A STRATEGY FOR STANDARDIZATION AND AUTOMATION OF DOOR DURABILITY CAE ANALYSIS USING ANSA TASK MANAGER

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ABSTRACT – to compete in the modern automotive industry with a heavy reliance on engineering analysis through cae, the cae analysis must be completed accurately and in an in increasingly efficient manner. further, an automotive company with a broad range of products and engineers working throughout the world requires analysis to be performed using standard methods for ease and clarity in communicating results and driving product decisions quickly.

Chrysler Group LLC and Beta CAE are working together to develop a suite of templates for performing door durability analysis utilizing the Ansa Task Manager. These templates are developed to automate routine tasks, reduce duplication of effort, increase quality, and facilitate standardization of the processes. Through utilization of the templates, Chrysler Group LLC expects to be able to build better quality products while getting to market faster with lower development cost.

At the heart of these templates is a standard door durability discipline model build which can be used for any door durability load case. The model is structured in a standard way by using a template for the discipline model build itself. Load case templates are then applied to the door durability discipline model to automate and standardize the load case setup. A template for door slam analysis has been completed and is in implementation stage. Templates for the remaining door durability load cases will follow later this year.

INTRODUCTION

Chrysler Group LLC, together with Beta CAE, have developed and begun to implement a strategy to standardize and automate pre-processing for door durability analysis using Ansa's Task Manager. Using the task manager functionality, templates have been developed for the door durability model build and for door slam analysis setup. Chrysler Group LLC plans to continue developing a suite of templates for all of the door durability load cases performed at Chrysler.

PROCESS OVERVIEW

In general, pre-processing for a finite element analysis can be broken into 3 stages.

Phase I is preparing the data common for all analysis disciplines. This includes preparing the geometry for meshing, defining the properties of the subsystem, defining the part connectivity and defining the mass content of the subsystems.

Phase II is creating the finite element model as appropriate for a specific type of analysis. This is the *discipline model*. This includes creating the finite element mesh with a particular mesh density, creating the FE representation for the connections, and assigning the model properties for the specific solver(s) that are used for the analysis. In this phase, different models may be developed for different disciplines. Durability analysis generally requires a fairly refined model to obtain accurate stress results. In contrast a coarse model is sufficient for NVH analysis and may be preferred to reduce system load. For door durability one refined model is created which is common for all of the door durability load cases.

Phase III is using the discipline model to prepare an input deck for an individual load case. The tasks performed in phase III are selecting specific model content for analysis, preparing modelling items specific to that load case, creating loads and boundary conditions, and defining analysis controls and output requests.

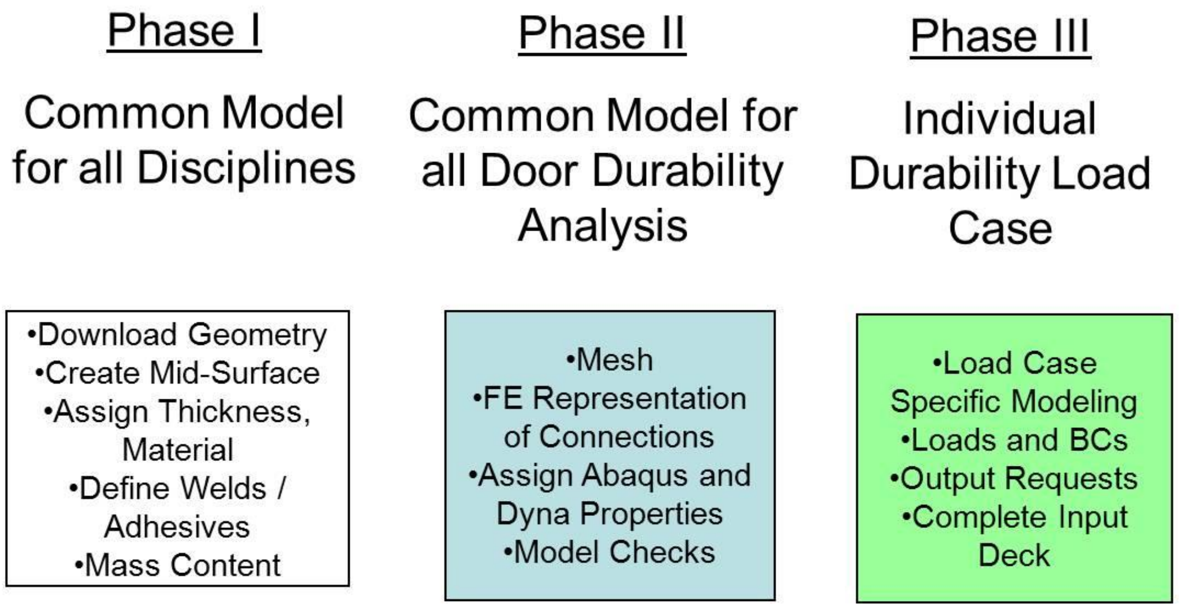


Figure 1 - Pre Processing Phases

THE ROLE OF TEMPLATES

Chrysler is developing and using Ansa Task Manager templates for Phase II and Phase III of the process for door durability analysis. The templates are a tool that assist the user while creating the discipline model and creating the input deck for an individual durability load case.

