

**SPATIAL FACTORS CONTRIBUTING TO THE TIME
MANAGEMENT OF CONSTRUCTION WORKERS AT
CONSTRUCTION SITES**

Keeniyagamalage Sangeetha Udamali De Silva

(189596B)

Degree of Master of Science in Project Management

Department of Building Economics

University of Moratuwa

Sri Lanka

December 2021

**SPATIAL FACTORS CONTRIBUTING TO THE TIME
MANAGEMENT OF CONSTRUCTION WORKERS AT
CONSTRUCTION SITES**

Keeniyagamalage Sangeetha Udamali De Silva

(189596B)

Thesis/Dissertation submitted in partial fulfillment of the requirements
for the degree Master of Science in Project Management

Department of Building Economics

University of Moratuwa

Sri Lanka

December 2021

DECLARATION

I declare that this is my own work and this thesis 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.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

.....

K.S.U De Silva

.....

Date

The above candidate has carried out research for the Master's thesis under my supervision.

.....

Ch. QS Prof. (Mrs.) B.A.K.S. Perera

Dissertation Supervisor

.....

Date

Spatial Factors Contributing the Time Management of Construction Workers at Construction Sites

ABSTRACT

Inefficient time management of construction workers at construction sites often leads to waste of money, unnecessary disputes and quality reductions of the project. Even though, many researchers try to find roots to these time losses and management strategies to overcome these construction delays, attention paid for spatial factors in construction sites and their contribution for efficient time management within construction sites is at a minimal level. Further, the construction sites tend to have robust spaces which are changing day by day with complex needs of clients. Therefore, this research is aimed at investigating the management of spatial factors contributing to time management of construction workers at site. Qualitative research approach was occupied for the study. Semi-structured interviews and case studies were selected as the data collection methods to attain the aim of the study. The empirical data collected from sixteen interviews were verified through three case studies and analyzed with the use of manual content analysis. Further, this allowed for data triangulation which helped to develop a comprehensive understanding of the phenomena. Spatial factors which contribute effective time management of construction workers at site, the way they contribute and strategies to manage those spatial factors were identified through literature review and interviews. How those strategies influence on effective time management of construction workers were solely identified through the interviews and then all these findings were verified via case studies. Findings implied the importance of introducing the concept of spatial management to the construction industry. Implementation of regulations, increasing awareness and implementing more studies in this field can be a solution for construction delays as it increases the efficiency of construction workers. Spatial factor management related studies are hardly found in any context. This study can be used as a benchmark study for further in-depth research studies in the area.

Key Words: *Spatial factors, Time management, Construction workers, Construction sites*

DEDICATION

TO MY PARENTS

For raising me to believe that any dream is possible...

TO MY HUSBAND

For encouraging me to follow any dream I wish...

ACKNOWLEDGEMENT

This research study embraces dedication and assistance received from many people, who contributed in plentiful ways to ensure the success of the final output.

First and foremost, I pay my heartiest gratitude to my thesis supervisor, Ch.QS.Prof. (Mrs.) B.A.K.S. Perera for her valuable guidance, advice and encouragement given to me at all times to make this research a success. I am indebted to my supervisor for steering me in the right direction throughout the process.

I would also like to acknowledge the Head of the department, Ch. QS. Suranga Jayasena, former Head of the department, Prof. (Mrs.) Yasangika Sandanayake, Programed Director Ch.QS Indunil Seneviratne and all the staff members of the Department of Building Economics, University of Moratuwa for the immense assistance and guidance during the course of this research and throughout the my academic career. My sincere gratitude is also extended towards all the members of non-academic staff of the Department of Building Economics for their support.

Furthermore, I express my indebtedness to all the experts who were involved in interview series, sharing their valuable knowledge and experience. Without their passionate participation and input, the study could not have been successfully conducted. I would like to thank my beloved parents, my family, my friends and all my well-wishers for supporting me in countless ways throughout this dissertation and my life.

De Silva K.S.U

September 2021

TABLE OF CONTENTS

Declaration	i
Abstract	ii
Dedication	iii
Acknowledgement.....	iv
List of figures	ix
List of tables	x
List of appendices.....	xi
1. Introduction.....	1
1.1. Background.....	1
1.2. Research problem	3
1.3. Aim and Objectives	4
1.4. Methodology.....	4
1.4.1. Literature Review	4
1.4.2. Case study survey	5
1.5. Chapter Breakdown	6
1.5.1. Chapter 1: Introduction.....	6
1.5.2. Chapter 2: Literature Review.....	6
1.5.3. Chapter 3: Methodology	6
1.5.4. Chapter 4: Findings and Analysis.....	6
1.5.5. Chapter 5: Conclusions and Recommendations	6
2. Literature survey	7
2.1. Introduction.....	7
2.2. What are the spatial factors?.....	7
2.3. Different Spatial Factors.....	8
2.4. Influence of spatial factors on human behavior.....	11

2.5.	Influence of spatial factors on time management	16
2.6.	Importance of Time Management in Construction Industry	21
2.7.	Importance of Time Management of Construction Workers.....	22
2.8.	How Spatial Factors Can Influence Workers in a Construction Site.....	23
2.9.	How to Manage Spatial Factors at Construction Sites	27
2.10.	Theoretical Framework	31
2.11.	Why Spatial Factor Management is Important for Construction workers to Achieve Better Time Management at construction sites.....	33
2.12.	Summary	34
3.	Research methodology	35
3.1.	Introduction.....	35
3.2.	Research Approach	35
3.2.1.	Available Research Approaches	35
3.2.2.	Selected Research Approach	36
3.3.	Research Strategy	37
3.3.1.	Available research strategies	37
3.3.2.	Selected Research Strategies	37
3.4.	Research Methods.....	38
3.4.1.	Available Research Methods	38
3.4.2.	Selected Research Methods	38
3.5.	Data Analyzing Techniques.....	39
3.5.1.	Manual Content Analysis.....	40
3.6.	Research Process.....	40
3.7.	Summary.....	41
4.	Findings and analysis	42
4.1.	Introduction.....	42

4.2.	Findings and analysis of the interviews.....	42
4.2.1.	Objectives of the Interviews	43
4.2.2.	Profile of Interviewees.....	43
4.2.3.	Identifying Spatial Factors that Can Influence Time Management of Construction Workers at Site.	45
4.2.4.	How spatial factors influence time management of construction workers at site	49
4.2.5.	Management strategies to manage the spatial factors which influence time management of construction workers at site and how those management strategies can improve time management of construction workers at site.....	53
4.3.	Findings and Analysis of Case Studies.....	60
4.3.1.	Objectives of the Case Study	60
4.3.2.	Case Study Selection Criteria	60
4.3.3.	Brief Background Details of the Case Studies.....	60
4.3.4.	Details of Case Study Interviewees	61
4.4.	Case Study Observations	61
4.4.1.	Spatial factors that can influence time management of construction workers at site.	61
4.4.2.	How spatial factors influence time management of construction workers at site	66
4.4.3.	Spatial factor management strategies and how these strategies can improve time management of construction workers.....	70
4.5.	Pattern Matching for the Research Study	77
4.5.1.	Spatial factors that can influence time management of construction workers at site.	77
4.5.2.	How spatial factors influence time management of construction workers at site.	80

4.5.3.	Spatial factor management strategies and how they influence time management of construction workers at site.	83
4.6.	Summary	85
5.	Conclusion and recommendations	86
5.1.	Introduction.....	86
5.2.	Overview of Objectives Achieved in the Study.....	86
5.2.1.	Objective 1- Identify the concept of spatial management	86
5.2.2.	Objective 2- Identify the spatial factors, which affects for effective time management in Construction sites.	86
5.2.3.	Objective 3- Identify the consequences of these factors to construction projects	87
5.2.4.	Objective 4- Propose strategies to manage the spatial factors, and investigate how the strategies can improve time management of construction workers at site.	87
5.3.	Recommendations.....	88
5.4.	Contribution	89
5.5.	Limitations	89
5.6.	Further Research	90
References	91
Appendix A:	Semi-structured interview guideline.....	110
Appendix B:	Expert interview guideline.....	117

LIST OF FIGURES

Figure 2. 1; Theoretical framework.....	32
Figure 3. 1; Research process.....	40

LIST OF TABLES

Table 2. 1; Different spatial factors introduced by past researchers.....	8
Table 2. 2; Influence of spatial factors on human behavior.....	12
Table 2. 3; Influence of spatial factors on time management.....	17
Table 2. 4; Spatial factor management strategies.....	27
Table 3. 1; Available research approaches.....	36
Table 4. 1; Details of interviewees.....	44
Table 4. 2; Spatial factors which influence time management of construction workers at site.....	45
Table 4. 3; How spatial factors influence on time management of construction workers at site.....	49
Table 4. 4; Spatial factor management strategies and how they can improve time management of construction workers at site.....	53
Table 4. 5; Brief background details of the case studies.....	60
Table 4. 6; Details of case study interviewees.....	61
Table 4. 7; Spatial factors that can influence time management of construction workers at site.....	62
Table 4. 8; How spatial factors influence time management of construction workers at site.....	67
Table 4. 9; Spatial factor management strategies and how these strategies can improve time management of construction workers.....	71

LIST OF APPENDICES

Appendix A: Semi-Structured Interview Guideline.....	110
Appendix B: Expert Interview Guideline (Case Studies)	117

CHAPTER ONE

1. INTRODUCTION

1.1. Background

People can clearly understand the space through the way it is organized (Dogu, 2000). It was observed that users' initial exploration of a space is partially influenced by the spatial factors within that space (Haq, 2003). Accordingly, spatial factors can be introduced as the factors related to the organization of a certain space and these factors help people to experience the space and feel it (Dogu, 2000; Haq & Zimring, 2003).

Person's sense and understanding about a particular space can differ according to the spatial factors, which are available in that space (Carlos, Saorin, & Medler, 2020). There are many spatial factors, which influence human mind such as legibility, permeability, robustness, etc. (Bentley, Alcock, Murrain, & McGlynn, 1985; Silavi, Hakimpour, Claramunt, & Nourian, 2017). Some spaces give us the information about them and it is easy to grab the idea of that space and to experience it (Dogu, 2000). Author further states that the spatial factors of various spaces are different to each other, and according to this, people get different understandings about different spaces. As an example, factors in one space can make it be attractive for people and in contrast, some other space may lead people through without making them interested to stay in there. Space is the thing, which makes this world three-dimensional. Therefore, the intervals, relationships and distances from person to person, between a person and an object and between objects can identify as space (Rapoport, 1977). Further, author discloses that the space is the central element of built environment. Therefore, the organization of space have to be considered before designing it with various shapes and material.

Some spatial arrangements may generate shorter work-cycle times than others (Kothiyal, 1995; Sanad, Ammar & Ibrahim, 2008). When human activities increase, the outcomes of these activities also increase and these outcomes may come in terms of built environment, money or quality (Rutten, 2009). Author further states that, to connect these activities and outcomes, there are networks created for distribution, exchange and utilization. Since spatial factors define human behaviors within spaces,

these networks could be influenced by spatial factors in the area where they operate. This can totally affect the outcomes in construction environment. These outcomes can introduce in terms of completing within budget, on time and to an acceptable level of quality ((Ling & Ang, 2013). Therefore, the effectiveness or ineffectiveness of construction outcomes mainly depends on how we manage the spatial factors in construction sites. One of the most common problems in construction field is the delays happening when delivering project outcomes (Al-Kharashi & Skitmore, 2009). In current scenario, most of the construction projects are seem to be delayed and contractors are often unable to complete and handover the buildings on planned date (Kongchasing & Sua-lam, 2020). The contribution of the construction industry to national economic growth necessitates improved efficiency in the industry by means of cost-effectiveness and timelines and would certainly contribute to cost savings for the country as a whole(Aibinu, 2002). These delays effect on economics of construction projects and cause several losses for various stakeholders involved in them (Kumar, 2020). Even though some of these losses can compensate, some of the losses cannot be atoned (Fakunle & Fashina, 2020). Therefore, to minimize these kinds of losses, it is crucially important to have better time management.

Utilizing time management effectively is essential for construction companies to achieve their goals within allocated budget and time constraints (Hodge G. H., 2013). Author further states that, it is not only a tool for construction management, but also a key to achieve maximum profitability and success. In a construction environment, time management is not something, which is optional. It is a principal factor, which measures the success of the project (Memon, Rahman, Ismail, & Zainun, 2014). There is a need to identify optimal organization and spatial arrangement of work site to achieve minimum work-cycle time for every job (Kothiyal, 1995; Post, 2020) Furthermore, authors state that, in order to get an optimal work site arrangement, knowledge of the spatial arrangement and work-cycle time is necessary.

Designer tries to influence on users and create more defined surrounding by designing not only the object, but also peoples' movements and behaviors around the object (Noble, 2010). Visual fields are created with heterogeneous elements that has various sizes, shapes, colors, etc. Therefore, to understand the visual fields more clearly,

people can organize these heterogeneous elements in to two groups (Ching, 1979; Irimia, 2017). Authors further state this first group as positive elements, which people call as figures and Second group as negative elements, which people call as voids. Both these figures and voids get together to create a space which a person can experience physically. Arrangement of elements can change and affect the way people response and engage with their surrounding space (Thompson, 1997; Ibrahim & Mikhail, 2016). Therefore, if people do not interact and engage with the space around them effectively, it can be probably because of lacking factors of spatial arrangement. Maximum space utilization and arrangement within site can be achieved by studying this as if a person knows what are the factors in construction project sites, which contributes to time management and how they effect, they can use this knowledge to decide the material store areas, walk passages and areas to set up equipment much more effectively.

1.2.Research problem

Consequences from inefficient time management at construction sites are high since they lead to waste of money, creation of disputes and arguments and reduction of expected quality (Tafazzoli & Shrestha, 2017; Owusu & Aggrey, 2020). Therefore, it is essential to find proper measures to resolve this issue (Memon, Rahman, Ismail, & Zainun, 2014). Since construction sites volatile and disorganized, people give least attention to their spatial arrangement (Zolfagharian & Irizarry, 2014).Authors further state that, this might be a leading factor for poor time management and unexpected time wastage. Parties involved in Construction projects (ex: Project managers) do not have an idea about how the spatial factors in construction sites influence the time efficiency of that project (Mamat & Zin, 2016). Therefore, there is a need to identify and introduce the strategies that spatial factors might influence the time constraints of a construction site. The topic “construction time management” has attracted the interest of many researches and as a result, many studies were conducted to identify the factors affecting time management considering environmental factors, economic factors, psychological factors...etc.in construction sites (Akanni, Oke, & Akpomiemie, 2015; Bekr, 2017; Dolage & Rathnamali, 2013; Meeampol & Ogunlana, 2006;Pheng & Chuan, 2006). However, the attention paid for spatial factors

contribution to the time management in construction sites is very few (Bansal, 2018; Marx, Erlemann, & Konig, 2010) and it is very limited related to the Sri Lankan context. Further, these special factors are changing according to the context (Bar & Ullman, 1996; Delbosc & Currie, 2011). Therefore, management of spatial factors contributing to time management of construction workers at site is a very timely research topic.

1.3.Aim and Objectives

Aim

The aim of this study is to investigate the management of spatial factors contributing to time management of construction workers at site.

Objectives

Following objectives are selected to achieve the aim.

1. To identify the concept of spatial management
2. To identify the spatial factors, which affects for effective time management in construction sites.
3. To identify the consequences of these factors to construction projects
4. To propose strategies to manage the spatial factors, and investigate how the strategies can improve time management of construction workers at site.

This research is limited to three case studies and only most frequently identified five spatial parameters will be evaluated.

1.4.Methodology

1.4.1. Literature Review

The literature survey was carried out with thorough study on research publications on field of spatial planning, human behavior and time management. Spatial factors, which contributes for effective time management, were identified through this survey and hierarchy of identified spatial factors were organized according to their rate of repetitiveness in work done by various scholars. How these spatial factors contribute to the effective time management of workers and spatial factor management strategies

were identified through the literature review. Relevant parameters were selected to check their applicability in physical space.

- **Semi-structured interviews**

Interviews were conducted with professionals and workers to check the existence of spatial factors at construction sites and the influence of those spatial factors for the effective time management of construction workers at site. Spatial factor management strategies that help to manage these spatial factors which influence time management of construction workers at site and how these management strategies will improve the time management of construction workers at site were identified through interviews.

1.4.2. Case study survey

Three case studies were selected to validate the findings of literature review and semi-structured interviews. Under case study survey, expert interviews and physical observations were conducted.

- **Case study interviews**

Case study interviews were carried out with three experts who were engaged with and fully aware about selected cases to validate the findings of literature review and semi-structured interviews.

- **Physical Observations**

Physical observations on construction workers' behavior were conducted to validate the information about the effect of spatial factors on their time management ability within selected case studies. Data gathered under these two folds will be linked through analysis to create a logical explanation on how the identified spatial parameters in construction sites influence time management of construction workers.

1.5. Chapter Breakdown

1.5.1. Chapter 1: Introduction

This chapter provides the background, aim, objectives, scope and limitation, research methodology, and the structure of the research.

1.5.2. Chapter 2: Literature Review

This chapter introduces a comprehensive literature review with evaluated information through the collected documents. Spatial factors and their contribution to time management of construction workers at sites have been discussed.

1.5.3. Chapter 3: Methodology

Chapter 3 illustrates the method of data collecting and analyzing. Furthermore, that chapter contends with the action that has been taken to improve the accuracy of the research.

1.5.4. Chapter 4: Findings and Analysis

This chapter discusses the data; collected through questionnaires and observations, which are critically evaluated and further, review the findings from the collected data.

1.5.5. Chapter 5: Conclusions and Recommendations

Chapter 5 present the research findings within the scope of the research. Further in that chapter, future research areas related to that subject area are included.

CHAPTER TWO

2. LITERATURE SURVEY

2.1.Introduction

This chapter intends to synthesize the current knowledge level regarding the research area namely spatial factors contributing the effective time management of construction workers at construction sites and further refers to establish the research problem. In the inception stage, the spatial factors are generally described and then gradually focusses to identify the spatial factor management and time management strategies. This critical review is conducted by utilizing the extracts of reliable primary and secondary literature sources namely books, research journals, conference proceedings and web sites. Spatial factors which influence time management, how those spatial factors influence on time management, how to manage spatial factors and why spatial factor management is important to achieve better time management is discussed here. Finally, the chapter concludes with the chapter summary.

2.2.What are the spatial factors?

Spatial factors define strategies, policies, design, effective creation and use of spaces. Furthermore, Spatial Factors are the factors which define spaces by supporting people to gather and process information about elements and space around them (Dogu, 2000). Here, Space can be defined as a physical location, which is consisted with objectively defined properties with characteristics such as areas, points, lines or routes, and surfaces (Smale, 2006). According to the observations, people initially identify environment by partially utilizing spatial factors and also it has been long recognized that the underlying spatial structure of a certain space is important to configure that particular space (Silavi, Claramunt, Hakimpour, & Nourian, 2017). Therefore, factors in a spatial layout and appearance of a space plays a critical role in comprehending and perceiving that place (Fard, 2014). To exemplify, permeability, a well-known spatial factor, offers people choice of routes and thereby provides greater visual interest and generates a higher level of activities while enhancing the security of people who use the routes (Essex planning officers association, 2019). Furthermore, unity,

another spatial factor, supports to improve visual composition of a space and express single idea by combining spaces with few different characteristics (Moughtin, Oc, & Tiesdell, 1999). According to past researches, spatial factors are the determinants of a successful space, including the physical, functional and perceptual properties as well as the associated concepts of accessibility and diversity (Razavivandfard, 2014). There are number of spatial factors and each one of these spatial factors have different qualities. As examples, legibility increases the capability of organizing an environment according to an imageable and coherent pattern(Koseoglu & Onder, 2011) while permeability, another spatial factor, increases directness of links and improves the density of connections within a space(healthyplaces.org, 2009). Different spatial factors and categorizations introduced by number of past researchers are included in below section.

2.3.Different Spatial Factors

There are number of spatial factors introduced by past scholars through their research publications. These spatial factors are categorized by some of those researchers considering the environment which they exist. Below table discloses different spatial factors introduced by past researchers and some of these spatial factors are amalgamated in to categories by considering their similar nature and similar interpretations. Table 2.1 depicts the different spatial factors introduced by past researchers.

Table 2. 1; Different spatial factors introduced by past researchers

Spatial Factor	Authors											
	A	B	C	D	E	F	G	H	I	J	K	L
Permeability (Visibility, Transparency, Accessibility, Linkages, View)	✓	✓	✓						✓	✓	✓	✓
Vitality (Richness, Variety, Surprisingness, Activity, Uses, Functions, Opportunity, Complexity/Simplicity)	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
Legibility	✓	✓	✓							✓	✓	✓
Robustness	✓	✓	✓									
Personalization	✓	✓	✓									
Unity				✓	✓	✓	✓		✓			
Safety								✓		✓		✓

Spatial Factor	Authors											
	A	B	C	D	E	F	G	H	I	J	K	L
Imageability										✓		
Openness (Level of enclosure)		✓		✓	✓	✓	✓				✓	
Scale (Proportion)								✓				✓
Comfort (Pleasantness, Visual appropriateness)	✓	✓	✓			✓						
Tidiness										✓		
A- (Bentley, Alcock, Murrain, McGlynn, & Smith, 1985), B- (Khalaf & Ja`afar, 2020), C- (Herath, 2005), D- (Rapoport, 1977), E- (Gauthier & Gilliland, 2006), F- (Ujang, 20012), G- (Yeo, Ho, & Heng, 2016), H- (Gehl, 2010), I- (Holscher, Dalton, & Turner, 2006), J- (Ujang, Salim, & Maulan, 2012), K- (Ewing & Handy, 2009), I- (Gomez, 2011)												

According to the above table, there are number of spatial factors identified by various scholars and categorized under various parameters. As an example, Bentley, Alcock, Murrain, McGlynn, & Smith (1985) in the book *Responsive Environments*, describes about spatial factors that should be included in a responsive and engaging environment. According to them, spaces which offers people maximum choices and opportunities should have spatial factors such as legibility, permeability, variety, robustness, richness, visual appropriateness and personalization. Herath (2005) agrees to this statement through his research paper. Khalaf & Ja`afar (2020) also agrees to Bentley, Alcock, Murrain, McGlynn, & Smith (1985), but further investigates through the avenue while comparing with other authors and then discloses that friendly, livable, walkable and sustainable space can be created by using spatial factors such as proportion and dimension, sense of enclosure, scale, transparency, unity and quality of view, comfort, accessibility and linkages. Rapoport (1977), discussed about spatial factors such as degree of enclosure, size of space, character of space, nature of enclosing elements, activity, function\ uses, pleasantness, complexity, Surprisingness, unity and enclosure. Gauthier & Gillilan (2006), Ujang (2012) and Yeo, Ho, & Heng (2016) agreed to those statements made by Rapoport and further discussed about those spatial factors in their work.

When it comes to categorization, Ujang (2012) divides spatial factors into three main components namely, physical elements, activity and image. Author argues that, accessibility and legibility of a space can be improved by using physical elements such

as location, access, layout, view, landscape features, signage, greenery, building façade, landmarks and nodes while vitality, diversity, choice and transaction of a space can be achieved through activity related attributes such as liveliness, street activity, people watching, entertainment, products, food and eating, day and night activities, communication and street vendors. Furthermore, the author states that legibility, distinctiveness, comfort and safety can be achieved through image, popularity, open spaces, distinction, uniqueness, facilities, maintenance and environmental quality. Gehl (2010), in his book *Cities for people*, discussed about protection, opportunity and scale as spatial factors which influence people in cities. Author further categorizes protection as protection against traffic and accidents, protection against crime and violence and protection against unpleasant sensory experiences while categorizing opportunity as opportunity to walk, opportunity to stand/ stay, opportunity to sit, opportunity to see, opportunity to talk and listen and finally, opportunity for play and exercise.

Ujang, Salim, & Maulan (2012) argues that context, structure, connectivity, accessibility, safety, legibility, permeability and imageability are the spatial factors which influence human mind when they are walking in a busy commercial city. Ewing & Handy (2009) also discusses about the walkability in city and they disclose permeability, vitality and diversity, legibility, richness and openness as spatial factors which should be included in urban design practices. C. Hölscher Dalton & Turner (2007), discloses that spatial factors namely, visibility, simplicity, connectivity, unity, and the ability to perceive as factors which effects on human spatial Cognition. Gomez (2011) divides spatial factors into four categories namely, possibility, motivation, opportunity and control, and under possibility author lists out spatial factors such as walkability, mobility, density, compactness and scale while listing spatial factors like circulation, access, activity and variety under possibility. Author further states that, connectivity, permeability and openness come under opportunity and comfort consists with spatial factors namely, pleasantness, safety and visual appropriateness. These spatial factors may address the senses of the individual and generate a spectrum of feelings which influence their behavior since the spaces which people occupy has a major role in their behavior. (Harrouk, 2020).

In above table, there are five factors which are amalgamated by considering the similarities of their nature and interpretation. Accordingly, the factors namely, visibility, transparency, accessibility, linkages and v are amalgamated in to permeability factor. Richness, variety, surprisingness, activity, uses, functions, opportunity and complexity/Simplicity factors are amalgamated in to vitality factor. Level of enclosure factor comes under the category of openness. Proportion is categorized as similar to the scale factor. Pleasantness and visual appropriateness factors are amalgamated in to comfort factor.

2.4. Influence of spatial factors on human behavior

Human behavior is the capacity and potential for physical, psychological, and social activities which people are engaged throughout their life (Lerner, 2020). Furthermore, human behavior can be described as the collaborative play of three components namely, actions, emotions, and cognition and from these three elements, action means everything that a person can observe, by using their eyes or by physiological detectors and these behaviors can perform within various time periods, ranging from muscular activation to sweat gland activity, swallow food, or take nap (Farnsworth, 2019). Author further states that, cognition describes both verbal and nonverbal ideas and psychological images people carry with them, an emotion can be illustrated as a short conscious experience with intense psychological activity, and that feeling cannot expressed from either reasoning or knowledge which usually can be marked on a scale, from positive (pleasant) to negative (unpleasant).

When it comes to the relationship between human behavior and spatial factors, past researchers have studied on this topic and their work have attempted to clarify the relationship between characteristics of spatial design or spatial factors and their influence on human behavior (Alahmed, Alaghbari, Ibrahim, & Salim, 2013). When understanding man's behavior in the environment, perception, cognition and spatial behaviors are particularly important since perception can be illustrated as the process of receiving inputs, cognition can be identified as the function which is involved with the process of thinking, memorizing and feeling and finally, behavior can be illustrated as the output of an person's action and response (Lang, 1979). The effectiveness of utilization pattern of a space can be identified only through an accurate analysis on

Influence of spatial factors on human behavior (Montgomery, 1995; Acar, et al., 2020). Dealing with the environment consists with both parameters namely, the influence which the environment has on a person and the reflection of that persons' behavior on the environment around him (Mahmoud, 2018). Therefore, the environment, which affects human beings, have several variables that we can call as spatial factors and these factors represent the psychological influences that surrounding environment have on a person (Sharif,1991). Table 2.2 illustrates the influence of spatial factors on human behavior identified by past researcher

Table 2. 2; Influence of spatial factors on human behavior

Spatial Factors	Influence	Authors															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
Legibility	Supports ease of movement and accessibility.	✓	✓														
	Provides sense of orientation and visual comfort.																
	Gives capacity of creating a clear and precise image of a space.																
Permeability	Promotes connectivity and accessibility.		✓	✓	✓												
	Strengthens the visual connectivity between activity nodes.																
	Increases choice of accessibility within a space.																
Imageability	Makes the space instantly recognizable for people.		✓			✓											
	Promotes the innate ability of people to identify and memorize patterns.																

