

**A FRAMEWORK TO MINIMISE PUBLIC NUISANCE
RELATED ISSUES OF URBAN CONSTRUCTION
PROJECTS IN SRI LANKA**

Saman Indrajith Mahawatta

189551J

Degree of Master of Science in Construction Law and
Dispute Resolution

Department of Building Economics

University of Moratuwa
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June 2022

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).



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.....

S.I. Mahawatta

Date

The above candidate has carried out research for the Masters dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

.....

.....

Prof. Y.G. Sandanayake

Date

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Saman Indrajith Mahawatta

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ABSTRACT

The construction industry is one of the major economic drivers of any country. Comparing to rural areas many construction projects are happened in urban areas. Urban construction projects usually have high risk processes with several constraints. Public nuisance is an aspect that is linked with urban construction projects due to its operations in congested environment. Although there are some researches have been carried out over public nuisance related issues of urban construction projects for the global context, there is a lack of an investigation about public nuisance related issues, and the causes behind them in urban construction projects of Sri Lanka. Hence, there is a need to investigate public nuisance related issues, their causes, mechanisms to minimize them in urban construction projects and legal provisions available in Sri Lanka. Therefore, this research aimed to develop a framework to minimise public nuisance related issues in urban construction projects in Sri Lanka.

The research followed a qualitative research approach with a case study method selecting three similar urban construction projects in Colombo metropolitan area. Semi structured interviews were conducted in collecting data from each selected case study along with observations and document review. Then the collected data were analysed through content analysis. As it was found from literature there are seven types of public nuisance related issues namely, noise & vibration, dust & smoke, mosquito breeding, odour effect, traffic impact, waste and water & air pollution. These issues were found in selected cases for the study and operation of concrete pumping machines, generators and drilling and grinding works, wall chasing, sanding putty for painting, and demolitions, incomplete concrete tanks, flower buckets, pool area and disposed water containable items, food waste and toilets, entering of heavy vehicles to the site, disposal of chemicals and polluted water were the causes for above mentioned nuisance issues. Court injunctions due to the noise & vibration and dust & smoke issues, additional cost due to mitigation works and delays in certain actions can be pointed out as the impacts of the issues of mosquito breeding, odour effect, traffic impact, waste and water & air pollution. Furthermore, through proper planning and executing, the impact of public nuisance in urban construction projects can be minimised. Moreover, conducting noise generating activities at night, using sound barriers, destroying mosquito breeding places, treating water stagnated areas, removing food and construction waste to the approved yards appropriately, educate workers to minimize water and air pollution, using filtration system before discharging water in to water resources were the strategies taken to minimise the issues due to public nuisance. In Sri Lanka, there are several legal provisions related to the public nuisance issues. Moreover, Nuisances Ordinance, National Environmental Act, Code of Criminal Procedure Act, Penal Code, Municipal Council Ordinance, Urban Councils Ordinance, and Pradeshiya Sabha Act are the commonly used public nuisance related legal provisions in Sri Lanka. Eventually, a framework was developed to minimise the Public Nuisance of urban construction projects by integrating the types of Public Nuisance, the causes for them, their impact to the construction projects and Nuisance Acts and Ordinances available in Sri Lanka.

Keywords: Construction Industry; Legal Provisions; Public Nuisance; Sri Lanka; Urban Construction Projects.

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LIST OF ABBREVIATIONS

BOD	Biochemical Oxygen Demand
CEA	Central Environmental Authority
CMC	Colombo Municipal Council
dB	Decibel
EAG	Environmental Authority Guidance
MBD	Mosquito-borne Diseases
PHI	Public Health Inspector
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION TO RESEARCH

1.1 Research Background

Construction is a complex, wide, dynamic and multifaceted industry that generally accommodates comprehensive processes for constructing structures and involvements of engineering projects (Behm, 2008). Further to the author, it also includes processes for refurbishments, renovation, additions, alterations or any maintenance and repairing of existing buildings and structures. Further, construction project plays a vital role in the growth of the national economy (Lewis, 2004; Ramachandra & Rameezdeen, 2006; Osei, 2013). The built environments that comprise buildings and structures create living spaces for human beings and offer a community for social and welfare benefits (Ofori, 2004; Sarkis et al., 2009). For example, housing will be accomplished to meet the demand of the high necessity of mankind elements by offering the shelters (George, 2002; Ijigah et al., 2013). The development of cities makes a considerable contribution to social and economic advancement at the national and local level while creating new jobs, houses and services for the community (Abeynayake, 2019).

Furthermore, the construction industry underpins to feed better quality of human life as it generally creates the built environments by providing tangible facilities with necessary infrastructures to fulfil the needs of people (Bartuska, 2007; Osei, 2013; Myers, 2013). Even though the construction projects completion as to serve the country's economy and the people's lifestyle, the construction process will directly influence the community's wellbeing while creating countless adverse effects for people and the environment (Sev, 2009; Abidin, 2010; Balaban, 2012; Matthews et al., 2015).

Especially, due to the high density of populations in urban areas, implementation of construction activities generally turns out to be a serious nuisance to adjacent people, residents and businesses community (Pucker et al., 2006; Gangoellis et al., 2009; Ferguson, 2012; Apeldoorn 2013). According to Çelik et al., (2017), the level of

construction causative nuisance incurred on to the surrounding community is highly dependent on the location of the projects. Gannoruwa and Ruwanpura (2007) stated that the noise produced and its effect during construction varies based on the location of the operations, the kind and condition of the machinery used, the condition of the local environment, and recognition of health and environmental policies lead to nuisance. Further to the authors, it creates negative effects to the densely populated areas in the construction projects compared to the lower populated areas. Although contractors place signboards indicating, “apologize for the inconvenience caused,” it will not help to eliminate nuisance (Yu & Lo, 2005; Najafi & Gokhale, 2005; Matthews et al., 2015). It also creates adverse impacts from the operation of construction sites in terms of traffic problems, pollution and impact on economic activities, while damaging the naturally built environment (Xueqing et al., 2008; Apeldoorn, 2013). These authors have been attempting to quantify the construction causation on “nuisance.” Gannoruwa and Ruwanpura (2007) state that the projects may have implemented much more different technologies in the planning process; even then, many projects have indeed been incurred with enormous expenses for nuisance management. The authors have further indicated the importance of controlling nuisance in urban areas throughout the construction project and the optimization of barriers are extremely significant in terms of project successes.

When considering legal aspects, law related to nuisance could have differed. There are instances where the Courts have moved from the principles given in the case law, *Donoghue v. Stevenson* (1932) as to prevent harmful occurrences to the neighbours (Gearty, 1989). According to Gearty (1989, p.242), “with its independence assured, and freed from negligence's debilitating concern with the yardstick of the reasonable defendant, there is no reason why nuisance should not thrive once again.” According to Bishop and Jenkins (2011), the legal influence of the land-use for the developments activities has given conflict context of the private property rights in the legal aspect of the law of nuisance. Bishop and Jenkins (2011) further stated that for transparency purposes and formal decision-making, the local planning authority's judgment related to the correct land use should be referred to a court's decision. Further to the authors, disputes regarding reasonable usage of the land will be escalated to the court

proceedings by providing a legal forum to dealing with individuals. They further pointed out when considering the development of construction projects, the action in private nuisance will continue to be possible in many cases of development, notwithstanding the grant of planning permission. Celik and Budayan (2016) describe any legal actions by the affected parties against the construction project and governmental agencies, which will turn into the delay in project completion, cost overruns and many more monetary losses. Therefore, the nuisance needs to be managed to prevent its adverse impacts on construction projects to prevent conflicts between neighbours and the project team (Celik and Budayan, 2016).

1.2 Problem Statement

Nuisance is a common feature in many urban developments, which has a serious threat to human life (Mix & Shriver, 2007; Baldwin et al., 2009; White, 2010; Wang & Tam, 2014). It will not be harmful only for the surrounding human population, but the environment as well (Sofer et al., 2012). Given its temporary existence, the construction of high-rise buildings can lead to local neighbourhoods being subjected to the unacceptable noise level in terms of a nuisance for many years. Furthermore, building renovations and improvements may in some cases follow one another, rendering the noise a daily nuisance (Gannoruwa & Ruwanpura, 2007). As indicated by Sofer et al. (2012), where these construction sites are not effectively managed, their local environment can be adversely affected. Further to the authors, numerous problems have been negatively impacted for the surrounding community when executing urban constructions. According to Gearty (1989); Sevinsky (1990); Szulczyński et al. (2017) the noise, polluting air, odours, garbage, light pollution and vibrations caused by the construction projects may result in disruptions that are viewed as actionable harm or civil wrongs. They further pointed out that in which case, the neighbouring owners may proceed with civil actions, either for seeking damages or for injunctions to prohibit the continuity of the construction nuisance, which can be harmful occurrences to the neighbours.

According to Abeynayake (2019), the Nuisance Ordinance No. 15 of 1892, Municipal Council Ordinance, Urban Council Ordinance and Pradeshiya Sabha Acts provide

nuisance prevention provisions and protection of the concept of sustainability in Sri Lanka. According to Zubair (2001), Salient features of the environmental impact assessment process in Sri Lanka have been proven, as has the necessity of alternate proposals and the use of a predetermined list to classify projects that must be reviewed. Further to Zubair (2001), it is important to address the shortcomings including integrated government policies, environmental data and effluent standards, a code of conduct for project-approving authorities, monitor, and enforce environmental regulations as necessary. Athapaththu and Karunasena (2018) stated that one of the biggest challenges in construction operations is mitigating the impacts of construction waste, which creates environmental and socio-economic problems. Moreover, new forms of emissions made place due to rapid industrialization (Zubair, 2001). According to Gannoruwa and Ruwanpura (2007), the importance of noise management in urban areas during construction is extremely significant in terms of nuisance and project cost. They further stated that alterations or repairs might often follow one after another while creating disruption to the high-rise building structure of nearby residents and rendering the noise a frequent nuisance.

Although there are several researchers carried out on the public nuisance related issues in global construction projects, there is a lack of an investigation into public nuisance related issues and the causes behind them in urban construction projects in Sri Lanka. Therefore, it is necessary to investigate the public nuisance related issues and mechanisms to minimize the issues in urban construction projects in Sri Lanka.

1.3 Aim and Objectives

This research aims to develop a framework for minimizing public nuisance related issues in urban construction projects in Sri Lanka.

The objectives of the study are set as follows;

1. Review issues related to public nuisance in construction projects and legal provisions available to minimize those issues.

2. Investigate public nuisance issues and the causes behind the issues in urban construction projects in Sri Lanka.
3. Determine the impact of the public nuisance in urban construction projects and commonly used legal provisions in Sri Lanka.
4. Propose strategies to minimize the impact of public nuisance related issues in urban construction projects in Sri Lanka.

1.4 Methodology

A comprehensive literature review was carried out by referring to journal papers, conference articles, books, thesis, acts and ordinances, case laws, institutional reports and official websites. The study then applied a qualitative research approach under which, 03 case studies were carried out to support in-depth study and to gain a better understanding of the situation. The public nuisance related issues, causes, impacts and mitigation measures in the selected urban construction projects were identified mainly by conducting semi-structured interviews with the project team members, site observations and document reviews. Content analysis was used for the data analysis in this research. Finally, the research findings were integrated into a framework to minimize public nuisance related issues in urban construction projects in Sri Lanka.

1.5 Scope and Limitations

This study covers the public nuisance related issues in urban construction projects in Sri Lanka. The scope is further limited to nuisances occurred during the construction phase of an urban construction project. Data collection was limited to 03 urban high-rise building construction projects within Western Province in Sri Lanka. These highly residential areas have been significantly impacted by the urban constructions project.

1.6 Chapter Breakdown

This dissertation consists of five chapters as shown in Figure 1.1.

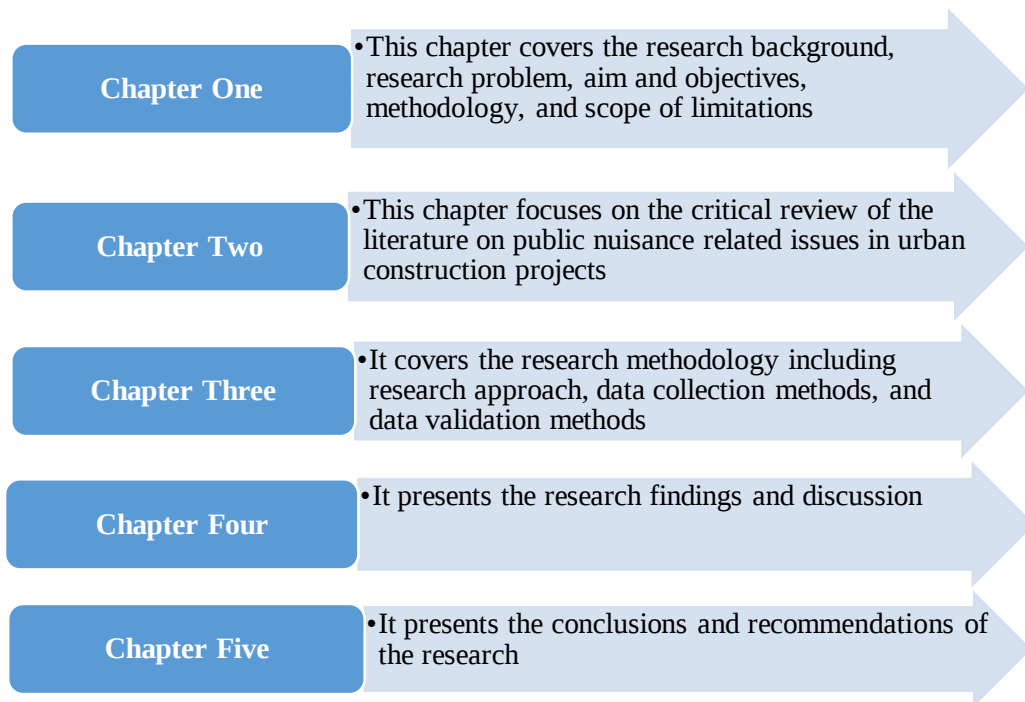


Figure 1.1 Chapter Breakdown

1.7 Chapter Summary

Construction projects in urban areas have been faced severe challenges in adhering to social and legal requirements while proceeding with construction activities. Therefore, a framework for minimizing the issues related to public nuisances of urban construction projects in Sri Lanka are highly essential to maintain the progress and avoid the budgetary creeps of the projects. Giving acknowledgements to the industrialization, urbanization and the exponential increase in the number of construction projects result from multiple conflicts among the parties. Nevertheless, by closely studying its legal consequences, greater planning awareness and improved construction standards can help to mitigate potential nuisance problems.

This chapter presented the background study, problem statement, and the aim and objectives of the study. Moreover, the research methodology, which was used to accomplish the aim and objectives of the research, is briefly described in the chapter. Finally, the scope and limitations of the research and chapter breakdown are developed to provide the direction for the dissertation.

2.0 LITERATURE REVIEW

2.1 Introduction

The development of industrial activities in the urban areas has caused severe issues not only harmful for the surrounding population but also the environment as well (Sofer et al., 2012). This situation has become more crucial since the adaptation of strategies to ensure the nuisance control-related legal actions at the initial stage have not been practical (Medlock & Vaux, 2014). It shows a tension situation where both private rights and public interest need to balance appropriately as to successful proceeding with the development activities (Bishop & Jenkins 2011). The authors further insist that the planning regime has to play a vital role as to balance legal constraints from the neighbour's and developer perspectives since Courts are always not the best suitable forum for finding solutions. It has further been supported by Celik and Budayan (2016) that the nuisance needs to be managed effectively to prevent the adverse impacts of construction projects since any legal actions by the affected parties will turn into delays and monetary losses for the developments. Hence, this chapter provides a comprehensive literature review on public nuisance related issues in urban construction projects. Further, it reviews the causes behind the public nuisance related issues and appropriate strategies to mitigate the disruptions.

2.2 Introduction to Nuisance

Nuisance is an “annoyance” in Law and it is concerned with maintaining the health and safety of individuals as well as the public in general (Nanayakkara, 2009). It could be any troublesome, inexcusable, unjustified and illegal use of property, which disrupt or harm to others, either to the individual or to the general public (Law Corner, 2020). Further to this source, nuisance can comprise any harmful smells, loud noise, burning, the distraction of water onto other property, and collection of bothersome activities. The nuisance law has been traditionally used by the courts to balance competing interests of landowners (Gevurtz, 1977). Generally, nuisance in law can be categorised

under public and private nuisance. According to Nanayakkara (2009), a public nuisance can affect the public at large who may come within the sphere of its influence, while the impact of a private nuisance is more limited. Hence, public nuisance concerns on protecting the public, whereas private nuisance protects individuals. Accordingly, public nuisance is not only a tort but also a crime. The next sub sections briefly explain the private and public nuisances.

2.2.1 Private Nuisance

Private nuisance is any illegal act of omission causing injury or danger to any individual or his/her property (Law Corner, 2020). The article further defined public nuisance as an unlawful interference with another's use and enjoyment of property or someone's right over or in connection with property. It falls within the definition of a cause of action under Section 5 of the Civil Procedure Code No. 2 of 1889 (as amended), being both a neglect to perform a duty (of not causing harm to others), and the infliction of an affirmative injury. In Sri Lanka, private nuisances are actionable before the District Court and may give rise to both temporary and permanent injunctions (Nanayakkara, 2009). Moreover, under the private nuisance, one can claim for personal injuries as well as damage to property.

2.2.2 Public Nuisance

Parpworth (2001; as cited in Abeynayake, 2019) stated that the public nuisance is generally a criminal violation under common law arising from an act or public officials, such as the Attorney General or local authorities, typically enforce omission that endangers the general public's life, health or comfort, and this. Public nuisance could lead to environmental problems that touched upon private rights (Abeynayake, 2019). According to Alan (2013), public nuisance is a violation of the right to use and enjoy the real property and actual land invasions are trespasses, so a disturbance may be considered a non-respiratory intrusion with real property use. Further, Sevinsky, (1990) identified public nuisance as a situation that interferes with a substantial public right. Further to the author, it describes the effect of conduct rather than the acts that give rise to the creation or maintenance of the nuisance. According to Gearty (1989),

the strategic surrenders will enable nuisance when turning into the undivided attention as to proceed to find out what it does best in protecting the neighbours against nonphysical damages or interferences for the enjoyment of their lands. The public nuisance will create unconscionable interferences for the public in several manners such as safety issues, natural peace, health, and comfort or many other inconveniences as according to case law held “State vs Lead Industry Associations [2001]”. According to the Indian Penal Code, public nuisance is defined as the injury, apprehension, annoyance caused to the people living at large in a certain locality and affecting their freedom of using any public right (Central Government Act, 2018). Moreover, public nuisance affects the health, safety and comfort of the public when enjoying the public properties (Law Corner, 2020).

In Sri Lanka, public nuisance is defined under Nuisance Ordinance No. 57 of 1946. This Ordinance provides guidance for the preservation of public health and the suppression of nuisances (Nuisances Ordinance, 1946). Moreover, Chapter IX of the Code of Criminal Procedure Act 15 of 1979 (as amended) titled ‘Public Nuisances’ empowers a Magistrate to make orders for the removal or abatement of a public nuisance which falls under below categories:

- Any unlawful obstruction or nuisance in any public way, harbour, lake, river or channel.
- Any trade or occupation or the keeping of any goods or merchandise that is injurious to the health or physical comfort of the community.
- The construction of any building or the disposal of any substance that is likely to cause conflagration or explosion.
- Any building or tree which is in a condition that it is likely to fall and injure passers nearby.
- Any tank, well or excavation adjacent to any public way or place which may be a danger to the public.

Christy Vs Davy (1892 I ch. 316) held that almost anything may become a nuisance. It was held that a nuisance is difficult to define whether it is a public or private nuisance. Even the most charming and rapturous music become a public nuisance, if it

is incessant and leads to the annoyance of neighbours or at least five families in the society. According to the above case law, if any nuisance is applicable to five or more than five families, it can be considered as a public nuisance. It may be noted that the number of families is not specified either in the Penal Code 9 - Section 261 or any other legislation (Section 98 of Criminal Procedure Code - or provisions of Nuisances Ordinance).

The above Acts and Ordinances cater to minimize both public and private nuisances affected to both public and individuals, respectively. However, this research is focusing on the impact of the public nuisance, where the impact is affecting the people at large in the locality of the urban projects.

2.3 Public Nuisance in Construction Operations

Environmental sustainability can be incorporated into a modern growth plan, which would be an alternative to the existing trend of industrialization (Cha, 1976). Vafai et al. (2020) stated that the protection and restoring permeable surfaces in an urban environment is one of the important ecological factors in sustainability. Athapaththu and Karunasena (2018) stated that one of the major challenges of the construction operations is to play an important role in reducing the environmental and local impacts. Suter (2002) showed that the varying and intermittent noise environments are typical in the construction industry unlike in the manufacturing industry, in which the noise is relatively continuous.

In congested urban areas, an increasing number of construction projects such as highway expansion and reconstruction, urban renewal programs, office and residential renovations, and utility buildings are taking place, which produces several nuisance outlets for the local population (Gilchrist et al., 2003). According to Gilchrist and Allouche (2005), the construction industry plays a vital role in fulfilling human needs, so it is not possible to ignore the construction activities, which are proceeding within the community. Further to the author, many of these activities should be carried out in metropolitan areas, so that these activities cannot be removed from urban centres. Celik and Budayan (2016) stated that construction operations are known as one of the main

causes of disturbance in urban areas. Teo (2013; as cited in Celik and Budayan, 2016) has shown that one of the project teams' deceptive behaviours is the tendency to disregard the adverse effects of construction projects on external parties during the management process, as external stakeholders experiencing these adverse effects can build resistance to construction projects. Mir and Feitelson (2004; as cited in Sofer et al., 2012) argue that the design of the construction activities and the complexities of implementing environmental regulations, with some degree of negligence and minimal knowledge, would generate sources of environmental nuisance (noise, air, water and soil contamination and heat emissions) that affect the local communities and reduce their quality of life. Baldwin et al. (2009) observe that construction activities always produce numerous wastes and are comparatively high related to other industries, which affect several environmental prolusions.

2.4 Different Types of Public Nuisance exists in Construction Projects

Celik and Budayan (2016) mentioned that any legal actions by the affected parties against the construction project and governmental agencies would turn into delays in project completion, cost overruns and many more monitory losses. In addition, neighbourhood members are also known to supplement the viewpoints of contractors, to get a holistic analysis from both perspectives (Brannen, 2005). Contractors are working in a congested urban environment that has been influenced by numerous external stakeholders. It is required to identify core issues and approaches to alleviate these concerns (Spillane et al., 2013). Upon adoption of the results, on-site management, professionals are operating in a high-density environment, which expected to proactively manage one of their most important external communities. He further elaborated contractors are not proactively defined the approaches to be followed while implementing contingency plans to minimize or eliminate the event of issues (Gilchrist et al., 2002). All neighbourhoods have the ability to be impacted by urban growth in both positive and negative ways, where most urban developers and residents can usually relate to this particular issue. Because of the design of construction work in such a congested area, noise pollution, high dust rates and traffic congestion are likely to affect the surrounding community (Islington Council, 2006).

Knop (1999; as cited Wilke et al., 2019) stated that the construction sites are part of the process of urbanization. Construction sites also cause significant environmental disruption, alter land use, increase human presence and produce significant quantities of waste, which have a major impact on local flora and fauna. Gannoruwa and Ruwanpura (2007) stated that over the years, greater numbers of building projects in urbanized areas produce persistent contamination of the air and annoying noise for the local population. Air contamination, floods and groundwater depletion are secondary effects due to a lack of commitment to safeguarding the permeable urban surfaces which creating while blockage of wind channels (Vafai et al. 2020).

According to the Islington Council (2005; as cited in Spillane et al, 2013) due to the existence of construction work in the congested area, noise emissions, high levels of dust and traffic congestion are likely to affect the local community. The constant nature of keep adding construction sites to an urban environment will prove high disruption to the local community and contractors have to handle the degree of disruption caused by their presence effectively (Spillane et al., 2013). Gilchrist et al. (2003) identified that significant construction-related annoyances include noise, vibrations, glare, dust and greenhouse gas emissions. Further to the author, methodologies for addressing such concerns are vital criteria for serving the public, engaging business professionally and fulfilling the applicable contract and by-law specifications.

A summary of the literature that discussed different types of public nuisance that exist in construction projects is given in Table 2.1.

