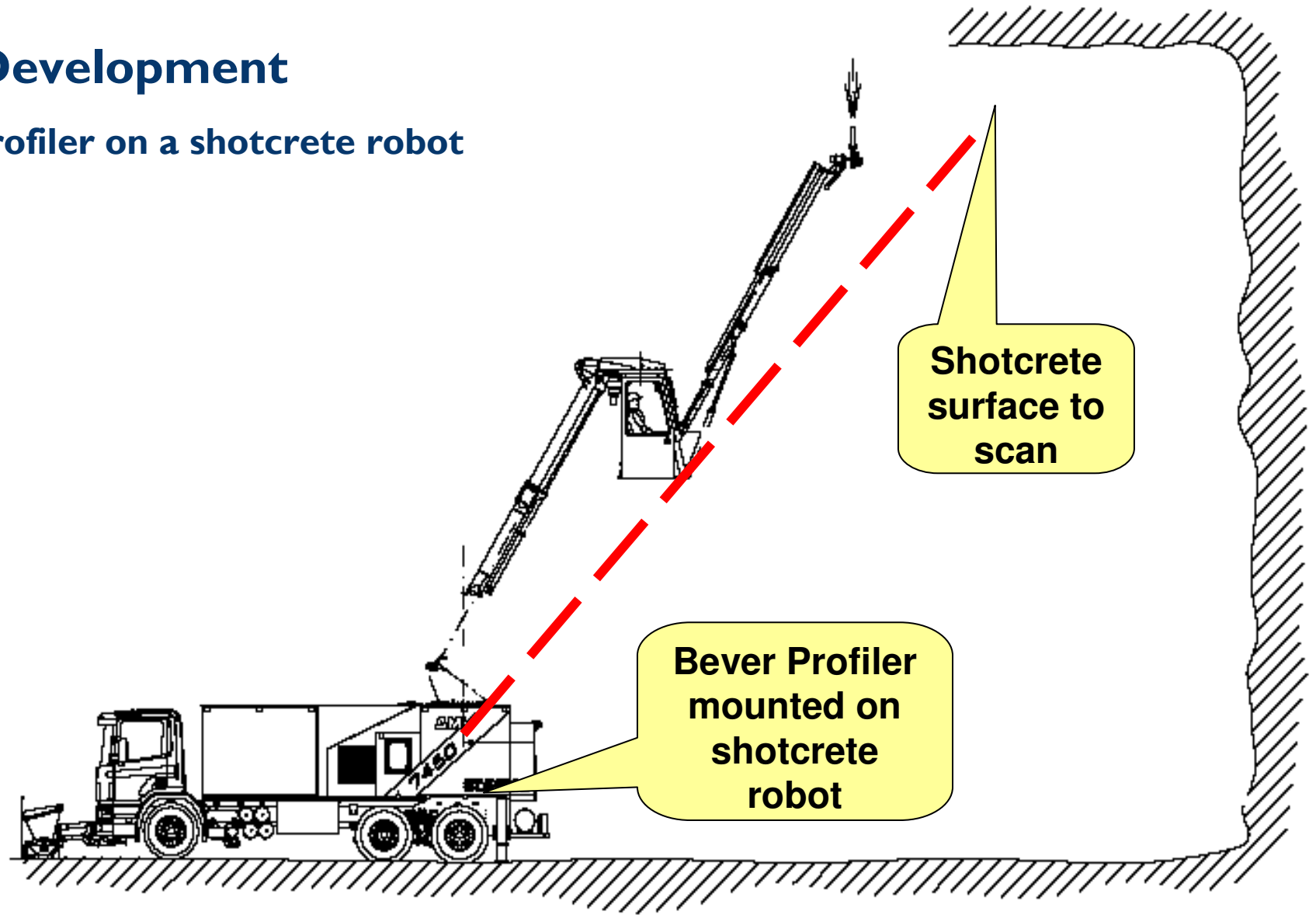


Contour scanned using Bever 3D Profiler and transferred to NPT



New Development

Bever Profiler on a shotcrete robot

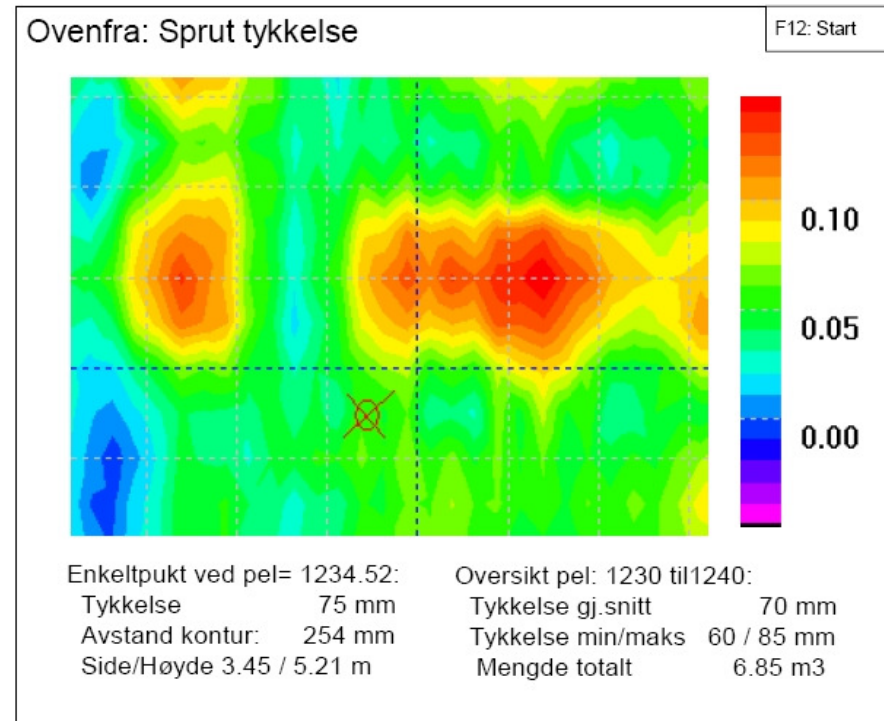
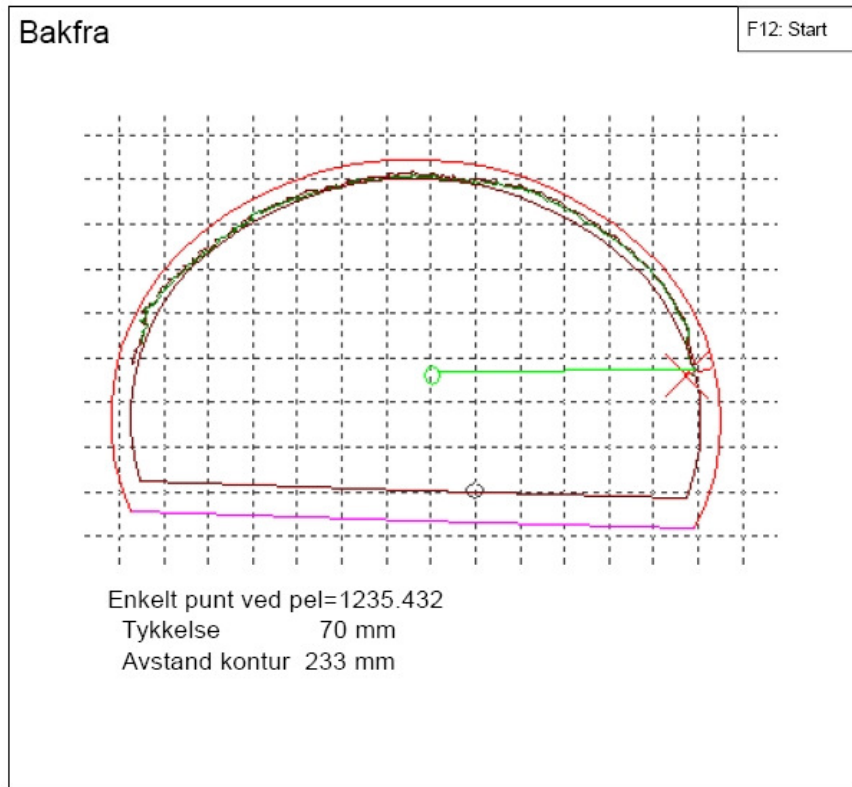


