Identification of the Most Appropriate Locations to extract Soil for Road Construction: with special reference to Kadawatha – Nittabuwa Road

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DECLARATION OF THE CANDIDATE

I do hereby declare that work described in this thesis was carried out by me under the supervision of Dr S.Heenkenda and Mr Prabath Malavige and report on this thesis has not been submitted in whole or in part to any University or any other institution for another Degree/Diploma

Date 22/03/16.....

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LIST OF ABBREVIATIONS

Abbreviation		
AASTO	-	American Association of State Highway and Transportation Officials
BS	-	British Standard
CBR	-	California Bearing Ratio
CIA	-	Central Environmental Authority
DBMS	-	Data Base Management System
DSD	-	Divisional Secretariat Division
EMP	-	Environmental Management Plan
GPS	-	Global Positioning System
GSMB	-	Geological survey & Mine Bureau
HTML	-	Hyper Text Markup Language
LL	-	Liquid Limit
OMC	-	Optimum Moisture Content
MDD	-	Maximum Dry Density
PI	-	Plastic Index
PL	-	Environmental Services Research Institute
RDA	-	Road Development Authority
SQL	-	Structured Query Language

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ABSTRACT

D.H.N.C.Kumara Wijesinghe

Gravel is a vital and cost control natural raw materials for construction and its mining has been one of the serious environmental problems around the globe in recent years. This often results in land degradation, loss of agricultural lands and biodiversity as well increased poverty among people with social conflict. In order to address these problems, pragmatic and explicit laws and regulations have to be developed by countries in a participatory manner so as to facilitate enforcement and compliance at all levels within the social settings. This study was therefore carried out to select the most appropriate gravel mining location for Colombo Kandy - highway from Kadawatha Nittabuwa road section. The GIS is the best tool for identifying most appropriate soil location considering government, environmental and social obligations. Creating model builder with specifying above said requirement as a model parameter can be able to find best Soil location for road construction project with different environment.

This model builder is vital importance in feasibility stage and construction stage for take decision for Road development authority and engage operation party to save resources usage and smooth progress in any part of the country. On the other hand this is assist to making real budget, taking Policy decision for availability of Soil quantity according to the developing road network in district master program.

Key words: California Bearing Ratio, Liquid limit, Multi Criteria, Maximum Dry Density, Optimum Moisture Contents, Plasticity Index.

CHAPTER ONE

INTRODUCTION

1.1. Background

Soil is an important source of raw materials such as clay, sand, gravel and minerals. It is a non-renewable natural resource with potentially rapid degradation rates and extremely slow formation and regeneration processes (Mwangi, 2007). Gravel is a heavy and cheap commodity made of small weathered stones used to make surface for paths and roads. The resource's compressibility, plasticity and textural properties have been valued in construction for hundreds of years. The ability of soil to be molded and its cohesion properties were the basis for using it to build the earliest houses defined soil as a mineral which protect the environment, buffer to strong tidal waves and storms, habitat for crustacean species and marine organisms. Therefor soil is categories with its engineering properties and different application.

1.1.1. Road Construction and development in a country

Development is related at improving the welfare of a society through appropriate social, political and economic conditions. The expected outcomes are quantitative and qualitative improvements in human capital (e.g. income and education levels) as well as physical capital such infrastructures (utilities, transport, telecommunications). While in the previous decades, development policies and strategies tended to focus on physical capital, recent years has seen a better balance by including human capital issues. Irrespective of the relative importance of physical versus human capital, development cannot occur without infrastructures.

Because of its intensive use of infrastructures, the transport sector is an important component of the economy and a common tool used for development. This is even more so in a global economy where economic opportunities are increasingly related to the mobility of people, goods and information. Relation between the quantity and quality of transport infrastructure and the level of economic development is apparent. High density transport infrastructure and highly connected networks are commonly associated with high levels of development.

When transport systems are efficient, they provide economic and social opportunities and benefits that result in positive multipliers effects such as better accessibility to markets, employment and additional investments. When transport systems are deficient in terms of capacity or reliability, they can have an economic cost such as reduced or missed opportunities and lower quality of life. (Rodrigue. & Notteboom, 2005)

Air, water and land type of transport modes are available for human day to day activity. But internal transport focused on land transport and important element is access roads and safe riding ability. In the event of safe riding ability of user, road should be compatible and enough safety consideration and meet the requirement of economy due to roads form the backbone of social and economic activities in Country.

