WORKSHOP NR 2

Recycled materials in road and airfield pavements

–OVERCOMING BARRIERS–

25 June 2005, OSLO, Norway

Granulated Foamed Glass for Civil Engineering Applications

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Statens vegvesen

SINTEF

Light weight fills and insulation materials

Gjenbruksprosjektet 2002-2005

Focused on:

Foamglass …shredded tires…

……flyash – small amounts in Norway

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Application areas

Increase the stability against failures

Reduce settlements

Insulation

Insulation for roads, constructions, ditches, floor on ground etc

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Traditonal light weight materials 60 og 70's

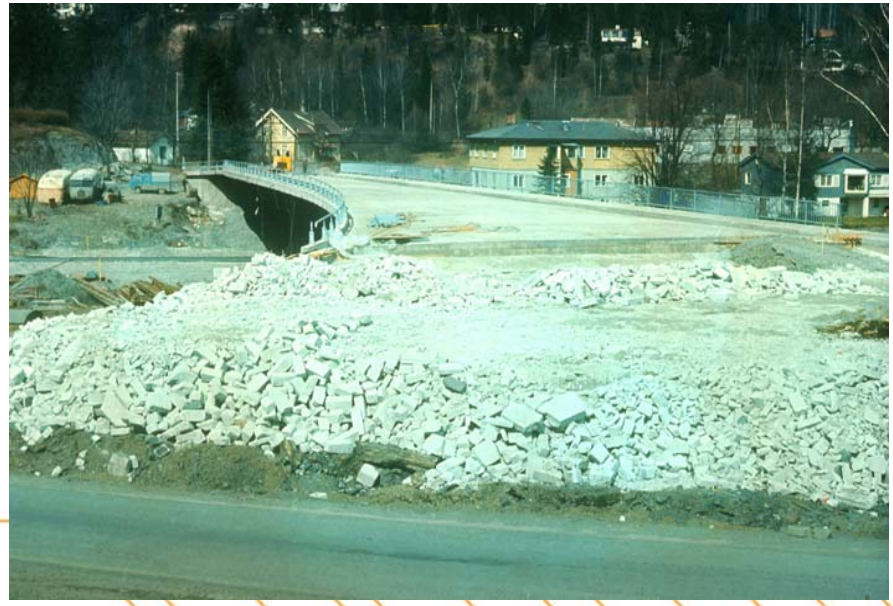
Sawdust and bark:

Waste from sawmills

Design density γ = 10 kN

Cellular concrete:

Building blocks/slabs production waste



Design density:

$\gamma = 10\ kN/m^3$

Materials seldom used today

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Competitors in 2004 for lightweight fill and insulation materials.

Ekspanded polystyrene (EPS):
Design density $\gamma = 0{,}5\ kN/m^3$
Includes recycling of blocks

Light Weight clay Aggregate
grain size: 0 - 32 mm /10-20mm
monitoring programme
Design density $\gamma = 6\ kN/m^3$

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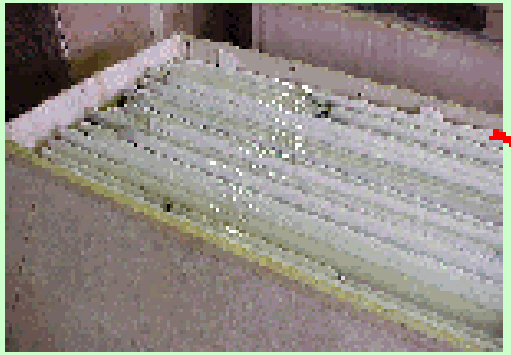
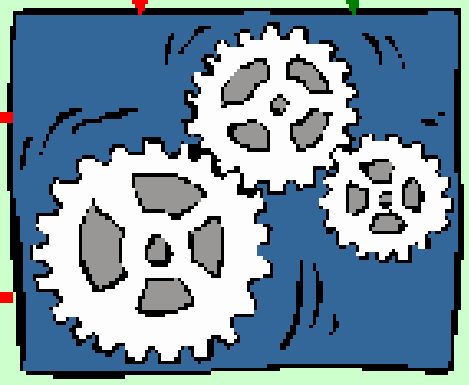
2003 01 08



Material stream analyses for year 2000



Plastic, Bakelite, porcelain, and others for landfill (approx. 2%)

Metals for recycling (approx. 2%)

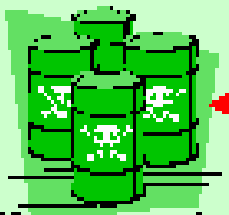
Plastic for energy production (approx 0,6 %)

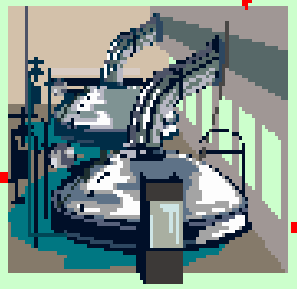
Metals for recycling (approx 0,4 %)

