

**SOCIAL COST FACTORS AND THEIR IMPACTS IN
SEWERAGE PIPE LAYING PROJECTS**

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SOCIAL COST FACTORS AND THEIR IMPACTS IN SEWERAGE PIPE LAYING PROJECTS

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“This dissertation was submitted to the Department of Civil Engineering of the University of Moratuwa in partial fulfillment of the requirements for the Master of Science in Construction Project Management”

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DECLARATION

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ABSTRACT

The construction projects have adverse and negative impacts on the residents who live at a neighborhood of a construction project. These negative impacts such as inconveniences, disturbances and economic losses which face by the community surrounding a construction project are referred to as “social costs”. More often the contractor of the construction contracts has no obligation, during his execution of works, to bear these social costs hence consequently have to be dured by the local community in and around the project area.

The scenario is true for the sewerage pipe laying related construction projects too as the sewer conveyance pipe lines are laid on the public road’s right of way in deep and wider trenches. In Sri Lankan point of view the sewerage pipe line trenching is mostly done by traditional open-cut method, with opening up wider trenches along the public roads attributing many social costs and impacts to the surrounding community and businesses. These social cost factors and impacts can take many forms, such as traffic delays and congestion, more fuel consumption, road and third party property damages, increased accidents, air and noise pollution, decreased revenue in businesses and annoyances.

To identify and itemize the social cost factors and their impacts to the local community, the literature was reviewed and the recently implemented sewerage pipe laying construction project in Ratmalana/Moratuwa was selected as a case study. By the use of researcher’s project experience, questionnaire surveys and interviews conducted with the project stake holders the nature and gravity of those social cost factors and impacts on the neighboring community, were analyzed. According to the findings the major social cost factors which businesses incur include customer decline and financial loss, whereas residents find traffic delays and traffic congestion problems to be more of an intrusive inconveniences. The findings further give the gravity of those social cost factors and impacts, effect to the local community and businesses.

This thesis concludes, as many techniques are available in the literature for quantification of social costs those social costs should be assessed and accommodated in the project budgets. On the other hand, this would give clear picture of the social costs the

community endures but neglected by the project parties. Furthermore the findings give alternative trenchless methods instead of traditional open-cut trenching for sewerage pipe laying, by which the foregoing road and property damages and associated social costs could be minimized. This is because the current way of conducting the sewerage pipe laying projects in the public roads by harming the community will lose the credibility of the contractual parties, i.e., the project proponent and the contractor, as the social costs are bared by the community besides the fact that the prime objective of implementing a sewerage project is to protect the environment and the ground by conveying the household sewage in a safe manner..

Keywords: public, social costs, impacts, sewerage pipe laying, local community

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ABRIVIATIONS

NWSDB – National Water Supply and Drainage Board

CEA – Central Environmental Authority

CGC – China Geo-Engineering Corporation

CMC – Colombo Municipal Council

BOQ – Bill of Quantities

SOCIAL COST FACTORS AND THEIR IMPACTS IN SEWERAGE PIPE LAYING PROJECTS

CHAPTER ONE–INTRODUCTION

1.1 Background

It is obvious that construction projects being executed, especially in populated areas are complex and difficult in the sense of achieving intended scope, time target, cost, quality and also objectives, site operations and always associated with inevitable social risk though lots of management and engineering techniques have been applied to address them. “Types of adverse impacts associated with construction activities are grouped under four headings: traffic, economic activities, air and water pollution, and damage to the physical environment. Potential impacts as a result of unregulated construction activities include traffic congestion and delays, disruption of economic activities, excessive generation of pollution and pollutants, damage to sensitive ecosystems, and damage to existing structures and infrastructure systems.” (Gilchrist, Allouche, 2014)

These sorts of social aspects are rarely looked at the beginning or at the planning and design but often runs through the implementation and construction stages perhaps at post construction stage as well. Although construction is beneficial to the communities in the long run, it can cause many disturbances in the phase of implementation and before completion. Different aspects of life are affected by construction activities including but not limited to local community, environment, atmosphere, and/or economic activities. These negative effects impacting the surrounding and local community are known as social costs and “include inconvenience to the general public and damage to the environment and existing Structures” (Najafi, Gokhale, 2005). In another reference, “The term ‘social costs’ refers to costs incurred due to the execution of a construction project that cannot be classified as either direct or indirect costs incurred by the parties engaged in the contractual agreement” (Allouche, Gilchrist, 2004). These costs involved in such aspects have the monetary value of resources expended; i.e., more fuel consumption in

traffic congestions, time delays, economic losses of surrounding businesses, property damages, insecurity, pollution in the air, noise and surrounding environments, damage caused to diversion roads due to rerouting, road damages or damage done to vehicles driving on roads with pavement issues surrounding the construction area.

Sri Lanka, being one of a fast developing countries, implements lots of infrastructure development projects such as Water Supply and Sewerage Infrastructure, Roads, Highways, Ports, Airports Power Plants, Canal Rehabilitations and also City development projects. All these projects though attempt to bring innumerable benefits also associated with unintended harmful effects on people and natural resources. The utility agencies that provide services to the customers such as water supply, sewerage, telephone, electricity and cable television, use the public road ways to lay down their infrastructure. This is the commonly practiced scenario world-wide. One of the core utility among the utilities lying in the road's right of way is "sewer reticulation pipe systems" which need to provide off-site sanitation systems to the major cities.

The off-site sanitation systems comprise collection of wastewater generated from the premises such as households, commercial places, institutions and industries, convey it to the Wastewater Treatment Facility by means of sewer pipe lines, manholes and lifting pump stations and dispose the treated effluent main water stream, lagoon or to the sea. Since these works involve heavy infrastructure construction, the organization ie; National Water Supply and Drainage Board (NWSDB), whom is the responsible for establishing central wastewater infrastructure facilities to the major cities in the Sri Lanka, formulates and executes projects with various magnitudes. The laying of such sewer pipe line system under the roads' right of way is considered to be the major task as it attributes severe damages to the road and the surrounding objects. In Sri Lanka point of view, a city sewerage disposal facility contains laying of pipe lines in "kilo meter" lengths on the roads varying from 20 km to 100 km. The connection rate expected in the planning stage is about 80% of the population; therefore most of roads are to be excavated to lay the sewer pipe lines.

At present, the piped sewerage sanitation coverage in Sri Lanka is in the lower figure; i.e. 2.5% of the population of the country in compared with the high figure of piped water supply coverage; i.e. 46% of the population. The requirement of proper sanitation was emphasized by the objectives given under the Millennium Declaration in year 2000, signed by the Sri Lankan government, in which established the goal 7; to Ensure Environmental Sustainability. In par with this goal the Government has set targets ; (1) Access to adequate sanitation to 93% of population by 2015 and 100% by 2025, (2) Provide pipe borne sewers in selected growth centers and major urban areas, (3) Acceptable on site sanitation to those not connected to sewer systems.

Under the second target , the Government aims to expand the piped sewerage coverage 2.5% at present up to 3% by year 2020 and 7% by year 2035. Since there is a growing need of development of piped sewerage infrastructure in the country and Government and the National Water Supply and Drainage Board have given priority to enhance the piped sewerage coverage in line with the targeted goals, more sewerage development projects are envisaged in the major cities of the country in the future. In-turn it is envisaged the increased social issues and impacts to the local community in the project areas when laying of sewerage pipes. The situation is further aggravated as the sewerage developments projects are planned in the urban cities and they are characterized by mixed land uses, where commercial establishments, institutions and industrial facilities are intermixed with residential buildings. As such social disruptions and physical damages to private properties are the major social issues recognized and experienced by people at the sewer pipe line constructing areas.

At this juncture, it seems that new approaches have to be developed to overall arrest of the social problems created by the implementation of sewerage projects as no projects in the globe have been carried out without creating social problems and more often intellectuals and ordinary people refer these in terms of development induced impact.

According to Rodolfo (2011), “to achieve sustainable construction project outcomes, it is necessary that all the stakeholders are involved in a fully integrated approach and that the project is seen as an integrated product, requiring cross-disciplinary teamwork early in the delivery method for its successful completion.”

Therefore the issues should be addressed not only with the technical means but also with sociological perspective since they are always interwoven with communities or public. This is where the understanding of people's opinion is more important and that is gained by this research. In such a way this study is an attempt to provide an introspective sociological analysis with in-house field experience over social issues emerged with the implementation of pipe laying construction attributed sewerage development project in Ratmalana/Moratuwa area in Western Province of Sri Lanka.

1.2 Social Costs in Construction

“The term ‘social cost’ refers to costs incurred due to the execution of construction project that cannot be classified as either direct or indirect costs incurred by the parties engaged in the construction agreement.”(Gilcrisp, Allouche, 2004). In another statement by Tolga, Cenk(2016) says that “loss of peace and quietude of the neighborhood, cleanliness of the house, and degradation of ambient conditions are identified as the most disturbing nuisances. In addition, the country conditions and culture of the region is considered as important factors that play an important role in the intensity of adverse impacts”.

On the other hand, it is often that the social costs are accounted in the estimation of construction project. Though the occurrence of more social disturbances and inconveniences are significant in the projects neither project planners nor the contractors consider it in their project budget. “These costs are due to inconveniences surrounding a construction site and are predominantly not included in a monetary cost analysis of the project. This can be attributed to the fact that it is difficult to measure and quantify these costs. Regardless of the complexity of quantifying social costs, it is imperative to analyze the impacts a construction endeavor will have on the community.”(Gilcrisp, Allouche 2004)

1.2.1 Traffic Disruption

For the local community in the project area, traffic disruption is one of the major social costs being experienced. People travel everywhere; whether it is to daily work or various

other activities, the public is always used the road and, naturally, construction activities being taken place in the roads will disturb these daily practices.

Gilcrist, Allouche (2004) gives the following classification.

Adverse impacts are; (i) Prolonged Closure of Road Space (ii) Detours (iii) Utility Cuts

Whereas social cost indicators are; (i) loss of parking space (ii) additional fuel consumption (iii) travel delay (iv) increased traffic accident rate (v) accelerated deterioration of roads (vi) road rage etc.

“Utility construction and highway renovation directly impact roads and generate traffic delays and lane closures. Delays occur due to reduced speed through the construction zone, lane closures and alteration of traffic circulation patterns. Off road construction sites in urban areas also create barriers to movement due to the additional movement of heavy trucks and equipment in and out of the site and in some cases changes to previously established traffic patterns.” (Gilcrist, Allouche 2004).

1.2.2 Economic Impacts

In a construction project especially the type of Sewerage Pipe Laying project is undertaken in the public roads, the economic impacts play a major role to the community and should take into consideration not only during the construction phase but also in the planning of a project. Further in a sewerage project, normally the gravity pipe laying work takes longer times due to its difficult nature (sometimes could go up to 06 to 18 months' time) it is a debatable factor why the general public incur money due to works of the project owner and the contractor.

According to, Amanda (2012), “Even though all of these advantages are economic stimuli once the completion of a project, it is difficult, hence giving less priority to evaluate the negative impacts due to the sewerage pipe laying related construction project may have on the community, bordering the area of such construction project. Yet in some cases, the damages such as loss of income or customers, decreased productivity, or property destruction are irrevocable and businesses are forced to close or relocate”.

Gilcrist, Allouche (2004) gives the following classification.

The social cost indicators are; (i) loss of income (ii) productivity reduction (iii) loss of tax revenues (iv) property damage etc.

1.2.3 Environmental Damages and Social Impacts

Pollution in construction leads to air, water, ground, and other environmental disturbances. In the Sri Lankan context, today, laws, policies and regulations, governed by the Central Environmental Authority (CEA), have been made available to ensure the environment remains safe during any construction project inclusive of sewerage construction project; but regardless of the many tactics available to eradicate the negative impacts they still reach the society and environment, even in the slightest manner. This is confirmed in a thesis by Kamat (2011) which studies the effect of dust generation on a traditional open-cut utility project. "The construction industry is challenged by safety issues, public inconvenience and disruption of everyday life due to nature construction operations. One of the major contributors to such conditions is dust generation on a construction site. The amount of dust a worker inhales during his or her career can be harmful to his or her health. Dust, being a form of air pollution, can contribute to asthma, allergies and other respiratory problems." (Kamat 2011).

Gilcrist, Allouche (2004) gives the following classification.

Pollution impacts are; (i) Noise (ii) Dust (iii) Vibration (iv) Air/Water Pollution

Further, Ecological/ Social/Health impacts are; (i) Surface/Sub surface disruption (ii) Damage to recreational facilities etc.

Whereas social cost indicators are; (i) treating compromised physical/mental health (ii) reduced quality of life (iii) restoration cost etc.

1.3 The Research Problem

It is a fact that the implementation of any projects would negatively affect to certain groups of people as they may have to undergo with severe issues, problems else inconveniences of which degree of effect or impact may vary depending on circumstances and degree of involvement. The scenario is mostly relevant for the

“sewerage pipe laying projects”, as the construction is done in the public roads and nearby the consumer premises the circumstances and degree of community involvement become more.

The research problem in this thesis is focused on that and is discussed in detail below.

1.3.1 Social Costs and their Impacts in Current Sewerage Pipe Laying Work

In Sri Lanka, the sewerage conveyance reticulation systems are often laid by open-cut trenching method. Therefore the pipe laying involves excavation for trenching, driving trench boxes or sheet piles as earth support, dewatering, placing the pipe, special pipe bedding and surround, backfilling with compaction and road reinstatement back to previous state. As the sewerage pipe laying has to follow many steps the contractors face many difficulties and problems at the sites while carrying out the work.

- Since sewer conveyance in the pipe lines occurs by gravity force the pipe lines have to be laid with required slope and along the straight trace carefully.
- Physically it is hard to achieve these conditions unless the trench is excavated wider since the roads occupy many of other existing utilities, presence of different soil strata and high water table in the ground.
- Normally the trenches tend to collapse due to the effect of vibration in the construction machines and formation of voids due to soil migration in dewatering.
- The trench collapses and formation of wider openings in the ground may lead to damage the other existing underground utilities (water pipes, telephone and electricity cables etc.), above ground utilities (culverts, pavements telephone/electricity poles etc.) and nearby third party properties.
- It would result to narrow-down the access of vehicles passing the site and consequently cause many public inconveniences and adverse social impacts to the community in surrounding the sites.

The recently completed sewerage pipe laying project (i.e.; during 2008 to 2013) naming “Wastewater Disposal Systems for Ratmalana/Moratuwa & Ja-Ela/ Ekala Areas”, carried out by National Water Supply and Drainage Board, provides good example to show the extent of involvement of social effects and public inconveniences due to the work. Those

are; (i) sewerage pipe laying has damaged one third party property in 107 meters of pipe laying, (ii) damaging water utility- 65 cases, telephone- 42 cases and power- 12 cases. Further other social costs and adverse impacts involved were; (i)Traffic Congestions and delays, (ii) Un-evenness of temporary road surface, (iii) Dirt/Dust Pollution, (iv) Noise Pollution, (v)Vibration of surrounding property, (vi) Additional wear and tear of the vehicles etc.

Therefore it is a fact that the current sewerage pipe laying would often create public burden and social impacts and finally the community has to incur cost for it.

