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Research Reports

Reports are listed by their corresponding report numbers starting with the most recent published document. Click on the "Report Number" for a pdf copy of the report, if available. Additionally, all these reports are also available to the U.S. public through the National Technical Information Service in Springfield VA.

RESEARCH & DEVELOPMENT (R&D;) REPORTS

REPORT NUMBER	TITLE
DOT/FRA/ORD-04/13.i	Supporting Railroad Roadway Worker Communications with a Wireless Handheld Computer: Volume I - Usability for the Roadway Worker
DOT/FRA/ORD-04/13.ii	Supporting Railroad Roadway Worker Communications with a Wireless Handheld Computer: Volume II - Impact on Dispatcher Performance
DOT/FRA/ORD-04/11	Impact of Data Link Technology on Railroad Dispatching Operations
DOT/FRA/ORD-04/03	Proceedings of the Human Factors Workshop: Improving Railroad Safety Through Understanding Close Calls
DOT/FRA/ORD-03/29	Gage Restraint Measurement System Comparison Tests: Railbound and Hi-Rail Vehicles
DOT/FRA/ORD-03/24	Estimation of Residual Stresses in Railroad Commuter Cars Wheels Following Manufacture
DOT/FRA/ORD-03/21	Railroad Tank Relief Valve Requirements for Liquid PIH Lading
DOT/FRA/ORD-03/18	Passenger Train Grade Crossing Impact Tests: Test Procedures, Instrumentation and Data
DOT/FRA/ORD-03/17.i	Passenger Rail Train-to-Train Impact Test Volume I Overview and Selected Results
DOT/FRA/ORD-03/17.ii	Passenger Rail Train-to-Train Impact Test Volume II Summary of Occupant Protection Program
DOT/FRA/ORD-03/17.iii	Passenger Rail Train to Train Impact Test Volume III Test Procedures, Instrumentation, and Data
DOT/FRA/ORD-03/16	Catalog of "Common Use" Rail Corridors
DOT/FRA/ORD-03/15	Human Reliability Analysis in Support of Risk Assessment for Positive Train Control
DOT/FRA/ORD-03/12	Railroad Dispatcher Communications Training Materials
DOT/FRA/ORD-03/11	Vertical Track Modulus in Plastic Composite Tie Test Zones at FAST
DOT/FRA/ORD-03/09	Selection of Railroad Dispatcher Candidates
DOT/FRA/ORD-03/07	Evaluation of Concepts for Locomotive: Crew Egress
DOT/FRA/ORD-03/06	Commuter Rail Seat Testing and Analysisof Facing Seats
DOT/FRA/ORD-03/04	Evaluation of Alternative Detection Technologies for Trains and Highway Vehicles at Highway Rail Intersections
DOT/FRA/ORD-02/03	Locomotive Crashworthiness Research: Locomotive Crew Egress Evaluation
DOT/FRA/ORD-02/01	Rail Commuter Vehicle Curving Performance
DOT/FRA/ORD-01/23	Locomotive Crashworthiness Research: Modeling, Simulation, and Validation
DOT/FRA/ORD-01/21.i	Evaluation of Semi-Empirical Analyses for Railroad Tank Car Puncture Velocity, Part I: Correlations with Experimental Data