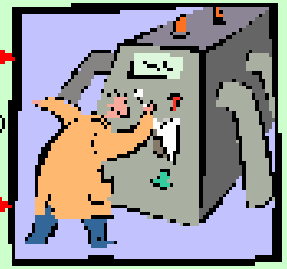
Approx. 10%

Approx. 86%

Approx. 99 %







<0,02%

Approx. 10%

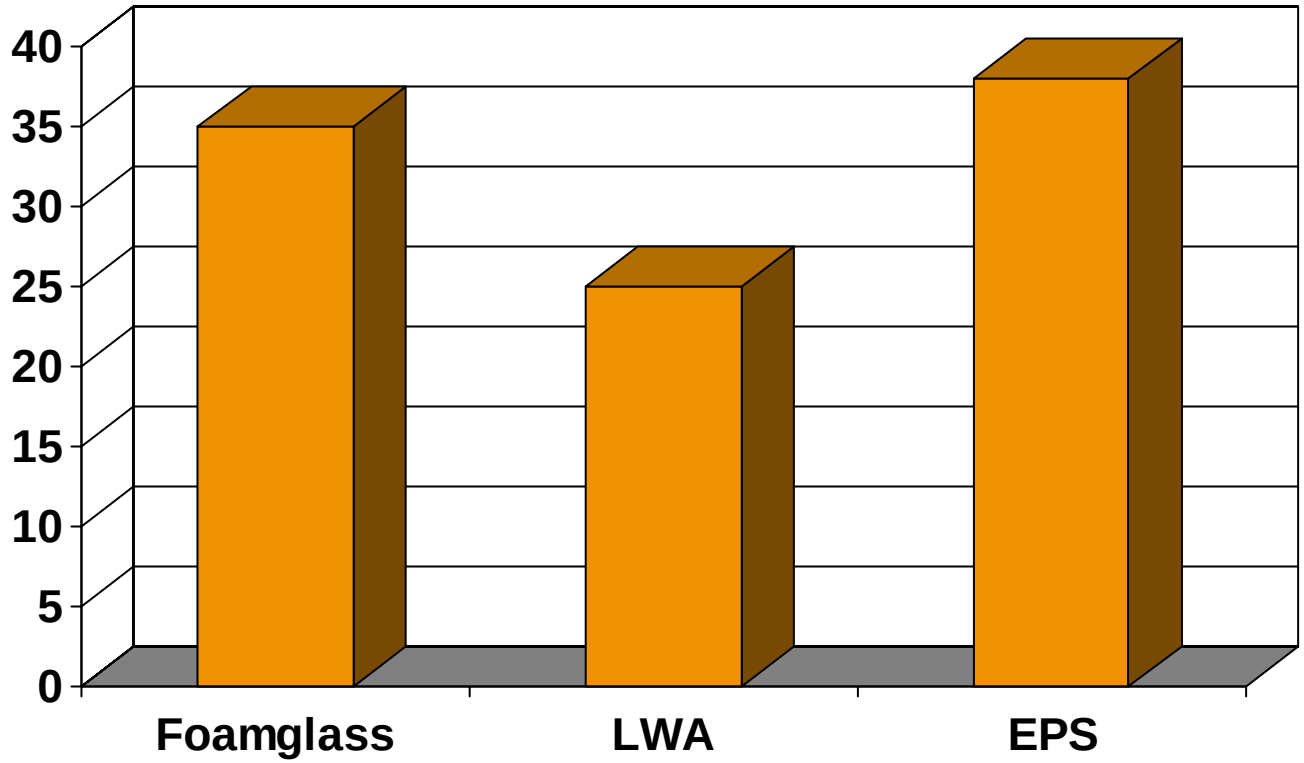
Heavy metals for special deposit

Vitrification

Glassfoam production

Light weight materials (EUR/m³)

Shredded tires: No cost so far!



Design density:	**3,5-4 kN/m³**	**5,5 kN /m³**	**0,5 kN/m³**

Consumption of foamglass in Norway and Sweden (1999 – 2004)

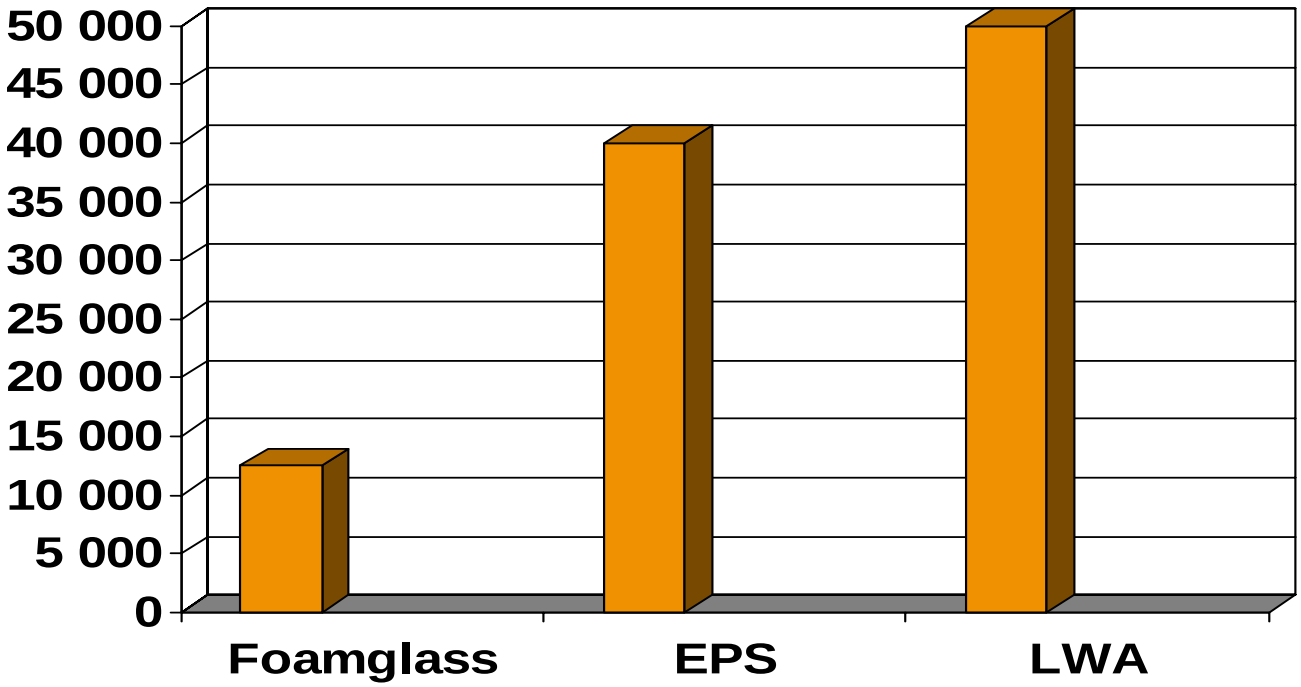
Lightweight embankments:

	Buildings	Roads
Norway	13880	26590
Sweden	2405	90
Irland	770	
Total	**16950**	**26680**

Insulation:

Norway	8070	16630
Sweden	1805	4986
Total	**9975**	**21616**

Annual consumption (m^3) road construction



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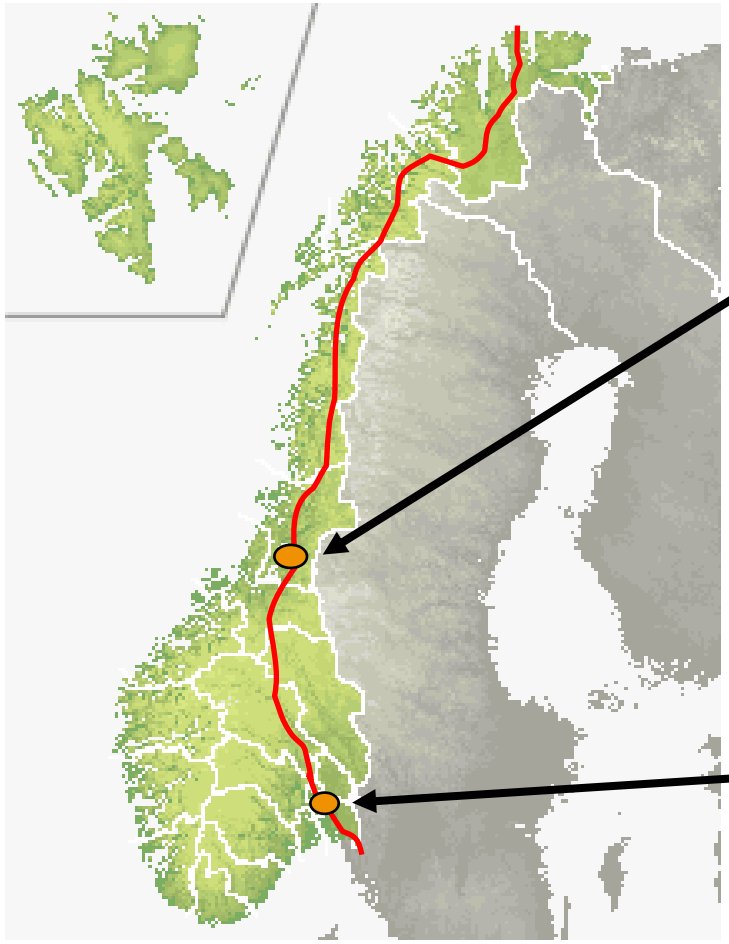
E 6 Main road through Norway
2 foamglass projects presented



More than 25 road projects in Norway since 1999

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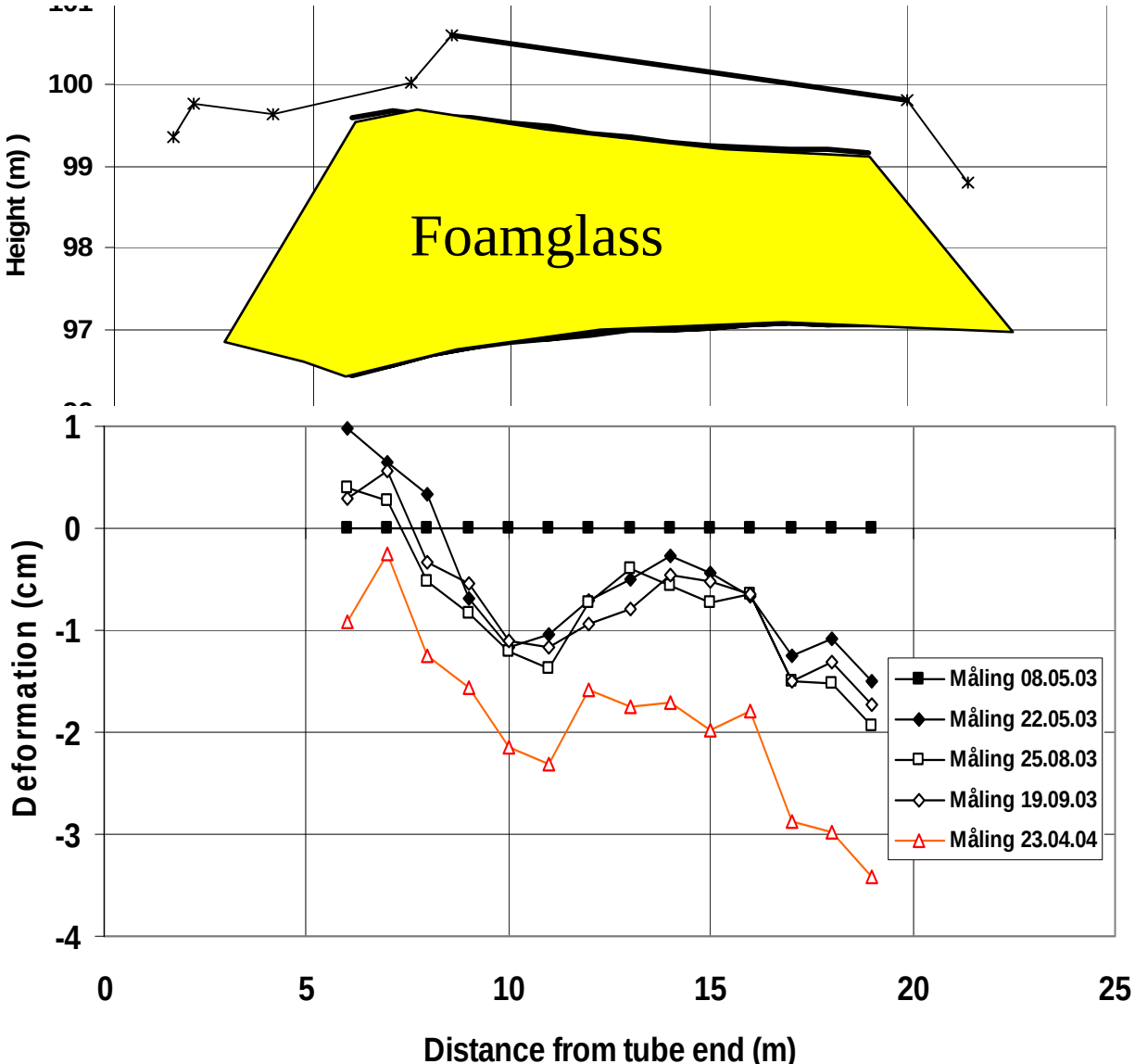
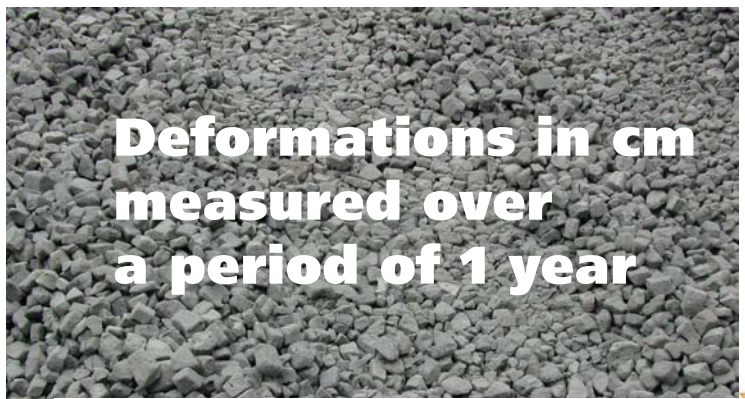
E 6 Klemetsrud – Temporary and permanent road construction with foamglass

