



Počítačové simulácie v procese vývoja brzdového strmeňa

www.continental-corporation.com

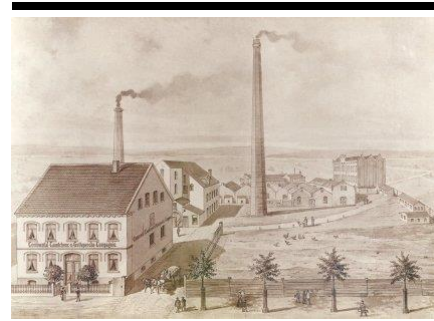
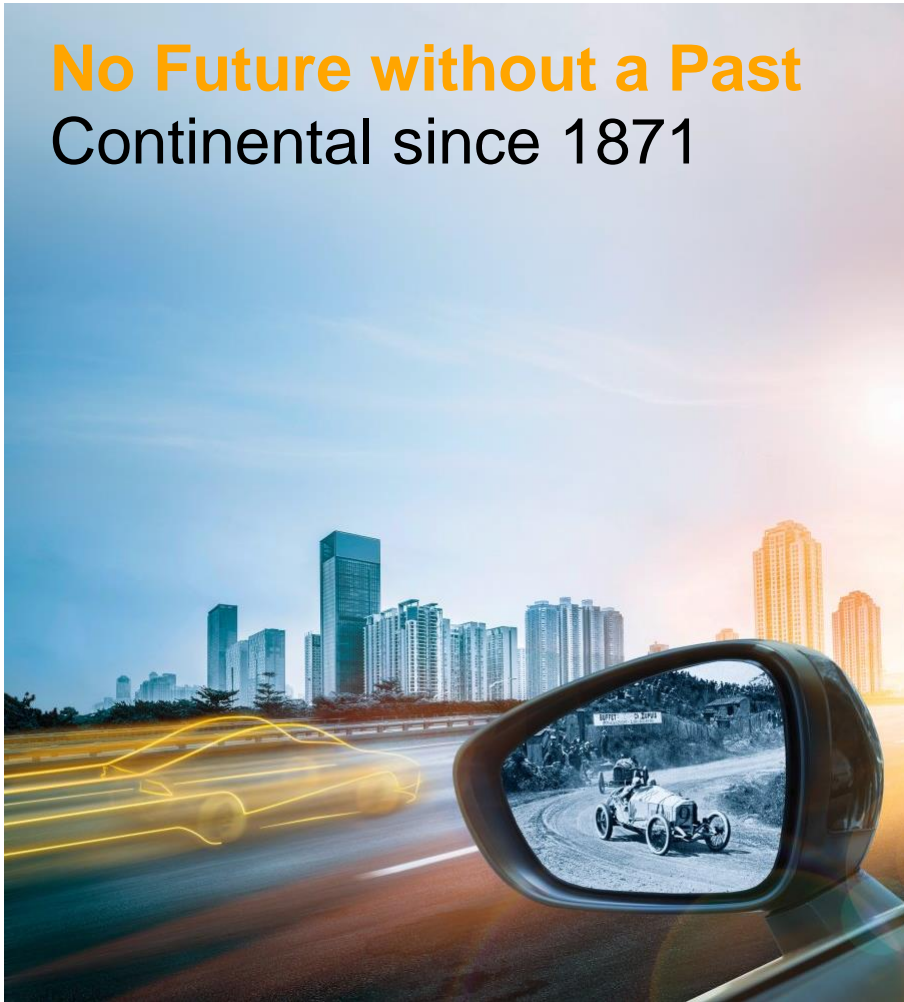
Maroš Bohunčák, Chassis nad Safety Division

Obsah

- Úvod
- Predstavenie Continental + Continental Zvolen
- Brzdový strmeň – popis, funkcia
- Vývoj brzdového strmeňa v Continental Zvolen
- Funkčné simulácie
- Hluky a NVH simulácie
 - Computational Matrix Test
- Ukážka výpočtových softvérov

No Future without a Past

Continental since 1871



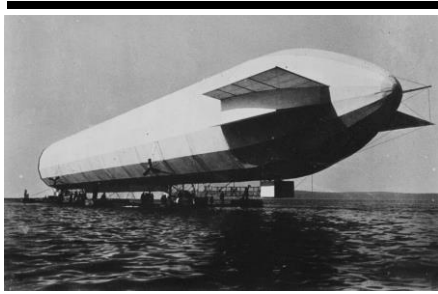
Continental-Caoutchouc- und Gutta-Percha Compagnie is founded in Hanover on October 8 as a joint stock company. Soft rubber goods such as hoof buffers for horses, rubberized fabrics, as well as pneumatic tires for bicycles and cars are manufactured.



The rampant horse is adopted as the trademark.

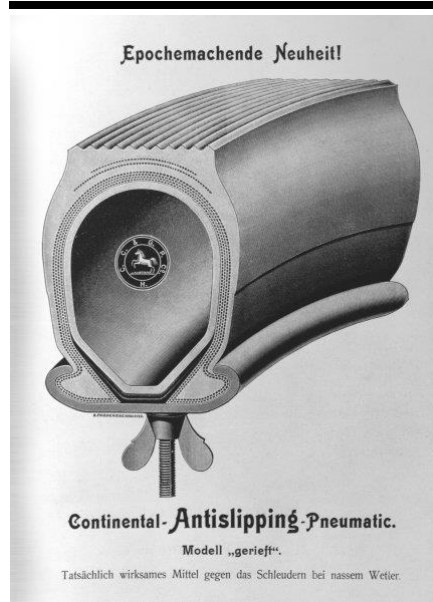
1871

1882



The first German airship LZ 1 rises above Lake Constance for its inaugural flight. The gas cells are sealed with Continental balloon material.

1900



Continental is the first company in the world to develop automobile tires with a patterned tread.