Control systems supplier

New Development

Bever Profiler on a shotcrete robot

Reports generated



Control systems supplier



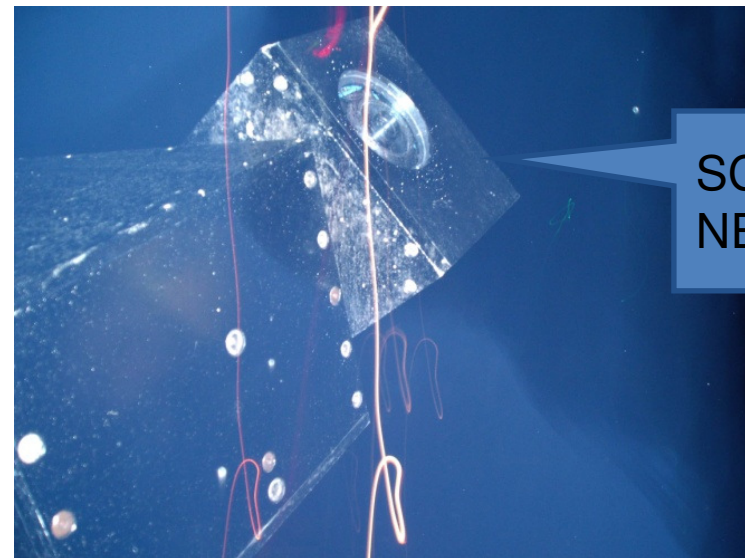
Operator environment in the test case



Our scanner in the test case

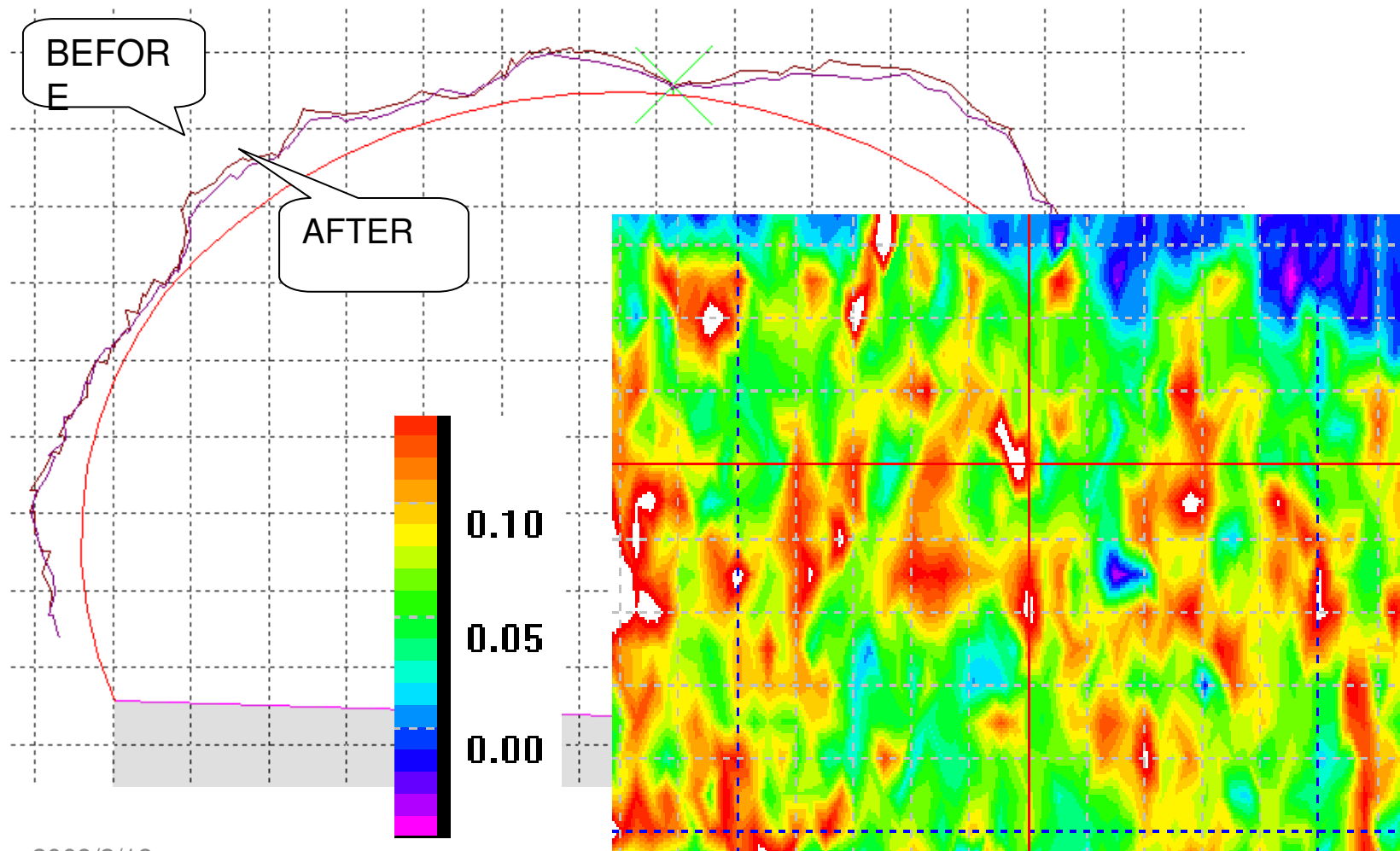


Touch
screen



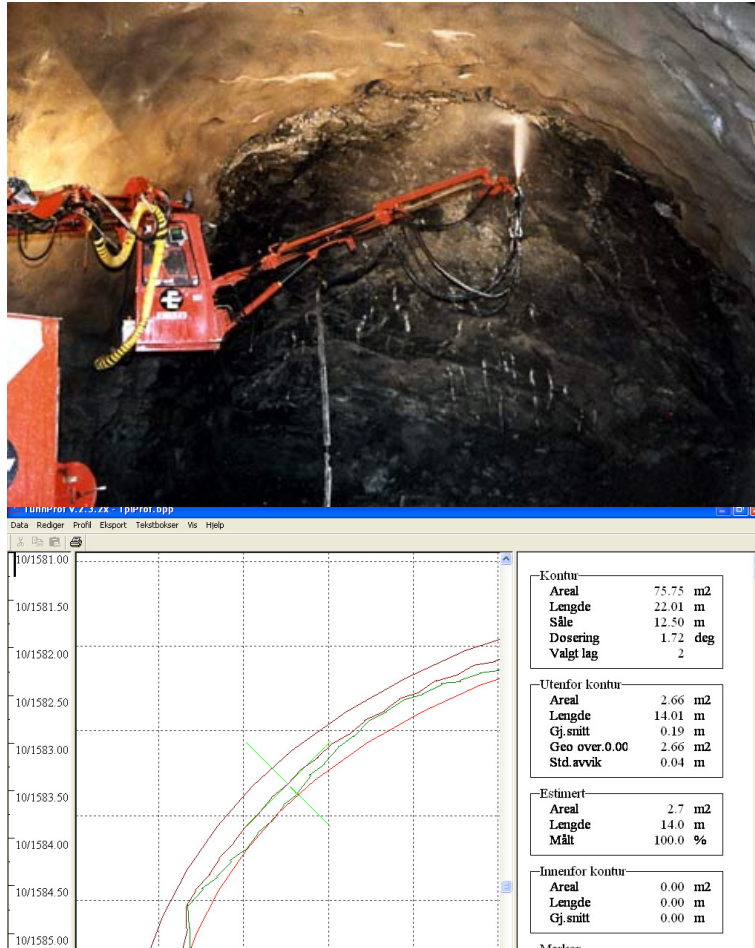
SCAN
NER

PROFILE SCANNING BEFORE AND AFTER SHOTCRETE

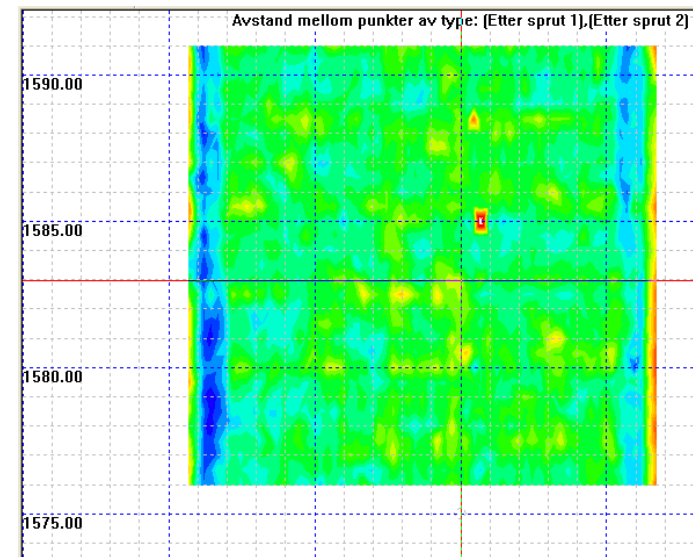


2009/2/18

Shotcrete scanning



Punkt typer som vises	Linjefarge
<input checked="" type="checkbox"/> Utsprengt	
<input checked="" type="checkbox"/> Sprut 1	
<input checked="" type="checkbox"/> Bolter 1	
<input checked="" type="checkbox"/> Bolter 2	