1.3.2 Non-application of Trenchless Technology

“Trenchless technology is advancement in the field of utility and pipeline construction and renewal compared with the traditional method which is trenching or open-cut. Using new equipment and improved technology, these techniques, such as micro tunneling, pipe jacking or horizontal directional drilling allow for minimal surface disruptions, decreased social costs, less footprint, enhanced safety, increased productivity, and in some cases less costs.”(Najafi, Gokhale 2005)

The trench-less methods are widely used globally for laying of sewerage pipes along public roads. Though the trench-less technology could be used for sewerage pipe laying in Sri Lanka too, it was understood by the researcher that it is not widely used because;

- its expensiveness compared to pipe laying by open-cut method,
- there are no contractors readily available locally hence always to be procure through international competitive bidding.

Besides its expensiveness the advantage of the Trenchless technology is, it associates with very less harmful effects to the road utility, third party property and surrounding community which were discussed in the above section and under 1.1.(However it was understood that the trenchless technology cannot be applied for the smaller roads and the roads having frequent bends rather it is very much suitable for major roads having more straight stretches in the project area.)

In Sri Lanka, still open-cut trenching is not widely used for sewerage pipe laying except very few projects which adopted trenchless technology for laying of some smaller lengths. The recent example was, about 8 km of sewerage pipe lines were newly laid in central of Colombo, Sri Lanka under “Greater Colombo Waste Management Project” implemented by NWSDB and Colombo Municipal Council (CMC) during 2014 to 2017, by trenchless technology (i.e. pipe jacking method) for which the contractor was procured from China. Furthermore according to the cost comparison given in the Table 2.3 in chapter 2, the micro-tunneling rates are about 4.3 to 6.3 times expensive than the open-cut trenching.

Therefore one main problem identified was the traditional open-cut trenching is the methodology often being used to lay sewerage pipe lines in Sri Lanka as it is hard to apply modern trenchless technology owing to its expensiveness and has to procure internationally.

1.3.3 Prolonged Negligence of Social Impacts will Lose Projects’ Credibility

The negligence of these social effects is enlightened by the general public besides all the importance and benefits of the sewerage project were understood and prime objective of the sewerage project is to make a clean environment by properly managing the wastewater generated by the activities of the human. On the other hand it harms the credibility of project implementation parties especially for the project proponent and the contractor to float sewerage development projects, creating embarrassing situation among the local community neglecting all sort of social impacts.

Therefore it is understood that, handling the pipe laying work of urban sewerage projects ignoring the all these social issues of the community, as does now, cannot be prolonged. The one of the problems is these sewerage pipe laying projects are planned by only by taking into consideration the technical phenomena but paying less attention to social and environmental aspects and resulted public burden. Therefore now the social costs arisen from the current construction are impinged on third parties without compensating.

It is often that project planners do not include social costs to the project estimates. In the Ratmalana/Moratuwa sewerage project also, it was evidenced by the researcher that no such fund allocation has been made available to compensate social costs (except the one provisional BOQ item was available in the contract for 'insurance' for compensate physical third party property damages). Therefore the 'social costs' emanated due to the execution of a construction of these sewerage projects are not accounted in the project estimates either as direct or indirect costs and usually are not incurred by the project proponent or the contractor but incur by the community.

1.3.4 Effect to the Project Completion Time

The sewerage pipe laying work takes long time period for its completion, due to its difficult nature of work in the public roads by confronting disturbances, public protests and utility handling. Should the people are not supportive to it, they make protests due to the prolong inconveniences. The problem is in-turn; it would cause delays in the project time, attributing increase in the project cost, loss of consumer benefits etc.

1.3.5 Interest for the Problem

The motivation behind studying this topic under the thesis is the fact that the researcher observed and felt all sorts of grievances, distresses and inconveniences of the public during his stay in the sewerage project and understood that the social costs are widely ignored in the construction of sewerage pipe laying project.

The author of this research engaged in the activities of the project of Wastewater Disposal Systems for Ratmala/Moratuwa and Ja-ela/Ekala Areas, implemented by National Water Supply and Drainage Board, in the capacity of Chief Engineer in duration of construction phase (i.e.; in year 2008 to 2014) and gained experiences by dealing with the social issues such as third party damages, road utility damages, issues with access to business places and residents, traffic disturbances, loss of income, complaints on dust and noise complaints, prolonged road closures.

1.4 Objectives and Scope

The main objective of this thesis is;

“to identify and itemize the social cost factors and their impacts that arisen in the sewerage pipe laying related projects, evaluate gravity of which effect to the local community and explore some methods to mitigate or avoid, with better knowledge and experience on the subject”.

The other underlying objectives, considered in the thesis are:

- To understand the public’s opinion of these social costs
- To identify and evaluate the effects of sewerage pipe laying on productivity and economic effects of social costs on businesses,
- To explore the negative effects of social costs in sewerage pipe laying, mitigation techniques of the negative effects and
- To present the public opinions on the control measures undertaken in sewerage pipe laying activities gathered from the public near a construction site those most affected by the activities

(Quantification and estimation of social costs are not included in this research.)

1.5 Methodology

The following methodology will be followed to achieve the objectives of this thesis:

- Review literature and identify and evaluate construction-related social costs affecting the community including sewerage construction projects.
- Conduct questionnaire surveys, interviews to obtain realistic data and opinion of the businesses and residents surrounding the recently completed sewerage pipe laying construction project.
- Analyze the survey results with experience of the Researcher to understand how sewerage pipe laying construction affects the community.
- Study the gravity of social effects and mitigation techniques that can be used by project owners and contractors to reduce the social costs and their impacts.

CHAPTER 2- LITERATURE REVIEW

This chapter deals with examining and reviewing of social costs and impacts associated with the construction including sewerage pipe laying, found in the literature and available alternative technologies for minimization those social impacts.

2.1 Social Cost in Transport Related Construction

According to the study for the thesis carried out by Ferguson(2012)on “Quantitative Evaluation of Transportation Construction Related Social Costs and their Impacts on the Local Community” says that “the construction causes many inconveniences to the surrounding area and the social costs affect the livelihood of businesses and interfere with the day-to-day activities of residents”.

According to the results of the surveys, it was emphasized that construction causes many inconveniences to the surrounding area; the social costs affect the livelihood of businesses and interferes with the day-to-day activities of residents. Both businesses and residents ultimately feel that the construction is necessary and will prove beneficial, but throughout the duration it causes more nuisances than advantages. The survey evidenced that, according to the 30% of the respondent, a range of 20% to 30% of the sales have gone down, which was the direct financial lost for businessmen whereas, 76% of business respondents have felt that they would or might lose customers permanently.

This study identifies the types of the social issues that neighboring businesses and residents confronted during the high way construction and look the effects of those through the questionnaire survey. It is interesting to see the calculation of cost of extramileage due to detours or construction avoidance which is a direct cost incurred by the out siders of that project. It says that “Additional mileage due to detours or construction avoidance can lead to additional fuel costs for residents. On average, residents drive an extra mile on their way to work which can cost an additional \$208 for the five year duration of the project. If a resident drives three extra miles a day it could cost \$638 for the five year duration of the project”(Ferguson, 2012)

In the same research study Ferguson (2012) stresses on having proper Traffic Management Plan saying that, “the local residents do not face the same financial loss as businesses but endure additional social costs including traffic disruptions, dust, and noise. Results showed that traffic disruptions, such as delays, congestion, and detours, are a major inconvenience to residents. The 67% of the survey respondents have said that they had to spend extra time when figuring travel time and almost all participants’ drive to work has increased. As such these traffic delays occurring during the construction could be mitigated by a thorough Traffic Management Plan which includes appropriate detours, signs, and traffic controlling and road maintenance.”

In order to show that simple methods could be derived to evaluate the social costs rather blaming to the social costs, following table grabbed from her study showed that valuation of additional fuel cost on extra miles.

Table 2.1: Additional Fuel Cost for Extra Miles to Work

Additional Miles	Additional Fuel Cost for a One Way Trip to Work (\$)	Additional Fuel Cost for One Person for the Duration of the Project (\$)
1	0.16	208
2	0.32	426
3	0.49	638
4	0.65	851
5	0.82	1,064

The study kept on saying that “Accordingly, on average, local residents spend an extra \$0.16 for fuel per trip to work and will spend an additional \$208.00 for the duration of the project. If a resident’s commute increases by five miles it will cost an additional \$1,064.00 in fuel. (These numbers do not include additional miles traveled outside of the commute to work which can add more mileage and ultimately more costs)”, Ferguson (2012)

Once the estimation is done it was said that “Therefore it can be evidence from these results that the monetary equivalent to extra time spent in the car, business loss, noise pollution, air pollution and more should also be quantified to determine the total cost of the project. Once these costs are computed more accurately it is not difficult task that those costs be incorporated into the construction budget to allow for mitigation methods.”(Ferguson, 2012)

This research Ferguson evaluates several social costs that arise due to construction of infrastructure of the transportation project and interestingly tries to evaluate the social cost for residents’ traffic delay. Therefore this research determines that social costs in construction can be quantified using different methods. This is very useful in the sense if the major social costs related to construction are evaluated and quantified the project designers and contractors could associate those costs to the project budgets so that people who victimized to those impacts could be compensated rather than fighting with them.

2.2 Social Costs of Traditional Construction Methods and Trenchless Technology

Rajesh Tanwani, (2011), in his Technical Paper on “Tracking and Steering Systems in Trenchless Construction”, stated about the peoples’ excitement about the project on improve roads and drainage, water supply and upgrade the wastewater system in the city of Houston; “As the City of Houston prepares for the construction improvements that will take place as a result of the Rebuild Houston initiatives as well as the water rate increase, many Houstonians are excited about the changes which will improve roads and drainage, provide clean water and upgrade the wastewater system. Along with the excitement, many Houstonians dread the construction challenges that this initiative will bring including traffic slowdowns resulting in increased commute times, construction noise pollution and traffic accidents in the work zones. Since most of the construction is going to be in heavily developed areas with high traffic volumes, these concerns are valid and should be addressed”

This project also provides a good global example to show that fear of the citizens of a city about potential effects to their day to day life and additional expenses has to bear. Tanwani went on saying that; “there is increasing pressure put on cities and

municipalities to avoid disrupting traffic with their activities. Citizens are realizing that construction, while it is good in the long term, comes at a high cost. The community looks at infrastructure improvements as an additional expense which citizens, businesses, residents and property owners surrounding the construction incur. And these costs are rarely accounted for. These social costs impact everyone involved in infrastructure projects”.

Tanwani revealed, therefore that, “the people are demanding innovations and alternatives to traditional construction which impacts their quality of life. What can we do as leaders of the infrastructure industry in our capacity as administrators, planners, designers and managers to serve the needs of our area and respect the wishes of the citizens?” This is an important point he arrived at in case of Sri Lankan point of view too. The planners and the designers, who deal with sewerage projects, should re-think how the people to be served by safeguarding their needs.

In his book, Tanwani identified the social costs associated with construction projects and said that it will be an element for calculation of total project cost. “The social costs associated with traditional construction can be a major element to calculating the total cost of a project. The social costs associated with a project include road damage, air pollution and traffic disruption to name a few, and will depend on the method of installation adopted.” (Tanwani, 2011)

Tanwani (2011) classifies and explains the utility and social costs generated by traditional open-cut trenching, are described below.

2.2.1 Effects of Utility and Social Costs in Open-Cut Trenching

2.2.1.1 Road Damages

The most irritating problem faced is the attempt to return the street surface to its prior condition – a difficult job even in the best of conditions. No matter how the cut is backfilled, compacted and surface patched, the soil underneath eventually settles causing

some degree of surface subsidence and/or potholes. The challenge comes in doing the job over again with no guarantee the repair will not subside in the future. Despite numerous precautions taken, utility excavations and subsequent pavement restoration remain a serious and expensive problem. Utility cuts or excavations significantly contribute to the decrease in pavement life expectancy. Inadequate restorations create higher costs for periodic repair, increase road user costs and generate public complaints.

2.2.1.2 Damage to Adjacent Utilities

Open-cut excavation operations put stress not only on the immediate areas, but on other areas of the street as well. For example, it is possible to have a water line break 10 feet away from the work site due to the compaction of the earth back to the required 95% level by the vibrator. Thus the possibility of damaging other buried utilities is another major problem faced during open-cut installation of utilities. Besides the cost of service disruption and repair, buried electrical and telephone cables present a serious danger to the work crews.

2.2.1.3 Damage to Adjacent Structures

Generally it has been found that open-cut methods of utility installation result in greater surface settlements in the immediate surroundings of the cut as compared to trench-less methods. It is due the vibration of the machineries and soil migration underneath when dewatering. These surface settlements are capable of damaging the adjacent structures due to differential settlements in the foundations resulting in cracks and sometimes collapse of the structure.

2.2.1.4 Noise and Vibration

Traditional open-cut construction requires the use of heavy equipment including pavement breakers, excavators and dozers for an extended duration which result in large scale vibrations and a greater noise level in the vicinity of the work area. Comparatively,

trenchless methods require the construction of shafts. Hence, this problem is limited to shaft locations for a shorter duration. The installation of utilities by trenchless methods often takes less time as compared to open-cut methods.

2.2.1.5 Air Pollution

The open trench method often requires excavation and transportation of large quantities of loose, fine soil particles. These particles generate windblown dust in the vicinity of the work area which is not only a cleaning nuisance but can have serious implications particularly in sensitive locations such as hospitals and laboratories where airborne particles may damage sensitive equipment and machinery in addition to the obvious health hazard. In addition, the longer journey and slower movement of traffic on the detour roads contributes to the pollution load in the atmosphere due to additional pollutants emitted by the vehicles.

2.2.1.6 Vehicular Traffic Disruption

Open-cut installation usually causes traffic disruption which, in most cases, results in social costs amounting to several times the direct cost of work. These costs result from delayed travel time and traffic jams due to the longer journey and slower movement of traffic on the detour roads, additional cost of fuel, greater number of accidents, etc. Trenchless methods require little excavation due to the construction of the access shafts and require minimum traffic disruption. If the shafts are located away from the main streets, there may not be any disruption.

2.2.1.7 Pedestrian Traffic Disruption

Another concern with the open-cut method is that it causes pedestrian traffic disruption. Typically, quiet roads are occupied by pedestrians, and the additional traffic on these roads, which act as detour roads during such times, impedes the pedestrian traffic to a great extent. Trenchless methods help relieve this problem to a great extent.

2.2.1.8 Business Loss

The open-cut method causes serious traffic disruption which causes businesses along the work site to be inaccessible to regular traffic. This results in loss to the local businesses and can lead to the business closing if the work proceeds for a long time. Even if a little access is provided, businesses suffer due to the natural tendency of people, whether vehicular or pedestrian, avoiding a construction zone.

2.2.1.9 Damage to Diversion Roads

The open-cut installation of utilities results in large scale traffic disruptions, therefore traffic is diverted to detour roads. These roads are not designed for the heavy traffic loads. The wear and tear causes potholes and patches which require a significant amount of money to be brought back to its prior condition.

2.2.1.10 Increased Road Accidents

During open-cut installation, traffic lanes are closed and/or lane widths are reduced causing unfamiliar driving conditions for motorists resulting in road accidents. In addition, the traffic is diverted to detour roads. The heavy volumes of traffic being diverted to these narrow residential streets can result in an increase in road accidents.

