Asia Highway Investment Forum

Long-life Asphalt Pavement in China

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OUTLINES

- Introductions
- Features of Long-life Pavement
- Experiences from China
- Benefits
- Challenges
- Conclusions
1. Introductions

- Highway transportation plays an important role in China's economic development in past decades.

- Asphalt pavement is more comfortable and easy constructed.

- More than 90% of the high grade highway adopt it in China.
1. Introductions

Problems

- Design life of pavement structure is: 15~18 years
- Deficient on construction quality
- Rehabilitation cycle is only: 5-8 years

Result in:

- Big budget on maintenance
- Environment Pollution and Resource Consumption
- Highway develop slowly
1. Introductions

In order to improve pavement performance, Achieve optimum highway investment income, Realize the sustainable, environment friendly construction idea.

Since 2000, the research and application of Long-Life Asphalt Pavement (LLAP) Technology had been gradually carried out in China.
2. Features of long-life pavement

What is long-life or perpetual pavement?

In 1997, presented by Nunn from British TRL:

— If the pavement can be used for 40 years, then the total life cycle cost will be lowest.

Based on this idea, The concept of long-life pavement was firstly be presented.

Now, Europe and United States has put forward their technical standard of LLAP respectively.
2. Features of long-life pavement

In China, the technical standard of LLAP is:

<table>
<thead>
<tr>
<th></th>
<th>Normal pavement</th>
<th>Long-life pavement</th>
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<tbody>
<tr>
<td>Design Life</td>
<td>15-20 Years</td>
<td>40-50 Years</td>
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<tr>
<td>Loading Durability</td>
<td>25 million standard loading times</td>
<td>100 million standard loading times</td>
</tr>
<tr>
<td>Rehabilitation Cycle</td>
<td>5-6 Years</td>
<td>10-12 Years</td>
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2. Features of long-life pavement

The three AC structures can achieve same target ——LLAP, except the investment. It is caused by local material, climate and traffic.
3. Experiences from China

Experiences in the past three decades:

- In 1978, Empirical-Mechanical asphalt pavement design system was established in China.

- In 1997, The semi-rigid base asphalt pavement was normally appointed as typical structure for high class highway design and construction.
3. Experiences from China

Semi-rigid base asphalt pavement is a main structure in the past three decades!
3. Experiences from China

Features of semi-rigid base asphalt pavement

**Benefits**

- Good foundation suitable capacity.
- Enhance the bearing capacity of road structure, suitable for heavy traffic and large volume traffic.
- Decreasing rutting depth of full structure for thin asphalt layer.
- Lower material costing: The cost of 1 cm asphalt mixture is equal to 4-5 cm semi-rigid material.
3. Experiences from china

Features of semi-rigid base asphalt pavement

- Bonding insufficient between semi-rigid base and asphalt surface. And this is the cause for water distress, rutting and even cracking.
- Reflecting cracking, especially in cold area, it is certain proportion of cracking.
- For S-R base no strong enough, the structure bearing capacity not more than 50 million standard loading times.
3. Experiences from China

Since 2000, To achieve the suitable approach of design and construction of LLAP for China, following works had been done:

- Learning LLAP experiences from the European and US;
- Summarizing the successful experiences of highway design and construction in China;
- Constructing the test road and long-term performance supervision.
3. Experiences from China

European and American’s experiences —— flexible base pavement:

- Increasing the thickness of asphalt layers, up to 40~50cm;
- Three layer typical structure:
  - Friction layer
  - Rutting resistant layer
  - Flexible fatigue resistant layer

Compared with semi-rigid base asphalt pavement

- Higher quality requirement of the foundation
- Extra heavy traffic rutting resistance need to verify
- Higher investment
3. Experiences from China

Summary successful experience from former project:

Jing-jin-tan and Jiqing are the first expressways in China. Built in the early 90’s.

100 million standard loading times, 5 times of initial design criteria.

No structural rehabilitation so far.

They are durable and good performance because:

- Reasonable structure design
- A strong and uniform foundation
- Good bonding
- Optimum material design is achieved
- Good construction and quality control
3. Experiences from China

The test road and projects of LLAP

Since 2004, China had built different type of LLAP road:

- Semi-rigid base structure

- Flexible base structure (thick asphalt layer structure, like E & U)

- Rigid base structure (cement concrete pavement is used in base).
3. Experiences from China

The test road and projects of LLAP

- Jiangsu Province——YanJiang expressway
3. Experiences from China

The test road and projects of LLAP

- Henan Province——XuWei expressway

Wei Shi-Xu Chang freeway (2005)

- 4cm SMA-13
- 28cm Cement Concrete
- 18cm lime-fly ash stone
  Semi-rigid base
- 20cm Treatment soil
3. Experiences from China

The test road and projects of LLAP

- Shandong Province——BinZhou test road
3. Experiences from China

The test road and projects of LLAP

In 2005, the MOT carried out “The heavy traffic of long-life semi-rigid pavement key technology research", and the completion of the Qinhuangdao test road in 2007.

