LIFE CYCLE COST CONSIDERATIONS FOR CHOICE OF PAVEMENT TYPE

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General requirements for pavement design

- **Structural efficiency during the whole design period**
- **Based on given random conditions**
  - Design traffic load
  - Bearing capacity of subgrade
  - Material properties of pavement layers
- **Minimized Maintenance Costs (surface only)**

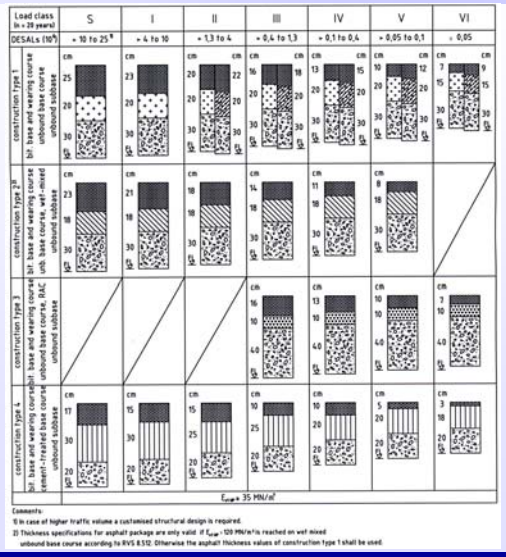
Routine pavement design (1)

- **Average or minimum values of**
  - Subgrade
  - Material properties and fatigue behaviour
- **Pavement design according to given design traffic (load class)**
- **e.g. catalogue type (like Austrian RVS 03.08.63, based on analytical calculations)**

Routine pavement design (2)

- **Resulting in a number of technically equivalent pavement solutions**
- **Based on availability of materials and/or on cost comparison the optimal solution can be selected together with possible alternatives**
- **But still a general solution based on plausible assumptions, not always most cost effective**

Design table RVS 03.08.63, bituminous pavements

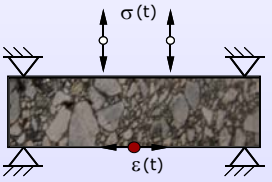


Possible improvement of economic efficiency (1)

- **Specific analytical design using the underlying procedure for the catalogue, but**
- **Real given values of bearing capacity of subgrade, material characteristics of layers, specific fatigue laws**
- **Also possibility to include new, innovative, not standardised materials**

Essential precondition

- **Exact and reliable information about input characteristics**
- **Performance based laboratory tests (stiffness modulus, fatigue behaviour etc.) functional requirements according to CEN**



- **Traffic forecast of high accuracy**

Benefits of specific pavement design

- **Better adaptation to existing subgrade situation**
- **Better utilisation of material properties**
- **Possibility for innovative materials and solutions**
  - Alternative bids
  - Performance related contracts

Consideration of costs

- **Construction costs**
- **Life-cycle costs**
  - Construction
  - Maintenance
    - Routine
    - Rehabilitation including
      - Traffic management at construction sites
      - Methods/measures
      - Intervals
  - Additional user costs (e.g. time loss)
  - Environmental costs (possibly)

Calculation of life-cycle costs

- **Prognosis of development of pavement condition necessary**
- **Prediction of life time, change of condition indicator-values and thus prediction of time and type of maintenance measure**

→ **Basic tasks for PMS/e.g. VIAPMS**

Change of approach and responsibilities

Actual:

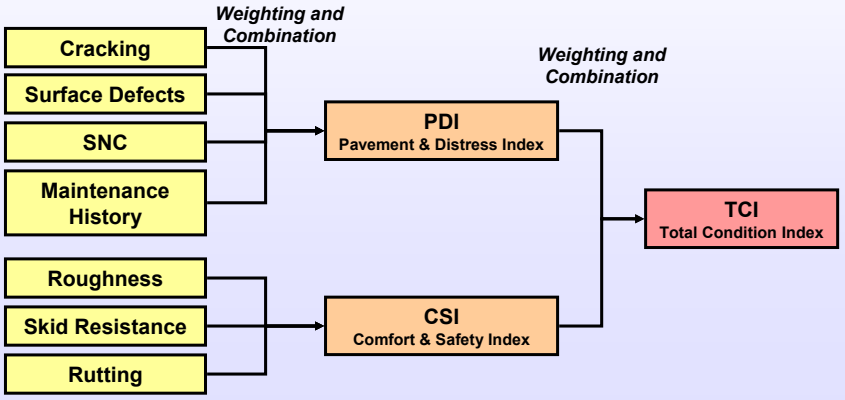
- **Only construction costs considered**
- **Client chooses contractor according to cost comparison**
- **Sometimes alternatives compared**

