

Summary of Research on Road Traffic in China

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Abstract: In order to promote the improvement of Chinese highway transport industry technology level and management level, promote the development of China's road transportation, through the summary and analysis of research status of domestic and foreign highway transportation industry in various fields in recent years, the system has combed the domestic and foreign highway transportation industry academic research situation and hot, problems, specific countermeasures and development prospects, in order for the scholars engaged in the construction of highway and transportation industries provide novel research perspective and basic research data.

Keywords: Road engineering; Bridge engineering; Tunnel engineering; Traffic engineering; Highway transportation economy; Automobile engineering; Mechanical engineering

1. Introduction

Since the founding of new China 60 years, the cause of China's road transport has changed dramatically, the academic research results of the road traffic is also one after another. In order to reflect more accurate and detailed the research condition of national highway transportation industry in recent years, highway journal editorial department arranged around the column of this print, more than 30 invited China's road transport industry in various fields, experts and scholars, summarizing and combing the highway transportation industry in China academic research status, existing problems, countermeasures and development foreground. Hope to be able to cast a brick to attract jade, to engage in highway traffic scientific research scholars, doctoral and master's programs, such as with an understanding of industry wide academic research platform, promote the progress and innovation of science and technology of China road traffic.

2. Road Engineering

In recent years, the rapid development of China's highway construction, as of the end of 2011, China's highway mileage reached 410.64 x 104 km, the highway 849 x 104 km, rural highway 356.40 x 104 km, greatly promote and guarantee for China's economic and social development. Highway mileage of substantial growth at the same time, Chinese road workers in the subgrade and pavement engineering and road geometric design aspects made many research results, application of the research results, for improving China's highway construction water to ensure the quality of highway engineering plays a very important role. From the point of view of subgrade engineering, road engineering and road geometric design,

the research achievements and prospects of highway engineering technology are summarized as follows.

3. Sub-grade Engineering

With the continuous expansion of the scale of China's highway construction and the improvement of the grade of the highway, the highway engineering design and construction technology has been put forward higher requirements. With the extension of the high grade highway to the complex area of the engineering geological conditions, the technical problems faced in the construction of subgrade are increasing gradually. China highway engineering and technical personnel after years of research and practice, in the design method for subgrade, subgrade settlement prediction and control, stability analysis of embankment, special subgrade treatment technology made fruitful research results, made an important contribution to the rapid development of China highway engineering construction, but also for the future of highway subgrade engineering design and construction of accumulated valuable experience.

Traditional design method will be of roadbed and pavement design alone, the vehicle load assumed as static load, subgrade design in the compaction degree and California bearing ratio as the subgrade strength control index, of different design of highway subgrade strength is the smallest and the compaction degree of the proposed the corresponding requirements, without taking into account effect of traffic grade, axial load level and heavy load and overload vehicles and other factors. With the development of highway transportation, the proportion of high speed and heavy duty vehicles is increasing, and the influence of dynamic load on highway engineering structure is more and more obvious. The research emphasis of

subgrade engineering is mainly composed of the physical properties of soil, static properties and carrying capacity, and the strength and fatigue behavior of subgrade soil under dynamic load. According to the current situation of China's highway transportation and the dynamic characteristics of subgrade structure analysis results, the paper puts forward to heavy traffic the traffic grade and subgrade design standard axle load, subgrade design and calculation of the indicators of the soil subgrade dynamic strength and dynamic modulus and design checking index for high pavement subgrade soil dynamic strain value, in order to meet the requirements of heavy load traffic on the highway subgrade strength.

With the development of the strategy of sustainable development and public awareness of environmental protection is gradually enhanced, highway subgrade design needs to consider the requirements of environmental protection. Therefore, in the design process of highway roadbed, into the design concept of environmental protection, in subgrade design at the same time to carry out environmental impact assessment and environmental protection design, at the same time, the design and construction at the same time, at the same time as the acceptance of and highway subgrade excavation, promote resource utilization, roadbed excavation on the ecology and the natural environment caused by the effects of reduced to a minimum, the natural environment surrounding the highway as far as possible from the impact of highway construction, animal migration routes and local residents life balance as far as possible not to break, in order to achieve the harmonious development of highway construction and environment.