Table 2.1: Review on different types of public nuisance exist in construction projects

No	Author	Noise & vibration	Odour effects	Dust & smoke	Waste	Mosquito breeding	Water & air pollution	Traffic impacts
1	Adeoye (2016)	X						
2	Baldwin, et al. (2009)				X			
3	Berglund and Lindvall (1995)	X						
4	BRE (2003)			X				

No	Author	Noise & vibration	Odour effects	Dust & smoke	Waste	Mosquito breeding	Water & air pollution	Traffic impacts
5	Butler (2009)	X						
6	Celik, et al. (2017)	X		X			X	X
7	Fyhri and Aasvang (2010)	X						
8	Gannoruwa and Ruwanpura (2007)	X						
9	Gilchrist, et al. (2003)	X	X	X				
10	Giyasov and Giyasova (2018)						X	
11	Kim and Kim (2010)							X
12	Kwon, et al. (2018)	X						
13	Medlock and Vaux (2014)					X		
14	Ministry of Defence (2010)			X				
15	Pam and Garba (2019)	X						
16	Rosa and Kenneth (2013)	X						
17	Schexnayder (1999)	X						
18	Sofer, et al. (2012)	X					X	
19	Spillane, et al. (2013)	X		X				X
20	Suter (2002)	X						
21	Szulczyński (2017)		X					
22	Tsai, et al. (2009)	X						
23	Vafai et al. (2020)						X	
24	Wang, et al. (2014)				X			
25	White (2010)				X			
26	Wilke et al. (2019)						X	
27	Wilke, et al. (2019)					X		
28	Woskie, et al. (2002)						X	

The above-identified different types of public nuisances are discussed in detail below.

2.4.1 Noise and vibration

Building work brings uncertainty with it and the level of multiple noises created is the very much common form in nuisance where it is created by the construction activities

(Ng, 2000). A wide range of sources like cranes, motors, portable machinery and large machinery can create noise. A neighbouring community would be prepared to deal with these nuisances across the construction process and, when they are unaware or consulted about the noise that occurs, they tend to dispute the matter more (Ministry of Defence, 2010). Moreover, disruptive vibration can often be felt throughout the construction site during drilling, pile driving, compacting, blasting and operation of heavy construction machinery that can destroy adjacent building site structures (Read and Vickridge, 2003, as cited in Çelik et al., 2017). Further to the author, in the high frequency of vibration, due to lack of safety psychology, psychological distress can be triggered; even low-frequency vibrations could have a psychological impact on society.

Any urban site's surrounding community faces conflicts, delays in traffic and noise pollution (Gilchrist, 2002). Hence, Adeoye (2016), states that noise and pollution control are essential requirements to carry out a project in a successful manner. More critically, when the noise becomes extremely high and uncontrollable, it degrades the air quality and adversely affects the surrounding environment, public health and human welfare (Pam & Garba, 2019). Gannoruwa and Ruwanpura (2007) mentioned that noise levels are calculated in decibels and the decibels are calculated on a scale identical to the Richter earthquake magnitude scale. Noise above the tolerable level will file charges that could result in project complications, such as undue expenditure due to delays, cost overruns and reimbursement (Kwon et al, Song, Lee, Kim, & Park 2018). The requirements for acceptable permissible levels of noise and working hours should indicate the noise sensitivity of neighbouring residents while providing guidelines for nuisance control (Schexnayder, 1999).

The negative effects of noise on people are interaction, rest and sleep disturbances and general discomfort. Such effects have a detrimental effect on well-being and perceived quality of life over long periods (Berglund & Lindvall, 1995; Fyhri & Aasvang, 2010). According to Gilchrist and Allouche (2003; as cited in Çelik et al., 2017), noise is characterized as any sound that has the potential to trigger physiological and emotional symptoms such as high blood pressure, cardiovascular disorders, anxiety, restlessness,

irritability, sleep disturbances and difficulty concentrating. Noise levels are intolerable as shown by the U.S. Department of Housing and Urban Development (Tsai et al., 2009). According to Rosa and Kenneth (2013), many social housing projects are subject to extreme noise effects at industrial or commercial buildings from numerous sources including highly trafficked highways, railways, interchanges with public transport, depots and mechanical plants. Eom and Paek (1998; as cited in Kwon et al., 2018) showed that despite the difficulties, construction noise should always be controlled as noise generated from sites. He further stated that construction noise would affect the surrounding areas, along with the inhabitants and the environment.

Gilchrist et al. (2003) stated that construction-related noise modelling and mitigation is more complicated because the different sizes, numbers, positions and functions of noise drivers are constantly changing depending on the form and stage of construction. According to their study findings, noise levels generated by selected construction equipment are listed in Figure 2.1

Equipment	Noise level (dBA)		Source ^a
	New equipment	Used equipment	
Compressor	73	76–80	3, 4
Backhoe	75–80	83–88	1, 3, 5, 6
Concrete mixer	75	85–87	3, 4–6
Concrete pump	75	82–85	1, 3, 4–6
Concrete saw	90	na	1
Concrete vibrator	75	76–80	1, 3
Crane	75	85–90	3, 5
Bulldozer	75	83–88	1–6
Dump truck	84	85–88	1, 3
Excavator	83	85–87	1–4
Grader	72–75	85–90	1, 3–6
Jackhammer	75–80	85–90	1, 3, 5, 6
Loader	80–85	92–95	2, 3
Paver	80–85	95–101	1, 3–5
Rock drill	80–85	95–98	1, 3, 5, 6
Roller	80	88–90	3, 4
Scrapers	78–83	96–98	4–6
Tractor	75	85–90	1, 5, 6
Trencher	83–88	na	4
Vibratory pile driver	95	na	1

Figure 2.1: Noise levels generated by selected construction equipment

Source: Gilchrist, Allouche and Cowan (2003)

The above Figure 2.1 demonstrates a comparison of the level of noise generated by several new and used construction equipment. According to the findings, the major noise levels are generated by used equipment. Furthermore, a higher level of noise is generated through large-scale equipment. Minimum noise level indicated for compressor with 73 dBA and maximum for vibratory pile driver with 95 dBA.

2.4.2 Odour effects

Odour is occurring in construction projects due to various circumstances such as chemical misusing, excavation and also the construction activities that create odour on the site and makes it annoying for the neighbours (Department of Health Sri Lanka, 2021). According to the Department of Health in Sri Lanka, the bad smell created from the construction environment will affect surrounding neighbours within the construction projects, which can be defined as an odour nuisance in legal terms. Szulczyński (2017) pointed out that odour has become a complex problem that contaminate air which will be resulting in environmental pollution. He further elaborated that it will create invisible and long-term effects and when identified any diseases, the potential causes cannot validate since the project may have been completed long before. Moreover, according to the health guidelines, people who are vulnerable to health issues tend to have breathing issues, dizzy and nauseous (Department of Health Sri Lanka, 2021). According to Gilchrist et al., 2003, construction activities are highly fragmented and related to complex involvements of machinery and equipment, which generates odours and the effects, will be depending on the nature of the surrounding community and the environment.

2.4.3 Dust and smoke

In relation to the high dust levels that can be created from building sites, roads and other construction projects, the buildings in surrounding communities could be discoloured. Depending on the source of exposure level, the dust created can be harmful. Dust rates can also affect visibility while driving or walking on roads adjacent to an urban area (Ministry of Defence India, 2010). In addition, buildings are generally not designed with regard to noise and dust levels, and because of this factor, the

surrounding community may suffer (BRE Publications, 2003). Woskie et al. (2005; as cited in Çelik et al., 2017) stated that high air dust concentrations could contribute to a decline in lung function, an increase in respiratory hospitalization and an increase in respiratory and cardiovascular mortality.

2.4.4 Waste

Construction, alteration, and demolition create a significant amount of waste, which has become a major environmental issue in many countries (Esin and Cosgun, 2007). Li (2001; as cited in Wang et al., 2014) showed that about 40% of the annual construction wastes have accumulated by the municipal waste in China, while Huang and Xu (2010; as cited in Wang et al., 2014) stated that over 200 million tons, 100 million tons of which are created from new building constructions. Ekanayake and Ofori (2010; as cited in Wang et al., 2014) stated that one of the best ways to reduce the environmental effect of waste is simply by reducing waste generation at the construction project.

Even construction material manufacturing will have the same impact. There is one case law decision given in the Superior Court in the Rhode Island related to the State of Rhode Island v Lead Industries Associations Inc. The case mentioned, “The trial court held that the paint manufacturers were financially liable for abatement of the lead paint in Rhode Island. On appeal, the Rhode Island Supreme Court dismissed the case holding no public right had been harmed (White, 2010). Lemaire (1999; as cited in Baldwin et al., 2009) emphasized the necessity of evaluating both environmental impact and health effects when choosing building materials that are required to evaluate their characteristics. Baldwin et al. (2009) showed continuous growth, urbanization of an old town eventually produces a significant volume of building waste from building and demolition activities, and that waste has a severe impact on human life. Kun and Hong (2003; as cited in Wang et al., 2014) discussed the building waste minimization during the design phase by optimizing the design while using innovative technology on the recycled materials to preserve environmental hazards.

2.4.5 Mosquito breeding

Wilke et al. (2019) stated that very little is understood to what degree biodiversity and proliferation of mosquito vector species are affected by environmental disturbances generated from construction sites. Medlock and Vaux (2014) mentioned that developing a mosquito management guideline is crucial to prevent possible public health hazards since the difficult nature of finding every breeding place at the sites. Medlock (2006; as cited in Medlock & Vaux, 2014) evaluated engagement with existing recording systems of nuisance species that needs to be enhanced to ensure more accurate reporting of nuisance and potential vector mosquito species.

2.4.6 Water and air pollution

According to Çelik et al., (2017), the machines used during the construction possess high performance engines, which generate harmful air emissions that cause serious damage to humans and other living organisms. The authors further stated these noxious emissions not only affect the lower atmospheric layer but also the ozone layer that absorbs damaging ultraviolet radiation from the sun. Hromov and Petrosjanc (2010; as cited in Giasov & Giasova, 2018) stated that the high-density development in some areas inhibits natural ventilation and triggers urban heat islands to develop, which impact air basin pollution. Çeliket al., (2017) stated the building projects will affect the ecological systems in the particular groundwater table, waterbodies in surface water, and recreation areas they are vulnerable to when the construction activities are processed. According to Gilchrist and Allouche (2009; as cited in Çelik et al., 2017), construction operations can disturb the surrounding structure of the water resulting in bank erosion, flooding, changes in the normal process of rivers and lakes and disruption to aquaculture. Further to the authors, these activities can have significant effects, such as the depletion of green life and the loss of agricultural water. Giasov and Giasova (2004; as cited in Vafai et al., 2020) the high-rise buildings played a vital role in creating urban heat island effects and the density of buildings exacerbates air pollution, which led to a change in the local climate. These effects can be analysed

using a system of static modelling to assess the dust and diesel emissions (Woskie et al., 2002)

2.4.7 Traffic impacts

Concerning traffic congestion, most urban environments are already facing traffic disruption. It will be further increased when on and off-site operations began to happen at the construction sites (Kim & Kim 2010). Construction sites tend to attract elevated volumes of traffic to an area due to the entry and exit of delivery vehicles in combination with congestion created by staff parking near the site (Pheng & Chaun, 2001). Further to Çelik et al. (2017), building projects in urban areas can impact traffic, thus, traffic-related social construction costs are identified not only for the highway rehabilitation projects but also in urban building projects. Although most construction activities are carried out within the limits of the site boundaries, some of the activities involve space outside the construction site, such as the movement of machinery where the entrance/existing corridors can have an intensive effect on the traffic flow (Çelik et al., 2017).

2.5 Impact of Construction Operations Related Public Nuisance to the Neighbourhood

Urban developments are visualized through construction activities within the high demand neighbourhood (United Nations, 2011). The population have been continuously moving from the rural areas to urban conurbations, which have created pressure to accommodate adequate infrastructures (Adams, 2012). A large number of ever-evolving construction projects have been placed faster than ever before to satisfy high demand within the urban areas (Hendrickson, 1998) and may be harmful to their surrounding neighbourhood, if not treated effectively. It is also important to comply with various pollution regulations, but once again, it is the care of people in these vulnerable areas that takes precedence (Environmental Protection Authority, 1996). Further, urban construction sites are very often located in several surrounding communities that include neighbourhood homeowners, neighbouring businesses and members of the public, contributing to increased acrimony and disturbance (Gilchrist

et al., 2002). Contractors engaged in work in an urban setting should avoid potential conflicts with local community members whenever possible while reducing acrimony and ill feeling with their various external stakeholders. In this conjunction with the increased management burden of operating in such an environment, the aspect of negligence must also be considered (Spillane et al., 2013). It is important to minimize the disturbance in the form of noise levels, the presence of dust particles and traffic congestion within the vicinity of a construction site caused to the adjacent locality needs to analyse the main issues faced by the contractors where it is associated with urban construction sites. It is also necessary to document the main strategies to deal with the potential problems faced by the construction of congested urban environments. According to Spillane, et al. (2013), the top three problems for contractors include disruption to surrounding buildings, hard-to-control noise levels, and ensuring off-site parking for construction personnel.

Çelik (2008); as cited in Çelik et al., (2017) mentioned that people themselves and the environment in which they operate, their residence and neighbourhoods are exposed to adverse impacts from the construction activities if they are located around the building construction zones. Further to the authors, in return, people react to their common patterns of life by altering their daily routine to solve or alleviate the exposed disruptions. Celik and Budayan (2016) described the most troubling nuisances as impacts to calm and quiet neighbourhood, house cleanliness and environmental degradation from the construction operations. The authors further stated the region's country environments and culture are seen as important factors that play a significant role in the severity of adverse impacts for the community. The facts showed that the construction activities are generating a considerable number of wastes that are seriously threatening human life (Baldwin et al., 2009; Wang & Tam, 2014). It contained toxic substances while contaminating the surrounding environment that is heavily dangerous for human health (White, 2010; Wang & Tam, 2014). Therefore, construction wastes lead to several invisible diseases and the impact will continue beyond the project period that can be indicated as silence treats in part of the nuisance. At the time when the noise level becomes unusually loud and goes beyond the control level, it will diminish the quality of the air in the atmosphere and adversely affect the

environment, public health and wellbeing of the people (Pam and Garba, 2019). According to Celik and Budayan (2016), among many adverse effects, the severe risks for human health can be impacted in the long term and, most critically, at the time of development, they are not aware of these impacts. Considering the high density of the urban area, it has been a major challenge to aim for a healthy and sustainable living atmosphere against various sources of pollution, including noise becoming one of the biggest effects of pollution (Rosa and Kenneth, 2013).

According to the Ministry of Defence (2005; as cited in Spillane et al., 2013), in response to the high dust levels that can be generated from construction projects, the neighbouring communities are often met with buildings and roads being discoloured. Further to the author, more significantly, the generated dust can be harmful depending on the source of exposure, and dust levels can affect vision while walking or driving on the roads adjacent to such an urban site. However, Çelik (2001; as cited in Çelik et al., 2017) stated that in return, people react to their common patterns of life by altering their daily routine to solve or alleviate the exposed disruptions.

According to Bianchini & Hewage (2004; as cited in Celik and Budayan, 2016), construction operations are considered to be one of the biggest reasons for environmental issues and it would create pollution and affect the surrounding community. According to Wood (1960; as cited in Bryson and Macbeth, 1972), the term "public nuisance" refers to a tort law provision that is criminally punishable when it is violated. Further to the authors, the use of public nuisance theory in different forms of environmental enforcement such as water, air and noise pollution is scrutinized and certain areas defined in which the most reasonable use might be made of public nuisance law. Cha (1976) emphasized environmental protection will become the function of the development strategy. Further to the author, there is a high possibility environmental protection can be integrated into the development strategy, which will allow construction owners to implement the alternative proposals as to proceed with the present pattern of industrialization. The interest of conserving the land, and preservation and productive exploitation in conserving the resources are equally important (McLaren, 1983).

2.6 Law Relating to Public Nuisance

Under the nuisance law, the right to the reasonable use and enjoyment of land is a critical aspect. It demonstrates that the primary concern is not focusing on all the externalities, but it is targeting the harmful concerns and the actions that are violating human rights (Keating, 2012). Malcolm and Pointing (2013; as cited in Abeynayake, 2019) categorized nuisance under the common law known as a private nuisance, public nuisance and statutory nuisance. This has originating in the 19th century and is now enshrined in Sections 79 to 85 of the 1990 Environmental Protection Act and other supplemental laws in India (Percival et al., 2021), such as the 1993 Noise and Public Nuisance Act in South Africa (Taylor, 2006) and the Clean Communities and Climate Act, 2005 in India. According to case laws, public nuisance concerns protecting the public, unlike private nuisance, which protects an individual. Hence, public nuisance is a matter of criminal law. However, if an individual can demonstrate that they, as an individual, have been especially affected by a public nuisance, then they can make a claim in tort (Attorney General vs PYA Quarries).

The Environmental Impact Assessment (EIA) process in Sri Lanka has managed to incorporate environmental as well as other public issues into the planning process of the town (Zubair, 2001). EIA in the Western countries started in 1969 with the adoption of the National Environmental Policy Act of Congress of the United States (Vafai et al., 2020). According to Bishop and Jenkins (2011), in terms of the law of nuisance private property rights are creating a conflicting situation concerning the legal influence of the land-use for the development activities. Further to authors, a legal forum is given while dealing with individuals that the disputes regarding reasonable usages of the land will be escalated to the court proceedings.

The action in private nuisance is affecting several actions such as for the development and planning aspects. The public nuisance is concerned in accountability and decision-making process supporting the local authorities and jurisdiction (Bishop & Jenkins, 2011). Editorial Committee of the Cambridge Law Journal (1923) describes interesting differentiation between the laws applicable to the anti-ordinary nuisances of the rule in the Rylands vs Fletcher [1868] case. According to the Rylands vs Fletcher rule, the

occupier of the land needs to bring or keep upon it any elements likely to face the damage if it escapes is bounded at his peril to prevent its escapes and is always liable for every natural consequence of its escapes even if he has been proven guilty of no negligence. In the case-law of *National Telephone vs Baker Kekewich* [1893] case, it has held that a man who creates the electrical current for his purposes and discharges the earth beyond his control the principle will apply the *Rylands vs Fletcher* [1868], as the person is responsible for the relevant damages caused as he had discharged the stream of water. In *Attorney-General vs. PYA Quarries Ltd*, (1957-2 WLR 770) case, the defendant owned a quarry, which emitted large amounts of dust and grime into the surrounding residential area. The equipment also caused damage via vibration to the surrounding properties. The judgement stated that “any nuisance is 'public', which materially affects the reasonable comfort and convenience of life of a class of Her Majesty's subjects”. There are large range of issues which can come under public nuisance, including picketing on a road as in *Thomas vs. UM*, (1986 ch20), blocking a canal as in *Rose vs. Miles* (1815-4 WLR 101), and disrupting traffic by queuing in a road as in *Lyons vs. Gulliver* (1914 1 Ch 63).

Accordingly, as to determine how the nuisance will affect for standards of comfortable living does not to have a simple universal rule which will depend with the place and the time. The action will lie for nuisance which, even though substantial, is due solely to the fact that the plaintiff is abnormally sensitive to deleterious influences, or uses his land for such purpose as requires exceptional freedom from any such influences (Annali, 1923). Keating (2012) argues that the right that correlates with the remedy of permanent money damage is a right not to bear the cost of substantial interference with one's reasonable use and enjoyment of one's land merely because that interference issues from the rational use and enjoyment of one's land by another property owner. According to the author, contrary to currently popular statements, damage does not lose its moral significance merely because it is faultlessly done and harm has moral significance inherent to it. Further, harm puts its victims in situations where they are deprived of their freedom, unable to react to their desires by the universe.

Under nuisance law, damage discourages its victims from putting their property to use and enjoyment wholly legitimate. “Nuisance is a law of harms and rights, not costs and benefits, and it aims to reconcile competing for claims fairly, not efficiently” (Keating, 2012). Nuisance law offers unrivalled instruction about the formal structure and substantive morality of strict liability in tort, and by so doing challenges the dominant theories of tort. Further, it does indeed address harmful spillovers caused by the productive use of land but its governing aim in addressing those spillovers is to reconcile equal, but conflicting, rights (Keating, 2012). “The act or failure to act by a Defendant need not be intentional or negligent to impose liability for creating a public nuisance” (White, 2010). He further stated that the law requires the evidence that the defendant parties have substantially contributed with their actions, which have created and proximately caused the public nuisance. “Public nuisance is not a tort; rather, when asserted by the sovereign, it is essentially an exercise of the police power to protect public health and safety and it has repeatedly been held to encompass the state's environmental interest” (Sevinsky, 1990).

Bishop and Jenkins (2011) showed that the Planning Act 2008 in England and Wales essentially excludes a nuisance action in the case of nationally important infrastructure projects; there is also no room for the courts to be interested in determining such situations where planning consent may contradict to the private interest. However, Bishop and Jenkins (2011) further argue where the courts are called upon to decide the public consent and the private interest; however, it should concentrate on the conventional position of using the locality doctrine to determine whether the land use is fair rather than involving itself in the development's 'public interest' existence. In relation to the content, the nuisance law provides unrivalled guidance on the formal structure and fundamental principles of strict liability in tort in relation thus contradicting the prevailing concepts of torture (White, 2010; Bishop & Jenkins, 2011). On the other hand, the nuisance law's structure and substance do not correspond to the economic statement. Hence, the tort is a lawyer interested in efficient externality management despite the nuisance (Keating, 2012).

In Sri Lanka, there are several nuisance related legislations applicable to the construction industry. Among them, Nuisances Ordinance 15 of 1862 plays a leading role. Apart from this Ordinance, National Environmental Act, Code of Criminal Procedure Act, Penal Code, Municipal Council Ordinance, Urban Councils Ordinance and Pradeshiya Sabha Act also provide provisions for better preservation of public health and the suppression of Nuisances caused by construction projects and construction industry. The Sri Lankan law relating to nuisance is English law. The Nuisances Ordinance of Sri Lanka provides preservations to safeguard public health and suppression of nuisances.

In *Keangnam Enterprises Ltd. vs Abeysinghe* (1992 SLLR 116) case law, the Petitioner-Company had established a metal quarry, a metal crusher and a premix plant at a site for developing and rehabilitating the Ambepussa-Dambulla-Anuradhapura Road (Abeynayake, 2012). The Magistrate granted an injunction restraining the operation of the quarry under Section 104(1) of the Code and also entered a conditional order under Section 98(1) of the Code for the removal of the public nuisance caused by the quarry. In more recent case, the Magistrate of Balangoda issued a conditional order and overrules the objections taken by the Keangnam Company, which has obtained an Environmental Protection Licence for its proposed activities. The Magistrate is of the view that such a licence did not fetter his power to determine whether a public nuisance had been committed. Subsequently, the Court of Appeal extensively reviewed the authorities in Sri Lanka and other jurisdictions and held that the Magistrate has jurisdiction to determine whether a public nuisance had been committed. A few more significant case laws in Sri Lankan context are available related to the public nuisance created by construction projects. Those are, *R. P. Weerasekera vs Keangnam Enterprises Ltd.*, *Saram vs Seneviratne*, *Deshan Harindra (a minor) vs. Ceylon Electricity Board*, *Environmental Foundation Limited vs. Urban Development Authority*, *S.C. Amarasinghe vs. Attorney General*, *Environmental Foundation Limited vs. Attorney General* to name a few.

The Acts and Ordinances related to nuisances in Sri Lanka are summarised in Table 2.2.

Table 2.2: Acts and Ordinances Related to Nuisances in Sri Lanka

Act/Ordinance	Original/Amendments	Focus/Coverage	Reference
Nuisances Ordinance	Section 15 of 1862 Section 61 of 1939 Section 03 of 1946 Section 57 of 1946	This ordinance provides the better preservation of public health and the suppression of Nuisances.	Nuisances Ordinance (1946)
National Environmental Act	Act No. 47 of 1980, Act No.56 of 1988 Act No. 53 of 2000	This Act makes provision for the protection and management of the environment and for matters connected therewith or incidental	National Environmental Act (2000)
Code Of Criminal Procedure Act	Act No. 05 of 1979 Act No. 36 of 1979 Act No. 68 of 1979 Act No. 52 of 1980 - Chapter IX - Public Nuisances	A – Orders for removal or abatement in cases of nuisance B – Temporary orders in urgent cases of nuisance	Code of Criminal Procedure Act (1980)
Penal Code	Several amendments in between 02 of 1883 and 25 of 2021 Chapter XIV (Specially Section 98 and 261)	Offences affecting the public health, safety, convenience, decency and morals	Penal Code (2021)
Municipal Council Ordinance	Several amendments in between 29 of 1947 and 20 of 2017.	There are clauses relevant to minimization of nuisances in construction sector	Municipal Council Ordinance (2017)
Urban Councils Ordinance	Several amendments in between 61 of 1939 and 21 of 2017.	There are clauses relevant to minimization of nuisances in construction sector	Urban Councils Ordinance (2017)
Pradeshiya Sabha Act	Act No. 15 of 1987 Act No. 34 of 1993 Act No. 14 of 1999	There are clauses relevant to detection and abatement of nuisances	Pradeshiya Sabha Act (1999)

The above acts and ordinances have clauses relevant to minimisation of nuisances in construction sector.

