

**MANAGEMENT OF DISPUTE RELATED TO
CONTRACTORS LIABILITY UNDER DIFFERING
SITE CONDITIONS IN DESIGN AND BUILD
PROJECTS**

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Master of Science in Construction Law and Dispute Resolution

Department of Building Economics

University of Moratuwa

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October 2022

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Dissertation submitted in partial fulfilment of the requirements for the
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DECLARATION

I declare that this is my own work, and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Further, I acknowledge the intellectual contribution of my research supervisor Ch. QS. Prof. (Mrs.) B.A.K.S. Perera for the successful completion of this research dissertation. I affirm that I will not make any publication from this research without the name(s) of my research supervisor(s) as contributing author unless otherwise, I have obtained written consent from my research supervisor.

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The above candidate has carried out research for the Dissertation under my supervision.

.....

.....

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

Date

Signature of the supervisor:

Management of Dispute Related to Contractor's Liability Under Differing Site Conditions in Design and Build Projects

ABSTRACT

The Design and Build Procurement method is one of the most frequently used procurement methods in the present construction industry. It releases Employers from the design responsibilities and transfers design and construction responsibilities to the Contractor. Further, Differing Site Conditions are one of the unforeseen, unpredictable risks construction projects face, and it acquires considerable additional time and cost to complete the project. Hence Contractors are keen on claiming the Differing Site Conditions situation, one of the highly disputed claim types in the Design and Build projects. Thus this research aims to manage the contractual disputes related to the Contractor's Liability under Differing Site Conditions in Design and Build Projects. Initially, a comprehensive literature survey was conducted, followed by selection of three case studies. Document review and expert interviews helped gather information about the Design and Build Projects in Sri Lanka. The research findings revealed that Contractors' Differing Site Conditions liabilities towards the D&B projects and types of Differing Site Conditions disputes from the literature review were validated via interviews. In addition, the interviews disclosed the new Differing Site Conditions liabilities of the Design and Build Contractor and Differing Site Conditions disputes. The research disclosed the D&B Contractor's non-perform DSC liabilities and reasons for the non-performance. The study outcome reveals that validation of Employer-provided data and not conducting a proper site investigation before bid submission are some DSC liabilities non-performed by the D&B Contractors. The research further identified that the main reasons for this non-performance are the negligence and unawareness of the DSC liabilities by D&B Contractors and the cost and time limit to include a detailed site investigation during the bidding period. The literature revealed the contractual and technical parameters to manage each type of Differing Site Conditions dispute, and the interviews introduced new parameters to manage the Differing Site Conditions disputes. The interview results revealed that establishing the DSC parameters, DSC evaluation techniques, and identifying DSC risk responsibilities in the Contract are primary contractual parameters. Doing a detailed site investigation and obtaining technical experts' knowledge to identify and analyse the potential DSC risks are a few technical parameters to manage the DSC risk as of the interview response. Managing the Differing Site Conditions disputes in the construction project is a win-win situation for both the Employer and the Contractor. This research can be a benchmark for further study in Differing Site Conditions disputes.

Keywords: *Differing Site Conditions, Design and Build Contracts, Contractor's Liabilities*

DEDICATION

*I dedicate this research to my little
angels - son and daughter - for their
patience and support*

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This research is a result of immense support and dedication given by many people in different ways. Therefore, all of them shall get gratitude for their great and honourable commitments provided.

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LIST OF ABBREVIATIONS

Abbreviation	Description
DSC	Differing Site Conditions
D&B	Design and Build
FIDIC	Fédération Internationale Des Ingénieurs-Conseils
EPC	Engineering, Procurement and Construction
ENAA	Engineering Advancement Association of Japan
CAR	Contractor's All Risk Policy

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CHAPTER 1

1. INTRODUCTION

1.1 Background

The construction industry is considered one of the prominent areas with a significant Gross Domestic Product (GDP) rate in different countries (Soni, Pandey, & Agrawal, 2017). The primary reason for the increase in the number of disputes and the delay in project progress is the fast-changing and complex nature of construction projects (Mahfouz, Davlyator, & Kandil, 2016). Conflicts are identified as such circumstances of disagreements between the values or aims to be accomplished, both as the individual and other related groups (Rauzana, 2016). In contrast, different factors such as the Employer, consultant, or any related third party impact the effectiveness and efficiency of work, which further interrupts the prospective project completion. Hence, it is vital to overcome such factors while maintaining the smooth execution or operation of a construction project with no conflicts and disputes for higher revenue, rate of yield, and timely completion of the project (Soni, Pandey, & Agrawal, 2017).

Contractors may identify different site conditions during a construction project period, which could be the main risk affecting the project's future (Amarasekara, Perera, & Rodrigo, 2018). A DSC is applied when a deviation exists between conditions mentioned in the contract documents and the actual site experience (Long et al., 2015). Permana (2015) states that the geographical ground refers to the place where things can go wrong during a construction project; under the worse ground condition, the risks become more outstanding. Further, according to Permana (2015), regarding present learnings related to construction claims and disputes, researchers have explained several decisions held by courts and contract boards that have been appealed over time. This indicates a greater possibility of increasing the risk of Contractor risks which are laydown due to differing site conditions clauses.

Geological uncertainty is identified as one of the most challenging risks in coping with construction. In design-build projects, the project value is immovable and fixed before

its design. Most of the time, the subsurface investigation is completed, the nature of the risk profile is principally altered, and the owner has the responsibility of addressing it (Puerto, Gransberg, & Loulakis, 2016). The central concept of Design and Build requires a contract to be formed with a single organization that should strongly represent the design, procurement, engineering, and commission (Puerto, Gransberg, & Loulakis, 2016). In the conventional system, the designer is only accountable for fulfilling the average degree of due skill and care of the design and does not typically guarantee fruitful outcomes for services (Jasri, 2011). However, Design and Build contracts differ from the standard of care for a Contractor, providing implied and expressed warranties of a successful project as a consequence of their services (Jasri, 2011).

The design of the design-bid-build project will be completed before forming the contract, but the design-build contract executes both the design and the construction with a single contract in the design-build concept. As such, the design and build project delivery method distinctly involves the possibility of undertaking the subsurface geotechnical investigation by the DB Contractor after commencing a fixed-price contract (Puerto, Gransberg, & Loulakis, 2016). This point poses a question: to what extent the investigation to be conducted, if any, should the Employer have to make a pre-advertisement of the Design and Build contract to classify the geotechnical conditions while competing for design-build teams for which the proposed price to be based on? (Puerto, Gransberg, & Loulakis, 2016).

Contractors generally encounter unforeseeable geologic and structural conditions during construction (Saaidin, Endut, Samah, & Ridzuan, 2017). The physical location and volume of the groundwater table and other geographic features, and conditions of current service utilities, for instance, to what extent they are unforeseeable and, consequently, generate the issues which result in changing the costs and schedules of the project. The intensity of the responsibility undertaken by the Contractor and the Employer for these similar conditions is determined by the atmosphere of the condition, the language of the Contract, and the acts of each party. In general, this

nature of responsibility is contractually awarded by change orders or the ultimate results of the claims raised by the Contractor (Thomas, 2012).

Walker (2013) stated the requirement for a Differing Site Conditions clause “It is clearly emphasized that the intention of a Differing Site Conditions clause is to transfer the risk of unforeseeable physical conditions to the Employer of the site by making sufficient allowances to the Contractor to look for an unbiased adjustment to the initial contract price at the time the Contractor experiences unforeseeable conditions. In essence, the consequence provides subsequent benefits to the Employer; the Contractor does not require to deviate its bid price to absorb the probability of the existence of such unforeseeable conditions” (Walker, 2013). Hence, a Differing Site Conditions clause acts as to avert “*transforming a construction contract into a way of gambling transaction*”.

Even though the DSC clause provides a risk-transferring mechanism to the Employer, with the basic concept of the Design and Build approach – “the single responsibility for both designs and constructions”, the extent of the risk transferring is a fundamental question.

1.2 Research Problem

In the DB contracts, the design-builder completes the design and the construction under a single contract in the design-build (Puerto, Gransberg, & Loulakis, 2016). Hence, D&B projects lead to more disputes (Molenaar, Gransberg, & Sillara, 2012). The primary reason for the increased number of disputes is the fast-changing nature and complex nature of construction projects (Mahfouz, Davlyator, & Kandil, 2016).

One of the significant risks in construction projects arises when the Contractor encounters a DSC during construction (Amarasekara, Perera, and Rodrigo, 2018). Tobgay (2015) stated that claims due to DSC ranked the highest (55%) in terms of severity of claim amount. In common, most of these unforeseen ground conditions exist since there is a constrained time for the Contractor to look into soil conditions

during tender, not perfect position soil investigations by the engineer, and it is (a kind of) lack of investigation. Even though the timely analysis is good and somewhat special, the Contractor must carry out the site investigations, which is not to be cost-effective or convenient to do by the Contractor (Permana, 2015).

The shifting of risk allocation between parties where the risk for an owner is lessening in D&B compares to the DBB method (Rostiyanti, Koesalamwardi, & Winata, 2018). Further allocation of risk is a significant question in D&B projects. An accurate risk allowance to the parties to the contract, primarily the Contractor, consultant, and Employer, is interested in responding to the best outcomes expected from the project performance (Saaidin, Endut, Samah, & Ridzuan, 2017).

The most common construction risk in D&B projects is the degree of geological investigation since the design stage is under the Contractor's responsibility (Rostiyanti, Koesalamwardi, & Winata, 2018). In D&B projects, the D&B Contractor will undertake the subsurface geological investigation after executing a fixed price (Puerto, Gransberg, & Loulakis, 2016). Similarly, a DSC clause provides a risk-transferring mechanism to the Employer, which leads to claims under DSC (Walker, 2013). Therefore, DSC severely burdens D&B Contractors (Zack, 2014).

Eight DB construction project risks were identified and allocated to the Employer: access to the site, DSC, delay payments, undiscovered utilities, permits and licences, changes in work, Government Acts and Regulations and changes in policies of taxes, and Acts of God (Banik & Hanna, 2003). According to Thomas (2012), even though Unforeseen/DSC risk transfers to the Employer through the contract clause of "unforeseen physical condition", it is a highly disputed clause in D&B Contracts.

Much literature has been dedicated to studying D&B's cost, schedule, productivity, and quality performance (Alleman, Guillermo, & Goodrum, 2018). Further, many researchers such as Sanders (2016), Hannan & Meloany (2016), Chu (2002), Laedlein (2003), McClure (1998), and Hatem (2014) have identified the Contractor's Liabilities toward DSC. Hannan & Maloney (2012) and Watts & Davis (2018) have further identified many technical and contractual parameters to manage DSC disputes.

However, only a few research recognises the DSC liabilities and manages the DSC disputes toward the D&B Contracts.

The background study mentioned earlier reveals that DSC is one of the direct causes of D&B project disputes. Even though contractual relief gives via the DSC clause, it is very complex to measure the extent of the obligations towards the D&B Contractor. Therefore, this research intended to study the research gap in the extent of the Contractor's liability for the DSC in the D&B Projects and propose a framework to manage the contractual disputes related to the Contractor's Liability under Differing Site Conditions in D&B Projects.

1.3 Aim

This research aims to propose a framework to manage the contractual disputes related to the Contractor's Liability under Differing Site Conditions in Design and Build Projects.

1.4 Objectives

1. To review what is Differing Site Conditions and their types.
2. To investigate the Contractor's liability for the Differing Site Conditions in Design and Build Projects.
3. To investigate the fulfilment of the Contractor's liability for Differing Site Conditions in the Design and Build Projects.
4. To investigate the disputes under the Contractor's liability for Differing Site Conditions in the Design and Build Projects.
5. To investigate the reasons for the above-identified disputes.
6. To propose suitable Technical and Contractual parameters to manage the disputes related to the Contractor under Differing Site Conditions in Design and Build Projects.

1.5 Scope and Limitations

The main scope is to investigate the industry facts on the contractual effect of Differing Site Conditions on Design and Build projects in Sri Lanka.

This research is limited to the infrastructure foreign-funded projects owned by the Government of Sri Lanka, following the contract conditions based on the ENNA.

1.6 Methodology

- An initial literature review was conducted through books, journals, and articles to exhaustively study DSC types, the Contractor's liabilities towards DSC in D&B projects, and disputes related to DSC with technical and contractual parameters existing in the industry to mitigate these disputes.
- A qualitative research approach with a case study strategy was employed to identify the extent of the Contractor's liability for the DSC claims and DSC parameters in the D&B projects. An in-depth study of the selected cases of DSC claims in D&B projects was performed to achieve the predetermined objectives.
- Conducted the document review for the case studies to get a basic knowledge of the existing technical and contractual facts related to DSC in the D&B Contracts.
- Expert interviews (semi-structured, face-to-face interviews) were held in case studies among the construction specialists with experience in the D&B projects, especially in DSC claims, to validate literature findings and qualitatively get their expert views.
- Structured interviews were held with the experts to identify the general overview of the DSC liabilities, disputes, and management strategies related to D&B Contracts.
- The collected data were profoundly analysed via qualitative data analysis techniques. The analysed data proposed a suitable strategic framework to minimise the disputes related to the Contractor's Liability under DSC in D&B projects.

1.7 Structure of the Thesis

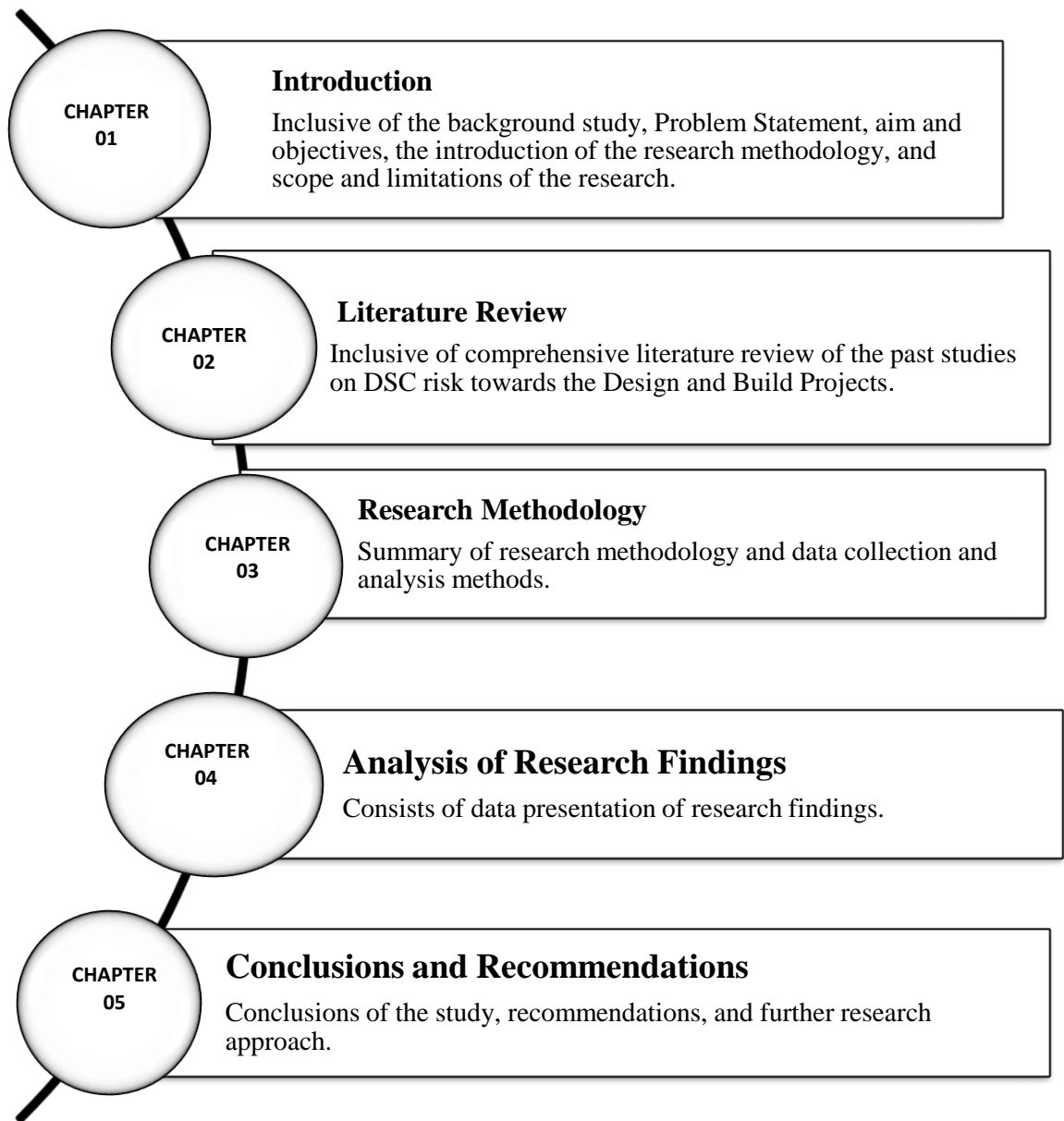


Figure 1.1: Structure of the Thesis

2. LITERATURE REVIEW

2.1 Introduction

The literature study is an integral part of this research, where the researcher explores the existing literature in this research area. The main objective of the literature survey is to study the significance of this research and analyse the contextualisation of research phenomena. It also identifies the knowledge gap in this research area and synthesises the existing and new perspectives related to it.

First, this literature review defines Differing Site Conditions and their types according to the presently available literature. A comprehensive literature review identifies the Contractor's Liability for the DSC in the Design and Build Projects and further describes the reasons for disputes under types of DSC in the Design and Build projects. At last, it classifies Technical and Contractual strategies to minimise the conflicts related to Contractors under DSC in Design and Build Projects.

