



# University of Peradeniya, Sri Lanka

## Conference Secretariat

International Conference on Structural Engineering and Construction Management – ICSECM 2013

Structures Laboratory, Department of Civil Engineering, University of Peradeniya, Peradeniya, Sri Lanka.

Telephone: +94 81 2393581 Ext: 3581 Fax: 081 – 4476797

E-mail: [ranjith@fulbrightmail.org](mailto:ranjith@fulbrightmail.org)

28th August 2015

Dr. R.U. Halwatura,  
Senior Lecturer,  
Department of Civil Engineering,  
University of Moratuwa,  
Katubadda,  
Moratuwa.

Dear Sir,

**Subject: International Conference on Structural Engineering and Construction Management - 2013**

This is to certify that Dr. Rangika Halwatura has published the following research paper in the International Conference on Structural Engineering and Construction Management held from 13<sup>th</sup> to 15<sup>th</sup> December 2013 in Kandy, Sri Lanka.

All the articles in this international conference have been subjected to a strict double-blind review process by two independent reviewers, and full papers have been published.

The details of the published article of the above mentioned author are as follows;

*M P K C Nandapala, **R. U. Halwatura**, Mitigation of safety issues in telecommunication towers, Proceedings on 4th International Conference on Structural Engineering and Construction Management, Kandy, December 13-15, 2013, pp 34-44.*

Thank you,

Yours faithfully,

**Prof. Ranjith Dissanayake**  
Head  
Department of Civil Engineering  
Faculty of Engineering  
University of Peradeniya

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**Prof. Ranjith Dissanayake**  
Co-Chair | ICSECM-2013  
Department of Civil Engineering  
Faculty of Engineering  
University of Peradeniya.

**Session 03**  
**SUSTAINABLE DESIGN**

**Session Chairs : Dr. P. Chun & Dr.S.H. Chowdhury**

Time	Paper Number	Title	Authors
15.30 – 15.50 hrs	SECM/13/227	<b>Key Paper:</b> STUDY ON THE GEOTECHNICAL PROPERTIES OF OPEN DUMPS IN SRI LANKA	<b>U.P. Nawagamuwa</b> W. D. S. P. Gunaratne P. Kirubajiny T. Thiviya H.K.A. Priyadharshana
15.50 – 16.05 hrs	SECM/13/261	ACHIEVING DISASTER RESILIENCE THROUGH THE SRI LANKAN EARLY WARNING SYSTEM: GOOD PRACTICES OF DISASTER RISK REDUCTION AND MANAGEMENT	<b>J.K.A.L. Darshaka</b> A.G.O.A. Chathuranga A.G.A. Wanshanatha W.K.C.N Dayanthi
16.05 – 16.20 hrs	SECM/13/236	SELECTION OF SUITABLE SITES FOR LAND FILLING OF SOLID WASTES USING GIS INTEGRATED WITH ANALYTIC HIERARCHY PROCESS (AHP): A CASE STUDY FOR THE GALLE MUNICIPAL COUNCIL AREA	<b>Mr. J.K.A.L. Darshaka</b> A.G.O.A. Chathuranga A.G.A. Wanshanatha W.K.C.N Dayanthi
16.20 – 16.35 hrs	SECM/13/121	MITIGATION OF SAFETY ISSUES IN TELECOMMUNICATION TOWERS	<b>M.P.K.C. Nandapala</b> R.U. Halwatura
16.35 – 16.50 hrs	SECM/13/74	EFFECTS OF SURFACE ROUGHNESS ON FLEXURAL PERFORMANCE OF CFRP/CONCRETE COMPOSITES	<b>M.R.E.F. Ariyachandra</b> J. C. P. H. Gamage
16.50 – 17.05 hrs	SECM/13/73	INVESTIGATION ON EFFECTIVE USE OF CFRP LAMINATES FOR FLEXURAL PERFORMANCE	<b>D.M.N. Wijerathne</b> J. C. P. H. Gamage
17.05 – 17.20 hrs	SECM/13/46	DETERMINATION OF LOAD-SLIP CHARACTERISTICS OF NAILED TIMBER JOINTS	<b>D.M. Wijesekara</b> M.T.P. Hettiarachchi W.A.D. Fernando J.A.D.A. Wijayantha
17.20 – 17.35 hrs	SECM/13/271	DEFLECTION RELATED SERVICEABILITY ISSUES IN STEEL BUILDINGS WITH LARGE SPAN GIRDERS	<b>N.Abeysuriya</b> M.T.R.Jayasinghe
17.35 – 17.50 hrs	SECM/13/272	TOLL GATES AND TOLL BUILDINGS IN SRI LANKA	<b>D.S.Hettiarachchi</b> P.Mendis W.J.B.S.Fernando B.D.Waduge

