Building Cost Planning: Best Practices and Insights

BUILDING COST PLANNING: BEST PRACTICES AND INSIGHTS

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University of South Australia

CONTENTS

ACKNOWLEDGEMENT OF PEOPLES AND COUNTRY

Kaurna, Boandik and Barngarla

We respectfully acknowledge the Kaurna, Boandik and Barngarla First Nations Peoples and their Elders past and present, who are the First Nations' Traditional Owners of the lands that are now home to the University of South Australia's campuses in Adelaide, Mount Gambier and Whyalla. We are honoured to recognise our connection to the Kaurna, the Boandik and the Barngarla lands, and their history, culture and spirituality through these locations, and we strive to ensure that we operate in a manner which respects their Elders and ancestors. We also acknowledge the other First Nations of lands across Australia with which we conduct business, their Elders, ancestors, cultures and heritage.

Mihi

Kei te mihi kau ake Te Kunenga ki Pūrehuroa
ki te mana whenua o Ōtehā ki a Ngāti Whātua ki Kaipara
te takahanga o ngā tūpuna e tū nei te papa ako
o Te Kunenga ki Pūrehuroa.
Mei kore ake te tautoko o Ngāti Whātua
hei pōhiri mai i te tini tangata
i ngā tini ahurea e tatū mai nei
ki Te Raki Paewhenua ki te whai i te mātauranga.

ABOUT THE AUTHORS

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Similar cost planning courses were coordinated and taught by her for 3 years in her previous career as a Senior Lecturer in the Department of Building Economics, University of Moratuwa, Sri Lanka. During this period, she has been invited and taught this course at the programs offered by other accredited Sri Lankan higher education institutions as a visiting lecturer. She has worked as a Quantity Surveyor at a major construction company in Dubai, United Arab Emirates for 4 years. The projects involved include a major shopping centre and the Dubai Airport expansion project.

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Dr Kahandawa graduated from the University of Moratuwa, Sri Lanka with a BSc. (Honours) in Quantity Surveying. He has completed his PhD in construction at Massey University. Dr Kahandawa holds a diploma in Project Management from Project Management Solutions, Sri Lanka, and a professional Graduate Diploma in Information Technology from the British Computer Society. He is an Associate Fellow of the UK Professional Standard Framework for teaching and learning support in higher education. He was a project team member and a collaborator of a research project on cost modelling Earthquake Damage Repair Loss Estimation in New Zealand, which received a research grant from Massey University Research Fund. He has authored several publications related to cost modelling with special reference to Earthquake Damage Repair Loss Estimation in New Zealand.

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Dr Rameezdeen is actively engaged with local industries and communities in the built environment and infrastructure, including SA Water, Master Builders SA, Construction Industry Training Board (CITB), Mates in Construction, Sara Construction, Legatus Group of LGA, Forest & Wood Products Australia, and Engineered Wood Products Association of Australasia, for partnership in research, as well as teaching and learning. He is a Council member and UniSA representative of the Australasian Universities Building Educators Association (AUBEA) and has contributed to shaping the teaching–research nexus within the Australasian universities that offer construction management degrees. He has also contributed to enhance online education in construction management as the Associate Dean Online Education at UniSA Online to design, create and implement new online degree programs in Construction Management that have gained huge success. He has been invited to serve on committees with work extending beyond research to shape professional practice related to construction management.

He is an Associate of the Royal Institution of Chartered Surveyors (UK) and Associate of the Australian Institute of Quantity Surveyors (AIQS). He was a Member of the Board of Directors for the Construction Industry Development Authority (CIDA), which as the construction industry regulator, functions under the Ministry of Construction and Engineering Services of Sri Lanka. He was a Member of the Technical Committee for the development of national standards in Sri Lanka, including Standard Methods of Measurement for Building Work and Civil Engineering, Construction Cost Estimating Guidelines (CIDA), and Construction Contractor Grading Criteria (CIDA). He has also been invited to be a part of the Judges Panel for the annual National Awards for Construction Excellence by CIDA and to cater as the Hon. Secretary of the Institute of Quantity Surveyors Sri Lanka (IQSSL).

Mr Don Leelarathne has 20 years' major project experience, having worked in Australia, the Middle East and Sri Lanka. Currently, he serves as a Director of the Project Cost Management Group (PCMG), Victoria, Australia. His expertise includes Capital and Recurrent Cost Planning, Feasibility Studies, Bills of Quantities, Procurement Selection, Value Management, Tax Depreciation, Bank Reports and Contract Administration. His sector experience includes Research Facilities, Hospitality, Healthcare, Education, Commercial, Mixed Use and Residential Developments. He specialises in the areas of Cost Planning and Feasibility Studies for large scale commercial projects.
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Mr Leelarathne has also been involved in major PPP projects in Australia, mainly in the Health, Education and Research sectors. Victorian Integrated Cancer Care Centre and National Bio Research Centre are recent projects he has been involved in under PPP procurement. He is a Fellow Member of the Australian Institute of Quantity Surveyors (FAIQS) and a Member of the International Cost Engineers Council of Australia (ICECA) and a Fellow Member of the Royal Institute of Chartered Surveyors (FRICS). He is also a Registered Building Practitioner with the Building Practitioner Board Victoria and a Registered Tax Practitioner (QS) with the Tax Practitioners Board, Australia. He extends his industry expertise to cater to professional development bodies and academic institutions in various capacities. He is the current Councillor and APC Chairman of the Victorian and Tasman chapter of the Australian Institute of Quantity Surveyors, an APC Assessment Panel Member of the RICS and a Quantity Surveyor Registration Assessor for the Victorian Building Authority. Mr Leelarathne is also a Guest Lecturer at the University of Melbourne and RMIT University in Cost Management courses.

Dr Inoka Withana Gamage is a Senior Associate Contracts Manager at Jacobs, New Zealand, with over 2 decades of experience in Quantity Surveying, commercial management, and program governance. He is a Chartered Quantity Surveyor and a member of NZIQS, RICS, and IQSSL, and has worked in several countries, including New Zealand, the United Kingdom, Qatar and Sri Lanka.
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Dr Gamage's areas of expertise include Quantity Surveying, Commercial Management, Procurement & Contracts, Program Governance, and Sustainability. He is also an accomplished researcher, with a focus on Procurement & Contracts, Waste, and Sustainability. He earned his doctoral degree from Loughborough University, United Kingdom, and completed his Quantity Surveying degree with first class honours at the University of Moratuwa, Sri Lanka.

Dr Gamage is highly respected in the field of Quantity Surveying and Commercial Management, known for his exceptional skills in managing complex projects. He has made significant contributions to the industry and continues to inspire and benefit his colleagues.

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CHAPTER 1: CONSTRUCTION INDUSTRY

1.0 Introduction

The construction industry is vast and unique compared to other industries, such as manufacturing. This chapter introduces the construction industry in general, including its nature and key stakeholders. The industry deals with different types of construction, including buildings and infrastructure. The chapter expands its focus on the building sector among various construction sectors. It provides a closer view of the Australian and New Zealand building construction, where the cost planning activities in this book are focused.

1.1 Overview of the construction industry

The construction industry encompasses construction, demolition, renovation, maintenance, and repair of building and civil engineering works, including various associated services ranging from planning, designing, controlling and managing. The construction industry inherits unique characteristics, given its nature.

1.1.1 Construction industry characteristics

The construction industry is heterogeneous, which means each product/type is customised. Construction projects involve a huge range of inputs, including materials, labour, plant and equipment. They are also affected by a range of other factors, such as site conditions and market conditions. The industry is also fragmented, where raw materials, suppliers, manufacturing plants and construction sites are scattered across the globe. Even though the construction industry can be characterised as unique, complex, high cost, and high risk, which complicates innovations, the industry flourisheswith technological advancements and impressive achievements across the globe, including stunning cityscapes, skyscrapers, massive infrastructure and sustainable construction every day. Its pragmatic, resilient and responsive characteristics enable rebuilding the industry for steady and rapid growth amid disruptions from disasters such as the COVID-19 pandemic and natural hazards.

1.1.2 Stakeholders in construction

The construction industry consists of a range of internal and external stakeholders. They can also be known as direct and indirect stakeholders. This categorisation can be varied based on the nature of the construction project and its type of contract. Key direct internal stakeholders in a construction project are the client, contractor/builder and consultant. Subcontractors and suppliers are also categorised as direct stakeholders. Some examples of indirect stakeholders are local, state and federal government departments and agencies, local communities, financing entities, industry associations and advocacy groups. The end users are considered indirect stakeholders in typical projects, who ultimately use or occupy the building or infrastructure. A few examples are employees who work in a new office building and drivers who use a new highway. However, their needs are important considerations for a construction project.

Interesting facts

- In some projects, 'end users' can be considered direct stakeholders. For example, in large mixed development projects where different spaces are leased to various end users, interior fit-outs are designed and installed as per the requirements of those end users. There can be individual interior fit-out projects within the large development where end users become direct stakeholders.
- The government is an indirect stakeholder in typical private sector projects, but the government will be the client for many public sector projects.

The roles and significance of key direct internal stakeholders are discussed in this section and will be referred to throughout the book.

Client

- The client is the initiator and the owner of the project.
- The government is often known as the biggest client in a country.
- An individual or an organisation can act as a client in the private sector.

Note: In Australian and New Zealand Standard Forms of Contracts, the client is referred to as 'Principal'.

(Standards Australia, 1997; Standards New Zealand, 2023).

Note: The contractor carries out the actual construction. In this part of the world, the term 'Builder' is used interchangeably with the term 'Contractor'.

Contractor

- The contractor will have a binding agreement with the client to physically execute the project.
- A contractor can be an individual, an organisation, or a collection of organisations.

Note: In different parts of the world, Standard Forms of Contracts refer to the client's representative using different terms:

- 'Superintendent' in the 'Standards Australia' Forms of Contracts (AS 4000-1997)
- 'Standards New Zealand' Forms of Contracts (NZS 3910: 2023) specifies 2 roles – 'Contract Administrator' as the client's representative and 'Independent Certifier' as the neutral party
- 'Engineer' in the International Federation of Consulting Engineers (FIDIC) Construction Contract (2nd ed., 2017 Red Book, reprinted 2022 with amendments)

Consultant

- The consultant is appointed by the client as the client's representative.
- Consultants are professionals who provide expert advice and administer the project, ensuring the project is delivered according to the client's requirements and project specifications.

The client may engage one or more consultants in different project stages depending on the project's complexity and requirements.

Professional consultants can be Project Managers, Architects, Engineers, Surveyors, Cost Managers and Legal Advisors.

1.1.3 Economics in construction industry

The construction industry is one of the major industries which significantly contributes to a nation's economy. According to Research and Markets (2022), the expected growth in the global construction industry is estimated as $10.5 trillion by 2023 and the growth rate is 4.2% from 2018 to 2023, where the largest share of the growth takes place in China and Asia-Pacific region (Craig, 2022). The global construction industry market is expected to grow at a rate of 9.8% until 2026 (The Business Research Company, 2022).

1.2 The construction industry in Australia and New Zealand

Australia and New Zealand are unique in their construction industry characteristics. This section provides some country-specific information, including industry contributions to countries' economies, professional bodies and industry standards.

1.2.1 Australian construction industry

The construction industry is one of the fastest growing industries in Australia with a significant influence on the country's economy. The Australian construction industry contributes to 9% of country's gross domestic product (GDP), with an annual growth rate of 2.4% projected from 2022 to 2027 (Parker Brent, 2022).

According to Australian Construction Industry Forum (ACIF) 2022 updates, the industry has been attaining a rapid recovery with unexcepted industry growth after the significant disruptions faced during the pandemic.

1.2.2 New Zealand construction industry

The construction industry plays a major role in New Zealand's national economy. According to the Ministry of Business, Innovation and Employment (2023) [PDF], the construction sector accounted for

6.7% of GDP in 2022, with a 4.3% growth rate over the last few decades. A comparison of the GDP growth of total industries and construction in New Zealand can be seen in **Figure 1.1**.

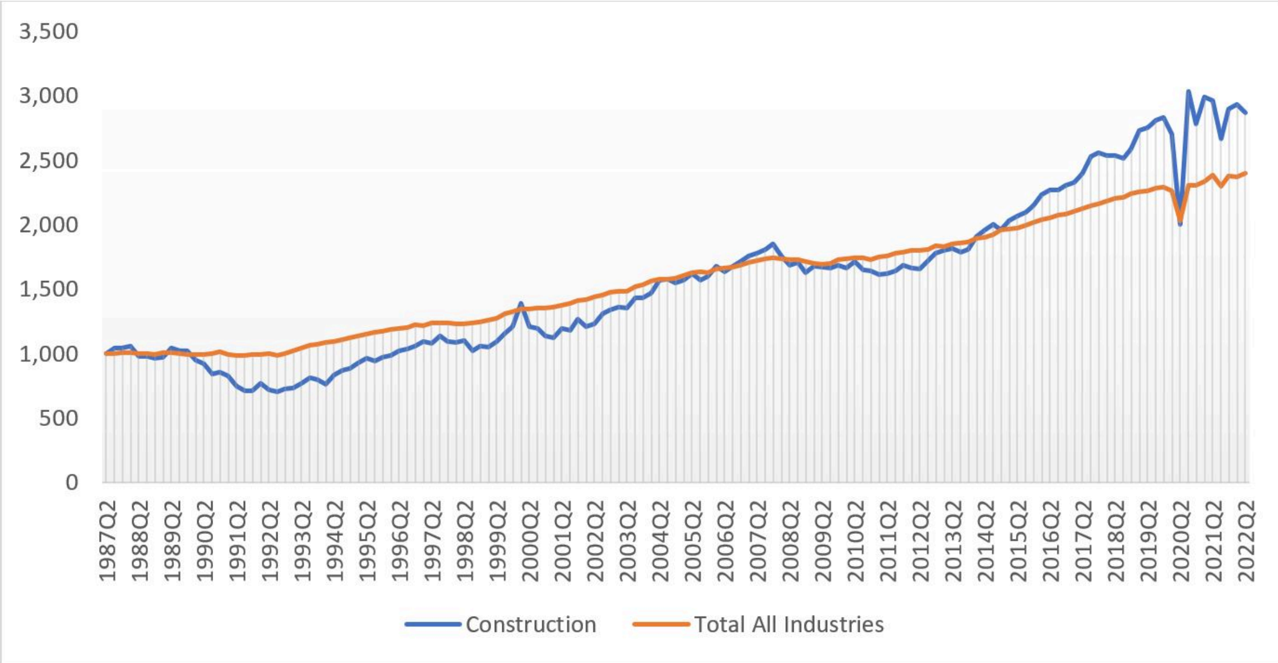


Figure 1.1: Seasonally adjusted quarterly GDP indices, created from data provided by [Statistics New Zealand (2022)](), licensed under a [CC BY 4.0 International licence]().

Interesting facts

In Australia and New Zealand, a larger percentage of construction businesses consist of small traders. For example, small traders account for 98% of the Australian construction industry (Master Builders Australia, 2021), and in New Zealand, 94% of construction-related enterprises have less than 10 employees (Statistics New Zealand, 2022).

1.2.3 Professional bodies

Professional bodies provide leadership and guidance related to a profession in an industry. These can be professional regulatory bodies, and other bodies such as professional associations each serve different functions. Regulatory bodies have the legal authority to enforce laws and regulations related to a particular industry or profession. They act with the intent of protecting the public interest. However, professional associations act with the intent of serving the interests of their members. Professional bodies promote the professional development of the respective professions in the construction industry and establish professional standards for technical and ethical competence. These bodies also contribute to educating and developing the skills of professionals, thereby ensuring that the professionals' contribution to the industry is up to the acceptable level to meet the industry requirements.

Some professional bodies in Australia and New Zealand are introduced in this section.

Australia

Standards Australia

Standards Australia is Australia's leading standards organisation, which represents the International Standards Organization for Standardization (ISO) and International Electrotechnical Commission (IEC). This organisation aims to establish standards, engage in the creation and acceptance of various international standards, and evaluate and sanction other entities to formulate Australian standards.

Australian Building Codes Board (ABCB)

ABCB is a standard writing body responsible for the National Construction Code (NCC), WaterMark and CodeMark Certification Schemes, and regulatory reform in the construction industry. It ensures safe and sustainable building and plumbing industries through regulatory and non-regulatory measures.

Master Builders Australia

Master Builders Australia is a national body which represents the interests, viewpoints and contributions of all sectors in the construction industry, to promote best practices in building and construction.

Australian Institute of Building (AIB)

AIB promotes excellence in the construction industry through education, training and professional development of construction managers and other professionals involved in the building and construction industry.

Royal Australian Institute of Architects (RAIA)

RAIA promotes excellence in architecture through education, training and professional development of architects in Australia.

Australian Institute of Quantity Surveyors (AIQS)

AIQS is a peak professional body which sets standards, codes and ethics and provides education for professionals working in the fields of cost planning, quantity surveying, cost estimating, contracts administration and construction management.

Engineers Australia

Engineers Australia is responsible for setting standards for engineering education and professional practice. It provides accreditation for engineering education programs.

Green Building Council of Australia (GBCA)

GBCA is a non-profit organisation established to lead and promote the sustainable transformation and environmental practices of the built environment. GBCA developed the Green Star rating system, which is a voluntary certification program that measures the sustainability of buildings and developments.

New Zealand

Ministry of Business Innovation and Employment (MBIE)

MBIE is a New Zealand ministry focused on growing New Zealand's economy and businesses, improving government policy, providing public services, creating regulations and sharing advice.

Standards New Zealand

Standards New Zealand supports creating standards, codes and practices for products and services. This organisation also created different types of Standard Forms of Contracts for buildings and civil engineering construction such as NZS 3910:2023, NZS 3917:2013, NZS 3915:2005.

New Zealand Institute of Building (NZIOB)

New Zealand Institute of Building is a charitable trust representing the construction industry in order to improve its performance, research, innovation and development of individual professionals.

New Zealand Institute of Quantity Surveyors (NZIQS)

NZIQS regulates and supports professional development of members such as quantity surveyors, estimators and cost managers.

New Zealand Institute of Architects (NZIA)

This organisation represents most of the registered architects and promotes architecture in New Zealand.

Building Research Association of New Zealand (BRANZ)

Building Research Association of New Zealand is a science-led organisation. It was set up under the Building Research Levy Act in 1969 to support research to create a building system that delivers better outcomes for all.

Master Builders

This organisation represents builder firms and advocates for standards for construction trade practices in New Zealand.

Association of Consulting and Engineering

This non-profit membership organisation aims to support consultants as a collective group, improve preparedness and uphold the professionalism of consultancy firms.

New Zealand Green Building Council (NZGBC)

This is a non-profit organisation dedicated to improving the use of green building practices in the construction industry.

Engineering New Zealand

Engineering New Zealand is a non-profit membership association. It is dedicated to promoting the interests of engineers and engineering professionals by actively engaging in relevant discussions and representing its members' viewpoints on current matters.

Masterspec

Masterspec supports design practices by providing specification systems for New Zealand's construction industry.

Site Safe New Zealand

This organisation supports maintaining health and safety in construction and high-risk industries through research, training, consultancy and auditing services.

1.2.4 Standards

Standards are formulated by groups of experts in order to codify best practices, methods and technical requirements of an industry. Standards help maintain professional and public interests.

Australia

National Construction Code (NCC) is Australia's primary standard that provides guidelines for the technical design and construction provisions of buildings. NCC encompasses minimum performance requirements that should be fulfilled when constructing buildings in relation to the structure, fire safety, access and energy efficiency, health and amenity, etc. All buildings in Australia should comply with the requirements mentioned in NCC.

Australian Standards (AS) is a set of voluntary documents developed and maintained by Standards Australia, that consists of specifications, procedures and guidelines for the Australian Construction industry. They have developed Standards Forms of Contracts for building and construction such as AS 4000-1997 General Conditions of Contract and AS 4902-2000 General Conditions of Contract for Design and Construct (D&C). Some examples of other industry standards are AS/NZS 1170: Structural design actions; AS/NZS 3500: Plumbing and drainage and AS/NZS 3000: Electrical installations.

New Zealand

In New Zealand, all work related to buildings must comply with the New Zealand Building Code. These codes help maintain the safety, health and durability of the occupants and users. The building code is enforced by the Building Act 2004. Building consent authorities assess the plans and specifications and check if they comply with the building code. When building consent authorities are satisfied that the proposed building meets the regulations, building consent is given. The building consent confirms that the building plans meet building code requirements (Ministry of Business Innovation and Employment, 2023).

Construction projects in New Zealand should also comply with Standards New Zealand like Construction Contracts Act 2002, Building Regulations Act 1992, and Construction Contracts Amendment Act 2015.

Interesting facts

There are other guidelines and manuals published by professional bodies to guide industry best practices.

For example, the Australian Cost Management Manual (ACMM) has been published by the

AIQS and endorsed by the Australasian Procurement and Construction Council Inc. (APCC) for cost management practices in construction projects. Similarly, the NZIQS has published an elemental analysis of the costs of building projects.

Currently, Australian and New Zealand professional bodies are working in collaboration to publish industry guidelines. For example, a strategic alliance between Australian and New Zealand professional bodies has published the Australian and New Zealand Standard Method of Measurement of Building Works (ANZSMM) and Australia and New Zealand Building Information Modelling (BIM) Best Practice Guidelines.

1.3 Building sector

According to the Department of Economic and Social Affairs of United Nations (2008), buildings are one of the complete products in the construction industry. Among different types of construction, the scope and the purpose of a building are mainly human occupancy, in contrast to a non-building which is a structure developed for other purposes. Buildings are predominately categorised as 'residential' and 'non-residential'. The scope of building projects varies from a single-storey residential dwelling/commercial warehouse to a skyscraper.

According to The Business Research Company (2022),the building sector acquires a major portion of the global construction market, accounting for 48.1% of the total market in 2022. Development of the building sector has been promising, with a 10.6% growth rate predicted from 2021-2026.

Reflection task

Consider the following questions to review what you have learned in this chapter.

1. Which different forms of contracts mentioned in this chapter did you already know about? What new ones did you learn?
2. What are the similarities and differences in the construction sector that you can identify in both countries under the following topics?
    - size of the industry

- professional organisations
- standards.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://oercollective.caul.edu.au/building-cost-planning/?p=55#h5p-3

CHAPTER 2: COST MANAGEMENT OF BUILDING CONSTRUCTION PROJECTS

2.0 Introduction

This chapter provides an overview of the concept of cost management and highlights the importance of cost planning in building projects. The chapter starts by identifying the goals of a construction project. The chapter then clearly defines the terms 'price', 'cost' and 'value' and highlights that each term has its own attributes in understanding the concepts in cost management. It also defines the term 'Budget' as the most common and important aspect of cost planning. Then the chapter briefly discusses the cost management process across different phases of a construction project. The chapter also briefly explains different procurement methods that can vary some activities in the cost management process.

2.1 Goals of a construction project

The client's primary objectives for a construction project are to obtain the final product within the agreed cost, time, and quality targets. These objectives are interconnected and are clear benchmarks to judge a project's success or failure. The relationships of these objectives can be illustrated in a triangle, often called the '**golden triangle in construction**'. These 3 objectives are illustrated and explained in **Figures 2.1a** and **2.1b**.

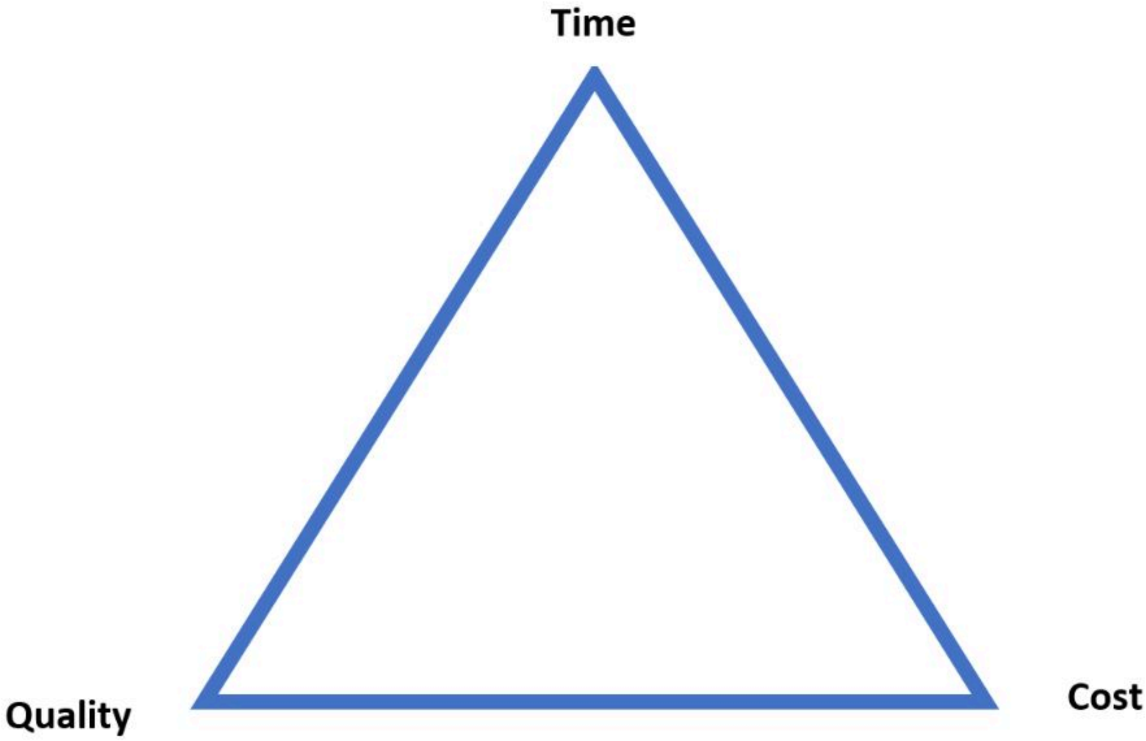


Figure 2.1a: Golden triangle in a construction project (Source: Created with reference to Yu et al., 2006)

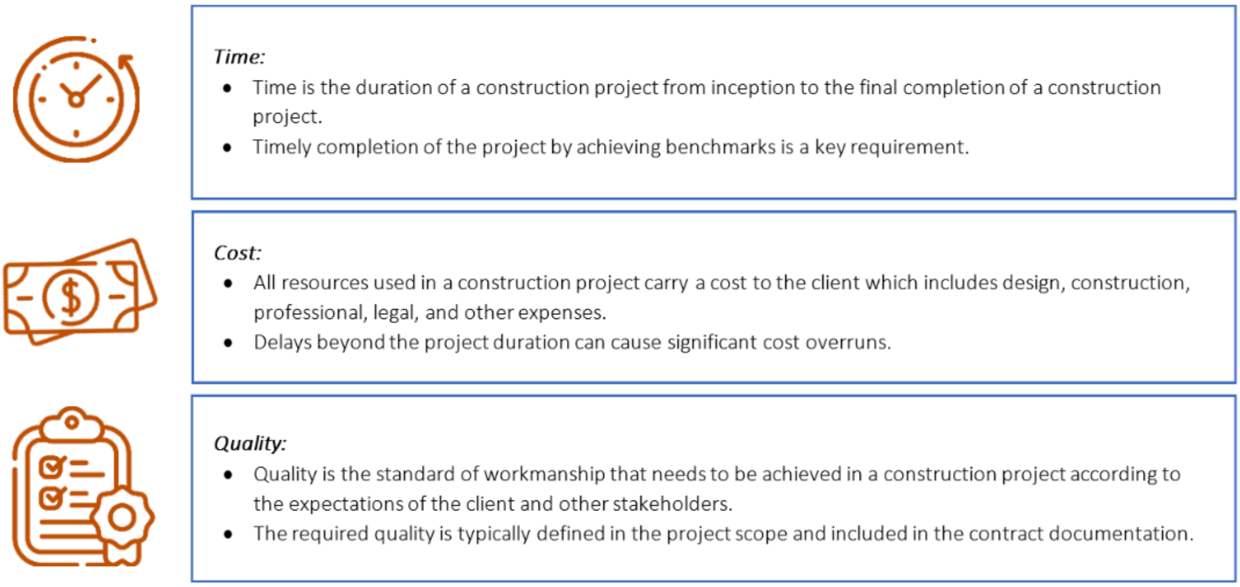


Figure 2.1b: Cost, time and quality: Objectives of a construction project (Source: Created with reference to Yu et al., 2006)

Clients do not have unlimited funds or time to achieve high-quality construction fulfilling their needs. Therefore, a construction project requires estimated time and cost limits when achieving the quality requirements, so the project is considered within the client's acceptable limits. There are trade-offs between

3 objectives and the client can attain value for money in a project by balancing time, cost and quality. However, achieving these 3 objectives simultaneously is not a simple task and is known to be very complex.

Scenario: Balancing time, cost, and quality

- If a client wants to **reduce construction time**, it can be done by **increasing the number of labourers and machinery** in work. This will **increase the cost of the work**. However, **new construction methods and technologies can be introduced** to **reduce the cost**.
- Structural integrity is a must for a quality project and cannot be compromised by cost savings. If so, it will result in safety issues, and high maintenance costs. Using some **economically advanced technologies** could potentially change the specifications and provide **an economically sound and effective structural design without compromising quality**.
- The workmanship required for fine arts or finishes such as cornices, architraves, and other decorative elements consumes a **considerable amount of time**. The **quality of these elements cannot be compromised** due to the time required. However, by **using precast elements** instead of in-situ construction, **time savings** are possible.

Each resource used in a construction project carries a cost. The client is financing the project and the amount of money that the client has allocated or can afford for a project is known as the client's 'budget'. The rule of thumb is not to exceed the client's budget. Hence, the cost can be identified as the governing factor of time and quality of construction.

2.2 'Price', 'cost', 'value' and 'budget'

Price, cost, value and budget are common terms when costing a construction project and sometimes are used interchangeably. However, each of these terminologies carries a different meaning in the construction industry. The difference occurs based on the client's and contractor's perspectives (see **Figure 2.2**). The contractor's cost is all expenses incurred by the contractor for a given project. After adding the contractor's profit to this cost, it becomes the client's cost. This is known as the price that the client pays to the contractor. In cost planning, cost means the price to the client and it can include other costs to the client and goods and services tax (GST). The budget is what is available to spend for a project. Therefore, the cost to the client (price) should not exceed the client's budget. In the cost planning process, the design may need to be refined to maintain the cost within the 'budget'.

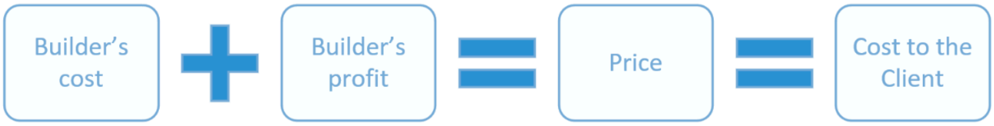


Figure 2.2: Relationship between cost and price, by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a CC BY-NC 4.0 licence.

A project budget can be determined based on the availability of funds.

For public sector projects, government agencies set a project budget based on a master plan and budgetary allocation per financial year.

Scenario: State government budget

The below is an example of a state government in Australia announcing the budget allocated for a hospital project. The project's cost planning should be undertaken within this announced budget.

> '**The Victorian Government is investing $595 million to redevelop and expand the Ballarat Base Hospital.**
>
> The redevelopment will deliver a new emergency department, a women and children's hub, state-of-the-art theatre suite and an extra 100 inpatient and short stay beds. A new and expanded critical care floor will bring together operating theatres, procedure rooms, an expanded intensive care unit, endoscopy suites and consulting rooms. This will deliver capacity for an additional 4,000 surgeries every year. Once completed, the upgraded hospital will have the capacity to treat at least 18,000 more emergency patients and an extra 14,500 inpatients per year.'
>
> — Victorian Health Building Authority, 2024)

Private sector project budgets depend on financial capacity and lending capacity approved by lending agencies (i.e. banks).

Compared to 'price' ,'cost' and 'budget', 'value' is a subjective term. Value is the perceived benefits or worth of construction to the client. Value of a construction project can be considered in terms of economic, social, environmental, political, aesthetic, moral and other factors. A commonly used term is the 'economic value' of the construction project. If the final project exceeds the client's expectations at the minimum possible cost, then the maximum economic value can be attained.

2.3 What is cost management?

As explained in Chapter 1, construction projects are unique and complex in nature. Construction projects involve many resources and long durations compared to other industries which require careful management of cost.

Cost management: Definitions

'The technique(s) used for managing the cost of a project from brief to final account.'

— AIQS (2022, p. 4)

'Cost management of a project includes establishing the budget and then effectively monitoring and reporting against that budget on a regular basis, cost planning the evolving design, preparing appropriate contract documentation and advising on variations and claims during the progress of the project.'

— AIQS (2012, p. 11)

Cost management for a general project is 'the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget'.

— Project Management Institute (2017, p. 231)

Cost management items related to the Quantity Surveyor's role include 'managing finances of any kind of project, keep work within time, and estimated budget; efficiently manage construction cost and production'.

— NZIQS (2023)

Based on these definitions, it is understood that cost management is a series of actions implemented in managing the cost of a project in different stages of the construction project, rather than a one-off activity. Therefore, we can simply say that cost management is a process of managing the cost of a project throughout the project's life cycle. This process is usually explained throughout different stages of a project's life cycle. Cost management might also be called 'cost engineering' in some countries.

2.3.1 Project stages

Different countries and regions follow standard documents or manuals providing categorisation of project stages and functions of each stage.

Royal Institute of British Architects (RIBA) Plan of Work

RIBA is a global professional body in architecture originated in UK. RIBA Plan of Work is a globally known framework that organises the process of managing building projects and administering building contracts. This framework is also followed by cost managers in the UK construction industry and most other countries in their cost management process. Royal Institution of Chartered Surveyors (RICS) has adopted the RIBA Plan of Work in their standards related to the cost management processes and presented in RICS New Rules of Measurement (2021).

OGC (Office of Government Commerce) Gateway Process

The OGC Gateway Process is an alternative to the RIBA Plan of Work by the Office of Government Commerce in UK. Some UK government departments and public sector organisations adopt this framework for designing and managing building projects.

Australian Cost Management Manuals (ACMM)

Australian Cost Management Manuals consist of a series of manuals published by the AIQS and endorsed by APCC for cost management of the construction process. They organise the cost management activities throughout a construction project following its stages.

New Zealand Construction Industry Council (NZCIC) Design Guidelines

NZCIC is a not-for-profit industry association of building, construction and property sector associations. Concerning the poor documentation prevailed in the New Zealand building industry, a committee endorsed by the NZCIC drafted the Design Guidelines. This document specifies the design process of 'building' projects in New Zealand providing general checklists and benchmarks.

Comparison of cost management stages in standard documents

Despite region-specific differences in terms, the standard documents mentioned in this section generally cover the key stages in the life cycle of a construction project. **Table 2.1** compares the cost management stages as given in standard documents in UK, Australia and New Zealand.

Table 2.1: Cost management stages in standard documents (Source: Adapted from New Rules of Measurements 1 (RICS, 2021), Design Guidelines (NZCIC, 2022) and ACMM (AIQS, 2022)

<table>
<tr><th></th><th>Royal Institute of British Architects: Plan of Work 2020</th><th>Royal Institution of Chartered Surveyors: New Rules of Measurement 1 (2021)</th><th>Office of Government Commerce (OGC)</th><th>New Zealand Construction Industry Council</th><th>Australian Cost Management Manual</th></tr>
<tr><td rowspan="2">Pre-design</td><td>Strategic Definition (0)</td><td>Rough order of cost estimate</td><td>Business Justification (1)</td><td>–</td><td>–</td></tr>
<tr><td>Preparation and Brief (1)</td><td>Order of cost estimate(s) (option costs)

Elemental cost estimate</td><td>Delivery Strategy (2)

Design Brief and Concept Approval (3A)</td><td>Project establishment</td><td>Brief (A)</td></tr>
<tr><td rowspan="6">Design</td><td>Concept Design (2)</td><td>Formal cost plan 1</td><td></td><td>Concept Design</td><td>Outline Proposals (B)</td></tr>
<tr><td>–</td><td>–</td><td>–</td><td>Preliminary Design</td><td>–</td></tr>
<tr><td>Spatial Coordination (3)</td><td>Formal cost plan 2</td><td>Detailed Design Approval (3B)</td><td>Developed Design</td><td>Sketch Design (C)</td></tr>
<tr><td>Technical Design (4)</td><td>Formal cost plan 3</td><td rowspan="3">Investment Decision (3C)</td><td>Detailed Design</td><td>Documentation (D)</td></tr>
<tr><td>Contractor Engagement (part of the technical design stage) (4)</td><td>Pre-tender estimate

Pricing documents (for obtaining tender prices)
Post-tender estimate</td><td>Procurement</td><td>Tender (E)</td></tr>
<tr><td>Manufacturing and Construction (5)</td><td>–</td><td>Construction Adminstration and Observation</td><td rowspan="2">Construction (F)</td></tr>
<tr><td>Handover</td><td>Handover (6)</td><td>Formal cost plan (renew/ maintain)</td><td>Readiness for Service (4)</td><td>Post Completion</td></tr>
<tr><td>In use</td><td>In use (7)</td><td>(Measured in accordance with NRM 3)</td><td>Operations Review and Benefits Realisation (5)</td><td>–</td><td>–</td></tr>
<tr><td>End of life</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
</table>

Despite the level of comprehensiveness, different terminologies and different approaches to categorising project stages, the key project stages found in these standard documents are Pre-Design, Design, Construction, Handover, In Use and End of Life. Each stage will be briefly discussed hereinafter.

Pre-design stage/s

Pre-design stage/s provide the project set-up and involve actions before the actual design starts. Client's requirements are communicated in this phase. NZCIC Design Guidelines and the ACMM cover pre-design activities in a single stage. In contrast, RIBA Plan of Work and RICS standard documents cover those in 2 stages. OGC Gateways standard, on the other hand, includes three stages for the pre-design activities, in which the third stage finalises the pre-design stage and continues to the design stage.

Design

Despite different terminologies, all these standard documents show similar categorisations of design stages, except the NZCIC guidelines having a separate stage for preliminary design and the OGC Gateways standard having 3 stages starting from pre-design and also covering the construction stage. The design stages include vital activities in the pre-construction phase in which the design is developed from concept/outline designs to detailed designs. The actual design development can involve several stages until the design is finalised and lead to complete documentation for tender, concluding most of the activities in the pre-construction phase.

Construction

Construction is usually covered through a single stage. Since RICS standard documents focus on cost estimating and planning which are pre-construction cost management activities, they do not mention the construction stage. Yet, the ACMM covers the cost management process and, hence, includes the construction stage.

Handover, In Use and End of Life

RIBA, RICS, OGC Gateways and NZCIC standards contain a separate stage for handover. NZCIC and ACMM do not contain an in use stage. Even though the construction industry practices require whole life cycle costing, including end-of-life work, none of these standards contain this stage yet.

Note: This book follows the cost management stages given in ACMM and NZCIC.

The steps in this section are mostly aligned with the six stages from Stage A to Stage F, presented in the ACMM (Volume 1) cost management line diagram. The line diagram shows the cost management activities carried out in each stage and the output which will be documented and presented to the client.

This line diagram is presented in the Appendix of this book and will be referred to throughout the book.

2.3.2 Cost management process activities

This section covers major steps in the cost management process.

Cost budgeting

According to the ACMM Volume 1 (2022, pp. 4) 'cost budgeting is a method of arriving at the sum of money within which it is expected that the project will be cost planned'. This activity is done at the very beginning of the cost management process to establish the initial budget. Generally, the project design team is responsible for establishing the budget.