2.7 Mechanisms to Minimize the Impact of Public Nuisance

Bishop and Jenkins (2011) stated that both private rights and public interest need to balance appropriately to carry out the developments. Further to the authors, the planning regime has to play a bigger role as to balance legal constraints from the neighbour's and developer perspectives. The project team members should be mindful

that different parties are susceptible to various adverse consequences for the neighbouring group and take their suggestions and opinions before initiating the project (Celik & Budayan, 2016). Martin et al. (1980) stated that construction noise control is always a combination of common sense and an understanding of the restrictions imposed by realistic engineering constraints. In order to minimize noise effect on the public nuisance and satisfy the criteria of applicable legislation and guidelines, passive design steps could be practised.

According to Çelik, et al. (2017), the adverse effects must be established primarily to pave the way a means of recognizing changes in people's everyday life, measuring the impact of living near a construction site. A deterministic model developed by Gilchrist, Allouche and Cowan (2003) is based on the Monte Carlo simulation technique, which is capable of predicting during each construction phase the magnitude and frequency of noise levels generated by construction equipment at the receptor locations around a construction site. Gannoruwa and Ruwanpura (2007) stated that the simulation model needs fewer resources and less expertise, which provides a forum for investigating the impact of noise while optimizing the barriers, required. In addition, it would be useful for construction designers and managers to ensure that projects are finished without neighbours' concerns. Schexnayder (1999) showed that the key nuisances connected with the construction are noise, vibration, dust and lights. That needed to define methods and strategies to minimize these nuisances also at the planning stage.

Gilchrist, Allouche, and Cowan (2003) showed that the noise control programme needs to be established to control the noise as follows:

- Analysis of the responsive noise receptors during the project design phase.
- Determination of background noise for each responsive receptor.
- Predictive analysing for expected noise levels of each equipment.
- An overview of gaps should be carried out in which expected noise levels are compared with acceptable noise levels.
- Develop control strategies to reduce the length and effects of the noise generations.

- Implement strategies for communication, tracking and compliance and put them into practice.

Contractors to reduce the impact on the surrounding community on an urban site may usually build temporary noise reduction systems; however, these are typically insufficient where constructive and enduring contingencies are considered (Schexnayder & Ernzen, 1999). According to US Transport Department (2008), source regulation, direction control and receptor control should be considered in minimizing unwanted sounds. Further, they highlighted that most contractors tend to ignore this fact and put in place inefficient and insufficient mitigation systems. They continue, through implementing successful schemes, contractors show to the public that they genuinely take the necessary steps to reduce noise levels. According to Spillane, et al. (2013), contractors performing work in an urban setting should avoid future conflicts with local community members whenever possible, while reducing acrimony and sickness feeling with their numerous surrounding communities. Schexnayder and Ernzen (1989; as cited in Gilchrist et al., 2003) have identified several techniques that can be implemented to reduce the effect of noise produced by construction equipment and activities on the urban environment in which noise levels are controlled at the source, along the transmission process and at the receiver. Related leading strategies could be taken as to the implementation of noise reduction systems, implementation of dust management measures, including avoiding obstruction for the local business entrances (Spillane et al., 2013). Using the data generated by the model, portable noise barrier systems can be built and moved to different locations around the construction project when sound levels are expected to exceed unsustainable levels (Gilchrist, et al., 2003). Webb (1988; as cited in Gilchrist et al., 2003) demonstrated that controlling the noise at the sources is the most efficient way to remove noise from construction and is the best way to track the construction sites. Gilchrist et al. (2003) proposed some strategies, which the contractor can adopt during the construction as follows:

- Synchronize the timing of noise operations,
- Use advanced technology with improved motor insulation and mufflers,
- Select the best construction materials and techniques in sensitive areas,

- Position material storage areas away from residential areas and sensitive facilities,
- Establish alternative approaches,
- Limit the use of especially noisy equipment.
- Enclose noisy operation or stationary equipment,
- Install noise barriers or curtains,
- Pushing the source equipment farther away from the detector,
- Artificially generating an equivalent but opposite noise wave, thereby cancelling the sound wave,
- Barrier length should be roughly twice the distance from the source to barriers,
- The barrier should also be positioned as close as possible to the source of the noise.

Gilchrist, Allouche and Cowan (2003) also proposed that the implementation of the model in a continuous simulation environment would also allow better representation of the interaction between construction equipment and activities in time and space to be achieved best. The authors stressed that the model can be further tested against field measurements, including projects involving noise barriers of varying dimensions and geometries in order to maintain the noise levels.

Gannoruwa and Ruwanpura (2007) argue that if the source control does not have sufficient noise reduction, it is possible to achieve a reduction in noise energy transmitted to listeners along the transmitting route via the construction structure, enclosures, absorptions and barriers. Gilchrist et al. (2003) stated that construction-related noise modelling and mitigation is more complicated because the different size of the number, position and function of noise drivers is constantly changing depending on the form and stage of construction. Schexnayder (1999) proposed that the source control can be taken as the most efficient way to reduce disturbance that reduces noise, vibration, glare and dust pollution are the best way to track a construction project. He emphasized that community awareness is a critical part of mitigating nuisance, which is required to maintain productive neighbourhood partnerships in tandem with practical initiatives. He further mentioned that the source controls of the nuisance

cannot be adequate to mitigate impacts on sensitive abutters and in certain cases, barriers may provide a major reduction in the nuisance effect but it is required to evaluate cost effectiveness.

When managing the construction dust at the site risk reduction approach is used with the identification of risk, assessing risk, controlling risk and recording and review of the risk. Therefore, the level and the type of risk are identified with the consideration of the level of energy consumption and the use of energy and time consumption (Fitzgerald, 2020). According to the author mainly reducing dust generated, reducing direct exposure, and reducing dust emitted are key strategies proposed to control dust in the construction and site. Moreover, continuous water addition, water suppression, mechanical ventilation, screens, and task rotation ensures the reduction of dust generation in the construction site, which is affecting the general community.

Waste accumulation is a major concern in urban construction projects. Therefore, to address this concern reduction of construction mistakes, precious procurement, storing material properly, recycling and reusing, developing new building methods, and working with suppliers are effective strategies to reduce and manage construction waste in sites (United Rentals, 2018). Similarly, Zafar (2021) emphasised proper storage, implementing recycle and reuse concept at the site, and organised process at the site are key features supporting the reduction of waste that affects the public and the neighbouring buildings.

Air and water pollution are controllable concerns at the site that support the avoidance of public nuisance. Use of on-site plants and vehicles, land clearing and demolition are strategies to minimise the air and water pollution affecting the construction site neighbours (Guzder, 2019). Furthermore, the use of recycling options and green solutions are effective measures to develop better air and water pollution strategies (Smart Bricks, 2021).

Additionally, the impact of traffic is a key concern in the construction site that is mostly applicable in urban construction projects. According to Maze (2007) increased incident management and removal capabilities, increase law enforcement during construction,

comprehensive use of ITS technologies, work zone traffic simulation and lane closure policies are supporting the traffic management around the site. Furthermore, long-term traffic plans and software solutions are key practices supporting the community practices in the traffic management around the site (Wiegel, 2020). According to the author, Hamburg construction site management was conducted with the implementation of software for better management practices. Moreover, this is a major accept in contemporary construction projects since drivers are spending over 71% on-road as a key concern that is affecting the construction project programmes.

In terms of the mosquito, breeding is a major concern in urban projects due to dengue prevention practices. CIDA has emphasised relevant rules and regulations to ensure the safety of the site and its operational practices to support the community in an effective manner (CIDA, 2021). According to the published guidelines, both public and private construction sites need to follow them to ensure that the site is free from mosquito breeding. Additionally, the Singapore government has proposed practical solutions for the construction sites to ensure the eradication of mosquito breeding issues. Therefore, the Singapore government emphasises that clear stagnant water regularly, applying anti-mosquito oil store building material under shelter, avoiding the use of canvas to cover material, disposing of demolished debris, covering tanks and drums, replacing damaged barriers, periodically pumping water out of trenches, and regrading uneven drains and channels supports the avoidance of mosquito breeding chances at construction sites (elcosh, 2020).

Having considered the above discussion, Table 2.3 summarises the literature on strategies to minimise public nuisance in construction projects.

Table 2.3: Strategies to Mitigate Public Nuisance

Strategies		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]
Noise and Vibration																		
Synchronize the timing of noise operations		✓					✓											
Use advanced technology with improved motor insulation and mufflers							✓											
Limit the use of especially noisy equipment		✓		✓														
Enclose noisy operation or stationary equipment		✓								✓								
Install noise barriers or curtains		✓																
Implement strategies for communication, tracking, and compliance and put them into practice		✓																
Imaginative acoustic design			✓				✓											
Odour effects																		
Direction control		✓						✓										
Source control		✓							✓									
Initiate construction structure, enclosures, absorptions and barriers		✓																

Strategies		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]
Source regulation		✓																
Position material storage areas away from residential areas and sensitive facilities					✓													
Dust and smoke																		
Select the best construction materials and techniques in sensitive areas				✓						✓								
Satisfy the criteria of applicable legislation and guidelines											✓							
Consider neighbours suggestions and opinions before initiating the project											✓							
Implementation of dust management measures											✓							
Initiate construction structure, enclosures, absorptions and barriers											✓							
Mosquito breeding																	✓	
Source control																		✓
Source regulation																		✓
Consider neighbours suggestions and opinions before initiating the project																		✓

Strategies		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]
Satisfy the criteria of applicable legislation and guidelines																		✓
Responsive Urban Planning																		✓
Water and air pollution																		
Community awareness														✓				
Initiate construction structure, enclosures, absorptions, and barriers														✓				
Source regulation													✓					
Implementation of dust management measures													✓					
Waste																		
Community awareness												✓						
Satisfy the criteria of applicable legislation and guidelines												✓						
Advanced technologies												✓	✓					
Establish alternative approaches													✓					
Sources: [1] Gilchrist, Allouche and Cowan (2003); [2] Schexnayder (1999); [3] Gannoruwa and Ruwanpura (2007); [4] Spillane, Flood, Oyedele, Meding & Konanahalli (2013); [5] US Transport Department (2008); [6] Pam & Garba (2019); [7] Rosa & Kenneth (2013); [8] Celik & Budayan (2016); [9] Bishop and Jenkins (2011); [10] Fitzgerald (2020) [11] United Rentals (2018) [12] Zafar (2021) [13] Smart Bricks (2021) [14] Maze (2007) [15] Wiegel (2020) [16] CIDA (2021) [17] Elcosh (2020)																		

Table 2.3, summarises the strategies identified to minimise public nuisance in the construction industry under 7 categories, i.e., (a) noise and vibration, (b) odour effects, (c) dust and smoke, (d) mosquito breeding, (e) water and air pollution, (f) traffic impacts, and (g) waste. These public nuisance types and strategies were further investigated during empirical investigation.

2.8 Conceptual Model

Figure 2.2 shows the conceptual model developed in this study by summarising the literature. The conceptual framework has been developed along with the literature findings and the summary of the information obtained in the research area. It demonstrates the connectivity of legal application, causes for nuisance, strategies and impact of nuisance on public nuisance in the Sri Lankan construction industry. The conceptual framework tries to identify the possible strategies to overcome the public nuisance in the construction industry.

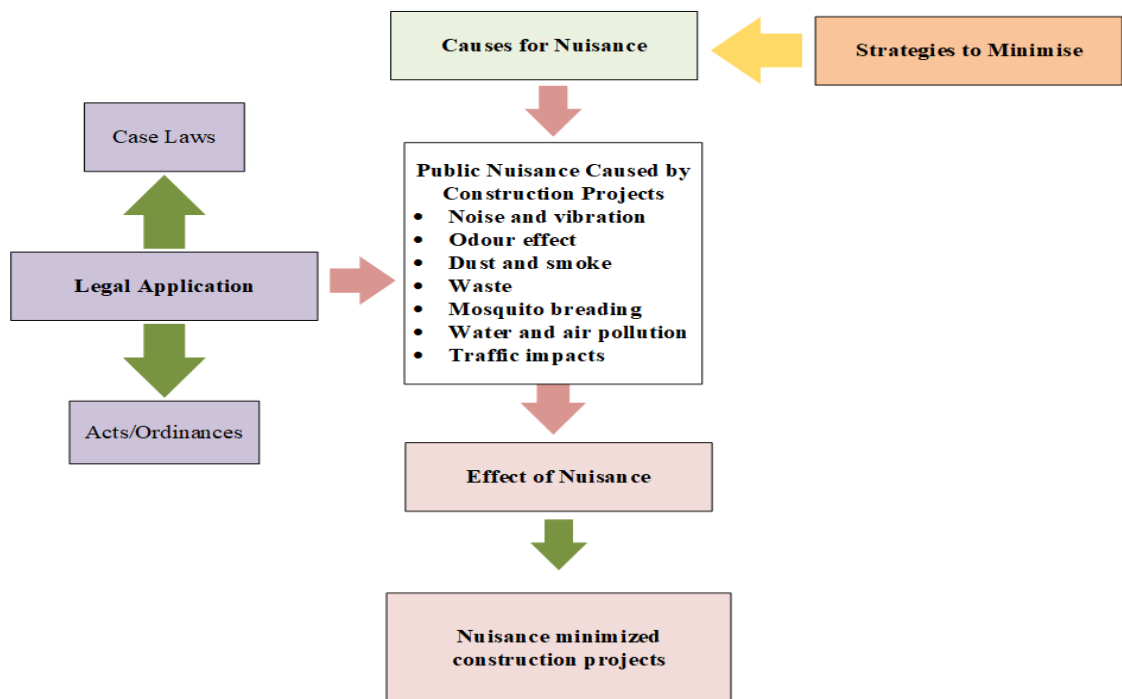


Figure 2.2: Conceptual Model

This conceptual model was used as a guide in the empirical investigation in this study in order to achieve the research aim and objectives.

2.9 Chapter Summary

This chapter reviewed the literature obtained via several reliable sources in terms of public nuisance. However, it was highlighted that there is a limited number of literature available in terms of the Sri Lankan perspective referring to public nuisances. The chapter revealed different types of public nuisance such as noise, vibration, odour effect, dust and smoke, waste, mosquito breeding, water and air pollution, and traffic impacts are affecting the livelihood of the neighbours around the urban construction projects. Additionally, the literature review was further extended to gather information on the impact of the public nuisance and the strategies to minimise its effect. Moreover, this chapter revealed the legal aspect in relation to the local legal system that is possible for addressing public nuisances. Accordingly, the identified literature review data is used for the development of the data collection instrument in the next stage. The next chapter will demonstrate the selection of the most suitable research methodology to achieve the aim and objectives of the research.

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides an overview of the research methodology that takes into account the methods used for data collection and data analysis to achieve the study's aim and objectives. It provides information about the process, which has been followed to conduct the study, and justification for the application of the method. The chapter also explains the different phases of the study, including the selection of participants, the process of collecting data and the process of analysing data.

3.2 Research Design

A strategy to address the research question is research design (Myers, Well, & Lorch Jr, 2010). The role of a research design has taken place is to ensure that the information gathered allows the research problem to be answered as clearly as possible (Tobi & Kampen, 2018). In order to achieve progress in the research process, the strategy should discuss the particular tasks to be carried out, who, how and when they will be accomplished (Polonskey & Waller, 2011). Naoum (1998) described from the initial question, which has based on the research up to the conclusion, the design of research as an action plan. Background study, literature review, data collection, data analysis and present research findings are included in the design of this study. The research design developed for this study is shown in Figure 3.1.

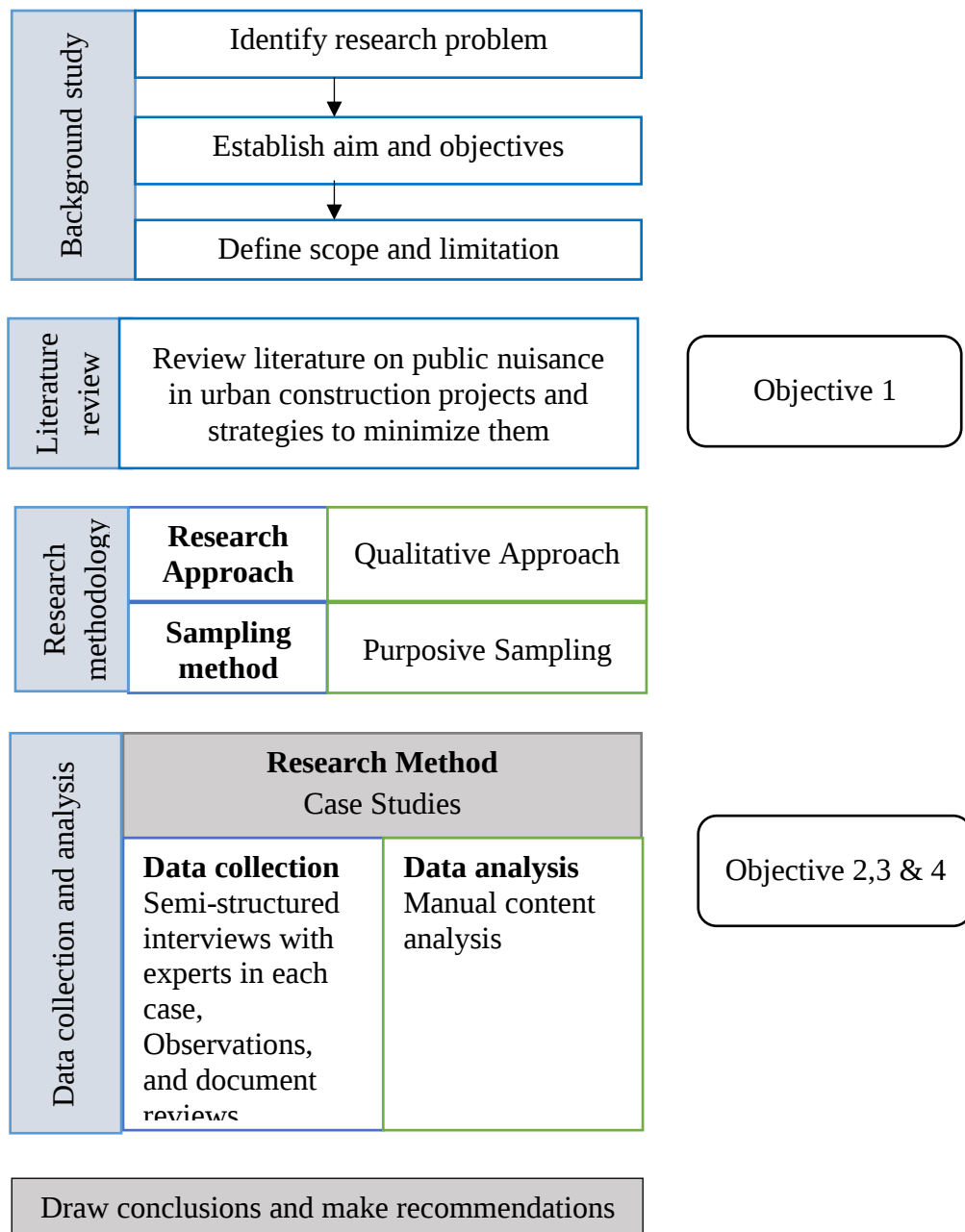


Figure 3.1: Research design

Following sections elaborate the aforementioned research design in detail.

3.3 Background Study

Initial background study has been carried out on a broader perspective to identify public nuisance related issues in urban construction projects in global and local contexts. In order to achieve this, various literature related journal papers, theses,

books, unpublished dissertations and other publications including professional associations, preprint libraries, university libraries, and scholars' articles were reviewed. However, it has been realised that although many researchers have been focused on public nuisance, there is a lack of an investigation into the public nuisance related issues in the construction projects in Sri Lanka. There is therefore a need to investigate public nuisance related issues and propose minimising strategies in urban construction projects in Sri Lanka.

3.4 Literature Review

The literature review has been conducted appropriately while focusing on the research problem comprehensively. After scrutinizing the research problem, the literature synthesis has been carried out to reveal the nuisance in urban construction projects. Relevant journals papers, conference articles, books, theses, unpublished dissertations including prominent and professional electronic sources have been incorporated to construct an effective literature synthesis. The journal articles have been given more concerns when conducting the literature survey of the study. The first objective of the research has been addressed through the literature review. Accordingly, issues related to public nuisance in construction projects and legal provisions available to minimize those issues were reviewed. It has been determined that depending on the occurrences and situation of nuisance, there are different remedies in the legal provisions.

3.5 Research Approach

The research approaches concern the coordination of research operations, including the processing of data in ways that are most likely to achieve research objectives. The choice of the appropriate method was considered with the requirements of the research study and that become a very important element to the successful proceeding of the study. Research approaches have been categorized as qualitative, quantitative and mixed approaches (Strijker et al., 2020). Survey research and experimental research are essentially approached quantitatively, while ethnography, case study research, action research and grounded theory methodology are taken into account in the qualitative approaches (Klingsieck et al., 2013).

The aim of the research is to investigate the public nuisance related issues in urban construction projects in Sri Lanka. In order to achieve the aim, an in-depth investigation of construction projects is needed. Further, the ideas and opinions of real-life project participants, project observations and document reviews were also very important in this study. The experience of the professionals and their approaches in each project has similarities as well as differences. Therefore, a qualitative approach is selected for this study.

3.6 Research Method

Yin (2011) has identified five major research methods namely, case studies, surveys, experiments, archival analyses and histories. Qualitative research is mostly associated with case studies (Rose et al., 2015). When the research problem comprises of how or why questions, undertaking case studies is the most suitable method since an in-depth investigation is required (Yin, 2011). Since an in-depth investigation is necessary to answer the research problem in this study, a case studies approach was employed for this research.

According to Yin (2009), either a single case study design or a multiple case study design can be undertaken when conducting research. Since this research is focused to investigate public nuisance related issues and propose minimising strategies in urban construction projects in Sri Lanka, multiple cases were mandated to conduct cross-case analysis and to enable triangulation of findings. Accordingly, multiple cases were selected for this study.

3.6.1 Data collection methods

This study has selected 03 high-rise condominium apartment projects under the case study approach. The non-probability purposive sampling technique is used for selecting the cases for study. Since the selection of cases is constrained by limited accessibility and time due to the COVID situation, cases were limited to 03 condominium apartment projects located in Colombo, which have faced several public nuisance issues during the construction process. The primary data collection was done

through semi-structured interviews with professionals involved in those projects, observations and document reviews. Three professionals, including project managers, contract managers, safety officers, engineers and administrative officers who are responsible for minimising public nuisance from each project were selected for interviews. The quality of the primary data is ensured through the site observations and documentation reviews of the selected case studies.

3.6.2 Data analysis techniques

In order to analyse the collected data, data analysis has been carried out as it is highly necessary to determine and reflects the study decision. The qualitative data gathered via expert interviews, observations and the documentation review are analysed using the manual content analysis technique. The outcome of the content analysis and the literature findings are discussed in the next chapter.

3.7 Chapter Summary

This methodology chapter was drawn up based on the study method to achieve the ultimate research aim. The methodology of research is identified as the primary systematic structure for achieving the purpose of research. This research was conducted under the qualitative approach. The background study, comprehensive literature survey, case studies, which were conducted with semi-structured interviews, observations and document reviewing as the data collection methods and data analysis are the main stages followed in this research.

4.0 DATA ANALYSIS AND RESEARCH FINDINGS

4.1 Chapter Introduction

This chapter presents the data analyses and findings of this research. Data collection is done through case studies where findings and analysis compare and contrast against the literature review. The purpose of this data gathering is to achieve the research objectives; the issues related to public nuisance in construction projects, understanding legal provisions to minimise those issues, to find causes behind such issues, understanding the impact of public nuisance issues in construction projects, especially in urban areas and mechanism to minimise that impact. Data gathering is accomplished through an interview of experts involved in selected cases, site observations and project document reviews. The collected data is analysed using a manual content analysis model. The chapter presents the research findings to propose mechanisms to minimise the public nuisance related issues in construction projects.

4.2 Case Studies

This study applied the case study method to collect data. The study further applied semi-structured interviews; observations and documents review for data collection under the selected cases. Semi-structured interviews were conducted through nine professionals representing the selected three apartment construction projects from leading construction companies in Sri Lanka. All nine professionals have over five years of experience in handling public nuisance in construction projects. The data collection was carried out using the data collection instrument and interviews took approximately 45 minutes. The researcher visited all three projects and made observations and reviewed documents to gather information related to public nuisance related issues, causes, impacts and mitigation measures.

The details of cases studied, respondent profile, observations made and documents reviewed under Sections I and II are summarised in Table 4.1.