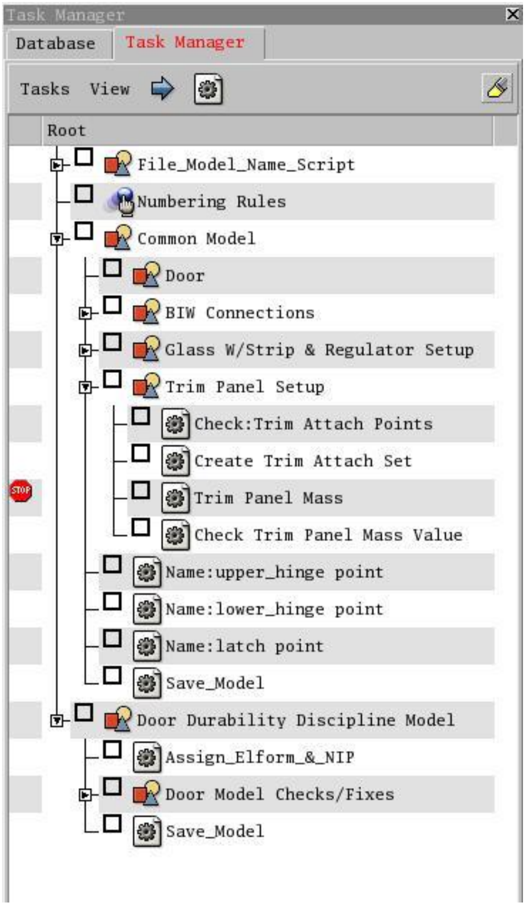
There are many advantages to using templates. For one, templates are a useful tool to bring standardization to model builds and analysis setup across many engineers and many vehicle platforms. In this way, the work is easier to share between CAE engineers and to track against the physical test performance. Templates do this by having pre-defined model properties, batch mesh parameters, analysis controls, numbering schemes, output requests and quality criteria built within the template.

Templates also help improve efficiency in several ways. Simply having the tasks laid out in sequence helps the engineer to move through complicated work in a quick and orderly fashion without missing a step or having to ponder what to do next. A well-executed strategy can also help eliminate duplication of effort among all of the different analyses that are performed for a particular design. Further, the task manager allows many of the required pre and post processing tasks to be automated when the models are prepared using a standard method.

The Task Manager templates also help to maintain the quality of the models and completeness of the input decks. Quality checks built into the task list ensure that the model is checked before the input deck is written and submitted to the solver. The Ansa Task Manger also recognizes which tasks need to be re-checked when the model is changed such that nothing is missed.

DISIPLINE MODEL TEMPLATES

Chrysler performs about ten different types of durability analysis on door systems using the same door discipline model as input. The primary role of the discipline model templates is to ensure that the model meets the compliance requirements of the analysis templates.



Some of these analyses are door component level analysis and some are system level analysis. We have chosen to maintain separate door and body models which will be used for door durability analysis. The durability model for the door is used in all door durability cases. The body model is prepared to use for any system level analysis of the doors.

One of the requirements of these models is that they are organized in a particular fashion such that operations can be performed on particular components. A pre-defined organization structure is setup within the template so the user can simply drag and drop the door subsystems into the correct part group. The process takes only a few minutes. Each group has a defined module id and name which are used to identify them for future reference. The tree is shown below.

Within the door durability template a few key coordinates are defined to assist in automating many of the analysis setup tasks. This is accomplished by creating points at the correct locations and assigning names using a task manager task. In the case of the door, the points define the hinge axis and the latch point. With just three points defined, we can automate tasks that create connections, rotate the door, create loads and boundary conditions, and identify areas around the main load paths to the door for contacts and output requests. Considering that these tasks are useful in almost every type of door durability analysis, identifying these three coordinates at the model level helps eliminate a significant amount of manual effort for the engineer. In similar fashion it is desirable to perform any tasks here that will be useful in more than one type of analysis.

