A discussion of the level crossing and train to train collision scenarios

- **Level crossing scenario:**
  - A more realistic obstacle
  - A more realistic crash scenario
  - A more representative obstacle
  - A more representative state of deformation
  - An energy absorbing obstacle
  - A deformable obstacle

A discussion of the level crossing and train to train collision scenarios

- **Train to train collision scenario:**
  - TSI high speed → 36Km/h
  - Euronorm (draft) → 36Km/h
    - *With reference to TSI ???*
  - SAFETRAIN /ERRI → 55Km/h

The proposed deformable 'simple' obstacle model has captured the cab space 'invasion' associated with the roll effect of the obstacle inherent to such collisions [Fig. 9]. Compared to the rigid wall load case, a deformable energy absorbing obstacle produces realistic deformations.

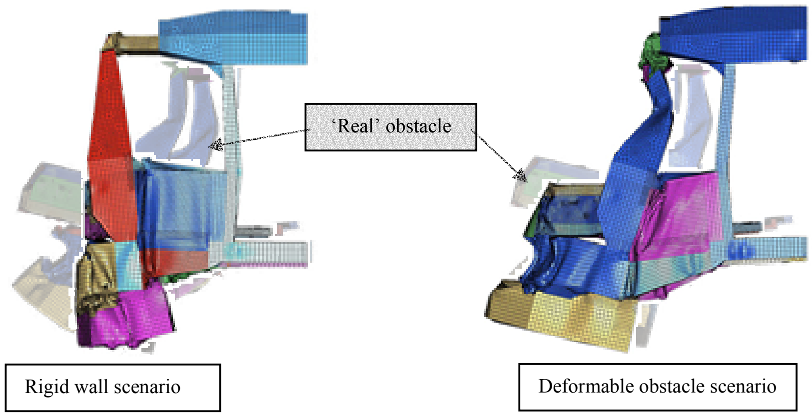

Fig. 8 Deformed Safetrain cab

Furthermore, the predicted energy level [Fig. 9] absorbed by the cab during a simulated collision with early *iterations* of the 'simple' deformable obstacle configuration, unlike the rigid wall, is close to that associated with the reference 'real' obstacle.

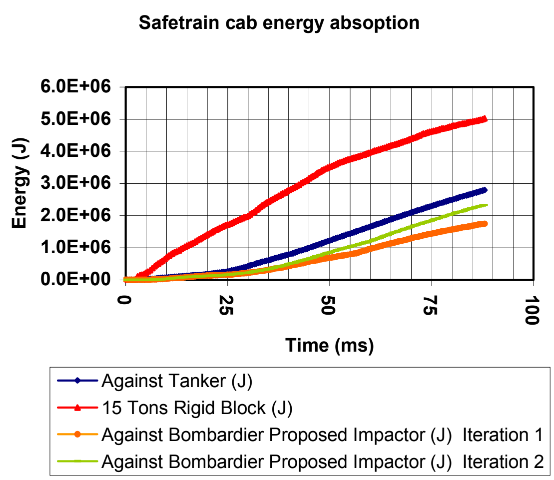

Fig. 9 Energy absorption comparison

2.3 Closure

During a collision between a train and a heavy high sided obstacle, the obstacle impacts the leading end of the underframe of the train and then tends to roll into the path of the train interacting with and 'crushing' the upper structure of the cab while being pushed. The deformable obstacle duplicates closely the mechanism observed in real level crossing collision accidents. This is not achieved with the 15T rigid wall scenario. 'Fully' deformable realistic obstacles are available enabling the calibration of simpler deformable obstacle models. Two parts 'rigid/deformable' reduced mass obstacles, similar to the two cylinders type arrangement for example, are also being investigated with promising results.
The CEN/TC 256 WG2 working group charged with drafting a crashworthiness European standard to bolster and complement the strength requirements detailed in EN 12663 [Ref. 2], is presently addressing and discussing this specific issue.

3 Train to train collision scenario: *What reference collision speed?*

3.3 Opening

The reference collision speed between two *'identical'* trains is, according to *the 1st collision scenario* of the 'High Speed TSI', 36Km/h.

3.4 Discussion:

The European Union Safetrain project has concluded that its most representative reference train to train collision scenario should be carried out at 55Km/h [Ref. 3]. This speed value was the result of a statistical analysis of the accidents having occurred in Europe between 1991 and 1995. This work sponsored by the UIC Passenger Commission was carried out by ERRI [Ref. 4]. Meanwhile, the British Group Standard GM/RT2100 specifies a collision speed of 60Km/h [Ref. 6].
The 36Km/h collision speed has now also found its way into the draft being developed by the CEN/TC 256 WG2 working group on the basis that *it is used in the TSI High Speed standard*. Yet, as mentioned above, the comprehensive work undertaken within the Safetrain project advocates a higher speed of 55Km/h.

3.5 Closure

A number of questions therefore arise:

- Is the 36Km/h reference collision speed statically supported?
- How was this speed limit substantiated?
- Were the Safetrain findings to conservative?
- Were the results of the ERRI statistical analysis misinterpreted?
- Is the 36Km/h collision scenario assumption valid?
- Is the 36Km/h collision scenario assumption sufficient for a safe design?
- Should the train to train collision speed be raised to 55Km/h?

4 Conclusion:

The heavy obstacle level crossing collision scenario and its shortfalls are being considered and debated by the CEN/TC 256 WG2. It is obvious that the original 15T rigid wall load case scenario is not representative and ought to be regarded as a preliminary sizing tool only. The cab cell is exposed to structural intrusions and therefore survival space reduction not captured by the rigid wall obstacle. An economical and representative numerical reference obstacle (or a set of) with deformable characteristics and able to duplicate the rolling-in motion can be and have been developed. Such representative obstacles are achievable as shown by Bombardier Transportation and the extensive work carried out on the subject by SNCF.

With regards, to the train to train collision scenario, the reference collision speed ought to be re-assessed taking into account the ERRI findings and the recommendations made by the Safetrain project. Beside the questions raised in the discussion here above, the database of accidents used by ERRI could be extended to cover a wider period and the statistical analysis re-assessed accordingly.

The Trainsafe project gives the railway rolling stock industry the opportunity to question, reflect on and clarify the issues herewith raised for safer trains.

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