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CONFERENCE

# Up-Shift Effort Simulation in Manual Transmission

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# Up-Shift Effort Simulation in Manual Transmission



Products: Rear Wheel Drive Light Duty Manual Transmissions,  
Service Parts & Components

TREMEC



**Querétaro, Qro.**

# Up-Shift Effort Simulation in Manual Transmission



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1. Introduction
2. Methodology:
  - Simulation Model
  - Validation of the model
3. Simulation results
4. Conclusions

# Up-Shift Effort Simulation in Manual Transmission



## 1. INTRODUCTION.

### Objective.

To analyze the Nibble Problem during Up-shift effort in manual transmission when oil temperature is minor to 20 °C.

FFD Ricardo defines the Nibble as “a form of partial clash following successful synchronizing action. It results from a speed differential generated during the period between indexing and final engagement”.

# Up-Shift Effort Simulation in Manual Transmission

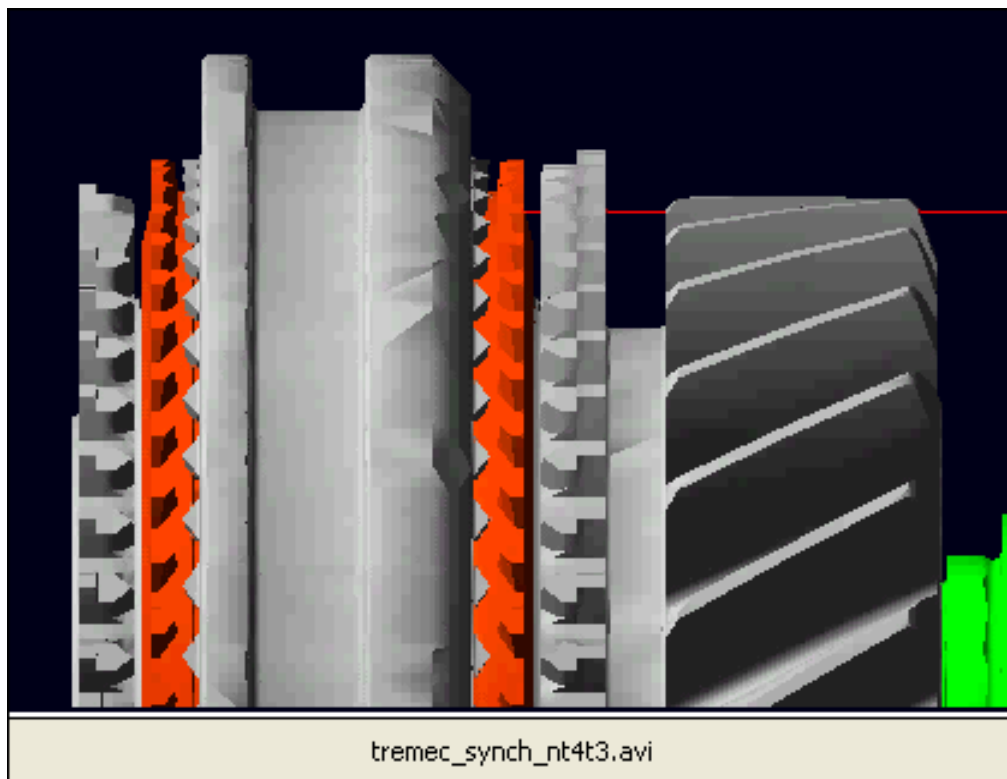


- **IMPORTANCE ABOUT NIBBLE PROBLEM SOLUTION IN TREMEC MANUAL TRANSMISSION**
- **The shift quality in the manual transmission has become a critical problem because the customer is nowadays very demanding.**
- **The Nibble problem was recorded by drivers during validation test of product when oil temperature was minor to 20°C, and this problem was great reason in order to cancel the production program for a specific customer.**

# Up-Shift Effort Simulation in Manual Transmission



Synchronizer.

