

INDUSTRIAL OUTREACH PROGRAM IN MEXICO



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



COUNCIL FOR SCIENCE AND TECHNOLOGY OF
QUERETARO (CONCyTEQ)



UNIVERSIDAD AUTONOMA DE QUERETARO (UAQ)
College of Engineering



INSTITUTO TECNOLÓGICO DE QUERETARO
(ITQ)

This past Summer (2002), 12 students from West Virginia University teamed up with 11 students from the University of Queretaro (UAQ) and Queretaro's Institute of Technology (ITQ) and formed 6 intermixed groups who teamed up with local industry and research centers in Queretaro, Mexico. A total of six challenging projects were conducted working alongside with engineering liaisons from industry and faculty from West Virginia and Mexico. The experience was an enriching, rewarding and intense professional-technical and cultural immersion, in which everyone involved learned drew benefits and yes..., it was also lost of FUN!!!

JOIN US IN QUERETARO
SUMMER-2003 !!

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 also 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.

Finally, this program seeks to bring faculty and engineers from industry to share expertise in formulating and solving engineering problems.



West Virginia and Mexico students visiting industrial sites in Queretaro Mexico.

Program description

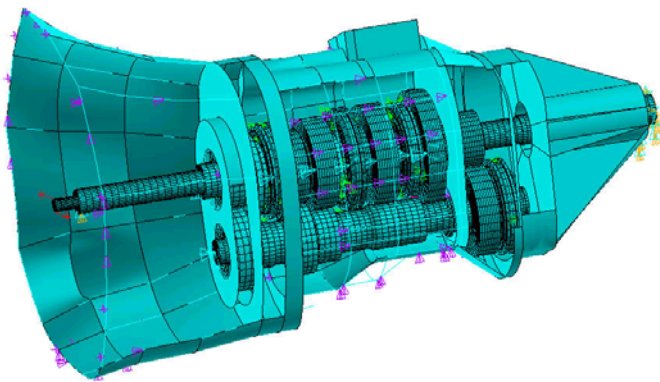
This year, twelve students from West Virginia University and eleven from Queretaro were grouped into small intermixed-teams (of four) and assigned an industrial project for a 6-week period. The students worked under the advice of a designated industrial liaison and three faculty members from West Virginia and Queretaro. Arrangements were made for WVU Students to live with local families while the companies provided logistic support for transportation and project development.

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 oral 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!!

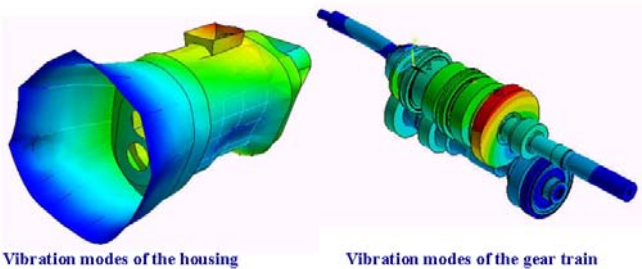
Project Descriptions: Summer of 2002

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.



Finite element model of a TREMEC transmission developed by the WVU-Queretaro team

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



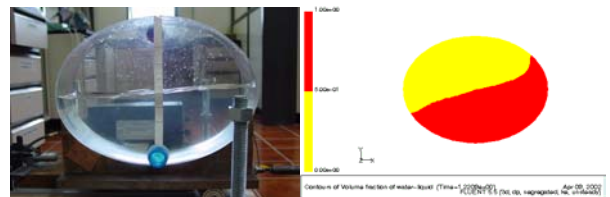
Modal Response of housing and gear train for an automotive standard transmission

Project 2. 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 computational fluid dynamics (CFD) model of the tank was developed to determine the sloshing natural frequencies. Experimental verification was conducted with various scale models, which feature the geometry and baffle configuration of the tankers for various fill levels. Experimental vs. computational results were within 2% error for the critical levels of fill. .



