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A Review Article of Comprehensive Observation of Highways Construction, Planning and Scheduling Using Sampling Method

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Abstract- A highway system serves a set of objectives, for example, arrangement of an adequate level of service, preservation of the office condition, safety, economic development, and others. It comprises of a number of physical facilities, for example, pavements, bridges, roadside elements, and traffic signal devices. The system is managed through operational elements of a highway agency, for example, arranging, design, construction, maintenance, etc. The highway system would thus be able to be envisioned in terms of a three dimensional lattice of objectives, facilities, and capacities, all of which interact with each other. The current trend of developing separate management systems for pavements, bridges, and maintenance activities is a piecemeal methodology, because it ignores the needs of the all out system. Consequently, many current systems are either clashing or involve duplication, or both. Instead, singular management subsystems, for example, planning management, bridge management, and maintenance management, ought to be developed in propercoordination with each other and with a clear understanding of the requirements of the complete system.

Keywords- Ontology, Semantic Web, Formalized knowledge, Infrastructure management, Integrated planning.

I. INTRODUCTION

Highways are public roads that connect cities or towns. Highways play a significant role in a country's development as these infrastructures are suggested to have positive correlations towards economic activities by allowing the rapid delivery of people and goods to meet regional demands [1, 2].

Furthermore, compared to other construction projects, highway projects are often inevitably recognized as high-risk projects due to its importance to a nation's economic, societal, and political development [3]. While being highly visible to the public, these projects are only established as successful if and only completed within the allocated time and budget, meets predetermined requirements and objectives, and cause minimal disruptions to the environment [4].

While governments are pushing for successful highway projects because of its importance, highway projects are negatively affecting India economic growth from delays and cost overruns [5]. Therefore, highway projects need to meet these success criteria to ensure project success [6].

II. RESEARCH MOTIVATION

Operation of comparison Four-stage method originated in the road traffic volume forecasting urban transportation planning, traffic forecast-ing it for not much discussed outside content. Domestic road network planning extensive use of this method, but the method itself many issues yet to be resolved highway network planning. In accordance with the operating procedure "of highway network planning approach" (data col-lection, status assessment, development scale forecast, road network layout, road traffic volume forecasting, construction sequence schedule, evaluation) can be widely used in the domestic four-stage road network planning model sys-tem, with total control method for comparison.

III. LITERATURE REVIEW

David Moore, Sustainability rating system for highway design:—A key focus for developing sustainable cities and societies in Nigeria: A growing body of evidence suggests that continuous increases in global population and urbanisation wield pressure across biodiversity. Nigeria and a few other Asian nations will account for 35% of the urban increase in the future, and there is a scientific projection that further megacities will emerge.

Besides, sustainable cities and societies are those that strive to leave a net-zero carbon footprints through smart urban planning and city management. So, in developing public transport scheme, it is essential to manage and implement sustainability assessment performance. In Nigeria, there is a sustainability literacy gap, due to a lack of measurable sustainability techniques, and this has

resulted in social, economic and environmental dissatisfaction towards completed highways and roads in the cities. The roads and highways are considered an essential part of modern daily life and will play a key role in the development of sustainable cities.

To bridge the knowledge gap, this study argues to develop a sustainability assessment rating system in evaluating highway and road designs in Nigeria. Thirty-six (36) sustainability indicators relevant in assessing highway design are identified along with the sustainability application framework. The findings contribute to gaining insight into climate change impact, and the benefits it makes in adopting an assessment rating system in highway development to decrease climate change catastrophe [1].

FredericoA.Silva, Analysis of no-passing zones to assess the level of service on two-lane rural highways in Brazil: The highway capacity manual (HCM) is used to assess the level of service on two-lane rural highways in several countries, including Brazil. The 6th version of the HCM will address the capacity and level of service for two-lane highways based on follower density (FD). Studies have been conducted in Brazil to obtain a suitable method for calculating the level of service on two-lane highways. However, there are no studies that have determined the impact of no-passing zones involving FD, which is the main objective of this research. To achieve this goal, a set of traffic data was obtained from highway segments with the primary purpose of calibrating and validating the VISSIM traffic simulator used in this study.

Using the simulator, traffic data were generated in hypothetical highway segments with a wide range of geometric and traffic characteristics. Traffic relationships for the simulation data were adjusted for the following conditions: (i) without no-passing zones, and (ii) with no-passing zones. The results of the analysis indicate that the models proposed in this study produce level of service and FD values close to values observed in the field [2].

