# CADfix®

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CADfix strengthens Lotus position

The increased integration of desktop modelling and analysis systems signals an acceptance among the engineering community of the need for predictive performance calculations as early as possible in the design process. It is becoming routine for engineers to run finite element analysis (FEA) on every component they create, checking for optimum performance according to packaging and function specifications. For straightforward checks such as stresses in single parts and simple assemblies this makes sense, but more complex situations require specialist analysis expertise. This is where a group like the CAE department at Lotus Engineering comes into its own.

Lotus Engineering is an engineering consultancy, which offers a complete vehicle and powertrain design and development service, including design and analysis consulting to manufacturers of automotive components in the UK and around the world. Its client list reads like a Who's Who of car and motorcycle OEMs and top tier suppliers. The Shoreham-based office concentrates on CAE analysis, and performs calculations for a wide range of OEM and supplier companies. A high percentage of the work performed by the consultancy involves advanced analysis of powertrain components.

Lotus has been using CADfix from ITI Transcendata for four years. CADfix is a suite of translation and repair tools for engineering product data that facilitates true interoperability between a comprehensive selection of CAD, CAM and CAE systems. The team at Lotus has developed ever more effective ways of using software. According to Richard Tyrrell, general manager of the Shoreham office, CADfix forms an effective central hub for all drawing model file manipulations: "Because all our clients have different CAD systems it's important to have a common hub that enables us to pool
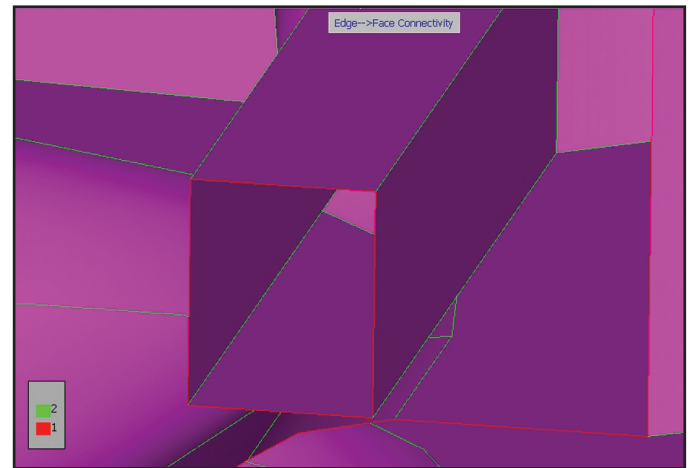
This example illustrates a typical 'impossible shape'. A hole in the casting overlaps the outside wall.

CAD data into one place, that we know how to drive well, so that we can understand what's going on. It's hard to over-emphasise the importance of this interoperability; this ability to look at data no matter who sent it to us. It used to be a real pain in terms of time and user effort to just transfer data from one system into another. Now we don't even think about it, we just load it up and look at it."

The consultancy uses CADfix as a model file translator between CAD and analysis packages; to identify and correct drafting and design errors; to prepare models for subsequent analysis and to perform design modifications. "CADfix enables us to turn projects around in significantly shorter timescales than was previously possible," explains Tyrrell. "In addition it makes some projects possible that would otherwise be impossible without further data from the client."

Data file translation

CADfix provides a comprehensive range of automatic and interactive tools for correcting errors and inconsistencies that arise when solid and surface modelling geometry is transferred from one application to another. Such problems stem from the inherent complexity of defining 3D forms: even 'neutral' file formats such as IGES can be seen as little more than a set of guidelines which different systems interpret in different ways. A slight variation in tolerance between one application and another, for example, can mean the difference between neighbouring surfaces flowing smoothly together or being separated by tiny unwanted gaps.

"What makes consultancies distinct from a lot of groups is that we have to handle data from many disparate sources," says Tyrrell. "CADfix has a variety of translators for reading data, as well as different translators for exporting the CAD data, depending on what software is going to be reading it
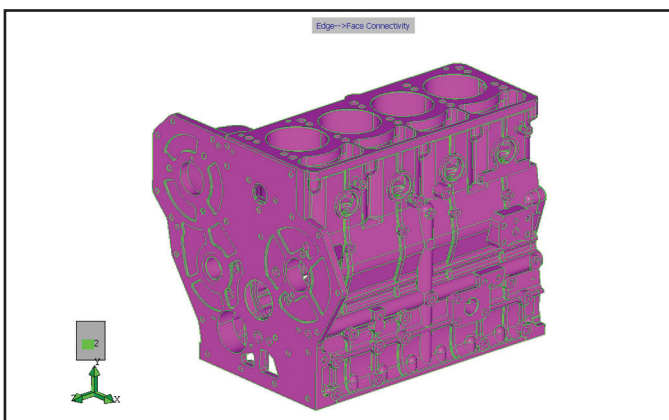
Typical CAD data

ultimately. It also has tools built in to clean things up. It cleans up CAD files so that a file generated in package A can be correctly and comprehensively understood by package B."