Another main indicator for economy development in a country is road density. Increase the road density, length of road should be increase and relatively road construction should be analyze with satisfying the compatible and enough safety consideration of road. Road geometry is the paramount element of road which is vary with class and type of road.

1.1.2. Geometry of the Road

Geometry of the road vary with class and road transvers area geographical features. Natural geographical features consist of landforms, ecosystems and environment. Environmental feature consist terrain types and physical factors of natural geographical features. Conversely, human settlements or other engineered are considered types of artificial geographical features.

All these features guide to design geometry element of vertically alignment, horizontally alignment, and vehicle speed limit, width of road, construction of hydrological structure and decide the cut and fill quantity in a road.

Another important aspect of the selection of a cross section is based upon the joint use of the transportation corridor by vehicles, including trucks, public transit, cyclists and pedestrians. Designers should recognize the implications of this sharing of the transportation corridor and are encouraged to consider not only vehicular movement, but also movement of people, distribution of goods, and provision of essential services. (Highway design manual 2015)

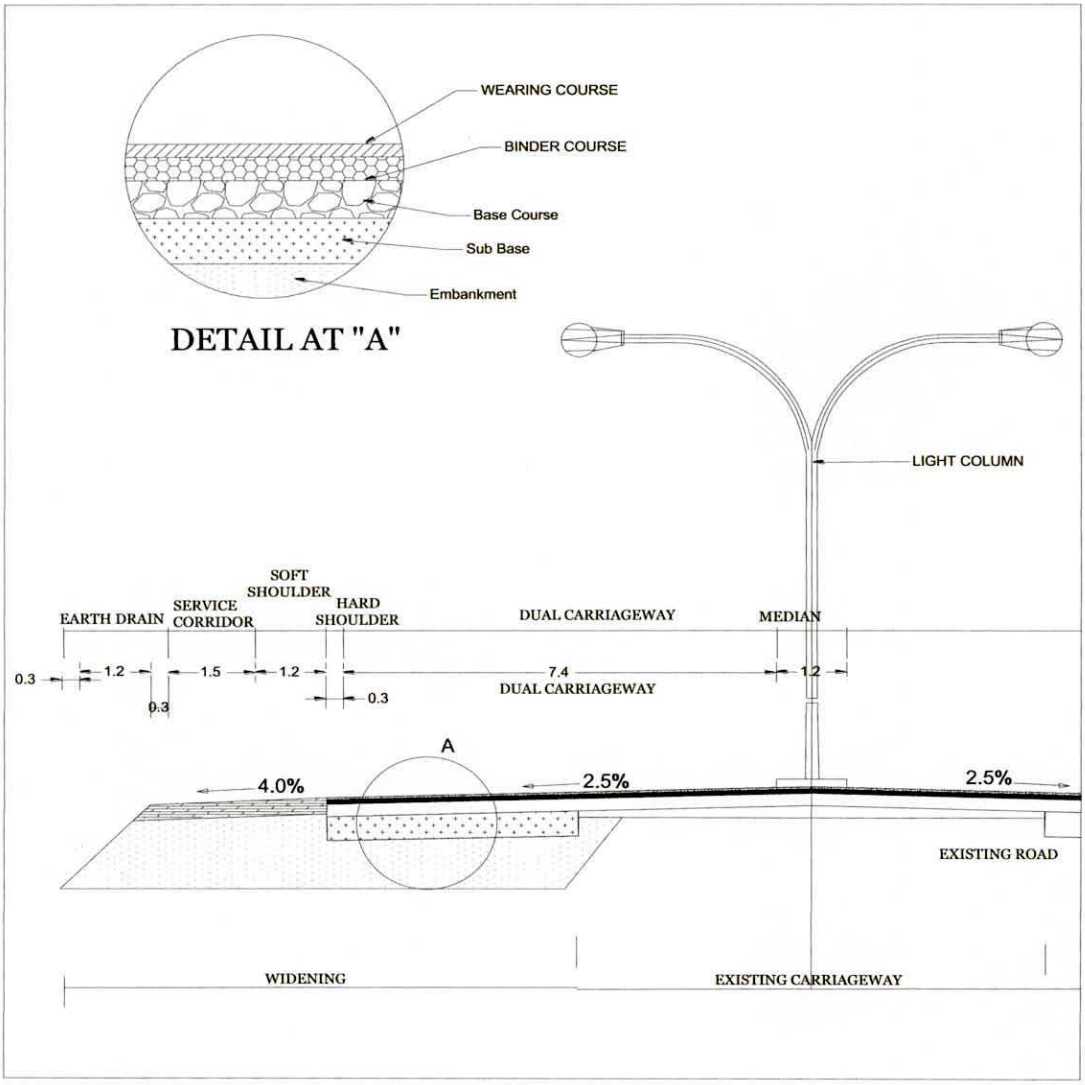
Typical road cross section consist of the roadway, drainage features, earthwork profiles and clear zones. The whole cross section, including the clear zone is defined as the road reserve. For a one or two lane road, the roadway is the portion of the road, consisting of the shoulders and the carriageway. The carriageway is the portion of the road used for the movement of vehicles exclusive of shoulders. Earthwork profiles are the side and back slopes of the road cross section explain by the Road geometric design manual (2011) Figure 1:1 illustrates the various components of the cross-section for a four lane road.