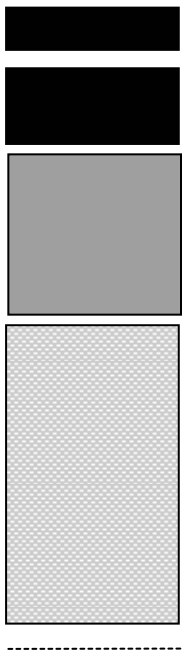




ÅDT: 30 000

% Heavy traffic: High

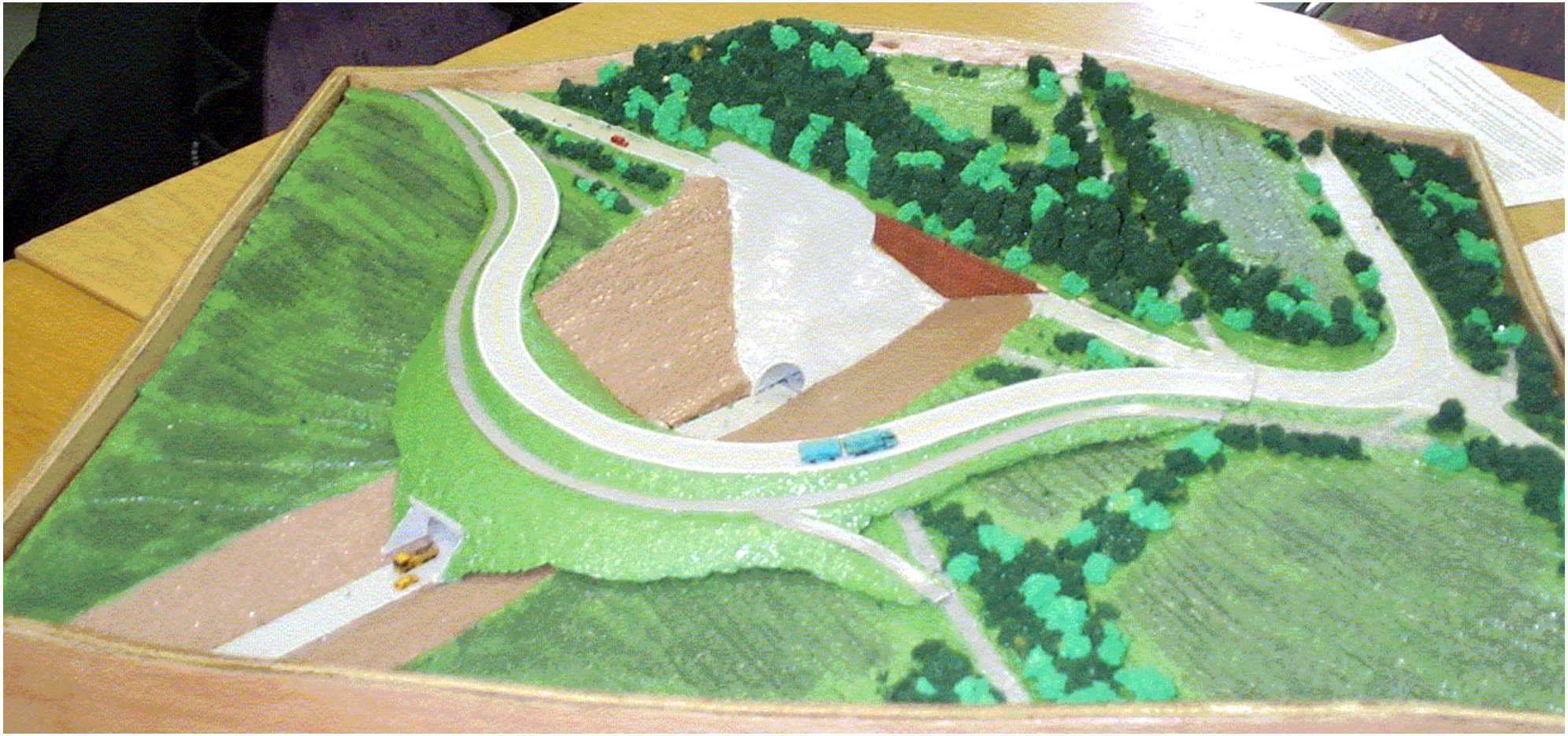
E6, Klemetsrud



Sieving tests performed on the material after 1 year in the construction show no tendency of crushing.