2.2.1.11 Increased Site Accidents

Since the open-cut method of utility installation takes a longer time and the use of heavy equipment, the probability of accidents is much higher. There have been many instances of trench collapse which has resulted in the loss of lives. In using trenchless methods, especially those that are remote controlled and do not require workers to enter inside the tunnel, there are reduced site accidents minimizing probability of the loss of life due to collapses.

2.2.2 Choice for Trenchless Technology

So, what can we do to minimize those disruptions to the public and reduce the social cost? Tanwani identifies that adoption of a substitution i.e.; trenchless methods can greatly reduce or eliminate the social damages that are happened during open-cut trenching and concluded as “During the design of any construction project, due consideration should be given to the method being adopted in light of the above social costs. The proper choice of method and thorough planning can result a better project. Trenchless construction methods offer a viable alternative to traditional methods in many cases. The adoption of trenchless methods can greatly reduce if not eliminate the damage that might otherwise occur not only to the structure and utilities below the roadways and the detour roads but also the inconvenience to residents and general public using the roadway and detour roads. In addition, it will reduce the indirect costs associated with a project and result in considerable savings to tax payers. In countries such as Singapore and Japan and several European countries, sewer installation and rehabilitation by trenchless methods is specified. With the latest advancements in trenchless technology and the increasing competition, it is seen that the total cost (both direct and indirect) associated with the trenchless installation of utilities may be lower than installation by traditional methods especially in congested urban areas.”(Tanwani, 2011)

2.3 Social Costs and Their Impacts to the Local Community - The Mega City Sewerage Management Project implemented in Sri Lanka

The project of “Wastewater Disposal Systems for Ratmalana/Moratuwa & Ja-Ela/ Ekala Areas”, carried out by National Water Supply and Drainage Board, in Ratmalana/Moratuwa and Ja-Ela/Ekala areas in Western Province is the mega wastewater management project implemented and completed in Sri Lanka recently. The project was implemented during 2008 to 2013 and included with laying of 65.6 km of sewerage pipe lines to convey sewer in the collection system. The followings give the findings of the Project Completion Report issued by the construction supervision consultant M/s Sweco International, Sweden, once the project was partially completed in 2013.

According to the report the sewerage pipe laying in all roads attributed lots of social costs, adverse impacts and high frequency of utility and third property damages and environmental effects to the surrounding local community.

2.3.1 Social Impacts and Third Party Property Damages

The report finds that one of the major social costs to the nearby community was the property damages caused by construction vibration and lowering ground water table while laying deep gravity pipes using open-cut trenching. The below Table 1.1 gives the details of property damages and other social costs and nuisances occurred to the road users and local community during period of construction of the project against the scope of pipe laying. The data considered are only for Ratmalana/Moratuwa project component excluding Ja-ela/Ekala.

Table 2.2: Pipe laying lengths and property damages, nuisances occurred to local community in Ratmalana/Moratuwa project area

Pipe Laying Length	Gravity Sewer Pipes (km)	27.7
	Force Mains (km)	6.3
	Rider Sewer Pipes (km)	11.6
	Lateral Sewer Pipes (km)	20
	Man Holes (Nos)	690
House & other Third Party Property Damages near pipe laying sites	Numbers of cases for which the compensation was paid by the project	613 cases
Existing Underground Utility Damages	Numbers of cases for which the compensation was paid by the project	Water utility – 65 cases Telephone Utility –42 cases Power Cables – 12 cases
Other social costs, impacts and nuisances occurred to the road users and local community	Traffic Congestions and delays	Frequent complaints
	Delays due to road diversions	Frequent complaints
	Un-evenness of temporary road surface	Frequent occurrence
	Dirt/Dust Pollution	Frequent complaints
	Noise Pollution	Frequent complaints
	Vibration of surrounding property	Frequent occurrence
	Additional wear and tear of the vehicles	Complaints (not frequent)

(Source: The data extracted from project completion report of Consultant Sweco International of Project Progress Reports of Wastewater Disposal Systems for Ratmalana/Moratuwa&Ja-Ela/ Ekala Areas)

The table shows, when laying 65.6 km of sewerage pipe lines in the project the types of social impacts and other nuisances, the local community has faced and number of third party damages i.e. 613 numbers, occurred near the pipe laying sites. Project Completion

Reports has mentioned that “even though the project parties, the Contractor and the Client have paid compensation for these house and property damages, through the contractor’s insurer, the house owners were not satisfied as the amount of compensations paid were according to damage assessed by the insurance company”.



Figure 2.1: Pictures of Damaged houses at KandawalaMawatha

(Source: The picture from project completion report of Consultant Sweco International of Project Progress Reports of Wastewater Disposal Systems for Ratmalana/Moratuwa & Ja-Ela/ Ekala Areas)

2.3.2 The Effects of Open-cut Trenching

The open-cut trenching for deep sewer pipe laying result exposing wider road widths attributing major disturbances to the road users. The following picture captured from the project completion report of the project, shows how much the road’s right of way is occupied by the open-cut sewerage pipe laying trenching.



8 WWTP- Gravity Laying T3-T6 [GRP1500] at Treatment Plant Road.



9 PSS- Gravity Pipe Laying [GRP800] at Egodahena Road.

Figure 2.2: Pictures of Deep Trenching and Damaged Widths

(Source: The picture from project completion report of Consultant Sweco International of Project Progress Reports of Wastewater Disposal Systems for Ratmalana/Moratuwa&Ja-Ela/ Ekala Areas)

Though the alternative solution to the open-cut trenching is the trenchless technology(micro-tunneling), would cause less disturbances to the public but it is expensive. The Table 2.3 below provides the cost comparison of open-cut trenching verses trenchless technology for sewer pipe laying.

Table 2.3: Cost comparison of open-cut trenching verses micro-tunneling technology

Sewer Pipe Diameter (mm)	Cost of open-cut trenching (LKR/ metre length)	Micro-tunneling technology (LKR/ metre length)	Price Increase (times)
225	25,889	163,270	6.3
300	35,141	168,200	4.7
375	51,410	264,335	5.1
450	59,810	281,010	4.6
600	76,099	327,265	4.3

(Source: (1) Wastewater Disposal Systems for Ratmalana/Moratuwa&Ja-Ela/ Ekala Areas, NWSDB (2) Greater Colombo Waste Management Project, CMC)

According to the figures given in the table, the micro-tunneling rates are about 4.3 to 6.3 times more than the open-cut trenching hence overall pipe laying construction of any sewerage project cannot be carried out with trenchless technology, owing to its expensiveness. Undoubtedly, the trenchless technology has not been adopted by the project proponent, NWSDB and the consultant in the Ratmalana/Moratuwa & Ja-Ela/ Ekala project must have been owing to its expensiveness. However presently in a city sewerage management projects, sewerage pipe laying in densely populated and highly commercialized roads are chosen with the micro-tunneling technology. For example in “Kandy City Wastewater Management project” 9% i.e.; 22 km out of 235 km of sewerage pipes are laid by choosing trenchless technology. However sewerage pipe laying in “Greater Colombo Waste Management project” which is done in the center of Colombo still used 82% of open-cut method while 18% i.e.; 8 km out of 44 km are laid by trenchless technology.

2.3.3 Effects to the Project Period

The project proponent and the contracting company always need to complete the project in the specified time period with the allocated budget. As the social costs and their impacts to the local community are not envisaged and assessed in the pre-construction stage of a sewerage construction project there is no plans to tackle inevitable public

unrest and agitation during the excavations on the roads. Sometimes the construction work has to be halted due to the unexpected public unrests and confrontations and should be delayed until it is resolved by the project parties.



Figure 2.3: Pictures of Settlement of the Ground due to Soil Migration at Deep Trenching at Katukurunduwatta road

(Source: Project for Wastewater Disposal Systems for Ratmalana/Moratuwa & Ja-Ela/Ekala Areas)

In turn this would cause delaying of project completion period. The project report said that, in Ratmalana/Moratuwa&Ja-Ela/Ekala project several sewerage pipe laying construction sites had to be temporarily suspended due to the public unrest and objections. The few of the cases are abstracted from records of the report and given below in order to get understanding of the severity of the problem.

- i) The contractor demobilized from the sewerage pipe laying site in Angulana Station road in Ratmalana due to the protest launched by private transport bus owners due to traffic delays at excavation by the side of the road. The work was temporarily abandoned for about 06-months until some compensation is paid.

- ii) The contractor demobilized from the sewerage pipe laying site in Thelawala road in Ratmalana due to the protest launched by local community whom use the road as the one way lane provided by the contractor at excavation was not trafficable hence leading to delays in their day to day journeys. The work was temporally abandoned for about 3 and half month time until the problem was solved.

The report found that, consequently, the total project period had to be extended by about 28-months that were more than stipulated contract period of 48-months and one of the prime reasons inter-alia for the delay was the hampering of the project activities by social interruptions as mentioned above.

2.4 Importance of Public Participation in Project Implementation: The Example from Upper Kotmale Hydropower Project in Sri Lanka

In Sri Lanka, Upper Kotmale Hydropower Project is one of the projects that ever delayed due to public protests. This has been planned to commence two decades back but it was impossible as the result of inadequate address of social and environmental impact of the project and invariably associated public protests.

This synopsis on “Importance of Public Participation in Project Implementation” recalls the proper accounts of public concerns, environmental issues in hydro plant projects. It is here mentioned that these two dimensions i.e. public concerns, environmental issues, have not been included such projects upto 1960s which was crucial in the event of realization of a project. However, since 1960 to 1990, these two dimensions came up and play a significant role in Hydropower projects. Further to that it emphasizes, unless social and environmental issues are addressed properly at the very first stage as much as technical and financial considerations it will never be able to have a successful project in the end as one can see in this Upper Kotmale Hydropower Project because hydropower project planning was, at this event, considered as a whole responsibility of engineers and economists to some extent.

As per Nandalal (2007) synopsis, the initial Upper Kotmale Hydropower Project is an instance where inadequate input of the outsider's concerns or the interests of communities and less attention over mitigation techniques of possible social problems. This project contained certain water diversions upstream of several scenic waterfalls together with relocation and resettlement programs. These programs also have not been adequately funded and designed with transparent, lack of benefits received by project affected parties. "As the result of these by the 1990s, involvement of affected people and other stakeholders became a part of overall approach to hydropower planning." (Nandalal,2007)

It is clearly shown as per the report that initial project ended as a failure with a waste of huge amount of money due to inadequate public participation in development of the project.

"However the World Bank now insists upon a formal consultation process as part of a Social Impact Assessment. Consultation ensures that the interests and concerns of local people are presented and integrated into other aspects of project planning. It also ensures transparency or openness in terms of information dissemination and participation in aspects of decision-making."(Nandalal,2007)

Nandalal (2007) identifies the influence of certain groups of people in Hydro plant projects. Influence of political Changes, Influence of Environmental Authorities Influence of NGOs and Influence of Project Affected Persons who could stop the continuation of the project. So in project, it is recommended to get enough of participation of public, professionals and other interest groups.

As such this synopsis emphasizes the importance of public participation in project implementation. It is further said that projects though have certain remarkable service or product at the end normally it involves with certain negative impact to the localities as they are socially put into trouble at the planning, implementing stages perhaps the post stages as well. "In order to avoid this, proper consultation procedure should be conducted with stakeholders such as National Governments, Civil Society Groups, Affected

Peoples' Organizations, Professional Associations, Private Sector and Bilateral Aid Organizations and Multilateral Development banks.”(Nandalal,2007)

2.5 Quantification of Social Costs Associated with Construction Projects

In the paper published by Gilchrist, Allouche (2014) on “Quantification of social costs associated with construction projects: state-of-the-art review”, seven methodologies in the field of economics were presented with concept of ‘social indicators’ to link adverse impacts generated by construction activities and their suitability for quantifying specific classes of social costs associated with construction projects are investigated.

“Types of adverse impacts associated with construction activities are grouped under four headings: traffic, economic activities, air and water pollution, and damage to the physical environment. Potential impacts as a result of unregulated construction activities include traffic congestion and delays, disruption of economic activities, excessive generation of pollution and pollutants, damage to sensitive ecosystems, and damage to existing structures and infrastructure systems. The valuation of social costs can be accomplished using different techniques, with the most appropriate choice depending on the nature of the impact under consideration. These techniques are grouped into two main categories, namely direct valuation techniques and indirect valuation techniques.” (Gilchrist, Allouche, 2014)

2.5.1 The Need for a New Paradigm

Gilchrist, Allouche (2014) emphasized on need for new paradigm for comprehensive consideration for sustainable construction by overlooking the old paradigm of time, cost and quality as indicated in the below diagram and described as “Traditional contractual and bid evaluation practices not account for economic losses resulting from construction-related activities that are borne by parties not engaged in the contractual arrangement. This can be attributed, at least partially, to the fact that owners and contractors normally

do not have to justify their choice of construction methods and practices based on any valuation approach that considers the costs borne by the community. The contractor is obligated to fulfill the project's objectives in accordance with the contract documents, drawings and specifications. Within these, his goals are to complete the project for the lowest cost, within the tightest time limits, and at the highest profit. Thus, the contractor is unlikely to implement low impact practices unless they are required contractually or are economically favorable to him.”

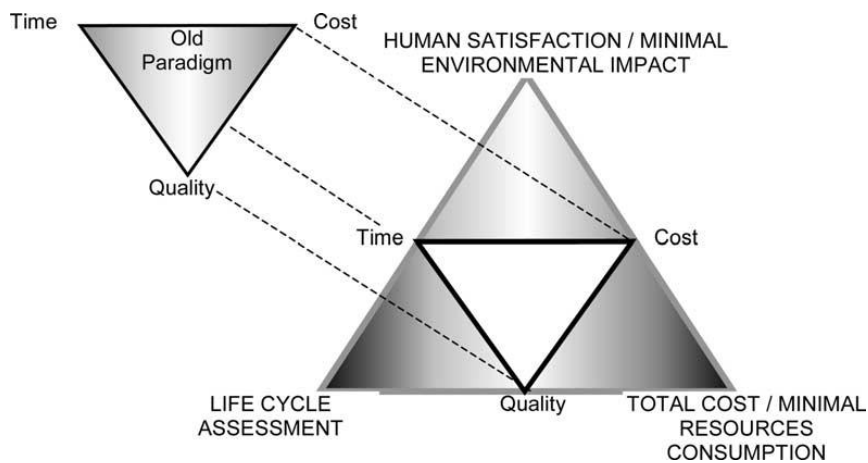


Fig. 2.4: The new paradigm for sustainable construction

The authors suggest that, mitigation of social costs can be accomplished effectively by incorporating them into the cost estimate and bid evaluation processes. Furthermore, it is argued that consideration of social costs during the bid evaluation process is an important component of the paradigm shift needed to move the construction industry toward a more sustainable oriented frame of mind.

This is exactly in case of contractors who do the sewerage construction projects in Sri Lanka too as contractors do not require to involve with social costs emanating out of his construction activities as he is not obliged by the contract agreement with the project proponent.

2.5.2 Adverse Impacts of Construction Projects on Natural and Urban Environments

A wide range of adverse impacts can result from construction activities. They vary in severity, predictability and nature (i.e. permanent vs. temporary). This paper introduces breakdown of construction-related impacts and social cost indicators that are classified under four categories: traffic, economic activities, pollution and ecological/social/health-related impacts. Gilchrist, Allouche (2014) classified the impacts and social cost indicators related to construction projects in urban environment, as shown in the Table 2.3 below.