DOT/FRA/ORD-01/21.ii	Evaluation of Semi-Empirical Analyses for Railroad Tank Car Puncture Velocity, Part II: Correlations with Engineering Analyses
DOT/FRA/ORD-01/20	An Examination of Railroad Yard Worker Safety
DOT/FRA/ORD-01/18	Progress in Rail Research Integrity Research
DOT/FRA/ORD-01/16	Fire Safety of Passenger Trains Phase II: Application of Fire Hazard Analysis Techniques
DOT/FRA/ORD-01/08	A Preliminary Examination of Railroad Dispatcher Workload, Stress, and Fatigue
DOT/FRA/ORD-01/07	Safety of Railroad Passenger Vehicle Dynamics: OMNISIM Simulation and Test Correlations for Passenger Rail Cars
DOT/FRA/ORD-01/05	Safety of Railroad Passenger Vehicle Dynamics: Final Summary Report
DOT/FRA/ORD-01/02	Understanding How Train Dispatchers Manage and Control Trains - Results of a Cognitive Analysis
DOT/FRA/ORD-00/07	Recognition of Rail Car Retroreflective Patterns for Improving Nighttime Conspicuity
DOT/FRA/ORD-00/06.ii	Acoustic Detection of Railcar Roller Bearing Defects: Phase II, Field Test Report
DOT/FRA/ORD-00/06.iii	Acoustic Detection of Rail Car Roller Bearing Defects: Phase III, System Evaluation Test
DOT/FRA/ORD-00/04	Switching Operations Fatality (SOFA) Analysis: Findings and Recommendations of the SOFA Working Group
DOT/FRA/ORD-00/02.i	Single Passenger Rail Car Impact Test Volume I: Overview and Selected Results
DOT/FRA/ORD-00/02.ii	Single Passenger Rail Car Impact Test Volume II: Summary of Occupant Protection Program
DOT/FRA/ORD-00/02.iii	Single Passenger Rail Car Impact Test Volume III: Test Procedures, Instrumentation and Data
DOT/FRA/ORD-99/13	Evaluation of a Top-of-Rail Lubrication System
DOT/FRA/ORD-99/11	Assessment of Potential Aerodynamic Effects on Personnel and Equipment in Proximity to High-Speed Train Operations: Safety of High-Speed Ground Transportation Systems
DOT/FRA/ORD-99/10	Railroad Horn Systems Research
DOT/FRA/ORD-99/09	Compliance with Railroad Operating Rules and Corporate Culture Influences: Results of a Focus Group and Structured Interviews
DOT/FRA/ORD-99/05	Non-Accident Release of Hazmat from Railroad Tank Cars: Training Issues

DOT/FRA/ORD-99/03	Risk/Benefit Assessment of Delayed Action Concept for Rail Inspection
DOT/FRA/ORD-99/02	Improving Railroad Safety and Rail Passenger Technology through Targeted Research and Demonstrations, 1992-1997
DOT/FRA/ORD-99/01	Fire Safety of Passenger Trains Phase I: Material Evaluation (Cone Calorimeter)
DOT/FRA/ORD-98/11	Freight Car Reflectorization
DOT/FRA/ORD-98/08	Training Requirements for Railroad Dispatchers: Objectives, Syllabi and Test Designs
DOT/FRA/ORD-98/07	Estimation of Rail Wear Limits Based on Rail Strength Investigations
DOT/FRA/ORD-98/06	Propagation Analysis of Transverse Defects Originating at the Lower Gage Corner of Rail
DOT/FRA/ORD-98/04	Field Evaluation of a Wayside Horn at a Highway-Rail Grade Crossing
DOT/FRA/ORD-98/03	Human Factors Guidelines for Locomotive Cabs
DOT/FRA/ORD-97/10	Crashworthiness of Passenger Trains Safety of High-Speed Ground Transportation Systems
DOT/FRA/ORD-97/09	The Effects of Work Schedule on Train Handling Performance and Sleep of Locomotive Engineers: A Simulator Study.
DOT/FRA/ORD-97/08	Rail Vehicle Crashworthiness Symposium
DOT/FRA/ORD-96/09	Human Factors Phase II: Design and Evaluation of Decision Aids for Control of High-Speed Trains: Experiments and Model
DOT/FRA/ORD-96/08	Crashworthiness Testing of Amtrak's Traditional Coach Seat. Safety of High-Speed Ground Transportation Systems
DOT/FRA/ORD-95/14.2	Driver behavior at rail-highway grade crossings: A signal detection theory analysis.
DOT/FRA/ORD-95/13	Safety of Highway-Railroad Grade Crossings: Use of Auxiliary External Alerting Devices to Improve Locomotive Conspicuity
DOT/FRA/ORD-95/08	Locomotive Crashworthiness Research Executive Summary
DOT/FRA/ORD-95/08.i	Locomotive Crashworthiness Research Volume 1: Model Development and Validation
DOT/FRA/ORD-95/08.ii	Locomotive Crashworthiness Research Volume 2: Design Concept Generation and Evaluation