Spatial Factors	Influence	Authors															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
Robustness	Increases the capability of utilizing a certain place for various purposes.			✓			✓	✓									
	Influences people to be more innovative, learn from the mistakes and increases the motivation to improve.								✓							✓	
Safety	Builds trust and confidence.																
	Increases the numbers of people in and around within different time periods throughout the day.										✓						
Vitality	Uptakes the facilities and numerous events																
	Improves the presence of an Active surrounding to the extent to which a place feels lively.																
	Increases people's ability to see their surroundings.										✓						
Openness	Improves user satisfaction.																
	Increases people's willingness to pay for a view.																
	Makes employees capable to be healthier and reduce the absenteeism rate											✓					

Spatial Factors	Influence	Authors															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
Unity	Gives a clear expression of a single idea.												✓				
	Visually compose of diversity of areas and elements.																
Personalization	makes a place's pattern of activities clearer			✓													
	Gives opportunity for to attain an environment with their unique values and preferences.																
Scale	A space which is compatible to the size of human beings is vital to achieve a 'sense of place'.															✓	
Tidiness	Improves human working accuracy.		✓											✓			

A- (Wall & Waterman, 2009), B- (Ujang, 2012), C-(Bentley I. , Alcock, Murrain, McGlynn, & Smith, 1985) ,D- (Carmona, 2003), E- (Ewing and Hardy,2009), F- (Herath, 2005), G- (UKEssays, 2018), H-(Ridgway, 2018), I- (Montgomery, 1998), J-(Shach-Pinsly, Fisher-Gewirtzman, & Burt, 2011), K-(Ali, Chua, & Lim, 2015), L- (Moughtin, Oc, & Tiesdell, 1999), M-(Mateo, Herna ´ndez, Jaca, & Blazsek, 2013), N- (Pettinger, 2015), O- (Khalaf & Ja`afar, 2020)

According to the data illustrated in the above table, these spatial factors influence on human behavior in various ways. Legibility supports ease of movement and provides a sense of orientation and visual comfort (Wall & Waterman, 2009). Ujang (2012) also agrees to this, but he further argues that legibility enables people to create a clear and precise image of a certain place. According to Bentley, Alcock, Murrain, McGlynn, & Smith (1985), Permeability promotes connectivity and accessibility, strengthens visual connectivity between activity nodes, and allows people a choice of access through it. Carmona (2003) agrees to this statement about permeability in the book Public places-

urban spaces: the dimensions of urban design. When it comes to imageability, imageability is a universal consideration in the fields of urban design, architectural design and research studies related to environmental behaviour (Maringa & Okello, 2006). According to Ewing and Hardy (2009) and Ujang (2012), Imageability influence human behavior by making a space instantly recognizable for people, promote the instinctive human ability to identify and remember patterns.

Robustness influences human behavior by increasing the degree of utilization of certain space for numerous purposes (Herath, 2005; UKEssays, 2018). Bentley, Alcock, Murrain, McGlynn, & Smith (1985) further discusses about robustness and they disclose that, the quality in a space which offer choices for people and can be used for many different purposes is called as robustness. When discussing about safety, according to Ridgway (2018) Psychological safety makes people to do more experiments, learn from the mistakes and increases their motivation to upgrade. Pettinger (2015) argues that safe work environment increases the belief in the reliability and trust within employees and therefore improves the confident behavior within workplace.

Vitality increases the amount of people in and around a certain space at different time periods throughout the day, uptakes the facilities and number of events, increases the energy of surrounding, and the degree to which a place feels alive (Montgomery, 1998). Openness increases people's ability to see their surroundings, improve their satisfaction and increase their willingness to pay for a view (Shach-Pinsly, Fisher-Gewirtzman, & Burt, 2011) while comfort given by physical environment in the workplace is claims to create a "healthier" building with optimum environmental conditions, which enable employees to be healthier and have a lower absenteeism rate, and hence be more productive (Ali, Chua, & Lim, 2015).

Unity gives a clear expression of a single idea and create visual composition out of diversity of areas and elements (Moughtin, Oc, & Tiesdell, 1999). Authors further states that unity produce clarity and singularity to distinguish figures from the background which helps people to orientate. Personalization of space could reach out to people in different ways and heighten experience for each individual user (Lehman,

2021) because, if a space has this personalization factor, it enables people to achieve spaces which matches to their unique preferences and values (Bentley, Alcock, Murrain, McGlynn, & Smith, 1985). Scale is important as it incorporate contrast to create visual interest within the space (Mastroeni, 2020). Furthermore, according to Mateo, Herna´ndez, Jaca, & Blazsek (2013), tidiness influences human behavior as it improves human working accuracy. Ujang (2012) adds that, creating and maintaining the tidiness of a place encourages the long-term attachment of a person to that space and increases his/her feeling of safety. Likewise, since these spatial factors can influence on human behavior, it may influence on time management ability of people as time management mainly depends on people’s behavior (Ahmad, Yusuf, Shobri, & Wahab, 2012)

2.5. Influence of spatial factors on time management

In work environments, delays and slipping deadlines are increasing day by day and it is expected to minimize those delays by doing proper time management (Dierdorff, 2020). Time management can be introduced as the act of planning and controlling the amount of time which spends on various activities, specifically to improve productivity and efficiency (Ahmad, Yusuf, Shobri, & Wahab, 2012). In a closer look, time management is taking purposeful control over the time period that a worker spends to complete any given task in order to achieve more effectiveness (Sima, 2017). Author further states that, the amount of time spends on inefficient activities can be decreased by tracking the activities and measuring the time spent for each activity. According to Tran (2015), resource allocation and effective time management are the key ingredients of successful project completion.

Physical environments directly influence workers work performance and productivity (Kamarulzaman, Saleh, Hashim, Hashim, & Abdul-Ghani, 2011). Some spatial arrangements can influence the likelihood and difficulty of engaging in different tasks and actions (Solman & Kingstone, 2019). Therefore, proper consideration on spatial factors of a workspace can have a huge impact on productivity of workers (Paljug, 2020). Many scholars have investigated on the relationship between physical work space and its influence on workers work performance since it can probably effect on

workers time management. (Khazanchi, 2018). Furthermore, the influence of spatial factors on time management is described in the table 2.3.

Table 2. 3; Influence of spatial factors in time management

Spatial Factors	Influence	Authors																		
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Legibility	Improve the effectiveness of finding person's way around the environment depicted.	√						√												
	Helps to figure out where a person stands at any given moment																			
	Minimize the time period to find the way back to any given point in the environment.																			
Permeability	Improve efficiency by encouraging "through movements".		√						√											
	Give ability to control the flow of people and circulation.																			
Imageability	Improves capacity to make a strong visual image which is highly useful.												√	√						
	Increase human ability to see and remember patterns within a space.																			
Robustness	Promotes adaptability, which enables work to get done better, faster, and more efficiently.					√					√									
Safety	Improves person's openness, flexibility and interdependence which requires to deliver high performance.			√							√									
	encourages more employee involvement																			
	Improves self-confidence, improves trust, and commitment from employees.																			

Spatial Factors	Influence	Authors																		
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Vitality	Makes a space vibrant and alive with potential to increase Collaboration, Engagement, well-Being, and Productivity															√				
Openness	can improve workers satisfaction and collaborative spirit			√					√											
	facilitates the collaboration in between workers																			
Comfort	Improves employee health to have lower absenteeism rate and this guides employees to be more productive															√				
Unity	Contributes to improve productivity by improving sense of calmness, limiting chaos in workplace, and also adding to the comfort level of a room																√			
Personalization	Improves ease of interaction within daily work flow and activity																		√	
Scale	Improves the feeling of safety																			√
Tidiness	Minimizes the time spends to find lost items.				√							√								
	Improves mental health and helps to focus on work																			
A- (Stamps, 2004), B- (Stoner, 2016), C- (Delves, 2020), D- (Bernstein & Turban, 2018), E- (Sander, 2019), F- (Nickl, 2020), G- (Weisman, 1981), H- (Alagamy, Al-Hagla, Anany, & Raslan, 2019), I- (Scalco, 2017), J- (Clarke, 2020), K- (Bentley I. , Alcock, Murrain, McGlynn, & Smith, 1985), L- (Mateo, Hernández, Jaca, & Blazsek, 2013), M-(Mohankumar, 2014), N-(Lynch K. , 1960),O-(Mars Drinks, 2015), P-(Ali, Chua, & Lim, 2015), Q- (Hatch Interior Design Inc., 2013), R-(Lehman, 2021), S-(Gehl, 2010)																				

Legibility Improves the effectiveness of finding person's way around the environment depicted while helping to figure out where a person stands at any given moment and minimize the time period to find the way back to any given point in the environment

(Stamps, 2004). Weisman (1981) also discusses about the impact of legibility on time management and his argument is that legibility is the extent to which an environment facilitates the process of way finding and it might have significant behavioral consequences that influence on person's time management. Also, permeability improves efficiency by encouraging "through movements" and helps to manage time efficiently (Stoner, 2016). To add up, Alagamy (2019) discusses about the influence of permeability on time management and he discloses that, permeability measures the visual continuity and physical connections from a space, and therefore supports time management by giving ability to control the flow of people and circulation. Both physical and visual permeability depend on how the space is divided into blocks and a place with small blocks gives more choice of routes than one with large blocks (Bentley I. , Alcock, Murrain, & McGlynn, 1985). A layout that has such connected spaces which offers a choice of direct routes to all destinations can improve time management since that allows easy, effective orientation and navigation for people who moves within site.

It is that shape, color, or arrangement; all aspects of form, which facilitate the making of vividly identified, powerfully structured, and highly useful, and therefore meaningful mental image of the environment (Lynch K, 1960; Maringa & Okello, 2006). This capacity provides by imageability helps to make a strong visual image which is highly useful (Mohankumar, 2014). Author further states that imageability supports time management of people by making it easier for them to find their way to certain spaces since it increases human ability to see and remember patterns within a space. Robustness is quality in a space which offer choices for people and if there is robustness, a space can be used for many different purposes according to the need (Bentley I. , Alcock, Murrain, McGlynn, & Smith, 1985). Robustness Promotes time management within a space by giving it adaptability, which enables the desired work to get done better, faster, and more efficiently (Nickl, 2020).

According to Delves (2020), Safety improves person's openness, flexibility and interdependence which requires to deliver high performance. When discussing about safety, Clarke (2020) reveals that safety improves time management ability in a work environment as it effects on productivity by Improving self-confidence, improving

trust, encouraging more employee involvement and increasing the commitment from employees. Also, if a construction site lacks in safety factor that might lead to accidents which will incur costs by losing time from the given project timeline (Enshassi, 2003). Vitality refers to a feeling of aliveness within a certain space (Dean, 2021). An environment that has vitality is vibrant, thriving, and alive with potential and therefore it can increase effective Collaboration, Engagement, well-Being, and Productivity of people who works within that space by creating a pleasant and encouraging environment to work (Mars Drinks, 2015).

Openness can influence on time management by improving workers' satisfaction and collaborative spirit (Bernstein & Turban, 2018). Scalco (2017), also agrees to this statement by describing that openness of a space can influence the time management aspect within that space since it facilitates the collaboration in between workers and results in greater productivity. According to Bos, Molinaro, Perrone, Sharer, & Greenberg (2017), Working in a more open work site improves the flexible support for collaboration, but it might reduce the ability of concentration of workers and this might lead to delays in work place.

Comfort level of a certain space can be measured by room temperature, relative humidity and luminance level (Ali, Chua, & Lim, 2015). Authors further state that, comfort comes from physical attributes within work place can create the space "healthier" as optimum environmental conditions increases employee's health and leads them to have low absenteeism rate, and hence be more efficient at work. Unity means bringing semantic, functional, and visual integrity of a space at the same time (Yilmaz, Mumcu, Düzenli, & Özbilen, 2016).Unity makes the elements of a space combine to be more harmonious, well balanced and completed for users of that space to feel right, pleasing and everything works together (Hatch Interior Design Inc., 2013).Authors further state that, Unity leads to create calmness and tranquility, controls unnecessary chaos within workplace and increases the degree of comfort which is very important to create good time management ability for workers who work within that space.

Personalization can increase user satisfaction and feeling of belonging within certain space (Yavari, Vale, & Khajehzadeh, 2015). Therefore, personalizing the experience within certain space would make architectural space more intuitive for users since it adapts to suit users' personal goals, suits users' individual preference or style, improves users' interactions with that space and create ease of interaction within daily work flow and activity (Lehman, 2021). When it comes to scale, scale is related to sense of enclosure and sense of place (Khalaf & Ja`afar, 2020). Authors further state that, Scale is dependent on the comparison of a set of dimensions with another set. Building scale and spaces ought to be proportional to human scale for people to feel secured (Gehl, 2010). When this feeling of security is developed in a facility, employee productivity eventually seems to be increase (Harter, 2020) .

Since our surrounding has a remarkable influence on peoples cognition, emotions, and behavior, affecting the relationships we create and the decisions we make, an untidy spaces may impact negatively on workers degree of tension and anxiety, as well as their ability to focus on work (Sander, 2019). Author further states that, tidiness improves workers' ability process information, and their productivity since it minimizes the time spends to find lost items and improves mental health which helps to focus on work.

2.6.Importance of Time Management in Construction Industry

Construction industry is continuously facing number of issues and time management is one of those issues which results in delayed project completions (Chin & Hamid, 2015). In present scenario, almost every construction project does not meet the deadline indicated in contract document and in fact, a construction project delays are becoming a totally normal incident to witness and at a certain point, it feels like it is an unavoidable scenario (LetsBuild, 2019). Construction delays can be defined as time overruns either beyond the contractual finish date or beyond the agreed finish date which is decided by project stakeholders.(Shahsavand, Marefat, & Parchamijalal, 2018). Authors further state that, to the owner, delay creates a loss of income through decreased production facilities and rentable space or a dependence on present facilities while to the contractor, delay creates high cost overheads due to extra work hours, high material costs through inflation, and due to increase of labor costs. 2020 report on

worldwide Construction Claims states the global average value of a construction delay dispute to be a staggering US\$30.7 million, a trend that has climbed upward from 2010 (Lepage, 2020). This report also illustrates that the average dispute takes approximately 15 months for a recovery.

The ineffective time management can negative influence on the long-term attributes of a project as time is considered as one of the triple constraints namely time, cost and quality as any deviation from the schedule may have major effects on the cost and scope of a project because time really is money (Tran, 2015). Author further states that, project delays can also add to the tension and frustration of the project manager and other team members. Even though owners want contractors to complete project under time and budget constraints, delays cost money and contractors normally hire subcontractors, who are given tight scheduled to ensure the contractor completes the job according to the schedule (Schneider, 2015). Author further discusses that, as the result of this process, contractors make unrealistic expectations and gives unrealistic schedules to workers, which pressurize the workers and lead them to work faster and ultimately may lead to unexpected injuries. Therefore, good time management enables workers to achieve goals, resources and schedules to reduce the project cost with purposeful usage of billable hours and energy (Hodge, 2013). Author further states that, Time management is major factor, which decides on contractors' profit levels, as they are working according to a contract where failure to abide by its terms and deadlines can partially reduce the payment or even cancel the contract.

2.7.Importance of Time Management of Construction Workers

Time management is a strategy to plan and control the constraints related to time slots allocated for certain activity, to increase the efficiency, productivity and profit (Hodge G. H., 2013). According to the general project management principles, effective time management is illustrated as the key to complete a project successfully (Bovteev, 2016).Time management is the process of recording and controlling time spent by workers on the project and it mainly depends on the people who engaged in the activity (Westland, 2006).

Time management can be implemented by setting goals, prioritizing the most crucial activities, planning other activities around prioritized events, decision making on time allocations to complete certain tasks, adjusting to the random problems, rescheduling and prioritizing goals on daily basis and observing behavior patterns and trends (Crutsinger, 1994). Time is critical for every participant in the construction process as knowing the contractual time and change provisions is important to minimizing time and cost overruns since they have to pay their crew for the extra time (Novotny, 2018). Time Management of Construction Workers is important because they often get hourly pay rate, so time management certainly supports to control salary costs and time management in construction is also crucial as the work delayed or behind schedule may hinder the whole project, especially when one group must wait for another group to finish a certain type of work before beginning the next step in the project (Reeder, 2020). Time Management is considered as the capability to plan and control the time spent on every task (Tran, 2015). Author further states that, Planning, setting goals and prioritizing for a better performance of workers and increase effectiveness and productivity of project to result in good time management. Precisely, Time management is the most desired skill of a worker, since most project delays happen due to poor time management ability of workers (Dierdorff, 2020).

2.8.How Spatial Factors Can Influence Workers in a Construction Site

As the structure of a physical environment can have a significant influence on individuals' ability to orientate within that environment (Slone, Burles, Robinson, Levy, & Iaria, 2014) the physical elements of the work site have the ability to influence workers' satisfaction, anxiety, tension, productiveness, and efficiency (Samani, Rasid, & Sofian, 2017). Design of the work site and its effect on users' behavior is recognized as having a significant impact on employees' behavior within work environment, employees' commitment towards completing given tasks and even on the knowledge generation within the organization (Vischer, 2008).

The construction industry is labor intensive compared to other industries and many construction sites are characterized by poor work environments (Hashiguchi, et al., 2020). Also, in every construction project, the work site layout is regularly and routinely developed and the decisions about work-site layout are made by considering

the locations for temporary offices, rest and dining areas, material storage areas, crane locations, access points, sanitary facilities, access routes, workshop areas, utilities and other important features (Small & Baquer, 2016). The productivity of a workspace can be determined by how well those spaces in the layout are being used and how efficient the workers are (Garzon, 2005). Therefore, spatial factors in construction sites, which exists according to its spatial arrangement, can influence workers work performance in numerous ways.

Large scale build environments are too extensive to be perceived entirely from a single location and it is necessary that information regarding specific locations, and the spatial relationship among those locations have to be stored in one's head to work effectively and efficiently within that space (Weisman, 1981). Author further states that, this readability of space is called as legibility. Less legible spaces can form confusing maze-like complex, illegible layouts which can limit workers' movements between available spaces, decrease collaboration between workers, and reduce overall ability of employee control (Harten, 2018). Furthermore, author explains that, good legibility can positively result to reduce stress and offer configurations that are easy to understand and easy to navigate for workers. When it comes to permeability, visually and physically interconnected spaces influence users since they reduce the segregation and isolation of sites and encourages the activities happening (Alagamy, Al-Hagla, Anany, & Raslan, 2019). Authors further state that, visual permeability of space increases the option of having better views across the space and provides a stronger visual and psychological image about the relationship of spaces to each other in the three-dimensional space while physical permeability of space encourages direct circulation and alternative routes. Within a permeable work space communication between workers tends to increase, teamwork seems to boost and the collaboration with other workmates usually enhances (Belyh, 2019).

Imageability is the quality which gives a high probability of evoking a strong image of a certain space within users' mind (Lynch, 1960; Lucus, 2012). Authors further state that, shape, color or arrangement of elements facilitates to arrange a unique, well structured, highly purposeful mental image of an environment. When a site is imageable, users tend to understand and remember the locations and routes better

(Lele, Ladkat, & Paradeshi, 2013). When discussing about robustness, Work spaces do not only facilitate to just complete given tasks, they bear the potential to increase the ability of achieving work tasks successfully as they provide optimum work environment for employees (Atkin & Brooks, 2000). Because number of activities are being carried out within a work space, space utilization should be more efficient and therefore more flexible spaces are needed (Hassanain, 2010). Robustness of a space promotes the user choice and since construction sites change the use of spaces continuously, robustness helps desired pattern of activities to take place as effectively as possible (Bentley I. , Alcock, Murrain, McGlynn, & Smith, 1985).

Safety and productivity in work site are going hand by hand since neither one of them function effectively without the other (Clarke, 2020). Author further discusses that, on work sites which provides a safe working environment, workers are most probably upholding optimal productivity and in sites which has easy access to health services can minimize chances of injuries among workers and this leads to create workers who feels secured and supported at work place, who is willing to do extra work and give extra contribution to meet the desired goals at work. When the vitality of a space is high, it means that the users have good interactions, sense of safety and belongingness towards that space (Işiklar, 2017). Author further states that, good interaction density results brief conversations between individuals that are helpful to obtain information and experiences from each other while safety and sense of belongingness, pave the way for development of genuine behaviors by allowing the individual to internalize the place they are present and leading he/she to see themselves as a part of it.

Many scholars describe that the openness of space supports communication between users of that space and therefore, is believed to uplift and improve the teamwork and inventiveness (Samani, Rasid, & Sofian, 2017). Armstrong (2012) and Hollis-Turner (2015) agrees by saying that openness in construction sites supports to encourage better collaboration with colleagues. Work spaces which have openness in it, facilitates communication and improves collaboration between workers as it generates adaptability and customization needed for both organization and its workers (Maher & Von Hippel, 2005). Comfort in work environment can have enormous influence on the collaboration between co-workers and managers as a comfortable work

environment gives employees the chance to exchange valuable opinions for the project success (Freedman, 2020). Author further states that comfort in the work space inspires and attracts the employees, leading to high work satisfaction, employee retention within the project and less stress among the workers. Comfortable work space offers safety, security and allows employees to achieve work targets optimally as the work environment can effect on employee emotions (Senata, Nuridja, & Suwena, 2014). Furthermore, authors state that, if the workers are satisfied about their work environment, then the workers will execute the given tasks to achieve the project time line successfully.

The idea behind the unity within a certain space is to create features of that space to support each other and all work together as a network to accomplish the final goal and avoid giving mixed messages to the user (Bradley, 2010). Author further states that, to achieve unity, elements within a space should look like they belong together and not be arbitrarily placed. Unity of a space has several benefits for users since it can improve usability, visual hierarchy, identity, and the overall user experience (InVisionApp Inc., 2021). Unity offers the feeling of calmness and supports to reduce chaos within workplace, and also improves the level of comfort, which helps increase productivity (Hatch Interior Design Inc., 2013). Dialing up personalization can transform boost employee engagement and job satisfaction while engendering a staff-led workplace culture(Pickup, 2020).Author further states that, personalized work space provide a greater sense of connection between the employee and the organization as fostering a relationship that suits the employee's circumstances, and an environment where the employer cares about these things creates a work space where individuals can better focus on their work in a more engaged and committed way.

The entire work space is considered to have a very important impact on individual's motivation, satisfaction and task performance and furthermore, scale has the largest impact on spatial functionality as it is essential to achieve the objective of enhancing employees everyday experiences within the environments they work (Hatch Interior Design, 2021).When it comes to tidiness, researchers have illustrated that the physical environment has a major effect on workers cognition, emotions, and behavior, influencing their decision-making and relationships with others. Untidy spaces can

negatively impact on workers stress and anxiety levels (Sander, 2019). Untidy work environments can effect on workers’ health and this may result in loss of productivity and lost work days (Garner, 2019). Author further states that, a clean and organized workspace is also beneficial for your worker’s mental health and therefore, contributes to better morale, increased productivity, and can even have a contagious effect on other co-workers.

2.9.How to Manage Spatial Factors at Construction Sites

Spatial factor management is the practice which is involved with tracking, controlling, supervising and properly utilizing the available space of an organization to manage its physical layout and for better space configuration (Prasad, 2019). Author further states that, work space layout organization is a major part of space management, which empowers an organization to use its work space at its best. Table 2.4 illustrates the spatial factor management strategies to achieve proper time management within work spaces.

Table 2. 4; Spatial factor management strategies

Spatial Factor	Management Strategy	Source
Legibility	Creating Landmarks within the site that help people orient themselves.	(Harten, 2018)
	Creating outside landmarks to guide people since one can also leverage outside landmarks and signage for guidance.	
	These markers allow employees to create a “mental map” of the layout and find any location within the building, even with limited experience with that building.	
	Creating clearly identifiable Paths, Districts, edges nodes landmarks within site.	(Lynch K. , 1960)
Permeability	Creating a well-connected layout which offer choice of direct routes	(Essex planning officers association, 2019)
Imageability	Improving identity of site (identity means a distinction from other objects)	(Damayaniti & Kossak, 2015)

Spatial Factor	Management Strategy	Source
	Improving the structure of the site (structure means a relationship to larger pattern of other elements)	
	Improving the meaning of site (meaning means a practical and emotional value for the observer)	
Robustness	Creating spaces that can adapt to different uses and activities, perhaps at different times of the day.	(Carmona, 2018).
Safety	Installing proper fall protections fences and nets.	(Roux, 2014).
	Marking the site properly to protect employees from hazards by showing necessary sign boards.	(American Society of Safety Professionals, 2019).
Vitality	Vitality of a space can be improved by increasing its accessibility, sustainability and environmental quality.	(Drewes & van Aswegen, 2010)
	Creating vibrant and diverse spaces and facilities.	(March, Rijal, Wilkinson, & Özgür, 2012)
Openness	Improving view, the light, the feeling of being in the open.	(Donnell Day Architects, 2021)
	Improving surface textures	
	Improving sequence of spaces.	
Comfort	Providing a superior acoustic environment.	(WBDG Productive Committee, 2018)
	Maintaining optimal thermal comfort.	
	Creating a high-quality visual environment.	
	Providing furniture and equipment that will enhance worker comfort.	
Unity	Creating a sense of cohesion in the space by repetition of particular elements throughout the entire space, whether they're colors, shapes or materials, to pull the look together.	(Mastroeni, 2020)
Personalization	Allowing employees to rearrange their work stations or furniture in any way they wanted in order to meet their evolving needs for collaboration or privacy.	(Pearce & Hinds, 2018)
Scale	Using standardized heights and ergonomic measures to design furniture in work site.	(Hatch Interior Design, 2021)

Spatial Factor	Management Strategy	Source
	creating widths of service routes by considering anthropometrics	
Tidiness	Providing Designated area for rubbish and waste.	(Darley PCM Ltd, 2018)
	Stacking and storing materials properly.	
	Keeping access routes clear.	

The construction industry is a key contributor to the gross domestic product (GDP) of a country's economy and the reduction of productivity within construction industry continuously came under the spotlight because due to this issue, construction industry fails to meet increasing performance expectations for long time (Sabet & Chong, 2020). Author further states that, it is crucial to uplift productivity out of this deadlocked state as the construction industry, directly and indirectly, effects on the economy and new strategies should be used to overcome this situation.

Effective spatial factor management leads to productive and functional work space by improving good time management (Revoy, 2020). As examples, Legibility is the level to which the physical elements of the surrounding aids people to create an effective mental image, "cognitive map" of the spatial relationships within a certain space, and the legibility facilitates the wayfinding ability of people (O'Neill, 1991). Large built environments are extremely complex and maze like (Nichols, Canete, & Tuladhar, 1992). Users face significant problems while finding their way within them (Brill, Asce, & Cook, 1984). These wayfinding difficulties may result in time losses by reducing work efficiency and increasing mental stress (O'Neill, 1991). According to Lynch (1960), to increase the Legibility, the landmarks in the area have to be recognizable and prominent, the site should have different sections which have distinct characteristics for easy identification, clear access ways, and important points of interest along paths and Structures or features providing borders to different sections or access ways (Ingram & Benford, 1996; Yavuz, Ataoğlu, & Acar, 2020). Legibility can be embedded in to the work environment by introducing landmarks that supports workers to orientate themselves. People can also leverage landmarks and signage situated outside of the work site as these markers allow employees to create a "mental

map” of the layout and find any location within the building, even if they have only limited experience with that building (Harten,2018).

