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SPECIAL REPORTS ON
ESCAP INTERGOVERNMENTAL MEETING OF HIGHWAY EXPERTS, 1983

BY

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Special Reports on

ESCAP INTERGOVERNMENTAL MEETING OF HIGHWAY EXPERTS, 1983

by

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PREFACE

In February 1983, ESCAP organized, in Thailand, the Inter-governmental Meeting for Highway Experts, following the 1981-Meeting, to discuss the regional problems in road and road transport in Asia and the Pacific. ESCAP invited all the country members to send their representatives to participate or to observe the meeting. As the meeting place is located in Bangkok, the Department of Highways sent some engineers to participate and to observe the meeting. In addition, the Department of Highways prepared some technical papers to distribute to the delegates from other departments and other countries as information and for discussion. Most of the papers concerned with policies of the Department, appropriate technology for road construction and maintenance, traffic laws enforcement, road maintenance, and road research. All the papers presented at this meeting were reprinted once more for more extensive distribution. It is believed that some general technical information in this combined volume of the reprints will be useful to engineers and researchers who are working on road and road transport.

(Seree Suebsanguan)
Director-General

TABLE OF CONTENTS

SOME POLICIES OF ROAD CONSTRUCTION AND MAINTENANCE IN THAILAND

SEREE SUEBSANGUAN
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Abstract

As the results of an oil crisis, some changed situations and results of research studies during the past time, the policy of road construction and maintenance has been modified to be suitable for the prevalent conditions. Some policies of road construction and maintenance of the Department of Highways at the present time and the near future are shown in the paper.

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Since the time of an oil crisis, the concepts of road construction and maintenance of the Department of Highways, Thailand have deviated from the initial trend. As the result of the increased price of the crude oil in the world market, truck configuration, engines, and capacity to carry the load have been modified to transport more goods with a lessened number of hauling. As a consequence, there are a lot of heavy trucks, especially overloaded trucks passing the major roads of the country. Even though the allowable maximum load for a 10-wheel truck will be allowed to increase up to 21 tons (originally 18 tons); but from the spot check, it is found that some heavy trucks have the weight over the limits. The highway patrol has tried to make an enforcement in order to make the truck owners follow the regulation by taking various actions so that the situation is later improved. These overloaded trucks are the main causes inducing pavement failure in many roadways, especially in the Central Plain where the soil foundation is soft to medium clay. As the financial and the national policies have been changed, so do the policies of road construction and maintenance. Some of the policies regarding the works of the Thai Highways Department will be briefly discussed in the following sections.

1. Policy of Concrete Road Construction in the Bangkok Metropolitan and Nearby Areas. As Bangkok is a major port and center of goods transporting on roads, overloaded trucks are common in the Bangkok Metropolitan and the affected nearby areas. In addition to the problem of overloaded trucks, the soft clay foundation and the sinking of part of the Bangkok areas make the roadway flooded during and after the rainy season. Some of the bituminous surface roads were seriously damaged during the last flood few years ago, and reconstruction is inevitable. As a result of the stated problems, the Thai Highway Department set up the policy to construct the concrete roads in this area even though the initial cost of investment is a little bit higher. However, after compensating to the maintenance cost and the cost of delay during the time of repairing the asphalt surface road, concrete pavement is very

competitive in this particular case. Up to the present time, the mileages of concrete road in this area have increased considerably.

2. Formation of the Task Committee for Drafting the Methods of Concrete Road Maintenance. In the past, the length of concrete road under the responsibility of the Thai Highways Department is a few, so there has been no standard methods setting up for repairing the concrete roads. According to the policy of the Thai Highway Department as earlier stated, quite a few mileages of concrete road have increased considerably. At present, all the newly constructed roads in the Bangkok Metropolitan are of concrete type. It is necessary to have the standard methods of identifying the occurred defects and the probable repairing works being assigned to those particular ones in order to enable the district engineers for maintenance to make an appropriate schedule for suitable repair.

In 1982, the Department of Highways appointed a Task Committee to study and to draft the methods of concrete road maintenance prevailing for the conditions of the Bangkok Metropolitan. Details of the works of the Task Committee could be found out in the document entitled "SCOPE OF WORKS OF THE TASK COMMITTEE FOR DRAFTING THE METHODS OF CONCRETE ROAD MAINTENANCE" by Arom Chulachumbok and Teeracharti Ruenkrairergsa.

3. Policy of Replacement of Conventional Crushed Stone Base by Soil - Cement Base. After more than 10 years of performance evaluation of the existing soil-cement roads in Northeastern Thailand, it is acceptable that soil-cement could be used for crushed rock base in the areas of rock products deficiency. As the problem of overloaded truck is so critical, it is insisted to use soil-cement as base course for road construction in Northeastern Thailand. Economic analysis shows that employing soil-cement base to replace conventional crushed rock base can save the construction cost for base more than 46 percent. At present, soil-cement base is put as an

alternative associated with crushed rock base at the time of bidding. Use of soil-cement base instead of crushed rock from the remote quarries will lengthen the service life of the road linking the project site and the rock sources.

4. Policy of International Cooperation. It is a prime policy of the Thai Highway Department to cooperate with other international organizations for the mutual benefits and for the wider knowledge and modern techniques in the fields of highway engineering. In 1982, the Department of Highways, Thailand hosted two international short courses in road construction and maintenance, namely, Group Training in Road Construction for Asian Developing Countries (1-23 March, 1982), and Road Maintenance Study Course (19 April - 2 May, 1982).

In addition, the Thai Highway Department supported many other international meetings and conferences such as REAAA Conference, SEAG Conference, ISSMFE Conference, IRF World Meeting, PIARC World Road Congress, by allocating the budget to send the qualified engineers and high ranking officers to participate all of them. Each time the delegates from the Department of Highways will prepare the research papers or documents for presentation to the meeting for mutual benefits of all participants.

5. Policy of Research Development. Both technical and research activities play an important role in the development of road construction and maintenance. Results of research and special investigated projects enable the Thai Highway Department to solve many complex problems which generally arisen in the field. It is the policy of the Department of Highways to expand and to improve the technical and research works of the Department in order to create qualified engineers of young generation for the future task which would be more difficult and complex.

6. Policy of Road Maintenance. It is the policy of the Thai Highway Department to keep the existing network of road transportation in good and passable conditions all the time. As the national policy has been diverted as stated, the budget of road construction was reduced. But it is necessary to adjust the budget of road maintenance in order that the roads will not be left without properly being maintained, and tolerated failure, until it is beyond the scope of maintaining. Proper periodic maintenance is cheaper than reconstruction of the whole road, and highway engineer is aware of this fact. The Thai Highway Department tries to make every effort in getting adequate amounts of money for maintaining the existing road network.

In addition, the Department of Highways tries to develop the efficient system of highway rating to set up the priority of road maintenance. This will make the proper allocation of the funds for the roads that being most probable maintained. Some forms of technical assistance or international cooperation might be necessary. At the moment, the Department of Highways is studying about this matter.

7. Organization of the Road Maintenance Study Course. According to the 1981 International Meeting of Highway Experts in Bangkok, most delegates expressed a strong interest in the importance of road maintenance, and this topic seems to be one of the most controversial subjects among highway engineers in all meetings. Following the 1981 Meeting, the Thai Highway Department in cooperation with Road Engineering Association of Asia and Australasia (REAAA), the Better Roads Association of Thailand (BRAT), UN-ESCAP, the World Bank, and other international organizations, organized a Road Maintenance Study Course in Bangkok between 19 April - 2 May, 1982. The course was very successful and instructive. There were about 86 participants from 10 countries

in Asia, and 22 invited lecturers from other developed countries such as the United Kingdom, France, Japan, U.S.A., Denmark, Australia, including Thailand. Participants from Thailand were about 58 and the rest were from other countries. The course seemod to cover a very extensive subject in road maintenance which was the first time of being organized in Southeast Asia.