2.2 Construction Project Procurement

The procurement method of construction projects gained more attention from the construction stakeholders due to the critical role that the project procurement strategy played in delivering the projects (Idoro, 2012). Different procurement methods have to be implemented depending on the nature of the construction projects, and the appropriate selection to be provided as a massive help to solve problems and act as the main element to attain project-specific milestones (Eyitope et al., 2012). Choosing an eligible procurement method helps minimise project costs with a 5% average, enhancing the project's success after selecting an appropriate procurement system (Naoum, 1994; Luu et al., 2003). The choice of the delivery method is identified as one of the most critical decisions with an essential effect on construction quality and project performance (Al Khalil, 2002; Gordon, 1994; Park et al., 2015).

Choosing the appropriate procurement method to implement a construction project is vital (Okunlola & Olugbenga, 2010). The clients are responsible for deciding the most suitable procurement method for the projects. This is imperative since the client must face different proposals to initiate the procurement of the project (Okunlola, 2012).

Several standard methods or available procedures associated with the project design, construction method, and management style should be considered earlier, from starting the procurement process of construction. Each path consists of many demands, risk sharing, and responsibilities on each party engaged to various cash flow individuals on the Employer check the highlighted part. The fact that the project's objectives differ from its type is sufficient to address the project delivery system (Construction Industry Institute, 2001).

2.2.1 Design and Build Projects

In general terms, Design-build (DB) is referred to a project handling and controlling system which facilitates a method to remove and control the vital disadvantages of the traditional project delivery methods, such as design-bid-build (DBB) (Shang & Migliacci, 2019). As one of the alternative project delivery methods, design-build (DB) has been a classic example of how to execute all types of construction projects efficiently and effectively, resulting in vital monetary benefits to the Employer. One of the significant positives of projects utilising alternative project delivery mechanisms is to transfer responsibilities of finance design and quality management from the Employer to other parties (Molenaar, Gransberg, & Sillars, 2012).

Many researchers have revealed higher/better performance of DB projects compared to traditional design-bid-build (D-B-B) projects (Tran, Diraviam, & Minchin, 2017). Masterman (2002) examined the design and construct procurement method as "An arrangement where single contract organization is accountable for sole responsibility, typically with a lump sum fixed price method, for the bespoke design and construction of a project".

Songer and Molenaar (1997) and the Design-Build Institute of America (2014) have defined Design-build (DB) as an integrated approach which launches features and services of design and construction under a contract with single-centred responsibility.

The Design and Build concept was discovered, and the idea was first born by the building Contractors in the early 1960s when they began to offer the package. Compared to traditionally fragmented procurements, the Contractor provides a complete “package” consisting of separate contract agreements with consultants and other Contractors. According to DBIA (2012), in the Design-Build project delivery method, a Contractor entity is engaged in a single contract with the Employer of the building to execute the design and construction services. Such services are provided concurrently or in a parallel and integrated manner (Muljono & Siahaan, 2018).

Ratnasabapathy and Rameezdeen (2006) defined design and build as a project delivery system with a group of “relationships, roles, and responsibilities of a project team and the order of activities required” for the capital placement of the project.

2.2.2 Characteristics of the Design and Build Project

Mathonsi and Thwala (2012) explained that Design and Build is understood as a system where a single organization, generally but not exclusively the Contractor, holds responsibility not only for the design but also for the project construction, where the client deals only with one organization. Furthermore, the Contractor risk transfer (typically not all risks), competitiveness of the design, the optimum potential of design and construction, readily available construction design expertise, prior obligation to optimum price, and poor construction data from the Employer are identified as the advantages of the DB system (Ratnasabapathy & Rameezdeen, 2006).

Ratnasabapathy and Rameezdeen (2006) further stated DB project delivery system is utilised for a client to make a contract with an individual party to perform both design and construction, engaging in a sole DB contract. From a contractual perspective, DB

provides the Employer with a single-oriented responsibility for both design and construction services. The design or construction may be performed partially or in full by a single DB Contractor or sub-contracting to other Contractors. In DB, designers have to cope with Contractors as a single team. Consequently, there is an absence of a confrontational relationship between Contractors and consultants, a common fact in DBB projects.

In Design-Build (DB) projects, the Contractor is responsible for the contractual terms for both design and construction works as a delivery method (Songer et al., 1997; Xia & Chan, 2010). Clients are interested in the design-build arrangement owing to the single-point responsibility, the price-related final cost, the buildability of designs, and overlapped design and construction stages resulting in a speedy completion (Brook, 2017).

The DB method has become popular in recent years as an effective delivery method, and provides many benefits to the clients, i.e., single-point responsibility, saving of time, steady financial stability, minimum disputes, and enhanced productivity (Konchar & Sanvido, 1998; Hale et al., 2009). However, the clients must acquire specific competencies for completing the DB projects. For instance, clients should clearly understand the project scope and probable outcomes and also be able to provide steady performance specifications instead of descriptive specifications at the beginning of the project (Bo & Chan, 2010).

As per the definition of Associated General Contractors of America (AGC), “a method for project delivery describes the general groups who take contractual responsibility and the performance of the Contract”. Implementing the clauses of the contract and these responsibilities complying with the prevailing legal framework is one of the riskiest tasks the Employer is engaged in for successful project implementation. In lump-sum DB projects, the Employer enters into a formal contract with a sole Contractor who wishes to complete both the design and construction services; hence, the Employer involves with a single contract (Touran et al., 2009; Gad, Davis, & Shrestha, 2019).

The design-builder, in his proposal, price a lump-sum bid for the design and build project; this ensures maintaining competition among competing DB teams. Lump-sum contracts are risky for the Contractor since the Contractor should bear the risk of the quantities compared to the Employer, where the contract is signed off for a fixed price for the whole scope of work as defined by the agreement (Kaplanogu & Arditi, 2009). In terms of payment, this has been one of the reasons why lump sum contracts are used for DB projects (Lam et al., 2008; Bogus et al., 2010; Isa et al., 2011; Chen et al., 2015; Gad et al., 2019).

2.3 What is meant by Differing Site Conditions?

Halligan, Hester, and Thomas (2015) defined an unforeseen condition as any kind of physical condition that the Contractor and/or the Employer could not have reasonably foreseen if the site data and information were willingly available to each party. Amarasekara, Perera, and Rodrigo (2018) stated, “A condition which the Contractor experience which is different physically from any of the conditions stated in the contract entered with the Employer of the project or what might be typically observed in the site is referred to a DSC”.

Different physical conditions should be comprised in nature where an experienced Contractor cannot encounter a similar nature known under the given usual project scope: *Alvin H. Leal v. the United States*, 276 F.2d 378 Ct. Cl. (1960) (Currie et al., 1985; Jensen, 2010).

According to the interpretation, a differing condition can be considered as a physical condition seen in the site, not indicated in the contract data in the agreement, or differs from work typically applicable to the construction project period. Hence, it is not expected to be overcome when the Contractor is willing to cover the total project scope of work (Jensen, 2002).

With reference to the above literature, differing site conditions or unforeseen physical conditions, ground surface conditions being significantly firmer or softer than

predicted, sub-surface water may be discovered where none was anticipated, or stable rock profile found only at a substantively lower depth than expected. In terms of technical definition, an unforeseen condition of the contract is descriptively defined as either Type I or Type II site condition (McClure, 1984; Jensen, 2002).

2.3.1 Type I Condition

A Type I condition is referred to a subsurface or latent physical condition that is different materially from the works stated in the tender documents and which, therefore, has been identified to be unforeseeable or ill-defined in the contract documents (Jervis & Levin, 1998; Callahan, 2005; Amarasekara, Perera, & Rodrigo, 2018).

Feldman and Keyes (2011) cited a good example of a Type I condition: i.e., an actual rock quantity gained from the excavation is significantly bigger than the size from the test boring results.

The Type I conditions are not unusual; they are known and expected to be present or unknown but usually encountered in such sites. Jensen (2002) cited to prove the Type I conditions should fulfil a) that the conditions stated must be different materially from a material perspective where those encountered; b) that the conditions observed must have been reasonably unpredictable depending on all prevailing data in the contract; c) that the Contractor must have practically responded with its interpretations and entitlements of the contract documents; d) that the Contractor must have reasonably been damaged as that of the material; e) subsurface conditions are observed; and f) the Contractor performs as a reasonably prudent Contractor while emphasising the content in the contract referring to the case law *Stuyvesant Dredging Company v. the United States*, 834 F.2d 1576 (Circ, 1987).

According to *Brechan Enterprises Inc. v. the United States (1987)*, the burden of proof for Type I condition needs to establish (1) real situations at the site different from the information mentioned in the contract, (2) conditions which could not have been

ascertained by a site investigation and a pre-bid review of the contract; (3) the Contractor's dependence on its interpretation of the contract; and (4) damage.

The following are the necessary elements the claimant needs to present in Type I condition:

Physical Condition

To qualify, the "condition" generally must be a "physical condition", i.e., an event or condition occurring in nature rather than an economic, governmental, or political condition (Hannan & Maloney, 2016).

Subsurface Physical Conditions

Any physical condition beneath the surface of the earth is defined as "subsurface conditions". The subsurface rock formations, the physical or mechanical properties of subsurface rock, the quantity of rock to be excavated, the presence of artesian water, physical properties of subsoil, and mechanical properties of subsoil and subgrade structures can qualify as Type I condition subsurface conditions.

Latent Physical Conditions

A latent condition is any physical condition reasonably unforeseeable to an ordinarily prudent Contractor acting in the same or similar circumstances of the contract.

At the Site

The differing condition must be located "at the site" of the work to entitle the DSC. The "site" is defined as any situation "designated" in the contract documents or any possible areas instructed to the Contractor to perform the work.

Materially Different

The material difference for the Type I condition defines by two parameters.

First, the condition must be substantially different from those the Contractor expected to encounter at the site. Second, the contract documents must “indicate“ the condition the Contractor claims to have anticipated.

It is necessary that the differing site conditions, which must have been one not presumably anticipated by the Contractor referring to the contract, an inspection of the site and usual experience.

Hannan and Maloney (2016) cited that even though a Contractor will not be deemed to know that only an expert could derive from the bid documents, the Contractor is held to know all that a reasonably prudent Contractor would have gained from a reading of the contract documents. It is the Contractor’s obligation that does a study on the materials provided by the client to the prospective bidders’ and will be supposed to identify and understand customary technical terms appearing in the contract documents. Hence Type I condition claim is based on express contractual statements or implicit representations.

2.3.2 Type II Condition

A Type II condition is considered an unidentified physical condition with the nature of unusual, consequently differs materially from which commonly confronted and predictable as naturally inhering in the works defined in the Contract (Medsger, 1988; Cibinic & Nash, 1995).

Medsger (1988) and Amarasekara, Perera, and Rodrigo (2018) cited that if a Type II condition is more arduous than a Type I condition, either the contract sounds silent on its survival of the condition, or the Contractor does not essentially wish to ensure that the condition differs from what is expressed in the contract. Further, the above authors quoted to entitle for the claim, and the claimant shall require to perfectly establish what risks are identical and what is normally available within site to present a claim under the category of Type II condition.

The Contractor should be able to substantiate two of the three following components to conduct a claim under Type II: (1) the physical condition at the site was not known; or (2) the condition was abnormal and could not reasonably be foreseen by the Contractor from his view and careful review of the contract documents, visit, and inspection of the site, and his practical experience, if any, in the contract performed area; and (3) the condition experience different from materially of those generally occurred and recognised in a similar type of work (Chu, 2016).

Therefore, as cited by Hannan and Maloney (2016), a Type II claim requires that the claimant presents that he has experienced something materially different from the “known” and the “usual” since the contract demonstrates no interpretations on ground conditions.

2.3.3 Type III Condition

Type III differing site conditions are newly emerged in the construction field. Contract documents consist of unidentified “hazardous waste” materials in advance, as a type of differing site condition different from Type I and Type II differing site conditions (Collins, 2014).

Since the language of Type III differing site conditions is comparably new, it is not precisely as formal as those of Type I and Type II languages. The examples similar to Type III contract clauses are as follows:

The American Institute of Architects documents include a form of Type III conditions as “a hazardous material or substance not mentioned in the contract documents and if sensible safeguards are possibly insufficient to avoid foreseeable bodily damage or accident deaths to persons subsequent from a material or substance, containing but not restricted to products like asbestos or polychlorinated biphenyl”.

Zack (2014) cited Type I differing conditions as, “A Hazardous Material is a kind of substance or material currently identified or in future as hazardous under the different legal frames or other substance or material that may be identified as hazardous or otherwise subjected to statutory or regulatory requirements which govern the handling, disposal, or clean up”.

The literature pertains to three types of DSC conditions in the industry, Type I, Type II, and Type III.

2.4 Contractor’s Liability for the Differing Site Conditions in the Design and Build Projects

Some significant important risks experienced in construction projects are linked with the physical obstacles or manmade changed conditions encountered within the project execution period (Amarasekara et al., 2018).

Puerto, Gransberg, and Loulakis (2016) identified Geotechnical uncertainty as one of the most difficult risks to be managed in construction by the Contractor.

However, the DB project delivery method is involved in the potential where the ground geotechnical investigation is to be carried out by the DB Contractor after initiating a fixed price contract. Therefore, that point raises the question: how much investigation is required, if any, should the Employer carry out before initiating the DB contract to classify the geotechnical conditions while engaging the competition of the design-build teams to base each proposed contract price (Loulakis et al., 2016).

They have only limited time for both the Employer and the successful DB team to carry out the soil investigations required to assess and mitigate the geographical risk of the DB project. In addition, the DB Contractor is generally grateful to come up with a firm fixed price throughout the tendering process, where the design is completed, and new soil investigations have been carried out in advance. Consequently, it convinces the

design-builder to price the contingencies for the risks that the geographical design assumptions made during the tendering process become a mistake (McLain et al., 2014).

Baker, Hill, and Halum (2021) stated that risks, responsibility, and financial problems of unforeseen site conditions had been directly moved to the Contractor, and under such conditions, their impacts on the project are no more considered by the Employer in the theoretical context. Hence, this is identified as the conventional and most common share of the responsibility for unforeseen site conditions. If the Employer selects this approach, it is expected that the Contractor will act steadily with the assigned risks and responsibilities. Moreover, the Employer requires the Contractor to execute any needed site investigations to submit a proper competitive bid. Under this situation, the Contractor should identify and analyse the risks associated with such conditions and incorporate these costs into the bid.

Toole (2016) identified the Contractor's Liability towards the DSC as follows:

- a. Careful review of the contract and analyse of how the risk of DSC is assigned.
- b. Investigate the contract for onerous exculpatory clauses or disclaimed contract language, which results in the accuracy of site data reflecting the tender documents.
- c. Conduct a fair site inspection and prepare a written, photographic record of the site investigation.
- d. If a DSC is discovered, a careful review of the contract notice necessitates waiting to receive commands from the Employer before taking any actions to differing site conditions.
- e. Maintain vigilant and isolated account details of the extra costs incurred due to changing site conditions.
- f. Understanding of immensely varied law enforcement, from region to region, in compliance with the reasonable risk allocations to the site conditions. Before tendering work under an unfamiliar jurisdiction, ask for an experienced and qualified construction lawyer.

As per Robinson (2011), site investigation duty adversely affects the Contractor's claim that it greatly relied upon information that appeared in the contract documents. The Contractor is held accountable for conditions possibly disclosed by a realistic site study.

For purposes of either a Type I or a Type II DSC claim, a Contractor will ordinarily be held to equip with constructive or imputed knowledge of any conditions which would have been discoverable with a reasonable pre-bid site inspection, whether or not the site inspection was conducted unless (1) the owner, a third party, or natural condition prevents the Contractor from conducting the inspection or (2) the owner or engineer withholds, conceals, or misrepresents conditions and thereby misleads the Contractor (Morrison-Knudsen Co., 170Ct. Cl. at 712,345 F.2dat 539).

All federal and most governmental contracts contain a clause obligating the Contractor, as stated in Standard Form 23A, to "give the contracting officer a prompt notice in writing [of the claimed DSC] before disturbing the condition. Failure to give timely written notice may defeat a claim if the contract expressly requires written notice". Schnip Bldg. Co. v. the United States, 645 F.2d 950, 958 (Ct. Cl. 1981).

It is noted that the failure of the Contractor to acquaint himself with the available information will not excuse his responsibility for estimating the work correctly. The language suggests that the Contractor must examine the available information, but the Employer is not liable for the interpretations made from that information (Long, Lane, & Kelly, 2015).

According to the literature review, the key responsibilities of the D&B regarding the DSC are as follows:

Table 2.1: Key Responsibilities of the Design and Build Contactor toward the DSC

Source	A	B	C	D	E	F	G
Contractor's Key Responsibilities							
Review the Contract and understand the DSC risk assigned.	✓		✓	✓	✓		✓
Contractually interpret the DSC Clause, if available.	✓	✓	✓		✓		✓
Identify heavy exculpatory clauses or disclaimed contract language representing the precision of site data reflected in tender documents.		✓	✓		✓	✓	✓
Perform the precise site investigation.	✓		✓	✓	✓		
Request all site information available to the Employer.		✓		✓		✓	✓
Review all available site information data by Technical Experts.		✓				✓	
Correctly examine and interpret the available site data.	✓	✓		✓	✓	✓	
Quote a possible cost and time for the DSC risk (as allocated) in the Tender.		✓				✓	✓
When occurs differing site conditions, follow the contract notice requirements.		✓	✓		✓	✓	✓
Keep contemporary records related to additional time and cost due to DSC.	✓		✓		✓	✓	✓
	A -(Sanders, 2016), B-(Hannan & Meloany, 2016), C- (Chu, 2002), D- (Charles & Laedlein, 2003), E – (McClure, 1998), F- (Hattem, 2014), G – (Randolph & Sumith, 2006)						

According to Table 2.1, most authors have identified that contractually interpreting the DSC Clause and correctly examining and interpreting the available site data are the primary responsibility of the Design and Build Contractor. The equally important DSC responsibilities to comply with the D&B Contractor are reviewing the Contract and understanding the DSC risk assigned, identifying onerous exculpatory clauses, performing the precise site investigation, requesting all site information available to the Employer, notice requirements, and keeping contemporary records. Only two authors identified reviewing all available site information data by Technical Experts as

DSC liability of D&B Contractor. Accordingly, more than five authors out of seven mainly identified eight DSC liabilities.