Method is drill
25 test holes
manually

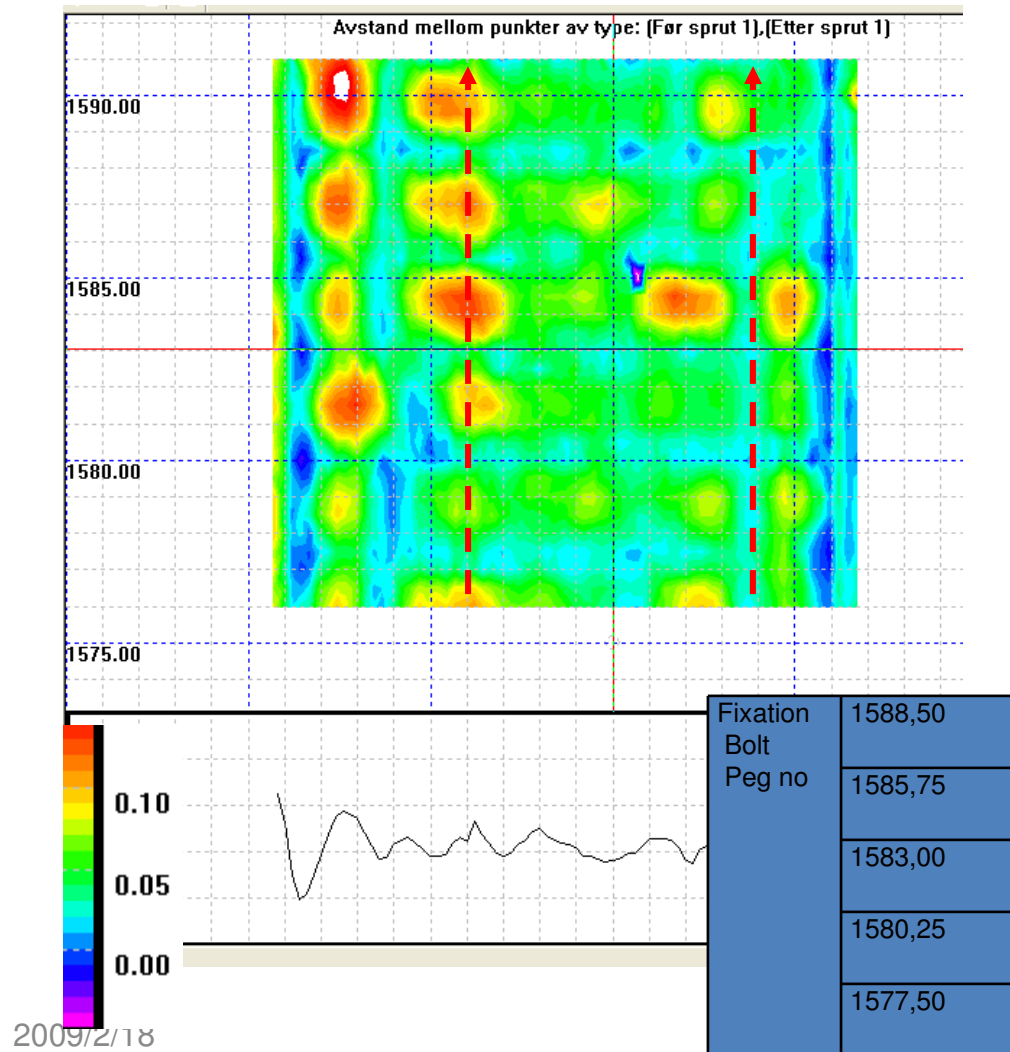
Average
is 7,8 cm

SHOTCRETE THICKNESS IS AN IMPORTANT PARAMETER OF QUALITY

TO DAYS THICKNESS control
IN NORWAY– ONLY 3 % IS NORMALLY
CHECKED

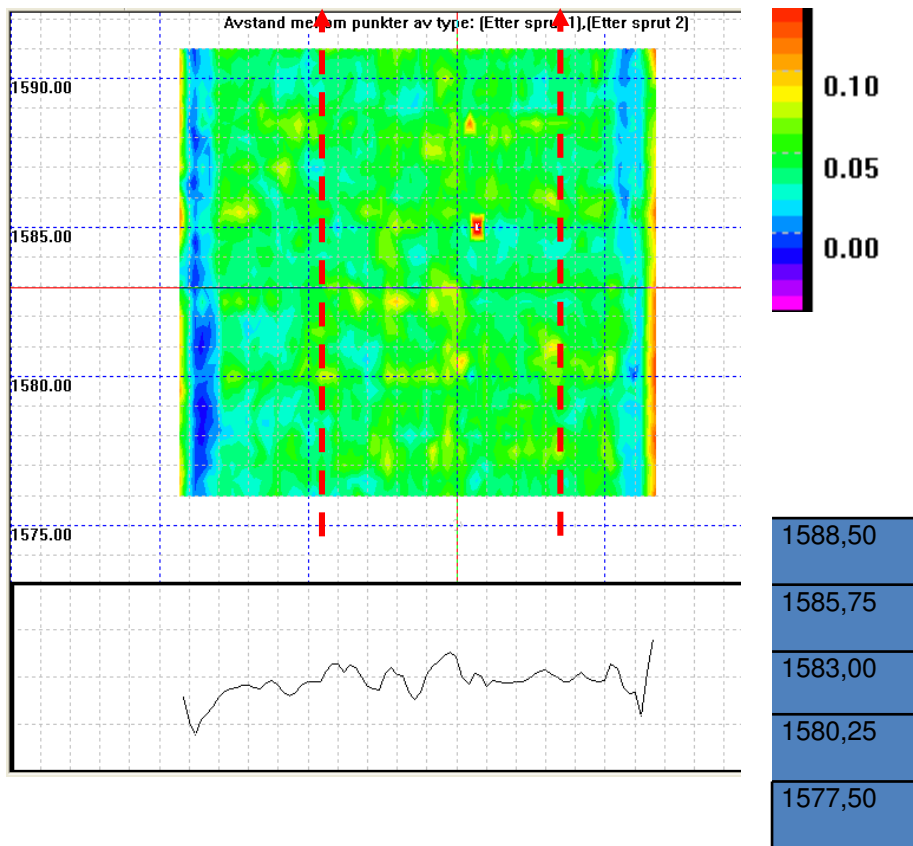
Method is drill test holes manually

Test results from spraying layer 1 – 2cm – problems due to deformations in lining



Drilling test after 1 layer		
Peg no	-4 meter	+4 meter
1589,0	2,1	2,0
1588,5	2,3	0,5
1588,0	1,7	0,6
1587,5	2,4	0,8
1587,0	2,8	0,7
1586,5	1,7	0,8
1586,0	2,1	0,4
1585,5	2,3	1,1
1585,0	1,2	3,6
1584,5	1,8	2,3
1584,0	2,0	2,8
1583,5	1,1	2,6
1583,0	1,6	2,5
1582,5	0,6	3,5
1582,0	1,7	0,6
1581,5	1,5	2,1
1581,0	1,8	1,3
1580,5	1,4	2,7
1580,0	1,2	2,7
1579,5	2,8	2,9
1579,0	2,6	1,9
1578,5	3,5	1,7
1578,0	4,3	0,7
Average	2,0	1,8
Std dev	0,82	1,03

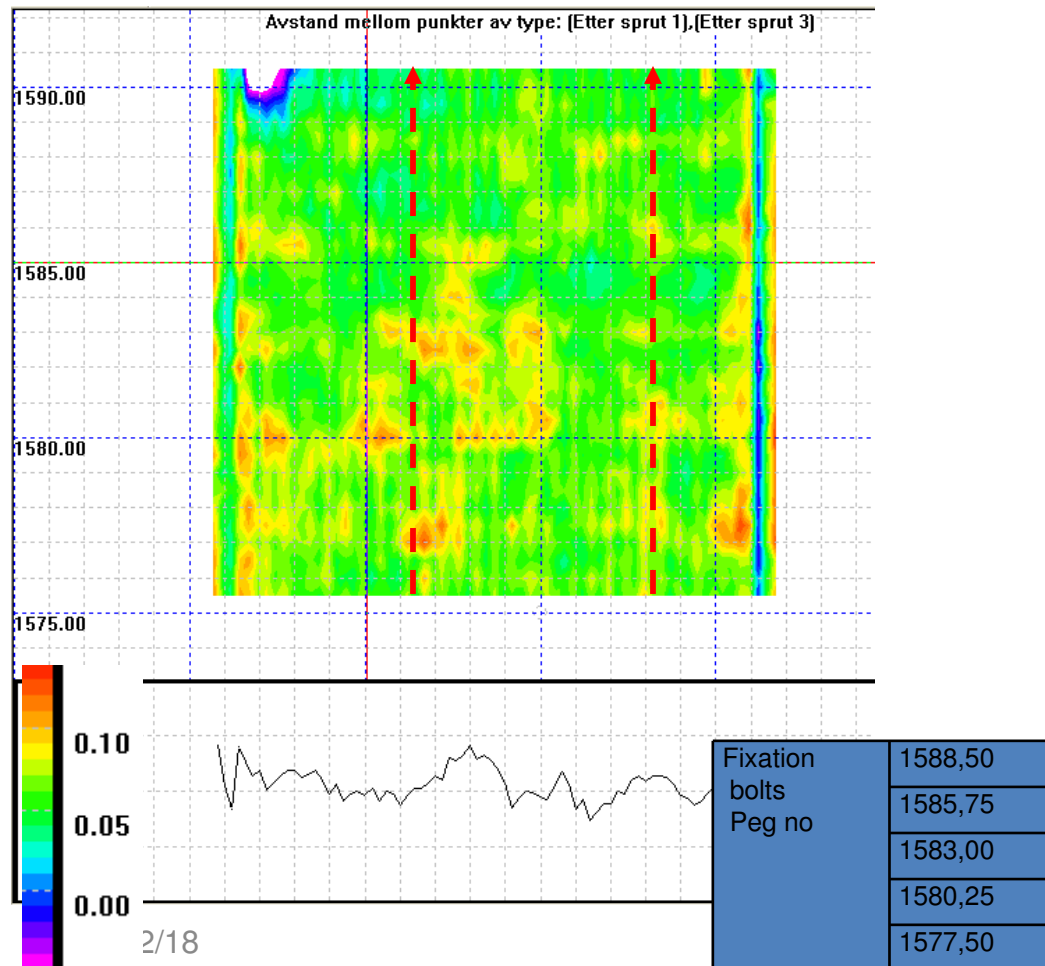
Test results from spraying layer 2 – 3.7cm – no deformation problem