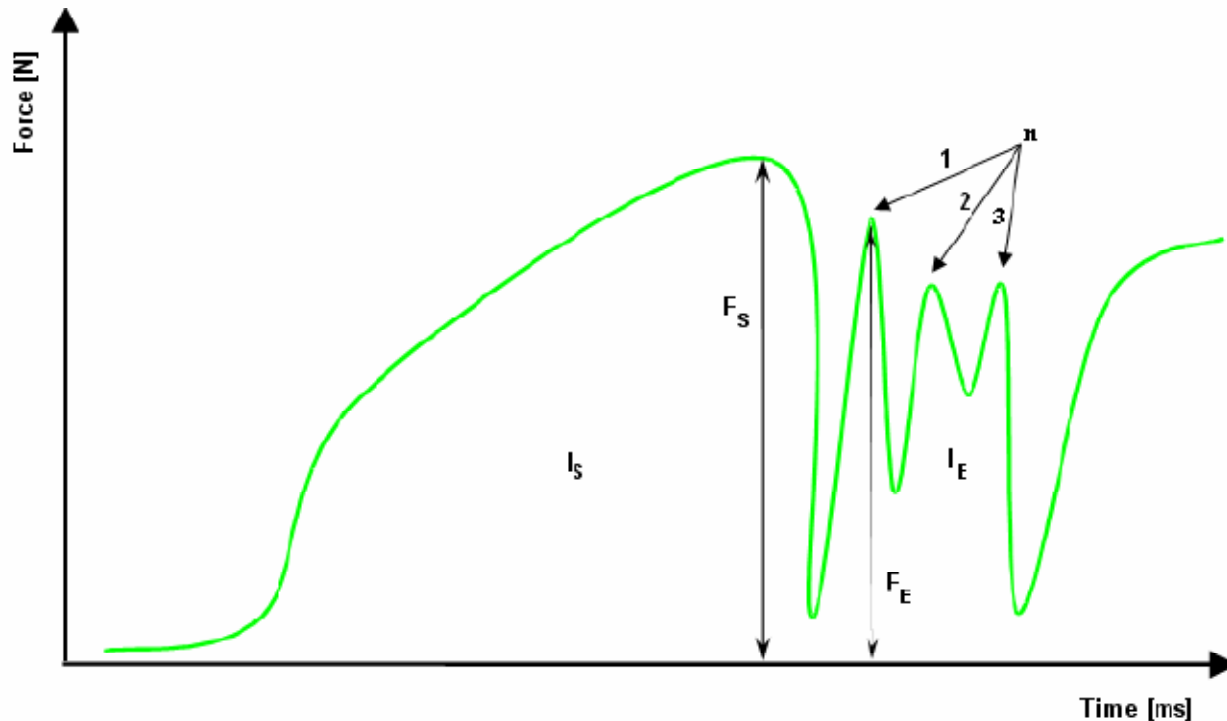


# Up-Shift Effort Simulation in Manual Transmission



## 1. INTRODUCTION.

- Nibble when  $n > 1$



- $I_s$  - Time Synchronisation Integral
- $I_E$  - Time Double Bump Integral
- $F_E/F_s$  - Double Bump / Sync. Ratio
- $n$  - Number of peaks

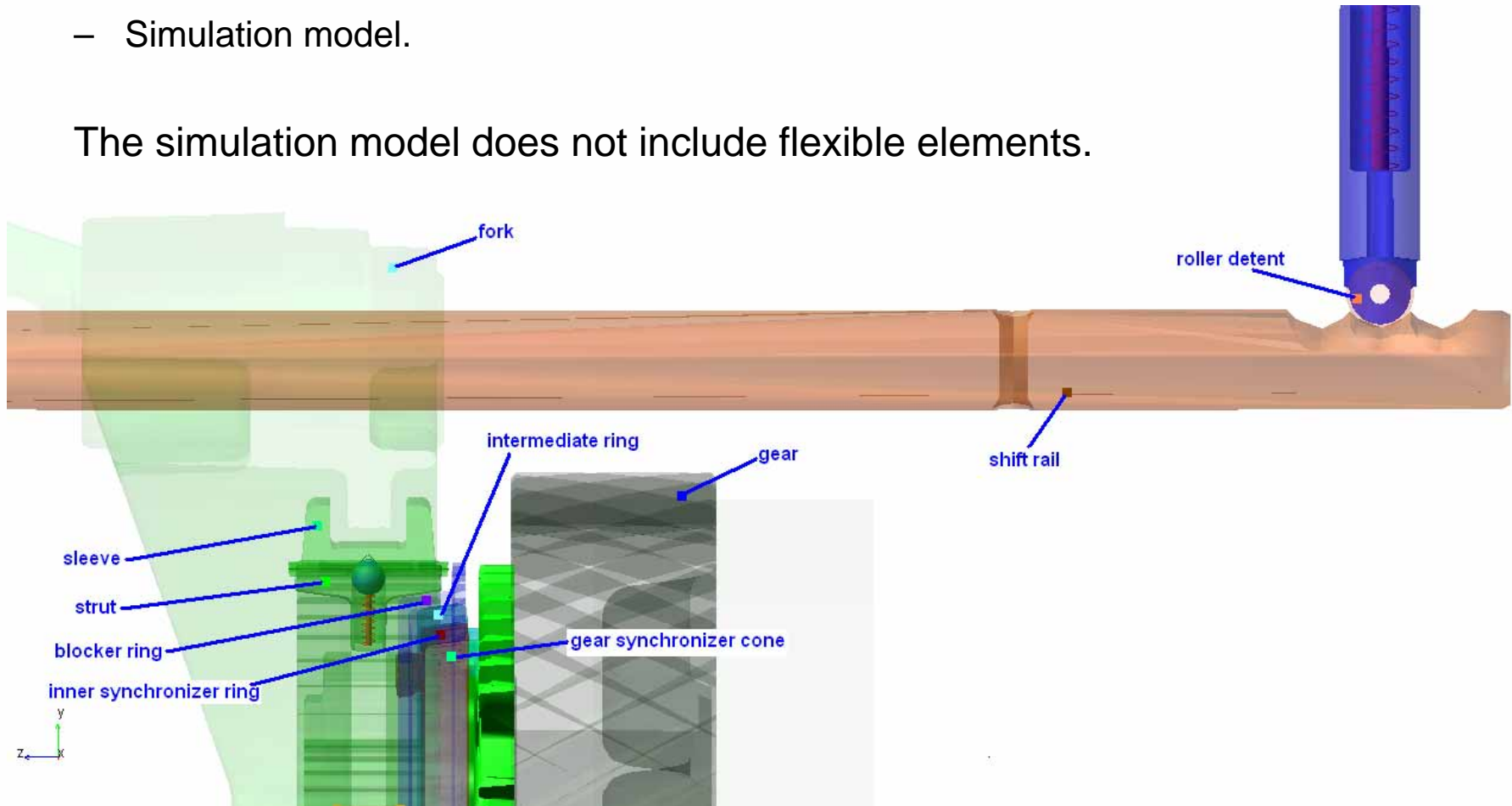
# Up-Shift Effort Simulation in Manual Transmission

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## 2. METHODOLOGY

- Simulation model.