2.5 Disputes in Differing Site Conditions in the Design and Build Projects

In the Construction industry, claims and disputes are constantly reported between different parties with contractual responsibilities, basically involving the Employer, the designer, and the Contractor. Disputes regularly arise due to dissatisfactions and disagreements between any representing contracting parties (Sayegh, Ahmad, Aljanabi, Herzallah, Metry, & Ashwal, 2020).

On the other hand, disputes arise from the claims as a consequence of differing site conditions, delays attributable to the Employer, design discrepancies or changes, any acceleration or suspension of work, failures of construction, and additional or omitted work (Yates & Epstein, 2006). Hence, a series of Court and Board cases continue to increase the Contractor's risk after considering differing site conditions (Steven, 2014).

DSC is one of the most significant determinants for arising claims in the Construction industry (Mahfouz, Davlyatov, & Kandil, 2016). At present, DSC claims are reported to be the most commonly identified disputes in the construction industry. Additionally, DSC claims are shaped by time and how Employers and Contractors absorb risk allocations to construction projects (El-Saadi, 1998).

In the early ages, Employers tended to transfer a large portion of the risks to Contractors (Levin, 1998). However, this mechanism was not popular as it is economically not effective and efficient since the additional risks presumed by the Contractor are directly linked to the tender price. At present, major contracts consider sharing equal risk between the Employer and the Contractor. Therefore, these types of contracts provide measurable allocations to cost reimbursements due to DSC. Thus, Contractors are more stimulated to include a reasonable price for their tenders. In addition, this DSC clause intentionally decreases the risk of the Employer, which

results in the breaching of the contract due to inadequate inclusions of the site conditions (Jervis & Levin, 1998).

The existence of a DSC leads to an excessive context of contractual complexity. Consequently, the matter of DSC is identified as the most dynamic litigated construction dispute (Donald & Jensen, 2002).

In D&B, if there is a lump sum fixed price project for its intended design, and in most cases, the investigation of the subsurface has been completed, the profile of the risk basically deviates, and the Employer must be able to investigate it in detail (Edward & Maloney, 2002).

2.5.1 Disputes related to Type I Condition

The research conducted by Jensen (2012) to identify the Type I DSC Claims concluded that “the issue related to the fact that if the Contractor performed in a reasonably diligent manner where the contract was interpreted as the most experienced dispute element”. The proof element, contract documents including parameters of conditions to be established, was the second highest arguable matter to encounter in the sample study. After that, the Contractor must have been able to rely on the contract indications reasonably. In conclusion, the most happening or prevailing proof element disputes are identified from the tendering stage of a construction project. Hence, two of these elements, namely: a) acted in a reasonable manner and b) made reasonable effort to count on contract indications, are highly concentrated in the bid document indication process.

Literature recognised the following as the leading disputed causes for the Type I condition claims:

01. Ambiguity in Contract documents containing signs of the conditions to be determined.
02. Limitations that the Contractor must be able to perform in a reasonable and prudent manner during the interpretations of contract documents.

03. Contractors have failed to rely reasonably on the contractual indications.
04. Identifying the conditions that may occur materially different from those specified in the contract documents.
05. Analyse the encountered physical conditions which must be reasonably unforeseen.
06. To determine the degree of the difference are the actual conditions from those conditions which should have reasonably been expected.
07. Contractor's failure to give prompt, timely served notice.
08. Existence of exculpatory/disclaiming contractual language.
09. Contractor's failure to make a proper investigation of the site.

2.5.2 Disputes related to Type II Condition

The Contractor must be able to prove the conditions were deemed to be “unknown” and “of an unusual nature”, to substantiate for a claim to be a Type II condition. This mainly differs material aspects from what commonly happens and is commonly recognised as an inherent work characteristic specified in the contract. However, “a Type II DSC is not required to be the same relationship to the contract documents which a Type I condition must be met. Due to the lack of contractual parameters in relation to the condition of the site, a Contractor should essentially perform a deep site investigation to prevail his entitlement on a claim for a Type II condition” (Sanders, 2014).

Type I conditions are more subjective and depend on the individual experience possessed by the Contractor. Most environmental matters have been classified as Type II differing site conditions. If a Contractor experiences unexpected contaminants, these unexpected substances, without any argument, are to be unknown or unusual conditions. Even though some water is most likely to be expected in the construction site, for instance, any presence of a large amount of contaminated water is considered under the Type II condition (McClure, 2011).

The literature states that the Contractor has a comparatively onerous burden of proof when declaring a Type II claim.

A Type II claim mainly specifies that the claimant should successfully present that he has experienced something in the material condition different from the “known” and the “usual” since there are no representations of underground conditions identified in the contract. Type II conditions typically involve encountering an undisclosed artificial or man-made obstruction (Edward et al., 2016).

The principle related to the extent of the Site Investigation towards the Type II claims is identified as the DSC clause requires the conditions to be “unknown and unusual”, and a site investigation is necessary. If a proper site investigation would reveal the condition, then the condition cannot be “unknown or unusual”. Further, McClure (2011) states, “In the ‘category two’ changed condition, the basis of comparison is something more simultaneously amorphous than in the ‘category one’; namely, what would regularly be experienced similarly in that specific geographical location while performing the characteristic work”.

The following are the main dispute-related issues when proving the Type II claims:

01. Deciding on the condition would be unfamiliar, unusual, and different from what a reasonable Contractor would be in a position to experience in executing the works in the contract.
02. Reasonableness of the practical knowledge of the Contractor, experience, and adequate measures to site investigation (Spirit Leveling Contractors v. the United States, 1989).
03. Establish the experienced conditions prominently deviate from the norms for the specific type of work (Cushman et al., 2000).
04. Disputes while Contractor to serve notice to the Employer when he experiences a DSC, but before the condition has been aware of (Blankenship Const. Co. v. North Carolina State Hwy. Commission, 1976).

Table 2.2 summarises the general DSC disputes identified through the literature survey in Type I and Type II conditions.

Table 2.2: DSC Disputes of Type I and Type II Conditions

DSC Dispute in Type I Condition	DSC Dispute in Type II Condition
Ambiguity in Contract documents. (A, B, C, D, G)	Deciding on the condition would be unknown, unusual and unreasonable. (B, G, H)
Barriers that the Contractor must be able to act in a reasonably prudent manner while interpreting contract documents. (A, E)	Determining the sensibleness of the general knowledge of the Contractor. Experience. (A, C, H)
The Contractor has failed to rely reasonably on the contract indications. (B, C)	Establish that conditions encountered pointedly diverge from the norm for the work. (E, F)
Identifying the conditions experienced differ materially from those specified in the contract documents. (C, D)	Failure to provide notice to the Employer just after he experiences a DSC but prior to disturbing the condition. (B, D, G)
Analyse the actual psychical conditions experienced must be reasonably unforeseen. (D, F, G)	Determining reasonable level and adequacy of site investigation. (E, G)
To determine the degree of the difference are the actual conditions that should have reasonably been expected. (B, D, E)	
The Contractor fails to give claim notice on time. (A, D, G)	
Existence of exculpatory/disclaiming contractual language. (A, H, G)	
The Contractor failed to investigate the site. (A, C, D, G)	
A - (Sanders, 2016), B - (Hannan & Meloany, 2016), C - (Chu, 2002), D - (Charles & Laedlein, 2003), E - (McClure, 1998), F - (Hatem, 2014), G - (Randolph & Sumith, 2006), H - (Long, Lane, & Kelley, 2015)	

Table 2.2 indicates that most disputes occurred in the Type I condition, probably because most existing cases occurred in the Type I condition. The referred literature signifies that it is difficult to determine Type II and Type I conditions.

After identifying the DSC disputes, the below section discusses the available solution to minimise these DSC disputes.

2.6 Contractual Parameters used in Design and Build Projects to minimise DSC Disputes

Before initiating the DSC clause, under the common law jurisdiction, a Contractor was found to have accepted the risks of the contract for an unforeseen site condition which has an impact on the project scope (Cushman, Bigda, & Sapers, 1985 cited Edward & Maloney, 2002).

Hence, the Contractor experiences either a financial loss or gain on the contract price as its functions do not encounter the risks of an unforeseen condition in the project. Consequently, the Contractor tends to include an allocation of risk contingencies to the contract price to its capable potential and possibility of experiencing a differing condition in the site not included in the tendering documents (Nagle, 1992 cited Edward & Maloney, 2002).

The provision of the DSC, thereby, establishes the intention of transferring the contractual risk to the Employer by requesting the Employer to make any adjustments to the price of the construction contract and time during the performance stage of contractual obligations to be accountable for changing site circumstances (Code of Federal Regulation, 1996; Edward & Maloney, 2002).

In essence, a contract is identified as a risk-transferring instrument, and the Employer generally drafts the contractual clauses that are more favourable to the same but concurrently do not escape the aspects of risk shifting mechanism related to the provision of DSC.

In general, such contractual language provides contractual conditions that maintain three major conditions precedent situations necessary to make a successful recovery with reasonable adjustments to the contract. Therefore, these additional risks transferred to contractual conditions are a) duty and care to investigate the site, b) exculpatory language form, and c) notice provisions (Farnsworth & Chambers Co. United States, 346 F.2d 577, Ct. Cl. 1965).

In design-build (DB), the project price is fixed in the design. In many cases, ground condition investigation has been completed, the risk profile has principally deviated, and essentially the Employer must be able to address it (Puerto, Douglas, Gransberg, & Loulakis, 2016).

Disclaimer Provisions

In this case, without any exclusion, the bidding documents issued to the bidders incorporate the general disclaimers or other exculpatory language forms, which puts the Employer in a reliable situation from the responsibility as to physical conditions of the site or data accuracy furnished to bidders (McNulty, Kutil, & Esquire, 2002).

A traditional disclaimer is a statement included in the contract documents to influence the following facts:

- (1) The Employer disagrees with any responsibility assigned with the accuracy of any ground data extracted and asks each bidder to satisfy his requirements as to the characteristic, quantity, and quality of subsurface materials to be experienced,
- (2) The budgeted quantities indicated in the contract cannot be ascertained and are included mainly to decide approximate figures or prepare estimates,
- (3) The subsurface data extracted to tenders do not represent a part of the contract and are included entirely for its information purpose, and
- (4) The tenderers should have the capability to do their own investigations to find ground conditions, and the Contractor is not allowed to make any claim for additional compensation, although any of which subsurface conditions have been observed.

According to Collins (2014), the DSC provision has become more common when the occurrences of DSC are considered or changed conditions, and recurring claims and Employers initiated make more concerning actions to safeguard the tenderers from DSC claims. Those defensive activities are:

- (1) Clauses of site investigations,
- (2) Unit price contracts stating some features of the work “incidental” to the settlement of the work, and
- (3) Disclaims of the Contract.

In some occurrences, the courts have imposed these exculpatory clauses to the detriment of the Contractor experiencing DSC. In other means of jurisdictions, courts have made decisions in favour of giving unqualified impact on such clauses, particularly if the contract is included a DSC clause which allows for recovery of such unanticipated costs. Nevertheless, if the contract is incorporated such an exculpatory clause, it is the Contractor’s obligation to

1. Quote a possible contingency in its bid,
2. Request all site data available to the Employer, and
3. Conduct a site inspection beyond the conventional “sight” inspection.

Site Inspection Clauses

Some contract agreements have provisions that require the Contractor to fulfil his own site inspections. It is necessary to satisfy itself, which has a good understanding of the provisions to be established for the project.

Differing Site Condition Clauses – Owner Bears the Risk

Common law generally holds the Contractor responsible for improved construction costs due to unforeseen site conditions. Current construction contracts incorporate “Differing Site Conditions” clauses to relieve Contractors from this risk. Hence, these clauses allow Contractors to entitle them to compensate for the increased costs due to these unforeseen site conditions (McNulty & Kutil, 2002).

Toole (2016) stated the DSC provides the Contractor has a chance to get compensated. It belongs to one of the two types: (1) “Type I” DSC, a site condition materially different from what is displayed or specified in the contract documents, or (2) “Type II” DSC, identified as an unknown physical condition of an abnormal nature, different from typically experienced material conditions. Commonly it is recognised as an intrinsic type of work incorporated into the contract.

Differing Site Condition Clauses – Contractor Bears the Risk

If the accountability for unforeseeable site conditions is to be transferred to the Contractor, the Employer tends to apply a Site Information Disclaimer and Site Investigation clause to the Contract (David, Weston, & Thomas, 2007).

2.6.1 DSC Clause in Design and Build Contracts

2.6.1.1 FIDIC Yellow Book

The FIDIC Conditions of Contract for Plant and Design-Build general conditions of the contract for construction have the following clauses to evaluate the DSC (FIDIC Silver Book, Sub-Clause 4.12).

GCC Clause - 4.12 Unforeseeable Physical Conditions

In this Sub-Clause, “physical conditions” refer to the natural physical conditions along with the artificial and other physical barriers and pollutants that the Contractor experiences at the site after implementing the Works, including sub-surface and hydrological conditions with the exclusions of climatic conditions.

If the Contractor is aware of an adverse physical condition that reflects having an unforeseeable situation, the Contractor shall timely submit notices to the Engineer as soon as practicable of the occurrence of the event.

This notice includes the physical conditions so the Engineer can inspect them quickly and indicate the causes of why such conditions are unforeseeable. However, the Contractor shall execute the Works, implementing such suitable and reasonable means

which are practicable for the physical conditions and shall also comply with any instructions given by the Engineer. Moreover, wherever an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply.

If, and to the extent that the Contractor experiences Unforeseeable physical conditions, providing such a notice, and incurs delay and/or any cost due to such conditions, the Contractor shall be subjected to Sub-Clause 20.1 [Contractor's Claims] to:

- (a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and
- (b) payment of any such Cost, which shall be included in the Contract Price.

Upon receipt of such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent these physical conditions were Unforeseeable, and (ii) the matters described in subparagraphs (a) and (b) above related to this extent.

However, prior to any agreement or determination of additional costs applicable under subparagraph (ii), the Engineer may also review whether other physical conditions that appeared in similar parts of the Works (if any) were more favourable than what could reasonably have been foreseen at the time of the tender. If and to the extent that these more favourable conditions were encountered, the Engineer may proceed in accordance with Sub Clause 3.5 [Determinations] to agree or determine the reductions in Costs due to these conditions, which may be included (as deductions) in the Contract Price and Payment Certificates. However, the net effect of all adjustments under subparagraph (b) and all these reductions for all the physical conditions encountered in similar parts of the works shall not result in a net reduction in the Contract Price.

The Engineer may act by considering any evidence of the physical conditions foreseen by the Contractor at the time of the Tender, which may be readily available by the Contractor, but shall not be bound by any such evidence.

2.6.1.2 FIDIC Silver Book - First Edition 1999

The FIDIC Conditions of Contract for EPC/Turnkey Projects' general conditions of the construction contracts have the following clause to address the DSC (FIDIC Silver Book. Sub-Clause 4.12):

GCC Clause 4.12 - Unforeseeable Difficulties

Except as otherwise stated in the Contract,

- (a) the Contractor shall be deemed to have obtained all necessary information as to risks, contingencies, and other circumstances which may influence or affect the Works;
- (b) by signing the Contract, the Contractor accepts total responsibility for having foreseen all difficulties and costs of successfully completing the Works; and
- (c) the Contract Price shall not be, in such case, to be adjusted to take account of any unforeseen difficulties or costs.

2.6.1.3 ENAA Model Form - International Contract for Process Plant Construction

GCC Clause 35.1 of General Conditions of Contract

“During the implementation of the construction works, the Contractor shall find and study the site on any physical conditions other than climatic conditions or artificial obstacles that could not have been sensibly forecast prior to the date of the agreement made with the experienced Contractor. It should be based on a reasonable examination of the data relating to the facilities, including any data as to boring tests provided by the Employer, and based on information that it could have obtained from a visual inspection of the Site if access to that was available, or other data readily available to it relating to the Facilities, and if the Contractor determines that it will in consequence of such conditions or obstructions incur additional cost and expense or require additional time to perform its obligations under the Contract that would not have been required if such physical conditions or artificial obstructions had not been encountered, the Contractor shall promptly, and before performing additional work or using additional Plant or Contractor’s Equipment, notify the Project Manager in writing of

the physical conditions or artificial obstructions on the Site that could not have been reasonably foreseen;

the additional work and/or Plant and/or Contractor's Equipment required, including the steps which the Contractor will or proposes to take to overcome such conditions or obstructions; and

the extent of the anticipated delay and the additional cost and expense that the Contractor is likely to incur.”

GCC Clause 35.2 of General Conditions of Contract

“Any reasonable additional costs and expenses incurred by the Contractor in following instructions from the Project Manager to overcome such physical conditions or artificial obstructions referred to in GCC Sub-Clause 35.1 shall be paid by the Employer to the Contractor as an addition to the Contract Price”.

GCC Clause 35.3 of General Conditions of Contract

“If the Contractor is delayed or impeded in the performance of the Contract because of any such physical conditions or artificial obstructions referred to in GCC Sub-Clause 35.1, the Time for Completion shall be extended in accordance with GCC Clause 40”.

2.6.2 Conditions Typically Covered by Differing Site Condition Clauses

Modern DSC clauses basically include unforeseeable, hidden, or latent physical conditions at the work site not mentioned in or materially different from the data available at the tender (Collins, 2014).

The three major key elements at the outline of a differing site condition claim are the following:

Un-foreseeability – The Contractor must demonstrate that the condition experienced was unforeseeable depending on all required data available at the time of tender (Cushman & Tortorello, 1992).

Physical condition – The condition encountered must be a physical condition. (Hallman v. United States, 68 F. Sup. 204, Ct. Cl. 1946).