Mehrdad Ghorbani Mooselu, Current European approaches in highway runoff management: a review: Highway runoff is one of the most significant non-point sources of pollution for the terrestrial and aquatic environment with biological, physical, and chemical effects. Considering local characteristics, treatment practices, and determining factors are essential for highway runoff management. The aim of this paper is to survey the review of highway runoff management in Europe with emphasis on runoff characterization, treatment, and modeling approaches and identifying possible knowledge gaps exists based on our review. The results showed that highway runoff has spatiotemporal variation, which is the main factor in the regional selection of the best management practice (BMP).
Also, recent studies have poorly deemed characterization of highway runoff in different climatic scenarios, performance assessment of the current BMPs, and uncertainty analysis in modeling approaches. Furthermore, economic and risk analysis, along with decision-making methods, provide an optimum plan for the design and operation of BMPs [3].

Hong Zhang, Formulating a GIS-based geometric design quality assessment model for Mountain highways: Highways play an important role in China's economic development, especially in mountainous regions. In reality, design of mountainous highways can be a challenging task due to complex geological and topographic conditions. From the safety perspective, it is also important that road geometric design defects and potential accident blind spots can be reasonably identified from the design. To this end, this study formulated an innovative Geographic Information System (GIS)-based geometric design quality assessment model for mountain highways. First, a fault tree analysis (FTA) was conducted to identify a series of highway design risk factors. Second, a decision-making trial and evaluation laboratory (DEMATEL) technique was employed to derive the factors' weight and sensitivity.

Third, road driving suitability, traffic safety sensitivity, design risk factors, and effective distance were taken into account to formulate a design quality assessment model. Forth, two case studies based on a mountainous highway located in southwest China were conducted to validate this model. The case studies established that improving geometric design quality can significantly improve the road traffic safety of mountainous highways. It is also revealed that the existence of steep slopes, tunnels, and rapid horizontal and vertical alignment change can considerably compromise the geometric design quality (GDQ), therefore, configuring these parameters is worth of further investigation. Last but not least, this study provides essential knowledge to the regime of accident prevention, high-risk road section location and mapping, traffic safety management, and design of smart transport systems [4].

Kai Heng, Vehicular impact resistance of highway bridge with seismically-designed UHPC pier: This study strives to numerically explore the performance of highway bridge supported by seismically-designed ultra-high performance concrete (UHPC) piers in resisting heavy truck impact. Firstly, six types of bridge piers are designed with considering two different concrete types (i.e., normal strength concrete (NSC) and UHPC) and three various seismic hazard levels (i.e., earthquake intensities (EI) of 7, 8, and 9) according to Chinese seismic design specifications, and the corresponding refined finite element (FE) models are established and validated by reproducing the tests of drop hammer impacting on reinforced NSC and UHPC members. Based on the well-verified FE models of simply-supported double-pier bent highway bridge and heavy truck, total 54 collision scenarios are carefully designed by referring to the actual

accidents, and the vehicle-pier collision analyses are numerically performed by using the nonlinear FE analysis program LS-DYNA.

Then, the effects of seismic fortification level and concrete type of impacted pier on the vehicular impact force and dynamic responses of entire bridge structure, as well as the damage and failure modes of both impacted pier and entire bridge are studied [5].

Jinxiao Wang, Structural analysis and optimization of an advanced all-GFRP highway bridge: In this research, a relative novel type of composite structure for a glass fiber reinforced polymer (GFRP) highway bridge was analyzed that consisted of a multi-cell GFRP deck and two U-shaped GFRP girders, and the structural analysis and optimization of such advanced structure was presented.

The deformation mechanism was analyzed using theoretical formulations. It was found that the deformation was mainly composed of flexural deformation rather than shear deformation. By employing laminated shell elements, a finite element (FE) analysis was carried out to investigate the structural behaviors of the bridge structure for various load cases.

The results indicate that the structural indexes including the deflection, stress, dynamic frequency, and anti-overturning stability all met the requirements of the design code. By using the zero-order optimization method, the multi-parameter structural optimization was further conducted to obtain the minimum weight of the structure, in which four sectional parameters of the girder (i.e., top flange thickness, bottom flange thickness, web thickness, and girder depth) were considered the design invariables. The optimal structural schemes for various combinations of design variables were obtained.

The results revealed that the thinner the top flange and the web were, or the thicker the bottom flange was, the lighter the optimized structure was. The achievements verified the applicability of such composite GFRP structures for highway bridges [6].