Cost planning

The ACMM Volume 1 (2022, p. 4) defines cost planning as:

> a systematic application of Cost Management to the design process between Brief Stage Cost and pre-tender estimate with the purpose of establishing, regulating and reconciling the Project Cost.

Cost planning is not a one-off activity, but a process carried out through the pre-construction cost management stages in line with the design development stages to identify the costs of a construction project. Therefore, different cost planning techniques are used at each stage based on the availability of design details and project information in each stage. At the initial stages, the budget can be expressed as a range due to lack of certainty and will become more accurate with more details in the later stages. Cost planning helps a project achieve acceptable value for money, valuing project risks by creating budgets and cost plans, comparing costs of different alternatives, and controlling the budget throughout the project.

Client's quantity surveyor/cost planner carries out the cost planning activities. However, it needs the continuous involvement of the project design team and other consultants (i.e. services engineers) to provide relevant details and cost components to update the cost plan with the design development.

Note: Cost planning is the focus of this textbook and will be discussed in later chapters along with different cost planning stages.

Tendering

After the design development and cost planning processes, documentation will be completed and the tendering will take place to select the contractor/builder to carry out the construction work. The process is also known as 'bidding' and the competitive contractors/builders will be referred to as 'tenderers' or 'bidders'.

This process generally involves:

1. developing tender documents
2. calling tenders, or inviting preselected bidders
3. contractors filling the bidding documents together with the estimate developed by the contractor's/builder's estimator (providing the price offered)
    a. bidders visiting the site
    b. providing additional information to contractor queries
4. bidders submitting completed bidding documents for evaluation
5. evaluating the bidding documentation by client's team and selecting the suitable contractor
6. final negotiations and signing the contract.

However, there are variants based on the procurement method and types of contracts such as selecting the contractor and negotiating the contract later.

Cost estimating

Cost estimating should not be misunderstood with cost planning. The term 'estimating' is used interchangeably during cost planning but mostly refers to the pricing of a project by the contractor's/builder's estimator to submit as a part of bidding documents.

Cost controlling

Construction projects are unique and complex in nature and involve many uncertainties. Therefore, variations are common in construction projects due to various reasons including changes to client's needs and unforeseeable circumstances. These will impact the project time, cost and quality. After an initial budget has been developed and accepted, cost controlling process would apply for a project. Cost control processes are applied to keep the final cost of the project within the acceptable cost ranges. With the progression of the project, the actual and estimated cost should be compared and the cost plan should be updated. If the cost of the project exceeds or is projected to exceed accepted levels, the client should be informed and action should be taken to make changes to the project construction and procurement process to bring the project to acceptable levels or change the acceptable levels.

It is understood that cost controlling should be conducted so an acceptable budget has been identified and not wait until the construction starts. This is because it is easy to make changes to the project at the initial stages of the project with less cost impact compared to the latter stages. Some changes might require rework, which would impact both project cost and time and require more work to be done in less time.

Final accounts

Final account reflects the final agreed cost of the construction project. Final accounts are developed at the end of the construction project after all work is completed. There will be no changes to the final cost of the construction project after the final accounts have been completed. The final accounts are first developed by the contractor/builder and evaluated by the client or client's representative. All parties to the contract should agree to the cost to be final accounts. When there are multiple contracts to a project, final accounts of all the contracts will be the final accounts of the project. Until final accounts are developed and finalised, all valuation payments for work done are subject to change.

Cost analysis

According to the Building Cost Information Service (BCIS) (2012, p. 9):

> the purpose of cost analysis is to provide data that allows comparisons to be made between the costs of achieving various building functions in a project with those of achieving equivalent functions in other projects.

Cost analysis can be considered as the process of analysing cost data from previous projects so that those data can be used in the cost planning and estimation of new projects.

Standard documents such as BCIS of RICS, ACMM and NZIQS elemental analysis of costs of building projects provide the basis for a systematic cost analysis following the elemental breakdown of building costs. The documents used to prepare the cost analysis should be stated. More often, this is the agreed price for the works – i.e. the priced bill or schedule of prices.

Chapter 5 is about cost analysis of construction projects.

2.3 Procurement methods

The term 'procurement' has broader meanings, but procurement methods in construction explain the contractual arrangements, project financing and payment methods. The selected procurement method for a project affects the cost management process and builder's involvement in different stages. Several characteristics of procurement methods that are commonly used in Australia and New Zealand are discussed below.

Traditional method/Construct only

- Client is responsible for the design and construction documentation and has the full control of the design and project outcome.
- Client engages consultants to undertake full design and documentation.
- Competitive tendering is carried out using the design and documents to select a contractor.
- Cost of tendering for contractors is low due to no design exercises involved during tendering.
- The selected contractor carries out the construction work only.
- Payment is usually based on a lump sum fixed price.

Design & Construct (D&C)

- Client engages a design consultant to prepare a concept or schematic design.
- This schematic design is provided to tenderers to develop as part of the tender process to inform the tender price and program.
- Cost of tendering for contractors may be higher due to cost of design and higher due diligence.
- Contractor is engaged to complete the detailed design and construct the project.
- Contractor bids a program that becomes the agreed baseline for the project.
- Payment method can be a combination of lump sum fixed price, schedule of rates, cost reimbursement, and target cost. A sharing of savings and overruns can involve.
- Contractor is responsible for design and constructability and has greater involvement over the design outcome.

Early Contractor Involvement (ECI)

- Client develops a functional brief which informs a concept or schematic design, and a pre-tender cost estimate for construction.
- Contractors bid a fixed price to develop schematic and/or detailed design during the design phase.
- Cost of tendering is lower because the single contractor is paid a fee for participating.
- Payment is usually based on a lump sum fixed price.
- Collaboration between the contractor and client on design may lead to better overall design outcomes.

Managing contractor

- Client engages a design consultant to prepare concept design.
- Competitive tendering process is used to select a Managing Contractor based on preliminaries, and design and management fee.
- Managing contractor designs the project with client's input and coordinates the construction and project delivery.

- Cost of tendering for contractors is lower compared to D&C mode as there is no up-front tender design involved.
- Subcontract trade packages are competitively tendered by the Managing Contractor.
- Payment is usually based on a lump sum fixed price for Managing Contractor, reimbursement of subcontractor, target cost with a share of gain/pain.
- Greater client influence and input in design, constructability and delivery, reducing the risk that the client's requirements will not be met.

The lump sum fixed payment is applicable for all available methods, given the well-defined project scope. Procurement methods such as construct-only, ECI, D&C and managing contractor use a lump sum fixed price method. While providing the client with the most certainty by minimising the risk of capital expenditure, it allocates most of the risk to the main contractors. In contrast, D&C and managing contractor do not purely rely on a fixed price lump sum method; thus, they follow a combined payment method to reduce the contractor's risk.

Did you know?

Compared to Construct Only, the ECI outcome was considered extremely successful, and the projects were delivered ahead of the contract program and on budget in a COVID-19 environment. The significant involvement of the builder maximises the value for money and improves end-year outcomes.

However, in general, the majority of public sector building construction projects follow the traditional/construct-only method, as the government, as a client, can maintain significant control over the projects.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://oercollective.caul.edu.au/building-cost-planning/?p=72#h5p-4

CHAPTER 3: COST PLANNING TECHNIQUES

3.0 Introduction

Cost planning is carried out in the early stages of the project cost management process, from the very initial brief stage through several design stages until the tender document cost plan. Cost consultants update the cost plans throughout these stages. Therefore, cost planning is not a one-time activity but a process carried out through the **pre-construction cost management phase** of a project. Various cost planning techniques are used in different stages depending on the level of information available. It is important to identify the suitable cost planning technique for each situation.

3.1 Availability of information

As a project evolves from the early design stages to the construction phase, more design details and other project information become available with the design development. Increasing levels of information facilitate increasing levels of accuracy of cost predictions. Therefore, suitable cost planning techniques should be selected as appropriate to the project stage and the available information.

Before discussing various cost planning techniques, let's see what type of information affects the cost of a project.

3.1.1 Type of a project/function of a building

There are different types of construction serving various functions. Building types can be classified as residential, commercial, educational, healthcare, industrial, and so on based on those functions. There are specific requirements for each type of project. This helps identify general and specific requirements of a project which incur various costs.

3.1.2 Size of a project

Project size can be indicated by the floor area, number of floors, and also the number of functional units for certain types of projects. For example, a single house does not have a specific functional unit.

3.1.3 Scope/quality of a project

The terms 'scope' and 'quality' are sometimes used interchangeably. Also, the term 'quality' has other broader meanings.

Examples

Client (Private sector)

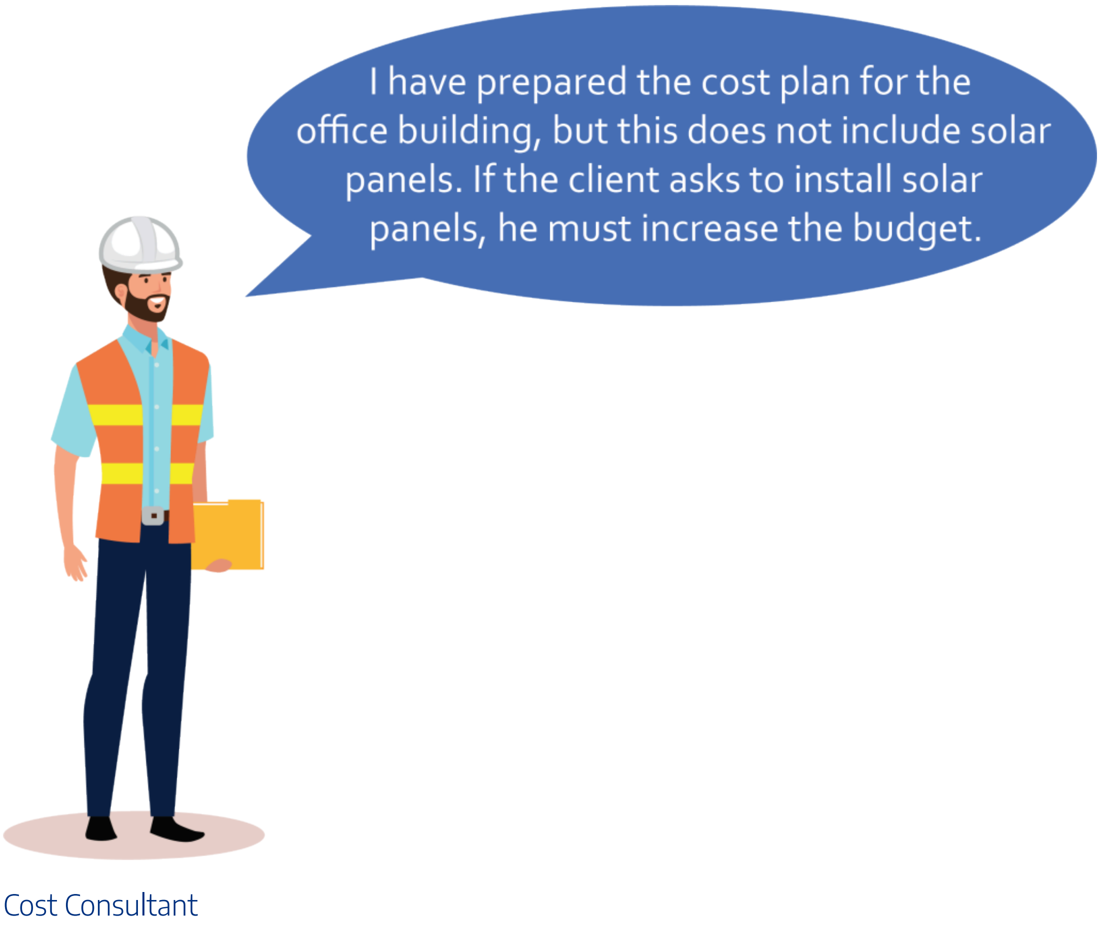
In this example, the type of project is 'hotel', in which the indication of the size of the project comes with 50 guest rooms. It also indicates the quality as '3-stars'.

Star categories indicate different levels of services provided in hotels and thus the quality of buildings and facilities. A 5-star hotel certainly incurs higher costs than a 3-star hotel the same size or accommodating the same number of guest rooms.

Client (Government)

In this example, the type of project is 'hospital', in which the indication of the size of the project comes by accommodating 100 beds. There is no clear indication of the quality, and thus, you need to ask more details from your client. The client can indicate the service level of the hospital which carries different requirements.

The scope should be stated clearly with inclusions and exclusions because any changes to the scope can result in a significant change to the cost, and also misunderstandings can occur by overlooking the cost items.



In this example, the cost consultant states the exclusions. Therefore, the client knows that the cost of solar panels is excluded from the current budget and can have a clear understanding of his financial commitments. Having solar panels can also be considered as an indication of the overall quality of the development.

3.2 Cost planning techniques

Cost planning is usually carried out by breaking down the components of a building/project and pricing them to derive the total cost. This is again based on the cost planning stage and the available information. You can find various cost planning techniques and categorisations in other books. This book will discuss the most common techniques followed in Australia and New Zealand. Cost planning techniques can be broadly classified as budget-setting techniques (in the early design stages to set the budget) and budget-distributing techniques (with detailed designs).

Budget-setting techniques:

- functional unit method
- area method
- functional area method.

Budget-distributing techniques:

- elemental cost planning.

3.2.1 Functional unit method

This is the simplest method that can be used in budget setting, in which only the client's brief is available with the least amount of information. The functional unit is determined based on the project type, which expresses the intended use of the building.

Scenario

Before discussing cost planning construction projects, let's take a simple example from our daily activities.

Scenario: Imagine that you are asked to organise a morning tea for classmates. You expect 20 attendees, and the budget is $500. You wish to cater cupcakes, mini pizzas and fruit juice bottles. You know that some cafes offer discounts, but you prefer some other cafes due to the quality and taste of food. How do you find out whether you can manage this budget?

Tip: First, as you know the budget and number of attendees, you can calculate the cost per person. We called this a '**per head cost**'. Then you can check if your menu is affordable or otherwise make any changes easily by checking the available food prices.

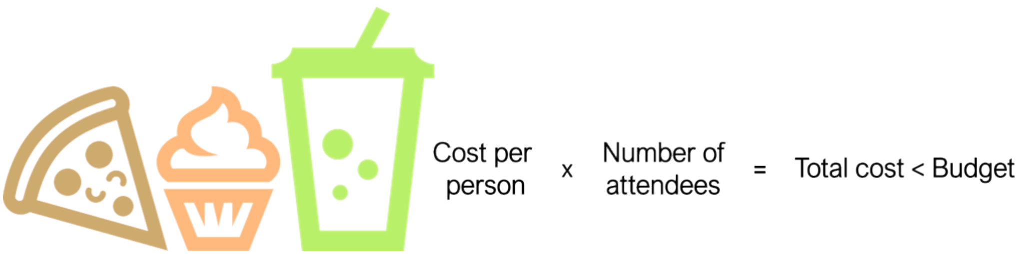


Figure 3.1: Per person cost, total cost and budget, by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a CC BY-NC 4.0 licence.

'Per head cost' in this example is a 'unit cost'. This can also be applied in cost planning construction projects, in which the functional unit is definable.

Functional unit: Definition

'... the units of performance or occupancy for which a building or section of a building is functionally designed' (AIQS 2022, p. 7).

Functional unit is 'a unit of measurement used to represent the prime use of a building or part of a building' (RICS 2021b, p. 25).

This rate method is simple and faster. Since this method does not go into specific details, it will have a lot of limitations in its accuracy. This technique is more appropriate for public projects such as hospitals and schools where a functional unit can be identified.

Examples of functional units are:

- hotel – number of rooms
- car park – parking spaces
- hospital – number of beds
- school – number of students.

It is not meaningful to use in projects where a functional unit cannot be indicated to appropriate the size of the building such as a house (a house for 2 adults and 3 kids does not provide a meaningful functional unit. Size indication of 2-bedroom or 3-bedroom house is not necessarily a functional unit compared to the small size of the building and other functional areas, which are not necessarily proportional to the number of bedrooms).

Also, this rate might not be suitable where all facilities are not equally shared, such as mixed development projects, because functional unit is an item that uniformly represents the building, including main facilities and sub-facilities.

Exercise: Hospital project

A city hospital project had 200-bed capacity and cost $30,000,000. What would be the estimate of a similar city hospital project if it were going to have 110 beds?

Answer

Cost per functional unit (bed) = $30,000,000 ÷ 200

Cost per bed = $150,000

Estimated cost = $150,000 × 110 beds

= $16,500,000 ($16.5 million)

3.2.2 Area method

The area method is also a simple technique of cost planning. This method requires the total area of the building. Usually, the Gross Floor Area (GFA) is applied in this technique. This technique can be used for any building type, including the types where the functional unit cannot be identified.

Gross Floor Area (GFA): Definition

This is the main building area as a sum of all functional areas. There are slightly different definitions and measurement rules given in ACMM (2022) and by NZIQS (2017).

See Chapter 8 for more details about GFA, including measured examples.

Exercise: School project

A school project had a GFA of 850 m^2 and cost $1,785,000. What would be the estimate of a similar school project if it had a GFA of 1,250 m^2?

Answer

Cost per m^2 GFA = $1,785,000 ÷ 850 m^2

Cost per m^2 GFA = $2,100

Total estimated cost = $2,100/$m^2$ × 1,250m^2

= $2,625,000

3.2.3 Functional area method

The functional area method is commonly used in the early cost planning stages.

Functional area (FA): Definition

'Any group of accommodation that has a common work function within a particular type of a building. It includes all circulation necessary within that area' (AIQS 2022, p. 6).

This technique can also be used in any type of building. Despite the common function of the building, various functional areas of a building serve different purposes, and the cost of constructing those functional areas can be varied due to factors such as the method of construction and types of finishes applied.

- In a hospital, bed-based service areas, administration areas and emergency departments are serving various functions related to the health service function of the building.
- In a school, classrooms, playrooms, laboratories and offices are serving various functions related to educational functions of the building.
- In residential buildings, wet areas such as bathrooms require waterproofing and tile finishes, whereas living areas can be finished with timber flooring. The types of finishes used are based on the different functional areas and the cost of construction varies.

Example: Boarding houseproject

Ref.	Functional areas	Area (m^2)	Rate ($/$m^2$)	Cost
a)	Reception and office	36	3,500	126,000
b)	Bedrooms	480	2,800	1,344,000
c)	Bathrooms	100	6,500	650,000
d)	Plant and storage	80	4,000	320,000
e)	Circulation/Travel areas	115	1,800	207,000
Total Building Cost*				2,647,000

*This example only indicates building cost based on the functional areas. Other cost components should be included in the cost plan to calculate the total project cost (See Chapter 6 and Chapter 7 for other costs).

3.2.4 Elemental cost planning

An elemental cost planning is a budget-distributing technique that can be applied when more design information is available. It is based on an elemental breakdown of works and measurement of elements and sub-elements to which rates are applied.

Element: Definition

'A portion of a project that fulfils a particular physical purpose irrespective of construction and/or specification' (AIQS 2022, p. 5).

Sub-element: Definition

'A part of an Element that is physically and dimensionally independent and separable in monetary terms' (AIQS 2022, p. 11).

For example, the element 'External Walls' can be divided into sub-elements such as Brick Walls, Brick Veneer Walls, Concrete Block Walls, In-situ Concrete Walls and so on.

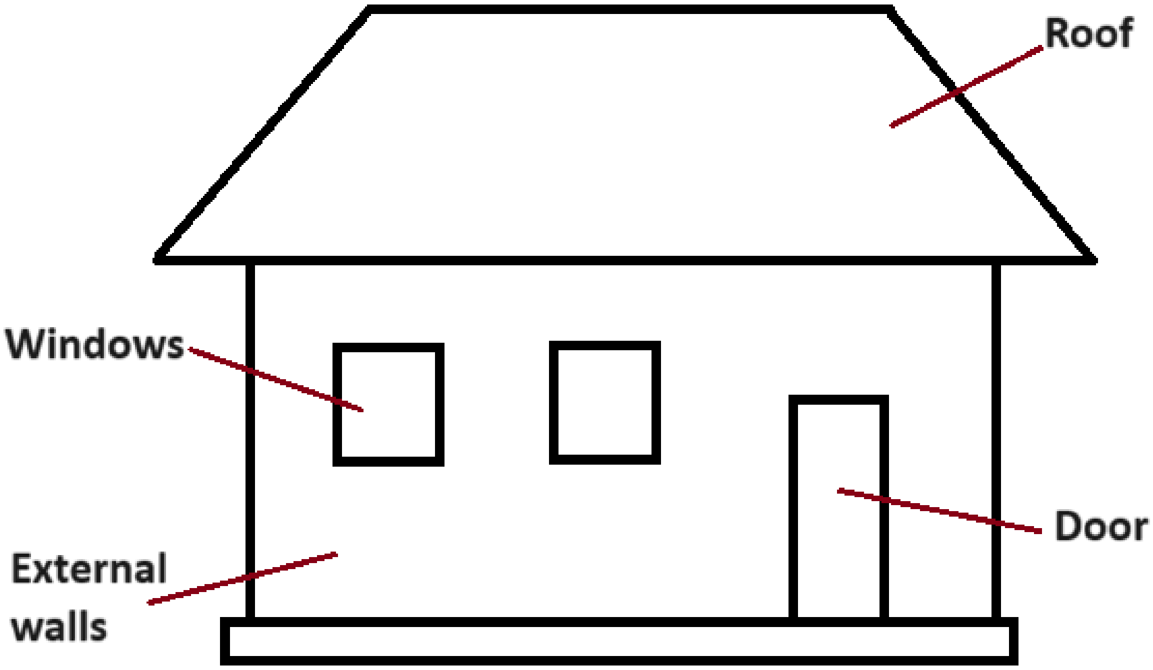


Figure 3.2: Illustration of elements in a building, by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a CC BY-NC 4.0 licence.

According to AIQS (2022), elemental cost planning can be started in a simple form when outline proposals are available. A detailed elemental cost plan can be then prepared in later stages when more details are available and further developed into a tender document cost plan.

Standard documents specify elemental breakdowns and define elements along with the unit of measurement and rules to measure elemental quantities. See Chapter 8 for a comparison of elemental breakdown between AIQS (2022) and NZIQS Elemental Analysis (2017).

Elemental quantity

If the necessary drawings are available, elemental quantities are measured in accordance with the definitions and measurement rules specified in a standard document (See Chapter 8 for measured examples). Otherwise, GFA will be used as the element unit quantity.

Elemental unit rate

The 'Elemental Unit Rate' is often derived by dividing the cost of an element by the Elemental Quantity when a Detailed Elemental Cost Plan is available. It is a cost data interpolated by cost analysing similar previous projects. These cost data should be then adjusted to time, location and quality (See Chapter 4 and Chapter 5).

Elemental Unit Rates are considered benchmark rates for cost planning and provide important cost information.

For example, experienced cost planners can determine whether an elemental rate is realistic for a given type of project in the market at current rates and compared to other benchmark buildings. This helps identify any errors in measurement of pricing .

Elemental cost

Elemental cost is the multiplication of Elemental Quantity and Element Unit Rate. The total cost of the building is then derived as the sum of all elemental costs as shown in **Figure 3.3**. This provides the basis for cost planning and cost controlling and facilitates value management practices.

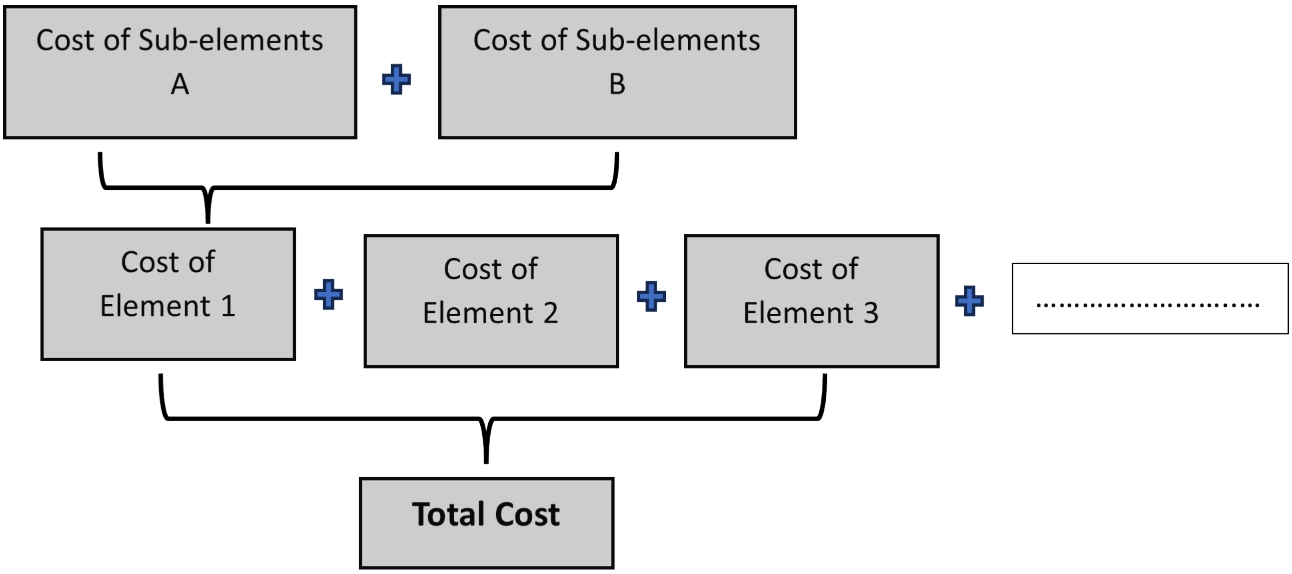


Figure 3.3: Elemental cost breakdown, by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a CC BY-NC 4.0 licence.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://oercollective.caul.edu.au/building-cost-planning/?p=80#h5p-5

CHAPTER 4: BUILDING COST INFORMATION (DATA/INDICES)

4.0 Introduction

This chapter discusses cost data and information that can be used in the cost planning process, including factors affecting construction costs, types and sources of cost data/information, and their use in different cost planning stages. The chapter delves into cost indices, which are a special type of cost data used in the cost planning process.

4.1 Cost data and information

A prerequisite of any kind of cost management system, including cost planning, is the need for reliable cost data in the form of cost information (Smith et al., 2016). In computer science, the difference between data and information was elaborated by Daniel Keys Moran, who is a famous American science fiction writer and programmer as:

> 'You can have data without information, but you cannot have information without data' (Martha & Mary, 2023, p. 3).

In technical terms, cost data are converted to cost information. It should be noted that cost information and cost data need to be understood contextually based on the factors affecting the costs, type and application of cost data/information in different stages of cost planning. **Figure 4.1** is an illustration of the evolution of cost information from cost data in a construction project. However, in the construction context, the terms 'cost data' and 'cost information' are used interchangeably.

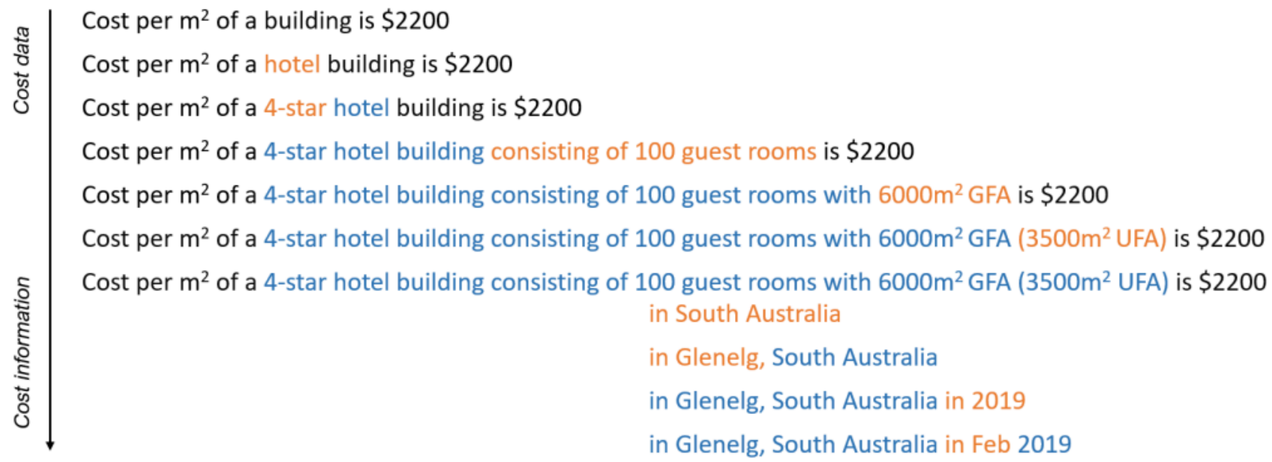


Figure 4.1: Evolution of the level of cost information, by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a CC BY-NC 4.0 licence.

GFA = Gross Floor Area, UFA = Usable Floor Area

As illustrated in **Figure 4.1**, the level of cost information gradually changes as per the level of project and design information available. Initially, the scope and quality level of the hotel are not provided. Later, the number of rooms defines the size and the star grade defines the quality level of the hotel. The specific location and time further define the scope and hence, increase the comprehensiveness of cost information. It further improves when the floor area is refined, and by the end with the confirmed GFA.

4.2 Factors affecting construction costs

There are a range of factors affecting construction costs in different contexts and hence, these should be reflected in cost information. Most of the sources of cost information (i.e. published) offer averaged cost information for typical scenarios, and hence, care must be taken when using such generic cost information and adjustments may be needed based on the factors affecting the cost data such as size and quality of project, location, market conditions, type of procurement and unusual/different features or circumstances. Therefore, this section provides the understanding of those factors.

Type and size of project

The type (i.e. residential, commercial) and size (i.e. number of storeys) of a building can significantly impact its cost, for example:

- Single storey administrative office building
- Single storey primary school building
- Two-storey office building
- Multi-storey apartment building.

Location

Costs can heavily depend on the geographical location of the project due to many factors such as:

- economic conditions
- availability of labour (or transportation from other locations)
- change in labour productivity through travel and other external influences
- availability of materials (in the locality or otherwise transport from other states/countries)
- regional workloads of contractors
- accessibility (confined sites)
- environmental factors (climate, topography, geology)
- local government restrictions
- industrial allowances for working on remote sites
- taxation.

Example: Location

- In the Adelaide CBD, construction costs can be higher due to confined access to sites and traffic management compared to regional areas. On the other hand, resource shortages (i.e. labour and materials) in regional areas can affect the cost.
- In New Zealand, compared to Auckland, projects in Whangārei should have a higher cost since contractors are typically based in Auckland, and they have to travel to that area.

A locality index will be applied to adjust available cost information considering these factors (see **Section 4.3.1**).

Market conditions

The overall economic conditions, including inflation rates, interest rates, currency exchange rates, and market trends, can affect the cost of the project. Economic recessions or booms can influence the availability and cost of resources and services.

Example: Market conditions

- The cost of labour varies based on factors such as labour supply and demand, skill level required, labour union agreements, and prevailing wage rates in the area.
- Similarly, the cost of materials is subject to fluctuations due to changes in supply and demand, market conditions, raw material prices and transportation costs.

Cost data published at a certain point in time may become outdated due to above conditions, and should be adjusted for the current prices. Price Indices are used for these adjustments (see **Section 4.3.1**). Moreover, given the nature of construction projects with longer durations, appropriate escalation factors should be applied in cost planning.

Unforeseen circumstances

Due to the unique nature of construction projects, construction costs are highly influenced by unforeseen circumstances and may incur additional costs. Factors such as complex designs, special materials, challenging site conditions, regulatory compliance, or environmental considerations can contribute to high risk and extra costs. Therefore, cost information should be adjusted to cover such conditions.

4.3 Types of cost information

Different types of cost data/information, either unpublishedor published, are used throughout the cost-planning process. These types can be found on several price databases in Australia and New Zealand.

Building cost per m^2 of GFA

Building cost per m^2 of GFA is provided with the type and size of the project.

Example: Building cost per m^2 of GFA

Australia

- Single-storey primary school in Adelaide without air conditioning: $1945-2100 m^2/GFA.

- Single-storey residential house unit in Brisbane with tile roof and built on a flat site with brick veneer wall: $1355-1460m^2/GFA (See Figure 4.2a).

New Zealand

- Primary/middle one storey school, with built-in cupboards and fittings, heating and ventilation, sprinklers, data/IT wiring, toilet facilities in Auckland: $6100m^2/GFA.
- Secondary school up to two storeys, with built-in cupboards and fittings, heating toilet facilities in Wellington: $5500m^2/GFA (See Figure 4.2b).

Figure 4.2a shows some extracts from *Rawlinsons Construction Cost Guide* which capture the building cost per m^2 of GFA in the Australian context.

4.0	**EDUCATIONAL**								
4.1	SCHOOLS (TEACHING)								
4.1.1	PRIMARY - single storey, standard finishes, buildings only, no air-conditioning	...	sqm	1945-2100	1730-1865	2085-2245	1765-1905	1660-1785	1840-1985
6.0	**HEALTH, ETC.**								
6.2	ANCILLARY								
6.2.1	CHILD CARE CENTRE - single storey, standard finishes, no air-conditioning, one playroom per ten children	...	sqm	2090-2250	2140-2310	2335-2515	2005-2165	2090-2250	2130-2300
		...	child	18800-20270	19280-20780	21000-22640	18070-19470	18790-20260	19190-20690
	ADD extra for :								
	External play areas or courtyards with enclosure walls	...	Note						
	Air-conditioning	...	Note						
6.2.2	FAMILY CENTRE - single storey, standard finishes, no air-conditioning, activity areas, small kitchen, etc.	...	sqm	1785-1925	1805-1950	2065-2225	1740-1875	1840-1985	1840-1985
6.2.3	GROUP PRACTICE SURGERY - single storey, standard finishes with consulting rooms, surgery, partial air-conditioning	...	sqm	2270-2445	2225-2400	2490-2685	2175-2340	2275-2450	2340-2525

Figure 4.2a: Building cost per m^2 of GFA in Australia (Source: Rawlinsons Quantity Surveyors, 2023, used with permission.)

Figure 4.2b shows extracts from QV CostBuilder which capture different building cost per m^2 of GFA in the New Zealand context.

Building costs per square metre | Elemental cost of buildings | Cost planning rates | Detailed rates | Pricing Tools | Knowledge Base

per square metre

Education: Schools

Education: Schools

Classroom Buildings

Support Buildings

Education: Schools

Classroom Buildings

Description	Unit	$ Auckland	$ Wellington	$ Christchurch	$ Dunedin	$ Hamilton	$ Palmerston North
Primary or Middle School. Built-in cupboards and fittings, heating and ventilation, sprinklers, data/IT wiring. Toilet facilities							
One storey	m2	6,100 - 6,400	5,500 - 5,800	5,500 - 5,800	5,500 - 5,800	6,000 - 6,300	5,200 - 5,500
Secondary School, up to 2 storeys. Built-in cupboards and fittings, heating. Toilet facilities							
Classrooms	m2	6,100 - 6,400	5,500 - 5,800	5,500 - 5,800	5,500 - 5,800	6,000 - 6,300	5,200 - 5,500
Laboratories	m2	6,100 - 6,400	5,500 - 5,800	5,500 - 5,800	5,500 - 5,800	6,000 - 6,300	5,200 - 5,500

Figure 4.2b: Building cost per m^2 of GFA in New Zealand (Source: QV CostBuilder, 2024, used with permission.)

Building cost per functional unit

Building cost per functional unit is determined based on the functional unit which expresses the intended use of the building.

Example: Building cost per functional unit

Australia

- Single-storey standard finishes, with no air conditioning, one playroom per 10 children: $188,800-20,270 per child.
- Three-storey apartment with one- or two-bedroom units, excluding balconies, no lift, with basic standard finish in Sydney: $134,500-145,000/apartment (See **Figure 4.3a**).

New Zealand

- Car park in multi-storey car park building in Auckland is NZD 26,500-29,500 per $28m^2$ car park (**Figure 4.3b**).

Figure 4.3a shows extracts from *Rawlinsons Construction Cost Guide* which capture the building cost per functional unit in the Australian context.

13.2.2	APARTMENTS - maximum three stories, one or two bedroom units, excluding balconies, no lift -								
13.2.2.1	Basic standard finish	...	sqm	1790-1930	1885-2035	2780-2995	2135-2305	1965-2120	2240-2415
		...	apart.	107500-115900	113200-122000	166800-179800	128200-138200	118000-127200	134500-145000

Figure 4.3a Building cost per functional unit in Australia (Source: Rawlinsons Quantity Surveyors, 2023, used with permission.)

Figure 4.3b shows extracts from QV CostBuilder which capture different building cost per functional unit in New Zealand context.

Building costs per square metre Elemental cost of buildings Cost planning rates Detailed rates Pricing Tools Knowledge Base

		- 2,450	- 2,400	- 2,550	- 2,350	- 2,350	- 2,175

Parking Buildings

Description	Unit	$ Auckland	$ Wellington	$ Christchurch	$ Dunedin	$ Hamilton	$ Palmerston North
Parking Building. Reinforced concrete construction, bitumen paving at ground level, open sides, minimal toilet facilities. Excludes lifts or mechanical ventilation							
Ground plus 1 level parking building	m2	790 - 890	770 - 870	790 - 890	740 - 840	750 - 850	720 - 820
Cost per carpark, at 30m2 per car	car	23,700 - 26,700	23,100 - 26,100	23,700 - 26,700	22,200 - 25,200	22,500 - 25,500	21,600 - 24,600
Ground plus 2 levels parking building	m2	790 - 890	770 - 870	790 - 890	740 - 840	740 - 840	720 - 820
Cost per carpark, at 30m2 per car	car	23,700 - 26,700	23,100 - 26,100	23,700 - 26,700	22,200 - 25,200	22,300 - 25,200	21,600 - 24,600
Multi-Storey Parking Building	m2	940 - 1,040	910 - 1,010	940 - 1,040	870 - 970	880 - 980	850 - 950
Cost per carpark, at 28m2 per car	car	26,320 - 29,120	25,480 - 28,280	26,320 - 29,120	24,360 - 27,160	24,700 - 27,440	23,900 - 26,600

Figure 4.3b Building cost per functional unit in New Zealand (Source: QV CostBuilder, 2024, used with permission.)

Elemental cost per unit

Elemental cost per unit is determined based on the quantity and specification of the building elements in a project.

Example: Elemental cost per unit

Australia

- Substructure of a warehouse low bay letting brick walls: \$123.50/m^2.
- Substructure of a warehouse low bay letting pre-case tilt-up walls: \$109.75/m^2 (See **Figure 4.4a**).

New Zealand

- Substructure of a warehouse under 20m clear span colour steel cladding: \$210/m^2.
- Substructure of a warehouse under 20m clear span 1200mm high precast or block walls with colour steel cladding above: \$209.48/m^2 (See **Figure 4.4b**).

Figure 4.4a shows extracts from *Rawlinsons Construction Cost Guide* which capture the elemental cost per unit in the Australian context.

			8.1.1.1 Warehouse Low Bay Letting Brick Walls		8.1.1.2 Warehouse Low Bay Letting Precast or Tilt-up Walls		8.1.1.3 Warehouse High Bay Letting Brick Walls		8.1.1.4 Warehouse High Bay Letting Precast or Tilt-up Walls	
			$/sqm	%	$/sqm	%	$/sqm	%	$/sqm	%
PRELIMINARIES	...	...	72.00	9.4	66.50	9.2	87.25	9.5	83.25	9.3
SUBSTRUCTURE	...	...	123.50	16.1	109.75	15.2	128.50	14.0	123.50	13.7

Figure 4.4a: Elemental cost per unit in Australia (Source: Rawlinsons Quantity Surveyors, 2023, used with permission.)

Figure 4.4b shows extracts from QV CostBuilder which capture the elemental cost per unit in the New Zealand context.

