Mechanical Support Group
High Energy Physics Division
Argonne National Laboratory

Victor Guarino P.E.

Group Leader - Mechanical Engineer

Argonne National Laboratory

High Energy Physics division

Mechanical Support Group Capabilities

- Project Management
- Structural analysis
- Finite Element modeling
- 3D solid modeling and 2D drafting
- Mechanical construction
  - Fabrication
  - Fixturing
- Machine design
- Fiber optics
- Material testing
  - Creep testing
  - Bolt strength testing
- Automatic control systems
- Safety Analysis
- Hydraulics
- Ultra-High Vacuum

Mechanical Support Group

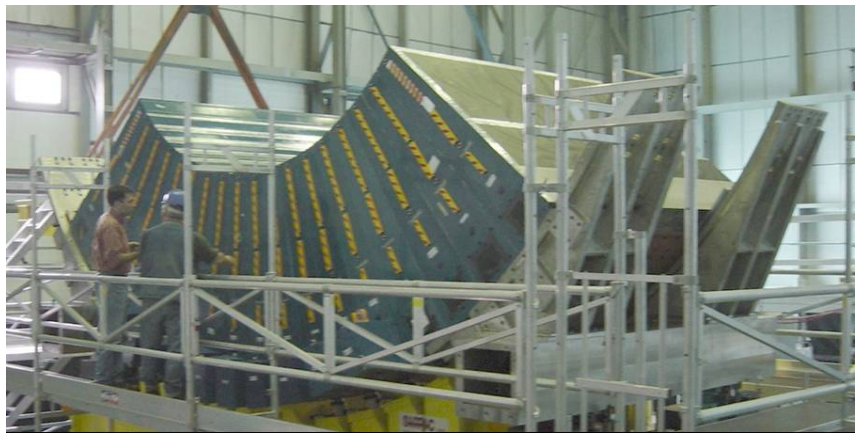
- Victor Guarino – Mech. Eng.
- Jim Grudzinski – Mech. Eng.
- Ken Wood – EA
- Frank Skrzez – EA
- Ivars Ambats – EA
- Tim Nephew – Technician
- Zelko Majijas – Technician
- Felipe Franchini – Technician
- Emil Petereit – Designer (part-time)

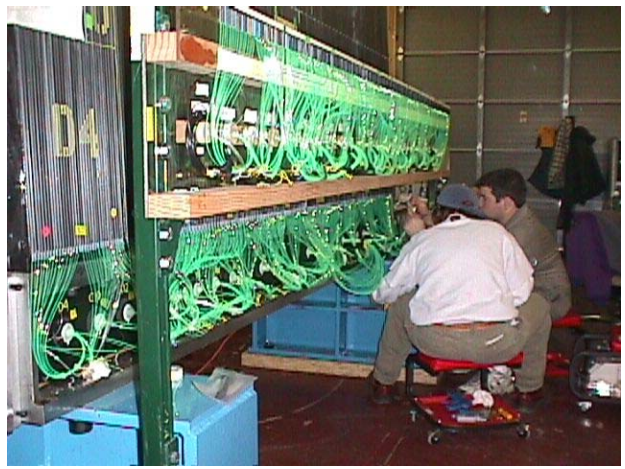
Current Experiments

- **Tile Calorimeter in ATLAS at CERN**
- **MINOS**
- **CDF Upgrade**
- **NOVA**
- **REACTOR experiment at Braidwood**
- **CHOOZ2**
- **Wakefield**

Atlas

- Supervised the fabrication of raw steel plates. (80,000 5mm thick steel plates stamped in Czech Republic using US die)
- Supervised the fabrication of welded girder in Spain which acts as main structural support.
- Constructed 65 Extended Barrel modules.
- Instrumented 65 Extended Barrel modules
- Performed the complete structural analysis for ATLAS
- Responsible for the design and implementation of the ATLAS moving system.
- Participating in support service installation
- Working with Technical Coordination on brackets and supports.