Daniel J.Findley, Part 4 - Highway geometric design: This part details the process of choosing appropriate geometric features for a highway. Design controls govern key aspects of highway design and are essential for safety and efficiency. The geometric features considered in this part include the basic components that guide horizontal and vertical alignment, including curvature and grades, and elements that form the cross section of the highway, including lanes, shoulders, and medians. Intersections and interchanges are an important part of highway design due to their significant impact on safety performance and operational efficiency [7].

Shuai Li, Multi-criteria optimal design and seismic assessment of SMA RC piers and SMA cable restrainers for mitigating seismic damage of simply-supported highway bridges: Recent strong earthquakes demonstrated that multi-span simply-supported highway bridges have high possibilities in experiencing serious damage of piers, unseating of bridge spans, and bearing failure, e.g. the Yematan bridge under 2021 Maduo earthquake. A newly proposed novel bridge system with shape memory alloy reinforced piers, i.e., SMA RC pier, and restraining devices, i.e., SMA Cable restrainer may be a potential alternative to prevent the bridge from such catastrophic collapses.

This paper aims at investigating the effectiveness of the novel bridge system, identifying the main influential factors, and optimizing the design of SMA RC piers and SMA restrainers. Nonlinear time history analysis is fist conducted to investigate the efficiency of the novel bridge system for a typical simply-supported bridge. Then, a sensitivity analysis is performed to estimate the effects of the main influential factors [8].

Ali Maghsoudi-Barmi, Probabilistic seismic performance assessment of optimally designed highway bridge isolated by ordinary unbonded elastomeric bearings: Following the idea of using unbonded isolators to eliminate the tensile stress and providing a cost-effective isolation system, recent experimental research has shown ordinary unbonded steel reinforced elastomeric bearings (SREBs) as an attractive option for seismic isolation of highway bridges. The focus of current research work is on the evaluation of the seismic vulnerability of a highway bridge isolated by unbonded SREBs through developing fragility curves of the structure.

This assessment considers parameters playing a key role in the isolation system behavior, namely the friction coefficient, as well as the isolator aging effects. In this regard, a typical three-span highway bridge is considered and designed with the rubber bearing isolation system by applying a multi-objective optimization procedure to reduce the seismic isolation deformation as well as the base shear simultaneously. The nonlinear models for bridge piers and isolation devices are incorporated [9].

MárciaR.O.B.C.Macedo, Traffic accident prediction model for rural highways in Pernambuco: Due to the need to update the current guidelines for highway design to focus on safety, this study sought to build an accident prediction model using a Geographic Information System (GIS) for single-lane rural highways, with a minimum of statistically significant variables, adequate to the Brazilian reality, and improve accident prediction for places with similar characteristics.

This analysis was conducted on 215 km of single-lane road segments of highway BR-232 in the State of Pernambuco. The development of a database made it possible to associate accident records for the period 2007

to 2016 from Federal Highway Police (PRF) data with the geometric parameters of the highway, obtained through geometric reconstruction of the vector data available at the National Department of Transportation Infrastructure (DNIT) and the semi-automatic extraction of highways from satellite imagery. The homogeneous segments were analyzed and classified by the Spatial method (Kernel-KDE density). A Generalized Estimating Equation (GEE) model was estimated to model the frequency and severity of accidents [10].

S.AlKheder, An Impact study of highway design on casualty and non-casualty traffic accidents: Background Road Safety has become a worldwide concern due to the alarming repercussions road accidents may bear. This study examined the relationship between different geometric design elements and the accident rates on Rashid Bin Saeed Street, Arabian Gulf Street, and Sultan Bin Zayed Street in Abu Dhabi, United Arab Emirates.Methods The geometric design was collected from the satellite images of google earth in compliance with the standard geometric design manual of Abu Dhabi roads.

The recorded geometric data consisted of the number of lanes, lane widths, median length, and width. The traffic volume data was provided by the Integrated Transport Center of Abu Dhabi, which was then converted into Annual Average Daily Traffic (AADT) for analytical purposes. For the studied roads, AADT ranges ranged between 26,509 and 121,890 vehicles per day. The crash data related to the period of 2012–2019 was collected from the online open-access data provided by the United Arab Emirates Ministry of Interior [11].

Yutao Pang, Risk-based design and optimization of shape memory alloy restrained sliding bearings for highway bridges under near-fault ground motions: The Shape Memory Alloy (SMA)-restrained bearing consists of a typical sliding bearing and SMA wires. The SMA wires are adopted to limit the excessive displacement caused by near-fault ground motions, which can improve the re-centering capacity and energy dissipation capability of sliding bearings. Such bearings should be carefully designed to balance the pier force and bearing displacement so that the bridge system can achieve better performance.