New approach (even if normal tender):

- **Consider life-cycle costs**
- **At least for road owner costs (construction and maintenance)**

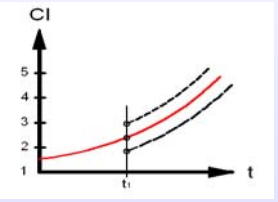
Most crucial point: Performance models

- **Performance models required for**
  - Structural development
  - Surface characteristics (especially for LLPs)



Most crucial point: Performance models (2)

- **Standard- type pavements, traditional materials**
  - Empiric results from database analysis
- **Innovative, new materials and pavements**
  - Prognosis based on analytical calculation



  - First assumption based on existing empiric functions and adaptation by periodic condition measurements (normally required in any case)

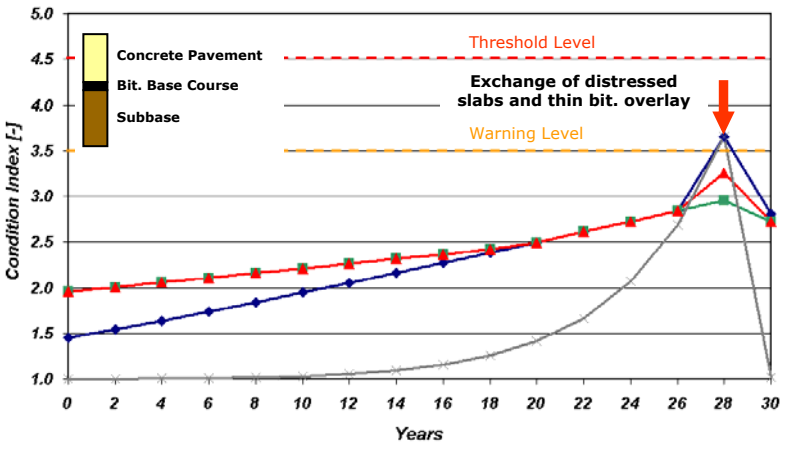
Optimized solution LCC

- **Construction costs**
- **Maintenance costs including additional user costs**

→ **Minimum life-cycle costs**

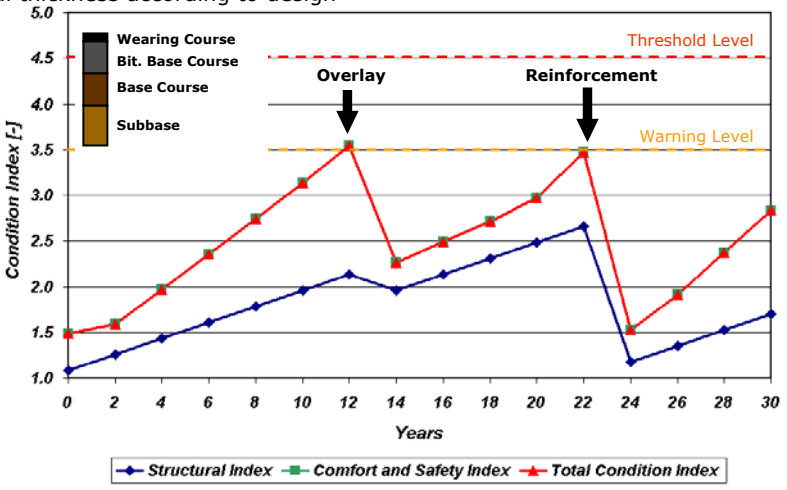
  - Most economic solution
  - In compliance with given quality requirements

Development Pavement Condition – Concrete Pavement



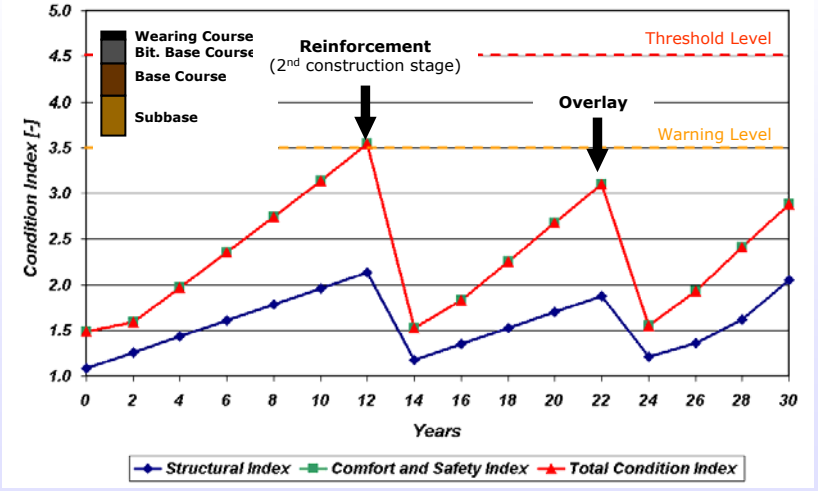
Development Pavement Condition – Asphalt Pavement