Qing Huangdao freeway (2007)

- 4cm SBS Modify asphalt SAC16
- 8cm HMAC SAC25
- 19cm Cement Bound Grade -25, \( R_7 = 6 \text{MPa} \)
- 19cm Cement Bound Grade -25, \( R_7 = 6 \text{MPa} \)
- 19cm Lime-Fly ash Bound Soil, \( R_7 = 1 \text{MPa} \)
- 19cm Lime-Fly ash Bound Soil, \( R_7 = 1 \text{MPa} \)
- 1.5m Soil Sub-base
3. Experiences from China

In 2009 ~2012, in Hebei, Inner Mongolia, Guangdong with different climate and geological conditions. Develop rapidly!
3. Experiences from China

Recommend long-life asphalt pavement structure
(Semi-Rigid Base Structure)

- Coarse-gap grade asphalt mixture
- HMAC down layer

4 layers
High-strength Semi-rigid Base 76cm

4cm SBS Modify asphalt SAC16

8cm HMAC SAC25

19cm Cement Bound Grade -25, R7=6MPa

19cm Cement Bound Grade -25, R7=6MPa

19cm Lime-Fly ash Bound Soil, R7=1MPa

19cm Lime-Fly ash Bound Soil , R7=1MPa

1.5m Soil Sub-base

Double bonding

RIOH
3. Experiences from China

POINTS 1: Good bearing capacity and structure safety

- Four high strength semi-rigid structure layers

- The deflection of integral pavement structure is less than 10, bearing capacity reach 200~500 million standard loading times
3. Experiences from China

POINTS 2: Setting two modified asphalt waterproof bonding layers

- Enhance the uniform of two layer
- Better Water proof
- Reflect cracking resistance

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Upper AC Layer
Water Proof
Down AC Layer
Semi-Rigid Base Layer
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POINTS 3: Selecting reasonable thickness of the AC layer

- Thickness of the AC layer is about 12~15cm
- The coarse aggregate gap gradation dense mixture is used
- Down layer use PEN20/30 binder: High Modulus Asphalt Mixture

- Excellent rutting resistance
- Good anti-slide durability
3. Experiences from China

POINTS 4: Technological innovation and good quality control in construction

- Single particle size processing requirements
- The improvement of semi-rigid material mixing equipment
- Strengthening semi-rigid material health

Single particle size
New equipment
Strengthening
3. Experiences from China

Generally say:

• Semi-rigid base asphalt pavement is a good choice of long-life pavement
• It has technique and economic benefits than flexible structure
• Good construction and quality control is essential

The long-life pavement design and construction guide are drafting in China
4. Benefits

• **Performance**
  
  – Durability
    
    • Increasing 3 times Standard loading times than normal pavement
    
    • Increasing rehabilitation cycle about 1 times
  
  – Better Rutting Resistance
  
  – Lower Water Distress Risk
4. Benefits

- Economic and Environment
  — Lower investment
  Comparing with full-depth flexible asphalt pavement, decrease 30%.
  - Lower maintenance cost
  - Lower resources consumption
    - More efficient use of resources
    - Environment friendly because of maintenance times decreasing
5. Challenges

- Design principle need to be developed further.
  - Multi-scale structure & material performance
  - Full-scale testing road verifying
  - LTPP data summary

- Good construction technology and quality control are same important as design principle.
6. Conclusions

- Durable, sustainable and green are features of long-life pavement.
- The research on Long-Life Road technology is a new but prospective development direction.
- Long-life pavement design principle is suitable for not only new construction but also rehabilitations.
Questions & Answers

Thank You for Your Attention!
• 经济问题是公路建设不得不考虑的问题；
• 即应选择满足技术要求，又经济合理的技术方案。
• 柔性基层和半刚性基层是两个不同的形式，可以达到相同的技术目标，但是工程造价却有明显的差异——至少在中国。
• 修建半刚性基层的长寿命沥青路面是一个有价值的技术问题。