# 604 STRUCTURAL PAVEMENT SECTION DESIGN

## 604.01 GENERAL

### 604.01.01 Pavement Design Methods

Pavement design is a challenging process because the analytical framework for design is so complex. Complexity is introduced both by the number of materials involved and the number of variables required for design. The pavement section itself consists of a surfacing material and several supporting layers. The strengths and moduli of these layers vary through several orders of magnitude, and at least the lowest layer (native subgrade) is best described by non-linear constitutive models. These factors by themselves make development of equations which control even simple material behaviors such as deflection under load extremely non-trivial.

The problem is exacerbated by the sheer number of variables which ought to be considered. The pavement is influenced by the soil upon which the pavement is supported, the number of vehicles expected to pass over the pavement, the weight of the vehicles which pass over, the spatial arrangement of the tires which support that weight, the tire pressure, the material properties of the pavement section materials, the temperature and temperature range, the moisture condition of the subgrade, the likelihood of freeze-and-thaw cycles, and probably several more. Many of these variables are extremely difficult to evaluate. The soil conditions under the pavement is evaluated at only a few points, and the weakest points are statistically likely to be missed. Traffic predictions are notoriously complicated and inaccurate. Furthermore, pavement failure is very difficult to define, as there are many possible failure modes. The analytical process underlying each failure mode is different.

Generally speaking, there is a spectrum of design approaches which could be taken, ranging from polar extremes of purely analytical methods to purely phenomenological methods.

The advantage of the phenomenological approach is that one does not need to spend resources on measurement of input variables. The advantage of the analytical approach, however, is that conditions outside the experience of the designer can be designed for by selecting the appropriate input variables.

Actual pavement design methods fall somewhere between these two extremes. Field and laboratory investigation of pavement properties and performance over the last 20 to 30 years have led to semi-analytical methods based on observations. The many input variables are introduced either through equations developed by regression or equations developed from first principles.

The TRIP pavement design method was based on the interim AASHTO method developed in the late 1970's. The approach to pavement design has advanced considerably since that time. In order to take advantage of these advances several state-of-the art pavement design methods were evaluated against the TRIP method for use in the Municipality.

The interim AASHTO method, upon which TRIP was based, was developed from the results of observations of roadway performance on test beds in the midwestern United States. This method was widely regarded as the best compromise between observation and analysis available in the late 1970's. However, because of its origins primarily in the Midwestern United States, the applicability of the method to other climates was questioned. Further, the characterization of the soil support was relatively unsophisticated, and there was no way to directly treat the desired level of confidence in the design. Economic analysis based on life-cycle was not explicitly incorporated. The method included no means for representing the statistical validity of the soil sampling or the traffic design. AASHTO continued researching the performance of pavements in the road test site to correct these problems after 1972. This research primarily consisted of more detailed monitoring of the test road beds, to allow better correlations to be drawn amongst more parameters than were included in the original method.