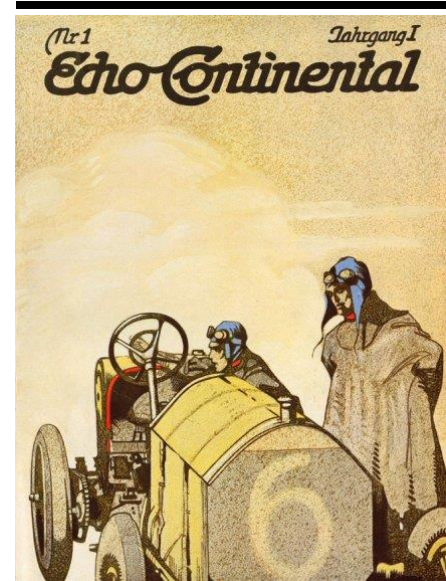
1904



Louis Blériot, the pioneer aviator, writes history with the first flight across the English Channel. Continental Aeroplan material covers the fuselage and wings of his plane.

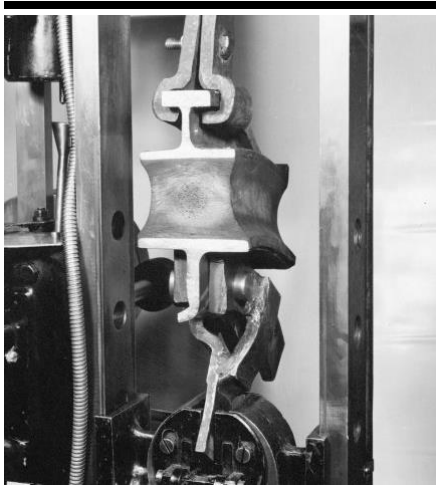
The same year, specimens of synthetic rubber developed at the Bayer laboratories are successfully vulcanized at Continental and processed to make the first test tires.

1909



The first edition of the customer magazine "Echo Continental" is published featuring contributions from young authors such as Erich Maria Remarque and drawings by well-known commercial artists.

1913



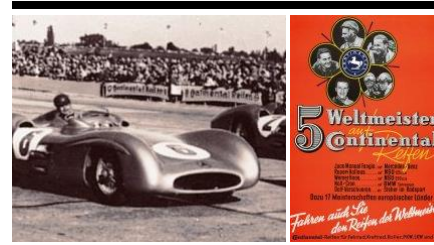
Continental markets a rubber-metal bonding under the registered trade name of Continental Schwingmetall. It is used to isolate vibrations and noise when supporting motors.

1932



Continental adds M+S tires for winter driving to its range of conventional tires.

1952



In close collaboration with Daimler-Benz and Porsche, Continental repeats its pre-war successes on the track.

Racing in cars fitted with Continental tires, drivers like Karl Kling, Stirling Moss and Juan Manuel Fangio win the 1952 Carrera Panamericana and the French, British, Dutch and Italian Grand Prix.

1951–55



Opening of the Contidrom tire testing facility on the edge of the Lüneburg Heath.

1967



The Automotive Systems division is established to intensify the systems business with the automotive industry.

1995



Continental acquires Siemens VDO Automotive AG and advances to among the top five suppliers in the automotive industry worldwide, at the same time boosting its market position in Europe, North America and Asia.

2007



Start of extensive automated-driving tests in the U.S. state of Nevada.

A highly automated Continental test vehicle has covered 15,000 miles on public roads without any accidents.

2012

For the first time, the company employs more than

235,000

employees all over the world.
Annual sales amount to €44 billion.

2017



Continental has built a test vehicle to enable driverless mobility, especially in cities. Called a **CUbE (Continental Urban Mobility Experience)**, this vehicle is being trialed at the Frankfurt site.



Through its architecture, the new Continental headquarters – which are to be inaugurated to mark the company's 150-year anniversary – symbolize and promote the culture of innovation and interconnectivity at Continental. The new campus meets the demand for agile, flexible and interconnected collaboration throughout the entire organization, as is already common practice at Continental worldwide.

Continental Corporation

Divízie

Chassis & Safety

Vehicle Dynamics

Hydraulic Brake Systems

Passive Safety & Sensorics

Advanced Driver Assistance Systems (ADAS)

Powertrain

Engine Systems

Fuel & Exhaust Management

Hybrid Electric Vehicle

Sensors & Actuators

Transmission

Interior

Instrumentation & Driver HMI

Infotainment & Connectivity

Intelligent Transportation Systems

Body & Security

Commercial Vehicles & Aftermarket

Tires

PLT
Original equipment

PLT, Repl. Business, EMEA

PLT, Repl. Business, The Americas

PLT, Repl. Business, APAC

Commercial Vehicle Tires

Two Wheel Tires

ContiTech

Air Spring Systems

Benecke-Hornschuch Surface Group

Conveyor Belt Group

Industrial Fluid Solutions

Mobile Fluid Systems

Power Transmission Group

Vibration Control

Chassis & Safety Division



- › The Chassis & Safety Division offers active and passive safety technologies which save lives as well as products that support driving dynamics
- › SensePlanAct as a core competency: vehicle state and surroundings monitoring (Sense), opportunities to act and plans to act (Plan), carrying out concrete actions (Act).
- › With our networking competence we are paving the way towards automated driving.



€9.8 billion
Sales



47,788
Employees

Závod Continental Zvolen

O nás



Division: Chassis & Safety
Business Unit: Hydraulic Brake Systems
Legal entity: Limited (Ltd.)
Products: Calipers (FA, FAc, FN, FNc)

Plant Area: 118.000 m²
Roofed Area: 34.000 m²
Start of production: February 2006
Employees: 1072