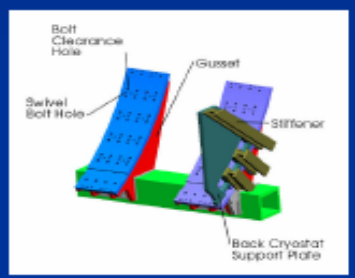
ATLAS Structural Analysis

ATLAS Tile Calorimeter Support Structure

High Energy Physics Division, Argonne National Laboratory

Pioneering Science and Technology

Argonne's High Energy Physics Division is collaborating on the LHC ATLAS experiment and was responsible for construction of a large fraction of the Extended Barrel Tile Hadron Calorimeter. HEPD is making a unique contribution to the experiment in terms of providing engineering design and analysis of much of the support structure of the calorimeter; the "saddles" on which the cylinders rest and the link plates which connect modules together. The resulting structure is entirely self-supporting .

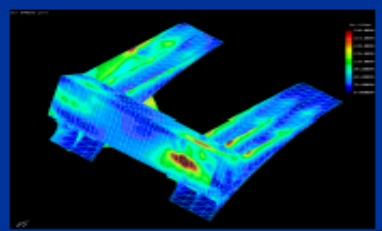


This schematic shows the main elements of the saddle. One pair of these is used to support each Extended Barrel cylinder, which is approximately 2.7m in length and 2 pairs of saddles are used to support the Barrel cylinder,which is 6m in length.

35mm diameter pins in the connecting plates between modules carry the tension load below the saddles which resists the moment from the modules above the saddles

A full pre-assembly of each cylinder will be carried out prior to final assembly in the ATLAS cavern.
The first of these is shown here. The assembled cylinder is itself over 8m high, weighs 640 tons and sits on 2 pairs of blocks below each of the saddle beams.

Modules in the region of the saddles simply rest on swivel bolts which are mounted in the holes shown.



Finite element analysis calculations were made for all connections in the structure. This figure shows the stress concentration in the saddles themselves. The stress concentration seen at the bottom of the beam results from the local load of the endcap calorimeter, which is itself supported from the tile calorimeter.

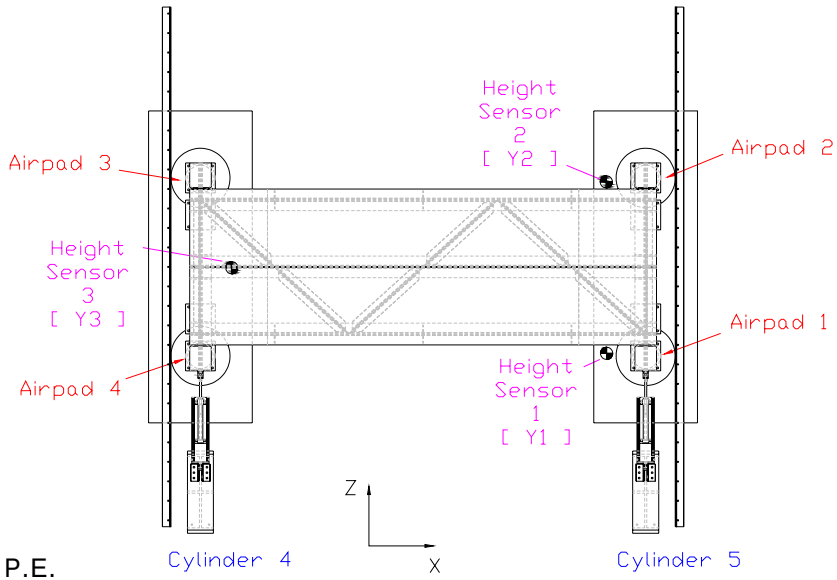
A special module for which the connecting plate is a single piece has a key which sits in the slots shown in the saddle. The key carries the vertical shear load in the cylinder which is transferred through the saddle to the ATLAS support rails..