Table 4.1: Case Study Profile

Case Code	Case Details	Respondent Code	Respondent Details	Observations Made	Documents Reviewed
A	▪ Luxury residential apartment project located in the heart of Colombo. ▪ 36 floors and 333 Apartments. ▪ LKR 12.47 billion ▪ 4 years and 6 months.	A1	Contract Manager with 7 years' experience	▪ Project is on-going. ▪ Observed the nature of surrounding area ▪ Observed the different nuisance minimisation mechanisms applied in site ▪ 32 houses around the site.	▪ Risk register ▪ Complaints register
		A2	Manager - Building Services with 35 years' experience		
		A3	Safety Officer with 10 years' experience		
B	▪ Luxury residential apartment project located in official administrative capital of Sri Lanka. ▪ 46 floors and 153 Apartments. ▪ LKR 5.79 billion ▪ 4 years and 6 months.	B1	Construction Manager with 19 years' experience	▪ Completed project. ▪ Observed the nature of surrounding area and completed project. ▪ 30 houses around the site.	▪ Risk register ▪ Customer complaints register
		B2	Senior Project Engineer with 10 years' experience		
		B3	Compliance Engineer with 10 years' experience		
C	▪ Luxury residential apartment project located in official administrative. capital of Sri Lanka ▪ 36 floors and 320 Apartments. ▪ LKR 6.29 billion. ▪ 4 years	C1	Project Manager with 14 years' experience	▪ Project is on-going. ▪ Observed the nature of surrounding area ▪ Observed the different nuisance minimisation mechanisms applied in site ▪ 25 houses around the site	▪ Public complaint register ▪ Register those records daily sound level
		C2	Admin Officer with 5 years' experience		
		C3	Safety Officer with 10 years' experience		

The data collected through the above methods and the research findings are discussed in detail under the following sections.

4.3 Defining and Understanding Public Nuisance

Section I of the data collection instrument was focused to capture the knowledge of respondents on public nuisance in construction projects. The responses given to interview questions 12-19 are critically analysed and summarised in the below sub-sections.

4.3.1 Defining Public Nuisance

The first two questions raised in this section were “According to your opinion, what is a public nuisance?” and “Is public nuisance a crime?” The responses given by the respondents are summarized in Tables 4.2 and 4.3, respectively.

Table 4.2: Defining Public Nuisance

Case A	Case B	Case C
A1: A public nuisance is a wrong done to a person or group. Unlawfully disturbing. A2: Anything that disturbs the day-to-day life of a person. A3: Act that affects the morale, safety health and freedom of the community.	B1: Disturb the public’s day-to-day life by creating excess sound, dust, pumping wastewater to water resources etc. B2: Disturb the public’s day-to-day life by creating excess sound, dust, pumping wastewater to water resources etc. B3: Result of any activity, which disturbs the normal life of the public beyond the accepted level.	C1: Inconvenience caused to the public from other parties C2: Disturbance for the public in the exercise or their enjoyment C3: Human activity or physical condition that is harmful or offensive for public property in perspective of morale, safety or health.

It is evident that all respondents have a very good understanding on the meaning of public nuisance. A1 identified as “*unlawfully disturbing*” to a “*person or group of people*”. Respondent A2 claimed that public nuisance is “*anything that disturbs the day-to-day life of a person*”. Significantly, Respondent A3 focuses on physical and moral damage resulting through construction sites as a public nuisance by defining it

as an “*Act that affects the morale, safety health and freedom of the community*”. State vs Lead Industry Associations [2001] also identify that public nuisance causes safety issues, natural peace, health, comfort, or other inconveniences to the community. Respondents B1 and B2 add “*creating excess sound, dust, pumping wastewater to water resources etc.,*” under public nuisance. Abeynayake (2019) also emphasises that public nuisance can cause significant issues as stated by Respondent B2. Respondents B3 and C1 identify it as “*inconvenience caused to the public*” and “*disturbance for the public*”. Respondent C1 also focuses on the public's moral, health and safety, identifying public nuisance as “*harmful or offensive for public property in perspective of morale, safety or health*”. Alan (2013) also defined nuisance, as a violation of the people is right of using and enjoy their real property. Therefore, in summary, public nuisance is an act or condition beyond the accepted level that disturbs the day-to-day life of the public, their morale, safety, health and freedom.

For the question on “Is public nuisance a crime?”, respondents have given the below responses (Refer Table 4.3).

Table 4.3: Is Public Nuisance a Crime?

Case A	Case B	Case C
A1: Yes. breach the common right of a person	B1: Public nuisance is a crime	C1: Yes, according to tort law it's a crime
A2: That could be treated as a crime if it continues to affect the public beyond its limits.	B2: Public nuisance is a crime	C2: Yes, it can become a criminal offence
A3: Yes, it is.	B3: Yes	C3: Yes, since it breaches the common right of a person.

Respondent A1 claims that public nuisance is a “*breach of the common right of a person*” and considers it as a crime. However, Respondent A2 has a different view stating, “*That could be treated as a crime if it continues to affect the public beyond its limits*”. Respondent A3 accepts public nuisance as a crime mentioning that “*property damages annoyance to the public or any injury can be prosecuted at panel court*” while accepting its moral inappropriateness. Respondents B1, B2, B3, C1, C2, and C3 accepts public nuisance as a crime. As per the Nuisance Ordinance, public nuisance is a crime. Although public nuisance is a crime, respondent C1 has wrongly

identified it as a tort, which is a misunderstanding of the respondent. Public nuisance is primarily a crime; it only becomes a tort (private nuisance) if the claimant can prove that they suffered "special damage" over and above the effects on the other affected (Christie v Davey (1892 I ch.316)). Hence, the public nuisance that continues to affect the public beyond its limits is a crime, which breaches the common rights of the community.

4.3.2 Experience of Public Nuisance Issues at the Site

The next question raised was “Have you experienced any public nuisance related issues at the site?”. Table 4.4 summarises the experience of the respondents regarding the public nuisance issues at the case study sites A, B and C.

Table 4.4: Experience of Public Nuisance Complaints

Case A	Case B	Case C
A1: Every construction site in urban areas especially in heart of Colombo can experience a public nuisance due to its limited space and congested nature. A2: Yes. When a construction project is started at a location like Colombo where a considerable amount of high society people are residing around they are subjected to frequent sound disturbance A3: Yes, Excessive noise and dust, vibration issues, air pollution, falling objects, excessive mosquito breeding from the site, vehicle congestion etc.	B1: Yes, the sound, dust, mosquito breathe issues. The public takes action against the contractor. Regarding mosquito breeding, PHI has taken the contractor under the public nuisance law B2: sound, dust, mosquito breathe issues. The lawsuit from the general public and PHI B3: Excessive sound, Dust, odour, traffic	C1: Yes, sound, dust C2: Yes, excessive noise, dust C3: Yes, air pollution, noise, dust

As per Respondent A1, construction sites in the heart of Colombo experience public nuisance “*due to its limited space and congested nature*” and has experienced public nuisance related complaints at the site. As per Respondent A2, the high society people who live in greater Colombo do not like high noise levels of the construction sites in vicinity. They expect calm and peaceful lifestyle. Respondents A3, B1, B2, B3, C1, C2, and C3 also have faced similar public nuisance issues as mentioned in the table.

Hence, all 3 sites have experienced public nuisance issues and complaints related to noise, dust, odour, air pollution, vibration, falling objects, excessive mosquito breeding, vehicle congestion, to name a few.

4.4 Establishment of Procedure for Public to Complaint

The respondents were asked as the next question, “Do you have any established procedure for the public to make complaints? Can you please explain?”. Based on the answers received, the mechanisms for public complaint recording in case A, B and C are demonstrated in Table 4.5.

Table 4.5: Procedures for Complaining Public Nuisance

Case A	Case B	Case C
A1: Maintain a complain register at the site so anybody can make their complaints in that register. Identified the critical neighbourhood of the project and have made a social media group so they can easily deliver their complaints using social A2: All holidays are declared as sound restricted days honouring their living comforts, especially on holidays	B1: Directly contact the Project Manager or any other relevant officer. Maintained the customer complaint register. B2: Directly contact the Project Manager or any other relevant officer. Maintained the customer complaint register. B3: Directly contact the Project Manager or any other relevant officer. Maintained the customer complaint register.	C1: 2 staff officers allocated; Neighbours' complaints register C2: Immediate actions to minimize the issue will be taken to satisfy their issue C3: Complain any public nuisance regarding issues to our administration officer or security officers at the gate.
A3: Formed health, safety and an environmental committee led by the Construction Manager, using social media platforms like Viber, WhatsApp for exchanging messages with the neighbours. Health and safety officers visit our neighbour houses once a week and record complaints.		
Documents Reviewed		
Risk register Complain register	Risk register Customer complaints register	Public complaint register Register those records daily sound level

In summary, all sites had some sort of public complaint receiving and recording mechanism. Respondent A1 has claimed that their site “*maintain a complain register,*” allowing anyone to make complaints. They have already identified critical neighbourhoods related to the project and developed a social media group as another public nuisance complaint receiving method. Respondent A2 highlighted that all holidays are declared as sound restricted days. All sound and noise-generating activities are prohibited on those days. Respondent A2 also highlighted that they have close contact with the residents and minimise the sound generated on-site upon the request. Site A has a health, safety and environmental committee headed by the Construction Manager to handle public nuisance-related complains, using modern social media to communicate with the neighbours. Further, their health and safety officers visit neighbours to collect public nuisance related complains once a week. Respondents A3, B1, B2, B3, C1, C2 and C3 also have taken similar measures to allow customers to reach and make complains. More C1 and C2 highlighted that the daily sound level was recorded within the site to confirm whether it is within the acceptable level.

4.4.1 The procedure of Handling Public Complains

The next question for the interviewees was “When there is a public complain, how do you handle public nuisance related issues at site?” This section discusses the actions taken to prevent public nuisances by the site management while addressing the public complaints on nuisances. Table 4.6 summarises the actions taken by 3 cases to prevent public nuisance.

Table 4.6: Actions to Prevent Public Nuisance

Case A	Case B	Case C
A1: Genuinely, we are acting upon. Try to find the root cause and take immediate actions to stop that activity and try to do remedial method to continue that activity without affecting site progress.	B1: Quick action has been taken by the relevant officer B2: Quick by the relevant officer B3: Quick by the relevant officer	C1: Assign a relevant officer and follow up action C2: Immediate actions C3: Immediate actions

A2: We immediately try to identify the sound generating work and stop it.		
A3: Cordial relationship and taking proactive actions.		

As a summary all the Respondents stated that all the sites have implemented a common mechanism to address the public complaints that are affecting the site's progress. Respondent A1 highlighted that *“genuinely we are acting upon”* the public nuisance related complaints. In addition, the respondent emphasized that *“we identify the root cause and take immediate actions to stop that activity and try to do remedial method to continue that activity without affecting to site progress”*. Respondent A2 voiced that, *“We immediately try to identify the sound generating work and stop it”*, limiting the measures only related to the sound. Respondent A3 highlights the importance of maintaining cordial relationships with the neighbourhood and taking proactive actions to handle public nuisance complaints. Respondent A3 further stated that being *“calm when handling public nuisance related issues”* and *“listen to them frequently”* as important qualities of the person who handles nuisance related complaints. Further, B3 mentioned that a contractor who deals with complaints supports the success of the project. As per Respondent A3, *“a knowledgeable contractor can avoid or mitigate any potential fallout by being proactive and following mitigation measures”*. Respondents B1, B2, B3, C1, C2 and C3 indicated that relevant assigned officers should take quick actions when there is a complain.

4.5 Responsible Person to Handle Public Nuisance Related Issues

For the question on “Who is responsible for handling the public nuisance related issues at the site?”, experts provided the below answers.

Project A has allocated a separate site supervisor to handle complaints and provide solutions to prevent nuisance from reoccurring. Respondent A2 further highlighted that they have allocated separate safety officers to handle public nuisance-related issues. As per Respondent A3, Construction Manager also look after the public nuisance-related issues and support the safety officers to handle them. Respondents B1, B2 and B3, mentioned that Project Manager and other relevant staff handle public nuisance-

related issues at their site. According to Respondents C1, C2 and C3, the Project Manager, Safety officers and other relevant officers handle the nuisance complaints.

4.6 Awareness on Legal Provisions on Public Nuisance Related Issues

The researcher raised the next question to check the awareness of respondents on laws, rules and regulations that govern public nuisance related issues. Respondents C1 and C3 highlighted that they are aware of the National Environmental Act of 1980 & Nuisances Ordinance provisions related to public nuisance. Respondent A2 highlighted the regulations and guidelines issued by the Central Environmental Authority and did not mention the Nuisance Ordinance. The respondent was aware of keeping sound levels less than 63dB, generator emission at the specified limits, discharge domestic sewer & wastewater from labour and office toilet to municipal lines, implement a proper rainwater discharge system, necessary fire protection facilities, proper drainage system to discharge rainwater to avoid pollution, controlling litter, insects, odour and vectors to prevent sanitary nuisance and good housekeeping. Respondent A3 mentioned that he is aware of Nuisance Ordinance No. 57 of 1946. However, Respondents B1, B2, B3, C1 and C2 did not have a thorough awareness about the legal provisions but had a basic understanding on the existence of legal provisions.

4.7 Types of Public Nuisance Issues Experienced at the Site

The researcher is then requested the respondents to share their experience on the seven types of nuisances identified through literature review and explain (a) the nature of each issue, (b) causes behind the issue, and (c) impact of the issue. The different types of public nuisances identified at each site are summarized in Table 4.7.

Table 4.7: Types of Public Nuisance at Each Site

Respondent	Case A	Case B	Case C
Noise and vibration	✓	✓	✓
Dust and smoke	✓	✓	✓
Mosquito breeding	✓	✓	✓
Traffic impacts	✓	×	✓

Respondent	Case A	Case B	Case C
Odour effect	×	✓	✓
Waste	✓	✓	✓
Water and air pollution	✓	✓	✓
Any other	• Worker behaviour • Obstruction of sunlight for the solar panels of the neighbouring buildings • Falling objects	• Quarrel	• Theft and vandalism

Noise & vibration, dust & smoke, mosquito breeding, Waste and Water & air pollution are common nuisances faced by all 3 cases. However, Cases A and C only had traffic impact since they were located in a busy city which is congested with several public sectorial offices. Therefore, the traffic congestion during morning and evening office hours is high. Moreover, due to location of several schools around the area a considerable traffic congestion is recorded from 12.30 pm to 2.00 pm on weekdays. Case A did not have odour effect related issues and Cases B and C had some issues due to odour.

Further, respondents identified worker behaviour, quarrel, theft and vandalism as some other nuisances at their sites. These disruptions from workers behaviour related to aggressiveness, quarrel, and theft and vandalism have made sever challenges related to nuisance related issues. Workers have been attempted to fight with each other and their colleague after they drunk when they get off from the work. Every weekend they used to singing songs loudly and crazy dance, which make inconveniencies, problems and difficulties for neighbours. There are many instances that neighbours have made complaints on wrongful act of the workers since they have attempted to enter neighbours premisses in the night in which neighbours were threatening with unsecured feeling. In order to eliminate these issues respondent's projects have been implemented appropriate strategies including with establish ground rules, conduct inductions and awareness programme, display warning notices, assigned gang leaders among the workers' group, place random police petrol and intervening, strict dispelling actions those who are violating the instructions, notorious workers keep outside the inhouse accommodation. Further respondents showed issues as results of obstruction

of sunlight shading patterns, inconvenience with high wind blow through “wind tunnel effects”, disruptions during heavy rains and water flow have been influenced nuisance related issues directly. Respondents have showed that, these complaints were managed while securing neighbours misunderstanding.

Further details of nuisances in 3 cases are discussed below.

4.7.1 Public Nuisances at Case A

All three respondents confirm that they had noise and vibration related complaints from neighbours. A1 highlighted that steel cutting, tile cutting and grinding works cause these noises and A2 added operation of the generator and demolition works to the list. A3 also raised the same causes pointed out by A1. In referring to the impacts due to noise and vibration, A1 and A2 uttered that, neighbours had taken a court injunction against construction works of the site and it reasoned to stop the works at night. Further, they revealed that it led to a delay of construction works. According to A3, due to the court order, working hours had to be limited from 8.30 am to 4.30 pm and this reasoned to use more labour and machinery and subsequently reasoned for incur additional cost.

Dust and Smoke was even had been reasoned for certain complains from the neighbours. This was highlighted by A1, A2 and A3. In accordance with A1, grinding, tile cutting and chipping works majorly caused for dust and smoke generation. A2 uttered that sanding the putty layer and the demolition works were reasoned for this as well. Further, A3 added that negligence of labourers and supervisors to take mitigation measures related to certain works such sanding putty, demolition, etc. were also caused for the unnecessary dust and smoke generation. Due to the issues such as continuous complains from the neighbours due to the dust and breathing difficulties, certain preventive mechanisms had to be taken at site level. A1 revealed that dust controlling mechanisms had to be taken such as stopping using grinders for external walls and it lead to addition cost. A2 uttered that adopting mitigation measures for dust and smoke controlling reasoned for delaying some scheduled activities. A3 even pointed the cost overrun which was highlighted by A1.

According to all three respondents, mosquito breeding and spreading of dengue fever were also identified as nuisance affecting the community including the site workers. According to the site observations, it was found that incomplete concrete tanks, pool areas and water collected containers were the main sources of mosquito breeding. Lack of awareness of dengue prevention among the workers and failure to remove stagnant water at the site was raised by the respondents as the causes for mosquito breeding. Lengthening of the project duration, workers being infected with dengue fever, extra cost for mosquito control, loss of project productivity for weekly site cleaning and legal actions against construction work were the major impacts of this issue. Therefore, both financial and health related impacts were identified with the increased mosquito breeding at the project site.

A1 and A3 highlighted that traffic impacts were detected during this construction project. Several complaints were received from the traffic police regarding the traffic impacts at the site during major construction work, unloading of materials from large containers as stated by A1. As highlighted by A1, due to this traffic impact the site management had to hire a separate land to unload large containers and several warnings were received from the traffic police to take necessary measures to reduce the vehicle congestion.

Odour effect was a nuisance for the general public as claimed by all three respondents. This includes food, toilet and sanitary waste generated by over 600 workers at the construction site. This resulted in additional cost for daily waste removal from the construction site.

Waste from the construction site has been a reason for certain complaints from the community. All three respondents claimed it to be a nuisance from the construction site to the public. A3 elaborated that construction waste from the site mainly concrete waste, block waste, steel off cuts were accumulated near the main entrance during disposal and it resulted in tripping and slipping hazards with major and minor injuries to the workers at the site and he also claimed that accumulation was mainly due to irresponsible disposal of waste, lack of awareness of hazards of waste accumulation and the incompetency of the supervisors involved. According to A2, accumulation of

waste at the construction site has also led for the site workers to be infected with several diseases and it has also resulted in extra cost for waste disposal.

All three respondents confirmed that water and air pollution had been a reason for certain complaints from the neighbours. Higher generation of fumes from the fuel exhaust of the machinery and disposal of chemicals and polluted water resulted in air and water pollution respectively. This resulted in respiratory ailments of the workers and general public and cost had to be expended to treat the disposed water before being released into drainage lines. This also gave rise to delay in the project due to mitigation mechanisms.

In addition to the above-mentioned nuisances, the other issues raised by the respondents were the (a) worker behaviour and (b) obstruction of sunlight for the solar panels of the neighbouring buildings due to excess dimensions of the buildings which ultimately resulted in less generation of power than previous.

4.7.2 Public Nuisances at Case B

In case B, all the three respondents revealed that they received public complaints related to noise and vibration especially due to the excess noise level. Respondent B1 mentioned the operation of concrete pumping machines, drilling and grinding works as the causes behind the issue and B2 added demolition works and operation of generators. Apart from the causes mentioned by B1 and B2, B3 highlighted concrete surface preparation and equipment unloading works. All three respondents confirmed that the public had taken a court injunction against the project as a result of this issue. In addition, they revealed that as a result of it, the project works were delayed due to the time consumed to mitigate the problems. Furthermore, B3 uttered that it added extra cost to the project due to the additional protections and precautions.

According to all three respondents, dust and smoke had been reasoned to the court injunction taken by the neighbours. Respondent B1 revealed that dust spreading due to the wall chasing and sanding putty for painting had caused this issue. Both B2 and B3 also pointed out the same causes. All the three respondents mentioned that because of this dust and smoke issue, the workers had got health problems related to the

respiratory system. Further, they confirmed that the project had been delayed due to this problem. Respondent B3 pointed out that dust and smoke controlling measures had caused additional costs as well.

As mentioned by the three respondents, dengue spreading caused due to the increase of mosquito breeding around the site also had faced by Case B. B1 revealed that excessive areas of balconies and swimming pools were the areas where mosquito breeding had taken place. B2 also mentioned the same thing revealed by B1. Respondent B3 added drains, plant boxes and flower troughs to the list. According to B1, B2 and B3, this nuisance had delayed the project because of the legal actions taken by the public health officer. Moreover, they highlighted that mosquito-controlling activities had incurred additional costs.

According to the respondents, case B had faced nuisance related to the odour effect. As mentioned by B1 and B2, food waste and toilets which are generating over 600 people had caused odour which had made neighbours uncomfortable. In addition, B3 highlighted that construction materials such as wet plywood and gunny cloths also had resulted in odour. Respondent B2 pointed that nuisance caused by uncomfortable odour had incurred additional costs for the project due to the daily removal of waste from the site. B3 uttered that the involvement of PHI and local authority officers and their procedures had affected the progress of the project.

Water and air pollution caused due to project B had affected the public. B3 revealed that they got public complaints due to air and water pollution. According to B1 and B2, air pollution had made neighbours uncomfortable. Respondent B3 revealed that this water and air pollution had caused health problems to the neighbours. B1 even stated that water pollution had affected the water bodies. According to B1 and B2, accommodating a large amount of people within the site premises had resulted in this issue. Apart from that, B2 pointed that the operation of a large number of machines and equipment such as generators, pump cars, and crawler cranes for a long time also resulted in pollution. Further, B3 added construction debris and human waste as causes of this issue. As stated by B2, this issue had incurred additional costs to their project and also resulted in the project getting delayed.

According to the respondents, obstruction of sunlight had caused a public nuisance in case B. B1, B2 and B3 mentioned that the area surrounded by the building was covered with the shadow of the building. Further, they explained that this issue was caused due to the height of the building. All three respondents confirmed that they got third-party complaints as a result of this issue.

As stated by the respondents, case B had caused community issues due to the behaviour of the construction workers. B1 and B2 revealed that aggressiveness and other behavioural problems of workers had caused this issue. Further, B3 added drug addiction of the workers and a high number of workers in the projects as the causes of this issue. B1 and B2 revealed that they got complaints regarding illegal deals and drugs from third parties.

4.7.3 Public Nuisances at Case C

In case C, excessive noise and vibration had been reasoned for the neighbours complains. C1 emphasised, “*noise and vibration are inherent issue in the construction projects.*” According to C1, the causes behind this issue are the operation of heavy machinery and pile hacking. However, C3 mentioned that these noises are difficult to minimize due to the nature of the works and the type of the machines. Respondents C1, C2 and C3 mentioned that neighbour complaints had resulted in project delay and productivity loss. Additionally, C3 highlighted labour idling and machine idling as impacts of this issue.

Construction dust and smoke emitted from the machinery had been declared as a public nuisance in case C. Respondent C1 mentioned that grinding and painting dust as the reasons for this issue. According to C2, fine construction dust particles spread around the site as a result of the wind blow and the gases and smoke emitted by the machines also had resulted in this problem. Furthermore, C3 added putty sanding works, and external wall preparation works without proper covering as the causes of this public nuisance. C1 revealed, “*34 neighbors were directly contacted due to this issue*”. All three members confirmed that these complaints had been reasoned for delay and productivity loss.

According to C1, mosquito breeding was the biggest challenge faced by them due to the flooding. Further water filled in the balconies had worsened the situation. Respondent C2 mentioned, “Due to the complexity of the site, many mosquito breeding places were found”. Therefore, it had been difficult to eliminate every mosquito breeding points. As stated by C1, and C2 neighbours had complained due to the spreading of dengue. As a result, PHI had warned them to control mosquito breeding within the site premises.

As stated by three respondents, local residents and road users had claimed that the project had caused traffic problems in the area. C2 revealed that this issue was caused due to the multiple entering of many heavy vehicles to the site”.

In case C, odour effect had caused a minimal impact to the public. Respondent C1 uttered that this issue had caused due to the irregular food and waste disposal procedures. However, C2 revealed that they were got very few complaints related to this issue.

According to the respondents, in case C, construction waste materials and food waste had been a problem to the residents in that area. C1 mentioned that difficulties in managing food and construction waste had resulted in this issue.

Water and air pollution done by the project had caused a public nuisance in case C. C2 explained that irregular waste control and carless behaviour of the site people had caused this issue. Furthermore, C1 added, “*irregular masks disposal made the issue worse*”. C1 revealed that they received complaints regarding the water and air pollution from the neighbours. Further, he added “*neighbours were suspected that that we are deposing polluted water into the canal*”.