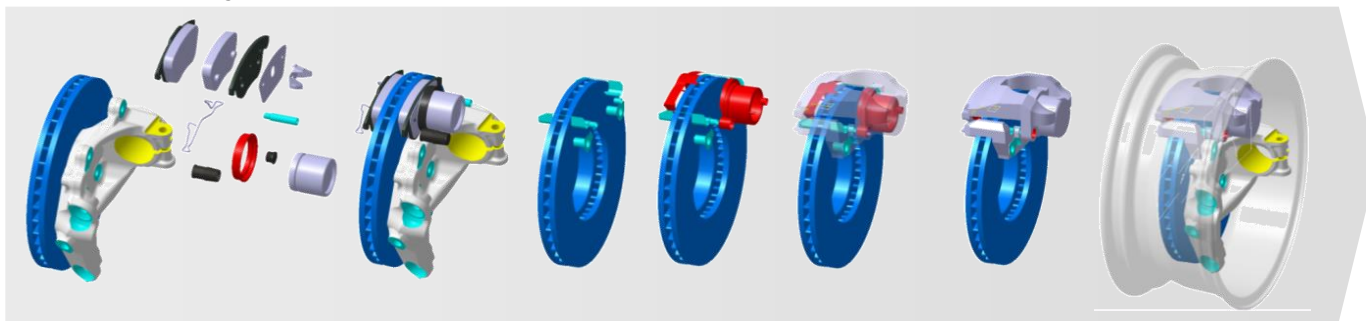
Continental Corporate Presentation
Public

Product Development HBS @ Continental AG

Vývoj a výskum v Continental Zvolen

O nás

- Konštrukcia strmeňa od fázy ponuky do začiatku sériovej výroby
- Základné a pokročilé FE a NVH výpočty (pevnosť, vlastné frekvencie...)
- Príprava dokumentácie pre technické uvoľnenie produktu
- Prototypovanie, Benchmark, podpora štandardizácie, postupov konštruovania a aplikačnej konštrukcie



Vývoj a výskum v Continental Zvolen

Vývojová skúšobňa

- Statické, dynamické, dlhodobé skúšky a skúšky na vozidlách pre hydraulické a EPB brzdové strmene a komponenty
- Systémové skúšky pre EPB
- Funkčné a modálne analýzy brzdového strmeňa a jeho častí, NVH analýza celého brzdového systému s nápravou
- Optimalizácia brzdového strmeňa a jeho častí



Vývoj a výskum v Continental Zvolen

Systémový a SW vývoj

- Projektový a skúšobný manažment SW vývoja
- Projektový manažment systémového vývoja
- SW vývoj, skúšky a dohľad na kvalitou vývoja
- Systémové skúšky
- Metodológia konštrukcie brzdového strmeňa
- Podpora automatizácie vývojového procesu - CoBra
- Analytické simulácie brzdových strmeňov a ich častí

Ciele konštrukcie brzdového strmeňa

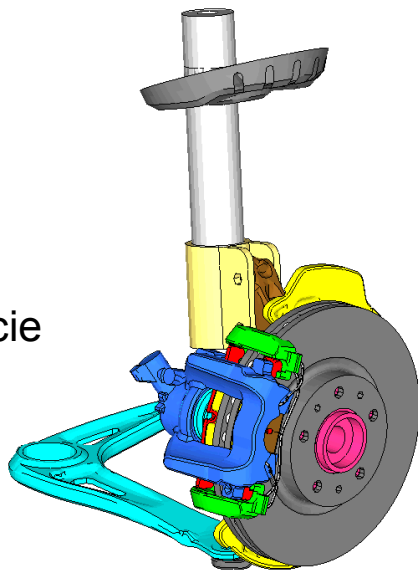
- Premena kinetickej energie na tepelnú
- Odstránenie hlukov



Vývoj a výskum v Continental Zvolen

FE Simulácie

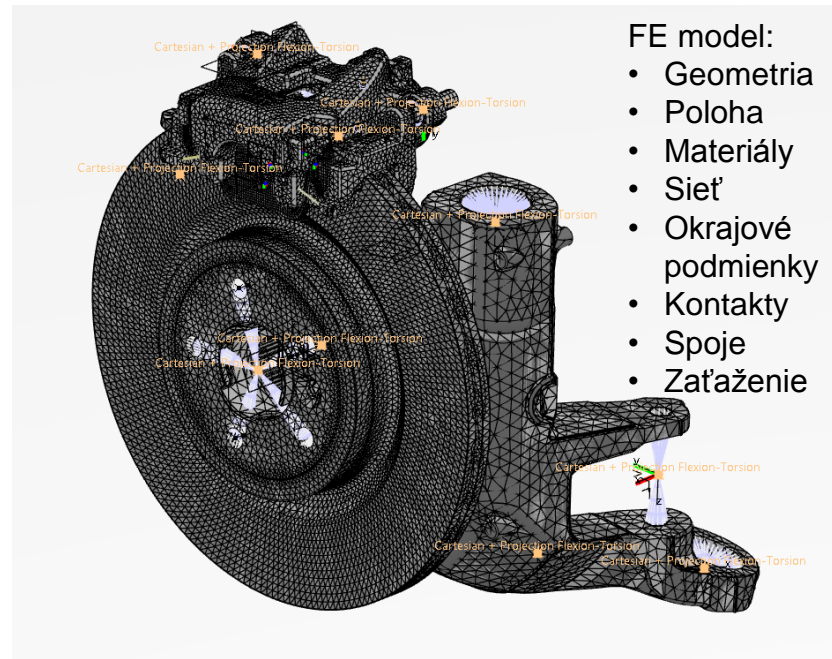
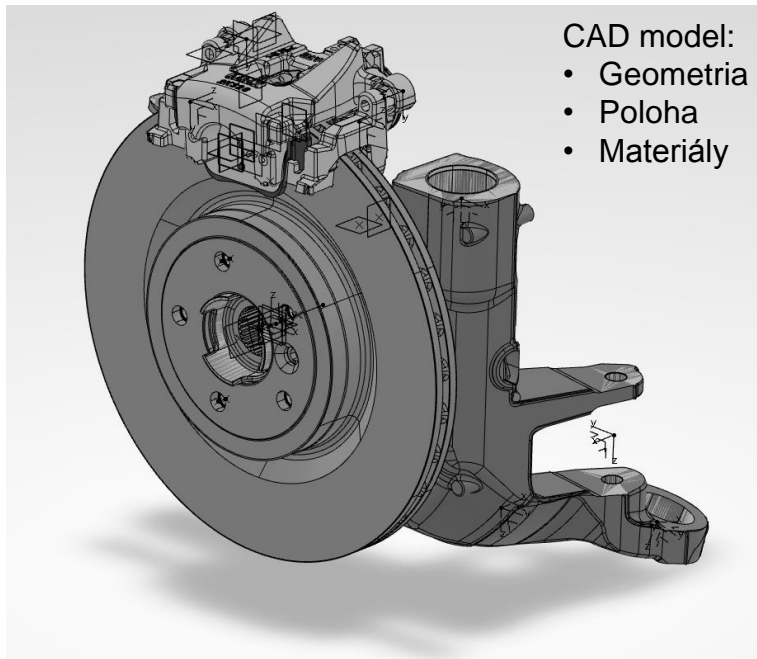
- Funkčné FE simulácie
 - Lineárne, nelineárne
 - Prestup tepla
 - Topologické optimalizácie



