

HVS Heavy Vehicle Simulator

Saving Money by Destroying the Roads

*Does VTI destroy the roads?
Why?!*

Yes! Not only do we contribute to the construction of high quality roads, but we also destroy them. However, please do not worry. It is all for the benefit of our customers, of course. Please let us tell you about the Heavy Vehicle Simulator!



Photo: Photos.com

What is a Heavy Vehicle Simulator?

The Heavy Vehicle Simulator, HVS, is an accelerated pavement testing facility that simulates traffic associated deterioration of a road over its design life (usually 20 years) in as little as three months. The HVS can be used to subject full-scale roads to accelerated traffic while studying how different types of road constructions manage heavy traffic flows.

Prior to the HVS, researchers had to wait many years to see if new laboratory test methods or field tests would indeed provide reliable results for pavements under actual truck loads and traffic.



Photo: VTI

How does the HVS work?

A huge machine is rolling a truck tire over a patch of asphalt or any type of road construction material. It goes back and forth, and simulates years of traffic in just weeks or months, to verify whether a pavement structure will last or fall apart.

What are the technical specifications of the HVS used by VTI?

Technical specifications

Test wheel	Dual or single
Load range	30-110 kN (corresponds to 6-22 tonnes axle load)
Capacity	150,000 passes/week
Loading direction	One or two directions
Max. test speed	12 km/h
Total lateral wander	0-0.7 m
Test length	8 m (of which 6 m of constant speed and load)
Test width	0.5-1.25 m
Pavement temperature	0-30° C
Power	Diesel or electricity
Length	23 m
Width	3.7 m
Height	4.2 m
Weight	approx. 50 tonnes

Furthermore, the tested pavement structure can be instrumented with transducers to measure strains, stresses, surface rutting and deformations. The response from these transducers can be analyzed, which in turn gives a huge amount of data that can be used to validate different pavement structures, as well as theoretical models.



Photo: VTI

Is it possible to simulate environmental conditions using the HVS?

It is well known that trucks are the worst enemies of a road, and the second worst is weather. Hence, the environmental influences - such as temperature and moisture variation in the pavement structure - can be simulated using a set of special facilities including a temperature control chamber. This capacity allows researchers to analyze HVS data relative to the performance of pavements under actual traffic and environmental conditions.



Photo: VTI

What are the scientific benefits of using the HVS?

International research performed using the HVS has contributed to increasing knowledge in a number of fields, for example:

- Material specifications and guidelines.
- Development of human resources.
- Promoting sustainable development.
- Constructive products and designs.

In addition, the HVS has been used to:

- Integrate the findings into improved mechanistic/empirical design methodologies for new and reconstructed flexible pavements.
- Evaluate the effect of environment on

resilient material properties.

- Develop an improved mechanistic subgrade failure criteria for new and reconstructed pavements.
- Predict pavement behaviour under different environmental conditions.
- Fill the important gap between laboratory developed tests and true field tests.
- Allow for optimal use of funds as well as natural resources.
- Minimize under and over design.
- Prevent rapid failures.
- Give the most cost-effective solutions.

Focus areas

Current HVS worldwide focus areas include:

- Evaluation of asphalt treated permeable bases
- Asphalt Concrete (AC) rutting and fatigue study
- Foamed bitumen base stabilization
- Rapid rehabilitation - long life Portland Cement Concrete Pavements (PCC)
- Evaluation of fast set cement for PCC sections
- Evaluation of pre-cast concrete panels
- Modified binder evaluation
- Warm asphalt studies
- Pavement treatments
- Subgrade performance for new mechanistic design
- Geogrid bases course reinforcement to extend pavement life
- The influence of polymer modification on super-pave mixes
- Rutting performance of coarse and fine-grained mixtures
- Pavement-vehicle interaction studies
- Investigations of the influence of the environmental conditions and load on joint deterioration
- The evaluation of an ultra-thin continuously reinforced concrete pavement
- Cold in situ recycling studies
- Compaction potential of emulsion treated materials
- Accelerated curing methods for emulsion treated materials
- Comparative testing: Full depth AC overlay vs half depth bitumen-rubber overlay

What are the financial benefits of using the HVS?