Building costs per square metre | **Elemental cost of buildings** | Cost planning rates | Detailed rates | Pricing Tools | Knowledge Base

Industrial

- Factories and Warehouses
- Factory or Warehouse with Office
- Cold Stores
- Workshops
- Fuel Storage Installations

Factories and Warehouses

	Warehouse, under 20m clear span, Colorsteel® cladding		Warehouse, under 20m clear span, 1200mm high precast or block walls, Colorsteel® cladding above		Warehouse, over 20m clear span, 1200mm high precast or block walls, Colorsteel® cladding above	
Element/Element Group	$/m2	%	$/m2	%	$/m2	%
Site Preparation	29.70	2.2	29.93	2.1	28.75	2.3
Substructure	210.60	15.6	209.48	14.7	188.75	15.1
Frame	287.55	21.3	286.42	20.1	381.25	30.5
Structural Walls	0.00	0.0	0.00	0.0	0.00	0.0
Upper Floors	37.80	2.8	37.05	2.6	0.00	0.0
Structure	**565.65**	**41.9**	**562.88**	**39.5**	**598.75**	**47.9**
Roof	221.40	16.4	222.29	15.6	188.75	15.1
Exterior Walls, Exterior Finish	197.10	14.6	265.04	18.6	102.50	8.2
Windows and Exterior Doors	52.65	3.9	52.73	3.7	83.75	6.7
External Fabric	**471.15**	**34.9**	**540.06**	**37.9**	**375.00**	**30.0**
Stairs and Balustrades	25.65	1.9	25.65	1.8	0.00	0.0
Partitions	0.00	0.0	0.00	0.0	0.00	0.0
Interior Doors	0.00	0.0	0.00	0.0	0.00	0.0

Figure 4.4b: Elemental cost per unit in New Zealand (Source: QV CostBuilder, 2024, used with permission.)

Sub-elemental cost per unit

Sub-elemental cost per unit is determined based on the quantity and specification of the building sub-elements under each element.

Example: Sub-elemental cost per unit

Australia

- 20MPa concrete for foundation beams in Adelaide: $296/m^3.
- 20MPa concrete for columns in Adelaide: $424/m^3 (See **Figure 4.5a**).

New Zealand

- 20 MPa with 19mm aggregate, standard ready-mixed concrete delivered to site is NZD 372.00/m^3 (See **Figure 4.5b**).

Figure 4.5a shows extracts from *Rawlinsons Construction Cost Guide* which capture the sub-elemental cost per unit in the Australian context.

CONCRETE

Prices for concrete are based on ready-mixed concrete prices and include for delivery to site, handling and placing in position and curing, as well as an allowance for wastage and loss during handling and placing. Refer page 111 for additional allowances to be made for pumping, samples and testing	...	Note						
20 MPa CONCRETE								
Blinding layer, 50mm thick	...	cum	296.00	263.00	372.00	387.00	387.00	422.00
Foundation beams	...	cum	290.00	287.00	311.00	317.00	317.00	343.00
Column or pier foundation	...	cum	296.00	292.00	317.00	319.00	319.00	345.00
Strip footing	...	cum	309.00	292.00	323.00	319.00	319.00	345.00
Raft slab and thickenings	...	cum	297.00	264.00	331.00	336.00	337.00	365.00
Ground slabs and thickenings	...	cum	300.00	267.00	334.00	340.00	340.00	369.00
Suspended slab	...	cum	300.00	264.00	331.00	336.00	337.00	365.00
Walls	...	cum	424.00	307.00	341.00	345.00	349.00	375.00

Figure 4.5a: Sub-elemental cost per unit rates (Source: Rawlinsons Quantity Surveyors, 2023, used with permission.)

Figure 4.5b shows extracts from QV CostBuilder which capture the sub-elemental cost per unit in the New Zealand context.

Building costs per square metre | Elemental cost of buildings | Cost planning rates | **Detailed rates** | Pricing Tools | Knowledge Base

Concrete Work

Concrete Work

General Notes

Supply Rates, Retail

Unreinforced Concrete

Reinforced Concrete, 20MPa

Concrete Filling to Piers and Blockwork

Sprayed Concrete, 30MPa

Samples and Testing

Concrete Finishes

Concrete Additives, Admixtures

Vapour Barriers and Underlay

Concrete Work

General Notes

Rates for concrete include ready-mixed concrete, delivery to site, discount, wastage and loss, handling and placing in position.

Supply Rates, Retail

Description	Unit	Hours	$ Auckland	$ Wellington	$ Christchurch	$ Dunedin	$ Hamilton	$ Palmerston North
Standard Ready-Mixed Concrete Delivered to site								
17.5 MPa, 19mm aggregate	m3		364.00	330.00	272.00	330.00	303.00	310.00
20 MPa, 19mm aggregate	m3		372.00	313.00	275.00	336.00	304.00	265.00
25 MPa, 19mm aggregate	m3		392.00	328.00	279.00	354.00	314.00	272.00
20 MPa, blockfill 13mm aggregate	m3		393.00	371.00	307.00	372.00	355.00	336.00
Historic Rates 20 mpa, 19mm aggregate								
2023 rates	m3		372.00	313.00	275.00	336.00	304.00	265.00
2022 rates	m3		313.00	264.00	246.00	280.00	249.00	239.00

Figure 4.5b: Sub-elemental cost per unit (Source: QV CostBuilder, 2024, used with permission.)

4.3.1 Building cost and price indices

Building cost and price indices are another type of published cost data/information.

> 'Indices are indicators of the performance or behaviour of a factor that is indexed. They are a very useful tools available for estimators to capture the cost and price behaviour of the whole industry, building materials, labour or plant.'
>
> — (Ashworth & Perera, 2015, p. 119)

Price indices are a specific type of cost information developed to make price adjustments considering the factors explained in **Section 4.2**. Since indices are predicted for a certain period from the current point of time, for price fluctuations within the construction project duration, appropriate escalation factors should be evaluated and applied.

Adjusted costs can be calculated as follows:

Adjusted cost for the new project = Cost × Current Index ÷ Base Index

- Base date index number (either tender date or earlier agreed date)
- Current index for the month for which the amount is to be adjusted
- Cost of the labour, plant and equipment and material.

Three types of indices, Building Costs Indices (BCI), Locality Index (LI) and Tender Price Indices (TPI), are discussed in the following sections.

Building Costs Indices

According to AIQS (2022, p.3), 'Building Costs Indices (BCI) is a numerical index relative to a base of 100 that reflects fluctuations in Building Costs and market conditions from the base date.' It represents long-term fluctuations of costs incurred by the contractor, considers the changes in the cost of major construction inputs (labour and materials) and ignores changes in profit levels, overheads, productivity and discounts.

Example: Building cost indices

- BCI for July 2015 in Sydney is 274.
- BCI for October 2023 in Canberra is 427.

Tender Price Indices

Tender Price Indices (TPI) not only consider the changes to costs of labour and material but also reflect the competition in the marketplace and risk and profit factored in the contractors' bids. The tender price index is produced by examining and analysing priced BQs for accepted tenders.

Locality Index

According to AIQS (2022, p. 8), locality index is 'a measure of the variation in cost from any index base for transporting and obtaining labour, material and equipment outside the location of that base. It excludes all design changes and site and climatic factors.'

It is used as a means to compare the similar nature of projects due to the regional variations in cost and expressed as a percentage compared to a base location.

Example: Locality index

In Australia, prices vary between major cities (Adelaide, Brisbane, Melbourne, Sydney, etc.) and also between suburbs.

- Building Price Index in Adelaide by 31 March 2020 is 116.56.
- Building Price Index in Sydney by 2018 is 120.00.
- Adelaide base index = 100, Port Augusta = 115, Victor Harbour = 103.

Figure 4.6 presents locality indices in a map of Adelaide.

Figure 4.6: Locality Index/Regional Indices of Adelaide (Source: Rawlinsons Quantity Surveyors, 2023, used with permission.)

Example: South Australian locality indices

According to **Figure 4.6**, within South Australia, locality index differs in Port Lincoln compared to the base city Adelaide.

- Adelaide = 1.00
- Port Lincoln = 1.291

Labour Cost Index

'The labour cost index (LCI) measures changes in salary and wage rates for a fixed quantity and quality of labour input. Service increments, merit promotions and increases (or decreases) relating to performance of the individual employee are not included in the index' (Reserve Bank of New Zealand, 2024a).

Example: Labour cost indices

In New Zealand, all sector nationwide salary and wages index under LCI.

- September 2023 = 1390
- September 2019 = 1229

Product Price Index (PPI)

'The inputs index measures the change in costs of production (excluding labour). The outputs index measures the change in prices received by producers' (Reserve Bank of New Zealand, 2024b).

Example: Product price indices

In New Zealand, the PPI utilises an index reference period corresponding to the December 2010 quarter which is set at 1000.

PPI for Construction Industry Building Construction:

- September 2019 = 1219
- September 2022 = 1476

Exercise: Cost estimates

You have used cost data from Dec 2018 in Project A to estimate the cost of Project B in December 2020, which is similar in nature (see project details below). What has been the cost estimate of Project B?

Project A details

- GFA = 250m^2
- Total cost as at December 2018 = $550,000

Project B details

- GFA = 275m^2

BCI in December 2018 is 153.3.

BCI in December 2020 is 159.5.

Answer

Project A

Total cost as at Dec 2018 = $550,000

Cost per GFA = $550,000 ÷ 250 = $2,200

Project B

Total cost = $2,200 × 275m^2

= $605,000

Adjusted cost of the Project B = Cost × (current index ÷ base index)

= 605,500 (159.5 ÷ 153.3)

= $629,468.36

4.4 Sources of cost data/information

This section discusses various sources of cost data/information.

4.4.1 Databases

Cost information can be stored in cost databases, which can benchmark rates maintained by analysing the cost of similar past projects. Cost databases can be published or unpublished depending on the sensitivity and confidentiality of the cost information. Irrespective of whether the information is published or not, cost databases have the following characteristics:

- should be able to update
- should be easily accessed.

Databases can be set up in software programs such as Access or Excel. Any takeoff software such as Bluebeam and CostX can also be used to create and use a rate library function, which caries unit rates of the items.

There are personal and organisational databases that can be used for cost planning.

Personal databases

Individual professionals (i.e. cost planners/quantity surveyors) can maintain their own databases and use them in similar future projects. Cost data can be generated from personal practice using various contractual documents (i.e. priced BQs, contractors' claims, final accounts), cost advice from suppliers, contractors or sub-contractors and from their own experience. This saves cost planners time in finding reliable and up-to-date cost information, because construction cost planning involves a lot of information and cost data. Such information is usually treated as confidential and used only at a personal level, hence, unpublished.

Organisational cost databases

Most cost consultancy organisations maintain cost databases (in-house cost data) as confidential sources of information. Some may not even maintain a proper cost database due to the risk of disclosing the information to a third party. As a result, personnel tend to maintain their own databases.

Example: Organisational cost databases

- Riders Digest was annually published by *Rider Levett Bucknall* (RLB) for different

states in Australia and New Zealand [PDF] with the purpose of keeping Cost Consultants and clients up-to-date regarding Building and Building Services Cost ranges, benchmarks and price indices.
- CostBuilder New Zealand published by QV is one of the largest construction cost databases available in New Zealand. It contains information on Building Costs per m2, Elemental costs of Buildings, Cost Planning Rates and detailed rates.

State government/government department cost databases

Most governmental agencies maintain cost databases and provide cost information related to national economic indicators, public projects, policies and regulations. These can be used in understanding the trends, economic forecasts and budgetary allocations at the national level in construction projects.

Example: State government/government department cost databases

- Everything you need to know about a school building project [Word 280KB] by the Victorian School Building Authority, Australia contains the information of standard budget breakdowns for the school projects such as a percentage or range between percentages (%) (allocated for construction, professional fees, project management and communications, project contingencies and furniture, equipment), additional funding allocations, project funding and project milestones.
- Statistics New Zealand publishes cost indices which are used in price fluctuation formulas.
- Cost estimating guideline for public sector health capital projects [PDF] is developed to aid Quantity Surveyors and Cost Estimators in creating and refining cost projections for Te Whatu Ora healthcare facilities across all phases of the project in New Zealand.

International databases

International databases compile cost data from multiple countries and regions, offering comparative analysis and insights into global economic trends, market dynamics and cross-border investments. These databases are used by multinational corporations, investors and policymakers.

Example: International database

Building Cost Information Service (BCIS) International collects, collates, analyses, models, and interprets cost information.

Did you know?

Step-in to BIG Data!

Cost consultancy and cost management companies have been using the concept of 'data centres', which are physical infrastructures designed to provide customised solutions in the field of cost management and Quantity Surveying. Data centres are evolving throughout the globe as organisations move to the cloud, which could accommodate thousands of servers to meet the current demand.

4.4.2 Construction annual price books

Annual price books compile standardised cost data for construction projects, elements and materials, labour, plant and equipment pricing for budgeting purposes.

Example: Construction annual price books

- Rawlinsons Construction Cost Guide is published annually and quarterly updates are issued. It is one of the largest databases in Australia, which includes detailed prices, Building Indices, Building Cost per m2, Elemental cost per unit and Comparative Costs.
- Cordell Construction Cost Index (CCCI) Australia and New Zealand is published by CoreLogic Australia and is a quarterly industry benchmark that tracks and monitors

the movement of the residential market.

4.4.3 Technical Journals

Technical journals publish articles, studies and research findings related to the construction industry, including cost analysis, pricing strategies, and economic trends. Researchers, professionals and academics often rely on these publications for in-depth analysis.

Example: Technical journals

- Construction Economics and Building Journal published journal by AIQS
- Built Environmental Economist jointly published by AIQS and NZIQS

4.4.4 Market rates

Cost planners can seek quotations from subcontractors, suppliers and builders' merchants to enhance the reliability and relevance of cost information.

Example: Market rates

Networking with cost consultants from different organisations and industry practitioners is another good but informal source of cost information. This helps gather the most recent and trending cost information.

Cost planners rely on readily accessible project cost information to ensure the accuracy and credibility of the cost-planning process. Utilising published cost data/information is favoured due to time constraints, the expenses linked with maintaining an extensive 'in-house' system, and the capability to aggregate costs across multiple projects, thus revealing true benchmark costs and avoiding 'one-off' outliers.

Despite the advantage of consistent, comparable data in the cost planning stage, published cost data typically only represent costs for normal or average projects. Therefore, caution should be exercised when using them, taking into account the unique aspects of the project and ensuring clarity regarding the inclusions and exclusions.

Exercise

Try out the following task to gain a deeper understanding of how these sources should be applied.

You have completed a Detailed Elemental Cost Plan and done the Building Analysis and come up with the following data for a multi-storey residential building: Building Rate ($/m2 GFA) is $3,280.

However, the price range given in a published source of cost information (e.g. Annual Price Book) is $2,250 to $2,850 for a multi-storey residential building. Explain the difference between these figures.

Note: Assume no time adjustments or location adjustments are required.

Answer
There may be elements designed outside the expected cost range – e.g. due to site conditions and unique design. Therefore, it's better to keep the published cost information as an indicator and select the cost information derived from the Building Cost analysis developed using a recently completed for a similar project.

4.5 Application of cost information in cost planning stages

As discussed in Section 4.3, different types of cost information are required according to the cost planning stages. **Figure 4.7** illustrates the cost information applied in the concept, schematic and detailed design stages.

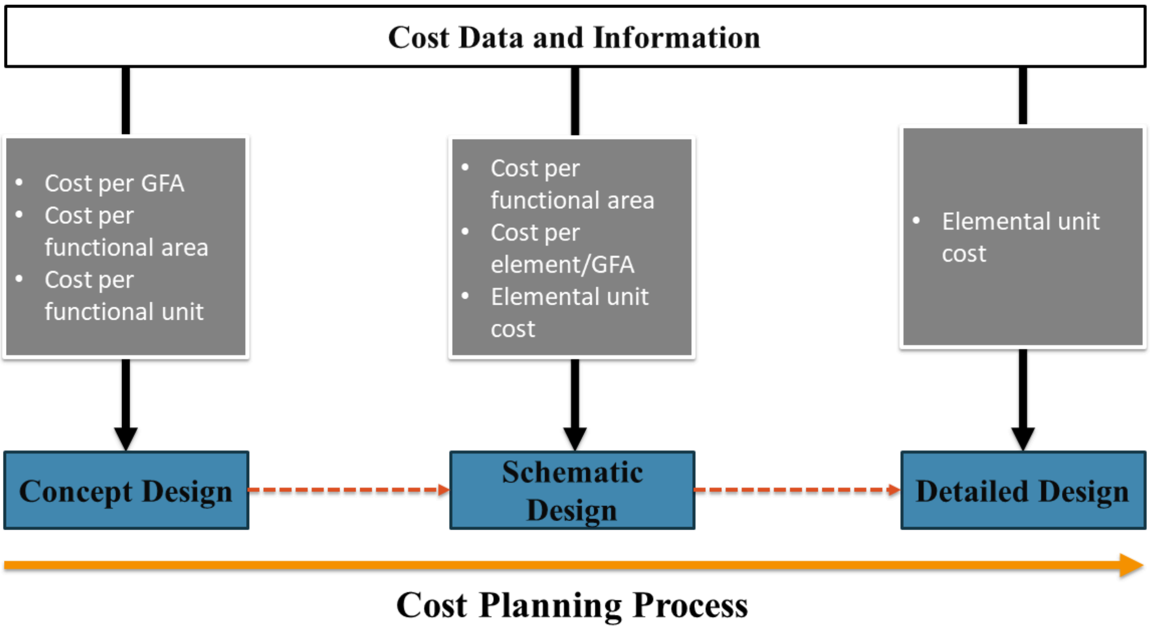


Figure 4.7: Cost data/information used in the cost planning process, by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a [CC BY-NC 4.0 licence](https://creativecommons.org/licenses/by-nc/4.0/).

During the concept design stage, cost information used is related to the type, function and size of the project such as cost per GFA, cost per functional area, and cost per functional unit. Once the level of information increases at the schematic design stage, cost per functional area and cost per element/GFA are used. Finally, cost per element is applied at the detailed design stage.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://oercollective.caul.edu.au/building-cost-planning/?p=78#h5p-6

CHAPTER 5: COST ANALYSIS

5.0 Introduction

This chapter examines the cost analysis process, which involves converting historical project data into cost information. The analysed cost data from previous projects can be utilised to formulate cost plans for upcoming projects. This chapter presents a detailed guide to performing a cost analysis in accordance with Australian and New Zealand standards.

5.1 Overview of cost analysis

The cost analysis process helps estimate future project costs by examining past construction project costs and using them to plan and compare costs of new projects.

Cost analysis: Definitions

'… a full appraisal of costs involved in previously constructed buildings … aimed … at providing reliable information which will assist in accurately estimating (the) cost of future buildings. It provides a product-based cost model, providing data on which initial elemental estimates and elemental cost plans can be based.'

— RICS (2012a, p. 12)

'Cost analysis can be defined as the systematic breakdown of costs, according to the sources from which they arise.'

— Seeley (1976)

'A systematic breakdown of tender cost data into the standard elements of a building.'

— Smith et al. (2016)

Costs of past projects should be analysed, arranged and stored in a systematic manner to retrieve when needed for cost planning future projects. Cost information obtained should be reliable, up-to-date and sufficiently detailed as useful for cost planning future projects. A comprehensive cost analysis exercise provides cost information such as unit costs, per area costs or more specific information such as cost per a particular element.

Following a standard document is the best practice to perform a systematic cost analysis.

There are standard documents that can be used for cost analysis exercises in different regions. They provide the basis for measurements (definitions and measurement rules for building areas, elements, etc.) and templates to present cost analysis.

- In Australia, *Australian Cost Management Manual (ACMM) Volume 1* (AIQS, 2022)is followed for cost analysis as well as cost planning.
- In New Zealand, the *Elemental Analysis of Costs of Building Projects* (NZIQS, 2017) is followed.
- In the UK, *Elemental Standard Form of Cost Analysis: Principles, Instructions, Elements and Definitions,* 4th (NRM) edition (RICS, 2012b) is a dedicated guide to performing a comprehensive cost analysis.

5.3 Types of rates developed from cost analysis

A cost analysis process develops different unit rates. Some common rates developed by cost analysis are:

- functional unit rate
- functional area and other area rates
- elemental rate.

The use of different unit rates under cost planning methods is discussed in Chapter 3 and more details about cost information are discussed in Chapter 4.

5.3.1. Functional unit rate

The rationale behind the functional unit rate is that the total costs of typical buildings, such as car parks, schools and hotels, are proportionally linked to the number of functional units (see Section 3.2.1) of the building. This rate is the most suitable for developing initial project budgets due to lack of available information in early design stages. To ensure accurate unit rates, it is necessary to analyse as many similar projects as possible to derive an average rate.

Total cost of the project ÷ Total number of functional units = Functional unit rate

Example: Functional unit analysis

The total accepted tender cost of a hospital building for 140 beds was $120,000,000. The project was located in Melbourne and the accepted tender cost is from 2008. Let's calculate the functional unit rate.

Functional unit rate for a hospital in Melbourne in 2008 = 120,000,000 ÷ 140 = $85,714.28/m^2

5.3.2 Functional area and other area rates

When developing these rates, floor areas are considered as unit quantities.

A building can be divided into different functional areas (see Section 3.2.3 for more details). A functional area rate is established by assigning elemental costs and the cost of preliminaries proportionately to specific functional areas.

ACMM and NZIQS Elemental Cost Analysis standards define several building areas as follows:

- Gross Floor Area (GFA)
- Fully Enclosed Covered Area (FECA)
- Unenclosed Covered Area (UCA)
- Building Area (BA)
- Usable Floor Area (UFA)
- Treated Area (this is mainly used for areas served by engineering services)
- Net Lettable Area (NLA)/Net Saleable Area
- Net Rentable/Tenantable Area.

Chapter 8 provides definitions of key areas with measured examples.

Total cost of the project ÷ Gross Floor Area = Rate per m^2 of GFA

GFA calculations: Australia versus New Zealand

It is necessary to follow the same basis for both cost analysis and cost planning – i.e. the same measurement rules should be applied for quantities taken as per the standard followed.

For example, GFA calculation methods are different in Australian and New Zealand standards:

- GFA calculation in Australia *excludes* external walls
- GFA calculation in New Zealand *includes* external walls.

For measured examples, see Chapter 8.

Example: GFA calculations

The total accepted tender cost of a hospital building for 140 beds was $120,000,000. The project was located in Melbourne, and the accepted tender cost is from 2008.

The Fully Enclosed Covered Area (FECA) of the building is 39,116m^2, and the Unenclosed Covered Area (UCA) is 5,334m^2. The total cost for FECA is 114,000,000.00, and UCA is 6,000,000.00.

Total GFA is FECA plus UCA = 39,116m^2 + 5,334m^2 = 44,450m^2

Rate per m^2 of GFA = $120,000,000 ÷ 44,450m^2 = $2,699.66m^2

Rate per m^2 of FECA = $114,000,000 ÷ 39,116m^2 = $2,914.41m^2

Rate per m^2 of UCA = $6,000,000 ÷ 5,334m^2 = $1,124.86m^2

These calculations are summarised in the table below.

Area type	Full area (m^2)	Area as % of GFA	Cost per m^2 ($)	Cost ($)
FECA	39,116.00	88	2,914.41	114,000,000
UCA	5,334.00	12	1,124.86	6,000,000
GFA	44,450.00	100	2,699.66	120,000,000

5.3.3 Elemental analysis

In the elemental analysis process, costs are allocated to each element, and an elemental rate is developed by dividing the cost of the element by the quantity of the element. Methods of measurement and units of measurement applied to each element quantity are given in each standard. Inclusions and exclusions in each element should be clearly identified as per the measurement rules. Section 3.2.4 provides more details of element quantities and Chapter 8 provides a few measured examples for key elements as per Australian and New Zealand standards.

Total cost of element ÷ Quantity of element = Element unit rate

Elemental rates are also developed by using GFA as the element quantity.

Total cost of element ÷ GFA = Elemental rate

GFA can also be used when element quantities are not measured.

Example: Elemental cost analysis

The total accepted tender cost of a hospital building for 140 beds was $120,000,000 (including margin). The project was located in Melbourne, and the accepted tender cost is from 2008 (2008.8.31). The GFA of the building, according to the Australian Cost Management Manual (AIQS, 2022), is 44,450m^2, and according to the NZIQS Elemental Analysis of Costs of Building Projects standard (NZIQS, 2017), is 44611m^2. The reference for the project is HB-20080-Q11.

The project has 892 number of D1 and 456 number of D2. D1 size is 0.8m × 2.1m (area per D1 door 1.68m^2). D2 size is 0.9m × 2.1m (area per D1 door 1.89m^2). The total cost for all the doors is $2,300,000. The following is an example cost analysis for doors according to the *Australian Cost Management Manual* and the NZIQS *Elemental Analysis of Costs of Building Projects* standard.

Total area of D1 doors = 0.8m × 2.1m × 892 = 1498.56m^2

Total area of D2 doors = 0.8m × 2.1m × 456 = 861.84m^2

Total area for doors = 1498.56 m2 + 861.84 m2 = 2360.4m^2

Australian Cost Management Manual

Project	GFA in m^2	Reference
Hospital building in Melbourne, 2008	44,450	HB-20080-Q11

Code	Element	Elemental			Gross Floor Area Rate ($/m^2) (Total element cost/GFA)	Elemental Co
		Quantity	Unit	Rate ($/unit)		
ND	Internal doors	2360.4	m^2	974.41	51.74	2,300,000.00

Elemental Analysis of Costs of Building Projects

Project	Hospital building in Melbourne, 2008 (GFA 44,611m^2)			GFA	44,611m
Element Title:	Internal Doors			Element No:	E11
Tender Date:	2008.8.31		Margin Included in Element Cost:		Yes
Element	Quantity	Unit	Element Unit Rate ($/unit)	Elemental cost ($/m^2)	Total Cost Element ($
	a		b = d/a	c = d/GFA	d
Internal door	2360.4	m^2	974.41	51.56	2,300,000.0

5.4 Cost analysis process

This section explains the cost analysis process.

5.4.1 Basis for cost analysis

The first step of cost analysis is to select the base documents from past projects.

According to ACMM, the total project costs used to develop cost breakdowns are taken from the 'accepted tender prices (including accepted tender price adjustments for provisional sums)' of past projects.

According to Elemental Standard Form of Cost Analysis 4th NRM edition, 'the costs analysed shall be the agreed price for the works described. Normally, costs analysed can be the agreed price at 'commit to construct', e.g. accepted tender contract sum, agreed target, etc.' (RCIS, 2012b).

The reason for using 'accepted tender prices', 'accepted tender contract sum' or similar is that a project's construction cost is closely based on the tender price. However, the rules for analysis can be applied at any stage during the project, but this basis should be clearly stated to have a uniform basis of analysed costs.

5.4.2 Information used for cost analysis

It’s recommended to obtain the following details from previous projects for the cost analysis process and to present with cost analysis documentation:

1. Project details – Project name, tender date, locations, job reference
2. Contract details – Contract amount, tender range, type of contract, tender date, reference document and brief description
3. Key measurements – GFA, net lettable area, number of stories, wall/ floor ratio, gross floor area, FECA, UCA, usable floor area, net rentable floor area, building area, and area efficiency
4. Cost and other factors – Total cost of the project, whether margin included in cost or not, cost weighting %, m^2 rate and, Cost Index Reference Series Used
5. Element and sub-element details – Elemental group type, description, quantity, unit, unit rate, elemental cost and total cost of the element.

5.4.3 Establishing unit rates

The cost analysis process does not simply calculate costs from one project. Establishing unit rates requires analysing costs from multiple projects. For this process, elemental cost analysis should be conducted for multiple similar projects, and rates from similar functional units should be cumulated to create average rates.

Figure 5.1 showcases a sample matrix derived from cost analyses conducted on 10 university lecture room buildings. It includes columns for elemental rates and total building costs incorporated with elemental cost analysis rates of the 10 university lecture room buildings. Using these rates, mean and average elemental rates are computed. These elemental rates offer greater accuracy than using rates from just one building. Amalgamation of these rates enables the development of per m^2 rates for various components such as groups, shell, fit-out, services and the overall building cost.

Per m2 rate for Lecture theatre for University Building

Building No	SUBSTRUCTURE	COLUMNS	UPPER FLOORS	STAIRCASE	ROOF	EXTERNAL WALLS	WINDOWS	EXTERNAL DOORS	INTERNAL WALLS	INTERNAL SCREENS	INTERNAL DOORS	WALL FINISHES	FLOOR FINISHES	CEILING FINISHES	FITMENTS	SPECIAL EQUIPMENT	SANITARY FIXTURES	SANITARY PLUMBING	WATER SUPPLY	GAS SERVICES	SPACE HEATING	VENTILATION	EVAPORATIVE COOLING	AIR-CONDITIONING	FIRE PROTECTION AND SUPPRESSION	ELECTRIC LIGHT AND POWER	COMMUNICATIONS	TRANSPORTATION SYSTEMS	SPECIAL SERVICES	BUILDING TOTAL
1	346	213	82	16	494	574	-	403	179	-	66	157	203	187	388	-	205	227	198	-	111	122	-	139	125	289	-	-	-	4725
2	291	212	75	16	444	608	373	382	149	121	66	121	196	198	436	-	147	211	191	-	173	174	-	346	243	260	-	6	-	5441
3	287	224	68	11	469	603	-	368	138	-	55	133	220	222	449	-	206	192	210	-	133	149	-	-	200	260	-	8	-	4608
4	356	222	87	15	475	517	-	388	148	123	51	137	232	227	393	-	174	199	143	-	234	163	-	248	175	246	-	-	-	4957
5	306	247	77	17	404	593	337	417	181	131	49	111	234	213	387	-	158	238	180	-	125	87	-	115	181	273	-	7	-	5073
6	288	213	65	20	487	580	381	386	195	-	68	110	191	232	395	-	142	205	158	-	204	174	-	105	242	453	-	2	-	5302
7	370	241	88	16	419	540	379	410	155	-	49	116	207	211	420	-	160	201	121	-	182	204	-	-	109	481	-	-	-	5086
8	360	282	85	12	381	513	-	422	141	-	49	112	195	187	448	-	140	242	232	-	156	203	-	278	157	445	-	8	-	5056
9	377	276	71	18	407	528	360	426	167	127	68	162	226	227	342	-	180	218	139	-	144	111	-	282	132	464	-	-	-	5461
10	358	241	74	23	448	521	344	438	128	-	60	141	228	191	368	-	143	199	203	-	207	199	-	195	168	347	-	10	-	5244
Median	351	233	76	16	446	557	341	407	152	-	58	127	214	212	394	-	159	208	186	-	165	169	-	167	172	318	-	4	-	
Average	334	237	77	16	443	558	362	404	158	126	58	130	213	210	403	-	166	213	178	-	167	159	-	214	173	352	-	7	-	
Group mean	SHELL								FITOUT								SERVICES													
	2431.43								1297.00								1627.03													
Total	5355.47																													

Figure 5.1: Per m^2 rate for Lecture theatre for University building (matrix), by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a CC BY-NC 4.0 licence.

Industry insights

Some companies conduct cost analysis activities when required during the cost planning stages (i.e. to acquire benchmark rates).

Most professionals mainly focus on developing per m^2 rate of GFA since the elemental cost analysis process is time-consuming.

Exercise

The total accepted tender cost of a car parking building for 350 car parking was $10,500,000 (including margin). The project was located in Sydney, and the accepted tender cost is from 2012 (2012.9.31).

The GFA of the building, according to the Australian Cost Management Manual, is 8,750m^2, and according to the NZIQS Elemental Analysis of Costs of Building Projects standard is 8,823m^2. The reference for the project is CP-FEE01.

The project has 32 number of D1 and 88 number of D2. D1 size is 1.6m × 2.1m. D2 size is 0.9m × 2.1m. The total cost for all the doors is $425,000.

1. Calculate the functional unit rate
2. Calculate the per m^2 unit rate according to the Australian Cost Management Manual (AIQS, 2022) and NZIQS Elemental Analysis of Costs of Building Projects standard (NZIQS, 2017)
3. Conduct an elemental cost analysis for doors according to the Australian Cost Management Manual and NZIQS Elemental Analysis of Costs of Building Projects standard

Reflection task

Based on your understanding from previous chapters, now you can try this question.

Read the following information from Project A (old project) and Project B (new project) to find the cost of the roof element for Project B.

Project A details

- GFA= 1000m^2
- Cost per m^2 of GFA for the Roof Element = $158.25/$m^2$ (Unpublished data – in-house rate)
- Measured quantity of the element from the completed project = 375m^2

Project B details

- Measured quantity of the element from the proposed project = 275m^2

Answer

Information from Cost Analysis

Cost of the roof retrieved from the Project A = 1000m^2 × $158.25/$m^2$ = $158,250.00

Element unit rate = $158,250 ÷ 375$m^2$ = $422.00/$m^2$ (Information used in future cost planning in Project B)

Note: You can also use a construction price book to derive this elemental unit ($422.00/$m^2$).

Information for Cost Planning

Element unit rate (retrieved from previous Project A) = $422.00/$m^2$

Cost of the element of the proposed Project B = 275m^2 × $422.00 = $116,050.00

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://oercollective.caul.edu.au/building-cost-planning/?p=76#h5p-7

CHAPTER 6: COST PLANNING CONSTRUCTION PROJECTS

6.0 Introduction

Cost is a key aspect of a construction project, and cost management is a process that is carried out throughout various stages of a construction project. Chapter 2 (Table 2.1) presented the cost management stages of a construction project as specified in the standard documents in several contexts, including Australia, New Zealand and the United Kingdom. The pre-construction cost management phase involves design development and cost planning processes, which are usually carried out simultaneously until the tender documentation. However, there can be changes based on the selected procurement method, and consultancy firms might follow this process with slight differences. This chapter focuses on the fundamentals of cost planning construction projects, including the basis of a cost plan, and concludes with the elaboration of major cost items in a cost plan.

6.1 Cost plan

The cost of a construction project is derived by pricing all relevant components of a project. A cost plan is a descriptive statement that shows the proposed distribution of the budget through the elements or sub-elements of the project. In this way, cost plans provide design parameters and cost targets for the design development within the project budget. Therefore, cost plans involve a process rather than a one-off estimate, and this process helps to give the client value for money by achieving a good balance of expenditure between the various components of the building project. A range of information is required in these pricing exercises at various stages.

Cost planning is carried out by using available project details combined with various other documents prepared by different players in a construction project. As the design develops, these documents will be updated with the latest information, and cost plans will also be updated with an increased level of project information. Historical data with adjustments based on sensitive factors like time, quality and location is a key ingredient in a cost plan (see Chapter 4).

A **cost estimate** and a **cost plan** should not be confused.

Note: Chapter 1 discussed the different parties to a construction contract and various professionals involved in a construction project. This section refers to the client, cost planner, quantity surveyor, cost consultants, contractor and estimator.

- When costing is carried out by the contractor's estimator for bidding purposes, we call it a **contractor's/builder's estimate**.
- When costing is carried out by the client's representative (cost consultants, cost planner, quantity surveyor) for cost management purposes in the pre-construction phase, we call it a **cost plan**.
- A **cost plan** will be updated with the design development. This involves designing to a cost (i.e. budget).
- The term **estimate** is used for a one-time figure at different points in the cost planning process.
- Therefore, the terms 'estimating' and 'estimates' are used in this book throughout the cost planning process.

Bills of Quantities (BQ) is also a key document used for cost managing construction projects. It's important to differentiate these terms. **Table 6.1** compares the characteristics of cost plan and BQ.

Cost plan	Bills of quantities
Involves a process and update alongside the design development stages during the pre-construction cost management phase.	Prepared at the tender document stage for tendering purposes and used for contract administration in later stages of cost management.
Prepared from early stage information through to the near completion of documentation.	Prepared with detailed measurements when sufficient information is available.
Prepared in elements as per Australian Cost Management Manuals and NZIQS Elemental Cost Analysis. (NZIQS, 2017) e.g. Substructure, External Walls, Roof, Windows	Prepared in trades, measured as per Australian and New Zealand Standard Method of Measurement (ANZSMM) (AIQS et al., 2022). e.g. Masonry, Concrete, Painting *One element contains several trades e.g. External Walls includes Masonry, Insulation and Painting
Provides other project costs as well, thus creates a wholistic view of the total end project cost to the client. These other costs can include demolition costs, land costs, professional and legal fees, authority fees and sometimes operational costs and life cycle costs.	Generally provides only the total construction cost.
Not seen by builders.	Sent unpriced BQ to builders for preparing tenders.
Priced by cost planners.	Priced by builders' estimators.

Table 6.1: Comparison of cost plan and BQ

6.2 Basis of the cost plan

Cost planning is a process and cost plans are documents prepared to predict the end cost to the client with applicable rates. Cost plans are updated with the design development, and the rates applied should be relevant to the project's current context. Therefore, it is paramount to state the basis of a cost plan, in terms of documents used, rates applied and the standards followed. Stating the inclusions and exclusions is also important to provide the client with a clear picture of the cost prediction. This section discusses what needs to be stated as the basis of a cost plan.

6.2.1 Basis of measurement of works

Available information in terms of drawings, specifications, site reports and other documents provides the basis for costing a project. Due to being an evolving process, cost plans need to be updated with the availability of information with the latest revisions of documents. It is very important to state the list of documents used for preparing a cost plan, including the date each document was produced because there may be several revisions. This can be included as a schedule/table with a list of documents and the date issued/received. This provides the basis for the measurement of building works.

> In the early stages of cost planning, when the design information is unavailable, appropriate allowances should be established in close consultation with the design team, and assumptions should be stated. This is common in cost planning building services where allowances are made with the advice of services engineering consultants.

6.2.2 Basis of pricing: Base rates, price indices, allowances

Cost plans are mostly prepared using historical cost data unless the latest rates are available to the cost planner. Therefore, it is necessary to state the basis of those historical cost data with the base date, location and quality of the base project. Price indices or allowances should be used to adjust the historical cost data (see Chapter 4). These details should also be stated clearly as the basis of a cost plan.

6.2.3 With or without tax

In Australia and New Zealand, goods and services tax (GST) is applicable, and any cost presented should state whether it includes or excludes GST. If the amounts are including GST, the percentage should be stated.

6.3 Professional practice and documentation

This section provides several good practices a professional cost consultant may follow during the documentation of any cost advice, including the preparation of cost plans as follows:

- Follow and refer to standards.
- Use clear and concise documentation.

As explained in Section 2.3.1, there are standard documents published by professional bodies in various regions. As professionals, it is always recommended to follow standard documents rather than following ad-hoc methods.

There are several benefits to following standards while documenting cost plans:

- Standards provide **a uniform basis** that can be understandable and can be easily followed by all those involved in a project. It also facilitates easy updates and an iterative process with progressive information. This is important for cost planning where the cost plan is updated with the design development with progressive design information.
- Standards also contain defined breakdown of items, and therefore, the cost plan will contain only the necessary information, making it **concise.**
- Another benefit of standards **is ease of comparison**, which helps using benchmark costs, reconciliation of costs between stages and effective cost controlling.
- Standards aid **effective communication** between the project team members and other parties as they would be familiar with the standard.
- Standards help maintain **accuracy** as it helps not to miss important components in a process.
- Therefore, using standards will provide **trustworthy** estimates (i.e. for banks and other financial bodies for approvals).

In Australia, the ACMM is followed to prepare cost plans. In both Australia and New Zealand, the ANZSMM is followed to prepare BQs or schedules of quantities (SOQ). SOQ is widely used in New Zealand.

In addition to these standard documents, there can be standard guidelines published by state government organisations. In Australia, there are guidelines published for building work and other capital works by various government departments. For major public sector projects, the relevant guidelines should be followed in preparing cost plans based on the type of project, apart from the ACMM.