The simulation model does not include flexible elements.

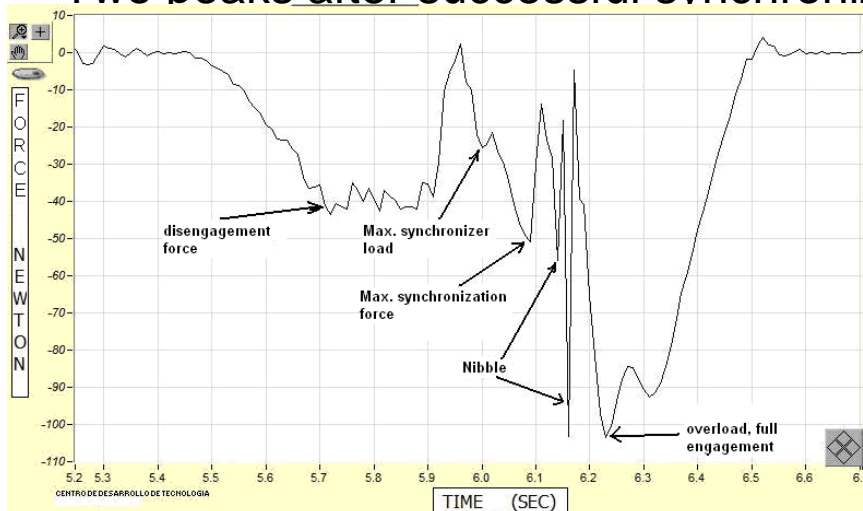


# Up-Shift Effort Simulation in Manual Transmission

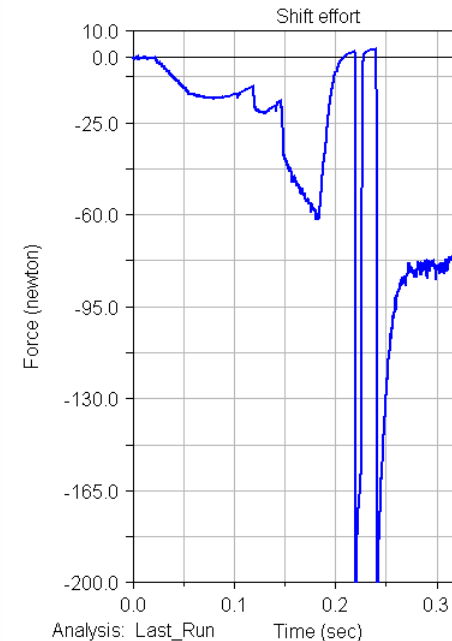


## 2. METHODOLOGY

- Validation of the model:
  - Same angular velocity on input shaft
  - Same Synchronization time
  - Included inner Drag Torque
  - Two peaks after successful synchronization



