

Large Payload Structural Dynamics Lab

Technical Center Building D



Caterpillar's emphasis on lean product and process development drives the need for integrated system level testing to feed simulation models and to minimize expensive total machine development.

Technical Center Building D is a new Large Payload Structural Dynamics Laboratory, which provides increased product structural durability validation capability for light fabrications in our machine product line. Structural durability tests conducted in Building D will provide simulation model input data and verification data, increasing the confidence in simulation to evaluate structural durability of machine and component systems including after-treatment packages, complete cabs, cooling structures, tanks, enclosures, and other light fabrications. Multi-axis simulation tables (often referred to as shake tables) such as those constructed in Building D accelerate durability testing of components and systems to significantly reduce expensive field endurance testing. This lean, accelerated testing increases the throughput of product development.

Construction of the new laboratory was completed in April 2009, marking the end of more than 18 months of detailed project work involving both integrated test equipment and building design as well as construction.



Key Facts:

- Building footprint = 10,698 sq ft
- Commissioned in May 2009
- Accelerated testing replicates 20 hours of machine damage in 1 hour of "shake" testing
- Building has two six degree of freedom test rigs
- Largest test payload has 35,000 lb capacity
- Smaller test rig has 7,500 lb payload capacity
- Largest actuators are equivalent to those used in Earthquake simulation labs
- Building includes two seismic masses with 8.2 million pounds of concrete to absorb dynamic loads



Power System Simulators (PS2) Technical Center Building G



Caterpillar's push to meet regulations creates the need for high velocity product development that is not dependent on field assessments, improves simulation and develops understanding that is leveraged across product lines.

Powertrain System Simulators enable us to run powertrains just as if they were installed in a machine and operating in a real world environment.

The powertrain consists of the:

- Engine
- Transmission
- Aftertreatment
- Hydraulic pumps
- All electronic control modules

Previously, we had to put this into a machine in order to give it operator commands that changed depending on the responsiveness of the powertrain. Computer models of the implement loads and the terrain where the machine is operated impose forces on the powertrain that mimic what would happen in a real machine.

Changes in the powertrain and controls will result in changes in the operation and the time it takes to complete an event like loading a truck. This determines performance differences including productivity and the cost of operation. The ability to assess the change in time of completing an event is a major improvement over the previous Drivetrain Simulators.

The programmable terrain lets us change things like the grades the machine must

travel on, the turns it must make and the path the bucket must travel to move material.

We can evaluate road construction, building construction, site development, quarries, mines, material handling and other work without any physical changes or moves by a quick loading of a different computer program. The data is fed to simulation to improve our models and understanding.



Key Facts:

- Five PS2s exist at Caterpillar
- Powertrain mounted on pallets for quick turnover
- Entire product line capability
- 300 data channel capability
- High velocity development on highly technical complex systems
- Thousands of complex algorithms, built by Caterpillar technical experts, simulate machine interaction within real customer applications
- Technology enabling technology. Virtual simulation married with next generation hardware – PS2
- Iterations hours and days - not weeks and months
- Optimized customer solutions prior to machine implementation
- T4 Engine
- Transmissions
- Aftertreatment
- Hydraulics
- Electronics
- Integrated controls

Cat® Clean Emissions Module (CEM)



The CEM simplifies aftertreatment installation with a flexible design that allows mounting in several possible configurations.



Key Facts:

- Minimizes impacts on fuel efficiency during regeneration
- Flexible regen options maximize uptime
- Minimum 4500 hour ash service
- Optimum flexibility for installation mounting options
- Multiple module options sized to engine output
- Multiple ash cleaning methods for optimum serviceability
- Designed with no additional installation impact at Tier 4 Final/Stage IV

C9.3 Tier 4 Interim/ Stage IIIB Engine



Through years of proven results with ACERT™ Technology, Caterpillar has provided the broadest range of emissions technology solutions in the industry with a full range of fuel system, engine system, aftertreatment, machine system design and integration capabilities.

Cat® Tier 4 Interim/Stage IIIB compliant engine platforms utilize the full complement of ACERT™ Technologies to achieve a significant 90 percent reduction of Particulate Matter (PM) and a 50 percent reduction of Oxides of Nitrogen (NOx).



Key Facts:

- 225-410 hp (168-305 kW)
- Capable of peak power over 440 hp (328 kW)
- Comparable dimensions and connection points to C9 ACERT™ (Tier 3)
- Common rail fuel system
- Electric priming pump
- Improved fuel consumption by up to 5%
- Pre engineered Cat Clean Emissions Module
- Cat® NOx Reduction Systems (NRS)
- Fully integrated Cat® Electronics
- Improved Starting Capability

Caterpillar Machine Development Center



Opened for business in October 2008, the Machine Development Center (MDC) at the Peoria Proving Ground (PPG) has come to symbolize a new era of validation capability and quality assurance for Caterpillar.

The MDC is the first facility of its kind at Caterpillar, enabling year-round, 24-hour, 7-day machine and instrumentation testing. It provides an unprecedented opportunity to validate our up-front predictions and systems level validation at the Machine Level to ensure we deliver on our performance and quality commitments.

The impetus for the MDC came from PPG's own employees. Anticipating a surge in development work generated by New Product Introductions in preparation for Tier 4 emissions regulations, a group of operators and engineers created the concept for an indoor arena to address testing delays caused by weather and nightfall. Estimates suggest that in the 60-year history of PPG approximately 15 years of productivity have been lost as a result of inclement weather.

A state-of-the-art Instrument Application Center adjoins the MDC and provides support for installation of data acquisition and telemetry equipment used in conjunction with testing and machine validation. The wireless Data Communication System is capable of handling over 25 separate machines operating simultaneously and generating live streaming video and sensor data.

Since its grand opening in late 2008, the MDC has enabled cooling system validation tests, multiple comparative performance evaluations and structural validation with greatly improved consistency and repeatability. The improved control of soil properties (such as moisture and density) and ambient operating conditions are key to accurate machine validation.

Key Facts:

- 150,000 sq. ft. under roof, 3.75 acres
- 41' ceiling height allows load/dump cycle for large excavators and quarry and construction trucks
- 4200 data channel acquisition and analysis capability
- Working soil working depth of > 50 ft for excavator development and hill simulations
- Soil is "reconditioned" with moisture and compaction for improved data quality

