FY04 Technical Program Summary

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Vehicle Technology Directorate -
Langley Site
US Army Research Laboratory
at
NASA Langley Research Center
Hampton, VA 23681-0001

The ARL Vehicle Technology Directorate at the Langley Research Center conducts research in two business areas:

Structural Mechanics and
Loads & Dynamics

Program areas funded under these technical competencies include basic (6.1) and applied (6.2) research in Aviation Technology and Ground Vehicle Technology. The following "Table of Contents" outlines the organization of the work packages and individual research projects within this document.

Aviation Loads & Dynamics Research - 6.1 - 61102 / AH66 / VS1015

VS1015.AL05	Aeroelastic Modeling of Advanced Rotor Configurations
VS1015.AL06	High Performance Piezoelectric Actuator Development
VS1015.AL07	Lightweight Multifunctional Structural Components Development
VS1015.AL08	Fuselage Dynamics and Tail Buffet
VS1015.AR01	Structural and Material Characteristics of Biological Morphologies
VS1015.DC01	Crashworthiness of Composite Frames and Floor Sections
VS1015.DR14	Modeling of Thin Membrane Structures

Ground Vehicle Loads & Dynamics Research - 6.1 - 61102 / AH42 / VS1016

VS1016.DC02	Nonlinear Mechanics of Elastomeric and Composite Structures

Aviation Structural Mechanics Technology - 6.2 - 62211 / A47B / VS2011

VS2011.CA02	SARAP Crash Safety Research Program
VS2011.CD01	Damage Initation and Growth Studies in Tailored Laminates
VS2011.IC02	Skin/Stiffener Debonding Analysis Methods
VS2011.IC03	Exploratory Research on Adaptive Sensors for Composite Rotorcraft
VS2011.IC04	Failure of Rigid Foams
VS2011.IF04	Z-pin Reinforcement Analysis
VS2011.IF08	Fatigue Life Methodology of Metallic Rotorcraft Dynamic Components
VS2011.IF11	Impact Damage Resistance & Tolerance of Thin Skin Composite Sandwich Structure
VS2011.IF12	Reliability-Based Design Methods
VS2011.IN01	Composite Thermal Nondestructive Evaluation
VS2011.IN07	SARAP NDE/Reparability Program

Ground Vehicle Structural Mechanics Technology - 6.2 - 62105 / AH84 / VS2012

VS2012.CA01	Research on Ground Combat Vehicles
VS2012.CA02	Buckling - Vibration Interaction
VS2012.CA03	Analysis of Structural Joints for Ground Vehicles
VS2012.CA04	Inflatable Structures
VS2012.CD01	Selective Reinforcement of Aluminum Structures
VS2012.CD02	Multi-Functional Structures
VS2012.IN07	NDE of Composite Structures Using Laser Ultrasonics
VS2012.IN12	NDE of Electrical Wire Insulation Using Ultrasonics

Aviation Loads & Dynamics Technology - 6.2 - 62211 / A47B / VS2015

VS2015.AA02	High-Speed Aeroelastic Research Models
VS2015.AE03	High-Voltage Electrical Systems
VS2015.AL04	Experimental Investigation of Active Twist Rotor Concepts for Vibratory Load Reductio
VS2015.AL05	Analysis and Design of Active Twist Rotor Blades
VS2015.DC08	Innovative Composite Fuselage Design for Improved Crashworthiness
VS2015.DC09	Soft Soil - Water Impact
VS2015.DC11	Crash Simulation of an ATR42 Aircraft
VS2015.DT01	Applications of Structural Tailoring Concepts

Ground Vehicle Loads & Dynamics Technology - 6.2 - 62105 / AH84 / VS2016

Date Last Modified: 06-JAN-04

BUSINESS SUBAREA: 6.2 STRUCTURAL MECHANICS

PE/PRJ/WP#/WP: 62105 AH84 VS2012 Ground Vehicle Structural Mechanics Technology

DIRECTORATE/DIVISION ARL Vehicle Technology Directorate Structural Mechanics

POC/PHONE: Dr. F. D. Bartlett, Jr. (757) 864-3952

THRUST:

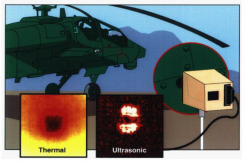
Applied and exploratory structural mechanics research to develop and validate advanced structural analysis design tools and nondestructive evaluation methods for thick metallic and composite structures, including multi-layered hybrid armor/structures.

New concepts and structural analysis methods for thick composites and multi-layered armor/structures in support of Army STOs and ATDs.