Shift effort from measurement



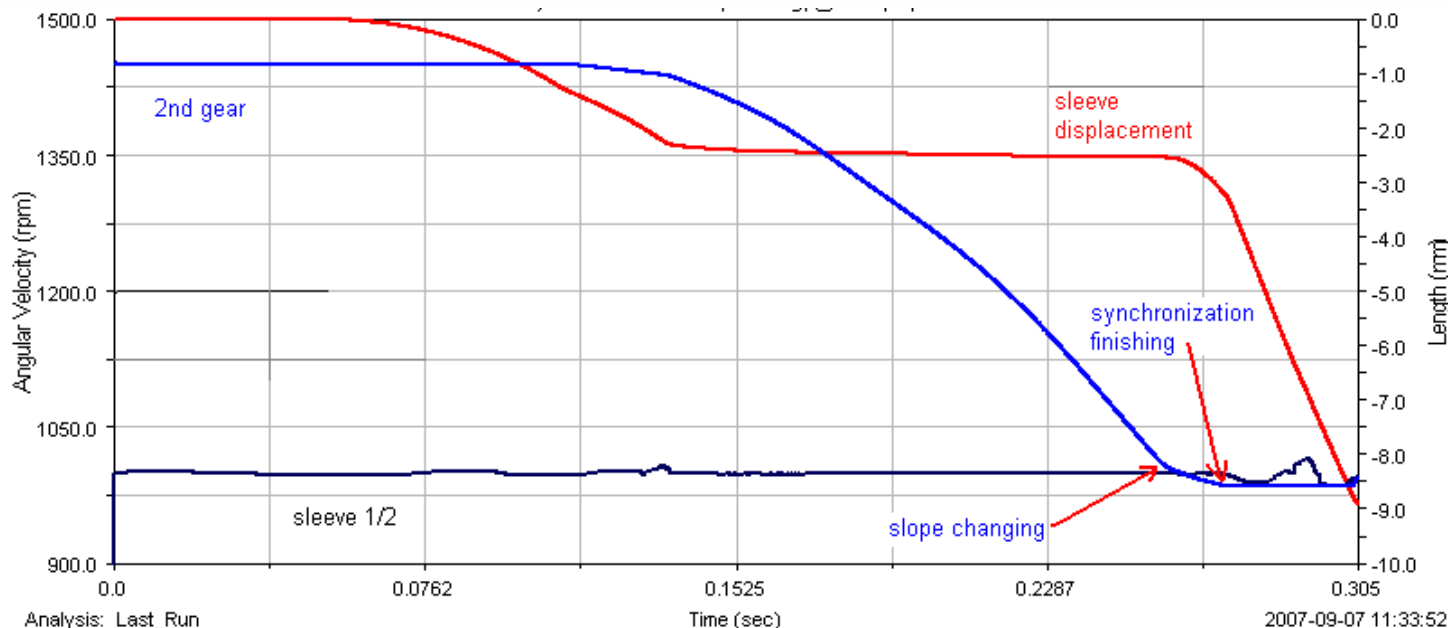
Shift effort from simulation

# Up-Shift Effort Simulation in Manual Transmission



## 3. SIMULATION RESULTS

No drag torque

