

**INTERNATIONAL HEAVY VEHICLE SIMULATOR WORKSHOP
7 & 8 OCTOBER 2002
INTUNDLA GAME LODGE**

Day 1: Monday, 7th October 2002

VTT / VTI – Leif Wiman (overhead slides)

Top five achievements/Sweden

- No cracks (due to fresh AC?);
- Hard to get correct layer thickness;
- Great influence of water in unbound layers;
- Lateral position should be random at high temperature tests (Single wheel);
- Steel reinforcement in AC layer did not decrease crack but rut propagation.

VTI website: www.vti.se

HVS-Nordic Sweden

Estimated Program cost

Year	Swedish Crowns
1998	1 800 000
1999	3 200 000
2000 (Jan)	180 000
Total	5 180 000

Test	Number of loading
SEO1	2 300 000
SEO2	1 135 000
SEO3	800 000
SEO4	165 000
Total	4 400 000

Cost per loading SEK	1.2
Cost per loading US\$	0.13

HVS-Nordic collaboration activities

- Sweden/Finland
- Sweden/Iceland
- Sweden/Finland/Poland

HVS-Nordic Cooperation Organisation

- Steering Committee (Approve R&D plans)
- Management Committee (make up R&D plans)
- Working Group (make up Test plans)

Collaboration Sweden/Finland

- Regular meetings, about twice a year
- Common Testing and Sampling Program (Basic Minimum)
- Common Data Acquisition System
- Common Data Base (Access)

Sampling and Testing (Basic Minimum & Absolute Basic Minimum Programmes)

Basic Minimum – Sampling and Testing

Green cell indicates **Absolute Basic Minimum** sampling and testing, uncoloured cell indicates optional sampling and testing depending on the purpose of the test.

Material Acceptance

Sampling and testing before delivery to test date

	Property	Test	Subgrade material		Unbound material		Hydraulic bound material		Bituminous bound material		Wearing course	
			FIM	SEK	FIM	SEK	FIM	SEK	FIM	SEK	FIM	SEK
Aggregate	Particle Size Distribution	Sieving	2 400	4 500	2 400	4 500	2 400	4 500	990	800	990	800
		Aerometric	1 580	2 600								
	Fines <0.063	Specific Surface area			950	1 300	950	1 300	950	1 300		
	Petrography	Petrography			480	650			480	650	480	650
	Resistance to Fragmentation	Ball Mill			1 200	2 250			1 200	2 250	1 200	2 250
		Los Angeles*			610	1 100						
	Particle shape	Flakiness Index			1 600	2 000					1 600	2 000
Crushed and Broken Surface in Coarse Aggregates Particles				400	500			400	500	400	500	
Purity	Organic Matter					440	650					
Summa Basic	SUMMA Basic		3 980	7 100	7 640	12 300	3 790	6 450	4 020	5 500	4 670	6 200
	SUMMA Basic ECU		669	852	1 284	1 477	637	774	676	660	785	744
Summa Absolute Basic	SUMMA Absolute Basic		2 400	4 500	5 600	9 250	2 400	4 500	2 590	3 550	2 590	3 550
	SUMMA Absolute Basic ECU		403	540	941	1 110	403	540	435	426	435	426

*Los Angelestal bestäms enligt CEN-standard.

Construction Samples, Test and Measurements

	Property	Test	Subgrade material		Unbound material		Hydraulic bound material		Bituminous bound material		Wearing course		
			FIM	SEK	FIM	SEK	FIM	SEK	FIM	SEK	FIM	SEK	
Aggregate	Particle Size Distribution	Sieving	2 400	4 500	2 400	4 500			2 400		2 400		
		Aerometric											
	Fines <0.063	Specific Surface area			950	1 300	950	1 300	950	1 300			
		Aerometric											
		Water absorption											
	Compactibility and Bearing Capacity	Proctor Test		2 500	3 000	2 500	3 000						
CBR-value			2 500	3 000	2 500	3 000							
Modulus			7 500	4 000	7 500	4 000							
Bitumen	Binder Content	Extraction							3 000	7 500**	3 000	7 500	
	Properties of Recovered Bitumen	Ring and Ball							3 000	6 400***	3 000	6 400	
Mix Properties	Plastic Deformation	Creep Test							6 500	7 000	5 500	7 000	
	Modulus	Resilient Modulus							4 000	5 000	4 000	5 000	
	Fatigue	Fatigue Test							50 000	10 000	50 000	10 000	
Structure	Density and Degree of Compaction	Volumeter											
		Isotopic Method	700	1 000	700	1 000	700	1 000					
		Static Plate Load Test	1 000	1 300	1 000	1 300							
	Moisture Content		600	1 000	1 200	2 000							
	Layer Thickness	Leveling	1 200	1 500	1 200	1 500					1 200	1 500	
	Bearing Capacity	FWD	1 200	1 500	1 200	1 500					1 200	1 500	
Visual Observations		Photography and Video Photography	Camera always available, photos taken when needed										
Quality Control	Core Samples Hydraulic Bound	Compression strength						1 500	1 800				
	Core Samples Bituminous Bound	Indirect Tensile Strength								2 300	3 900	2 300	3 900
		Air Void Content									2 300	3 600	2 300
Summa Basic	SUMMA Basic		19 600	20 800	23 150	23 100	3 150	4 100	74 450	44 700	74 900	46 400	
	SUMMA Basic ECU		3 294	2 497	3 891	2 773	529	492	12 513	5 366	12 588	5 570	
Summa Absolute Basic	SUMMA Absolute Basic		6 400	9 800	9 000	10 800			10 700	17 500	13 100	20 500	
	SUMMA Absolute Basic ECU		1 076	1 176	1 513	1 297			1 798	2 101	2 202	2 461	