When it comes to permeability, a layout that encourages permeability should be well-connected and offer a choice of direct routes to all destinations (Essex planning officers association, 2019). They further state that, this allows easy, effective orientation and navigation within site. To improve safety, construction sites should have proper fall protection measures (Roux, 2014). American Society of Safety Professionals (2019) argues that, Construction sites must be marked to protect employees from hazards by showing necessary sign boards since signs make enormous contribution to inform workers what hazards might be present at site and how to avoid possible injuries. Robustness can be achieved by introducing adaptable spaces that has flexibility towards various uses and activities, perhaps at different time periods or according to the demands placed on those spaces (Carmona, 2018). This quality leads to increase productivity and engagement of workers since tailoring the surrounding to facilitate the evolving needs of workers encourages them to give their best in the tasks they are assigned to (Samuel, 2019).

Uncomfortable conditions in buildings and spaces such as too hot, too cold, too noisy, too dark, too light and too much glare restricts the ability of workers to function to full capacity and can lead to lowered job satisfaction and increases in illness symptoms (WBDG Productive Committee, 2018). Authors further state that, comfort is important to achieve effectiveness, satisfaction, and physical and mental well-being at work and it comfort can be attained through providing a superior acoustic environment, maintaining optimal thermal comfort, creating a high quality visual environment and by provide work stations with furniture and equipment that increases workers performance. Using unity to create a sense of cohesion makes it easy to recognize initial patterns as our brains categorize those repeated details and similarities much faster than they would if none of the design elements fit together, which subconsciously allows us to be calmer when we’re in that particular space (Mastroeni, 2020). Author further states that, this unity factor can be achieved through repetition of particular elements throughout the entire space, whether they’re colors, shapes or materials, to pull the look together.

When workers believe they had the latitude to personalize the space, they feel more place identity (Pearce & Hinds, 2018). Author further states that, giving opportunity to adapt employees work stations in different configurations to meet their evolving needs for collaboration or privacy can improve work efficiency. Without consideration of scale, in particular, human scale, activities would be more difficult and using standardized heights for furniture in work space and creating widths of service routes by considering anthropometrics can improve comfortability and feeling of safety within work space. Tidiness in a construction site can be achieved by providing designated area for rubbish and waste, stacking and storing materials properly and Keeping access routes clear (Darley PCM Ltd, 2018).

2.10. Theoretical Framework

The theoretical framework gives the information on where the research is oriented, allowing to convincingly interpret, describe and generalize from the findings (Vinz, 2020). The theoretical framework is the structural formula which supports the flow of theory within the research study as it illustrates the theory that explains why the research problem under study exists (USC Libraries, 2021). Furthermore, they state that a theoretical framework consists of concepts, definitions and reference to relevant literature from past scholars and existing theory that is used for the particular study. The theoretical framework is developed by investigating literature, which can give the explanation to understand the research problem (Kumar A., 2011). The theoretical framework for this research is shown in figure 2-1 and it developed as a flow chart.

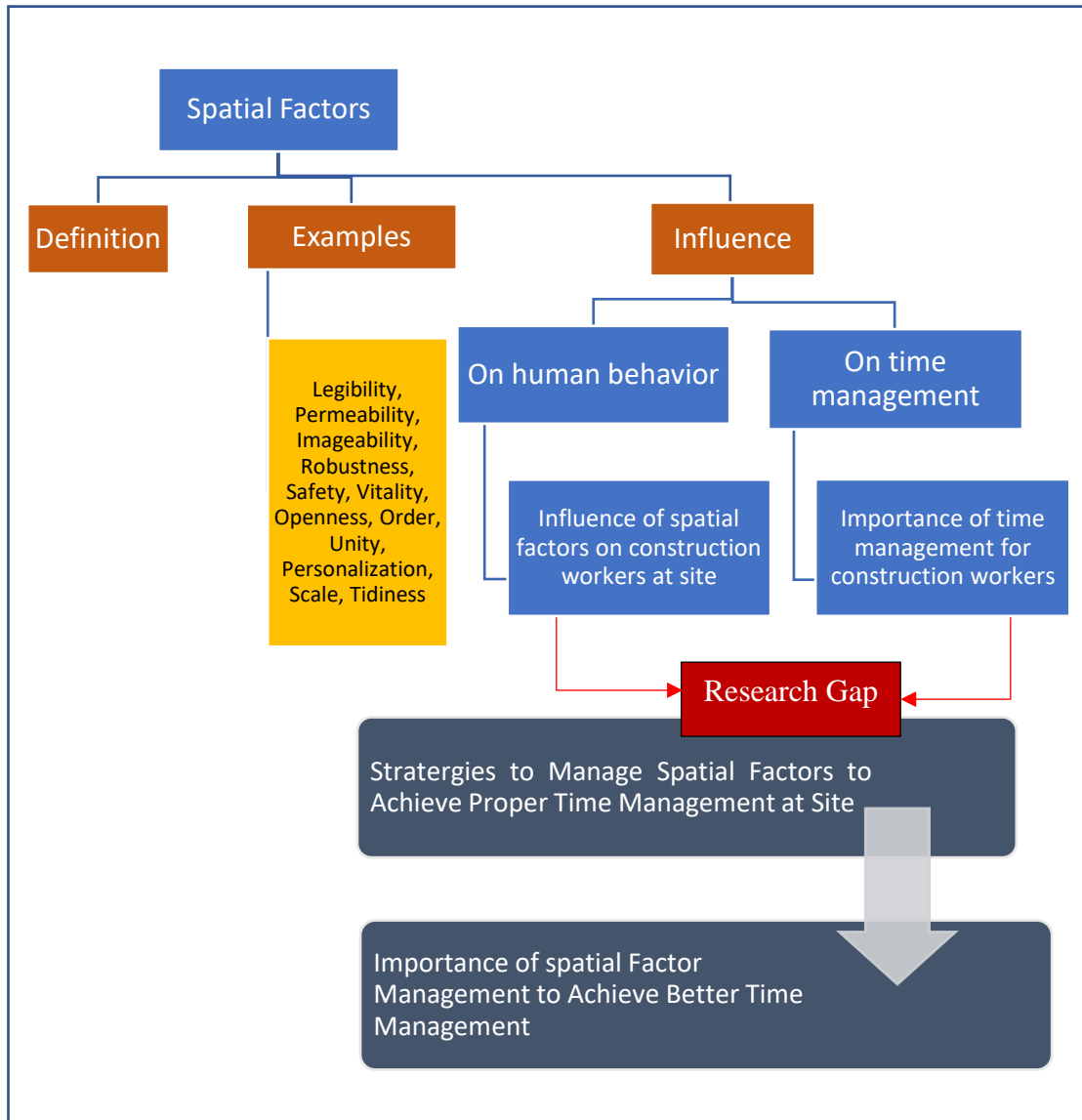


Figure 2. 1; Theoretical framework

According to the figure, the study is carried out under main identified themes. Firstly, spatial factors were identified with their definitions, examples and their influence on human behavior and time management. Moving through the avenue, influence on spatial factors on behavior of construction workers which results in their time management ability was identified to propose strategies to manage spatial factors at construction sites. This helps to understand importance of time management of construction workers at site and to propose ways to achieve better time management.

2.11. Why Spatial Factor Management is Important for Construction workers to Achieve Better Time Management at construction sites.

To date, the effect that individuals' perception of their work space arrangement has on their overall behavior and task achievement is rarely being in the spotlight.(Samani, Rasid, & Sofian, 2017) But, achieving better time management through spatial factor management is much effective since it is involved in increasing work speed of workers by improving their work space satisfaction (Revoy, 2020). Spatial factor management includes managing the work site layout, location of elements and equipment and the flow between employee work spaces (Post, 2020). Author further states that if someone want their employees to improve their productivity they have to focus to the structure and setting of that work space.

To exemplify, If the legibility in work space is increased by improving the space configuration, that helps workers to create a “psychological map” of the layout which sets up a predictable pattern for them to easily understand or guess how to navigate through the space and find any location in the building(Harworth, 2020).A strategy to increase productivity within work site by spatial planning is making sure that there are always viewpoints, sightlines and key interior landmarks that will orientate people(Penny, 2019). When considering permeability, a permeable site can improve efficiency of work by improving movement patterns and by offering alternative ways as choices to go through that space (Stoner, 2016; Bentley, Alcock, Murrain, McGlynn, & Smith, 1985). Increasing the safety factor of work site can lead to project success as workers who feel secured in their work space are more efficient than the ones who have been injured in there past and therefore, have increased the degree of tension and fright (Martic, 2020). Author further states that, lowering the level of possible hazards within work environment enables employees to stay invested in their work and work optimally. Openness of a work environment encourages better time management as it influences on energy and movement within a space (Donnell Day Architects, 2021). Improving tidiness in a construction site is important since a tidy work soace eliminates dangerous situations, reduces possible injuries and enhances safety (Darley PCM Ltd, 2018). Furthermore, authors state that, tidiness makes work more productive since if a site is organised and tidy, everyone knows where everything

is. Finally, improving robustness in a work site is important for workers time management as it promotes adaptability, which enables work to get done better, faster, and more efficiently (Bentley, Alcock, Murrain, McGlynn, & Smith, 1985; Nickl, 2020).

Negative work spaces create work stress that contributes to reduce the healthiness and productivity of workers since absenteeism, demotivation, and trust issues significantly increase costs and badly impact on the bottom line (Anderson, 2017). Author further states that, taking actions to create a good work space can create a dynamic work culture, which includes ambition, competitiveness, creativity, flexibility, enthusiasm, and initiative that gives ability to take risks and bear responsibility for workers to be more productive. Workers spend the most of their time within the construction site, where the physical attributes of the surrounding can affect their health, job performance and efficiency. It is commonly known that the employees, who are more satisfied with the physical environment of the work place generate better job output (Kamarulzaman, Saleh, Hashim, & Abdul-Ghani, 2011).

2.12. Summary

This chapter was focused on collecting the background knowledge on the research area and it primarily focused on spatial factors, Time management at construction sites and construction workers. Literature findings identified that; it is important to manage the spatial factors which influence time management of construction workers at site. Then it identified process of ensuring project success through spatial factor management and the importance of finding strategies to manage spatial factors in construction sites. All the collected data from the literature review will be helpful for analyzing with other collected data from interviews and case studies.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1.Introduction

Chapter two discussed about the significant research areas and opinions of past researchers which are important for continuing this study by referring existing literature. This upcoming chapter explains the methodology followed to achieve expected goals of the study. The chapter begins with the research design that briefly illustrates research methodology which explains the way this research was conducted. Then, the research design consists with the selected research approach and the selected research methods. Finally, the data collection tools that are required to conduct this study was identified with an explanation on the selected data analyzing method for this study.

3.2.Research Approach

The research approach is a plan and procedure that consists of the steps of broad assumptions to detailed methods of data collection, analysis, and interpretation (Chetty, 2016). Author further states that, therefore it is based on the nature of the research problem being addressed. The overall decision about the research approach involves selecting the most suitable approach for the topic, philosophical assumptions about selecting that approach, procedures of inquiry and specific research methods of data collection, analysis and interpretation (Grover, 2015).

3.2.1. Available Research Approaches

There are two major research methodologies namely quantitative and qualitative (Gunnell, 2016). Author further states that, there is also a third methodology called mixed method, which is a combination of both qualitative and quantitative approaches has recently generated as a new research approach and it is gaining acceptance as a way to improve and substantiate research findings. Table 3.1 depicts the available research approaches and their characteristics.

Table 3. 1; Available research approaches

Research Approach	Characteristic of the Research Approach
Qualitative Approach	Qualitative methodologies are used to analyze and evaluate non-numerical information(Gunnell, 2016)
	Qualitative methods are applicable to studies that involve relationships between individuals, individuals and their environments, and motives that drive individual behavior and action (Gunnell, 2016).
	Qualitative methods allow “richness of the personal experience” by providing in-depth information in the natural language of the experience (Berrios & Lucca, 2006).
Quantitative Approach	This method often translates into the use of statistical analysis to make the connection between what is known and what can be learned by research (Chetty, 2016).
	Quantitative methods rely on experiments and surveys to collect measurable data such that statistical processes can be applied (Creswell, Research design: Qualitative, quantitative, and mixed methods approach (2nd ed.), 2003)
	A major advantage of quantitative methods is that the results are usually generalizable to larger populations (Gunnell, 2016).
Mixed Approach	Mixed approach focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies (Creswell & Clark, 2007).
	Its central premise is to use quantitative and qualitative approaches in combination to provide a better understanding of research problems than either approach alone (Creswell & Clark, 2007).

As indicated in Table 3.1 there are number of different characteristics to each type of research approach. The selection of the most suitable research approach for the study has to be done based on the type of collected data and the applicability of their characteristics to attain the final intention to be achieved from the research findings.

3.2.2. Selected Research Approach

When research tends to understand how people experience the world the most suitable and most used research approach is qualitative approach (Bhandari, 2020). Qualitative research is defined as a step-by-step investigation into social phenomena in natural settings (Teherani, Martimianakis, Stenfors-Hayes, Wadhwa, & Varpio, 2015). Authors further state that, these phenomena can include, but are not limited to, how people experience the daily events of their lives, how people behave in certain events,

how people organizations events or activities, and how people create relationships with each other. Qualitative methods are applicable to studies that involve relationships between individuals, individuals and their environments, and the factors that decide people's behavior and action (Gunnell, 2016). Therefore, since this research involves in-depth information about human behaviors, human abilities and spatial factors, qualitative research method is being selected to carry out this research. As per Flick (2018), triangulation in data collection helps to develop a comprehensive understanding of phenomena and in-depth study for qualitative research. Thus, this research used triangulation by using more than one method for data collection as discussed below.

3.3. Research Strategy

3.3.1. Available research strategies

A Research Strategy is a step-by-step plan of action that gives direction by enabling scholars to conduct research systematically and on schedule to produce quality results and detailed reporting (Dinnen, 2014). There are many research strategies such as research strategies, such as experiment, survey, case study, ethnography, grounded theory, action research, and phenomenology (Johannesson, 2014).

3.3.2. Selected Research Strategies

- **Survey**

Survey research can be defined as a strategy to collect information from a sample of individuals through their responses to questions (Check & Schutt, 2012). As they are used to describe and explore human behavior and human experience, surveys are frequently used in social and psychological research (Singleton & Straits, 2009). Therefore, since this study involves with human behavior and experience, this strategy is utilized in the study.

- **Case Study**

Case study surveys tend to enable a holistic review by offering the chance for researchers to utilize number of tools on one topic which offers time and opportunity to construct a detailed understanding about the subject, establishing a strong base to

investigate the details of case studies (Salmon, 2017). Therefore, case study strategy is used to validate the findings from survey.

3.4. Research Methods

3.4.1. Available Research Methods

For qualitative research, the semi-structured or unstructured interview is often used (Bolderston, 2012) and also case study method is a very commonly used methodology in academic field by researchers interested in qualitative research (Rashid, Rashid, Warraich, Sabir, & Waseem, 2019; Baskarada, 2014). Furthermore, since qualitative research gathers data about lived experiences, emotions or behaviors, data collection methods such as interviews, observations, focus groups, document review are identified as research methods (University of Newcastle Library, 2020). Gill, Stewart, Treasure, & Chadwick (2008) agrees to this by saying there are number of methods to collect data in qualitative research namely, observations, textual analysis, visual analysis and interviews (individual or group).

3.4.2. Selected Research Methods

Qualitative interviews offer researchers opportunities to investigate, in an in-depth manner, matters that are unique to the experiences of the interviewees, giving insights into how different events are experienced and perceived by various people (Palmgren & Liljedahl, 2009). Therefore, under the survey strategy, semi-structured interviews were adopted as the research method. In other hand, Case study research includes number of data collection tools such as interviews, observations, questionnaires, and relevant documents and multiple data collection sources are generally used to conduct case study surveys (Yin, 2014). Therefore, expert interviews and observations were carried out under the case studies.

- **Semi Structured Interviews**

Interviews are effective for qualitative research since them helps to explain research subjects' opinions, behavior, experiences, and phenomenon. (Virginia Tech University Libraries, 2018). Semi structured interviews are guided by a flexible interview protocol and supplemented by follow-up questions and comments to allow the researcher to collect open-ended data, to explore participant thoughts, feelings and

beliefs about a particular topic (DeJonckheere & Vaughn, 2019). Furthermore, when considering the inter-relationship between participants and researchers and the emphasis on the exploration of human phenomena, interviews are long known as a data-collection method linked with qualitative research (Palmgren & Liljedahl, 2009). Therefore, within this study, semi structured interviews were conducted with professionals and construction workers to identify the connection between spatial factors in site and their influence on time management of construction workers.

- **Expert Interviews**

Expert interview is a kind of individual interviews carried out between interviews and respondent – a specialist in the subject in question (Libakova & Sertakova, 2015). Author further states that expert interviews are aimed to obtain additional unknown or reliable information, authoritative opinions, serious and professional assessments of the research topic, these interviews involve questions that allows the expert to assess the possible options. In this research, three experts from selected three case studies will be interviewed as it is important to validate gathered information from persons who carries deep knowledge about the case.

- **Physical Observations**

Physical observation method involves observing people's behavior in the environment in which it typically occurs (Price, Jhangiani, Chiang, Leighton, & Cuttler, 2017). Observation is the process enabling researchers to learn about the activities of the people under study in the natural setting (DeWalt & DeWalt, 2002). Under the case study strategy, physical observations were used to observe how spatial factors influence behavior of construction workers and how construction workers' behavior influence on their time management ability to understand the connection between spatial factors within construction site and time management of construction workers. These observations were used to validate the findings of semi structured interviews.

3.5.Data Analyzing Techniques

The analyzing of the data collected should be done with vital attention. Since this is qualitative research, the data analysis method which is used in this study is manual content analysis.

3.5.1. Manual Content Analysis

Content analysis is a research method used to identify patterns in recorded communication and therefore, to conduct content analysis, systematically data collected from a set of texts, which can be written, oral, or visual is needed (Luo, 2021). From the perspective of validity, it is important to report how the results were created. Readers should be able to clearly follow the analysis and resulting conclusions (Schreier, 2012). In this study, the interviews and case studies were used to collect data from the professionals and construction workers. That led to use the manual content analysis method for this study

3.6. Research Process

Following figure 3.1 illustrates the research process of this research on spatial factors contributing the time management of construction workers at construction sites.

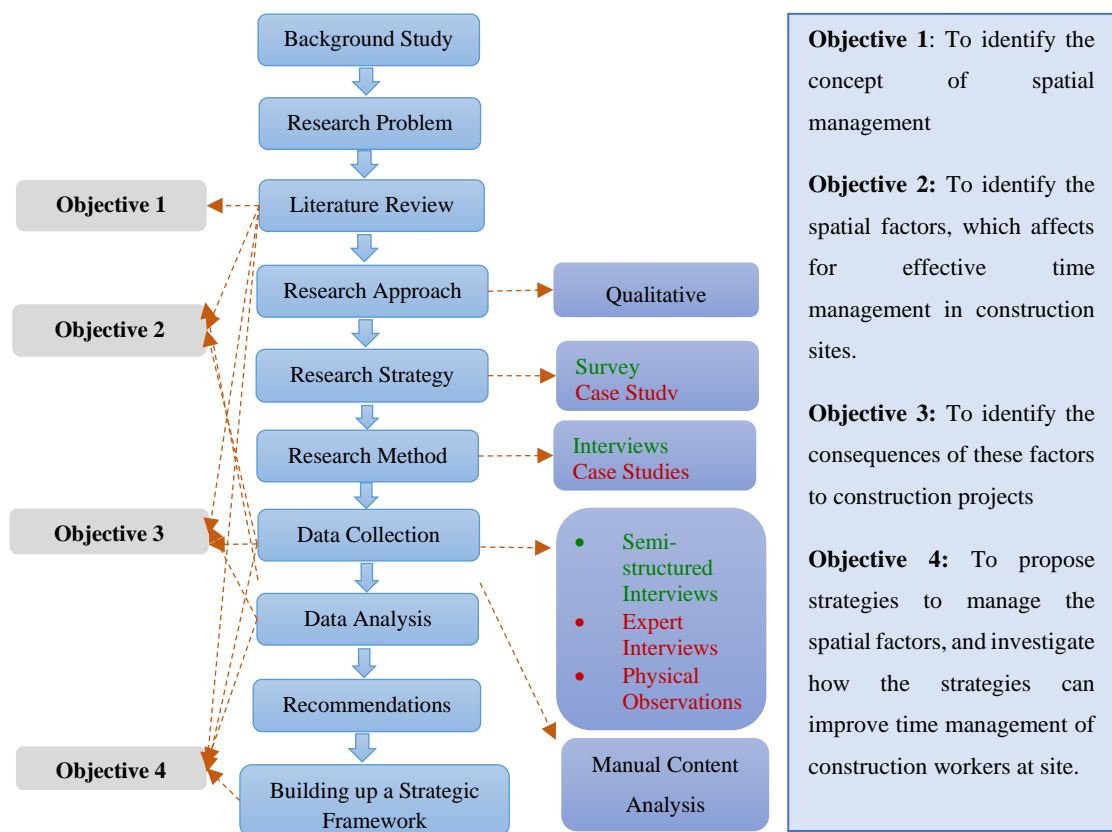


Figure 3. 1; Research process

According to Figure 3.1, first chapter of the research is introduction. The need to find strategies to manage the spatial factors contributing to time management of construction workers at site was briefly discussed in introduction chapter. Then literature chapter was begun as the second chapter. Spatial factors, their influence on time management of construction workers and spatial factor management strategies were discussed in more theoretically in literature review. Data collection was done with two methods as case study surveys and interviews. Using these collected data, data analysis was done through manual content analysis to cover objective four. Final chapter was the conclusions and recommendations.

3.7.Summary

The process of resolving the research problem is discussed within this chapter with the selection criteria for research approach, data collection, and data analysis and also with the framework developed to attain aim and objectives of the study. Accordingly, qualitative research approach was selected to proceed with the study by using research methods namely semi-structured interviews and case studies. To collect the data from case studies, expert interviews and physical observations were selected as data collection tools. In this chapter, it is apparent that all the objectives were started fulfilling from the literature review stage, and validated with the data collection stage. Finally building up a strategic framework was attained as the final step of the research process. Likewise, the systematic approach for this research was as illustrated above and the next chapter is on the research findings and data analysis of this study.

CHAPTER 04

4. FINDINGS AND ANALYSIS

4.1. Introduction

Research methodology and the process of data collection was described in previous chapter. This chapter illustrates the research findings collected by following that methodology and analysis of those findings. The findings to attain each research objective are derived from this in-depth analysis and this analysis is conducted by utilizing manual content analysis method. Data collection process was carried out with two major steps namely, semi-structured interviews and case studies with expert interviews and physical observations within them. The purpose of conducting semi-structured interviews was to specify the applicability of the literature review findings to construction workers in construction sites while determining the best path to proceed to the aim of the study. Then to validate semi-structured interview findings, case studies were carried out selecting three cases. Expert interviews and physical observations were carried out within those case studies. The expected final outcome of this chapter is to investigate how management of spatial factors contribute to time management of construction workers at site.

4.2. Findings and analysis of the interviews

As the first step of data collection process, semi structured interviews were carried out with eight industry professionals and eight construction workers, who have been passionately involving in the building construction projects in Sri Lanka and possess more than three years of professional experience. The findings of above mentioned semi-structured interviews were analyzed widely using the manual content analysis technique. These interviews were conducted focusing on covering five areas namely, background information of the interviewee, spatial factors which influence time management of construction workers at site, how those spatial factors influence time management of construction workers at site, strategies to manage these spatial factors and how spatial factor management strategies will improve time management of construction workers at site. The inputs of semi-structured interviews were used for the development of framework as a guide for the case study data collections and further in-depth analysis.

4.2.1. Objectives of the Interviews

The main objective of the semi-structured interview was to identify spatial factors which contributes to the effective time management of construction workers at site, the way those spatial factors influence, spatial factor management strategies and how those strategies contribute to the time management of construction workers at site. The literature findings were mainly focused on spatial factor management strategies and there were not enough findings to identify how those spatial factor management strategies influence time management of construction workers at site. Hence, the intention was to understand how the identified spatial factor management strategies influence time management of construction workers at site and to investigate new spatial factor management strategies which influence time management of construction workers at site. Through these interviews, it was intended to cover data collection needed to fulfill all four objectives to attain a good understanding on the way this research proceed forward. The findings from interview round were very useful as it added necessary input to succeed the research ahead.

4.2.2. Profile of Interviewees

The above-mentioned semi-structure interviews were carried out with expert professionals well qualified and experienced in building construction projects and with construction workers who are well experienced and engaging in many buildings related construction projects in Sri Lanka.

Only architects and project managers were selected for expert interviews because architects are the only available experts who has both adequate experience and conceptual knowledge about spatial factors and their applicability within building construction projects and project managers are the experts who work with construction workers, construction delays and who handle the site plan (deciding material storage areas, areas for various work stations) throughout the construction period. Table 4.1 illustrates the details of interviewees selected for the semi-structured interviews.

Table 4. 1; Details of interviewees

Interviewee code	Details				
	Profession	Designation	Key role	Experience	Type of Projects involved
I1	Architect	Principal Architect	Designing	21 Years	Residential, Industrial and commercial buildings
I2	Architect	Principal Architect	Designing	27 Years	Residential, Industrial and commercial buildings
I3	Architect	Project Architect	Designing and site inspections	5 Years	Residential and commercial buildings
I4	Architect	Project Architect	Designing and site inspections	12 Years	Residential, Industrial and commercial buildings
I5	Architect	Junior Architect	Support designing and site inspections	3 Years	Residential and commercial buildings
I6	Civil Engineer	Project Manager	planning, executing and monitoring	11 Years	Residential, Industrial and commercial buildings
I7	Civil Engineer	Project Manager	planning, executing and monitoring	5 Years	Residential and commercial buildings
I8	Civil Engineer	Project Manager	planning, executing and monitoring	3 Years	Residential buildings
I9	Mason	Skilled worker	Concrete Works	12 Years	Residential and commercial buildings
I10	Mason	Skilled worker	Plastering	10 Years	Residential, Industrial and commercial buildings
I11	Painter	Skilled worker	Painting walls	5 Years	Residential and commercial buildings
I12	Plumber	Skilled worker	Installing pipes and fixtures	8 Years	Residential and commercial buildings
I13	Plumber	Skilled worker	Installing pipes and fixtures	4 Years	Residential and commercial buildings
I14	Titanium Worker	Skilled worker	Floor finishes	11 Years	Residential and commercial buildings
I15	Tile worker	Skilled worker	Floor finishes	4 Years	Residential buildings
I16	Electrician	Skilled worker	Installing wires and fixtures	5 Years	Residential, Industrial and commercial buildings

	Interviewees from expert category
	Interviewee from construction worker category

The interview guideline (Refer Appendix A) was contained with five main categories of questions which contains information that was broadly discussed in the literature review. First, it collects background data of the interviewees. Then, the interview moves to find out information on the spatial factors which influence time management of construction workers at site. After that, it describes how the spatial factors influence time management of construction workers at site and then, strategies to manage these spatial factors which influence time management of construction workers at site are discussed. Finally, the guideline asks the interviewees about their views on how spatial factor management strategies will improve time management of construction workers at site.

