Concept BIW development using new CAE technology

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KEYWORDS –

Concept BIW development, LS-DYNA, ANSA, mETA-Post

ABSTRACT –

By adopting the CAE-based design approach (predominantly involving 1-Dimensional FE models) proposed in this paper, enormous gains can be realized early in BIW development. Apart from crunching timelines, this approach offers much more flexibility vis-à-vis traditional FE-based design approaches, where full vehicle FE models have to be in place to carry out exhaustive studies.

This approach can help engineer light weight & high performance vehicle bodies for different car platforms. The technology presented here can help to rapidly build reduced/primitive FE models from styling data & carry-over 3-Dimensional FE models. These can be analyzed to accurately predict the required cross-sections needed to meet the desired static and dynamic characteristics. All this can be achieved independent of the availability of complete CAD data. Correlation even with these reduced models is generally good paving the way for the incorporation of subsequent design changes & narrowing down of design options.

Correlation of analysis results predicted using the FE models generated by this new technology and those predicted using the more orthodox high-accuracy large-scale models has been found to be extremely good. It is thus possible to predict performance very early in the BIW development cycle & make necessary course corrections in the initial stages of development using this new technology.

This approach also includes the creation of 3-Dimensonal models from the 1-Dimensional models for the purpose of optimization, after a good portion of the design is finalized using the 1-Dimensional models.

TECHNICAL PAPER –

Scope:

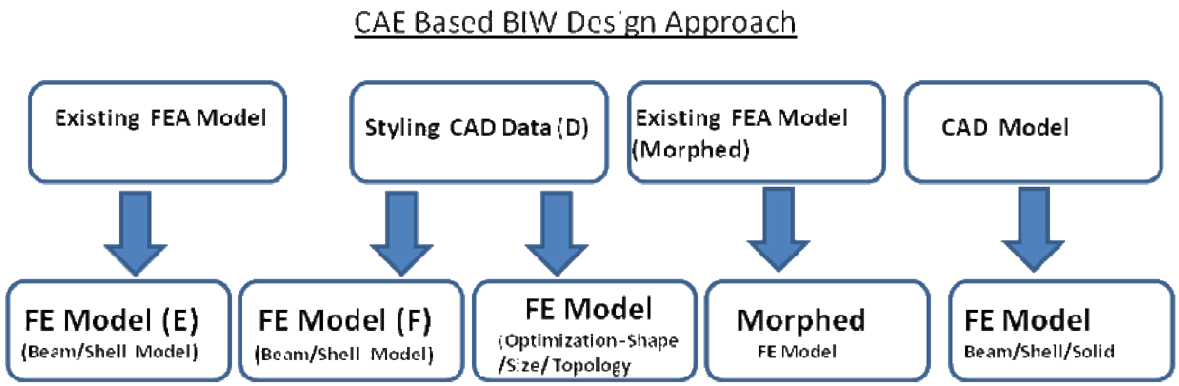

Figure-1

Process steps **C, D, E, and F** that are shown in the above flow chart (Figure-1) constitute the scope of this paper.