8. Formation of the Technical Committee to Revise the Specifications of Highway Construction. In the past, road construction techniques have been developed and changed greatly, but there seems to be only little modifications of the specifications of highway construction as adopted by the Department of Highways. Actually the in use specifications do not cover some types of construction such as concrete pavements, embankment filling in soft clay, rock-filled embankment, single surface treatment, soil-cement base construction, etc. In order to make the specifications more up-to-date, the Thai Highway Department appointed a Technical Committee to Revise the Specifications of Highway Construction in 1982. It should take some time to get the work done.

All the above policies are on highway construction and maintenance. Some of them might not be considered as policy, but it is part of the activities supporting the main regarded policy. All the policies as stated are considered to be suitable for the strategic and economic situation of the country at present. However, all policies could be changed, depending on many influencing factors.

Report No. : MR 84 Materials & Research Division, Department of Highways
Author : Seree Suebsanguan
Title : Some Policies of Road Construction and Maintenance in Thailand
Abstract : As the results of an oil crisis, some changed situations and results of research studies during the past time, the policy of road construction and maintenance has been modified to be suitable for the prevalent conditions. Some policies of road construction and maintenance of the Department of Highways at the present time and the near future are shown in the paper.
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รายงานฉบับที่ : วว.๘๔ กองวิเคราะห์และวิจัย กรมทางหลวง
ผู้เขียน : เสรี สืบสงวน
ชื่อเรื่อง : นโยบายบางประการในการก่อสร้างและบำรุงทาง
บทคัดย่อ : ในปัจจุบันนโยบายเกี่ยวกับการก่อสร้างและการบำรุงทางของกรมทางหลวงได้แปรเปลี่ยนไปจากเดิม อันเป็นผลมาจากการที่น้ำมันมีราคาสูงขึ้น สถานการณ์ที่ผันผวน และผลการศึกษาวิจัยในระยะเวลาที่ผ่านมา นโยบายบางอย่างของกรมทางหลวงซึ่งจะได้ยึดถือในการดำเนินงานในปัจจุบันและอนาคตอันใกล้ได้กล่าวไว้ในเอกสารฉบับนี้

คัพท์เฉพาะเรื่อง : นโยบาย การก่อสร้าง การบำรุงทาง
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APPROPRIATE TECHNOLOGY FOR THAILAND ROAD CONSTRUCTION AND MAINTENANCE

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Abstract

In the past, the Department of Highways has been trying to make every effort in employing the local resources for developing the road system of the country. As a result of applied research of the Department, a number of techniques have been adopted for road construction and maintenance in Thailand.

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During the past ten years, the Department of Highways conducted a lot of research studies and special investigations on some problems affecting road construction and maintenance. Results of these studies could be practically applied in Thailand, and hopefully, in other Southeast Asian Countries. Some of them will be briefly described as follows.

1. Lateritic Soil-Cement Stabilization. Road construction in Northeastern Thailand encounters with the problem of material deficiency, especially rock products for base and surface courses for many years. The long haul distance of the rock products from the remote quarries makes the construction cost of the highway go up unceasingly. In addition, the overloaded trucks transporting the construction materials tend to reduce the life of the existing roads that they passed. Results of research study on lateritic soil-cement stabilization during the past time showed that lateritic soil-cement could properly replace crushed rock base. Furthermore lateritic soil-cement road could sustain overloaded truck better than conventional crushed rock base, which is reflected by the lack of rut depth and plastic failure in the base and surface course. Economic analysis shows that lateritic soil-cement base could be cheaper than crushed rock base for about 46 percent for road construction in some remote areas which have the hauling distance of rock products of about 200-300 kilometers.

2. Deep Hole Lime Stabilization for Unstable Slopes. Landslide of roadway fills and excavations in North and Peninsula Thailand poses serious problems. Causes have been attributed to excessive deformation, settlement, or water infiltration into loosely compacted soil, and also underseepage leading to subsurface erosion and subsequent slippage. Where an embankment is of excavated weathered clay shale, disintegration and decomposition of clay shale lumps in the embankment have induced volume changes connected with soft materials, having low stability and high swelling potential,

leading to landslides.

The possible use of deep hole lime stabilization of unstable clay shale embankment was initiated some years ago. The potentially unstable weathered clay shale was cut into a bench, then a series of 150 mm. diameter holes were drilled by hand auger at 3 m spacings along the steps of the benching. The holes were drilled down to the boundary between the fill material and the original hillslope. Lime powder and water were simultaneously poured into the holes while being stirred to make the lime-water mixture more uniform. Water was poured into the holes followed by stirring three to four times a day in order to accelerate the lime migration from the holes into the adjoining soil. Halo effect due to lime migration tends to stabilize the surrounding soil and make the slope more stable.

The technique of deep hole lime stabilization is extended to increase the stability of embankment on soft clay and cut slope in clay shale. Some more test sections are under investigation.

The technique of deep hole lime stabilization as employed tends to promote the use of more labour force in road maintenance. Thus it is a very good and basic technology for the developing countries.

3. Use of Spent Sulphite Liquor as Dust Palliative. Spent sulphite liquor is a waste product derived from pulp and paper manufacturing, and there are many paper mills, particularly in the outskirts of Bangkok on the banks of waterways. The waste water from the large volumes of water required in manafacturing process is normally discharged and is harmful to the normal aquatic ecological cycle.

In the sulphite paper making process, the paper mill retains the fibres and the cementing materials are wasted from the process in a water solution called "spent sulphite liquor" or "black liquor". The major constituent in the liquor that has the

property of dust laying is known as lignin. A test road was conducted using black water mixed with the indigenous soil and the results compared with a section where fresh water was used. It was found that the sulphite liquor was effective in reducing dust from improved roads for about one year. It is insisted to use spent sulphite liquor for dust reduction in unpaved road in the area close to the paper mill, and where the relative humidity is relatively high.

4. Common Salt Stabilization of Unpaved Roads. About 200 km of lateritic roads in the Central Plain have been stabilized using common salt. The quantity of salt used was approximately 1 percent by weight. Subsequent observations on performance have really been very satisfactory. Very little dust is now raised in comparison with the very dusty conditions which prevailed previously.

5. Geotextile Reinforcement of Highway Embankment on Soft Clay. The introduction of geotextile fabric into the embankment construction on soft clay has been shown to provide some tensile reinforcement to the structure and prevent contamination of the embankment material by the underlying mud. Results of the test section indicated that there is some improvement in embankment stability and strength, and assistance in the consolidation of the upper layers of the underlying soft soil.

Many highway embankments in the Central Plain also serve as embankments or dykes as part of irrigation canal networks. Landslides have occurred as a result of fluctuation of water levels in the canals (drawdown). In order to improve embankment stability in such cases a combined piling-geotextile system has been tried in many locations along some roadway embankments.

6. Use of Bearing Unit in Settlement Reduction near the Bridge Approach. As there exists the differential settlement between the bridge and the approach causing bumping while driving, the system of

bearing unit was introduced in some high bridge approached to reduce the amount and rate of settlement of the soft soil foundation under the embankment. The system of bearing unit is found to be satisfactory in some areas, and not to be good in the others. Research project to study the appropriate design of bearing unit is programming.

7. Use of Airphoto in Exploring the Sources of Highway Materials. The technique of airphoto interpretation has been employed for exploring the sources of sand deposit in the Bangkok Plain and the nearby areas for about three years. At present, quite a number of sand deposit areas are mapped for being served as embankment construction in the Central Plain.

In addition to sand deposits in the Central Plain, the project will be extended to cover lateritic soil in Northeastern Thailand. It is hoping that the technique of airphoto interpretation will enable engineer to plan about the location design of the roadway in the future.

8. Construction of Soil-Cement Test Roads for Serving Heavy Traffic. Most soil-cement roads were constructed to serve low to medium traffic volume in Northeastern Thailand. It is instructive to study the performance of soil-cement road serving heavy traffic, and a research project is launched by constructing a test road with an ADT of about 4000 vpd. This field research is co-operated by the Japanese Government by supplying some equipment necessary for the project. The result will come out approximately within 3 years.

9. Stability Improvement by Soil Nailing. The technique of driving two of three rows of piles in the potential area of landslide was tried and it was found that stability of the embankment is improved. The technique of soil nailing will be expanded for more application in the future.