4.7.4 Summary of Findings on Causes and Impacts of Public Nuisances

The summary of findings of the public nuisances related issues, their cases and impacts of Case A, Case B and Case C are shown in Table 4.8.

Table 4.8: Summary of Findings on Causes and Impacts of Public Nuisances

Public Nuisance	Nature of the issue	Causes behind the issue	Impact of the issue
Noise and Vibration	Complains due to higher noise level	• Using grinding machines • Steel and tile cutting works • Using generators • Demolition works • Worker behaviour • Drilling works • Using concrete pumping machines	• Court injunction • Loss of productivity • Working hours were limited (8.30 a.m – 4.30 p.m) and it led to increase the need of labour and machinery force and it reasoned to incur the additional cost • Projects delayed due to mitigation process • Additional protection and precautions increase the additional cost
	Complains due to high vibration level	• Operating heavy machinery for pile hacking	
Dust and Smoke	Complains due to dust and smoke spreading	• Grinding work • Tile cutting and chipping work • Sanding putty • Wall chasing • Painting dust • Negligence of supervisors and labours for dust and smoke mitigation measures • External wall preparation works without proper covering	• Project getting delay by taking all mitigation measures • Control measures led to cost overruns • Court injunctions • Workers suffered from health problems related to respiratory system • Loss of productivity
Mosquito breeding	Spreading of Dengue fever in the community including project workers	• Incomplete concrete tanks, • Flower buckets and drains • Pool area and disposed water containable items	• Extra cost to control mosquito breeding • Loss of productivity due to weekly site cleaning. • Extending the project duration • Workers being infected with dengue fever

Public Nuisance	Nature of the issue	Causes behind the issue	Impact of the issue
		• Excessive areas of balconies and swimming pools • Flooding • Due to the size of the project, it will be difficult to eliminate every mosquito breeding places • Lack of awareness about dengue prevention among workers • Failure to remove stagnant water in the site	• Legal actions against mosquito breeding in the site
Traffic impacts	Complaints from traffic police due to vehicle congestion	• During major concreting work, unloading of materials from large containers • Multiple entering of many heavy vehicles to the site	• Hire a separate land to unload materials from large container and deliver in small lorries • Traffic congestion
Odour effect	Uncomfortable for general public	• Food waste • Toilet and sanitary waste from the project workers • Construction material such as gunny cloths and wet plywood	• Incur additional cost for waste disposal • Loss of productivity due to control measures and legal actions taken by the local authority officers and PHI
Waste	Waste from the construction site (concrete waste, block waste, paint and putty waste, steel off cuts)	• Irresponsible disposal of the waste • Lack awareness of hazards of waste accumulation • Incompetency of the supervisor involved in the job	• Site personnel and visitors exposed to tripping and slipping hazards, led to minor and major injuries • Construction workers infected with several diseases • Extra cost

Public Nuisance	Nature of the issue	Causes behind the issue	Impact of the issue
	were accumulated at the main entrance	Difficulties in managing the food waste and construction waste	
Water and air pollution	Air pollution causing breathing difficulties in the community	- Higher generation of fuel exhaust from machinery and equipment (generators, pump cars, crawler cranes), - Dispose of chemicals and polluted water to the environment	- Extra cost to treat the disposed water before being delivered to drainage line Project duration got delayed by the mitigation mechanism - Health issues to neighbours - Additional cost for legal procedures after community complains
	Water pollution in adjacent natural water containers	- Construction debris and human waste release into water resources - Irregular waste control - Careless behaviour	
Other	Obstruction of sun light for the solar panels.	Due to the excess dimensions of the building, neighbouring buildings getting less sunlight to their solar panels	Increase the area of solar panels
	Disturbance to neighbours	- Worker's behaviour (Aggressive behaviour, drug addictions, unethical behaviour) - Theft and vandalism	Complains regarding the illegal deals and drugs from third parties and it effected the flow of the work

4.8 Strategies to Mitigate Public Nuisance Planning Stage

Section II of the data collection instrument was dedicated to identify the measures to mitigate public nuisances. Question 20 in the instrument is about the public nuisance abate methods that the sites have planned during the planning stage of project. Table 4.9 demonstrates the overview of the responses regarding the mitigating strategies used at sites to avoid public nuisance at planning stage.

Table 4.9: Public Nuisance Mitigation Strategies at Planning Stage

Case A	Case B	Case C
A1: Develop plans to use soundproof concrete pumps, covering of generators with soundproof materials, water treatment plant before disposal of drainage water A2: Develop plans to construct sound barriers around the site, use sound level measuring equipment to monitor sound levels and stop work where necessary, Use tarpaulin covers to screen the dust and use wet screens within the building apartments whenever dust-creating work is started. A3: Develop waste management plan, motor traffic control plan, Noise control plan, develop an effective electricity usage plan, develop protocol for the use of PPE, develop water management plan, dust control plan	B1: Need to design a suitable building based on the surrounding B2: Need to design a suitable building based on the surrounding B3: Need to design a suitable building based on the surrounding	C1: Develop plans to use safety nets, dust barriers, the programme has been targeted to accommodate the working time restrictions, vehicle movement management plan C2: set out possible actions to deal with inherent nuisances such as develop plans to use sound barriers, waste management mechanism. C3: Develop plans to use soundproof concrete pumps & use new machines

A1 highlighted “developing plans to use *soundproof concrete pumps, covering of generators with soundproof materials, water treatment plant before disposal of drainage water*” as critical public nuisance mitigating strategies taken by the company.

A2 also highlighted the same mitigation strategies raised by A1 and in addition added that they developed plans to use tarpaulin covers to screen the dust. A3 indicated more wide precautionary methods than A1 and A2 such as they had planned to develop a waste management plan, motor traffic control plan, noise controlling plan, dust controlling plan and water management plan.

In referring to case B, all three respondents uttered that designing a building with appropriate attention to the surrounding and neighbourhood reasons to minimise the public nuisance. C1 pointed out the importance of developing plans to use dust barriers, safety nets, to manage vehicle (which drive close by the site) movement. Then, C2 highlighted that set out possible actions to deal with inherent nuisances such as planning to use sound barriers, waste management mechanism. C3 raised the same strategy which was pointed out by A1.

In summary, developing on-site management practices and developing the surrounding environment to mitigate the nuisance activities are key strategies during the planning stage identified throughout the case study review.

4.9 Public Nuisance Abate Methods – Construction Stage before Receiving a Complaint

The next question was “What are the public nuisance abate methods that the site has implemented during the construction stage of the project, before it led to a public complaint?” Accordingly, this section demonstrates the mitigating strategies implemented during the construction stage of the urban construction projects. Table 4.10 illustrates the Public Nuisance mitigation strategies taken during the construction stage.

Table 4.10: Public Nuisance Mitigation Strategies - Construction Stage

Case A	Case B	Case C
A1: Use of sound barrier fence along with the site premises, use of gunny bags	B1: Sound – we have monitored the sound level according to CEA regulation	C1: Special design for rainwater piping system to eliminate water spreading, dust barricades improvements, improve

to control the dust penetration A2: A sound barrier wall constructed. Sound monitoring equipment was issued for the site to check constantly in and out sound levels. Tarpaulin used to screen the dust around the site and within apartments whenever dust-creating activities were underway. In addition, staff deployed on constant monitoring. A3: Arranging all kinds of noisy works during day time	Dust – cover the area by using appropriate materials B2: For sound – we have monitored the sound level according to CEA regulation Dust – cover the area by using appropriate measures B3 Mosquito breeding – removing stagnated rain water on daily basis	noise control actions, issues mitigating when night works are being executed C2: Checklist and regular inspection, Neighbour complaints register, delegated officer to handle them, awareness programme among site workers. C3: Construct a sound barrier fence along the site premises and use gunny bags at dust generating locations.
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In referring to Case A, A1 has highlighted that during the construction phase, before receiving public complaints, the site has implemented a sound barrier fence to control noise pollution and used gunny bags to control the dust penetration. A2 stated that they have deployed staff to monitor and spot public nuisance activities during the construction phase. As per A3, arranging all kinds of noisy works during the daytime, avoiding them after 6.00 pm, and the availability of competent tower crane operators and signal workers to avoid failure of lifting activities are the key measures taken during the construction phase.

In moving to Case B, B1 and B2 uttered same strategies. According to them, they had monitored the sound level according to CEA regulations and had covered the area by using appropriate measures such as using GI sheet cladding, timber boards. B3 highlighted that they removed the stagnated rain water daily to prevent mosquito breeding.

In Case C, C1 pointed out that that had a special design for rainwater piping system to eliminate water spreading, improved noise control actions and dust control mechanism to minimise public nuisance within the construction stage. C2 uttered that they had a checklist of activities which reason for public nuisance and regular inspection was done to minimise the effect of them. Further, neighbour complain register was also maintained and a person was appointed to handle them. Most importantly, they had

conducted an awareness programme to the workers of the site to minimise public nuisance issues due to their day-to-day operations within the site. C3 said that they constructed a sound barrier fence along the site premises and used gunny bags at dust generating locations.

As a summary, guiding the workers, regular inspection and executing the planned actions can be highlighted as common approaches to mitigate Public Nuisance within the construction stage of urban construction projects.

4.10 Public Nuisance Abate Methods After Receiving Public Complains

The researcher then questioned about the public nuisance abate methods that the site has implemented during the construction stage of the project, but after a public complaint. Table 4.11 summarises the mitigation strategies taken by the site management after receiving a public complaint regarding a public nuisance.

Table 4.11: Public Nuisance Mitigation Strategies - After Public Complains

Case A	Case B	Case C
A1: Delay of sound-generating work during morning time and early stoppage during the evening A2: We managed to maintain communication links with the residents around the site through rough telephone links so that the residents are able to make their complaints directly to us for our prompt action. A3: Discuss with the complainer and ask for a solution from their side, and maintain records as customers complain. Discuss with all the parties who can manage the nuisance and achieve a solution for the problem elevated.	B1: Immediately take action to mitigate/stop the customer complaint B2: Create social media (WhatsApp) group Brief workers in morning meeting related current issues Improve mitigation systems (used double nets for demolition areas) B3: Create social media (WhatsApp) group Brief workers in morning meeting related current issues Improve mitigation systems (used double nets for demolition areas.	C1: Quick actions have been taken in every event of the complaints, shifting the activities from the place where they operate to minimize the sounds C2: Limit sound generating activities to 8.30 am to 6.00 pm C3: Limit sound generating activities to 8.30 am to 6.00 pm

A1 indicated “*delay of sound-generating work during morning time and early stoppage during evening*” as further actions taken by the site management after public complaints received related to noise. A2 especially highlighted “*maintain communication links with the residents*” via phones, as a strategy that they have implemented enabling neighbours to complain about the public nuisance issues and take prompt actions. As per A3, first discussing with the complainer and asking for a solution before the company provides a one is successful.

In referring to Case B, B1 said if there was such complain from the public, they immediately taken actions related to the complaint and built up the confidence on them about the flexible complain handling process. B2 and B3 highlighted the same points and in accordance with them, if there was such complain from the public, they informed it to all labours and staff through the “WhatsApp” groups they had created. Further, they had briefed the issue and the actions taken related to the complaint at the morning meeting of the workers. Moreover, some precautionary actions had been taken such as using double nets for demolition areas.

In moving to Case C, C1 uttered that they even had taken immediate actions regarding the complains as it was highlighted by B1. C2 and C3 said the higher noise generating activities were limited to 8.30 am – 6.00 pm.

As a summary, all sites have taken immediate measures to address public nuisance complaints by informing the management and the site worker regarding the actions.

4.11 Strategies to Mitigate Public Nuisance in Urban Construction Projects

The 23rd question of the data collection instrument was based on the strategies use to mitigate the public nuisances. The strategies were identified from literature and presented to respondents to identify the strategies used in the case study project and strategies used in the past projects that they have involved. The research findings are discussed under below 7 types of nuisances.

4.11.1 Noise and Vibration

Strategies to mitigate noise and vibration proposed by the respondents of all 3 cases are summarised in Table 4.12.

Table 4.12: Strategies used to mitigate noise and vibration

Strategies	Cases			Past experience of Respondents
	A	B	C	
Synchronize the timing of noise operations	x	x	x	A2 A3 B1 B2 B3 C1 C2
Use advanced technology with improved motor insulation and mufflers	x	x	x	A2 A3 B1 B2 B3 C1 C2 C3
Limit the use of especially noisy equipment	x	x	x	A1 A2 A3 B1 B2 C1 C3
Enclose noisy operation or stationary equipment	x	x	x	A1 A2 A3 B1 B2 C1 C3
Install noise barriers or curtains	x	x	x	A1 A2 B1 B2
Implement strategies for communication, tracking, and compliance and put them into practice	x	x	x	A2 A3 B1 B2
Imaginative acoustic design		x		B1 B3

In case A, they have synchronized the timing of noise operations to control the impact of noise and vibration. Accordingly, they had carried out the noise generating activities only a certain time frame. Further, they have given instruction to all the staff to start excessive noisy works from 8.30 am to 6.00 pm on weekdays and avoided using machineries on Sundays and public holidays. Respondents A2 and A3 mentioned that they had followed the same type of strategies in the projects had involved previously. In case B, they also had carried out the noise generating activities only certain time frame. As stated by the respondents, in case C, they had adjusted the working time to operate different machines and carry out work activities. Respondents A2, A3, B1, B2, B3, C1, and C2 mentioned that they had followed the same type of strategies they had involved previously.

According to the respondents, in the three cases, they have used advanced technology with improved motor insulation and mufflers to minimize the impact of noise and

vibration cause due to the project. They have used soundproof generators and concrete pumps to mitigate the noise. In case B, they had controlled the noise and vibration by removing unsuitable machinery to maintain the sound level and reduce unnecessary vibrations. In case C, they have used advanced technology with improved motor insulation and mufflers to minimize the impact of noise and vibration. Further all the members in A, B, and C cases confirmed that they have used the same strategies in their previous projects to reduce the impact of noise and vibration.

Case A have limited the use of noisy equipment. They have used different pre-cut granite & marble and pre-finished timber flooring. In addition, they have used electric machinery rather than pneumatic tools to minimise sound and vibration. In case B, they also have utilized the same procedures. In case C, they have limited the usage and early planned time slot for concrete stationary pump, generators and air compressors. A1, A2, A3, B1, B2, C1 and C3 had utilized the strategies in the projects they have been involved in previously.

In cases A, B and C, they have enclosed noisy operation or stationary equipment to reduce the impact of noise and vibration. Case A had enclosed the generators with soundproof materials. In case B they had covered the area with soundproof materials. Further, in case C they also had covered generators with soundproof materials. A1, A2, A3, B1, B2, C1 and C3 had experience in using the same strategies in their previous projects as well.

Installation of noise barriers or curtains also had done by projects A, B and C. In case A, they had used sound barrier along the perimeter. Project B had installed sound blankets to minimize the noise and vibration. In case C, they had fixed the sound barrier along the site premises. Respondents A1, A2, B1 and B2 had used the same strategies such as gunny bags with a water sprinkler system.

As stated by the respondents, projects A, B and C had implemented strategies for communication, tracking, and compliance and had put them into practice. In case A, they had checked the availability of neighbours and carryout noise generation works accordingly. In case B, they also had adopted the same procedure used by project A.

Respondents A2, A3, B1 and B2 had used strategies such as starting rock blasting after three siren alarm sounds and checking the off-shopping seasons to works near the shopping complex in their previous projects.

In cases A and C, they have not used imaginative acoustic designs to minimize the impact of noise and vibration caused by their project. However, in case B, they had used imaginative acoustic design for the permanent electric generator. Respondents B1 and B3 had applied the same strategies in their previous projects as well.

4.11.2 Odour effect

The strategies used to mitigate odour effect in all three projects are summarized in Table 4.13.

Table 4.13: Strategies used to mitigate odour effect

Strategies	Cases			Past experience of Respondents
	A	B	C	
Direction control	x	x	x	A2 B2
Source control	x	x	x	A2 A3 B2 B3
Initiate construction structure, enclosures, absorptions and barriers	x	x	x	A1 A2 B2 C3
Source regulation	x	x		A1 A2 B2
Position material storage areas away from residential areas and sensitive facilities	x	x	x	A1 A2 A3 B2

In case A, they had adopted direction control strategies to control the odour. They had located garbage bin based on distance of neighbours. In case B, they had used the exhaust well above from neighbours properties. Further, they had removed the human waste by using gully bowers to approved yards regularly. Project C has chosen isolated areas to dispose waste. A2 and B2 respondents had used the same kind of strategies in their previous projects.

As stated by respondents, cases have applied source control methods to control odour. In case A, they had conducted awareness program to reduce food wastage and impose of fines. Moreover, they had disposed food wastage on daily basis with the help of

(CMC). In case B, they had used high efficiency AC for the garbage room to control the source. Further, they had removed the human waste by using gully bowers to approved yards regularly. In project C, enclosed areas have been used to dispose waste. A2, A3, B2 and B3 respondents had applied above mentioned method to control the odour in their previous projects.

In A, B and C cases, they had initiated the construction structure, enclosures, absorptions and barriers to control odour. In case A, they had used of enclosed bins to dispose the garbage. Project B had used odour barrier and had kept the exhaust level well away from the general public living height. Respondents A1, A2, B2 and C3 had applied the same methods such as using of enclosed bins to dispose the garbage in the projects they have participated in previously.

According to the respondents in cases A and B, they had applied source regulation methods to control the odour in the construction site. They had maintained BOD & COD level according to CEA regulations. In case B, they also had maintained BOD level according to CEA regulation. However, in case C, they had not adopted any source regulation strategies to control odour. A1, A2 and B2 had utilized the same approaches in their previous projects as well.

4.11.3 Dust and smoke

The strategies that can be used to mitigate dust and smoke are summarised in Table 4.14.

Table 4.14 Strategies used to mitigate Dust and Smoke

Strategies	Cases			Past experience of Respondents
	A	B	C	
Select the best construction materials and techniques in sensitive areas	x	x	x	A1 A2 A3 B1 B2 C3
Satisfy the criteria of applicable legislation and guidelines	x	x	x	A1 A2 A3
Consider neighbours suggestions and opinions before initiating the project			x	

Implementation of dust management measures	x	x	x	A1 A2 A3 B1 B2 C3
Initiate construction structure, enclosures, absorptions and barriers		x	x	B3

In case A, they had selected the best construction materials and techniques in sensitive areas to minimize the emission of construction dust and smoke. They had carried out the tile cutting work in a separate yard. Further, they had used pre-cut granite & marble, pre-finished timber flooring and nano technology painting for external surfaces. In case B, they had applied all the strategies applied in case A. Apart from that, they also had selected high efficiency diesel generator and used high efficiency paint for the car park floor to control the dust and smoke emission. In case C, they had used prefabricated items to minimize the dust. A1, A2, A3, B1, B2 and C3 had selected the best construction materials and techniques in their previous projects to control the dust and smoke emissions caused due to the construction work.

In all three cases, they had satisfied the criteria of applicable legislation and guidelines to control dust and smoke in the site. A and B cases had followed the guidelines from CEA and got the fire department approval for fire doors.

In order to minimize the dust and smoke emission, only case C had considered neighbours suggestions and opinions before initiating the project. They had sprayed water on the road to control dust on the access road. However, none of the respondents had applied this strategy in their previous projects.

All A, B and C cases had implemented dust management measures to control the dust and smoke emission to the air. Project A had prohibited the burning of waste within site. Further, they had sprinkled water along the access road and carried out core cutting rather instead breaking. In project B they also had implemented the same implanted in case B. In case C, they had covered the building perimeter. Moreover, they had used additional dust control nets to control the dust. Respondents A1, A2, A3, B1, B2 and C3 had applied the above measures in their previous projects.

In cases B and C, they had initiated construction structure, enclosures, absorptions and barriers to control dust and smoke. In case B, they had used wet gunny cloths to cover

dust emission areas. In case C, they had used an air compressor with water inlet for slab cleaning work. Respondent B3 had used wet gunny cloths to cover dust emission areas in his previous projects as well.

4.11.4 Mosquito breeding

The strategies that can be used to mitigate mosquito breeding are summarised in Table 4.15.

Table 4.15: Strategies used to mitigate mosquito breeding

Strategies	Cases			Past experience of Respondents
	A	B	C	
Source control	x	x	x	A1 A2 B2 B3 C3
Source regulation	x	x	x	A1 A2 B2 B3 C3
Consider neighbours suggestions and opinions before initiating the project				
Satisfy the criteria of applicable legislation and guidelines	x	x	x	A1 B2 B3 C3
Responsive urban planning	x	x	x	A1 A2 A3 B2 C3

In order to control mosquito breeding within the site premises, all three projects had used source control strategy. In case A, they had checked water contained areas daily. Further they had put fish into the water tanks. In case B, they had removed all water stagnated area to destroy mosquito breeding places. In case C, a 3rd party had involved to control mosquitos and breeding places on a regular basis. Further, ten workers had involved in cleaning drains to prevent water stagnation. Respondents A1, A2, B2, B3 and C3 had applied the above-mentioned approaches in their previous projects.

All three cases had applied source regulation strategies to prevent mosquito breeding within the site premises. A, B and C projects had followed the guideline given by public health inspector to control the mosquito breeding in their sites. A1, A2, B2, B3 and C3 respondents had adopted the same approaches in the projects they had previously involved.

None of the cases had considered neighbours suggestions and opinions before initiating the project to control the mosquito breeding in their sites. Further, none of the respondents had considered neighbours suggestions and opinions in their previous projects.

In case A, they had satisfied the criteria of applicable legislation and guidelines to control mosquito breeding. At their site, water stagnated areas have been treated in regular basis. Further, the site had been checked by PHI and other relevant authorities. In case B and C, they also had adopted the same approaches adopted by project A. Respondents including A1, B2, B3 and C3 had applied the above-mentioned approaches in their previous projects as well.

In case A and B, they had built perimeter drain & road drain according to the urban planning to minimize mosquito breeding. Project C also had followed the same strategies. Other than that, they had minimized water stagnating points to destroy mosquito breeding places. A1, A2, A3, B2 and C3 respondents had used the same strategies in their previous projects.

4.11.5 Waste

The strategies that can be used to mitigate waste are summarized in Table 4.16.

Table 4.16: Strategies used to mitigate Waste

Strategies	Cases			Past experience of Respondents
	A	B	C	
Community awareness	×	×	×	A2, B1, B2, B3
Satisfy the criteria of applicable legislation and guidelines	×	×	×	A1, A2, A3, B1, B2, C3
Advanced technologies	×	×	×	A2, A3, B1, B2
Establish alternative approaches	×	×	×	A1, A2, A3, B1, B2

In all three Cases, they have used community awareness as a waste reduction strategy. Especially in Cases A and B, they have conducted awareness programs not to use any

chemically treated waste woods (plywood, pallets, etc) and educated the workers to minimize the unnecessary materials/raw material wastage, and SWM. A2, B1, B2, and B3 respondents experienced similar awareness programs in previous projects they have worked.

Out of the total of three cases, the criteria of applicable legislation guidelines were used as a strategy. All three cases have segregated solid waste as per the council regulation as a strategy for satisfying the criteria of applicable legislation and guidelines. Furthermore, A2, A3, B2, and C3 have mentioned that they have similar experience in the previous projects as well. Apart from that Case A and Case B have used the correct colour code bin as per the council regulation and removed the wastage based on local council regulation. Case C has used a special strategy to satisfy the criteria of applicable legislation and guidelines by complying with ISO procedure, taking waste minimizing steps as project objective, logistic handling caring, and waste stagnating procedure were implemented. But none of the respondents in Case C have previously experienced these strategies which were used only on their site.

All the 3 Cases have used different advanced technologies to mitigate waste in their projects. Respondent A1 has mentioned that they use food waste to generate power and fertilizers. Case A and Case B used cutting wizard software for r/f works, system formwork (recyclable aluminium) to minimize wood wastage, and used self-levelling concrete to minimize undulation which is needed to chisel. Further, Case A and Case B respondents have mentioned that they have experienced using the cutting wizard software for r/f works in previous projects they have worked. However, these strategies used in Case A, A3 mentioned he has experience in using garbage chutes to bring garbage from the upper floor to the ground floor in his previous project. When considering Case B, they have used a recyclable formwork system (aluminium) to minimize wood wastage, used hazard-free chemicals as a concrete pumping grout, and imported system formwork instead of conventional plywood formwork. This could use repetitively, and no waste is made, this is sent to recycling to the mother company. Respondent B1 mentioned that petroleum permachannel filter systems, products running to water sources some of his previous experiences of mitigating the wastage

in his previous projects. According to C1, they use this waste management strategy only in the implementation stage of the project. Although there were such practices conducted in Case 3, none of the Case 3 respondents have experienced a similar kind or any other advanced technologies to reduce the wastage in previous projects they have been involved.