# **Safety issues arising in communication towers**

R U Halwatura, M P K C Nandapala

Department of Civil Engineering

University of Moratuwa

## **Abstract**

The increase in mobile phone use and newer technologies, like wireless email and web access, has created a virtual explosion in tower construction. Even though there are labour legislations in Sri Lanka regarding safety issues still the state of affairs at sites are not favourable enough to safeguard the workers. There are evidences for occurring serious accidents, injuries at a high level in construction sites than in other industries during last few years. This research was carried out to understand the major safety issues in different stages and to create the knowledge among the community on how the people and environment get affected from the tower construction. This was carried out mainly by collection of information and interviews on in house issues and through a survey on communication towers. It was noted that there are key issues, which are not addressed or rather not paid enough attention from relevant authorities, such as regular maintenance of steel structures, identification the role of each stakeholders, inter communication lags, lack of knowledgeable people to manage the after implement work, etc. Based on all the key findings, a safety audit check list was formulated for new and operating towers to improve the quality and safety of the structure.

**Key words:** Communication towers, safety issues, safety audit, service providers

# 1. Introduction

The telecommunications industry is experiencing a robust growth on a global scale. By the year 2012, the industry predicts that there will be as many as 4.8 billion mobile phone subscribers worldwide. Since the introduction of mobile phones in the mid-1980s, there has been a significant increase in the number of mobile phone users and installations of base stations. In others, mobile phones are very popular because they allow people to maintain constant and continuous communication without hampering their freedom of movement. This in turn has created a competition between the service providers to provide a better & faster network to the consumer.

As a result of this competition more & more towers are built to have a greater advantage by providing a seamless connection to the wider consumer population. This will lower the safety standards of both tower & workers as found out in the survey. Clients must be concerned not only with the risk to their employees, but also have to consider about the safety of the public in the tower locations. They have to consider the drawbacks of public lawsuits that may arise.

It is also important to avoid or minimize potential damage to properties, from the perspective of public safety. Therefore institutions like Telecommunications Regulatory commission (TRC) are committed to protect public health, safety and general welfare by implementing regulations and guidelines to reduce the impact on environment also.

The construction is the one of the most hazardous among all industries (Jaseiskis, Suazo, 1993). The major causes of accidents are related to the unique nature of the industry, human behavior, difficult work-site conditions, and poor safety management which results in unsafe work methods, equipment's and procedures (Harper, Kohen, 1995). In recent years the construction industry has had a high number of fatalities and high injury rate which is ranking as 3rd worst nationally among industry groups (Construction Industry Council, 2004-2010). Further it cause to economic loss, then to the GDP of the country. Nobuyoshi Yabuki, PetcharatLimsupreeyarat and Tanit Tongthong (Collaborative Visualized Safety Planning for Construction-2010) state the reported cost in construction is billions in dollars in economic loss, the cost exceeds beyond its evidence. Indirect cost of accidents might be as much as six times the direct cost or more.

Falls are a significant public health risk and a leading cause of both nonfatal and fatal injuries among construction workers worldwide. A more comprehensive understanding of casual factors

leading to fall incidents is essential to prevent falls in the construction industry (Hinze, Pedersen, & Fredley, 1998).

People are struck by material falling from loads being lifted and material that rolls or is kicked off work platforms; others are struck or buried by falling materials when excavations, buildings or tower structures collapse (Stephen Williams, 1996).

People undergo electric shock and burns when they employ unsafe equipment and overhead power lines and buried cables (Stephen Williams, 1996).