SIMULATION SEQUENCE

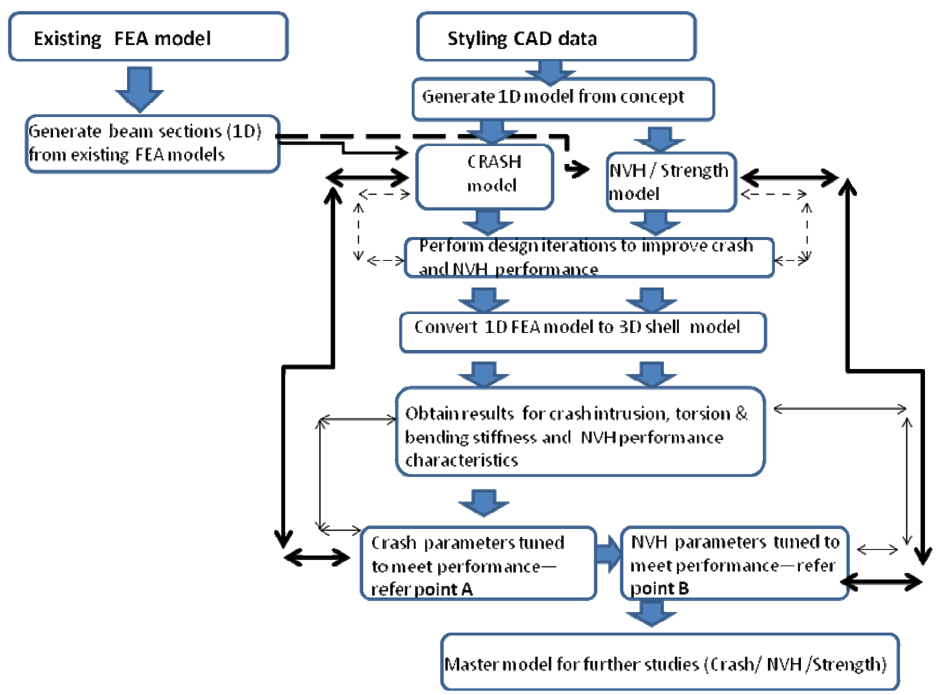

Figure-2: Process flow for the generation of BIW Crash, NVH, & strength models

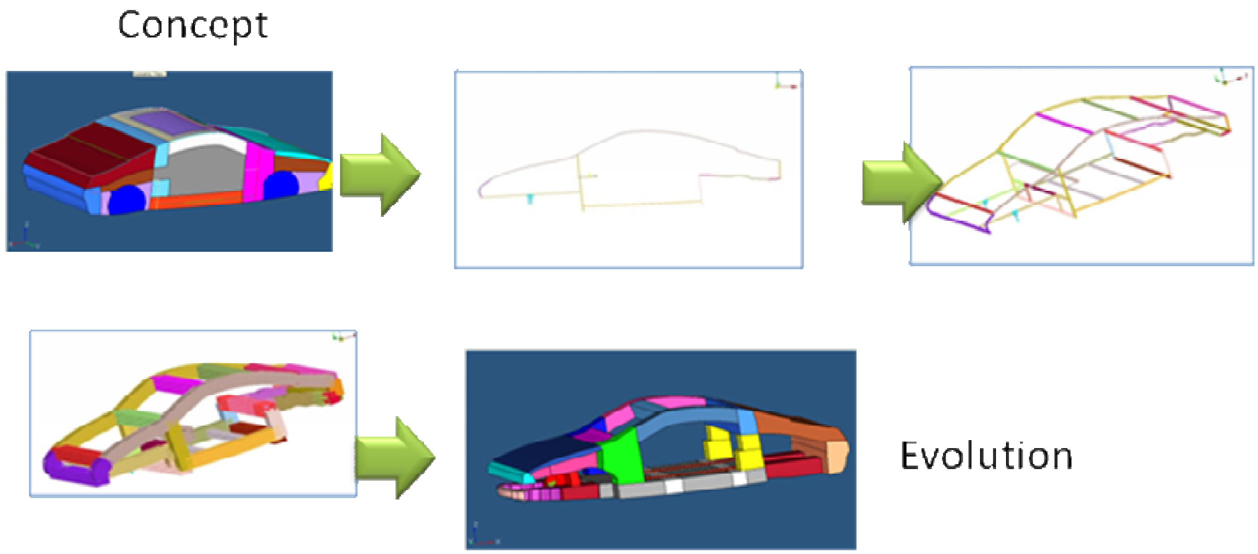

Figure-3: Process flow for the creation of FE models using the proposed technology