- NVH FE simulácie
 - Prirodzené vlastné frekvencie
 - Komplexné vlastné frekvencie
 - Optimalizácia parametrov

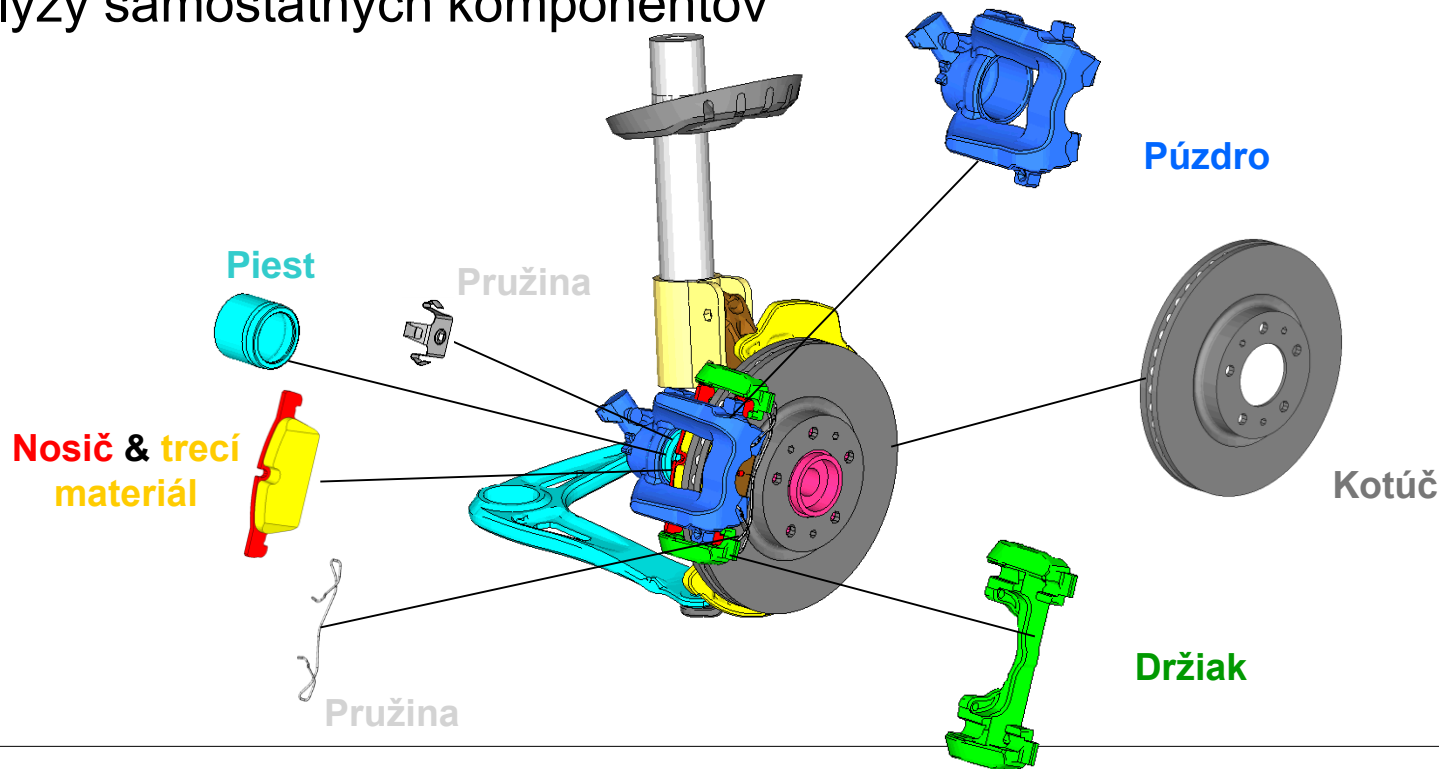
Vývoj a výskum v Continental Zvolen

CAD a FE model



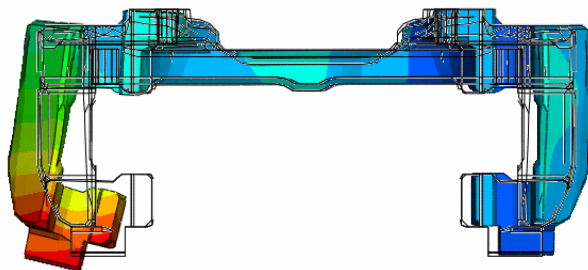
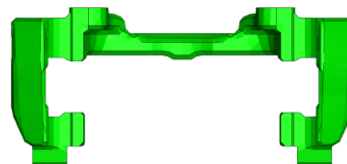
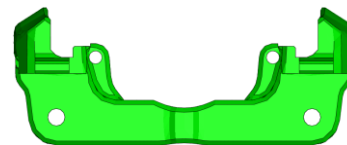
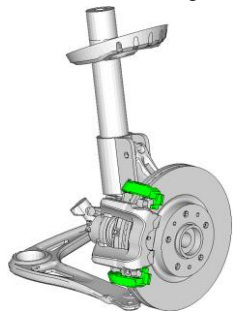
Funkčné FE simulácie