Example: Standard documents

- In Australia, a healthcare project such as a hospital should follow the standards of the Department of Health, Capital Works Guidelines and Department of Health Project Brief.
- In the state of Victoria (Australia), government school building projects should follow the guidelines of the Victorian School Building Authority (VSBA).
- In New Zealand, Cost Estimating Guideline for Public Sector Health Capital Projects [Word, 1.86MB] was developed for the healthcare sector.
- In public sector civil works, Waka Kotahi NZ Transport Agency has produced a Cost Estimation Manual (SM014) for the development of estimates for capital projects.

6.4 Major cost items

This section explains major cost items in a cost plan in accordance with the templates and definitions provided in the ACMM Volume 1 (AIQS, 2022). The Elemental Analysis of Costs of Building Projects (NZIQS, 2017) covers cost items other than the construction cost under 'other development costs'.

Element	**Cost**
*Elemental/Functional area costs (including or excluding building services)	$ XXXXX
Building Services (related to the building, unless included above)	$ XXXXX
Preliminaries (related to the building cost)	$ XXXXX
Building Cost	*$ XXXXX*
Project specifics	
Alterations	$ XXXXX
External Works	$ XXXXX
External Services	$ XXXXX
Preliminaries (related to construction cost other than building cost)	$ XXXXX
Net Project Cost/Construction Cost	*$ XXXXX*
Special provisions	
Design Contingencies (%)	$ XXXXX
Contract Contingencies (%)	$ XXXXX
Escalation	$ XXXXX
Loose Furniture, Loose Equipment	$ XXXXX
All Costs in Connection with Design, Documentation & Supervision	$ XXXXX
Statutory Charges	$ XXXXX
Headworks	$ XXXXX
Client Costs	$ XXXXX
Gross Project Cost (excluding GST)	***$ XXXXX***

6.4.1 Building cost

Building cost constitutes a major part of the construction cost of a project. Building cost can be derived through suitable cost planning techniques (see Chapter 3) depending on the availability of information (i.e. based on functional area costs or elemental costs). This includes building services cost and the proportion of preliminaries related to the building.

6.4.2 Project specifics

Project specifics are presented separately in a cost plan. These vary from project to project. For example, if the same building layout is used in 2 projects, despite the similar building areas, external works will depend on the site conditions. The proportion of preliminaries related to these items should also be included.

Project specifics can include, but are not limited to:

- alternations
- external works and services external to the building
- any other cost items specific to the project.

6.4.3 Services costs

Services costs are usually known as 'engineering services costs'. This cost in a project is based on advice from services engineering consults or separately provided by them. Building services costs are presented with building costs, while external services costs are presented with external works.

6.4.4 Preliminaries

In the early stage of cost planning, a percentage of relevant costs are calculated as preliminaries. The percentage is decided as appropriate for the project, taking cognisance of program, the complexity of the work and current market conditions. Ideally, these should be estimated as specific to the project requirements.

6.4.5 Construction cost

ACMM (AIQS, 2022) defines this as the 'Construction Cost' or the 'Net Project Cost'. It constitutes the building cost plus project specifics and the related preliminaries. Construction cost plus special provisions and other client's costs will give the total end project cost to the client. This also reflects the major difference between a tender document cost plan and a priced BQ, where the later does not include other project costs to the client, but what is offered by the contractor to carry out construction works.

6.4.6 Special provisions

Risk management items such as contingencies and escalation are calculated as special provisions. There are also other items which might not be included in the main contract, but will incur in the project, and therefore, should be considered in the client's budget. These are calculated under special provisions.

A list of items that are considered under special provisions can be found in the elemental breakdown given in the ACMM.

Works to utilities off-site: Some projects require diversions or capacity enhancements of public utility mains off-site up to the on-site connections, in accordance with project requirements. Examples include the installation of additional electrical substations, improvements to public access roads, or work related to other utility connections, such as water, sewer and gas.

Loose furniture and equipment: These include furniture and equipment not normally covered by the main construction contract. However, this will be a cost to the client as per project requirements. These are not normally installed before the completion of construction and mostly include furniture and equipment that are not stationary but movable (e.g. mobile equipment). These will depend on the type of project (e.g. hospitals and aged care facilities require special mobile equipment).

Professional fees: This cost covers all the design and documentation consultants such as architects, engineering consultants, surveyors, specialist consultants and quantity surveyors. There can be specialist advisors such as a health advisor on a hospital project involved in the project designing and planning due to its specific requirements. It also includes the cost of any value management studies carried out during the design development and cost planning stages. Project director fees, site supervision charges, and project management fees also need to be calculated into the total project cost.

Statutory charges: Costs incurred due to charges and levies in relation to the project duration from planning and design up until the project inspections need to be calculated in cost planning. These also include authority charges for testing.

6.4.7 Contingencies

The ACMM (AIQS, 2022. p. 4) defines '**contingency** as an allowance for risks and unforeseen items which could be encountered generally applied to the '**Net Construction Cost**'.

> *Contingencies cover 'unknowns'.*
>
> *Remember, contingency is not a substitute for proper cost planning.*

As mentioned in Chapter 1, construction projects are unique, complex and subjected to many external conditions. Also, changes to the scope (variations) throughout a construction project are inevitable. Therefore, risk factors should be considered while planning construction projects in terms of time, cost and other resources.

Risk allowances should be included throughout the cost management of construction projects.

AIQS (2022) considers 4 types of contingency factors in cost management:

1. Planning Contingency
2. Design Contingency
3. Contract (Construction) Contingency
4. Project Contingency.

The cost planner includes a suitable provision for contingency allowances depending on the nature of the project using their intuition, past experience and historical data. Contingencies are usually calculated as percentages and can vary given the level of design development on a project.

Some public authority guidelines on building works provide recommended percentages to be used on their projects. These can vary with the project type, complexity and special requirements.

Contingency percentages could go higher on complex projects such as those including major alterations and renovations or 'hi-tech' projects such as advanced laboratories.

Planning contingencies

- Early-stage cost plans involve planning risks. For example, those cost plans are based on approximation of functional areas and there is a risk of not being able to plan and design spatial relationships accurately (i.e. functional areas/circulation areas).
- Sometimes the sketches are also not available in very early stages. Therefore, an allowance can be made to cover this risk.
- However, this risk will disappear along with the design development and usually reduced to zero when the building layouts and dimensioned drawings are available.

Design contingencies

- Cost planning as a process evolving with the design development needs to consider the risk of 'unknowns' in the design, depending on the level of information available.
- An allowance is made as a percentage of the net construction cost to cover this design development risk.
- This amount should be shown separately in the cost plan.
- The design contingency allowance will be gradually reduced over the design development and will be zero at the tender document stage when the design is finalised and ready to tender.

In the initial stages, a higher contingency percentage would be added for the design development changes (in New Zealand, this can go up to 30%).

Example: Contingencies

In the example hospital project in Australia (see Chapter 7), the design contingency allowance has been gradually reduced from 5% to 0% throughout the design development stages.

*Cost plan	Design contingency allowance
Stage A	5%
Stage B	5%
Stage C1	3%
Stage C2	1.5%
Stage D	0%

*This is as per the cost planning stages in accordance with the ACMM. Chapter 7 explains these stages in detail.

Contract (Construction contingencies)

- Variations are inevitable in construction projects, and unforeseen conditions can be encountered during construction.
- An allowance is made as a percentage of the net construction cost to cover these risks of changing scope of work.
- This is an important risk management component.
- This amount should be shown separately in the cost plan.
- This allowance will be constantly included in all cost planning stages and will not disappear like planning and design contingencies because this it involves the risks during construction.

Example: Construction contingencies

In the example hospital project in Australia, (see Chapter 7), the **construction contingency allowance of 5%** is applied in **all stages of cost plan.**

Project contingencies

An allowance may be added to cover delays and/or inflation, major changes required by the client or authorities, fee negotiations, latent conditions and similar.

What's happening in the industry?

Project contingencies or project prolongation contingencies are used to cover overall project delays. Government agencies have specified these contingency percentages applicable to their projects and therefore, specifically applied in government projects.

6.4.8 Escalation

Costs associated with construction projects tend to fluctuate over the time. Given the nature of construction projects with longer durations, appropriate escalation factors should be included in cost plans.

Several time periods need to be considered when applying escalation factors.

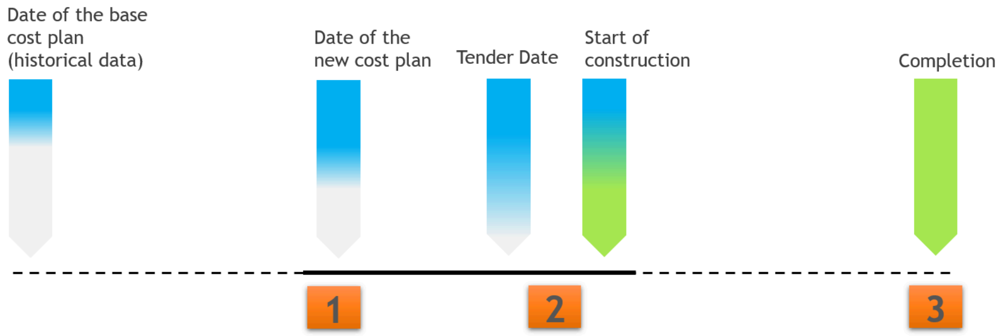


Figure 6.1: Project timeline, by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a CC BY-NC 4.0 licence.

1. Escalation from the date of base cost plan to the date of the new cost plan

In any cost plan, the prepared date should be stated. If the rates used are applied from a previous project (historical data), they will be adjusted for the time difference. Relevant indices should be used to calculate the escalation and convert those rates into current rates. Chapter 4 and Chapter 5 provide more details about cost data derived by cost analysing previous projects and the use of indices.

2. Escalation from the date of the new cost plan to the tender date/start of construction

There can be a considerable time (several weeks or months) from the date of preparing the cost plan and the tender/start of the construction. Any escalation during this time should be considered as this will affect the prices and cost to the client.

As per cost planners in the industry, the time taken between tender and construction start is generally not very significant. Therefore, the terms 'escalation to tender' or 'escalation to commencement' are used interchangeably in cost plans. Any considerable time periods need be taken into account considering the market conditions.

3. Escalation from the start of construction to project completion

The construction stage can span over months or years. The prices of key project inputs can fluctuate during this project duration. Depending on the procurement method and the payment method (see Section 2.3 for procurement methods), such fluctuations can affect the project cost. It is prudent to include a contractual provision to capture these fluctuations. In Australia, such a clause is usually known as 'rise and fall' and in New Zealand, as 'cost fluctuations'. When there is a contractual provision, major and cost effective items such as cost of steel materials, concrete materials and labour costs will be adjusted using a specified formula. This potential additional cost to the client should be considered and included in cost planning. Cost planners calculate a percentage to apply for this escalation by considering the project's predicted cashflow distribution using project's 'S curve' and market conditions.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://oercollective.caul.edu.au/building-cost-planning/?p=82#h5p-8

CHAPTER 7: COST PLANNING STAGES

7.0 Introduction

This chapter explains the cost planning stages as per the Australian Cost Management Manual Volume 1 (AIQS, 2022) and the Elemental Analysis of Costs of Building Projects (NZIQS, 2017). Cost planning is given much emphasis in the cost management process in Australia and New Zealand and knowing the standard process and industry insights is very important for construction professionals. Chapter 6 introduced the major items to be considered in a cost plan, and this chapter presents their applications in each cost planning stage with real-life examples and lessons learned.

7.1 Cost planning process in the Australian context

ACMM presents a construction project's cost management activities under 6 stages (Stage A to Stage F) and demonstrates them in a line diagram. **Figure 7.1** is an extract from this line diagram showing the pre-construction cost management and cost planning activities (the complete line diagram is available in **Appendix A**). As provided in Section 2.3.2, ACMM explains cost planning as the application of cost management to the design process from the Brief Stage (Stage A) until the Tender Documentation Stage (Stage D). After Stage D, tendering will take place and construction will begin. The focus of this textbook is on cost planning, and therefore, Stage A to Stage D will be explained hereinafter referring to this line diagram.

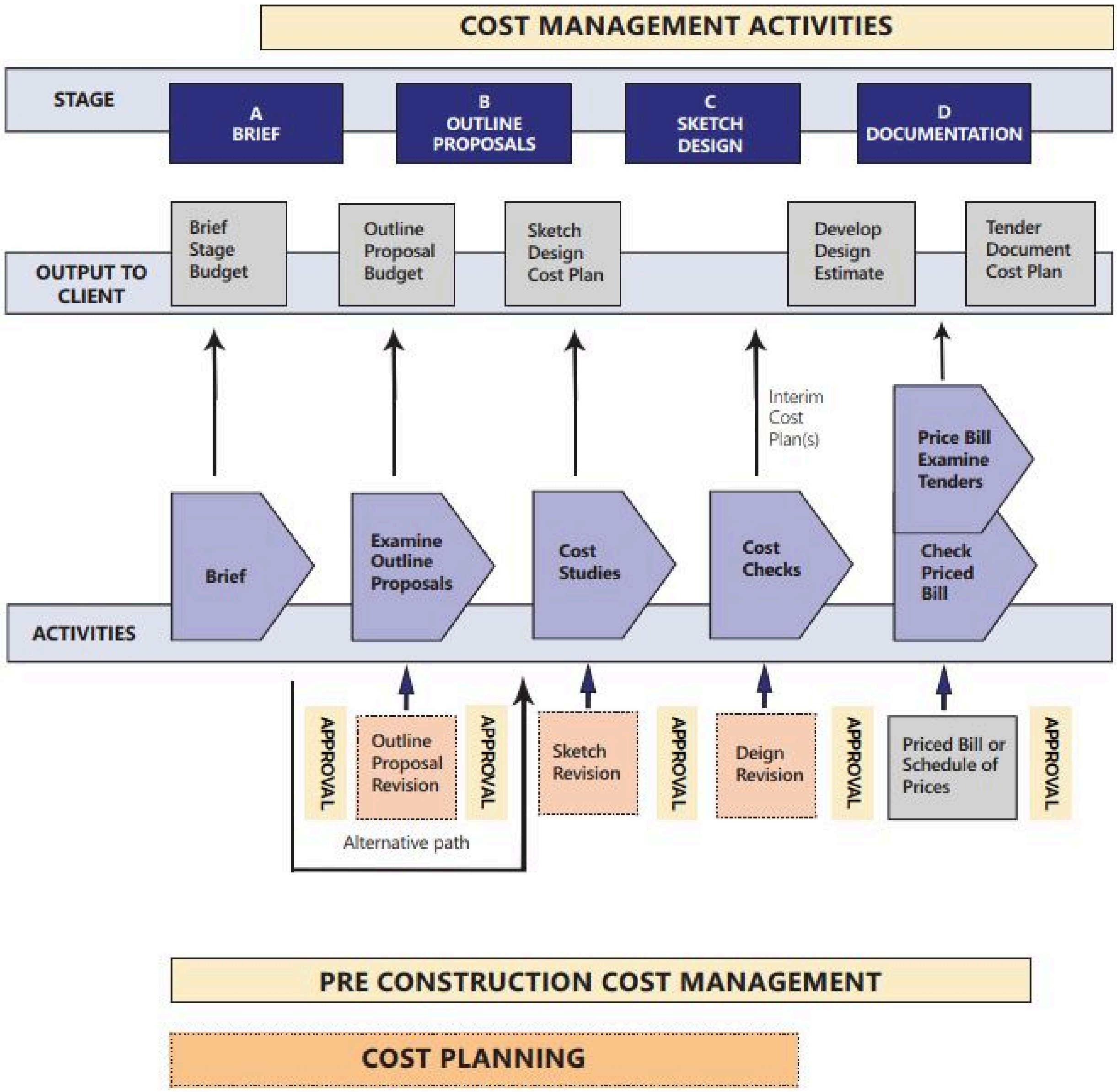


Figure 7.1: Cost management stages and activities (Source: AIQS, 2022, used with permission.)

The accuracy of a cost estimate will usually increase with the level of information available. A construction project involves a range of documents, including drawings, specifications, schedules and other reports (e.g. soil investigation report). More detailed documents will be available in each progressive project stage. As the cost planning process evolves with the design development, the accuracy and certainty of estimates will be increased with the availability of information (see Chapter 6). Based on the information available, suitable cost planning techniques (see Chapter 3) can be applied. Before discussing each stage, **Figure 7.2** presents an overview of the documents generally available, information used, and suitable cost planning techniques in each cost planning stage of ACMM.

In the industry practice, these stages are also specified as **concept design, schematic design, tender design and detailed design**.

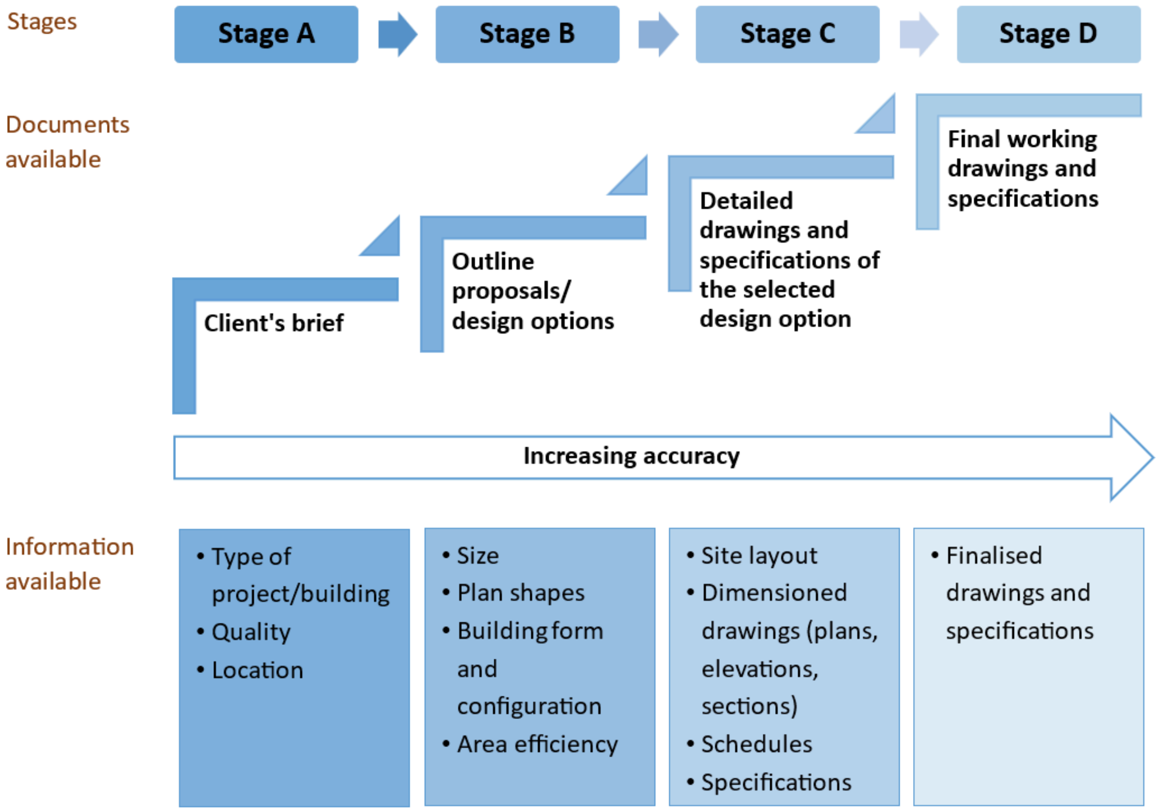


Figure 7.2: Documents available and information used in different stages, by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a CC BY-NC 4.0 licence.

Best practices for cost planning

During the cost planning process, **reconciliation** in the form of comparison of cost items between 2 stages (See Section 7.2) helps identify the impacts of design development on project costs. It is a part of Tender Document Cost Plan (Stage D) as per ACMM. This can also be done simply in other stages to see the impact of design/scope changes to the cost.

Value management studies are also carried out to give the best value for client's money and to maintain the end project cost within the budget, by comparing alternative designs, materials, methods and so on.

Cost planning activities in each stage are detailed hereinafter.

7.1.1 Brief (Stage A)

AIQS (2022, p. 2) defines the Brief Stage Cost as 'a first cost indication to the client based on an outline statement of the client's needs. The indicative cost is intended only as a guide for feasibility' and planning purposes; it is not an estimate and should not be quoted as such'.

The major purposes of this stage can be establishing the initial budget or to confirm that the Client's budget is feasible. It indicates the Client's financial commitment and affordability. Therefore, it determines the continuation of the project and subsequent cost planning (whether to continue or not with the project).

In actual projects, Stage A can involve further developed design information cost plans.

Documents available

- In this initial stage, the **Client's brief** is used as the basis to produce an indicative cost.
- The Client's brief can be an outline statement of the Client's needs.
- Drawings are usually not available in this stage.
- Any available sketches and information will be used.

Information used

Example: Information used

In Australia, classes of office buildings are described as **premium**, **A-grade** and **B-grade**, which indicates the **quality** of the building. Premium office buildings are probably more expensive than other building classes.

- **Type of building/project:** The type of building is always related to its purpose and function. This help identify the specific requirements of a project.
    - Types can be residential, commercial, office building, hospitals, schools, stadiums and so on.
- **Quality:** Some building types can be categorised based on their quality. This is usually done based on the level of services provided in relation to its primary function during the operational stage of the building. The building should be completed in a way to facilitate that level of service.
    - Hotels can be categorised with star grades (5-star, 4-star).
    - Offices can be categorised as Premium, A-grade or B-grade.
- **Location:** Even with the same building design and materials, the cost of 2 projects can differ due to their location.
    - Project areas such as in a central business district (CBD), city fringe, suburban areas.
- **Space requirements:** Although the design and building layout is not decided, the client will probably have an idea of the size of the project to be.
    - This can be indicated in the number of functional units, and/or floor areas (lettable office area/ useable floor area).
- Any available project specific information will be used in this stage.

The common industry practice in Australia is to provide the functional area schedule in the Stage A cost plan. It is generally used at the Master Planning Stage of the project.

Master plan documents are prepared by main consultants and sub-consultants. They define the scope of work.

7.1.2 Outline proposals (Stage B)

The purpose of this stage is to identify the best means of satisfying the client's requirements by comparing alternative proposals. The selected proposal will be the basis for cost planning in the next stage.

Documents available

- Outline proposals and/or design options prepared by the architect or design team (several outline proposals might exist).

Information use

- Project description (in this stage, more information will be available compared to the Client's brief in Stage A) (see **Figure 7.2**).
- Scope of the works related to the size, plan shape of the building, etc.
- Alternative designs can be available for building configuration, form and area efficiency.
- More information on functional areas.
- Building services plan drawings.

7.1.3 Sketch design (Stage C)

The purpose of this stage is to confirm and set the final budget. Therefore, it is prepared based on the approved design produced by the project design team based on the selected outline proposal in Stage B. This cost plan provides the client with an estimate of the total end cost of the project, identifies any risks to achieving completion of the project within the overall project budget and identifies any opportunities for further development of the cost plan at the completion of the design development phase of the project.

Documents available

- Site layout, including contours and external works information (extent of roads, paths, landscaping, service mains, covered ways, fencing, etc.).
- Dimensioned sketch plans, elevations, sections.
- Structural sketches with dimensions of members and details.
- Schedule of finishes.
- Specification notes.
- Building services design and specifications.

Information used

Alternative construction methods, materials and systems will be considered to ensure that the overall design is the most effective. This can be done by establishing elemental cost benchmarks (see Section 4.3).

Cost planning can be performed using elemental breakdowns with specific construction methods and materials.

Although the overall design in terms of building shape, plan size and building configuration is finalised when moving from Stage B to Stage C, the design in terms of methods and materials such as specific finishes and services can be further analysed and refined to meet the budget. Elemental breakdown with specific methods and materials will be important in this task.

Figure 7.3: Finishes elements comprise a breakdown of various types, by Jayawickrama, T., Jayasinghe, R. & Kahandawa, R., licensed under a CC BY-NC 4.0 licence.

Interim cost plans may be prepared in this stage before finalising the design and to maintain the costs within the budget. Thereafter, the final tender document cost plan can be prepared in Stage D.

Remember the difference between cost and the budget? (See Section 2.2)

7.1.4 Tender document cost plan (Stage D)

Tender Document Cost Plan (Stage D) is used at the documentation stage of the project getting ready for tendering. This stage will provide a detailed cost plan with finalised construction drawings and specifications. This cost plan is also based on accurate assessments of marketplace cost conditions and escalation.

There may be several other important activities in this stage to ensure that the overall design is contained within the budget:

- Comparison with cost plans in previous stages will be carried out to report on the variances in the form of **Reconciliation Statements** (see **Section 7.3**). This enables the design team to be aware of the cost implications of the design to ensure the completed design is contained within the agreed cost limit/budget. It also facilitates comparisons in elemental basis to meet elemental cost limits. This is a common practice in government projects.

- **Cost checks** on major elemental or area measurements and elemental costs is another important activity in this stage. Some rules of thumb can be used for this based on the experience of cost planners. Examples are presented later in this chapter.

Example: Cost checks

Cost checks can be carried out by comparing major elemental quantities for accuracy. Any differences have to be identified with reasons. Such comparisons can include the following:

- *Substructure (SB) + Upper Floors (UF)* and *Fully Enclosed Covered Area (FECA)*
- *Ceiling Finishes (CF)* and *FECA*
- *Floor Finishes (FF)* and *FECA*
- *External Walls (EW) + Internal Walls (NW) × 2* and *Wall Finishes (WF)* (this element refers to internal finishes)

Note: These elements, elemental codes and area measurements are as per ACMM. Measured examples are available in Chapter 8.

The following ratios can also be checked:

- [External Walls (EW) + Windows (WW)] / FECA
- WW / (EW + WW)

Documents available

- Final working drawings and specifications.
- Engineering services cost plans.

Information used

- All the details of the project necessary for cost planning will be available at this stage with more accuracy.

7.2 Cost plans with a sample project

This section presents an example hospital project in Australia to demonstrate cost planning in each stage. The project is now completed, but this explains the steps carried out during design development and cost planning process.

Example: Hospital project

Project information

Project title: ABCD Hospital Redevelopment in Melbourne

Client: The Department of Health, Victoria, and a Health Services facility

Scope of the project: The project consists of the new build construction of a hospital building, together with significant earthworks to raise site levels and the construction of a separate ambulance station.

Budget: The approved funding and budget for the project was $22.7 million. There is no surplus or deficit in the current approved budget.

Project milestones

- Out to tender: mid-January 2013
- Construction start date: 15 April 2013
- Construction completion: 15 August 2014

Reference documents

- Department of Health Project Brief
- Australian Cost Management Manual
- Department of Health, Capital Works Guidelines

Assumptions

The term cost estimate is used in this section, but it should not be confused with Builder's estimates (see Section 6.1).

- Cost estimates assume that a traditional procurement route will be adopted for the project and which will be competitively tendered to achieve a fixed price lump-sum for each element of the works.
- Cost estimate also assumes that the project will be constructed as a single stage construction.
- No allowance is included for any additional costs associated with adopting non-traditional forms of building procurement.
- If a 'cost-plus' or similar route is adopted, or if a sufficient quantity of suitable tenderers cannot be achieved within the marketplace, then it is likely that a cost premium will be realised and must be added to the budget.

Cost plan A

In this example, cost planners prepared this in the Brief Stage (Stage A) based on *functional/departmental areas* of the hospital. Chapter 3 also provides a simple example of a cost plan based on the functional areas for a boarding house project.

Documents used as the basis of the Cost plan A

Sketch drawings and documents, which were available on May 2012, were used for this cost plan, including:

- master plan sketch drawings (There were several options of master plan sketches available to consider at this initial stage.)
- proposed schedule of accommodation (functional areas)
- the master plan estimate for services provided by the services consultant
- no separate structural or civil drawings were available.

Basis for measurement and pricing

- Cost estimates were based on area measurements taken from architectural drawings adopting historical costs of similar projects from the project's cost consulting company's database of health project costs.
- Functional area method is the cost planning technique used here. These are also known as 'departmental areas'.
- Building Services costs have been incorporated with departmental area rates while External Services are shown separately as project specifics. Both costs are from engineering cost estimates based on the advice from the services consultant.
- Costs of Central Energy Systems, Infrastructure Services and External Services are project-specific estimates based on the advice from the services consultant. This cost also includes any infrastructure upgrades required for the continuation of the project (i.e. ACMM element of Work to utilities off-site (see Section 6.4.2).
- Cost estimates were based on the current rates at the time, including site and locality allowances (see Chapter 4) as at May 2012 (BPI 190).

Preliminaries

- Preliminaries related to building works are captured within the departmental area rates.
- Preliminaries related to site works are calculated at a percentage.

Project specifics

- In addition to the common items such as site works, landscaping and services, this project needs to consider environmentally sustainable (ESD) initiatives.
- ESD allowance is calculated as 2.5% of building costs.
- Also, there is a specific requirement to fill the site area with suitable materials above the flood level.

Special provisions

Based on Department of Health Guidelines, allowances have been included for:

- Design Contingency at 5.0%
- Construction Contingency at 5.0%
- Escalation to tender issue (evaluated separately)
- Escalation to completion (evaluated separately)
- Locality allowance for building works has been included in the benchmark rates
- Locality allowance for site works has been calculated at a percentage.

Other project costs

- Other project cost items are calculated using appropriate percentages.
- Consultant fees are calculated using an appropriate amount.

Exclusions

- Land acquisition cost is not included in this cost plan at this stage.
- Demolition of old hospital is funded separately and is not included in this cost plan at this stage.
- Project Prolongation Contingency.
- Allowance Temporary Accommodation for the Hospital,
- Hospital Operations Costs.
- Impact of Carbon Tax.
- GST.

<u>Cost plan A summary</u>

Date of Cost plan A: 20 May 2012

Project Component	Area (m^2)	Rate ($\$/m^2$)	*Total [1]
Administration	163	3,345	546,000
Bed-Based Services	858	3,894	3,342,000
Emergency Department	76	3,956	301,000
Support Services	462	3,638	1,681,000
Primary Health	658	3,337	2,196,000
Medical Clinic	278	3,683	1,024,000
Ambulance Station	217	3,280	712,000
Subtotal – Gross Departmental Area	**2,712**	**3,615**	**9,802,000**
**Interdepartmental Travel (10%)	272	2,434	662,000
Subtotal – Gross Building Area	**2,984**	**3,507**	**10,464,000**
Project Specifics			
Central Energy & Infrastructure Services			2,990,000
***Site Works including Landscaping			2,066,000
External Services			387,000
ESD Initiatives		2.5%	262,000
Allowance for flood Resilience Works			351,000
Net Construction Cost		***5,537***	**16,520,000**
Special Provisions			
Design Contingency		5.0%	826,000
Construction Contingency		5.0%	826,000
Project Prolongation Contingency			Excluded
Total Construction Cost		***6,090***	**18,172,000**
Other Project Costs			
Fittings, Furniture & Equipment (FF&E)		8.0%	1,454,000
IT & Communications & Audio-visual Equipment		5.0%	909,000
Consultant Fees			1,483,000
Authority Charges, Headwork Fees, etc.		0.6%	110,000
Agency Management Support/Administration		0.8%	137,000

Department of Health (DH) Management Support/ Administration		0.8%	137,000
Total Project Cost (@ May 2012)		***7,508***	**22,402,000**
Escalation To Tender (evaluated separately)			109,500
Escalation To Completion (evaluated separately)			188,500
Land Acquisition			Excluded
Total Project End Cost (Excluding GST)		***7,608***	**22,700,000**
Allowance for Demolition of Old Hospital			400,000

1 Totals are rounded up to the nearest 1,000 multiples.

Details of site works

Site Specific Allowances have been included.

Site Preparation & clearance	77,000.00
Building Demolition	30,000.00
Rock Removal	20,000.00
Removal of Contamination material	20,000.00
Roads and Paths	350,000.00
Carparking (50 cars)	400,000.00
Ambulance turning bays/Carpark	120,000.00
Road sealing work	50,000.00
Walls & Fences	60,000.00
External pedestrian steps/ramp footpath (Extraover Allowance)	60,000.00
Entry Canopy	96,000.00
Fire Water Storage	140,000.00
Garden Sheds	22,000.00
Service Vehicle Shed	210,000.00
Landscaping	206,000.00
Subtotal	**1,861,000.00**
****Preliminaries & Locality Allowance on Site Works (11%)	205,000.00
Total Site Work	**2,066,000.00**

Learnings from sample Cost plan A

Functional/Departmental areas

As the detailed drawings are not available at this stage, cost planners use sketches or approximation of functional areas. These are also known as 'departmental/accommodation areas'.

*Rounded figures

The amounts are rounded up to the nearest 1,000 multiples. This is a general practice of using approximate figures in early stage cost plans. This will indirectly increase the figures to cover any risks. However, more accurate figures will be used in later stages with the availability of more accurate project information.

**Interdepartmental travel

As the layout of functional areas are not finalised at this stage, a percentage allowance (10% in this example) is made for the circulation areas between the functional areas to obtain the total building area. In this cost plan, it is called 'interdepartmental travel areas'. As per ACMM, **Interdepartmental travel** includes links, wall thickness, lifts and plant areas are included in the project.

Rates of various functional areas

Rates per m^2 of various functional areas have been applied. As mentioned in Chapter 4 and Chapter 5, benchmark rates can be derived by cost analysing similar previous projects .

Per gross area rates

Per gross building area rates are calculated for each subtotal. This provides a benchmark rate to have a better idea of the cost of the overall project in comparison to previously completed projects.

****Preliminaries & locality allowance on site works

A single figure has been used to capture preliminaries and locality allowance for site works. Such practices are common in early stage cost plans, where the purpose is to capture all cost items for budgeting purposes. In later stages, these cost items will be presented separately and with details.

Cost plan B

The hospital building design was developed to have 15 beds with an approximate GFA of 3,156 m^2.

Documents used

This Stage B cost plan has been prepared using the following documents provided by the relevant consultants:

- architectural drawings (Proposed Schedule of Accommodation/Area Schedule, Site Plan, Floor Plan of the selected concept design)
- engineering drawings (Structural and Civil Sketches)
- geotechnical report
- services engineering feasibility cost estimate (prepared by the engineering services cost consultant of the project)
- structural foundation and fill options analysis.

Basis for measurement and pricing

- The rates included in the cost plan have been generated using the project's cost consulting company's database of historical costs, adjusted for the specific nature of this project (i.e. time, location).
- An elemental basis has started to be used in this stage.
- The rates for engineering services have been provided by the project's services consultants.
- The rates are current at the time as at May 2012 (BPI 190).

Preliminaries and contingencies

- The preliminaries allowance is based on 12% of the total construction costs and is shown separately in the cost plan summary.
- **Design contingency** allowance is still 5% in this stage as the design risk still pertains.

Project costs

- Project cost items are calculated using similar percentages to Stage A.
- Consultants' fees – The figure provided by the project management company increased to $1.5 million.

Assumptions

- Substructure – The estimate for the substructure is based on the site fill design option provided by the structural engineers
- External Walls – Assumed brick veneer external wall construction with 15% of external wall area as external feature cladding.
- Windows – Assumed 25% of external wall area for aluminium framed windows.
- External Doors – Assumed 8% of external wall area for external doors.
- Infrastructure – Sewer relocation costs are based on indicative cost estimate provided by the relevant engineering cost consultant.

Exclusions

The following items are expressly excluded from the cost plan:

- project prolongation contingency
- allowance of temporary accommodation for the hospital
- hospital operations costs
- land cost
- Impact of Carbon Tax
- GST.

The following items have been costed, however, they will need to be separately funded (not within the project budget mentioned in Stage A):

- demolition of the existing hospital.

The estimate for the demolition of the existing hospital was only preliminary at this stage.

The following items are assumed to be included elsewhere in the client's overall project budget:

- artworks
- client finance costs
- client insurances
- client legal costs
- client marketing costs
- models/visuals.

Risks and opportunities

The following items present the most significant costs risks to the project given the current stage of the design:

- risk of further increases to GFA due to changing project requirements
- potential to re-use site silt layer to be verified
- authority charges and fees to be confirmed.

The following items present opportunities to reduce the current cost estimate, which could be explored at later stages in the design:

- reduce cost for imported structural fill based on finding a local supply of suitable quality
- adjustment of current building location to reduce the extent of fill
- adopt the most suitable substructure option as selected for the filled area
- refine Fittings, furniture and Equipment (FF&E) and IT & Communications (ICT) budgets.

Cost plan B summary

Date of Cost plan B: 09 July 2012
Gross Floor Area (GFA): 3,156 m^2

Description	Total	Cost per m^2 of GFA	% of TEC
Shell	2,716,424	861	12.0
Fit-out	2,761,500	875	12.1
Services	3,695,676	1,171	16.3
Subtotal – Building Costs	**9,173,600**	**2,907**	**40.4**
Project Specifics			
Centralised Energy and Infrastructure Services	2,606,130	826	11.5
External Works and External Services	2,317,176	734	10.2
ESD Initiatives	262,000	83	1.2
Flood Resilience Works	369,900	117	1.6
Subtotal	**14,728,806**	**4,667**	**64.9**
Preliminaries @ 12%	1,767,457	560	7.8
Net Construction Costs	**16,496,263**	**5,227**	**72.7**
Contingencies			
Design Contingency @ 5%	824,813	261	3.6
Construction Contingency @ 5%	824,813	261	3.6
Total Current Construction Cost	**18,145,889**	**5,750**	**79.9**
Escalation to construction commencement – Apr 2013 @ 0.50%	90,729	29	0.4
Escalation to construction completion – Oct 2014 @ 1%	181,459	57	0.8
Total Estimated Construction Cost (TCC)	**18,418,077**	**5,836**	**81.1**
Other Project Costs			
Fittings, Furniture and Equipment (FF&E) @ 8%	1,473,446	467	6.5
ICT @ 5%	920,904	292	4.1
Consultant fees	1,500,000	475	6.6
Authority charges, headworks fees, etc. @ 0.6%	110,508	35	0.5
Agency management support/administration @ 0.75%	138,136	44	0.6

DH management support/administration @ 0.75%	138,136	44	0.6
Total Estimated End Cost (TEC)	**22,699,207**	**7,192**	**100.0**

Total End Project Cost is expressed as **22,700,000**.

Extracts of Elemental breakdowns for Shell, Fit-out and Services

Description	Total	Cost per m^2 of GFA	%
Shell			
Substructure	801,624	254	29.5
Columns	157,800	50	5.8
Upper Floors	78,900	25	2.9
Staircases	–	–	–
Roof	946,800	300	34.9
External Walls	613,900	195	22.6
Windows	89,000	28	3.3
External Doors	28,400	9	1.0
Subtotal – Shell	**2,716,424**	**861**	**100**
Fit-out			
Internal Walls	261,948	83	9.5
Internal Screens	88,368	28	3.2
Internal Doors	233,544	74	8.5
Wall Finishes	631,200	200	22.9
Floor Finishes	394,500	125	14.3
Ceiling Finishes	347,160	110	12.6
Fitments	678,540	215	24.6
Special Equipment	126,240	215	4.6
Subtotal – Fit-out	**2,761,500**	**875**	**100**
Services			
Sanitary Fixtures	410,280	130	11.1
Sanitary Plumbing	410,280	130	11.1
Water Supply	–	–	–
Gas Service	–	–	–
Space Heating	–	–	–
Ventilation	–	–	–
Evaporative Cooling	–	–	–

Air Conditioning	1,192,968	378	32.3
Fire Protection	233,544	74	6.3
Electric Light & Power	959,424	304	26.0
Communications	331,380	105	9.0
Transport Systems	–	–	–
Special Systems	157,800	50	4.3
Subtotal – Services	**3,695,676**	**1,171**	**100.0**

Reconciliation to Previous Cost Plan

Description	Total $
Current Cost Plan (Cost plan B)	22,700,000
Previous Cost Plan (Cost plan A)	22,700,000
The increase from previous cost plan	**NIL**

Budget Reconciliation

Description	Total $
Current approved budget for the project	22,700,000
Current estimated total end cost (as per Cost plan B)	22,700,000

There is no anticipated surplus or shortfall to currently approved funding.

