

## MINI-REPORT 2004

### INDUSTRIAL OUTREACH PROGRAM IN MEXICO – QUERETARO



WEST VIRGINIA UNIVERSITY  
and the  
COUNCIL FOR SCIENCE AND TECHNOLOGY  
OF QUERETARO (CONCyTEQ)

Participating Institutions:

UNIVERSIDAD AUTONOMA DE QUERETARO (UAQ)

INSTITUTO TECNOLÓGICO DE QUERETARO (ITQ)

INSTITUTO TECNOLÓGICO DE ESTUDIOS  
SUPERIORES DE MONTERREY (ITESM)



Dr. Victor Mucino surrounded by WVU and Mexican students during the 2004 Closing Ceremony.

This year, Dr. Victor Mucino took 10 WVU students to team up with 13 Mexican students in the **Industrial Outreach Program in Mexico**. This is an “Extended Learning” Program the Department of Mechanical and Aerospace Engineering (MAE) has developed in coordination with the Council for Science and Technology of the State of Queretaro (CONCyTEQ) in Mexico. During six weeks in the summer, WVU senior engineering students team up with Mexican engineering students from various universities in

Queretaro and form intermixed working groups. Each group is assigned to work at an industrial site on engineering problems, which are the tackled working alongside with engineers from industry. The environment is a professional one but with the added dimension of a cultural and a language immersion, which brings about cultures and personalities from the two countries, four institutions and as many industries involved.



Group visiting “Pena de Bernal”

### 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.

By teaming up with Mexican students, WVU students acquire a cultural exposure that is reciprocated to the Mexican students. The mix of professional environment with a different culture provides a framework that brings

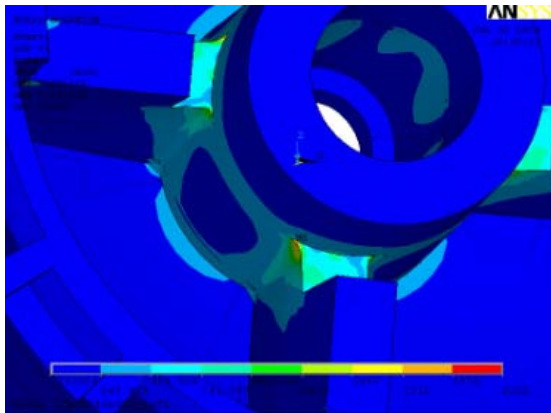
an added dimension to the whole experience. Students learn and fine-tune their engineering skills while they hone their communication and interpersonal skills. At the end of the six-week exercise, students give a professional presentation to the sponsored industries using the Spanish that they learn while working with Mexican professionals, while Mexican students deliver their presentation in English they learn with the help of our students. This is a character- building exercise that brings the cultures and personalities to the forefront of the projects. Students live with local families who provide a home away from home environment for a total cultural immersion.

### **Description of Sample Projects**

This year 8 different projects were conducted with 6 different companies, such as CIAT (General-Electric Air-Craft Engines), Arvin-Meritor, Condumex-Gabriel, MABE (General-Electric Appliances), Turboreactors-Industry (Pratt&Withney) and CENAM (Mexico's NIST). The projects ranged from design assessment and trouble shutting to industrial design process analysis and development, including fieldwork, engineering design and system modeling and analysis.

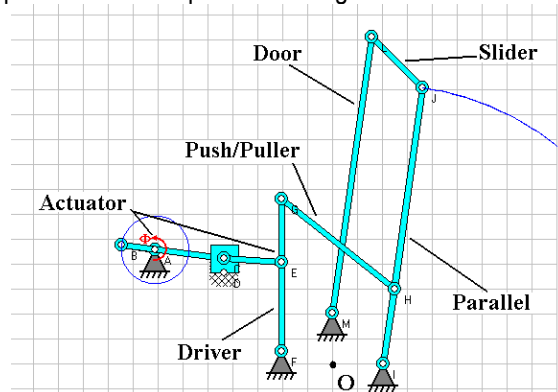
### **Project at MABE (GE-Appliances)**

Two different projects were undertaken at MABE. The first involved the design, analysis and testing of components for domestic appliances. Finite element modeling and rapid prototyping of these components were made to design specific components. The student team developed alternate designs, which were also modeled analyzed and scrutinized by Mabe's engineers.



Finite element model of components in domestic appliances.

The second project involved the kinematic synthesis of a proposed 6-link Watt mechanism for the design of a universal testing device to be used in testing the reliability of various articulated or sliding systems used in domestic appliances under repetitive loading.