Apart from these strategies they have established new approaches in Case A, Case B, and as well as in Case C to reduce the wastage. Such as resale cardboard, coconut shell, off cut metals, etc. for recycling, using pre-cut granite & marble, introducing new strategies to the canteen to minimize food waste, taking care of two pigs for eating food waste, using the old furniture for new projects, used excess concrete to manufacture curbs, paving slabs, etc., lean construction methodologies, providing only required material without any additional material into the working floor, minimizing handling time while providing items to exact location, Reinforcement cutting wizard software was used to reduce the wastages and gas production through food waste. However, some of the respondents had past experience in other projects in using the old furniture for new projects, using dry mixed concrete for curb laying, manhole enhancement to avoid the concrete wastage, used dry mixed concrete for curb laying, and manhole enhancement to avoid the concrete wastage.

4.11.6 Water and Air Pollution

The strategies that can be used to mitigate water and air pollution are summarized in Table 4.17.

Table 4.17: Strategies used to mitigate Water and Air Pollution

Strategies	Cases			Past experience of Respondents
	A	B	C	
Community awareness	×	×	×	
Initiate construction structure, enclosures, absorptions, and barriers	×	×	×	A1, A2, A3, B1, B2, B3, C3
Source regulation	×	×	×	A1, A2, A3, B1, B2, C3
Implementation of dust management measures	×	×		A1, A2, A3, B1, B2, B3, C3

In all three cases, they have conducted awareness programs and educated workers about the importance of water and air quality to minimize water and air pollution but none of the respondents have engaged in such practices in their career before.

Cases A, B, and C have initiated construction structure, enclosures, absorptions, and barriers as a strategy to minimize the water and air pollution. In achieving that they have built of sedimentation tank while dewatering, built a silt trap for perimeter drains used suitable grating for drains, carried out regular service for all plants to increase the efficiency and reduce fuel consumption, used a filtration system before discharging water into water resources, carried out regular service for all plant to increase the efficiency and reduce fuel consumption, built concrete collection pit for concrete truck washing and pump washing. This prevents to flow of grouts into the water body from mixing with rainwater. Further the sites have constructed concrete sewer tanks for workforce toilet waste collecting and regularly emptying by using gully browser to Ceylon Fertilizer Cooperation plants. This prevents both water and air pollution. Regular service and conduct eco tests for machinery that have been used on the site to prevent air pollution. Moreover, the rainwater management system and re-use method was carried out while collecting rainwater and into storage tanks and complies with CEA guidelines when obtaining the relevant certificates. Apart from these strategies some of the respondents had previously experienced numerous other strategies to minimize water and air pollution. Such as a filtration system before discharging water into water resources, used a plant nappy as a spill tray during the construction period to avoid oil entering the water source (The Plant Nappy helps keep your site free of oil spills that may otherwise affect sewage systems and features a reusable absorbent liner that soaks up oil only, separating it from the water), installed petrol interceptor next to last discharge point of stormwater (A petrol interceptor is a trap used to filter out hydrocarbon pollutants from rainwater runoff. It is typically used in road construction and on Petrol Station forecourts to prevent fuel contamination of streams carrying away the runoff).

As another strategy to minimize the water and air pollution, they have implemented dust management measures in each Case. They have checked BOD & COD levels of discharge water, maintained a hard-core access path for vehicles, used a vacuum cleaner together with a sanding machine to absorb the dust, covered the construction area with 2 layers of nets, sprinkled water along the construction area, especially the access road, tyre washing bay use to reduce wheel dust, use vacuumed cleaners to clean the surface dust instead swiping with brooms, avoid harmful causes to water and air pollutions by providing protective nets and barriers use of wetted gunny bags to mitigate dust spreading and used latest machines for wall chasing. However, some of the respondents had past experience in other projects in using of washing bay with filtration, road brush (road sweeping machine) to clean the access road and entrance area from time to time to minimize the dust enter into the project environment.

According to the respondents, they had applied different source regulation methods to minimize water and air pollution. Such as, strictly following the CEA guideline, BOD, and groundwater sample checking, complying with UDA regulations, and strictly following the local authority guidelines. Some of the respondents have gained the same experiences in previous projects by using source regulation methods to minimize water and air pollution.

4.11.7 Money Spent on Public Nuisance Minimisation Actions

In order to properly minimise the Public Nuisance, a certain budget has to be incurred. Therefore, this was raised within each interview. All interviewees mentioned that they had to allocate a budget to complete the public nuisance minimisation actions. Table 4.18 summarises the approximate amount spent on public nuisance mitigation activities.

Table 4.18: Money Spent on Public Nuisance Mitigation Activities

Case A	Case B	Case C
Around 20 million rupees, around 0.15% from the project value.	Approximately 0.5% of the total project value.	Approximately 1.0% of the total project value.

As a summary, all sites have allocated money for handling and minimizing Public Nuisance. According to the overview of respondents, approximately 1% of the budget has been allocated for all three projects. In analysing it further, Case A, Case B and Case C have allocated approximately around 0.15%, 0.5% and 1% of the project value respectively.

4.12 Industry Best Practices for Public Nuisance Minimisation

Respondent A1 highlighted that initiating protocols to understand public nuisance issues before the construction project starts, listing them, identifying possible measures to minimise them while allocating a sufficient budget is mandatory. In addition, the solution should be friendly to the neighbourhood and trying to have a separate location to conduct noise and dust-related work as possible are best industry practices. Further, using wet gunny bags, monitoring noise levels, daily fogging to minimise mosquitos, waste collection and waste treatment are some of the other best practices according to respondents. As per Respondent A3 analysis of environmental and planning law, government policy compliance, knowing neighbours, and understanding the impact on the surrounding are key industry best practices.

4.13 Strategies to Minimise the COVID-19 Related Public Nuisance Issues

This section discusses the strategies taken by the selected sites to minimise the COVID-19 related public nuisance issues. Table 4.19 summarises the strategies taken by each case to minimise the COVID-19 related public nuisance issues.

Table 4.19: Strategies to Minimise the COVID-19 Related Public Nuisance Issues

Case A	Case B	Case C
A1: Made a bio bubble within the site without letting the labours to go out, provide accommodation and canteen facilities inside the site. A2: Only the employees who have at least one dose	B1: Only the employees who have at least one dose of vaccination allowed to enter the site, temperature of all were checked at entrance. B2: temperature of all were checked at entrance, hand	C1: Instructed the site office staff to work at home. C2: Only the employees who have at least one dose of vaccination allowed to enter the site, hand wash and sanitizer facilities were

of vaccination allowed to enter the site. A3: Only the employees who have at least one dose of vaccination allowed to enter the site, hand wash and sanitizer facilities were available for all staff and labours through the day (within the site).	wash and sanitizer facilities were available for all staff and labours through the day (within the site). B3: Instructed the office staff to work at home	available for all staff and labours through the day (within the site). C3: Made a bio bubble within the site without letting the labours to go out, didn't let outsiders to come within the site if there is no such urgency.
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The main COVID-19 related public nuisance was the possibility of outsiders to get affected by the labours inside the site. Therefore, all three selected sites had taken necessary steps to minimise it. In referring to Case A, A1 highlighted that a bio bubble was made inside the construction site and all labours were kept inside without letting them to move out. Further, he uttered that accommodation and canteen facilities were provided to the labours within the site itself. According to him, this made a significant contribution to minimise the COVID-19 related public nuisance issues that could create as there were around 500 labours. A2 pointed out that only the employees (e.g., engineers, Qs, etc.) who had at least one dose of COVID-19 vaccination were allowed to enter the site premises. Then, A3 also raised the same point highlighted by A2 and further he said hand wash and sanitizer facilities were available within the site premises for all staff and labours throughout the day.

In accordance with Case B, B1 raised the same point uttered by A2. B2 pointed out that the temperature of all were checked at entrance within each day. Moreover, he raised that hand wash and sanitizer facilities were also available within the site premises for all staff and labours throughout the day. B3 highlighted that the site office staffs (e.g. Qs, etc.) were instructed to follow the work at home method and this helped a lot to run the office works of the site smoothly as none of the office staff got affected by COVID-19.

C1 highlighted that their site even followed the same strategy highlighted by B3. Next, C2 pointed out that only the employees who have at least one dose of vaccination allowed to enter the site and hand wash and sanitizer facilities were available for all

staff and labours through the day (within the site). In referring to C3, he also raised the same point highlighted by A1.

Other than all above, labours and staff of all three sites had been instructed to remove their masks properly to the arranged bins rather than removing them carelessly to the environment

4.14 Framework for Minimizing Public Nuisance Related Issues in Urban Construction Projects in Sri Lanka

The framework has been developed with the combination of strategies to minimise nuisance, legal applications, and impact of nuisance to minimise the public nuisance in construction industry. The final framework developed by incorporating the research findings is shown in Figure 4.1.

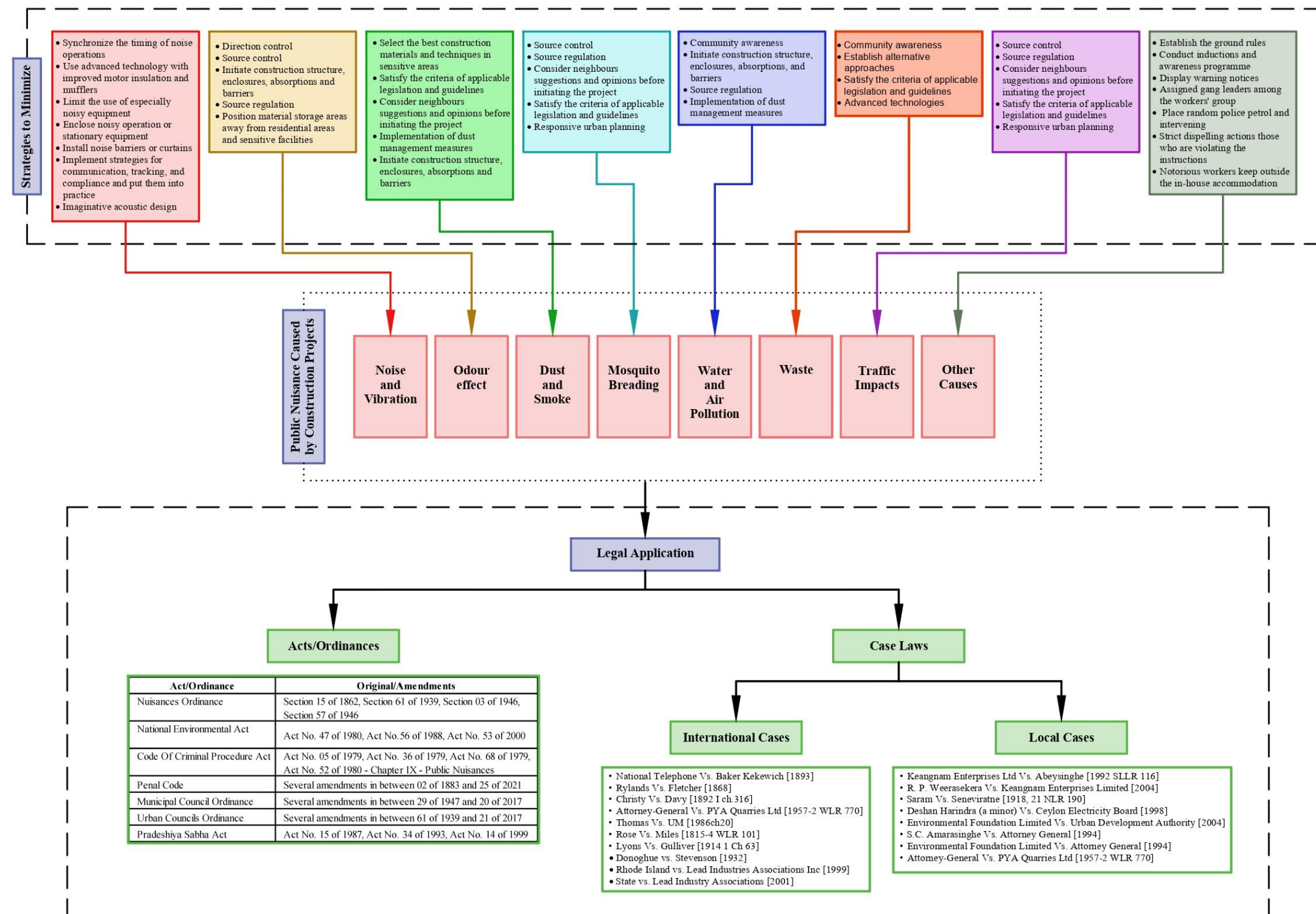


Figure 4.1: Framework for Minimizing Public Nuisance Related Issues in Urban Construction Projects in Sri Lanka

Accordingly, strategies were identified for each public nuisance addressed in the research. Additional to the strategical approaches taken by the construction industry stakeholders' legal implications are generating a horizontal pressure to the public nuisance that influence the construction stakeholder and the neighbours to be vigilant on the public nuisance. Legal applications are consisting both case laws Acts, and ordinances.

Therefore, the combined impact of the strategies and legal applications generate the impact to the nuisance to minimise in the construction projects. Hence, the key concern of the process is to maintain a well-arranged urban construction projects in Sri Lanka with less disturbance to the neighbouring community. Therefore, the project related negative influences, additional costs, and health issues are minimised. Hence, it is the ultimate objective of the research to develop among the construction community in urban construction projects.

Therefore, in the Sri Lanka construction industry majority of the projects are initiated in congested Colombo area where the population density is high. Furthermore, the implication of this research framework is possible to apply in the construction sector to address the current issues among urban construction projects. However, it is the responsibility of the contractor, consultant, and employer to ensure the application of legal provisions and strategical moves to eradicate the public nuisance. This is benefitting both site management and the neighbours to conduct construction process with mutual understanding and less damage.

4.15 Chapter Summary

This chapter discussed the data collection, analysis and the findings. There the data were collected from three cases (three urban construction projects) blended with three semi structured interviews for each case, observations and document reviews. As per the responses in all three cases, public nuisance in construction sector can be considered as a crime and it breaches the rights of the people and there it creates certain bad impacts to the construction projects. Furthermore, proper planning and executing the plans are key concerns in minimizing the impact of public nuisance in urban

construction projects. Moreover, prior identification of the possible impacts, planning precautionary actions, budgetary allocation, and increasing the awareness of the employees within the construction site are effective solutions to minimise public nuisance in urban construction projects.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study developed a framework for minimizing public nuisance-related issues of urban construction projects in Sri Lanka. With the application of the case study method as the research method, semi-structured interviews, observations, and document reviews were adopted to collect data of three different urban construction projects. Then the collected data were analysed with the use of content analysis. Based on the findings gained through the analysis certain conclusions were made. They have been discussed under each objective.

Objective 01 – Review issues related to public nuisance in construction projects and legal provisions available to minimize those issues

According to the literature findings public nuisance is a criminal violation under common law. The construction activities are inherently interfering and noisy. Therefore, construction projects often face issues related to public nuisance. In this study seven issues related to public nuisance in urban construction projects were identified. They were, noise & vibration, dust & smoke, mosquito breeding, odour effect, traffic impact, waste and water & air pollution.

Causing public nuisance is illegal. Therefore, there are legal provisions for the protection of the third party in an occurrence of any circumstances. In Sri Lankan legal framework Nuisances Ordinance (Section 15 of 1862), National Environmental Act (Act No. 47 of 1980), Code of Criminal Procedure Act (Act No. 05 of 1979), Penal Code (02 of 1883), Municipal Council Ordinance (29 of 1947), Urban Councils Ordinance (61 of 1939), and Pradeshiya Sabha Act (Act No. 15 of 1987) and their amendments have provided some legal provisions related to public nuisance in construction projects.

Finally, based on the literature findings, a conceptual model was developed including issues related to public nuisance and legal provisions available to minimise those issues.

Objective 02 – Investigate public nuisance issues and the causes behind the issues in urban construction projects in Sri Lanka

Public nuisance issues faced by the three cases were identified through the expert interviews, document review and observations. According to the respondent's answers, it was identified that noise & vibration, dust & smoke, mosquito breeding, odour effect, traffic impact, waste and water & air pollution had been faced by all three cases. The causes of the above-mentioned public nuisance issues were also identified through the interviews.

Operation of concrete pumping machines, generators and drilling and grinding works were the most common causes behind the noise and vibration issue. The prominent causes of dust and smoke issue were wall chasing, sanding putty for painting, and demolitions. Incomplete concrete tanks, flower buckets, pool area and disposed water containable items were identified as the causes of mosquito breeding issue. According to the respondent's answers, the multiple entering of heavy vehicles to the site had created the traffic congestion. The most common causes of odour effect were the food waste and toilets. Furthermore, large number of people in the construction site had worsened the situation. Construction and food waste were the main causes of the waste issue in all three cases. As stated by the respondents, accommodating large amount of people with the site premises and disposal of chemicals and polluted water had been the major causes behind the water and air pollution issue in all three cases. Hence, it can be concluded that noise generated by machineries, construction operations and labourers, dust and smoke generated from construction and demolition activities, mosquito breeding, odour effect generated from food waste and toilets, traffic congestion due to the use of heavy machineries and vehicles, waste of construction materials and water & air pollution are the main public nuisance issues caused by construction industry. Under the other nuisance related issues, it has identified mainly disruptions from workers behaviors and aggressiveness, issues as results of quarrel and

vandalism, obstruction of sunlight shading patterns, inconvenience with high wind blow through “wind tunnel effects”, disruption during heavy rains and water flow which has given sensitive impacts for surrounding neighbours.

Objective 03 – Determine the impact of the public nuisance in urban construction projects and commonly used legal provisions in Sri Lanka

The third objective of this study was to determine the impact of the public nuisance in urban construction projects and commonly used legal provisions in Sri Lanka. This objective was achieved through the case studies and expert interviews. The impacts of the seven types of issues were discussed separately with the respondents. The urban construction projects had received court injunctions due to the noise & vibration and dust & smoke issues. In addition, the mitigating mechanisms had incurred additional costs and delayed the projects. Mosquito breeding issue also had incurred additional cost to the projects because of the control procedures. In order to mitigate the odour effect and waste issue, they removed the waste from site on daily basis. This procedure had added extra costs to their projects. Water and air pollution issue had caused multiple impacts to the three projects.

Under the other nuisance related issues in line with workers are always attempting to fight with each other their colleague after they drunk while they finished off from the work. Every week ends they are enjoying with singing songs and dance. There are few incidents that neighbours have made complaints, that these people are attempting to enter their premisses in the night in which neighbours were threatening with unsecured feeling. As a result of this issue, project had got delayed. Further mitigating procedures had incurred additional costs in all three cases.

In Sri Lanka, there are several legal provisions related to the public nuisance issues. Nuisances Ordinance, National Environmental Act, Code of Criminal Procedure Act, Penal Code, Municipal Council Ordinance, Urban Councils Ordinance, and Pradeshiya Sabha Act are examples for the commonly used public nuisance related legal provisions in Sri Lanka.

Objective 04 – Propose strategies to minimize the impact of public nuisance issues in urban construction projects in Sri Lanka

In Sri Lanka, the urban construction projects use different types of mechanisms and strategies to minimize the impact of public nuisance. In order to minimise the impact of noise and vibration, the noise generating activities can be carried out in the night. Furthermore, the sites had used soundproof materials and sound barrier and changed the location of the heavy machinery. As the mechanisms to minimise odour effect, they had removed the human, food and construction waste to the approved yards regularly. In addition, the cases had, initiated the construction structure, enclosures, absorptions and barriers to control odour. The urban construction projects had adopted various strategies such as carrying out the tile cutting work in a separate yard, using high efficiency diesel generators and spraying water on road. The mosquito breeding control mechanisms used by the urban projects are, destroying mosquito breeding places, checking the possible breeding places on daily basis and treating water stagnated areas. The urban construction projects had followed several strategies to minimize the waste issue. The major strategies are, educate the workers to minimize the unnecessary materials/raw material wastage, remove the wastage based on local council regulation and resale cardboard, coconut shell, off cut metals etc. for recycling. Similarly, to minimize the water and air pollution, the projects had educated the workers on how to minimize water and air pollution. Moreover, the sites can use filtration system before discharging water in to water resources. In order the eliminate these issues, respondents have been implemented appropriate strategies including establish ground rules, conduct inductions and awareness programme, display warning notices, assigned gang leaders among the workers' group, place random police petrol and intervening, strict dispelling actions those who are violating the instructions, notorious workers keep outside the inhouse accommodation. Further, respondents showed issues as results of obstruction of sunlight shading patterns, inconvenience with high wind blow through “wind tunnel effects”, inconvenience disruption heavy rain and water flow have been influenced nuisance related issues directly. Respondents have showed that, these complaints were managed while securing neighbours misunderstanding while validating its technical aspects.

In conclusion, this research has developed a framework incorporating public nuisance related issues, causes behind them, strategies to minimise the public nuisance issues and legal provisions available to minimise nuisances in urban construction projects in Sri Lanka.

5.2 Recommendations

Based on the research findings, the following recommendations can be made.

- The identified Public Nuisance related issues, causes for them, impacts of those issues for the project and strategies to minimise them can be incorporated within the planning and construction stage of any urban construction project in Sri Lanka to minimise the cost overruns and project delays.
- Adopting the proposed framework for urban construction projects in Sri Lanka as a whole, Sri Lankan construction industry will be benefited with less conflicts and issues due to public and may reason for boosting the reputation of the industry as well.

5.3 Further Research Areas

Following further research areas can be highlighted.

- A framework to minimise public nuisance related issues of road construction projects in Sri Lanka.
- A comparative study on cost and time overrun effects of public nuisance to construction projects.
- A framework to minimise public nuisance related issues of infrastructure projects in Sri Lanka.

REFERENCES

- Abeynayake, M. D. T. E. (2019). Legal Aspects Concerning Sustainable Buildings and Cities Relating to the Urban Development in Sri Lanka. Digital Library, University of Moratuwa. Retrieved from <http://dl.lib.mrt.ac.lk/handle/123/14509>
- Adeoye, D. O. (2016). Challenges of Urban Housing Quality: Insights and Experiences of Akure, Nigeria. *Procedia-Social and Behavioural Sciences*, 216, 260-268. Retrieved from <https://www.sciencedirect.com/science/article/pii/S1877042815062163>
- Anderson, M. (2011). Public nuisance and private purpose: Policed environments in British India, 1860-1947. *SOAS School of Law Research Paper*, (05). Retrieved from https://sci-hub.tw/https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1884551
- Allouche, E. N., Ariaratnam, S. T., & AbouRizk, S. M. (2000). Multi-dimensional utility model for selection of a trenchless construction method. In *Construction Congress VI: Building Together for a Better Tomorrow in an Increasingly Complex World* pp. 543-553. Retrieved from [https://ascelibrary.org/doi/abs/10.1061/40475\(278\)59](https://ascelibrary.org/doi/abs/10.1061/40475(278)59)
- Athapaththu, K. I., & Karunasena, G. (2018). Framework for sustainable construction practices in Sri Lanka. *Built Environment Project and Asset Management*. Retrieved from <https://doi.org/10.1108/BEPAM-11-2016-0060>
- Balaban, O. (2012). The negative effects of construction boom on urban planning and environment in Turkey: unraveling the role of the public sector. *Habitat International* 36(1), 26–35. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0197397511000348>
- Baldwin, A., Poon, C. S., Shen, L. Y., Austin, S., & Wong, I. (2009). Designing out waste in high-rise residential buildings: Analysis of precasting methods and

traditional construction. *Renewable energy*, 34(9), 2067-2073. doi:10.1016/j.renene.2009.02.008.

Bartuska, T. (2007). The built environment: definition and scope. In: Bartuska, T., Young, G. (Eds.), *The Built Environment: A Creative Inquiry into Design and Planning*. Crisp Publications. Retrieved from https://www.academia.edu/37051017/The_Built_Environment_A_Collaborative_Inquiry_Into_Design_and_Planning_2nd_Edi_

Bassett, W. A. (2006). Deviatoric stress: a nuisance or a gold mine?. *Journal of Physics: Condensed Matter*, 18(25), S921. Retrieved from <https://iopscience.iop.org/article/10.1088/0953-8984/18/25/S01/meta>.

Behm, M. (2008). Construction sector. *J. Saf. Res.* 39 (2):175–178. Retrieved from <https://pdfs.semanticscholar.org/b885/9c3f90661f6ebc2a64e51be75c3c878dec41.pdf>

Bishop, P., and Jenkins, V. (2011). Planning and Nuisance: Revisiting the Balance of Public and Private Interests in Land-Use Development. *Journal of Environmental Law*, 23(2), 285–310. doi:10.1093/jel/eqr002.

