

## INDUSTRIAL OUTREACH PROGRAM IN MEXICO MINI-REPORT



**WEST VIRGINIA UNIVERSITY**  
College of Engineering and Mineral Resources  
(WVU-CEMR)



**CONCyTEQ COUNCIL FOR SCIENCE AND TECHNOLOGY OF  
QUERETARO (CONCyTEQ)**



**UAQ UNIVERSIDAD AUTONOMA DE QUERETARO (UAQ)**  
College of Engineering



**INSTITUTO TECNOLÓGICO DE QUERETARO  
(ITQ)**

*This past Summer (2001), 10 students from West Virginia University teamed up with 10 students from the University of Queretaro (UAQ) and Queretaro's Institute of Technology (ITQ), forming 5 intermixed teams to work on projects from the local industry in Queretaro. A total of seven challenging projects were conducted working alongside with engineering liaisons from industry and faculty from West Virginia and Queretaro. The experience was an intense professional and cultural immersion as much as a self discovery journey for all involved and of course, ... we all had lots of fun...!!*

**JOIN US IN QUERETARO  
SUMMER-2002 !!**

*Queretaro, Mexico July 1 to August 16, 2001*

### Objectives of the Program

The objective of this program is first and foremost, to add value to engineering education and to produce top quality engineering graduates, by providing a meaningful industrial exposure in a multicultural and multilingual professional environment.

The program seeks to bring value to industry through the projects assigned to the participating students, who develop practical engineering skills as well as communication, leadership and human-relations skills.



*West Virginia and Mexico students teaming up for a professional engineering and cultural experience.*

*Back row: Andres, Shannon, Chris, Jesus.*

*Front row: Tim, Marcos and Ivan*

### Program description

This year, ten students from West Virginia University and ten from Queretaro were grouped into small intermixed-teams (of four) and assigned an industrial project for a 6-week period. The students worked under the advice of at least two industrial liaisons (designated by each host company) and of three faculty members, one from West Virginia and two from Queretaro. Arrangements were made for WVU Students to live with local families while the companies provided logistic support for transportation.

At the end of the six weeks, students prepare a professional presentation for the company on the findings and results of the project, which are delivered through a final presentation.

Mexican students are required to make their presentation in English, whereas WVU students are required to do half of their presentation slides in Spanish, regardless of the level of proficiency in the language. We gladly report that they all survived the challenge!!

### Project Descriptions: Summer of 2001

Project 1. Noise reduction in automotive manual transmissions. The host company was **TREMEC**, subsidiary of **DANA Corporation** in the USA. In this project a finite element model was developed for vibration analyses for noise reduction purposes. The model allows for gear tooth backlash effects to be included and will be useful for noise reduction studies.



*Testing TREMEC transmissions on a VIPER*

Experimental analysis was also conducted at the laboratory facilities of TREMEC for the assessment of vibration behavior of gear trains.



*WVU and Queretaro students testing transmissions with engineers from TREMEC*

Project 2. Heavy-duty transmission vibrations. This project was developed for **SPICER-TSP** Company, subsidiary of **DANA Corporation** In this project, a dynamic model of a heavy duty transmission was developed that included the backlash effect.



*Gear and bearing elements of a heavy duty transmission*

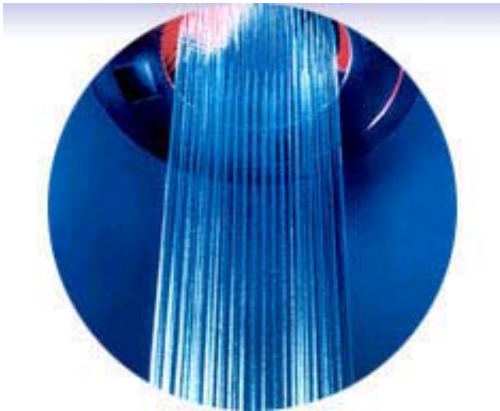
The model was aimed at determining how resonance conditions were affected by the presence of increased backlash in the gear mesh, caused by tolerances of assembly.