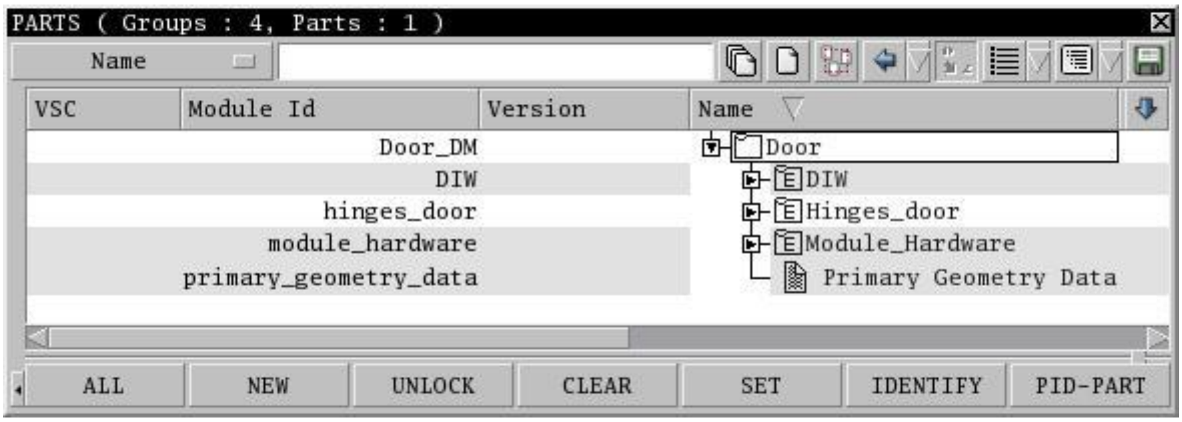


Figure 2: Door Durability Model Organization

Lastly the template contains quality checks for the discipline model. Within the common model definition, the task manager checks to make sure that the finite element model is complete. That is there are no empty parts, no unmeshed macros, and no unrealized connections. Element quality checks and model sanity checks are also performed at the end of the task list. The check tasks act as a built in check list that reviews the model for you and assists in identifying and resolving quality issues. Because these checks are defined within the task manager, they are performed every time the model is changed. By storing the 'check list' within the model itself, any engineer who uses the model can quickly identify the quality status without manually completing the check process again.

LOAD CASE TEMPLATES

The load case templates are used to prepare the input deck for analysis. A unique template will be created for each load case which can be applied to any door model created using the discipline model template. The load case templates provide the task list for completing the model assembly and selecting the model content specific to that load case. The templates also include tasks for setting up contacts, initial conditions, loads and boundary conditions, analysis controls and output requests.

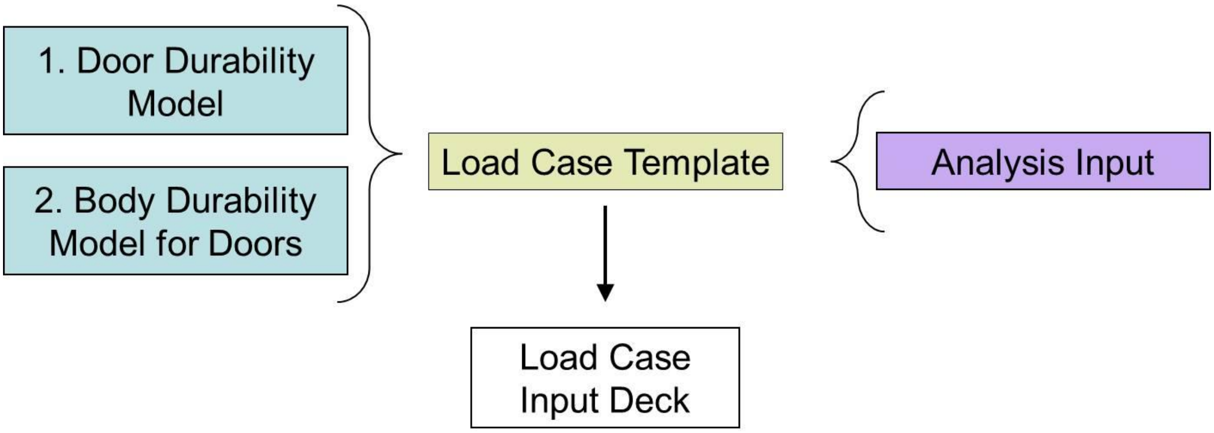
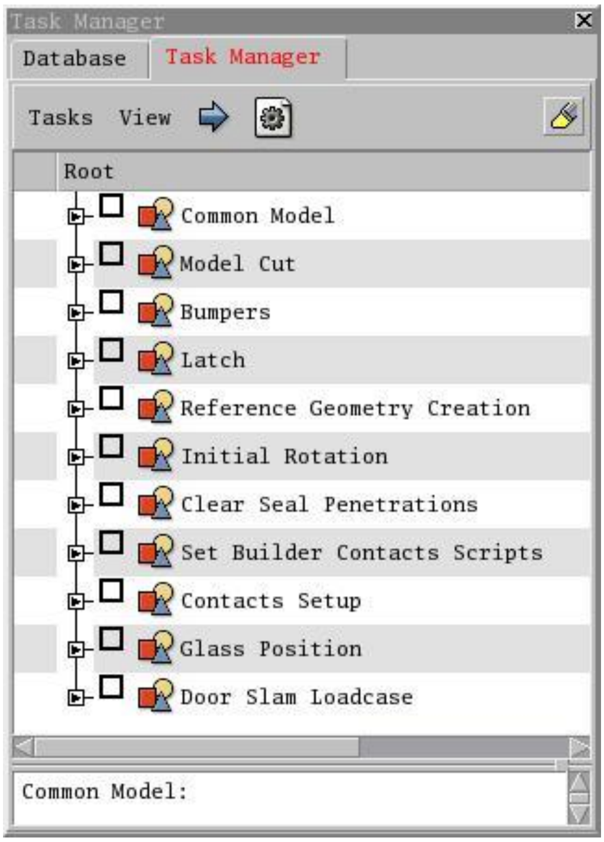