The present paper proposed a novel seismic risk-based methodology for the optimization design of SMA-restrained sliding bearings for highway bridges subjected to near-fault ground motions. First, the seismic risk of the bridge system was served as the performance index in this methodology. Second, identical component fragility curves were derived in order to minimize the seismic risk of the whole bridge system. Then, the Particle Swarm Optimization (PSO) approach was implemented to obtain the optimal mechanical properties of SMA-restrained sliding bearings that yield the same fragility curves. Finally, a simplified optimization design method was proposed for searching optimal designs, which can significantly reduce the computational effort but maintain the accuracy of optimal results [12].

Xinchen Ye, Feasibility study of highway alignment design controls for autonomous vehicles: In recent years, the development and testing of autonomous driving technology have become widespread around the world. However, due to differences in perception abilities between autonomous vehicles and human drivers, the current geometric design controls for highway alignments, designed for the human driver, may not be applicable to the autonomous vehicle (AV). Few studies, however, have systematically investigated the design controls for autonomous vehicles, though we face full driving automation in the next few decades.

Because the range of modern AV sensors reaches 250 m, with expected further improvements in the near future, there is a need to determine how the sensors' perception field and perception-reaction time may affect the current road design standards developed for human drivers. This study therefore tested the feasibility of the current design controls for fully-autonomous vehicles by separately computing controls for vertical alignments and combined horizontal and vertical alignments, considering the AV's perception abilities of perception-reaction time (PRT), sensor height, and upward angle from the horizontal [13].

Yikai Chen, Spatiotemporal analysis of crash severity on rural highway: A case study in Anhui, China: Traffic crashes are the result of the interaction between human activities and different socio-economic, geographical, and environmental factors, showing a temporal and spatial relationship. The temporal and spatial correlations must be characterized in crash severity studies, for which the geographically and temporally weighted ordered logistic regression (GTWOLR) model is an effective approach.

However, existing studies using the GTWOLR model only subjectively selected a type of kernel function and kernel bandwidth, which cannot determine the best expression of the spatiotemporal relationship between crashes.

This paper explores the optimal kernel function and kernel bandwidth considering the aforementioned problem to obtain the best GTWOLR model to analyze the crash data based on the crash data of rural highways in Anhui Province, China, from 2014 to 2017. First, the GTWOLR models with Gaussian or Bi-square kernel function and fixed (the spatiotemporal distance remains constant of local sample) or adaptive (the quantity of the local sample is constant) bandwidth are compared. Second, the log-likelihood and Akaike information criterion are used to compare the GTWOLR model with the ordered logistic regression (OLR) model [14].

XiangLi, Back analysis of a collapsed highway embankment – A numerical study on the rigid reinforcement and time-dependent grouting: A sliding accident occurred in the embankment slope of a highway in the south of China. The cause of the failure was investigated based on the geological data, construction conditions and numerical results. Measures were taken to reinforce the embankment including loading berm, steel pipe grouting and steel sheet pile. The applicability of the reinforcements and the stability of the reinforced embankment were analyzed through numerical simulation.

A scheme for the time-dependent slurry diffusion was proposed. The grouting process was realized in the numerical model through extensive programming, and the diffusion range of the cement slurry with the duration of grouting can be monitored in the numerical model, whereby the effect of the grouting was evaluated. The paper not only can provide valuable hints for the research relating to the stability analysis of slopes, but also are instructive for the treatment of sliding accidents in the soft soil embankments in the area of heavy rainfall [15].

IV. CONCLUSION

Highway project durations that are longer than necessary delay the delivery of benefits to road users. Budget constraints often preclude the use of additional funds to shorten total project duration. Therefore, state highway agencies seek ways to decrease construction project durations without increasing costs. Research has recommended formal constructibility reviews as an effective approach to meeting this goal. Formalized constructibility reviews have been effective in isolated cases but only about one-quarter of state highway agencies currently have a formal constructibility review program.

An inadequate understanding of implementation issues, including the effective use of resources, is a potential cause. The effects of constructibility reviews on the design phase, construction phase, and project durations are modeled and analyzed. Results illustrate and explain how intermediate-sized constructibility reviews reduce project durations more than very large or small reviews and the potential impacts of a design-build approach on constructibility review effectiveness.

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