FATIGUE RELIABILITY STUDY ON HIGH SPEED TRAIN BOGIE IN SERVICE

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12th July, Session: Rolling Stock Design 4
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- Part 1  CHINA HIGH-SPEED RAILWAY NETWORK
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In Jan. 2004, the first “Long-term Railway Network Plan” in Chinese history which describes the blueprint of China high-speed railway development was authorized by the State Council. More than 7,000km high-speed railways were built during Chinese “Eleventh Five-Year Plan” period and 18,000km is expected by 2020. The development strategy of “high-speed for passenger transport and heavy-load for freight transport” was established.
2008~2011: WuHan-GuangZhou (WH-GZ), BeiJing-ShangHai (BJ-SH)

- 26th SEP. 2009, 968km WH-GZ Passenger dedicated line, 350km/h high-speed train
- 1st JUL. 2011, 1320km BJ-SH high-speed railway, new generation CRH380 high-speed train
2008~2011: WuHan-GuangZhou (WH-GZ), BeiJing-ShangHai (BJ-SH)

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2012~2013: BeiJing-ShiJiaZhuang-WuHan (BJ-SJZ-WH), Harbin-DaLian (HRB-DL)

- 281km BJ-SJZ passenger dedicated line and 840.7km SJZ-WH passenger dedicated line, 350km/h high-speed train, at the end of 2012.
- 904km HAB-DL passenger dedicated line, 350km/h high-speed train developed for cold area, at the end of 2012
METHOD OF STRESS AND LOAD MEASUREMENTS

Bogie of High-speed Train

Bogie frame of High-speed Train

Strain Gauge Positions

Load Test Sensors

Test Equipment Installation

Test Scheme

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DYNAMIC STRESS TEST RESULTS

Fig 1. Relationship between equivalent stress and running speed

Fig 2. Relationship between equivalent stress and service condition

Fig 3. Relationship between equivalent stress and service mileage
WHEEL PROFILING INFLUENCE ON LOAD CHARACTERISTICS

Axle box spring load characteristics before and after wheel reprofiling _Vertical Load

Table 1: Vertical load statistics on axle box springs under high speed straight line condition (Unit: kN)

<table>
<thead>
<tr>
<th>Status</th>
<th>Spring No.</th>
<th>Max. Load</th>
<th>Min. Load</th>
<th>Load Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before wheel profiling</td>
<td>3-H</td>
<td>63.6</td>
<td>59.9</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>4-H</td>
<td>62.2</td>
<td>58.1</td>
<td>2.1</td>
</tr>
<tr>
<td>After wheel profiling</td>
<td>3-H</td>
<td>62.1</td>
<td>60.1</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>4-H</td>
<td>60.1</td>
<td>57.2</td>
<td>1.5</td>
</tr>
</tbody>
</table>

High speed straight line condition

Numbers of the axle box spring

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**WHEEL PROFILING INFLUENCE ON LOAD CHARACTERISTICS**

*Axle box spring load characteristics before and after wheel reprofiling.*

**Vertical Load**

**Table 2 Vertical load statistics on axle box springs under curve passing condition (Unit: kN)**

<table>
<thead>
<tr>
<th>Status</th>
<th>Spring No.</th>
<th>Max. Load</th>
<th>Min. Load</th>
<th>Load Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before wheel profiling</td>
<td>3-H</td>
<td>71.4</td>
<td>58.7</td>
<td>6.4</td>
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<tr>
<td></td>
<td>4-H</td>
<td>63.8</td>
<td>55.8</td>
<td>4.0</td>
</tr>
<tr>
<td>After wheel profiling</td>
<td>3-H</td>
<td>67.1</td>
<td>61.5</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>4-H</td>
<td>61.9</td>
<td>56.3</td>
<td>2.8</td>
</tr>
</tbody>
</table>
**WHEEL PROFILING INFLUENCE ON LOAD CHARACTERISTICS**

Axle box arm load characteristics before and after wheel reprofiling - Lateral Load

### High speed straight line condition

#### Before wheel profiling

#### After wheel profiling

**Table 3** Lateral load statistics on axle box arms under straight line condition with high speed (Unit: kN)

<table>
<thead>
<tr>
<th>Status</th>
<th>Axle box arm</th>
<th>Max. Load</th>
<th>Min. Load</th>
<th>Load Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before wheel profiling</td>
<td>3-H</td>
<td>15.1</td>
<td>-11.0</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>4-H</td>
<td>15.2</td>
<td>-11.4</td>
<td>13.3</td>
</tr>
<tr>
<td>After wheel profiling</td>
<td>3-H</td>
<td>7.1</td>
<td>-6.0</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>4-H</td>
<td>5.6</td>
<td>-6.7</td>
<td>6.1</td>
</tr>
</tbody>
</table>
## WHEEL PROFILING INFLUENCE ON LOAD CHARACTERISTICS

Axle box arm load characteristics before and after wheel reprofiling - Lateral Load

### Curve passing condition

<table>
<thead>
<tr>
<th>Status</th>
<th>Axle box arm</th>
<th>Max. Load</th>
<th>Min. Load</th>
<th>Load Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before wheel profiling</td>
<td>3-H</td>
<td>20.9</td>
<td>-20.9</td>
<td>20.9</td>
</tr>
<tr>
<td></td>
<td>4-H</td>
<td>24.7</td>
<td>-16.7</td>
<td>20.7</td>
</tr>
<tr>
<td>After wheel profiling</td>
<td>3-H</td>
<td>7.3</td>
<td>-15.3</td>
<td>11.3</td>
</tr>
<tr>
<td></td>
<td>4-H</td>
<td>19.6</td>
<td>-6.3</td>
<td>13.0</td>
</tr>
</tbody>
</table>

Table 4: Lateral load statistics on axle box arms under curve passing condition (Unit: kN)

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Comparison of the load spectrum before and after wheel reprofiling

(a) Sink-floating load spectrum

(b) Side-rolling load spectrum

(c) Torsion load spectrum

(d) Lateral load spectrum

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...Thank you for your kind attention