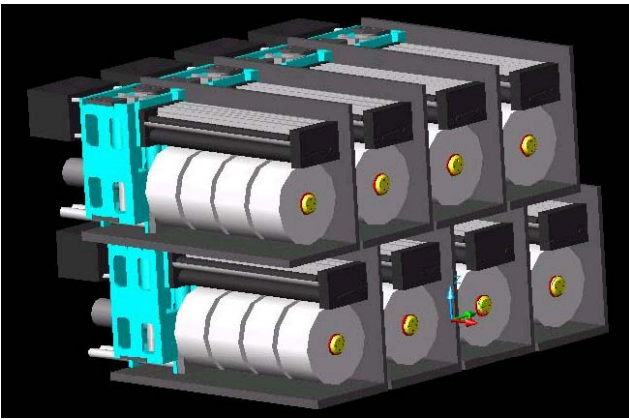
WVU-Queretaro students conducting experiments on the sloshing of a tank model



Experimental and computational sloshing models within 2% error

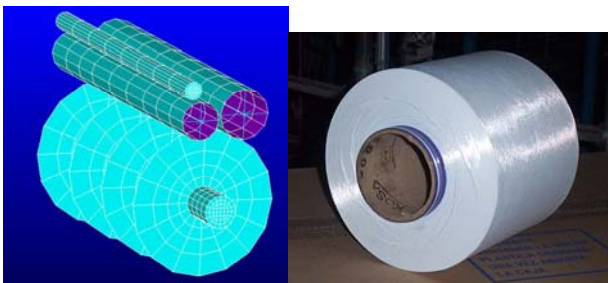
A finite element model developed last year for a tanker truck, can now be used to conduct stability analysis and critical velocity studies for standard maneuvers in the operation of the trucks.

Project 3. Vibration signature analysis in fiber winding 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 use to wind the fiber into packets. The high speed of the filament (thread) requires high (and variable) speeds of operation for the rollers, which in turn must operate very quietly (free of vibrations). The objective of the study was to characterize the vibratory signature of a bank of winding machines, for various filament speeds.



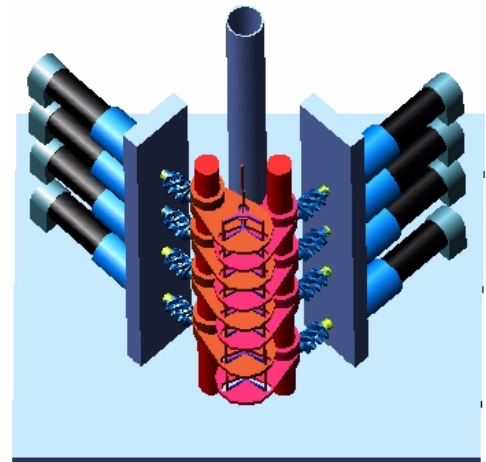
CAD Model of Polyester fiber winding machines studied by the WVU-Queretaro Team

Students modeled the rotors for one of the machines and were able to identify the changes in modal characteristics for various rotational speeds for the rotors. Banks of multiple machines are yet to be assessed in subsequent analysis.

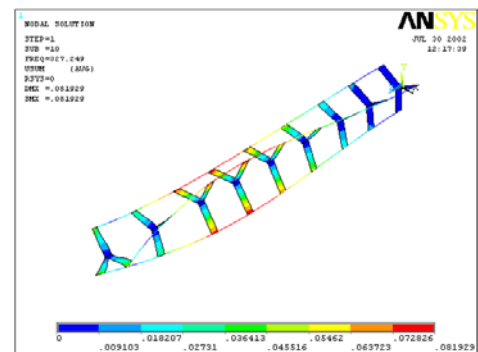


High speed rotor mode for polyester fiber production studied by the WVU-Queretaro team

Project 4. Design of a high precision balance structure for standards weights. The site was the National Center of Metrology CENAM (Mexico's NIST Equivalent). The project consisted of a conceptual design and analysis for a system for maintaining the standard for weights (up to a 100 gr), with a precision of one undredth of a milligram. The structure was to be designed to weight less than 10 gr. The balance was to operate without dynamic effects, nor magnetic or heat perturbations. Students developed a design made of composite materials (graphite-epoxy) which rendered a structure less than 9 gr. Capable of sustaining the load under the prescribed constrains.