At the site – The condition encountered must be in the project site. In general, the “site” is the location where the project is being executed (Tobin Quarries, Inc. v. United States, 114 Ct. Cl. 286, 1949).

According to Sweeney, Kelleher, Beck, and Hafer (2016), the Differing Site Conditions clause covers the following conditions.

1. Bearing Capacity of soils and Unstable Soils
2. Unsuitable Fill
3. Rocks, Boulders, Debris, and Other Subsurface Obstructions
4. Unanticipated Water Conditions, Perched Water, Artesian Water
5. Groundwater and Subsurface Water
6. Undisclosed Concrete Piles
7. Failure to Designated Borrow Pits or Quarry Sites to Produce
8. Inaccurate Quantities of Materials or Substances to be discharged
9. Undisclosed Utilities and Structures
10. Undisclosed Ductwork
11. Archeological and Paleontological Sites
12. Multiple Roofs to be Removed
13. Dangered Species
14. The thickness of a Concrete Floor
15. Hazardous Wastes
16. Excessive, Large Subsurface Boulders
17. Incorrect Disposal Site Area
18. Inaccurate Rock Elevations
19. Inaccurate Borings
20. Unanticipated Weathering of Rock
21. Inaccurate Moisture Retention Qualities
22. Undisclosed Conduits in Floors or Walls

23. Hard or Cemented Soils

24. Limitations on Site Access

Apart from the Contractual parameters, many reliable techniques are available to pre-identify the existing site conditions before commencing the actual construction. The below area discusses such techniques quoted in literature.

2.7 Technical Parameters used in Design and Build Projects to minimise DSC Disputes

For purposes of either a Type I or a Type II DSC claim, a Contractor ordinarily hold to have constructive or imputed knowledge of any conditions discoverable by a reasonable pre-bid site inspection, whether or not the site inspection was conducted, unless (1) the owner, a third party, or natural condition prevents the Contractor from conducting the inspection, or (2) the owner or the engineer withholds, conceals, or misrepresents conditions and thereby misleads the Contractor (Hannan & Maloney, 2012).

In general, the contract documents are comprised of provisions which require tenderers to investigate the site before tenders are submitted, and compulsorily, it is the tenderer's responsibility to conduct a proper investigation. It should essentially be identified, however, that such "Site Investigation" provisions do not necessarily nullify the provisions of a DSC clause or expect the Contractor to observe, at his peril, site conditions would not be discoverable after a successful pre-tender investigation. In essence, the sufficient measure of constituting a fair site inspection typically differs in every case, but wherever the conditions identified would have been confirmed by an adequate site examination with all the access data to tenderers. Any failure by the Contractor to make such a pre-tender investigation cannot grant an affordable relief to the extent that he has experienced DSC (Dwyre et al., 2010).

A DBB project's design is completed before it advertises the contract; however, the design-build Contractor manages to meet both the design and the construction,

engaging in a sole contract in D&B. In D&B project delivery, it is possibly engaged to the great potential that the subsurface geographical investigation to be carried out by the D&B Contractor after entering into a lump sum fixed price contract. Therefore, those factor raises the question: what extent to the investigation, if any, should the Employer convince before it advertises the D&B contract to segregate the geographical conditions depending on which competitive D&B team Contractor accurately base their proposed price? (Christensen & Meeker, 2002).

Watts and Davis (2018) identified the following items necessary to have a comprehensive site investigation:

1. Conducting a fundamental desktop assessment of the site's eligibility (e.g., about past and present land usage, natural resources, soil condition, and the surface and groundwater tables). A few sites are possibly analysed in this manner at a low cost.
2. Geological investigations extracted data from the physical characteristic of soil, rock and/or shallow groundwater throughout the site to evaluate the eligibility of the construction materials and to prepare the design of earthwork supports and foundations with higher accuracy.
3. Undertaking a site inspection to assess and record the design constraints of the site. During the site inspection, topographic constraints must be highlighted, e.g., flood inundation lines, rock outcrops, slope gradients, green coverage (shrubbery and large trees), surface water content, groundwater, and sensitive receptors.
4. A site survey should be established with the help of vertical and horizontal control marks and record and highlight the natural and manmade features and elevations of the surface.
5. Checking with other Contractors to ascertain that survey and design information can be essentially incorporated into the guidance of machine equipment.
6. Obtaining data on the physical characteristic of soils inside the site to design earthwork supports and foundation structures and evaluate the compatibility of the construction material.

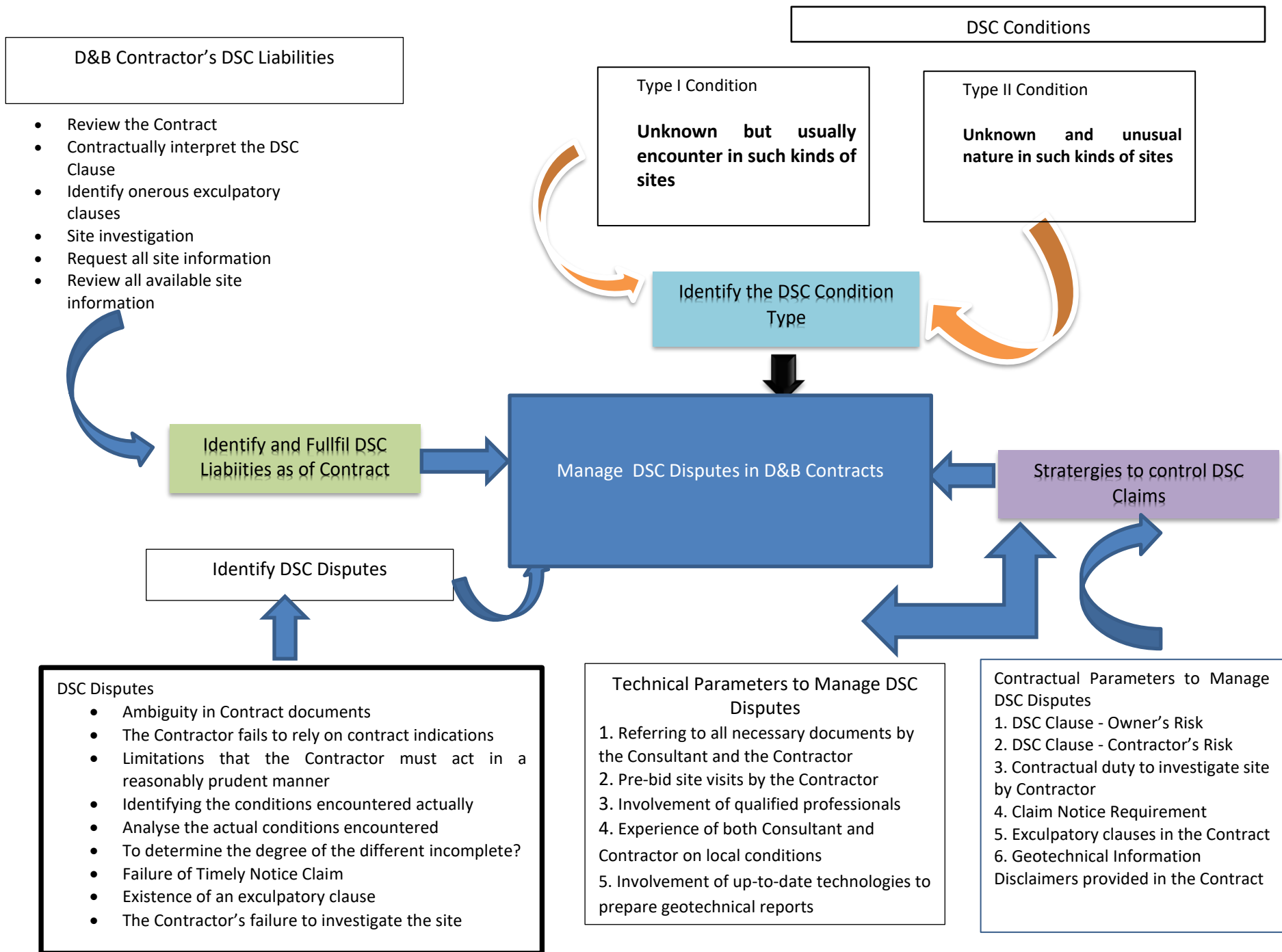
7. Make a proper record of the exact locations of boreholes and test pits.
8. Checking the eligibility of the nearest water supplies for cattle drinking.

Amarasekara (2016) identified the following technical methods to assess the impacts of DSC:

- Engagement of qualified professionals to make geotechnical reports
- Engagement in up-to-date technical strategies to make geotechnical reports
- Pre-tender site visits and inspections of the Contractors
- Expert knowledge of both consultant and the Contractor under the local conditions of the project
- Careful study of all the required documents and drawings concerning the site conditions from the parties representing both consultant and Contractor

2.8 Theoretical Framework

The path of research to be conducted is discussed in the theoretical and conceptual framework, and it assists in grounding the research steadily to the theoretical concepts related (Adom & Hussein, 2018). Based on the literature finding, Arambewela and Zuhair (2003) quoted that it guides the right direction to designing the research and data analysis. The conceptual framework demonstrated the main items to be observed in research, and it could be illustrated like a tree diagram, flow chart, or mind map (Roberts, 2010). Figure 2.1 shows a developed theoretical framework for the results of the comprehensive study of the prevailing literature concepts (of the study).



2.9 Why is it important to manage the contractual disputes related to the Contractor's Liability under Differing Site Conditions in Design and Build Projects?

As of research conducted by Kumaraswamy (1997), the author explained that unforeseeable ground conditions were placed fourth among the top ten popular classifications of construction claims as processed by Contractors, Employers, and consultants in Hong Kong (Ndekugri & McDonnell, 1999). Furthermore, Hadikusumo and Tobgay (2015) stated that claims owing to DSC were placed in the first place regarding the strictness of the claim amount. The projects may get delayed or disrupted due to their high financial integrity.

DSC occurs because the Contractor experiences a site condition that differs materially from what was specified in the contract or from what is to be generally possible in the area (Long et al., 2015).

Chen and Liew (2003) also argued that disputes owing to DSCs are more casual, and predominantly, those disputes arise due to a misunderstanding of geotechnical reports, requirements of site visits, and disclaimers incorporated in contract documents.

According to Cushman et al. (2000), under general common law, Contractors must bear the risk due to the performance of the contractual obligations exceeding the price agreed to execute. However, the increased costs were owing to unforeseeable difficulties.

Hence, the DSC clause was created to absorb some gambles from unpredicted conditions (Hannan & Maloney, 1990). Sweet, Schneier, and Wentz (2014) revealed that the DSC clause provides advantages for the tenderers since they do not want to put weightage on the cost of bearings besides the risk of occurrence due to DSC. Also, they do not need to risk the success of the tender by determining how much contingencies provision must require to safeguard the risk of occurring a DSC.

DSC can be classified into two distinct types, Type I and Type II (McClure, 1984). The main reason for DSC claims is parties have not adequately understood their

liabilities, and many barriers have prevented the proper execution of the identified liabilities. When it complies with Design and Build projects, as the Contractor owes design responsibility, it is a highly sensitive matter to determine the DSC claim, which mainly directs to disputes.

The Sri Lankan construction industry has experienced many DSC claims and disputes in Design and Build projects in the last decade. Hence it is a significant and valuable effort to research the DSC liabilities owed to Design and Build Contractors, the DSC dispute reasons, and the framework of the contractual and technical parameters to mitigate the DSC disputes.

2.10 Summary

In Chapter 2, the literature survey studied the prevalent knowledge in the research area by referring to books, journals, websites, claim documents, and other reliable sources of information. The literature survey revealed what DSC meant, the available DSC types, and the Contractor's liability for the DSC in the Design and Build Projects. Next, the causes for DSC claims and the available Technical and Contractual strategies to minimise the disputes related to Contractors under DSC in Design and Build Projects were reviewed. These literature survey findings helped develop the theoretical framework, which assisted in developing the practical research design approach.

3. RESEARCH METHODOLOGY

3.1 Introduction

This chapter systematically illustrates the methodology employed to achieve the defined research aim. It deliberates the research approach, research design and strategies, data collection methods, and data analysis techniques. Research methodology is a systematic way to address the research problem adequately and find a solution for the research problem. It is identified as a science of study on how to research scientifically (Kothari, 2004). Rajasekar, Pitchai, and Veerapadran (2006) explained that the research method is the overall research technique and the way of conducting the research.

3.2 Research Design

Singh (2006) states, “Research is a scientific and systematic method in which information is collected for a reliable solution to a specific problem”. The key aim of research design is how the solution identifies the path to solve the research problem (Kumar, 2011). Hence, a research design is a complete process of conducting the research effectively and efficiently with reliable data collection and analysis methods and finally interpreting the research output. The three basic research approaches are quantitative, qualitative, and mixed methods (Creswell, 2007).

3.3 Research Approaches

Kothari (2004) stated that the most used research approaches are qualitative and quantitative methods. Further, Khan (2018) quoted, “The two main approaches to social science research are, in practice, qualitative and quantitative or unstructured and structured.” Quantitative research collects and analyses statistical data focusing on measurement range, phenomenon frequency, and scale (Kumar, 2011). Qualitative research interprets the approach of collecting and analysing data to explore and explain

a phenomenon and is often in the form of a case study of a particular instance (Cao, 2007).

Table 3.1 illustrates the characteristics of each approach as to the many researcher's philosophies.

Table 3.1: Summary of available Research Approaches

Characteristic	Quantitative Approach	Qualitative Approach	Mixed Approach
Concept	Examination of variables that can be calculated on instruments from which numerical data analysis is conducted using statistical procedures to evaluate objective hypotheses	Understanding and examining the meaning given to a specific human or social problem by a person or a group of individuals	An approach to reinforce the analysis by mixing both approaches with theoretical frameworks
(Mafuwane, 2011)			
Questions from the study	Questions focused on Instruments	Questions open-ended	Both
(Creswell, 2014)			
Technique	Statistical analysis	Text and image analysis	Both
(Creswell, 2014)			
Methods of data collection	Output data, data on attitude, observational data, and data from the questionnaire	Data from interviews, data from observations, data from records, and audio-visual data	Both
(Creswell, 2013)			
Limitations	Improper representation of the target group	Difficulty experienced during analysis and a large amount of data	Both
(Yin, 2013)			
Decision-making	Answers for what, where, and when (if questions)	How and why the investigation	Both
(Rajasekar, Philominaathan, & Chinnathambi, 2013)			

Bricki and Green (2007) stated that qualitative research is the choice if the researcher wants the experience of people and their various viewpoints. Hence, the Qualitative

approach is selected to reach a basic understanding of the structure, process, and driving forces of a research problem area (Jansen, 2010).

When qualitative and quantitative approaches do not stand alone to provide desired research objectives, the successful strategy would be the combination of approaches in the forms of both quantitative and qualitative, referred to as the mixed approach. The approach is based on the type of data to be collected in the research study (Creswell, 2014).

3.4 Selection of Appropriate Research Approach for this Study

The present research aims to identify the Contractor's liability towards the DSC in Design and Build projects and propose a framework to manage the contractual disputes related to the Contractor's Liability under DSC in Design and Build Projects. The qualitative approach provides personal perspectives and experience-based answers (Hammarberg, Kirkman, & de Lacey, 2016). Taylor (2011) explained that the advantages of a qualitative approach are the ability to focus on a specific group of people which provides an in-depth study of a broader topic, more latitudes when choosing topics, and represents people's ideas and perspectives. An in-depth analysis of the particular scenarios from expert perceptions is necessary to achieve the research objectives. Hence, the most appropriate research method would be the qualitative approach when considering the characteristics of the qualitative research approach and the study's objectives.

3.5 Research Strategy

The research strategy is a complete proposal for conducting a comprehensive research study (Johannesson & Perjons, 2014). Research strategies adopted to improve strategic management research require analysis concepts, theoretical construction, formal analysis techniques, and operating procedures (Vargas-Hernandez, Arandia, & Cordova-Rangel, 2016). Some research strategies are quasi-experiments, surveys, experiments-laboratory, case study research, action research, ethnography, and grounded theory (Kagioglou, Cooper, Aouad, & Sexton, 2000). Dhanaraj (2006)

explained that the research strategy under the qualitative approach operational for research is the case study, ethnography, action research, and grounded theory.

The case study is a written description of a research problem, and the particular case becomes the origin of a thorough, holistic, and in-depth analysis of the characteristics the investigator wishes to discover (Rahi, 2017).

3.5.1 Selection of Research Strategy for this Study

According to the nature of this research and analysis of the research methodology theories, document review and case study were selected as the most appropriate research strategies for this research.

3.5.1.1 Case Study Design

Gillham (2000) stated that identifying the analysis unit and case selection criteria are the main areas to be considered while designing a case study. Case studies have two design types, i.e., single and multiple designs (Whitehead, 2003). In this research, three case studies were selected that fulfil the research requirement of DSC claims in the Design and Build contract. The study's unit of analysis is the Design and Build of contract projects with DSC claims.

3.5.1.2 Documentary Review

Documentation acts as a means of cross-validating information collected from semi-structured interviews; perhaps what people say is different from what people do (Yin, 2009). Glenn and Bowen (2009) also defined *Document review* as a systematic procedure for reviewing or evaluating documents, which are printed and electronic documents. Documents related to DSC claims, contractual correspondence, Contract Documents, and site investigation reports in the design and build projects were referred to get aware of the contractual and technical background of the DSC claims liabilities. Expert interviews were held within the case study and with industry experts to achieve the research objectives.

3.5.1.3 Expert Interviews

Interviews can reveal individual participants' experiences, beliefs, opinions, and motivations (Gill, Stewart, Treasure, & Chadwick, 2008). Three means of topics to be incorporated into an interview guide: the research literature, the knowledge and experience of the interviewer about the relevant field, and casual preliminary study like a discussion with people who already possess personal experience of the research topic (King, 2004). Further, Walliman (2011) and MacDonald and Headlam (2011) quoted that an interview can be considered as structured, semi-structured, and unstructured interviews, and the most generic type of these three is semi-structured interviews, driven by a particular framework; however, it enables the researcher flexibility in discussing and evaluating the responses obtained.