Analýzy samostatných komponentov

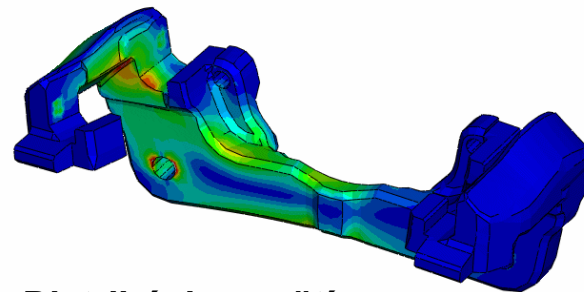


Funkčné FE simulácie

Analýzy samostatných komponentov - držiak



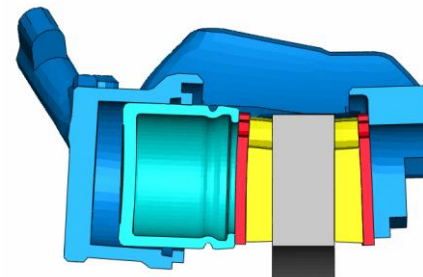
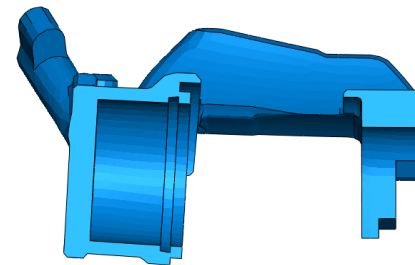
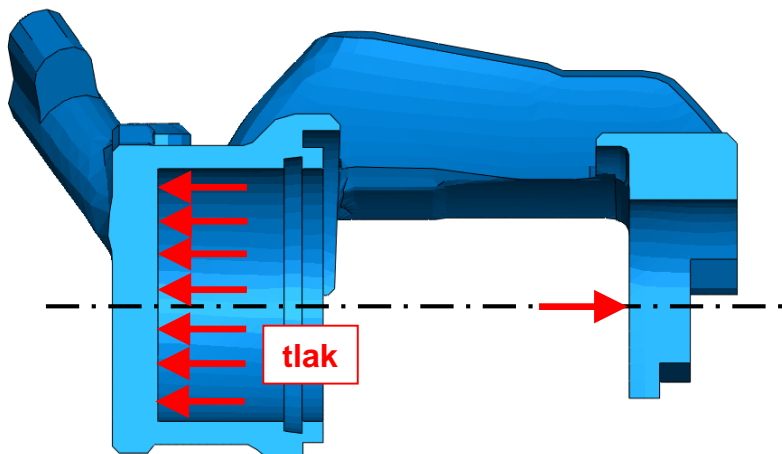
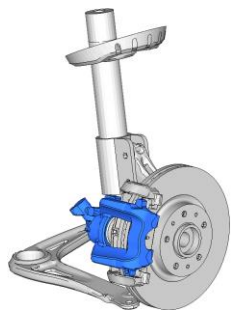
Deformácia držiaka (zväčšená)



Distribúcia napätí

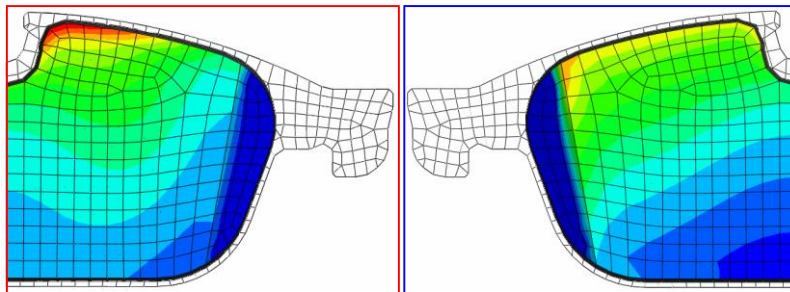
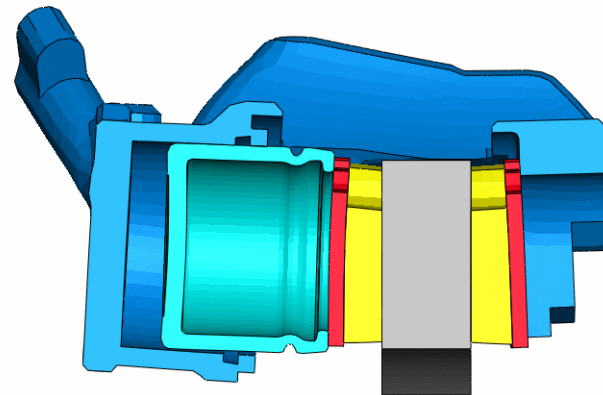
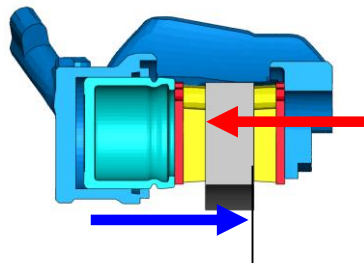
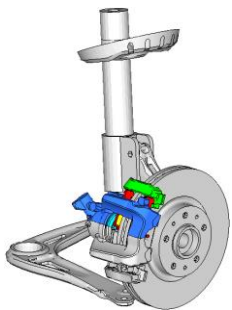
Funkčné FE simulácie

Analýzy samostatných komponentov - púzdro



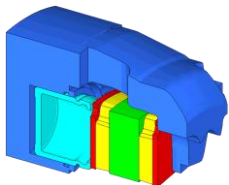
Funkčné FE simulácie

Analýzy samostatných komponentov - platnička



Vývoj a výskum v Continental Zvolen

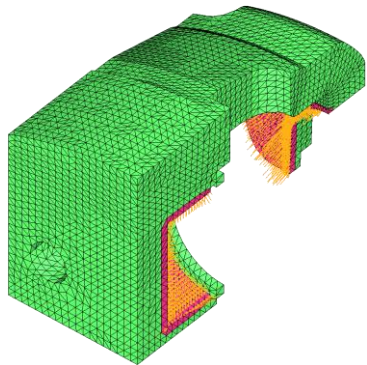
Analýzy samostatných komponentov – optimalizácia púzdra