Leaching of RCA and foamglass – full scale test starting October 2004

E 6 Eggemarka :
Use of foamglass for road constructions



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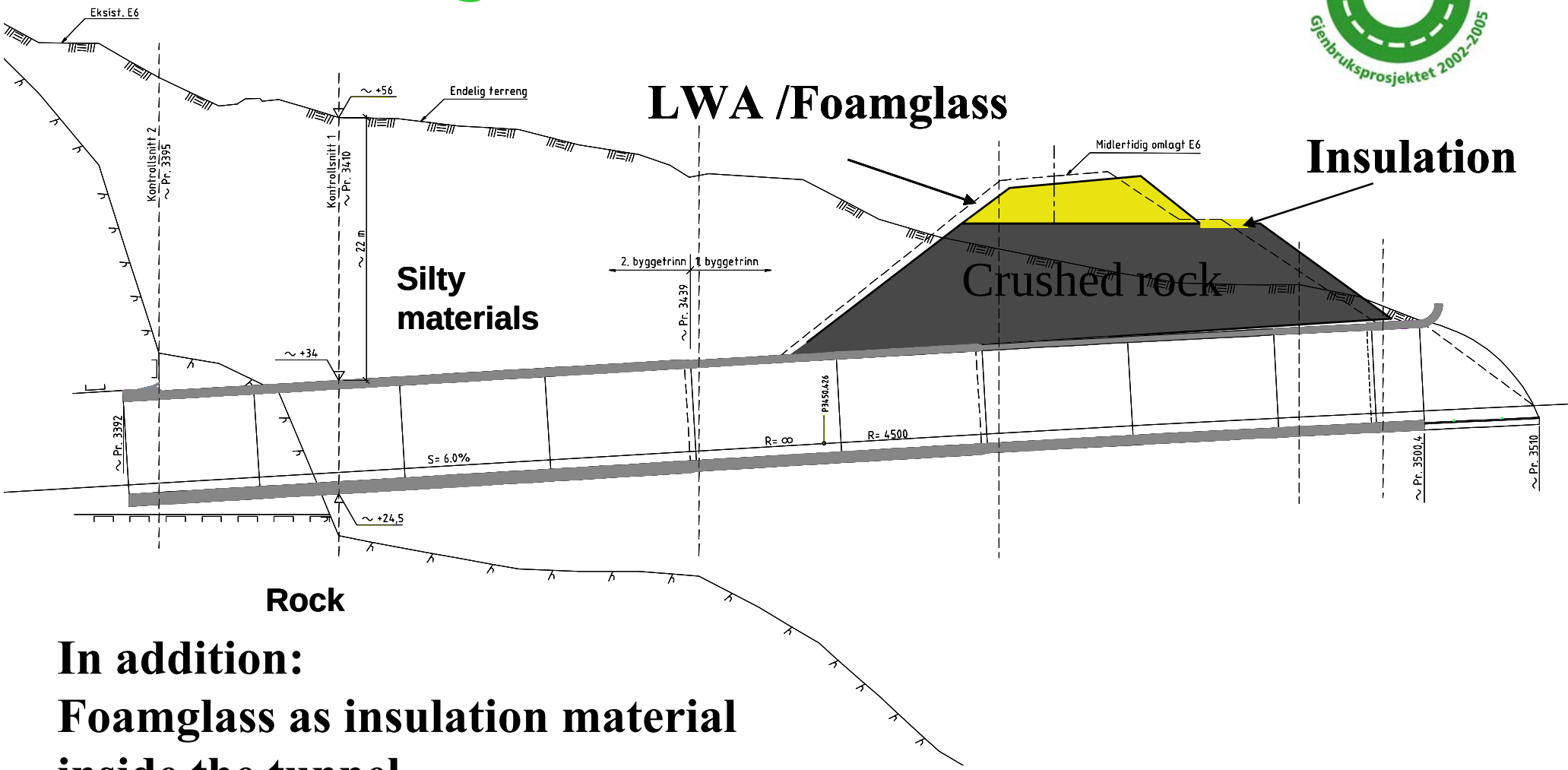
E 6 Eggemarka
Use of foamglass for road constructions



In addition:
Foamglass as insulation material inside the tunnel.