In the roadbed design, in order to develop effective settlement treatment scheme and the subgrade construction quality monitoring and need to on different period of subgrade settlement and final settlement is estimated. As a classical soil deformation calculation method in soil mechanics, the stratified summation method is one of the earliest theoretical methods used to calculate the settlement of subgrade. But the calculation method assumes that the foundation soil is not deformed in the lateral direction, only in the vertical compression deformation, the result of the settlement calculation of soft soil foundation is small. The correction coefficient of the existing foundation standard is large, and the precision of the settlement calculation results need to be improved. The calculation method of stress path method is reasonable, but it requires a higher standard of sampling, and the test workload is big, the technical difficulty is higher, the practical application is limited. With the development of numerical fitting technique, a variety of curve model was used for settlement prediction calculation, such as index curve model, hyperbolic model, logistic model, Verhulst model, growth curve model etc.. The curve model has high precision for predicting the settlement and final settlement

of the subgrade, but it takes a long time to observe the data, otherwise it will cause the error of the calculated value. Nonlinear finite element numerical model development makes the calculation of the settlement of roadbed can be used non elastic and elastic - plastic and viscoelastic plastic of a variety of soil stress - strain relationship model, but also take into account the complex constitutive relations of soils, such as elasto visco plastic model, considering damage effect of elastic and plastic damage model and so on. Finite element method can be considered should be the complex boundary condition, soil stress - strain relationship of nonlinear characteristics of soil and should stress history and multi field coupling effect, the simulated field step by step loading and processing super filling problems, can consider lateral deformation, three-dimensional seepage influence on settlement, and can calculate arbitrary time settlement, horizontal displacement, pore water pressure and effective stress changes.

The accuracy and reliability of the prediction of subgrade settlement. The research of the control standard of subgrade settlement has experienced 3 stages in each country. Phase 1 is to allow the wrong height or allow industry and trade settlement as the criteria for the control and the stage of mainly by field experiment based, to absolute industry and trade settlement as the criteria for the control basically requires bridgehead transition section settlement is less than 30cm, in order to allow fault height index of settlement control standard in between 1.5 to 5.0 cm. Phase 2 is to allow longitudinal slope difference index of settlement control standard, the standard formulation of mainly aimed at setting the bridge take plates of the road bridge transition section, relevant scholars propose the control standard for longitudinal allowable differential slope between 0.4% ~ 1.0%. The third stage is to human body vibration comfort of criteria for the control and the standard is proposed mainly based on the human exposure to whole-body vibration evaluation guide ", by the power of the vehicle road coupled system response analysis is presented on the basis of settlement control criteria considered the driving speed and other factors, the standard is relatively high. The development of settlement control standard is gradually developed from the safety control standard to the comfort control standard.

China's research on the calculation method of subgrade stability began in the early twentieth Century. In the early stage of engineering practice, the stability evaluation of the road base mainly adopts 3 kinds of methods: engineering geological analogy method, theoretical calculation method, and standard recommendation method. The reliability of engineering geological analogy method is related to the knowledge and experience of designers. The theoretical calculation method of roadbed stability analysis uses Fellenius method or simplified Bishop method. Due to the uncertainty of the mathematical model

and the uncertainty of the parameters, these methods are easy to cause the calculation results and the actual difference between the two factors. Current norms for different regions, different age, different soil, given a high degree of 30m within the slope of the corresponding slope. Along with the continuous improvement of the theoretical analysis method, a series of analysis methods of subgrade stability have been formed, including the limit equilibrium method and the analytical method, limit analysis method and numerical analysis method. The development of the limit equilibrium method is more perfect, and is widely used in practical engineering. In recent years, a large number of operations research methods are applied in geotechnical engineering.

Neural network and genetic algorithm are more active in engineering. The neural network model can predict the stability of the slope, the sensitivity analysis of the influence factors of the slope, and the knowledge base of the dynamic deformation of the slope. The genetic algorithm in the highway embankment construction is used to search the most dangerous sliding surface of slope.