Figure 3: Load Case Template



The task list for door slam analysis setup is shown here. Each of the tasks has been automated to the extent possible by taking advantage of the standard structure of the discipline model. Many of the tasks utilize the standard functions available within the task manager. These are set builders, generic entities, contact definitions, control card definition, quality checks, and of course the deck output. These are setup to reference the module ids and point names defined in the standard discipline model.

Where standard functions are not available for a particular task, scripts have been written to carry out the operations. With the aid of engineers from Beta CAE, scripts have been written to apply standard naming conventions to the file, apply model properties, manipulate the model orientation, and perform specific checks that are unique for that load case. Some of the scripts perform operations in the background, while others bring up a gui to request user input.

The load case templates also contain pre-built modelling items used for that load case. These may be fixtures or a standard model of some hardware that is used for the load case.

When a discipline model is loaded into the load case template, there are tasks to check whether all the appropriate data has been brought in. Within the common model task group, the necessary organization is checked to make sure all of the required groups have a model assigned to them. The discipline model tasks are also loaded into the load case template and ensure that modelling requirements are satisfied if the model needs to be manipulated. Assembly of the door to the body (if required) is achieved using generic connector entities.

Certain door load cases required the door to be oriented in a position other than design position. That is, the door is rotated about the hinge axis to a specified open angle. With the door organized into its own group and the hinge axis points defined in the discipline model, the door rotation task is automated for each load case. If the rotation angle is not standard, a script can be used to ask the user the correct angle.

Contacts are widely used in door durability analysis to obtain accurate stress results. The standard contacts required for each load case are pre-defined in the load cases templates. The surfaces used in the contacts can also be filled automatically using the discipline model organization to fill Set Builders for the contacts. Time spent on pre-processing contacts is virtually eliminated in this way.

Loads and boundary conditions are also prepared from the task list. Several door load cases have loads or boundary conditions at the latch and hinges. These can be applied automatically using generic boundary conditions or scripts because the latch and hinge points are being defined in the discipline model.

Standard controls and output requests are defined in the task list. This standardization again helps achieve consistency of results and also allows automation of the post processing steps. With the same output requests specified in the same way for the same set of data, it is much easier to create post-processing templates that can be used across several vehicle platforms.

The task list also includes a complete set of pre-processing checks specific to the load case and solver used. Because the template requires these tasks to be completed before writing the deck, quality errors are significantly reduced.

CONCLUSIONS

CAE process standardization and automation allows the work to be completed faster and with better and more consistent quality. Chrysler Group LLC is achieving this using Ansa Task Manager to create a suite of templates used for door durability analysis. By coordinating the door durability model build template and the various load case templates we achieve the most efficiency gains. Almost every task in the load case preparation can be automated in this way with a very small amount of up front effort during the model build. For Chrysler Group LLC, that means getting products to market faster at lower cost.

REFERENCES

(1) ANSA version 12.1.5 User's Guide, BETA CAE Systems S.A., July 2008.