Table 2.4: The impacts and social cost indicators related to construction projects in urban environment

IMPACTS AND SOCIAL COST INDICATORS RELATED TO CONSTRUCTION PROJECTS IN URBAN ENVIRONMENTS				
	Traffic	Economic Activities	Pollution	Ecological/Social/Health
Adverse Impacts	Prolonged closure of roads		Noise	Surface/Sub surface disruption
	Detours		Dust	Damage to recreational facilities
	Utility cuts		Vibration	
			Air/Water pollution	
Social Cost Indicator	Loss of parking space	loss of income		treating compromised physical/mental health
	Additional fuel consumption	productivity reduction		reduced quality of life
	Travel Delay	loss of tax revenues		restoration cost
	Increased traffic accidents rate	property damage		
	Accelerated deterioration of roads			
	Road rage			

The following sections focus primarily on impacts relevant to construction activities in urbanized areas. Emphasis is given to the construction phase rather than the cost/benefit of the final product to the local economy.

2.5.3 Techniques for the Valuation of Social Costs

The paper presents seven valuation techniques developed in the field of transportation engineering, economic and actuary that can be used to value social cost indicators as a resource cost.

The total cost of a construction project can be defined as:

Total cost = construction costs + social costs; where construction costs include direct (e.g. material, labor and equipment) and indirect (e.g. supervision and office overhead) costs, while social costs are the costs described in the above sections.

The valuation techniques presented in this paper are classified into two groups: direct techniques and indirect techniques. The list of methods covered by this paper is by no means exhaustive, but is intended to serve as a guideline in the valuation of social costs associated with construction projects. The choice of a valuation technique for a given social cost indicator is a function of the quality and quantity of the available data as well as the nature of the indicator being considered.

Direct valuation techniques; are the most widely used techniques to value the social costs since they are based on market and measurable values. However, their strength is also their weakness, as adequate market data must be available regarding the loss under consideration. The direct valuation techniques could be applicable to evaluate;

- i) Loss of Productivity
- ii) Human Capital

- iii) Replacement Cost
- iv) Lane Closure Cost

Indirect valuation techniques; are mostly used in case of commodities and services do not have a market value (e.g. the atmosphere and public parks). When social costs cannot be measured directly in monetary terms, indirect techniques can be used to assign known market values for another good or service to arrive at an approximate cost. Commonly used indirect valuation techniques are described below.

- i) Hedonic pricing: This method analyzes the impact on property values due to pollutants and traffic factors. It compares prices of properties in affected areas with prices of similar properties in quieter, cleaner and safer areas. Hedonic pricing can also be applied to the deterioration of the aesthetic quality of a property and thus its associated value reduction.
- ii) User delay costs: ‘User delay costs’ is a method used to evaluate the total time delay that the user experiences due to reduced speed through construction areas or when traffic demand exceeds capacity due to congestion in the affected areas.
- iii) Contingent valuation technique: This technique is used to survey a representative sample of the local population on how much they value a particular non-market preference. It can be applied to environmental protection or society improvements. The method tries to identify people’s preferences by asking direct questions about how much they are willing to pay (willingness-to-pay) to obtain, maintain, or increase some environmental benefits.

Identification of applicable techniques and methods for evaluation of “social costs and their impacts” in construction is imperative in view that most of the people in various disciplines talk about it without having monetary value. It is revealed that the social costs and impacts associated with the sewerage pipe laying be measured and evaluated utilizing these techniques to the fare and acceptable way and quantified them to monetary terms.

In conclusion, Gilchrist, Allouche (2014) further emphasized that;

- Most adverse impacts contribute to multiple social cost indicators. Thus, the minimization of a given impact may result in reduced social costs in multiple areas.
- Social cost indicators are in many cases difficult to quantify using conventional estimation methods. However, some methodologies have been developed in the areas of economic and actuary that can assist in their valuation.
- The inclusion of social costs in the evaluation of construction projects will promote the utilization of low impact construction equipment and methods as well as provide an incentive to research and development efforts in the areas of off-site fabrication and prediction and mitigation of construction-related impacts.

Further Centre for Good Governance, (2006); the guidance book says that “Social Assessment or Social Impact Assessment is a process for ensuring that development activities are (i) informed by and take into account the key relevant social issues and formulate mitigative measures, and (ii) incorporate a strategy for participation of wide range of stakeholders” this is a process which should be arranged in a stages manner. Here it has identified seven stages as depicted follows.

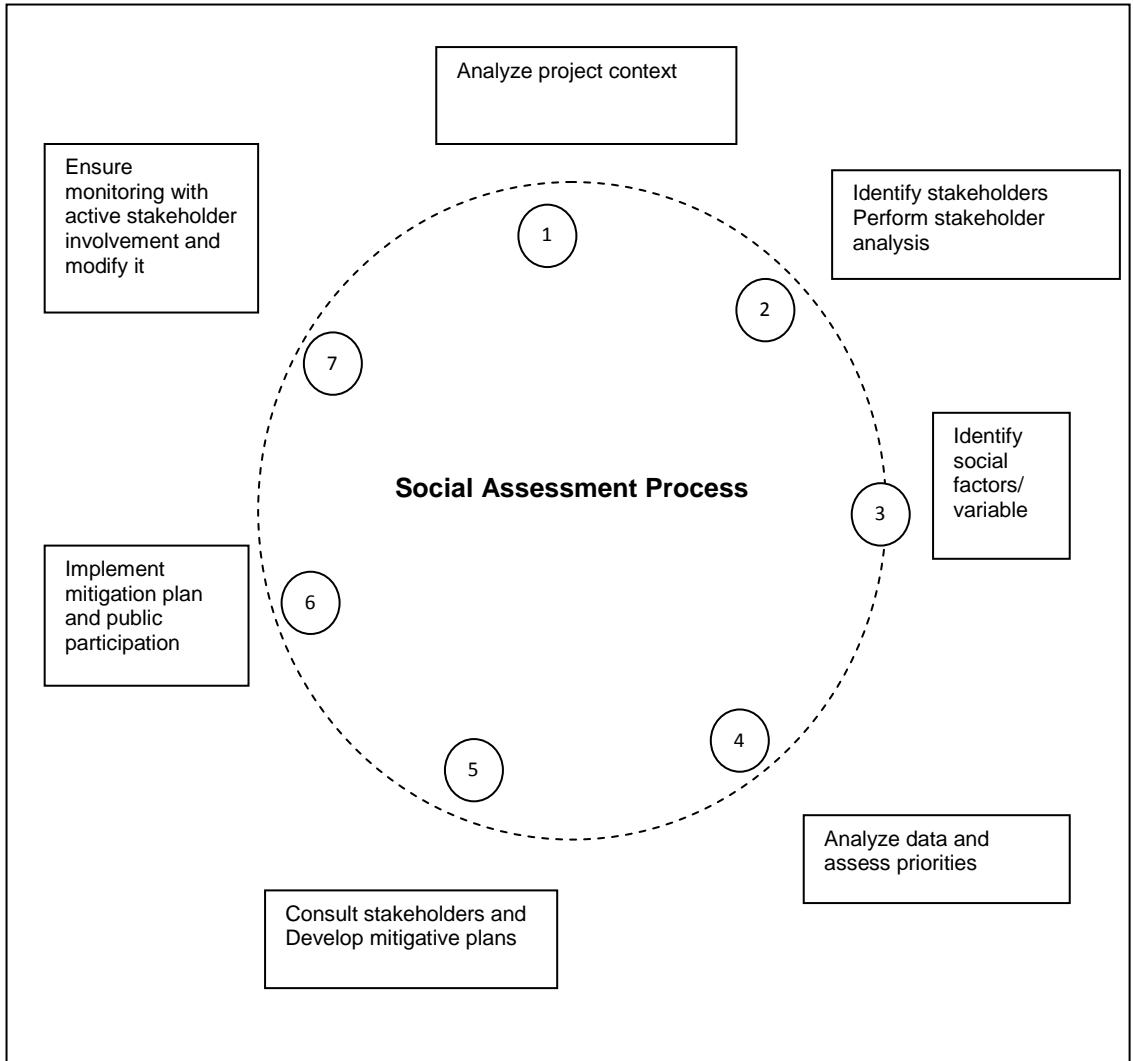


Figure 2.5: Social Assessment Process Cycle

CHAPTER 3- METHODOLOGY

3.1 Methods Used

To achieve the proposed research goals, several tasks were carried out. These tasks consist of:

- Collecting information on known social impacts and economic losses and mitigation techniques,
- Surveying a community by a questionnaire, both residents and businesses, residents bordering the corridor of sewerage pipe laying construction site,
- Conducting interviews and discussions with project stakeholders including the community.
- Analyzing and evaluating survey results to have better understanding on the types of social costs and their impacts and gravity and magnitude to which the sewerage construction affects the local community.
- At the same time site observations were done for proper understanding over the subject matter.
- Field experiences of the same project also were utilized to explore the social issues arisen out of construction arrangements.

The above methodologies were used to gather the information to fulfill the objective of this thesis.

3.2 The Research

The literature review was carried out with the intention of gathering information regarding social costs and their impacts and economic losses on the community when performing construction work as well as methods being applied to mitigate their effects. There were some previous researches and studies available on the aspect of the effects of social costs on the community in construction. The literature focuses on what are social impacts and costs are and the negative outcomes they have on the area surrounding a construction project. Also the literature gives some methods of calculating social costs and says it is dependable on the project activity and situation. It identifies that the social

costs are rarely considered in the pre-implementation phases of construction projects including sewerage pipe laying. Though the mitigation measures are the main approach taken by construction contractor, sometimes in par with the recommendations stated down in the Environmental Impact Assessment Report (EIA) those are being materialized minimally.

In order to explore the mitigation measures for the negative impacts in par with the interests of the public the project experiences the researcher gained, were further strengthened by the results of the business and residential surveys and conducted interviews with the project stakeholders and local community.

3.3 The Details of the Selected Project for Study

This study is experience gained, a case based on the project of “Wastewater Disposal Project for Ratmalana/Moratuwa and Jaela/Ekala Areas”, implemented by National Water Supply and Drainage Board in Ratmalana area in the Western Province of Sri Lanka. The construction activities of the project were based in two areas of Ratmalana/Moratuwa and Jaela/Ekala. The geographical boundaries of the study fall within Ratmalana and Moratuwa industrial, commercial and residential area situated along the coast about 15km south of Colombo Metropolitan Area. The area has undergone with major industrial development and thus characterized by mixed land uses where industrial facilities are intermixed with residential buildings and commercial establishments, although dominated by industries.

In Ratmalana and Moratuwa area this so called industrialization and urbanization created serious problems related to the increasing inflow of wastewater and sludge by the industries, commercial Institutions, housing complex and houses. The project has been implementing with the aim of appropriate collection of industrial and domestic wastewater and sewage and treats in central treatment plants with disposal of treated effluent in such a way that it is not harmful to the environment or the people. (Environmental Impact Assessment Report, Wastewater Disposal Project for Ratmalana/Moratuwa Area, 2005)

The project covered 5- numbers of Grama Niladari Divisions such as Katukrunduwatte, Attidiya South, Kandwala, Ratmalana East, Ratmalana West from Ratmalana Divisional Secretariat while 9- numbers of Grama Niladari Divisions such as Kaldemulla, Soyzapura North, Soyzapura South, Dahmpura, Thelawala South, Thelawala North, Laxapathiya North, Angulana North, Angulana South were covered from Moratuwa Division Secretariat. The Figure 3.1 shows the lay out plan of the pipe line system of the project area.



Figure 3.1: The Map of Ratmalana/Moratuwa Project Area

(Source: Project for Wastewater Disposal Systems for Ratmalana/Moratuwa&Ja-Ela/ Ekala Areas)

The main stakeholders of the project are;

Employer : National Water Supply & Drainage Board, Sri Lanka

Financier : Swedish International Development Cooperation Agency, Sweden

Construction Supervision Consultant: SWECO International AB, Sweden

Contractor : JV Pihl/ Lackeby–Purac (Joint Venture), Denmark

Sub-Contractors:

Civil Sub Contractor : China Geo-Engineering Corporation, China

M &E Sub Contractor : Access Engineering Ltd, Sri Lanka

(Source: Project documents of Wastewater Disposal Project for Ratmalana/Moratuwa Area, 2008)

Since it was expected to provide complete wastewater management facility the project components comprise Gravity Sewer Network, Force Mains, Pumping Stations, Treatment Plants and Sea Outfall. The Table 3.1 below gives the total scope of the project.

Table 3.1: The Scope of the Project

Component	Capacity	Total length of pipes	Sizes of the Pipes
Treatment Plant	17,000 m ³ /day	NA	NA
Pumping Station 1	1260 m ³ /hour	NA	NA
Pumping Station 2	1782 m ³ /hour	NA	NA
Pumping Station 3	302 m ³ /hour	NA	NA
Pumping Station 5	1444 m ³ /hour	NA	NA
Gravity Sewer	NA	27.7 Km	160 – 1500 mm
Force Main	NA	6.3 Km	250 – 800 mm
Rider Sewer	NA	11.6 Km	160 mm
Lateral Sewer	NA	20.0 Km	110 mm
Sea Outfall	NA	Km	1100 mm

3.4 The Selected Study Location and Scope of Work

The study location is the road named, “New Air Port Road” located in “Kandawala” Grama Niladhari Division, in Ratmalana where 250 mm to 800 mm Diameter and 2.1 km length of corrugated type Poly Ethylene Main Gravity Sewer pipe line together with 160 mm Diameter Rider Sewers and 125 mm Diameter Lateral Sewers were laid. The 94 numbers of Interceptor Chambers were placed in the consumer premises to obtain consumer sewer connections to the sewer system. The depth of the sewer pipes were varied from 2.0 m to 7.0 m and open-cut method with interlocking sheet piles were used. The machineries involved were Pile Driver, Cranes, Back-hoe Excavators and Vibrating and Roller Compactors. The road is surrounded with government and private institutions and business places and few residents whereas at the end of the road few housing blocks

naming “Kanadawalawatta Housing” comprising about 60 numbers of residents. The Figure 3.1 shows the lay out plan of the pipe trace, selected for this study.



Figure 3.2: The AerialMap of New Air Port Road

3.5 Collection of Data

Having selection of the study location and the research methodology, a questionnaire survey was carried out in the surrounding local business places and residents in the corridor of the above road. Further the interviews and discussions with project stakeholders including the community were carried out.

3.5.1 The Details of Business and Residential Surveys

For the Business Survey, the survey forms were distributed among the managers of the business place by asking to hand over it among the workers to fill their response. Similarly, for the Residential Survey the survey forms were distributed among the residents who pass the pipe laying construction site for their day to day activities, to fill their response.

The purpose of the surveys conducted for this thesis was to focus on the effects of social impacts and economic losses have on the business places and the community. The process, as described below, was followed in order to compile the questions and conduct

correct and useful survey. Designing of Survey Questionnaire was done by taking in to consideration the following facts.

- The questions were designed to achieve the goals and objectives of the study.
- Types of social costs and impacts are itemized.
- Possible multiple answers of the respondent were identified.
- Tried to avoid biases of the survey author.
- The resources and time for the survey could be allocated were assessed.
- The parameters were defined answers were structured so that participants could respond easily.
- The number of business places and residents in the sample to be surveyed was decided.