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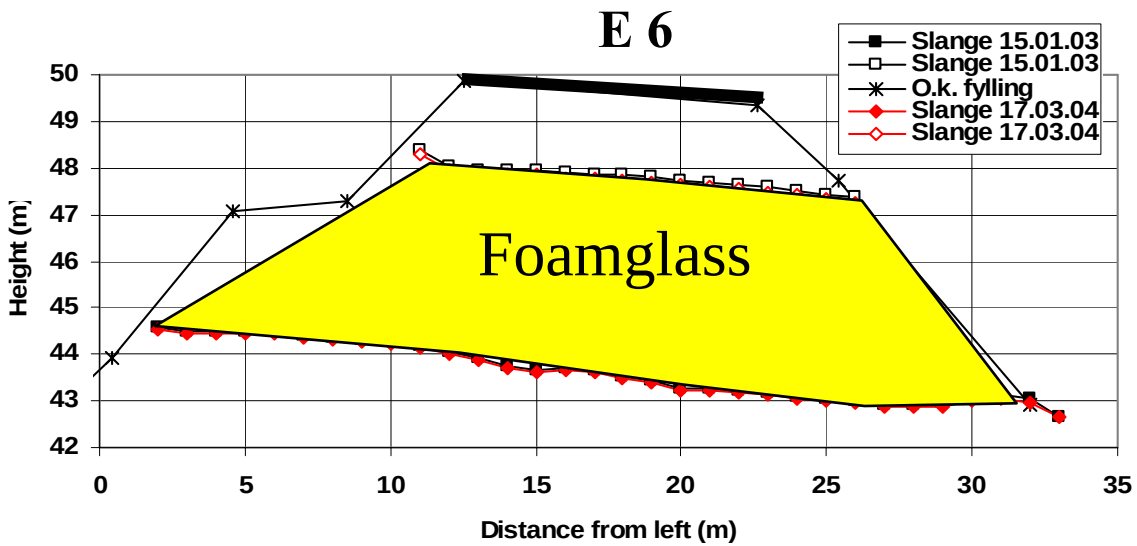

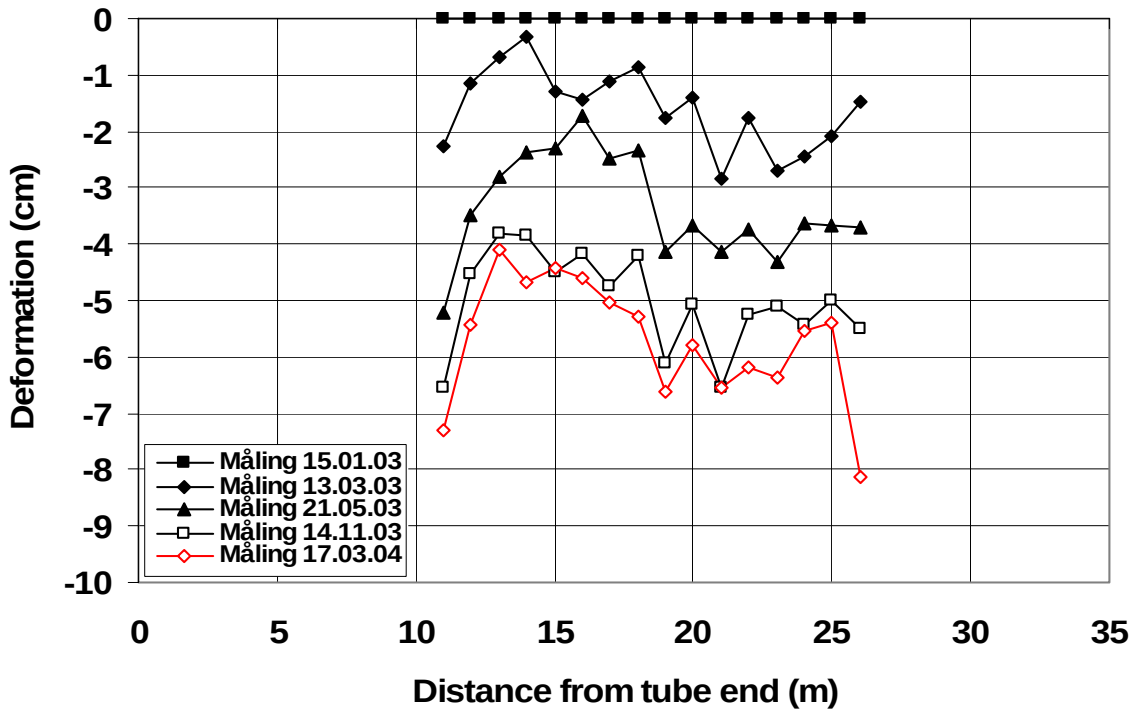

E 6 Eggemarka Use of foam-glass for road constructions.

Deformations

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N-0314 Oslo
Tel. 47 22 96 55 55
Fax 47 22 69 54 38

BYGGFORSK

MEMBER OF EOTA

Gjenbruksprosjektet 2002-2005

Authorised and notified according to Article 10 of the Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products

European Technical Approval No. ETA-xx/xxxx

(draft 06.06 2005)

Request no. 12.01/08

Trade name:	®HASOPOR
Holder of approval:	Has Consult AS Dronningens gt. 9 N-7011 Trondheim Norway Tel. + 47 73 99 19 80 Fax+ 47 73 52 31 90
Generic type and use of construction product:	Cellular glass loose fill for use as thermal and frost insulating layer, water capillary barrier, drainage, and light fill in building foundations and road construction applications
Valid from: to:	xx.xx.2005 xx.xx.2010
Manufacturing plant:	Miljøtek Hasopor AS N-7531 Meråker Norway Tel. + 47 40 00 57 85 Fax+ 47 74 81 00 45
This European Technical Approval contains:	13 pages including 1 Annexes which form an integral part of the document