A semi-structured interview was conducted in this research with the interview guideline among two groups. One group of interviewees are experts directly engaged in the selected DSC case studies. Semi-structured interviews were conducted among the experts with industry experience in the DSC areas but outside of the selected case studies to validate and generalise their results.

3.6 Research Process

The research process is the framework explaining how to conduct the research step-wise and how to achieve each objective of the research through a literature survey and data collection survey. This research has six objectives to accomplish the research aim, and Figure 3.1. presents the procedure followed.

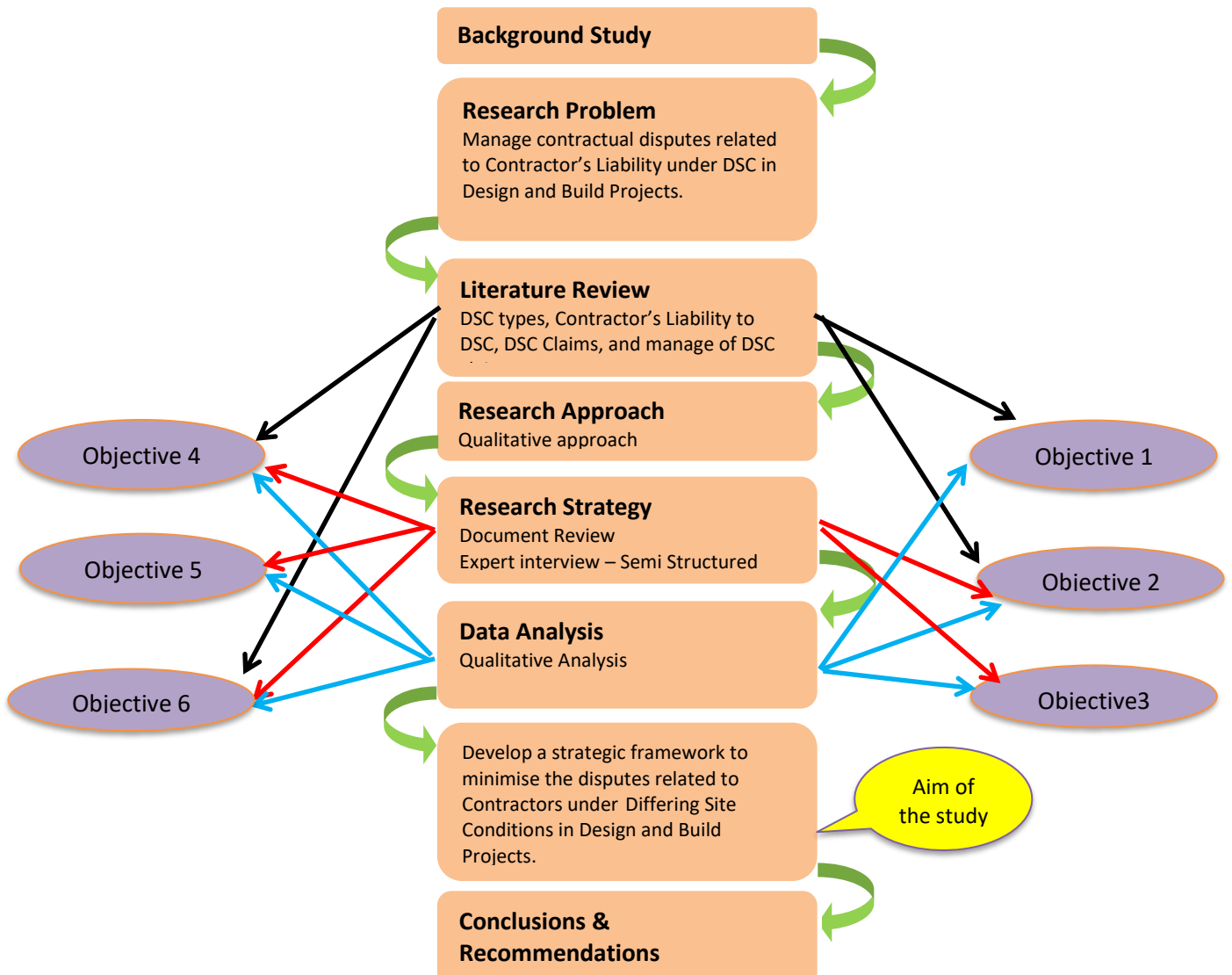


Figure 3.1: Research Process

3.7 Summary

This Chapter discussed the systematic way of researching to fulfil the aim and objectives of the research problem. It analysed the available research approaches and determined the most appropriate approach for this study. Accordingly, the Qualitative research approach is used. Empirical data were collected from semi-structured expert interviews. Further, a comprehensive document review provided the background details for each case study. The gathered data were evaluated and analysed by content analysis.

4. RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

Chapter 4 explains research findings that have become the input of the research gap identified through the literature review. Hence the chapter outlines the selected case studies and the data collection procedure. Next, it discusses the interview results aligned with the research objectives. The latter part of the chapter framed the suggestions and improvements to reduce the DSC disputes in Design and Build projects through document review and the interviewer's perceptions. Finally, Chapter 4 summary briefly describes the data discussion outcomes.

4.2 Analysis of Case Studies

The adopted research strategy to collect data for this research is conducting a case study. The first phase of the case study involved document review, followed by semi-structured expert interviews in the contract administration area of each case study. Semi-structured expert interviews were held with experienced DSC professionals from the industry. The objectives of the case studies are to extract a comprehensive and authentic understanding of DSC disputes which is more compatible with achieving the research objective through an in-depth analysis rather than a statistical measure.

4.2.1 Document Review

Document review assistance in identifying the case study facts in a detailed manner and further contextualisation of the contractual and theoretical data with practical knowledge gathered from semi-structured interviews.

A document review was performed to identify the Design and Build Contractor's liability owed to DSC and further study the contractual conditions, contractual

correspondence, and disclaimer provisions related to DSC in the Contract Document. Further, the background of the DSC dispute and the present status of the disputes were identified comprehensively.

4.2.1.1 Details of Reviewed Documents

Table 4.1: Details of Reviewed Documents

Doc. No	Document Name	CS.01	CS.02	CS.03
D1	Conditions of the Contract	Sub Clause 35 - Unforeseen Conditions in GCC. Sub Clause 44 - Claims in GCC, entitled to claim additional time and cost under SC-35 above.	Sub Clause 35 - Unforeseen Conditions in GCC. Sub Clause 44 - Claims in GCC, entitled to claim additional time and cost under SC-35 above.	Sub Clause 35 - Unforeseen Conditions in GCC. Sub Clause 44 - Claims in GCC, entitled to claim additional time and cost under SC-35 above.
D2	Employer Requirements	Sub Clause 1.2.1- 6A states it is the Bidder's responsibility to establish the surface and subsurface soil conditions at the site. Sub Clause 1.11.4 - 6B adds the design risk of soil parameters to the Contractor.	Sub Clause 1.8.2- Geotechnical Survey states Employer does not guarantee the correctness and actual availability of provided data. Sub-Clause 1.5.1- Design Responsibility Contractor shall carry out all necessary geotechnical tests before proceeding with the detailed design.	Sub Clause 6.1-2.3 (a) Investigation Scope Contractor is responsible for reviewing the Investigation data provided by the Employer and thereby investigating the data gap. (b) Contractor is fully responsible for conducting the necessary investigation such as geological, utilities etc.
D3	Employer-Provided Geological Data	Three nos. of Borehole data per site carried out by the Employer are provided in the Supplementary Information – Annexure to the Contract.	Employer-provided borehole data and further mapped the rock profile indicating the type of rock and volume along the tunnel alignment.	Three nos. of Borehole data per site carried out by the Employer are provided in the Supplementary Information – Annexure to the Contract.
D4	Contractual Correspondence (Letters, Claim Submissions, Contemporary records)	The Contractor submitted a claim notice, claim, interim particulars, and final claim statement. The Employer provided responses for each Contractor's submission.	The Contractor submitted a claim notice, claim, interim particulars, and final claim statement. The Employer provided responses for each Contractor's submission.	The Contractor submitted a claim notice, claim, interim particulars, and final claim statement. The Employer provided responses for each Contractor's submission.

Contract Conditions, Employer Requirements (Performance Specifications), and Employer-Provided Geological Data such as maps, rock profiles, and soil profiles of each case were closely referred to obtain the relevant details. Table 4.1 presents the referred documents.

The D1 document is the heart of the Contract, which elaborates on the contractual responsibilities and roles of the parties to the Contract. It gives Conditions of the Contract, and all three case studies projects include the DSC clause under the title of Unforeseen Conditions, where the Employer takes the risk for the unforeseen physical condition if the Contactor experiences adverse physical conditions that are considered to be unforeseeable.

D2 is often present in Design and Build Contracts where the Employer elaborates the product or process requirements in performance parameters; further, any limitations of the Employer's Liabilities and enforcement of the Contractor's obligations are defined. In all three case studies, the Employer has restricted the liability of unforeseen physical conditions/DSC that may occur due to the exclusive use of Employer-provided geological and soil investigation data by adding a disclaimer clause.

D3 is the supplementary information provided by the Employer to all bidders during the bidding process. These supplementary details are mainly borehole data, soil investigation reports, and utility maps. These supplementary data do not form a part of the Contract; it is an annexure to the Contract where it denies the contractual liabilities owed to the Employer regarding the accuracy of provided data.

D4 is the contractual correspondence exchange between the Engineer/Employer and the Consultant. The related documents are the notice of claim, detailed claim submission, interim particulars with contemporary records, and final claim statement with claim amount and time. The Engineer/Employer has responded to each Contractor's submission, and those documents analyse the claim entitlement.

4.2.2 Semi-Structured Interviews

Twelve (12) semi-structured interviews were held with the professionals directly engaged in the DSC disputes in the selected cases and from the industry. For each case study, two interviewees were chosen a Consultant (Engineer) and a Contractor representing one member from each party. Another six (06) semi-structured interviews were conducted with professionals with experience in DSC claims selected from the industry. Due to the Covid-19 pandemic, the respondents were interviewed online for approximately 60 - 75 minutes. The semi-structured interview guidelines were prepared using a literature review (Annexure 1 for reference).

4.2.2.1 Objectives of Interviews

This research comprises six objectives. These objectives are fulfilled through literature review, document review, and semi-structured interviews. Interviewees have provided their perceptions regarding the DSC liabilities towards Design and Build Contractors differently. It is mainly based on their individual perceptions, developed with their professional experience and knowledge in the area of DSC with D&B contracts. When responding to the DSC's liabilities towards the Contractor and Contractual and Technical parameters to manage the DSC disputes have used their practical experience in the research area.

4.2.3 Respondent details for interviews

Twelve (12) interviews were successfully held according to the semi-structured interviews guideline. All respondents had over five years of experience in the claim management field, and all are presently engaged in the DSC disputes process having hands-on experience with DSC disputes occurring in Design and Build contracts. Table 4.2 demonstrates the summary of the particular interviewees.

Table 4.2: Profile of Interviewees

Code	Designation	Case study Ref & Organization	No. of years in the Construction Industry	No. of years in D&B projects	No. of years in Claim Mgt
I 1	Contract Administrator	CS.1 - Consultant	26	18	18
I 2	Contract Administrator	CS.1 - Contractor	7	5	5
I 3	Contract Administrator	CS.2 - Consultant	50	10	15
I 4	Contractor Engineer	CS.2 - Contractor	8	5	5
I 5	Contract Administrator	CS.3 - Consultant	45	20	25
I 6	Claim Engineer	CS.3 - Contractor	14	8	6
I 7	Claim Specialist	Industry - Consultant	24	15	18
I 8	Contract/Planning Manager	Industry - Contractor	8	5	5
I 9	Senior Quantity Surveyor	Industry - Consultant	15	10	7
I 10	Project Quantity Surveyor	Industry - Contractor	10	7	6
I 11	Claim Specialist	Industry - Consultant	27	17	15
I 12	Quantity Surveyor	Industry - Contractor	8	5	5

4.2.4 Background of Cases

The three cases were selected for the data collection of this research, considering the time availability. The selected cases are Design and Build projects with DSC disputes. Table 4.3 provides a summary of the case details.

Table 4.3: Background of Cases

Case Study	Case - CS 01	Case - CS 02	Case - CS 03
Details			
Type of Project	Civil Engineering Project	Civil Engineering Project	Civil Engineering Project
Procurement Type	Design and Build	Design and Build	Design and Build
Payment Modality	Lump Sum	Lump Sum	Lump Sum
Initial Contract Sum (Without VAT)	Euro 5,672,980 + US\$ 10,942,198 + INR 268,292,593 + LKR 4,576,155	US\$ 32,098,155 + LKR 246,060,603	LKR 7,256 Mn
Initial Contract Period	910 Days	24 Months	156 Weeks
Contract Condition	ENNA Contract	Specific to the project, but followed the ENNA contract basic format	ENNA Contract
DSC Claim Details	Change in the shoring method from sheet pile to secant pile (Tender vs Detail Design) due to change in the soil condition	The encounter of additional rock strata in tunnel alignment	Change in the shoring method from sheet pile to secant pile (Tender vs Detail Design) due to not meeting hard rock as of soil investigation reports
DSC Claim Type	Type I	Type I	Type I
DSC Claim demands claimed by the Contractor	An additional cost of LKR 617 Mn and 177 Calendar Days EOT	An additional cost of US\$ 6.8 Mn + LKR 152 Mn and 3 Months EOT	An additional Cost of LKR 344 Mn and 132 Days
Reasons for DSC claim to become a DSC dispute	Availability of Disclaimer Provisions related to Employer-provided soil reports and borehole data	Availability of Disclaimer Provisions related to Employer-provided rock profile	Availability of Disclaimer Provisions related to Employer-provided soil reports and borehole data
Present Status of Dispute	Under International Commercial Arbitration Review	Review under Employers Claim Committee	Under Dispute Adjudication Boards Review

Description of Case CS.01

Case CS.01 is an infrastructure project related to the sewer network system of urban areas in Sri Lanka. The project was procured under Design and Build procurement method, where the Employer provided a conceptual design with detailed Employer Requirements with performance specifications. It is the Contractor's liability to do the detailed site investigation and the detailed design and construction. When the Contractor did the detailed site investigation and borehole to design the shoring method for the underground pumping stations, it revealed that the soil characteristics of the subsurface had deviated from the tender data. Hence it led to a change in the shoring method from sheet piling to secant pile where Contract claims under Differing Site Conditions. The Engineer and the Employer denied the claim imposing a disclaimer provision in the contract, which led to a major project dispute.

Description of Case CS.02

Case CS.02 is a remarkable construction project in Sri Lanka as it is the first stormwater tunnel project in an urban area. The project has been awarded to the successful bidder under Design and Build contract terms. The Employer's requirements were elaborated in performance parameters for the tunnel network, and the Employer provided rock profile and borehole reports with conceptual drawings to the bidders. However, there is a disclaimer clause about geological data provided by the Employer. At the time of detail, tunnel profiles have drawn after the boreholes along the tunnel profile by the Contractor himself, who identified that the actual hard rock quantity had increased along the tunnel path. This deviation made a substantial additional cost to the Contractor as he had not recognized this deviation from Tender data, which he could not foresee. Hence, the Contractor submitted a geological change claim, which the Engineer of the Contract denied due to the geological disclaimer clause provided in the Contract. The claim became a dispute to the project. The Employer has appointed an independent committee to determine the claim entitlement and quantum if any.

Description of Case CS.03

Case CS.03 is also an infrastructure project in an urban area where Design and Build Contractor has to fully design and construct the entire sewer network, including two pumping stations in the Colombo Municipal Council area. The Employer has defined the sewer flow rate in performance parameters and provided the entire existing sewer network to develop the Tender Designs. The Employer also provided available soil data and borehole reports, with the Employer adding a disclaimer provision limiting the accuracy level of provided soil reports. While interpreting the Employer provided data, the Contractor developed the conceptual design at the bidding stage and quoted the price accordingly. When the Contractor carried out a detailed soil investigation to design the pumping station foundations to retain structure, the tender proposal of sheet pile was infeasible due to the weak soil stratum. Hence the shoring method, including the entire pumping station foundations, has been changed. The Contractor submitted additional cost and time of changing the foundation and retiming structure according to the Differing Site Condition claim. The Engineer and Employer rejected the claim stating that no claim entitlement is available under the DSC clause as the changed soil condition does not cause unforeseen conditions.

4.3 Research Findings

The research findings were analysed and presented in a sequential order to achieve the research objectives as follows:

4.3.1 Contractor's Liability related to Differing Site Conditions in Design and Build Projects

The first part of the interview discussed the Contractor's Liability connected to Differing Site Conditions in Design and Build Projects. The DSC liabilities towards D&B Contractors were identified using a literature review and the experiences of experts engaged in DSC claim management. Table 4.4 presents the DSC liabilities towards D&B Contractors.

The literature identified ten DSC liabilities toward D&B Contractors, and the interview identified another three liabilities. Those liabilities are, as of I5, “It is Contractor’s responsibility to analyse all the possible DSC risks associated with the particular project and allocate the high-profit margin”. Further, I7 stated, “Before submitting the bid, bidders should do their detailed site investigation and quote the bid adding DSC risks”. Interviewee I9 commented that the DSC Contractor must verify the data gap of the Employer-provided data with geological experts available in the project-located geological country or state.

Table 4.4 presents the analysed interview data regarding DSC's Liabilities towards the D&B Contractor. The interviewers proposed the highlighted Contractor’s Liabilities.

