4.2 Pavement Evaluation

It is the study of various factors pertaining to pavement, such as subgrade support, pavement composition and its thickness, traffic loading and environmental condition.

The main aim:

- To assess as to whether and to what extent the pavement fulfills the design requirements.
- To investigate the structural inadequacy of pavements and also the requirements for providing safe and comfortable traffic operations.

Methods of Evaluation of Pavements:

- Structural Evaluation
- Evaluation of Pavement Surface Condition

Structural Evaluation

- Plate bearing test can be conducted for both flexible and rigid pavements to assess the structural capacity.
- The assessment may be made by
  - ✓ The load carried at a specified deflection at a place or
  - ✓ The amount of deflection at a specified load on the plate
- The performance of a flexible pavement is closely related to the elastic deformation under loads or its rebound deformation.

Evaluation of Pavement Surface Condition

- Surface conditions of flexible pavements may be determined by their unevenness, patches, ruts and cracks. These surface conditions affect the riding quality of the pavements.
- Unevenness of the pavements may be measured using unevenness indicator, profilograph, profilometer or roughometer.

  Unevenness Index:

  It is the index by adding the unevenness of the surface on a cumulative scale represented as cm/km length of road.

Table 1 Unevenness with Ride Quality

Unevenness Index, Cm/Km	**Riding Quality**
Below 95 95 to 119 120 to 144 145 to 240	Excellent Good Fair Poor
Above 240	Very poor (Resurfacing is required)
In new pavements Below 120 120 to 145 Above 145	 Good Fair Poor

Strengthening of Existing Pavements

- A highway is expected to have adequate stability to withstand the design traffic under prevailing climate and subgrade conditions.
- Only solution to manage the increased traffic is either to direct the traffic on some adjacent roads or to strengthen the existing pavements.
- Strengthening may be done by providing additional thickness of pavement provided the subgrade is strong enough.

Overlay

Construction of one or more layers over the existing pavement

Types of overlay:

- Flexible overlays are bituminous surfaces constructed over existing flexible pavements or existing concrete pavements.
- Rigid overlays consists of plain, simply reinforced or continuously reinforced concrete pavements.

Combination of Overlays:

Table 2 Types of Overlay

Existing pavement	Overlay
Cement concrete	Cement concrete
Cement concrete	bituminous
Bituminous or flexible	Cement concrete
Bituminous or flexible	Bituminous or flexible

The choice of overlay depends on various factors

- Total thickness of overlay required
- Wheel load
- Sub grade strength, etc.

Benkelmann Beam Deflection Method for Structural Evaluation of Pavement

Benkalmann Beam is a device used to measure the rebound deflection of a pavement.

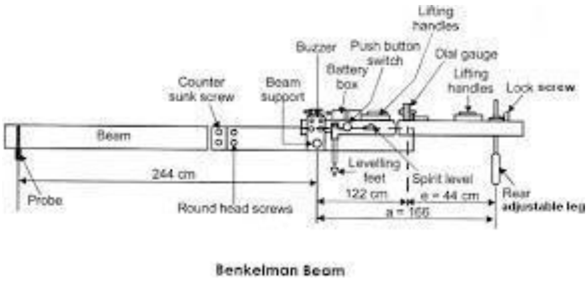
Principle:

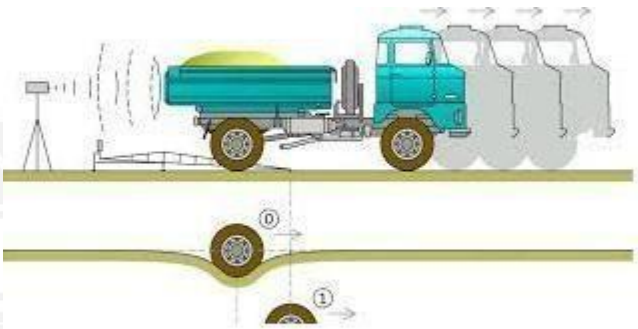
A well designed and constructed flexible pavement which has been well conditioned also deforms elastically under the design wheel load i.e. there is an elastic recovery or rebound of the deformed pavement surface. This is the basic principle of deflection method of pavement which is used to design the overlay thickness.

Equipment:

Benkelmann beam consists of a slender beam 3.66 m long pivoted at a distance of 2.44 m from the tip. The tip is a probe end. The datum frame rests on a pair of front leveling legs and a rear leg with adjustable height.

By suitably placing the probe between the dual wheels of a loaded trucks, it is possible to measure the rebound and the residual deflection of the pavement structure. Rebound deflection is used for overlay design and the residual deflection may be used attributed to non-recoverable deflection of the pavement.





Deflection Test on Road surface

Procedure

- The road to be evaluated is first surveyed to assess the general conditions of the pavement.
- The pavement stretches of length not less than 500 m are classified and grouped on to different classes of length, viz., good, fair and poor for the purpose of studies.
- Loading points for deflection measurements are located along the wheel paths.
- A minimum of 10 deflection observation points may be selected and its may be staggered if necessary.
- The truck is stopped in such a way that the left side rear dual wheel is centrally placed over the first point for deflection measurement.
- The probe end of the benkelmann beam is inserted between the gap and positioned exactly over the deflection observation point.
- The initial dial gauge reading, D_o is noted.
- The truck is moved forward through a distance of 207 m from the point and stopped. The intermediate dial gauge reading D_i is noted.
- The truck is then moved further forward 9m. The final dial reading, D_f is

recorded.

- These three deflection dial readings, D_o, D_i and D_f form one set of readings at one deflection point.
- Temperature at intervals of one hour are taken on the pavement surface.

Rebound deflection value D at any point is given by one of the following two conditions:

a. If (D_i - D_f) < 0.025 mm, then D = 2 (D_o – D_f) = 0.02 (D_o - D_f)mm

b. If (D_i - D_f) > 2.5 division of dial gauge. A correction has to be applied for the vertical movement of the front legs.

D = 2 (D_o – D_f) + 2 K (D_i - D_f) division The value of

$$K = \frac{3d-2e}{f}$$

Where d = distance between the bearing of the beam and the rear adjusting leg

e = distance between the dial gauge and the rear adjusting leg

f = distance between the front and rear legs

The value of K depends on the type of equipment. The value of K for the equipment available in India is 2.91.3

D = 0.02 (D_o – D_f) + 0.0582 (D_i - D_f) mm

The mean value of deflection at n points is given by

D =D/n

The standard deviation of the deflection value is given by,

Characteristics deflection D_c is given by

D_c = D + t σ

Where t is to be chosen upon the percentage of the deflection values to be covered in the design.

When t = 10,

D_c = D+ σ covers about 84 % of the cases of deflection values on the pavement When t = 2.0, D_c = D + 2σ covers about 97.7 % of the cases of deflection values on the pavement IRC recommends D_c = D + σ