Quality of construction should be maintained in construction projects. Then construction project to be marketable including accident free culture quality of the construction should be maintained. Safety is a major dimension in construction (Baden-Hellard, 1991).

## **2.0 OBJECTIVES AND METHODOLOGY**

Major aim of this report is to identify and discuss the major safety issues and health hazards in different stages of communication tower construction for general public and find solutions for them.

## **3. Data Collection Analysis & Discussion**

Analysis of the following items was carried out which based on tower construction industry. Targeted group in this survey was neighbours in Sri Lankan tower construction industry. Whereas the public survey targeted, the population that has been in contact with tower construction and has been effected by the negligence and improper conduct.

This research was carried out in three districts (Matale, Negombo and Colombo). The questionnaire samples were equally distributed among neighbours who lived around the constructed towers. The analysis and discussion is carried out upon the collected data.

### **3.1 Data Collection regarding towers.**

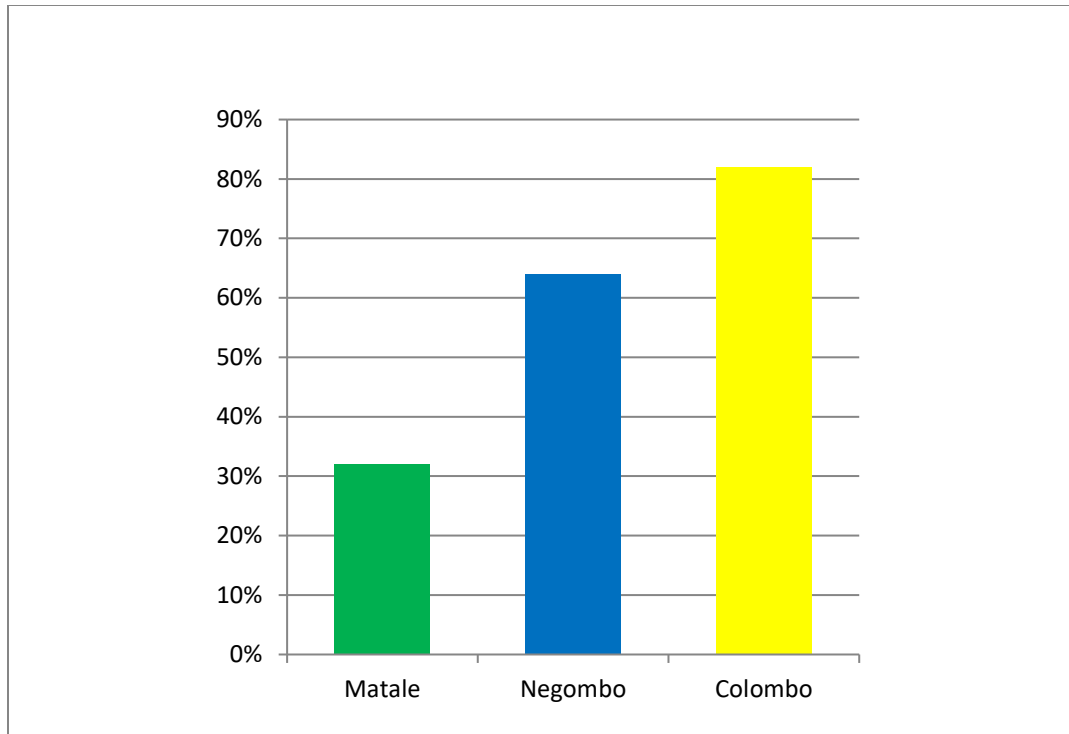
There are several local and international organisations involved in the Sri Lankan telecommunication industry and the number of towers has increased from 400 in 1990 to over 5000 at present (Table 1).