4.2.3. Identifying Spatial Factors that Can Influence Time Management of Construction Workers at Site.

In the first part of the interview, it was discussed about the spatial factors which can influence time management of construction workers at site. Those spatial factors which influence time management of construction workers at site were identified through the literature review and validated through interviews. Table 4.3 indicates previously identified spatial factors and the responses of both interviewee categories (professionals and construction workers) about their influence on time management of construction workers at site. There were 12 identified spatial factors from literature review and no other factors were added during the interviews.

Table 4. 2; Spatial factors which influence time management of construction workers at site

Spatial Factors	Professionals								Construction workers							
	I1	I2	I3	I4	I5	I6	I7	I8	I9	I1	I1	I1	I1	I1	I1	I1
Legibility	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Safety	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Openness	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Comfort	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓
Permeability	✓	✓	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓
Robustness	✓	✓	✗	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓
Scale	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓
Tidiness	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✗
Imageability	✓	✓	✓	✓	✓	✗	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓

Spatial Factors	Professionals								Construction workers							
	I1	I2	I3	I4	I5	I6	I7	I8	I9	I1	I1	I1	I1	I1	I1	I1
Personalization	✓	✓	✓	✓	✓	✓	✗	✗	✓	✗	✓	✗	✓	✓	✓	✓
Vitality	✗	✓	✗	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
Unity	✓	✓	✓	✗	✗	✓	✓	✓	✗	✓	✓	✓	✗	✓	✗	✓

Above table 4.2 implies the interviewee’s opinion about the spatial factors which influence time management of construction workers at site. The factors are arranged according to the descending order and most of the respondents have agreed with the spatial factors that are stated in the literatures.

All interviewees, including both professionals and construction workers, agreed that legibility and safety factors in a construction site influences the time management of construction workers who works in that site. When it came to the openness, I2 argued that, *“Openness in a work site might lead to easy movements, psychological satisfaction and good collaboration between workers that increase productivity. But at the same time, it may increase unnecessary discussions and easy distractions that leads to construction delays. Therefore, when considering both these aspects, openness would not occur much difference to the time management ability of workers”*. When considering comfort, a construction worker, I14 disagreed stating *“normally, construction sites are uncomfortable for workers as there is dust, dirt and heat and workers know about this situation before they start working as a construction worker. Therefore, according to my opinion, comfortability do not matter when it comes to managing their time. If they get paid well and given strict instructions, they try their best to manage the time as scheduled”* as the reason for why comfort does not influence time management of construction workers at site.

One professional and one construction worker disagreed with permeability factor. *“Too much permeability may increase physical and visual linkages within site. But in construction sites, too much connectivity also distracts people and might reduce the legibility within site. Therefore, there are no any solid evidence to say permeability influences the time management of construction workers”* I5 stated as a professional who disagrees that permeability in a construction site influences the time management

of construction workers who works in that site. Construction worker I9 added that, *“even though the construction site may be huge, workers work in a limited area at one time. Well permeable site might speed up the logistics within site and it might ease up the site supervision activities. But, since most construction workers work within a limited area at one time, there is no link between permeability of site and the time management of construction workers”*.

When it comes to robustness, all of the construction workers agreed that robustness can influence their time management at site. Even though, many interviewees from professional category also agreed, two interviewees from that category pointed out contradictory ideas. I3 stated that, *“robustness tends to increase confusions and also create untidy, uncomfortable environment.”* as the reason to disagree and I8 accepted that idea by saying *“being volatile is the nature of construction sites. To manage time within these sites we have to create more organized environment within site. Not robust spaces that leads to create the space more disorganized”*.

One interviewee from each category disagreed that the factor scale influence time management of construction workers at site. From professional’s category, I4 stated that, *“usually time line of a project is decided after considering the scale of the spaces that have to be constructed”* as the reason for disagreement. I11 from construction worker category, agreed with I4, and every other interviewee from both categories agreed that scale influences construction workers time management at site.

Every professional approved that tidiness in a construction site leads to construction delays and influence on time management ability of construction workers at site. But, two construction workers, I14 and I16 disagreed and I14 argued that, *“construction sites are not tidy places by their nature. Also, it is hard to maintain the tidiness within a construction site and it might require additional time and money to maintain tidiness within site”*. I16 added by saying *“Construction workers know that tidiness cannot be expected from an ongoing construction site. Therefore, the tidiness of a site will not influence their working pattern in any way”*.

“Creating a mental image of the site is not equally important thing for every construction worker. They are constantly guided by professionals about what they do”

I6 described as the reason for disagreement about the statement that imageability influence time management of construction workers at site. From the category of construction workers, two interviewees, I9 and I13 also disagreed. I9 described the reason for disagreement by saying “When working in a construction site, we can follow given drawings and supervisor’s instructions to do the work. There is no need to remember everything” and I13 also agreed with that.

When considering about personalization, even though majority of both categories agreed that personalization influences time management of construction workers at site, two interviewees from each category, I7 and I8 from professionals and I10 and I12 from construction workers, disagreed with the statement. I7 stated that, “*workers know that working in a project is not a long-term job. They do not expect any personal connection with spaces in construction site and therefore personalization of space does not influence them in any way*”. I10 and I12 from construction workers category agreed and as a professional, I8 added that, “*construction sites consisted with spaces that changes day by day and construction workers know that they are building this for someone else. Due to both these facts, it is hard for them to feel personalization within those spaces and personalization does not influence construction workers time management at site*”.

Three interviewees from professionals and one interviewee from construction workers disagreed that vitality influence time management of construction workers at site. “*In one hand, vitality might create more interesting work environment but, in other hand, it might lead to create chaotic and confusing work environment*” I1 argued. I3 and I6 agreed by saying that vitality in a work environment would create distractions and construction delays. I16 from construction workers was also agreed with I1, I3 and I6 by saying that it is hard to work in an environment where too much activities were going on.

Two interviewees from professionals’ category and three interviewees from construction workers’ category disagreed that unity influence construction workers at site. “*Unity is something which is nearly impossible to achieve within an ongoing construction site and it is not something workers in a construction environment worry about*” I4 described as the reason for why unity does not influence time management

of construction workers at site. I5 agreed with I4 and, from construction workers, I9, I13, and I15 also disagreed by arguing that unity is not something which people expect to feel within a construction site as construction sites have constantly changing spaces.

As per the summary of the response given by the interviewed sample, majority of interviewees from each category agreed that spatial factors found through literature review influences time management of construction workers at site. How these factors influence time management of construction workers is discussed under following heading.

4.2.4. How spatial factors influence time management of construction workers at site

This section is consisted of the interviewees’ perspectives about how spatial factors influence time management of construction workers at site. The influence of spatial factors on time management was identified by literature review and this section of interview was to specifically identify how spatial factors influence on time management of construction workers at site. Table 4.4 illustrates the findings on how spatial factors influence time management of construction workers at site. Bold letters indicate the findings which were newly added from the interviews and normal letters indicate the literature findings which were also confirmed from interviews.

Table 4. 3; How spatial factors influence on time management of construction workers at site

Spatial factors	How spatial factors influence time management of construction workers at site
	Findings after Interviews
Legibility	5. Helps to identify spaces, routes and locations 6. Helps to identify shortest routes to increase productivity of logistics. 7. Decrease confusions related to space identification within site. 8. Increase the ability of giving and understanding instructions
Safety	<ul style="list-style-type: none"> • Reduces accidents within construction site and leads to law absenteeism rate. • Improves confidence of workers within site. • Improves trust and commitment towards employee.
Openness	<ul style="list-style-type: none"> • Improve communication between workers. • Makes spaces more flexible and adaptable for use.

Spatial factors	How spatial factors influence time management of construction workers at site
	Findings after Interviews
Comfort	<ul style="list-style-type: none"> • Creates a healthy, work-friendly environment for workers • Improves workers satisfaction.
Permeability	<ul style="list-style-type: none"> • Gives the choice of routes and increase the ability of creating short cuts within site. • Visual permeability increases the ability to observe work. • Reduce traffic in material transportation within site by providing alternative routes.
Robustness	<ul style="list-style-type: none"> • Throughout the construction process, need of various spaces change and therefore, if those spaces have the ability to adapt, it makes work more efficient. • If the adjacent spaces can be used to facilitate the ongoing constructions within a certain space, it is much easier for workers as it minimizes the logistics.
Scale	<ul style="list-style-type: none"> • Creates a sense of connectedness between workers and site. • Optimum level of scale makes it more comfortable for workers to work within.
Tidiness	<ul style="list-style-type: none"> • Creates pleasant work environment • Minimizes the time spends to find lost items. • Increase ability to focus on work. • Creates healthy environment and therefore leads to low absenteeism rate.
Imageability	<ul style="list-style-type: none"> • Ability of creating a mental image of site helps to identify spaces and routes within site without confusion.
Personalization	<ul style="list-style-type: none"> • Improves commitment to work by giving sense of ownership for workers. • Creates more comfortable work space which suits workers individual preference.
Vitality	<ul style="list-style-type: none"> • Creates an interesting and encouraging work environment within site.
Unity	<ul style="list-style-type: none"> • Creates more interesting and sequential space to work. • Increase visual comfortability and makes it easy to work.

All the interviewees agreed that legibility influences time management of construction workers because legibility helps to identify spaces, locations and routes clearly with less confusions. I7 from professionals' category added that, "*within a legible space, it is easier for head workers to give instructions to their staff by referring the elements within that space and similarly, workers can clearly understand the instructions given by their superiors*". I8 from Professionals category agreed to this. I1 from professionals' category and I13 and I15 from construction workers category described

that legible space lets workers to identify shorter routes to reach locations within the site and therefore contributes to the time management of workers.

Safety was also proved as a spatial factor which influences time management of construction workers since all the interviewees agreed on that. All the interviewees from construction workers category and half majority of the interviewees from professionals' category described that safety reduces accidents within construction site, leads to low absenteeism rate and therefore it impacts on time management of construction workers. I2 and I6 added that, Safety improves confidence of workers within site. I3 argued that, *"Safe work site improves workers trust and commitment towards employee and therefore workers tend to work up to employees' satisfaction and tries to minimize delays"*. Only one interviewee, I12 disagreed that openness influences time management of construction workers by saying that openness may increase unnecessary discussions and easy distractions. Many argued that, Openness improves communication between workers and therefore increases the ease of work and contributes to their time management ability. I7 added that, *"openness makes spaces more flexible and adaptable for use and therefore creates easy working environment which makes time management easier for workers"*. I1 and I4 argued that, openness improves time management of workers by creating a healthy, work-friendly environment which improves workers satisfaction.

Other than interviewee I14, all other interviewees agreed that comfort influences time management of construction workers at site. Many of them argued that Comfort does that by creating a healthy, work-friendly environment for workers which is interesting to work within. I14 disagreed and stating that it is normal for construction sites to get uncomfortable and construction workers are used to these kinds of harsh situations. I4 and I5 from professionals' category argued that comfort improves workers satisfaction and drives them to work more efficiently. All the interviewees, other than I5 and I9, agreed that permeability influences time management and many said that permeability gives choice of routes to move through and increases the ability of finding short cuts within site as the reason to their agreement. I5 disagreed by stating *"too much connectivity distracts people"* and I9 stated that *"since most construction workers work within a limited area at one time, permeability is not important for them"* I6 added that,

Visual permeability increases the ability to observe work. I10 argued that, *“permeability reduces traffic in material transportation within site by providing alternative routes and therefore supports workers with time management”* and I13 Agreed to this.

I3 and I8 from professionals’ category disagreed that robustness influences time management of construction site by saying that I3 stated that robustness tends to create unorganized, confusing spaces. Every other interviewee was agreed and many said that, need of various spaces change throughout the construction process and therefore, if those spaces have the ability to adapt, it makes work more efficient. I7 from professionals’ category and I10, I15, I16 from construction workers’ category argued that if the adjacent spaces can be used to facilitate the ongoing constructions within a certain space, it is much easier for workers as it minimizes the logistics. Many agreed that scale influences time management of construction workers at site as it creates a sense of connectedness between workers and site. I1 from professionals’ category argued that, *“Optimum level of scale makes it more comfortable for workers to work within and therefore leads workers to effectively manage the project time”*. I12, I13 and I16 from construction workers category agreed to his argument. When it comes to tidiness, only I14 and I16 did not think that it influences of construction workers. Many agreed that it influences the time management ability of construction workers. Many interviewees from both categories stated that tidiness creates pleasant work environment which drives workers to work effectively. I3 and I4 from professionals’ category described that tidiness creates healthy environment and therefore leads to low absenteeism rate. I6 from professional’s category argued that, *“tidiness minimizes the time spends to find lost items and therefore reduces the delays”*. I11, I13 and I15 from construction workers argued that tidiness increase ability to focus on work.

Thirteen out of sixteen interviewees agreed that imageability influences time management of construction worker at site by stating that imageability influences time management because it gives ability of creating a mental image of site and therefore helps to identify spaces and routes within site without confusion. Twelve interviewees agreed with Personalization factor and majority of them stated that personalization improve the influences time management of construction worker at site by giving sense

of ownership for workers. This sense of ownership drives people to increase their commitment to work. I5 and I6 from professionals' category argued that personalization creates more comfortable work space which suits workers individual preference. Majority of the interviewees agreed that vitality influences time management of construction worker at site because it creates an interesting and encouraging work environment within site. Eleven out of sixteen interviewees agreed on unity and majority stated that it happens because unity can create more interesting and sequential space to work. I1 and I3 from professionals' category argued that unity influences time management of construction worker at site because it increases visual comfortability and makes it easy to work.

4.2.5. Management strategies to manage the spatial factors which influence time management of construction workers at site and how those management strategies can improve time management of construction workers at site.

In the literature review it is discovered that there are various management strategies to manage spatial factors accordingly. However, existing literature could not reveal how those spatial factor management strategies improve time management of construction workers at site. Therefore, spatial factor management strategies and how those management strategies can improve the time management of construction workers at site was identified through the next part of the interview. Findings from interview survey is listed out in following table 4.4. The findings listed in the second column are totally from interviews. Bold letters indicate the new findings from interviews and normal letters indicate the literature findings which were confirmed from interviews.

Table 4. 4; Spatial factor management strategies and how they can improve time management of construction workers at site

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.
Legibility	Creating Landmarks within the site	Can easily identify their location, destinations and routes without confusions by referring to landmarks within site.
	Creating Landmarks around the site	Can easily identify their location, destinations and routes without confusions by referring to landmarks around the site which are located in a visual distance.

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.
	Creating network of Paths	Good network of major and minor routes increase the efficient circulation within site and therefore contributes time management of workers.
	Creating common identifiable districts (medium-to-large sections) with clear edges	Dividing site into easily identifiable few major parts with clear edges also leads workers to easily identify their location, destinations and routes without confusions.
	Creating attractive nodes (centers of attraction) within site.	Nodes act as landmarks which support workers to identify their location, destinations and routes without confusions and creates lively and encouraging work environment within site.
Safety	installing proper fall protections fences and nets	Reduce time losses by reducing accidents and improving confidence of workers.
	Marking the site properly to protect employees from hazards by showing necessary sign boards.	Sign boards indicates workers on potential hazards how to avoid them. Therefore, reduces accidents which leads to project delays.
	Keeping the construction site clean.	Reduces unexpected injuries from accidents due to clutter and improves work efficiency.
Openness	Improving view, the light, the feeling of being in the open.	Makes the work environment more interesting and motivational to improve efficiency of work.
		Improve the opportunity to collaborate and communicate with co-workers.
	Improving surface textures.	Improve the feeling of spaciousness and make the work environment more relaxing.
	Improving sequence of spaces.	Facilitate the ease of movements within site.
Comfort	Providing a superior acoustic environment.	Increase the ability to focus on work and therefore increase the efficiency of work.
	Maintaining optimal thermal comfort.	Increase the ability to focus on work
		Creates attractive and interesting work environment which increase the efficiency of work.
		Contributes to the health of workers and therefore leads to low absenteeism rate.
	Creating a high-quality visual environment	Creates attractive and interesting work environment which increase the efficiency of work.
Providing furniture and equipment that will enhance worker comfort.	Increase the ability to focus on work and therefore increase their performance.	
Permeability	Creating a well-connected layout which offer choice of direct routes	Increases the efficiency of circulation within site and therefore contributes time management of workers.
		Gives a safe and secured feeling to construction workers to work confidently.
		Supports easy communication between co-workers.

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.
Robustness	Creating spaces that can adapt to different uses and activities, perhaps at different times of the day	Creates work space more flexible and interesting to work more efficiently and effectively.
	Having adjacent spaces which facilitates the ongoing constructions within a certain space	Reduces the unnecessary circulation, ease the logistics and therefore decreases the time losses.
Scale	Using standardized heights and ergonomic measures to design furniture in work site.	Increase the ability to focus on work and therefore increase their performance.
	creating widths of service routes by considering anthropometrics	Support healthy postures which helps to reduce injuries and leads to low absenteeism rate.
Tidiness	Providing Designated area for rubbish and waste	Makes workers circulation more effective.
	Stacking and storing materials properly	Helps to prevent ill-smells and create pleasant work environment which increases workers' efficiency.
	Keeping access routes clear	Reduces time spend to find lost items.
Imageability	Improving identity of site (identity means a distinction from other objects)	Ease up the workers circulation and material logistics and therefore decreases the time losses.
	Improving the structure of the site (structure means a relationship to larger pattern of other elements)	Leads workers to easily identify their location, destinations and routes without confusions
	Improving the meaning of site (meaning means a practical and emotional value for the observer)	Increases the ability to focus on work, improves visual comfortability, increases the ability of workers to memorize things and therefore increases their performance.
Personalization	Allowing employees to rearrange their work stations or furniture in any way they wanted in order to meet their evolving needs for collaboration or privacy.	Create more motivational work environment.
Vitality	Improving accessibility within site	Fulfills workers evolving needs for collaboration and privacy to create more flexible and motivational work environment.
	Improving Sustainability in site	Increases the efficiency of circulation within site and therefore contributes time management of workers.
	Improving environmental quality.	Creates attractive and interesting work environment which increase the efficiency of work.
	Creating vibrant and diverse spaces and facilities.	Contributes to the health of workers and therefore leads to low absenteeism rate.
		Creates lively and encouraging work environment within site.

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.
Unity	Creating a sense of cohesion in the space by repetition of particular elements throughout the entire space, whether they're colors, shapes or materials, to pull the look together	Makes the space visually pleasant and interesting to work.

According to the findings of literature review, Legibility can be improved by using five strategies. First one is creating Landmarks within site. I1 stated that *“landmarks located within site can help workers to identify their location and reduce time consuming confusions”*. I5 stated that *“this strategy improves time management because it gives opportunity to identify destinations and routes quickly and easily by referring to landmarks within site”*. Next strategy is to create landmarks around the site. According to the statement of I2, *“workers can easily identify their location, destinations and routes without confusions by referring to landmarks around the site which are located in a visual distance”* and therefore it improves time management ability of workers. Third strategy is creating network of Paths and according to I7, *“good network of major and minor routes increases the efficient circulation within site and therefore contributes time management of workers”*. Forth strategy is creating common identifiable districts (medium-to-large sections) with clear edges. According to I6, *“this strategy leads workers to easily identify their location, destinations and routes without confusions”*. Creating attractive nodes (centers of attraction) within site is the final strategy to improve legibility. According to I1 and I2, nodes act as landmarks which support workers to identify their location, destinations and routes without confusions and creates lively and encouraging work environment within site. Every other interviewee in professional and construction worker categories held similar ideas which are agreeable with above statements.

When it comes to Safety, first strategy was to install proper fall protection fences and nets. I10 described that, *“if sites are properly protected with fences, it surely reduces time losses by reducing accidents”* I3 added that, *“installing proper fall protection improves workers’ efficiency by improving confidence of workers”*. Marking the site properly to protect employees from hazards by showing necessary sign boards is the second strategy. According to the majority of interviewees, sign boards indicate

potential hazards and how to avoid them. Therefore, workers can reduce accidents which leads to project delays. I8 proposed that, *“Safety can be improved by keeping the construction site clean and it improves time management of construction workers by reducing unexpected injuries from accidents due to clutter and improves work efficiency”*.

Openness can be improved by increasing views, the light and the feeling of being in the open. I4 stated that *“this strategy makes the work environment more interesting and motivational to improve efficiency of work”*. I8 added that, through this strategy we can improve the opportunity to collaborate and communicate with coworkers. Second strategy is to improve surface textures and third is to improve sequence of spaces. According to the opinion of majority, the second strategy can improve the feeling of spaciousness and make the work environment more relaxing while third strategy contributes to increase the ease of movement within site.

Comfort can be improved by providing a superior acoustic environment. I3 stated that, *“this strategy increases the ability to focus on work and therefore increase the efficiency of work”*. Second strategy to improve comfort is to maintain optimal thermal comfort. I10 stated that *“thermal comfort reduces time losses by increasing the ability to focus on work”*. Majority of other interviewees described that thermally comfortable site Creates attractive and interesting work environment which increase the efficiency of work. I6 added that *“thermal comfort Contributes to the health of workers and therefore leads to low absenteeism rate”*. Third strategy to increase comfort is creating a high-quality visual environment. Creates attractive and interesting work environment which increase the efficiency of work. Fourth strategy is providing furniture and equipment that will enhance workers’ comfort. Majority of the interviewees stated that this strategy improves the time management of construction workers by increasing the ability to focus on work and therefore increases their performance.

Permeability can be introduced to a site by creating a well-connected layout which offer choice of direct routes. I11 stated that, *“well connected layout increases the efficiency of circulation within site and therefore contributes time management of workers”*. Majority from construction workers category and few from professional category stated

similar ideas. I4 stated that *“well connected layout with direct routes contributes to time management of construction workers by giving a safe and secured feeling to work confidently”*. I6 adds that *“this strategy supports easy communication between co-workers and improves effectiveness of work”*. I7, I14 and I16 held similar opinions.

According to the findings of literature review, robustness can be introduced to the construction sites by creating spaces that can adapt to different uses and activities, perhaps at different times of the day. Majority of the interviewees agreed by saying that this strategy improves work efficiency by helping to create work space more flexible and easier to work more efficiently. I2 proposed that having adjacent spaces which facilitates the ongoing constructions within a certain space as a strategy to increase robustness. The interviewee added that, this strategy reduces the unnecessary circulation, ease the logistics and therefore decreases the time losses.

When it comes to scale, first strategy to improve scale factor is by using standardized heights and ergonomic measures to design furniture in work site. I1 stated that, *“standardized and ergonomically right furniture increases the ability to focus on work and therefore increases worker’s performance”*. I2 and I6 presented similar opinions and I8 added that, *“this strategy supports to maintain healthy postures which helps to reduce injuries and leads to low absenteeism rate”*. Majority of interviewees’ idea was similar to I8 and final strategy to improve scale factor is creating widths of service routes by considering anthropometrics. Interviewees agreed to it by saying that this strategy increases time management of construction workers by making their circulation more effective. To maintain and improve Tidiness within construction site, first strategy is providing designated area for rubbish and waste. I7 stated that, *“providing designated area for rubbish and waste helps to prevent ill-smells and create pleasant work environment which increases worker’s efficiency”*. Many other interviewees from both categories agreed by stating similar ideas. Stacking and storing materials properly is the second strategy to improve tidiness. According to I9, *“This strategy reduces time spends to find lost items and therefore reduces time losses and delays”*. Keeping access routes clear is the third strategy to increase tidiness. Majority of the interviewees explained that, this strategy eases up the workers circulation, material logistics and therefore decreases the time losses.

First strategy to increase Imageability is improving identity of site (identity means a distinction from other objects). I4 stated that, *“this leads workers to easily identify their location, destinations and routes without confusions”*. Second strategy is improving the structure of the site (structure means a relationship to larger pattern of other elements). I1 stated that *“this strategy increases the ability to focus on work, improves visual comfortability, increases the ability of workers to memorize things and therefore increases their performance”*. Third strategy is improving the meaning of site (meaning means a practical and emotional value for the observer). According to I2, *“this strategy Creates more motivational work environment and therefore contributes to time management of workers.*

According to the literature findings, personalization can be improved by allowing employees to rearrange their work stations or furniture in any way they wanted. Majority of interviewees agreed to this by saying this strategy fulfills workers evolving needs for collaboration and privacy to create more flexible and motivational work environment. To improve vitality factor, first strategy is improving accessibility within site. Many interviewees from both categories agreed that it increases the efficiency of circulation within site and therefore contributes time management of workers. Second strategy is improving Sustainability in site. I8 explained that *“by introducing sustainability to construction sites we can create attractive and interesting work environment which increase the efficiency of work”*. Third strategy is improving environmental quality. I6 described that, *“good environmental quality contributes to the health of workers and therefore leads to low absenteeism rate”*. Creating vibrant and diverse spaces and facilities is the fourth strategy to improve vitality. Many interviewees agreed to this by saying vibrant and diverse spaces creates lively and encouraging work environment within site. Unity can be introduced to a construction site by creating a sense of cohesion in the space by repetition of particular elements throughout the entire space, whether they’re colors, shapes or materials, to pull the look together. I3 described that this strategy makes a space visually pleasant, interesting to work and therefore increases time management ability of workers.

4.3. Findings and Analysis of Case Studies

This was the second step of the data collection process. Under case study analysis three building projects located within western province were selected to carry out this data collection process. Within each case study one Architect, either the principal Architect or project Architect was interviewed with a semi-structured interview. Also, physical observation method was used to observe and understand the connection between spatial factors within construction site and time management of construction workers.

4.3.1. Objectives of the Case Study

The main objective of the case study analysis is to validate the findings of literature review and semi-structured interviews on spatial factors influencing time management of construction workers, how those spatial factors influence time management of construction workers, spatial factor management strategies and how these spatial factor management strategies can influence time management of construction workers at site. Such a validation can improve the accuracy of research outcome. In this process, residential building projects were selected based on the availability of relevant data.

4.3.2. Case Study Selection Criteria

All three selected cases were ongoing residential building projects within western province. Approximate cost is within 50Mn-100Mn range. With 3-4 stories, all of these cases were similar in complexity.

4.3.3. Brief Background Details of the Case Studies

Following table 4.5 illustrates the details of selected case studies.

Table 4. 5; Brief Background Details of the Case Studies

Description	Case 1	Case 2	Case 3
Type of Building	Residential	Residential	Residential
Area of the Building	25,000 Sq.ft	16,000 sq.ft	10,500 sq.ft
Number of Floors	4	3	3
Approx. Cost	Rs.95Mn	Rs. 87 Mn	Rs. 65Mn
Location	Colombo	Gampaha	Colombo
Time period	3 years	2 years	1.5 years

Description	Case 1	Case 2	Case 3
Spatial arrangement	This building has open courtyard in the middle of the building and the rest of the building is designed around the courtyard.	This building also has an open courtyard with a pool and building structure is simple and distributed around the pool area.	This building is designed in a linear land and built according to the shape of the land. Comparing with other two, space distribution is compacted.

4.3.4. Details of Case Study Interviewees

Table 4.6 illustrates the details case study interviewees.

Table 4. 6; Details of case study interviewees

Case Study	Details				
	Profession	Designation	Key role	Experience	Type of Projects involved
Case A	Architect	Project Architect	Designing and site inspections	7 Years	Residential, Industrial and commercial buildings
Case B	Architect	Project Architect	Designing and site inspections	10 Years	Residential, Industrial and commercial buildings
Case C	Architect	Project Architect	Designing and site inspections	5 Years	Residential and commercial buildings

Project Architects from each case were selected as interviewees by following purposive sampling technique and observing previous interviews results. It was observed that Architects had a good knowledge on spatial factors and their influence on human behavior. Project Architects from each case was selected as they are fully aware about that particular case.

