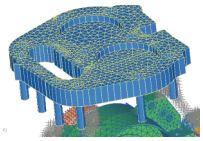
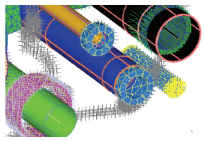
Automotive OEM

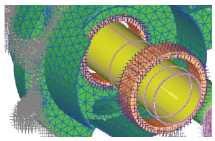
Next-generation Norton motorcycle gets a boost from FEA

Analysis of new aluminum engine helps manufacturer combine classic Norton look with modern weight and performance characteristics

PREDICTIVE ENGINEERING







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Business challenges

Support Norton in combining its classic engine look with modern weight and performance characteristics

Validate structural behavior of new aluminum engine block

Keys to success

Using Femap® software to model the engine block; combining element types to simulate real-world conditions

Solving the analysis with "real Nastran" – NX™ Nastran software

Results

Finite element model with 270,000 nodes and 144,000 elements

Fast solution time allowed for twenty analysis iterations

New Norton platform is a success; first models completely sold out

The first new Commando in almost 30 years

Norton Motorcycles, a manufacturer with more than 100 years of motorcycle tradition, recently began a new chapter of its history with the introduction of an all new platform. This platform forms the basis for multiple new models including the Commando, Commando S, Dominator and Atlas. Each new model draws inspiration from the past and builds on the Norton legacy for the future. For example, the 961/SS Commando, the first model launched from the new platform, combines classic sculptural forms with raw functionalism, laying beautiful shapes over a structural frame and new, muscular motor.

During the development of the new motor, Norton Motorcycles was faced with the challenge of remaining true to the classic look of its earlier engines while giving the new motor modern weight and performance characteristics. For help, the company turned to Predictive Engineering, an engineering service provider specializing in finite element analysis. "Being a long time enthusiast for all things with two wheels, it was a blast to have an opportunity to work with Norton Motorcycles on the development of their next-generation bike," says George Laird, founder and president of Predictive Engineering. "Our task was to support engine development by validating the structural behavior of the new aluminum engine block."

Complex model tackled with Femap

Predictive Engineering used Femap as its pre and post-processor and NX Nastran as its solver (solutions from UGS' NX digital product development software portfolio) for this work. Femap is his company's preferred preprocessor, according to Laird, for a number of reasons, such as the fact that it can work with any CAD data and that it has its own extensive geometry creation capabilities. With the Norton engine, it was Femap's meshing capabilities that stood out. "Because

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Solutions/Services

Femap with NX Nastran

Client's primary business

Predictive Engineering provides finite element analysis support, training and consulting.
www.predictiveengineering.com

Client location

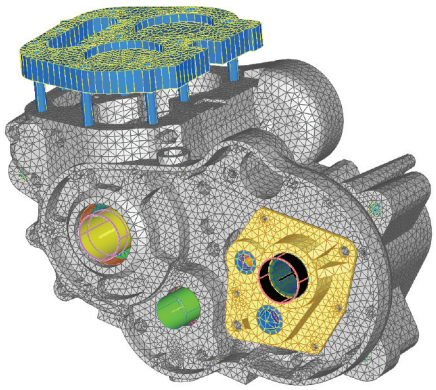
Seattle, Washington
United States

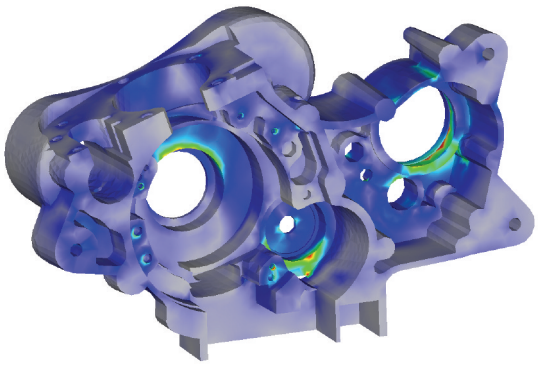
"Because the analysis model was fairly complex, I needed my full grab bag of modeling tricks and tweaks. These were completely supported by Femap."

George Laird
President
Predictive Engineering

the analysis model was fairly complex, I needed my full grab bag of modeling tricks and tweaks. These were completely supported by Femap," Laird says.

For example, it was possible to create a finite element model of the engine using a variety of element types, for a more accurate simulation of real-world performance conditions. Norton Motorcycles provided SolidWorks geometry (in Parasolid format), which Laird imported into Femap and used to create solid elements representing the geometry of the prototype crankcase. The crankcase shaft, balance shaft and transmission shafts were modeled using beam elements. The bearings of these shafts were modeled using plate elements that were connected via gap elements (nonlinear elements that can bear compressive loads but not tensile loads) to the solid FEA model. "This arrangement of element types had the advantage of letting us distribute the shaft loads onto the crankcase bearing seats in a uniform 'bearing-like' manner," Laird explains. "That is, only compressive forces normal to the crankcase bearing seat were applied."





A "real Nastran" solution

The analysis model had 270,000 nodes and 144,000 elements. "Knowing it was a nonlinear analysis (because of the gap elements), we purposely kept the model as small as possible so it would run quickly," Laird says. Determining the various load sets required some "back and forth" with Norton Motorcycles, as Laird explains. "Along with the main crankshaft power stroke, inertia forces from the main crankshaft and balance-shaft had to be considered, and of course, the traction torque of the chain," he says. "As the engine is cycled from full power to full RPM, various peak forces are encountered in different regions of the motor drive train. Norton Motorcycles supplied us with detailed calculations for all major load cases."

Using NX Nastran, complete contact behavior was simulated between all bearing surfaces and all corresponding crankcase surfaces. "We used NX Nastran because it is a true Nastran solution with a pedigree going back 30 years," Laird says. "It is the solver I trust for accuracy." In all, Predictive Engineering ran about 20 different analyses (multiple analyses were necessary to refine the load cases). The result for the client was a good prediction of an aluminum engine's performance in next-generation Norton Motorcycles.

It appears that Predictive Engineering played a role in a commercial success. The new Norton machines were a hit with motorcyclists as soon as they were released and the first new models are already sold out. The company is now taking orders for 2007 deliveries.

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Americas 800 498 5351
Europe 44 1276 702000
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