<b>Name of Operator</b>	<b>Issued date of License</b>	<b>No of towers constructed up to (2011 Dec.)</b>
<b>Etisalat Lanka (Pvt) Ltd</b>	02.09.1988	789
<b>Hutchison Telecommunications Lanka</b>	12.02.1992	421
<b>Mobitel (Pvt) Limited</b>	12.02.1993	713
<b>Dialog Axiata PLC</b>	27.09.1993	1465
<b>Bharti Airtel Lanka (Pvt) Ltd</b>	10.04.2007	927

Table 1: Major telecommunication service providers in Sri Lanka (News in depth-daily newspaper 30-01-12, 11)

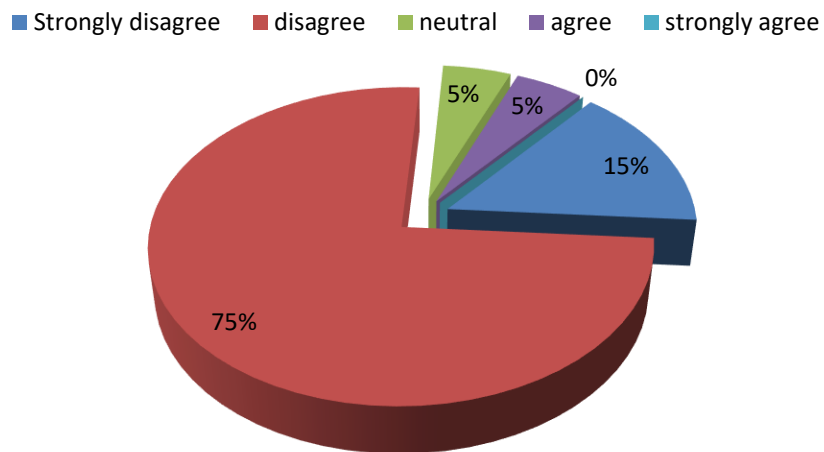
### 3.2 Analysis of the Questionnaire

Complete questionnaire survey was carried out to identified and discussed the effects and causes of poor safety aspects in tower construction industry in Sri Lanka. Out of that, Figure 1.1 shows that 32% located in Matale have communication towers around their radius 1 km. when compared to with Negombo and Colombo this percentage increased 64% and 82% respectively. In Matale 68% people have their communication towers greater than the 1 km distance.

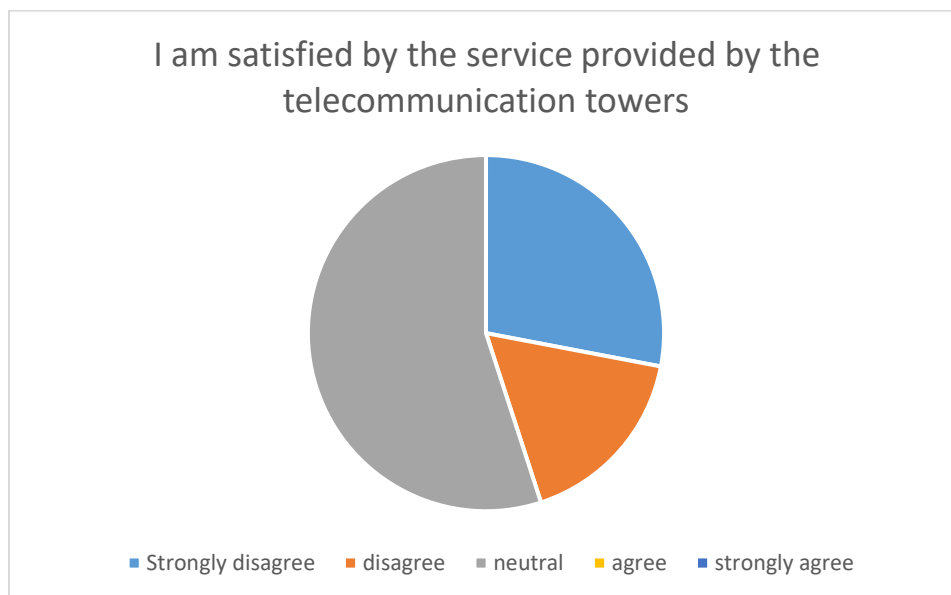


*Figure 1.1: Communication Towers located within 1 Km*

Figure 1.2 & Figure 1.3 show the personal feelings of communication towers with their satisfactory levels. From that neighbours disagreed and 75% said they are less aware about the communication towers, 55% shows they are neutralized by the service provided by the communication tower. As well as 28% of said they strongly disagree about the service provided by the tower. Less than 10% of agreed the above feelings from the questionnaire.