4.4. Case Study Observations

Naturalistic Observations was done in all selected cases in Morning and afternoon of a Monday and a Friday. Each observation session was three hours long.

4.4.1. Spatial factors that can influence time management of construction workers at site.

Following table depicts the case study findings about the spatial factors that can influence time management of construction workers at site

Table 4. 7; Spatial factors that can influence time management of construction workers at site.

Spatial Factor	Interview Results	Case A			Case B			Case C		
		Interviews	Observations	Details of Observations	Interviews	Observations	Details of Observations	Interviews	Observations	Details of Observations
Legibility	✓	✓	✓	<ul style="list-style-type: none"> • Site was legible with landmarks such as a feature wall, court yard, pool, stair case and meditation rooms. • Workers communicated by referring to those landmarks • Workers were moving within the site without confusions 	✓	✓	<ul style="list-style-type: none"> • Had a very simple layout which is easy to read. • Pool was the main landmark and reference point. • Workers communicated by referring to the location of pool. • Workers were moving within the site without confusions 	✓	✓	<ul style="list-style-type: none"> • Since space distribution was compacted and site is smaller, it was easy to read spaces. • The stair case, courtyard and pond acted as main landmarks. • Workers communicated by referring to those landmarks • Workers were moving within the site without confusions
Safety	✓	✓	✓	<ul style="list-style-type: none"> • There were no safety nets or fences around edges and open courtyard area. • Workers had to be very attentive towards their own safety. • Workers were unable to focus when they work around edges. 	✓	✓	<ul style="list-style-type: none"> • Safety nets were used in edges. • This site did not have any dark areas and sun light was penetrating to every space. • Workers seem to work more freely and efficiently when working around edges. 	✓	✓	<ul style="list-style-type: none"> • Site was smaller and enclosed. • Safety fences were located and safety signs were shown where necessary. • Workers seem to work more freely and efficiently when working around edges.
Openness	✓	✓	✓	<ul style="list-style-type: none"> • Located in a urban area amidst of many buildings and therefore the surrounding views were not attractive or distracting workers. • Openness of the site seems to make communication and co-working much easier for workers. 	✗	✗	<ul style="list-style-type: none"> • Sometimes workers were distracted by surrounding sceneries. • Site was easily getting untidy with sand. • Inefficiencies and time wastes were observed to happen due to openness of site. 	✓	✗	<ul style="list-style-type: none"> • Had the minimum openness when comparing with others. • The distractions from surrounding environment was minimum. • Openness of the site seems to be enough to make communication and co-working much easier for workers.
Comfort	✓	✓	✓	<ul style="list-style-type: none"> • Working on the rooftop area seems to be bit hard due to high temperature and dust. • Working in other areas was observed to be more comfortable. • It was observed that the workers like to work in shady areas since it is tiresome to work in sunny areas like rooftop. 	✓	✓	<ul style="list-style-type: none"> • Was located in coastal area and continuously affected by high temperature and sea breeze. • Construction workers in was observed to get easily tired and more uncomfortable. 	✓	✓	<ul style="list-style-type: none"> • Since this site is much enclosed and not located on a roadside, it was observed that the workers work more efficiently even when the sun is high.
Permeability	✓	✓	✓	<ul style="list-style-type: none"> • Site was permeable to a satisfactory level. • Only the basement area was lacking the permeability. • It was observed that, the workers do not like to work in basement area since it is dark and enclosed. 	✓	✓	<ul style="list-style-type: none"> • Site was very permeable, both physically and visually. • The permeability of site seems to support co-working and communication. 	✓	✓	<ul style="list-style-type: none"> • Site was permeable to a satisfactory level. • This permeability supports logistics within site and communication between workers.
Robustness	✓	✓	✓	<ul style="list-style-type: none"> • The site was robust during construction phase. 	✓	✓	<ul style="list-style-type: none"> • The site was robust during construction phase. 	✓	✓	<ul style="list-style-type: none"> • The site was robust during construction phase.

Spatial Factor	Interview Results	Case A			Case B			Case C		
		Interviews	Observations	Details of Observations	Interviews	Observations	Details of Observations	Interviews	Observations	Details of Observations
Scale	✓	✓	✓	<ul style="list-style-type: none"> the building heights and widths are bit larger than anthropometric measures. It was observed that it is hard to work when the scale is not compatible with human scale and workers are getting easily tired when working in such spaces. 	✓	✓	<ul style="list-style-type: none"> the scale of a building have to be compatible with human scale. When working, workers seem to be more comfortable with dimentions. 	✓	✓	<ul style="list-style-type: none"> the scale of a building have to be compatible with human scale. When working, wworkers seem to be more comfortable with dimentions.
Tidiness	✓	✓	✓	<ul style="list-style-type: none"> Site was clean to a acceptable level. It is easy to find things and chance to face accidents due to unclean environment (like slipping over things) is low. 	✓	✓	<ul style="list-style-type: none"> Site was bit untidy compared to other two due to it's location and lack of clients' attention. This seems to create distracting environment. 	✓	✓	<ul style="list-style-type: none"> Site was clean and organaized. It is easy to find things since the site is well organized and chance to face accidents due to unclean environment (like slipping over things) is low.
Imageability	✓	✓	✓	<ul style="list-style-type: none"> layout was imageable with unique landmarks such as feature wall, open coartyard, pool, outdoor dining areas and ponds. This quality seems to help workers to remember and identify spaces and routes without confusions. 	✓	✓	<ul style="list-style-type: none"> Site was imageable with the unique character of the house and the layout distributed around the pool. The uniqueness of surrounding environment also increases imageability of this site. This quality seems to help workers to remember and identify spaces and routes without confusions. 	✓	✓	<ul style="list-style-type: none"> layout was imageable with landmarks such as open coartyard, pool and stair case. This quality seems to help workers to remember and identify spaces and routes without confusions.
Personalization	✓	✓	✓	<ul style="list-style-type: none"> Some construction workers seems to personalize their work spaces as this layout is spacious. This personalization was done through the way that workers keep their equipment and the way they arrange their work stations. 	✓	✓	<ul style="list-style-type: none"> Some construction workers seems to personalize their work spaces as this layout is spacious. This personalization was done through the way that workers keep their equipment and the way they arrange their work stations. 	✓	✗	<ul style="list-style-type: none"> Spaces were smaller and many people were working collaboratively within those spaces. Construction workers from could not make their work space personalized. This seems to guide workers to work in more organized manner.
Vitality	✓	✗	✓	<ul style="list-style-type: none"> Vitality of the site seems to make it more interesting to work. Vitality of the site created a friendly atmosphere between co-workers. Communication between workers was positively influenced by vitality factor. 	✓	✓	<ul style="list-style-type: none"> Vitality of the site seems to make it more interesting to work. Vitality of the site created a friendly atmosphere between co-workers. Communication between workers was positively influenced by vitality factor. 	✗	✓	<ul style="list-style-type: none"> Vitality of the site seems to make it more interesting to work. Vitality of the site created a friendly atmosphere between co-workers. Communication between workers was positively influenced by vitality factor.
Unity	✓	✓	✓	<ul style="list-style-type: none"> As a house designed by an Architect, spaces were designed to be compatible with each other. This created visual comfortability and good spatial progression for workers to move through spaces easily. 	✓	✓	<ul style="list-style-type: none"> As a house designed by an Architect, spaces were designed to be compatible with each other. This created visual comfortability and good spatial progression for workers to move through spaces easily. 	✓	✓	<ul style="list-style-type: none"> As a house designed by an Architect, spaces were designed to be compatible with each other. This created visual comfortability and good spatial progression for workers to move through spaces easily.

According to the case study results, interviewees from all three cases agreed that, legibility influences time management of construction workers at site. Interviewee from case B stated that, *“Since this building is really legible, I have never seen workers losing their time over confusions about the paths and locations within the site”*. Also, according to the observations, all three cases were legible and this legibility influenced time management of construction workers. In case A, a feature wall, court yard, pool, stair case and meditation rooms acted as landmarks to increase legibility. Case B had a very legible and simple layout and pool acted as its main landmark. Case C had a bit compacted layout, but, the stair case, courtyard and pond acted as main landmarks there. The workers communicated instructions and other opinions regarded with spaces within the site by referring to those landmarks.

All the interviewees also agreed that safety influences time management of construction workers at site. Interviewee from case A stated that, *“there is no proper safety measures around the open courtyard and there is a probability of meeting with accidents when working around that void area in upper levels. Therefore, workers have to work consciously and carefully. I think it also reduces their work speed when working around that area”*. Also, according to the observations, the safety measures around the rooftop area and open courtyard was not properly implemented and there was probability of construction workers getting into accidents. Therefore, workers had to work carefully and sometimes it reduces their efficiency. In case B and case C, it was observed that, safety measures are taken in to a satisfactory level and when comparing with case A, construction workers worked more confidently and effectively around accident prone areas such as heights and edges due to proper safety measures.

Interviewee from case A and case C agreed that, Openness influences time management of construction workers at site. Interviewee from case B disagreed by stating that, *“Sometimes openness can distract construction workers from their designated work”*. It was observed that case A and case B has open layouts when comparing with case C. case A was located in a urban area amidst of many buildings and construction workers seems to utilize this openness for their time management since it made communication and co-working much easier. But case B was located near beach area and the sceneries around the site seems to easily distract workers. Also, the wind and the sand became an

issue due to the openness as they created some extra works in cleaning the site. Therefore, in case B, it was observed that, Openness does not influence time management of workers. Case C had the minimum openness when comparing with others. There was enough openness for communication, but, since it was not very open to the surrounding, distractions were minimum. According to this observations level of openness influenced positively on workers' time management. When it comes to comfort, all the interviewees agreed that comfort influences construction workers time management at site. Also, according to the observations, case A and case C was much comfortable than case B as case B is located in coastal area and continuously affected by high temperature and sea breeze. Therefore, construction workers in case B tend to be more tired and uncomfortable. This situation led to reduce their work speed. Also in case A, working on the rooftop area seems to be bit hard due to high temperature and dust. However, these observations can be concluded as comfort influences time management of construction workers at site.

All the interviewees and observations proved that; permeability influences the ability of time management of construction workers at site. Interviewee from case A stated that, *“with the open courtyard and space arrangement, this site is physically and visually permeable and that quality helps workers to manage their time as it increases visual links between spaces and creates short cuts to their destinations”*. Also, according to the observations this seems to be true. Every interviewee agreed that robustness is a factor that influences time management of construction workers. Observations proved this as in all three cases, the ability of adaptation of spaces to facilitate the ongoing constructions needs seems to support workers time management by optimizing space utilization. All the interviewees and observations also agreed that scale influences time management of construction workers at site. Interviewee from case C stated that, *“the scale of a building has to be compatible with human scale to makes it more comfortable for workers to work within that building”*. Case A was owned by a CEO of a renowned company and it since it had to accommodate for corporate events, the building heights and widths are bit larger than anthropometric measures. Therefore, it was observed that it is hard to work when the scale is not compatible with human scale and workers are getting easily tired when working in such

spaces. All these case study findings proved that scale influences time management of workers at site. Tidiness also proven to be a factor that influences time management of construction workers at site according to interviewee ideas and observations.

When considering imageability, all the interviewees agreed that, imageability can influence construction workers time management at site. Also, according to the observations, layouts of all three cases were imageable as they had spaces with unique characteristics. This quality seems to help workers to remember and identify spaces and routes without confusions. All the interviewees agreed that personalization influences time management ability of construction workers. According to observations, some construction workers from Case A and case B seems to personalize their work spaces as case A and case B had wider spaces than case C. This personalization was done through the way that workers keep their equipment and arrange their work stations. As case C had smaller spaces and many people were working collaboratively, construction workers from case C could not make their work space personalized. But, according to observations, this did not influence on reducing these workers work speed and they just had to work in more organized manner when working within such spaces.

Interviewees from case A and case C disagreed that, vitality influences time management ability of construction workers. Interviewee from case A stated that, *“vitality might lead construction workers to get distracted while working”*. Interviewee from case C agreed by saying *“trying to increase vitality may course unwanted behaviors and unnecessary chaos within site. This might impact negatively on workers efficiency”*. But, according to observations, vitality in all these sites supported time management of workers as this vitality factor made co-working more interesting by improving communication and mental relaxation of workers. Unity also proven to be a factor that influences time management of construction workers at site according to interviewee ideas and observations.

4.4.2. How spatial factors influence time management of construction workers at site

Table 4.8 depicts the case study findings on how spatial factors influence time management of construction workers at site.

Table 4. 8; Ways the spatial factors influence time management of construction workers at site.

Spatial Factor	Interview Results	Case A			Case B			Case C		
		Interviews	Observations	Observation details	Interviews	Observations	Observation details	Interviews	Observations	Observation details
Legibility	Helps to identify spaces, routes and locations	✓	✓	It was easy to identify spaces, routes and locations with unique characteristics in site.	✓	✓	It was easy to identify spaces, routes and locations with unique characteristics in site.	✓	✓	It was easy to identify spaces, routes and locations with unique characteristics in site.
	Helps to identify shortest routes to increase productivity of logistics.	✓	✓	There were few short cuts identified by workers which increased the work efficiency	✓	✓	There were few short cuts identified by workers which increased the work efficiency	✓	-	Since the layout was smaller and compacted, there were no observations on short routes.
	Decrease confusions related to space identification within site.	✓	✓	No one was observed to be confused or lost within the site.	✓	✓	No one was observed to be confused or lost within the site.	✓	✓	No one was observed to be confused or lost within the site.
	Increase the ability of giving and understanding instructions	✓	✓	Head workers were giving instructions by referring to the unique characteristics within site because it is easier for other workers. (Ex: the space in-between pool and meditation rooms.	✓	✓	Head workers were giving instructions by referring to the unique characteristics within site because it is easier for other workers. (ex: the space adjacent to the pool)	✓	✓	Head workers were giving instructions by referring to the unique characteristics within site because it is easier for other workers. (ex: the space in-between pond and stair case)
Safety	Reduces accidents within construction site and leads to low absenteeism rate.	✓	-	No observations were made	✓	✓	Employees were protected by safety fences in edges.	✓	✓	Workers were aware about accident prone areas and safety fences in were protecting employees from accidents.
	Improves confidence of workers within site.	✓	✓	Since there were no proper safety measures around edges, workers were not working confidently around edges.	✓	✓	Workers were seem to work confidently around the edges since they were properly guarded by safety fences.	✓	✓	Workers were seem to work confidently around the edges since they were properly guarded by safety fences.
	Improves trust and commitment towards employee.	✓	✓	Workers were complaining and blaming the client when working because he does not pay enough attention towards their safety.	✓	✓	Workers were happy about the client since he has provided necessary protection to accident prone areas.	✓	✓	Workers were happy about the client since he has provided necessary protection to accident prone areas.
Openness	Improve communication between workers.	✓	✓	Workers could see each other and ask for others help when needed.	✓	✗	This layout had the openness most and it helps communication between workers. But sometimes this impacts negatively since this site is not under tight supervision and workers seem to talk unnecessary things while working.	✓	✓	This layout had the least openness. But, workers were using open spaces to communicate (ex: worker in upper level could speak with worker in ground level through courtyard opening.
	Makes spaces more flexible and adaptable for use.	✓	✓	Workers were utilizing and placing their equipment in the spaces with openness much freely than in enclosed spaces.	✓	✓	Workers were utilizing and placing their equipment in the spaces with openness much freely than in enclosed spaces.	✓	✓	Since this layout had more enclosed spaces, workers had to place their equipment and utilize spaces in more organized manner.
Comfort	Creates a healthy, work-friendly environment for workers	✓	✓	Workers were more interested to work in comfortable areas such as shady areas.	✓	✓	When the sun and coastal wind was high, workers were getting tired easily.	✓	✓	Workers were more interested to work in comfortable areas such as shady areas.
	Improves workers satisfaction.	✓	✓	Workers were happy when they get to work in more comfortable areas.	✓	✓	Workers were not happy and complaining when they had to work in uncomfortable weather.	✓	✓	Workers were happy when they get to work in more comfortable areas.

Spatial Factor	Interview Results	Case A			Case B			Case C		
		Interviews	Observations	Observation details	Interviews	Observations	Observation details	Interviews	Observations	Observation details
Permeability	Gives the choice of routes and increase the ability of creating short cuts within site.	✓	✓	There were few optional routes to some locations.	✓	✓	There were many optional routes within site.	✓	✓	There was an alternative route created by workers to go to rooftop area.
	Visual permeability increases the ability to observe work.	✓	✓	With the visual permeability in some spaces workers and supervisors could easily observe few workers at once.	✓	✓	With the visual permeability in this layout workers and supervisors could easily observe number of workers at once.	✓	✓	Visual permeability was very low and mostly supervisors could only observe workers in one space at one time.
	Reduce traffic in material transportation within site by providing alternative routes.	✓	✓	When workers from few firms transport material within site, the traffic becomes high and to reduce the traffic optional routes were used by different firms to material transportation.	✓	✓	When workers from few firms transport material within site, the traffic becomes high and to reduce the traffic optional routes were used by different firms to material transportation.	✓	✓	There were no alternative routes which could transport material and when number of people transport material within site, it was chaotic and creates traffic.
Robustness	Throughout the construction process, need of various spaces change and therefore, if those spaces have the ability to adapt, it makes work more efficient.	✓	✓	Some spaces were used for different purposes at different times. As example one space was first used for mixing concrete and after some period carpenters used that same space to assemble wooden items.	✓	✓	Some spaces were used to store different items at different times. As example one space was first used to store iron bars and after some period that same space used to store landscape items.	✓	✓	Some spaces were used for different purposes at different times. As example there was a space used as workers dining area and later that space was converted as a store room and workers used to dine in a different space.
	If the adjacent spaces can be used to facilitate the ongoing constructions within a certain space, it is much easier for workers as it minimizes the logistics.	✓	✓	When working in one space, workers were utilizing other adjacent spaces also to keep their equipment and material.	✓	✓	When working in one space, workers were utilizing other adjacent spaces also to keep their equipment and material.	✓	✓	When working in one space, workers were utilizing other adjacent spaces also to keep their equipment and material.
Scale	Creates a sense of connectedness between workers and site.	✓	✓	Since the heights and widths were bit larger compared to human scale, visually and physically it felt like incompatible.	✓	✓	Since the heights and widths were according to anthropometrics, visually and physically it felt like compatible with human scale.	✓	✓	Since the heights and widths were according to anthropometrics, visually and physically it felt like compatible with human scale.
	Optimum level of scale makes it more comfortable for workers to work within.	✓	✓	Workers were bit uncomfortable and needed to use additional tools to work since the scale of this building is bit larger in size compared to human scale.	✓	✓	When compared with case A, Workers were more comfortable to work with the dimensions of this building.	✓	✓	When compared with case A, Workers were more comfortable to work with the dimensions of this building.
Tidiness	Creates pleasant work environment	✓	✓	This site was tidy since it was continuously under clients' supervision. The site was visually pleasant and no bad odors.	✓	✓	This site was bit untidy compared to other two and it was not visually pleasant.	✓	✓	This site was tidy since it was continuously under clients' supervision. The site was visually pleasant and no bad odors.
	Minimizes the time spends to find lost items.	✓	✓	All material and equipment were stored properly, so chance to lose items is minimum.	✓	✓	Items in this site were not stored properly as much as case A and C. So there was a chance of losing items.	✓	✓	Since the site was well organized, it was easy to find items when needed.
	Increase ability to focus on work.	✓	✓	Since the site was clean, workers were seem to have ability to focus on their work compared with workers in case B.	✓	✓	Distracting incidents happens such as losing tools and it is hard to find items since they are not organized well.	✓	✓	Since the site was clean and well organized, workers seems to have ability to focus on their work compared with workers in case B.
	Creates healthy environment and therefore leads to law absenteeism rate.	✓	✓	Since site was clean, it was mentally pleasing for workers and also minimum chance for the diseases such as dengue.	✓	✓	Since the site is untidy, there were number of places that could turn as dengue habitats.	✓	✓	Since site was clean, it was mentally pleasing for workers and also no chance for spreading the diseases such as dengue.

Spatial Factor	Interview Results	Case A			Case B			Case C		
		Interviews	Observations	Observation details	Interviews	Observations	Observation details	Interviews	Observations	Observation details
Imageability	Ability of creating a mental image of site helps to identify spaces and routes within site without confusion.	✓	✓	It was easy to remember and imagine spaces, routes and locations with unique characteristics in site.	✓	✓	It was easy to remember and imagine spaces, routes and locations with unique characteristics in site.	✓	✓	It was easy to remember and imagine spaces, routes and locations with unique characteristics in site.
Personalization	Improves commitment to work by giving sense of ownership for workers.	✓	✓	Some temporary workstations were personalized by workers and they did not like others doing their work on those stations. (ex: carpentry station)	✓	✓	Some storage areas were personalized by workers and they did not like others to store things in that area (ex: area where gardeners store their equipment)	✓	-	No observations were made on this.
	Creates more comfortable work space which suits workers individual preference.	✓	✓	Workers seems to prefer working in the temporary work stations that they were personalized rather than working in other places.	✓	✓	Workers seem to be more comfortable to store things in personalized way as such storage areas made finding items easier.	✓	-	No observations were made on this.
Vitality	Creates an interesting and encouraging work environment within site.	✗	✓	Workers from same firm and different firms were all seem to be positively communicating and it makes the site interesting to work.	✓	✗	Communication between workers were seem to be negatively impacting on time management as they talk unnecessarily within work hours.	✗	✓	Workers from same firm and different firms were all seem to be positively communicating and it makes the site interesting to work
Unity	Creates more interesting and sequential space to work.	✓	✓	Even though, the building was in construction stage, unity of spaces were there with patterns and shapes of spaces. That makes spatial progression sequential.	✓	✓	Even though, the building was in construction stage, unity of spaces were there with patterns and shapes of spaces. That makes spatial progression sequential.	✓	✓	Even though, the building was in construction stage, unity of spaces were there with patterns and shapes of spaces. That makes spatial progression sequential.
	Increase visual comfortability and makes it easy to work.	✓	✓	The sequential patterns and colors easily guides the eye through spaces and it was comfortable to eye.	✓	✓	The sequential patterns and colors easily guides the eye through spaces and it was comfortable to eye.	✓	✓	The sequential patterns and colors easily guides the eye through spaces and it was comfortable to eye.

According to the case study findings on how spatial factors influence time management of construction workers at site, majority of the findings from literature review and semi-structured interview round were verified as true. Only, the spatial factors namely, personalization and vitality were not hundred percent verified by case study findings. All the interviewees agreed that, openness improves communication between workers and therefore it positively influences time management of workers. However, observations from case B contradicted with this statement. In case B, openness was high and it was observed to boost communication between workers. But, this communication seems to affect negatively on time management of construction workers at site as sometimes this leads workers to talk unnecessary things and waste time. Since case C had a compacted layout, every space is well organized. Therefore, no observations on personalization factor could be done within case C.

Interviewees from case A and case C disagreed that vitality influences time management of construction workers at site. Interviewee from case A stated that, *“it is true that vitality can create an interesting and encouraging work place but, sometimes if workers do not have enough discipline, it can also create chaotic and distracting environment to work. This may negatively impact time management of construction workers at site.”* Observations of case B have also verified this statement as in case B, since the client was not around, workers were not strictly supervised. This was creating time losses due to unnecessary chatting and loitering. Interviewee from case C agreed with Interviewee from case A by saying that, *“Vitality can be seen within a construction site to a certain amount and that vitality is needed to keep worker’s positive attitude towards work. But, if we try to forcefully add vitality to the work environment, it may lead to create distracting work environment which occurs unexpected time losses”.* However, the amount of vitality in case C was observed to be positively contributing towards time management of construction workers.

4.4.3. Spatial factor management strategies and how these strategies can improve time management of construction workers.

Table 4.9 depicts the case study interview and observation findings on spatial factor management strategies and how these strategies can improve time management of construction worker

Table 4. 9; Spatial factor management strategies and how these strategies can improve time management of construction workers.

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.	Case A			Case B			Case C		
			Interviews	Observations	Observation details	Interviews	Observations	Observation details	Interviews	Observations	Observation details
Legibility	Creating Landmarks within the site	Can easily identify their location, destinations and routes without confusions by referring to landmarks within site.	✓	✓	Landmarks within site, such as feature wall, pool and ponds were observed to be supportive in identifying spaces.	✓	✓	Landmarks within site, such as the pool was observed to be supportive in identifying spaces.	✓	✓	Landmarks within site, such as pond and staircase were observed to be supportive in identifying spaces.
	Creating Landmarks around the site	Can easily identify their location, destinations and routes without confusions by referring to landmarks around the site which are located in a visual distance.	✓	✓	There was a huge tree in the neighboring land (near to site boundary) and workers seems to identify locations by referring to this tree.	✓	✓	There was a rock in the beach side which workers referred to when talking about locations within site. (ex: the bed room located to the direction of rock)	✓	✓	The boundary wall of the neighboring house acted as a landmark and workers referred to it when talking about locations within site. (ex: the bench near the green color boundary wall)
	Creating network of Paths	Good network of major and minor routes increase the efficient circulation within site and thereby contributes time management of workers.	✓	✓	There was a good network of routes within the site and it was helping to reduce the traffic in material transportation and improve work efficiency by giving choice of routes.	✓	✓	There was a good network of routes within the site which helped to reduce traffic in material transportation and improve work efficiency by giving choice of routes.	✓	✓	Due to space restrictions, there was limited routes within site. This caused traffic in material transportation and reduce efficiency due to lack of choice of routes to move through.
	Creating common identifiable districts (medium-to-large sections) with clear edges	Dividing site into easily identifiable few major parts with clear edges also leads workers to easily identify their location, destinations and routes without confusions.	✓	-	Since this strategy was not implemented in site, no observation was made on this.	✓	-	Since this strategy was not implemented in site, no observation was made on this.	✓	-	Since this strategy was not implemented in site, no observation was made on this.
	Creating attractive nodes (centers of attraction) within site.	Nodes act as landmarks which support workers to identify their location, destinations and routes without confusions and creates lively and encouraging work environment within site.	✓	✓	Main courtyard acted as an attractive node since it was the center point of the site and many work stations located around it. Since the center of the site is very lively, energetic and active, the environment within site was encouraging and motivating for workers.	✓	✓	Dining area with pool acted as an attractive node. This was the center point of the site and many work stations located around it. As the center of the site was very lively, energetic and active, the site was encouraging and motivating for workers.	✓	✓	There were attractive nodes near the main entrance, in the kitchen area and in second floor dining area because many work stations located near these areas. These nodes seems to make the environment within site more encouraging and energetic.
Safety	installing proper fall protections fences and nets	Decrease time losses by reducing accidents and improving confidence of workers.	✓	✓	This strategy was not implemented in site. It was observed that workers could not focus on work when they work around dangerous edges since proper fall protection measures were not taken and it was reducing their work efficiency.	✓	✓	Proper fall protection with safety fences were installed within site and workers seems to work more confidently around such edges when compared to site A.	✓	✓	Proper fall protection with safety fences were installed within site and workers seems to work more confidently around such edges when compared to site A.
	Marking the site properly to protect employees from hazards by showing necessary sign boards.	Sign boards indicates workers on potential hazards how to avoid them. Therefore reduces accidents which leads to project delays.	✓	-	Since this strategy was not implemented in site, no observation was made on this.	✓	-	Since this strategy was not implemented in site, no observation was made on this.	✓	✓	Sign boards were used to indicate potential hazards such as slippery areas, potential fall areas and electrical accident prone areas. This seems to reduce accidents and injuries of construction workers.

