Case Study: **Kiekert**

Adams Dramatically Reduces Time to Design Child Safety Latch

Based on an interview with: Stelian Borlodan - Project Engineer Simulation and FEA, Kiekert
Dirk Eichel - Mechanical Engineer FEA and Simulation, Kiekert
Darius Schendzielorz - Mechanical Engineer Simulation, Kiekert

Overview

Latches with child safety locks are built into the rear doors of most automobiles to prevent the passengers in the rear seats from opening the doors of the vehicle while the vehicle is moving or at rest. The child safety lock is a mechanism that temporarily disables the operation of the inside door handle. When the child safety lock is engaged, the rear doors can only be opened from the outside. On newer models, this safety lock is activated or deactivated electronically utilizing a small motor within the side door latch by a switch, typically located near the driver's side door lock switch.

The side door latch is a complex system consisting of cables, cams, leverages, couplings, actuators, gears, pawls and catches. The side door latch secures the door by activating the catch and pawl so that they clamp around the striker, which is a u-shaped part that is secured to the C-pillar. The child safety lock is just one of multiple functions that must be performed by a side door latch including; lasting the life of the vehicle, operating at a wide range of temperatures, meeting noise and vibration requirements and maintaining the integrity of the lock in the event of a crash.

Typical side door latch mechanism with child safety lock

“Kiekert selected Adams multibody simulation software because of its ability to simplify the process of building functional virtual prototypes of complex mechanisms early in the design cycle.”

Stelian Borlodan, Project Engineer Simulation and FEA for Kiekert

Challenge

In the past, Kiekert engineers used manual methods including kinematics analysis and engineering handbook formulas to produce the initial design for side door latch mechanisms. Kinematics analysis is limited by the fact that it does not take the dynamic characteristics of the mechanism into account while handbook formulas are not capable of addressing the specific geometry of the mechanism. For these reasons, the initial mechanism design iteration usually did not meet the design requirements.

Engineers built and tested the initial design. Based on the test results, they iterated the design and built a new prototype. This build and test process continued through as many design iterations as were needed to meet the design specifications. The considerable expense and lead time involved in each prototyping iteration drove up the time and cost involved in designing a new latch. It took from six to eighteen months to design a latch mechanism using the build and test method.

Kiekert management committed to implementing a virtual prototyping capability that would enable the company to accurately characterize the performance of proposed design iterations using engineering simulation prior to the prototyping phase. A key aspect of the virtual validation process involves the ability to accurately simulate the performance of a mechanism including both its kinematic and dynamic characteristics while taking the full geometry of the mechanism into account.

Solution

Kiekert selected Adams multibody simulation software because of its ability to simplify the process of building functional virtual prototypes of complex mechanisms early in the design cycle. Kiekert has been using Adams simulations for 15 years. For this particular project, they used the Adams flex body capability to simulate the child safety lock mechanism within a side car door latch. The objective of this new design was to replace the springs. The springs had been used exclusively up to that point to return the actuator to the unlocked position, with plastic levers that provide just the right amount of elasticity to unlock the mechanism. This reduces raw material and manufacturing costs by reducing the number of components in the mechanism.