2009/2/18

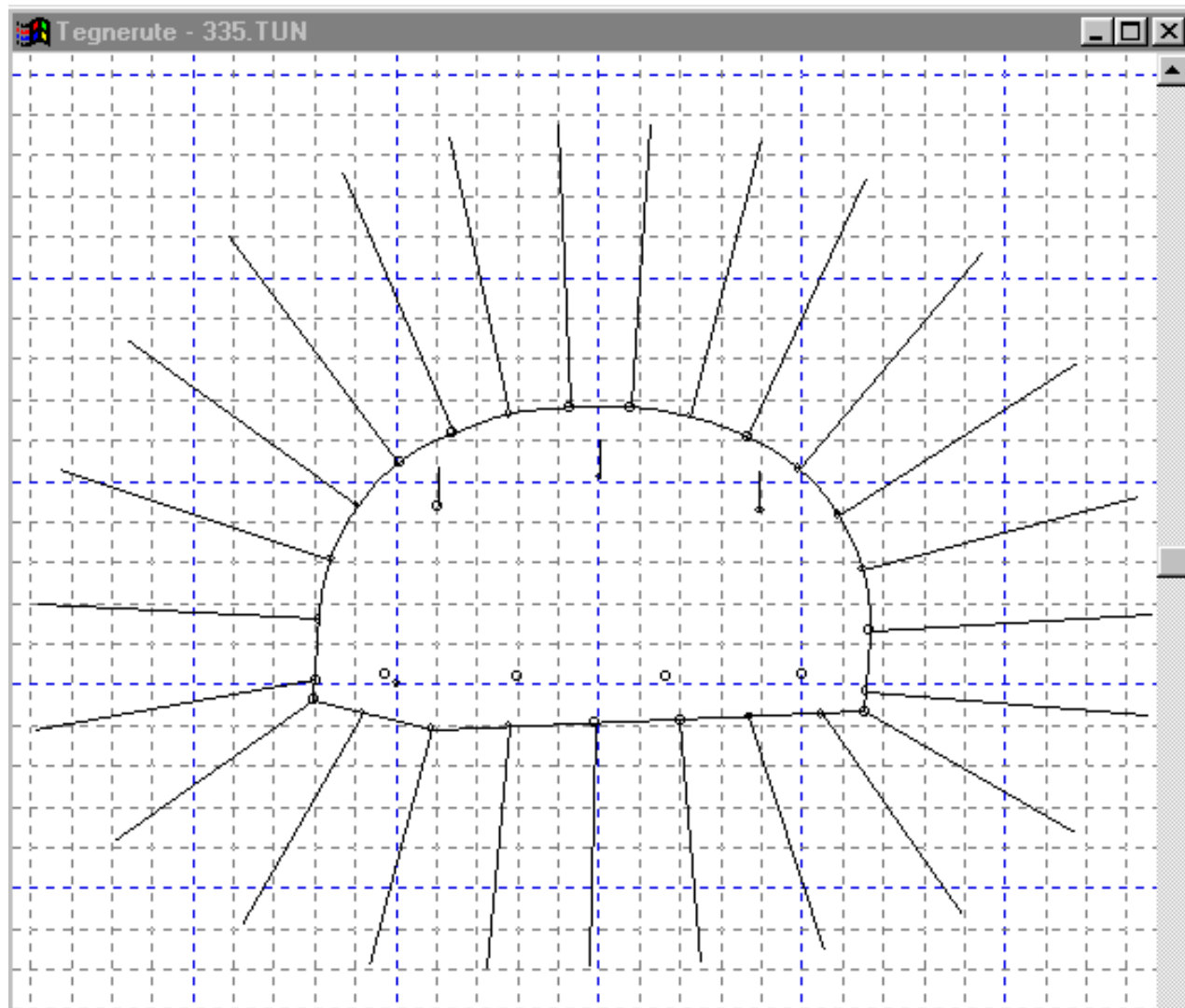
Drilling test after 2 layer		
Peg no	-4 meter	+4 meter
1589,0	7,0 cm	7,0 cm
1588,5	6,0	7,0
1588,0	6,5	5,5
1587,5	6,0	6,0
1587,0	5,5	5,0
1586,5	6,0	6,0
1586,0	7,0	4,5
1585,5	6,0	7,0
1585,0	7,0	5,0
1584,5	5,5	6,0
1584,0	6,0	6,0
1583,5	4,5	6,5
1583,0	5,5	5,0
1582,5	6,5	6,0
1582,0	5,5	5,0
1581,5	5,0	6,0
1581,0	4,5	6,5
1580,5	5,0	7,5
1580,0	6,0	7,5
1579,5	4,5	7,0
1579,0	5,5	5,0
1578,5	5,5	5,5
1578,0	4,7	4,5
Average	5,7 cm	6,0 cm
Std.dev	0,78 cm	0,93 cm