Research conducted with the HVS equipment results in significant savings in road building and rehabilitation costs. The HVS enables the performance prediction of new road materials and designs, as well as the optimization of road design. Through the testing of trial sections, well ahead of their implementation in practice, costs are cut and expensive failures are avoided. Of course, the biggest hurdle to repairing roads is cost, but with the right prediction tools costs can be minimized.

According to a case study carried out by the VTI team before the construction of a 100 km highway (part of the Berlin - Warsaw highway), the Polish authorities wanted to use a 30 cm cement stabilized gravel layer in the pavement structure. The HVS team found that 15 cm was sufficient. With the help of the HVS equipment, the VTI team could show that a design depth of 15 cm managed the specified traffic loads. If the Polish authorities accepted the 15 cm design depth, money saving of up to 10 million euro could be achieved (compared to the cost of about 0.5 million euro for the entire test project where the HVS equipment was used).

Therefore, the HVS can be used in evaluating new road concepts and maintenance strategies to decrease costs and environmental impact.



Can the Heavy Vehicle Simulator be used outside of Sweden?

The VTI Heavy Vehicle Simulator can be moved between test sites and is available for use by researchers in other countries than Sweden, which is unique in Europe.

The HVS has been used in evaluating new road designs and maintenance on existing roads in other European countries, for example in Slovenia and Poland.



Test site in Poland



Test site in Slovenia

In addition, it is possible to send materials to VTI and build the road structure with road materials from a specific country in the full-scale test facilities (3 m depth, 5 m width and 15 m length) at VTI in Linköping, Sweden.

For example, that was the case when Icelandic road materials were taken to Sweden by boat and two Icelandic road structures were tested at the VTI test facility.

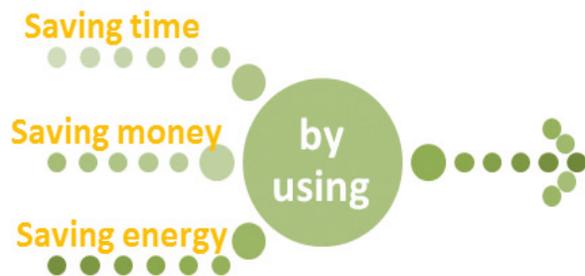


Photo: VTI

What clients have requested the HVS so far?

VTI has carried out tests for clients like, for example:

- The Swedish Transport Administration
- The Icelandic Road Administration
- NCC, Strabag (Poland)
- EU-projects
- COWI-consult, DRI, the Road Directorate (Denmark)
- SVEVIA

Why should we use the HVS to test roads in our country?

There are several reasons, for example:

- The HVS machine has a well-proven technology.
- It has had a significant impact on the development of pavement engineering over the past four decades.
- Significant savings in road building and rehabilitation costs will be made.

Who should we contact in order to request the HVS?

Please do not hesitate to contact one of us:

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Photo: VTI

VTI, the Swedish National Road and Transport Research Institute, is an independent and internationally prominent research institute in the transport sector. The institute is a government agency under the Ministry of Enterprise, Energy and Communications.

VTI's principal task is to conduct research and development related to infrastructure, traffic and transport. We work with all modes of transport and the fields of pavement technology, infrastructure maintenance, vehicle technology, traffic safety, traffic analysis, people in the transport system, environment, planning and decision making processes, transport economics and transport system. The knowledge that the institute provides gives a greater basis for decisions for players in the transport sector and in many cases finds direct application in both national and international transport policies.

VTI conducts commissioned research in an interdisciplinary organisation. The institute also works with investigations, provides consultancy services, and performs different kinds of measurement and testing services. The institute also has a great deal of technically advanced equipment and world-class driving simulators. There is also a laboratory for road materials and a crash test laboratory.

VTI's researchers participate continuously in international research projects, principally in Europe, and in international networks and alliances. In Sweden, VTI collaborates with universities and other higher education institutions that conduct related research and education.

VTI has a total of some 200 employees. VTI's head office is in Linköping, with branch offices in Stockholm, Gothenburg and Borlänge.

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