FURTHER INFORMATION: Argonne ATLAS Projects: gate.hep.anl.gov/fpeac/atlas/atlas.htm
ATLAS Experiment: atlas.web.cern.ch/Atlas/Welcome.html

TileCal COLLABORATORS
Argonne National Laboratory plus institutions from Armenia, Brazil Belarus, Czech Republic, France, Greece, Italy, Portugal, Romania, Russia, Spain, Sweden, Slovak Republic, and the United States.

ATLAS Moving System

- Test set-up for development of control system for detector movement
- Movement control system will be used for installation and access needs of major components
  - Barrel 1800 tons
  - Extended Barrel 1000 tons
  - Toroid Endcap 350 tons
  - JD 120tons
- Control system for Horizontal motion and vertical leveling control
- Automated system
  - Touch screen user interface
  - DAQ interface
  - 3-4 axis closed loop control of motion via PLC
  - 11 pressure sensors, 6 position/angle sensors
  - 10 hydraulics valves (4 proportional,3 check, 3 on/off)
  - Significant error detection routines for user and detector safety



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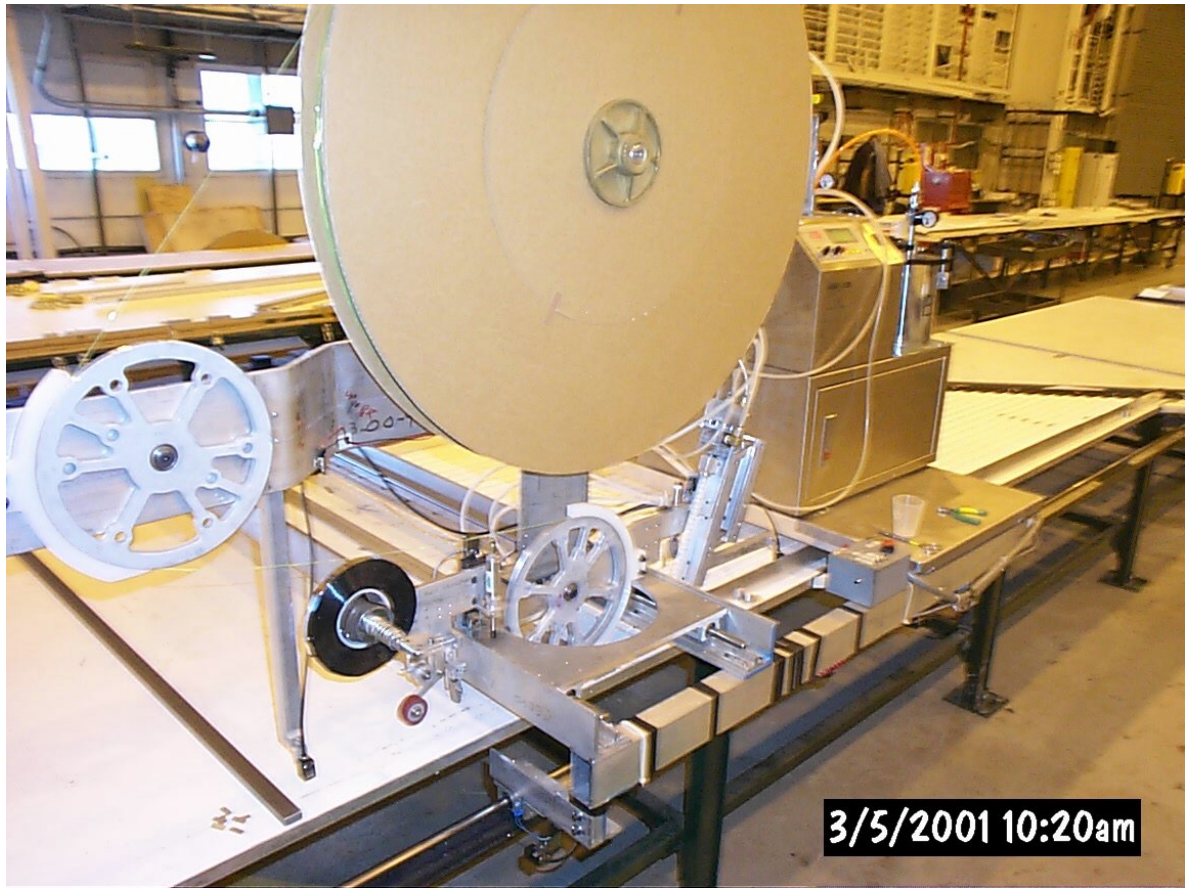
MINOS