*Heavy duty transmission studied by the WVU-Queretaro Team*

In addition, a lubrication analysis was conducted of an actual bearing application to determine life expectancy of the transmission. The work done involved tests conducted in the field as well as in the laboratory. Recommendations for design improvements were put forward to the company.

Project 3. Bearing Failure analysis in polyester fiber making machinery. The host company was **KoSa** (Formerly Celanese). In this project, machinery for manufacturing polyester fibers was considered. A specific type of equipment used in the process has cantilever rollers, which are meant to stretch the fiber as it is extruded. Bearing failure produced by extreme heat transfer between the roller and bearing cause the process to stop, creating a costly disruption to the overall operation.



*Polyester fiber process studied by the WVU-Queretaro Team*

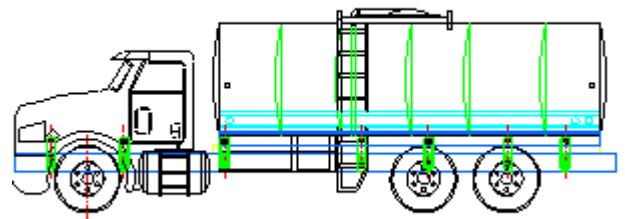
Students determined the causes of failure and put forward recommendations for the selection of appropriate bearings and lubrication requirements that would reduce the incidence of failures.



*High speed rotor (godet) for polyester fiber production studies by the WVU-Queretaro team*

Project 4. Rollover stability of tanker trucks .

The host was the Mexican Institute of Transportation (IMT). This Project involved the modeling and analysis of tanker trucks for the assessment of lateral stability with emphasis on the sloshing effects of the fluids in the tank. PEMEX fuel trucks were used for the study, in which a finite element model of the tank was produced to determine the overall bending and torsional stiffness, which combined with the fluid sloshing produces lateral rollover characteristics. The development of a model was needed to conduct studies that allow the determination of critical speeds associated with various fill levels for the trucks.



*Fuel tanker truck modeled for lateral rollover stability by the WVU-Queretaro team*

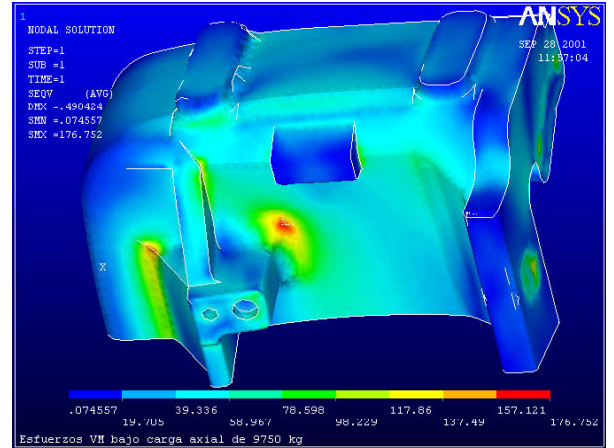
A working computational finite element model was developed for the tanker truck, which can be used to conduct stability analysis and critical velocity studies for standard maneuvers in the operation of the trucks. The Mexican Institute of Transportation conducts research related to safety in highways and is collaborating with WVU in the area of tanker truck sloshing dynamics.

Project 5. Stress analysis of agricultural tractor components. The host company was **New Holland de Mexico**. In this project, two tractor components were modeled for finite element analysis purposes. The first was a retractable rollover protective structure (ROPS), under static and equivalent dynamic loads, with emphasis on the strength of the welded joints and the design of the supports. CAD models developed by NH personnel were translated into a finite element mesh that was subsequently used to determine the behavior of the ROPS under design loads.