Learnings from sample Cost plan B of the hospital project

Basis of the cost plan: This Stage B cost plan is prepared based on the selected outline proposal. GFA is available. Stage A cost plan was based on functional areas of the building, where this Stage B cost plan includes elemental breakdown of costs.

Elemental Breakdown: The cost plan summary presents the building cost under categories, namely shell, fit-out and services. However, this cost plan is prepared using an elemental breakdown. Elemental breakdowns of Centralised Energy and Infrastructure Services, External Works and External Services are also available.

Preliminaries are now added as a percentage (12%) to the **Net Construction Cost**; whereas, preliminaries for building works were captured in benchmark rates in the Stage A cost plan.

Calculation of Escalation: It is interesting to note that in the Stage A cost plan, Escalation is applied at the end before calculating the other project costs. However, in this cost plan, escalation is applied at the Total Construction Cost before calculating the other project cost allowances. If you do a simple calculation, this order makes no difference when applying percentages. However, the consultancy fees are a fixed amount and should be calculated at current rates.

Cost plan C

From Stage B to Stage C, the design is further refined, and the GFA is now 3,148 m^2, whereas it was 3,156 m^2 previously.

Additional Department of Health funding of $452,958 is now approved.

Scope of work

The project now includes the following:

- demolition of the old hospital
- cost of all land purchases
- all initial consultants fees engaged by the client.

Basis for measurement and pricing

- Elemental cost planning is used in this stage.
- The rates were current at the time of Sep 2012 (BPI 195).
- ESD design allowance is now fixed at $ 175,000.

Special Provisions

- **Escalation %**
- **Design contingency** allowance is now 3% in this stage (within the Department of

Health Guidelines).

Other project costs

The cost estimate includes the following costs in accordance with project requirements:

- purchase of the original land $299,990 (expended)
- initial consultancy fees $127,887 (expended)
- demolition of the old hospital $320,000 (estimated).

The estimate for the demolition of the existing hospital was only preliminary at this stage. This estimate was tested in the marketplace in the later few weeks.

Preliminaries

- The preliminaries allowance is now calculated at 11% of the total construction costs as appropriate to the project scope.

Assumptions

- Substructure – The estimate for the substructure is based on the site fill design option provided by the structural engineers and assumes locally sourced material to be used for site fill.
- Infrastructure – Sewer relocation costs are based on indicative cost estimates provided by the relevant engineering cost consultant.
- Other assumptions made in the previous stage are no longer required as the design is now further developed.

Remember interim cost plans may be prepared in this stage (see **Section 7.2.1**)

This project has an interim cost plan and, therefore, these are named as cost plan C1 and C2.

Cost plan C1 summary

Date of Cost plan C1: 22 October 2012
GFA: 3,148 m^2

Description	Total	Cost per m^2 of GFA	% of TEC
Shell	3,180,284	1,010	13.7
Fit-out	2,890,558	918	12.5
Services	3,785,103	1,202	16.3
Subtotal – Building Costs	**9,855,945**	**3,131**	**42.5**
Project Specifics			
Centralised Energy and Infrastructure Services	2,461,700	782	10.6
External Works and External Services	2,334,090	741	10.1
ESD Initiatives	175,000	56	0.8
Flood Resilience Works	404,040		1.7
Subtotal	**15,230,775**	**4,838**	**65.6**
Preliminaries @ 11%	1,675,385	532	7.2
Net Construction Costs	**16,906,160**	**5,370**	**72.9**
Contingencies			
Design Contingency @ 3%	507,185	161	2.2
Construction Contingency @ 5%	845,308	269	3.6
Total Current Construction Cost	**18,258,653**	**5,800**	**78.7**
Escalation to construction commencement – Apr 2013 @ 0.25%	45,647	15	0.2
Escalation to construction completion	155,210	49	0.7
Total Estimated Construction Cost (TCC)	**18,459,509**	**5,864**	**79.6**

Other Project Costs			
Fittings, Furniture and Equipment @ 7%	1,292,166	410	5.6
ICT @ 3.5%	646,083	205	2.8
Consultant fees	1,550,000	492	6.7
Authority charges, headworks fees, etc. @ 0.5%	92,298	29	0.4
Agency management support/administration @ 0.75%	138,446	44	0.6
DH management support/administration @ 0.75%	138,446	44	0.6
Allowance for Sewer Diversion Works	135,200	43	0.6
Original Land Purchase	249,990	79	1.1
Additional Land Purchase	50,000	16	0.2
Demolition of Old Hospital	320,000	102	1.4
Initial Planning and Business Case Cost	127,887	41	0.6
Total Estimated End Cost (TEC)	**23,200,025**	**7,370**	**100.0**

Extracts of Elemental breakdowns for Shell, Fit-out and Services

	Description	Total	Cost per m^2 of GFA	%
	Shell			
01 SB	Substructure	820,864	260	25.8
02 CL	Columns	73,101	23	2.3
03 UF	Upper Floors	–	–	–
04 SC	Staircases	–	–	–
05 RF	Roof	1,301,847	412	40.9
06 EW	External Walls	638,072	202	20.1
07 WW	Windows	180,400	57	5.7
08 ED	External Doors	166,000	53	5.2
	Subtotal – Shell	**3,180,284**	**1,008**	**100.0**
	Fit-out			
09 NW	Internal Walls	203,593	65	7.0
10 NS	Internal Screens	210,945	67	7.3
11 ND	Internal Doors	355,950	113	12.3
12 WF	Wall Finishes	751,707	238	26.0
13 FF	Floor Finishes	394,595	125	13.7
14 CF	Ceiling Finishes	420,245	133	14.5
15 FT	Fitments	491,573	156	17.0
16 SF	Special Equipment	61,950	20	2.1
	Subtotal – Fit-out	**2,890,558**	**916**	**100.0**
	Services			
17 SF	Sanitary Fixtures	883,827	280	23.4
18 PD	Sanitary Plumbing	–	–	–
19 WS	Water Supply	–	–	–
20 GS	Gas Service	–	–	–
21 SH	Space Heating	–	–	–
22 VE	Ventilation	–	–	–
23 EC	Evaporative Cooling	–	–	–

24 AC	Air Conditioning	1,206,198	382	31.9
25 FP	Fire Protection	231,378	73	6.1
26 LP	Electric Light & Power	967,890	307	25.6
27 CM	Communications	330,540	105	8.7
28 TS	Transport Systems	–	–	–
29 SS	Special Systems	165,270	52	4.4
	Subtotal – Services	**3,785,103**	**1,199**	**100.0**

Extract of detailed item-wise cost breakdown for Substructure

Item	Description	Quantity	Unit	Rate	Total
01	**Substructure**				
	Ground Slab				
A	100 thick concrete slab. SL82 mesh top, 30mm cover on 0.2mm moisture barrier on 50mm compacted sand bed	3,284	m2	155	509,020
B	Termite Barrier	557	m	22	12,254
C	Allow for setdowns to wet area	257	m2	60	15,420
	Pad Footings				
D	Pad Footing 300 x 500 X 1600D (PF1)	2	m3	600	1,200
E	Pad Footing 1200 x 1200 X 600D (PF2)	3	m3	600	1,800
F	Pad Footing 900 x 900 X 600D (PF3)	6	m3	600	3,600
G	Pad Footing 450 dia X 600D (PF4)	2	m3	600	1,200
	Strip Footing				
H	Strip footing 500 x 500D [SF500]	2	m3	700	1,400
I	Strip Footing 500 D [SFA, SFB]	2	m3	700	1,400
	Edge Beams/Internal Beams				
J	Edge Beam 300W x 500D (EB300)	116	m3	700	81,200
K	Internal Beam 300W x 500D (IB300)	192	m3	700	134,400
	Sundries				
L	Miscellaneous connections (5%)				38,145
M	Allowance for 500mm high precast perimeter upstand beam along external walls	305	m2	65	19,825
	Total – Substructure				**820,864**

Reconciliation to Previous Cost Plan

Description	Total $
Current Cost Plan (Cost plan C1)	23,202,025
Previous Cost Plan (Cost plan B)	22,700,000
The increase from previous cost plan	502,025

The reason for this increase is the inclusion of the following scope into the cost plan:

- demolition of the existing hospital
- land purchase and
- initial consultant fees.

Budget Reconciliation

Description	**Total $**
Approved Project Funding	22,700,000
Additional Department of Health Funding	452,958
Total Available Funding (Budget)	**23,152,958**
Current estimated total end cost (as per Cost plan C1)	23,202,025
Shortfall to current funding	**49,067**

An interim cost plan (Cost plan C2) had to be prepared due to this shortfall.

Interim Cost plan C2 summary

The design is further refined and the GFA is now 3,181 m^2, whereas it was 3,148 m^2 previously.

Date of Cost plan C2: 13 January 2013

GFA: 3,181 m^2

No.	Description	Total	Group total	Cost/ GF
	Shell		**3,206,000**	**1,**
01 SB	Substructure	826,000		
02 CL	Columns	73,000		
03 UF	Upper Floors	–		
04 SC	Staircases	–		
05 RF	Roof	1,206,000		
06 EW	External Walls	721,000		
07 WW	Windows	244,000		
08 ED	External Doors	136,000		
	Fit-out		**2,928,000**	
09 NW	Internal Walls	216,000		
10 NS	Internal Screens	149,000		
11 ND	Internal Doors	352,000		
12 WF	Wall Finishes	815,000		
13 FF	Floor Finishes	397,000		
14 CF	Ceiling Finishes	440,000		
15 FT	Fitments	505,000		
16 SE	Special Equipment	54,000		
	Building Services		**3,931,000**	**1,**
17 SF	Sanitary Fixtures	1,064,000		
18 PD	Sanitary Plumbing	–		
19 WS	Water Supply	–		
20 GS	Gas Service	–		
21 SH	Space Heating	–		
22 VE	Ventilation	–		
23 EC	Evaporative Cooling	–		
24 AC	Air Conditioning	1,332,000		
25 FP	Fire Protection	279,000		
26 LP	Electric Light & Power	753,000		
27 CM	Communications	239,000		
28 TS	Transport Systems	–		

29 SS	Special Systems	264,000		
	Subtotal		**10,065,000**	
00 PR	Preliminaries (Proportion for Elements 01 to 29) at 11%		1,107,000	
	Total Building Cost		**11,172,000**	
30 CE	Centralised Energy Systems		2,377,000	
31 AR	Alterations & Renovations		–	
	Site Works		**2,816,000**	
32 XP	Site Preparation	948,000		
33 XR	Roads, Footpaths and Paved Areas	942,000		
34 XN	Boundary Walls, Fencing and Gates	85,000		
35 XB	Outbuildings and Covered Ways	587,000		
36 XL	Landscaping and Improvements	254,000		
	External Services		**515,000**	
37 XK	External Storm Water Drainage	515,000		
38 XD	External Sewer Drainage	Included		
39 XW	External Water Supply	Included		
40 XG	External Gas	Included		
41 XF	External Fire Protection	Included		
42 XE	External Electric Light and Power	Included		
43 XC	External Communications	Included		
44 XS	External Special Services	–		
	ESD Allowance (Fixed)	Included		
45 XX	External Alterations & Renovations	–		
00 PR	Preliminaries (Proportion for Elements 30 to 45) at 11%		628,000	
	Net Construction Cost		**17,508,000**	**5,**
46 YY	**Special Provisions**		**1,138,000**	
	Infrastructure Upgrade Allowance [Included in Centralised Energy Systems]	Included		
	Design Contingency (1.5%)	262,600		
	Construction Contingency (5%)	875,400		
	Total Construction Cost		**18,646,000**	**5,**

	Other Project Costs		**4,307,000**	**1,**
	Fittings, Furniture and Equipment	Fixed	1,175,216	
	IT & Communications & Audiovisual Equipment	Fixed	446,129	
	Consultant Fees	Fixed	1,550,000	
	Authority Charges, Headwork Fees, etc.	Fixed	60,000	
	Agency Management Support/Administration	Fixed	138,456	
	DH Management Support/Administration	Fixed	138,456	
	Allowance for Sewer Diversion Works	Fixed	116,000	
	Original Land Purchase	Fixed	249,990	
	Additional Land Purchase	Fixed	25,000	
	Demolition of Old Hospital	Fixed	280,000	
	Initial Planning and Business Case Cost	Fixed	127,887	
	Total Current Project Cost (as at Nov 2012)		**22,953,000**	**7,**
	Escalation (On Total Construction Cost)		200,000	
	Total Project End Cost (excluding Goods and Services Tax)		**23,153,000**	**7,**

Extract of detailed item-wise cost breakdown for Substructure

No.	Description	Quantity	Unit	Rate	Total
01	**Substructure**				
	<u>Ground Slab</u>				
1.1	100 thick concrete slab. SL82 mesh top, 30mm cover on 0.2mm moisture barrier on 50mm compacted sand bed	3,330	m2	155	516,150
1.2	Extra over for 150 thick ground slab	67	m2	55	3,685
1.3	Termite Barrier	700	m	22	15,400
1.4	Allow for setdowns to wet area	259	m2	60	15,540
	<u>Pad Footings</u>				
1.5	Pad Footing 300 x 500 X 1600D (PF1)	2	m3	600	1,200
1.6	Pad Footing 1200 x 1200 X 600D (PF2)	4	m3	600	2,400
1.7	Pad Footing 900 x 900 X 600D (PF3)	8	m3	600	4,800
1.8	Pad Footing 450 dia X 600D (PF4)	3	m3	600	1,800
	<u>Strip Footing</u>				
1.9	Strip footing 500 x 500D [SF500]	2	m3	700	1,400
1.10	Strip Footing 500 D [SFA, SFB]	8	m3	700	5,600
1.11	Strip footing 300 x 500 [SF300]	2	m3	700	1,400
	<u>Edge Beams/Internal Beams</u>				
1.12	Edge Beam 300W x 500D (EB300)	110	m3	700	77,000
1.13	Internal Beam 300W x 500D (IB300)	180	m3	700	126,000
	<u>Sundries</u>				
1.14	Miscellaneous connections – 5%				38,619
1.15	Allowance for 500mm high precast perimeter upstand beam along external walls	150	m2	100	15,000
	Total				**825,994**

Reconciliation to Previous Cost Plan

Description	Total $
Current Cost Plan (Cost plan C2)	23,153,000
Previous Cost Plan (Cost plan C1)	23,202,000
The decrease from the previous cost plan	49,000

There were value management exercises carried out resulting in savings from the previous cost plan C1.

Budget Reconciliation

Description	Total $
Total Approved Budget	23,152,958
Current estimated total end cost (as per Cost plan C2)	23,153,000
Shortfall to current funding	**41.77**

Learnings from sample Cost plan C of the hospital project

- Interim cost plans are required if the estimated project cost exceeds the approved budget. This usually happens between Stages C and D because in Stage D, the tender document cost plan will be prepared with finalised details.
- **Design contingency** allowance was initially reduced to 3% from Stage B, and further into 1.5% in the cost plan C2 as the design has been further developed now that more detailed information is available. Hence, the design risk is now low and the design contingency allowance has been reduced.

Cost plan D

This is the Documentation Stage and the Tender Document Cost Plan is prepared in this stage marking the final stage of the cost planning process.

Basis of measurement of works and pricing

- Trade-wise costing is done in this stage.
- **Net Construction Cost** has been calculated with more detailed costing of work items with current rates at the time. Therefore, **escalation** allowance is not separately presented and captured within the construction cost.
- **Preliminaries** are now calculated in detail with current rates instead of allocating a percentage, and included in the Net Construction Cost.

Special Provisions

- **Design contingency** allowance is now 0% because the design is finalised at this stage.
- **Contract contingency** allowance remains through to the construction stage.

Date of Cost plan D: 28 February 2013
GFA: 3,181 m^2

Element Group	Cost per GFA ($/m2)	Total
Net Construction Cost	5,637	17,932,400
Special Provisions		
Design Contingency (0%)		0
Construction Contingency (5%)		896,620
Total Current Construction Cost	**5,919**	**18,829,020**
Escalation		Included
Total Estimated Current Construction Cost (TCC)	**5,919**	**18,829,020**
Other Project Costs (Fixed)		
Furniture & Equipment		1,155,216
IT & Communications & Audiovisual Equipment		446,129
Consultant Fees		1,557,000
Authority Charges, Headwork Fees, etc.		90,000
Agency Management Support/Administration		138,456
DH Management Support/Administration		138,456
Allowance for Sewer Diversion Works		116,000
Original Land Purchase		249,990
Additional Land Purchase		25,000
Demolition of Old Hospital		280,000
Initial Planning and Business Case Cost		127,887
Total Project Cost – Current (at Feb 2013)	**7,279**	**23,153,154**
Total Project End Cost (excluding GST) (Rounded)	**7,279**	**23,153,000**

7.2 Cost planning process in the New Zealand context

The New Zealand Construction Industry Council (NZCIC) Design Guidelines provide the stages in a construction project and the Elemental Analysis of Costs of Building Projects (NZIQS, 2017) is used for cost management exercises, following its elemental breakdown, definitions and measurement rules. This section provides insights into the cost planning process of construction projects in New Zealand.

7.2.1 Project establishment stage

At this stage, the project will be started and established. The client or the consultants will start collecting preliminary information regarding the site, time frame, budget and stakeholders. Client's brief information will be created at this stage, which should help manage the rest of the project stages. Factors that impact the consultant's scope and program like the procurement process will be established at this stage.

Costing

No estimate will be prepared at this stage. Only the client's budget restrictions will be identified.

7.2.2 Concept design stage

At this stage, different design concepts are explored to check if the client's brief is achievable. In this sense, the site is checked to see if the project can be developed there and the concept estimate is prepared to check the feasibility of the project. To go forward from design to resource consent, the required consultants are engaged in this process. An outline of the legal constraints and compliance is also accumulated. When the client approves the concept design, program and initial estimate, the next stage can begin.

In some projects, a single stage will cover project establishment and concept design.

Cost

- Concept cost estimates will be prepared for each concept design to check the project's feasibility.

Costing process

- Cost planners typically use the functional area method or functional unit method (see Chapter 3) to estimate the project cost.
- Historical cost data will be used for costing and then adjusted based on the location, building type, price and date (see Chapter 4).

Industry insights

- Similar to that of the Australian context, the **functional area method is preferred** in this stage.
- Historical data from comparative past projects, QV Cost Builder database and market insight updates from Rider Levett Bucknall (RLB) are used as data sources to develop

the unit rates. Some companies maintain their own database for this purpose (see Chapter 4).

7.2.3 Preliminary design stage

The concept design was further developed at this stage into the preliminary design. The preliminary design would include a scale, spatial sizes, cross-section drawings, elevation drawings, major structural elements zones and plant rooms. This includes selecting major elements such as building material, structure type and mechanical process. These selections and designs should be compatible with governmental regulations, resource consent and building consent requirements. Specialised consultants will be selected and hired at this stage to develop **Resource Consent**.

Resource Consent involves obtaining approval from the local council for activities that have an impact on the environment (Ministry for the Environment, 2021).

Based on the updated design and details, the project program and estimate will be updated. At this stage, preliminary estimates are developed to check project feasibility. At the end of this stage, Resource Consent might be applied.

Cost

- Preliminary cost estimates will be prepared for each concept design to check the project's feasibility.

Costing process

- Cost estimators typically use the Elemental Analysis of Costs of Building Projects (NZIQS, 2017) to estimate the project cost. Based on the available details, QS practitioners will decide detailed depth of the estimation process.
- Historical data are used for elemental costs and should be adjusted based on the location, building type, price, date and construction element type variations.

Industry insights

- In addition to published data sources, instance quotations from builders are sometimes used as data sources to develop the unit rates. This depends on access to such quotations in the network as contractors/builders sometimes are not willing to provide quotations for these estimates.

7.2.4 Developed design stage

A developed design will be completed at this stage so the client and relevant stakeholders can approve the aesthetics, functionality and cost of the project. The design should clearly define and coordinate major building elements and gross building areas. The scope of all building elements is finalised so that there are only a few missing details. Design documentation with scales, levels, and dimensions will be produced. All parties must work together to complete this stage.

In some projects, this stage is combined with the preliminary design stage so that there will be one estimate developed.

Cost

- An elemental cost plan is developed.

Costing process

- Similar to the preliminary stage, the Elemental Analysis of Costs of Building Projects (NZIQS) can be used to estimate the project cost or previous estimates are updated at this stage.

7.2.5 Detailed design stage

At this stage, a detailed design will be developed to have clear and defined quality and quantity of all building systems, elements and materials. Design professionals from all disciplines work together and coordinate to develop a detailed design which should include drawings, specifications, schedules and performance requirements. These details designs will be used to apply for building consent which should include tender document details. Cost planners develop a tender estimate to evaluate the contractor's tender submissions which might be a Schedule of Quantities.

Cost

- Preparation of tender document.
- Consultant's Schedule of Quantities for tender evaluation is developed based on detailed design.

Costing process for tender document preparation

- The Elemental Analysis of Costs of Building Projects (NZIQS, 2017) or ANZSMM (AIQS et al., 2022) is used to develop the cost estimate. Specific documents used depend upon the consultant's and client's requirements.
- The consultant will develop their own BOQ or SOQ to evaluate the tender document.
- If the ANZSMM is used, NZIQS has developed a sample BOQ/SOQ which might be used by QS to develop the estimate and the BOQ/SOQ can be included in the tender document.

7.2.6 Procurement stage

In this stage, the cost planning process is concluded, and the final contract price is agreed with the selected builder.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://oercollective.caul.edu.au/building-cost-planning/?p=91#h5p-9

CHAPTER 8: DEFINITIONS/TERMINOLOGY

8.0 Introduction

This chapter introduces, defines and explains the standard wordings and items used in the cost planning process. These include standard areas and elements. This chapter uses actual university buildings from Australia and New Zealand to discuss how to measure the aforementioned standard areas and elements. The definitions in the Australian context are sourced from the Australian Cost Management Manual (AQIS, 2022), while those in the New Zealand context are sourced from the Elemental Analysis of Costs of Building Projects (NZIQS, 2017).

8.1 Standard areas

The definitions of standard areas in both Australia and New Zealand vary. Therefore, the following sections separately provide the definitions of standard areas in each country and explain them with a worked example using edited drawings of an actual building, named '**Building A**'. Building A includes a library, lecture halls and administration areas.

8.1.1 Fully Enclosed Covered Area (FECA)

Fully Enclosed Covered Area (FECA): Definition

'The sum of all such areas at all building floor levels, including basements (except unexcavated portions), floored roof spaces and attics, garages, penthouses, enclosed porches and attached enclosed covered ways alongside buildings, equipment rooms, lift shafts, vertical ducts, staircases and any other fully enclosed spaces and usable areas of the building, computed by measuring from the normal inside face of exterior walls but ignoring any projections such as plinths, columns, piers and the like which project from the normal inside face of exterior walls.

It shall not include open courts, light wells, connecting or isolated covered ways and net open areas of upper portions of rooms, lobbies, halls, Interstitial Spaces and the like that extend through the Storey being computed.'

— AIQS (2022, p. 6)

There is no such separate definition for FECA in the New Zealand context. The following are the worked examples of the FECA of Building A in Levels 1, 2 and the Roof Level (examples of the FECA of Building A in Levels 1, 2 and the Roof Level) [PDF].

The FECA of the building area, is measured as follows:

Table 8.1: FECA areas for Building A

Building A Level	**FECA area**
Level 1	2,159 m2
Level 2	900 m2
Level 3 (Roof level)	183 m2
Total	**3,242 m2**

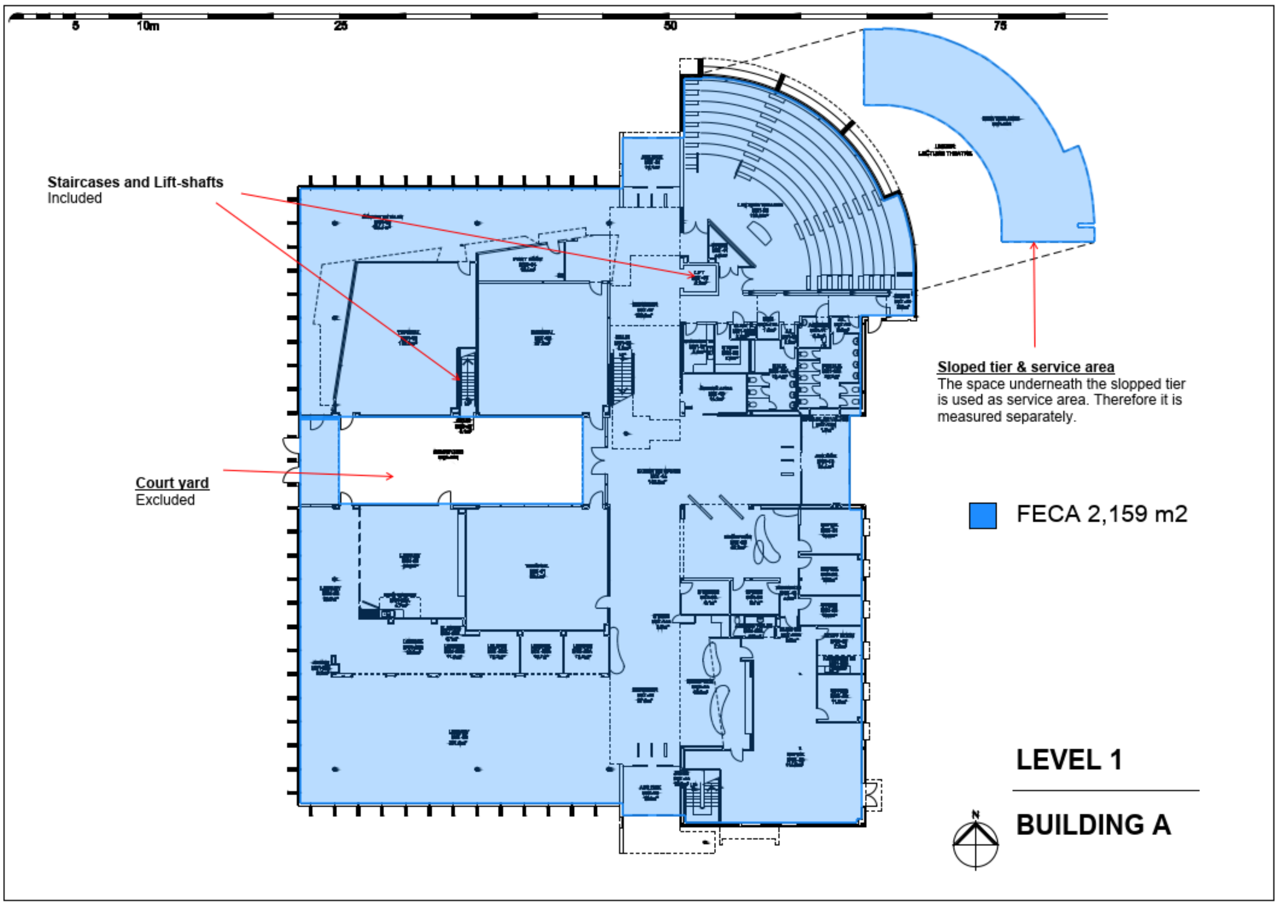


Figure 8.1a: Building A – FECA – Level 1

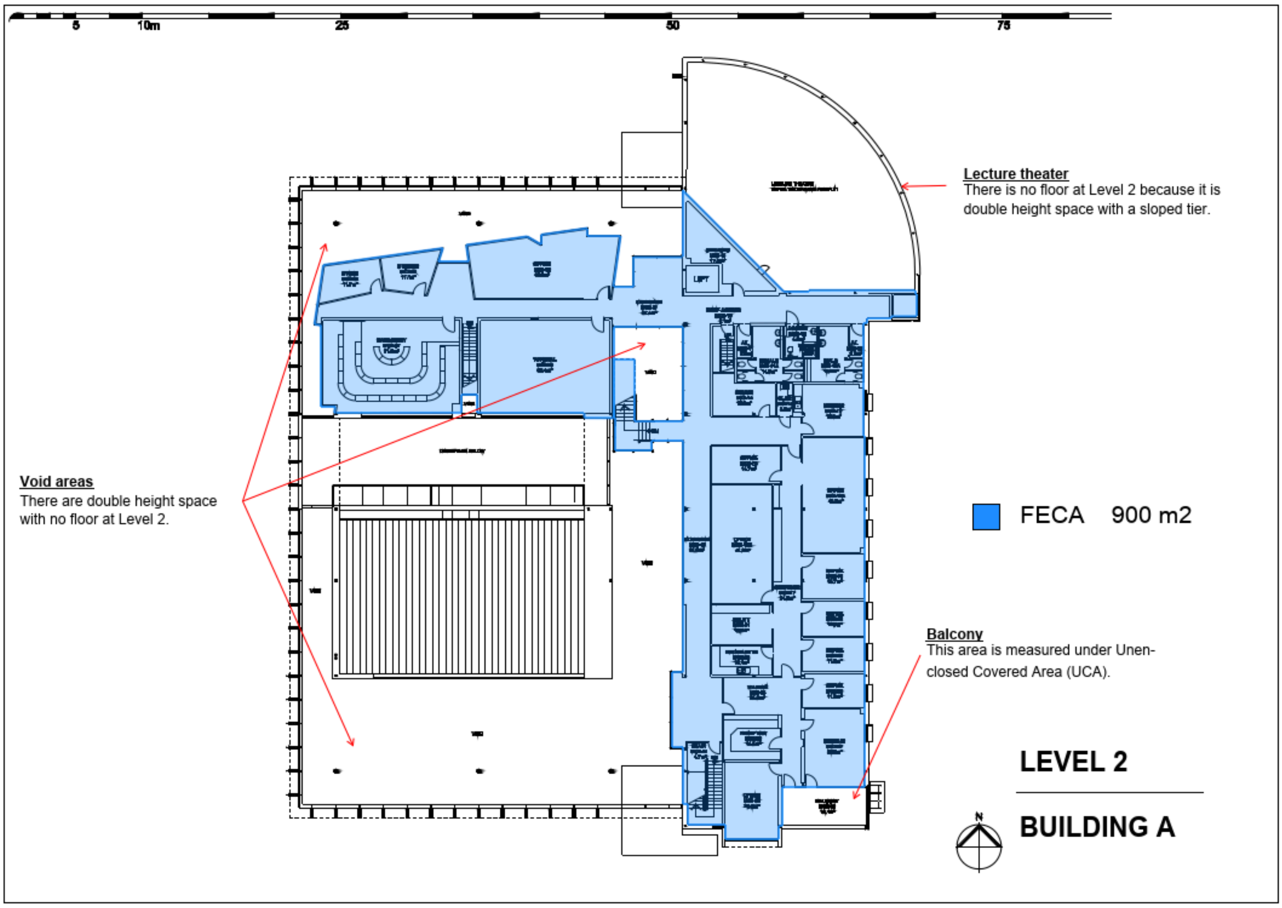


Figure 8.1b: Building A – FECA – Level 2

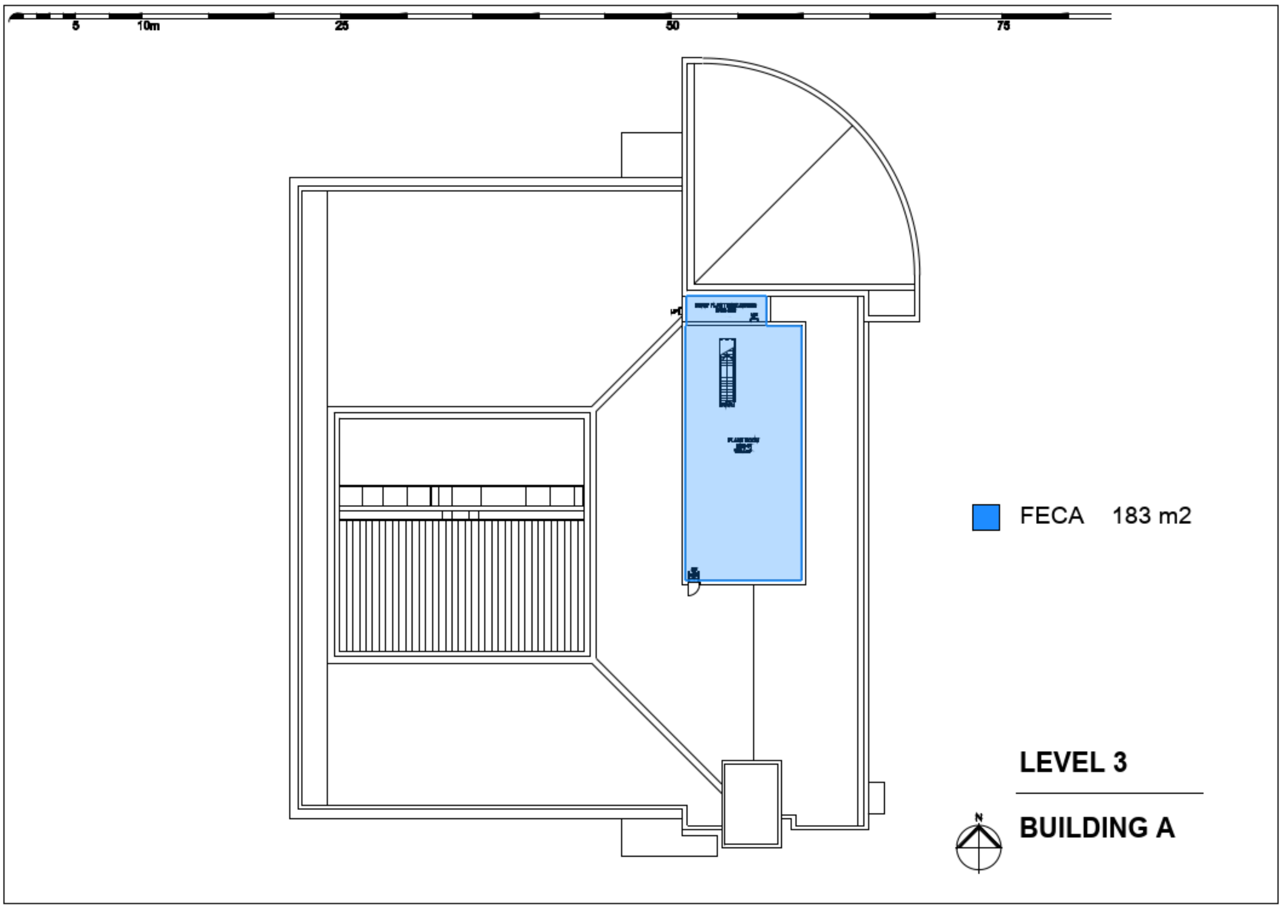


Figure 8.1c: Building A – FECA – Level 3 (Roof Level)

The key points to understand from the calculations in **Figures 8.1a**, **8.1b** and **8.1c** are as follows:

- **Level 1** – **The courtyard** is excluded from Level 1 when measuring the FECA, as it is not fully enclosed and not covered from the above.
- **Level 1** – The space underneath the **sloped tier** is used as the service area.
- **Level 2** – The **sloped tier** is considered under Levels 1 and 2 as it is a double height. Therefore, this area has not been measured in Level 2 FECA.
- **Level 2** – The **balcony** is not enclosed by full-height walls and it is excluded from FECA and measured under UCA.

Why are voids excluded and lifts and vertical ducts included in FECA?

As per the definition, FECA should be a floor area and a usable area. Empty spaces, called voids, don't count as usable areas because they're double-height spaces with a floor at that level. Therefore, the void can be excluded from FECA.

Even though the lift does not have a fixed floor, the lift still serves at each floor level. Similarly, vertical ducts are also used for a particular purpose, such as running the services for each floor. Therefore, lifts and vertical ducts are included in the FECA.

8.1.2 Unenclosed Covered Area (UCA)

Unenclosed Covered Area (UCA): Definition

'The sum of all such areas at all building floor levels, including roofed balconies, open verandas, porches and porticos, attached open covered ways alongside buildings, undercrofts and usable space under buildings, unenclosed access galleries (including ground floor) and any other trafficable covered areas of the building which are not totally enclosed by full height walls, computed by measuring the areas between the enclosing walls or balustrade (i.e. from the inside face of the UCA excluding the wall or balustrade thickness).

When the covering Element (i.e. roof or upper floor) is supported by columns, is cantilevered or is suspended, or any combination of these, the measurements shall be taken to the edge of the paving or to the edge of the cover, whichever is the lesser.

UCA shall not include eaves overhangs, sun shading, awnings and the like where these do not relate to clearly defined trafficable covered areas, nor shall it include connecting or isolated covered ways.'

Unit of Measurement: Square Metres (m_2)

— AIQS (2022, p. 12)

There is no such separate definition for UCA in the New Zealand context.

The following are worked examples of the UCA of Building A in Levels 1, 2 and the Roof Level (Example for UCA from Building A [PDF]).