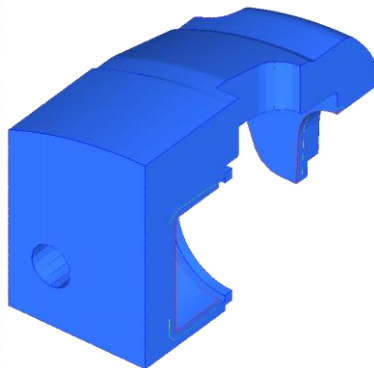
Cieľová funkcia: maximalizácia tuhosti

Ohraničenie: výsledná hmotnosť

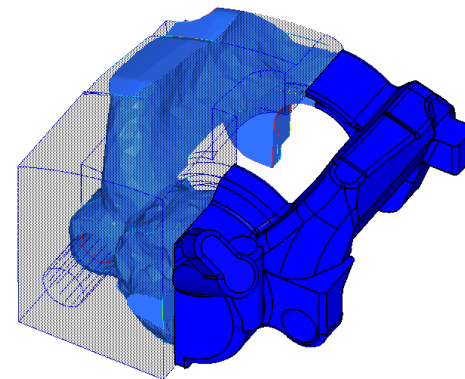
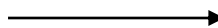
Ohraničenie na vyrobiteľnosť: smer vyťahovania formy, minimálna hrúbka



FE model



Topologická optimalizácia








Redesign

NVH (Noise, Vibration, Harshness) simulácie

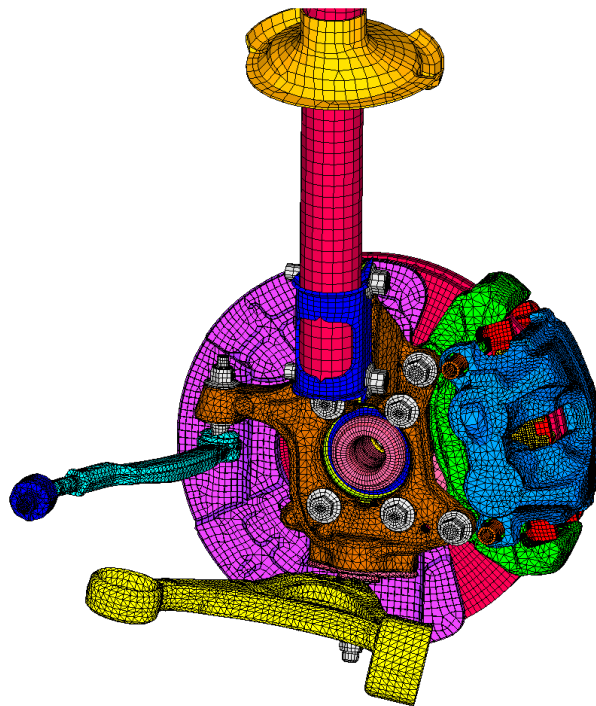
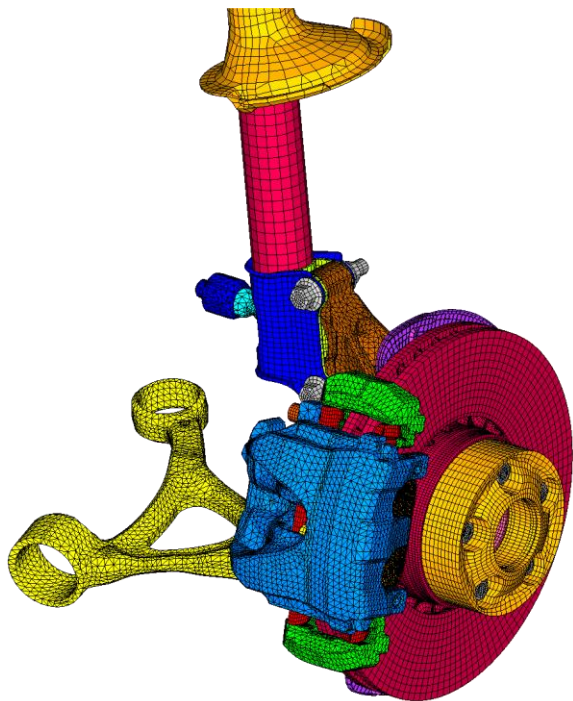
Hluky

- › Pískanie a iné hluky vplývajú na komfort jazdy
- › Môžu byť redukované minimalizovaním vibrácií
- › Na to je potrebné identifikovať vlastné tvary a Operational Deflection Shapes (ODS)

LF-Squeal		Rattle	
HF-Squeal		Clonk	
(Hot-)Judder		Wire-brush	
Groan		Chirp	
Moan		Creak	