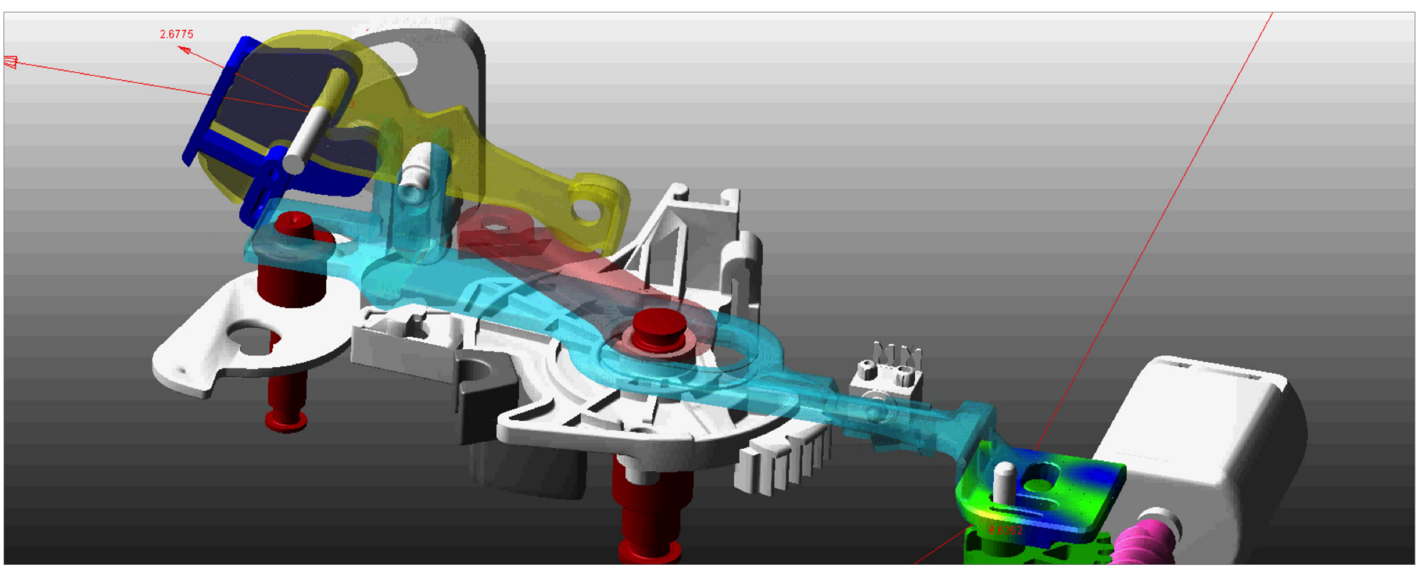
Key Highlights:

Product: Adams

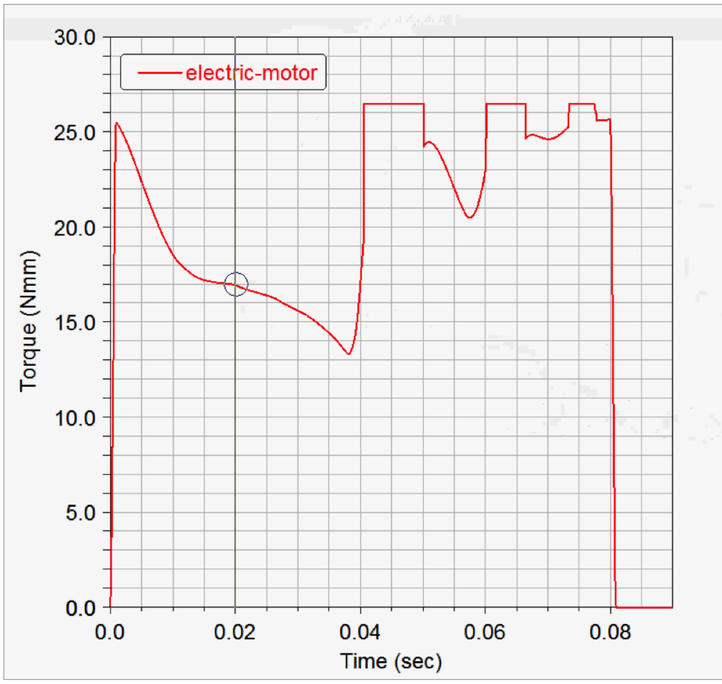
Industry: Automotive

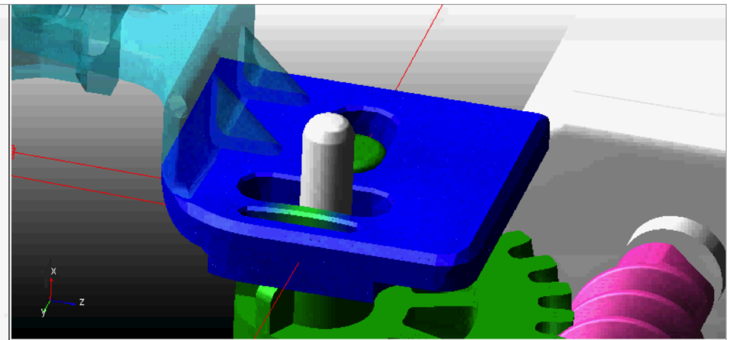
Benefits:

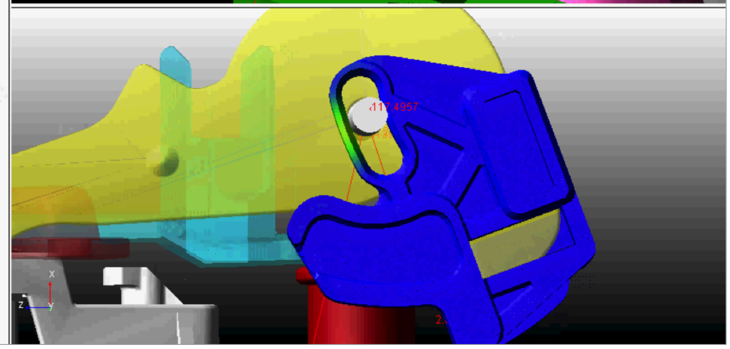
- The Adams simulation dramatically reduced the time required to design the child safety lock mechanism to only about three weeks
- Kiekert accurately characterized the performance of proposed design iterations using engineering simulation prior to the prototyping phase
- Using Adams flexible body, they precisely captured the deformation of the plastic levers and how that affects the system performance



Adams simulation of child safety lock







Adams plot helped determine torque requirement for electric motor

Darius Schendzielorz, Mechanical Engineer Simulation for Kiekert, started by importing the CATIA V5 geometrical definition of the initial design concept into Adams. He defined the gears, bearings and electrical motor in the child lock simply by entering parameters that define their characteristics. For example, he defined the gears in the mechanism by selecting the gear type, location, gear ratio, materials, connections, and other parameters. It was critical to accurately model the behavior of the plastic levers. With the new Adams option to create flexible bodies from solids within Adams View, Darius Schendzielorz created modal neutral files (MNF) for the aforementioned levers. The modal neutral files contain information such as the inertia matrix, the mode shapes and modal frequencies.

To make sure the now flexible levers are sufficiently accurate, their behavior was validated by an FEA performed by Dirk Eichel.

Stelian Borlodan, Project Engineer Simulation and FEA, then simulated the performance of the child safety lock mechanism under the complete range of design conditions. For example, he evaluated its performance at different temperatures, exposed it to loading that would be seen in a hypothetical crash, and evaluated the impact of manufacturing variation on mechanism performance. The simulation was used to size the electric motor used to drive the child safety lock mechanism. Darius Schendzielorz then generated an animation which helped diagnose issues with the mechanism and helped engineers iterate to a design that met all requirements. Only at this point did the company build a prototype whose performance correlated well with the simulation results.

Results/Benefits

Using multibody dynamics simulation, Kiekert engineers dramatically reduced the time required to design the child safety lock mechanism to only about three weeks. The child safety lock is part of a side door latch that is still in the development process but previous projects have demonstrated that the use of simulation – including finite element analysis and tolerance analysis in addition to multibody dynamics – can substantially reduce the time required to bring a new latch to market to less than 18 months.

About Kiekert

Kiekert develops, produces and sells tailor-made custom automotive locking systems, such as side-door latches, latch modules, rear compartment and hood latches and a broad range of actuators for side doors, sliding doors, decklids and various interiors solutions. In its more than 150-year history, the company has produced well over 1.5 billion latches for the international automotive industry. Kiekert has a market share of around 20 percent and is the world market leader in the field of automotive side-door latches. The company has 5,100 employees in six development, six production and two sales centers in nine countries.

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