According to the worked example in **Figures 8.1a, 8.1b** and **8.1c**, only the trafficable, unenclosed and covered areas are marked under UCA at all 2-floor levels. There is no such UCA that can be identified at the roof level. The reason for considering the unenclosed covered areas around the curved lecture theatre is that those are trafficable. The UCA of the building area measures as follows:

Table 8.2: UCA areas for Building A

Building A Level	**UCA area**
Level 1	54 m2
Level 2	18 m2
Level 3 (Roof level)	0 m2
Total	**72 m2**

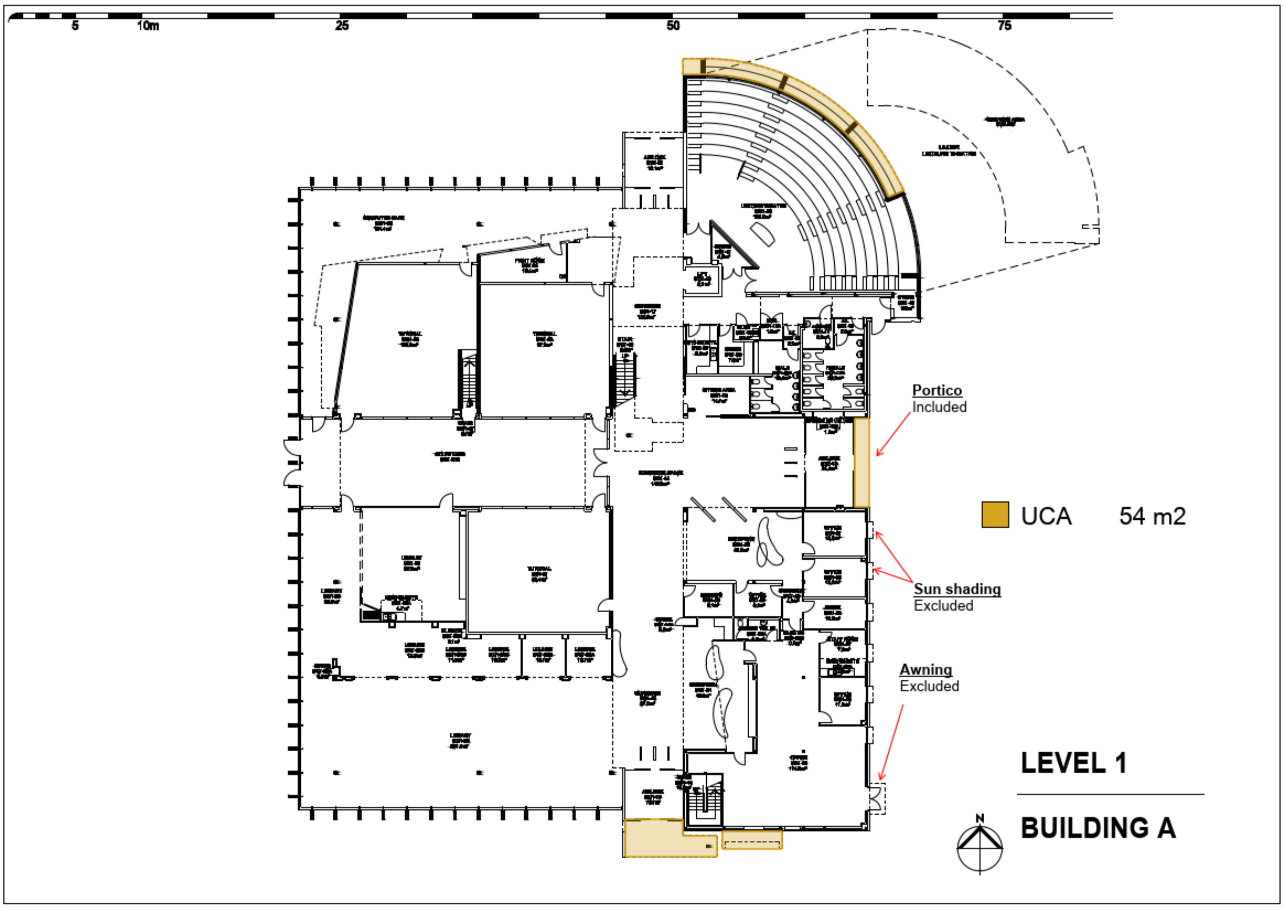


Figure 8.2a: Building A – UCA – Level 1

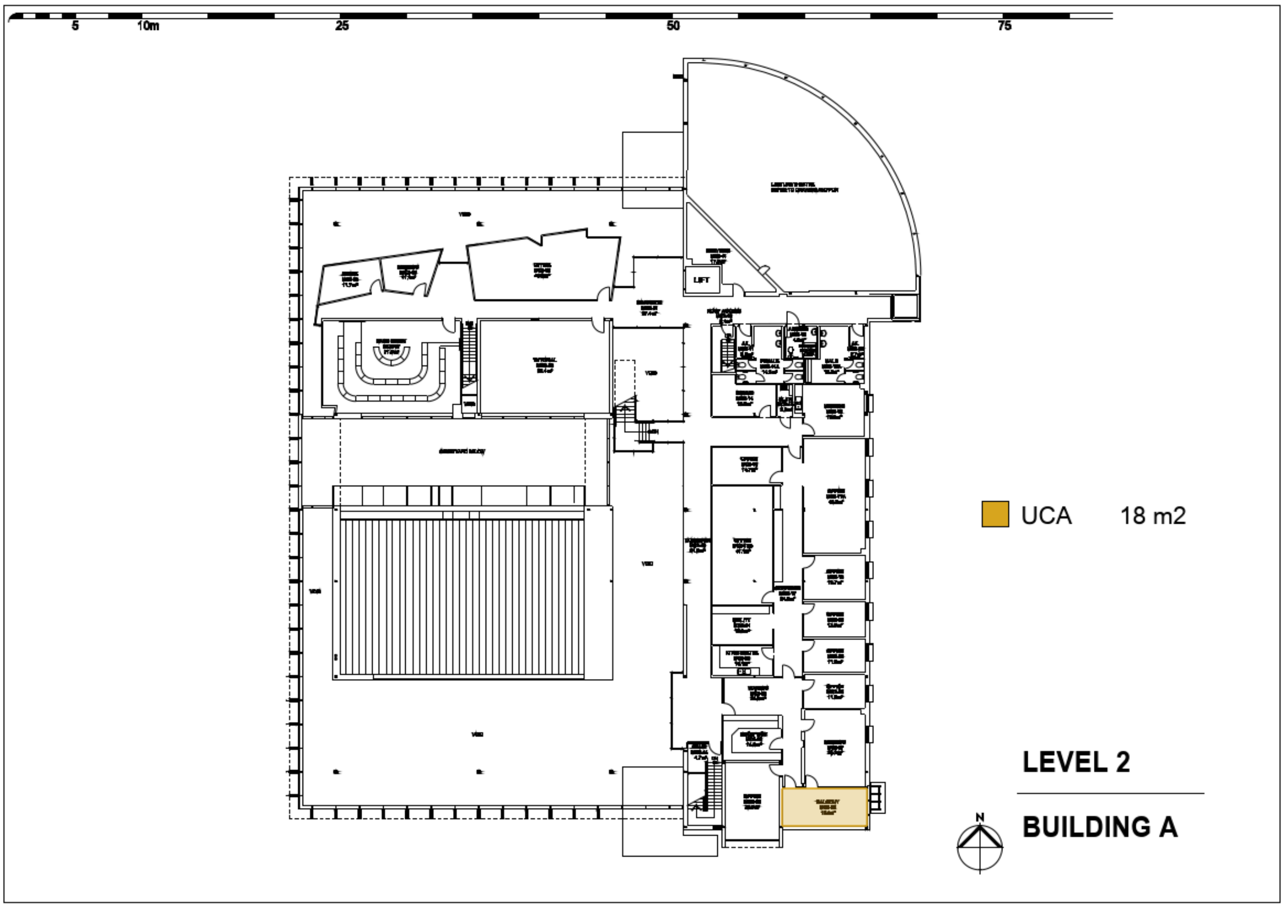


Figure 8.2b: Building A – UCA – Level 2

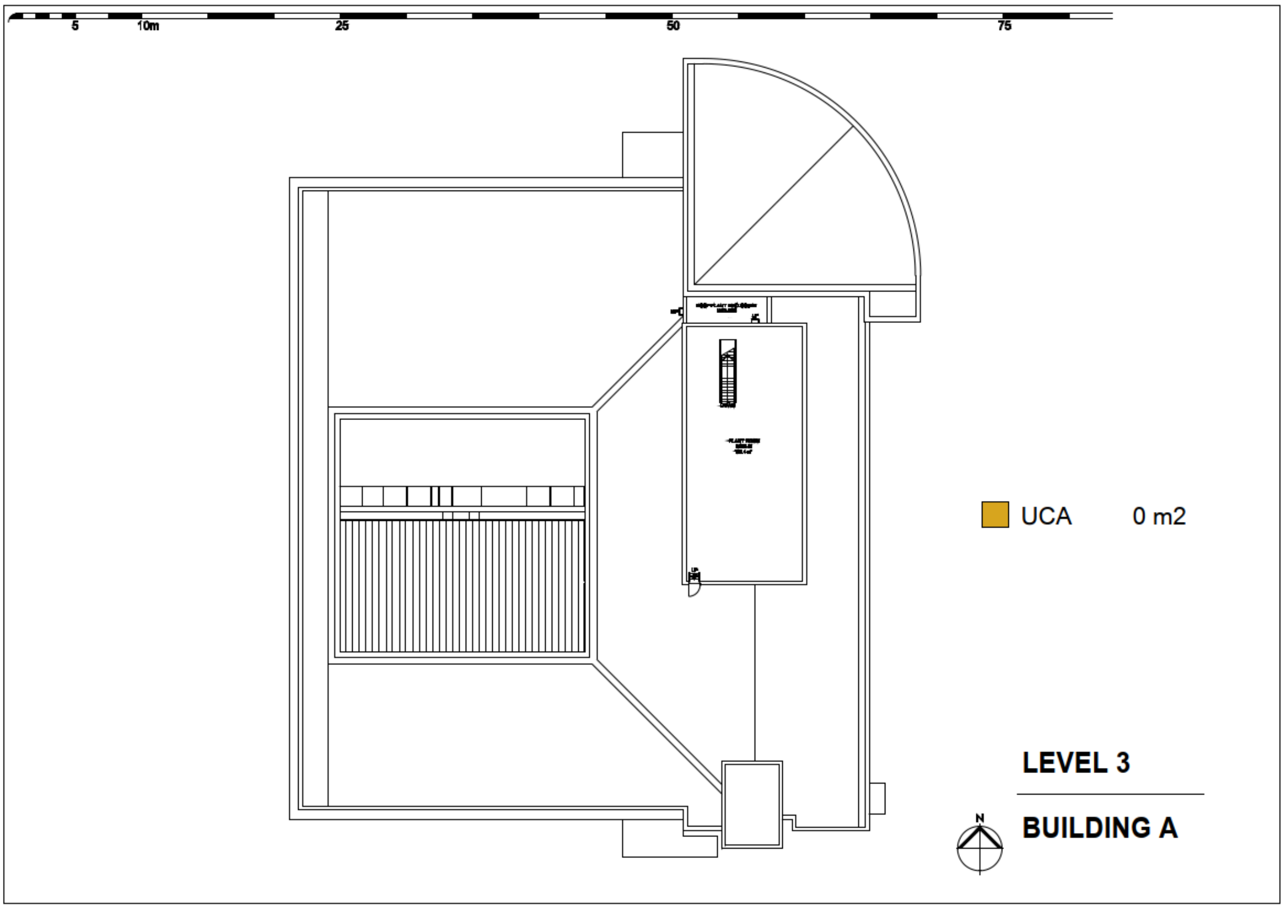


Figure 8.2c: Building A – UCA – Level 3 (Roof Level)

8.1.3 Gross Floor Area (GFA)

There are two definitions for GFA in both countries. The following is the definition in the Australian context:

Gross Floor Area (GFA) (Australia): Definition

'The sum of the Fully Enclosed Covered Area and Unenclosed Covered Area as defined in this document'. Unit of Measurement: Square Metres (m_2)

— AIQS (2022, p. 7)

According to the Australian context, GFA can be obtained by adding the measured FECA and UCA. Therefore, FECA and UCA are parts of GFA.

The following are worked examples of the GFA of Building A in Levels 1, 2 and 3 (Roof Level) (Example for GFA from Building A [PDF]).

The UCA of the building area measures as follows, according to the worked example in **Figure 8.3a**, **8.3b** and **8.3c**.

Table 8.3: GFA (Australian) areas for Building A

Building A Level	GFA area
Level 1	2,159 m2
Level 2	918 m2
Level 3 (Roof Level)	183 m2
Total	**3,260 m2**

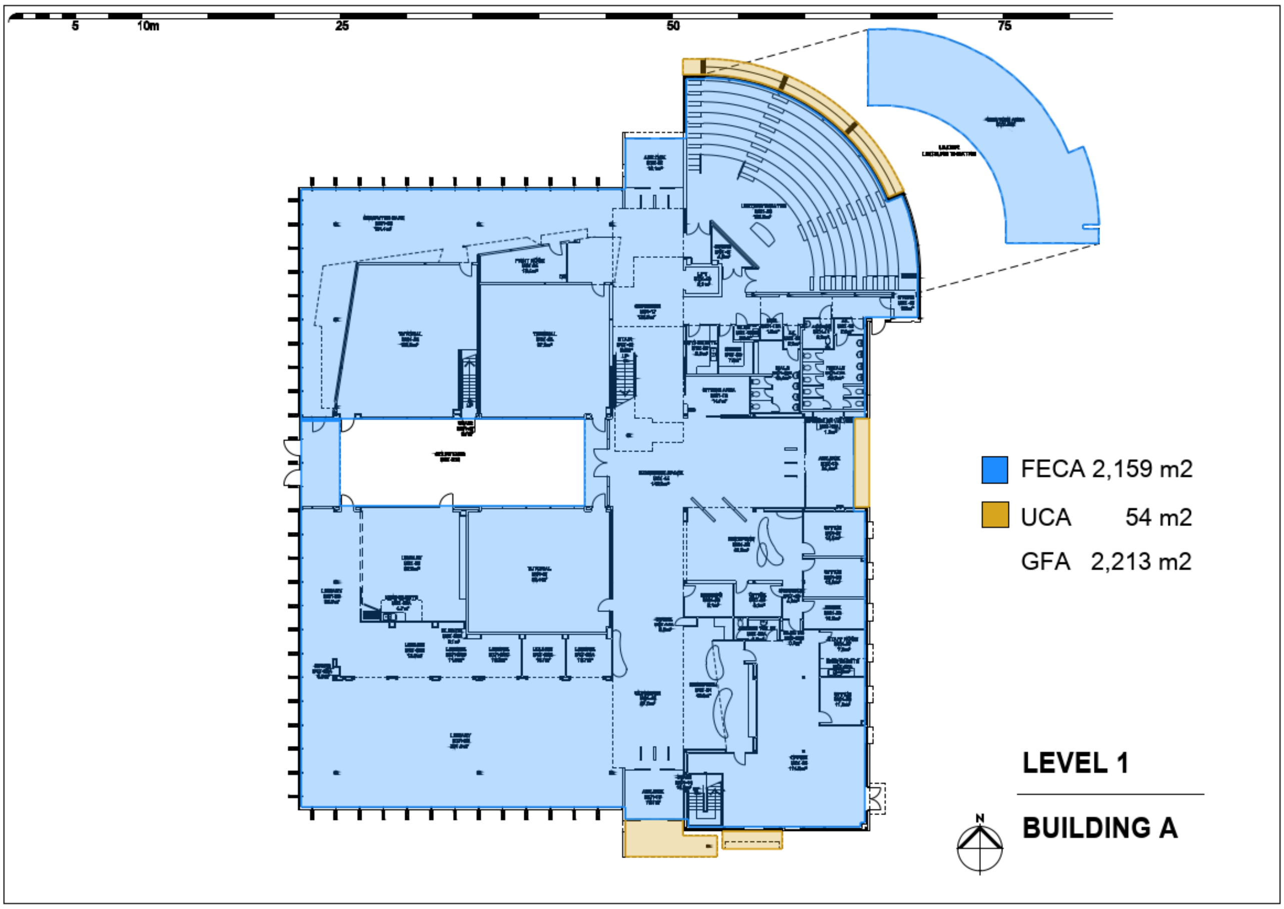


Figure 8.3a: Building A – GFA – Level 1

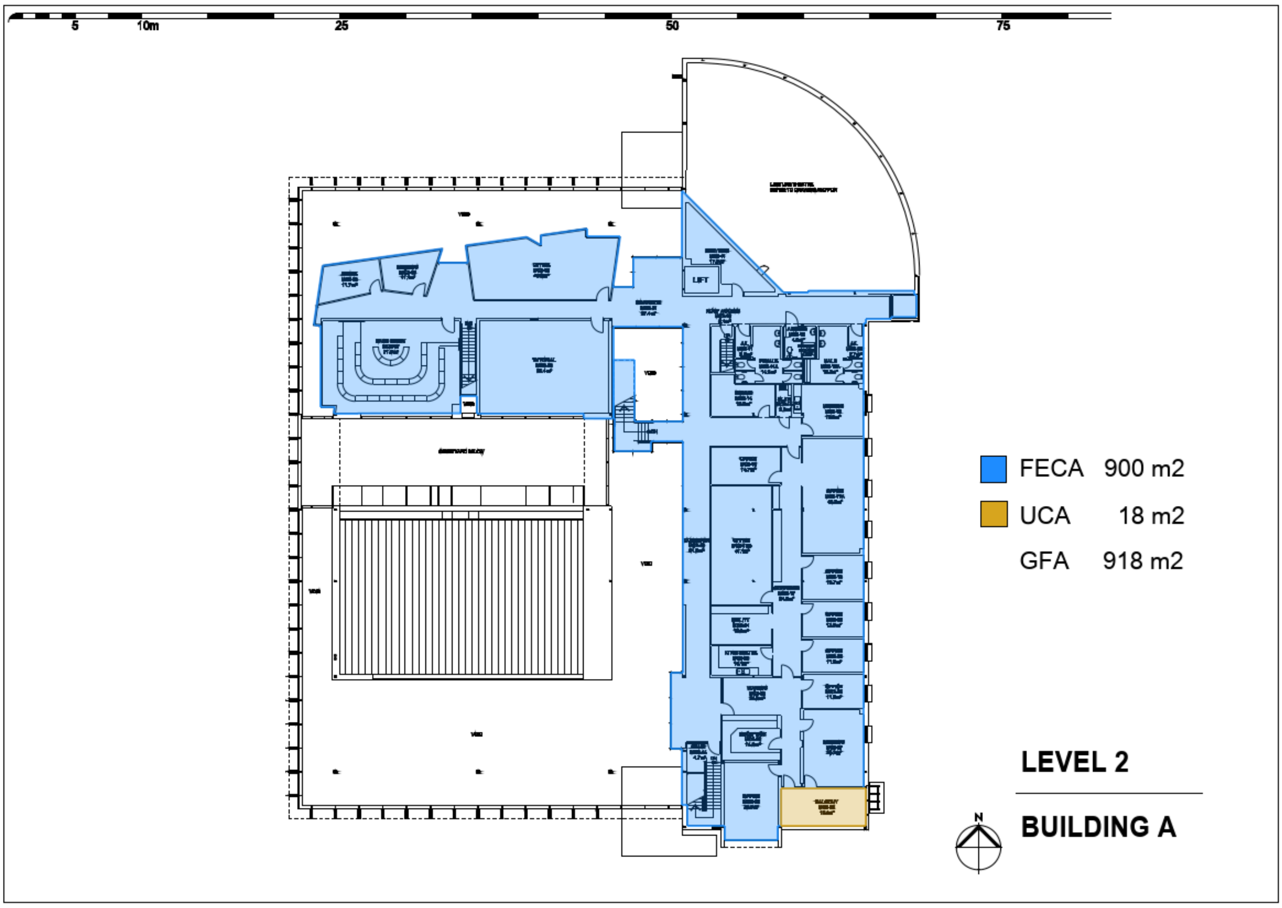


Figure 8.3b: Building A – GFA – Level 2

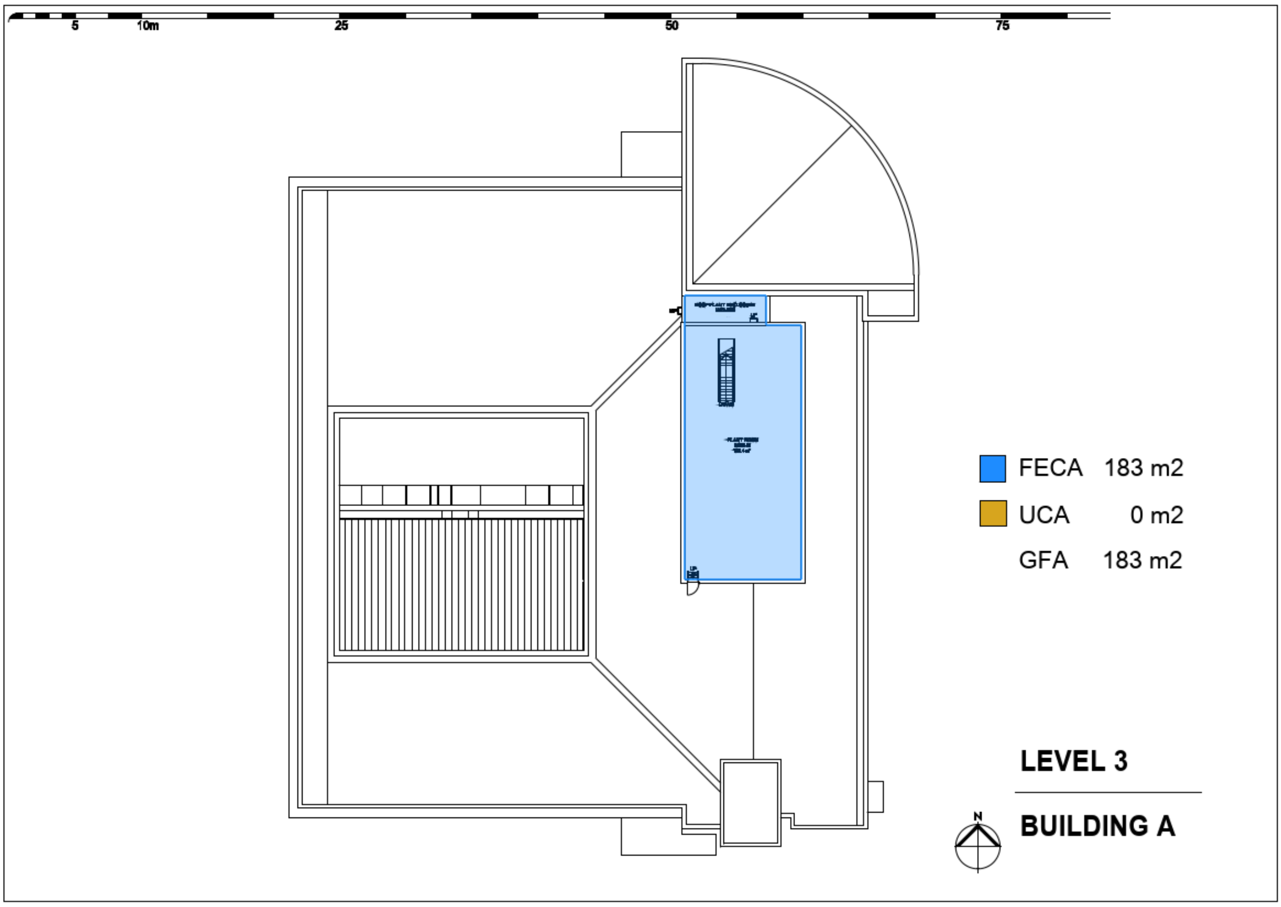


Figure 8.3c: Building A – GFA – Level 3 (Roof Level)

The following is the definition in the New Zealand context:

Gross Floor Area (GFA): Definition (New Zealand)

'The area used for the calculation of element costs is the gross floor area, measured over all the exterior walls of the building, over partitions, columns, interior structural or party walls, stairwells, lift wells, ducts, enclosed rooftop structures and basement service areas. All exposed areas such as balconies, terraces, open floor areas and the like are excluded.

Generally, projections beyond the outer face of the exterior walls of a building such as projecting columns, floor slabs, beams, sunshades and the like shall be excluded from the calculation of gross floor areas.

Where the outer face of the exterior walls of a building are not regular vertical surfaces, the overall measurements shall be taken at floor levels and notes made of the vertical profile of the wall line.

Where mezzanine floors occur within a structure the gross floor area of this mezzanine shall be added to all other complete floor areas and become a constituent part of the gross floor area'

— NZIQS (2017, p. 4)

According to the New Zealand context, the following are worked examples of the GFA of Building A in Levels 1, 2 and 3 (Roof Level) (Example for GFA from Building A in New Zealand Context [PDF]).

The UCA of the building area measures as follows, according to the worked example in **Figures 8.4a**, **8.5b** and **8.5c**.

Table 8.4: GFA (New Zealand) areas for Building A

Building A Level	GFA area
Level 1	2,204 m2
Level 2	922 m2
Level 3 (Roof Level)	201 m2
Total	**3,327 m2**

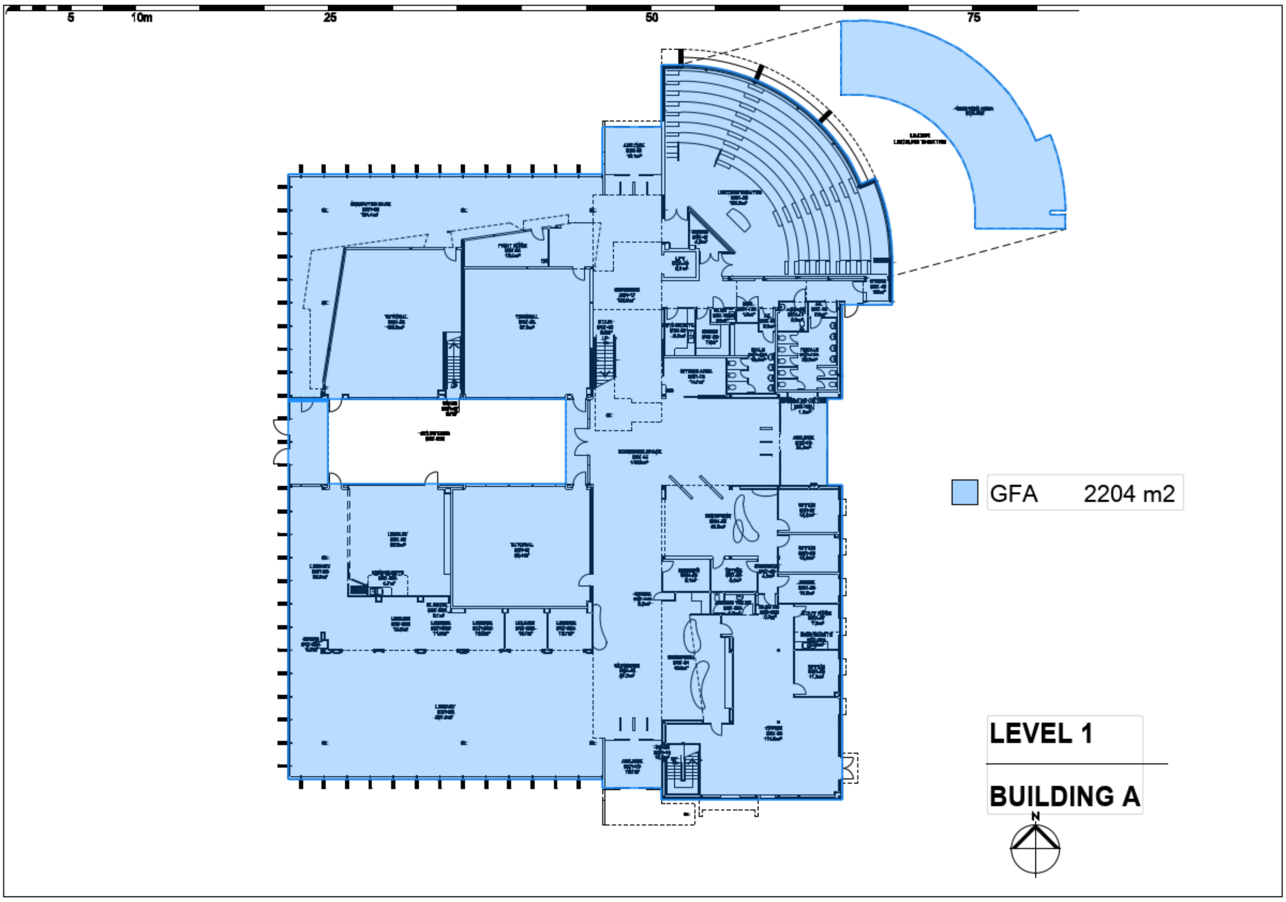


Figure 8.4a: Building A – GFA (NZ) – Level 1

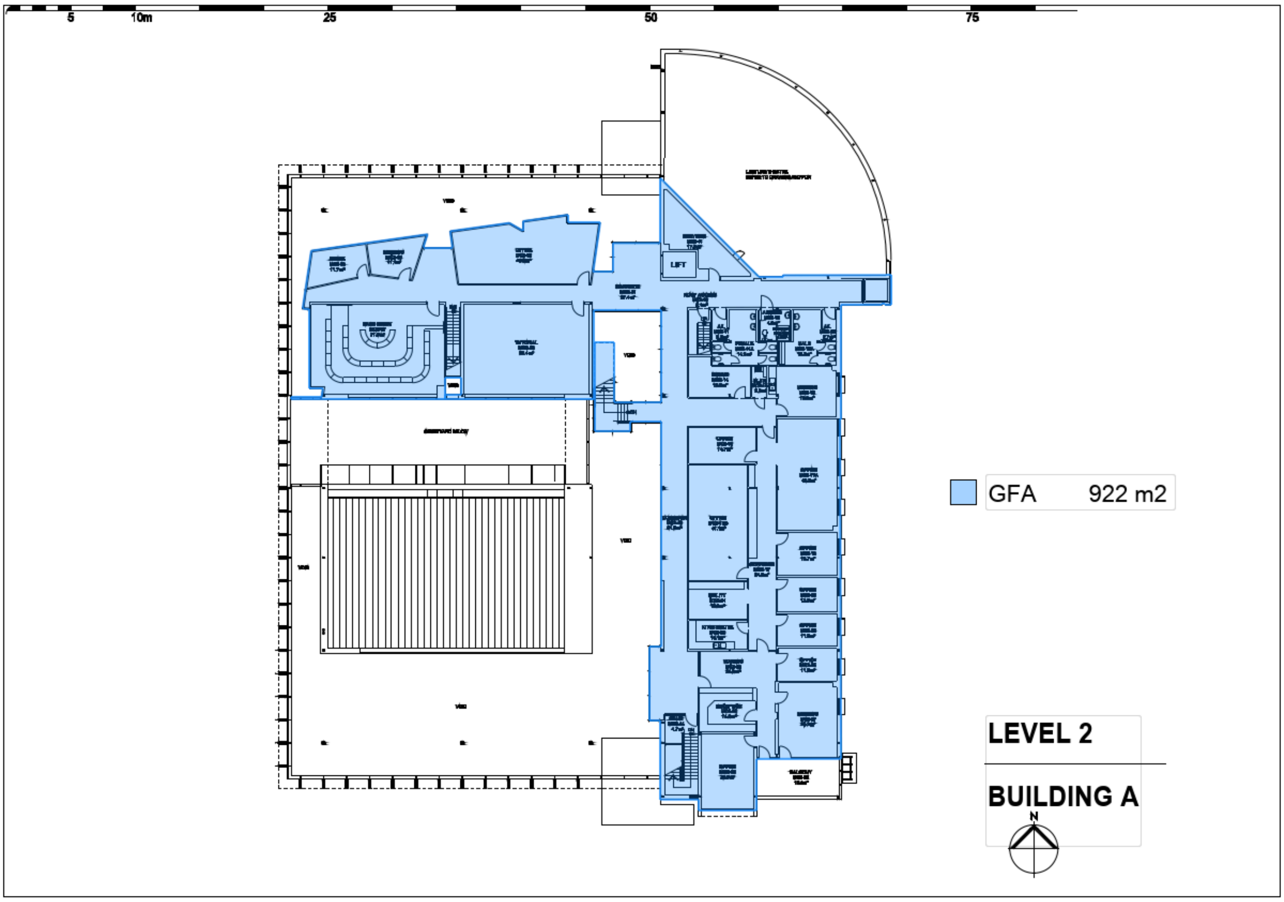


Figure 8.4b: Building A – GFA (NZ) – Level 2

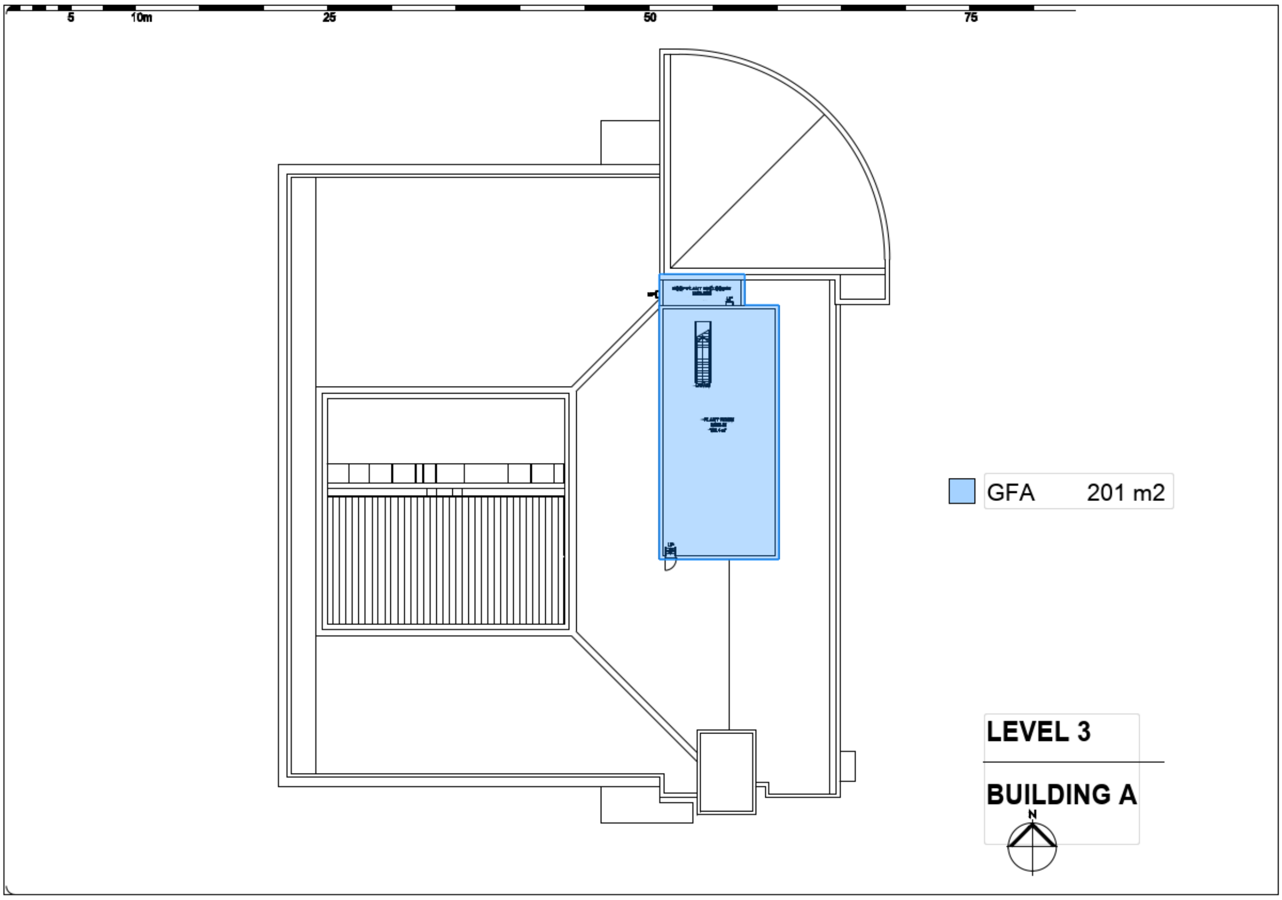


Figure 8.4c: Building A – GFA (NZ) – Level 3

The main difference between the Australian and New Zealand contexts is that New Zealand does not consider FECA and UCA measurement separately, nor those areas mentioned in the definition of GFA. **Table 8.5** provides a comparison of GFA measurement between the Australian and New Zealand contexts.

Table 8.5: Comparison of GFA in both Australian and New Zealand contexts

	Australia	**New Zealand**
Measurement rule	Measured from the internal face of external walls	Measured from the external face of external walls
Enclosed/ unenclosed floor area	Consider both enclosed and unenclosed covered floor area	Consider only enclosed covered floor area
Ignored area	Projections beyond the inner face	Projections beyond the outer face

8.1.4 Building Area

Building Area: Definition (Australia)

'The total enclosed and unenclosed area of the building at all building floor levels measured between the normal outside face of any enclosing walls, balustrades and supports.'

Unit of Measurement: Square Metres (m_2)

— AIQS (2022, p. 3)

There is no such separate definition for building area in the New Zealand context. The difference between the building area and GFA is that the Building Area is measured over the enclosed external walls, whereas the GFA is measured from the inner face of external enclosed walls.