Different technological methods described before are in the process of development for being applied in road construction and maintenance. Some more research and special investigations are needed.

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Author : Komate Wongtonglua
Title : Appropriate Technology for Thailand Road Construction and Maintenance
Abstract : In the past, the Department of Highways has been trying to make every effort in employing the local resources for developing the road system of the country. As a result of applied research of the Department, a number of techniques have been adopted for road construction and maintenance in Thailand

Keywords : soil stabilization, local materials
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ชื่อเรื่อง : เทคโนโลยีที่เหมาะสมสำหรับการก่อสร้างทางและบำรุงทางในประเทศไทย
บทคัดย่อ : ในช่วงเวลาที่ผ่านมากรมทางหลวงได้ใช้ความพยายามทุกวิถีทางที่จะใช้ทรัพยากรในท้องถิ่นนั้นมาพัฒนาระบบทางหลวงของประเทศ จากผลงานวิจัยประยุกต์ทำให้กรมทางหลวงได้ใช้เทคนิคหลายอย่างในการก่อสร้างและบำรุงทางปัจจุบัน

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SCOPE OF WORKS OF THE TASK COMMITTEE FOR DRAFTING THE METHODS OF CONCRETE ROAD MAINTENANCE

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Abstract

During the past five years, a number of mileages of concrete road in the Bangkok area have been increased more than it used to be. This is following the policy of the Department of Highways to construct concrete road in this sinking area. As the Department is lack of the methods of concrete road maintenance, a Task Committee is formed to draft a manual for repairing the damaged concrete pavement.

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1. Statement of the Problem

Bangkok is located in the soft clay formation with low shearing strength and excessive settlement. Bangkok is not only the capital and the largest city of Thailand, but also the most important port city. So, quite a few heavy trucks and overloaded trucks transporting goods will pass all the major roads around this city. Road construction in this region encountered the problems of both local failure during construction, and plastic failure after construction. The road embankment will settle continuously with time, the formation of rut depth and uneven surface in the pavement. In addition, some parts of the Bangkok Metropolitan are sinking due to the dewatering of ground water. As a consequence, most of the old roads which have low elevation will be flooded in the rainy season. Some of them have been severely damaged, and reconstruction is inevitable.

It is the policy of the Department of Highways, Thailand to change the conventional flexible pavement construction into rigid pavement for road construction in soft clay formation in the Bangkok area, to tolerate the aforementioned problems. During the past five years, quite a number of roads in the Bangkok Metropolitan as constructed by the Department of Highways, Thailand as well as by other organizations are to be concrete pavement. As the mileage of the concrete road in the Bangkok area increased unceasingly, and so far the Department of Highways, Thailand has not had the standards for maintaining the concrete road, in 1982, the Department of Highways, Thailand appointed a Task Committee to draft the methods of concrete road maintenance, using as an applied guideline for both routine and periodic maintenance.

2. Scope of Works of the Task Committee

The Secretary of the Task Committee has drafted the scope of the Methods of Concrete Road Maintenance for discussion in the meeting as follows.

2.1 Methods of Surface Evaluation and Condition Survey

- Method of surface evaluation and condition survey
- Method of data collection
- Typical surface and structural defects as well as their symbols (for field data gathering)
- Recommendations and extent of repair

2.2 Methods of Joint Repair

- Selected joint sealing materials
- Equipment for old joint excavating
- Equipment for new joint installing
- Method of field operation
- Method of life estimate
- Precaution during operation
- Staffing

2.3 Methods of Surface Defect Repair

- Crack repair
- Spalling repair
- Surface patching
- Thin bonded overlay
- Scaling repair
- Pop-out repair

2.4 Methods of Structural Crack Repair

- Longitudinal crack
- Transverse crack
- Diagonal crack
- Corner break
- Shattered slab
- Equipment, personnel, etc.

2.5 Methods of Repairing the Settled Slab

- Highway slab
- Bridge approach slab
- Side slope slab (near bridge approach)

2.6 Methods of Repairing the Pumping Joints

- Selection of the grouting materials
- Equipment for grouting and other operational works
- Methods of field operation
- Staffing
- Precautions

2.7 Methods of Demolishing the Old Slab and Replacing with a New One

- Method of operation
- Equipment
- Material
- Personnel
- Precautions and construction techniques

2.8 Equipment for Concrete Road Maintenance

- Equipment for joint repair
- Equipment for surface defect repair
- Equipment for structural crack repair
- Equipment for pumping joint repair
- Others

3. Basis for Drafting

The Task Committee will review the past experience of concrete pavement maintenance as adopted by some State Highway Departments in the United States and other organizations. Some of them are as follows.

- Iowa Department of Transportation
- Michigan Department of Transportation
- Texas Department of Transportation
- Federal Highway Administration
- Portland Cement Association
- Highway Research Board, U.S.A.
- Others

4. Research on Concrete Road Maintenance

As Concrete road maintenance is rather new for highway engineers in Thailand, and the Task Committee believes that information and data regarding typical damage and conventional repairing methods for the pertinent defects will be valuable and instructive for young engineers; so the Task Committee, in addition to drafting the methods of concrete road maintenance, set up the probable research topics for being conducted associated with the conventional repairing works. Some of them could be listed below.

4.1 Durability of Some Selected Joint Sealing Materials
4.2 Performance of Thin Bonded Overlay
4.3 Typical Surface and Structural Defects of Concrete Roads in the Bangkok Areas
4.4 The Probable Pavement System for Concrete Road in the Bangkok Areas
4.5 Specifications for Concrete Road Design and Construction with Reference to the Bangkok Environments

Report No. : MR 84 Materials & Research Division, Department of Highways
Authors : Arom Chulachumbok and Teeracharti Ruenkrairergsa
Title : Scope of Works of the Task Committee for Drafting the Methods of Concrete Road Maintenance
Abstract : During the past five years, a number of mileages of concrete road in the Bangkok area have been increased more than it used to be. This is following the policy of the Department of Highways to construct concrete road in this sinking area. As the Department is lack of the methods of concrete road maintenance, a Task Committee is formed to draft a manual for repairing the damaged concrete pavement.

Keywords : concrete road, maintenance
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ชื่อเรื่อง : ขอบข่ายหน้าที่ของคณะทำงานจัดร่างวิธีซ่อมบำรุงถนนคอนกรีต
บทคัดย่อ : ในช่วงเวลาหาปีที่ผ่านมาปริมาณกิโลเมตรของถนนคอนกรีตได้เพิ่มขึ้นจากเดิมหลายเท่าตัว ซึ่งเป็นผลของการประกาศนโยบายที่จะก่อสร้างถนนเป็นถนนคอนกรีตในบริเวณกรุงเทพมหานครซึ่งมีปัญหาเรื่องการทรุดของดินฐานราก เนื่องจากกรมทางหลวงยังไม่มีมาตรฐานวิธีซ่อมบำรุงถนนคอนกรีต กรมทางหลวงจึงได้ตั้งคณะทำงานขึ้นมาชุดหนึ่ง เพื่อดำเนินการจัดร่างคู่มือดังกล่าวเพื่อใช้ในการซ่อมถนนคอนกรีต

คำหัวเฉพาะเรื่อง : ถนนคอนกรีต การบำรุงรักษา
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ROAD RESEARCH ACTIVITIES OF THE DEPARTMENT OF HIGHWAYS, THAILAND

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Abstract

History and development of road research of the Department of Highways are briefly described. Scope of research and active research projects as well as the publications are included. The establishment of the international co-operation for expanding the research activities is proposed.

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1. HISTORICAL BACKGROUND OF ROAD RESEARCH ACTIVITIES AT THE DEPARTMENT OF HIGHWAYS.

Research at the Department of Highways is part of activities of the Materials and Research Division, officially established in 1963. Most research studies at the early stage were in the form of special projects to investigate some preblem induced damage, or failure of the roadway such as :

(a) Design and construction of Lateritic soil-cement base.
(b) Design and construction of embankment on soft marine clay.
(c) Use of floating technique for settlement reduction of embankments on soft marine clay.
(d) Trial sand asphalt mix as low cost surface for low volume roads.
(e) Others regarding materials and pavement.