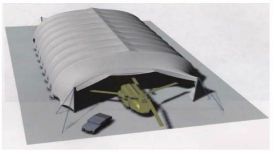
OBJECTIVES:

* Apply advanced structural analysis methods to composite/hybrid structures and validate design tools for accurate loads and stress analysis.
* Incorporate composite delamination failure criteria for strength and failure predictions to evaluate static/fatigue limits of thick composite structures.
* Apply and validate advanced NDE methods for field inspection of thick composites and "hidden" structures.
* Transfer NDE technology to TACOM through TPAs and to the ground vehicle industry through CRDAs.

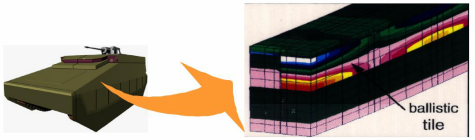
PORTABLE NDI FOR COMPOSITES



MAINTENANCE SHELTERS



MULTI-LAYERED COMPOSITES STRUCTURAL INTEGRITY



PROGRAM SCHEDULE:

RESEARCH STUDIES	2003	2004	2005	2006	2007
Research on Ground Combat Vehicles	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪
Buckling - Vibration Interaction	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪
Analysis of Structural Joints for Ground Vehicles		▪▪▪▪			
Inflatable Structures	▪▪▪▪	▪▪▪▪	▪▪▪▪		
Selective Reinforcement of Aluminum Structures		▪▪▪▪	▪▪▪▪	▪▪▪▪	
Multi-Functional Structures		▪▪▪▪	▪▪▪▪	▪▪▪▪	
NDE of Composite Structures Using Laser Ultrasonics	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪
NDE of Electrical Wire Insulation Using Ultrasonics	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪	▪▪▪▪

FY04 KEY DELIVERABLES:

* Investigate influences of load introduction associated with combined loading of elastically-tailored structures.
* Conduct a parametric studies of anisotropy effects on the dynamic response of composite panels.
* Analyze joint designs used in FCS concepts and establish design criteria for improved structural joint designs.
* Assess and develop improved techniques for global modeling of structural joints.
* Develop a pressurized beam finite element for use in a commercial FE code.
* Conduct fatigue crack growth investigation of selectively reinforced materials.
* Complete characterization of microstrip antennas having ultrathin dielectric layers.
* Apply laser-based ultrasonic techniques to inspect carbon-carbon composite material and rotorcraft composite samples.
* Assemble a prototype ultrasonic wire NDE tool to quantify wire insulation degradation.

This chart covers Fiscal Year 2004

Business SUBAREA:	6.2		STRUCTURAL MECHANICS	
PE/PRJ/WP#/WP:	62105	AH84	VS2012	Ground Vehicle Structural Mechanics Technology

Workyears	2003	2004	2005	2006	2007
ARMY	3.15	4.4	4.4	3.9	2.9
NASA	.8	1.9	1.4	1.3	.8
OTHER	.65	1.25	1.15	.5	0

STRUCTURAL MECHANICS

OBJECTIVE

The objective of Workpackage VS2012 is to develop and validate an integrated structural integrity and composites design technology which provides superior design tools and concepts to the US ground vehicle industry and Army user community. The focus of the current S&T is on the development of advanced structural analysis design tools and nondestructive evaluation methods for thick composites, structures with joints and multi-layered integrated armor/structures.This applied research supports FCS-related STOs.

APPROACH

Lightweight armor, advanced structural concepts, improved ballistic performance, more durable structures, low-cost manufacturing, and reduced O&S costs are essential to meeting the vehicle performance and affordability goals of the next generation of Army ground vehicles. Incorporating advanced materials such as lightweight metals, ceramics, composites, and energetic materials requires advances in structural modeling and inspection methods to accurately predict and measure structural response. The VTD addresses these technology and capability needs by providing new and improved nondestructive evaluation (NDE) methods for FCS vehicle concepts. The research focuses on advanced inspection methods for complex armor/structure configurations to: (1) make sure that a practical inspection capability is integrated with the vehicle design process; (2) provide quality assurance during manufacture; and (3) guarantee reliability, durability, and safety for vehicle operations and support. Structures research is also investigating functionally-graded, elastically-tailored and multi-functional structural configurations to evaluate potential benefits in armored ground combat vehicles by reducing weight while improving vehicle performance. A better understanding of joining methods and joint design is needed to design and build ground vehicles utilizing lightweight armor concepts. Thus, the in-house research develops and validates advanced structures technologies that focus on improved damage tolerance, durability, and reliability of innovative armor/structure configurations.

SIGNIFICANCE

The deliverables of this Work Package are analysis methods, hardware, technical data, and design criteria for the US ground vehicle developers and users. The benefits of this research are validated inspection methods and design tools for advanced lightweight armor/structure vehicle concepts. These products ensure the capability of US defense contractors to design and build lightweight, durable, safe, and low-cost ground combat vehicles essential for meeting Objective Force requirements. Furthermore, this technology will provide the Army user community with needed maintenance and inspection procedures for operating and supporting fielded systems.