To avoid complexity of questions a simple and conversational language was used. However, the questionnaire for Residential Survey was prepared in Sinhala language in order to obtain realistic responses with own language. To facilitate unbiased responses, proper questions were designed in the questionnaires to accurately assess the opinions of the community. The both questionnaires mainly contained close-ended questions to give limited alternative responses and asked to choose the one closest to his or her viewpoint as answering is easy by taking less time. However few optional open-ended questions were also included to obtain their identification attitudes while scaled questions were used to obtain attitudes on the control measures taken at the site. The loaded questions, double barreled items and making assumptions were avoided. Concise questions were created with simple, clear language to understand questions to eliminate any uncertainty or difficulty for any participant for response. The focus of the business survey was, began with respondent's information and move on to concentrate on time delays, business operations, economic losses, loss of income, productivity loss and employment problems. The scaled questions were aimed at capturing the workers of the business places' and residents' attitude towards several construction nuisances faced by them while passing the sites as safety, property protection, noise and air pollution control measures taken by the project parties. The guidance was taken for questionnaire preparation from the text

book “Business Research Methods, 8e, a south Asian Perspective by Zikmund, Babin, Carr, Adhikari, Griffin (2013).

This 16-question survey was taken to businesses along the corridor of the sewer pipe laying project in “New Air Port road” in Ratmalana. The survey papers were distributed among the business places after giving the introduction verbally. The owners or managers of the business places were asked to aware the workers of the various disciplines of the business and asked to fill out the survey since their position affords them more knowledge of the business.

The Surveys to local residents focused on the delays for their daily routine works and nuisances due to a major construction project near their home. Multiple choice questions were asked to examine effects of the sewerage pipe laying construction for journey to work and/or local driving through and around construction. The scaled question concerns the participant’s personal opinion regarding contractor’s safety measures, construction nuisances the public faces on a daily basis. Residents living surrounding the sewer pipe laying site and housing blocks located at the end of New Air Port road were handed over the survey questionnaire after explaining the need for obtaining the complete response. Besides, giving verbal introduction for the survey the purpose of the survey is written on the top of the form for confirmation and encouraging for participation. The blank survey forms are included in the Annexure-A.

3.5.2 The Details of Interviews Conducted

Interview is a tool which allows respondents to have a great account of the subject matter with his or her own term of reference. This increased even a person’s understanding about what he or she is sought to bring about. While building necessary rapport, the respondents were encouraged to come up with more information.

In this case specific structure was followed in order to lead the interviewee dig information to the depth as much as possible. This enabled to capture their point of views on their property damages, social issues or inconveniences caused due to construction of sewerage pipe laying construction. The several interviews were conducted not only

focusing in specified site in New Airport road but also contacted effected persons in the other sites as well.

3.5.3 Use of theProject Experience

As was mentioned in the Chapter 1 above, the author of this research had been engaging in the above project for this study in the capacity of Chief Engineer in whole duration of construction phase (i.e.; in year 2008 to 2014) and experience was gained with the aforesaid social issues while carrying out construction work. The author was working on behalf of the project proponent of the project i.e.; for National Water Supply and Drainage Board and engagedand represented in resolving social issues, public confrontations, third party property damages, complaints on business losses etc. arisen out of the pipe laying construction work apart from the usual engineering activities and attending of formal site discussions and Meetings. In this research his experiences,observations and findings were utilized as “participant’s observer” to analyze and discuss the identified social issues.

3.6 Analysis of Data

Data collected by the Questionnaire surveys was tabulated to show in a summary and analyzed to reveal the opinions and understandings of those most affected by the sewerage pipe laying construction project, and evaluations, explanations and conclusions were based on the frequencies of the respondents.This analysis, along with survey results, is given in the next chapter. In the results of the questionnaire, there are both numerical data and categorical data. The data are presented in the tables. Statistical analysis of the data consists of frequency distribution, mean and mode. However, as the “mode” of a set of data defines, the most popular value with the highest frequency, the mode identified for evaluation and explains the results.

Further the information from the affected people and their understanding about the project activities obtained from the conducted interviews were summarized and explained.

Simultaneously, the findings from the above surveys and interviews were explained and concluded by inter-mixing the experiences of the author of this research. These results and findings would lead to better understanding of sewerage pipe laying construction and its impact on the community.

CHAPTER-4- ANALYSIS AND DISCUSSION OF RESULTS

This chapter presents the results, analysis and explanations of subject of the research as methods described in Chapter 3. Results are separated into following groups.

- 1) outcome from business survey
- 2) outcome from residential survey
- 3) outcome of interviews conducted

Further the findings from the above surveys and interviews were explained and concluded by inter-relating the experiences of the author of this research as participant's observer.

4.1 The Business Survey for Collection of Data

The survey examines social costs endured by the personal and business operation due to sewerage pipe laying construction. The log of business places who participated for the survey is given in the Annexure-B. Out of the sample size of 48 numbers of the people in 21 numbers of businesses places that were asked to participate, thirty-one (31) were filled out a complete survey. This is a seventy-one percent (71%) response rate.

The below section gives the results of an individual question asked in the questionnaire and analysis presented in the table form. Initial questions in the questionnaire are related to personal costs incurred during travelling whereas others are in relation with the business operation, property damages and individual perception over the construction activities, safety and measures taken for controlling public nuisances.

4.1.1 The Personal Travel Time

The analysis and evaluation of the first two questions were taken at once as they are related with the workers travelling time to work place daily.

Question No- 01: Before construction began, how many minutes did you travel to office/work from Galle road/or from Borupona Road?

Table 4.1: Results on Travel Time

Response	No of Respondents	Percentage of Respondents
0-10 minutes	21	68%
10-15 minutes	4	13%
15-20 minutes	3	10%
Above 20 minutes	3	10%

Question No- 02: If your travel time to work has increased because of construction, how many extra minutes do you spend?

Table 4.2: Results Travel Time Increase

Response	No of Respondents	Percentage of Respondents
0-05 minutes	2	06%
05-10 minutes	11	35%
10-15 minutes	12	39%
16-20 minutes	16	19%

The responses for the question-01 shows that majority of the workers i.e.; 68%, take zero to 10 minutes to travel to their work place. The results from Question-2 of the survey show that it has taken 39% the participants between 05 to 10 minutes time increase and 35% of the participants between 10 to 15 minutes time increase, to drive to work after the construction was began. These figures are evidenced that following the commencement of construction the inconveniences and congestion slowed down the travel when passing the pipe laying construction area and as a result the average travel time to work has increased by 05 to 15 minutes.

Moreover analyzing of residents' travel times are also taken here and the following two questions and results are on the topic of travel time delays in the residential survey.

Question No- 04: Before pipe laying began, how many minutes did you take to travel to Galle Road?

And, answers in the tables 4.20 were; 0-10 minutes was taken by 13%, 10-15 minutes were taken by 61%, 15-20 minutes was taken by 13% and finally more than 20 minutes was taken by 13% of the people.

Question No- 05: After pipe laying began, how many minutes did you take to travel to Galle Road?

And, answers in the tables 4.21 were; 0-10 minutes was taken by 0%, 10-15 minutes were taken by 18%, 15-20 minutes was taken by 50% and finally more than 20 minutes was taken by 32% of the people.

The tables 4.20 and 4.21 given under the residential survey results show that the 61% majority of residents usually spend 10 to 15 minutes to travel to the main road whereas once the pipe laying began the 50% took 15 to 20 minute and 32% took more than 20 minutes. The three-wheeler divers said they have to spend even 30 minutes time to reach to the main Galle road by passing the site.



Figure 4.1: Picture of Traffic due to road closure in Attidiya road in Ratmalana

(Source: Project for Wastewater Disposal Systems for Ratmalana/Moratuwa&Ja-Ela/
Ekala Areas)

The results of the surveys pertaining to the travel delays are further evidenced by the excerpts of the interviews conducted with the people in the selected sample site as well as in the other areas in the project.

As was data gathered, there are 15 three-wheels in the park at New Airport road and all are keeping an eye on catching a hire. However, with this pipe laying construction works, it takes 20 minutes or more which was 5-7 minutes before starting the construction with following constrains.

The Three-wheeler owner, Respondant-01 responded to the interview that,

“When excavators are in operation we have to wait and see till the work is over. Sometimes we have to wait 10 to 15 minutes on the roads and thus we consume more than 20 minutes per hire which of course maximum 7 minutes in normal time.”

These are the basic constrains many of the Three-wheel service providers faced in the pipe line construction area.

It is well known fact that the project area has high traffic congestion even without these constructions as roads are being narrow and high rate of vehicles on the roads. Normally, peak traffic congestion is, in the morning, from 6.00am to 9.30am and in the evening from 4 to 8.30 hours. This ordinary traffic congestion has been more exaggerated by road closures, reduced lanes, lowered speed limits and signs of “Stop” and “Go” and resulted with following issues.

The factor to be taken here is that the people weresuffered as increased fuel consumption of vehicle due to traffic at pipe laying sites.

Respondant-02, the vehicle owner said that,

“I am driving along this three four times a day to do my business andhome work. Now I have to wait here about 10 to 15 minutes more for passing one way of my journey. You see how much fuel I have to consume additionally per day. Who pays me that money?”

The Respondant-03, the other traveller, said that,

“While I was driving my vehicle with view of fuelling in immediate filling station I got caught to a huge traffic. I was right middle with low fuel indication has been on. I had no way of turning back and no one knows the pressure I had. I was concerning about if vehicle is ceased with no fuel how is the situation, no one to support and there will only be insult and blaming.”

The outcomes from these questions evidenced that construction causes inconveniences, extra time to their daily travelling to work, incurring additional fuel consumption in the vehicles, added vehicle wear and tear and annoyance. However it was observed at the site that the project contractor put few traffic controllers at the points where the road was narrowed down for trenching to lead to pass the both ways' traffic alternatively. At interview with the Respondant-04, the contractor's Project Manager, said that “they are unable to open up more road access to pass the traffic as it is unsafe for travellers to reach near deep trench excavation”. He also mentioned that “they are unable to speed up the work as interlocking sheet piling is done as shoring for deep trenching and that sheet piling work goes slowly. For completion about 60% of pipe laying it has already taken about five and half months' time hence the traffic destruction can betaken place for long period”. These social costs related to daily travelling time of the public are neglected and do not taken to the project estimates and consequently should be beard by the society.

4.1.2 The Individual's Business Productivity

In the questionnaire following question was asked to test any effects on productivity of the individuals of the business places once passing the pipe laying site in the morning travelling.

Question No- 03:How is your work productivity affected when you get to work after passing the sites?

Table 4.3: Results on Business Productivity

Response	No of Respondents	Percentage of Respondents
Negatively	18	58%
Not effected	13	42%
Positively	0	0%

The more numbers of respondents i.e. 58% response rate, stated that their productivity, in turn the efficiency of individuals has gone down once they face the daily disturbances in their morning travelling by passing the construction site. However the Client’s (National Water Supply and Drainage Board’s) Project Managers of the project has not received any such complaints from the managers of the business places, not only from this sample site of “New Air Port road” but in overall project sites regarding the decrease of productivity of their workers but could guess that morning mood of the people could affect their efficiency. However 42% of the workers have done their daily work in the usual pattern though they have confronted disturbances.

4.1.3 Communication with Third Parties

The analyzing of following two questions was taken together as the question 5 is filtered question from 4 regarding the pre-information and pre-arrangements for reduce inconveniences.

Question No- 04:Were you pre-informed by the project staff about this pipe laying project in order to plan your activities ahead?

Table 4.4: Pre-information on Site Works

Response	No of Respondents	Percentage of Respondents
Yes, via written communication	07	23%
Yes, via verbal communication	10	32%
No, we were not informed	14	45%

Question No- 05: If yes, did the contractor express/or done any methods/ or remedies to reduce the inconveniences due to construction for your business?

Table 4.5: Results on Remedies for Inconveniences

Response	No of Respondents	Percentage of Respondents
Yes	06	35%
No	11	65%

According to the results of the response to the Question No-4 regarding the pre-informing the surrounding places prior to commence pipe laying activities of the aforesaid stretch of the construction the 55% of the respondents were informed either via written or verbal communication. It is known by this researcher that as per the contractual conditions of this project it is the duty of the contractor to pre-inform the public about starting time of the pipe laying and make necessary pre-arrangements for the specific concerns of business places and households and for their inconveniences.

The pre-information is vital in the situations where if any business party needs to move their heavy vehicles or containers prior to closer of the one lane for trenching. According to the response to the Question-5, the 65% of respondents out of the 17 business places

who have pre-informed the ahead of the project as per Question-4 said that the contractor has not done any remedies to reduce the inconveniences prior to start of pipe laying construction. It was observed that in most of the areas where there are no alternative by-lanes available wide enough to move the industry or commercial heavy vehicles, fallen within the project area. There were several occasions where the client; the NWSDB's project staff in the project had to convene discussions among the parties to resolve the complaints regarding difficulties of moving industry vehicles due to lack of pre-information by the contractor. The one time the excavated trench had to be backfilled to obtain access to the container of "Elephant Maconite" Asbestos Roofing Industry in Katukurunduwatta road due to the coordination problem. At the time of that problem arises, the Respondant-05, the Manager of the "Elephant Maconite", said that some time ago a letter was received from the contractor stating about the proposed pipe laying work and the likely property damages but they have not given notice to them about the exact date of one lane closure. Another manager at one bank in the New Airport road responded at the interview to this question by saying "the contractor gave us his personal business card but not the exact working time so we can give him feedback or if we need anything to help our business." Therefore the businesses face many social costs that can ultimately lead to economic losses due to lack of proper communication and coordination by the project parties.

4.1.4 Property Damages

The following two questions are discussed together as the question 7 is filtered question from 6 as they are connected with property damages of business places. Furthermore, the response results to the similar questions asked in the Residential survey, i.e. question no- 8 and 9 were also taken here to analyze and discuss.

Question No- 06: Has any of your property damaged due to vibration/trenching of pipe laying work?

Table 4.6: Results on Property Damages

Response	No of Respondents	Percentage of Respondents
Yes	12	39%
No	16	52%
Not Responded	01	09%

Question No- 07: If yes, what was the damage and approximate cost?

Table 4.7: Results of Amount in Property Damages

Response	No of Respondents	Percentage of Respondents
Less than Rs. 10,000	04	33%
Between Rs. 10,000 to 50,000	0	0%
Between Rs. 50,000 to 100,000	05	42%
More than Rs. 100,000	03	25%

According to the response for the question 6 shows that about 39% of the properties of business places have been damaged whereas most of the damages, i.e. 42% are fallen between the amount LKR 50,000 to 100,000. The 33% says that their damages were minor and the amount is less than LKR 10,000.

Moreover according to the response results to the similar questions- 8 and 9, asked in the Residential survey shows that about 37% of the properties of residences were damaged whereas most of the damages, i.e. about 71% are fallen between the amount of LKR 50,000 to 100,000. The 21% has said that their damages were minor and the amount is less than LKR 10,000.