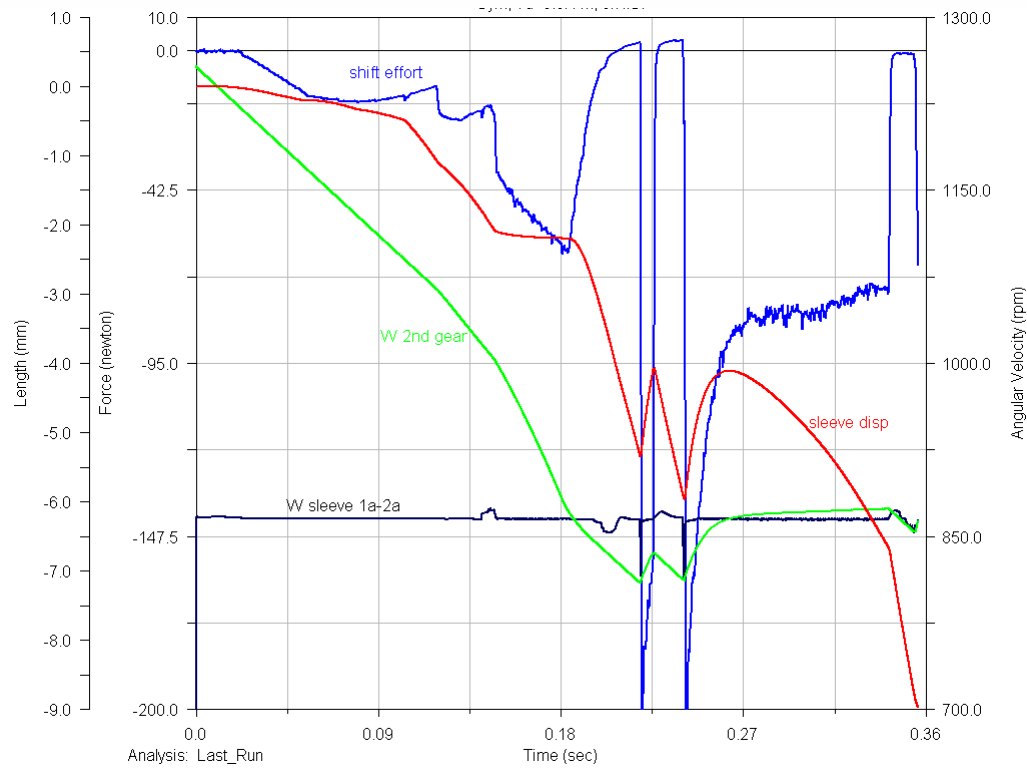


# Up-Shift Effort Simulation in Manual Transmission

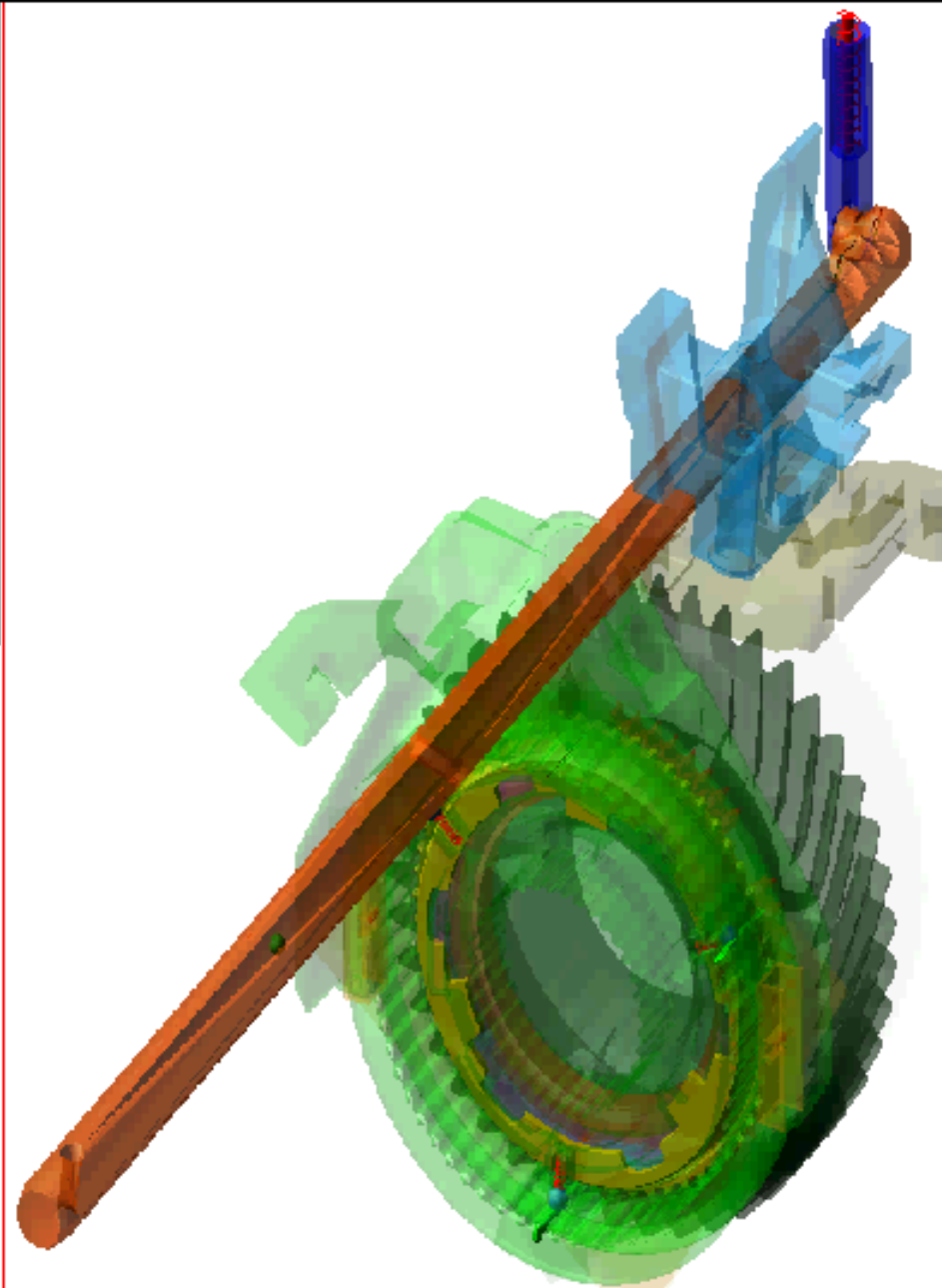
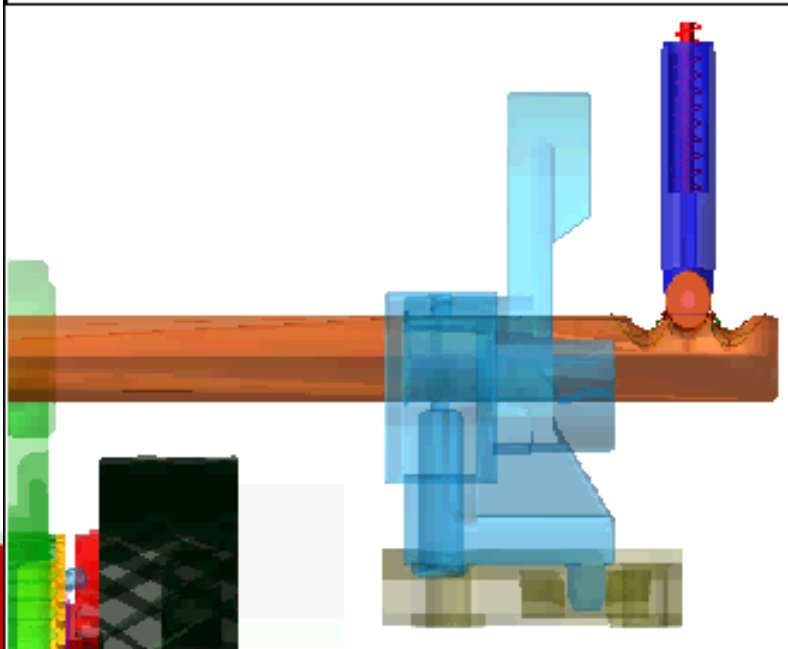
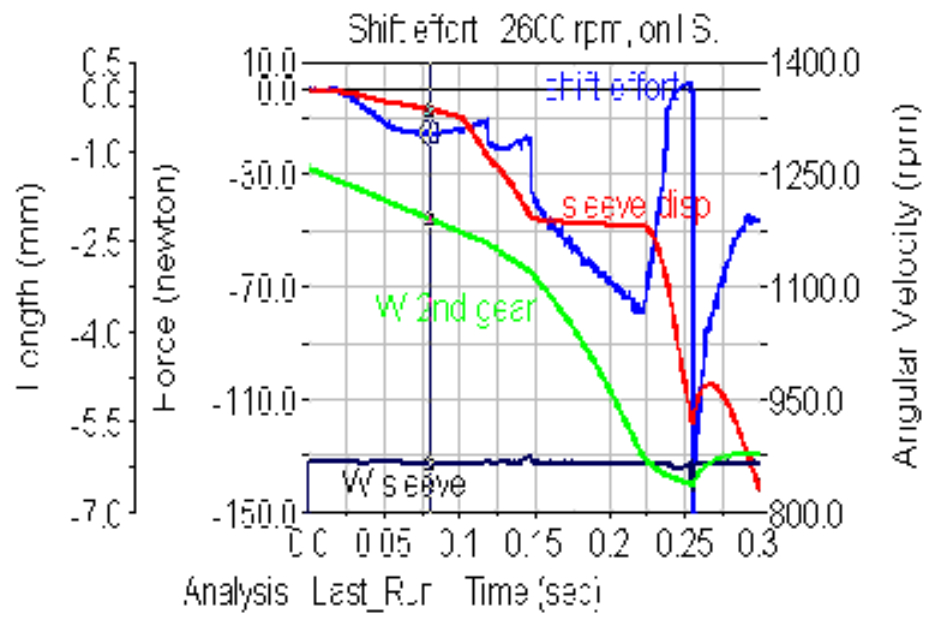


