

## **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.

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### **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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**United States. National Highway  
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Evaluation of Pavement Friction Characteristics John Jewett Henry,2000 This synthesis report will be of interest to pavement design construction management and research engineers highway safety officials and others concerned with pavement friction characteristics It describes the current state of the practice and discusses the methods used for evaluating wet pavement friction characteristics of new and restored pavements This synthesis reviews models used for measuring and evaluating friction and texture causes for friction changes over time and aggregate and mix design to provide adequate friction Also presented are construction and surface restoration practices for providing good pavement surface characteristics In addition considerations of noise and ride quality are discussed when compromise may be required

*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

**Measurement, Construction, and Maintenance Of Skid-Resistant Airport Pavement Surfaces, AC No: 150/5320-12B, November 12, 1991 ,** 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

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**A methodology for determining the role of vehicle handling in accident causation** United States. National Highway Traffic Safety Administration,1977

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**The Effects of Grinding on PCC Pavements** Thomas H. Wenzel,David A. Kuemmel,1999 A Subject Bibliography from Highway Safety Literature United States. National Highway Traffic Safety Administration,1979

**Principles of Highway Engineering and Traffic Analysis** Fred L. Mannering,Scott S. Washburn,2012-03-27 The 5th edition of the Mannering s Principles of Highway Engineering and Traffic Analysis continues to offer a concise approach that covers all the necessary fundamental concepts New features in this edition include updates and more consistency with the latest edition of the Highway Capacity Manual HCM the inclusion of sample FE exam questions call out of common mistakes and added coverage on a qualitative description of the mechanistic approach

**Advances in Materials and Pavement Performance Prediction II** K. Anupam,A.T. Papagiannakis,A. Bhasin,D. Little,2020-12-08 Inspired from the legacy of the previous four 3DFEM conferences held in Delft and Athens as well as the successful 2018 AM3P conference held in Doha the 2020 AM3P conference continues the pavement mechanics theme including pavement models experimental methods to estimate model parameters and their implementation in predicting pavement performance The AM3P conference is organized by the Standing International Advisory Committee SIAC at the time of this publication chaired by Professors Tom Scarpas Eyad Masad and Amit Bhasin Advances in Materials and Pavement Performance Prediction II includes over 111 papers presented

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Development,1978 **Engineered Cementitious Composites for Electrified Roadway in Megacities** Ali Aryo Bawono,2022-01-03 This book describes the development of an innovative solution for electrified roadway pavements based on engineered cementitious composites which are exhibiting an extreme tensile strain capacity that is much higher than conventional concrete This enables the pavement to work without steel reinforcement and to embed a dynamic wireless power transfer technology for charging electric vehicles At first the book presents a modified performance driven design approach to improve the composites to achieve the optimum pavement design in terms of functional and structural performance It shows that the modified composites can be used to fulfil the safety and comfort factors without neglecting the characteristics of conventional ones Further 3D finite element and fluid dynamics models are used to analyse the pavement properties The validated models can predict the functional performance including skid resistance surface water drainage and noise In the remaining part of the thesis an environmentally friendly photocatalytic function for pavement made of engineered cementitious composites is investigated In turn a multi criteria design analysis is proposed to identify the optimum functional performance of the pavements All in all this book reports on a comprehensive approach to design analyse and optimize engineered cementitious composites for electrified road pavement application A special emphasis is given on applications in Singapore and other tropical megacities 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 Department of Transportation and Related Agencies Appropriations for 1983 United States. Congress. House. Committee on Appropriations. Subcommittee on Department of Transportation and Related Agencies Appropriations,1982 **Impact of Truck Overloads on the Highway Trust Fund** United States. Congress. House. Committee on Ways and Means. Subcommittee on Oversight,1978 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 Guimar es 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 Green and Intelligent Technologies for Sustainable and Smart Asphalt Pavements Xueyan Liu, Kumar Anupam, Sandra Erkens, Lijun Sun, Jianming Ling, 2021-11-25 Green and Intelligent Technologies for Sustainable and Smart Asphalt Pavements contains 124 papers from 14 different countries which were presented at the 5th International Symposium on Frontiers of Road and Airport Engineering IFRAE 2021 Delft the Netherlands 12-14 July 2021 The contributions focus on research in the areas of Circular Sustainable and Smart Airport and Highway Pavement and collects the state of the art and state of practice areas of long life and circular materials for sustainable cost effective smart airport and highway pavement design and construction The main areas covered by the book include Green and sustainable pavement materials Recycling technology Warm cold mix asphalt materials Functional pavement design Self healing pavement materials Eco efficiency pavement materials Pavement preservation maintenance and rehabilitation Smart pavement materials and structures Safety technology for smart roads Pavement monitoring and big data analysis Role of transportation engineering in future pavements Green and Intelligent Technologies for Sustainable and Smart Asphalt Pavements aims at researchers practitioners and administrators interested in new materials and innovative technologies for achieving sustainable and renewable pavement materials and design methods and for those involved or working in the broader field of pavement engineering

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