# CRUSHABLE FRAME SPRINGS FOR CONCEPT VEHICLE DESIGN

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## ABSTRACT

In the concept phase of an automotive development programme the use of detailed FE methods typically applied in later phases of the development programme are expensive in terms of time, resource and computational commitments. Reduced fidelity models, such as the crushable frame spring (CFS) method, decrease the demand on both these resources; thus providing information more quickly than would otherwise be possible. The concept design phase is where there is most design freedom and the highest rate of design change. In order to provide meaningful design direction, before the design has moved on, creation and analysis of models must be rapid; providing feedback in days rather than the weeks associated with traditional methods. The CFS method allows the user to map the crush response of a thin-walled cross section from a detailed shell analysis to a specially formulated spring element for later use. The CFS element, available in RADIOSS 13.0 (Altair, 2015), is a 6 degrees of freedom non-linear spring that may communicate its collapse status to neighbouring elements and has function curves for collapsed and un-collapsed crush phases allowing it to better capture crush response.

By replacing computationally expensive shell elements with spring elements, as shown in Figure 1, the CFS method will reduce the computation cost of an analysis and capture key crash characteristics such as the energy absorption of the vehicle during a crash event and section force limits. This will enable quick analysis of structural section layouts and allow for effective sizing studies to be performed to help understand the important characteristics required from each section.

A calibration method for the CFS properties has been developed. In this paper a validation study will be performed using a public domain automotive finite element model. Key crash components will be replaced with representative CFS elements and the comparative performance of the CFS elements assessed. The outcomes and experience obtained by this validation study will be used to improve the calibration method and provide notes on best practice.

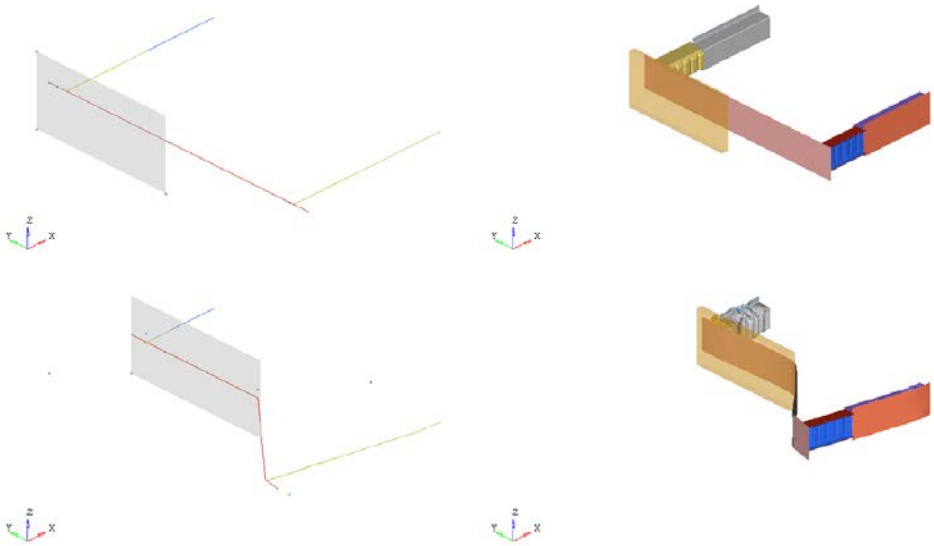

**Figure 1: Example Bumper modelled using Crushable Frame Springs and corresponding shell element model. The upper images show the bumper in its un-deformed state and the lower images show the bumper after impact by a heavy plate.**

## REFERENCES

Altair. (2015, 01 25). Retrieved from HyperWorks Online Help: http://www.altairhyperworks.com/hwhelp/Altair/hw13.0/help/hwsolvers/hwsolvers.htm?prop_type44.htm

## SUGGESTED THEMES

Finite element analysis, Automotive crash analysis, Low fidelity crash analysis, Concept development