Unfortunately, because of limitations of the budget and personnel of Materials and Research Division, as well as routine work, reports of investigation have not been published. However, the results of these special studies assist engineers to make decisions for solving the problems enocountered successfully.

Programmed research was initiated for the first time in 1967 by the Department of Highways with the co-operation of the Government of the United States under the AID financial assistance programme. The research project is regarding properties and uses of lateritic soil, which is abundant in Thailand, in road construction. A research team consisting of Thai engineers from the Materials and Research Division, co-operated with research engineers and technicians from Woodward Clyde and Associates, Miller Warden Western Inc., and Materials Research and Development, Inc. As a result of this study, two technical reports

regarding formation, characteristics, properties and uses of lateritic soil in road construction were published in 1969. Since then many applied research projects regarding materials, foundation, pavement, and soil mechanics have been formulated and studied by the Materials and Research Division. In 1972 three research sections, namely highway materials, soil foundation and traffic engineering, were set up as part of Materials and Research Division to conduct more systematic and extensive research.

In 1977 road maintenance and structural engineering research were incorporated into the framework of a Transport and Road Research Centre. Up to the present time, research work has been initiated in the Department of Highways only for about 13 years; about 20 research projects in various phases of road engineering are active and more than 80 research and technical reports have been published. Now the Department of Highways is planning to establish a Transport and Road Research Centre officially to conduct more extensive research in other fields such as transport, operation, construction, etc.

2. SCOPE OF RESEARCH ACTIVITIES AT THE DEPARTMENT OF HIGHWAYS

Generally, research works could be classified as basic research and applied research. In basic research, studies are made deep in detail to find the theoretical or factual solution as well as the basic aspects of the problem. For applied research, studies are focussed to the methods of solving the problems encountered regarding road construction and maintenance. In road construction, quite a few unsolved and unexpected problems arise. Special studies are needed to find reasonable means of solution. It is shown that there are needs in road research in Thailand to solve the regional and particular problems. Hence, most research projects conducted at the Department of Highways are concentrated in applied research, but future planning for the basic research in some particular projects is made. After

formulating the problems encountered, five research sectors are formed in the skeleton of the proposed Transport and Road Research Center, Department of Highways as aforementioned. The scope of research work in each individual section is described as follows.

2.1 Highway Materials Research. This research section is responsible for studying geotechnical properties of various highway materials employed in road construction. The regional local earth materials in the scope of this investigation are lateritic soil, weathered rocks, silty and sandy soils, limestone and sandstone as well as some particular types of waste materials such as slag ash, fly ash, rice husk ash, spent sulphite liquor, etc. Some methods of soil stabilisation and construction of test roads to observe their performance are also included. The objective of the research projects is to set up the probable specifications for each type of material, and to make more effective use of local materials in order to cut down the cost of the road. The use of the techniques of airphoto interpretation and geophysical exploration in finding out the earth materials are also in the scope of this research section. Research on determination of the strength characteristics of residual soil and weathered rock also falls in the band of investigation of the material properties.

2.2. Soil Foundation Research The scope of investigation of the soil foundation research is concentrated in studying strength and performance of the road foundation. The active programmes include the basic study and application of strength, stability and settlement data of soft Bangkok Clay in design and prediction for road performance in this type of soil which covers extensive areas of Central Thailand. Projects concerning the stability of road formation on silty soil and stability of cut slopes in mountainous terrain are also active. Case studies regarding foundation problems are also included in the investigation programme, for example, the effect of ground water fluctuation in reducing stability of embankments, the effect of

traffic loading in increasing settlement and instability of roads on soft clay deposits, use of fabric in stability and settlement improvement of the soft foundations. It is the prime objective of the Soil Foundation Research to develop design criteria for road construction in various types of collapsible soil.

2.3 Transport and Traffic Engineering Research. There are many transport and traffic engineering problems unsolved in the Bangkok Metropolitan Area and other big cities. Examples of these problems are the trends of increasing road accidents, environmental effects induced by traffic, damage of road surface and pavement structure by overloaded trucks and skidding resistance of different types of road surface. Research studies about the impacts of different transportation modes on the economic condition in the big cities and in the country, as well as feasibility studies of various modes of transportation in some selected areas are also included in the scope of work of this research section. Use of bus and truck lanes and traffic dividing zones for reducing congestion and accidents in some selected roads in the Bangkok Area are also of interest.

2.4 Road Maintenance Research. There are more than 45,000 km of road under the responsibility of the Department of Highways. It is found to be rather difficult to draw up the effective maintenance programme for roads with variable standards, road surface, terrain, as well as available resources with a very limited budget. Road Maintenance Research has tried to make extensive studies on various phases of pavement performance and failure in order to develop the criteria for maintaining each type of surface in any particular region of the country. Some other projects are maintenance rating for highway pavement, prediction of pavement life, and critical deflection criteria for each type of surface.

2.5 Structural Engineering Research. Research studies in this field are about the properties and performance of concrete and steel structures employed in highway works. The behaviour of these structural components is also in the scope of investigation. Surveys and studies of the existing highway structures will be included in the programme for predicting the future performance.

2.6 Other Research. In addition of the activities described above, some research projects regarding pavement performance, pavement technology, engineering geology and terrain evaluation shown in the next section are also active. These projects are carried out by the co-operation among engineers from Highway Materials, Soil Foundation and Road Maintenance Research.

Nearly all research projects are performed by the staff of the proposed Transport and Road Research Center under the assistance and co-operation of the supporting staff from the Materials and Research Division, Planning Division and Maintenance Division. Some are joint research projects between the Department of Highways and other institutions such as some Universities, Department of Land Transport, State Railway of Thailand, Port Authority of Thailand, etc. Such a co-operation will induce more extensive activities as well more applicable research results.

3. SOME ACTIVE RESEARCH PROJECTS

Quite a few research projects in various phases of transport and road engineering are active at the Materials and Research Division, even though Transport and Road Research Centre has not been legally set up. Some of the active projects in each individual research section are described briefly as follows :

3.1 Highway Material Research.

(a) Research on Lateritic Soil. The purpose of this project is to make a detailed investigation on properties as well as geological interpretation of the formative areas to draw conclusions about the modes of formations and specifications to be used in road construction and maintenance. Soil stabilisation and more advanced studies are included in the programme.

(b) Properties and Stabilisation of Some Selected Weathered Rocks. Decomposed granite and some other weathered rocks are widely found in the North and the South of the country. They have been used in road construction for many decades. This project is planned to make detailed investigations on various types of decomposed rocks for use in different layers of the pavement.

(c) Research on Dust Palliatives for Unpaved Roads. It is the purpose of this project to investigate the feasibility of employing some types of industrial waste and chemicals as dust palliatives. Industrial wasted under study are spent sulphite liquor and molassess.

(d) Performance of Soil-Cement Roads in Thailand. To study the existing soil-cement roads in Thailand in order to evaluate their performance, associated with the pavement structure as well as strength of soil-cement itself.

(e) Deep Hole Lime Stabilisation for Active Landslide. In high fill embankments especially in mountainous terrain, the result of inadequate compaction induces progressive failure of the slope. Deep hole lime stabilisation

find properties of soft marine clay mostly in the control part of Thailand, its behaviour under the road embankment, performance of the road overlying the soft soil foundation and improvement of soft foundation. Research work on soft marine clay is still going on to find the road performance, effect of road foundation on the pavement strength, criteria for pavement design employing the Benkelman Beam deflection, strengthening of the soft foundations, pre-consolidation of the soft soil, etc.

(b) Stability of Road Embankments on Silty Soil Foundations. This project is conducted to find practical means of preventing erosion of silty soil when it is serving as road foundation.

(c) Dynamic Response for Pavement Evaluation and Design. The purpose of this research project is to apply dynamic deformation of the road surface under an impact load in evaluation the pavement strength and the design of the pavement structure. A field test on a road with different conditions has been performed.

(d) Stability of Road Foundations in Mountainous Terrain. The problem of slope failures, both the back slope and embankment slope, are generally found on roads constructed in the mountainous area. Investigations were done to find the geological condition, the properties of the foundation materials, terrain condition, effect of surface and ground water, climatic condition, effect of the construction procedure and design adequacy. The cases were analysed to failure.

technique is introduced to strengthen the soil slope and improve stability.