Breining, M. T., & Phillips, J. J. (2008). *Return on investment in meetings and events*. Routledge. Retrieved from https://books.google.lk/books?hl=en&lr=&id=4kdv9WRZ5wEC&oi=fnd&pg=PR3&dq=Breining,+Phillips+%26+Phillips,+2008&ots=VjmJb3XtQ8&sig=conIEmI5LsOhcv0O3srwSoCprC8&redir_esc=y#v=onepage&q=Breining%2C%20Phillips%20%26%20Phillips%2C%202008&f=false

Brenner, J. F. (1974). Nuisance Law and the Industrial Revolution. *The Journal of Legal Studies*, 3(2), 403–433. doi:10.1086/467519.

Bryson, J. E., & Macbeth, A. (1972). Public Nuisance, the Restatement (Second) of Torts, and Environmental Law. *Ecology IQ*, 2, 241. Retrieved from <https://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?article=1028&context=elq>.

- Butterworth, I. (2000). The Relationship Between the Built Environment and Wellbeing: A Literature Review. The Victorian Health Promotion Foundation (Prepared for the Victorian Health Promotion Foundation. Retrieved from <https://journals.sagepub.com/doi/abs/10.1177/104515950201300203?journalCode=alxa>
- Çelik, T., Kamali, S., & Arayici, Y. (2017). Social cost in construction projects. *Environmental Impact Assessment Review*, 64, 77–86. doi:10.1016/j.eiar.2017.03.001.
- Centre for Good Governance (2006). A Comprehensive Guide for Social Impact Assessment. Retrieved from <http://www.rlarrdc.org.in/images/Guide%20to%20SIA.pdf> Central Government Act, 268 (Indian Penal code 2018).
- Central Government Act, 268 (Indian Penal code 2018).
- Cha, M. J. (1976). An Evaluation of Environmental Policy: With Reference to the Public Nuisance Prevention Law in Korea. *Global Economic Review*, 5(2), 43-62. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/12265087609431844?journalCode=rger19>.
- Chen, J. J. (1996). The impact of public construction investment upon special economic zones - the Chinese experience. *Constr. Manag. Econ.* 14 (2):175–182. *Condensed Matter*, 18(25), S921–S931. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/014461996373610>
- Cheshire, W., and Chester (n.d.) How to prevent nuisance during construction. Retrieved from <https://www.cheshirewestandchester.gov.uk/documents/business/environmental-health/contaminated-land/nuisance-during-construction-work.pdf>.
- Code Of Criminal Procedure Act (1980), http://www.commonlii.org/lk/legis/num_act/cocpa15o1979276/s98.html.

- Davies, P. J., & Wright, I. A. (2014). A review of policy, legal, land use and social change in the management of urban water resources in Sydney, Australia: A brief reflection of challenges and lessons from the last 200 years. *Land Use Policy*, 36, 450–460. doi:10.1016/j.landusepol.2013.09.009.
- Demortier, L. (2008). P values and nuisance parameters. Retrieved from <http://cds.cern.ch/record/1099967/files/p23.pdf>
- Dowling, T. J. (2000). Reflections on Urban Sprawl, Smart Growth, and the Fifth Amendment. *University of Pennsylvania Law Review*, 148(3), 873. doi:10.2307/3312828.
- Edafe, U. (2016). Reflection on the relevance of private and public nuisance in environmental protection. 10.13140/RG.2.1.1965.4804.
- Ellickson, R. C. (1973). Alternatives to Zoning: Covenants, Nuisance Rules, and Fines as Land Use Controls. *The University of Chicago Law Review*, 40(4), 681. doi:10.2307/1599220.
- Ende, L., and Marrewijk, A. (2014). The ritualization of transitions in the project life cycle: A study of transition rituals in construction projects. *International Journal of Project Management*, 32(7), 1134–1145. doi:10.1016/j.ijproman.2014.02.007.
- Ferguson, A. (2012). Qualitative Evaluation of Transportation Construction Related Social Costs and Their Impacts on the Local Community. *The University of Texas*, 22 (5):541–549. Retrieved from <https://rc.library.uta.edu/uta-ir/handle/10106/11165>
- Gangolells, M., Casals, M., Gassó, S., Forcada, N., Roca, X., Fuertes, A. (2009). A methodology for predicting the severity of environmental impacts related to the construction process of residential buildings. *Build. Environ.* 44 (3):558–571. Retrieved from <https://scholar.google.com/citations?user=PQFOXO4AAAAJ&hl=en&oi=sra>

- Gannoruwa, A., and Ruwanpura, J., Y. (2007). Construction noise prediction and barrier optimization using special purpose simulation. 2007 Winter Simulation Conference. doi:10.1109/wsc.2007.4419839.
- Gearty, C. (1989). The place of private nuisance in a modern law of torts. *The Cambridge Law Journal*, 48(2), 214-242. Retrieved from <https://www.cambridge.org/core/journals/cambridge-law-journal/article/place-of-private-nuisance-in-a-modern-law-of-torts/5DCB4DB66E657E99F894BF073F31CBDB>
- George, C. K. (2002). *Basic Principles and Methods of Urban and Regional Planning*. 2.Aufl. Libro-Gem Books, Lagos. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0195925516303419>
- Gevurtz, F. (1977). Obstruction of sunlight as a private nuisance. *California Law Review*. 65, 94.
- Ghertner, D. A. (2011). Nuisance Talk and the Propriety of Property: Middle Class Discourses of a Slum-Free Delhi. *Antipode*, 44(4), 1161–1187. doi:10.1111/j.1467-8330.2011.00956.x.
- Gilchrist, A., Allouche, E. N., & Cowan, D. (2003). Prediction and mitigation of construction noise in an urban environment. *Canadian Journal of Civil Engineering*, 30(4), 659–672. doi:10.1139/l03-019.
- Gilchrist, A., Allouche, E. N. (2005). Quantification of social costs associated with construction projects: state-of-the-art review. *Tunn. Undergr. Space Technol.* 20 (1):89–104. doi:10.1139/l03-019.
- Giyasov, B., & Giyasova, I. (2018). The Impact of High-Rise Buildings on the Living Environment. In *E3S Web of Conferences* (Vol. 33, p. 01045). EDP Sciences. Retrieved from <https://doi.org/10.1051/e3sconf/20183301045>
- Ijigah, E. A., Jimoh, R. A., Aruleba, B. O., Ade, A. B. (2013). An assessment of environmental impacts of building construction projects. *Civil and*

- Environmental Research 3 (1), 93–105. Retrieved from https://www.researchgate.net/publication/269518681_An_Assessment_of_the_Impacts_of_Construction_Projects_on_the_Environment_in_the_Gaza_Strip
- Keating, G. C. (2012). Nuisance as a Strict Liability Wrong. *Journal of Tort Law*, 4(3). Retrieved from <https://academic.oup.com/ojls/article-abstract/39/3/455/5479993?redirectedFrom=fulltext>
- Kim, K., and Kim J. K. (2010) Multi-agent-based simulation system for construction Operations with congested flows. "Automation in Construction", 19(7), 867–74. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0926580510000828>
- Klingsieck, K. B., Grund, A., Schmid, S., & Fries, S. (2013). Why students procrastinate: A qualitative approach. *Journal of College Student Development*, 54(4), 397-412.
- Kramer, R. C., Michalowski, R. J., & Kauzlarich, D. (2002). The Origins and Development of the Concept and Theory of State-Corporate Crime. *Crime & Delinquency*, 48(2), 263–282. doi:10.1177/0011128702048002005
- Kukadia, V., Upton, S., & Hall, D. (2003). Control of dust from construction and demolition activities. Watford, UK: Building Research Establishment. Retrieved from <http://www.shoreclubcommunityinformer.com/PDF/news-paint-Documents/Document-12-BRE-Control-of-Dust-from-Construction-&Demolition%20Activities.pdf>
- Kwon, N., Song, K., Lee, H.-S., Kim, J., & Park, M. (2018). Construction Noise Risk Assessment Model Focusing on Construction Equipment. *Journal of Construction Engineering and Management*, 144(6), 04018034. doi:10.1061/(asce)co.1943-7862.0001480.
- Lewis, T. M. (2004). The construction industry in the economy of Trinidad & Tobago. *Constr. Manag. Econ.* 22 (5):541–549. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/0144619042000190234>

- Liability Vibrations Due to Building Operations. *The Cambridge Law Journal*, Vol. 2, No. 1 (1924), pp. 111-113. Retrieved from <https://www.jstor.org/stable/i407046>
- McLaren, J. P. S. (1983). Nuisance law and the industrial revolution – some lesson from social history. *Oxford Journal of Legal Studies*, 3(2), 155–221. Retrieved from <https://sci-hub.tw/https://academic.oup.com/ojls/article-abstract/3/2/155/1543610>
- Marin, D., Cockerell, M., Sarsby, R., Ororke, G., & Hunter, G. (1980). Discussion, Road Construction Noise Measurements, Predictions and Controls. *Proceedings of the Institution of Civil Engineers*, 68(3), 533–538. doi:10.1680/iicep.1980.2252.
- Matthews, J. C., Allouche, E. N., Sterling, R. L. (2015). Social cost impact assessment of pipeline infrastructure projects. *Environ. Impact Assess. Rev.* 50:196–202. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S0195925514001036>
- Medlock, J. M., & Vaux, A. G. (2014). Colonization of a newly constructed urban wetland by mosquitoes in England: implications for nuisance and vector species. *Journal of Vector Ecology*, 39(2), 249-260. Retrieved from <https://onlinelibrary.wiley.com/doi/full/10.1111/jvec.12099>.
- Mix, T. L., & Shriver, T. E. (2007). Neighbours, nuisances and noxious releases: Community conflict and environmental hazards in the atomic city. *The Social Science Journal*, 44(4), 630-644. doi:10.1016/j.sosci.2007.10.004.
- Mohit, M. A. (2013). Quality of life in natural and built environment – an introductory analysis. *Procedia -Social and Behavioral Sciences* 101:33–43. Retrieved from <https://www.sciencedirect.com/science/article/pii/S1877042813020715>
- Municipal Council Ordinance (2017), <https://www.srilankalaw.lk/Alphabetical-List-of-Statutes/municipal-councils-ordinance.html>.

- Myers, D. (2013). *Construction Economics: A New Approach*. third ed. Routledge.
Retrieved from file:///C:/Users/MacBook%20Pro/Downloads/9780203384435_googlepreview%20(1).pdf
- Nanayakkara A. (2009). Chapter 2: Environmental Laws, Institutions and Mechanisms: An Overview, In Gomez M. (Eds.), *Judges & Environmental Law: A Handbook for the Sri Lankan Judiciary* (pp. 73-98). Environmental Foundation Limited.
- Najafi, M., Gokhale, S. (2005). Social costs of utility construction: a life cycle cost approach - access engineering from McGraw-Hill. In: Najafi, M. (Ed.), *Trenchless Technology: Pipeline and Utility Design, Construction, and Renewal*. Odour Nuisance of Railway Sleepers Saturated with Creosote Oil. Retrieved from https://scholar.google.com/citations?user=BA_KcGoAAAAJ&hl=en&oi=sra
- Naoum, S. G. 1998, *Dissertation Research and Writing for Construction Students*, Butterworth-Heinemann, Oxford, UK.
- National Environmental Act (2000), <https://www.srilankalaw.lk/Volume-VI/national-environmental-act.html>.
- Nuisances Ordinance (1946), <https://www.srilankalaw.lk/Volume-VI/nuisances-ordinance.html>.
- Ofori, G. (2002, May). Construction industry development for disaster prevention and response. In *Proceedings of i-Rec Conference on Improving Post-Disaster Reconstruction in Developing Countries* (pp. 23-25). Retrieved from <http://www.grif.umontreal.ca/pages/i-rec%20papers/ofori.pdf>
- Osei, V. (2013). The construction industry and its linkages to the Ghanaian economy-polices to improve the sector's performance. *International Journal of Development and Economic Sustainability*, 1(1), 56-72. Retrieved from <https://pdfs.semanticscholar.org/80e8/e45bcb8be45a2dc11520c013a1f5d5326b5f.pdf>

- Pam, A. A., & Garba, Y. (2019). Examination of the Legal Regulation on Noise Pollution in Nigeria. Available at SSRN 3416436. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3416436
- Pearce, D. (2003). The social cost of carbon and its policy implications. *Oxford review of economic policy*, 19(3), 362-384. Retrieved from <https://doi.org/10.1093/oxrep/19.3.362>
- Penal Code (2021), <https://www.srilankalaw.lk/Volume-VI/penal-code-ordinance.html>.
- Perera, N. G. R., Emmanuel, M. P. R., & Mahanama, P. K. S. (2013). Projected urban development, changing “Local Climate Zones” and relative warming effects in Colombo, Sri Lanka. In International Conference on “Cities, People and Places”- ICCPP. Retrieved from https://www.researchgate.net/profile/Narein-Perera/publication/285396866_Projected_urban_development_changing_'Local_Climate_Zones'_and_relative_warming_effects_in_Colombo_Sri_Lanka/links/565dc78d08ae1ef9298363a0/Projected-urban-development-changing-Local-Climate-Zones-and-relative-warming-effects-in-Colombo-Sri-Lanka.pdf
- Polonsky, M. and D. Waller (2011): Designing and managing a research project. Sage: London. Retrieved from https://www.scirp.org/html/3-2120398_47651.htm
- Pradeshiya Sabha Act (1999), <https://citizenslanka.org/wp-content/uploads/2016/02/Pradeshiya-Sabhas-Act-No-15-of-1987-E.pdf>.
- Pucker, J., Allouche, E. N., Sterling, R. L., 2006. Social Costs Associated with Trenchless Projects: Case Histories in North America and Europe. North American Society for Trenchless Technology No-Dig. Retrieved from <https://pdfs.semanticscholar.org/88b2/44cd0dfe208430bba86cd0389d9adf5a604e.pdf>
- Rahman, S., Vanier, D. J., Newton, L. A. (2005). MIIP Report: Social Cost Considerations for Municipal Infrastructure Management. NRC Publications Archive, Ottawa. Retrieved from <https://www.researchgate.net/publication/>

- Ramachandra, T., Rameezdeen, R. (2006). Study of linkages between construction sector and other sectors of the Sri Lankan economy. *Built Environ.* 6 (2):1–15. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.163.1561>
- Rayman, S., & Lunau, J. (2015). Navigating the Jungle: Private Nuisance and Renewable Energy Projects. *Journal of Environmental Law and Practice*, 27(3), 253. Retrieved from <http://rbllp.com/wp-content/uploads/content/pdf/E11v2%20-%20Navigating%20the%20Jungle.pdf>
- Sarsby, R. (1978). Construction Noise Study - M67 Hyde bypass. *Proceedings of the Institution of Civil Engineers*, 64(4), 539–551. doi:10.1680/iicep.1978.2691.
- Sassi, P. (2016). Built Environment Sustainability and Quality of Life (BESQoL) assessment methodology. *Engaging Stakeholders in Education for Sustainable Development at University Level World Sustainability Series*, pp. 21–32. Retrieved from https://link.springer.com/chapter/10.1007/978-3-319-26734-0_2
- Schexnayder, C. J. (1999). Dealing with Nighttime Construction Nuisances. *Practice Periodical on Structural Design and Construction*, 4(2), 77–82. doi:10.1061/(asce)1084-0680(1999)4:2(77).
- Sev, A. (2009). How can the construction industry contribute to sustainable development? A conceptual framework. *Sustainable Development* 17(3), 161–173. Retrieved from <https://onlinelibrary.wiley.com/doi/abs/10.1002/sd.373>
- Sevinsky, J. A. (1990). *Natural Resources & Environment*, Vol. 5, No. 1, Two Decades of Environmental Law (Summer 1990), pp. 29-32, 58-60. Published by: American Bar Association. Retrieved from <https://www.jstor.org/stable/40923880>

- Smith, M., Thorpe, R., Jackson, P., & Lowe, A. (2008). *Management research: theory and practice*. Sage Publications Ltd., London, UK, 101, 210. Retrieved from <https://ireadnow.me/show/management-research-theory-and-practice-paperbac.html>
- Sofer, M., Potchter, O., Gnaim, N., & Gnaim, J. M. (2012). Environmental nuisances from industrial activities in residential areas of Arab municipalities in Israel. *Applied Geography*, 35(1-2), 353-362. doi:10.1016/j.apgeog.2012.08.005.
- Spillane J, P., Flood, M., Oyedele, L, O., Meding, J, K., Konanahalli, A. (2013) Urban high-density construction sites and their surrounding community: issues encountered and strategies dopted by contractors in: Smith, S.D and Ahiaga-Dagbui, D.D (Eds) Procs 29th Annual ARCOM Conference, 2-4 September 2013, Reading, UK, Association of Researchers in Construction Management, 871-880. Retrieved from https://www.researchgate.net/publication/289243035_Urban_high-density_construction_sites_and_their_surrounding_community_Issues_encountered_and_strategies_adopted_by_contractors
- Strijker, D., Bosworth, G., & Bouter, G. (2020). Research methods in rural studies: Qualitative, quantitative and mixed methods. *Journal of Rural Studies*, 78, 262-270.
- Suter, A. H. (2002). Construction noise: exposure, effects, and the potential for remediation; a review and analysis. *Aiha Journal*, 63(6), 768-789. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/15428110208984768>
- Szulczyński, B., Wasilewski, T., Wojnowski, W., Majchrzak, T., Dymerski, T., Namieśnik, J., & Gębicki, J. (2017). Different ways to apply a measurement instrument of e-nose type to evaluate ambient air quality with respect to odour nuisance in a vicinity of municipal processing plants. *Sensors*, 17(11), 2671. doi:10.3390/s17112671.
- Urban Councils Ordinance (2017), <https://www.srilankalaw.lk/Alphabetical-List-of-Statutes/urban-councils-ordinance.html>.

- Taherdoost, H. (2016). Sampling methods in research methodology; how to choose a sampling technique for research. How to Choose a Sampling Technique for (April 10, 2016). Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3205035
- Vafai, H., Parivar, P., Sehat Kashani, S., Farshforoush Imani, A., Vakili, F., & Ahmadi, G. (2020). Environmental impact analysis of high-rise building for resilient urban development. *Scientia Iranica*. Retrieved from http://scintiairanica.sharif.edu/article_21908_b303cd3c77f90e35771f5e1b2a27b2de.pdf
- Wang, J., Li, Z., & Tam, V. W. Y. (2014). Critical factors in effective construction waste minimization at the design stage: A Shenzhen case study, China. *Resources, Conservation and Recycling*, 82, 1–7. doi:10.1016/j.resconrec.2013.11.003.
- White, N. J. (2010). Lead Paint Is Not a Public Nuisance. *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 2(2), 132-133. doi:10.1061/(asce)la.1943-4170.0000013.
- Wilke, A. B. B., Caban-Martinez, A. J., Ajelli, M., Vasquez, C., Petrie, W., & Beier, J. C. (2019). Mosquito Adaptation to the Extreme Habitats of Urban Construction Sites. *Trends in Parasitology*. doi:10.1016/j.pt.2019.05.009.
- Woskie, S.R., Kalil, A., Bello, D., Virji, M.A. (2002). Exposures to quartz, diesel, dust, and welding fumes during heavy and highway construction. *AIHA J.* 63 (4):447–457. Retrieved from <https://doi.org/10.1080/15428110208984733>
- Xueqing, W., Bingsheng, L. L., Allouche, E. N., Xiaoyan, L. (2008). A practical bid evaluation method considering social costs in urban infrastructure projects. 2008 4th IEEE International Conference on Management of Innovation and Technology 2000. IEEE: pp. 617–622. Retrieved from <https://ieeexplore.ieee.org/abstract/document/4654436>

- Yin, R. K. (2014). *Case Study Research: Design and Methods* (5th edn.). Thousand Oaks, CA: SAGE Retrieved from <https://evaluationcanada.ca/system/files/cjpe-entries/30-1-108.pdf>
- Yu, W. D., Lo, S. S. (2005). Time-dependent construction social costs model. *Constr.Manag.Econ.* 23 (3):327–337. Retrieved from <https://www.tandfonline.com/doi/abs/10.1080/01446190500040281>
- Abidin, N. Z. (2010). Investigating the awareness and application of sustainable construction concept by Malaysian developers. *Habitat International*, 34(4), 421-426, Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S019739750900099X>.
- Zubair, L. (2001). Challenges for environmental impact assessment in Sri Lanka. *Environmental Impact Assessment Review*, 21(5), 469-478. Retrieved from [https://doi.org/10.1016/S0195-9255\(01\)00081-6](https://doi.org/10.1016/S0195-9255(01)00081-6)

Annexure A – Data Collection Instrument

COVERING LETTER

Saman Indrajith Mahawatta,
M.Sc. in Construction Law and Dispute Resolution,
Department of Building Economics,
University of Moratuwa

10th October 2021

Dear Sir/Madam,

Data Collection Instrument for the thesis on “A Framework to Minimise Public Nuisance Related Issues Of Urban Construction Projects in Sri Lanka”

I am Saman Mahawatta, a postgraduate of the Department of Building Economics, University of Moratuwa. I conduct the research on the above-stated topic for the fulfilment of the research in my postgraduate degree under the supervision of Prof. Yasangika Sandanayaka of the Department of Building Economics, University of Moratuwa.

The research is conducting for the identification and assessment of public nuisance occurring in the Sri Lankan urban construction projects. Even public nuisance is less concerned in the Sri Lankan context, it has a higher impact on the project progress in urban construction projects. Hence, this research focuses to identify effective methods to minimise public nuisance and developing a framework to minimise public nuisance related issues in urban construction projects in Sri Lanka.

This semi-structured interview guideline is developed to obtain the relevant information to achieve the research objectives and fill the knowledge gap. This interview will be conducted approximately for 30-40 minutes and note taking and voice recording will be done only with your fullest consent.

I assure that the information collected and the content discussed will be used only for research purpose. Furthermore, all the information gathered will be treated confidentially. The information shared and the time dedicated despite the busy schedule is highly appreciated.

Thank You,

Yours faithfully,
Saman Indrajith Mahawatta
saman@maga.lk
077-7309547

INTERVIEW GUIDELINE

PRELIMINARY SECTION A – INTERVIEWEE DETAILS

1. Name (Optional) :
2. Designation :
3. Professional experience (no. of years) :

PRELIMINARY SECTION B – PROJECT DETAILS

4. Project name (Optional) :
5. Location :
6. Gross floor area :
7. Land extent :
8. Building height :
9. No. of floors :
10. Building purpose and details :
11. Project duration (start and finish date) :

SECTION I – PUBLIC NUISANCE

12. According to your opinion, what is a public nuisance?
13. Is public nuisance a crime? What is your opinion?
14. Have you experienced any public nuisance related issues at the site?
15. Do you have any established procedure for the public to make complaints? Can you please explain?

16. When there is a public complaint, how do you handle public nuisance related issues at the site?

17. Who is responsible for handling the public nuisance related issues at the site?

18. Do you aware of the laws, rules and regulations that govern public nuisance related issues? If 'Yes', can you briefly explain them.

19. (a) Have you experienced the below public nuisance at your site? Please state Yes or No.

(b) If 'Yes', can you briefly explain the issue that you have faced?

(c) What are the causes for the above identified public nuisances that you have experienced at the site? Briefly explain.

(d) What are the impacts of those public nuisances towards the project that you have experienced at the site? Briefly explain.

Public Nuisance	(a) Yes/No	(b) Nature of the issue	(c) Causes behind the issue	(d) Impact of the issue
Noise and vibration	Yes/No			
Dust and smoke	Yes/No			
Mosquito breeding	Yes/No			
Traffic impacts	Yes/No			
Odour effect	Yes/No			
Waste	Yes/No			
Water and air pollution	Yes/No			
Obstruction of sun light	Yes/No			
Community issues by the construction workers	Yes/No			

SECTION II – STRATEGIES TO MITIGATE

20. What are the public nuisance abate methods that you have planned during the planning stage of the project?
21. What are the public nuisance abate methods that you have implemented during the construction stage of the project before it leads to a public complaint?
22. What are the public nuisance abate methods that you have implemented during the construction stage of the project, after a public complaint?
23. (a) Have you used the below strategies to mitigate public nuisances in your construction project? Briefly explain with examples.
- (b) Do you have experience in using the below strategies to mitigate public nuisances in past projects? Briefly explain with examples.