Test results from spraying layer 3 – 1.9 cm

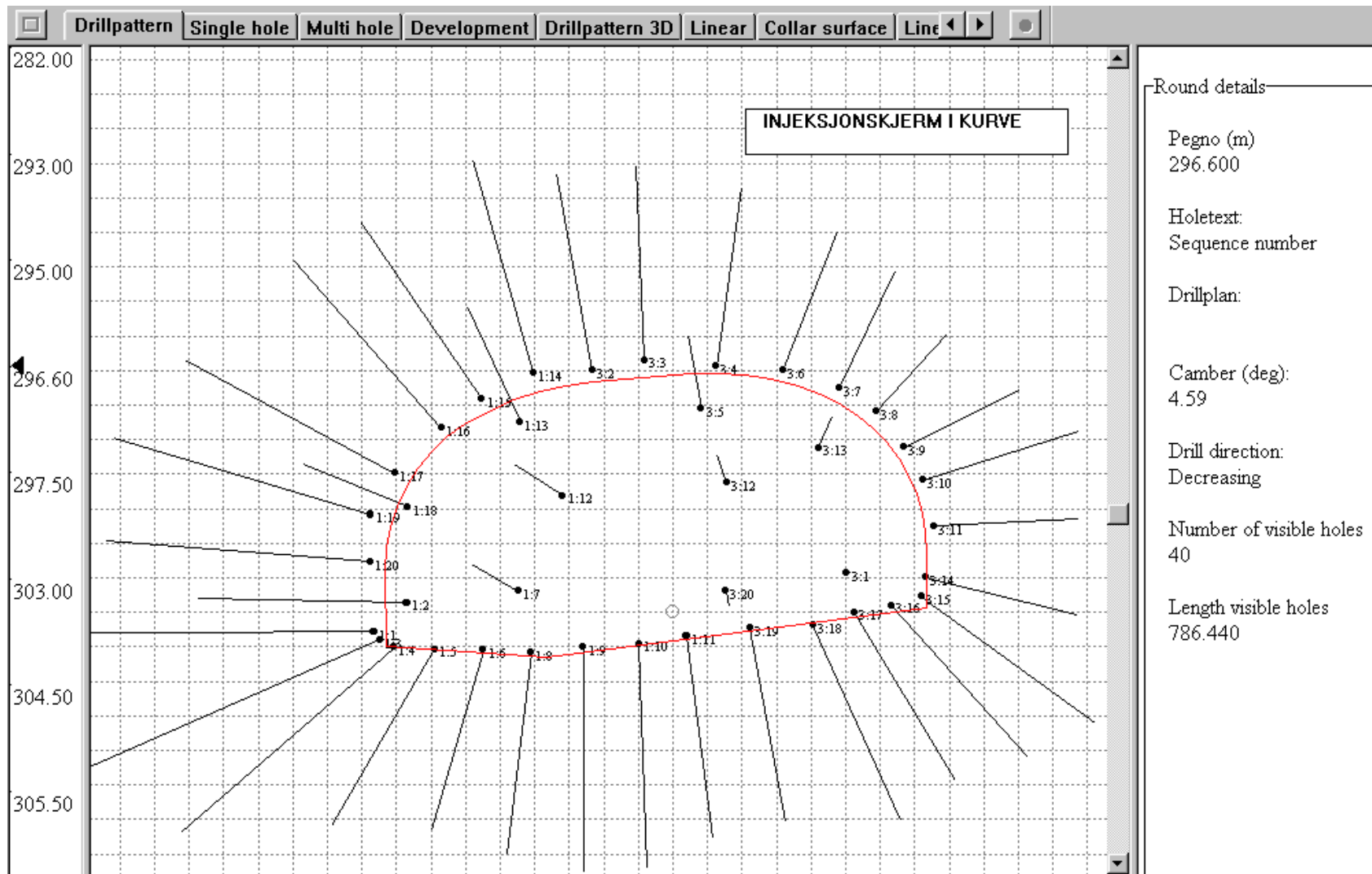


Drilling test after 3 layer (total)		
Peg no	Left side -4.2m	Right side +3.8m
1589,0	7,8	8,5
1588,5	9,5	8,7
1588,0	7,9	8,0
1587,5	8,0	7,5
1587,0	7,2	7,7
1586,5	8,0	8,0
1586,0	8,0	9,0
1585,5	8,5	8,7
1585,0	8,0	7,0
1584,5	8,0	7,3
1584,0	8,3	8,0
1583,5	8,5	9,0
1583,0	9,0	8,5
1582,5	7,8	9,0