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.	Case A			Case B			Case C			
			Interviews	Observations	Observation details	Interviews	Observations	Observation details	Interviews	Observations	Observation details	
	Keeping the construction site clean.	Reduces unexpected injuries from accidents due to clutter and improves work efficiency.	✓	✓	Site was clean to an acceptable level and this seems to reduce the possibility of accidents such as slipping or tripping over objects.	✓	✓	Site was low in cleanliness compared to other two. It was observed that this unclean environment increases the possibility of accidents happen due to slipping or tripping over objects.	✓	✓	Site was clean and organized. This seems to reduce the possibility of accidents such as slipping or tripping over objects.	
Openness	Improving view, the light, the feeling of being in the open.	Makes the work environment more interesting and motivational to improve efficiency of work.	✓	✓	This building had openness to a satisfactory level and workers seems to enjoy working in open spaces with good light condition than in dark places.. There was many view points but since this was surrounded only with buildings, views were not distracting workers.	✓	✗	This building layout was very open and had a great view. But this seems to distract workers and since site was open to wind and sun, weather conditions were affecting the work negatively.	✓	✗	This building layout had the minimum openness when comparing with others. But this seems to reduce distractions from surrounding environment and also protect workers from poor weather conditions and high heat.	
		Improve the opportunity to collaborate and communicate with co-workers.	✓	✓	Open spaces of the site seems to facilitate and improve communication within site and make co-working much easier for workers.	✓	✓	Open spaces of the site seems to facilitate and improve communication within site and make co-working much easier for workers. But it was observed that this also create time losses due to unnecessary communication.	✓	✓	Even though the open spaces were limited in this layout, existing open spaces seems to facilitate and improve communication within site and make co-working much easier for workers.	
		Improving surface textures.	Improve the feeling of spaciousness and make the work environment more relaxing.	✓	✓	Some surface textures seems to create visual illusions to increase the feeling of openness within that space.	✓	✓	Some surface textures seems to create visual illusions to increase the feeling of openness within that space.	✓	-	Surface textures were not finished and therefore no observations were made on this.
		Improving sequence of spaces.	Facilitate the ease of movements within site.	✓	✓	Since this was an Architect designed building, spatial progression was taken in to the consideration and this sequential distribution of spaces were also seem to facilitate workers movements within site.	✓	✓	Since this is an Architect designed building, spatial progression was taken in to the consideration and this sequential distribution of spaces also seems to facilitate workers movements within site.	✓	✓	Since this was an Architect designed building, spatial progression was taken in to the consideration and this sequential distribution of spaces were also seem to facilitate workers movements within site.
Comfort	Providing a superior acoustic environment.	Increase the ability to focus on work and thereby increase the efficiency of work.	✓	✓	Even though this site was located near the main road, the building was designed to minimize the excess noise entering to the building from surrounding. This made the work environment more peaceful and quiet for workers and it was easier for them to focus on their work.	✓	✓	This building was located in a peaceful surrounding with no excess noise. This made the work environment more peaceful and quiet for workers and it was easier for them to focus on their work.	✓	✓	Even though this site was located near the main road, the building was designed to minimize the excess noise entering to the building from surrounding. This made the work environment more peaceful and quiet for workers and it was easier for them to focus on their work.	
	Maintaining optimal thermal comfort.	Increase the ability to focus on work	✓	✓	Thermal comfort was good and it was easy to focus on work since the environment is less tiresome.	✓	✓	Thermal comfort was low. Workers were getting tired easy due to high heat and it was hard to focus on work.	✓	✓	Thermal comfort was good and it was easy to focus on work since the environment is less tiresome.	
		Creates attractive and interesting work environment which increase the efficiency of work.	✓	✓	Comfortable thermal conditions were seem to keep workers motivated, energetic and less tired.	✓	✓	Due to uncomfortable thermal conditions, workers seems to get tired easily and this seems to reduce the work efficiency.	✓	✓	Comfortable thermal conditions seems to keep workers motivated, energetic and less tired.	

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.	Case A			Case B			Case C		
			Interviews	Observations	Observation details	Interviews	Observations	Observation details	Interviews	Observations	Observation details
Permeability		Contributes to the health of workers and therefore leads to low absenteeism rate.	✓	-	No observations were made on this.	✓	-	No observations were made on this.	✓	-	No observations were made on this.
	Creating a high quality visual environment	Creates attractive and interesting work environment which increase the efficiency of work.	✓	✓	Visual environment was good since the site was clean and the building was well designed. Workers seems to have ability to focus on their work compared with workers in case B.	✓	✓	The visual environment was poor since this site was untidy and unorganized. This poor visual environment seems to distract workers easily.	✓	✓	Visual environment was good since the site was clean and well organized. workers seems to have ability to focus on their work compared with workers in case B.
	Providing furniture and equipment that will enhance worker comfort.	Increase the ability to focus on work and therefore increase their performance.	✓	✓	Comfortable work stations which were suitable with workers anthropometrics seems to increase workers ability to focus on work.	✓	✓	Comfortable work stations which are suitable with workers anthropometrics seems to increase workers ability to focus on work.	✓	✓	Comfortable work stations which were suitable with workers anthropometrics were seem to increase workers ability to focus on work.
Robustness	Creating a well-connected layout which offer choice of direct routes	Increases the efficiency of circulation within site and therefore contributes time management of workers.	✓	✓	There was a good network of routes within the site and it was helping to ease the circulation by giving choices and improve work efficiency.	✓	✓	There was a good network of routes within the site which supported to ease the circulation by giving choices and improve work efficiency.	✓	✓	Due to space restrictions, there was limited routes within site. This seems to reduce efficiency due to lack of choice of routes to move through.
		Gives a safe and secured feeling to construction workers to work confidently.	✓	✓	Since this site had many open spaces, workers could see each other and the surrounding while working. This was seem to improve the feeling of safety within site.	✓	✓	Since this site had many open spaces, workers can see each other and the surrounding while working. This seems to improve the feeling of safety within site.	✓	✓	This site had limited visual permeability and this enclosed spaces gives bit unsafe feeling.
		Supports easy communication between co-workers.	✓	✓	Since this site had many open spaces, workers could communicate with each other easily.	✓	✓	Since this site had many open spaces, workers can communicate with each other easily.	✓	✓	Even though this site had limited open spaces and visual permeability is low, workers were seem to communicate through existing permeable areas.
Scale	Creating spaces that can adapt to different uses and activities, perhaps at different times of the day	Creates work space more flexible and interesting to work more efficiently and effectively.	✓	✓	Some spaces were used for different purposes at different times. As example one space was first used for concrete mixing and after some period carpenters used that same space to assemble wooden items. This ability was making the work more efficient.	✓	✓	Some spaces were used to store different items at different times. As example one space was first used to store iron bars and after some period that same space used to store landscape items. This ability was making the work more efficient.	✓	✓	Some spaces were used for different purposes at different times. As example there was a space used as workers dining area and later that space was converted as a store room and workers used to dine in a different space. This ability was making the work more efficient.
	Having adjacent spaces which facilitates the ongoing constructions within a certain space	Reduces the unnecessary circulation, ease the logistics and therefore decreases the time losses.	✓	✓	When working in one space, workers were utilizing other adjacent spaces also to keep their equipment and material. This was seem to reduce unnecessary logistics and circulation.	✓	✓	When working in one space, workers were utilizing other adjacent spaces also to keep their equipment and material. This seems to reduce unnecessary logistics and circulation.	✓	✓	When working in one space, workers were utilizing other adjacent spaces also to keep their equipment and material. This seems to reduce unnecessary logistics and circulation.
	Using standardized heights and ergonomic measures to design furniture in work site.	Increase the ability to focus on work and therefore increase their performance.	✓	✓	In this building, the heights and widths were bit larger compared to human scale and this seems to make workers tired easily and decrease their performance.	✓	✓	Since the heights and widths are according to anthropometrics the building was compatible with human scale. Therefore it seems to be more easier for workers to focus on their work when compared with case A.	✓	✓	Since the heights and widths are according to anthropometrics the building was compatible with human scale. Therefore it seems to be more easier for workers to focus on their work when compared with case A.

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.	Case A			Case B			Case C		
			Interviews	Observations	Observation details	Interviews	Observations	Observation details	Interviews	Observations	Observation details
		Support healthy postures which helps to reduce injuries and leads to law absenteeism rate.	✓	✓	Since the dimensions of this building were larger compared to human scale sometimes workers could not maintain healthy postures while working.	✓	✓	Dimensions of the building which were compatible with human scale seems to support workers to maintain healthy postures while working.	✓	✓	Dimensions of the building which were compatible with human scale seems to support workers to maintain healthy postures while working.
	creating widths of service routes by considering anthropometrics	Makes workers circulation more effective.	✓	✓	Service routes were wide enough for few people to pass by a carry equipment such as wheel barrows. This seems to reduce traffic and ease up the material transportation within site.	✓	✓	Service routes were wide enough for few people to pass by a carry equipment such as wheel barrows. This seems to reduce traffic and ease up the material transportation within site.	✓	✓	Some service routes were smaller for two people to pass by and this created traffic an inefficiencies in work.
Tidiness	Providing Designated area for rubbish and waste	Helps to prevent ill-smells and create pleasant work environment which increases workers efficiency.	✓	✓	Areas for rubbish and waste were designated and labelled properly. This was observed to be supporting to create clean, organized and pleasant work environment.	✓	✓	Areas for rubbish and waste were designated. But due to the lack of supervision, workers seems to put waste in random places. This was creating unpleasant work environment which reduce workers motivation to work.	✓	✓	Areas for rubbish and waste were designated and labelled properly. This was observed to be supporting to create clean, organized and pleasant work environment.
	Stacking and storing materials properly	Reduces time spends to find lost items.	✓	✓	All material and equipment were stored properly, so chance to lose items was minimum. This was reducing the time spends to find lost items.	✓	✓	Items in this site was not stored properly as much as case A and C. So there was a good chance of losing items and this creates unexpected time losses.	✓	✓	Since the site is well organized, it was easy to find items when needed. This was minimizing the time spends to find lost items.
	Keeping access routes clear	Ease up the workers circulation and material logistics and therefore decreases the time losses.	✓	✓	Access routes were clear and this was reducing the chances of creating unnecessary traffic within site.	✓	✓	In few places there were unnecessary items stacked on the sides of service routes and this was making inefficiencies in logistics.	✓	✓	Access routes were clear and this was reducing the chances of creating unnecessary traffic within site.
Imageability	Improving identity of site (identity means a distinction from other objects)	Leads workers to easily identify their location, destinations and routes without confusions	✓	✓	Unique characteristics of the site was making it easy to remember and imagine spaces, routes and locations.	✓	✓	Unique characteristics of the site was making it easy to remember and imagine spaces, routes and locations.	✓	✓	Unique characteristics of the site was making it easy to remember and imagine spaces, routes and locations.
	Improving the structure of the site (structure means a relationship to larger pattern of other elements)	Increases the ability to focus on work, improves visual comfortability, increases the ability of workers to memorize things and therefore increases their performance.	✓	✓	Since this was well designed site, the structure of the site was well planned and it was making it easy to remember spaces, routes and locations.	✓	✓	Since this was well designed site, the structure of the site was well planned and it was making it easy to remember spaces, routes and locations.	✓	✓	Since this was well designed site, the structure of the site was well planned and it was making it easy to remember spaces, routes and locations.
	Improving the meaning of site (meaning means a practical and emotional value for the observer)	Create more motivational work environment.	✓	-	No observations were made on this.	✗	-	No observations were made on this.	✓	-	No observations were made on this.
Personalization	Allowing employees to rearrange their work stations or furniture in any way they wanted in order to meet their evolving needs for collaboration or privacy.	Fulfills workers evolving needs for collaboration and privacy to create more flexible and motivational work environment.	✓	✓	Some temporary workstations were personalized by workers and they were seem to enjoy working on that personalized spaces rather than working in common areas.	✓	✓	Some storage areas were personalized by workers and they did not like others to store things in that area. It was observed that they like to keep their items in their own way and it make work more comfortable for them.	✓	-	No observations were made on this

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.	Case A			Case B			Case C		
			Interviews	Observations	Observation details	Interviews	Observations	Observation details	Interviews	Observations	Observation details
Vitality	Improving accessibility within site	Increases the efficiency of circulation within site and therefore contributes time management of workers.	✓	✓	Accessibility of site was good with number of routes. This was helping to reduce the traffic in material transportation and improve work efficiency by giving choice of routes.	✓	✓	Accessibility of site was good with number of routes. This was helping to reduce the traffic in material transportation and improve work efficiency by giving choice of routes.	✓	✓	Due to space restrictions, there was limited routes within site. This was seemed to cause traffic in material transportation and reduce efficiency due to lack of accessible within site.
	Improving Sustainability in site	Creates attractive and interesting work environment which increase the efficiency of work.	✓	✓	Sustainable methods such as reusing rain water and recycled water for construction and gardening purposes were implemented in this site and workers were excited and enjoying these new methods.	✓	-	No observations were made on this.	✗	-	No observations were made on this.
	Improving environmental quality.	Contributes to the health of workers and therefore leads to low absenteeism rate.	✓	✓	Environmental quality was good and it was easy to work within site.	✓	✓	Environmental quality was good and it was easy to work within site	✓	✓	Environmental quality was good and it was easy to work within site
	Creating vibrant and diverse spaces and facilities.	Creates lively and encouraging work environment within site.	✗	✓	Site had various kind of spaces and facilities for workers and this was seemed to encourage workers by adding liveliness to the site.	✓	✗	Due to lack of supervision within site, these types of spaces were seemed to act as nodes where workers gather and talk unnecessarily and therefore distracting workers to influence negatively on their efficiency.	✗	✓	Site had various kind of spaces and facilities for workers and this was seemed to encourage workers by adding liveliness to the site.
Unity	Creating a sense of cohesion in the space by repetition of particular elements throughout the entire space, whether they're colors, shapes or materials, to pull the look together	Makes the space visually pleasant and interesting to work.	✓	✓	Even though, the building was in construction stage, unity of spaces were there with patterns and shapes of spaces. That makes spatial progression sequential and easily guides workers through spaces.	✓	✓	Even though, the building was in construction stage, unity of spaces was there with patterns and shapes of spaces. That makes spatial progression sequential and easily guides workers through spaces.	✓	✓	Even though, the building is in construction stage, unity of spaces was there with patterns and shapes of spaces. That makes spatial progression sequential and easily guides workers through spaces.

According to the findings illustrated by above table, all the interviewees agreed on strategies to improve legibility within construction site and how they influence time management of construction workers. Observations also verified all the strategies other than the fourth one, creating common identifiable districts with clear edges. The reason for this is that all three case studies were house projects and they were not large enough to divide as few major areas. When it comes to safety, all the strategies other than marking the site properly by showing necessary sign boards were verified as true by both interviews and observations. Only the observations of case C verified the said strategy as only the case C was marked properly with necessary sign boards.

When considering openness, only the observation results from case C verified that using the strategy of improving view, the light and the feeling of being in the open makes the work environment more interesting, motivational and improves efficiency of work. Observations from case B and C proved that this is not true in the practical situation. In case B, the view was distracting workers and since the site was very open, weather conditions were affecting the work negatively. Case C had the minimum openness factor in all three cases. But it seems to reduce unnecessary distractions and difficulties due to poor weather conditions. There were no any observations to verify that openness can be improved through creating high quality visual environment and this high-quality visual environment reduces absenteeism rate of workers. Reason for this was that, all these cases were in construction stage and therefore any of the cases did not offer high quality visual environment for workers. It proves that this strategy is not suitable to improve comfort factor within construction sites.

Also when it comes to the imageability factor, no observations were made to verify that improving the meaning of site (meaning means a practical and emotional value for the observer) can create more motivational work environment. Interviewee from case B also disagreed with this strategy by stating that, *“The observer in this scenario is the construction workers and these workers work in these sites for very short period of time. They do not have any ownership or emotional connection with these sites and therefor implementing this strategy is not doable”*. When considering personalization factor, there were no observations from case C to prove that personalization can be improved by allowing employees to rearrange their work stations or furniture in any

way they wanted in order to meet their evolving needs for collaboration or privacy and it creates more flexible and motivational work environment. Reason for this was that, case C had a compacted layout with limited space and workers had to work in a very organized manner. Therefore, there was no room for personalized work stations.

When it comes to vitality, strategy of improving sustainability of site was only implemented in case A. Therefore, no observations were made on this strategy in case B and C. Interviewee from case C disagreed that improving sustainability of site can create attractive and interesting work environment by saying *“Introducing sustainability to the site is profitable and interesting to the owner. But workers only work there temporarily and if they get the facilities they need, they get satisfied. They do not worry about the method that facilities are operating”*. Also, the strategy of creating vibrant and diverse spaces and facilities to create lively and encouraging work environment within site was proven to be wrong according to the case B. In this site there were these kinds of spaces but due to lack of supervision within site, those spaces seem to act as places where workers gather and talk unnecessarily and therefore distracting workers to influence negatively on their efficiency. Also, interviewees from case A and case C disagreed with this strategy by saying that these kinds of spaces create chaos and distractions within site.

4.5. Pattern Matching for the Research Study

4.5.1. Spatial factors that can influence time management of construction workers at site.

Through the literature review, twelve spatial factors were identified as factors which influence time management of people. Stamps (2004) disclosed legibility as a spatial factor that can influence time management of construction workers at site. When discussing about safety, Clarke (2020) reveals that safety improves time management ability in a work environment. All the interviewees agreed on this and also case study findings proved that this is true. Openness can influence on time management of workers (Bernstein & Turban, 2018). Also, Bos, Molinaro, Perrone, Sharer, & Greenberg (2017), accepted that openness influences time management. In the interviews only one participant (I2) disagreed with openness by stating that, *“Openness may increase unnecessary discussions and easy distractions that leads to construction*

delays". In case studies, one interviewee and two out of three observation results did not verify that openness influences time management of construction workers at site. Ali, Chua, & Lim (2015) stated that comfort influences time management. In semi structured interviews, I14, an interviewee from construction worker category disagreed to this by stating that workers are well aware about harsh conditions of construction sites and they do not expect the sites to be comfortable. But, according to case study results, all the interviewees and observations agreed that comfort influences time management of construction workers at site.

Stoner (2016) and Alagamy (2019) disclosed that permeability as a factor which support time management. In semi-structured interviews I5 disagreed to this by saying that *"too much connectivity also distracts people"*. I9 disagreed by saying that most construction workers work within a limited area at one time and therefore permeability of site is not important for them. Robustness enables the desired work to get done better, faster, and more efficiently (Nickl, 2020). In interviews, two interviewees from professional category disagreed. I3 stated that, *"robustness tends to increase confusions and create untidy, uncomfortable environment."* and I8 accepted it. According to the case study results, both interviews and observations verified that permeability and robustness influences the time management of construction workers at site.

According to literature review, building scale and spaces ought to be proportional to human scale for people to feel secured (Gehl, 2010). This feeling of security is developed in a facility, employee productivity eventually seems to be increase (Harter, 2020). Two interviewees, I4 and I11 disagreed that scale influence time management of construction workers at site. I4 stated that, *"usually time line of a project is decided after considering the scale of the spaces that have to be constructed"* as the reason for disagreement. Tidiness improves workers' productivity since it minimizes the time spends to find lost items and improves mental health which helps to focus on work (Sander, 2019). In interviews, two construction workers, I14 and I16, disagreed and I14 argued that, *"it might require additional time and money to maintain tidiness"*. I16 added by that *"Construction workers know that tidiness cannot be expected from an ongoing construction site. Therefore, the tidiness of a site will not influence their working pattern in any way"*.in case studies, all the interviewees and observations

proved that scale and tidiness are spatial factors which influences time management of construction workers.

Mohankumar (2014) stated that imageability is highly useful and supports time management of people. In interviews, three interviewees disagreed with imageability by saying that workers are getting instructions constantly and follows given drawings and therefore they do not need to remember spaces. But, according to case study results, all the interviewees and observations were proving that imageability influences the time management of construction workers at site. Personalization improves daily work flow and activity (Lehman, 2021). In the interviews, even though majority of both categories agreed that personalization, four interviewees disagreed and due to reasons, such as workers do not expect any personal connection with construction sites, sites are changing continuously and those buildings are owned by someone else. All the case study interviews and two out of three observation results proved that personalization influences time management of construction workers.

Vitality can increase Productivity of people who works within a space (Mars Drinks, 2015). Four interviewees disagreed with vitality factor and I1 argued that, *“In one hand, vitality might lead to create chaotic and confusing work environment”*. I3, I6 and I16 agreed with this. When it comes to case studies, even though all the observations verified vitality as a factor which influences time management of construction workers, two out of three case study interviewees disagreed with that. Unity of a certain space create good time management ability for workers (Hatch Interior Design Inc., 2013). Five interviewees disagreed that unity influence construction workers at site. I4 described that *“Unity is something which is nearly impossible to achieve within an ongoing construction site and it is not something workers in a construction environment worry about”*. I5 agreed with I4 and, I9, I13, and I15 also disagreed with unity by arguing that it is not a factor which workers expect to be within a construction site as construction are constantly changing. All the case study interviews and two out of three observation results proved that unity influences time management of construction workers.

4.5.2. How spatial factors influence time management of construction workers at site.

In literature review, stamps (2004) described that legibility influence time management by improving the efficiency of way finding, helps to figure out person's location and minimizes the time period to find the way back to any given point. In the interview round, no interviewee supported the third finding which states that legibility helps to identify way back to reach any given point. All other findings were confirmed by the statements of interviewees and I7 added that "*within a legible space, it is easier for head workers to give instructions and similarly, workers can clearly understand the instructions given by their superiors*". Also, I1, I13 and I15 added that legibility influences time management of construction sites by letting workers to identify shorter routes within site. According to Delves (2020), Safety improves person's openness, flexibility and interdependence which requires to deliver high performance. Clarke (2020) revealed that safety improves time management ability by Improving self-confidence, improving trust, commitment and encouraging more employee involvement. In interviews, no interviewee presented similar ideas to Delves' opinion but I2, I3 and I6 agreed with clearks' opinion. Majority of interviewees added that Safety Reduces accidents within construction site, leads to low absenteeism rate and therefore it impacts on time management of construction workers. When it comes to case studies, all the interviewees and observations proved that these findings are true.

Openness can influence on time management by improving worker's satisfaction and collaborative spirit (Bernstein & Turban, 2018). From interviews, both these were among interviewee opinions. I7 added that, "*openness makes spaces more flexible and adaptable for use and therefore makes time management easier for workers*". In case studies, all the interviewees agreed with this but observations of case B did not verify the method of improve communication between workers. According to literature, comfort improves employee health to have lower absenteeism rate and this guides employees to be more productive (Ali, Chua, & Lim, 2015). Majority of interviewees agreed and I4 and I5 from professionals' category added that comfort improves worker's satisfaction and drives them to work more efficiently. All the case study interviews and observations verified above findings.

Permeability improves efficiency by encouraging “through movements” and helps to manage time efficiently (Stoner, 2016). To add up, Alagamy (2019) disclosed that it supports time management by giving ability to control the flow of people and circulation. Majority of the interviewees agreed that permeability gives choice of routes to move through and increases the ability of finding short cuts within site as the reason to their agreement. I6 added that, Visual permeability increases the ability to observe work. I10 added that, “*permeability reduces traffic in material transportation within site by providing alternative routes*”. According to the literature, robustness Promotes time management within a space by giving it adaptability, which enables the work to get done more efficiently (Nickl, 2020). Every interviewee other than was agreed. I7 from professionals’ category and I10, I15, I16 from construction workers’ category added that if the adjacent spaces can be used to facilitate the ongoing constructions within a certain space, it is much easier for workers as it minimizes the logistics. When it comes to case studies, interviews and observations verified all these methods confirmed after interview round.

Building scale and spaces ought to be proportional to human scale for people to feel secured (Gehl, 2010). When this feeling of security is developed in a facility, employee productivity eventually seems to be increase (Harter, 2020). No interviewee confirmed these methods but majority stated that scale creates a sense of connectedness between workers and site. I1 from professionals’ category argued that, “*Optimum level of scale makes it more comfortable for workers to work within and therefore leads workers to effectively manage the project time*”. All the case study interviews and observations verified above findings. According to Sander (2019), tidiness influences time management by reducing workers stress and anxiety levels, improving workers’ ability to process information, minimizing the time spends to find lost items and improving mental health which helps to focus on work. In interviews, the first two methods were not confirmed. Majority of interviewees stated that tidiness creates pleasant work environment which drives workers to work effectively. I3 and I4 from professionals’ category described that tidiness creates healthy environment and therefore leads to law absenteeism rate. I6 from professionals’ category argued that, “*tidiness minimizes the*

time spends to find lost items”. All the case study interviews and observations verified all the findings from semi-structured interview round.

Mohankumar (2014) stated that imageability influences time management of construction workers by improving capacity to make a strong visual image which is highly useful and increasing human ability to see and remember patterns within a space. Thirteen out of sixteen interviewees agreed that imageability influences time management of construction worker at site but all of them stated that imageability influences time management because it gives ability of creating a mental image of site and therefore helps to identify spaces and routes within site without confusion. This was also confirmed by case study interviews and observations. According to Lehman (2021) personalization improves ease of interaction within daily work flow and activity. This was not confirmed by interviews but majority of interviewees added that personalization improves time management of construction worker at site by giving sense of ownership for workers which drives people to increase their commitment. I5 and I6 from professionals' category argued that personalization creates more comfortable work space which suits worker's individual preference. All the case study interviews and observations verified the findings from interview round.

Vitality makes a space vibrant and alive with potential to increase Collaboration, Engagement, well-Being, and Productivity (Mars Drinks, 2015). This was not confirmed by interviews but, majority of the interviewees agreed that vitality influences time management of construction worker at site because it creates an interesting and encouraging work environment within site. This finding was not fully verified by case studies as only one out of three interviewees and two out of three observations confirmed it. Unity contributes to improve productivity by improving sense of calmness, limiting chaos in workplace, and also adding to the comfort level of a room (Hatch Interior Design Inc., 2013). In interviews, majority stated that unity influences time management because unity can create more interesting and sequential space to work. I1 and I3 from professionals' category argued that unity influences time management of construction worker at site because it increases visual comfortability and makes it easy to work. All the case study interviews and observations verified the findings from interview round.

4.5.3. Spatial factor management strategies and how they influence time management of construction workers at site.

Harten (2018) presented management strategies for legibility such as creating Landmarks within the site and creating Landmarks around the site. Lynch (1960) added that creating network of Paths, creating common identifiable districts (medium-to-large sections) with clear edges and creating attractive nodes (centers of attraction) within site as management strategies for legibility. Input of Participants from interview round explained how those management strategies influence time management of construction workers at site. All the interviewees and all the observations done were confirmed above findings. When it comes to safety, Roux (2014) proposed the strategy of Installing proper fall protections fences and nets. Another strategy was to mark the site properly to protect employees from hazards by showing necessary sign boards (American Society of Safety Professionals, 2019). In interview rounds, interviewees disclosed the way these strategies influence time management of construction workers and I8 added the strategy of keeping the construction site clean as it improves time management of construction workers by reducing unexpected injuries from accidents due to clutter and improves work efficiency. All this information was verified through case studies.