For data transfer the team at Lotus either uses the built-in access capabilities of CADfix to read the client's native file or data in generic file formats such as IGES or STEP. All models are checked within CADfix and then exported in a suitable format for file generation. "The direct link into the FEMSYS suite is invaluable for many applications," says Tyrrell. "The ability of CADfix to translate most regularly used geometric entities into consistent forms often aids import into the mesh generation packages for analysis applications such as ABAQUS and PATRAN."

Drafting error correction

One of the main functions of CADfix is to repair data, making it coherent and valid. "Only about one percent of CAD models received from clients is 100 percent coherent," says Tyrrell. "Error recognition tools are built into CAD packages. They're supposed to be built into the mind of the designer but in the real world we make mistakes. Not least of our functions is to perform a checking operation on drawings."

At first glance a surface on a drawing might appear good, (smooth and well connected with its neighbours), but could in fact be poorly connected even though the drawing has been read with the specified drawing tolerance. Typical causes include poorly generated geometry not identified in the CAD process, or errors caused by the use of different tolerances in the translation process. Such an example would prevent the creation of an enclosed volume or solid body.

"What CADfix does for us, either automatically or manually, is let us fix this type of problem," explains Tyrrell. "CADfix's ability to find and fix these errors is a major strength. Not only does it repair the holes, it also ensures that the resultant surfaces meet required tolerance levels for aspects such as smoothness and sloppiness."

Design errors

Lotus groups design 'errors' into two broad categories. The first is the type of drafting error described above. The second is an error in terms of an impossible shape. Lotus makes extensive use of the various data checking tools within CADfix to help identify such errors. These tools can save many hours of trying to mesh an impossible design. Other features such as the diagnostic tool, help to uncover and fix potential model problems that would otherwise prevent the CADfix exported model from being read into the destination program.

Tyrrell says: "We are firstly engineers, secondly analysts. Unfortunately, we are not all experienced in the nitty-gritty use of CAD packages. However, we do all use CADfix on an almost daily basis due to its broad applicability. It is therefore invaluable for us to be able to use CADfix to re-work local aspects of a design, or even to create new geometry, via the 'geometry builder' facilities."

Preparation for analysis

Most analysis work performed by Lotus makes use of solid models. For detailed local results, Lotus makes extensive use of 'zoom' or sub-models. It is in these cases that the geometry splitter/planar splitter tools come into its own. "These tools enable us to quickly create highly detailed sub-models from original CAD data," comments Tyrrell. "This could previously take days to complete manually on a large complex model."

Design modification

Occasionally, clients require the team at Lotus to modify an existing design. "This can occur either while we are working on the initial design, or at a later stage once an initial analysis has been completed," explains Tyrrell. "Depending on how much work has already been carried out on a model and the extent of the design changes, it is usually quicker, and therefore more time and cost effective, to modify an existing model rather than starting from scratch." With CADfix, it is possible to read in any model changes as IGES into an existing CADfix database. Using the geometry manipulation and merge tools, it is possible to delete the old unwanted features of a model and stitch-in the new design changes. This method is particularly efficient for large complex models, which only need small isolated changes. The process is even quicker and more automated if the new areas share surrounding geometry with the original model.

A recent feature of CADfix that has proven to be very useful to Lotus is the ability to duplicate a set or groups of geometry and move or rotate the copy to anywhere else in the model. "This feature is useful if one design change is duplicated many times throughout a model, or if a component in one model is in a different orientation or location to its neighbouring component in an other model."

Power of visualisation

A huge amount of the work done at Lotus Engineering involves trying to understand the CAD operator's design and this involves a lot of visualisation. "We need to be able to see a 3D model and rotate it and shade it. We also have to be able to graphically represent our results," says Tyrrell. "A typical calculation produces bucketfuls of numbers. The only way to interpret that volume of data is graphically. CADfix is very good for visualising designs. It used to take us a couple of days to fiddle around getting a mechanism to even see the data. So graphical representation within CADfix alone is actually quite important."

Tyrrell sums up the importance of CADfix for Lotus Engineering. "People come to us because they want to know whether their designs will work – and if not why not," he says. "For us to give meaningful answers to such questions and to suggest improvements and adjustments that are going to help in design optimisation we need to dedicate all of our time to complex engineering calculations. Without CADfix this would be impossible – we'd spend far too much time either editing messy CAD files or remodelling from scratch. "Put simply," he concludes, "CADfix allows us to do the job that we're paid for."

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