(f) Stabilisation of Sandy Soils. Sandy soils are common in Thailand. Soil materials in this category are silty sand, granitic sand, mineral sand and beach sand. It is expected that these materials could be economically improved and used as base course of low volume roads in the remote areas.

(g) Research on Stability of Cut Slope in Weathered Rocks. Road cutting through the formation of weathered rocks in the North and the South of Thailand encounters the stability problem, especially in the rainy season. It is the objective of this research to study the geotechnical aspects of stability of slopes in different types of weathered rock.

(h) Some Other Related Research Projects. There are some other research projects regarding highway materials, engineering geology and soil mechanics.

* Use of airphoto interpretation for location of sand deposit in Central Thailand
* Dynamic behaviour of highway materials
* Geotechnical properties of limestone and other carbonate rocks in Thailand
* CBR of subgrade soil in Thailand

3.2 Soil Foundation Research

(a) Research on Soft Marine Clay. This research project is a continuation of many sub-projects which have been carried on for the past eight years. The work have been done to

3.3 Transport and Traffic Engineering Research

(a) Research on Road Safety. There are many sub-projects in this phase of research, namely:

* Comparison of skidding resistance values on main highways with various ages, surface types, aggregate types, and traffic volume

* Accident studies on highways in Thailand

* Use of synthetic aggregates to improve road surface skid resistance

* Traffic speeds on wet and dry pavement surface

An increase in number and severity of road accidents is one of the problems needed to be solved. Like other tropical countries, Thailand has about 5 months of rainy season during which road surfaces are always covered with water film. In addition to the climatic condition, the other problem is the lack of granite and other high Polished Stone Value aggregates. More than 90 percent of road surface have to be constructed using limestones with PSV of only about 45. So the projects on road safety were dealing mainly with road accidents and skid resistance.

(b) Research on Traffic Environment. Research Projects falling into this category are:

* Study of the effects of heavy vehicles on pavement and geometric design, road safety, and environment

* Traffic noise, vibration survey and control

* Relationship between traffic speeds and pavement roughness

* Properties and service life of road line paints

Problems which affect people living near highways are noise and vibration produced by traffic. Studies of noise and vibration levels are needed as well as methods of reduction such as noise barriers. To minimise maintenance cost, pavement thickness requirements should also consider the characteristics and size of heavy vehicles.

(c) Impacts of Highways on National Transportation. The research work concerns impacts of the highway transportation upon the national transportation, the benefits of roads to the people, the movement of the national cargoes by different modes of transportation and recommendations for the modal split in such a way that the optimum benefit is obtained.

3.4 Road Maintenance Research

(a) Maintenance Rating for Highway Pavements. Flexible pavement are generally designed for a period of 7 to 10 years and a strengthening programme should be provided before major failures. The pavement rating programme has been established to study all pavements in the country to decide the order of priority of roads to be maintained. The project is still active for the major primary highways. More investigation is going to be made on some selected secondary roadways.

(b) Prediction of Pavement Service Life by Deflection Criteria Consideration. Criteria for the overlay design by employing Benkelman Beam deflection are set up by collecting and making an analysis of the existing data on different roads from various parts of Thailand. The criteria are going to be used as standards for judging

the priority of roads being put into the active maintenance programme.

(c) Research on Seasonal Variation on Road Performance. In connection with the pavement behaviour, in order to judge the quality of the pavement it is usual to take the Benkelman Beam deflection measurement when moisture content in the underlying soil is highest. This is the weakest condition and the maximum deflection should be reached. This condition will be in the mid rainy season or about 1 to 2 months after that. It seems that the appropriate time for deflection measurement is very limited. A project of deflection measurement is proposed for all periods of the year to see variations of the value with time. Attention is focussed on the optimum values both in the dry and wet seasons. Criteria are expected to be drawn based on these values.

3.5 Structural Engineering Research.

(a) Use of Plate Theory to Design Slab type Reinforced Concrete Bridges. This study is undertaken to develop a more realistic analysis of rectangular slab concrete bridges. The present slab bridge design is considered to be simply supported on two edges while the other two are stiffened by kerbs. It is anticipated that the proposed method for designing this type of bridge will result in a more economical structure compared to the one currently used.

(b) Rigid Structure on Piles in Soft Marine Clay. The construction and maintenance cost of embankments on soft marine clay is very expensive the continuous and non-uniform settlement of such embankment reduces the life of the pavement considerably. The design of rigid structures such as short span flat slab on piles of 30 years design

life will be used as a trial to substitute 7 to 10 years on embankments. The increments cost analysis for both cases will be made and compared.

(c) Service Life of Concrete Bridges in Thailand. This study is divided into two parts. The first one is the field investigation and collection of all records of some selected concrete bridges in Thailand. Service life, traffic load and strength of concrete at present are studied and evaluated. The second part is a laboratory study of a simulated concrete structure under repetition of load. The goal of this project is to develop the bridge design life from the result of investigation.

3.6 Other Research. In addition to the research projects as described in the preceding sections, there are other special projects pertaining to the local problems in Thailand. Some of them are :

(a) Studies of Heavy Vehicles on Highways.
(b) Corrugated sheet steel beams for highway guardrails.
(c) Use of local materials for road maintenance.
(d) Use of bamboo as reinforcements in waterproof concrete pavement
(e) Computerised design for post-tensioned prestressed
(f) Study of concrete strength at various curing times.
(g) Design and performance of roadway pavement in Thailand.

4. PUBLICATIONS

- Typical Moisture-Density Curves of Some Types of Soil in Northeastern Part of Thailand (Thai)
- Sandy Silt Stabilisation by Using Emulsion with Lime or Cement

- Skidding Resistance Values of Some Types of Highway Surfaces: Route No.1, Section Bangkok-Saraburi (Thai)

- Sitly Sand Stabilisation for Use as Basecourse

- Test Embankment on Soft Marine Clay

- Penetration Macadam as a Surface to Minimise the Reflected Crack from Soil-Cement Base

- Comparison of Skidding Resistance Values on Two Main Thai Highways with Various Ages

- The Use of Fascines to Reinforce Fill Embankment on Very Soft Clay

- Special Report on Investigation of Dhonburi-Paktho Highway

- Construction of the Road on Soft Clay (Thai)

- Maintenance Cost Analysis (Thai)

- Reports of Settlement Observations on Bangkok-Sriracha Highway

- Special Report on the Investigation of the Embankment Failure on the Angthong-Potong Highway (Thai)

- Report on Highway Pavement Design by CBR Method in Comparison with the Benkelman Study

- Pavement Surface Characteristics and their Skid Resistance Values.

- Improvement of Road Surface Skid Resistance by Chip Seal Coats in Thailand

- Soil Consolidation and Erosion Control by Consolid 444 and Conservex for Road Construction

- Stability Improvement of Embankment on Very Soft Subsoils.

- Maintenance Cost Analysis (Modified)

- Performance of Test Road Using Silty Sand Stabilisation as Basecourse Materials.

- Deflection Measurement of Pavement on Soft Foundations

- Marine Clay in the Southern Chao Phraya Region (Thai)

- Using the Bamboo as Reinforcement in Waterproof Concrete Pavement (Thai)

- Materials of Construction and Material Improvement for Low Cost Roads in Thailand

- Polished Stone Values of Road Surface Aggregates in Thailand

- Low Cost Pavement Design in Thailand

- Traffic Characteristics and Road User Benefits on Bang Pa In Nakorn Sawan Toll Highway (Thai)

- Cement Stabilisation of some Selected Weathered Rocks

- Investigation and Preliminary Rehabilitation Design of Highway Route No. 34, Bang Na - Bang Pakong Section (North Bound Lane) (Thai)

- Bearing Capacity of Piles (Thai)

- In-Situ Strength and Total Stress Analysis for an Embankment on Soft Foundations.