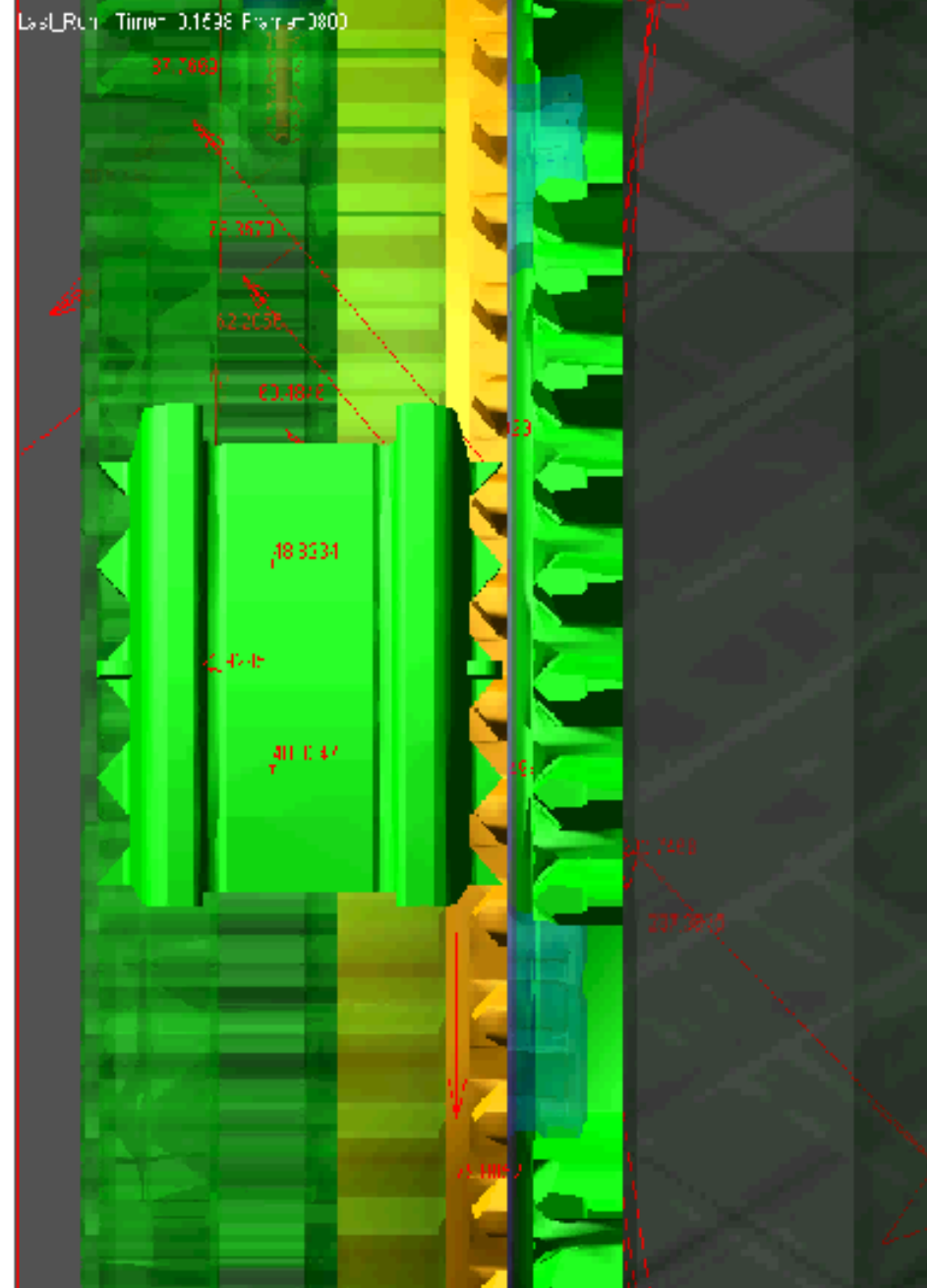
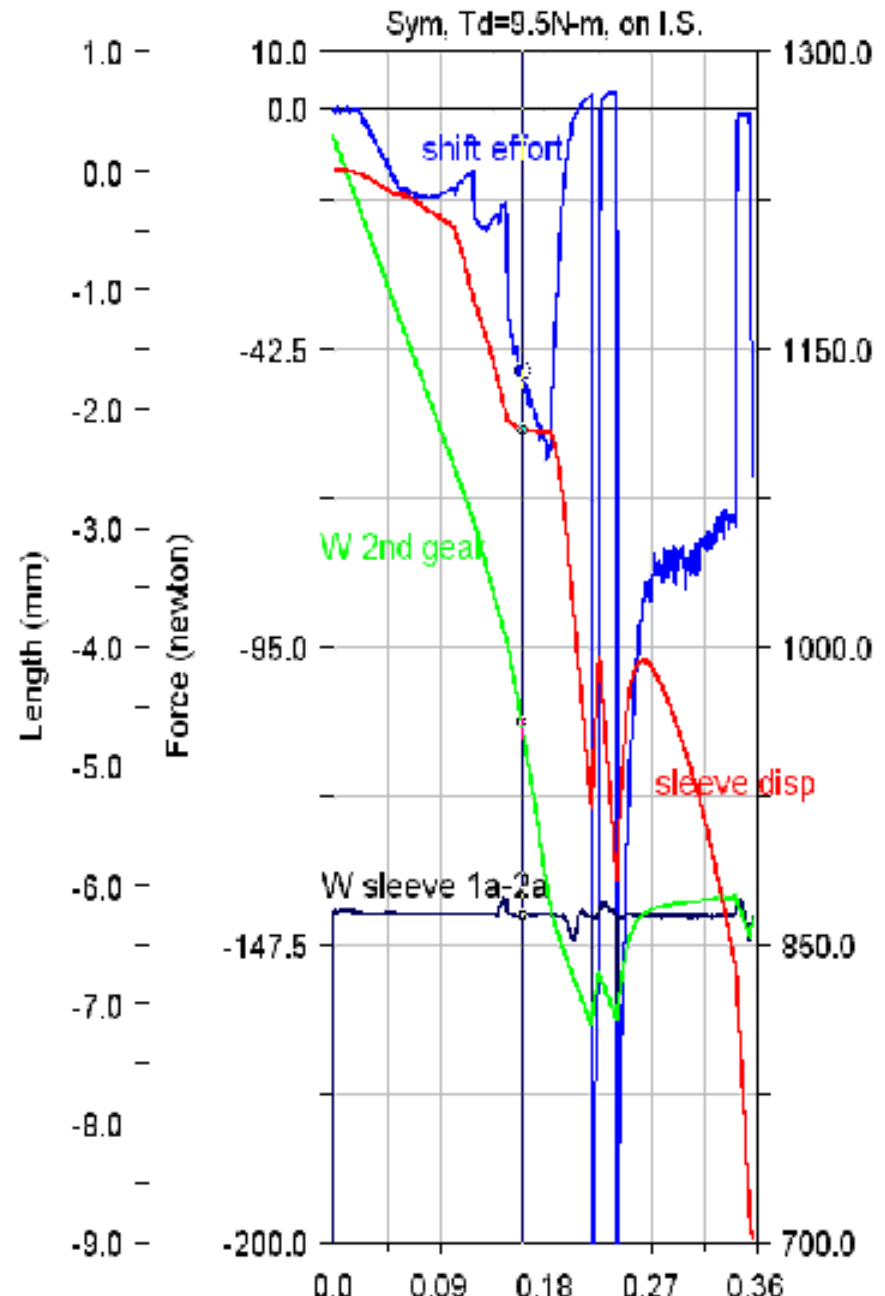
## 3. SIMULATION RESULTS

