BEHAVIOUR OF THE LOWER LEVEL (DECK) OF DOUBLE-DECK VEHICLES IN ROLLOVER

99th GRSG session
2010, October

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delegate of Hungary
The Hungarian proposal to R.66: insert a new paragraph as follows ((ECE/TRANS/WP.29/GRSG/2010/2)

5.6. Testing of double deck vehicles

In the case of a double deck vehicle only the upper level (UL) of the vehicle shall comply with the general requirement specified in paragraph 5.1. The whole lower level (LL) shall be considered as a rigid part, therefore no test is required on it.
Among the definitions of R.66, the rigid part is specified:

2.28. „Rigid part” means a structural part or element which does not have significant deformation and energy absorption during the rollover test.

„Rigid part” could be the underfloor structure, the roof structure, certain parts of door and window columns between plastic hinges, etc.
Annex 4 in R.66 gives examples for rigid parts

Figure A4.1 - Derivation of the superstructure from the bodywork
The advantages of this proposal:

- Much simpler approval test (no observation and measurement on the LL)
- Significant cost reduction in the approval test
- Clearer and unified calculation approval methods (in quasi-static calculation and dynamic computer simulation)
CONSTRUCTIONAL ARGUMENTS

The LL of a DD vehicle is reinforced by strong structural elements, coming from the design and arrangement of this kind of vehicles:

- Engine compartment in the rear part
- Driver compartment in the front part
- Wheel arches in the front part
- Staircase(s) in the mid of the vehicle
- Toilet
- Baggage compartment(s)
CONSTRUCTIONAL ARGUMENTS

The structural reinforcements of LL
CONSIDERED TYPES OF ROLLOVER

Tip over (turn on side)
Angle of rotation $\alpha \approx 90^\circ$

No reaction force on the cantrail $F_r = 0$
Less dangerous rollover
CONSIDERED TYPES OF ROLLOVER

Turn on side, but the other side of a ditch or the inclining ground hits the cantrail.

Angle of rotation $\alpha \approx 45^\circ - 60^\circ$

Considerable reaction force on the cantrail $F_r > 0$
CONSIDERED TYPES OF ROLLOVER

Roll down on a slope
Angle of rotation $\alpha \approx 90^\circ - 180^\circ$

Strong reaction force on the cantrail  $F_r >> 0$
Most dangerous rollover
TIP OVER

Tip over at an exit of a tunnel
(The left wheels run up a rising concrete barrier)

- No significant, but slight deformation on the UL
- Residual space (RS) remained intact
- Rigid LL
Tip over on a flat road

- No significant deformation on the UL
- RS remained intact
- Rigid LL
TIP OVER

Flat road, flat snowy ground
- No significant deformation on the UL,
- intact RS
- Rigid LL
TIP OVER

Flat, saft grassy ground
- No significant deformation on the UL
- Rigid LL
After a severe frontal collision (on the driver’s cab) the bus run down on the slope and a railway embankment turned it back onto the slope.

- Slight deformation on the UL
- RS remained intact
- Rigid LL (deformation only as the result of the frontal impact)
The bus turned into a ditch having an inclining elevated other side

- Considerable deformation on the front half of the UL
- Possible intrusions into the RS on the UL
- Rigid LL
ROLL DOWN ON A SLOPE

- The UL collapsed
- RS disappeared on the UL
- Rigid LL
ROLL DOWN ON A SLOPE

After a frontal collision on the driver’s cab side, the bus rolled down on a slope

- Asymmetrically collapsed UL
- RS strongly damaged
- No structural deformation on LL except due to the frontal collision
After a frontal collision on the driver’s cab the bus rolled down… on a slope

- Considerable deformation on the UL
- Possible intrusion into the RS on the UL
- Rigid LL
After a severe frontal collision on the driver’s cab, the bus rolled down on a slope.

- The UL collapsed
- RS disappeared on the UL
- Rigid LL (deformation only due to the frontal collision)
ROLL DOWN ON A SLOPE

- Severe, locally concentrated deformation on the UL
- Harmed RS on the UL
- Rigid LL
ROLL DOWN ON A SLOPE

- The UL collapsed (Firemen cut it down to rescue the passengers)
- RS disappeared on the UL
- Rigid LL
<table>
<thead>
<tr>
<th>Type of rollover</th>
<th>Σ</th>
<th>No deformation</th>
<th>No significant (only slight) deformation</th>
<th>Significant deformation</th>
<th>Severe deformation</th>
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<tr>
<td></td>
<td></td>
<td>UL</td>
<td>LL</td>
<td>UL</td>
<td>LL</td>
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<td>$\alpha = 90^\circ$</td>
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<td>12</td>
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If somebody can show a DD rollover accident, in which the LL put up significant structural deformation, due to the rollover, Hungary will withdraw the proposal.