*Ingår i extraktionen

**5 lines; centre line and $\pm 0,5$ & $\pm 1,0$ m / 0,5 m apart. Kostnadsberäkningen är gjord för tre lager.

***3 lines; centre line and $\pm 0,5$ m from centreline/ 1,0 m apart. Kostnadsberäkningen är gjord för tre lager.

Post Mortem, Sampling and Testing

	Property	Test	Subgrade material		Unbound material		Hydraulic bound material		Bituminous bound material		Wearing course	
			FIM	SEK	FIM	SEK	FIM	SEK	FIM	SEK	FIM	SEK
Unbound Layer	Particle Size Distribution	Sieving <50 mm*			7 300	13 500						
		Sieving >50 mm**			7 300	13 500						
	Resistance to Fragmentation	Specific Surface area										
		Ball Mill Los Angeles										
Particle Shape	Flakiness Index											
Structure	Degree of Compaction	Volumetric										
		Isotopic Method			1 000	3 000						
	Bearing Capacity	FWD								1 200	1 800	
	Visual Observations	Photography and Video										
Photography Mapping of Distress										4 000	5 000	
Quality Control	Core Samples	Air Void Content							10 000	14 400	10 000	14 400
Cross Section Excavations	Mutations of Structure, Surface Distress, Moisture Content	Leveling 0,1 m apart Photography and Video Documentation 5 000 FIM, 8 000 SEK										
Summa Basic	SUMMA Basic			15 600	2 700			10 000	14 400	15 200	21 200	
	SUMMA Basic ECU			2 622	3 241			1 681	1 729	2 555	2 545	
Summa Absolute Basic	SUMMA Absolute Basic			1 000	3 000			5 000	8 000	5 200	6 800	
	SUMMA Absolute Basic ECU			168	360			840	960	874	816	

*Sample from upper 50 mm of unbound layer

**Sample from lower than 50 mm from surfaced of unbound layer.

Sammänställning av kostnaderna i respektive land

Basic Minimum (uncoloured & green cells)

	Land	Finland		Sverige	
	Valuta	FIM	ECU	FIM	ECU
Material Acceptance		39680	6669	62900	7551
Construction Samples, Test, Measurements		234450	39403	197700	23733
Post Mortem, Sampling and Testing		52000	8739	80400	9652
Summa		326130	54812	341000	40936

Absolute Basic Minimum (green cells)

	Land	Finland		Sverige	
	Valuta	FIM	ECU	FIM	ECU
Material Acceptance		15580	2618	25350	3043
Construction Samples, Test, Measurements		39200	6588	58600	7035
Post Mortem, Sampling and Testing		11200	1882	17800	2137
Summa		65980	11089	101750	12215

1 EUR = 5,95 FIM

1 EUR = 8,33 SEK

22 augusti 2000

Screen print from database

Computer presentation at this point.

**Verification of Pavement Design for A2 Toll Motorway in Poland Using Heavy Vehicle Simulator
(Progress Report, July 2002)**

HVS Mark IV

Main Project Objectives

- To verify the design assumptions used for 1st stage of A2 Toll Motorway pavement design in respect of the fatigue life of the pavement (residual pavement life after design load)
- To verify the influence of thickness of cement stabilized layers on pavement design life

Pavement structures to be investigated

- Asphalt concrete wearing course 5cm
- Asphalt concrete base course 10 cm
- Upper cement bound sub-base 5,0 MPa 20 cm
- Lower cement bound sub-base 3,5 MPa 20 cm
- Drainage Layer (Frost-Protection-Layer) 20 cm
- Sub-grade $E_2 \geq 60$ MPa

Measuring Instrumentation Test Field HVS 2

HVS Test conditions

- Dual wheel load = 80kN
- Type pressure = 1000 kN
- Speed of loading = 12 km/h
- Lateral wheel movement = $\pm 0,25$ m
- Lateral Load Distribution Per 500 Cycles:
2; 8; 30; 60; 90; 120; 90; 60; 30; 8; 2
- Loaded Area = 8 m x 0,5 m
- Number of Loads Per Day = about 20.000
- Total number of Loads = maximum 600.000

HVS Response Measurements and frequency

- Dual Wheel Load = 80 kN \pm 2% guaranteed
- Tire Pressure = 10 bar; 1 times per day
- Speed of loading = 12 km/h; not measured
- Temperature (air, asphalt) = every hour
- Stresses and Strains (Soil Pressure Cells, Strain Transducers, Surface Deflection Gauges) = under 4 passes; 1 times per 2 days of loading, at the 58kN loading value, at 2 positions of loading wheel
- Transverse profile = 1 times per 2 days of loading