Austroads Safety Barrier Assessment Panel – Technical Advice

Assessment of Finite Element Analysis

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Austroads

Preamble

Increasingly finite element analysis has become a popular technique for predicting the response of roadside hardware such as guardrails, bridge rails, and sign supports, in crash events. The method in which the Austroads Safety Barrier Assessment Panel (the Panel) assesses the results of finite element analysis is summarised below.

Audience

- Road Agencies
- Road safety hardware industry.

Background

AS/NZS 3845.1 Section D 4.4.2 discusses that if simulation techniques are to be used, then appropriate verification of the calibrated model needs to be undertaken with known full scale tests and other physical testing. Confidence in the results of computations depends on a careful verification and validation process. An extensive verification and validation process is provided by NCHRP Report 179, which should be followed.

Therefore, the Panel expects that in accordance with the recommendations of AS/NZS 3845, that verification and validation be undertaken in accordance with the process documented in NCHRP Report 179.

Commentary

NCHRP Report 179 sets out a process and identifies key documentation to give decision makers the information required to make informed decisions. It is not specific to NCHRP 350 and/or MASH testing protocols. EN1317 testing and validation is included in the templates in the appendices of the report.

The NCHRP Report 179 process is summarised as:

1. Identify the baseline experiment,
2. Build the computational model of the baseline experiment
3. Use the model to simulate the baseline experiment
4. Validate the model by comparing the simulation results to the physical test results
5. Modify the model to represent incremental improvements
6. Use the model to predict the performance of the incremental improvement, and
7. Evaluate the performance of the incrementally modified device

Therefore, to assure the Panel that the model accurately represents the real world physical testing, the following key documentation to allow assessment of simulated data is required:

1. A Verification & Validation report that documents the comparison between a full-scale crash test and the simulation inclusive of:
   - Phenomena Importance Ranking Table

- Analysis Solution Verification Table
- Time history evaluation table
- Side by side photographs

2. A simulation report documenting the results of the analysis of the untested design including hardware and vehicle data

Recommendations

The Panel will consider simulations as a method of engineering justification, as long as the simulation model is not being used to extrapolate significantly beyond the full-scale crash test data, and that accurate validation and verification of the model has been undertaken in accordance with NCHRP Report 179. It should be noted that where the validation report criteria is not met, the report should include commentary which would assist the Panel to undertake thorough consideration of the outcomes.

Where simulation is used to justify performance of variants or site specific situation, there will be careful consideration of the degree of prediction, which will depend on the system complexity (e.g. the number of moving components).

References

Standards

AASHTO 2016, *Manual for assessing safety hardware,* 2nd edn, American Association of State Highway andTransportation Officials, Washington, DC, USA

AS/NZS 3845.1:2015, *Road safety barrier systems and devices: part 1: road safety barrier systems.*

EN1317*, European Standard EN 1317 Road Restraint Systems*, European Committee of Standardization, CEN 1998

NCHRP Report 179, *Procedures for Verification and Validation of Computer Simulations Used for Roadside Safety Applications,* Transportation Research Board, Washington, DC, 2010

NCHRP Report 350, *Recommended Procedures for the Evaluation of Highway Features,* Transportation Research Board, Washington, DC, 1993