*New Holland Tractor team: Andres, Toño, Jesus, Chris and Marco Antonio*

Developed by NH personnel was taken and translated into a solid model in a finite element software application for meshing and stress analysis purposes

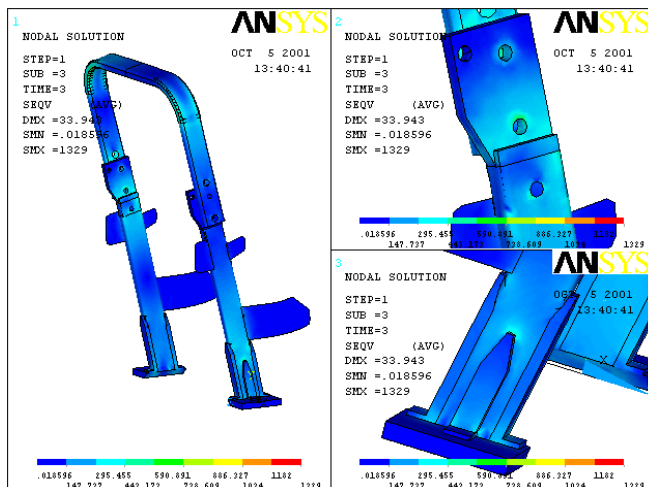


*Front-end support under symmetric axial front loads.*

These models can be used to simulate various tractor loading scenarios.

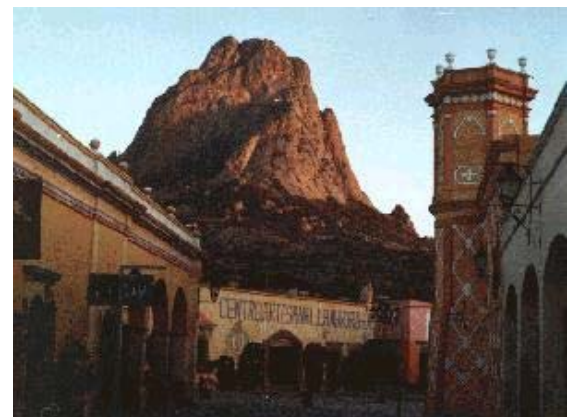
### Cultural Highlights

While work in industry was intense (30 hrs/week), Queretaro offers magnificent opportunities for sightseeing during weekends such as “Pena de Bernal” and “La Sierra Gorda”, in addition to local attractions such as bullfights, state-fairs, markets and great restaurants! Finally, after the projects were completed...yes, Acapulco awaits for a long and well deserved weekend.



*Finite element model of the ROPS under lateral load (elastostatic stress analysis)*

The same tractor has a component called the “front end support, which was also subject of modeling for stress analysis purposes. A CAD solids model



*“Peña de Bernal” and the colonial atmosphere of Queretaro*



*Mision Jalpan, "Sierra Gorda" of Queretaro*



*Nice suntan guys !! Tim, Chris, Eric, Melissa, Angie, Bob, Shannon, Rob and Andres*



*Students about to discover what real tacos taste like !!*

### **Five Year Summary**

After five years, this program has involved a great number of people from various institutions, industries, and research centers from both countries.

Students, faculty and industrial liaisons have teamed up to work on 13 meaningful projects. (See summary Table below).

Some of the alumni of this Program have returned to the industries in a professional capacity, as most of the companies have either corporate or customer-supplier relations with US industry. That is particularly the case with the companies that are subsidiaries of US companies.

### **Agreement between WVU, CNCyTEQ, UAQ and ITQ**

For the next cycle (2002), an agreement between the participating institutions has been officially signed by the institutional authorities, which provides a formal frame for collaboration and support for this Program.

This Agreement is intended to extend further the outreach of this Program to industries of Queretaro and the USA, and provides the institutional framework to expand and support the program to engage into multidisciplinary and multicultural academic endeavors with a global perspective in mind.

The agreement was signed by: Dr. Alejandro Lozano, Director of **CONCyTEQ**; M. en C. Dolores Cabrera Muñoz, Rector of **Universidad Autonoma de Queretaro** and Ing. Carlos Fernandez Perez, President of **Instituto Tecnologico de Queretaro**. For **West Virginia University**: Dr. Eugene Cilento, Dean of the College of Engineering and Mineral Resources (**CEMR**); Dr. Donald W. Lyons, Chairman of the Department of Mechanical and Aerospace Engineering (**MAE**) and Dr. Daniel Weiner, Director of International Programs (**OIP**).