Total thickness according to design

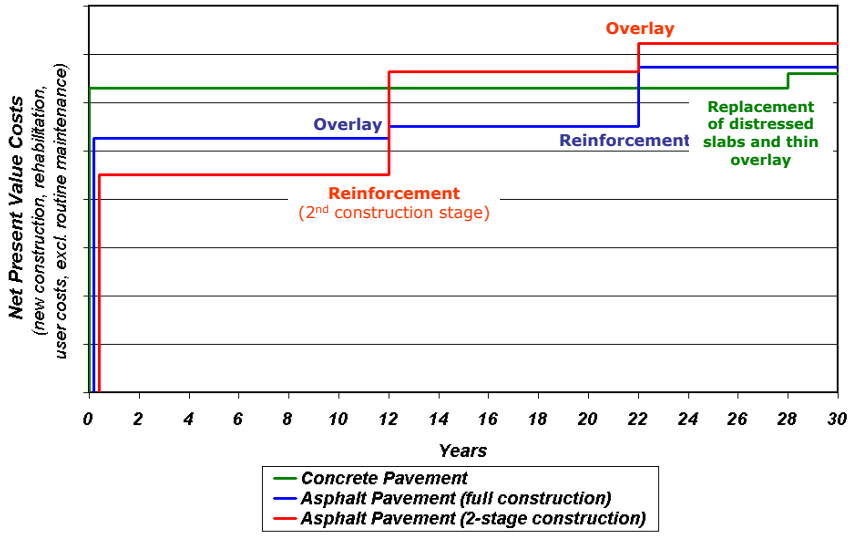


Development Pavement Condition – Asphalt Pavement

2-stage pavement construction

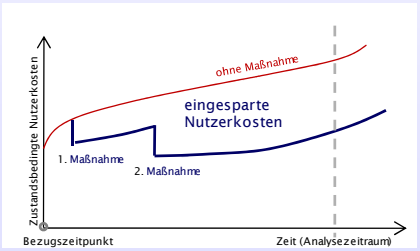


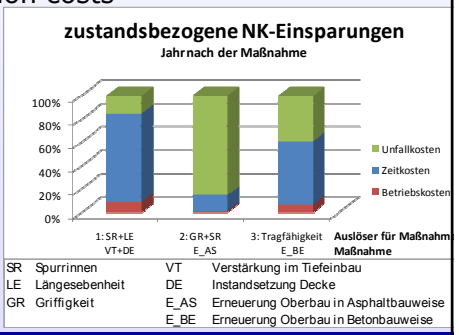
Comparison Total Costs (including user costs)



Definition of user costs (1)

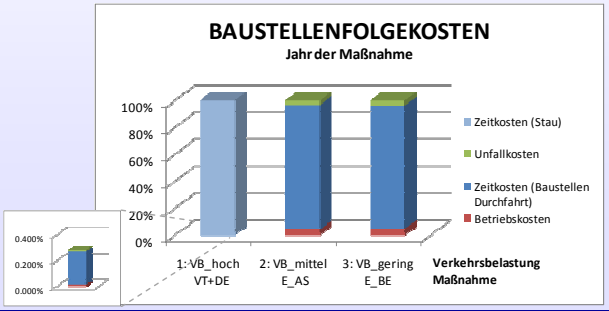
- **Austrian research project on "User Cost Module for VIAPMS-Austria" finished 2009**
- **Condition related user costs**
  - Additional time costs
  - Additional vehicle operation costs
  - Additional accident costs





Definition of user costs (2)

- **Additional user costs related to constructions sites**
  - Additional time costs
  - Additional vehicle operation costs
  - Additional accident costs



Additional random conditions

- Assessment of real construction costs often difficult (competition) → comparative calculations based on alternative bids (example S1 – Wiener Südrandstraße)
- Avoidance of frequent changes of pavement type (in Austria in the past fixed pavement plan based on function)
- Specific high requirements on noise reduction → affordable with PA only

Conclusions

- Life cycle cost calculations (including user costs) as valuable tool for decision on pavement type (total economic view, not only road owner's view)
- Increased practical application during the decision process, at least for road owner's cost
- Stepwise approach recommended (without and with evaluation of user costs)
- Sometimes almost no choice because of given random conditions

Thank you for your attention