

Determination of the Influence of Pavement Friction on the Initial Velocity Using the Accident Reconstruction Engineering Principles

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Abstract: Several studies were conducted on the accidents of cars using the fundamental principles of physics and engineering including Newton's Laws of Motion and First Law of Thermodynamics. The objective of this study is to determine the influence of and pavement friction on the initial velocity. Regression analysis on the results of these variables was conducted. Excellent correlation coefficient was found for the relationship at $\alpha = 0.05$ significance level.

Keywords: Accident Reconstruction, First Law of Thermodynamics, Initial Velocity, Pavement Friction, Regression Analysis.

I. INTRODUCTION

Accident reconstructing engineering is the planning, surveying, measuring, investigating, analyzing, and report making process on the intricate engineering details of how accidents occurred. The analysis and conclusions are based on the extensive application of fundamental principles of physics and engineering including Newton's Laws of Motion [1] and First Law of Thermodynamics [2]. The first law of thermodynamics when applied to accidents states that the total energy before and after the accident will be the same. The input variables include roadway, vehicle, driver and environmental conditions. Accident reconstruction engineering studies can be utilized by the industry, city and state governments for modifying the structural facilities such as roads. The modifications may include obtaining improved friction factors, increased number of lanes and lane widths and better site distances. Vehicle manufacturers use the results of the studies for developing better designs of vehicles. Some of the recent vehicles may use event data recorder containing information on the speed of the vehicle before and at the time of the accident. Some manufacturers, such as GM and Ford, allow downloading the information from these boxes after an accident [3]. The results of the accident reconstruction studies are also used for producing better navigations aids to assist the drivers.

In this study the guidelines of Accreditation Commission for Traffic Accident Reconstruction (ACTAR) [4] are used. There are many research studies on the application of accident reconstruction engineering principles. One of the most important one is that of Hurt's [5]. Hurt found that motorcyclists needed to develop their capabilities on controlling skids and proper use of helmets significantly reduced head injuries. Hurt further found that out of all the turning movements, the left turners were involved in the accidents while turning in front of the oncoming motorcycles.

II. SCOPE OF THE STUDY

The study is limited to the accidents caused by negligent drivers of cars hitting the parked cars. All the accidents caused elastic deformations only. There are no significant plastic deformations.

III. METHODOLOGY

C2 was a parked car by the side of the road. The speed limit of the road is 15 mph. C1 was driven by a negligent driver. The friction coefficients of the shoulder and pavement were measured. C1 saw C2 too late and hit the brakes. C1 skidded and hit C2. C2 skidded on to the shoulder and stopped. In most of the cases C2 was damaged and its driver was injured. As the plaintiff, C1's driver sued the negligent driver of C1. In most of the cases C2 driver underestimated his or her speed at the time of the accident.

Parked vehicle Car 2

The following steps were followed.

1. Deceleration = Friction factor * acceleration due to gravity
2. Final velocity of C2 = 0
3. Initial velocity of C2 is shown in the following equation 1.

$$u = \sqrt{2 * a * s}$$

(1)

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Static and Dynamic Performance Analysis of Structures and Materials Under Complex Loads and Environmental Excitation Ping Xiang, Abdelmoumen Anis Bousahla, Huaping Wang, Adesola Ademiloye, 2025-05-29 With the development of structural materials more and more new materials and construction methods are applied to infrastructure construction in order to achieve carbon neutrality and emission peak Nowadays people have more and more strict requirements for the comfort safety and resistance to environmental disasters of infrastructure Therefore the static and dynamic performance of new structures and materials under complex environment and load becomes more and more important in construction and design of infrastructure engineering Modern civil engineering has been developing towards intelligence Both construction technology and material technology are developing towards a more intelligent direction How to take new means to make the structure have good mechanical performance and can sense the external environment and load excitation is a development direction of civil engineering This Research Topic welcomes researches on the macro and micro mechanical performance analysis of materials static and dynamic response analysis of structures in construction engineering bridge engineering railway engineering and geotechnical engineering In addition under the action of wind load and earthquake load the large scale vibration of structures will seriously endanger the safety The safety and stability performances of infrastructures still represent a serious challenge to researchers engineers and constructors This Research Topic is dedicated to the most recent advances in research into the mechanical performances of structures and materials and some related applications We welcome scientists and investigators to contribute Original Research and Review articles addressing the main issues facing the field Potential topics include but are not limited to the following New theoretical numerical and experimental methods for vibration of structures Assessment of dynamic responses of infrastructures under static and dynamic loads Innovative design and mechanical performances of composite structures Intelligent structural health monitoring with optical fiber sensing technology Mechanical performances of structures and materials from micro to macro scales Mechanism of vehicle bridge coupling vibration Structural fatigue performance analysis under earthquakes Infrastructure innovations for durability and resilience with new structure system and materials Dynamic evolution of structural damage under extreme loads such as earthquake typhoon and impact Structural health monitoring of large scale infrastructures Numerical modelling and computational mechanical analysis of structures and infrastructures