1582,0	7,7	7,9
1581,5	8,0	8,0
1581,0	7,8	8,0
1580,5	8,0	9,0
1580,0	8,8	9,0
1579,5	7,3	8,0
1579,0	8,0	7,3
1578,5	8,0	8,1
1578,0	11,4	8,9
Average		
Std.dev		
8,2		
0,85		
8,2		
0,62		

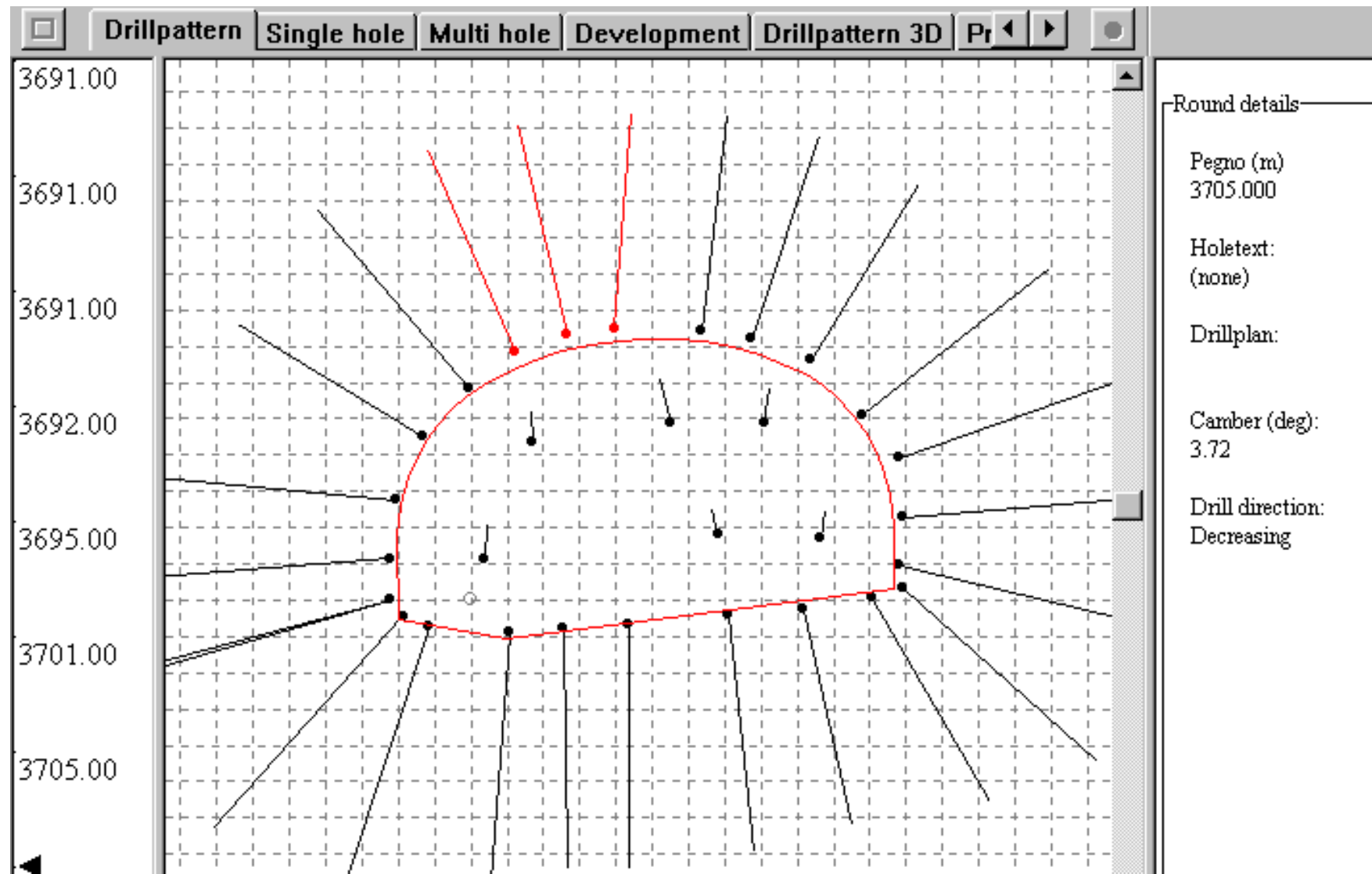
Drill plan – injection drilling



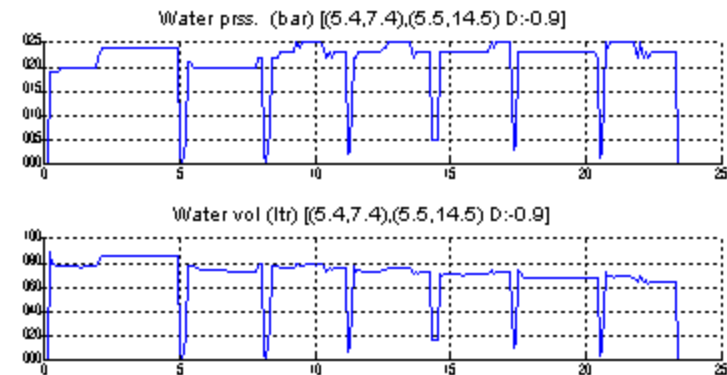
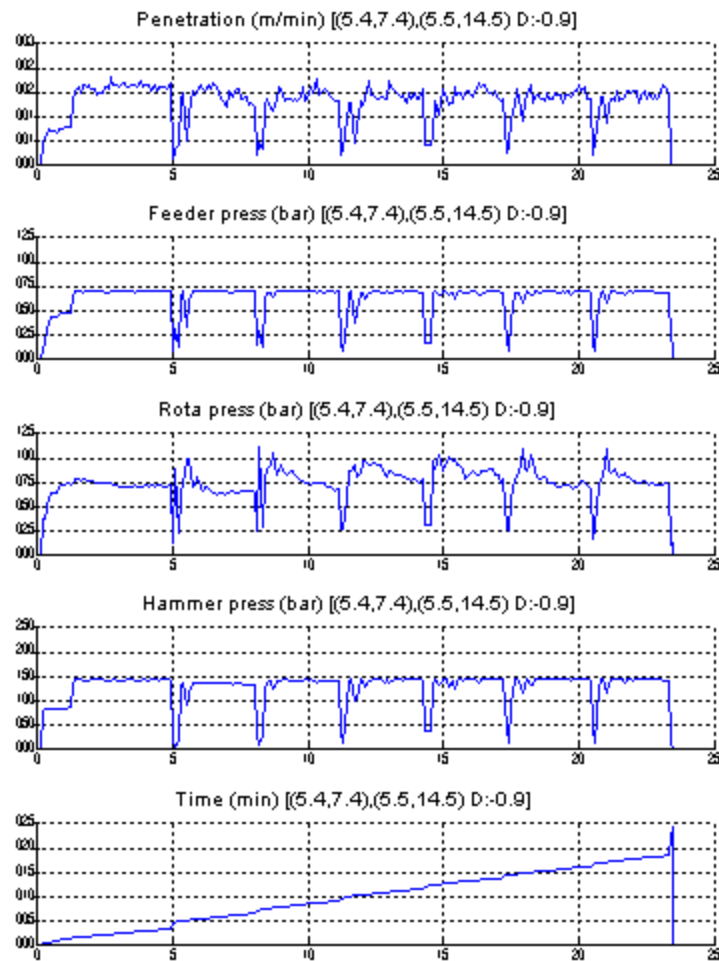
INJECTION DRILLING -LOG