DOT/FRA/ORD-95/08.iii	Locomotive Crashworthiness Research Volume 3: Freight Locomotive Crashworthiness Concepts
DOT/FRA/ORD-95/08.iv	Locomotive Crashworthiness Research Volume 4: Additional Freight Locomotive Calculations
DOT/FRA/ORD-95/08.v	Locomotive Crashworthiness Research Volume 5: Cab Car Crashworthiness Report
DOT/FRA/ORD-93/25	The Safety of Highway-Rail Grade Crossings: Study of the Acoustic Characteristics of Railroad Horn Systems
DOT/FRA/ORD-93/02.i	Collision Avoidance and Accident Survivability Volume 1: Collision Threat
DOT/FRA/ORD-93/02.ii	Collision Avoidance and Accident Survivability Volume 2: Collision Avoidance
DOT/FRA/ORD-93/02.iii	Collision Avoidance and Accident Survivability Volume 3: Accident Survivability
DOT/FRA/ORD-93/02.iv	Collision Avoidance and Accident Survivability Volume 4: Proposed Specification
DOT/FRA/ORD-92/17	Engineman Stress and Fatigue: Pilot Tests

RAILROAD DEVELOPMENT (RDV) REPORTS

REPORT NUMBER	TITLE
DOT/FRA/RDV-02/02	Five-Year Strategic Plan for Railroad Research, Development, and Demonstrations
DOT/FRA/RDV-00/05	Assessment of Risks for High-Speed Rail Grade Crossings on the Empire Corridor Next Generation High-Speed Rail Program
VNTSC-RR897-PM-98-22	Evaluation of Retroreflective Markings to Increase Rail Car Conspicuity - Safety of Highway-Railroad Grade Crossings

MAGNETIC LEVITATION (MAGLEV) REPORTS

REPORT NUMBER	TITLE
VNTSC-FRA-02-13	Noise Characteristics of the Transrapid TR08 Maglev System
VNTSC-FRA-02-11	Electromagnetic Field Characteristics of the Transrapid TR08 Maglev System
VNTSC-FRA-02-06	Vibration Characteristics of the Transrapid TR08 Maglev System
VNTSC-RR994-PM-99-1	Passenger Acceptance of Alignments with Frequent Curves in Maglev or Other Very-High-Speed Ground Systems

TECHNICAL PAPERS

TITLE	ABSTRACT

"Reliance" and "Distraction" Effects in PTC Automation This document was requested on 3/3/99 by the PTC Human Factors Team of the Federal Rail Administration (FRA) as part of the ongoing discussions of PTC standards.	Questions have been raised about the possible propensity for a locomotive engineer or conductor to become over-reliant on PTC automation and/or to become distracted by the additional monitoring burdens required by the automation, and for these effects to compromise the performance of their duties and for safe and efficient train operation.
Rail Passenger Equipment Accidents and the Evaluation of Crashworthiness Strategies Paper presented at 'What Can We Realistically Expect From Crash Worthiness? Improving Train Design to Withstand Future Accidents', Institute of Mechanical Engineers Headquarters, London, England, May 2, 2001.	The approach taken in conducting this research has been to review relevant accidents, identify options for design modifications to improve occupant survivability, and to apply analytic tools and testing techniques for evaluating the effectiveness of these strategies.
U.S. Rail Equipment Crashworthiness Standards Paper presented at 'What Can We Realistically Expect From Crash Worthiness? Improving Train Design to Withstand Future Accidents', Institute of Mechanical Engineers Headquarters, London, England, May 2, 2001.	These new regulations and standards include conventional strength-based requirements for equipment used below 200 kph (125 mph), crash-energy management for equipment used above 200 kph (125 mph), and dynamic sled testing of occupant seats.
Development of a Hazard-Based Method for Evaluating the Fire Safety of Passenger Trains Reprinted from InterFlam '99, 8th International Fire Science and Engineering Conference. Proceedings. June 29 - July 1, 1999, Edinburgh, Scotland.	The fire safety of U.S. passenger rail trains currently is addressed through small-scale flammability and smoke emission tests and performance criteria promulgated by the FRA using modeling techniques.
Alternative Analyses of Locomotive Structural Designs for Crashworthiness Presented at the International Mechanical Engineering Congress and Exposition, November 6, 2000, Orlando, Florida.	Enhanced crashworthiness performance of North American locomotives is proposed by both increasing the design loads on specific structural components or by describing the crashworthiness performance under specific impact conditions.
Rail Passenger Equipment Collision Tests: Analysis of Occupant Protection Measurements Presented at the International Mechanical Engineering Congress and Exposition, November 6, 2000, Orlando, Florida.	The FRA has been conducting research on occupant protection in train collisions. As part of this research, computer simulations have been performed, passenger seats have been sled tested, and two full-scale collision tests of rail passenger cars have been conducted.
Rail Passenger Equipment Crashworthiness Testing Requirements and Implementation Presented at the International Mechanical Engineering Congress and Exposition, November 6, 2000, Orlando, Florida.	This paper describes the requirements and the implementation of a series of impact tests of rail passenger equipment. The test requirements are dictated by the characteristics of the vehicle, as well as uncertainties in the analysis techniques used to evaluate the collision behavior of the equipment.
Rail Passenger Equipment Collision Tests: Analysis of Structural Measurements Presented at the International Mechanical Engineering Congress and Exposition, November 6, 2000, Orlando, Florida.	The objectives of the two-car test were to measure the gross motions of the car, to measure the force/crush characteristic, to observe the car-to-car interaction, to observe failure modes of the major structural components, and to evaluate selected occupant protection strategies.
Risk Analysis Based CWR Track Buckling Safety Evaluations Presented at and included in the proceedings of the International Conference on Innovations	Research is being conducted to evaluate track lateral strength and stability limits for improved safety and performance. This paper deals with a part of this research addressing the development of a comprehensive CWR