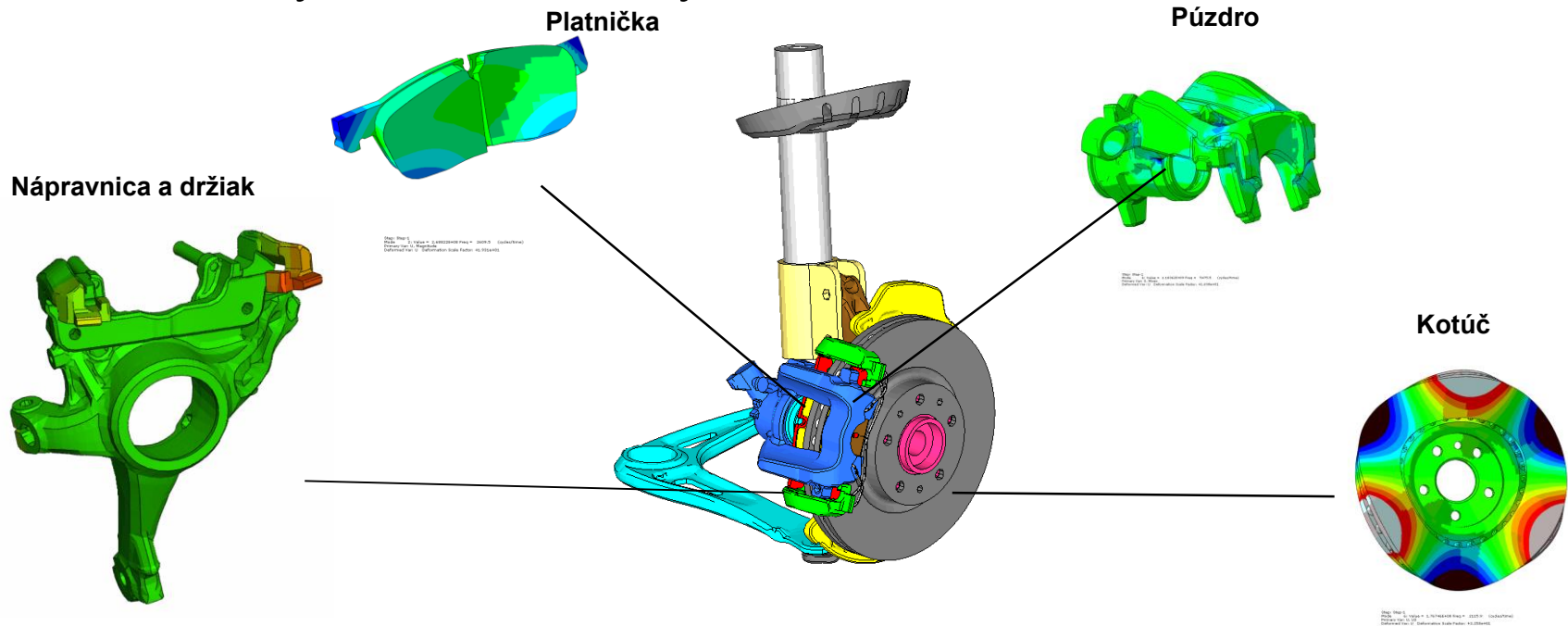
NVH simulácie

NVH FE model

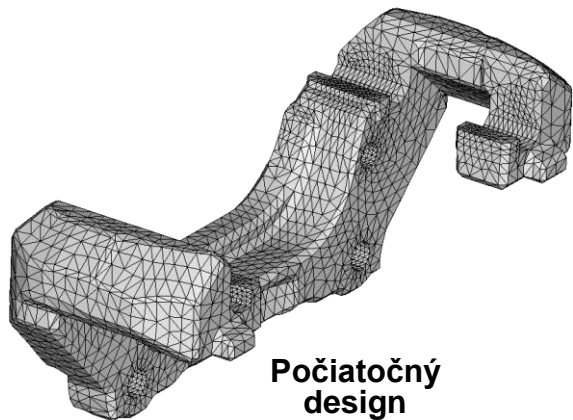


NVH simulácie

Modálna analýza a vlastné tvary

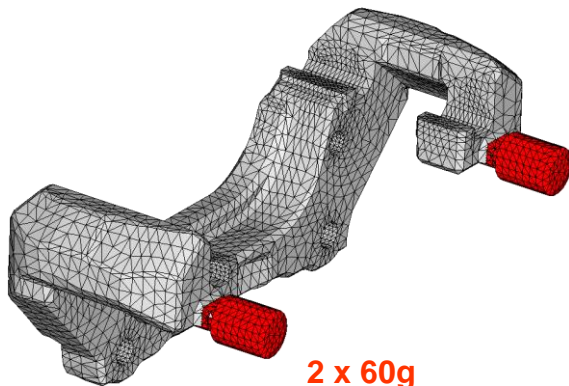


Prototyp => Konečný design



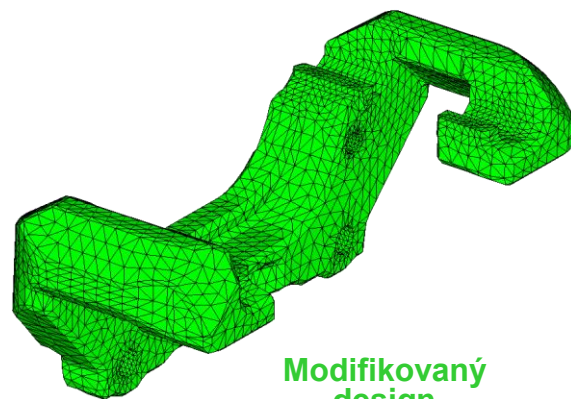
Počiatkový
design

m=2560g



2 x 60g

m=2680g