Texturing of Concrete Pavements Jim W. Hall, Kelly L. Smith, Paul Christopher Littleton, 2009 Explores a recommended process for determining the type of concrete pavement texture that may be used for a specific highway project The process considers the effects of texture type on friction and noise characteristics

Principles of Highway Engineering and Traffic Analysis Fred L. Mannering, Scott S. Washburn, 2020-07-08 Highly regarded for its clarity and depth of coverage the bestselling Principles of Highway Engineering and Traffic Analysis provides a comprehensive introduction to the highway related

problems civil engineers encounter every day Emphasizing practical applications and up to date methods this book prepares students for real world practice while building the essential knowledge base required of a transportation professional In depth coverage of highway engineering and traffic analysis road vehicle performance traffic flow and highway capacity pavement design travel demand traffic forecasting and other essential topics equips students with the understanding they need to analyze and solve the problems facing America s highway system This new Seventh Edition features a new e book format that allows for enhanced pedagogy with instant access to solutions for selected problems Coverage focuses exclusively on highway transportation to reflect the dominance of U S highway travel and the resulting employment opportunities while the depth and scope of coverage is designed to prepare students for success on standardized civil engineering exams

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Dr. Ashad Ullah Qureshi, White topping is a rehabilitation method for moderately distressed hot mix asphalt HMA pavements by plain concrete PC or fiber reinforced concrete FRC overlay White topping is constructed with thinner and shorter slabs The structural stiffness of the existing HMA layer and the interface bonding between the concrete and HMA layers are accounted for in the mechanistic design procedure This results in the need for a thinner concrete slab The main advantage of this type of overlay over the traditional HMA overlays is the use of the underlying HMA layer to carry the traffic load and thus reducing the thickness of the overlay

Impact of Truck Overloads on the Highway Trust Fund United States. Congress.

House. Committee on Ways and Means. Subcommittee on Oversight,1978

An Economic Analysis of the

Environmental Impact of Highway Deicing Don Murray,Ulrich F. W. Ernst,1976

Report No. FHWA-RD. United

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Vehicle Accident Analysis and

Reconstruction Methods

Raymond M Brach,Matthew Brach,2011-04-12 Designed for the experienced practitioner this new

book aims to help reconstruction specialists with problems they may encounter in everyday analysis The authors demonstrate how to take the physics behind accidents out of the idealized world and into practical situations Real world examples are used to illustrate the methods clarify important concepts and provide practical applications to those working in the field Thoroughly revised this new edition builds on the original exploration of accident analysis reconstruction and vehicle design Enhanced with new material and improved chapters on key topics an expanded glossary of automotive terms and a bibliography at the end of the book providing further reading suggestions make this an essential resource reference for engineers involved in litigation forensic investigation automotive safety and crash reconstruction Police officers attorneys and insurance professionals will also find the book to be a definitive resource in reconstructing accident scenes New Topics Event data recorders EDRs Frictional drag coefficients for sliding tires Railroad grade crossing collisions New practical applications of mathematical methods Enhanced Features Expanded glossary of automotive terms Bibliography with further reading suggestions Improved chapters on tire forces rollover accidents crush energy pedestrian collisions vehicle dynamic

simulation **Dynamical Systems: Theoretical and Experimental Analysis** Jan Awrejcewicz, 2016-09-17 The book is the second volume of a collection of contributions devoted to analytical numerical and experimental techniques of dynamical systems presented at the international conference Dynamical Systems Theory and Applications held in Poland on December 7-10, 2015. The studies give deep insight into new perspectives in analysis, simulation, and optimization of dynamical systems, emphasizing directions for future research. Broadly outlined topics covered include bifurcation and chaos in dynamical systems, asymptotic methods in nonlinear dynamics, dynamics in life sciences and bioengineering, original numerical methods of vibration analysis, control in dynamical systems, stability of dynamical systems, vibrations of lumped and continuous systems, non-smooth systems, engineering systems and differential equations, mathematical approaches to dynamical systems, and mechatronics.