Adding Drag Torque when oil temperature is  $-10^{\circ}\text{C}$



# Up-Shift Effort Simulation in Manual Transmission **TREMEC**

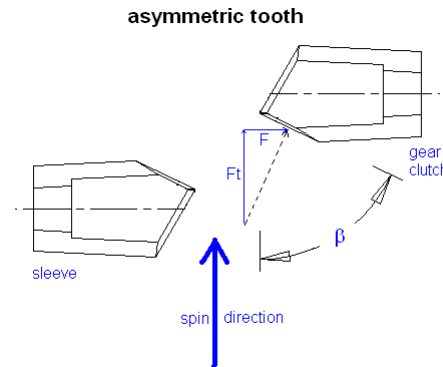
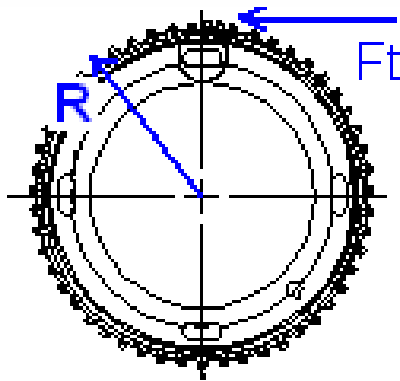




# Up-Shift Effort Simulation in Manual Transmission

## 3. SIMULATION RESULTS

Tangential force on gear clutch teeth in order to complete the last synchronization step.