## Conclusion

Our Program is unique. It pursues the main objective of adding value to engineering education through an industrial exercise in an international setting. The program addresses issues that range from communication skills and cultural differences to human relations in the context of a practical engineering project.

This experience has brought forward not only the practical engineering dimension (from industry), but also the human dimension that comes with the territory.

Indeed, cultural differences actually exist. They come forward when people disagree, when people negotiate, when people reach agreements. In the concept of "value" as well as in attitudes toward life. But being able to understand and better yet, anticipate cultural differences may be the difference between failure and success in professional situations in today's industry.

In an increasingly globalized professional environment, we are doing our share to meet the challenge.

Institutions Involved	Participant students	Faculty from both countries	Industrial Liaisons	Industries/Research Centers	Projects developed
<ul style="list-style-type: none"> <li>• West Virginia University</li> <li>• University of Guanajuato</li> <li>• University of Queretaro</li> <li>• Institute of Technology of Queretaro</li> <li>• CONCyTEQ</li> </ul>	<ul style="list-style-type: none"> <li>• 35 (WVU)</li> <li>• 10 (UG)</li> <li>• 15 (UAQ)</li> <li>• 13 (ITQ)</li> </ul>	<ul style="list-style-type: none"> <li>• 3 (WVU)</li> <li>• 2 (UG)</li> <li>• 2 (UAQ)</li> <li>• 1(ITQ)</li> </ul>	<ul style="list-style-type: none"> <li>(2) GM (Gto)</li> <li>(4) TREMEC (Qro)</li> <li>(2) Transm-TSP (Qro)</li> <li>(1) Micro-Troq. (Qro)</li> <li>(2) IMT (Qro)</li> <li>(2) LAPEM (Gto)</li> <li>(2) I. TurboReact. (Qro)</li> <li>(1) Terramite (WV)</li> <li>(2) KOSA</li> <li>(2) New Holland</li> </ul>	<ul style="list-style-type: none"> <li>• GM</li> <li>• TREMEC</li> <li>• Transm-TSP</li> <li>• Micro-Troquelados</li> <li>• IMT*</li> <li>• LAPEM*</li> <li>• I. TurboReact.</li> <li>• Terramite Corp.**</li> <li>• New Holland</li> <li>• KOSA</li> <li>* Research Centers</li> <li>** From West Virginia</li> </ul>	<ul style="list-style-type: none"> <li>(1) GM Mexico</li> <li>(5) TREMEC</li> <li>(3) SPICER-TSP</li> <li>(1) Micro-Troq.</li> <li>(3) IMT</li> <li>(2) LAPEM</li> <li>(1) I. TurboReactors</li> <li>(1) Terramite Corp.**</li> <li>(2) KOSA</li> <li>(2) New Holland</li> </ul>
<b>5 Institutions</b>	<b>73 Students</b>	<b>8 Faculty</b>	<b>20 Liaisons</b>	<b>10 Companies</b>	<b>21 Projects</b>

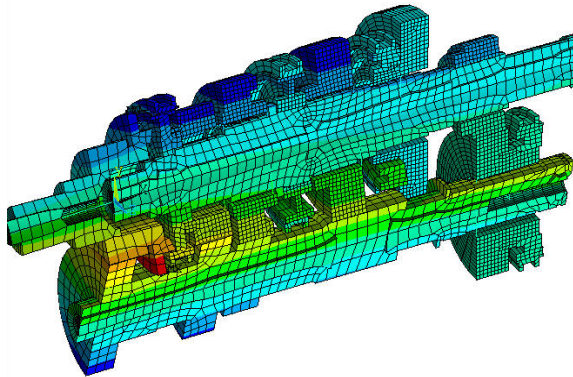
Five-year summary table of people, companies and projects developed in this Program.