According to the project data given in the Table 1.1 in chapter 1, the 613 numbers of properties have been damaged while laying of 65.6 km of sewerage pipes in this Ratmalana/ Moratuwa sewerage project. Therefore it can be estimated that at completion pipe laying activities of the project, one property in every 107 meter length has been damaged irrespective of the damage is major or minor and property is business, industry or house. The project area including the selected sample road is such a good precedence for mixed land use patterns. In the construction zones/sites the housing, commercial structures are in lines or arrays. Sometime there are more than 3 arrays of building structures located along the roads following one by one. The following picture captured from katukurunduwatt road in the project shows that.



Figure 4.2: Existing Patterns of private properties at New Airport Road

(Source: Project for Wastewater Disposal Systems for Ratmalana/Moratuwa&Ja-Ela/ Ekala Areas)

This is because sometimes it might be thought that only first array of the construction site will face damages and there will not be effects and damages in next array of structures.

But the scenario is different and there were evidences about the damages to the next arrays.

The excerpts from some interviews conducted to the owners of damaged properties are mentioned below. These responses indicate their real worries and criticisms over the project owner and the contractor since the project has damaged their own living place then that is “their home sweet home”.

The Respondant-06 at Kandawala Road explained that,

“I bought this house three (3) years back and repaired completely. It cost me a lot and now all are again badly cracked. Construction of this project created severe cracks of beams, separation of walls of kitchen and bathroom. How can I get these restored and I was given only one hundred thousand rupees by which even cracks on boundary wall can't be repaired”.

The Respondant-07 at Abaya Mawatha, Borupana Road revealed that,

“My house has been damaged due to the vibration caused by trenching and piling work carried out for laying of pipe lines in front of my house. According to opinion of our engineer wall cracks are very severe and visible so it is a threat to our life as my house can collapse at any moment”

4.1.4.1 Delay in Payment of Compensation for Damages

As was mentioned in the Chapter 3 in the contract conditions of this project, the third party damages are handled by an Insurance Company whom was selected and appointed by the contractor during the bidding stage. According to the procedures set by the insurance company a complaint is to be logged in writing (first verbally) and subsequently the acceptable cost estimation has to be submitted. Once such are received, site inspections are carried out by the insurance company and accordingly insurer estimate the damages by his own. Normally in all instances, the insurer's estimate gives lower amount hence the dispute over the two estimates take in place for long period until the compensation is made. Then the procedure is not simple and quick. As the pipe laying for sewerage conveyance are done with the slopes and in deep trenches the completion of

construction activities in a road stretch take long time and would go up to 06 to 12 months. If damages are high, claim is left out for some time by the contractor negating all the risk involved. Hence the victims of property damages should wait long time to for compensation even when the disputes are concurred.

At the interview the Respondant-08, one house owner, who was waiting for long time for compensation in New Air Port road, said

“I feel very much unsafe living in my house with my grandchildren who are minors as your deep underground Sewerage project has resulted severe damages to our residence. This is a pure violation of fundamental rights of any lawful citizen of the country. The delay in settling has caused continuous unrecoverable damages which have made us much greater inconveniences”.

Further during an interview the Respondant-09 at Katukurunduwatte Road highlighted the need for quick settlement of compensation, as,

“You see how my house is, my mother in law, husband, two children are at home. The top roof is to be collapsed and many points are lowered. Yet no compensation has been given to us. We all are in newly built one room in the back with all difficulties. Say, it is okay, how I can stop children’s coming here. They are in danger... do we need to scarify our lives for this miserable project”

According these points and other technical reasons the victims have to wait and see until all the problems are solved from the insurer’s side to pay their claims. Further any attempt to get immediate remedies will also be neglected with playing same tunes. In such a way delay in settlement taken place due to lack of pre-arrangements and insurer’s reluctance for paying.

4.1.4.2 Posing Threat to Lives

Threat to life is the greatest problem that majority of respondents emphasized during the interviews with regard to damages to private properties. If structures got suddenly collapsed, there shall be injuries or death. Who has the responsibility if one injured and

died with high risk and high possibility of falling? These have not adequately considered project parties in the project preparatory stage, but just ignoring.

In this regard, The Respondant-10, the resident at Thelawala road said that,

“Concreted floor areas thereby doors and window frame have been separated from the wall and entire tiled roof of the residential house has been broken and lowered at many points. Damaged wall and roof can be collapse any time and further damages will cause to my properties neighbors and road users and life too.”

In such cases the value of human life has not been considered. Basically road users and inhabitants are in danger of becoming victims of such. These are high risk involving facts when the social is concerned and for which no enough consideration has been made during the project planning.

The social costs and issues enlightened owing to this high rate of property damages are unbearable to local community as well as it is burden to the project proponent and the contractor as the path for rapport two parties forsettling the disputes was a bitter exercise.

4.1.4.3 The Adoption of Proper Methods/Techniques

The causes behind the occurrence of so much of property damages when laying the pipes was open-cut trenches getting widen and deepened, using high powered machinery for shoring work, following unsuitable construction methods such as using Box Piling instead of Sheet Piling, hammering on Sheets instead of Silent Piling and not having proper stoppage of soil migration while dewatering etc. The selection of relevant technology, proper equipment and suitable materials for the work are highly dependent on the contractor and partially dependent on the project planners and designers. It means that these types of social costs and public burdens can be highly mitigated by selecting proper and modern technology during the design phase of the project. A dissertation by Rodolfo Valdes-Vasquez (2011) says that “The construction workforce and contractors can be affected by poor planning and design. For instance, Dai et al. (2007) investigated the negative effects of poor engineering drawings on construction labor productivity.

Owners also report that poor quality design documentation increases complaints about and disruptions of the construction processes. Previous research has also found a link between a project’s design and the number of construction site injury and fatality incidents”. Further, according to Gilchrist and Allouche (2005) “At the community level, potential adverse impacts of construction projects include prolonged closure of road space, air/water pollution, noise, and damages to current community infrastructures”.

4.1.5 Economic Impacts on Businesses

The next eight questions in the survey pertain to economic impacts the businesses face due to sewerage pipe laying construction.

Question No- 08:Have your business activities/sales reduced since this pipe laying project?

Table 4.8: Results in Business Reduction

Response	No of Respondents	Percentage of Respondents
Yes	10	32%
No	21	68%

Question No- 09:If yes, by what percentage do you think your business/sales have decreased?

Table 4.9: Results in Percentage of Business Reduction

Response	No of Respondents	Percentage of Respondents
Less than 10%	08	80%
Between 10% to 20%	01	10%
Between 20% to 30%	01	10%
More than 30%	0	0%

Question No- 10: Is there any type of compensation by the project for business loss?

Table 4.10: Results on Compensation Payment

Response	No of Respondents	Percentage of Respondents
Yes	01	03%
No	28	90%
Not Responded	02	07%

Question No- 11: Do you think your customers may temporarily go elsewhere because of the pipe laying?

Table 4.11: Results on Customer Reduction

Response	No of Respondents	Percentage of Respondents
Yes	14	45%
No	08	26%
May be	09	29%

Question No- 12: If yes, by what percentage do you think your customers will go elsewhere??

Table 4.12: Results in Percentage of Customer Reduction

Response	No of Respondents	Percentage of Respondents
Less than 5%	04	29%
Between 5% to 10%	06	43%
Between 10% to 25%	04	29%
More than 25%	0	0%

The above three questions are regarding the responses over the effects to the business and the magnitude and therefore, are inter-related with each other. Therefore analyzing and discussion are done together.

The minority of 32% of the respondents has said that their business activities and sales were reduced since this pipe laying project in New Airport Road while majority i.e. 68% were not affected. Normally the industries are not customer related as much as other businesses hence effects are less. But the businesses of Small Groceries and Retailers, Pastry Shops/ Food Centers /Tea shop, Video Shops/Communications, King Coconut Sellers, Pharmacies, other different service providers- welders, mechanic, technician, Banks, Shops with household items, Small Boutiques etc. are merely customer related hence their businesses were got effected due to disturbances of closure of access road. Further the most of the businessmen i.e. 80% of respondents, whose businesses got affected, have said that their businesses have gone down by 10%. While this is good example to evidence that businesses are affected due to disturbances on the access to their places, obviously the extent of business losses are varied depending on the customer focus, business type and size of the pipe lines being laid. In the case of complete closure of roads, as was happened in Angulana Station road and Thelawala road in the project, the customer oriented businesses might have affected more that 10% of sales reduction. However, when the pipe laying projects are implemented, people have confronted sudden changes which have negatively affected on their business and income generating activities making their life a mess.

Following gives the excerpts of the interviews conducted in Bellekkade Junction and Attidiya road in the project.

According to the Respondant-11, the marketers at Beleckade, it is more consolidated.

“A crowd of 1000 to 1500 comes to the fair per day but due to the construction of project, the coming of people decreased from 80% resulting huge income lost for all sorts of selling from 70 – 80% compared to other days”

The Respondant-12, a king coconut seller at Attidiya road said that,

“No construction was taken place but made close some part of the of Attidiya road. Now no person is hanging here but a huge crowd was before the construction. Now I don’t know what to do, I don’t know anything but I have no sale now”

The life of the business runners solely based on the customers and consumers. Thus, the competition for customer attraction, retention, customer satisfaction is high and all business runners equally get every effort to provide their service continuously and quality. As such when businessmen happen to leave out their customers due to the construction arrangements in-turn they got involved against the construction activities.

4.1.5.1 Difficulties for Customers to Access the Shop/Market

The ratio of sales depends on visiting and purchasing abilities of the customers. However, customers do not attempt to arrive at sale shops rather look for another place when there is restriction like huge trench middle of road close to business place and only two-three feet have been allocated for walking. Nowadays people preference is to do shopping at nicely decorated shops with attractive environment which is not a trait at shops in construction sites. Thus, following picture shows access difficulties faced by the business shops in the sample “New Airport road”.



Figure 4.3: Access Difficulties for Businesses at Katukurunduwatta road

(Source: Project for Wastewater Disposal Systems for Ratmalana/Moratuwa&Ja-Ela/ Ekala Areas)

The subsequent two questions relate to employee retention and productivity.

Question No- 13: Throughout the construction process has it been difficult to maintain employees? If so, approximately how many do you lose per month?

Table 4.13: Results Losing of Employees

Response	No of Respondents	Percentage of Respondents
1-3 employees	08	26%
4-6 employees	02	06%
7-9 employees	0	0%
I have maintained all of my employees	21	68%

Of the 31 businesses surveyed 21 have not lost any employees. This could be indicative of a number of things besides construction, one of which could be the demand for jobs.

Also, employees who are satisfied with their jobs are less likely to leave regardless of travelling conditions affected by pipe laying work. The one business that lost 1 to 3 workers is a factory but according to the Respondant-13, the Manager of the factory during an interview, said that “they are minor grade workers hence can’t say that their leaving was due to construction disturbances”. Fortunately, from the results, in general majority of the businesses i.e. 68%, have maintained their employees even during construction.

Question No- 14:Has productivity among employees decreased since the start of construction? (This question is to respond for the manager of business)

Table 4.14: Results in Decrease of Productivity

Response	No of Respondents	Percentage of Respondents
Yes	19	61%
No	09	29%
Not Responded	03	10%

The response to this question provides a picture of how construction can affect employee productivity. Overall it is split nearly evenly between respondents who feel that construction has affected productivity and those who do not. The 61% of Managers of businesses feel that their employees’ productivity has decreased due to pipe laying sites on the way. This could be credited to the fact that workers must drive through the congestion and headache caused by construction to get to work. This can cause agitation and irritation which can overflow to the workplace.

Construction may be inevitable in most circumstances as the people needs infrastructure for living as is the case in this study. And although business loss may be highlighted during construction, once it is complete, business will flourish due to increased mobility. The following responses show that the people think that their businesses will increase once completion of this sewerage facility to the area.

Question No- 15:Do you think business will increase with the completion of this construction project?

Table 4.15: Results in Business Increase after the Project

Response	No of Respondents	Percentage of Respondents
Yes	18	58%
No	06	19%
Not Responded	07	23%

These are the intentions of construction and can ultimately increase business. Businesses may have to endure the distressing social costs during construction but the benefits can outweigh the damages if the business can survive during these constructions.

The final question of the business survey was a scaled question reflecting the respondent's position, whether satisfied or dissatisfied, on their attitudes regarding controlling and migratory measures taken the project contractor on the surrounding factors in the site. The Table 4.16 shows the results of question 16 of the business survey and could be interpreted that more responses started from higher figure of dissatisfaction and leaning towards the mean of 10% satisfaction. Hence in average 40% of the people who see the contractor's work frequently has of the pinion that the contractor has not perform the adequate measures onproperty protection arrangements, provision of customer/Employee vehicle parking, noise control, traffic signs, evenness of temporary road surface, dirt/dust pollution control etc. However, fortunately according to the percentage results of the opinion in each cage the people accepted that the some controlling actions have been undertaken.

4.1.6 Persons' Opinion of on Site Controls

Question No- 16:Rank the following with regards to your business from 1-5, 5 being completely satisfied and 1 being completely dissatisfied.

Table 4.16: Results on Persons' Opinion in Site Controls

	Dissatisfied			Satisfied			Not Responded
	1	2	3	4	5		
Property protection by the contractor	42%	29%	13%	3%	6%	7%	
Customer/Employee vehicle Parking	55%	19%	0%	6%	10%	10%	
Noise Control	26%	29%	19%	3%	10%	13%	
Traffic Signs	19%	26%	23%	6%	16%	10%	
Evenness of temporary road surface	39%	13%	19%	6%	6%	13%	
Dirt/Dust Pollution control	55%	13%	6%	3%	13%	10%	

4.2 The Residential Survey for Collection of Data

The residential survey was carried out along the New Airport road and residents of “Kanadawalawatta Housing” blocks situated at the end of the road. The survey questionnaire consists of eleven questions concerning the social impacts and public's opinion of construction of sewerage pipe lines on the right of ways on roads. This survey forms were distributed among the residents and asked to fill after briefing about the research study. Figure 4.1 shows the location of these residents. The sample size was 55 residents which is fairly better sample and the response rate was about 70% i.e. 38 residents. The analysis following question results from the residential survey comply resident's attitudes towards the social impacts and about benefit of the project which gives sewerage infrastructure facility for the area.



Figure 4.4: Location of Resident Survey in New Air Port Road

4.2.1 The Residents' Information

The first three questions were aimed to obtain some information of residents to have a base for the subsequent responses. Accordingly, majority of the residents i.e. 52% uses vehicles to travel to main road i.e. to Galle road, passing the pipe laying work site in New Airport road. According to the other information obtained and observations, about half of them were three-wheelers.

Question No- 01: Approximately, how many kilo-meters is your residence from Galle Road?

Table 4.17: Results on Resident's Travelling Distance

Response	No of Respondents	Percentage of Respondents
0.5- 1 km	0	0%
1- 1.5 km	12	32%
1.5- 2 km	12	32%
More than- 2 km	14	36%

Question No- 02: How many times do you travel on New Air Port Road to Galle Road?

Table 4.18: Results on Resident's Travelling Times

Response	No of Respondents	Percentage of Respondents
01 time per day	2	5%
02 time per day	7	18%
More than 02 time per day	27	72%
Not Responded	2	5%

Question No- 03: What is the mode of your transport to travel to Galle Road?

Table 4.19: Results on Mode of Transport

Response	No of Respondents	Percentage of Respondents
By vehicle	20	52%
By Motor Bike	10	26%
By Push Bike	5	13%
Walking	3	9%

4.2.2The Residents' Travel Time

The following two questions are on the topic of travel time delays and, were already discussed under the business survey.