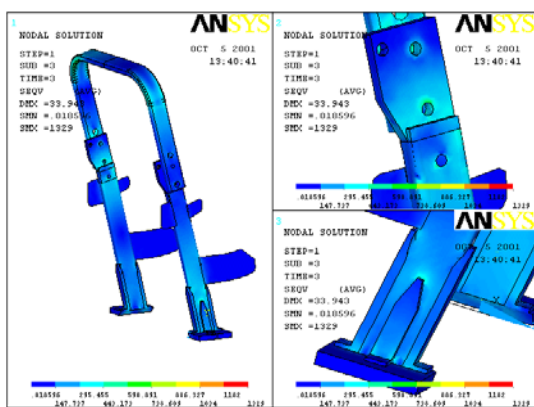
Conceptual design for a structure for a high precision balance developed by the WVU-Queretaro Team



FEM model of the supporting structure made of graphite-epoxy composite material, developed by the WVU-Queretaro Team

Project 5. Dynamic analysis of a ROPS (rollover protective structure) for an agricultural tractor.

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.



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



Tractor for which the ROPS is being designed

The model developed by the team of WVU and Queretaro students is now available for dynamic impact analyses, for the assessment of design performance under actual dynamic conditions. FEM simulations will assist in anticipating design improvements on the ROPS to dissipate the impact energy of a rollover occurrence.

Project 6. Development of a training program for operators of CNC Machinery.

The host company was **In-Mec (Engineering and Mechatronics)**, of Queretaro. This project dealt with the CNC-Machine-tool technology and its acceptance in the local industry. Currently, training programs exist to capacitate operators and technicians in the use of CNC-machine-tools, but many (if not most) of these programs lack some basic ingredients that render this technology not a widely accepted trait, specifically in the medium and small industry in Queretaro. The challenge here involved the consideration of “technology culture” issues that are necessary to incorporate in standard training programs. For example, CAD/CAM technology acceptance by older operators, economics of CNC versus conventional machines, quality and productivity and job safety were all issues that need to be addressed in training programs.

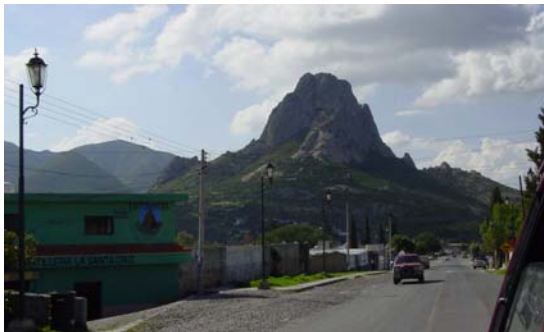
Daily Time Table (Daily)	Curriculum Type	Hr	First Quarter		Second Quarter		Third Quarter		Forth Quarter				
			Hr		Hr		Hr		Hr				
Two Hours	Operator and Technician Technical Curriculum	½	Mathematics	½	Material Sciences	½	Introduction to NC Machine Tools	½	Advanced CNC Machine Tool Process				
		½	Metrology	½	Conventional Machine Tool Basics and Machine Tool Processes	1	Introduction to CNC Machine Tools and Processes	1	Applied CNC Machine Tool Processes				
		½	Drafting	1	Computer Basics	½	Basic Technical English	½	Quality and The Machining Process				
Two Hours	Operator and Technician Cultural Curriculum	½	Introduction to Machine Tooling Industry	½	Computer Applications	½	Advanced Technical English	½	Advanced Technical English				
		½	Manufacturing Economics	½	Special Machining Processes	1	Advanced CAD	½	Advanced CAM				
		1	CNC Installation	½	Introduction to CAD	1	Introduction to CAM	½	CAD/CAM Application Project				
Time Line (Year)		J A N	F E B	M A R	A P R	M A Y	J U N	J U L	A U G	S E P	O C T	N O V	D E C

Basic training program proposed to In-Mec

In this project, the students had to visit several shops and small companies and conduct surveys and interviews with operators and technicians. They also visited and reviewed the educational programs at various technical schools, finally, students became familiar with the machine-tool components, the controls, the software and the operator manuals in order to identify the most important issues to address in the proposed program.

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.



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



Magnificent Santa Rosa Church, Queretaro City



WVU-Queretaro group visiting Teotihuacan Pyramids

Six Year Summary

After six 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 (2003), an agreement between the participating institutions will be continued, 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 in 2001 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 Tecnológico de Queretaro**. For **West Virginia University**: Dr. Eugene Cilento, Dean of the College of Engineering and Mineral Resources (**CEMR**); Dr. Donald W. Lyons, Former 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 anticipate and better yet understand cultural differences may be the difference between failure and success in professional situations in today's industry.