- Evaluation of Penemulsion as a Soil Stabilising Agent

- Some Problems of Road Construction and Maintenance in Weathering Rocks in Northern Thailand

- An Investigation of Slope Failures in the Northern Part of Thailand

- Pavement Failure Evaluation and Corrections in Thailand

- Some Sources and Basic Properties of Granitic Soil in Thailand

- The Study of Highway Conditions for Maintenance Purposes (Thai)

- The Highway Route 1 Maintenance Priority Study

- The Highway Route 1 Priority Study for the Purpose of Budgeting and Method of Maintenance (Thai)

- Strength Parameters of Sandy Soils Stabilised with Emulsified Asphalt and Other Additives

- Use of Spent Sulphite Liquor as a Dust Palliative for Unpaved Roads

- Pavement Rating of Highways in Thailand

- Design for Road Embankments on Soft Foundations

- Accident Studies on 4-lane Divided and 2-lane Rural Primary Highways in Thailand

- Compaction and Strength Characteristics of Granitic Soil

- Earth Electrical Resistivity Characteristics of Some Types of Soil and Rock in Thailand

- Embankment Failures of Lampang-Denchai Highway Construction Project

- Using Theory of Plates to Design Slab Type Reinforcement of Bridges

- Investigation Performance of Roads on Soft Foundations (Thai)

- Geotechnical Aspects of Low Volume Road Design and Construction in Northeastern Thailand

- Geological and Seismological Aspects of Landslides in Northern Thailand

- Strength Parameters of Cement Stabilised Granitic Soils by Soil Classification

- Traffic Noise along Bangkok Suburban Highway (Thai)

- An Application of Base Sheet in a Highway Embankment (Bang Boh Test Section)

- Settlement of Bridge Approach Embankment on Soft Foundation (Thai)

- Mechanical Properties of the Non-Woven Fabric

- Accident Studies on Primary Highway Routes 1,2,3 and 4 (Thai)

- Special Reports on ESCAP Intergovernmental Meeting Expert in 1981

- Techniques for Minimization of Reflection Cracking in Asphaltic Concrete Overlays on Portland Cement Concrete Pavements (Thai)

- Highway Accident Prevention Campaign in Thailand

- Evaluation of Sand Asphalt Mix as Low Typed Surface for Low Volume Road

- Stability of Beach Sand Mixed with Emulsified Asphalt and Other Additives

- Road Pavement Evaluation and Rehabilitation in Thailand

- Potential Use of Granitic Soil in Road Construction in Thailand

- Polished Stone Value and Some Other Properties of Clay Aggregate Under Heat Treatment Blastfurnace Slags, Glass Chip and Limestone (Thai)

- The Application of Road Maintenance Management For District Engineers (Thai)

- Accident Studies on Primary Highways - Routes 31, 32, 34 and 35 (Thai)

- Cycle Use Attitude Surveys of Cyclists on Highways (Thai)

- Priority Rating of Road Maintenance Programme (Thai)

- Bangna - Bang Pakong Highway Improvement (Thai)

- Ironstone Gravels in Eastern Thailand

- Cause Analysis and Traffic Accident Preventions on Highways (Thai)

- Some Experiences from Bang Na-Bang Pakong Highway Project (Thai)

- An Evaluation of Traffic Low Enforcement Effectiveness Case Study : Highway No. 3 Section Chonburi - Pattaya

- Deep Hole Lime Stabilization for Unstable Clay Shale Embankment

- Strength and Consolidation Characteristics of Bangkok Subsoil at Don Muang International Airport

- Investigation of the Existing Concrete Pavement of the Bangkok International Airport

- The Analysis of Damage and Standard of Corrugated Sheet Steel Beam Highway Guardrail (Thai)

- Joint-Sealant Failures of Concrete Pavement and Field Performance Evaluation (Thai)

- Economic Analysis of Soil-Cement Base Construction as Compared to Crushed Rock Base

- Design and Performance of Highway Pavement in Thailand : Case Study for the National Highway Route No.2 Saraburi - Nongkhai

- Proposed Specifications for Soil-Cement Base Construction in Thailand

- Design, Construction and Performance of Silty Sand Stabilized Road Base

5. FUTURE EXPANSION OF RESEARCH ACTIVITIES

According to the past experience in all aspects of road planning, design, construction, maintenance and operation, as well as results of some national and international seminars in road engineering, it has been found necessary to increase research activities in various phases of road engineering to solve some regional problems in the country. So far there is no institution in the country responsible for research or special studies in the field of road engineering, except the Road Research Section of the Materials and Research Division, Department of Highways. Realising the needs of research in road engineering, the Department of Highways has planned to establish the Transport and Road Research Centre legally to induce more research studies and more possibilities of solving the common regional problems belonging to many other departments as well as the Department of Highways. The proposal for the establishment of a Road Research Centre has been drafted and submitted to some financial institutions, such as the World Bank, with a request for loans for the purchase of some scientific equipment. The proposal is also submitted to some developed countries to ask assistance in constructing the office building, laboratories and other facilities for the new Research Centre. The Department of Highways has provided the land of about 20 acres (50 rais) in the Bangkgk Metropolitan Area for the institution.

The new Research Center will induce more national and international co-operation in research advancement in the country and in the region. In addition to the research activities regarding the problems of some governmental institutions, the Research Centre will serve other private and semi-governmental sectors investigating some particular problems in the form of Contracted Research Projects.

In addition to research works which are the main duty of the Research Centre some patterns of training, lecturing, and national and international conferences in the fields related to transport and road engineering will be associated activities, inducing technology transfer and experience exchange amongst engineers and technologists in this region. They will be included in the programme of the function of the Research Centre. It is anticipated that the aforementioned activities will promote the co-operation among research institutes in this part of the world in conducting joint research projects.

6. INTERNATIONAL CO-OPERATION

6.1 Workshop of Road Research and Information for South East Asia. In 1980 Australian Road Research Board in co-operation with Road Engineering Association of Asia and Australasia organized a Workshop of Road Research and Information for South East Asia for the first time in Melbourne, Australia. The purpose of the Workshop is to exchange ideas, information and publications between national road research institute in South East Asia and Australasia. There are more than 30 delegates from 10 countries and other organizations, namely, The World Bank, The Permanent International Association of Road Congress, Transport and Road Research Laboratory, etc. participating the Workshop. The Department of Highways contributed four papers regarding research activities and road information center of the Department. All the papers contributed to the Workshop have been published in the Proceedings. So this Proceedings is a valuable source of information

about the research activities in all countries in this region. All the delegates have the unanimous resolution to have the Workshop like this is the future. At the moment, the Department of Highways is preparing to apply for the member of this Workshop.

6.2 Round Table Conference on Transport Research Centers in Developing Countries. In 1977 Transport and Road Research Laboratory in United Kingdom invited delegates from 15 developing countries to discuss about the establishment and operation of road research centers in those countries. The Meeting is later known as Round Table Conference. All the delegates have the unanimous resolution that there should be cooperation between the developing countries in planning and conducting the joint research in the future. In 1980 Transport and Road Research Laboratory organized another Round Table Conference and there was delegate from the Department of Highways participating the Conference. The member of the meeting has set up the priority of the probable transport research projects that should be conducted in various countries. This tends to promote the exchange of the results of investigation. At the moment the Department of Highways is applying for the member of the Conference which will be organized once in a while in the future.

6.3 The Road Engineering Association of Asia and Australasia (REAAA). The Road Engineering Association of Asia and Australasia was formed in 1973 with the following objectives:

- To promote and advance the science and practice in road engineering and related professions.

- To encourage communications between persons charges with the technical responsibility for the planning, design, construction, and maintenance of roads and allied structures.

- To obtain and diffuse among members, information on road engineering and related matter affecting the profession.

- To educate and seek to improve, extend and elevate the technical and general knowledge of members and persons concerned with road engineering.

- To serve as a focal point for exchange of ideas related to road engineering.

During the past the Association organized two conferences, the first in Bangkok (1976) and the second in Manila (1978). Quite a few engineers from the Department of Highways participate both conferences. There are many research papers from the Department contributed to the conference. The Association induced many research activities in various phases of road engineering in the Department. The Department co-operated with the Association by organizing the technical visit and study tour in Thailand. The Department is preparing to be the member of this Association.

