High Performance?
Impact of Equivalent Young’s Modulus Ratio Values b/w Material Layers on Pavement Structural Fracture Performance
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Stiffness of French pavement materials

- Modulus range in MPa

- Subgrades
- Unbound materials
  - Unbound granular materials
- Bituminous materials
  - Gravel emulsion
  - Bituminous concrete (BB)
  - Grave Bitume (GB)
  - High modulus bit. mix (EME)
- Hydraulic materials (GC)
  - Gravels and Sands treated with HB
  - Concrete

- French Context

\[ E_{E,adm} = \frac{\left( \frac{NE}{10^6} \right)^b \times kC \times kr \times ks \times kd}{\sqrt{\phi}} \]

- Fatigue test NF EN 12697-34

(Burnister, 1943)
- Elastic Multilayers
- 2D axisym.
- Half Inf space

Transp Res Apl 1539:116–124

... But for top layers?

- Tension stress

- Shear stresses

- Lateral loadings

DEVIN PROJECT
INRETS - LMT Cachan - SMIT/LCPC
(Hammoum et al., 2010)
EME2 uses & limitations?

- Good performance:
  - High Young modulus → Fatigue / Rutting ok
  - Used for heavy traffic or bus way
- But need:
  - Good soil
  - Thickness design value
    - Correct traffic hypothesis
  - Construction care: Cst % of void and good bond between layers

Dedicated pavement analysis

Dedicated M4-5nW analysis
#T°C → Effect of # E Ratio on Interface stresses

Bending case with Discontinuities and climate change

Debonding?


High performance of bituminous materials...
- Loading conditions?
- With other layers?
- New pavement geometries?

Bending case: geometry & $E_2/E_1$

Hun PHD thesis (2012)

Tension stress at the Bottom of layer 2

normal

shear

Interface 1,2 stresses


Bond ALT for urbain French roads


Cold T°C 3 materials? Hot T°C: $E_{oc} >> E_{ac}$

Why? When?

Solar RoadWays
**eRoads examples**

One Geometrical Solution proposed by KTH (Chen, PHD 2016)


**eRoad composite system**

(Chabot & Deep, 2019)

High Bond Performance Needs!

Chabot A., Deep P., 2019. 2D Multilayer Solution for an Electrified Road with a built-in Charging Box. *RMPJE*, 20 (sup2), s590-s603.

**Multi-axle loads**

ALT vs visco-elastic calculus

(Kerzreho et al., 2012)