

NX

Composites Innovation Centre

Integrated design and analysis paves way for smart design of advanced composites-based vehicle

Industry

Automotive

Business challenges

Reduce/eliminate manual rework of analysis models

Evaluate a large number of parameter combinations

Reduce product development cycle time

Increase personnel productivity

Analyze products made of complex composite materials

Keys to success

Integrated NX design and analysis environment

Powerful geometry editing and clean up capabilities

Rapid and automatic updating of analysis models

Robust laminate composite modeling capabilities

Results

Component weight reduction exceeding 40 percent

Faster creation of analysis models

Composites Innovation Centre uses NX CAD and NX CAE to rapidly evaluate design alternatives in half the time

Taking advanced composite technologies to the real-world

The Composites Innovation Centre Manitoba Inc. (CIC) is a leading not-for-profit organization, focused on the development and commercialization of composite materials and technologies. Based in Winnipeg, Manitoba, CIC employs a staff of 26 at its 21,000 square-foot facility. The facility includes laboratory space for composite material characterization and a prototype assembly area, in addition to office locations for digital design and analysis activities.

Founded in 2003 as a consortium of industry partners, CIC is currently funded in part by the governments of Manitoba and Canada in addition to members of its industrial alliance. CIC offers a combination of technical advisory, design, analysis, prototyping and fabrication services for major clients, including Boeing, Magellan Aerospace, Cormer Aerospace, Emteq Canada, Motor Coach Industries, and New Flyer Industries.

Beating greenhouse gases through weight reduction

In the face of skyrocketing energy costs and increasingly stringent legislation mandating the reduction of harmful emissions



Kestrel lightweight concept vehicle.

from automobiles, automakers are expanding their range of options to fulfill these new market requirements. Vehicle weight reduction represents a major prong in the solution mix for automakers contending with this challenge. Lighter vehicles simply require less energy to move, directly impacting the amount of fuel consumed and carbon dioxide (chemical formula CO₂) released into the atmosphere. "The challenge with taking the weight out is ensuring that you don't take the strength, stiffness and rigidity out with that weight," says Alastair Komus, principal engineer responsible for the ground transportation sector at CIC. "That's where high strength-to-weight ratio materials like composites come in."

Komus' team was approached by Motive Industries, a respected design outfit, for assistance in developing a fiber-reinforced plastic passenger car. Dubbed Kestrel, the

Results (continued)

Faster design-analysis iterations

Evaluation of more design alternatives

Almost complete elimination of manual rework

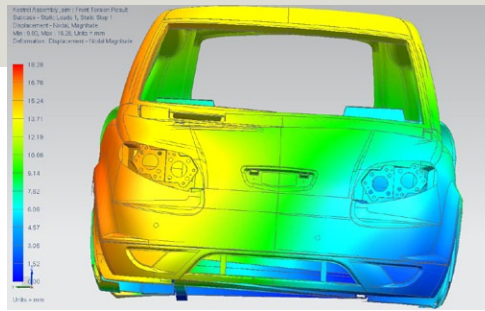
Accurate representation and analysis of laminate composite structures

Compliance with federal safety standards

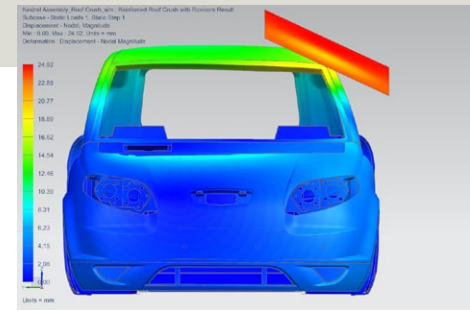
“Previously, we used standalone CAD and FEA software packages. Whenever we wanted to make changes to the geometry we would have to make them in the CAD software, reimport the model into the FEA software, and then start the analysis from scratch. This was extremely time-consuming.”

“With composites there are so many options, and so a flexible interface that allows you to quickly specify and experiment with a variety of parameters is essential. Use of NX Laminate Composites enables precisely that. The tool allows us to really understand the stress in each ply and then change material orientation angles, ply location, or choice of material to optimize the weight and performance of the design.”

Alastair Komus
Principal Engineer
Ground Transportation Sector
Composites Innovation
Centre



Example results from front torsion evaluation.



Example results from roof crush evaluation.

vehicle is underpinned by an aluminum frame, and powered by a hybrid drivetrain. CIC was called in to incorporate exotic bio-fibers, including flax and hemp, into the body of the vehicle.