EOTA European Organisation for Technical Approvals

CUAP / ETA

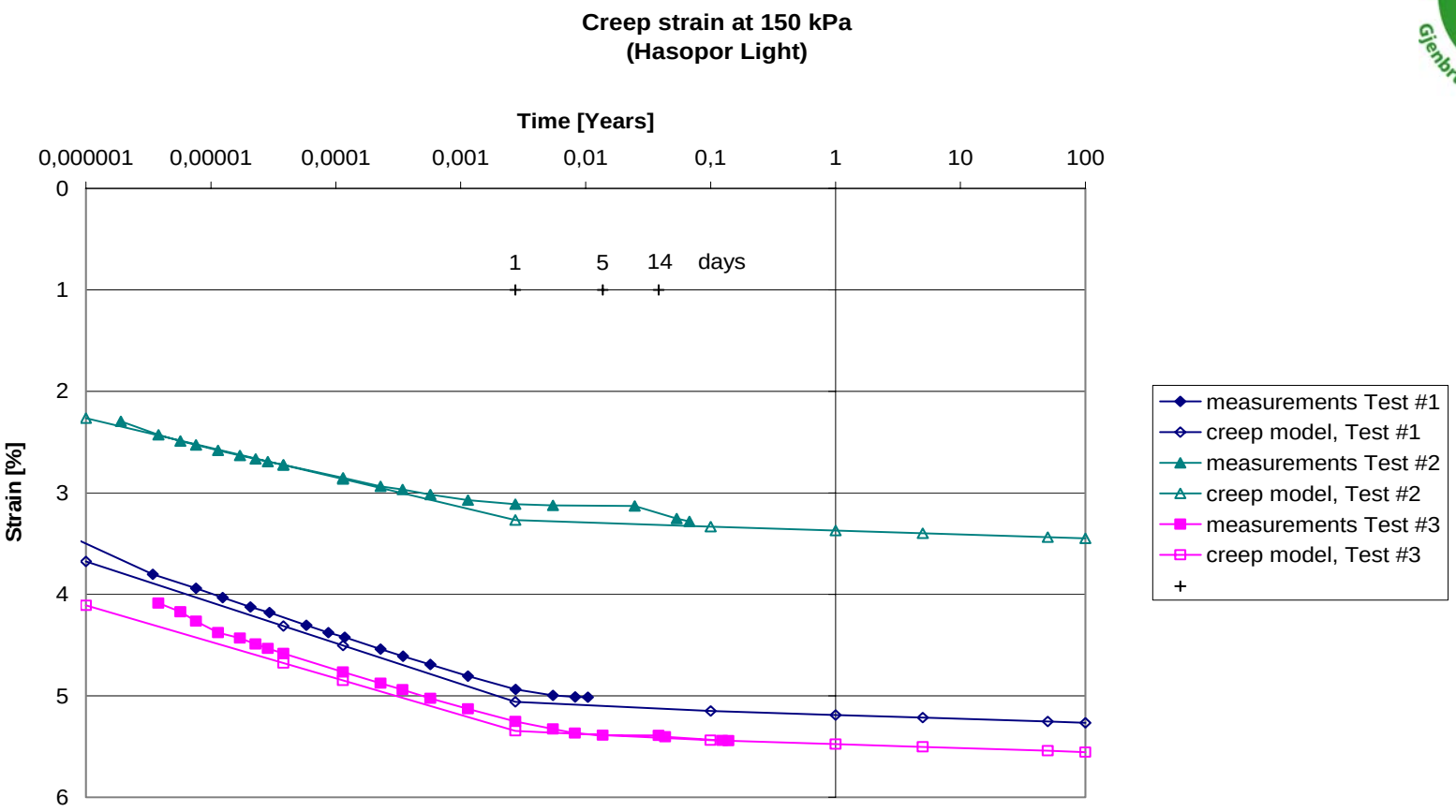
CUAP / ETA

Relevant characteristics

The initial type-testing conducted by Norwegian Building Research Institute (NBI) and SINTEF Technology and Society, Rock and Soil Mechanics. Initial type-tests are now finished in accordance with CUAP no. ETA request 12.01/08.

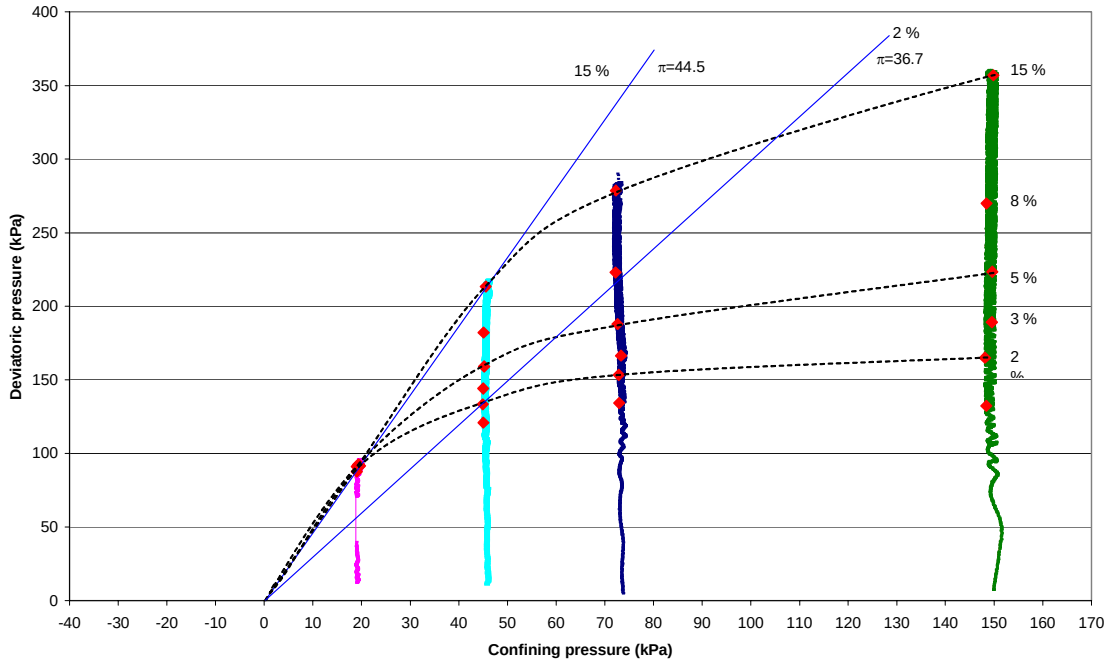
CUAP clause for Verification method	Relevant limit value or classification
4.1.1 Load bearing capacity	5.1.1
4.1.2 Crushing resistance	5.1.2
4.1.3 Behaviour under cyclic load	5.1.3
4.7.1 Resistance to freezing and thawing	5.5.1
4.3.1 Release of dangerous substances	5.3.1
4.6.4 Thermal conductivity	5.4.1
4.6.2 Capillary water suction height	5.4.2
4.6.3 Water absorption	5.4.3
4.6.5 Density	5.4.4
4.6.6 Particle size distribution	5.4.5
4.7.1 Resistance to freezing and thawing	5.5.1
4.6.2 Capillary water suction height	5.4.2
4.6.3 Water absorption	5.4.3
4.6.4 Thermal conductivity	5.4.1