*Figure 1.2: awareness of the community of telecommunication towers.*

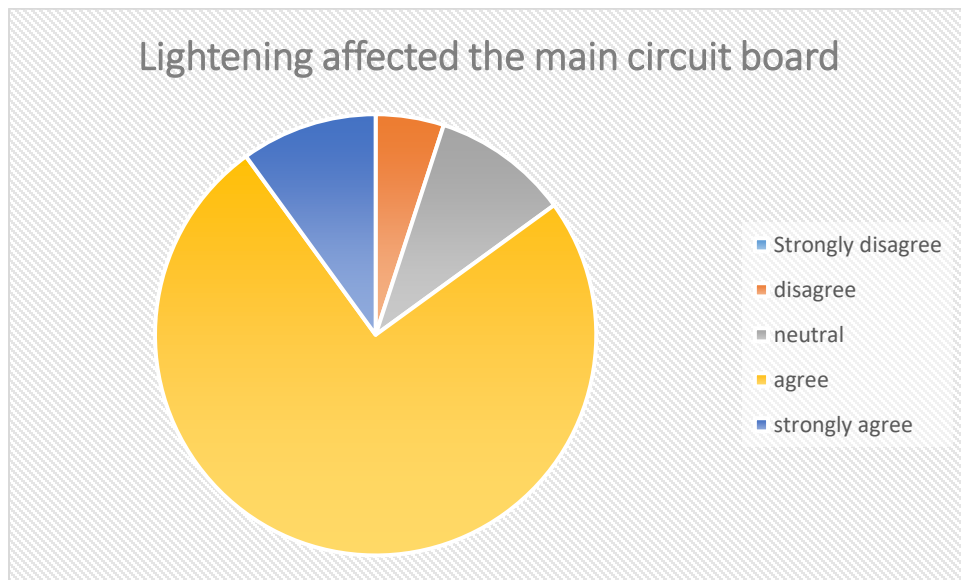
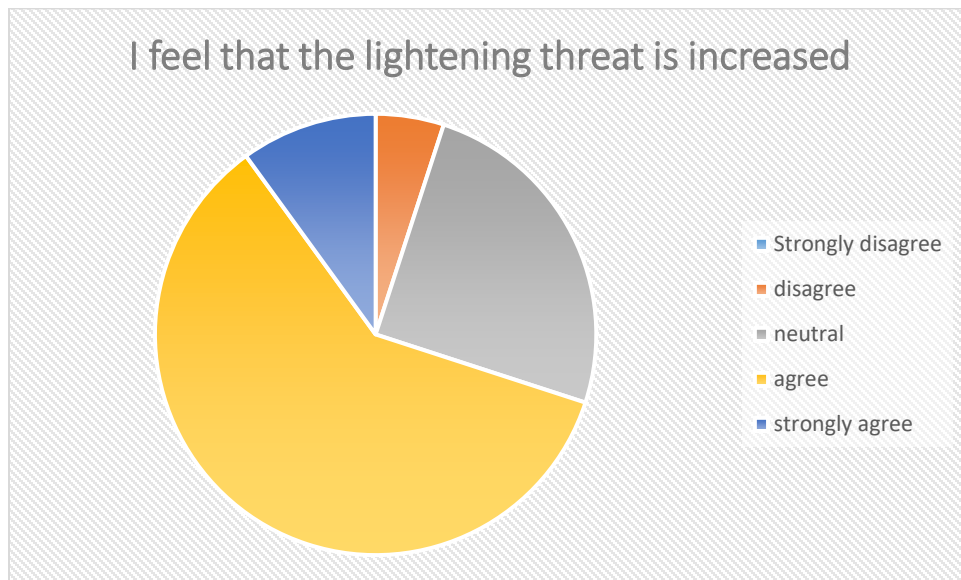