In an increasingly globalized professional environment and society, 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"> • West Virginia University • University of Guanajuato • University of Queretaro • Institute of Technology of Queretaro • CONCyTEQ 	<ul style="list-style-type: none"> • 47 (WVU) • 10 (UG) • 21 (UAQ) • 18 (ITQ) 	<ul style="list-style-type: none"> • 3 (WVU) • 2 (UG) • 2 (UAQ) • 2(ITQ) 	(2) GM (Gto) (4) TREMEC (Qro) (2) Transm-TSP (Qro) (1) Micro-Troq. (Qro) (3) IMT (Qro) (2) LAPEM (Gto) (2) I. TurboReact. (Qro) (1) Terramite (WV) (3) KOSA (3) New Holland (1) InMec (1) CENAM (2) ANSYS/Mexico	<ul style="list-style-type: none"> • GM • TREMEC • Transm-TSP • Micro-Troquelados • IMT* • LAPEM* • I. TurboReact. • Terramite Corp.** • New Holland • KOSA • InMec • CENAM * Research Centers ** From West Virginia	(1) GM Mexico (6) TREMEC (3) SPICER-TSP (1) Micro-Troq. (4) IMT (2) LAPEM (1) I. TurboReactors (1) Terramite Corp.** (3) KOSA (3) New Holland (1) CENAM (1) InMec ** From West Virginia
5 Institutions	96 Students	9 Faculty	27 Liaisons	12 Companies	27 Projects

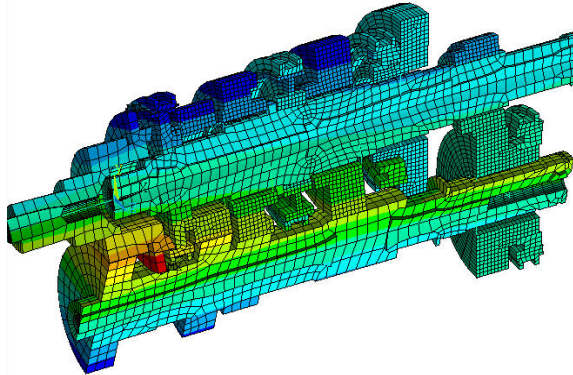
Six-year summary table of people, companies and projects developed in this Program.

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Previous Year's Projects



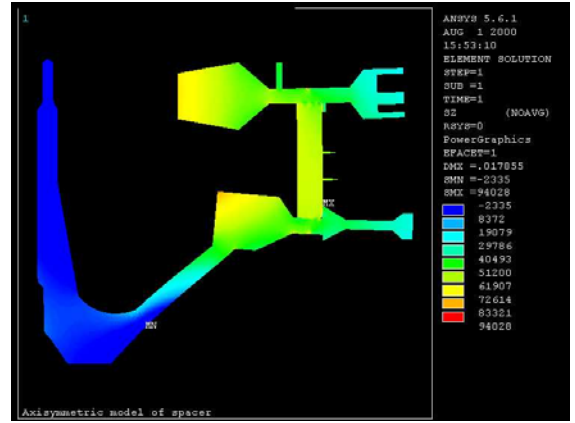
Finite element model of a gear train for dynamic analysis for TREMEC



P&W Aircraft engine being serviced by ITR



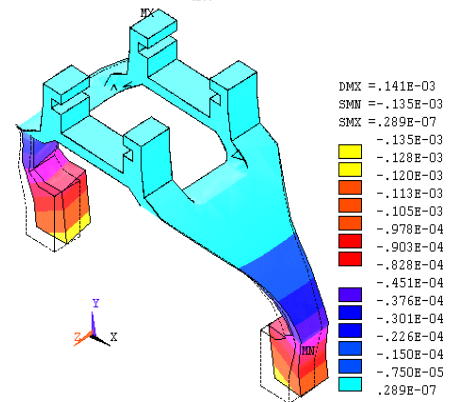
Compact construction equipment: Linkage finite element analysis for Terramite Corporation of WV



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

Join us in Queretaro 2003 !!