Question No- 04: Before pipe laying began, how many minutes did you take to travel to Galle Road?

Table 4.20: Results on Resident's Normal Travel Time

Response	No of Respondents	Percentage of Respondents
0-10 minutes	5	13%
10-15 minutes	23	61%
15-20 minutes	5	13%
More than 20 minutes	5	13%

Question No- 05: After pipe laying began, how many minutes did you take to travel to Galle Road?

Table 4.21: Results on Travel Time After the Works Began

Response	No of Respondents	Percentage of Respondents
0-10 minutes	0	0%
10-15 minutes	7	18%
15-20 minutes	19	50%
More than 20 minutes	12	32%

The 63% of responses to the below question meant that the residents surrounding and stayed at the corner housing blocks in New Airport road do not go out of your way of New Air Port road to get any of their tasks done because of pipe laying construction. By asking the question 'why' the one resident replied that diversions are difficult as alternative by-lanes are also congested. However 8 people have said for the question-7 that they go out of the way but the occasions are less than 25%. Similarly, answering to the question-10 the majority i.e. 60% of residents rarely stay at home without going for work rather than dealing with these inconveniences.

Question No- 06: Do you go out of your way (New Air Port road) to get any of your tasks done because of construction?

Table 4.22: Results in Using Alternative Routes

Response	No of Respondents	Percentage of Respondents
Yes	8	21%
No	24	63%
Not Responded	6	16%

Question No- 07: If yes, what percentage of the time do you do this?

Table 4.23: Results on Percentage of De-routing

Response	No of Respondents	Percentage of Respondents
Less than 25%	5	62%
25% to 50%	2	25%
50% to 75 %	1	13%
More than 75%	0	0%

The majority of people live in residential areas have got their own vehicles and accustomed to use these vehicles, hiring vehicles or public transportation for their travelling. On the other hand, there are lots of roads and by roads of one to four kilometers length with dead ends which have no public transportation system. As such all would use private vehicles or taxies to get into desired places while some people used to walking. What has happened with construction is that difficulties in hiring three wheelers, taxies whether public transportation systems are available or not.

The Respondant-14, the resident at Thelawala explained that,

“When potholes are on the road surrounding the sites three-wheelers are refusing to serve as their vehicles are damaged. Three wheelers are one of the common and high influential way of transportation system of all categories of people as it is convenient, cheap and easy to access”

One parent of school children stated that,

“Since school vehicle services refuse to come down from Galle road to our homes passing the site, many people have to wake up early and coming down to Galle road about one and half Kilo Meters to get the service which is a problem for students themselves and parents. For parents an extra effort has to be kept which causes pressure and tiredness while students struggling to get used to the new time schedule and walking at dawn”.

The residents may also take alternate paths which lengthen travel in order to avoid construction. Both added time and miles can depreciate the vehicle more quickly due to the increased wear and tear on the vehicle. These social costs are the price local residents pay and are hardly investigated by the Contractor. But it is a fact that these could be mitigated and probably avoided if the proper pre-planning is carried out by the project Engineers, Public Relation Officers and Sociologists.

The following two questions 8 and 9 are pertaining to the property damages, were already discussed in lengthy under the business survey.

Question No- 08: Has any of your property damaged due to vibration/trenching of pipe laying work?

Table 4.24: Results on Residents’ Property Damages

Response	No of Respondents	Percentage of Respondents
Yes	14	37%
No	21	55%
Not Responded	3	8%

Question No- 09: If yes, what was the damage and approximate cost?

Table 4.25: Results on Amount of Property Damages

Response	No of Respondents	Percentage of Respondents
Less than Rs. 10,000	3	21%
Between Rs. 10,000 - 50,000	10	71%
Between Rs. 50,000 - 100,000	1	8%
More than 100,000	0	0%

Question No- 10: Instead of going along New Air Port road with pipe laying traffic what percentage of the time do you stay home rather than deal with this incontinence?

Table 4.26: Results Percentage of Stay at Home due to incontinence

Response	No of Respondents	Percentage of Respondents
Less than 25% (Rarely)	23	60%
25-50% (Sometimes)	6	16%
50-75% (Often)	2	5%
More than 75% (Regularly)	2	5%
Not Responded	5	14%

4.2.3 The Residents' Opinion Survey

Question No- 11: Rank the following with regards to your personal opinion of pipe laying from 1-5 below. (Marking "5" is being you strongly agree whereas "1" being you strongly disagree).

Table 4.27: Results on Residents' Opinion in Site Controls

Event	1	2	3	4	5	
	Disagree		Agree			Not Responded
Pipe laying work negatively affects my mood	12%	19%	33%	13%	13%	10%
Weather Project staff made aware you about the work	12%	3%	4%	10%	65%	6%
I tend to take a different route to avoid pipe laying	62%	3%	3%	0%	10%	22%
Is Dirt/dust pollution control is done	42%	29%	13%	3%	6%	13%
Safety Signs, Traffic Diversions are well marked	52%	23%	13%	3%	4%	5%
I am more stressed when I pass the site to my destination	12%	3%	4%	10%	55%	16%
I go to use same New Air Port road even though it disturbs my way	12%	3%	2%	7%	61%	15%
I feel road users safety has been considered by the Project	42%	25%	13%	3%	6%	11%
The sites are illuminated satisfactorily during night	52%	20%	13%	3%	6%	6%
I experienced vibration during the pipe laying work in the project and was a nuisance	12%	9%	15%	4%	45%	15%
Noise pollution has increased with this pipe laying project and is a nuisance	13%	9%	15%	4%	51%	8%
My property was effected due to	45%	26%	14%	3%	6%	6%

activities of the project						
I feel that this construction is necessary	10%	3%	4%	12%	65%	6%
I feel that the inconveniences I am dealing with now will be worth it after construction is complete	2%	3%	7%	12%	74%	2%

The final question of the residential survey was a scaled question reflecting the respondent's position, whether satisfied or dissatisfied, on different factors according to their feelings, knowledge and attitudes towards the mitigation measures taken by the project contractor on the surrounding factors in the site. The Table 4.16 shows the results of question 16 of the business survey and could be interpreted that more responses started from higher figure of dissatisfaction and leaning towards the mean of 10% satisfaction.

4.2.4 Noise Nuisance

“You see how difficult to manage the things with bad noises, as my baby son constantly gets frightened and cried”

This is the complaint quoted from an interview with the Respondant-15, one father, staying near New Airport road.

In average about 60% have said that noise pollution has increased with this pipe laying project and is a nuisance.

Noise nuisance is a common and sometimes a minor issue faced by all businesses and residents who stay near sites whereas it could be a severe disturbance for the school children, patients and older people who work or stay at home. The unaccustomed sound generated by these of machines and equipment during the carrying out of the project activities can be identified here as noise nuisance. The hammering to the trench boxes and sheet piles, wheeling and acceleration of machines' noises are considered as unwanted disturbance by people. The term noise is defined and interpreted by the World

Health Organization as “when people hear not a pleasant sound but an unwanted objectionable sound. Such unpleasant noises are produced by machines and airplanes sound and noise is different to a person to another. Thus one person sound is noise for another”.

The same thing could witness from the people at Miraj Housing Scheme and the Respondant- 16, the resident, 60 years old urged as follows.

“We did not want to bear the terrible noises generated by these vehicles. Actually we have no surrounding annoyance, nuisance but have wonderful calm and quiet residential areas. One of my cousin brothers lived by next lane where the same pipelines are being laid, said me that he had not been able to overcome the sound and he has taken ear plugs though it is so difficult to wear.”

Still some of the respondents’ view, about 40%, is that there is a bearable range of noise nuisance which is in favor of the sewerage project or national intensives. However, prevalence of unpleasant noises for long period has made severe difficulties and problems for people at constructing sites. Though the problem has been a common issue affected by all there has been significant impact over some segments of people. The noise nuisance has been real burden for mothers with infants, elders, schooling students, educationalists and patients while some peaceful environment lovers too were in strongly against the noise nuisance.

4.2.5 Dust Generation

“Do we expect to bear all these horrible and live under cloud of dust?”

The construction has been causal fact for creating dust when construction machines are moved and when wind is blown by which people get affected. It is proven that in the question asked “Is Dirt/dust pollution control is done”, about 71% disagreed. This prevalence of dust has been not only during construction period but in post construction stages as well. It is because road authorities do not attempt to reinstate road immediately after pipe laying construction work is finished rather wait for some period of time till road is fully settled.



Figure 4.5: Muddy and unleavened road surfaces just after completed work of New Airport road

(Source: Project for Wastewater Disposal Systems for Ratmalana/Moratuwa&Ja-Ela/ Ekala Areas)

This may further delay as per tender procedures in awarding contract and financial allocations. Though the authorities have been paid specifically and separately for each road reinstatements before commencement of the projects, the funds are utilized for other purposes. Then roads are just seemed like deserts for long period of time.

The Respondant-17, a lawyer at Abaya Mawatha revealed her experience,

“Before China Geo-Contractor started implementing the project we had perfectly good road. We have been informed by CGC that millions of Rupees has been paid to Maratuwa Municipal Council for the refurbishment works of the road prior to the project start. I asked that do we have to lobby with MMC to get our road repaired or would the NWS&DB request MMC to build the road on case by case as and when they complete roads. If we wait till whole project ends next year how do you guarantee that the funds already paid to MMC for the restoration of roads. Do we expect to bear all these and live under cloud of dust till then?”

The prevalence of dust of course a common issue faced by all but following personnel has experienced many effects due to long term prevalence of dust of clouds in the areas in these sewerage pipe laying sites. They are patients, babies and business people near sites. It was convinced by the about 71% of people in the above survey, confirming that the project contractor did not control the dust despite the methodologies like covering the dust generating materials laying at site, watering the floor etc., are available. These controlling measures are merely the expenses for the contractor but has not envisaged and extra allocations are made in the project costs.

4.3 Mitigation of social impacts by Better Project Management and Coordination

The study results found different categories of the social costs and their impacts which arisen due to current way of trench excavations for laying of sewerage conveyance pipes and peoples' attitudes towards them. Further the gravity of those effects is understood by the percentages of negative responses in the surveys and the peoples' voices raised in the interviews.

According to the survey results and voices in the interviews, it was found that some inconveniences and issues confronted by people are due to the lapses with the project owner, project contractor and individual behavior patterns and personal traits. This has been confirmed by the some of the results given below.

Table 4.28: Summary of Results on Business and Residents' Opinion in Site Controls

Event	Yes	No	Not Responded
Weather Project staff made aware you about the work	72%	22%	6%
Is Dirt/dust pollution control is done?	16%	71%	13%
Safety Signs, Traffic Diversions are well marked	20%	75%	5%
I am more stressed when I pass the site to my destination	65%	19%	16%
I feel road users safety has been considered by the Project	22%	67%	11%
The sites are illuminated satisfactorily during night	22%	72%	6%
Pre-informed prior starting of Site Works	55%	45%	0%
Remedies to reduce the inconveniences was done	35%	65%	0%
Property protection was done by the contractor	22%	71%	7%
Customer/Employee vehicle Parking were provided	16%	74%	10%
Evenness of temporary road surfaces was maintained	16%	71%	13%

Percentage of responses in the above summary table shows that the majority of the people are not happy about the contractor's site controls and which in-turn directly affects them. The events given in the table are merely under control of the contractor's project management staff hence is able to improve by engaging adequate site resources and proper coordination with the public. Therefore, yetsome effects of those social issues could be effectivelymitigated and/or avoidedbyapplying better project management principles and proper coordination mechanism with the public neighboring the site. In that effect, following gives some of actions for implementation to lesser the social costs and their impacts to the people.

- i) Get the community participation in project implementation stages for proper understanding about the project and for concurrence of activities.

- ii) Introduce proper communication arrangement between the project parties and public.
- iii) Deploy sufficient staff for supervision of project activities through Engineers, Site Inspectors and Technical Officers in order to take control of everything.
- iv) Engage suitable and sufficient workers and equipment to the sites to make a track on the work schedule.
- v) Establish a proper mechanism to handle complaints, grievances and social issues of the public to act and respond fast. Appoint actors like Sociologists and Public Relation Officers for coordination.
- vi) Plan and schedule the project activities to avoid delays to give roads back to use by public.
- vii) The works at sites should consent with know-how and properly follow the work methods.
- viii) Implementation of strong actions for property safety, night site illumination, display enough safety signs and change directions etc., public vehicle parking, even road surfaces on temporary roads and just completed roads so forth.

The next chapter will conclude the results and give some recommendations to gather further knowledge and improvements to handle the social costs in a better manner.

CHAPTER- 5- CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

As the main objective of this research is to identify and itemized the attributed social costs and their impacts that arise in the sewerage pipe laying related projects and evaluate gravity of which effect to the local community by taking in to account the recently implemented sewerage project in urbanized Ratmalana/Moratuwa Area in Sri Lanka as case study.

Accordingly, the followings give conclusions on the findings and the discussion in the previous chapter.

- i) Construction activities can have a significant impact on their surrounding society and environment. This is particularly true for urban sewerage pipe laying related construction projects as well, since construction activities are carried out in the public roads.
- ii) According to the literature, these inconveniences that confront the general public when executing a sewerage construction project can be itemized as traffic delays and congestion, more fuel consumption due to waiting time, long distances in diversion routes, increased accidents, air/dust and noise pollution, decreased revenue in businesses, annoyances and are attributed with the “social costs”.
- iii) The analysis of results from the questionnaire surveys i.e. percentage of respondents and interviews with public show the “gravity” of which effect to the local community understanding the social costs.

For example;

- a) The 39% of the participants of the business survey took averagely, 7.5 minutes and 35%, took 12.5 minutes additional time to travel to work after construction began in the sewerage pipe laying site in New Airport road. Therefore the public should incur the additional costs.

- b) Similarly residential survey results show that 17.5 minutes extra time taken by the 50% of the people and more than 20 minutes extra time taken by 32% of people to pass this construction site in their daily routing.

Therefore the public should incur the additional costs for these.

- iv) The 'social costs' arisen due to the execution of a construction of these sewerage pipe laying projects are not accounted in the project estimates either as direct or indirect costs and usually are not incurred by the project proponent or the contractor. Under chapter 2.5 of the Literature Review Gilchrist, Allouche(2014) gives techniques for valuation of social costs and could apply in the event of calculating social costs, applicable in the project costs.
- v) Trenchless construction methods offer a viable alternative to traditional open-cut method in sewerage pipe laying. Under chapter 2.2.2 of Literature Review, Tanwani (2011) describes that trenchless construction method can greatly reduce the damages in all aspects of social cost factors. Therefore the adoption of trenchless methods can greatly reduce if not eliminate the damage that might otherwise occur not only to the third party structures above and utilities below, the roadways and the diversion routes but also the inconvenience and nuisances the general public confronted.
 - a) It was evidenced from the responses that 39% of the properties of business places have been damaged due to vibrations and undermining of soil with open-cut trenching. Similarly the residential survey shows that 37% of the properties of residences were damaged.
 - b) Further Ratmalana/Moratuwa project data given under Chapter 2 evidenced that the open-cut sewerage pipe laying has harmed one third party property along 107 meters of pipe laying.

Obviously this is the major disaster of the sewerage pipe laying by open-cut trenching which was experienced by this researcher while working in the project.