Table 4.4: DSC Liabilities toward the D&B Contractor

Ref. No.	Contractor's Liability	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12
1	Review the Contract and understand the DSC risk assign	✓	✓	✓	✓	✓	✓	X	✓	✓	✓	✓	✓
2	Contractually interpret the DSC Clause, if available	✓	✓	X	✓	✓	X	✓	✓	✓	✓	✓	✓
3	Identify heavy exculpatory clauses under different sections or contract language rejecting the precision of site conditions and physical details shown in the tender document	✓	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	Perform the precise site investigation	✓	✓	✓	✓	✓	✓	✓	X	✓	✓	✓	✓
5	Request all site information available to the owner	X	✓	✓	X	✓	X	X	✓	✓	✓	✓	✓
6	Review all available site information data by Technical Expert	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	✓
7	Correctly examine and interpret the available site data	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	Quote a possible cost and time for the DSC risk (as allocated) in the Bid	✓	X	X	✓	✓	✓	X	X	✓	✓	✓	X
9	When occurs differing site conditions follow the contract notice requirements	X	✓	X	✓	✓	✓	✓	✓	✓	✓	✓	X
10	Keep contemporary records related to additional time and cost due to DSC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11	Analyse all possible DSC risks associated with the particular project and allocate the high-profit margin	X	X	X	X	✓	X	X	X	X	X	X	X
12	Before submitting the bid, bidders should do their detailed site investigation and quote the bid adding DSC risks	X	X	X	X	X	X	✓	X	X	X	X	X
13	The Contractor is to verify the data gap of the Employer provided data with geological experts available in the geological country or state in which the project is located	X	X	X	X	X	X	X	X	✓	X	X	X

Interview results show that all respondents agreed to the “Correctly examine and interpret the available site data” factor and “Keep contemporary records related to additional time and cost due to DSC”. The least agreed liability is “Quote a possible cost and time for the DSC risk (as allocated) in the Bid”. Out of 12 respondents, only seven agreed that this was a D&B Contractor’s liability. 13 commented, “If the DSC clause is available, there is no necessity to add unnecessary risk monetary value to the Bid price and submit a high bid price which declines the D&B Contractor’s bid acceptance”.

Further, I4 and I11 agreed with the factor while imposing the condition that “The Contract will be able to price the DSC risk as of the available data which can refer at the Bidding time and any deviations if the actual to the bidding time available refereed date makes a DSC to the project”.

The second lowest factor is “Request all site information available to the owner”, only positively addressed by eight respondents. Interviewee I4 commented, “If the Employer provides site data with the bid, then Bidders believe that as a responsible Employer, he had disclosed all available reliable site data to achieve project success”.

The liability “When occurs differing site condition refers to the requirements of contract notices” has been rejected by three respondents, and I12 stated, “When to understand the DSC is continuing at that time can give the claim notice”. Similarly, I3’s opinion is “Not like other claims, the time bar does not apply to DSC claims as DSC condition is continuing and to understand the magnitude of the DSC status will take time”.

Almost 11 respondents agreed to “Review the Contract and understand the DSC risk assigned, identify onerous exculpatory clauses or contract language disclaiming the precision of site data reflected in the tender documents, and perform precise site investigation liabilities”. The I4, I5, I7, I8, and I11, I12 commented that as of the Contract, before performing a detailed design after awarding the Contract, the D&B Contractor must do a detailed site investigation. Further, I3 has a view about exculpatory clauses—even if bidders understand the contractual interpretation of such clauses at the bidding stage, it is not practical to do a detailed site investigation.

Further, if the DSC clause is available, bidders can transfer the DSC risk to the Employer.

Only two respondents disagreed with the Contractually interpret the DSC Clause, if available, and reviewed all available site information data by Technical Expert factors. I11 stated that there was no contractual requirement to review the data by Technical experts; hence it is unnecessary.

4.3.2 Fulfilment of the Contractor's Liability under DSC in D&B Projects and Reasons for not performing the Contractor's Liability towards DSC

The second part of the interview questioned the respondents about their opinion of whether the Contractor fulfils the Liability towards DSC as of Contract, and if not, which DSC-related liability is not performed by the Contractor. Out of 12 respondents, six (i.e., I3, I4, I7, I8, I11 and I12) stated that the Contractor had fulfilled the DSC-related liabilities towards the Contractor. That is exactly 50% of the selected sample. Five respondents, i.e., I2, I5, I6, I9, and I10, stated that the Contractor did not perform the DSC-related liabilities as of the Contract. Respondents 01 and I1 agreed that their Contractor had partially fulfilled the DSC-related liabilities.

The Interview guideline has a provision to provide the respondents' opinion about the reasons for not performing the Contractor's Liability towards DSC. Table 4.5 reveals the result of the respondent's opinion about the fulfilment of the Contractor's liability under DSC in D&B projects and the reasons for not performing the Contractor's liability towards DSC.

Table 4.5: Investigate the fulfilment of the Contractor's Liability of DSC and Reasons for not performing the Contractor's Liability towards DSC

Response	Fulfil the DSC Liability	If not, which DSC-related liability is not performed by the Contractor	Reasons for not performing Contractor's Liability towards DSC
I1	Partially fulfil	Not performing the proper site investigation and not reviewing the DSC risk obliged to Contractor.	It is assumed that a claim is a belated approach.
I2	No	No site investigation and verifying Employer-provided data.	Unawareness and negligence of the Contract Scope.
I3	Yes	All DSC liabilities are fulfilled by the Contractor.	The Contractor fulfilled the DSC liabilities. Nothing is left without fulfilment.
I4	Yes	As per the Contract, the Contractor must do a detailed project design after the Contractor performs the detailed investigations. The Contractor followed the same.	The Contractor performed DSC liabilities as it is.
I5	No	The Contractor did not follow the exculpatory clause and only referred to the Employer-provided site data, which was declined under the exculpatory clause.	Due to the competing bidding, the Contractor did not consider the DSC risk. The submitted bid denotes that the Contractor did not obtain the service from experts to value the DSC risk.
I6	No	The Contractor had not acted according to the Contract clause to give the notice of claim at the time, though the Contractor was aware of the submission of the Geotechnical Investigation Report for the project very early.	The Contractor did not perform according to the Contract clause to give the notice of claim at the time, although the Contractor became aware of the DSC early.
I7	Yes	-	Not applicable because the Contractor fulfilled all DSC liabilities as of the contract.
I8	Yes	The Contractor referred to the Employer-provided site data (borehole data) and quoted for the project. As per the Contract, the Contractor did a detailed site	Due to the limited time allocated for the bid stage, bidders do not have time to do a detailed site investigation. Further, with the allocated bid value, it is impossible to bear

		investigation before doing the detailed design.	DSC's actual expenses. Since the DSC clause is available in the Contract, the Contractor would not add DSC risk.
I9	No	The Contractor did not verify the data gap in the Employer-provided data during the bid stage.	Not aware of DSC claims until the Contractor occurred. Contractor's less experience on the D&B contracts risks-sharing towards DSC.
I10	No	The Contractor has not taken a detailed investigation to design the appropriate shoring system.	The Contractor did not refer to the documents appropriately.
I11	Yes	-	The Contractor covered DSC liabilities.
I12	Yes	Except for the detailed borehole at the site during the bid stage.	Due to high-cost involvement and time taken to review the available DSC risks.

The respondent I1 commented that the Contractor did not complete the site's investigation properly and did not review the DSC risk obliged to the Contractor as of the Contract Clauses. The respondent I2 explained in detail that the Contractor did not bring out the site inquiry and verify the Employer-provided data, while respondent I5 claimed that the Contractor did not follow the exculpatory clause and only referred to the Employer-provided site data, which was declined under the exculpatory clause.

The Contractor had not performed according to the Contract clause to give the notice of claim at the time, although the Contractor became aware of the submission of the Geotechnical Investigation Report for the project at an early stage; this was the unfulfilled DSC obligation by the Contractor as of I6. Further, respondents I9 and I10 commented that the Contractor did not verify the data gap in the Employer-provided data during the bid stage. The Contractor has not performed a detailed investigation to design the appropriate shoring system.

According to respondents' results, deciding whether the Contractor has fulfilled the DSC liabilities owed by the Contract terms is highly subjective and idiosyncratic. Each

respondent believes their liabilities have been fulfilled with the perception of the rights and obligations owed to the respective party. Hence, respondents from the Contractors' party stated that they had fulfilled all DSC liabilities. In contrast, respondents from the Consultant party stated that the Contractor did not fulfil the DSC liabilities as of the Contract.

As per respondent I1, the Contractor takes the opportunity of the DSC occurrence to belate the high time and cost claims amounts. However, according to I2, I10, and I9, the Contractor's unawareness, less experience, and negligence of the Contract Scope and document reference towards DSC risk are the reasons for not performing the DSC liabilities. Due to competing bidding, the Contractor did not consider the DSC risk and did not obtain experts' services to value the DSC risk; such reasons led to the failure to perform DSC liabilities by contract quoted by I5. As of I8 and I12, due to the limited time for bid submission, bidders do not have sufficient time for a detailed site investigation. Also, it is a high-cost involvement activity to review the available DSC risks.

Further, the Contract contains a DSC clause that gives contractual entitlement to claim the DSC risk at actual occurrences, which adds the boundaries to review the available DSC risks. The Contractor did not perform according to the Contract clause - to give the notice of claim at the time - although the Contractor became aware of the DSC at an early stage, as recited by I6. However, as per respondents I3, I4, I7, and I11, the contracts fulfilled all DSC liabilities of the Contract.

4.3.3 Differing Site Condition Disputes in the Design and Build Construction Projects

All respondents were asked to identify DSC Disputes in Construction Projects to fulfil the third research objective. The researcher already provided the DSC disputes identified from the literature to guide the respondents. In addition, modifications and additions gave provisions to respondents to add their experiences related to the DSC dispute types. Accordingly, respondents identified two more disputes, highlighted in Table 4.6. The results of that question are presented in a tabulated form.

Table 4.6: Differing Site Condition Disputes in the Design and Build Construction Projects

Item	DSC Dispute	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12
Type 1													
1	Ambiguity in Contract documents contains indicators of due conditions.	X	√	√	X	X	√	√	√	√	√	√	X
2	Limitations that the Contractor must be able to act in a reasonably prudent manner while interpreting contract documents.	√	√	X	√	√	√	√	√	√	√	√	√
3	The Contractor has failed to rely on contract indications reasonably.	√	√	X	X	√	X	X	X	X	√	√	√
4	Identifying the conditions encountered differs materially from those specified in the contract documents.	√	√	√	√	X	√	√	√	√	√	X	√
5	Analyse the physical conditions encountered belonging to the condition of reasonably unforeseeable.	X	X	√	√	√	√	√	√	√	√	√	X
6	To determine the degree of the difference are the actual conditions from those conditions that should have reasonably been expected.	X	√	√	√	√	√	√	√	√	X	X	√
7	The Contractor failed to give proper notice and did not do a timely file.	√	√	√	X	√	√	X	X	X	X	X	X
8	Existence of exculpatory/disclaiming contractual language.	X	√	√	√	√	X	X	√	√	√	√	√
9	The Contractor failed to investigate the site.	√	√	X	X	√	√	X	X	√	√	√	√
10	Practically do not have enough time to do the detailed site investigation at bid time.	X	X	X	√	X	X	X	X	X	X	X	X
11	Contractor's failure to investigate the site during the bid period.	X	X	X	√	X	X	X	X	X	X	X	X

Type 2													
1	Deciding on the condition would be different from what a reasonably experienced Contractor would be acting on a similar type of work in the contract.	×	√	√	NA	NA	×	NA	NA	NA	NA	NA	NA
2	Reasonableness of the general knowledge of the Contractor, experience, and competence in site investigation.	√	√	√	NA	NA	√	NA	NA	NA	NA	NA	NA
3	Establish that conditions experienced significantly deviated from the norms for the work.	√	√	√	NA	NA	×	NA	NA	NA	NA	NA	NA
4	Disputes while the Contractor delivers notice to the holder when he experiences a DSC, but before the condition is concerned.	√	√	√	NA	NA	×	NA	NA	NA	NA	NA	NA

After analysing the result of DSC disputes related to Type I condition, the most occurred DSC dispute is “Limitations that the Contractor should be acting in a reasonably prudent manner when interpreting contract documents”. Out of 12 respondents, 11 respondents agreed with this DSC dispute parameter.

The second highest DSC dispute is “Identifying the conditions actually experienced differential materially from those showed in the contract documents”. Ten respondents identified this as a DSC dispute root. The third highest DSC disputes are “Analyze the physical conditions encountered belongs to the condition of reasonably unforeseeable”, “Determine the degree of the differences are the actual conditions from those conditions which should have reasonably been expected”, and “Existence of exculpatory/disclaiming contractual language” which nine out of 12 respondents agreed.

The least DSC dispute is the dispute that occurred due to the Contractor’s failure to give proper notice and do timely filing. Only six respondents agreed with this DSC dispute. The ambiguity in contract documents contains indicators of due conditions, and the Contractor’s failure to investigate the site is the equally scored DSc dispute, which is in fourth place. The fifth-ranked DSC dispute is “Contractor has failed to reasonably rely on the contract indications”, as agreed by 50% of respondents.

The DSC disputes of Type II conditions rarely exist in the projects, as per the research findings. Eight of 12 respondents have quoted that Type II conditions have not occurred in their projects. Of the respondents who identified Type II conditions, the highest quoted DSC dispute is “Reasonableness of the general knowledge of the Contractor, experience, and adequacy of site investigation”, where all respondents (04 nos) agreed. Three out of four respondents agreed on “Found that conditions identified remarkably diverged from the norms for the particular type of work and established that conditions encountered pointedly deviated from the norm for the specific type of work”. The least Type II DSC dispute is “Decide on the condition would totally deviate than what a reasonable professional Contractor might expect in performing the similar work in the contract”.

4.3.4 Reasons for DSC disputes in the Design and Build Construction Projects

The next question was to identify the reasons for the DSC disputes in the project.

According to I1 comments on reasons for the DSC dispute of the project, the Contractor has purposely misused the dispute resolution process to gain undue business benefits from the prospective investors of the company by showing healthy company accounts, including the part of undue claims. The four respondents, I3, I4, I7, and I11, stated that ambiguity in the Contract document with exculpatory and DSC clauses where the Engineer/Employer does not accept the DSC claims is the main reason for the dispute. Respondents I2, I8, and I9 quoted that the Contractor did not perform a detailed soil investigation, included foreseen DSC risk cost to bid, and did not verify the Employer-provided geological data in a technical capacity; such are the reasons for the DSC dispute.

Analysing the literature findings state that the highlighted reasons in Table 4.7 are hosted by interviewers during the interview.

The results produced by each respondent are as follows:

Table 4.7: Reasons for DSC Disputes in the Design and Build Construction Projects

Item	Reasons for DSC Dispute	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12
Type 1													
1	The Contractor purposely misuses the dispute resolution process to gain undue business benefits from the prospective investors of the company by showing healthy company accounts, including the part of undue claims.	✓	×	×	×	×	×	×	×	×	×	×	×
2	The Contractor did not carry out a detailed soil investigation and added foreseen risk of such cost to bid during the bidding stage.	×	✓	×	×	×	×	×	✓	✓	×	×	×
3	Ambiguity in Contract document with exculpatory and DSC clause, Employer Requirements, Site Investigation Reports, where Engineer/Employer did not accept the DSC claims.	×	×	✓	✓	×	×	✓	×	×	×	✓	×
4	The Contractor did not verify the Employer-provided geological data in a technical capacity.	×	×	✓	✓	×	×	✓	×	×	×	✓	×
5	Limitations of the soil profiles and borehole data provided by the Employer along with the Tender Document.	×	×	×	×	×	×	✓	✓	×	×	✓	×
6	The Employer did not conduct a proper feasibility/soil investigation study at the bidding stage.	×	×	×	×	×	×	✓	✓	×	✓	✓	×
7	The Contractor did not clearly understand the bid document and could not identify the DSC events.	×	×	×	×	✓	✓	×	×	×	×	×	×
8	No specific contract clause regarding the change/variation of DSC parameters.	×	×	×	×	×	×	×	×	×	×	×	×
9	The Employer did not select the most appropriate procurement system for DSC risk transfer to the Contractor.	×	×	×	×	×	×	✓	×	×	×	×	×
10	The Consultant's interpretation of the DSC clause is not fair and reasonable and favours the Employer.	×	×	×	×	×	×	×	×	×	×	×	×
11	Employer-provided borehole data has significant deviations from the actual site data.	×	×	×	×	×	×	×	×	✓	×	×	×
12	Sudden changes in the soil profile cause deviance from the detailed design.	×	×	×	×	×	×	✓	×	×	×	×	×
13	The Employer did not recognise changes in soil parameters as unforeseen physical conditions.	×	×	×	×	×	×	✓	×	×	×	×	×

The four respondents, I7, I8, I10, and I11, stated that the limitations of the soil profile provided by the Employer along with the Tender Document and not performing the proper feasibility/soil investigation study at the bidding stage are the leading causes for DSC disputes.

As of I5 and I6, the primary reason for the DSC dispute is that the Contractor did not clearly understand the bid document and failed to identify the DSC events. Other than that, no specific contract clause regarding the change/variation of DSC parameters directs to DSC disputes. Respondent I7 stated that the Employer did not select the most appropriate procurement system for DSC risk, and transfer to the Contractor also led the project to DSC disputes.

Supplementary reasons provided by the respondents to DSC disputes in their projects are (1) the Consultant's interpretation of the DSC clause is not fair or reasonable but favours the Employer, (2) Employer-provided borehole data having major deviations from the actual site data, (3) Sudden changes in the soil profile cause to deviate the detailed design, and (4) Employer did not recognise changes in the soil parameters as unforeseen physical conditions.

4.3.5 Management of DSC Disputes in Design and Build Projects

The main objective of this research is to manage the DSC disputes in Design and Build projects by identifying the Contractual and Technical parameters to control the DSC disputes through the literature and obtaining respondents' reviews through a questionnaire.