Strategies to manage openness are improving view, the light, the feeling of being in the open, improving surface textures and improving sequence of spaces (Donnell Day Architects, 2021). Similarly, comfort can be managed by providing a superior acoustic environment, maintaining optimal thermal comfort, creating a high-quality visual environment and providing furniture and equipment that will enhance worker comfort. Interview round explained how these strategies influence on time management of construction workers at site. Even though all the strategies to manage comfort were confirmed by case study interviews and available observations, the first strategy of managing the openness by improving view, the light and the feeling of being open was not verified by the observations in case B.

Strategy to manage permeability within site is creating a well-connected layout which offer choice of direct routes (Essex planning officers association, 2019). Results of interview round explained how this strategy influences time management of

construction workers and case study results verified all those findings. When it comes to robustness, Carmona (2018) stated the strategy of creating spaces that can adapt to different uses and activities, perhaps at different times of the day. In the interview round, I2 proposed that having adjacent spaces which facilitates the ongoing constructions within a certain space as a strategy to increase robustness. Also, the way both these strategies influence time management of construction workers was identified through interviews and case studies verified all these findings.

Scale can be managed by strategies such as Scale using standardized heights and ergonomic measures to design furniture in work site and creating widths of service routes by considering anthropometrics (Hatch Interior Design, 2021). Strategies to manage tidiness are providing designated area for rubbish and waste, stacking and storing materials properly and keeping access routes clear. According to Damayaniti & Kossak (2015) imageability can be managed by improving identity of site (identity means a distinction from other objects), improving the structure of the site (structure means a relationship to larger pattern of other elements) and improving the meaning of site (meaning means a practical and emotional value for the observer). Interview findings explained how these strategies influences time management of construction workers and case study results verified all those findings.

Strategy to manage personalization is allowing employees to rearrange their work stations or furniture in any way they wanted in order to meet their evolving needs for collaboration or privacy (Pearce & Hinds, 2018). In the interview round, participants disclosed how the use of this strategy can influence time management of construction workers at site. All the case study interviewees and available case study observations proved that this is true. When it comes to vitality, Drewes & van Aswegen (2010), proposed management strategies such as increasing accessibility, sustainability and environmental quality. Another management strategy is creating vibrant and diverse spaces and facilities (March, Rijal, Wilkinson, & Özgür, 2012). Data on how these strategies can contribute on time management of construction workers were collected through interviews. Case study interviewee from case C did not verify the strategy of increasing sustainability and both interviewees from case A and C did not verify the strategy of creating vibrant and diverse spaces and facilities. This final strategy was

also did not confirmed by observations in case B.A strategy to manage unity is creating a sense of cohesion in the space by repetition of particular elements throughout the entire space, whether they're colors, shapes or materials, to pull the look together (Mastroeni, 2020). Interview findings explained how this strategy influences time management of construction workers and case study results verified all those findings.

4.6.Summary

The chapter illustrates the analysis of collected data from the semi structured interviews and case studies which are analyzed via manual content analysis. The topics were structured according to the objectives and analysis contends investigation of management of spatial factors contributing to time management of construction workers at site. Findings from the interviews and case studies comparatively elaborated in relation to the findings from literature via pattern matching. In the final chapter the results of the study were concluded, and recommendations were identified. The study will be finally concluded thereafter.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1.Introduction

This fifth and concluding chapter comprises the conclusion made by final outcomes which fulfill the research gap. This chapter provides a comprehensive conclusion to the each and every objective that had been examined in the study. Furthermore, includes the general conclusion which adds more facts to the objectives. Latter part of the chapter discusses about the limitation for the research. At the end, it has identified the areas that can be used to conduct any further studies.

5.2.Overview of Objectives Achieved in the Study

Under each objective stated in sub section 1.3, captioned as Objectives, has illustrated the research findings that have concluded, and the methodology followed to conduct the study.

5.2.1. Objective 1- Identify the concept of spatial management

This objective was attained through literature findings. Under this objective, Spatial factors, their influence on people, the importance to manage them and the methods to manage them were discussed. Therefore, it was identified that, spatial management includes identifying relevant spatial factors to achieve the desired goal, identifying how those spatial factors influence on human behavior, understanding the strategies to manage these spatial factors, understanding the consequences of implementing these strategies within the particular space and finally, implementing these strategies to achieve the desired goal.

5.2.2. Objective 2- Identify the spatial factors, which affects for effective time management in Construction sites.

This objective was attained through literature review, interviews and case studies. From the findings of literature review, twelve spatial factors were identified as factors influencing time management. Through the interviews and case studies all these twelve spatial factors were confirmed as spatial factors influencing time management of construction workers at construction site as majority of the participants agreed with them. Finally, with the case study interviews and observations, those spatial factors

were verified to be contributing to effective time management of construction workers at site. These twelve spatial factors which contributes to the time management of construction workers are namely, legibility, permeability, imageability, robustness, safety, vitality, openness, comfort, unity, personalization, scale, tidiness.

5.2.3. Objective 3- Identify the consequences of these factors to construction projects

This objective was attained through literature review, interviews and case studies. Majority of the findings after semi-structured interview round was verified through case studies and for some findings there were no enough observations from some cases. It was observed that identified spatial factors contribute to effective time management of construction workers via influencing on their behavior. Improving communication between workers under openness factor and creating an interesting and encouraging work environment within site under vitality factor was not fully confirmed by case studies as some interviewees and observation results opposed with them. But these findings revealed number of ways these factors can influence construction projects and specifically the impact of these factors on effective time management of construction workers at construction sites.

5.2.4. Objective 4- Propose strategies to manage the spatial factors, and investigate how the strategies can improve time management of construction workers at site.

First part of this objective was attained through literature review, interviews and case studies and the second part, the ways all those strategies contribute to improve time management of construction workers, was solely identified through semi-structured interviews. Then the case studies conducted to verify these findings. Majority of the findings after semi-structured interview round was verified through case studies. For some findings, there were no enough observations from some cases. Some strategies to manage openness, imageability and vitality was not completely verified by case studies as some interviewees and observation results did not agree with those strategies and how they contribute to the effective time management of construction workers at site. The study revealed strategies for each spatial factors and by following these strategies, time management of workers at site can be improved. Each of these strategies has their

own way of influencing construction workers spatial cognition and behavior to improve their time management ability. Therefore, it is important for project managers to pay their attention towards planning the work site layout by considering these spatial factors and their management strategies.

5.3.Recommendations

Recommendations focus on successful implementation of spatial factor management strategies to reduce delays in construction projects.

Making it mandatory to Prepare Construction Site Layout Plan by considering spatial factor management strategies.

Preparing proper construction site layout with involvement of professionals who are knowledgeable on spatial factors, human psychology and human behavior can improve the chances of creating a construction site with optimum efficiency level.

Conducting time-to-time inspections within the site to check whether spatial factor management strategies are implemented properly throughout the process.

Since Construction sites are volatile, spatial arrangement may change over time by not considering initially prepared work site layout. Therefore, time-to-time inspections are necessary to keep everything in place throughout the process.

Including necessary clauses to tender documents about spatial factor management and making it compulsory for project managers to follow those guidelines.

This improves contractors' awareness about spatial factor management and makes it compulsory for contractors to implement spatial factor management strategies within site.

Organizational level awareness programs

This is the most practical way of engaging and giving awareness about implementation of spatial factor management strategies and its consequences in construction projects to people in all the levels.

Encouraging practical implementation at organizational level

Construction organizations need to implement these strategies practically to test and yield the results.

Implementing regulations

Proper regulations add a legal background to implement these strategies in construction sites

Implementing research and development

In-depth investigations are required to gather further knowledge on implementation of spatial factor management strategies to reduce delays in construction projects and more valuable outcomes.

5.4. Contribution

The findings of this study can be utilized to achieve proper time management in construction projects and to reduce construction delays. knowledge on the spatial factors in construction project sites, which contributes to time management and how they effect, gives a framework to decide the floor plan of a construction site to positively impact on workers' behavior and to increase work efficiency. Furthermore, there was a dearth of knowledge in how spatial factors influence on effective time management of construction workers and these research findings contribute to fill that gap in theory.

5.5. Limitations

Since this study was conducted under qualitative methodology, using limited sample of interviewees and three case studies only, the findings are not generalized and limited to those contexts where the study was carried out. Therefore, the results cannot be used in other contexts in Sri Lanka and other countries.

5.6.Further Research

In order to extend the research area on how to manage spatial factors within construction sites, further researches are encouraged on,

- Impact of implementation of spatial factor management strategies to workers stress level at construction sites.
- Effectiveness of implementing spatial factor management strategies in construction sites: Perspective of construction cost
- Strategies to introduce the concept of spatial management to the consultancy companies in Sri Lanka

REFERENCES

- Acar, H., Aysel, Y., Eroglu, E., Acar, C., Sancar, C., & Degermenci, A. S. (2020). Analysis of activity, space and user. *Indoor and Built Environment*, 1-20.
- Ahmad, N. L., Yusuf, A. N., Shobri, N. D., & Wahab, S. (2012). The relationship between time management and job. *International Congress on Interdisciplinary Business and Social Science*, 937-941
- Aibinu, A. A. (2002). The effects of construction delays on project delivery in Nigerian construction industry. *International Journal of Project Management*, 20(8), 593-599
- Akanni, P. O., Oke, A. E., & Akpomiemie, O. A. (2015). Impact of environmental factors on building project performance in Delta State, Nigeria. *HBRC Journal*, 11(1), 91-97. doi: 10.1016/j.hbrcj.2014.02.010
- Alagamy, S. F., Al-Hagla, K., Anany, Y., & Raslan, R. (2019). An integrated approach for analyzing connectivity in atria. *Alexandria Engineering Journal*, 58(1), 15-324.
- Alagamy, S. F.-H. (2019). An integrated approach for analyzing connectivity in atria. *Alexandria Engineering Journal*, 58(1), 15-324.
- Alahmed, H., Alaghbari, W., Ibrahim, R., & Salim, A. (2013). The influence of spatial design characteristics on low-rise residential neighbourhoods in Basra city. *International Journal of housing markets and analysis*, 559-585.
- Ali, A. S., Chua, S. J., & Lim, M. E. (2015). The effect of physical environment comfort on employees' performance in office buildings. *Structural Survey*, 33(4/5), 294-308.
- Al-Kharashi, A., & Skitmore, M. (2009). Causes of delays in Saudi Arabian public sector construction projects. *Construction Management and Economics*, 27(1), 3-23.

- American Society of Safety Professionals. (2019). *Three ways signage can improve workplace safety*. Retrieved from <https://www.assp.org/news-and-articles/2019/05/24/three-ways-signage-can-improve-workplace-safety>
- Anderson, C. (2017, October). *Positive work environment*. Retrieved from Falconer Electronics: <https://falconerelectronics.com>
- Armstrong, B, T. (2012, May). *Open Workspaces Are Here to Stay. Now, How Do We Get Any Work Done?*. Retrieved from <http://www.forbes.com/sites/barbaraarmstrong/2012/05/24/balancing-the-needs-for-collaboration-and-privacy-a-tall-order-in-workplace-design>
- Atkin, B., & Brooks, A. (2000). *Total Facilities Management*. UK: John Wiley & Sons, Ltd.
- Bansal, V. K. (2018). Use of GIS to consider spatial aspects in construction planning process . *International Journal of Construction Management*, 20(3), 207-222.
- Bar, M., & Ullman, S. (1996). Spatial context in recognition. *Perception*, 25(3), 343-352.
- Baskarada, S. (2014). Qualitative case study guidelines. *The Qualitative Report*, 19, 1–25.
- Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, 13, 544–559.
- Bekr, G. A. (2017). Factors affecting performance of construction projects in unstable political and economical situations. *ARPJ Journal of Engineering and Applied Sciences*, 12(19), 5384-5395.
- Belyh, A. (2019). *How open office plans affect workplace productivity*. Retrieved from: <https://www.cleverism.com/how-open-office-plans-affect-workplace-productivity/>

- Bentley, I., Alcock, A., Murrain, P., McGlynn, S., & Smith, G. (1985). *Responsive environments*. Oxford: Elsevier.
- Bernstein, E. S., & Turban, S. (2018). The impact of the ‘open’ workspace on human collaboration. *Philosophical Transactions of The Royal Society B Biological Sciences*. doi.org/10.1098/rstb.2017.0239
- Berrios, R., & Lucca, N. (2006). Qualitative methodology in counseling research: Recent contributions and challenges for a new century. *Journal of Counseling & Development*, 84(1), 174-186.
- Bhandari, P. (2020, July). *An introduction to qualitative research*. Retrieved from <https://www.scribbr.com>
- Bolderston, A. (2012). Conducting a research interview. *Journal of Medical Imaging and Radiation Sciences*, 46, 66-76.
- Bos, N., Molinaro, K., Perrone, A., Sharer, K., & Greenberg, A. (2017). Workplace Satisfaction Before and After Move to an Open Plan Office - Including Interactions with Gender and Introversion. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 61(1), 455-459.
- Bovteev, S. V. (2016). Development of methodology for time management of. *Magazine of Civil Engineering*, 102-112.
- Bradley, S. (2010, January). *Unity In Design: Creating Harmony Between Design Elements*. Retrieved from <https://vanseodesign.com>
- Brill, M. (1984). Using office design to increase productivity (Vol. 1). Buffalo, NY: Workplace Design and Productivity, Inc.
- Carlos, C. C., Saorin, J. L., & Medler, S. H. (2020). Spatial orientation skills for landscape architecture education and professional practice. *Land* 2020, 9(5), 161-177. doi: 10.3390/land9050161
- Carmona, M. (2003). *Public Places-Urban Spaces : The dimensions of urban design*. Boston: Architectural Press.

- Carmona, M. (2018). Principles for public space design, planning to do better. *Urban Design International* , 24, 47-59.
- Check J., Schutt R. K. Survey research. In: J. Check, R. K. Schutt., editors. *Research methods in education*. Thousand Oaks, CA: Sage Publications; 2012. pp. 159–185.
- Chetty, P. (2016, October). *Importance of Research Approach in a Research*. Retrieved from <https://www.projectguru.in>
- Ching, F, D. K. (1979). *Architecture: Form, Space, and Order*. New York: John Wiley & Sons.
- Chin, L., & Hamid, A. R. (2015). The practice of time management on construction project. *The 5th International Conference of Euro Asia Civil Engineering Forum*, 32-39
- Clarke, M. (2020, February). *How workplace safety can affect your productivity*. Retrieved from: <https://thriveglobal.com/stories/how-workplace-safety-can-affect-your-productivity/>
- Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approach (2nd ed.)*. Thousand Oaks: Sage Publications.
- Creswell, J. W., & Clark, V. L. (2007). *Designing and conducting mixed methods research*. Thousand Oaks: Sage Publications.
- Crutsinger, C. (1994). *Thinking smarter: Skills for academic success*. Carrollton, TX: Brainworks.
- Damayaniti, R., & Kossak, F. (2015). Extending Kevin Lynch's theory of imageability in third space reading (*Doctoral dissertation*). Retrieved from *University of Sheffield*.
- Darley PCM Ltd. (2018). *10 Good housekeeping rules for a tidy construction site*. Retrieved from <https://www.haspod.com/blog/construction/good-housekeeping-rules-construction-site>
- Dean, B. (2021). *Authentic happiness*. Retrieved from <https://www.authentichappiness.sas.upenn.edu>

- DeJonckheere, M., & Vaughn, L. M. (2019). Semistructured interviewing in primary care research: a balance of relationship and rigour. *Family Medicine and Community Health*, 7(2). doi:10.1136/fmch-2018-000057
- Delbosc, A., & Currie, G. (2011). The spatial context of transport disadvantage, social exclusion and well-being. *Journal of Transport Geography*, 19(6), 1130-1137. doi:10.1016/j.jtrangeo.2011.04.005
- Delves, R. (2020, February). *How Psychological Safety Drives Productivity and Engagement*. Retrieved from <https://blog.bonus.ly/how-psychological-safety-drives-productivity-engagement>
- DeWalt, K. M., & DeWalt, B. R. (2002). *Participant observation: a guide for fieldworkers*. Walnut Creek, CA: AltaMira Press.
- Dierdorff, E. (2020, January). *Time Management Is About More Than Life Hacks*. Retrieved from <https://hbr.org/2020/01/time-management-is-about-more-than-life-hacks>
- Dinnen, J. (2014, March). Phase #2: Clearly Define Your Research Strategy. Retrieved from <https://www.mackenziecorp.com/phase-2-clearly-define-research-strategy/>
- Dogu, U. E. (2000). Spatial factors affecting wayfinding and orientation: A case study in a shopping mall. *Environment and Behavior*, 32(6), 731-755. doi: 10.1177/00139160021972775
- Dolage, D. A., & Rathnamali, D. L. (2013). Causes of Time Overrun in Construction Phase of Building Projects. *Engineer*, 46(3), 9-18.
- Donnell Day Architects. (2021). *Openness and enclosure*. Retrieved from <https://www.donnellday.co.nz/thoughts/openness-and-enclosure/>
- Drewes, J. E., & van Aswegen, M. (2010). Determining the vitality of urban centres. *WIT Transactions on Ecology and the Environment*, 142, 15-25.
- Enshassi, A. (2003). Factors affecting safety on construction projects. In Proceedings of the International Conference on Construction Project Management

- Systems: The Challenge of Integration. Retrieved from <https://www.irbnet.de/daten/iconda/CIB1444.pdf>
- Essex planning officers association. (2019). *The essex design guide*. Retrieved from <https://www.essexdesignguide.co.uk>
- Ewing, R., & Handy, S. (2009). Measuring the Unmeasurable: Urban Design. *Journal of Urban Design*, 14(1), 65–84.
- Fakunle, F. F., & Fashina, A. A. (2020). Major delays in construction projects: A global overview1. *PM World Journal*, 9(5), 2-13.
- Fard, H. R. (2014). Evaluating Spatial Behavior in the Urban Public Space of Kadıköy Square. *In Proceedings of 2nd International Conference on Architecture and Urban Design*. Retrieved from https://www.researchgate.net/publication/320596125_Evaluating_Spatial_Behavior_in_the_Urban_Public_Space_of_Kadikoy_Square
- Farnsworth, B. (2019, July). *Human Behavior: the complete pocket guide*. Retrieved from: <https://imotions.com/blog/human-behavior/#what-is-behavior>
- Flick, U. (2018). Triangulation in data collection. *The SAGE Handbook of Qualitative Data Collection*, 527-544.
- Freedman, M. (2020, June). *4 Ways to Improve Your Office's Work Environment*. Retrieved from Business News Daily: <https://www.businessnewsdaily.com>
- Garner, J. (2019, July). *The morale benefits of a clean and tidy office*. Retrieved from <https://www.smallbizdaily.com/the-morale-benefits-clean-tidy-office/>
- Garzon, G. J. (2005). The impact of office design on business performance. *Management Services*, 49(3), 12-15.
- Gauthier, P., & Gilliland, J. (2006). Mapping urban morphology: a classification scheme for interpreting contributions to the study of urban form. *Urban Morphology*, 41-50.
- Gehl, J. (2010). *Cities for People*. Washington: Island Press.

- Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal*, 204, 291–295.
- Grover, V. (2015, February). *Research approach*. Retrieved from <https://www.slideshare.net>
- Gunnell, M. (2016, December). *Research Methodologies: A comparison of quantitative, qualitative and mixed methods*. Retrieved from <https://www.linkedin.com/pulse>
- Haq, S., & Zimring, C. (2003). Just down the road a piece: The development of topological knowledge of building layouts. *Environment and Behavior*, 35(1), 132-160. doi: 10.1177/0013916502238868
- Harrouk, C. (2020, March). *Psychology of space: how interiors impact our behavior?* Retrieved from <https://www.archdaily.com/936027/psychology-of-space-how-interiors-impact-our-behavior>
- Harten, A. (2018, June). *Is your agile workspace legible?* Retrieved from <https://blog.haworth.com/content/spark/en/articles/2018/is-your-agile-workspace-legible>.
- Harter, A. (2020, June). *The connection between safety, quality, and productivity*. Retrieved from: <https://anvl.com>
- Harworth. (2020). *5 key design features that drive employee happiness*. Retrieved from <https://blog.haworth.com/content/spark/en/articles/2018/5-principles-for-creating-happier-workplace.html>
- Hashiguchi, N., Cao, J., Lim, Y., Kubota, Y., Kitahara, S., Ishida, S., & Kodama, K. (2020). The effects of psychological factors on perceptions of productivity in construction sites in japan by worker age. *International Journal of Environmental Research and Public Health*, 17(10). Retrieved from <https://doi.org/10.3390/ijerph17103517>

- Hassanain, M. A. (2010). Analysis of factors influencing office workplace planning and design in corporate facilities. *Journal of Building Appraisal*, 6, 183–197.
- Hatch Interior Design. (2021). *Elements of design part 5: scale and proportion*. Retrieved from <https://www.hatchdesign.ca>
- Hatch Interior Design Inc. (2013). *Principles of interior design part 5: harmony and unity*. Retrieved from <https://www.hatchdesign.ca>
- healthyplaces.org. (2009). Design Principle – Connectivity and Permeability. Retrieved from <https://pdf4pro.com/view/design-principle-connectivity-and-permeability-56d0e4.html>
- Herath, A. H. (2005). *Robustness in Street Architecture; A study of some selected streets in Colombo and Kandy (master's thesis)*. Retrieved from <http://dl.lib.uom.lk/handle/123/1493>
- Hodge, G. H. (2013, June). *Civil engineering & time management for your project*. Retrieved from: <https://ghhllc.com/blog/civil-engineering-blog-bid-297762-civil-engineering-time-management-for-your-project>
- Hollis-Turner, S. (2015). The influence of open plan work-environments on the productivity of employees: The case of engineering firms in Cape Town. *Problems and Perspectives in Management*, 13(2), 51-56.
- Holscher, C., Dalton, R., & Turner, R. (2006). Space Syntax and Spatial Cognition. In *Proceedings of the Workshop held in Bremen.*, Retrieved from https://www.sfbtr8.spatial-cognition.de/papers/Space_allen.pdf
- Ibrahim, A., & Mikhail, R. (2016). *Architectural Design Process Based on Spatial Human Behavior Parameters through Computational Methodology*. In proceedings of Mediterranean Cultures in Art and Architecture MCAA, Retrieved from https://www.researchgate.net/publication/318114479_Architectural_Design_Process_Based_on_Spatial_Human_Behavior_Parameters_through_Computational_Methodology

- Ingram, R., & Benford, S. (1996). The Application of Legibility Techniques to Enhance Information Visualizations. *The Computer Journal*, 39(10), 819-836.
- InVisionApp Inc. (2021). *Unity principle of design*. Retrieved from <https://www.invisionapp.com>
- Işiklar, S. (2017). Vitality of the cities. *International Journal of Architectural Engineering Technology*, 4, 18-23.
- Johannesson, P. (2014). *An Introduction to Design Science*. Springer International Publishing
- Kamarulzaman, N., Saleh, A. A., Hashim, S. Z., Hashim, H., & Abdul-Ghani, A. A. (2011). An overview of the influence of physical office. In *Proceedings of the 2nd International Building Control Conference* (pp. 262-268). Retrieved from <https://cyberleninka.org/article/n/14857>
- Khalaf, O. B., & Ja`afar, N. H. (2020). User-friendly streets for a walkable, liveable and sustainable environment: A review. *Jurnal Kejuruteraan*, 409-414.
- Khazanchi, S. S. (2018). A spatial model of work relationships: the relationship-building and relationship-straining effects of workspace design. *Academy of Management Review*, 43(4).
- Kongchasing, N., & Sua-lam, G. (2020). The major causes of construction delays identified using the delphi technique: Perspectives of contractors and consultants in Thailand. *International Journal of Civil Engineers*. doi: 10.1007/s40999-020-00575-8
- Koseoglu, E., & Onder, D. E. (2011). Subjective and objective dimensions of spatial legibility. *Procedia - Social and Behavioral Sciences*, 1191-1195.
- Kothiyal, K. P. (1995). Workplace Design for Manual Assembly Tasks: Effect of Spatial Arrangement on Work-Cycle Time. *International Journal of Occupational Safety and Ergonomics*, 1(2), 136-143. doi: 10.1080/10803548.1995.11076310

- Kumar, A. (2011). *Research and Writing Skills*. New York: Lulu Press.
- Kumar, V. (2020). Delay in construction of highway and expressway projects. *International Research Journal of Engineering and Technology (IRJET)*, 2137-2142.
- Lang, P. J. (1979). A bio-informational theory of emotional imagery. *Psychophysiology*, 16(6), 495–512.
- Lehman, M. L. (2021). *Personalizing architecture through interface design*. Retrieved from <https://www.sensforma.com>
- Lele, R., Ladkat, N., & Paradeshi, J. (2013, October). *Image of the city*. Retrieved from Slide Share: <https://www.slideshare.net/PlanningTheory/image-of-the-city>
- Lepage, M. (2020, August). *Types of schedule delays in construction projects*. Retrieved from <https://www.planacademy.com>
- Lerner, R. M. (2020, November). *Human Behaviour*. Retrieved from <https://www.britannica.com/topic/human-behavior>
- LetsBuild. (2019) *7 reasons that cause construction project delays*. Retrieved from <https://www.letsbuild.com/blog/7-reasons-that-cause-construction-project-delays>
- Libakova, N. M., & Sertakova, E. A. (2015). The method of expert interview as an effective research procedure of studying the indigenous peoples of the north. *Journal of Siberian Federal University. Humanities & Social Sciences*, 1(2015-8), 114-129.
- Ling, F. Y., & Ang, W. T. (2013). Using control systems to improve construction project outcomes. *Engineering, Construction and Architectural Management*, 20(6), 576-588.
- Lucas, K. (2012). Transport and social exclusion: Where are we now? *Transport Policy*, 20(C), 105-113.
- Luo, A. (2021, February). *What is content analysis and how can you use it in your research?*. Retrieved from <https://www.scribbr.com>

- Lynch, K. (1960). *The image of the city*. Cambridge: MIT Press.
- Maher, A., & Von Hippel, C. (2005). Individual differences in employees reactions to open-plan offices. *Journal of Environmental Psychology*, 25 (1), 219-229.
- Mahmoud, A. M. (2018). The Impact of Built Environment on Human Behaviors. *International Journal on Environmental Science and Sustainable Development*, 2(2), 29-41. doi: 10.21625/essd.v2i2.157
- Mamat, M. Z., & Zin, R. B. (2016). Site layout designs that ensures the efficiency at constructions site. *Vol 2 Construction Management, Geotechnics and Transportation* (pp. 110-121). Johor: Faculty of Civil Engineering, Universiti Teknologi Malaysia, Malaysia.
- March, A., Rijal, Y., Wilkinson, S., & Özgür, E. F. (2012). Measuring building adaptability and street vitality. *Planning Practice & Research*, 27(5), 531-552.
- Maringa, P. M., & Okello, P. (2006). The relationship between imageability and form in architecture: Considerations for design of imageable landmark buildings in cities. *African Journal of Design and Construction*, 1(1), 1-9.
- Mars Drinks. (2015). *Work place vitality*. Retrieved from marsDrinks_WorkPlace_Vitality_A_Global_Phenomenon_Revealed
- Martic, K. (2020, September). *The importance of workplace safety and how to keep employees safe*. Retrieved from <https://blog.smarp.com/workplace-safety-importance-best-practices>
- Marx, A., Erlemann, K., & König, M. (2010). Simulation of construction processes considering spatial constraints of crane operations. *Proceedings of the international conference on computing in civil engineering*. Nottingham: The University of Nottingham.
- Mastroeni, T. (2020, October). *Design, the importance of scale and proportion in interior*. Retrieved from <https://www.mymove.com>
- Mastroeni, T. (2020). *The importance of harmony and unity in interior design*. Retrieved from: <https://www.mymove.com>