The carriageway is regarded as the surface on which the vehicles are expected to run. The carriageways are classified as single – lane, two – lanes or multi-lane. A traffic lane is defined for the use of single line of traffic operation. The desirable lane width is 3.7m. In this project two lane width is 7.4m, hard shoulder width 0.3m, service corridor 1.5m and earth drain 1.2m in each side of road, The road layer combination important layers are asphalt surface, aggregate base Couse layer, Sub base layer and foundation of sub base construction on existing sub grade or embankment fill and shoulder for laterally support.

Foundation is important component of the structure and it is bear total weight of structure and live loads. In the road foundation is existing ground of artificially form embankment fill and sub base layer which is capable to withstand all weight of vehicle movement and super structure load. That withstanding capacity of foundation vary with the several factors and generally normal ground condition soil is used for foundation materials with specific engineering property.

Soil engineering property categories with the traffic volume and life time of road apply. Road Design manual specify required engineering property when design the road.

One of major natural material beside Aggregate and Sand, component for road construction is soil and other materials made by combination of several natural raw materials. Aggregate products, cement, steel, timber and product, bitumen and PVC product etc. are the raw materials used for road construction. There are several definition and application of soil considering its behavior.



Source : Kadawatha Nittambuwa Road Price Proposal.

Figure 1:1 Typical Cross Section of Road Construction

1.2. Definition of Soil

The lithosphere is the upper part of the earth. It includes the crust and the solid portion of the mantle. Lithosphere interacts with atmosphere, hydrosphere, and biosphere and produces the pedosphere (the soil with its biotic and abiotic components). The lithosphere contains rocks, minerals, and soils. It is made up with more than 100 chemical elements, but most of them are rare. Only eight elements, oxygen (O), silicon (Si), aluminum (Al), iron (Fe), calcium (Ca), sodium (Na), potassium (K), and magnesium (Mg), constitute more than 99 percent of its volume. The soil is define as

The word "Soil" is derived from the lathin word "Solium" which, according to Webster's dictionary, means the upper layer of the earth that may be dug or plowed: specifically, the loose surface material of the earth in which plant grow (Osman, 2013) .

The 'Soil 'in Soil Engineering is defined as an unconsolidated material, composed of solid particles, produced by the disintegration of rock. The void particles can be separated by such mechanical means as agitation in water. (Arora, 2000)

1.3. Application of Soil

Soil is a basic element to how life on our world survives. All living creatures, such as insects, animals, humans, and plants rely on soil to live. There are many different types of plants that grow in soil. Plants release oxygen and absorb carbon dioxide in a cycle called respiration. Without soil for plants to grow, there would be no oxygen for us to breathe. Some plants are also food - for humans, animals and insects. In a world without soil, we would not have food to eat (winter, 2012). Therefor soil is unable to group for application or use and it is the main row material in planet being and human being. Considering major activity involved with soil it most applicable area is Engineering purpose, stabilization of ecosystem and cultivation purpose. Typical properties are very from Cultivation, stabilization of ecosystem and Engineering Purpose.

1.3.1. Application of Soil in Agricultural and Ecosystem

Soil is the basis of farming. It delivers water and nutrients to crops, physically supports plants, helps control pests, determines where rainfall goes after it hits the earth, and protects the quality of drinking water, air, and wildlife habitat (Robert, Kouacs &.Sheahan 2013).

Soil provides ecosystem services critical for life: soil acts as a water filter and a growing medium; provides habitat for billions of organisms, contributing to biodiversity; and supplies most of the antibiotics used to fight diseases. Humans use soil as a holding facility for solid waste, filter for wastewater, and foundation for our cities and towns. Finally, soil is the basis of our nation's agro ecosystems which provide us with feed, fiber, food and fuel.