CHAPTER 3
Rural Road Widening Project based on Prediction of Level of Service (LOS) – A Case Study

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ABSTRACT

The profession or work of examining and recording the area and features of a piece of land so as to construct a map, plan, or detailed description of it is called Surveying. Surveying or Land Surveying is the technique, profession, art and science of determining the terrestrial or three-dimensional positions of points and the distances and angles between them. A land surveying professional is called a Land Surveyor. Surveyors work with elements of geometry, trigonometry, regression analysis, physics, engineering, metrology, programming languages, and the law. They use equipment, such as total stations, robotic total stations, theodolites, GNSS receivers, retroreflectors, 3D scanners, radios, inclinometer, handheld tablets, digital levels, subsurface locators, drones, GIS, and surveying software.

Keywords: *Surveying , elements of geometry, trigonometry, regression analysis, physics, etc*

INTRODUCTION

A road widening project is usually commissioned when the road width is not adequate for the traffic, or when extra lanes are needed. Road widening can improve traffic safety and capacity. There are many special issues in road widening. If widening is made poorly, several problems can occur, and many are common to all countries. Typical problems in road widening are construction joint cracking between the old and new parts of the road, non-uniform settlements between the old and new part of the embankment and stability problems. In cold areas frost action causes significant additional problems. Harmful effects however can be avoided by good survey and design. Damages can be avoided or repaired by using techniques such as geo- reinforcement, steel nets, stabilization and soil replacement, and by improving drainage. These methods usually increase construction costs, but they can decrease life cycle cost.

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Choosing the correct widening or repair method and structure is therefore very important for avoiding additional long term costs.

Many road widenings fail without engineers knowing the reasons for the failures. The goal in this report will be to improve road widening diagnostic methods in order to find objective information on the reasons for the failures. For this new technologies and their integrated analysis methods need to be tested.

SURVEY SITES

The road chosen for widening is from Nehru Institute of Technology Kaliyapuram to Nehru Institute of Engineering and Technology Thirumalayampalayam. The length of the chosen road is 2.5kms. Reason for choosing this road is its small width due to which there is traffic and congestion. College buses and Government buses travel mostly in this area and due to the small width, it is very difficult for the buses to travel.

SURVEY TECHNIQUES

Carefully performed surveys and measurements are essential before starting the design of a road widening. It is important to find out the conditions on the site such as the thickness of the old road structural layers, the material properties of the subgrade and layers in the old embankment, the road shape and its surroundings, any problem areas and damages on the existing road, etc. The type and range of survey techniques to be used will depend on each individual case, but typically at least video recording, laser scanner measurement and GPR measurement should be made. A short description of the techniques used in the road widening field surveys is given in the following chapters. All of the techniques listed are discussed and explained elsewhere in more detail.

DIGITAL VIDEOS

A Road Doctor CamLink system was used for the video data collection. This system is designed to collect videos, audio commentary and a drainage or pavement distress inventory on the road, together with GPS coordinates. Modern digital photo and video techniques provide very useful tools for documenting a road, its surroundings and pavement damages. Visual recording is vital to make the correct diagnosis of any problems on the existing road. Video recording gives a continuous record of the road. It can detect road surface condition, pavement distress, road markings, traffic signs etc. It can also be a very useful aid in surveying the topography of the road and its surroundings. Video recording is a useful tool for comparing the road condition before and after widening.

LASER SCANNING

Laser scanning is a technique where the measurement of distance is derived from the travel time of a laser beam from the laser scanner to the target and back. When the laser beam angle is known, and beams are sent to a range of directions from a moving vehicle with a known position, it is possible to make a surface image, or “point cloud”, of a road and its surroundings. The point cloud can have millions of points, with every point having x, y & z coordinates and additional reflection or emission characteristics.

The laser scanner technique was used in many sites in the road widening research project to obtain continuous height information and cross section profile of the road. From this information useful data can be obtained, e.g. the angle of side slopes which can help in evaluating the effects on the slopes due to widening. Other useful parameters that can be obtained are the road width and the ditch depth. Laser

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scanning is a very efficient tool for comparing the road profile before and after widening . A combination of laser scanner data together with other road survey data can provide an excellent basis for analysing the reasons for failures on an existing road.

GPR SURVEYS

Ground Penetrating Radar (GPR) data collection and analysis is one of the most important survey techniques. It provides continuous information on the thicknesses and the quality of the road structural layers. GPR measurements should be done in 3D for road widening works using several parallel longitudinal profiles, and GPR cross sections are also recommended. GPR cross sections are especially important in road widening cases for the evaluation of the performance of the widening and the reasons for any damages. Cross sections can, for example, provide information on the differences in layer thicknesses and/or material properties, old structures below or inside the road structure, settlement and rutting problems. Rutting mode can also be determined from GPR cross sections. The correct identification of the reasons for rutting on the existing road can help in selecting the most appropriate widening or repair method.

THERMAL CAMERA MEASUREMENTS

Thermal camera measurements can provide a continuous thermal video recording of the whole road length. The temperature distribution over the road's cross section can be obtained from the data and analyzed to locate any temperature differences between the widening and the old road structure. A non-uniform temperature distribution may be an indication of possible frost or moisture problems.

FALLING WEIGHT DEFLECTOMETER SURVEYS

The Falling Weight Deflectometer (FWD) is an automated stationary impulse load method used to measure deflections in the road surface, which can then be used in calculating the bearing capacity of the road. From FWD measurements the E- modulus value of each structural layer and the subgrade can be calculated, and these moduli can then be used for calculating the bearing capacity of the existing road and for the widening design. The FWD can be used for many purposes in addition to bearing capacity measurement, for example the investigation of reinforcement requirements, identifying weak spots on the road, establishing priorities for road strengthening, as wells as monitoring the strength of layers during construction.

DATA ANALYSIS TECHNIQUES AND SOFTWARE USED

All of the data collected in the surveys was processed and analyzed using Road Doctor Pro software. This software enables GPR, FWD, laser scanner and other data to be combined together with videos and maps. The Thermal Diagnostics module of the Road Doctor Pro software was used to process the thermal camera data. "Elmod 6" software can be used to back calculate the layer moduli values on the basis of the FWD data and the layer thicknesses. This was used in an integrated module with Road Doctor Pro software. An integrated data analysis utilizing comparisons and correlations between different factors affecting the road behavior is easier to make when all the data is linked together.

CONCLUSION

Thus the project of Road Widening of NIT Kaliyapuram to NIET Thirumalayampalayam has been successfully completed. The graphs and calculations have been done carefully and the result has been achieved.

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