$$F_t = F * \tan \beta$$

$F$  = Axial force

$F_t$  = tangential force

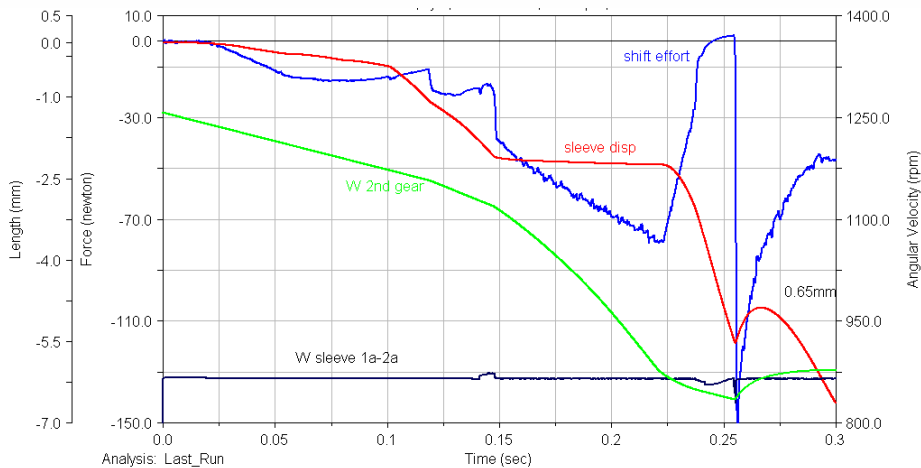
$\beta$  = Chamfer angle

$R$  = pitch radius

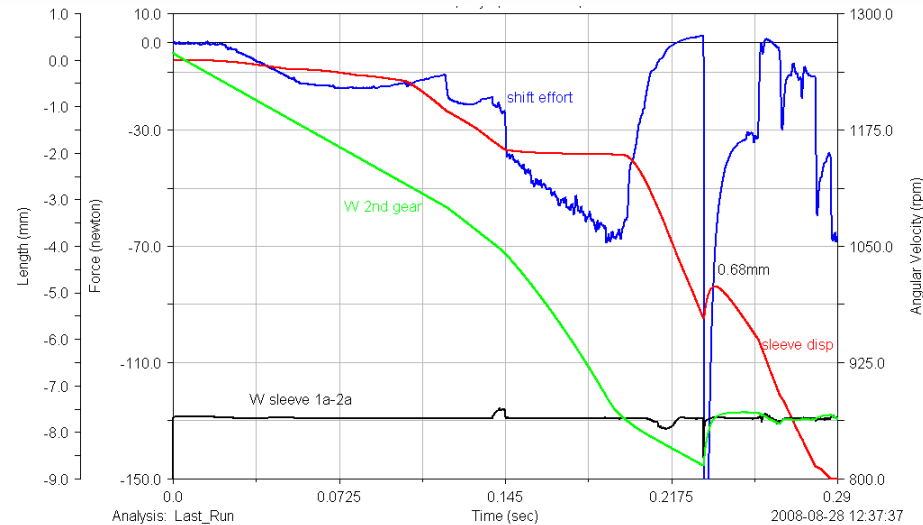
# Up-Shift Effort Simulation in Manual Transmission



## 3. SIMULATION RESULTS



Current design (20°C)



Proposal design (-10°C)

Comparing the simulation results before and after changes to the design, the rebound difference represent a 95.5 % of reduction to the Nibble problem.

# Up-Shift Effort Simulation in Manual Transmission



Shift effort measurement after design changes were implemented on sleeve and gear clutch teeth.

Table 1. Nibble on Up shift 1st-2nd gear, -10°C,		
	Number of shift	shift with Nibble
Current design	30	29
After of design changes	30	2

The Nibble problem was decreased 93 % after the design changes were implemented and oil temperature was -10°C, according to the measurements results on test rig.

# Up-Shift Effort Simulation in Manual Transmission



## 4. CONCLUSIONS

- The model validation is an important step.
- The simulation model helped to identify the specific performance problem.
- Must be identified the parameter in order to quantify the improvement quantity between current and proposal design.

# Up-Shift Effort Simulation in Manual Transmission



- **SOME CUSTOMER COMMENTS ABOUT TREMEC TRANSMISSIONS**

Automobile Magazine – August 1, 2007: “2008 Chevrolet Corvette”

*“There’s also good news from the transmission department. Another massage of the old faithful Tremec (Mexican-made six-speed manual shared with the Ford Mustang and the Dodge Viper) has achieved shorter throws with lower effort. **Thanks to friction reductions and synchronizer improvements, shifting is now more wrist action and less elbow crunching.**”*

# Up-Shift Effort Simulation in Manual Transmission



- CUSTOMER COMMENTS ABOUT TREMEC TRANSMISSIONS**

## TOYOTA MR2 COUPE (US SPEC, FIRST GEN)

"I think this was the best shifter I ever used, coming into contact with it about 20 years ago. The unit was smooth, spring-loaded, and short-throw - a pleasure to use. More recently, the 2008 Corvette, has a completely new TR6060 Tremec 6-speed transmission and it is by far the

best Corvette shifter in the 54-year history of the marque."

*Jim McCraw*

# Up-Shift Effort Simulation in Manual Transmission



- **CUSTOMER COMMENTS ABOUT TREMEC TRANSMISSIONS**

[Autoline on Autoblog with John McElroy - 2010 Chevy Camaro Edition!](#)

by [John McElroy](#) on Mar 20th 2009 at 6:00PM

## **2010 CHEVY CAMARO: DRIVING IMPRESSIONS**

“I'm sure there are a lot of Autobloggers out there who know the specifications of the new Camaro far better than I do. But numbers on paper don't mean much until you experience them through the seat of your pants. So here are my driving impressions of the new Camaro, after spending the better part of a day with four different models, driving them hard over a variety of different roads”.

“There are two different 6-speed manual transmissions. One is made by Japanese company Aisin and comes with the V6. I found it kind of clunky and notchy to use. The other 6-speed is made by Mexican company Tremec and **shifts very nicely with short throws that are precise and sure**”.

# Up-Shift Effort Simulation in Manual Transmission



- **CUSTOMER COMMENTS ABOUT TREMEC TRANSMISSIONS**

From: [http://carsguide.news.com.au/site/motoring-news/story/two\\_utes\\_and\\_the\\_open\\_road/](http://carsguide.news.com.au/site/motoring-news/story/two_utes_and_the_open_road/)

One addition which will be **welcome** by the engineering buffs as well as those who enjoy a sporty drive is the 6-speed **Tremec 6060** manual and new clutch. This gearbox has been lifted out of the Shelby Mustang and is a **marked improvement** over the previous addition.

The **shift quality**, which was often described as truck-like in the past, is **much kinder and the clutch take-up point is smoother and sweeter**.

# Up-Shift Effort Simulation in Manual Transmission



- **CUSTOMER COMMENTS ABOUT TREMEC TRANSMISSIONS**

From: <http://editorial.carsales.com.au/car-review/2933076.aspx>

**Tremec** has replaced T56 with the **sublime TR6060**, a hugely improved six-speed manual that has already appeared in Ford's new FG range as the default manual choice behind all Falcon engines. A special version which is scheduled to appear in the W427, as fitted to LS7-powered Corvette models, will be the first Holden/HSV application of the TR6060 manual

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- For further information please contact

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