A Trial with Simplified Semi-Rigid Pavements in Developing Countries

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2. Component of Semi Rigid Pavement
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1. Introduction

- **Typical Pavement Design For Road Construction**:

  - **Flexible pavement**
    - asphalt concrete pavement
  
  - **Rigid pavement**
    - cement concrete pavement
  
  - **Semi-rigid pavement**
    - porous asphalt concrete filled with cement mortar
1. Introduction

- Comparison of Three Types of Road Pavements:

<table>
<thead>
<tr>
<th>Compared properties (selected properties)</th>
<th>Flexible Pavement</th>
<th>Rigid Pavement</th>
<th>Semi-Rigid Pavement (SRP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Resistance to rutting/deformation</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>2. Skid resistance properties</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>3. Resistance to petroleum products, oil and chemical</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>4. Resistance to moisture damage</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>5. Maintenance and repair</td>
<td>Easy</td>
<td>Difficult</td>
<td>Easy</td>
</tr>
<tr>
<td>6. Life span</td>
<td>Short</td>
<td>Long</td>
<td>Long</td>
</tr>
<tr>
<td>7. Flexural strength properties</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>8. Expansion joint</td>
<td>Not required</td>
<td>Required</td>
<td>Not required</td>
</tr>
<tr>
<td>9. Installation and open to traffic</td>
<td>Within hours</td>
<td>0.5-3.0 months</td>
<td>Within 24 hours</td>
</tr>
<tr>
<td>10. Construction and maintenance costs</td>
<td>Lower const. cost; High maint. cost</td>
<td>Higher const. cost; Low maint. cost</td>
<td>Low const. cost; Low maint. cost</td>
</tr>
</tbody>
</table>

- Semi rigid pavement has been widely used in developed countries
1. Introduction

Composition of semi rigid pavement:

Porous Asphalt Concrete (PAC) (void content: 25-30% by volume) + high strength high fluidity polymer modified cement mortar

(a) Porous Asphalt Concrete (PAC)  
(b) Polymer Modified Cement Mortar  
(c) Semi-Rigid Pavement (Cored Sample)
2. Component of Semi-Rigid Pavement

2.1 Component of Semi-Rigid Pavement

Porous Asphalt Concrete (PAC) (void content: 25-30% by volume) & high strength high fluidity polymer modified cement mortar

2.2 Component of Porous Asphalt Concrete (PAC)

<table>
<thead>
<tr>
<th>Components</th>
<th>Percentage by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregates</td>
<td>92.9%</td>
</tr>
<tr>
<td>Filler</td>
<td>3.0%</td>
</tr>
<tr>
<td>Polymer modified bitumen (PG76)</td>
<td>3.6~4.6%</td>
</tr>
</tbody>
</table>
## 2. Component of Semi-Rigid Pavement

### 2.3 Aggregate Gradation

<table>
<thead>
<tr>
<th>Sieve Size in mm</th>
<th>0.075% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
</tr>
<tr>
<td>19.0</td>
<td>100</td>
</tr>
<tr>
<td>13.2</td>
<td>85</td>
</tr>
<tr>
<td>9.5</td>
<td>27</td>
</tr>
<tr>
<td>6.3</td>
<td>1</td>
</tr>
<tr>
<td>2.36</td>
<td>1</td>
</tr>
<tr>
<td>0.600</td>
<td>0</td>
</tr>
<tr>
<td>0.300</td>
<td>0</td>
</tr>
<tr>
<td>0.075</td>
<td>0</td>
</tr>
</tbody>
</table>
## 2. Component of Semi-Rigid Pavement

### 2.4 Aggregate properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Method of Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact Value</td>
<td>≤25%</td>
<td>B.S.812 Part 112:1985</td>
</tr>
<tr>
<td>Crushing Value</td>
<td>≤25%</td>
<td>B.S.812 Part 110:1985</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>≤1%</td>
<td>B.S.812 Part 2:1975</td>
</tr>
<tr>
<td>Flakiness index</td>
<td>≤25%</td>
<td>B.S.812 Part 105:1:1985</td>
</tr>
<tr>
<td>Elongation Index</td>
<td>≤30%</td>
<td>B.S.812 Part 105:2:1985</td>
</tr>
<tr>
<td>L.A. Abrasion Value (500rev)</td>
<td>≤20%</td>
<td>S.S 73:1974</td>
</tr>
<tr>
<td>Silt Content of Aggregate in Hot bin (by weight)</td>
<td>≤0.3%</td>
<td>B.S.812 Part 1:1975</td>
</tr>
</tbody>
</table>
3. Simplified Semi-Rigid Pavement