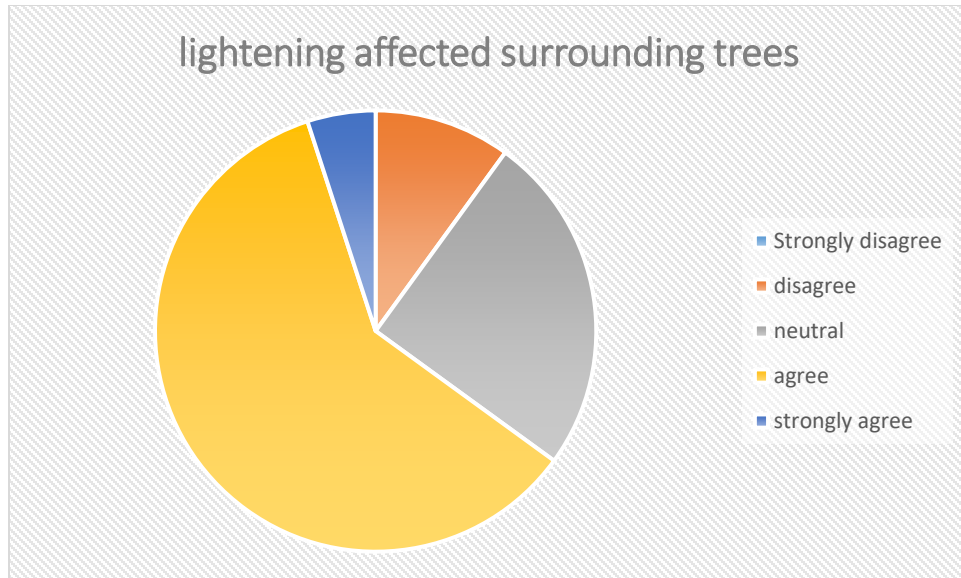
*Figure 1.3: Satisfactory levles of the community of telecommunication towers.*

From section 1 of questionnaire people show their response to lightning experience after construction of communication towers, this illustrated on figure 1.3. This shows 60% to 75% are



agreed that lightning is increased and lightning is affected to main circuit board. 10% shows they disagree with feel that lightning is affected to surrounding trees and 30% neutralized it.





*Figure 1.3 Response to lightning experience after construction of communication towers*

Awareness of communication towers safety can be identified from section 10 of figure 1.4. This shows that 82 % of neighbours were unaware about the communication towers safety and only 18% agreed with the awareness of communication tower safety.

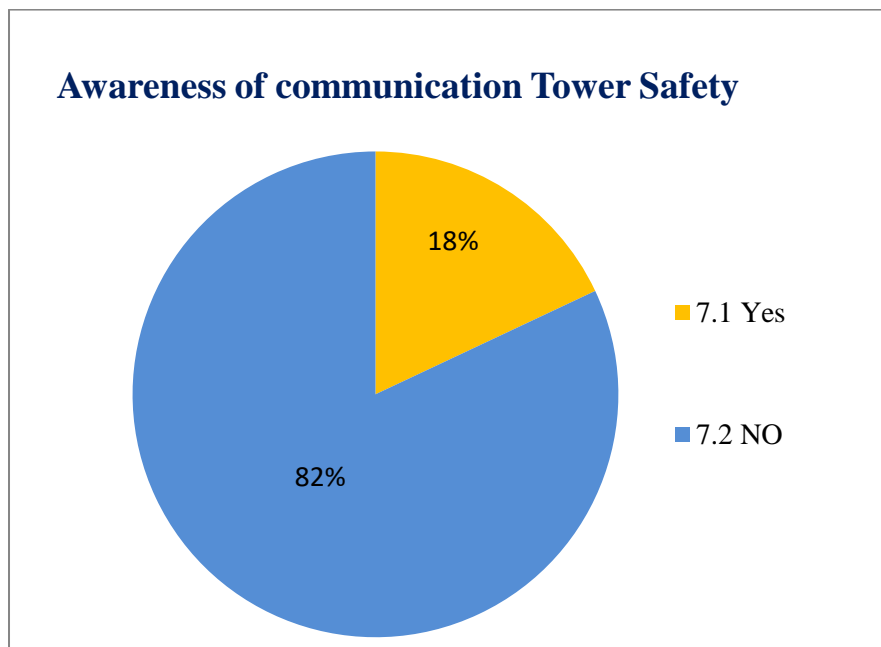


Figure 1.4: Awareness of communication Tower Safety

Health hazards after constructing of communication towers can be identified from figure 1.5. This shows 50 % of asthmatic patient problems raised and 42% are sleepless. Out of that 3% to 5% are having other problems such as headaches and depressions respectively.

