

# **FUNCTIONAL AND MEASURABLE ROAD SURFACE PARAMETERS AND HOW THEY RELATE.**

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## **INTRODUCTION**

Performance contracting means that a principal (a representative of the public sector) and an agent (a commercial enterprise) sign a contract on the construction and maintenance of a road. The difference compared to today's more common contracting giving a number of technical specifications to be fulfilled is that the performance based contract rather states the performance or functionality of the road that has to be fulfilled during the contracting period.

An internal VTI project focusing on and summarising the core features, i.e. the design and specification, of performance based contracts and making recommendations for further research has recently been carried out.

As a part of the project a specification and suggestion of road surface parameters related to functionality, which should be used to measure the performance of road, has been done.

Even though there is a generally expressed desire to have more performance based contracts the number of contracts has not increased very much over the past years. A performance contract must be very precise with respect to which parameters are to be included in the contract and with which strength the respective performance parameters shall be remunerating or punishing the contractor. There must consequently also be ways and means to monitor the performance.

Four of the reasons for the low number of contracts that are truly performance based that have been identified are:

- Lack of suitable measures
- Unknown quality among the measuring/monitoring methods
- Uncertain roles regarding responsibility among entrepreneurs and road owners
- Uncertainty of threshold levels

This paper will deal with the first reason, i.e. selection of suitable measures and how they relate to the road surface functionality.

## **ROAD FUNCTION FROM A ROAD USER'S POINT OF VIEW**

When using performance based contracts the requirements of functionality have to be defined as well as how this shall be verified, i.e. including measurement methods. With this principle the focus will be more on the consequences of an action and the

constructions final function. The contracts should be of long term to stimulate the entrepreneur to search for innovative and cost effective solutions and to make investments in the technical development. All this relies on the assumption that it is possible to measure the function. When contracting for a certain performance of a road good knowledge about at least the following must be fulfilled:

- Safety
- Accessibility and comfort (ride quality)
- Vehicle operating costs
- Noise
- Availability (point of time when the construction opens for traffic)
- Environmental effects (E.g. concentration of inhalable particles (PM10))
- Day to day maintenance and operations that affects safety, vehicle operating costs, comfort and accessibility.
- Furthermore the ability to measure or reliable estimate the roads remaining lifetime or standard at the end of the contract period are important.

## **FUNCTIONAL VERSUS TECHNICAL CONDITION**

The Swedish Road Authority divides the needs of measurements in two categories, *Functional condition* that covers the road users' needs and *Technical condition* that covers the road owners needs. The *Functional condition* is rated from measurements of longitudinal (IRI= International Roughness Index) and transverse evenness (Rut depth), crossfall and singular (local) unevenness. The *Technical condition* is rated from surface defects, drainage and bearing capacity. It should be enough to cover/measure the road users' point of view as assessment of the functionality of a road. The problem is that this will not be enough to assess the remaining technical function of the road, for example at the end of the contracting period. There must therefore also be a way to measure the technical remaining lifetime of the road.

In VTI report 560 – 2006 a number of measures have been selected as necessary to cover the functionality of a road.

## **MEASUREMENT METHODS AND STANDARDISATION**

The success of functional performance related contracts relies on the availability of suitable measures and a well functioning market for operators and providers of measurements. The measurement methods must be reliable and preferably also certified. The standardisation organisation CEN has on its schedule to introduce this type of test procedure. CEN has also some preliminary standards ongoing regarding measures and classification of equipment, prEN13036-5 and prEN 13036-8.

## **REQUIREMENTS ON MEASURES**

The reliability of selected measures and measurement services can be divided into repeatability, reproducibility and relation to a reference, see figure 1. The concentration of blue dots gives the repeatability. The spread of dots, boxes and stars gives the reproducibility and alpha gives the relation to a selected reference.