Special roadbed mainly includes soft soil roadbed, frozen soil roadbed, collapsible loess roadbed, saline soil roadbed, etc.. The treatment technology of soft soil subgrade. The development process of China soft foundation treatment technology is basically divided into 2 stages. The first stage is the initial stage Chinese soft soil foundation treatment technology development. In the fifties and sixties of the 20th century, in order to meet the needs of China's infrastructure, from the former Soviet Union introduced a lot of soft soil foundation treatment technology. Including: chemical grouting, the methods of sand gravel cushion, pile load pre pressure method, sand pile compaction method and lime soil pile soft foundation treatment technology. At that time because of the lack of relevant technical standards and norms, and soft soil engineering properties differed larger, many projects in the construction process with no specific situation, the soft foundation treatment measures and effects are not fully play, extent limits the popularization and application of the soft soil foundation treatment technique. The second stage is the development stage of the treatment technology of soft soil foundation in china. From the late 70s of 20th century so far, a variety of treatment technology such as lime pile, crushed stone pile, dynamic compaction method has been applied and promoted in the actual construction, especially soft soil composite foundation treatment technology has been rapid development.

In recent years, with the strengthening of the concept of energy saving and environmental protection, utilization of industrial waste and urban construction waste ground treatment has become the focus of many scholars to study, has researched and developed the cement fly ash gravel pile composite foundation, cement gravel pile composite foundation, lime ash soil composite founda-

tion, sand and gravel pile composite foundation and muck pile composite foundation. The flexible pile composite foundation has been applied in recent years Chinese highway soft base treatment. At present, composite foundation treatment technology has become main form of highway soft soil foundation reinforcement, and accumulated some experience in engineering practice, has formed a variety of composite foundation construction technology and methods, including all kinds of sand and gravel pile composite foundation, the low strength pile composite foundation, rigid pile composite foundation, lime soil pile composite foundation, cement powder spray pile composite foundation, reinforced foundation etc.. A comprehensive foundation treatment technology has become the main development direction in the future China highway soft soil foundation.

4. Bridge Engineering

Civil engineering is an ancient discipline, and it is not considered how much development. However, in the past 20 years, due to the progress of materials, structural analysis and construction technology, great progress has been made in the field of bridge engineering. This paper focuses on the progress and development trend of bridge engineering in the following aspects.

4.1. New ideas for sustainable Bridge Engineering

With increasing attention for a limited resource conservation and environmental protection by the people, the sustainable development of the economy as the strategic goal of governments, international appeared the new concept of low-carbon and energy-saving engineering and project sustainability and green engineering. The bridge structure design in 21st century pay more attention to the structure safety and durability, low carbon energy-saving, economic life, reduce non renewable resource consumption, industrial and construction waste reuse and reduce the damage and impact on the environment, has put forward new theory of sustainable bridge engineering. The basic concepts of sustainable bridge project includes as follows: the basic principles of sustainable bridge engineering for bridge renewable utilization performance. The goal for long-term growth and does not threaten the offspring development; bridge engineering sustainable by economy, ecological and social sustainability, including safety, reliability, structural durability, suitability and ability can expansion of four basic requirements; sustainable bridge engineering to through the planning, design, construction, use and dismantling the five stages to implement.

4.2. Based on the performance of the bridge design method

The performance based design method was first produced in the field of structural seismic research, and was

adopted by various countries about the seismic design code of building structures. In recent years, foreign scholars carried out based on the performance design of bridge seismic analysis, steel arch bridge, nonlinear analysis, tower analysis and concrete bridge pier seismic evaluation. Japan has put forward the design code of Highway Bridge Based on performance. Tongji University professor Chen Airong proposed in the literature, the performance of the bridge wind resistance design, the design method of ship collision. The existing design methods of bridge performance in various countries have been focused on the design methods of extreme action, such as seismic, ship collision and wind resistant design, which are rarely involved in other areas of bridge performance design. Generally speaking, according to the literature in the new century performance design of bridge structure should include the main contents are as follows: safety performance, the use of performance, durability, economic performance, low carbon and energy saving performance, regeneration using performance and environmental performance. Traditional permit should force method and experience probability limit state method has been unable to meet the needs of development of bridge design performance. Therefore, the research and development of the third generation performance design of bridge structure method is very neces-

sary, will also be a new direction for the development of design theory of bridge structure.

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