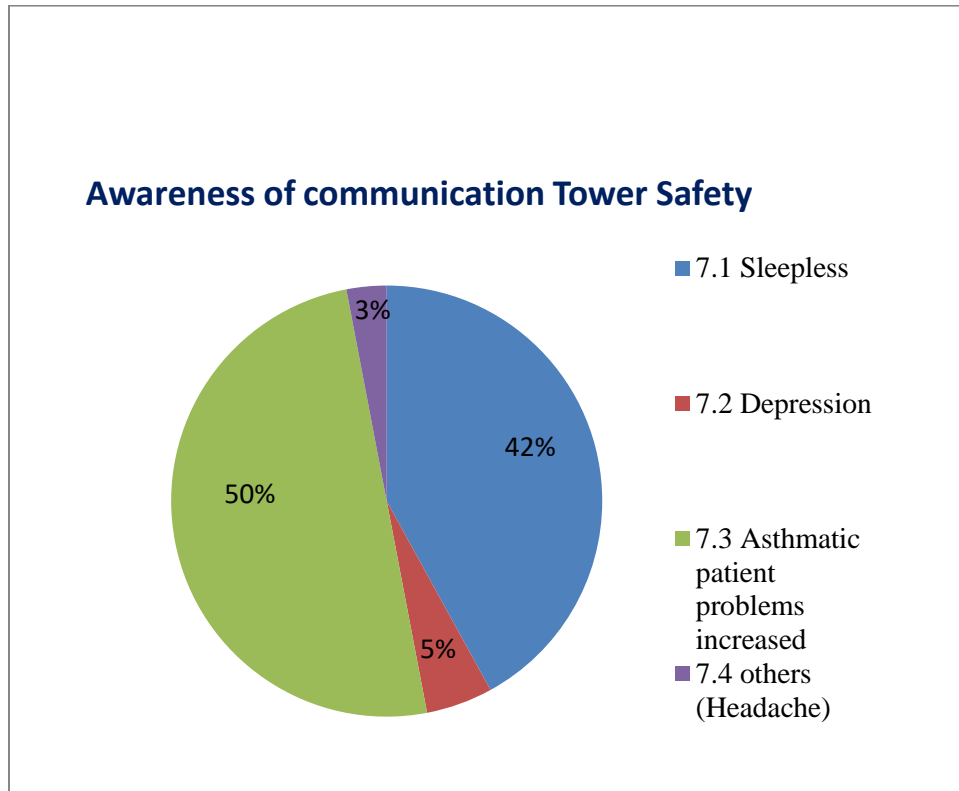


Figure 1.5: Health hazards after construction of communication towers

The knowledge about health and safety policy was come across through the section nine. This illustrates 65% people in Colombo city know about the safety concepts.while the other two cities didn't know about the health and safety policy.

## 2 Issues of Tower construction industry

Safety issues have been arisen due to the lack of knowledge and carelessness of workers, contractors or surrounding community itself. Here, an in-depth view of the issues from the community's perspective is elaborated through a Relative Importance Index analysis. Results are as tabulated in Table 2.

<b>Identified issue</b>	<b>RII</b>
Not maintaining daily inspection check lists	0.456
Ineffective site keeping such as letting the debris like wooden pallets, steel offcuts to get accumulated at site.	0.476
Neglecting the use of personal protective equipment such as dust masks, respiratory protective equipments, safety goggles and gloves, when using power tools in adverse environments.	0.488
Non arrangement of operating manuals.	0.492
Unavailability of qualified Site supervisors and Safety officers, when works is in progress.	0.496
Failure to arrange hand over meetings with relevant consultants & contractors	0.504
Failure to obtain all guarantee bonds, product warranty etc., from contractor.	0.524
Not incorporating safety & warning signs, fire extinguishers and first aid kits to minimize the damage and increase the awareness of danger against existing hazards.	0.528
Not using of Approved site safety plans.	0.536
Not using of approved quality material at sites.	0.572
Unavailability of hand rails, guard rails and hinged covers in ladderways.	0.576
Not completing the sites in time	0.612
Not barricading any openings through which a person or tools could fall.	0.624
Failure to co-ordinate the progress of commissioning and handover.	0.628
Failure to obtain clearance from supervisor to hoist near high voltage electrical lines or equipments.	0.64
Not issuing final certificates for final inspection.	0.64