According to respondents' results, "to manage the Ambiguity in contract documents", the proposed contractual solutions include the DSC clause as, Contract - Owner Bears the Risk, DSC Clause included in Contract - Contractor tolerates the Risk, Geotechnical Information Disclaimers provided in the Contract, DSC Conditions quarried at Pre-Bid Meeting, Obtain service of qualified Contract Administrator at Tender Stage, specify variation in case of change quantity, Ambiguities address at pre-bid meetings, and Manage DSC risk with Provisional Sum. Technical solutions were also proposed as geotechnical Information Disclaimers provided in the Contract,

which refer to all essential documents and drawings associated with site conditions by both Contractors. The risk is to be managed by Technical and Contractual experts.

The dispute of limitations that the Contractor's duty is to act in a reasonably sensible manner when understanding and interpreting contract documents to be managed through contractual parameters like Differing Site Condition Clause included in Contract - Owner Bears the Risk, the Differing Site Condition Clause included in Contract - Contractor Bears the Risk, Contractual condition of duty to investigate site by Contractor, Geotechnical Information Disclaimers provided in the Contract, refer all contractual documents at the bid stage and risk allocation for DSC risk, refer all contractual documents at the bid stage and risk allocation for DSC risk, Clearly define and explain the methodology, scope, risk rear responsibility of bidders to the bidders at bidding time. In addition, technical solutions like pre-bid meetings and visits to the site and proper inspections by Contractors, participation of qualified experts to make reports on geotechnical investigations, connection with the latest technologies to submit reports, and employment of Contract Experts during the bidding stage to interpret the contract document until completion.

The DSC dispute of 'Contractor failed to reasonably rely on the contract indications' can be treated with contractual constraints of Differing Site Condition Clause included in Contract - Owner Bears the Risk, Differing Site Condition Clause included in Contract - Contractor Bears the Risk, Contractual condition of duty to investigate site by Contractor, Exculpatory clauses in Contract, Geotechnical Information Disclaimers provided in the Contract, and Imposed contractual clause barriers and define consequences to the Contractor in such cases.

Table 4.8 presents the results of Contractual Parameters to Manage DSC Disputes in Design and Build Projects identified through the research. In the respective table, the highlighted parameters are introduced by the interviewers.

Table 4.8: Contractual Parameters to Manage DSC Disputes in Design & Build Projects

Ref. No.	Contractual Parameters	DSC Dispute												
		Type 1									Type 2			
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13
1	Differing Site Condition Clause included in Contract -Owner Bears the Risk	✓	✓	✓	×	×	×	×	✓	✓	×	×	×	×
2	Differing Site Condition Clause included in Contract -Contractor Bears the Risk	✓	✓	✓	×	×	×	×	✓	×	✓	✓	×	✓
3	Contractual condition of duty to investigate site by Contractor	×	✓	✓	×	×	×	✓	×	✓	×	×	✓	×
4	Claim Notice Requirement	×	×	×	×	×	×	✓	×	×	×	×	×	✓
5	Exculpatory clauses in Contract	×	×	✓	✓	✓	✓	×	✓	×	×	×	✓	×
6	Geotechnical Information Disclaimers provided in the Contract	✓	✓	✓	✓	✓	✓	×	✓	✓	×	×	×	×
7	DSC Conditions, DSC ambiguities quarried at Pre-Bid Meeting	✓	×	×	×	✓	×	×	×	×	×	×	×	×
8	Required to specify variation in case of change quantity	✓	×	×	×	×	×	×	×	×	×	×	×	×
9	Manage DSC risk with Provisional Sum	✓	×	×	×	×	×	×	×	×	×	×	×	×
10	Refer to all contractual documents at the bid stage and risk allocation for DSC risk	×	✓	×	×	×	×	×	×	×	×	×	×	×
11	Clearly define and explain the methodology, scope, risk rear responsibility of bidders to the bidders at bidding time	×	✓	×	×	×	×	×	×	×	×	×	×	×
12	Imposed contractual clause barriers and defined consequences to the Contractor in such cases	×	×	✓	×	×	×	×	×	×	×	×	×	×
13	Establish and interpret technical parameters at pre-bid meetings	×	×	×	✓	×	×	×	×	×	×	×	×	×
14	Add different material parameters to the Contract Document, Ex: Rock Hardness	×	×	×	✓	×	×	×	×	×	×	×	×	×
15	Required to elaborate transparently for D&B quantity in the bid document	×	×	×	×	✓	×	×	×	×	×	×	×	×
16	Importance of involving the Contract Administrator throughout the project	×	×	×	×	×	×	✓	×	×	×	×	×	×
17	DSC condition is an ongoing process, and hence time bar does not matter	×	×	×	×	×	×	✓	×	×	×	×	×	×
18	Identify the limitations of exculpatory/disclaiming clauses if available	×	×	×	×	×	×	×	✓	×	×	×	×	×

19	The Employer has to give reliable data and give permission to use such data for bidding purposes	×	×	×	×	×	×	×	×	✓	×	×	×	×	×
20	Notify the exculpatory notice at the bid time to all bidders	×	×	×	×	×	×	×	×	✓	×	×	×	×	×
21	Analyse the reliability level of the Employer-provided site data and allocate risk accordingly	×	×	×	×	×	×	×	×	×	✓	×	×	×	×
22	Add DSC risk to the tender price	×	×	×	×	×	×	×	×	×	✓	×	×	×	×
23	Design not to be approved	×	×	×	×	×	×	×	×	×	✓	×	×	×	×
24	Required to specify variation in case of change in quantity in bid document for underground site conditions	×	×	×	×	×	×	×	×	×	×	✓	×	✓	×
25	Indicate foreseen differing site conditions in the Contract, then easy to know real unusual conditions	×	×	×	×	×	×	×	×	×	×	×	✓	×	×
26	The owner shall address such risks in the contract document	×	×	×	×	×	×	×	×	×	×	×	×	×	✓
DIS.	D1 - Ambiguity in Contract documents contain indications of conditions to be experienced; D2 - Limitations upon which the Contractor must be able to act in a reasonably prudent manner when interpreting contract documents; D3 - Contractor has failed to rely on the contract indications in a reasonable manner; D4 - Identifying the conditions actually encountered differ materially from those indicated in the contract documents; D5 - Analyse the physical conditions experienced, must be reasonably unforeseen; D6 - To determine the degree of the difference are the actual conditions from those conditions which should have reasonably been expected; D7- Contractor failure to give proper notice not timely filed; D8 - Existence of exculpatory/disclaiming contractual language; D9 - Contractor failure to site investigation; D10 - Decide on the condition would be unknown, unusual, and different from what a reasonable Contractor would expect in doing the type of work involved in the contract; D11- Reasonableness of the general knowledge of the Contractor, experience, and adequacy of site investigation; D12 - Establish that conditions experienced remarkably deviate from the norms for the particular work; D13- Disputes while Contractor to provide notice to the Employer when he encounters a DSC, but before disturbing the condition.														

Identifying encountered circumstances materially different from those specified in the contract documents is another DSC dispute. The following technical solutions are proposed to mitigate this DSC dispute: pre-tender site visits and inspections by Contractors, engagement of qualified professionals to prepare geotechnical reports, establishing and interpreting technical parameters at a pre-bid meeting, and getting expert advice at the bidding stage to interpret DSC.

The proposed contractual solutions are exculpatory clauses in the Contract, geotechnical information disclaimers provided in the Contract, and adding different material parameters to the Contract document, ex: rock hardness and defining soil/rock parameters.

Analysing actual conditions experienced must be reasonably unforeseen. It can be mitigated with exculpatory clauses in the Contract, geotechnical information disclaimers provided in the Contract, elaborate transparently for D&B quantity in the bid document, understanding the possible site deviations at the bidding stage by both parties, and establishing a way of measuring and method of proof for DSC circumstances.

The available technical solutions to mitigate the DSC disputes that occurred due to the degree of difference are the actual conditions from those conditions. They should have reasonably been expected to do proper site investigation at the bidding stage and get technical expert views, and exculpatory clauses in the Contract and geotechnical information disclaimers provided in the Contract are proposed contractual parameters.

Table 4.9 summarises the available technical parameters to manage the DSC disputes in Design and Build projects. The interviewers introduced the highlighted technical parameters during the interviews.

Table 4.9: Technical Parameters to Manage the DSC Disputes in Design & Build Projects

Ref. No.	Technical Parameters	DSC Dispute												
		Type 1							Type 2					
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13
1	Geotechnical Information Disclaimers provided in the Contract	✓	×	×	×	×	×	✓	✓	×	✓	×	×	✓
2	Referring to all the necessary documents and drawings related to the site conditions by Contractors	✓	×	×	×	×	✓	✓	✓	×	✓	×	×	✓
3	Pre-tender site visits and inspections by Contractors	×	✓	✓	✓	×	×	×	✓	✓	×	×	×	×
4	Engagement of qualified professionals to prepare geotechnical reports	×	✓	×	✓	✓	✓	×	×	×	✓	✓	✓	×
5	Experiences of both Consultant and Contractor under the general conditions of the project location	×	×	✓	✓	✓	✓	×	×	✓	✓	✓	✓	×
6	Involvement of up-to-date technologies to prepare geotechnical reports	×	✓	×	✓	✓	✓	×	×	✓	✓	✓	✓	×
7	DSC risk is to be managed by Technical and Contractual experts throughout the project, especially those with experience in similar projects	✓	×	✓	×	×	×	×	×	✓	×	×	✓	×
9	Disqualified Bidders during bid selection	×	×	✓	×	×	×	×	×	×	×	×	×	×
10	Get expert advice at the bidding stage to interpret DSC	×	×	×	✓	×	×	×	×	×	×	×	×	×
11	Understand the possible site deviations at the bidding stage by both parties	×	×	×	×	✓	×	×	×	×	×	×	×	×
12	Establish a way of measuring and method of proof of DSC circumstances	×	×	×	×	✓	×	×	×	×	×	×	×	×
13	Do proper site investigation at the bidding stage and get technical expert views	×	×	×	×	×	✓	×	×	×	×	×	×	×
14	Educate site staff about the importance of proper claim notices and maintain contemporary records	×	×	×	×	×	×	✓	×	×	×	×	×	×
15	Encourage bidders to do pre-bid site investigations and allow time during the pre-bid period for the bidder's site investigation	×	×	×	✓	×	×	×	✓	×	×	×	×	×

16	Employer to provide only raw data and not to provide analysed, interpreted site investigation information	×	×	×	×	×	×	×	×	√	×	×	×	×	×
17	At the bidding stage, educate the bidders; bidders should receive clarifications	×	×	×	×	×	×	×	×	√	×	×	×	×	×
18	Involvement in proper site investigation activities with qualified technical staff	×	×	×	×	×	×	×	×	×	×	√	×	×	×
19	Establish technical parameters related to DSC	×	×	×	×	×	×	×	×	×	×	√	×	×	×
20	The contract should list the DSC risk types and the ones covered under a CAR policy	×	×	×	×	×	×	×	×	×	×	√	×	×	×
21	Educate the bidding team about specific project geological risks at the tender stage	×	×	×	×	×	×	×	×	×	×	×	√	×	×
22	The adequate sit investigation work related to borehole investigation for rock classification	×	×	×	×	×	×	×	×	×	×	×	√	×	×
23	Do the proper site investigation and get into the knowledge area of general site conditions	×	×	×	×	×	×	×	×	×	×	×	×	√	×
24	Define Type II conditions which can foresee in the project	×	×	×	×	×	×	×	×	×	×	×	×	√	×
25	Clarity about the time of occurrence of differing site condition events relevant to the project with knowledge of technical experts	×	×	×	×	×	×	×	×	×	×	×	×	×	√
26	Knowledge of the contract team about notice requirements and fellow up by higher management	×	×	×	×	×	×	×	×	×	×	×	×	×	√
DIS.	D1 - Ambiguity in Contract documents contain indications of conditions to be experienced; D2 - Limitations that Contractor must be able to act in a reasonably prudent manner when interpreting contract documents; D3 - Contractor has failed to rely on contract indications in a reasonable way; D4 - Identifying the conditions actually encountered differ materially from those indicated in the contract documents; D5 - Analyse psychical conditions experienced must be reasonably unforeseen; D6 - To determine the degree of the difference are the actual conditions from those conditions which should have reasonably been expected; D7- Contractor failure to give proper notice, not timely filed; D8- Existence of exculpatory/disclaiming contractual language; D9 - Contractor failure to investigate the site; D10 - Decide on the condition that would be unknown, unusual, and different from what a reasonable Contractor would expect in doing the type of work involved in the contract; D11 - Reasonableness of the general knowledge of the Contractor, experience, and adequacy of site investigation; D12 - Establish conditions experienced remarkably deviate from the norms for the particular work; D13- Disputes while Contractor to provide notice to the Employer when he encounters a DSC, but before disturbing the condition.														

Contractor failure to give proper notice not timely filed can be controlled via the contractual condition of duty to investigate the site by the Contractor, claim Notice Requirement, involve the Contract Administrator, refer all the required drawings, specifications and documents related to the DSC of the site by Contractors, instruct site staff about the requirement of having an of appropriate claim notices, maintaining all contemporary records, and geotechnical information disclaimers provided in the Contract. Some respondents stated that the DSC condition is an ongoing process, so the time bar does not matter.

The exculpatory/disclaiming contractual language is one of the major disputed factors. It could be managed through contractual factors by identifying the limitations of exculpatory/disclaiming clauses if available, DSC Clause included in Contract - Owner Bears the Risk, DSC included in Contract - Contractor Bears the Risk, Contractual condition of duty to investigate site by Contractor, Claim Notice requirement, exculpatory clauses in Contract, Geotechnical Information Disclaimers provided in the Contract, the Employer has to provide reliable data and give permission to use such data for bidding purpose, and notify the exculpatory notice at the bid time to all bidders. Further, technical parameters such as allowing a pre-bid period for the bidder's site investigation, Employer to provide only raw data and not to provide analysed, interpreted site investigation information, at the bidding stage educated the bidders and further bidders also need to get clarifications, geotechnical information disclaimers provided in the Contract.

The failure of the Contractor to investigate the site is a DSC dispute which should be mitigated. As of the analyses, data responses proposed the following contractual and technical solutions to control the dispute to some extent:

Analyse the reliability level of Employer-provided site data and allocate risk accordingly, add DSC risk to the tender price, design not to be approved, allow provisional sum to allocate DSC risk, encourage bidders to do pre-bid site investigations, pre-tender site visits and inspections by the Contractor party, the experience of both Consultant and Contractor on the general conditions of the project being supported, and contributions of new technologies to make geotechnical reports.

Type II DSC disputes were also analysed, and suitable contractual and technical solutions were proposed in this research. Accordingly, deciding on the condition would totally deviate and unusual from what a reasonable Contractor would undertake in the type of work engaged in the Contract; this can be diminished via the involvement of appropriate site investigation activities with qualified technical staff, establishing technical parameters related to DSC, the contract should list the types of DSC risks and the ones covered under CAR policy, specify variation in case of change in quantity in bid document for underground site conditions, and providing geotechnical information disclaimers in the Contract.

Reasonableness of the general knowledge of the Contractor, experience, and adequacy of site investigation can be treated by applying, indicating foreseen differing site conditions in the Contract, then easy to know real unusual conditions, get an expert view in the bidding stage, educate the bidding team about specific project geological risk at tender stage, adequate site investigation work related to borehole investigation for rock classification.

Further, it revealed that the confronted conditions have remarkably deviated from the norms for the specific type of work. DSC disputes can be managed through the Contractual state of duty to investigate the site by the Contractor, exculpatory clauses in the Contract, required to establish the change of quantity in DB contract document contractual parameters, and do the proper site investigation and get into the knowledge area of general site condition.

Analysing all data showed that most proposed contractual parameters to manage the DSC disputes are the Contradictory site condition clause included in the Contract - Contractor Bears the risk, Claim Notice requirement, exculpatory clauses in the Contract, and geotechnical information disclaimers provided in the Contract. Connection of capable professionals to formulate and submit geotechnical reports, knowledge and practice of both Contractor and Consultant on the local circumstances of the project location, contribution of updated technologies to formulate and submit geotechnical reports, and engaging up-to-date technologies to prepare geotechnical reports are the most efficient technical parameters to manage the DSC disputes.

4.4 Discussion

All three selected case studies have Type I DSC conditions. Experts from the industry also stated they have more experience with Type I condition in the Sri Lankan context. They expressed their perceptions about Type I and Type II conditions with their knowledge of DSC in D&B projects. The research identified 13 DSC liabilities to be performed by the D&B Contractors. It revealed the following main DSC liabilities: Correct examination and interpretation of the available site data, keeping contemporary records related to additional time and cost due to DSC, reviewing the Contract and understanding the DSC risk assigned, identifying onerous exculpatory clauses or contract language disclaiming the precision of site data reflected in the tender documents, and performing precise site investigation liabilities.

The DSC liabilities not performed by the D&B Contractors are not performing proper site investigation and not reviewing the DSC risk obliged to the Contractor, not doing site investigation and verifying the Employer-provided data, and neglecting the exculpatory clause quoted by interviewees. The main reasons for the non-performance of DSC liabilities by D&B Contractors are the limited time allocated for the bid stage and bidders having insufficient time for a detailed site investigation, Contractor not adding DSC risk to the bid value since the DSC clause is available in the Contract and high-cost involvement in doing a detailed site investigation.

The Type I DSC main disputes are the limitations the Contractor should be acting in a reasonably prudent manner when interpreting contract documents, identifying the actual conditions experienced and materially different from those shown in the contract documents, analysing the physical conditions encountered with the condition of reasonably unforeseeable, and determining the degree of differences are the actual conditions from those conditions which should have reasonably been expected and the existence of exculpatory/disclaiming contractual language.

The Type II DSC disputes are limited, and “reasonableness of the general knowledge of the Contractor, experience, and adequacy of site investigation” found that conditions identified remarkably diverged from the norms for the particular type of

work and established that conditions encountered pointedly deviated from the norm for the specific type of work” are some of those.