According to the Australian context, the following are the worked examples of the Building Area of Building A in Levels 1, 2 and 3 (Roof Level) (Example for Building Area from Building A [PDF]). The building area, is measured as follows, according to the worked example in **Figures 8.5a**, **8.5b** and **8.5c.**

Table 8.6: Building areas for Building A

Building A Level	**Building area**
Level 1	2,389 m2
Level 2	942 m2
Level 3 (Roof Level)	201 m2
Total	**3,532 m2**

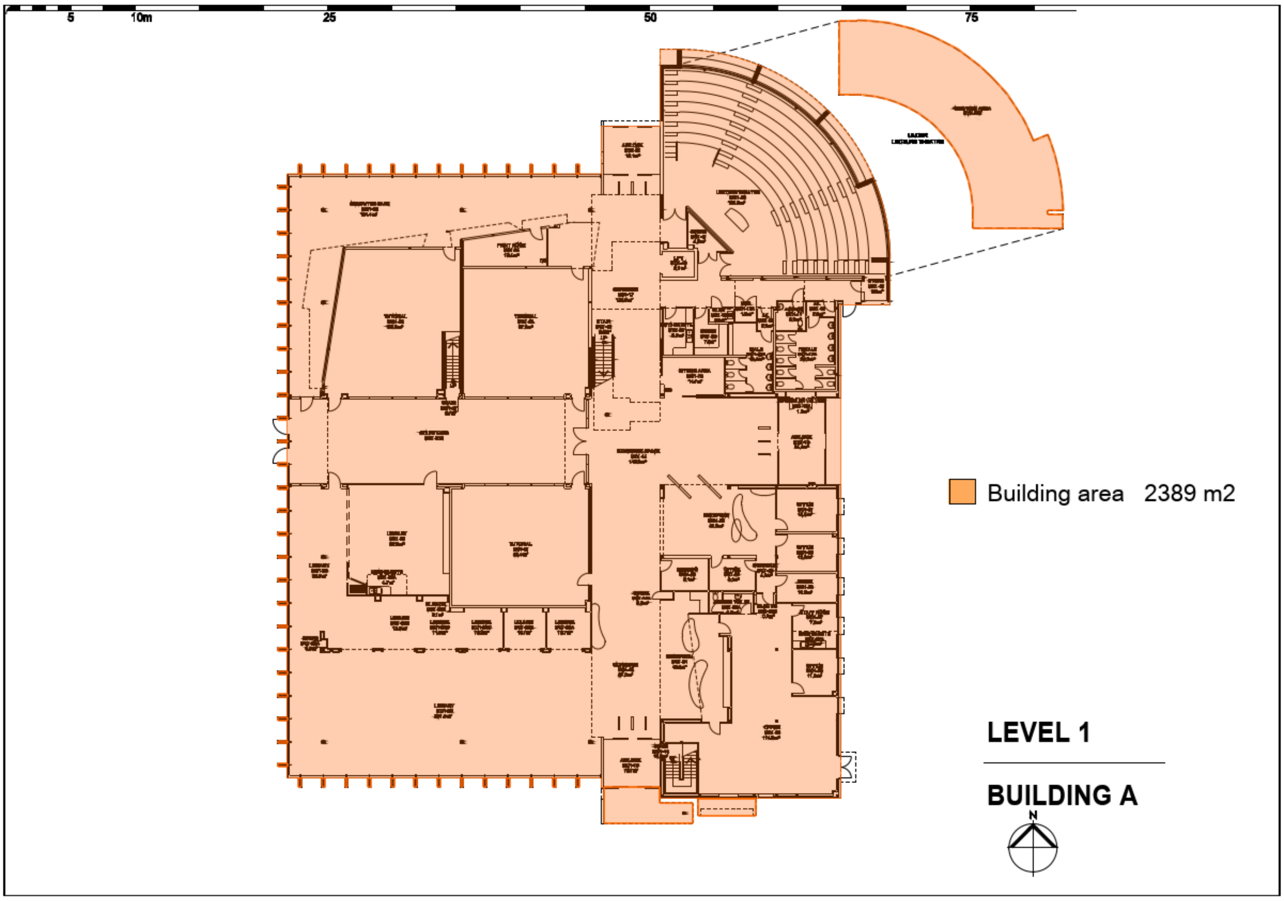


Figure 8.5a: Building A – Building Area – Level 1

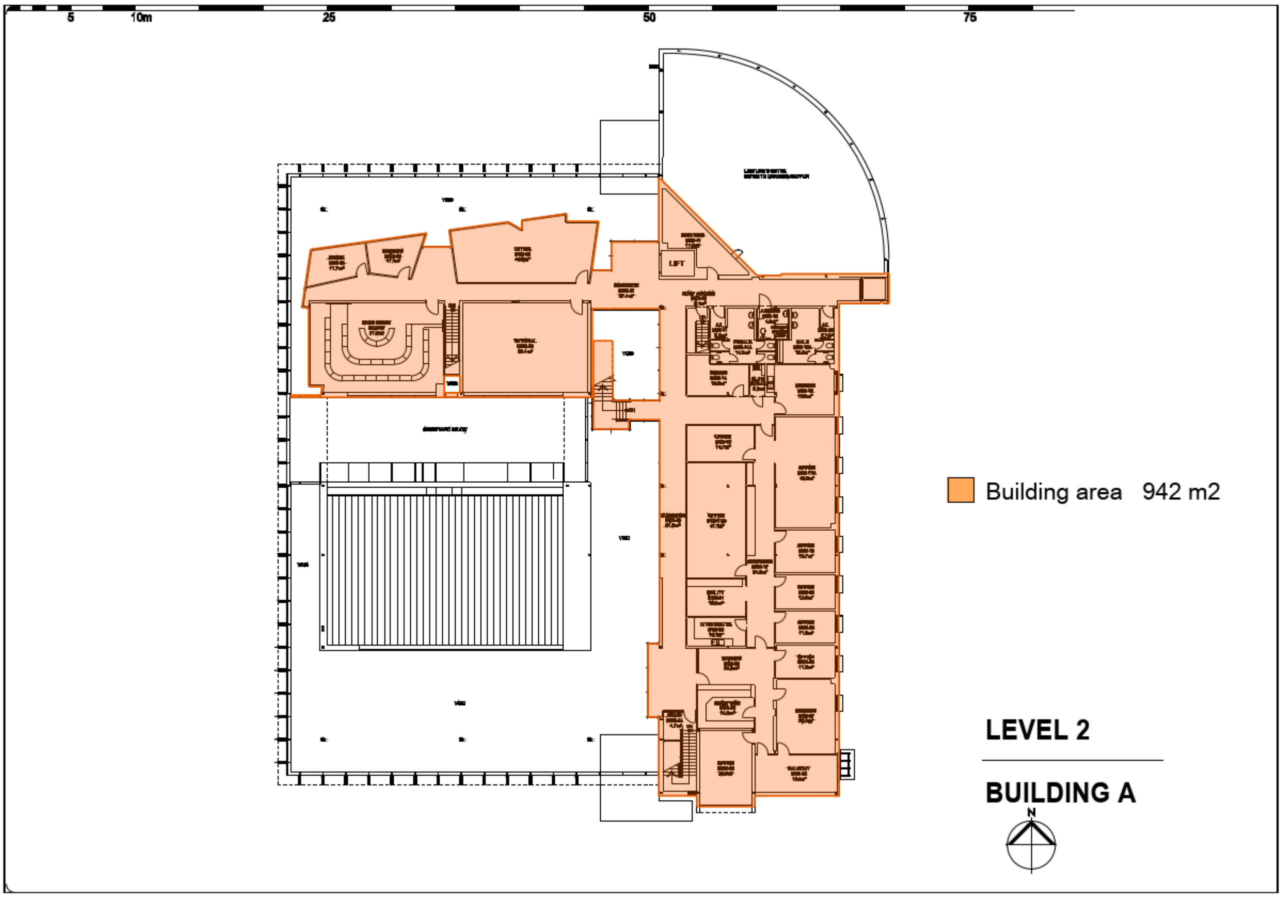


Figure 8.5b: Building A – Building Area – Level 2

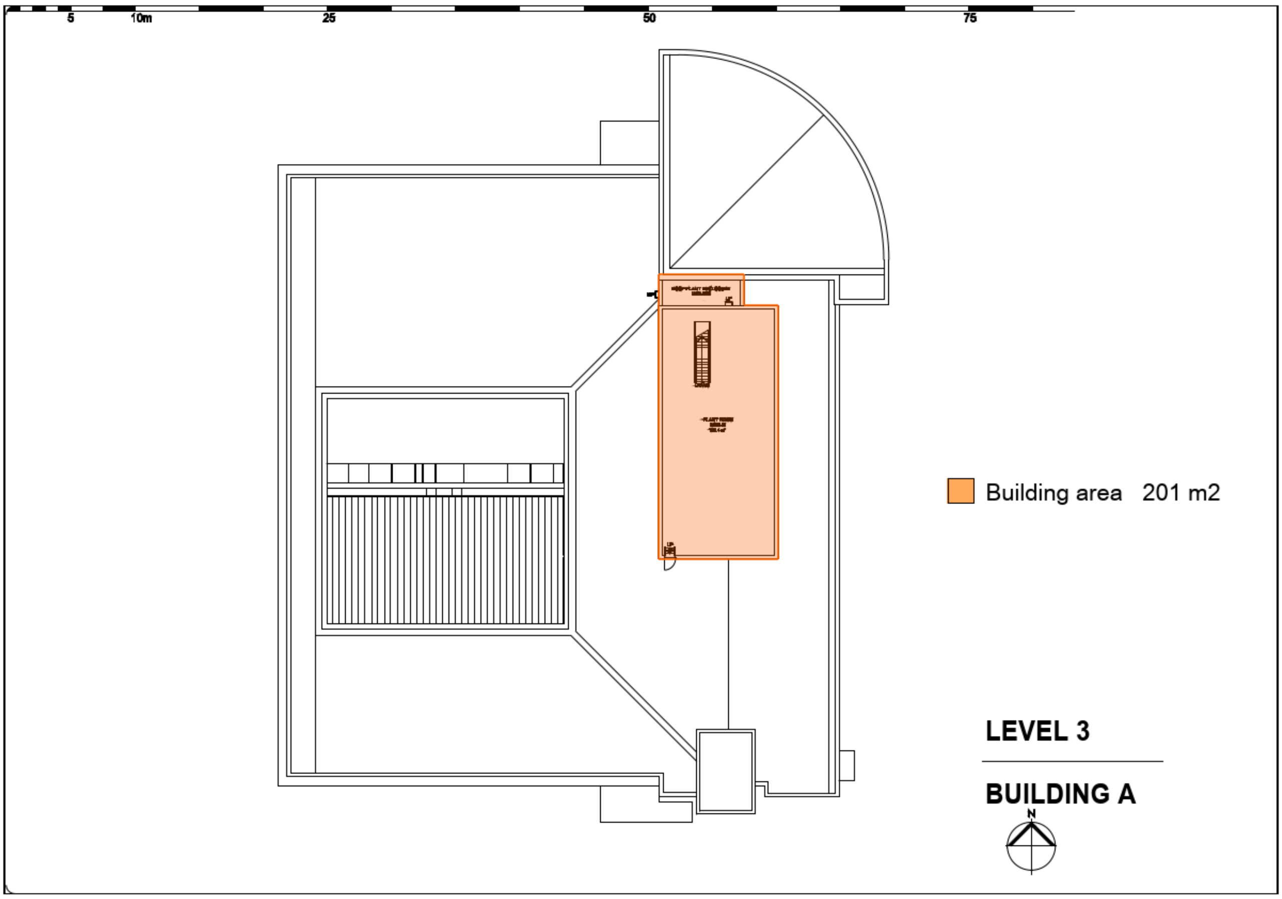


Figure 8.5c: Building A – Building Area – Level 3

8.1.5 Net Rentable/Tenantable Area

Net Rentable/Tenantable Area: Definition (New Zealand)

'This is the area available for occupation less public circulation spaces, plant and service areas and the like.'

Unit of Measurement: Square Metres (m2)

— NZIQS (2017, p. 4)

According to the New Zealand context, the following are worked examples of the Net Rentable/ Tenantable Area of Building A in Levels 1, 2 and 3 (Roof Level) (Example for Net Rentable from Building A in New Zealand Context [PDF]).

The UCA of the building area measures as follows, according to the worked example in **Figures 8.6a**, **8.6b** and **8.6c.**

Table 8.7: Net rentable areas for Building A

Building A Level	**Net Rentable/Tenantable area**
Level 1	1,365 m2
Level 2	443 m2
Level 3 (Roof Level)	177 m2
Total	**1,985 m2**

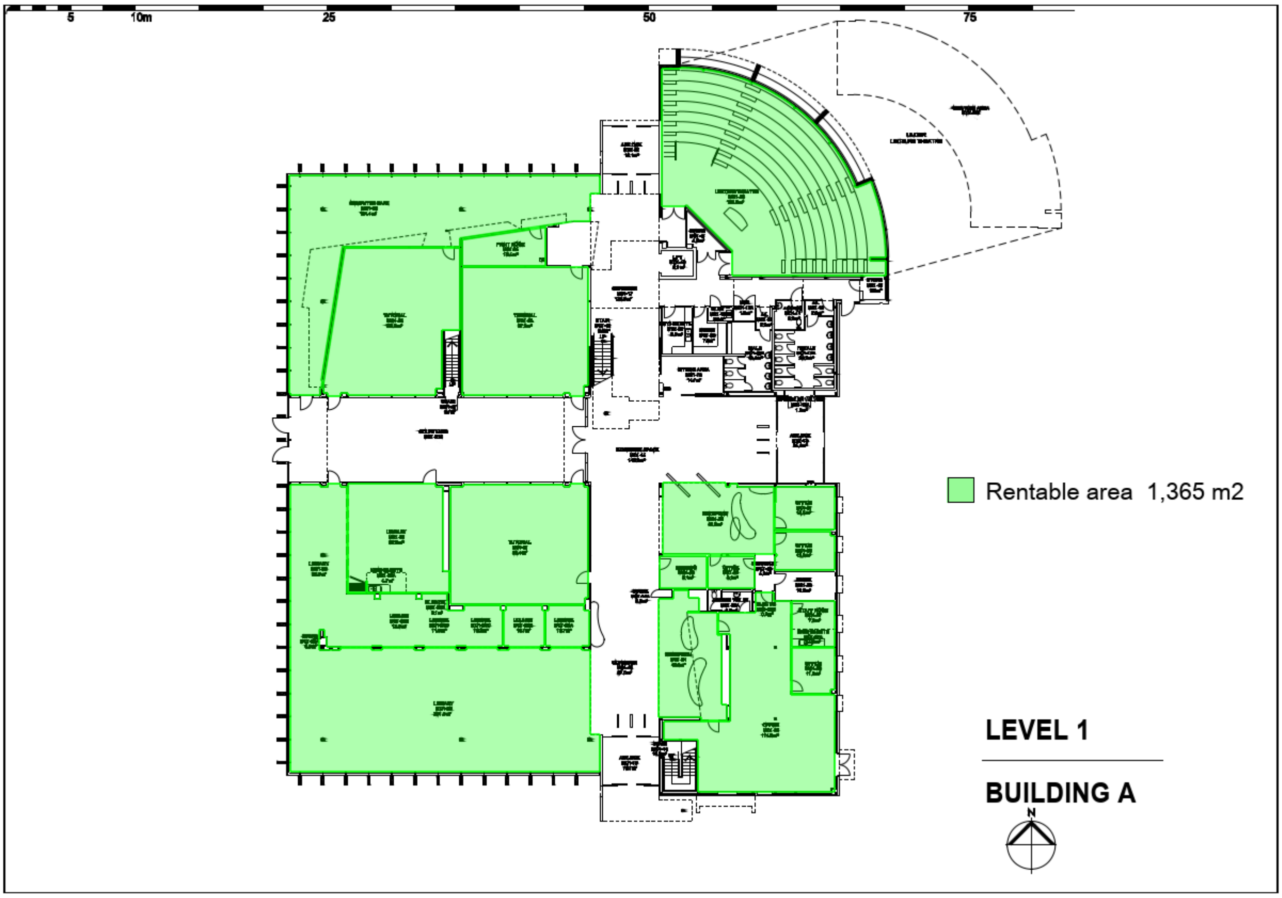


Figure 8.6a: Building A – Rentable area – Level 1

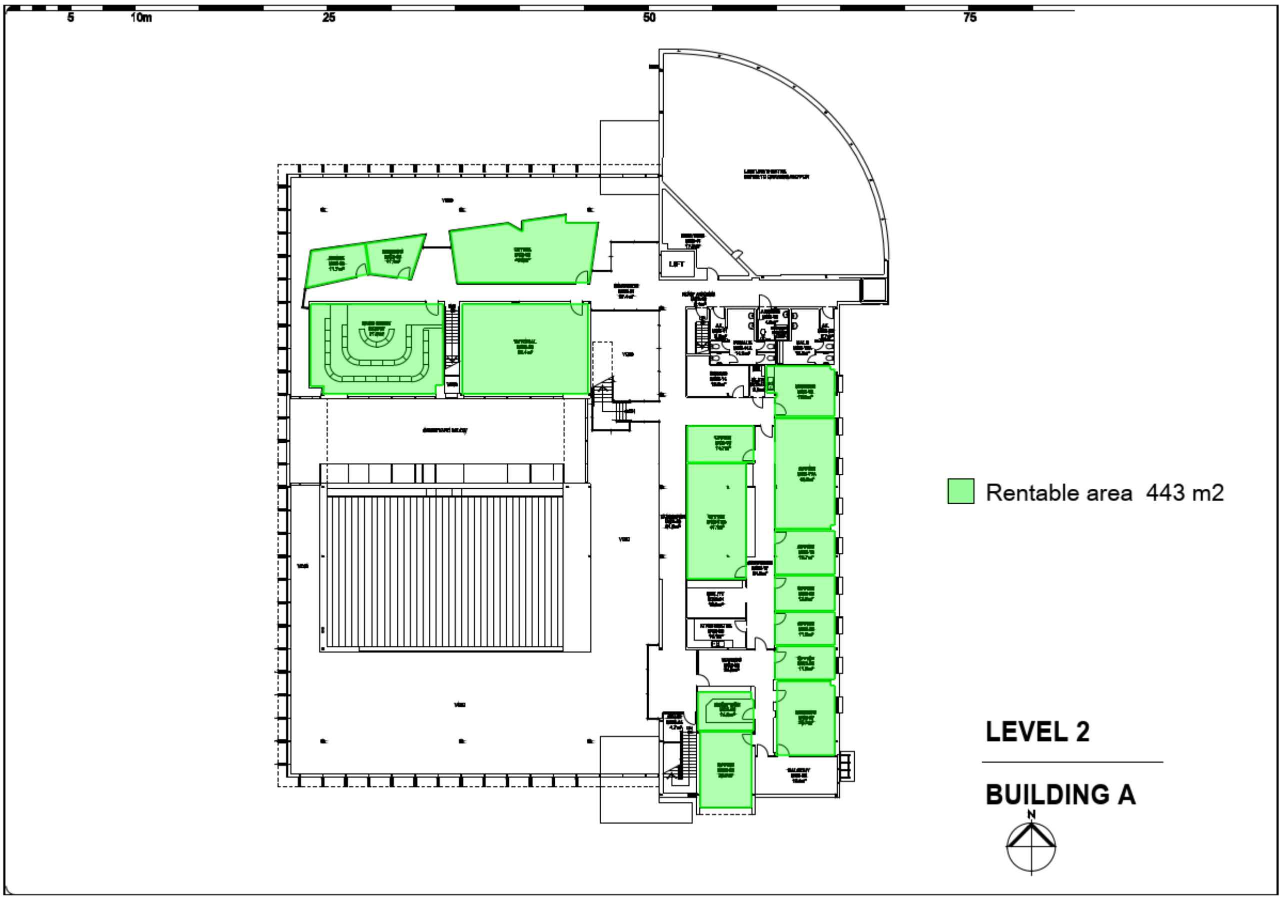


Figure 8.6b: Building A – Rentable area – Level 2

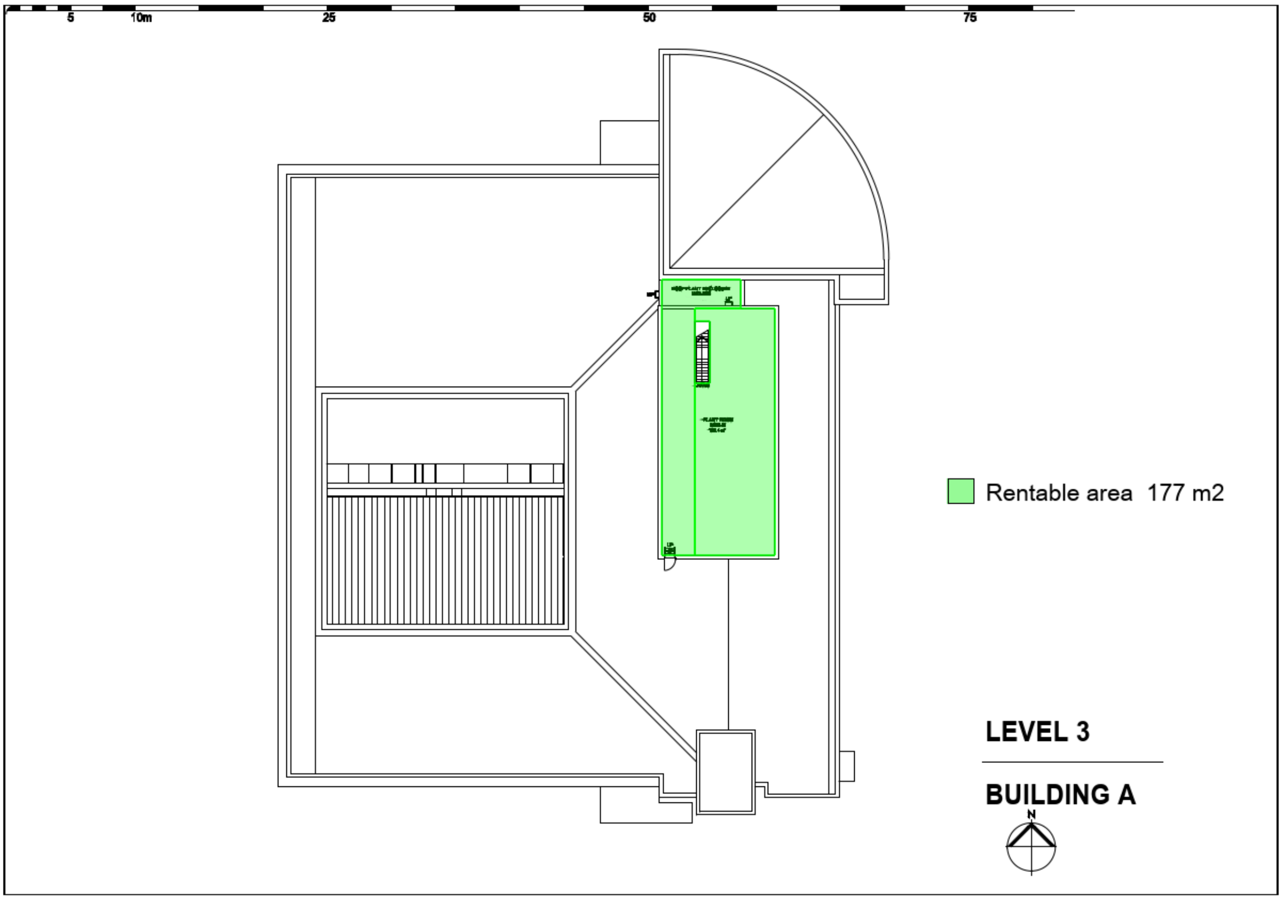


Figure 8.6c: Building A – Rentable area – Level 3

8.1.5 Usable Floor Area (UFA)

Usable Floor Area (UFA): Definition

'The sum of the floor areas measured at floor level from the general inside face of walls of all interior spaces related to the primary function of the building. This will normally be computed by calculating the FECA and deducting all of the following areas supplementary to the primary function of the building:

Deductions:

a. Common Use Areas: All floored areas in the building for Circulation and standard facilities provided for the common use of occupiers, tenants and/or the public such as lobbies and foyers to entrances, stairways and lifts, stairways, landings and fire escapes, verandas and balconies, corridors and passages, toilet and rest room areas, cloak and locker areas, cleaner's rooms including stores and cupboards, tea making

> and similar amenities areas
>
> b. Service Areas: All areas set aside for building plant supplying services and facilities common to the building for the use of occupants, tenants and/or the public, such as mechanical plant and equipment rooms, electrical equipment and switchrooms, tank rooms, lift motor rooms, meter cupboards, telecommunication switchrooms, refuse collection areas, loading bays and all car parks including access ways thereto
>
> c. Non-habitable Areas: All non-habitable building space such as that occupied by internal columns and other structural supports, internal walls and permanent partitions, lift shafts, service ducts and the like.'
>
> — AIQS (2022, p. 12-13)

Usable Floor Area has a similar definition to **Net Rentable/Tenantable Area**. However, no such detailed explanation is provided for inclusions and exclusions of Net Rentable/Tenantable Area.

According to the Australian context, the following are worked examples of the Usable Floor Area of Building A in Levels 1, 2 and 3 (Roof level) (Example for Usable Floor Area from Building A in New Zealand Context [PDF]).

The Usable Floor Area of the building area measures as follows, according to the worked example in **Figure 8.7a**, **8.7b** and **8.7c.**

Table 8.8: Usable floor areas for Building A

Building A Level	Usable floor area
Level 1	1,365 m2
Level 2	443 m2
Level 3 (Roof level)	177 m2
Total	**1,985 m2**

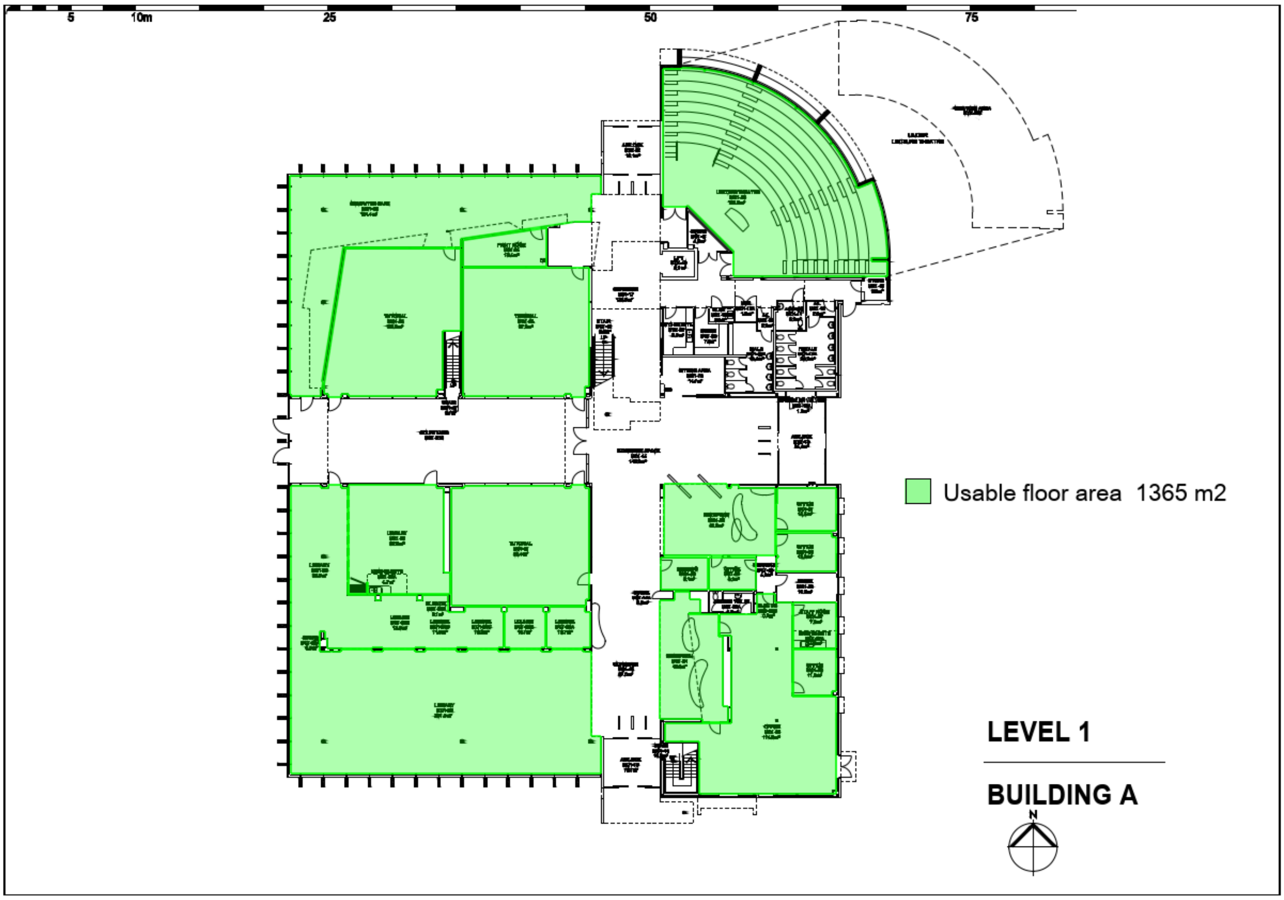


Figure 8.7a: Building A – Usable Floor Area – Level 1

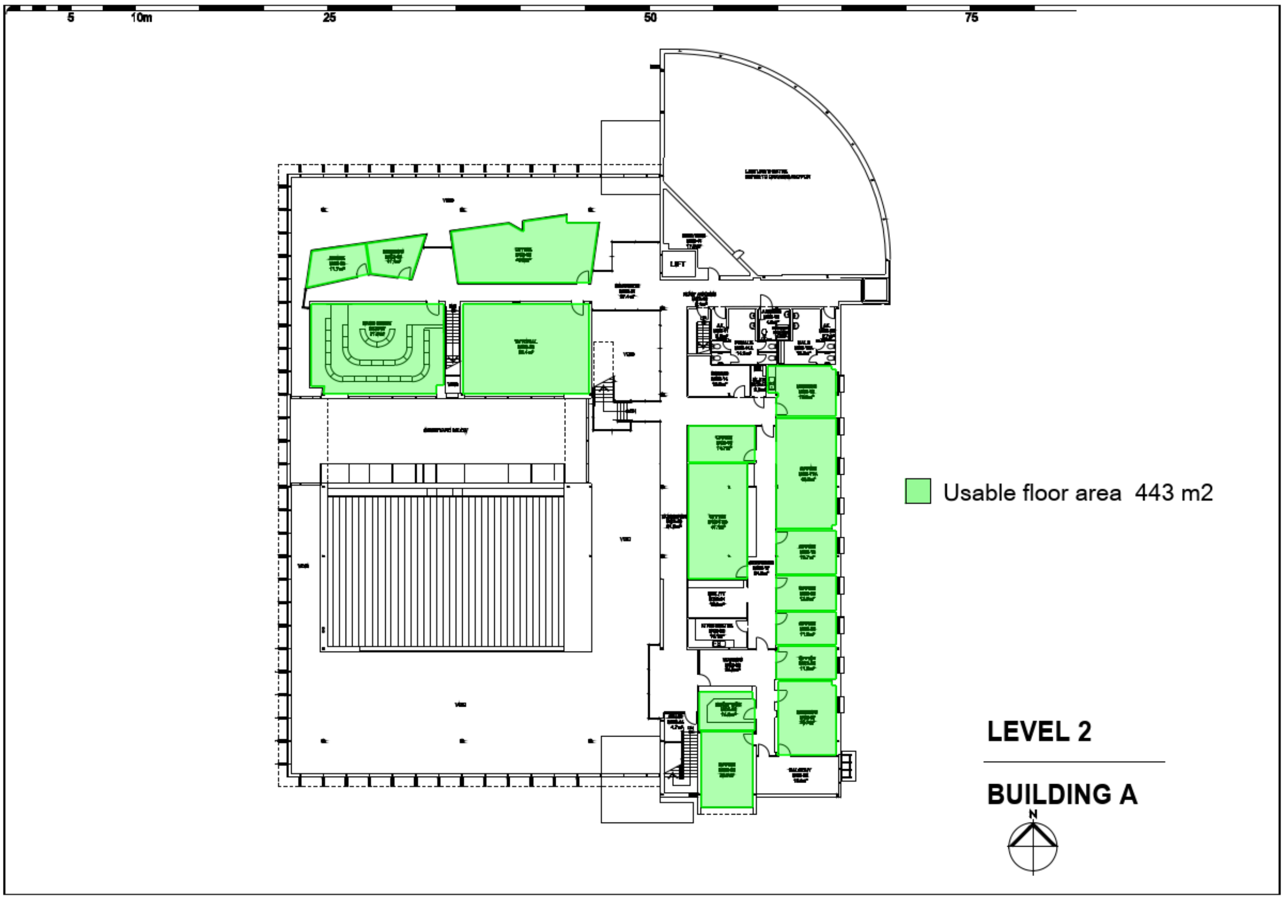


Figure 8.7b: Building A – Usable Floor Area – Level 2

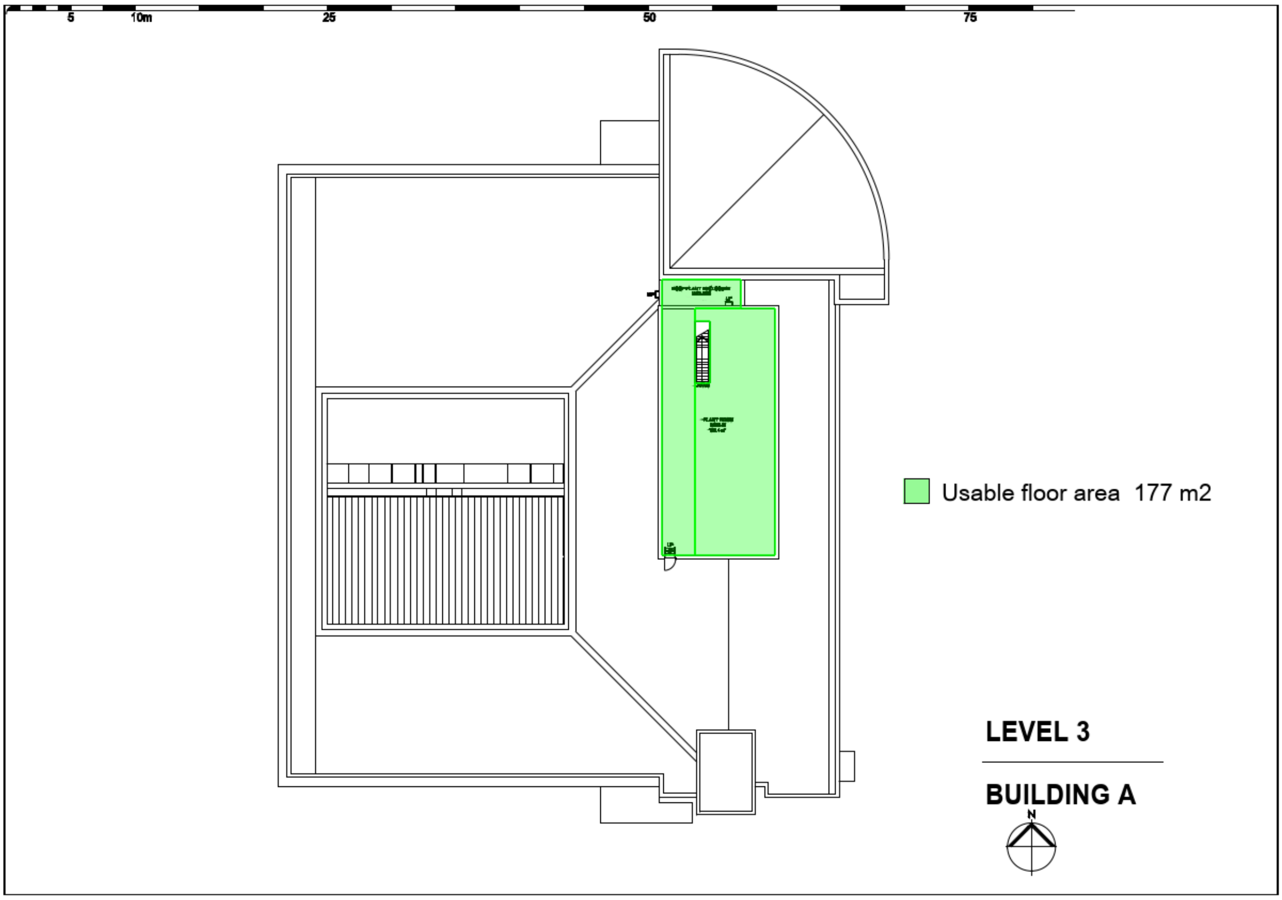


Figure 8.7c: Building A – Usable Floor Area – Level 3

8.1.7 Treated Area (TA)

ACMM defines the treated area when particular engineering services are provided in the drawings.

Treated Area (TA): Definition

'The sum of all areas at all building levels to which a particular engineering service is provided. The area is computed by measuring from the normal inside face of exterior walls, but ignoring any projections such as plinths, columns, piers and the like which project from the normal inside face of exterior walls, to the centre line of internal walls, as applicable, which enclose the area treated.

Notes:

a. A Treated Area may need to be computed separately for each engineering service
b. The Treated Area for such services as Space Heating (21 SH), Ventilation (22 VE), Evaporative Cooling (23 EC) and Air Conditioning (24 AC) as referred in this document

should include all areas to which treated air is supplied

c. The Treated Area for Fire Protection (25 FP) comprises the sum of protected floor space, the area of protected ceiling space and the area of protected under floor spaces.'

Unit of Measurement: Square Metres (m2)

— AIQS (2022, p. 12)

8.2 Elements

The categorisation of building elements (See Chapter 3.2.4) varies in both countries. **Table 8.9** compares the categorisations of building elements given in the Australian Cost Management Manual 2022, published by the Australian Institute of Quantity Surveyors (AIQS), and New Zealand context are extracted from the Elemental Analysis of Costs of Building Projects 2017, published by New Zealand Institute of Quantity Surveyors (NZIQS).

Table 8.9: Comparison of categorisations of building elements

Australian Cost Management Manual (ACMM) 2022			Differences in NZIQS Elemental Analysis	NZIQS Elemental Analysis 2017			Difference in ACMM
Code	**Elements**	**UoM**		**Code**	**NZIQS Elemental Analysis**	**UoM**	
Preliminaries				***Structure***			
PR	Preliminaries	N/A	Categorised under 'P&G, Margins and Contingencies' (E25), E25 expressed as a percentage value of the sum of elements E1 – E24 inclusive	E1	Site Preparation	m2	Explained under Section 'Alteration and Site Work' and measure only the treated area (XP)
Substructure				E2	Substructure	m2	Covers the area below the lowest floor finish (SB)
SB	Substructure	m2	Covers the area below the lowest floor level (E2)	E3	Frame	GFA m2	Covered under columns (CL) and Upper floors (UF)
Superstructure				E4	Structural walls	m2	Covered under 'External Walls' (EW)
CL	Columns (framed buildings)	m2	No separate element is called 'columns'. Columns are covered under Frames (E3)	E5	Upper floors	m2	Includes beams along with other slab elements (UF)
UF	Upper Floors	m2	Does not cover Beams. Only slab elements are covered (E5)	***Exterior Fabric***			
SC	Staircases	m2	Covered under 'Internal Finishing' (E9)	E6	Roof	m2	Covered under 'superstructure' (RF)
RF	Roof	m2	Covered under 'Exterior Fabric' (E9)	E7	Exterior Walls and Exterior Finish	m2	Covered under 'external walls' (EW)

EW	External Walls	m2	Structural walls are covered separately (E4), non-structural walls are covered separately (E7)
WW	Windows	m2	Covered under 'Windows and Exterior Doors' (E8)
ED	External Doors	m2	Covered under 'Windows and Exterior Doors' (E8)
NW	Internal Walls	m2	Covered under 'Interior Finishes' (E10)
ND	Internal Doors	m2	Covered under 'Interior Finishes' (E10)
NS	Internal Screens and Borrowed Lights	m2	Covered under internal walls (NW)
Finishes			
WF	Wall Finishes	m2	Covered under 'Interior Finishes' (E13)
FF	Floor Finishes	m2	Covered under 'Interior Finishes' (E12)
CF	Ceiling Finishes	m2	Covered under 'Interior Finishes' (E14)
Fittings			
FT	Fitments	m2	Covered under 'Fittings and Fixtures' (E15)
Services			

E8	Windows and Exterior Doors.	m2	Covered separately under Windows (WW) and External Doors (ED)
Interior Finishing			
E9	Stairs and Balustrades	GFA m2	Covered under 'superstructure' (SC)
E10	Interior Walls	m2	Covered under superstructure (NW)
E11	Interior Doors.	m2	Covered under superstructure (NW)
E12	Floor Finishes.	m2	Covered under Finishes (FF)
E13	Wall Finishes.	m2	Covered under Finishes (WF)
E14	Ceiling Finishes	m2	Covered under Finishes (CF)
E15	Fittings and Fixtures	GFA m2	Covered under Fitments (FT) and Sanitary Fixtures (SF)
Services			
E16	Sanitary Plumbing	Enumerated	Covered under 'Sanitary Plumbing' (PD)
E17	Heating and Ventilation Services	Enumerated	Covered under Ventilation (VE), Evaporative cooling (EC), Air Conditioning (AC)
E18	Fire Services	GFA m2	Covered under 'Fire Protection' (FP)

SE	Special Equipment	m2	Covered under 'Special Services' (E21)	E19	Electrical Services	GFA m2	Covered under 'Electric Light and Power' (LP)
SF	Sanitary Fixtures	No	Covered under 'Sanitary Plumbing' (E16)	E20	Vertical and Horizontal Transportation	GFA m2	Covered under 'Transportation' (TS)
PD	Sanitary Plumbing	No	Covered under 'Sanitary Plumbing' (E16)	E21	Special Services	GFA m2	Covered under 'Special Services' (SS), "Special Equipment (SE)
WS	Water Supply	m2	Covered under 'Sanitary Plumbing' (E16)	E22	Drainage	GFA m2	External Stormwater Drainage (XK), External Sewer Drainage (XD)
GS	Gas Service	m2	Covered under 'Special Services' (E21)	***External Works and Sundries***			
SH	Space Heating	m2	Not covered	E23	External Works	GFA m2	Covered under External water supply (XW), External Gas (XG), External Fire Protection (XF), External Electric Light and Power (XE), External Communications (XC), External Special Services (XS)
VE	Ventilation	m2	Covered under 'Heating and Ventilation Services' (E17)	E24	Sundries	GFA m2	Not covered in a specific section
EC	Evaporative Cooling	m2	Covered under 'Heating and Ventilation Services' (E17)	***P&G, Margins and Contingencies***			
AC	Air Conditioning	m2	Covered under 'Heating and Ventilation Services' (E17)	E25	Preliminaries	GFA m2	Covered under 'Preliminaries' (PR)
FP	Fire Protection	m2	Covered under 'Fire Services' (E18)	E26	Margins	GFA m2	Not covered in a specific section

LP	Electric Light and Power	m2	Covered under 'Electrical Services' (E19)		E27	Contract contingencies	GFA m2	Covered under 'Risk Allowanced/ Contingencies' (YR)
CM	Communication	m2	Covered under 'Special Services' (E21)		E28	Other development Cost	GFA m2	Covered under 'Special Provisions'

TS	Transportation System	None	Covered under 'Vertical and Horizontal Transportation' (E20)	
SS	Special Services	None	Covered under 'Special Services' (E21)	
CE	Centralised Energy Systems	None	Not covered	
Alterations and Site Works				
AR	Alterations and Renovations	None	Covered under 'Sundries' (E24)	
XP	Site Preparation	m2	Covered under 'Structure'	
XR	Roads, Footpaths and Paved Area	m2	Covered under External Works (E23)	
XN	Boundary Walls. Fencing and Gates	m2	Covered under External Works (E23)	
XB	Outbuilding and Covered Ways	m2	Covered under Sundries (E24)	
XL	Landscape and Improvements	m2	Covered under Sundries (E24)	
XX	External Alterations and Renovation	None	Covered under Sundries (E24)	
External Services				
XK	External Stormwater Drainage	None	Covered under 'Drainage' (E22)	
XD	External Sewer Drainage	None	Covered under 'Drainage' (E22)	
XW	External Water Supply	None	Covered under 'External Works' (E23)	
XG	External Gas	None	Covered under 'External Works' (E23)	
XF	External Fire Protection	None	Covered under 'External Works' (E23)	

XE	External Electric Light and Power	None	Covered under 'External Works' (E23)	
XC	External Communications	None	Covered under 'External Works' (E23)	
XS	External Special Services	None	Covered under 'External Works' (E23)	
Special Provisions				
YU	Work to utilities off-site	None	Not covered	
YF	Loose Furniture and Equipment	None	Covered under 'Other development Cost' (E28)	
YD	Design and Documentation Fees	None	Covered under 'Other development Cost' (E28)	
YQ	Quantity Surveyor Fees	None	Covered under 'Other development Cost' (E28)	
YP	Project Delivery Fees	None	Covered under 'Other development Cost' (E28)	
YM	Project Management Cost	None	Covered under 'Other development Cost' (E28)	
YS	Statutory and Approval Fees	None	Covered under 'Other development Cost' (E28)	
YR	Risk Allowanced/ Contingencies	None	Covered under 'Contract contingencies' (E27)	
YE	Escalation	None	Covered under 'Other development Cost' (E28)	
YO	Other Special Provisions	None	Covered under 'Other development Cost' (E28)	

Client Costs				
YC	Site Acquisition	None	Covered under 'Other development Cost' (E28)	
YA	Administrative, Finance, Legal and Marketing	None	Covered under 'Other development Cost' (E28)	
Goods and Services Tax				
YG	GST		Not covered	

The following sections interpret the definitions of a few key elements of the selected building project as per the Australian Cost Management Manual (AQIS, 2022).