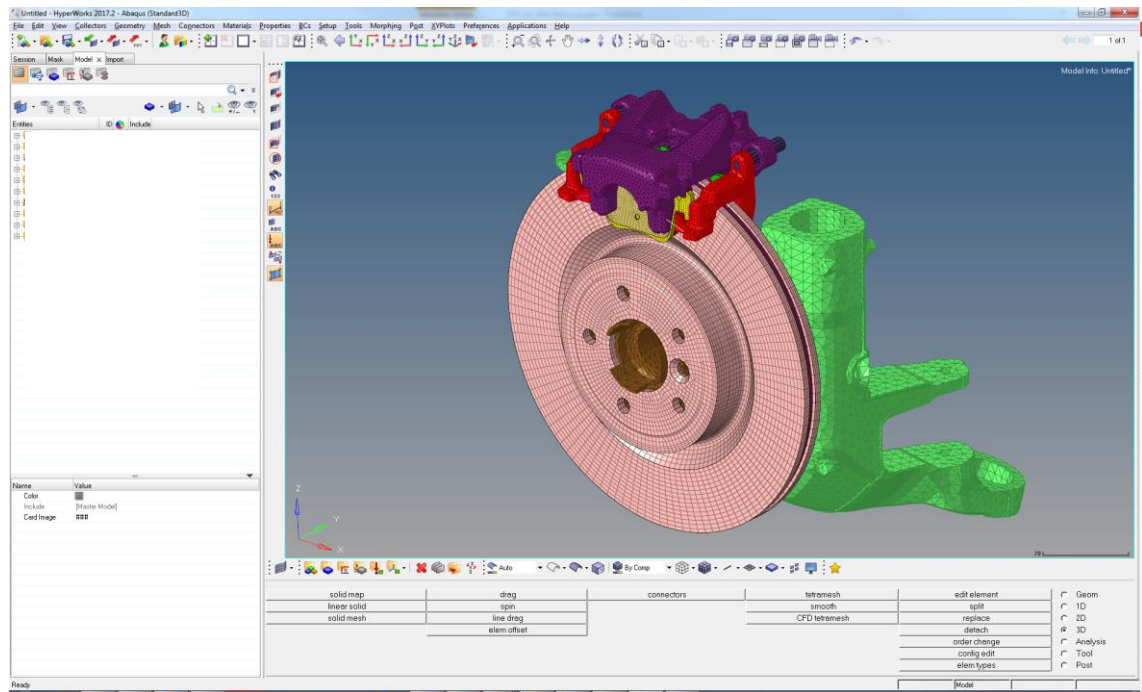


Modifikovaný
design

m=2580g

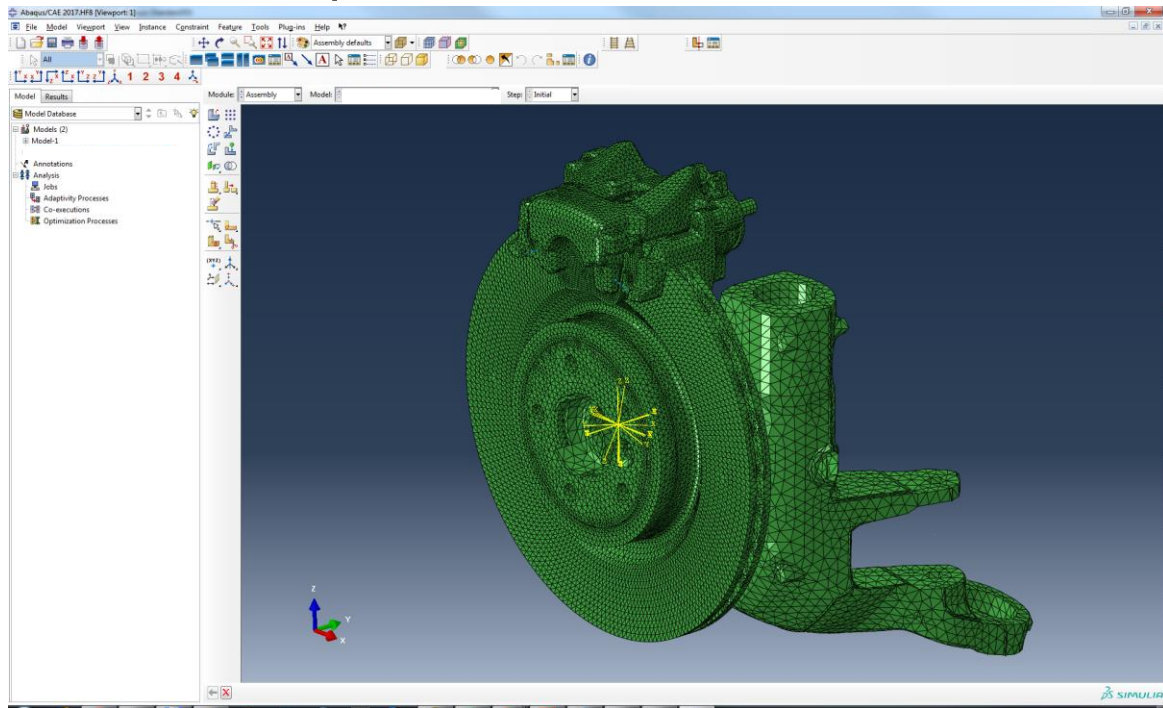
Ukázky výpočtových softvériov

Altair HyperMesh



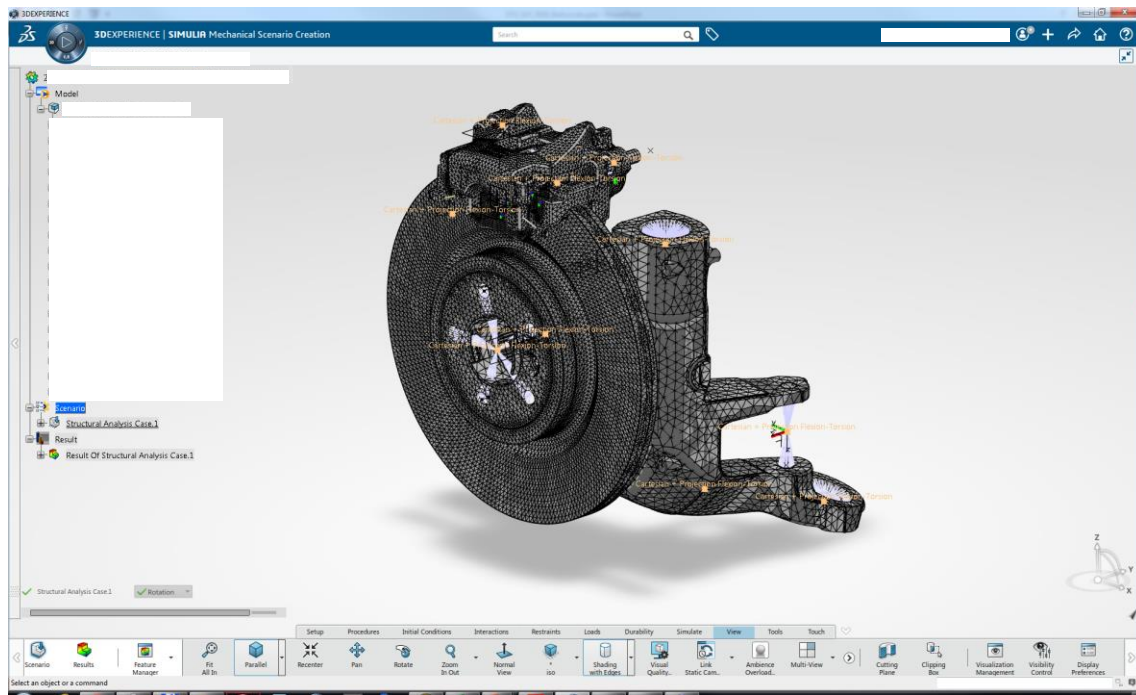
Ukážky výpočtových softvérov

Simulia Abaqus



Ukázky výpočtových softvériov

Dassault Systemes 3DEXPERIENCE



Ďakujem
za pozornosť!