in the Design & Assessment of Railway Track, Delft University of Technology, The Netherlands, December 2-3, 1999.	buckling safety analysis which includes a risk analysis based approach for prediction of probable number of buckles on a given track.
Fundamentals of Track Lateral Shift for High-Speed Rail Applications Presented at the European Rail Research Institute's Interactive Conference on "Cost Effectiveness and Safety Aspects of Railway Track," Paris, France, December 8-9, 1998.	The fundamental mechanics of track lateral shift due to vehicle and thermally induced loads are defined, and an analytic approach is presented for the determination of "limit" loads and deflections on the track to prevent progressive lateral shift.
Static and Dynamic Crush Testing and Analysis of a Rail Vehicle Corner Structural Element Presented at the 8th ASME Symposium on Crashworthiness, Occupant Protection and Biomechanics in Transportation. November 14-19, 1999, Nashville, Tennessee.	This paper presents the results of an experimental study to establish the strength and energy absorption capability of cab car rail vehicle corner structures built to current strength requirements and for structures modified to carry higher loads and absorb more energy.
Simulation of an Oblique Collision of a Locomotive and an Intermodal Container Presented at the ASME International Mechanical Engineering Congress and Exhibition, November 15-19, 1999, Nashville, Tennessee.	This paper presents an approach to modeling an oblique collision of a locomotive and an intermodal container. This analysis uses a three-dimensional model to determine the trajectories of the equipment.
Crashworthiness Studies of Locomotive Wide Nose Short Hood Designs Presented at the ASME International Mechanical Engineering Congress and Exhibition, November 15-19, 1999, Nashville, Tennessee.	This paper investigates the parameters that influence the structural response of typical wide nose locomotive short hoods involved in offset collisions. The objective of the study is to determine the current baseline level of crashworthiness of locomotive hood structures and the potential effectiveness of stronger corner structures.
A Numerical Evaluation of Protection Strategies for Cab Car Crashworthiness Presented at the ASME International Mechanical Engineering Congress and Exhibition, November 15-19, 1999, Nashville, Tennessee.	One part of a larger study in which several strategies were examined for improving the protection afforded to the operator and the passengers in cab car collisions. The focus here was on evaluating the effectiveness of strengthened cab-end structures through explicit dynamic finite element-based calculations simulating the crush behavior of the cab car.
Engineering Studies in Support of the Development of High-Speed Track Geometry Standards Presented at and included in the proceedings of the IEEE/ASME Joint Railroad Conference, March 18, 19, and 20, 1997, held in Boston, Massachusetts.	These standards are intended to cover train operating speeds from 110 mph to 200 mph. The studies conducted include evaluation of the use of measuring track geometry with offsets from several chord lengths, computer simulations of vehicle response to track surface and alignment variations, application of the proposed specificationsto previously measured track geometry, and comparison of proposed specifications to foreign practice.
Evaluation of Cab Car Crashworthiness Design Modifications Presented at and included in the proceedings of the IEEE/ASME Joint Railroad Conference, March 18, 19, and 20, 1997, held in Boston, Massachusetts.	A study was conducted to evaluate the effectiveness of structural modifications to rail cab cars for increased crashworthiness protection in train collisions. The focus of the study was a collision scenario in which a cab car-led consist traversing a switch onto mainline track obliquely collides with a locomotive-led consist traveling in the opposing direction on the mainline track.
Train Crashworthiness Design for Occupant Survivability	Studies were conducted evaluating the effectiveness of alternative strategies for providing crashworthiness of the vehicle structures. Conventional practice results in