- vi) In the construction contracts the insurance company pays the property damages of the third party. It was evidenced by responses that the property owners are unhappy about the amount estimated by the insurer and delay for compensation. It is obvious that the insurer always tries to go away by paying lesser amount to the victim and, him such way estimates the damage.

- vii) Besides, all the importance and benefits of the sewerage project are understood and prime objective of the sewerage project is to make a clean environment to their living area of the people, the negligence of these social effects by the project implementers is highlighted by the general public. The worth-ness of the project was felt by 74% of the residents in the residential survey, went on to say that “the inconveniences they were dealing during the pipe laying now will be worth after construction is completed”. In order continue making of these sounds of appreciation in the future projects the project planners and the contractor should re-think how to mitigate the social costs by making proper pre-arrangements.

- viii) It is harmful to the credibility of the project owner and the contractor to float sewerage development projects by harming the local community and neglecting those social costs as such. So, what can we do to minimize the disruptions to the public and reduce the social cost? All the criticisms made by the public in interviews intimated that they are unhappy with such of road diggings which causes so much of problems to them.

- ix) As discussed in the “Literature Review” in chapter 2, now some global voice has raised for compensation for social costs in projects. This theme is very much relevant for the sewerage pipe laying projects as well. Therefore the identified social costs could be quantified by applying the suitable techniques learned from Gilchrist, Allouche (2014) and reserve money in the project budget for compensating for social costs when executing.

- x) The scheduled project completion time may affect in the event of temporary suspension of pipe laying on the roads until solve the public inconveniences and objections. This would cause delays in the overall project completion time;in-turn would increase in the project cost, loss of consumer benefits as discussed in Chapter 1.

Hence during the planning and design of any sewerage construction project, due consideration should be given to the method being adopted in light of the above social costs, grievances management techniques and quantification and estimation of social costs and allocation of required funds in the project budgets for compensating. Gilchrist, Allouche (2014) says, “In recent years, there has been a growing awareness among the public as well as local government agencies of the significance of social costs and a growing pressure to minimize them”.

By fulfilling those requirements, the project proponent and the contractor will be able to afford to the community, a better project than now by dealing the “social costs and their impacts in sewerage pipe laying related construction projects” in a better manner.

5.2 Limitations of the Study

Following are some of the limitations that can be found in this research.

- 1) The some of the business places situated in the selected sample area are not direct customer oriented but are warehouses and industries. Therefore response results in customer related questions may not be unbiased and reflect the real picture.
- 2) Some efforts had to be made to obtain the survey questionnaire forms back from the residents as some of they were not interested to fill it. Though the residents were made aware about the research study prior handing over the questionnaire forms we understood that some of them were taken it lightly and reluctant to fill

it. After several reminders were done we managed to take back the filled forms. Therefore some of the responses of the residential survey might not reflect the true picture in their side.

- 3) The interviews were conducted not only within the sample area selected for the business and residential survey but went beyond that. But the researcher was unable to meet the all categories of the people i.e.; in various disciplines, in all businesses, in low level, in high level and so forth. Therefore the views and ideas of the interviews presented in the thesis could have been differed to some extent if the sample could be able to select representing all categories.

5.3 Recommendations for Future Study and Research

Followings are the recommendationsto expand objective of this research further.

- 1) To conduct a research to find and compare total cost (including the presented social costs) of both open-cut and trenchless technologies. For this purpose the presented social costs in this research are to be quantified by obtaining more data. However trenchless technology cannot be applied in every road in a project as small lanes and by-roads having many bends. The trenchless technology needs some bigger pits in intervals to insert the pipe jacking machine.
- 2) Study to identify better “grievance management mechanism” to deal with the public inconveniences and social cost mitigationfor future sewerage construction projects.
- 3) Find and adopt thesuitable estimating techniques to calculate and quantify the presented social costs related to sewerage pipe line construction so that it could be included to project cost.Find and adopt the suitable estimating techniques to calculate and

- 4) Study where are the lapses why the project parties are not totally implement the recommendations identified in the Environmental Assessment Reports (EIA) compiled by the projects which acts as a legal document of the project and regulates by the Central Environmental Authority (CEA) of Sri Lanka. In that context investigate how the project parties totally not abide by it and do the little at site. It is worthwhile studying it as the social effects and mitigation measures are provided in the EIA.

- 5) This study could be performed together sewerage construction projects by involving a larger sample size in order to obtain more accurate results and enhanced understanding of the general public's opinion on the social costs and their impacts of sewerage construction activities.

LIST OF REFERENCES

- Allouche, E.N., Gilchrist, A. (2004). "Quantification of Social Costs Associated with Construction Projects: State-of-the-Art Review." *Tunneling and Underground Space Technology*, 20, 89-104.
- Centre for Good Governance(2006). *A Comprehensive Guide: for Social Impact Assessment*, A book of digital document library, [https:// www.scribd.com](https://www.scribd.com)
- Ferguson, A. (2012). "Quantitative Evaluation of Transportation Construction Related Social Costs and their Impacts on the Local Community", the thesis, in partial fulfillments of the requirements for the degree of Master of Science in Civil Engineering, presented to University of Texas at Arlington, TX,.
- Kamat, S.M. (2011). "Comparison of Dust Generation from Open-Cut and Trenchless Technology Methods for Utility Construction", the thesis,in partial fulfillments of the requirements for the degree of Master of Science in Civil Engineering,presented to University of Texas at Arlington.
- Najafi, M., Gokhale, S.(2005). "Social Costs of Utility Construction: A Life Cycle Cost Approach." *Trenchless Technology: Pipeline and Utility Design, Construction, and Renewal*, McGraw-Hill, New York.
- Nandalal H.K. (2007). *International Conference on Small Hydropower - Hydro Sri Lanka, Importance of Public Participation in Project Implementation: Upper Kotmale Hydropower Project in SriLanka*, Department of Civil Engineering, University of Peradeniya, Sri Lanka.
- National Water Supply and Drainage Board (2014). "Public Investment Programme on Sewerage Projects, 2015-2020"
- Rodolfo Valdes-Vasquez (2011).*Social Sustainability Considerations During Planning and Design: A Framework of Processes For Construction Projects; A Dissertation Presented to the Graduate School of Clemson University, for the Degree Doctor of Philosophy Civil Engineering*.Tiger Prints publication.

Sauer, G. (1998). Urban Tunneling Consequences, World Tunneling, The Mining Journal Ltd., London, UK.

Sweco International, Sweden (2013). Project Consultant's Project Completion Report of Wastewater Disposal Systems for Ratmalana/Moratuwa&Ja-Ela/ Ekala Areas, issued for National Water Supply and Drainage Board, Sri Lanka.

Tanwani, R. (2011). Technical Paper on Tracking and Steering Systems in Trenchless Construction, published in Journal of Construction Engineering and Management, Volume 324- March 2011.

Tolga Celika, Cenk Budayanb (2016). How The Residents Are Affected from Construction Operations Conducted in Residential Areas: World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium WMCAUS 2016, Turkey, Published by Elsevier Ltd.

William G.Zikmund, Barry J.Babin, Jon C. Carr, atanu Adhikari, Mitch Griffin (2013). "Business Research Methods", 8e, a south Asian Perspective, A publication of Cengage Learning, India.

ANNEXURE - A

BUSINESS AND RESIDENTIAL SURVEY QUESTIONNAIRES

“Evaluation of Sewerage Pipe-Laying Related Social Impacts to local and Business Community”

Survey in Business Places

This survey will assist in the study of “Sewerage Pipe-Laying Related Social Impacts” for a Thesis at the University of Moratuwa, Katubedda. The purpose of this survey is to obtain the data and social attitudes for better understanding the negative impacts Sewerage Pipe-Laying have on the surrounding community. The area has been selected in “**New Air Port Road**” and in which the major pipe laying work of the “Project for Wastewater Disposal Systems for Ratmalana/Moratuwa and Ja-Ela/Ekala Areas” is carried out.

Thank you for your corporation.

Business Place/Address :

Respondent's Name :

Respondent's Title :

Q - 1 : Before construction began, how many minutes did you travel to office/work from Galle road/or from Borupona Road ?

0-10 minutes 10-15 minutes 15-20 minutes Minutes

Q - 2 : If your travel time to work has increased because of construction, how many extra minutes do you spend?

0-5 mins 6-10 mins 11-15 mins 16-20 mins

Q - 3 : How is your work productivity affected when you get to work after passing the sites?

Negatively Not affected Positively

- Q - 4 : Were you pre-informed by the project staff about this pipe laying project in order to plan your activities ahead?
 Yes, via written communication
 Yes, via verbal communication
 No, we were not informed
- Q - 5 : If yes, did the contractor express/or done any methods/ or remedies to reduce the inconveniences due to construction for your business ? Yes
 No
 What were they : _____
- Q - 6 : Has any of your property damaged due to vibration/trenching of pipe laying work?
 Yes No
- Q - 7 : If yes, what was the damage and approximate cost ?
 Less than Between Rs.10,000 Between Rs. More than Rs.
 Rs.10,000 to 50,000 50,000 to 100,000 100,000
- Q - 8 : Have your business activities/sales reduced since this pipe laying project ?
 Yes No
- Q - 9 : If yes, by what percentage do you think your business/sales have decreased ?
 Less than 10% Between 10% to Between 20% to More than 30%
 20% 30%
- Q - 10 : Is there any type of compensation by the project for business loss ?
 Yes No
- Q - 11 : Do you think your customers may **temporarily** go elsewhere because of the pipe laying ?
 Yes No May be
- Q - 12 : If yes, by what percentage do you think your customer will go elsewhere ?
 Less than 5% Between 5% to 10% Between 10% More than 25%
 to 25%

Q - 13 : Throughout the construction process has it been difficult to maintain employees ? If so, approximately how many do you lose per month ?

1-3 employees

4-6 employees

7-9 employees

I have maintained all of my employees

Q - 14 : Has productivity among employees decreased since the start of construction ?

Yes

No

Q - 15 : Do you think business will increase with the completion of this construction project ?

Yes

No

Q - 16 : Rank the following with regards to your business from 1-6, 6 being completely satisfied and 1 being completely dissatisfied.

	Dissatisfied					Satisfied
Property protection by the contractor	1	2	3	4	5	
Customer/Employee vehicle Parking	1	2	3	4	5	
Noise Control	1	2	3	4	5	
Traffic Signs	1	2	3	4	5	
Evenness of temporary road surface	1	2	3	4	5	
Dirt/Dust Pollution control	1	2	3	4	5	

Additional Comments

“Evaluation of Sewerage Pipe-Laying Related Social Impacts to local and Business Community”

Residential Survey

This survey will assist in the study of “Sewerage Pipe-Laying Related Social Impacts” for a Thesis at the University of Moratuwa, Katubedda. The purpose of this survey is to obtain the data and social attitudes for better understanding the negative impacts Sewerage Pipe-Laying has on the surrounding community. The area has been selected in “**New Air Port Road**” and in which the major pipe laying work of the “Project for Wastewater Disposal Systems for Ratmalana/Moratuwa and Ja-Ela/Ekala Areas” is carried out.

Thank you for your input.

NAME OF RESPONDANT: _____

ADDRESS _____ :

Q - 1 : Approximately, how many kilo-metres is your residence from Galle Road?

0.5-1 km 1-1.5 km 1.5-2 km More than 2 km

Q - 2 : How many times do you travel on New Air Port Road to Galle Road?

01- 02-time/day More than 02- times/day -times/week
time/day

Q - 3 : What is the mode of your transport to travel to Galle Road?

By vehicle By Motor Bike By Push Bike Walking

Q - 3 : Before pipe laying began, how many **minutes** did you take to travel to Galle Road?

0-10 minutes 10-15 minutes 15-20 minutes Minutes

Q - 8 : Rank the following with regards to your personal opinion of pipe laying from 1-5 below. (Marking “5” is being you strongly agree whereas“1” being you strongly disagree).

Strongly Disagree

Strongly Agree

Event	1	2	3	4	5
Pipe laying work negatively affects my mood					
Weather Project staff made aware you about the work					
I tend to take a different route to avoid pipe laying					
Is Dirt/dust pollution control is done					
Safety Signs, Traffic Diversions are well marked					
I am more stressed when I pass the site to my destination					
I go to use same New Air Port road even though it disturbs my way					
I feel road users safety has been considered by the Project					
The sites are illuminated satisfactorily during night					
I experienced vibration during the pipe laying work in the project and was a nuisance					
Noise pollution has increased with this pipe laying project and is a nuisance					
My property was effected due to activities of the project					
I feel that this construction is necessary					
I feel that the inconveniences I am dealing with now will be worth it after construction is complete					

Additional comments concerning construction **inconveniences**:.....

ANNEXURE - B

LOG OF SURVEYED BUSINESS PREMISES

LOG OF SURVEYED BUSINESS PLACES

ITEM NO.	NAME	BUSINESS
1	Convenience Food Pvt Ltd	SoyaMeet Production
2	Mas Holding Pvt Ltd (No 131)	Garment
3	Mas Holding Pvt Ltd (No 144)	Office
4	Planty Food	Ware House & office
5	Convenience Food Pvt Ltd (ware house)	Ware House
6	Ideal Motors Pvt Ltd / Car Mart	Garage & Service Center
7	Goodwill Restaurant	Restaurant
8	Sitara Limited	Office
9	BOC Bank	Bank
10	Boutique	Sweep Ticket Seller
11	Kumara Trade Centre	Retail Shop
12	Sathis Trade Centre	Retail Shop
13	Bathiya Trading Lanka	Printing Shop
14	HSBC Bank	Bank
15	Univotec Institute	Education
16	Government Textile Institute	Textile
17	Pack Well Lanka Pvt Ltd	Stores
18	Kamson Trading Company	Office & Stores
19	Alloy Fabrication	Steel
20	Pharmaceuticals Corporation	Pharmaceuticals

ANNEXURE - C

LOG OF RESPONDANTS INTERVIEWED

LOG OF RESPONDENTS INTERVIEWED

Respondent ID.	Respondent's Name	Category	Location/Institution
1	Mr. Manjula	Three Wheel Driver	New Airport Road
2	Mr. Sarath	Vehicle Owner	New Airport Road
3	Mr. WimalNoris	Traveler	New Airport Road
4	Dr. Woo	Construction's Project Manager	China Geo-Engineering Corporation
5	Mr. Jayawardane	Manager	Elephant Masconite Company
6	Mrs. K.G.K. Dissanayake	Resident	Kandawala Road
7	Mr. H. Chandana Silva	Resident	Abaya Mawatha
8	Mr. M.G. Perera	House Owner	New Airport Road
9	Mrs. Ranjani	Resident	Katururunduwatta Road
10	Mr. Cooray	Resident	Thelawala Road
11	Mr. Seneviratne	Marketer	Belekkade Junction
12	Mr. Siripala	King Coconut Seller	Attidiya Road
13	Mr. Kumudu	Manager	MAS Holdings (Pvt) Ltd.
14	Mr. Milroy Fernando	Resident	Thelawala Road
15	Mr. Gunasekara	Father	New Airport Road
16	Mr. Dahanayake	Resident	Miraj Housing Scheme
17	Mrs. P. Weerasekara	Lawyer	Abaya Mawatha

ANNEXURE - D

SUMMARY OF RESPONSE OF BUSINESS SURVEY