The cooperation with other countries is generally for the development and research expansion. So there are many technical and research reports published as a result of research works at the Department.

6.4 Joint Research on Lateritic Soil. In 1982 a research on cement stabilization of lateritic soil was launched by the cooperation between the Department of Highways, Thailand and the Public Works Research Institute., Japan. The duration of Cooperation is a two year term. The objectives of this project is to study about the design and performance of lateritic soil-cement road for serving the heavy traffic. It is hoping that quite a number of information could be obtained from this field research work.

6.5 Research Expansion under the World Bank Grant. The World Bank allocated a funds of U.S.$ 200,000 for the Department of Highways to purchase some new equipments for being used in research expansion. From this amount of money, it is expected that research works at the Department of Highways, Thailand will be advanced considerably in the next few years. It is hoping that some unsolved problems could be clarified from these new equipments.

Report No. : MR 84 Materials & Research Division, Department of Highways
Author : Phophit Thipmongkhon
Title : Road Research Activities of the Department of Highways, Thailand
Abstract : History and development of road research of the Department of Highways are briefly described. Scope of research and active research projects as well as the publications are included. The establishment of the international co - operation for expanding the research activities is proposed.

Keywords : road research
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รายงานฉบับที่ : วว.๘๔ กองวิเคราะห์และวิจัย กรมทางหลวง
ผู้เขียน : พ็อพิศ ทิพยมงคล
ชื่อเรื่อง : งานวิจัยของกรมทางหลวง
บทคัดย่อ : รายงานนี้โดยบรรยายประวัติความเป็นมาและการพัฒนางานวิจัยทางด้านวิศวกรรมการทางของกรมทางหลวง ขอบข่ายของงานวิจัย รวมทั้งโครงการวิจัยที่กำลังดำเนินการอยู่ ตลอดจนเอกสารทางวิชาการที่ได้จัดพิมพ์ไปแล้วได้รวบรวมไว้ในรายงานนี้ การติดต่อประสานงานกับสถาบันวิจัยในต่างประเทศ เพื่อร่วมกันในการดำเนินงานวิจัย และการจัดประชุมทางวิชาการได้รวมไว้ในรายงานนี้

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AN EVALUATION OF TRAFFIC LAW ENFORCEMENT EFFECTIVENESS ON MAIN HIGHWAY IN THAILAND

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ABSTRACT

The purpose and scope of this research project were to evaluate effectiveness of traffic law enforcements on highways. Route No. 3 section Chonburi - Pattaya was chosen in this study. The operation was conducted by the Highway Police Division. Vehicle speeds and vehicles in wrong lane were measured and inspected. Checking of driving licences, giving written orders and fines were also operated. The operation of the project, statistics, analysis, result discussion and conclusions were included in this report. The benefits from this project will be a guide for operating such enforcements on other highway and adopted to be a nationwide campaign project in the future.

The main findings of this study were the number of accidents and severity as well as the violators decreased significantly after the process of public relations, verbal warnings and arrest.

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Road accidents are considered to have direct impact to the development of the country because they considerably cause loss of lives and properties which are valuable resources. In an attempt to reduce road accidents, the Highway Police Division which always closely cooperates with the Highway Department has, therefore, launched a practical and effective traffic law enforcement project in addition to the routine enforcement measure on main highways especially on Route No. 3 and 34.

The evaluation from this study shows that the success of the project in decreasing the number, fatality and severity of road accidents relies on the use of efficient and effective system of traffic law enforcement and it should be done along with the traffic engineering and traffic safety education measures.

This study would appreciably be able to use as a guideline to develop any road accident counterneasures. However, as road accidents are one of the very severe problems which obstruct the development of the country, it is necessary that all the departments concerned should continuously play a mutual role by sharing views, efforts and resources in order to fulfil the objective of the national plan for prevention and control of road traffic accidents.

The purpose and scope of this research project were to evaluate effectiveness of traffic law enforcements on highways. Route No. 3 section Chonburi - Pattaya was chosen in this study. The operation was conducted by the Highway Police Division. Vehicle speeds and vehicles in wrong lane were measured and inspected. Checking of driving licences, giving written order and fines were also operated. The operation of the project, statistics, analysis, result discussion and conclusions were included in this report. The benefits from this project will be a guide for operating such enforcements on other highways and adopted to be a nationwide campaign project in the future.

The main findings of this study were the number of accidents and severity as well as the violators decreased significantly after the process of public relations, verbal warnings and arrest.

INTRODUCTION

Problems

In 1978, only in the Highway Police responsible area, there were at least, 3,964 road accidents occurred, causing 2,983 fatalities and 6,657 injuries. This problem is considered to have direct impact to the development of the country because road accidents cause loss of lives and properties which are valuable resources of the nation.

With the responsibility to maintain public safety on highway, the Highway Police Division, in an attempt to fight against the fatality and severity from road accidents, therefore, launched a systematic traffic law enforcement project on highway No. 3 and 34 from Bang Na to Pattaya in addition to the routine law enforcement measure. This project was determined, as a pilot project, to control road users' behaviour by using an effective and efficient law enforcement system.

Objectives, Scope and Expected Benefits of the Research Project

The objective and scope of this research project were to evaluate effectiveness of traffic law enforcement on highways by choosing the operation of the Highway Police Division on main Highway Route No. 3 section Chonburi - Pattaya during 1979 - 1980. Vehicle speeds and driving vehicles in wrong lane were measured and inspected as well as checking of driving licences, giving written orders and fines were also operated. The major benefits from this operation were the decrease in both numbers and severity of traffic accidents and the traffic laws have been more respected by road users. The expected benefits from this study will be a guide to the concerned Departments to continue such the operation with more effectiveness and success.

THE OPERATION OF THE PROJECT

Principles

- Publicity of traffic safety campaign urging road users to co-operate with law enforcers by following traffic regulations and helping each other in the use of highways.
- Implementation of strict and continuous traffic law enforcement, by arresting those who violate or do not comply with the traffic regulations, setting up a fair fining system to the possible maximum, suspending the verbal warning system in order to provide a fair treat to all road users.
- Improvement of law enforcement personnel by giving them more traffic regulation background, some new techniques and tactics in enforcement in order to make them able to build up a better understanding with road users and also able to conduct their duties to the maximum efficiency possible.

It is stressed that the success of this project is based on the mutual co-operation and better understanding between road users and law enforcers.

Chosen Route for the Research Study

Route No. 3 (Bang Na - Trart) section Chonburi - Pattaya was chosen for this research study. This is four-lane divided main highway from the capital to the east of the country. The surface width of each direction is 7.00 metres and paved with limestone asphaltic concrete. The traffic volume in 1980 was approximately 15,000 vpd. About 30 percent were heavy buses and trucks.

This section was chosen for the study because the procedures and all types of data collected by the Highway Police Division were rather perfect. The high accident occurrence was the other reason that why this portion of the Route No. 3 was selected.

It was noticed that the other section of this main highway such as Bang Na - Bang Pakong(on Route No. 34) was improving to be a divided highway during this study but the Chonburi - Pattaya had been perfectly constructed before, so the data used in the analysis was not effected by the construction.

Steps and Details in the Project Operation

- The Project began in April 1979.

- During the period of January to March 1979, publicity of Traffic safety campaign through all types of mass media, was widely launched in the operational area, in order to publicize traffic safety education to road users, and also to warn them of a strict and continuous arrest for traffic violators from April.

- During the public relations period. Verbal warnings were used to warn traffic violators.

- After the campaign, the arrest of traffic violators were strictly and seriously conducted by the Highway Police Division. The project, at that time, was stressed on arresting those who didn't drive on the left of the roadway*. And after April 1980, the arrest of violators driving above maximum speed limit began to be implemented.

- After being arrested, violator would be told the mistake he had done. The driving licence would be checked and kept by the highway police officer. The violator would receive the written order and he could pay a fine and would receive his driving linoence back either at

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* According to section 34 of the Land Traffic Oct 1979, a driver must drive in the outtermost left lane, except :-

(1) There is obstruction or traffic is closed on the lefthand side of the roadway.