Drill log – injection drilling



EXAMPLE FROM LOG ON INJECTION DRILLING



penetration rate

feed pressure

rotation

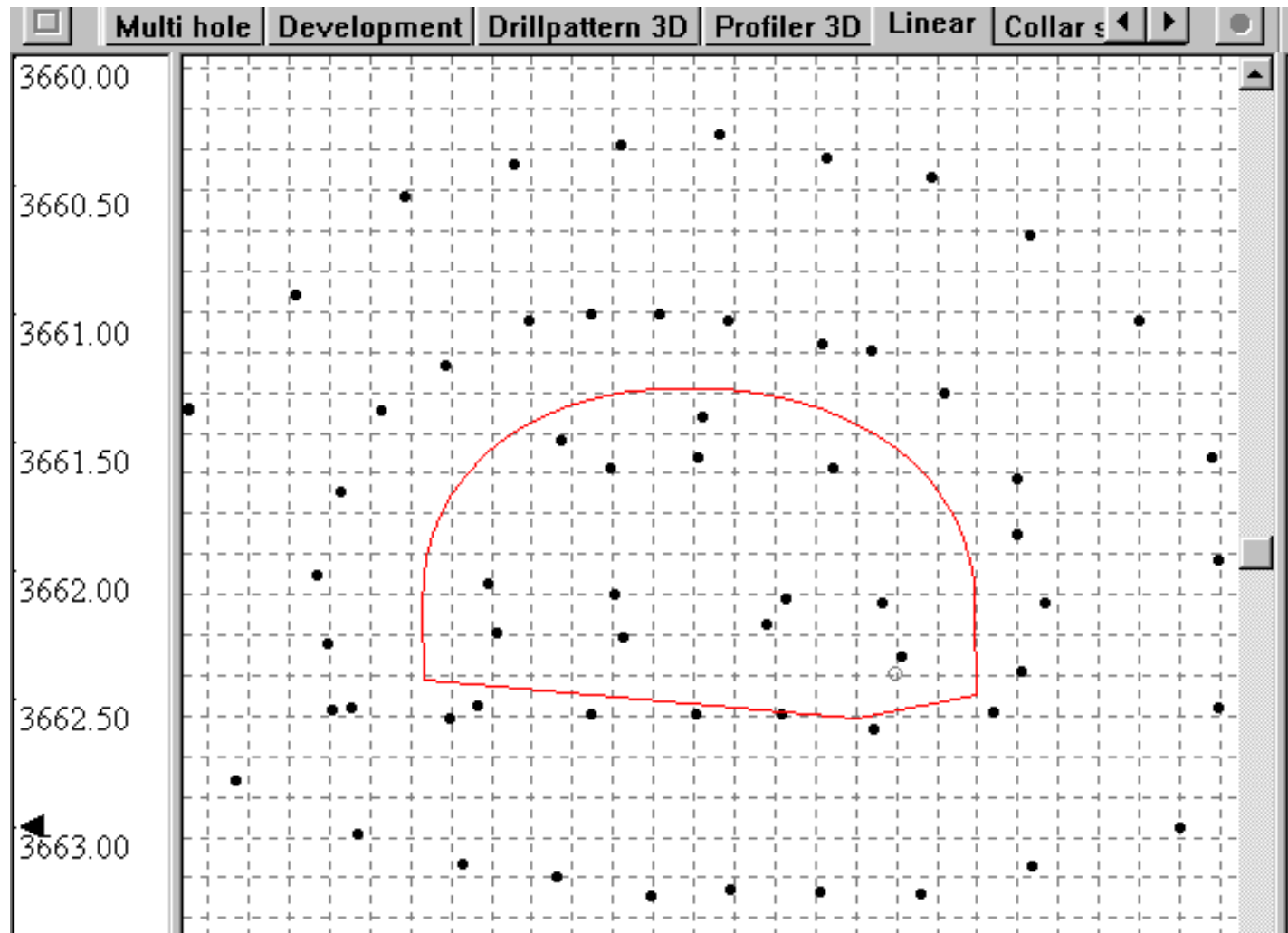
pressure

percussion
pressure

water pressure

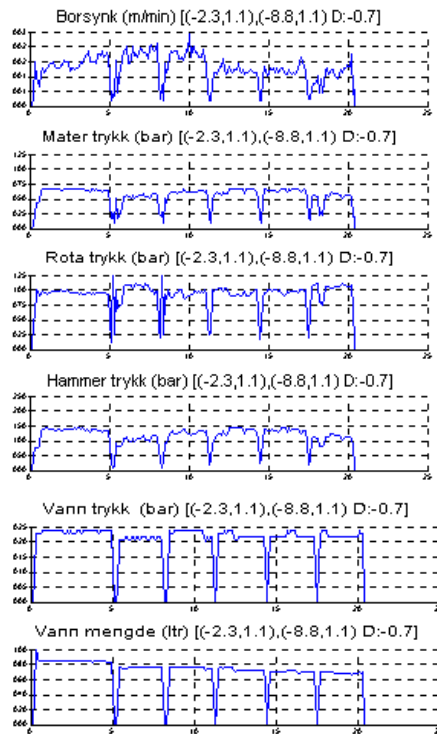
waterflow

Linear cut – injection drilling – see hole distribution also in curves

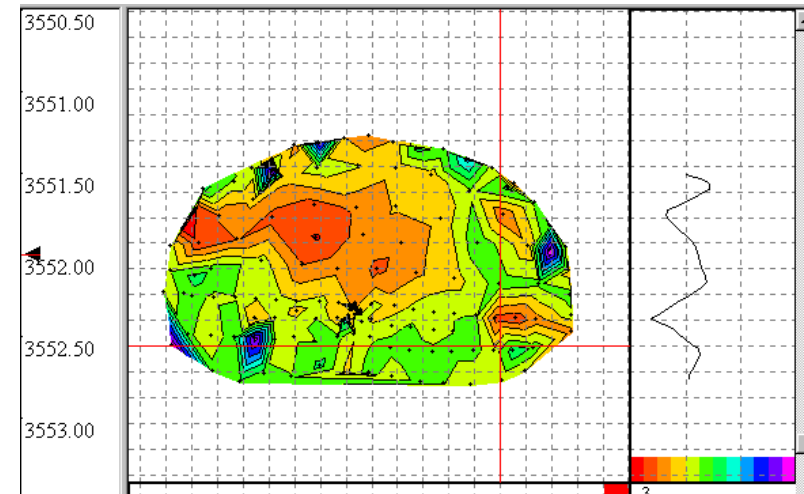


MWD Baneheia

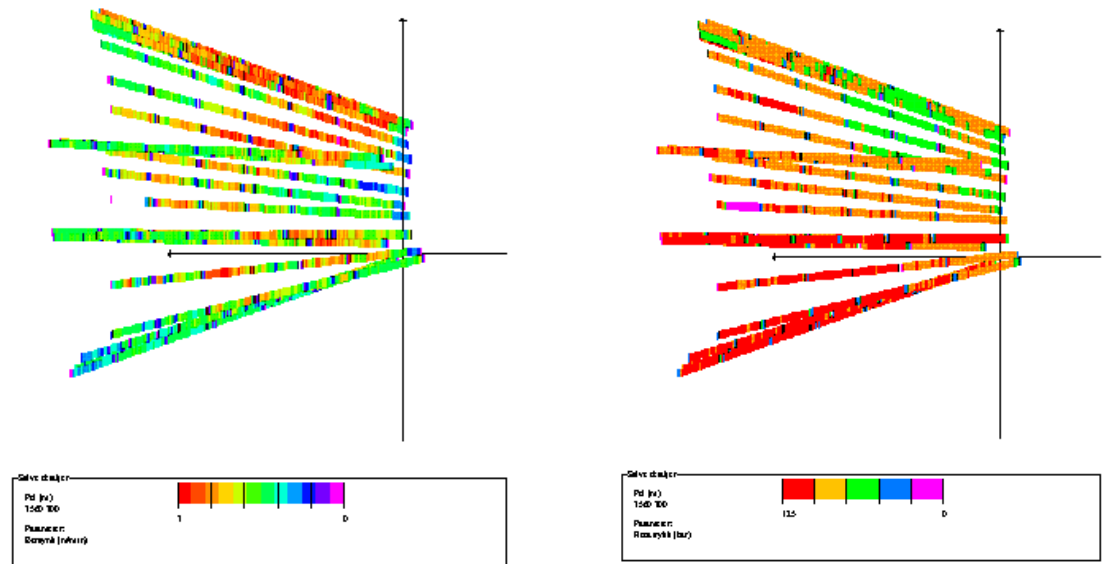
B1000 Peg 3540-3560
(Bever Team Prints)



Drilling data injection



Drilling rate round drilling

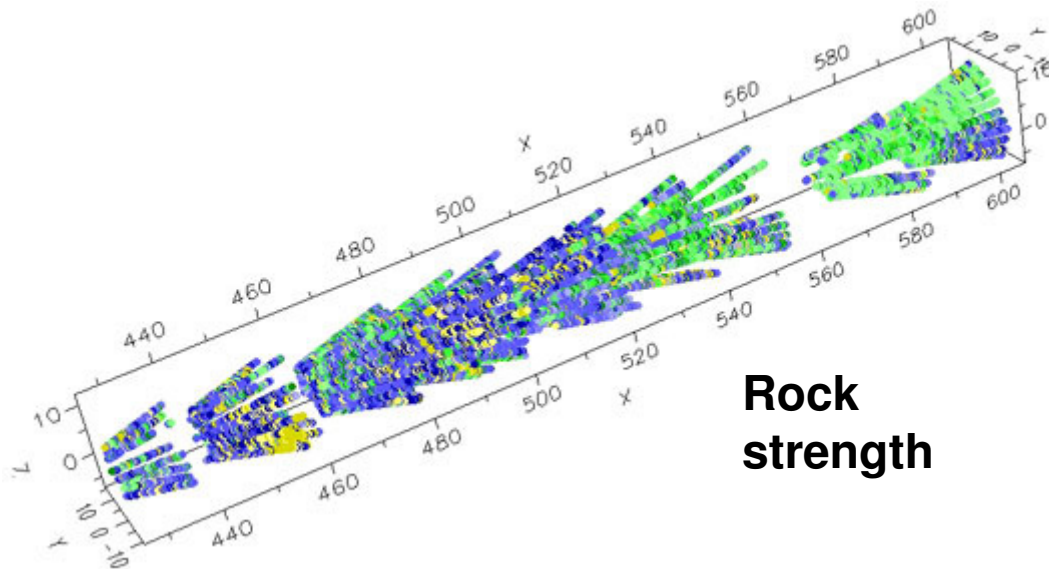
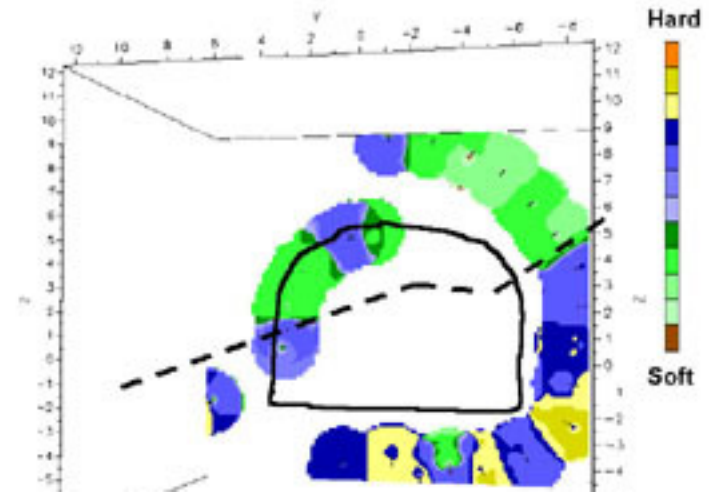


Drilling rate

Rotation torque

GEOLOGY MAPPING (OSLO)

Rock strength
Rockma Analysis
limestone-blue
slate-green
diabase-yellow



Rock
strength



DRILL LOG – STATISTICS FOR A PERIODE OF TIME OR TUNNEL

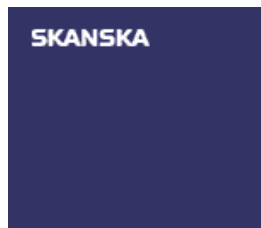
LENGTH

Period report - selected

Date: 20000403 20:40

Source	Peg	Total Normal drilling	Total Length	Round length
<hr/>				
Drill log	10/3691.000	00:00	206.84	20.68
Drill log	10/3691.000	00:00	363.59	21.39
Drill log	10/3692.000	00:00	341.26	24.38
Drill log	10/3705.000	00:00	758.57	24.47
Drill log	10/3705.000	00:00	496.22	24.81
Drill log	10/3719.000	00:00	296.01	22.77
Drill log	10/3719.000	00:00	351.43	16.73
Drill log	10/3733.000	00:00	14.13	14.13
Drill log	10/3733.000	00:00	417.80	23.21
Drill log	10/3733.000	00:00	252.52	22.96
Drill log	10/3733.000	00:00	232.06	23.21
Drill log	10/3747.500	00:00	726.59	24.22
Drill log	10/3761.300	00:00	716.93	23.13
Drill log	10/3776.700	00:00	54.27	27.14
<hr/>				
		00:00	5228.22	

References



Control systems supplier



Thank you for your attention!

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www.amv-as.no

mail@bevercontrol.com

www.bevercontrol.com



Control systems supplier