- Designed and fabricated the production equipment used to fabricate modules
  - Scintillator cutting station
  - Forming Station
  - Assembly trays
  - Module curing racks
  - Fiber gluing machine
  - Connector flycutter
  - Module Source Mapper
- Fabricated near detector modules
- Helped to design module components
- Performed R&D on Scintillator extrusions

Fiber Gluing Machine

- PLC controlled semi-automatic operation
- Applies epoxy, fiber, and tape in single operation
- Operator controls on both sides of carriage
- Accommodates 8 different type of module geometry
- Fiber and glue dispensing tracks scintillator groove



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REACTOR at Braidwood

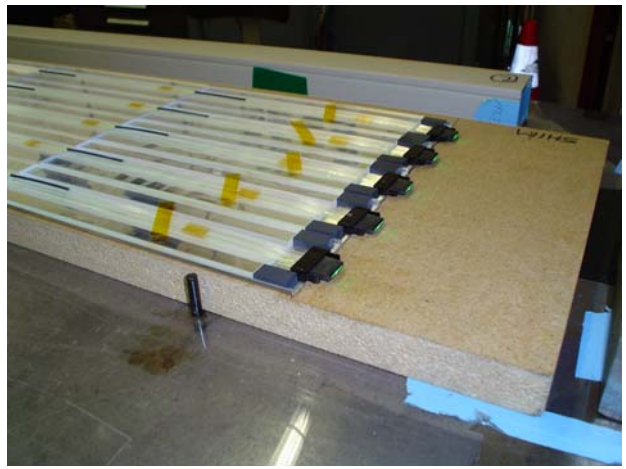
- Working on Site selection
- Developed baseline design
- Performing research on construction using acrylic
- Doing R&D on liquid Scintillator, filling, and handling.

- Baseline report can be found at:

http://www.hep.anl.gov/vjg/

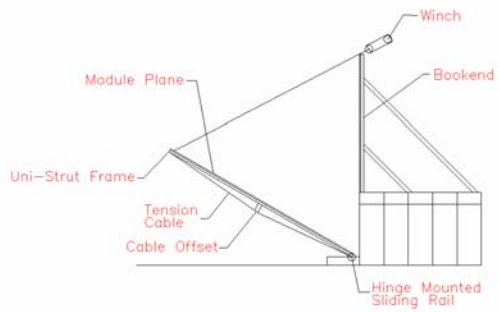
CDF Upgrade

- Designed and constructed CPR and CCR modules.
  - Optimized design for minimum deflection with maximum scintillator volume.
  - Developed fixturing and assembly techniques for efficient production
  - Mounting details
  - Tests of bond strengths, bond creep, module deflection
- Constructed 56 CPR modules, 56 CCR modules



NOVA

- Performing Structural Analysis of proposed structure
- Conducting tests on materials
- Constructed large particle board prototype
- Currently constructing a 27ft. x 15ft. Four plane prototoype.
- Conducting PVC and epoxy evaluations.