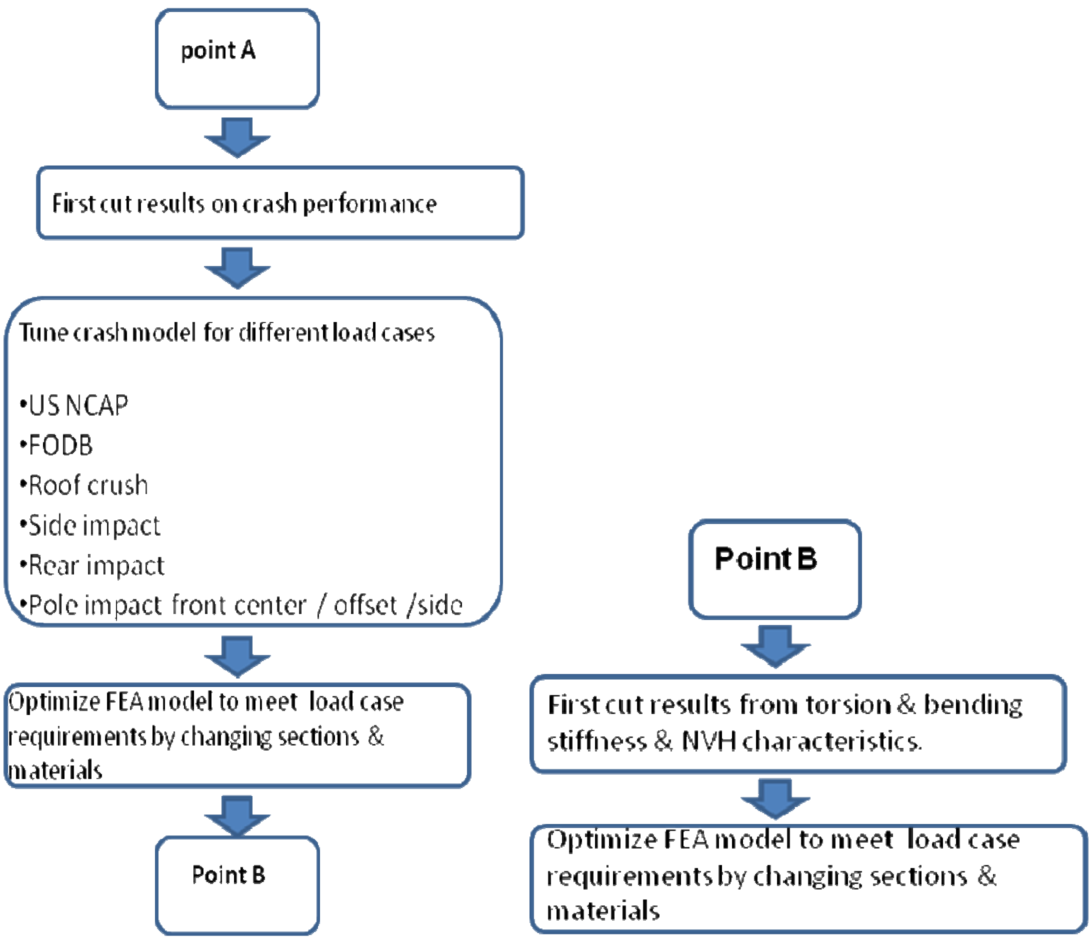

Figure-4: Process flow for various load cases considered during development

Development for crash, NVH, and strength studies

The initial set of simulations can start with 1-Dimensional models created from full FE models belonging to the closest previous program. These 1-Dimensional models would primarily consist of beam elements with sections and material properties assigned from the existing full FE models. Correlation of results between the 1-Dimensional and full models can subsequently be established for all scenarios (Crash, NVH and strength).

As is the norm, the principal crash factors and issues that can be compared/correlated are intrusion levels, crash pulses, reaction forces, vehicle cross over point (Energy). Similarly on the NVH side, global & local frequencies and mode shapes can be compared. On the strength side, torsional and bending stiffness values can be compared.

Subsequently, FE models predominantly consisting of 1-Dimensional beams can be built from the available styling data (corresponding to non-carry over parts) & integrated with the already available 1-Dimensional FE models (corresponding to carry over parts from the above step). Care should be taken at joineries while bringing sections together. All analyses can then be repeated with this new model. The incorporation of design changes & narrowing down of design options can be performed at this juncture (thus avoiding the need to carry out costly iterations with bulky 3-Dimensional FE models created from CAD data).

In the next step, optimization can be carried out using 3-Dimensional shell models generated from the available 1-Dimensional models. Here, enough caution has to be shown – each section has to be studied & carefully represented in FE using appropriate material & section properties and flanges should be added to represent welds. Bolts, spot weld, glues, mastics, seam welding, and other regular types of connections and contacts should be properly represented. Weight balancing for each assembly should be performed.

The next sets of analyses can then be performed using the newly created 3-Dimensional model using the flow shown in Figure 2 and Figure 4.

As is typically done, special emphasis can be given to center pole impact & side pole crash load cases, which normally lead to bumper sub-system design enhancements and door beam & reinforcement strengthening to absorb kinetic energies & minimize intrusions.

NVH & strength calculations can be performed using these enhanced models for gauge optimization to meet NVH & strength targets. Changes to beads, gauge increase /decrease can be incorporated during this stage. By experience, suggested design changes from optimization runs are not applied to crash parts as they are already tuned for superior performance in crash scenarios.

CHALLENGES

- Customization / standardization of sections.
- Automation of post processing/reports.

BENEFITS SUMMARY

- Reduction in development time and reduced costs
- Quick improvements in design with minimal effort.
- Quick visualization of assembly hurdles

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CONCLUSIONS

- Reduction in overall development time (concept to reality at a much faster pace than traditional methods)
- Reduction in dependency on CAD data
- Excellent correlation between test and FE results

REFERENCES

(1) ANSA version 14.0.2 User's Guide, BETA CAE Systems S.A., Feb 2013.
(2) μETA PostProcessor version14.0.2 User's Guide, BETA CAE Systems S.A., Feb 2013.;2