Design method
Design method

• Dutch design method has been adapted to the harmonised European Standards for asphalt

• these allow the fundamental approach (specification of stiffness, fatigue resistance, resistance to permanent deformation, water resistance) for asphalt concrete; the Netherlands has chosen this option

• the design parameters obtained from the type testing according to the European standards (stiffness, fatigue resistance) are translated to characteristic (85% reliable) values

• these are used in combination with partial factors of safety according to NEN-EN 1990 Eurocode 0 to incorporate design reliability
Design method

- Stiffness and fatigue testing

![Diagram showing a load cell and a strain gauge with a plot of stiffness modulus vs. number of load cycles.](image-url)
Design method

- asphalt stiffness
Design method

- asphalt strains and stiffness $\rightarrow$ fatigue life $N_f$
Design method

- Triaxial testing
Design method

- Water resistance
Design method

- Use of functional properties

<table>
<thead>
<tr>
<th>Functional properties</th>
<th>E&amp;C - contracts</th>
<th>D&amp;C contracts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ITSR</td>
<td>f_{cmax}</td>
</tr>
<tr>
<td>PA and SMA</td>
<td>empirical</td>
<td>empirical</td>
</tr>
<tr>
<td>AC wearing courses</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>AC binder courses</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>AC base courses</td>
<td>T</td>
<td>T</td>
</tr>
</tbody>
</table>

T = fixed value, dependent on traffic and application
O = no fixed value, actual value is used in the design
Design method

- Use of functional properties

<table>
<thead>
<tr>
<th>Property layer</th>
<th>Class (traffic related)</th>
<th>HRmin</th>
<th>HRmax</th>
<th>water-resistance</th>
<th>stiffness min*</th>
<th>Stiffness max.</th>
<th>Creep resistance</th>
<th>Fatigue resistance*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base layer</td>
<td>OL-A</td>
<td>Vmin2,0</td>
<td>Vmax7</td>
<td>ITSR70</td>
<td>4500</td>
<td>Smax11000</td>
<td>fcmax1,4</td>
<td>e6-100</td>
</tr>
<tr>
<td></td>
<td>OL-B</td>
<td></td>
<td></td>
<td></td>
<td>5500</td>
<td>Smax14000</td>
<td>fcmax0,8</td>
<td>e6-80</td>
</tr>
<tr>
<td></td>
<td>OL-C</td>
<td></td>
<td></td>
<td></td>
<td>7000</td>
<td></td>
<td>fcmax0,4</td>
<td>e6-90</td>
</tr>
<tr>
<td></td>
<td>OL-IB</td>
<td></td>
<td></td>
<td></td>
<td>7000</td>
<td></td>
<td>fcmax0,2</td>
<td>e6-90</td>
</tr>
</tbody>
</table>
Design method

- horizontal asphalt strains in bottom of different asphalt layers
  - fatigue failure of asphalt layers

- asphalt strains (highly dependent on asphalt stiffness) are compared to fatigue resistance of asphalt
Design method

- Tensile stresses in semi-bound road bases (slag bound bases or self-cementing bases) -> disintegration of road base

- Tensile stresses usually tested against standard max. tensile stress value of 130 kPa
Design method

- tensile stresses in bottom of cement bound road bases at extreme loading
  - instantaneous failure of road base

- tensile stress under high wheel loading is compared to characteristic tensile strength of road base material
Design method

- repeated tensile stresses in bottom of bound road bases
  -> fatigue failure of road base

- tensile stresses are compared to characteristic fatigue strength of road base material

- however this fatigue life is extremely hard to determine for conventional cement bound materials
Design method

- compressive stress at top of cement bound road base
  - crushing of road base

- compressive stresses are compared to characteristic compressive strength of base material
Design method

- compressive strains at top of subgrade
  - permanent deformation of subgrade

- compressive strains are compared to characteristic deformation resistance of subgrade
Design method

- subgrade strain $\rightarrow$ subgrade deformation resistance

- this resistance is defined as the number of strain repetitions until deformation reaches intervention level

- is derived from classical SPDM relation, which proved (in Lin-track ALT testing) applicable for standard Dutch subgrade sand

- not to be used for any material!