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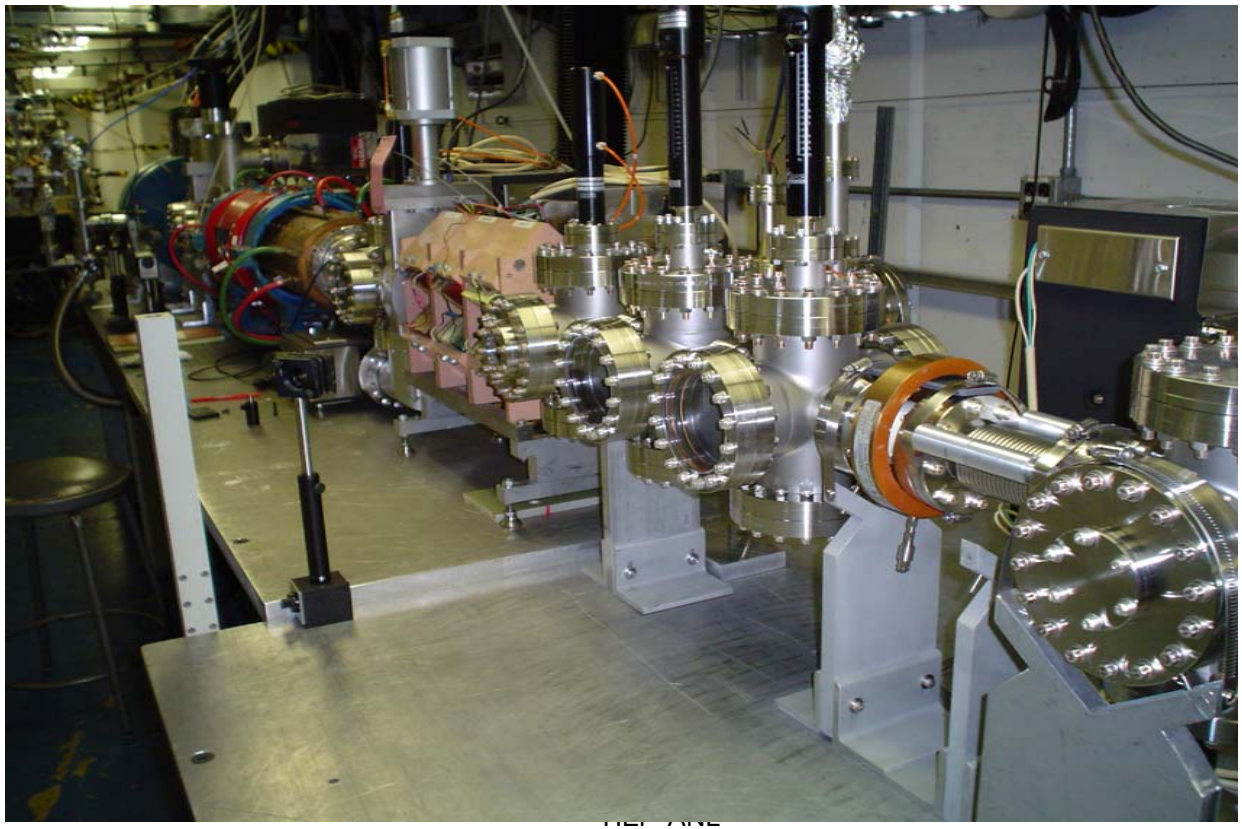
CHOOZ2

- Developing baseline Veto shield design.
- Providing mechanical engineering support
- Developing costs for proposed Veto shield

Wakefield

- Provide engineering services
- Technician support.



Conclusion

- Mechanical engineering and construction are central to the success of any HEP experiment today.
- ANL is often I a position to provide major mechanical engineering and construction of the larger components of an experiment to complement the work of university collaborators.
- Although currently modest in size, the Mechanical Support group has a broad range of skills and capabilities needed by high energy physics.
- ANL Mechanical Support has been a central component of the success of ANL's past experiments and are at the center of much of the work of exploring and preparing for the next generation of experiments.