Kinematic synthesis of a 6-link Watt mechanism for testing repetitive opening and closing apparatus

### **Project at CONDUMEX-Gabriel**

The student team was assigned to proposed improvements in the design of an automotive strut. Various perspectives were considered including strength characteristics, manufacturing considerations and finally cost considerations were considered.

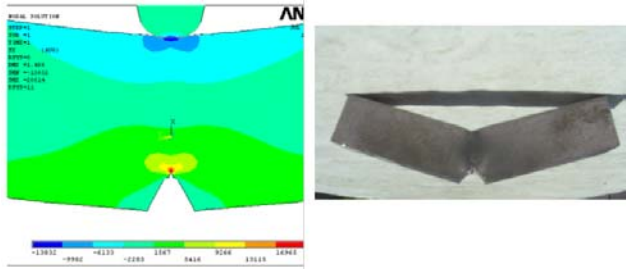


WVU and Mexican students conducting experimental tests on automotive struts at Condumex- Gabriel's plant

Finite element models were developed for the current design and alternate proposed designs to establishing a comparison frame from which the best design was selected.

### **Project at CENAM (Mexico's NIST)**

The project at CENAM involved the modeling and testing of material toughness using Charpy tests specimens for impact. The project had an experimental task as well as a computational task in which a simulation of an impact and crack propagation were conducted to characterize a specific material.

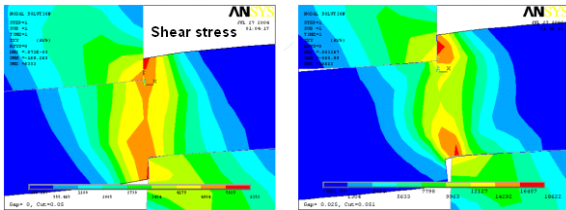


Transient impact analysis and crack propagation. Simulation and experimental verification for material toughness.

The simulation allows a more detailed description of the elastodynamic behavior of the specimen in the neighborhood of the crack and also at the tip of the impactor.

**Project at Arvin-Meritor**

Design robustness of suspension components was considered in the context of the manufacturing process and the design characteristics of the parts, the tools and materials used in the process. The student team developed a data management system for tools and designs, and considered potential improvements in the manufacturing process to improve efficiency of the industrial operation based on the mechanical analysis via finite elements of a shearing operation used in the manufacturing process for suspension parts.



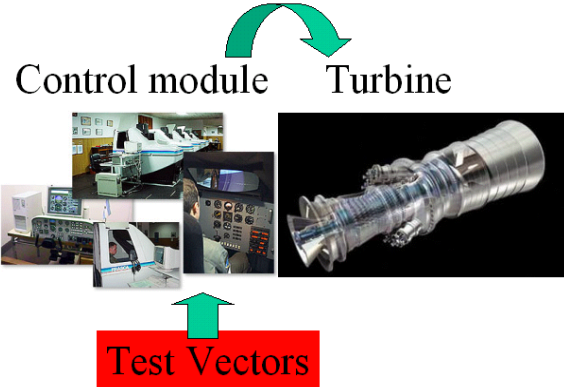
Model for the sensitivity of shear operation to shear gap



Group of students, advisors and industrial liaisons

**Project at CIAT (GE-Aircraft Engines)**

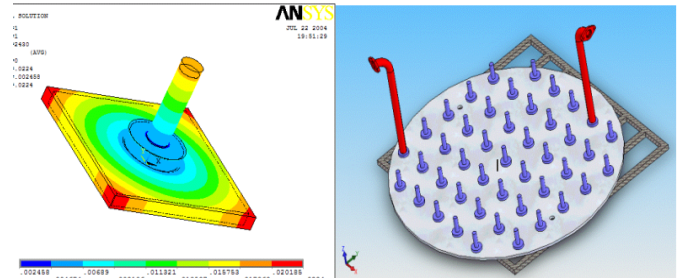
Two projects were conducted at CIAT, one dealing with a mathematical model development of the heat transfer in a turbine duct under prescribed ambient temperatures operating conditions. Students developed predictive models based on experimental data as well as finite element models to assess variations in the ambient conditions. A second project involved the development of a data management system for test vectors used in specific aircraft applications.



Control system for test vectors used in aircraft applications

**Project at ITR (Pratt & Withney)**

The student team was assigned a problem dealing with characteristics of stainless steel tools used in the heat treatment of aircraft engine components. Some of these components (tubes) are heat treated and annealed at very high temperatures and the tools used for this purpose are subjected to thermal expansions.