Advances in Materials and Pavement Prediction Eyad Masad, Amit Bhasin, Tom Scarpas, Ilaria Menapace, Anupam Kumar, 2018-07-16 Advances in Materials and Pavement Performance Prediction contains the papers presented at the International Conference on Advances in Materials and Pavement Performance Prediction AM3P Doha, Qatar, 16-18 April 2018. There has been an increasing emphasis internationally in the design and construction of sustainable pavement systems. Advances in Materials and Pavement Prediction reflects this development, highlighting various approaches to predict pavement performance. The contributions discuss links and interactions between material characterization methods, empirical predictions, mechanistic modeling, and statistically sound calibration and validation methods. There is also emphasis on comparisons between modeling results and observed performance. The topics of the book include but are not limited to: Experimental, laboratory material characterization; Field measurements and in situ material characterization; Constitutive modeling and simulation; Innovative pavement materials and interface systems; Non-destructive measurement techniques; Surface characterization; Tire surface interaction; Pavement noise; Pavement rehabilitation; Case studies. Advances in Materials and Pavement Performance Prediction will be of interest to academics and engineers involved in pavement engineering.

Vehicle Accident Analysis and Reconstruction Methods Matthew Brach, James Mason, Raymond M. Brach, 2022-01-07 In this third edition of Vehicle Accident Analysis, later chapters present applications of the methods and include example reconstructions. As a result, Vehicle Accident Analysis: Reconstruction Methods remains the definitive resource in accident reconstruction.

Proceedings of the 10th International Conference on Maintenance and Rehabilitation of Pavements Paulo Pereira, Jorge Pais, 2024 Zusammenfassung This book gathers the proceedings of the 10th International Conference on Maintenance and Rehabilitation of Pavements MAIREPAV10 held in Guimarães, Portugal, on July 24-26, 2024. The conference series has been established to promote and discuss state-of-the-art design, maintenance, rehabilitation, and management of pavements. The respective contributions share the latest insights from research and practice in the maintenance and rehabilitation of pavements and discuss advanced materials, technologies, and solutions for achieving an even more sustainable and environmentally friendly infrastructure.

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B. Fambro, Kay Fitzpatrick, Rodger J. Koppa, National Research Council (U.S.). Transportation Research Board, National Cooperative Highway Research Program, 1997 *Proceedings*, 1994 *Bearing Capacity of Roads, Railways and Airfields* Andreas Loizos, Imad Al-Qadi, Tom Scarpas, 2017-07-20 Bearing Capacity of Roads Railways and Airfields includes the contributions to the 10th International Conference on the Bearing Capacity of Roads Railways and Airfields BCRRRA 2017 28 30 June 2017 Athens Greece The papers cover aspects related to materials laboratory testing design construction maintenance and management systems of transport infrastructure and focus on roads railways and airfields Additional aspects that concern new materials and characterization alternative rehabilitation techniques technological advances as well as pavement and railway track substructure sustainability are included The contributions discuss new concepts and innovative solutions and are concentrated but not limited on the following topics Unbound aggregate materials and soil properties Bound materials characteristics mechanical properties and testing Effect of traffic loading In situ measurements techniques and monitoring Structural evaluation Pavement serviceability condition Rehabilitation and maintenance issues Geophysical assessment Stabilization and reinforcement Performance modeling Environmental challenges Life cycle assessment and sustainability Bearing Capacity of Roads Railways and Airfields is essential reading for academics and professionals involved or interested in transport infrastructure systems in particular roads railways and airfields *Highway Safety Literature*, 1979 **A Subject Bibliography from Highway Safety Literature** United States. National Highway Traffic Safety Administration, 1979 **Transactions of the American Society of Civil Engineers** American Society of Civil Engineers, 1927 Vols 29 30 contain papers of the International Engineering Congress Chicago 1893 v 54 pts A F papers of the International Engineering Congress St Louis 1904 *Highway Research and Development Studies Using Federal-aid Research and Planning Funds* United States. Bureau of Public Roads. Office of Research and Development, 1968

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