According to the research outcomes, the main reasons for the DSC disputes are ambiguity in the Contract document with exculpatory and DSC clauses where the Engineer/Employer does not accept the DSC claims, Contractor did not perform a detailed soil investigation and includes foreseen DSC risk cost to bid, the Contractor did not verify the Employer provided geological data in a technical capacity.

This research aims to identify the Contractual and Technical parameters to manage the DSC disputes in D&B projects. Fifty-two Technical and Contractual parameters were identified via the research outcome. The identified few contractual parameters are the DSC Clause included in the Contract - owner bears the risk / Contractor bears the risk, exculpatory clauses and Geotechnical Information Disclaimers, DSC Conditions, DSC ambiguities quarried at Pre-Bid Meeting, Required to specify variation in case of change quantity, manage DSC risk with Provisional Sum, refer all contractual documents at the bid stage and risk allocation for DSC risk, clearly define and explain the methodology, scope, risk rear responsibility of bidders to the bidders at bidding time, establish and interpret technical parameters at pre-bid meetings, and employ Contract Administrator throughout the project.

The probable few technical parameters are the engagement of qualified professionals to prepare geotechnical reports, the use of up-to-date technologies to prepare geotechnical reports, disqualified Bidders during bid selection who has not considered the probable DSC risk, getting expert advice at the bidding stage to interpret DSC, understand the probable site deviations at the bidding stage by both parties, educate site staff about the importance of proper claim notice and maintain contemporary records, establish a way of measuring and method of proof of DSC circumstances, encourage bidders to do pre-bid site investigations, and allow time at pre-bid period for bidder’s site investigation.

4.5 Summary

This chapter presents the analysed data collected through structured interviews for all case studies conducted. The analysed data were presented in a structured manner following each objective achieved via each interview question. Findings for the interviews elaborated in relation to the findings obtained through the literature review and finally tabulated the management strategies to mitigate the DSC disputes in the Design and Build projects to achieve the research objective. This chapter directs the development of the conclusion, recommendations, and further research opportunities presented in Chapter 5.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The content of Chapter 5 comprises decisions drawn from research findings described in Chapter 4. Additionally, it provides recommendations to manage the DSC disputes in the Design and Build Contracts to close the research gap. The conclusion illustrates a comprehensive conclusion to each objective set in the research. Further, it includes the general conclusion by adding a more descriptive evaluation of the research aim. The latter part of the chapter explains the limitations of the research. Finally, the chapter identifies the parts that need to be further researched in the DSC sector.

5.2 Overview of the Objectives Achieved in the Study

Each objective of the research stated in subsection 1.4 is concluded with the research findings and methodology adopted to achieve the objective.

Objective 1 - Review what is Differing Site Conditions and their types

This is the first research objective, accomplished from the literature review in detail, as elaborated in Chapter 2. Type I and Type II are the basic types of DSC conditions. Type I conditions are not unusual; in fact, they are known and expected to be present, or they are unknown but usually encountered in such a site (Jensen, 2002).

A condition recognised as Type II is already consistent with an unusual nature, thus materially contradictory from those mostly confronted and recognised as naturally embodied in the contract work (Medsger, 1988; Cibinic & Nash, 1995). The literature disclosed nine Type I DSC disputes and five Type II DSC disputes. Further, the literature survey revealed ten key responsibilities of the Design and Build Contractor towards the DSC. Finally, the literature review notified six from each technical and contractual parameter.

Objective 2 - Investigate the Contractor's liability for the differing site condition in Design and Build Projects

This objective has been realised by validating the collected literature findings through semi-structured interviews. Subtopic 2.4 discussed the literature findings of this objective, the Contractor's liability for the DSC in the Design and Build Projects. It was possible to identify ten key responsibilities quoted by seven researchers regarding the Design and Build Contractors towards the DSC.

Next, a semi-structured interview was conducted with experts to validate the literature findings. The respondents validated the literature findings of ten key responsibilities of the Design and Build Contractor towards the DSC.

The respondents suggested three key liabilities, in which the Contractor is responsible for analysing all possible DSC risks associated with the particular project - Allocating the high-profit margin, and before submitting the bid, bidders should do their detailed site investigation and quote the bid adding DSC risk. In this study, the authors identified thirteen (13) primary responsibilities of the Design and Build Contractors towards the DSC.

Objective 3 - Investigate the fulfilment of the Contractor's liability for the differing site condition in the Design and Build Projects

This objective was successfully satisfied through the semi-structured interview while questioning each respondent whether the D&B Contractor fulfilled the DSC liabilities as per the Contract Terms. If the Contractor does not fulfil the DSC liabilities, identify the non-performing DSC liabilities and then review the reasons for not performing those DSC liabilities through the data collection. The research identified six DSC liabilities as non-perform by the D&B Contractors as of the contract terms. The reasons for each contractual nonperformance were also revealed through data collection.

Objective 4 - Investigate the disputes under the Contractor's Liability for Differing Site Conditions in Design and Build Projects

The methodology adopted for Objective 2 was also followed to realise Objective 4. Initially, a literature survey was conducted, followed by semi-structured interviews to validate the literature facts. The literature identified nine DSC disputes for Type I and four DSC disputes for Type II conditions. Comparing Type I and II conditions revealed that most DSC occurrences are in Type I condition, and Type II conditions produce only a few dispute reasons. The respondents agreed upon all identified disputes in the literature survey and introduced two DSC disputes related to Type II conditions. The respondents who revealed disputes practically do not have enough time to do a detailed site investigation at bid time. The Contractor's failure to investigate the site during the bid period may cause DSC disputes in the Type I condition.

Objective 5 – Investigate the reasons for the above-identified disputes

The interviewees were questioned about the reasons for the DSC disputes identified in Objective 4 of the research. The output was the thirteen reasons quoted by the respondents. The Contractor purposely misuses the dispute resolution process to gain undue business benefits from the prospective investors of the company by showing healthy company accounts, including the part of undue claims.

A few DSC dispute reasons were disclosed through this research findings. The Contractor did not perform a detailed soil investigation and added foreseen the risk of such cost to bid during the bidding stage, ambiguity in contract document with exculpatory and DSC clause, Employer Requirements, site investigation reports, where the Engineer/Employer did not accept the DSC claims, the Contractor did not verify the Employer-provided geological data in a technical capacity, and limitations of the soil profiles and borehole data provided by the Employer along with the Tender Document.

Objective 6 - To propose suitable Technical and Contractual parameters to manage the disputes related to the Contractor under Differing Site Conditions in Design and Build Projects

The final research objective was fulfilled via semi-structured interviews, and its contents were developed based on the literature findings. The literature review exposed six (6) technical and six (6) contractual parameters. Respondents were requested to validate the given DSC dispute management parameters and propose new practical DSC dispute management parameters in contractual and technical views across the identified DSC disputes. The identified parameters were confirmed by the respondents. In addition, the respondents introduced twenty (20) new DSC dispute management parameters for each technical and contractual view aligned to the DSC dispute. This research exposed around fifty-two (52) technical and contractual parameters, which were identified across the DSC dispute type.

As a general conclusion, this research discussed the practical issues of the Design and Build projects presently faced by most Contractors, Employers, and Consultants. Even though Design and Build Contracts transfer all design responsibilities to the Contractor, a contractual and technical gap exists when deciding the DSC occurred in the project. Frequently, the quoted cost and time for the project scope would exceed due to the occurrence of DSC conditions. Then the tolerance and limitations of the Contractor's Liabilities will be a disputed issue.

Hence most projects consist of exculpatory clauses and Geotechnical Information Disclaimers to safeguard the Employer. Even though exculpatory disclaimer clauses protect the Employer, it is a complicated and uncertain matter to read the underground conditions at the pre-bid stage. Even though bidders can price that risk to overcome this practical issue, it is not a suitable decision for them to follow in the competitive bid. Further, timely notice is compulsory to get the claim entitlement in other claims. In the DSC occurrences, as the event is continuously happening and the consequences are not predictable until real work happens, most DSC claims have been positively taken by the Dispute Adjudication/Judicial without considering the time bar.

5.3 Recommendations

Recommendations are focused on managing the DSC disputes in Design and Build Contracts in the following manner.

Pre-Tender Stage Responsibilities

The Employer and the Contractor are responsible for clearly understanding the DSC risk and contractual liabilities in DSC occurrences and doing reliable and effective pre-tender soil/ground/utility investigations. They should get the service of professional Contractor administrators and Geo-Technical experts from the tender stage until the completion stage. The Contractor should closely evaluate the available DSC risk with geological experts, refer to all the tender documents, including supplementary information, and understand the DSC clause if available. Pre-conditional claim requirements to get entitlement for DSC claims are critical aspects to study at the pre-bid phase.

Exculpatory Clauses and Geotechnical Information Disclaimers

If the D&B Contract consists of Exculpatory Clauses and Geotechnical Information Disclaimers, the Engineer/Employer must highlight such clauses. The Contractor should analyse and price such risks to the bid or plan to manage such risks with risk transfer methods.

Site Investigation Responsibility

The contractual liability of investigating the geological/site condition owes to the D&B Contractor in D&B contracts. Hence the D&B Contractor should act positively and effectively to analyse the foreseen DSC risk interlaid with the project in the pre-bid stage, Technical Bid submission, Detail Design Stage, and Construction stage.

Educate the Construction Team about DSC Claim Pre-Conditional Requirements

DSC claims are very costly and time-consuming and involve technical issues. Hence it is imperative to provide knowledge to the technical team about the existing DSC

clause in the Contract, how to keep contemporary records, timely notice requirements, and resources and time plans.

Factors to be considered in Tender Evaluation

It is recommended that the Employer/Consultant evaluate the Contractor's DSC risk management method, consider the Exculpatory Clauses, Geotechnical Information Disclaimers included in the contract, Pre-Site Investigation method, and allocated rating system for those factors in the Tender Evaluation.

5.4 Limitations

This research is limited to the Design and Build projects in Sri Lanka. The results would be entirely different if this study was conducted for Traditional Procurement (Separated Procurement) projects. Further, these selected case studies are contextualizations of the Sri Lanka economic system, where projects are funded through International funds under the loans obtained by the Sri Lanka Government. The Employer uses public money, and thus, it is necessary to maintain accountability and transparency consistently, which can affect the DSC claim process and the attitude of the Claim Management Process.

5.5 Further Research

The following areas are proposed to research in future by considering the limitations of the present investigation:

- Employer's and Contractor's DSC Liabilities in Separated Procurement System.
- Cost and Time effect due to DSC occurrences in Construction projects.
- An effective ARD method for DSC Disputes.

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7. APPENDIX A: INTERVIEW GUIDELINE

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

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Dear Sir/Madam,

Conducting an Interview for M.Sc. Thesis

I am a candidate of M.Sc. in Construction Law and Dispute Resolution from the Department of Building Economics, University of Moratuwa. I am conducting my M.Sc. Research Thesis on the topic of **“Study on Contractor’s Liability under unforeseen Ground Conditions in Design and Build Projects” under the supervision of Prof. Ms Kanchana Perera.** The mode of data collection is deemed as an online semi-structured interview.

The Interviews are conducted with construction industry experts who have in-depth knowledge and experience in the Differing Site Condition claim management process. I have identified you as a potential participant who could provide me with valuable information for this research. Therefore, I would like to interview you for **approximately 25-30 minutes** about 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 interview duration identified in the write-up is different. Please check

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 Thesis. I solicit you to facilitate my research by providing your valuable knowledge and opinion regarding this research topic.

Thank you.

Yours faithfully,

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I.A.D.S.S. WEERAWARDHANA

INTERVIEW GUIDELINE

1. BACKGROUND OF THE STUDY

1.1 *Topic of the Study*

Study on Contractor's Liability under unforeseen Ground Conditions in Design and Build Projects

1.2 *Aim of the study*

The aim of this research is to manage the contractual disputes related to Contractor's Liability under Differing Site Conditions in Design and Build Projects. If the aim is changed following viva ensure that it is changed here also

1.3 *Objectives of the study*

1. Investigate what is Differing Site Conditions and their types.
2. Identify the Contractor's liability for the Differing Site Condition in the Design and Build Projects.
3. Investigate the disputes related to Contractors under Differing Site Conditions in Design and Build Projects.
4. To propose suitable Technical and Contractual strategies to minimize the disputes related to Contractor under Differing Site Conditions in Design and Build Projects.

2. Details of Respondent

Designation: **Contracts Specialist**

Total No of Years in Construction Industry:

No of Years of Experience in D&B Contracts:

No of Years of Experience in Claim Management:

Type of company Contractor Consultant Employer or any other

3. Project and related DSC dispute of the Project

3.1 Brief Description of the Project (Scope, Cost and Time)

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3.2 Contract type and adopted Conditions of Contract

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3.3 Brief description of the DSC dispute in the project

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3.4 Present Status of the DSC dispute

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INTERVIEW QUESTIONS

- “DSC” stands for Differing Site Conditions
- **Type I condition: The Contractor invokes the clause to receive an equitable adjustment to recover costs of performing work due to the existence of conditions other than those indicated in the contract or reasonably expected. (Gregory H. McClure, 2014)**
- **Type II condition: The conditions are not indicated in the contract; they are simply unknown and unusual to the geographical area or trade.**

1. What are the types of Differing Site Conditions Claim occurred in your project?

Item	Contractor’s Liability	Applicability to your project		Modifications	Remarks
		Yes	No		
1	Review the Contract and understand the DSC risk assign	X			
2	Contractually interpret the DSC Clause, if available	X			
3	Identify onerous exculpatory clauses or contract language disclaiming the precision of site information reflected in the bid documents	X			
4	Perform the precise site investigation.	X			
5	Request all site information available to the owner		X		
6	Review all available site information data by Technical Expert				Up to the bidders
7	Correctly examine and interpret the available site data.	X			
8	Quote a possible cost and time for the DSC risk (as allocated) in the Bid.	X			
9	When occurs differing site conditions follow the contract notice requirements.		X		Alleged DSC
10	Keep contemporary records related to additional time and cost due to DSC	X			

Item	Contractor's Liability	Applicability to your project		Modifications	Remarks
		Yes	No		
	Specify any New Liabilities				

Type I Condition or Type II Condition:

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2. What is the Contractor's Liability related to Differing Site Conditions in your project as of the Contract Document?

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3. Does the Contractor fulfil the Liability towards to DSC as of Contract?

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4. If not, which DSC-related liability does not perform by the Contractor?

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5. What are the reasons for not performing Contractor's Liability towards DSC?

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6. What are the reasons for DSC Dispute in your project?

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7. What are the Differing Site Condition Disputes in your project?

Item	DSC Dispute	Applicability to your project		Modifications	Remarks
		Yes	No		
Type 01					
1	Ambiguity in Contract documents contains indications of conditions to be encountered.				
2	Limitations that Contractor must act in a reasonably prudent manner when interpreting contract documents.				
3	Contractor has failed to reasonably rely on the contract indications.				
4	Identifying the conditions actually encountered differ materially from those indicated in the contract documents.				
5	Analyze the actual conditions encountered must be reasonably unforeseeable				
6	To determine the degree of the difference are the actual conditions from those conditions which should have reasonably been expected.				
7	Contractor failed to give proper notice not timely filed				
8	Existence of exculpatory/disclaiming contractual language.				
9	Contractor failure to investigate the site.				
Type 02					
1	Decide on the condition would be unknown, unusual and different from what a reasonable Contractor would expect in doing the type of work involved in the contract				
2	Reasonableness of the general knowledge of the Contractor, experience, and adequacy of site investigation.				

Item	DSC Dispute	Applicability to your project		Modifications	Remarks
		Yes	No		
3	Establish that conditions encountered significantly deviate from the norm for the particular type of work.				
4	Disputes while Contractor to provide notice to the owner when he encounters a DSC, but before the condition is disturbed				

8. The following are the Contractual Parameters and Technical Parameters identified through the literature survey to manage the DSC disputes.

9.

Contractual Parameters	
1	Differing Site Condition Clause included in Contract -Owner Bears the Risk
2	Differing Site Condition Clause included in Contract -Contractor Bears the Risk
3	Contractual condition of duty to investigate site by Contractor.
4	Claim Notice Requirement.
5	Exculpatory clauses in Contract
6	Geotechnical Information Disclaimers are provided in the Contract.
Technical Parameters	
7	Referring to all the necessary documents and drawings related to the site conditions by both consultants.
8	Referring to all the necessary documents and drawings related to the site conditions by both Contractors.
9	Pre-bid site visits and inspections by Contractors.
10	Involvement of qualified professionals to prepare geotechnical reports.
11	Experience of both consultant and Contractor in the local conditions where the project is carried out
12	Involvement of up-to-date technologies to prepare geotechnical reports.

Kindly proposed Contractual and Technical Parameters to manage the DSC Disputes from the above parameters or new parameters as of your experience.

Item	DSC Dispute	Contractual Parameters	Technical Parameters
Type 01			
1	Ambiguity in Contract documents contains indications of conditions to be encountered.		
2	Limitations that Contractor must act in a reasonably prudent manner when interpreting contract documents.		
3	Contractor has failed to reasonably rely on the contract indications.		
4	Identifying the conditions actually encountered differ materially from those indicated in the contract documents.		
5	Analyze the actual conditions encountered must be reasonably unforeseeable		
6	To determine the degree of the difference are the actual conditions from those conditions which should have reasonably been expected.		
7	Contractor failed to give proper notice not timely filed		
8	Existence of exculpatory/disclaiming contractual language.		
9	Contractor failure to investigate the site.		
Type 02			
1	Decide on the condition would be unknown, unusual and different from what a reasonable Contractor would expect in doing the type of work involved in the contract		
2	Reasonableness of the general knowledge of the Contractor, experience, and adequacy of site investigation.		
3	Establish that conditions encountered were significantly deviate from the norm for the particular type of work.		
4	Disputes while Contractor to provide notice to the owner when he encounters a DSC, but before the condition is disturbed	4	

Thank You

Saranga Weerawardhana
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