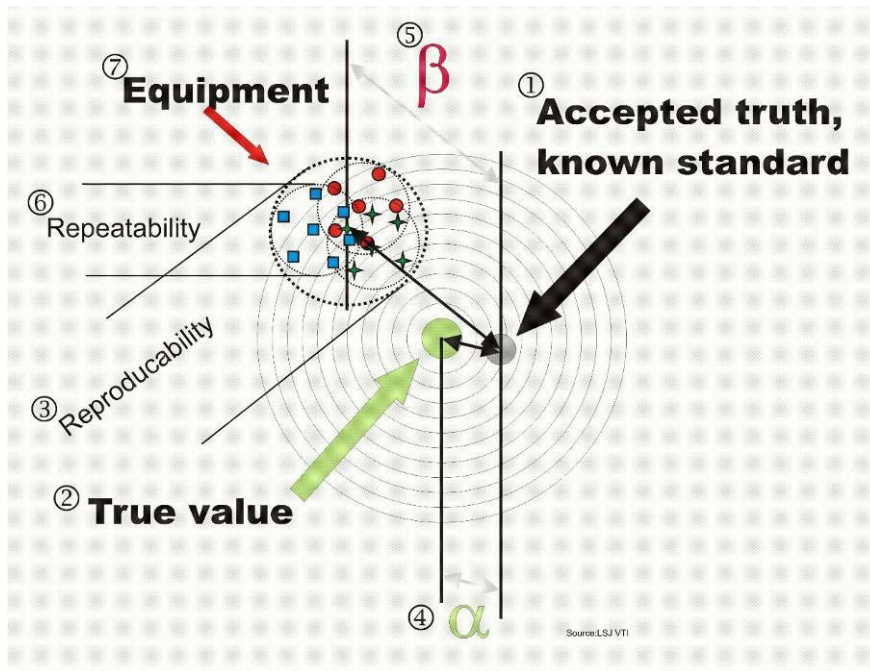


Figure 1. The reliability of measures

### WHAT NEEDS TO BE MEASURED TO ESTABLISH THE FUNCTIONALITY?

In an earlier work at VTI an approach to evaluate and assess the process from functionality to measurable parameter has been done. Matrices have been created covering functionality related to measurable parameters. In the figure 2 the process is illustrated, from traffic effects (e.g. ride quality) to functional characteristics (e.g. vibration) and material and construction parameters (e.g. longitudinal unevenness). The matrices in Figure 2 are an extract from a number of matrices in the original work.

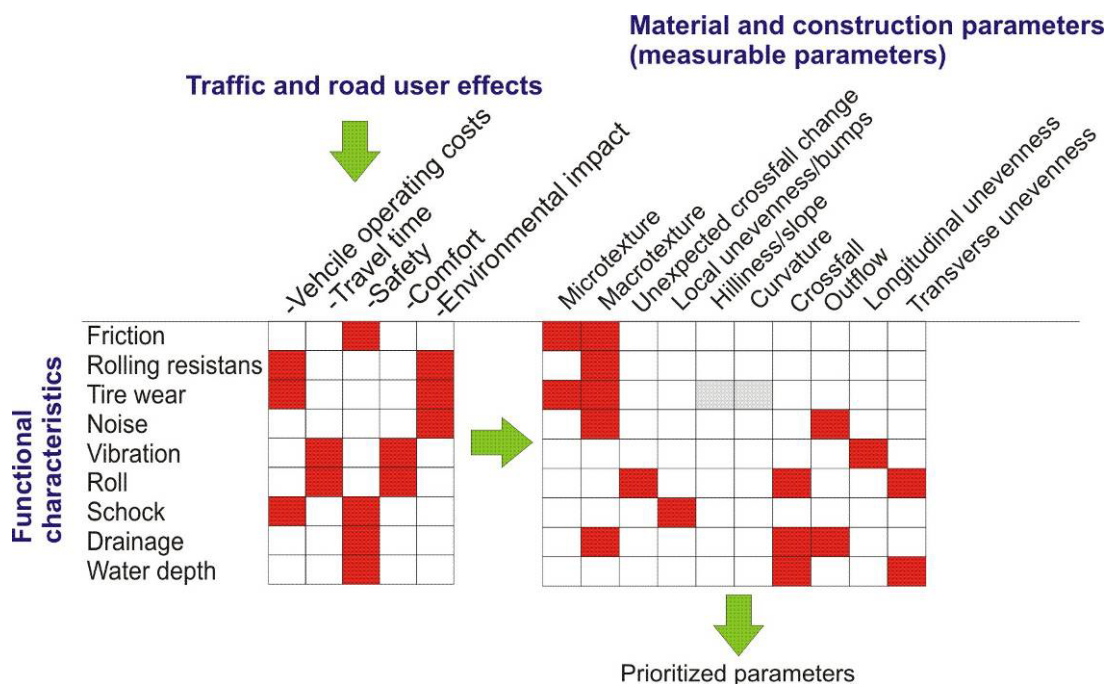


Figure 2 Illustration of the process from traffic effects to measurable parameters

Traffic effects of the road surface and pavement life can be described by the following factors

- Vehicle operating costs
- Travel time
- Safety
- Comfort
- Environmental impact
- Pavement durability

Those factors can in turn be described by the following functional characteristics:

- Friction
- Rolling resistance
- Tire wear
- Noise
- Vibration
- Roll
- Shock
- Drainage
- Water depth

By different combinations of the following technical parameters those functions can be measured:

- Longitudinal unevenness
- Local unevenness/bumps
- Transverse unevenness
- Microtexture
- Macrottexture
- Megattexture
- Hilliness/slope
- Curvature
- Crossfall
- Unexpected crossfall change
- Outflow
- Bearing capacity?
- Cracks

The approach to investigate what is necessary to know about functionality and then find out if it is possible to measure seems to be rarely used. In most cases one has used the available measures and used them as performance indicators, even if they are not suitable! In the selection of important technical parameters macrottexture has come out as important. This was interesting and means that it has to be one of the selected technical parameters besides longitudinal and transversal profile. The crossfall of the road is another selected parameter.

The next step is to create the detailed performance indices from combination of parameters. The parameters have to be measured with a sampling distance around one meter to be suitable to build needed performance indices. To complete the needed performance bearing capacity has to be covered. One possibility is to use traffic speed equipment to measure at the end of the contract time. It is important to

define the detailed measures and also precise thresholds to be able to award the contractor. It is preferable to have common levels of assessment on an international base. This could support a grooving market for service providers of measurements.

**REFERENCES:**

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