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Previous Year's Projects



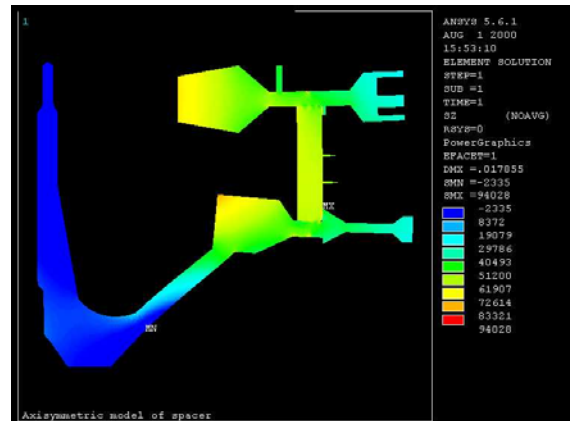
Finite element model of a gear train for dynamic analysis for TREMEC



P&W Aircraft engine being serviced by ITR



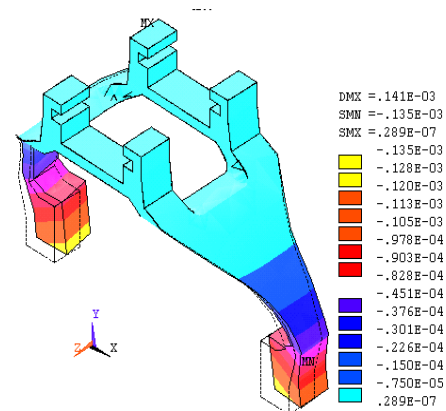
Compact construction equipment: Linkage finite element analysis for Terramite Corporation of WV



Axisymmetric model of a spacer with disks analysis done for ITR



Students from WVU (Jaime) and Mexico (Veronica) with the liaison from TREMEC (Eric) setting an experiment



Shift mechanism fork deformation analysis for TSP-SPICER

***The Cultural Opportunities in Queretaro***



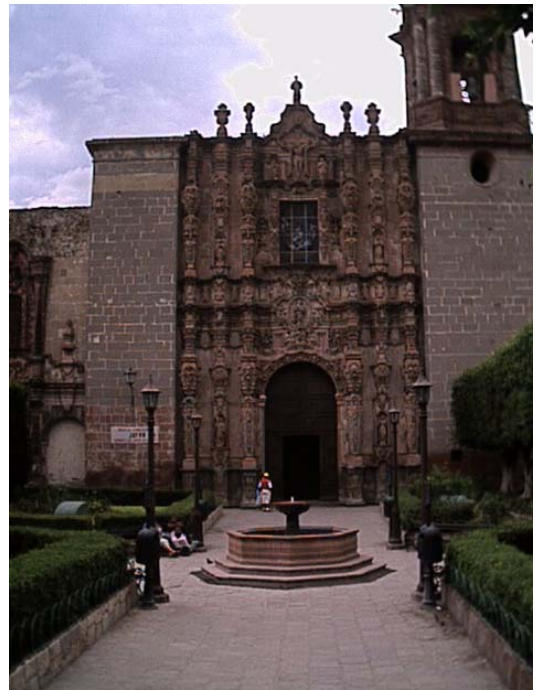
*Tequisquiapan, Queretaro, vine yard country*



*Peña de Bernal, Queretaro, the largest monolithic formation in Mexico*



*The Sun Pyramid in Teotihuacan, Mexico*



*San Miguel Allende, in neighboring Guanajuato State*



*Magnificent Santa Rosa Church, Queretaro City*



*Whatch out Andres !!... Shopping in San Miguel Allende, Guanajuato with Chris and Marcos*





*Visiting New Holland....Can't wait to get to work !!!*



*Are you ready for real echiladas !!!*



*If my friends could see me now !!*



*Touches of industrial culture.*



*The whole group, What a Team !!*

**Time for Fun !!**



*WVU Team (Bob and Tim) hard at work in Acapulco, Guerrero!!*



*Some tough looking fellows (Andres and Tim) fending off UV rays*



*Acapulco for a looong weekend Ahhh.....Perfect !!*



*Time for sunshine..Smile!! Back row, left to right: Eddie, Angie, Shannon, Little Eric, Diana, Big Eric, Chris, Melissa, Tim. Front row: Rob, Sheryl, Bob, Andres was the man with the camera.*

# Join us in Queretaro 2002!!