3.1 Porous Asphalt Concrete With Low Bitumen Content Filled With Chemilink SS-141

- Aggregate size range: 4~20mm
- Bitumen content: 3.0%
- Bitumen: no polymer modified

Loose PAC before compaction
3. Simplified Semi-Rigid Pavement

3.1 Porous Asphalt Concrete With Low Bitumen Content Filled With Chemilink SS-141

Porosity is around 28.6%

Compacted PAC
3. Simplified Semi-Rigid Pavement

3.1 Porous Asphalt Concrete With Lower Bitumen Content Filled With Chemilink SS-141

Note: Surface texture looks very good and thus skid resistance will be sufficient.
3. Simplified Semi-Rigid Pavement

3.1 Porous Asphalt Concrete With Lower Bitumen Content Filled With Chemilink SS-141

Cored samples

Note: It shows that voids in porous asphalt concrete are fully filled by SS-141
3. Simplified Semi-Rigid Pavement

3.1 Porous Asphalt Concrete With Lower Bitumen Content Filled With Chemilink SS-141

Compressive Strength Testing

Compressive Strength: 6.50~10.50MPa
Average: 9.00MPa
3. Simplified Semi-Rigid Pavement

3.2 Porous Asphalt Concrete With Higher Bitumen Content Filled With Chemilink SS-141

- Aggregate size range: 4~20mm
- Bitumen content: 4.5%
- Bitumen: no polymer modified

Loose PAC before compaction
3. Simplified Semi-Rigid Pavement

3.2 Porous Asphalt Concrete With Higher Bitumen Content Filled With Chemilink SS-141

- Porosity is around 29.0%

Compacted PAC
3. Simplified Semi-Rigid Pavement

3.2 Porous Asphalt Concrete With Higher Bitumen Content Filled With Chemilink SS-141

Note: Surface texture looks quite good and voids in porous asphalt concrete are fully filled by SS-141
3. Simplified Semi-Rigid Pavement

3.3 PAC Formed By Selected Coarse Particles From Normal Asphalt Concrete Filled With Chemilink SS-141

- Normal Asphalt Concrete
- Selecting Corse Particles From Normal Asphalt Concrete to form PAC
3. Simplified Semi-Rigid Pavement

- 3.3 PAC Formed By Selected Coarse Particles From Normal Asphalt Concrete Filled With Chemilink SS-141

Heating

Compacted
3. Simplified Semi-Rigid Pavement

3.3 PAC Formed By Selected Coarse Particles From Normal Asphalt Concrete Filled With Chemilink SS-141

Surface Just Filled With Chemilink SS-141

Hardened Surface

Note: Surface texture looks quite good and thus skid resistance should be high enough.
3. Simplified Semi-Rigid Pavement

3.3 PAC Formed By Selected Coarse Particles From Normal Asphalt Concrete Filled With Chemilink SS-141

Cored Sample

Note: the voids in porous asphalt concrete are fully filled by SS-141
3. Simplified Semi-Rigid Pavement

3.4 Pure Aggregate Filled With Chemilink SS-141

Loose aggregate

Compacted aggregate
3. Simplified Semi-Rigid Pavement

3.4 Pure Aggregate Filled With Chemilink SS-141

Note: Surface texture looks good and voids in aggregate are fully filled by SS-141
4. Conclusions

- Semi rigid pavement has advantages of rigid pavement and flexible pavement, so it starts to attract attentions of developing countries.

- Due to limitations of Porous Asphalt Concrete (PAC) technology in developing countries and their lower requirements, various simplified semi rigid pavements are required to be developed to meet their local special requirements.

- Further trials and studies are needed, including flexural strength analysis, to comprehensively compare the differences between the simplified and standard semi rigid pavements, in order to find out the right ways for applying the local simplified semi rigid pavement in different developing countries.
Thank You for Your Attention!