Laboratory testing, creep model Hasopor Light



Creep model gives less than 0.6 % creep strain from day 1 to 50 years (at stress level 250 kPa)

Laboratory testing, static triaxial tests



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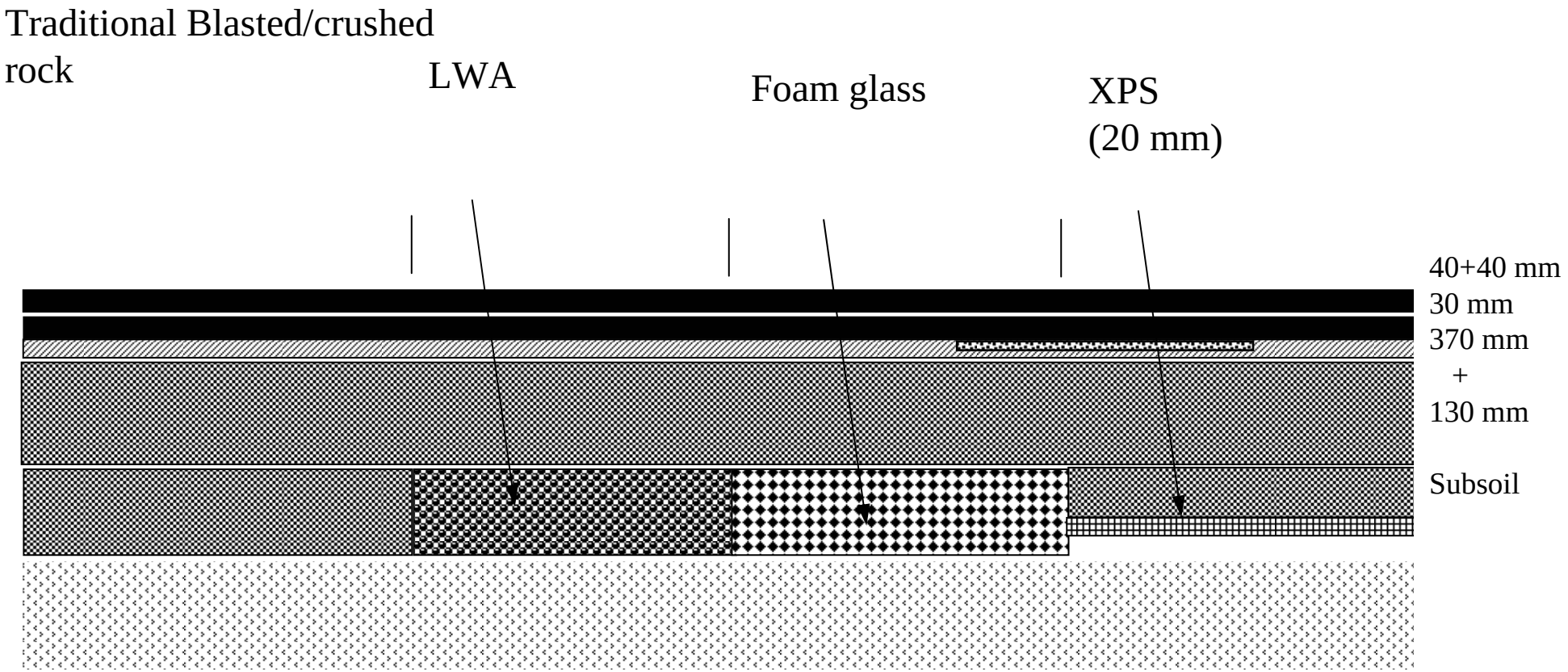
Field test on frost insulation

- Comparing foam glass, Light weight clay aggregate and extruded polystyrene XPS plates with the uninsulated traditional road structure.
- Planned installation summer 2005 and running for 3 years.
- Measuring temperature/frostpenetration giving the resulting frost index when the frost penetrates into the subsoil.

Field section, 40 meters (4x10)



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Monitoring field program

- Deformation – creep (settlement tubes)
- Deformation/crushing due to compaction
- Density – water content
- Sieving tests
- Bearing capacity (Plate bearing tests and falling weight measurements)
- Temperature

Compaction / crushing in the construction period and long time performance.

Project	Max height light weight fill. [m]	Thickness of compacted layer [m]	Compaction factor	Def. Short term [%]	Def. Long term [%]	Def. in slopes [%]
G/S-veg Lodalen	2	2	1,25	1,5 – 2,5	+0,5 – 1,0	4
Rv 120 Nannestad	3	1	1,60	1	+0 – 0,5	2 – 3
E6 Klemetsrud	3	1,5	1,20	0,5	1	2
E6 Steinkjer	4	1 - 1,5	-	2	+0,5 – 1,0	2 - 3

Conclusions

Foamglass granulate

- is technically and economically an interesting material for many civil engineering applications
- is fully resistant to possible chemical degrading agents in a road structure.
- has proved this in more than 25 road projects

Environmental policy

Gjenbruksprosjektet 2002-2005

Pollution control authorities (SFT),

criteria for recycled materials:

- **Material must have a function**
- **The material must satisfy specifications**
- **There must be a commercial interest**
- **The material must be *clean***

Gjenbruksprosjektet 2002-2005

Be bright

Think light

And do it right !

Thank you for your attention !