Failure to avoid underground utilities and overhead power lines.	0.652
Unavailability of security guards to prevent unauthorized entry to tower construction site	0.668
Use of operating machineries at unsafe speeds.	0.684
Steps to minimize the accidents prevailing in sites.	0.696
Weekly safety meetings to employees on the project.	0.704
Use of defective tools and equipments.	0.708
Ineffective maintenance at sites.	0.716
Not using of hard hats, long pants, shirts with sleeves required onsite for all workers.	0.72
Not using of approved safety programs required for general contractor and all sub contractors on the job.	0.772

## 4.0 Discussion of Results

A formal attempt was made to reveal the areas of risks and accidents that could happen (effected by poor safety measures in all stages of tower construction).

According to the findings, the neighbour related problems are the most influencing factor in causing unsafely work condition in Sri Lankan tower construction industry. It followed that the workers have not obtained enough training with regards to safety, and their educational background is not enough to understand the health and safety concepts. As a result the tower construction workers are unwilling to adopt safety measures. Lack of safety instruments at the site, poor site supervision and unawareness of health and safety policy are also some aspects. As project related problems; lack of attention on safety supervision, regular working of more than

eight hours. Lack of safety audits, crash project planning and overlapping activities can be considered as next critical factors in stages of tower construction.

This study of questionnaire survey found that Sri Lankan construction experienced various significant effects due to poor safety culture in the tower construction industry and it shows neighbours suffer from the lack of safety for the tower construction activities. They believe lightning is increased due to the construction of communication towers. Finally based on the analysis the results will be discussed upon the factors influencing the poor safety aspects in tower construction industry in Sri Lanka.

The most critical factors found out in the study are violating safety issues in tower construction. Lack of attention on health and safety supervision is also another factor.

Workers and neighbours has not been given enough training with respect of health and safety, the construction workers are reluctant to adopt safety measures, lack of health and safety instruments, poor site supervision, day and night shifts, no safety audits were conducted, unawareness of safety policy.

## **5. Conclusions**

As prescribed at the beginning of this report tower construction industry is one of the most blooming industries in Sri Lanka on today's context. There is a huge competition exists amid the operators. Thus everyone tries to make their market share and the profit.

This study revealed safety is weak in every aspect, in tower construction industry in Sri Lanka. Neighbours haven't got any general knowledge about communication towers. Also they had less awareness about the rules and regulations practised in Sri Lanka.

The findings further illustrate that all the parties involve to constructions, violate the responsibilities on safety aspect in Sri Lankan tower construction industry.

## **6. Recommendations**

Based on the conclusion and discussions of the study, some useful information and a safety audit check list can be suggested in order to diminish the causes and effects of poor safety in tower construction industry in Sri Lanka.

1. Proper lighting protection devices and painting of Antenna Structures must be in accordance with the specifications of CAASL (Civil Aviation Authority of Sri Lanka) should be installed to safeguard the neighbours.
2. If the antenna mast would cause problems to the public security, disturbance to the neighboring community and problems with the future physical planning purposes of the area, then the developer should agree to dismantle and relocate the facility if so directed.
3. Management of safety should co-ordinate activities of project and ensures that safety is managed by proper supervision to shield neighbours.
4. Management should adapt safety measures to safeguard the neighbours.
5. Management should develop a safety audit check list. A Technical Advisory Committee (TAC) should be appointed by the TRCSL to address any specific issues related to the Antenna Structure Policy.
6. The cumulative Electromagnetic Operating Frequency emission level and output power of an Antenna Structure Farm should be maintained within the limits specified by the International Commission on Non Ionizing Radiation Protection (ICNIRP) and

followed by the Telecommunications Regulatory Commission of Sri Lanka (TRCSL) and MOD (Ministry of Defence).

7. The organization should plan site safety, establish rules, monitor performance routinely by special safety audits appropriate.
8. Government should set up cautious rules and regulations to adapt safety measures in tower construction industry in Sri Lanka.

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