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Noise and vibration		
Use advanced technologies with improved motor insulation and mufflers		
Imaginative acoustic design		
Implementation of Monte Carlo simulation model		
Select the best construction materials and techniques in sensitive areas		
Analysis of the responsive noise receptors during the project design phase		
Determination of background noise for each responsive receptor		
Limit the use of especially noisy equipment		
Synchronize the timing of noise operations		
Predictive analysing for expected noise levels of each equipment		
Odour effect		
Pushing the source equipment further away from the detector		
Source control		

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Source regulation		
Direction control		
Position material storage areas away from residential areas and sensitive facilities		
Dust and smoke		
Initiate construction structure, enclosures, absorptions and barriers		
Continuous water addition		
water suppression		
Use of screens		
Task rotation		
Mechanical ventilation		
Mosquito breeding		
Rules and regulations		
Clear stagnant water regularly		
Applying anti-mosquito oil		
Store building material under shelter		
Avoid the use of canvas to cover material		
Dispose of demolished debris regularly		
Covering tanks and drums		
Replacing damaged barriers		
Periodically pumping water out of trenches		
Regarding uneven drains and channels		
Water and air pollution		
Use of on-site plant and vehicle		
Use of recycling option		
Green solutions		
Land clearing and demolition		
Traffic impacts		
Increased incident management		
Long term traffic planning		
Software solution		
Removal capabilities		
Increase law enforcement during construction		
Comprehensive use of ITS technologies		
Work zone traffic simulation		
Lane closure policies		
Waste		
Concern reduction of construction mistakes		
Proper storage		
Implementing recycle and reuse concept at site		
The organised process at the site		

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Precious procurement		
Storing material properly		
Recycle and reusing		
Developing new building methods		
Working with suppliers		
Maintain productive neighbourhood partnerships in tandem with practical initiatives		
Community awareness		
Consider neighbours' suggestions and opinions before initiating the project		

24. How much you had to spend on public nuisance minimisation in your project? State the amount as a percentage of the project value.
25. What are the procedural best practices that you suggest to minimise public nuisance related issues in the construction industry?
26. Has the COVID-19 pandemic led to special public nuisance related issues on your site?
27. What are the actions that you have taken to minimise the COVID-19 pandemic related special public nuisance issues that occurred at your site?

SITE OBSERVATIONS

28. Observation on the below types of nuisances in the construction site.

- Noise and vibration
- Dust and smoke
- Mosquito breeding
- Traffic impacts
- Odour effect
- Waste
- Water and air pollution
- Any other (please state)

29. Observation of the mitigation measures used by the site management to minimise the effect of the above types of nuisances in the construction site.

30. Any other observations.

DOCUMENTS REVIEW

31. Documents maintained by the construction site to record public nuisance related issues, complaints and mitigation measures in the site.

32. Procedures established by the construction organisation to mitigate the public nuisance related issues and complaints in construction projects.

33. Public nuisance related clauses and cost items in the contract document.

.....

34. Any other documents reviewed

.....

THANK YOU FOR YOUR TIME AND CONTRIBUTION

Annexure B – Interview Transcript

COVERING LETTER

Saman Indrajith Mahawatta,
M.Sc. in Construction Law and Dispute Resolution,
Department of Building Economics,
University of Moratuwa

10th October 2021

Dear Sir/Madam,

Data Collection Instrument for the thesis on “A Framework to Minimise Public Nuisance Related Issues Of Urban Construction Projects in Sri Lanka”

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This semi-structured interview guideline is developed to obtain the relevant information to achieve the research objectives and fill the knowledge gap. This interview will be conducted approximately for 90 minutes and note taking and voice recording will be done only with your fullest consent.

I assure that the information collected and the content discussed will be used only for research purpose. Furthermore, all the information gathered will be treated confidentially. The information shared and the time dedicated despite the busy schedule is highly appreciated.

Thank You,

Yours faithfully,
Saman Indrajith Mahawatta
saman@maga.lk
077-7309547

INTERVIEW GUIDELINE

PRELIMINARY SECTION A – INTERVIEWEE DETAILS

1. Name (Optional) : xxxxxxxxxxx
2. Designation : xxxxxxxxxxx
3. Professional experience (no. of years) : 07

PRELIMINARY SECTION B – PROJECT DETAILS

4. Project name (Optional) : xxxxxxx
5. Location : Colombo 07
6. Gross floor area : 84,050.0 m²
7. Land extent : 161 perch
8. Building height : 159 metres
9. No. of floors : 36
10. Building purpose and details : Residential, condominium apartments
11. Project duration (start and finish date) : 04 ½ Years (Nov'2017 - June'2022)

SECTION I – PUBLIC NUISANCE

12. According to your opinion, what is a public nuisance?
A public nuisance is a wrong done to a person or group of people by another unlawfully disturbing the former in his enjoyment of his property or his personal space or in some senses in the enjoyment of a common right.
13. Is public nuisance a crime? What is your opinion?
Since it breaches the common right of a person, yes it is a criminal wrong
14. Have you experienced any public nuisance related issues at the site?
Normally, every construction site in urban areas specially in heart of Colombo we can experience a public nuisance due to its limited space and congested nature. So yes, we do experience.
15. Do you have any established procedure for the public to make complaints? Can you please explain?
We are generally maintaining a complain register at Site so anybody can make their complains in that register. Further, we have identified the critical neighbourhood of the Project and have made a social media group so they can easily deliver their complains using social
16. When there is a public complaint, how do you handle public nuisance related issues at the site?

Once we received any complain regarding public nuisance, genuinely we are act upon that. We try to find the route course and take immediate actions to stop that activity and try to do remedial method to continue that activity without affecting to Site progress.

17. Who is responsible for handling the public nuisance related issues at the site?

We have specially appointed a separate safety officer to handle these complains to have a better solution

18. Do you aware of the laws, rules and regulations that govern public nuisance related issues?

If 'Yes', can you briefly explain them.

National Environmental Act of 1980 & Nuisances Ordinance

19. (a) Have you experienced the below public nuisance at your site?

Please state Yes or No.

(b) If 'Yes', can you briefly explain the issue that you have faced?

Generation of noise more than the permitted limit (Generally the limit permitted by CEA is not practical). We use wet gunny bags and exhaust fans to control dust penetration from Site to outside premises.

(c) What are the causes for the above identified public nuisances that you have experienced at the site? Briefly explain.

Most vital public nuisance will be higher noise level. It can be occurred due to use of more grinding machines, steel and tile cutting work.

Major after cause from these public nuisances will be legal action against the Site. It can be injunction or any court case. Apart from that we are make sure to delay the noise generating work as much as possible without disrobing their personal space during morning time and evening and night

(d) What are the impacts of those public nuisances towards the project that you have experienced at the site? Briefly explain.

Public Nuisance	(a) Yes/No	(b) Nature of the issue	(c) Causes behind the issue	(d) Impact of the issue
Noise and vibration	Yes/No	Complains from Neighbourhood	Due to use of grinding machines, steel and tile cutting work.	Court injunction, Loss of productivity, more labor and machinery idling
Dust and smoke	Yes/No	Complains from Neighbourhood	Grinding, tile cutting and chipping work	Extra cost for dust controlling
Mosquito breeding	Yes/No	This will impact on public as well as site premises	Incomplete concrete tanks, flower buckets, pool area and	Extra cost to control the mosquito breeding. Productivity loss

			disposed water containable items	due to special weekly Site cleaning before commence the Work.
Traffic impacts	Yes/No	Complains from city police	During major concreting work, unloading of materials from large containers.	We have hired a separate land to upload the large container and deliver in small lorries
Odour effect	Yes/No			
Waste	Yes/No		Construction & other wastes	Extra cost to dispose construction and other waste daily basis
Water and air pollution	Yes/No		Dispose of chemicals and polluted water	Extra cost to treat the disposed water before dispose the drainage water to drainage line
Any other (please state)	Yes/No			

SECTION II – STRATEGIES TO MITIGATE

20. What are the public nuisance abate methods that you have planned during the planning stage of the project?

Use of sound proof concrete pumps, covering of generators with sound proof materials, water treatment plant before disposal of drainage water

21. What are the public nuisance abate methods that you have implemented during the construction stage of the project before it leads to a public complaint?

Use of sound barrier fence along the site premises, use of gunny bags to control the dust penetration

22. What are the public nuisance abate methods that you have implemented during the construction stage of the project, after a public complaint?

Delay of sound generating work during morning time and early stoppage during evening

23. (a) Have you used the below strategies to mitigate public nuisances in your construction project? Briefly explain with examples.
- (b) Do you have experience in using the below strategies to mitigate public nuisances in past projects? Briefly explain with examples.

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Noise and vibration		
Synchronize the timing of noise operations	Yes, carry out the noise generating activities only certain time frame	Used robotic machine to minimize the vibration transfer to operatives
Use advanced technology with improved motor insulation and mufflers	Yes, removing unsuitable machineries to maintain the sound level	Used only the approved/branded tools
Limit the use of especially noisy equipment	Yes, used electric machineries rather than pneumatic tools to minimize the sound and vibration Used core cutting	Yes, used electric machineries rather than pneumatic tools to minimize the sound and vibration Used core cutting
Enclose noisy operation or stationary equipment	Yes, covered the area with sound proof materials	Yes, used sound blanket

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Install noise barriers or curtains	Yes, used sound blanket	Yes, especially during night time demolishing next to dense population area
Pushing the source equipment farther away from the detector	Yes, change the machine direction based on wind direction	Yes, keeping the plant and machineries away from the residence area
Artificially generating an equivalent but opposite noise wave, thereby cancelling the sound wave	No	No
Analysis of the responsive noise receptors during the project design phase	No	No
Determination of background noise for each responsive receptor	No	No
Predictive analyzing for expected noise levels of each equipment	No	No
Develop control strategies to reduce the length and effects of the noise generations	Yes, using generator at certain length	Yes, allowed to work only day time near the residence area by fulfilling the regulation
Implement strategies for communication, tracking, and compliance and put them into practice	Yes, check the availability of neighbours and carryout noise generation works accordingly	Yes, checking the off-shopping seasons to works near the shopping complex/schools
Maintain productive neighbourhood partnerships in tandem with practical initiatives	Yes, create social media group with	No

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	neighbours to report their problem quickly	
Community awareness	Yes, Through leaflet and social media	Yes, through social media and radio (specially to divert the traffic)
Source control	Yes, using national grid power as early as possible to mitigate the sound generating from generator Avoiding pneumatic tools to reduce noise	Yes, avoiding pneumatic tools to reduce the noise level Using core cutting rather than the breakers
Initiate construction structure, enclosures, absorptions and barriers	Yes, sound proof barrier along the perimeter of developing area	Yes, sound proof barrier along the perimeter of developing area
Portable noise barrier systems	No	Yes, using the portable barrier for local road improvement area (covering demolishing area)
Contractors show to the public that they genuinely take the necessary steps to reduce noise levels	Yes, by introducing safety net along the perimeter, by covering the	Yes, by maintain the all-boundary wall in proper condition

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	lower-level machineries by using sound barrier	By introduce portable noise barrier
Source regulation	Yes, Maintain sound level according to CEA regulation	Yes, Maintain sound level according to local council regulation
Direction control	Yes, changing the static machine exhaust direction	Yes, changing the static machine exhaust direction
Advanced technologies	Yes, using the sound proof/low sound generating plants	Yes, using the sound proof/low sound generating plants
Imaginative acoustic design	Yes, for permanent electric generator	Yes, for permanent electric generator
Passive design measures (non-noise sensitive buildings such as multi-storey car parks or commercial buildings, podium, architectural fin wall	Yes, used multi-story car park with natural ventilation to escape the sound quickly	Yes, open spaces have been designed
Satisfy the criteria of applicable legislation and guidelines	Yes, maintain sound level as stipulated in the CEA documents	Yes, maintain sound level as stipulated in the local council

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Consider neighbours suggestions and opinions before initiating the project	No	Yes, by contacting the meeting with public through the local council
Any other (please state)		
Odour effect		
Responsive urban planning	No	No
Advanced technologies	Yes, used high efficiency treatment plant for swear/storm water recycling	Yes, used underground settlement tank for solid waste treatment plant
Direction control	Yes, used the exhaust well above from neighbours properties	No
Maintain productive neighbourhood partnerships in tandem with practical initiatives	Yes, time to time getting feedback from neighbourhood	No
Community awareness	Yes, Through leaflet and social media	No
Source control	Yes, using high efficiency AC for garbage room to control the source	

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Initiate construction structure, enclosures, absorptions and barriers	Yes, used odour barrier and keep the exhaust level well away from the general public living height	No
Source regulation	Yes, Maintain BOD level according to CEA regulation	No
Consider neighbours suggestions and opinions before initiating the project	Yes, during the design stage to select the treatment plant location	Yes, by contacting the meeting with public through the local council
Satisfy the criteria of applicable legislation and guidelines	Yes, Obtained necessary approval from the relevant department	Yes, Obtained necessary approval from the relevant department
Passive design measures (non-noise sensitive buildings such as multi-stored car parks or commercial buildings, podium, architectural fin wall	No	No
Position material storage areas away from residential areas and sensitive facilities	Yes, store all waste material that can be created odour away from neighbourhood	No
Select the best construction materials and techniques in sensitive areas	Yes, Odour free paints and	Yes, Odour free paints and

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	finishing materials	finishing materials
Establish alternative approaches	Yes, Installed odour free/less treatment plant	Yes, installed self-sustain Permachannel for car park area that can create less odour
Any other (please state)	No	No
Dust and smoke		
Select the best construction materials and techniques in sensitive areas	Yes, using nano technology painting for external surface selected high efficiency diesel generator Used high efficiency paint for car park floor	Yes, used electrical tool rather than Pneumatic Tools Maintained either soft or hard landscaping to reduce the dust generation Used prefabrication permanent toilets cubes for Prisons
Establish alternative approaches	Yes, used natural ventilation for car park area	Yes, complete first stage of hard landscaping before starting the project to avoid the unnecessary dust
Passive design measures (non-noise sensitive buildings such as multi-stored car	Yes, double glazed glasses	Yes, used prefinished items like cladding,

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
parks or commercial buildings, podium, architectural fin wall	for perimeter doors Installed prefinished timber doors Installed passive fire dedication system	timber door, floor etc.,
Satisfy the criteria of applicable legislation and guidelines	Yes, got the fire department approval for fire doors Installed fire protection system as per the local council regulation	No
Consider neighbours suggestions and opinions before initiating the project	No	No
Direction control	Yes, Keep the emergency power generate exhaust well away from neighbourhood	
Responsive urban planning		
Advanced technologies	Yes, used vacuum cleaner especially with all dust	

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	generating equipment	
Implementation of dust management measures	Yes, sprinkled water along the access road Carried out core cutting rather than breaking	Yes, sprinkled water along the access road Carried out core cutting rather than breaking
Maintain productive neighbourhood partnerships in tandem with practical initiatives	No	No
Community awareness	Yes, awareness the neighbour not to use as a firewood any treated timber (plywood/pallet etc.,)	No
Source control	Yes, used high efficiency generator and other diesel driven engine Installed 121kwh solar panel system to minimize the dust generating from national grid	Yes, stored the heat energy generating from refrigerator operation during night time and supply the same heat energy during the day time for shopping complex
Initiate construction structure, enclosures, absorptions and barriers	No	No

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Any other (please state)	No	No
Mosquito breeding		
Maintain productive neighbourhood partnerships in tandem with practical initiatives	Yes, supplied cape fish to neighbourhood	No
Community awareness	Yes	No
Source control	Yes, removed all water stagnated area	No
Source regulation	Yes, followed the guideline given by public health inspector	No
Consider neighbours suggestions and opinions before initiating the project	No	No
Satisfy the criteria of applicable legislation and guidelines	Yes, checking the site through PHI and other relevant authorities	No
Responsive urban planning	Yes, by maintain nearest water sources	No
Advanced technologies	Yes, used underground utilities to discharge the water	No
Any other (please state)	No	No

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Traffic impacts		
Implement strategies for communication, tracking, and compliance and put them into practice	No	No
Maintain productive neighbourhood partnerships in tandem with practical initiatives	No	No
Consider neighbours suggestions and opinions before initiating the project	Yes, to develop the access road based on peak time of traffic	Yes, through the local council
Avoiding obstruction for the local business entrances	Yes, by arranging the delivery during night time	Yes, avoiding concrete during the football season
Direction control	Yes, kept the entrance and exit facing to separate road (used only one-way traffic) Planned the concrete delivery based on low traffic direction control side	No
Satisfy the criteria of applicable legislation and guidelines	Yes, followed up local council traffic guidelines	Yes, got the local council permission prior to close the road
Responsive urban planning		

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
Advanced technologies	Yes, used PORT (PORT-Personal Occupant Requirement Terminal) technology to manage the vertical traffic inside the building	Yes, used ground loops (Induction loops are coils of wire) to along the road to detect the vehicle density/traffic jam next to traffic lights, accordingly traffic signal timing can be adjusted automatically Installed automatic number plate detecting system to facilitate the entrance gate management
Establish alternative approaches	Yes, avoid concreting heavy traffic time including Monday morning and Friday evening	Yes, avoid the major concrete during the football match time
Any other (please state)		
Waste		
Community awareness	Yes, give awareness programme to not to use any	Educated the workers to minimize the unnecessary

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	chemically treated waste woods (plywood, pallet etc) Educated the workers to minimize the unnecessary materials/raw material wastage and also SWM	materials/raw material wastage
Satisfy the criteria of applicable legislation and guidelines	Yes, Checked BOD level from water resource Removed the wastage based on local council regulation	Yes, segregate all wastage based on the hazarers level
Advanced technologies	Yes, used recyclables formwork system (aluminum) to minimize wood wastage Used hazard free chemical as a concrete pumping grout	Yes, used Permachannel filter system petroleum product running to water source Used hazard free chemical formwork mold release agent.
Select the best construction materials and techniques in sensitive areas	Yes, used recyclables formwork	Yes, used recyclables formwork system

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	system (aluminum) to minimize wood wastage Used LEAD freed paint internal and external walls	to minimize wood wastage Used recyclables gypsum boards as a partition wall
Establish alternative approaches	Yes, resale cardboard, coconut shell, off cut metals etc for recycling Used the old furniture for new projects Used excess concrete to manufacture kerbs, paying slabs etc.,	Yes, resale cardboard, off cut metals etc for recycling Used the old furniture for new projects Used dry mixed concrete for kerb laying, manhole enhancement to avoid the concrete wastage
Any other (please state)		
Water and air pollution		
Implement strategies for communication, tracking, and compliance and put them into practice		
Maintain productive neighbourhood partnerships in tandem with practical initiatives	Yes, by explained the impotency of water and air pollution and	

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	how to reduce both pollution	
Community awareness	Yes, Educated the workers to impotency of water and air quality and also educated to how to minimize the both pollution	
Source control	Yes, Checked BOD level from water resource Cleaned and maintained the water pond next to site Completely cover the demolition area Used core cutting rather than breaking stop the dust	Build it Right at First Time to avoid unnecessary cutting, grinding and dust creations etc., Completely cover the demolition area to dust enter in to the environmental Used core cutting rather than breaking to stop the dust
Initiate construction structure, enclosures, absorptions and barriers	Yes, used filtration system before discharging water in to water resources Carried out regular service	Yes, used plant nappy as a spill tray during the construction period to avoid oil enter in to water source (The Plant Nappy

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	for all plant in order to increase the efficiency and reduce fuel consumption	helps keep your site free of oil spills that may otherwise affect sewage systems and features a reusable absorbent liner that soaks up oil only, separating it out from water) Installed petrol interceptor next to last discharge point of storm water (A petrol interceptor is a trap used to filter out hydrocarbon pollutants from rainwater runoff. It is typically used in road construction and on Petrol Station forecourts to prevent fuel contamination of streams carrying away the runoff) Carried out regular service for all plant in order to increase the efficiency and

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
		reduce fuel consumption
Source regulation	Yes, strictly followed the CEA guideline	Yes, strictly followed the local regulation and guideline
Implementation of dust management measures	Yes, covered construction area with 2 layers of nets Sprinkled water along the construction area especially access road Maintain hard-core access path for vehicle Used vacuum cleaner together with sanding machine to absorb the dust	Yes, reduce direct fuel driven plant and used electric operated machineries Maintain hard-core access path for vehicle Used road brush (road sweeping machine) to clean the access road and entrance area time to time to minimize the dust enter in to the environmental
Consider neighbours suggestions and opinions before initiating the project	Yes, always getting the community suggestions to control and minimize the water and air pollution	Yes, especially to discharge the storm water and swear
Direction control	Yes, kept the generator	

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	exhaust point well above the neighbours property level	
Satisfy the criteria of applicable legislation and guidelines	Yes, Checked BOD level from water resource Installed the waste water treatment plant based on council regulation and maintain the plant accordingly through the expert organization	Yes. Checked the air quality through independent organization next to construction area Built the storm water storage system under the car park and discharge the water based on the local council requirements (automatically) to protect the main water source water level
Responsive urban planning	Yes, using storm water / treated water for the purpose of toilet flushing and gardening Installed solar panel system to generate the 121kwh to lighting up the	Yes, installed permeable paving system to water penetrate to the natural ground

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	common area, it will save huge amount of carbon footprint generation	
Advanced technologies	Yes, used natural lighting system during the operational stage of building and it will save huge amount of carbon footprint generation Yes, used regenerating drive for lift operation and it will generate electricity (only small amount) to minimize air pollution Used automatic drip irrigation system, it will sprinkle water based on environmental condition and also save huge amount of water	Yes, installed petrol interceptor next to last discharge point of storm water (A petrol interceptor is a trap used to filter out hydrocarbon pollutants from rainwater runoff. It is typically used in road construction and on Petrol Station forecourts to prevent fuel contamination of streams carrying away the runoff)
Passive design measures (non-noise sensitive buildings such as multi-stored car	Yes, used the passive design	

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
parks or commercial buildings, podium, architectural fin wall	for apartments layout to reduce mechanical cooling (AC use), lighting and ventilation system to save the air pollution Car park area – used natural lighting and ventilation system The above passive saving generating of carbon footprint	
Position material storage areas away from residential areas and sensitive facilities	Yes, located the garbage room away from residential area	
Select the best construction materials and techniques in sensitive areas	Yes, used homogenous porcelain tile for all apartments and common area, the tile thickness is 5.5mm it will save huge amount of carbon footprint	Yes, used permeable paving for car park area used Permachannel filter system petroleum product running to water source

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	during the manufacturing Used customized length reinforcement to reduce the wastage of reinforcement	
Establish alternative approaches	Yes, installed solar panel system to generate the 121kwh to lighting up the common area, it will save huge amount of carbon footprint generation	Yes, Store the storm water to under the car park area, store water can be discharged to water sources during non-rainy period
Any other (please state)	Yes, used shear wall as partition wall and load transferring structure, by using dual purpose it is possible to reduce masonry work materials such as brick, block etc., and save huge amount of hazardous gas	

Strategies to Mitigate Public Nuisances	(a) Used in this project	(b) Used in past projects
	enter in to the environmental Plant enough tress each and every floor, by carried out it is possible to keep the environmental stability at high level around the building area By carried out waste water treatment, reduce the fresh water consumption from national grid	

24. How much you had to spend on public nuisance minimisation in your project? State the amount as a percentage of the project value.

Around 0.15% from the project value

25. What are the procedural best practices that you suggest to minimise public nuisance related issues in the construction industry?

1. Identify possible nuisances that could occur and rank them in order to allocate budgets
2. Implement public nuisance management plan in preplanning stage considering all aspects such as Noise & vibration, Dust & smoke, Mosquito breeding, Traffic impacts, Odour effect, waste management & Impacts for water & air pollution
3. Allocate necessary staff to monitor relevant work

4. Implement proper communication platform with relevant staff & neighbours to immediate actions
5. Adhere to the proposed management plan & do necessary changes as required

26. Has the COVID-19 pandemic led to special public nuisance related issues on your site?

Yes. There are lot of external stakeholders involving with the project. Hence there is a high tendency to event can occur regarding public nuisance

27. What are the actions that you have taken to minimise the COVID-19 pandemic related special public nuisance issues that occurred at your site?

1. We have made a bio bubble within the site to make sure both internal & external parties are safe
2. Always adhere to the COVID-19 health & safety guidelines provided by the government & implement best site practices which is more practical considering the site environment.
3. Provide in-house canteen & accommodation facilities

SITE OBSERVATIONS

28. Observation on the below types of nuisances in the construction site.

- Noise and vibration
- Dust and smoke
- Mosquito breeding
- Traffic impacts
- Odour effect
- Waste
- Water and air pollution
- Any other (please state)

29. Observation of the mitigation measures used by the site management to minimise the effect of the above types of nuisances in the construction site.

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30. Any other observations.

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DOCUMENTS REVIEW

31. Documents maintained by the construction site to record public nuisance related issues, complaints and mitigation measures in the site.

1. Maintain of public complain register
2. Daily monitor the sound level and maintain a register

32. Procedures established by the construction organisation to mitigate the public nuisance related issues and complaints in construction projects.

1. Daily monitor the sound level around the building rather than taking actions after receiving complaints
2. Routine checklists for safety officers to maintain nuisance free environment

33. Public nuisance related clauses and cost items in the contract document.

- Sub clause 2.2 (Permit granted by Central Environmental Authority)
- Sub clause 2.2 (Permit granted by Colombo Municipal Council)
- Sub clause 4.13
- Sub clause 4.19

34. Any other documents reviewed

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THANK YOU FOR YOUR TIME AND CONTRIBUTION