(2) The roadway is prescribed by the traffic officers as oneway roadway

(3) It is necessary to enter the correct lane when approaching a junction.

(4) When about to overtake another vehicle.

the Highway Police Station in the project area or at the Sub-Division 3, Highway Police Division Headquarters in Bangkok within 7 days.

ACCIDENT STATISTICS, ADT, NUMBER OF ARRESTED VIOLATORS AND FINES

Table 1 Accident Statistics and ADT on Highway Route No. 3 (section) Chonburi - Pattaya)*

Item \ Year	1978	1979	1980
Number of accidents	334	237	139
Number of fatalities	88	131	66
Number of injuries	344	316	213
ADT	14,380	15,740	15,044

* Source : Highway Police Division

Table 2 Statistics of Number of Arrested Violators and Number of Reported and Fined Violators *

Month \ Year	No. of Arrested Violators 1979	No. of Arrested Violators 1980	Note
Jan.	Public Services & Public Relations Period	305	- In 1979 number of reported and fined violators were 1,020 (64.5 %)
Feb.		204	
Mar.		198	
Apr.	115	352 **	
May.	150	508	
Jun.	175	556	- In 1980, number of reported and fined violators were 2,739 (76.2 %)
Jul.	192	316	
Aug.	180	211	
Sep.	125	310	
Oct.	112	225	
Nov.	252	218	
Dec.	280	230	
Total	1,581	3,663	

* Source : Highway Police Division

** From May 1980, the number of arrested violators on driving over maximum speed limit were included.

From Table 1 the accident statistics on Highway Route No. 3 (Section Chonburi - Pattaya) obtained from the Highway Police Division were compared between the year 1978, 1979 and 1980. The results showed the reduction of the number of accidents in 1979 and 1980 compared with 1978 (year before the project was implemented). The number of injuries also gradually decreased from the year 1978. The number of fatalities increased in 1979 and then decreased in 1980. The average daily traffic in these 3 years were also shown in this Table)

Table 2 showed the number of arrested violators on this highway section by months in the year 1979 and 1980. The number of fined violators were also shown in this Table. In addition, the number of arrested violators driving over speed limit from May 1980 were also illustrated.

DISCUSSION AND RECOMMENDATIONS

Traffic Law Enforcement

- Traffic law enforcers must be developed in order to :
  - have sound knowledge on traffic regulations.
  - understand the nature of the problems.
  - be able to make fair decision in arresting violators.

- The operation must be strictly and continuously conducted.
- Adequate manpower, equipment and budget play important role in achieving the possibility and success of the project.
- Revision, control and evaluation of the project are fully necessary.
- Suspending of all types of privilege ie. verbal warning instead of arrest or fine etc.
- Law enforcers must honestly and seriously conduct their duties.

Traffic Engineering

Discussion and recommendations on traffic engineering point of view are :

- Accident data collections and details should be more precise and perfect in order that they can be completely evaluated.
- Check points should be located without disturbing traffic flow.
- Statistical evaluation should be made both the number of accidents and severity in order to know the significance of accident reduction.
- Equipment used must be accurate and reliable.
- Accurate pavement structure must be designed so that the "slow lane" or the "left lane" will not be destroyed before the design life.
- The results from traffic engineering point of view should be a guide for operating and evaluating enforcement effectiveness on other highways.

Others

- Urging road users to participate in the traffic education and law enforcement programs ie. traffic volunteers corps etc.
- A static law enforcement policy must be set up in order to treat all roadusers with the same measure, for example, a find for the first violation of the same charge should be the same for all violators.
- Excluding the arrest of traffic violators, traffic safety campaign must be implemented in order to reduce the number of violators.
- Collection and analysis of violator response should be done in order to study their attitude and behaviour.
- Promotion of traffic safety education programs to public of all levels must be conducted to create a mutual responsibility to the society.

CONCLUSIONS

From this study, the main conclusions can be drawn as follows :

- The success of this law enforcement project shows that the use of efficient and effective system of law enforcement can result the decrease in the number, fatality and severity of road accidents.
- The efficiency and effectiveness of this law enforcement project rely on :
  - Adequacy of manpower, equipment and budget.
  - Co - operation of road users.
  - Perfection of road condition such as markings, roughness on left lane and position of check points.
  - Using of responsible and competent law enforcers.
  - Suspending of all types of privilege.
  - Strict and continuous operation of the project.
  - Continuity of revision, control and evaluation of the project.
  - Publicity of traffic safety education and traffic regulations.

However, it can also be concluded that :

- Due to the limited supply of resources this project seems to be applicable only for a short - time period. Or it can be said that this project is suitable only for being a temporary countermeasure against road accidents.
- Because of the limitation of resources, especially in developing countries, this project can hardly be conducted throughout the country at the same time. A partially and occasionally operated project on main highways or in major area will be more relevant.
- For a long - term road accident prevention, traffic safety education to all levels of road users is still favorably recommended. But it should be done along with the traffic engineering and law enforcement measures.
- This type of campaign should not only be supported by the Highway Police Division and some other concerned Departments but also up to the governmental level.

Report No. : MR 84 Materials & Research Division, Department of Highways
Authors : Chawalit Sukhawan, Chalat Kichtham and Thongchai Somnemitr
Title : An Evaluation of Traffic Law Enforcement Effectiveness On Main Highway in Thailand

Abstract : The purpose and scope of this research project were to evaluate effectiveness of traffic law enforcements on highway. Route No.3 section Chonburi - Pattaya was chosen in this study. The operation was conducted by the Highway Police Division. Vehicle speeds and vehicles in wrong lane were measured and inspected. Checking of driving licences, giving written orders and fines were also operated. The operation of the project, statistics, analysis, result discussion and conclusions were included in this report. The benefits from this project will be a guide for operating such enforcements on other highways and adopted to be a nationwide campaign project in the future.

The main findings of this study were the number of accidents and severity as well as the violators decreased significantly after the process of public relations, verbal warnings and arrest.

Keywords : traffic law enforcement, evaluation, effectiveness, route No.3

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รายงานฉบับที่ : วว.๘๔ กองวิเคราะห์และวิจัย กรมทางหลวง
ผู้เขียน : ชาลิต สุขะวรรณ ชลัท กิจธรรม และ ชงไชย สมนิมิตร
ชื่อเรื่อง : การประเมินผลประสิทธิผล ของการบังคับควบคุมการจราจรให้เป็นไปตามกฎหมาย

บทคัดย่อ : วัตถุประสงค์และขอบข่ายของโครงการวิจัยนี้ คือเพื่อประเมินผลประสิทธิผลของการบังคับควบคุมการจราจรบนทางหลวงให้เป็นไปตามกฎหมาย โดยเลือกศึกษาบนทางหลวงหมายเลข ๓ ช่วงชลบุรี – พัทยา กองตำรวจทางหลวงเป็นหน่วยงานที่ได้ดำเนินการบังคับควบคุมนี้โดยเน้นที่ยานพาหนะขับเร็วเกินกำหนดและขับผิดช่องทาง นอกจากนี้การดำเนินการในสนามยังรวมถึงการตรวจใบขับขี่ ออกใบสั่งและปรับกวย การศึกษาวิจัยในการประเมินผลนี้ได้รวมถึงการรวบรวมวิเคราะห์สถิติอุบัติเหตุ จำนวนผู้กระทำผิดและการปรับตลอดจนถึงสรุปผล ข้อคิดเห็นแนะนำและเสนอแนะประโยชน์ที่จะได้รับจากโครงการนี้คือเพื่อเป็นแนวทางในการดำเนินงานในลักษณะนี้เพื่อเป็นโครงการรณรงค์ในระดับชาติต่อไปในอนาคต

ผลการศึกษาวิจัยพบว่าจำนวนและความรุนแรงจากอุบัติเหตุบนทางหลวงช่วงที่ศึกษานี้ลดลง นอกจากนี้จำนวนผู้ฝ่าฝืนกระทำความผิดได้ลดลงอย่างเห็นได้ชัดภายหลังจากที่ได้ดำเนินการด้านการประชาสัมพันธ์ การว่ากล่าวตักเตือนก่อนที่จะดำเนินการจับกุม

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