Heat transfer analysis of tool used for heat treatment of engine components

**8 Year Summary**

In eight years, this program has impacted more than 120 students in Mexico and WVU, through over 40 industrial projects, worked with 6 institutions in Mexico, and about 20 different industries. The summary table below provides a quick reference on the extent of this program.



**Cultural Highlights**

Cultural opportunities are plentiful throughout the six weeks. From archeological sightseeing to horse back riding outings to golden sunset in Acapulco in the company of Mexican students.

Host families also provide a major cultural opportunity, as they provide a “home away from home” environment, clean and safe environment along with some kind of an “extended family” feeling. Students learn about Mexican food, Spanish, traditions and participate fully on social activities with the friendly local people of Queretaro.

**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, but also the human dimension that comes with the territory.

Indeed, cultural differences actually exist. They come forward when people disagree, when people negotiate and when people reach agreements. Those differences are inherent 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.



WVU and Queretaro students visiting ITR



WVU Students with Mucino, enjoying the archeological site of Teotihuacan

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 Queretaro</li> <li>• ITESM (Tec. De Monterrey)</li> </ul>	<ul style="list-style-type: none"> <li>• 59 (WVU)</li> <li>• 10 (UG)</li> <li>• 25 (UAQ)</li> <li>• 23 (ITQ)</li> <li>• 3 (ITESM)</li> </ul>	<ul style="list-style-type: none"> <li>• 3 (WVU)</li> <li>• 2 (UG)</li> <li>• 2 (UAQ)</li> <li>• 3 (ITQ)</li> <li>• 2 (ITESM)</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>(3) IMT (Qro)</li> <li>(2) LAPEM (Gto)</li> <li>(2) I. TurboReact. (Qro)</li> <li>(1) Terramite (WV)</li> <li>(3) KOSA</li> <li>(3) New Holland</li> <li>(1) InMec</li> <li>(1) CENAM</li> <li>(1) ANSYS/Mexico</li> <li>(1) Irving de Mexico</li> <li>(2) Mabe</li> <li>(2) CIAT</li> <li>(2) Conduxex</li> <li>(2) Arvin Maritor</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>• InMec</li> <li>• CENAM</li> <li>• Irving- Composites</li> <li>• Crown Industries</li> <li>• Grupo SSC (ANSYS)</li> <li>• Mabe</li> <li>• CIAT</li> <li>• Conduxex*</li> <li>• Arvin Maritor</li> <li>* Research Centers</li> <li>** From West Virginia</li> </ul>	<ul style="list-style-type: none"> <li>(1) GM Mexico</li> <li>(7) TREMEC</li> <li>(4) SPICER-TSP</li> <li>(1) Micro-Troq.</li> <li>(4) IMT</li> <li>(2) LAPEM</li> <li>(2) I. TurboReactors</li> <li>(1) Terramite Corp.**</li> <li>(3) KOSA</li> <li>(3) New Holland</li> <li>(3) CENAM</li> <li>(1) InMec</li> <li>(1) Irving</li> <li>(2) Mabe</li> <li>(2) CIAT</li> <li>(1) Conduxex</li> <li>(1) Arvin Maritor</li> <li>** From West Virginia</li> </ul>
<b>6 Institutions</b>	<b>120 Students</b>	<b>12 Faculty</b>	<b>35 Liaisons</b>	<b>19 Companies</b>	<b>39 Projects</b>

8 year Summary Table



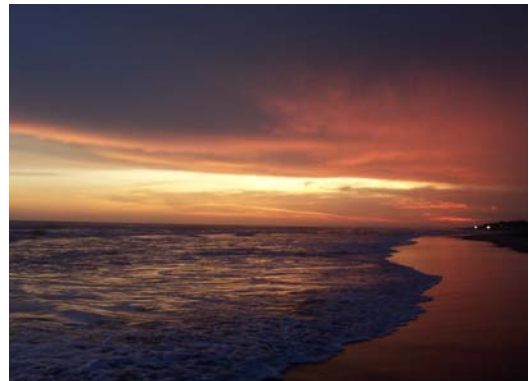
Mexican and American students with WVU advisors enjoying a final escapade to Acapulco.



Bullfight in San Miguel Allende – Guanajuato



A horseback riding outing in Tequisquiapan, Queretaro.



A golden sunset in Acapulco



Field trips with ITQ's Bus



Awaiting the sunset in the beach

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