- Mateo, R., Hernaández, J. R., Jaca, C., & Blazsek, S. (2013). Effects of tidy/messy workenvironment on human accuracy. *Management Decision*, 1861-1877.
- Meeampol, S., & Ogunlana, O. (2006). Factors affecting cost and time performance on highway. *Journal of Financial Management of Property and Construction*, 3-20.
- Memon, A. H., Rahman, I. A., Ismail, I., & Zainun, N. Y. (2014). Effective Time Management and its importance for construction projects. Time Management techniques and tools. In Proceedings of the *2014 IEEE Colloquium on Humanities, Science and Engineering* (pp. 61-65). Retrieved from <https://core.ac.uk/download/pdf/42954251.pdf>
- Mohankumar, V. (2014, May). *Urban design collective*. Retrieved from: <https://urbandesigncollective.wordpress.com>
- Montgomery, J. (1998). Making a city: Urbanity, Vitality and Urban design. *Journal of Urban Design*, 93-116.
- Moughtin, C., Oc, T., & Tiesdell, S. (1999). *Urban Design: Ornament and Decoration*. Oxford: Architectural press.
- Nichols, F., Canete, I. J., & Tuladhar, S. (1992). Designing for pedestrians : A cad-network analysis approach. *CADline*, 379-398.
- Nickl, R. (2020). *Flexible offices*. Retrieved from <https://spaceiq.com/blog/coworking-or-co-working/>
- Noble, C. A. (2010). Architecture and body. *Forward 110*, 3-6.
- Novotny, R. (2018, July). *5 Tips for delivering on time construction projects*. Retrieved from <https://esub.com/blog/5-tips-for-delivering-on-time-construction-projects/>
- O'Neill, M. J. (1991). Evaluation of a conceptual model of architectural legibility. *Environment and Behavior*, 23(3), 259-284.
- Owusu, P. K., & Aggrey, D. E. (2020). Examining the Effect of Project Delays in Construction Field, A Case Study of Prime Engineering and Service Ghana

Limited . *Asian Journal of Applied Science and Technology*, 4(3), 129-144. doi: 10.38177/ajast.2020.4317

- Paljug, K. (2020, January). *How to design a workspace that improves productivity*. Retrieved from <https://www.business.com/articles/workspace-design-for-productivity/>
- Palmgren, P. J., & Liljedahl, M. (2009). Twelve tips for conducting qualitative research interviews. *Medical Teacher*, 41(9), 1002-1006.
- Pearce, B., & Hinds, P. (2018, January). *How to make sure people won't hate your new open office plan*. Retrieved from <https://hbr.org>
- Penny, J. (2019, November). *6 Open Office Design Tips that Increase Productivity*. Retrieved from <https://www.buildings.com/articles/27444/6-open-office-design-tips-increase-productivity>
- Pettinger, C. (2015, August). *Human behavior*. Retrieved from <https://www.safetyandhealthmagazine.com/articles/12832-human-behavior>
- Pheng, L. S., & Chuan, Q. T. (2006). Environmental factors and work performance of project managers. *International Journal of Project Management*, 24(1), 24–37.
- Pickup, O. (2020, January). *The benefits of personalisation in the workplace*. Retrieved from <https://www.raconteur.net>
- Post, J. (2020, January). *How to create a workspace that improves productivity*. Retrieved from <https://www.businessnewsdaily.com/7456-workspace-design-productivity.html>
- Prasad, A. (2019, February). *A complete guide on space and workplace management for facilities managers*. Retrieved from <https://www.quickfms.com>
- Price, P. C., Jhangiani, R. S., Chiang, I. A., Leighton, D. C., & Cuttler, C. (2017). *Research methods in psychology (3rd American Ed.)*. Minneapolis, MN: Press Books.
- Rapoport, A. (1977). *Human aspects of urban form: Towards a man environment approach to urban form and design*. Oxford: Pergoman press Ltd.

- Rashid, Y., Rashid, A., Warraich, M. A., Sabir, S. S., & Waseem, A. (2019). Case study method: a step-by-step guide for business researchers. *International Journal of Qualitative Methods*, 18. Retrieved from <https://doi.org/10.1177/1609406919862424>
- Razavivandfard, H. (2014). Evaluating Spatial Behavior in the Urban Public Space of Kadıköy Square. In *Proceedings of 2014 2nd International Conference on Architecture and Urban Design*. Retrieved from https://www.academia.edu/33495257/Evaluating_Spatial_Behavior_in_the_Urban_Public_Space_of_Kadıköy_Square
- Reeder, E. (2020, December). *What is the importance of time management in construction*. Retrieved from <https://www.wisegeek.com/what-is-the-importance-of-time-management-in-construction.htm>
- Revoy, J. (2020). *How can space management and planning help with growth*. Retrieved from <https://spaceiq.com/blog/space-planning-management-growth/>
- Ridgway, A. (2018, October). *People management: how to create a psychologically safe environment at work*. Retrieved from <https://www.hrzone.com/lead/culture/people-management-how-to-create-a-psychologically-safe-environment-at-work>
- Roux, L. (2014, January). *11 Steps to Improving Safety Culture in the Construction Industry*. Retrieved from: <https://www.safetyproresources.com/blog/11-steps-to-improving-safety-culture-in-the-construction-industry>
- Rutten, R. W. (2009). The spatial dimension of social capital. *European planning studies*, 18(6), 863-871.
- Sabet, P. G., & Chong, H. (2020). Pathways for the improvement of construction productivity: a perspective on the adoption of advanced techniques. *Hindawi-Advances in Civil Engineering*, 1-17.
- Salmon, L. (2017, May). *The importance of case studies in social research*. Retrieved from <https://www.changeworks.org.uk>

- Samani, S., Rasid, S. Z., & Sofian, S. (2017). the effect of open-plan workspaces on behavior and performance among malaysian creative workers. *Global Business and Organizational Excellence*, 36(3), 42-52.
- Samuel, B. (2019, June). *Workplace Flexibility and Productivity (How Flexibility Can Increase Productivity in an Organization)*. Retrieved from <https://www.opensourcedworkplace.com/news/workplace-flexibility-and-productivity-how-flexibility-can-increase-productivity-in-an-organization>
- Sanad, H.M., Ammar, M.A. and Ibrahim, M.E. (2008). Optimal construction site layout considering safety and environmental aspects. *Journal of Construction Engineering and Management*, 134, 536-544.
- Sander, L. (2019, March). *The case for finally cleaning your desk*. Retrieved from: <https://hbr.org/2019/03/the-case-for-finally-cleaning-your-desk>
- Scalco, D. (2017, January). *How open office plans affect workplace productivity*. Retrieved from <https://www.business.com/articles/dan-scalco-workplace-productivity>
- Schneider, S. (2015, September). *Addressing the root of the stress problem in construction*. Retrieved from <https://www.lhsfna.org>
- Schreier, M. (2012). *Qualitative Content Analysis in Practice*. Thousand Oaks, CA: Sage Publications.
- Senata, I. W., Nuridja, I. M., & Suwena, K. R. (2014). Pengaruh lingkungan kerja terhadap produktivitas kerja karyawan. *Jurnal Manajemen*, 3(2), 1-5.
- Shach-Pinsly, D., Fisher-Gewirtzman, D., & Burt, M. (2011). Visual exposure and visual openness: an integrated approach and comparative evaluation. *Journal of Urban Design*, 233-256.
- Shahsavand, P., Marefat, A., & Parchamijalal, M. (2018). Causes of delays in construction industry and comparative delay analysis techniques with SCL protocol. *Engineering, Construction and Architectural Management*, 25(4), 497-531.

- Silavi, T., Hakimpour, F., Claramunt, C., & Nourian, F. (2017). The legibility and permeability of cities: Examining the role of spatial data and metrics. *International Journal of Geo Information*, 6(4), 101, doi: 10.3390/ijgi6040101
- Sima, L. (2017, October). *Time management & task management: key differences*. Retrieved from <https://toggl.com/blog/time-management-vs-task-management>.
- Singleton R. A., Straits B. C. Approaches to social research. New York: Oxford University Press; 2009.
- Slone, E., Burles, F., Robinson, K., Levy, R. M., & Iaria, G. (2014). Floor plan connectivity influences wayfinding performance in virtual environments. *Environment and Behavior*, 1-30.
- Smale, B. (2006). Critical perspectives on place in leisure research, *Leisure/Loisir*, 30(2), 369-382.
- Small, E. P., & Baquer, M. (2016). Examination of job-site layout approaches and their impact on construction job-site productivity. In proceedings of *Creative Construction Conference* (pp. 383-388).
- Solman, G., & Kingstone, A. (2019). Spatial organization to facilitate action. *PLoS One*, 14(5). Retrieved from <https://doi.org/10.1371/journal.pone.0216342>
- Stamps, A. E. (2004). Mystery, complexity, legibility and coherence: A meta-analysis. *Journal of Environmental Psychology*, 1-16.
- Stoner, T. (2016, January). *Permeability & connectivity: a tale of two cities*. Retrieved from <https://timstonor.wordpress.com/2016/01/05/permeability-connectivity-a-tale-of-two-cities/>
- Tafazzoli, M., & Shrestha, P. (2017). Factor analysis of construction delays in the U.S. construction industry. *International conference on sustainable infrastructure* (pp. 111-122). New York: American Society of Civil Engineering.
- Copper Team. (2017). *Why it's important for project managers to focus on effective time management*. Retrieved from

<https://www.copperproject.com/2017/06/important-project-managers-focus-effective-time-management/>

- Teherani, A., Martimianakis, T., Stenfors-Hayes, T., Wadhwa, A., & Varpio, L. (2015). Choosing a qualitative research approach. *Journal of Graduate Medical Education*, 7(4), 669–670.
- Thompson, C. (1998). A projective approach to a language of landscape design. *Landscape review*, 4(2), 27-40.
- Tran, L. (2015, April). *The importance of time management (aspects of project management part 1)*. Retrieved from <https://www.inloox.com/company/blog/articles/the-importance-of-time-management-aspects-of-project-management-part-1/>
- Ujang, N. (2012). Place Attachment and Continuity of Urban Place Identity. In *Proceedings of 1st National Conference on Environment-Behaviour Studies* (pp. 156 – 167). Retrieved from <https://pdf.sciencedirectassets.com/277811/1-s2.0-S1877042812X0020X/1-s2.0-S1877042812031102/main.pdf?X-Amz->
- Ujang, N., Salim, A., & Maulan, S.B. (2012). The influence of context and urban structure on the walkability of Bukit Bintang commercial district, Kuala Lumpur, *Alam Cipta*, 5, 15-26.
- UKEssays. (2018, November). *Fundamental Urban Design Principles Relevancy Cultural Studies Essay*. Retrieved from <https://www.ukessays.com/essays/cultural-studies/fundamental-urban-design-principles-relevancy-cultural-studies-essay.php#citethis>
- University of Newcastle Library. (2020). *Research methods: what are research methods?* Retrieved from <https://libguides.newcastle.edu.au>
- USC Libraries. (2021). *Research guides*. Retrieved from <https://libguides.usc.edu>
- Vinz, S. (2020, August). *Sample theoretical framework of a dissertation*. Retrieved from <https://www.scribbr.com>

- Virginia Tech University Libraries. (2018). *Research methods guide: interview research*. Retrieved from <https://guides.lib.vt.edu>
- Vischer, J. C. (2008). Towards a user-centred theory of the built environment. *Building Research & Information*, 36(3), 231-240.
- Wall, E., Waterman, T. (2009). *Basics Landscape Architecture 01: Urban Design*. UK: Bloomsbury Academic.
- WBDG Productive Committee. (2018). *Provide Comfortable Environments* . Retrieved from: <https://www.wbdg.org>
- Weisman, J. (1981). Evaluating architectural legibility: way-finding in the built environment. *Environment and Behavior*, 189-204.
- Westland, J. (2006). *The Project Management Life Cycle: A Complete Step-by-step Methodology for Initiating Planning Executing and Closing the Project*. London, UK: Kogan Page Limited.
- Yavari, F., Vale, B., & Khajehzadeh, I. (2015). Guidelines for personalization opportunities in apartment. In *Proceedings of the Living and Learning: Research for a Better Built Environment: 49th International Conference of the Architectural Science Association* (pp. 143–152).
- Yeo, S. J., Ho, K. C., & Heng, C. K. (2016). Rethinking spatial planning for urban conviviality and social diversity: a study of nightlife in a Singapore public housing estate neighbourhood. *Town Planning Review*, 87(4), 379–399.
- Yilmaz, S., Mumcu, S., Düzenli, T., & Özbilen, A. (2016). Analyzing the unity concept in design on student works: a case study of architectural design course. *Inonu University Journal of Art and Design*, 6(14), 1-12.
- Yin, R. K. (2014). *Case Study Research: Design and Methods (5th ed.)*. Thousand Oaks, CA: Sage Publications.
- Yavuz, A., Ataoğlu, N. C., & Acar, H. (2020). The identification of the city on the legibility and wayfinding concepts: a case of trabzon. *Journal of Contemporary Urban Affairs*, 4(2), 1–12.

Zolfagharian, S., & Irizarry, J. (2014). Current trends in construction site layout planning. In Proceedings of the Construction Research Congress (pp. 1723-1732). Retrieved from <https://www.semanticscholar.org/paper/Current-Trends-in-Construction-Site-Layout-Planning-Zolfagharian-Irizarry/3bfebfcb9ab425ec3b5c05ec94d53e2e53eb022c>

APPENDIX A: SEMI-STRUCTURED INTERVIEW GUIDELINE

COVERING LETTER FOR INTERVIEW GUIDELINE

MSc in Project management postgraduate,

Department of Building Economics,

University of Moratuwa.

.....

Dear Sir/Madam,

Conducting an Interview for Dissertation

I am a postgraduate student who follows MSc in Project management at Department of Building Economics, University of Moratuwa & currently conducting a research under the module of “Dissertation” on the topic of “spatial factors contributing the time management of construction workers at construction sites”. The mode of data collection is deemed as one to one interview.

The interviews will be conducted with the professionals and construction workers in the construction industry. I have identified yourself as a potential participant who could provide me valuable information to this research. Therefore, I would like to interview you for approximately 30-40 minutes in my research literature findings and your expert opinion. The medium of collecting data will be voice recording (with the permission of the interviewee) to collect data more precisely.

The information collected through this interview will not be disclosed to any other party and confidentiality retained. It should be used only for the purpose of the dissertation. I solicit you to facilitate my research by providing your valuable knowledge and opinion regarding this research topic.

Thank you.

Yours faithfully,

.....

De Silva K.S.U

APPENDIX A – SEMI-STRUCTURED INTERVIEW GUIDE LINE

SPATIAL FACTORS CONTRIBUTING THE TIME MANAGEMENT OF CONSTRUCTION WORKERS AT CONSTRUCTION SITES

Interview Guideline for Semi-structured Interviews

Part I: Respondents Details

1. Designation :
2. Profession :
3. Key role :
4. Number of years' experience in the construction industry:
5. Type of the Project :
6. Respondent :

Aim and Objectives of the study

Aim

The aim of this study is to investigate the management of spatial factors contributing to time management of construction workers at site.

Objectives

Following objectives are selected to achieve the aim.

1. To identify the concept of spatial management
2. To identify the spatial factors, which affects for effective time management in project environment
3. To identify the consequences of these factors to construction projects
4. To propose strategies to manage the spatial factors, which affect time management of construction workers at construction sites.

Part II

1. According to the results of literature survey, following spatial factors can influence time management of construction workers at site. Indicate whether you agree/ disagree that these spatial factors influence time management of construction workers at site.

If disagree, please state the reason.

Spatial Factors	Agree	Disagree	Reason to disagree
Legibility			
Permeability			
Imageability			
Robustness			
Safety			
Vitality			
Openness			
Comfort			
Unity			
Personalization			
Scale			
Tidiness			
Any other spatial factors which influence time management of construction workers			

2. According to your experience and knowledge, how these spatial factors influence time management of construction workers at site?

(Include newly identified spatial factors to the table)

Spatial Factors	How this spatial factor influence time management of construction workers.
Legibility	
Permeability	
Imageability	
Robustness	
Safety	
Vitality	
Openness	
Comfort	
Unity	
Personalization	
Scale	
Tidiness	

Spatial Factors	How this spatial factor influence time management of construction workers.

3. What are the management strategies that you propose to manage these spatial factors which influence time management of construction workers at site?
According to your opinion, how these management strategies will improve time management of construction workers at site?

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.
Legibility	Creating Landmarks within the site	
	Creating Landmarks around the site	
	Creating network of Paths	
	Creating common identifiable districts (medium-to-large sections) with clear edges	
	Creating attractive nodes (centers of attraction) within site.	
Safety	Installing proper fall protections fences and nets	
	Marking the site properly to protect employees from hazards by showing necessary sign boards.	
Openness	Improving view, the light, the feeling of being in the open.	

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.
	Improving light conditions, surface textures and sequence of spaces.	
Comfort	Providing a superior acoustic environment.	
	Maintaining optimal thermal comfort is essential.	
	Creating a high quality visual environment	
	Providing furniture and equipment that will enhance worker comfort.	
Permeability	Creating a well-connected layout which offer choice of direct routes	
Robustness	Creating spaces that can adapt to different uses and activities, perhaps at different times of the day	
Scale	Using standardized heights and ergonomic measures to design furniture in work site.	
	creating widths of service routes by considering anthropometrics	
Tidiness	Providing Designated area for rubbish and waste	
	Stacking and storing materials properly	
	Keeping access routes clear	
Imageability	Improving identity of site (identity means a distinction from other objects)	

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.
	Improving the structure of the site (structure means a relationship to larger pattern of other elements)	
	Improving the meaning of site (meaning means a practical and emotional value for the observer)	
Personalization	Allowing employees to rearrange their work stations or furniture in any way they wanted.	
Vitality	Improving accessibility within site	
	Improving Sustainability in site	
	Improving environmental quality.	
	Creating vibrant and diverse spaces and facilities.	
Unity	Creating a sense of cohesion in the space by repetition of particular elements throughout the entire space, whether they're colors, shapes or materials, to pull the look together	

APPENDIX B: EXPERT INTERVIEW GUIDELINE

COVERING LETTER FOR INTERVIEW GUIDELINE

MSc in Project management postgraduate,

Department of Building Economics,

University of Moratuwa.

.....

Dear Sir/Madam,

Conducting an Interview for Dissertation

I am a postgraduate student who follows MSc in Project management at Department of Building Economics, University of Moratuwa & currently conducting a research under the module of “Dissertation” on the topic of “spatial factors contributing the time management of construction workers at construction sites”. The mode of data collection is deemed as one to one interview.

The interviews will be conducted with the professionals in the construction industry. I have identified yourself as a potential participant who could provide me valuable information to this research. Therefore, I would like to interview you for approximately 30-40 minutes in my research literature findings and your expert opinion. The medium of collecting data will be voice recording (with the permission of the interviewee) to collect data more precisely.

The information collected through this interview will not be disclosed to any other party and confidentiality retained. It should be used only for the purpose of the dissertation. I solicit you to facilitate my research by providing your valuable knowledge and opinion regarding this research topic.

Thank you.

Yours faithfully,

.....

De Silva K.S.U

APPENDIX B –EXPERT INTERVIEW GUIDELINE (CASE STUDIES)

SPATIAL FACTORS CONTRIBUTING THE TIME MANAGEMENT OF CONSTRUCTION WORKERS AT CONSTRUCTION SITES

Interview Guideline for Case Study Interviews

Part I: Respondents Details

1. Designation :
2. Profession :
3. Key role :
4. Number of years' experience in the construction industry:
5. Type of the Project :
6. Respondent :

Aim and Objectives of the study

Aim

The aim of this study is to investigate the management of spatial factors contributing to time management of construction workers at site.

Objectives

Following objectives are selected to achieve the aim.

1. To identify the concept of spatial management
2. To identify the spatial factors, which affects for effective time management in project environment
3. To identify the consequences of these factors to construction projects
4. To propose strategies to manage the spatial factors, which affect time management of construction workers at construction sites.

1. According to the results of literature survey and semi-structured interviews, following spatial factors can influence time management of construction workers at site. Indicate whether you agree/ disagree that these spatial factors influence time management of construction workers at site.

Spatial Factors	Agree	Disagree	Reason to disagree
Legibility			
Permeability			
Imageability			
Robustness			
Safety			
Vitality			
Openness			
Comfort			
Unity			
Personalization			
Scale			
Tidiness			

2. According to the findings after semi-structured interviews, following table depicts how above mentioned spatial factors influence effective time management of construction workers at site. Indicate whether you agree/ disagree with the given methods

Spatial factors	How spatial factors influence time management of construction workers at site	Agree	Disagree	Reason to disagree
Legibility	Helps to identify spaces, routes and locations			
	Helps to identify shortest routes to increase productivity of logistics.			
	Decrease confusions related to space identification within site.			
	Increase the ability of giving and understanding instructions			
Safety	Reduces accidents within construction site and leads to law absenteeism rate.			
	Improves confidence of workers within site.			
	Improves trust and commitment towards employee.			
Openness	Improve communication between workers.			
	Makes spaces more flexible and adaptable for use.			
Comfort	Creates a healthy, work-friendly environment for workers			
	Improves workers satisfaction			
Permeability	Gives the choice of routes and increase the ability of creating short cuts within site.			
	Visual permeability increases the ability to observe work.			
	Reduce traffic in material transportation within site by providing alternative routes.			

Robustness	Throughout the construction process, need of various spaces change and therefore, if those spaces have the ability to adapt, it makes work more efficient.			
	If the adjacent spaces can be used to facilitate the ongoing constructions within a certain space, it is much easier for workers as it minimizes the logistics.			
Scale	Creates a sense of connectedness between workers and site.			
	Optimum level of scale makes it more comfortable for workers to work within.			
Tidiness	Creates pleasant work environment			
	Minimizes the time spends to find lost items.			
	Increase ability to focus on work.			
	Creates healthy environment and therefore leads to low absenteeism rate.			
Imageability	Ability of creating a mental image of site helps to identify spaces and routes within site without confusion.			
Personalization	Improves commitment to work by giving sense of ownership for workers.			
	Creates more comfortable work space which suits workers individual preference.			
Vitality	Creates an interesting and encouraging work environment within site.			
Unity	Creates more interesting and sequential space to work.			
	Increase visual comfortability and makes it easy to work.			

3. According to the findings after semi-structured interviews, following table illustrates management strategies and how those management strategies improve time management of construction workers at site. Indicate whether you agree/ disagree with the given methods.

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.	Agree	Disagree	Reason to disagree
Legibility	Creating Landmarks within the site	Can easily identify their location, destinations and routes without confusions by referring to landmarks within site.			
	Creating Landmarks around the site	Can easily identify their location, destinations and routes without confusions by referring to landmarks around the site which are located in a visual distance.			
	Creating network of Paths	Good network of major and minor routes increase the efficient circulation within site and therefore contributes time management of workers.			
	Creating common identifiable districts (medium-to-large sections) with clear edges	Dividing site into easily identifiable few major parts with clear edges also leads workers to easily identify their location, destinations and routes without confusions.			
	Creating attractive nodes (centers of attraction) within site.	Nodes act as landmarks which support workers to identify their location, destinations and routes without confusions and creates lively and encouraging work environment within site.			
Safety	installing proper fall protections fences and nets	Reduce time losses by reducing accidents and improving confidence of workers.			
	Marking the site properly to protect employees from hazards by showing necessary sign boards.	Sign boards indicates workers on potential hazards how to avoid them. Therefore reduces accidents which leads to project delays.			

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.	Agree	Disagree	Reason to disagree
	Keeping the construction site clean.	Reduces unexpected injuries from accidents due to clutter and improves work efficiency.			
Openness	Improving view, the light, the feeling of being in the open.	Makes the work environment more interesting and motivational to improve efficiency of work.			
		Improve the opportunity to collaborate and communicate with coworkers.			
	Improving surface textures.	Improve the feeling of spaciousness and make the work environment more relaxing.			
	Improving sequence of spaces.	Facilitate the ease of movements within site.			
Comfort	Providing a superior acoustic environment.	Increase the ability to focus on work and therefore increase the efficiency of work.			
	Maintaining optimal thermal comfort.	Increase the ability to focus on work			
		Creates attractive and interesting work environment which increase the efficiency of work.			
		Contributes to the health of workers and therefore leads to low absenteeism rate.			
	Creating a high quality visual environment	Creates attractive and interesting work environment which increase the efficiency of work.			
Providing furniture and equipment that will enhance worker comfort.	Increase the ability to focus on work and therefore increase their performance.				

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.	Agree	Disagree	Reason to disagree
Permeability	Creating a well-connected layout which offer choice of direct routes	Increases the efficiency of circulation within site and therefore contributes time management of workers.			
		Gives a safe and secured feeling to construction workers to work confidently.			
		Supports easy communication between co-workers.			
Robustness	Creating spaces that can adapt to different uses and activities, perhaps at different times of the day	Creates work space more flexible and interesting to work more efficiently and effectively.			
	Having adjacent spaces which facilitates the ongoing constructions within a certain space	Reduces the unnecessary circulation, ease the logistics and therefore decreases the time losses.			
Scale	Using standardized heights and ergonomic measures to design furniture in work site.	Increase the ability to focus on work and therefore increase their performance.			
		Support healthy postures which helps to reduce injuries and leads to law absenteeism rate.			
	creating widths of service routes by considering anthropometrics	Makes workers circulation more effective.			
Tidiness	Providing Designated area for rubbish and waste	Helps to prevent ill-smells and create pleasant work environment which increases workers efficiency.			
	Stacking and storing materials properly	Reduces time spends to find lost items.			
	Keeping access routes clear	Ease up the workers circulation and material logistics and therefore decreases the time losses.			

Spatial Factor	Management Strategy	How it can improve time management of construction workers at site.	Agree	Disagree	Reason to disagree
Imageability	Improving identity of site (identity means a distinction from other objects)	Leads workers to easily identify their location, destinations and routes without confusions			
	Improving the structure of the site (structure means a relationship to larger pattern of other elements)	Increases the ability to focus on work, improves visual comfortability, increases the ability of workers to memorize things and therefore increases their performance.			
	Improving the meaning of site (meaning means a practical and emotional value for the observer)	Create more motivational work environment.			
Personalization	Allowing employees to rearrange their work stations or furniture in any way they wanted in order to meet their evolving needs for collaboration or privacy.	Fulfills workers evolving needs for collaboration and privacy to create more flexible and motivational work environment.			
Vitality	Improving accessibility within site	Increases the efficiency of circulation within site and therefore contributes time management of workers.			
	Improving Sustainability in site	Creates attractive and interesting work environment which increase the efficiency of work.			
	Improving environmental quality.	Contributes to the health of workers and therefore leads to low absenteeism rate.			
	Creating vibrant and diverse spaces and facilities.	Creates lively and encouraging work environment within site.			
Unity	Creating a sense of cohesion in the space by repetition of particular elements throughout the entire space, whether they're colors, shapes or materials, to pull the look together	Makes the space visually pleasant and interesting to work.			