CAD/CAE integration delivered

Prior to investing in Siemens PLM Software’s NX™ software, engineers at CIC used multiple tools for geometry preparation and analysis of composite structures. Despite being functional, this computer-aided design (CAD)/computer-aided engineering (CAE) approach was time-consuming and repetitive due to the disconnected nature of the tools themselves. Engineers at CIC wanted a more cohesive workflow and the productivity benefits it would bring. After evaluating numerous systems, they decided on NX for its tightly integrated design and simulation environment. Komus explains, “Previously, we used standalone CAD and FEA (finite element analysis) software packages. Whenever we wanted to make changes to the geometry we would have to make them in the CAD software, reimport the model into the FEA software, and then start the analysis from scratch. This was extremely time-consuming.”

The goal with Kestrel was to create parts that were as light as possible, without compromising structural integrity. This meant frequent design-analysis iterations to be certain this delicate balance was being met across the entire vehicle assembly. The seamless associativity between design geometry and analysis models using NX allowed design changes to be quickly pushed to analysis models, with no need for manual updating.

More variants, and faster

NX Laminate Composites was deployed in defining and optimizing the ply layout. “With composites there are so many options, and so a flexible interface that allows you to quickly specify and experiment with a variety of parameters is essential,” says Komus. “Use of NX Laminate Composites enables precisely that. The tool allows us to really understand the stress in each ply and then change material orientation angles, ply location, or choice of material to optimize the weight and performance of the design.”

CIC engineers appreciated the software’s intuitive, menu-driven workflows for specifying key layout attributes, such as stacking recipe, reference temperature and failure theory. This functionality, coupled with the consistent user interface extending across the design and analysis domains, reshaped the way they go about their everyday task of designing composite structures. “For the Kestrel, we examined over 50 ply designs in the context of 4 load cases,” says Komus. “This would have been out of scope with our former toolset.”

Advancing compliance with federal safety standards virtually

CIC engineers simulated federal motor vehicle safety compliance tests within NX. This included roof crush-resistance, which requires the roof to sustain a static load equivalent to 1.5 times vehicle weight. Also evaluated was seat belt assembly anchorage to determine the proper location of the assembly for effective occupant restraint and reduced likelihood of failure.

Solutions/Services

NX
NX CAE
NX Laminate Composites
www.siemens.com/nx

Client's primary business

The Composites Innovation Centre Manitoba Inc. (CIC) is a leading not-for-profit organization, focused on the development and commercialization of composite materials and technologies.
www.compositesinnovation.ca

Client location

Manitoba
Canada

"The switch to NX software allowed us to perform design and analysis projects that would have previously been impossible. The efficiency with which we can make design changes and verify their performance has dramatically increased."

"By analyzing 50 different ply configurations, we were able to reduce the weight of the front tub component from 242 pounds (109 kilograms) to 142 pounds (64 kilograms), a weight saving of 41 percent."

Alastair Komus
Principal Engineer
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Fabricated prototype of a vehicle hood.

"Being able to conduct these tests within the integrated environment of NX and not have to export the data to another tool is a huge time saver," notes Komus.

Increased productivity and results that speak for themselves

With NX in place, engineers at CIC are taking on increasingly complex projects and exploring a greater number of design variants, while delivering results to their clients in record time. Whether it's down-selecting from a wide range of initial options or verifying and optimizing the performance of a more mature concept, NX represents a single, integrated digital solution for accomplishing this swiftly and intuitively. Komus notes, "The switch to NX software allowed us to perform design and analysis projects that would have previously been impossible. The efficiency with which we can make design changes and verify their performance has dramatically increased."

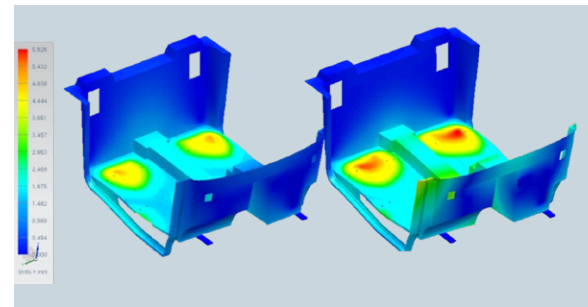
Use of NX helped the CIC team secure dramatic weight reductions on the Kestrel project, without compromising safety or durability of the vehicle. The ability to evaluate such a wide range of design variables in a very competitive timeframe allowed them to maximize the use of light-weight biofiber composite materials in the design. "By analyzing 50 different ply



Biofibers used to reinforce composite structure.

configurations, we were able to reduce the weight of the front tub component from 242 pounds (109 kilograms) to 142 pounds (64 kilograms), a weight saving of 41 percent," says Komus.

In addition to the productivity-based benefits resulting from the use of NX, CIC received prompt and capable technical support from Maya, their local Siemens PLM Software solution partner. Komus says that collaboration with MAYA enabled CIC to hit the ground running. "MAYA is a great company to work with," he says. "They've helped us fill a critical gap in the value chain."



The effect of different ply layups on component displacement.