Presented at the ASME International Mechanical Engineering Congress and Exposition, November 12-17, 1995, in San Francisco, CA	cars of essentially uniform longitudinal strength. The crash energy management approach requires varying strength through the train, with high strength in the occupied areas and lower strength in the unoccupied areas.
Analysis of Occupant Protection Strategies in Train Collisions Presented at the ASME International Mechanical Engineering Congress and Exposition, November 12-17, 1995, in San Francisco, CA	A study of the occupant dynamics and predicted fatalities due to secondary impact for passengers involved in train collisions with impact speeds up to 140 mph is described. The principal focus is on the effectiveness of alternative strategies for protecting occupants in train collisions, including friendly interior arrangements and occupant restraints.
Estimation of Residual Stresses in Railroad Commuter Car Wheels Following Manufacture Presented at and included in the proceedings of the International Mechanical Engineering Congress and Exposition in Anaheim, CA, November, 1998	A finite element simulation is presented for the prediction of residual stresses resulting from the heat treatment of railroad commuter car wheels during manufacture. The quenching and annealing segments of the wheel manufacturing process are simulated using a decoupled heat transfer and stress analysis.
Locomotive Crashworthiness Design Modifications Study Published in Proceedings of the 1999 IEEE/ASME Joint Railroad Conference, April 13-15, 1999 , IEEE Catalog Number 99CH36340, ASME RTD Volume 16.	A study has been conducted of locomotive crashworthiness in a range of collision scenarios to support the efforts of the Locomotive Crashworthiness Working Group of the Federal Railroad Administration's Railroad Safety Advisory Committee (RSAC) to develop locomotive crashworthiness requirements.
Evaluation of Service-Induced Residual Stresses in Railroad Commuter Car Wheels Presented at and included in the proceedings of the International Mechanical Engineering Congress and Exposition in Anaheim, CA, November, 1998	Analyses of the effects of service conditions on the distribution of residual stresses in railroad commuter car wheels are presented. Novel software has been applied to estimate the effects of service conditions on the as-manufactured state of these wheels. Contact loads resulting from wheel and rail interaction and thermal loads from on-tread braking are considered.
EVects of hot and cold temperature exposure on performance: a meta-analytic review A meta-analysis to mathematically summarize the eVect of hot and cold temperature exposure on performance was completed. The results from 515 eVect sizes calculated from 22 original studies suggest that hot and cold temperatures negatively impact performance on a wide range of cognitive-related tasks. ERGONOMICS, 2002, VOL. 45, NO. 10, 682 ± 698	Adjusting to and working under hot or cold temperatures has long been a challenge for people living under immoderate weather conditions. In spite of the ability in industrialized societies to control indoor temperatures, a similar challenge continues for many people who are regularly exposed to extreme temperatures while working. Concern about the eVects of temperature on work-related performance has prompted the National Institute for Occupational Safety and Health (NIOSH) to attempt to establish upper limits for occupational exposure (1972). However, in their revised criteria of 1986, NIOSH did not include upper limits for heat exposure under the assumption that there was not a well-established relationship between performance and heat (NIOSH, 1980).
Development of a Passenger Rail Vehicle Crush Zone Published in Proceedings of the 1999 IEEE/ASME Joint Railroad Conference, April 13-15, 1999 , IEEE Catalog Number 99CH36340, ASME RTD Volume 16.	The objective of this study was to determine the advantages, disadvantages, and issues related to incorporating crush zones at the ends of coach cars for protection in collisions between two trains.

OTHER REPORTS

TITLE	ABSTRACT

North Carolina "Sealed Corridor" Phase I U.S. DOT Assessment Report Report to Congress Office of Railroad Development September 2001	In response to a request in the Senate Report 107-38 accompanying the Department of Transportation and Related Agencies Appropriations Act, 2001, this report documents the benefits of the State of North Carolina's "Sealed Corridor" initiative and the improvements completed at highway-rail grade crossings from March 1995 through September 2000 in terms of "Lives Saved." The analysis concludes that five lives were saved during the study period and that this positive benefit of the Sealed Corridor improvements will grow as vehicle volume, trains frequency and train speeds increase.

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