8.2.1 Substructure

The substructure is the area of the building at the lowest floor level measured over external walls and includes UCA. Substructure accounts for 2,250 m2 (See **Figure 8.8**)

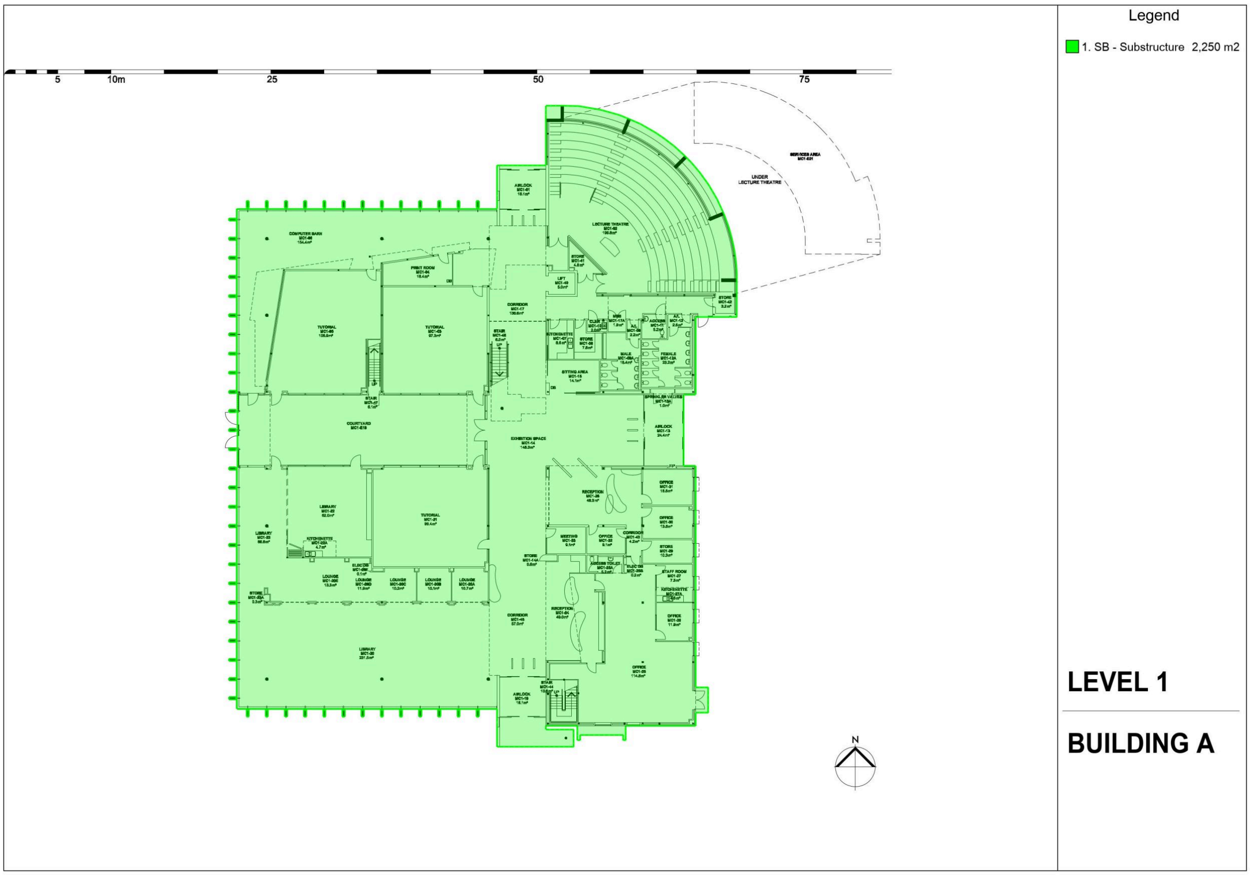


Figure 8.8: Building A – Substructure measured as per ACMM (AQIS, 2022)

The area covered under sunscreen blades is considered under the substructure in both figures, even though it goes beyond the external face of load-bearing external walls.

8.2.2 Upper Floors

Upper floors are any floor structures above the lowest level of the building. According to **Figure 8.9**, the total of upper floors is 1,499 m3

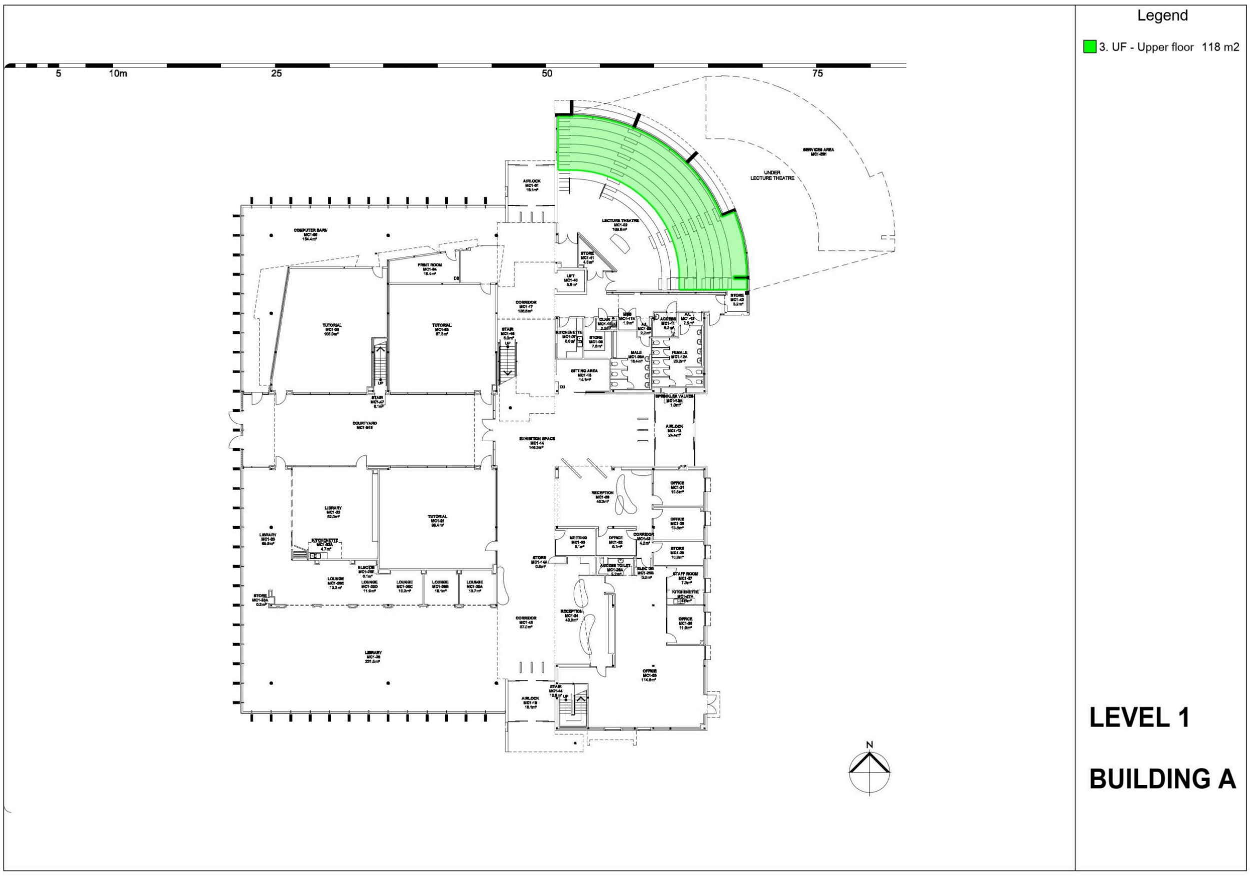


Figure 8.9a: Building A – Upper Floor (Level 1) measured as per ACMM (AQIS, 2022)

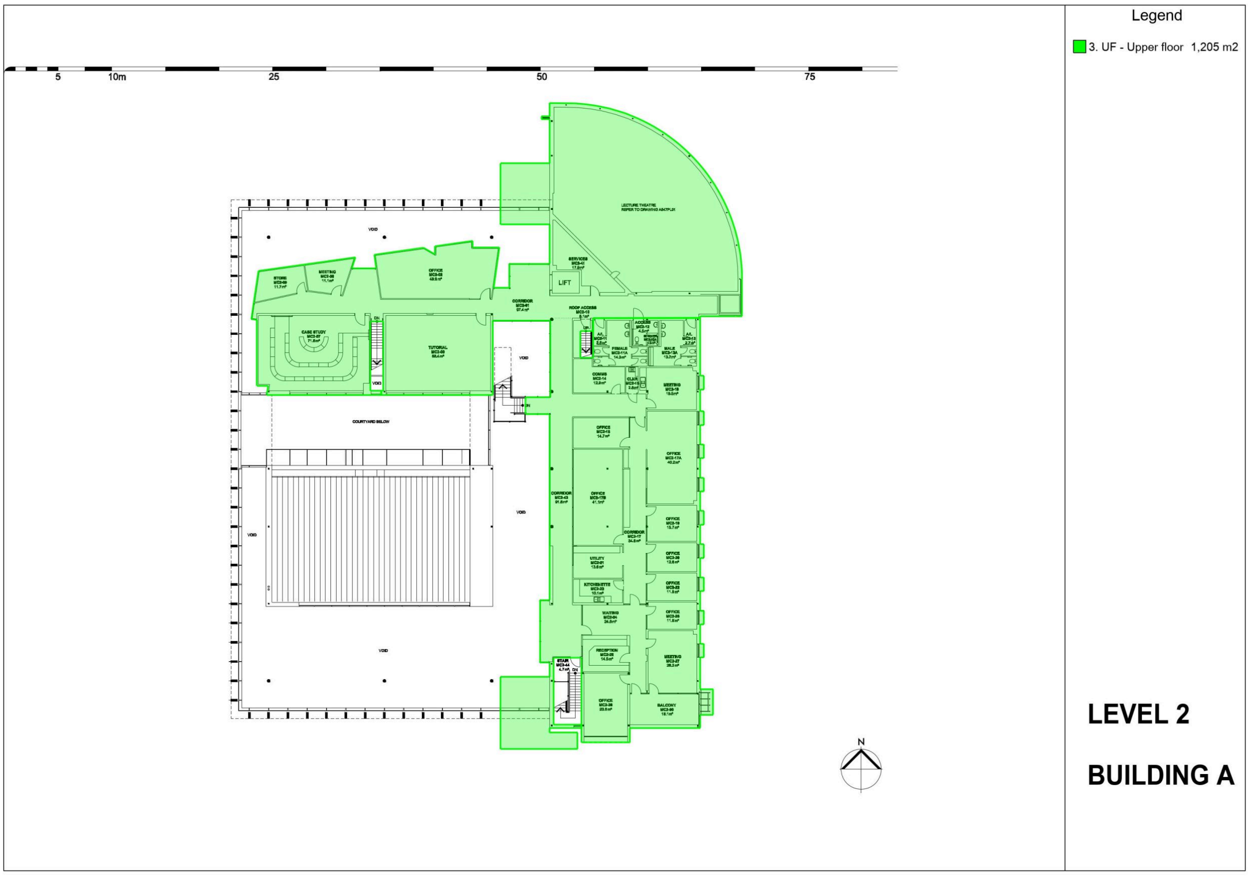


Figure 8.9b: Building A – Upper Floor (Level 2) measured as per ACMM (AQIS, 2022)

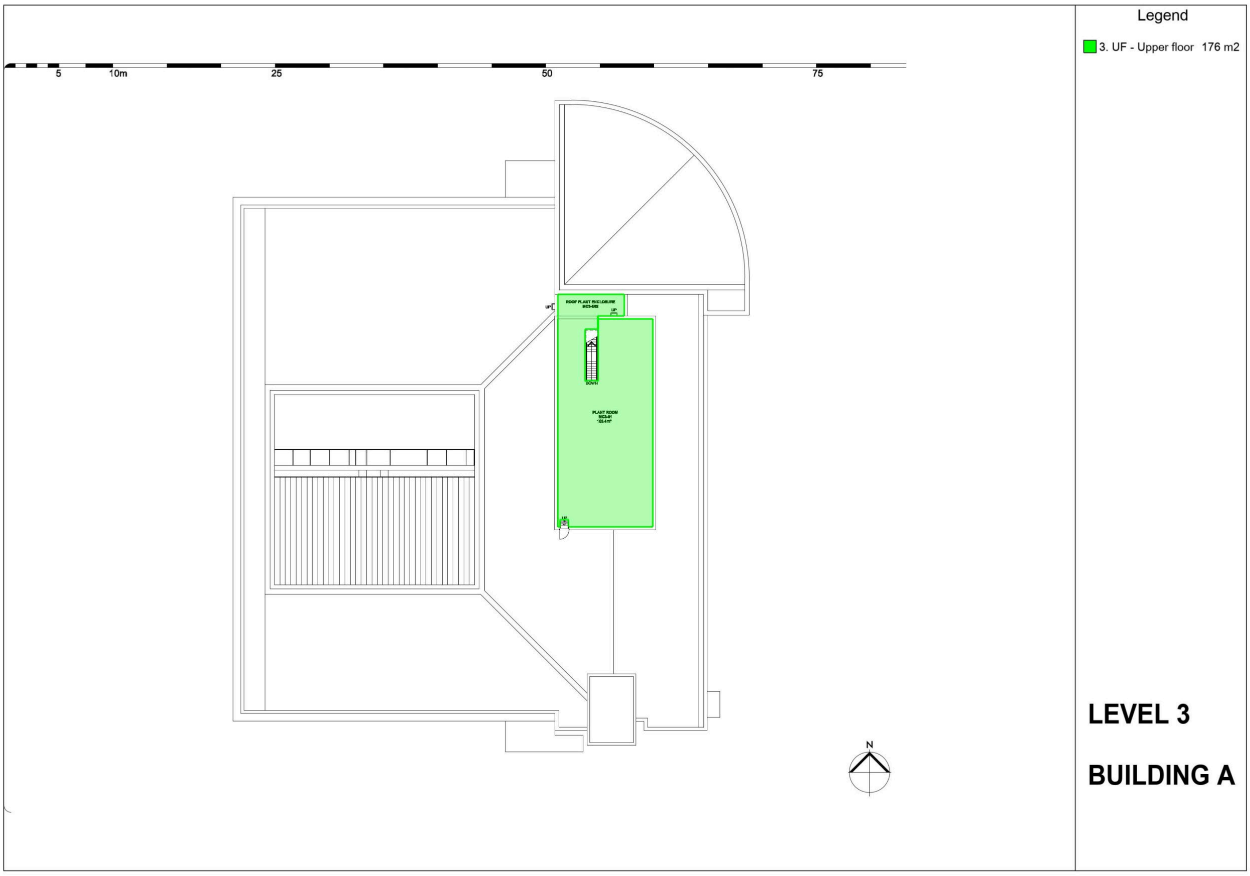


Figure 8.9c: Building A – Upper Floor (Level 3) measured as per ACMM (AQIS, 2022)

Even though the measurement rule in ACMM excludes staircases (SC) under upper floors, the steps running from the ground floor level to the ceiling at Level 1 in the auditorium should not be considered as 'steps in a staircase'. Therefore, according to **Figure 8.9a**, the steps in the auditorium are considered as the only upper floor area in Level 1.

8.2.3. Staircases

The staircase is a structural connection between 2 or more floor levels or to roof, plant rooms and motor rooms together with associated finishes. According to **Figures 8.10a**, **8.10b** and **8.10c**, the total measurement of the staircases in Building A is 45 m2.

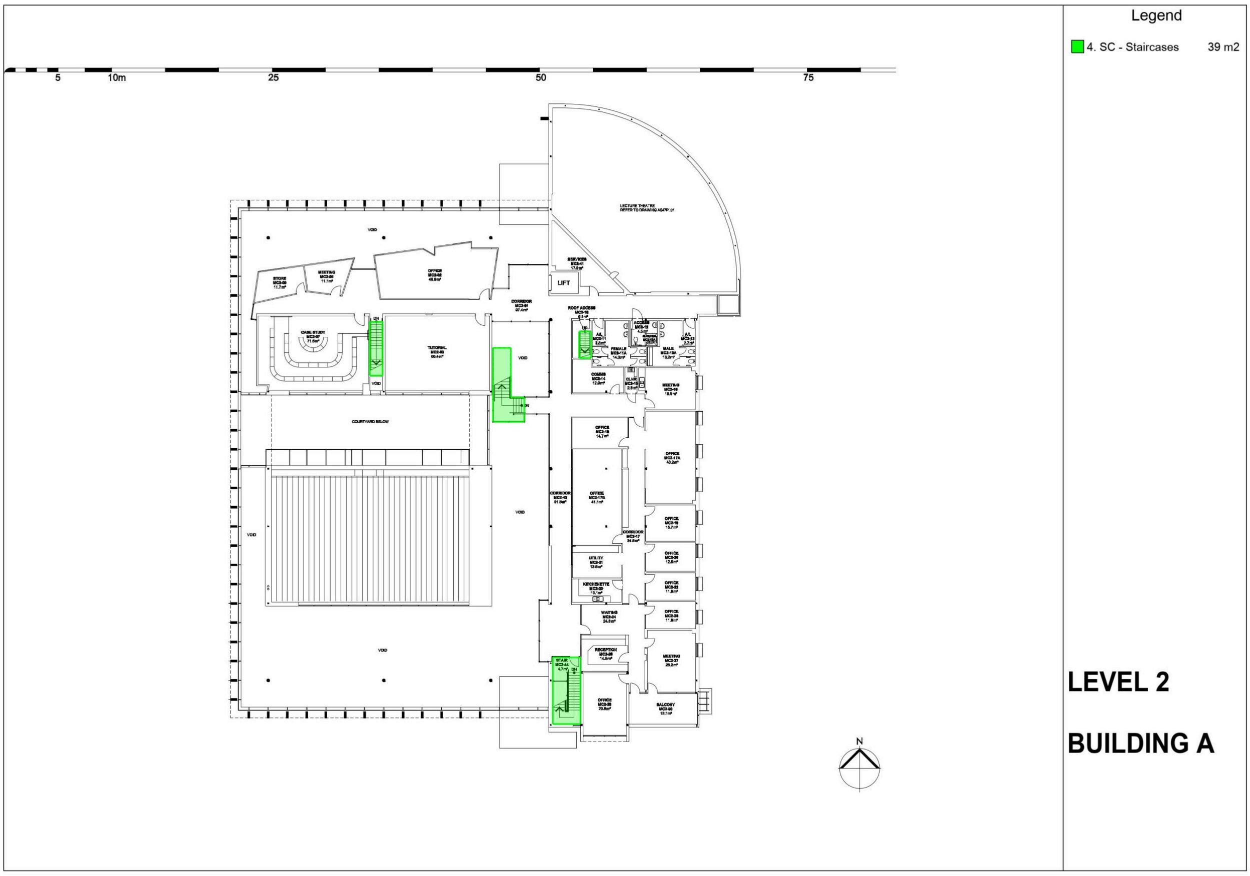


Figure 8.10a: Building A -Staircase (Level 2) measured as per ACMM (AQIS, 2022)

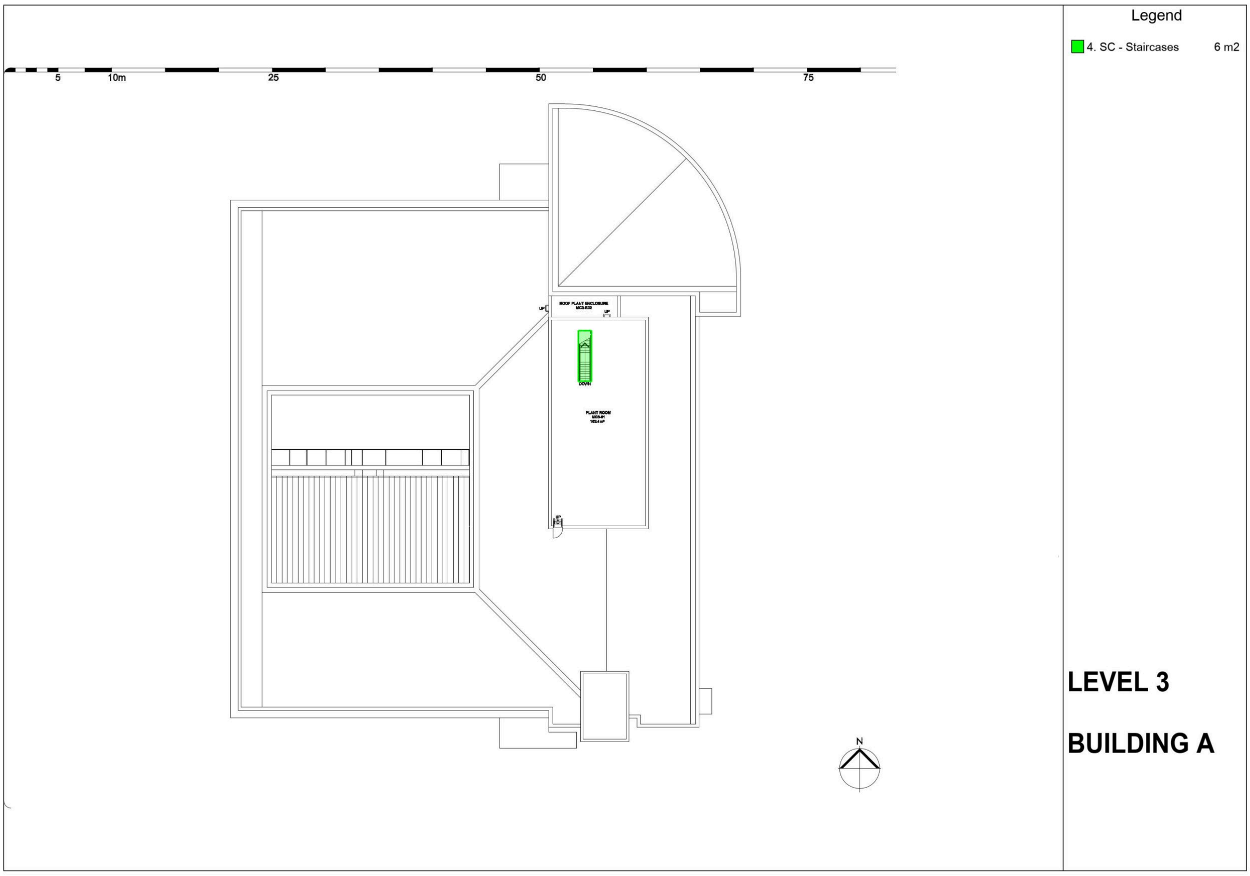


Figure 8.10b: Building A -Staircase (Level 3) measured as per ACMM (AQIS, 2022)

Since staircases are measured at each upper floors, there is no measurement taken at Level 1 (0 m2). The measurement does not include the landings at the same level as it had already been included under the 'upper floors'. However, intermediate landings are part of the staircases.

8.3.4 Roof

A roof is a structurally sound and watertight covering over the building. According to **Figures 8.11a** and **8.11b**, the total measurement of the upper floors in Building A is 2,308 m3.

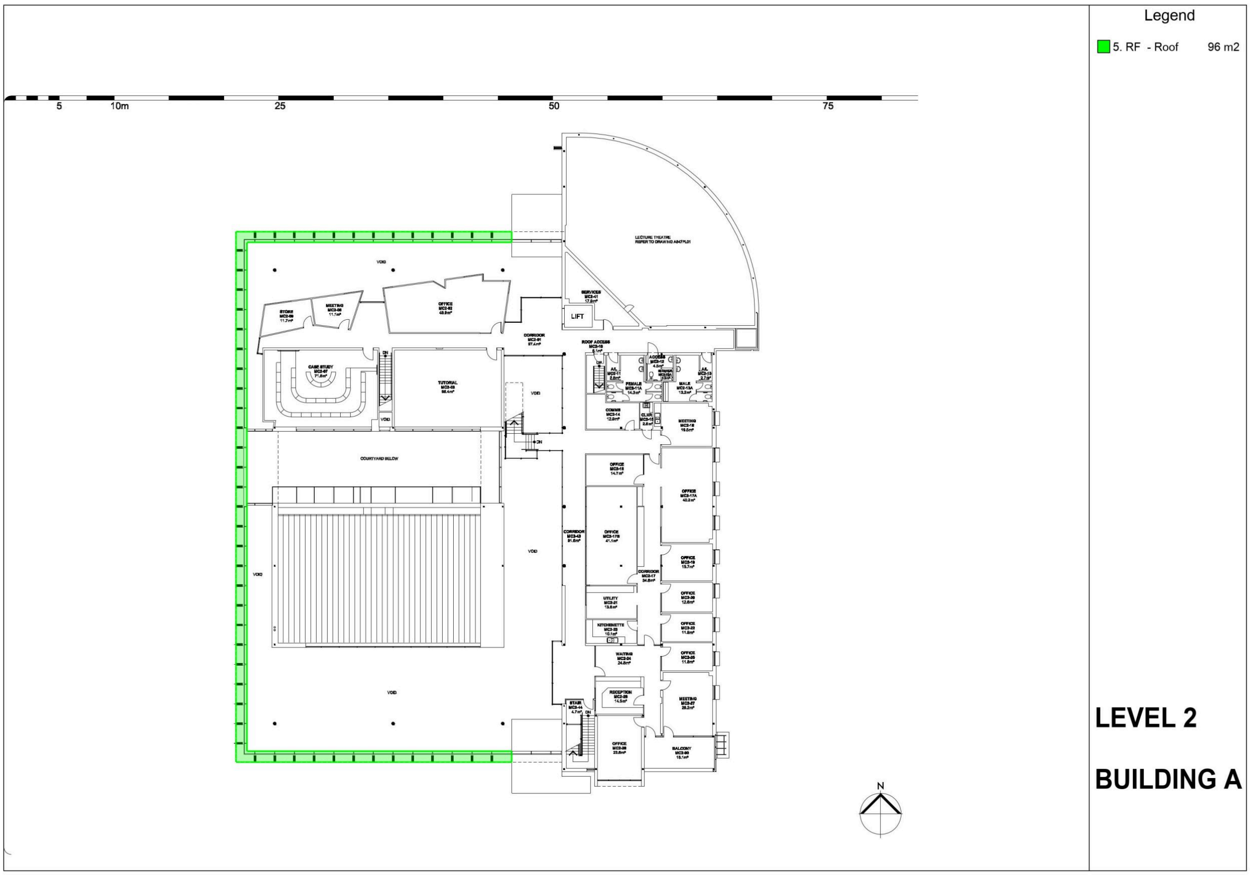


Figure 8.11a: Building A – Roof (Level 2) measured as per ACMM (AQIS, 2022)

As illustrated in **Figure 8.11a**, the roof at Level 2 was measured above the sunscreen blades.

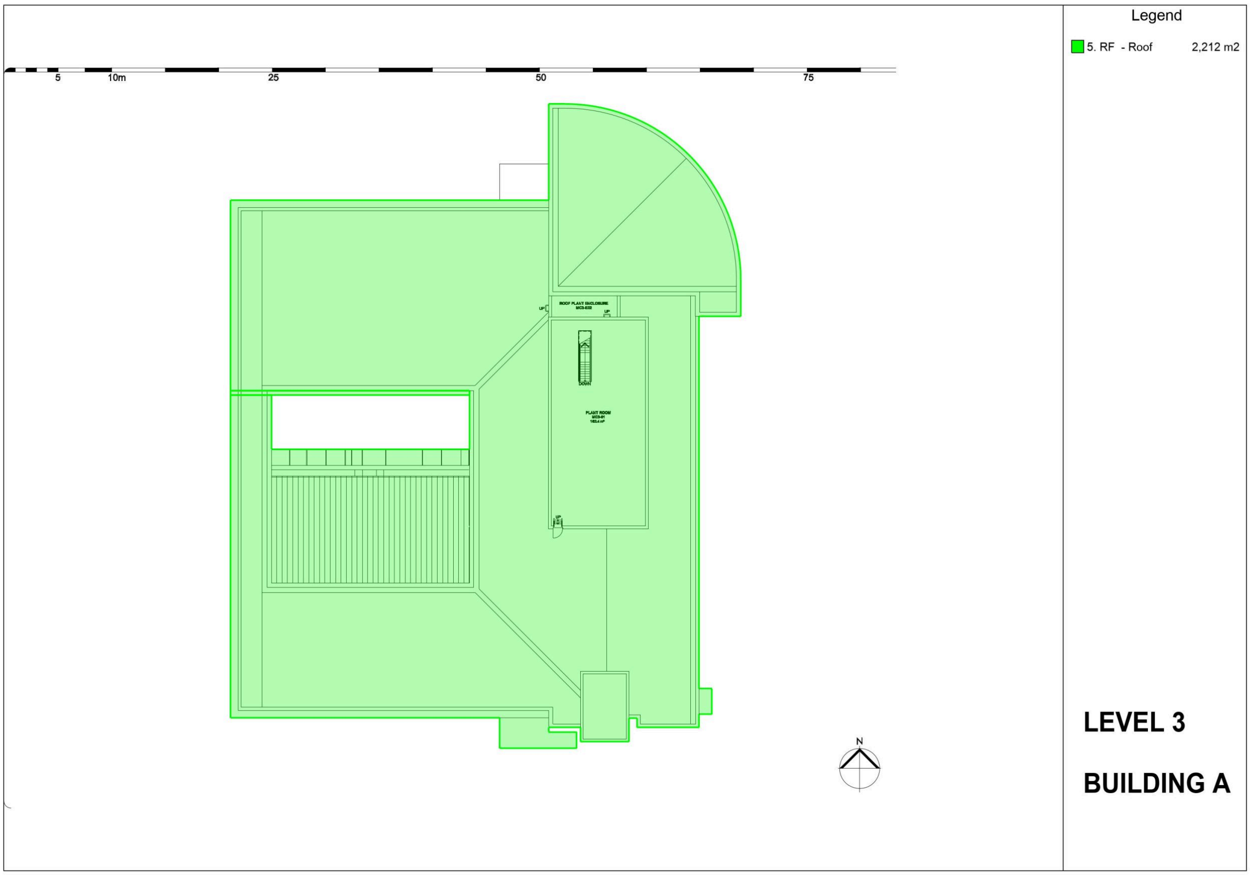


Figure 8.11b: Building A – Roof (Level 3) measured as per ACMM (AQIS, 2022)

According to **Figure 8.11b**, the roof at Level 3 consists of parapet walls (part extending above the Roof Level) and as per the ACMM (AQIS, 2022), the area covered by parapet walls is included in the measurement.

8.2.4 Column

ACMM (AQIS, 2022) defines columns as the total supported area of upper floors (UF)+Stair Case (SC)+ Roof (RF), indicating the extent of this element rather than just measuring the volume of columns. The total measurement of the columns for Building A is 3,749 m2

8.2.5 Internal walls, internal doors and internal screen and borrowed lights

It is important to distinguish between internal walls, internal doors and internal screen and borrowed light. **Table 8.10** discusses the differences between those 3 elements.

Table 8.10: Comparison of internal walls, Internal doors and internal screen and borrowed light

	Internal Walls (NW)	**Internal Screens and borrowed light (NS)**	**Internal Doors (ND)**
Definition as per ACMM	'Permanent division of internal spaces into separate rooms or to enclose duct and other non-usable areas' (AIQS, 2022, p.34)	'To screen off or temporarily divide internal spaces into separate compartments and to allow the transfer of light through "Internal Walls"'(AIQS, 2022, p.34)	'Passageways through internal walls, internal screens and partitions and to provide access to service cupboards and ducts' (AIQS, 2022, p.34)
Purpose and characteristics	Separation of spaces and no transfer of light or passageway	It is in an internal wall or similar to one, but transfer of light	It is in an internal wall and creates a passageway through internal walls
Examples	Full-height soil internal walls	Part height solid internal walls and internal glazed partitions	

According to **Table 8.10**, if the internal spaces are temporarily divided or screened off using a part height wall without a glazed screen, then it should be considered as an internal screen or borrowed light. Examples include

- Partitions separating the toilets
- Partitions separating office cubicles
- Glazed walls separating the shower area.

Exercises

According to the definitions and measurement rules in ACMM 2022 and NZIQS Elemental Analysis 2017, measure the key elements of a cost plan for the given Building A.

Drawings

Building A – Level 1 [PDF]

Building A – Level 2 [PDF]

Building A – Level 3 [PDF]

Answers

The following are the answer files covering measurements of the key elements of a cost plan in Building A (See **Table 8.11**):

Table 8.11: Measurements of the key elements of a cost plan in Building A

ACMM 2022		**NZIQS Elemental Analysis 2017**	
Element	**Measurements of the elements**	**Element**	**Measurements of the elements**
Substructure	Building A – Elemental – SB – Substructure [PDF]	Site Preparation	Building A – NZ – elemental – E1. Site Preparation [PDF]
Columns	Building A – Elemental – CL – Columns [PDF]Building A – Elemental – CL – Columns [PDF]Building A – Elemental – CL – Columns 3 [PDF]	Substructure	Building A – NZ – elemental – E2. Substructure [PDF]
Upper floors	Building A – Elemental – UF – Upper Floor 1 [PDF] Building A – Elemental – UF – Upper Floor 2 [PDF] Building A – Elemental – UF – Upper Floor 3 [PDF]	Frame	Building A – NZ – elemental – E3. Frame – Level 3 [PDF]Building A – NZ – elemental – E3. Frame – Level 2 [PDF]Building A – NZ – elemental – E3. Frame – Level 1 [PDF]
Staircases	Building A – Elemental – SC – Staircases 1 [PDF] Building A – Elemental – SC – Staircases 2 [PDF] Building A – Elemental – SC – Staircases 3 [PDF]	Structural wall	Building A – NZ – elemental – E4. Structural Wall – level 1 [PDF]
Roof	Building A – Elemental – RF – Roof 3 [PDF]Building A – Elemental – RF – Roof 2 [PDF]Building A – Elemental – RF – Roof 1 [PDF]	Upper floors	Building A – NZ – elemental – E5. Upper Floor – Level 3 [PDF]Building A – NZ – elemental – E5. Upper Floor – Level 2 [PDF] Building A – NZ – elemental – E5. Upper Floor – Level 1 [PDF]
External walls	Building A – Elemental – EW – External Walls 3 [PDF] Building A – Elemental – EW – External Walls 2 [PDF] Building A – Elemental – EW – External Walls 1 [PDF]	Roof	Building A – NZ – elemental – E6. Roof – Level 1 [PDF]Building A – NZ – elemental – E6. Roof – Level 2 [PDF]Building A – NZ – elemental – E6. Roof – Level 3 [PDF]
Internal Walls	Building A – Elemental – NW – Internal Walls 3 [PDF] Building A – Elemental – NW – Internal Walls 2 [PDF] Building A – Elemental – NW – Internal Walls 1 [PDF]	Exterior Walls	Building A – NZ – elemental – E7. Exterior walls & F. – L 2 [PDF]Building A – NZ – elemental – E7. Exterior walls & F. – L 1 [PDF]Building A – NZ – elemental – E7. Exterior walls & F. – L 3 [PDF]

Floor Finishes	Building A – Elemental – FF – Floor Finishes 3 [PDF] Building A – Elemental – FF – Floor Finishes 2 [PDF] Building A – Elemental – FF – Floor Finishes 1 [PDF]	Windows and Exterior Doors	Building A – NZ – elemental – E8. Windows and Doors – Level 3 Building A – NZ – elemental – E8. Windows and Doors – Level 2 Building A – NZ – elemental – E8. Windows and Doors – Level 1
Ceiling Finishes	Building A – Elemental – CF – Ceiling Finishes 1 [PDF] Building A – Elemental – CF – Ceiling Finishes 2 [PDF] Building A – Elemental – CF – Ceiling Finishes 3 [PDF]	Stairs and Balustrades	Building A – NZ – elemental – E9.2 Staircases & bal. – Level 3 [PDF] Building A – NZ – elemental – E9.2 Staircases & Ba. – Level 2 [PDF]
		Internal Walls	Building A – NZ – elemental – E10. Internal walls – Level 3 [PDF]Building A – NZ – elemental – E10. Internal walls – Level 2 [PDF]Building A – NZ – elemental – E10. Internal walls – Level 1 [PDF]
		Floor Finishes	Building A – NZ – elemental – E12. Floor Finishes – Level 3 [PDF]Building A – NZ – elemental – E12. Floor Finishes – Level 2 [PDF]Building A – NZ – elemental – E12. Floor Finishes – Level 1 [PDF]
		Ceiling Finishes	Building A – NZ – elemental – E14. Ceiling Finishes – Level 3 [PDF]Building A – NZ – elemental – E14. Ceiling Finishes – Level 2 [PDF]Building A – NZ – elemental – E14. Ceiling Finishes – Level 1 [PDF]
		Floor Finishes	Building A – NZ – elemental – E12. Floor Finishes – Level 3 [PDF]Building A – NZ – elemental – E12. Floor Finishes – Level 2 [PDF]Building A – NZ – elemental – E12. Floor Finishes – Level 1 [PDF]
		Fittings and Fixtures	Building A – NZ – elemental – E15. Fittings and Fix – Level 3 [PDF]Building A – NZ – elemental – E15. Fittings and Fix – Level 2 [PDF]Building A – NZ – elemental – E15. Fittings and Fix – Level 1 [PDF]

		Sanitary Plumbing	Building A – NZ – elemental – E16. Sanitary Plumbing – Level 3 [PDF]Building A – NZ – elemental – E16. Sanitary Plumbing – Level 2 [PDF]Building A – NZ – elemental – E16. Sanitary Plumbing – Level 1 [PDF]
		Fire Services	Building A – NZ – elemental – E18. Fire Services – Level 3 [PDF]Building A – NZ – elemental – E18. Fire Services – Level 2 [PDF]Building A – NZ – elemental – E18. Fire Services – Level 1 [PDF]

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://oercollective.caul.edu.au/building-cost-planning/?p=89#h5p-10

APPENDIX

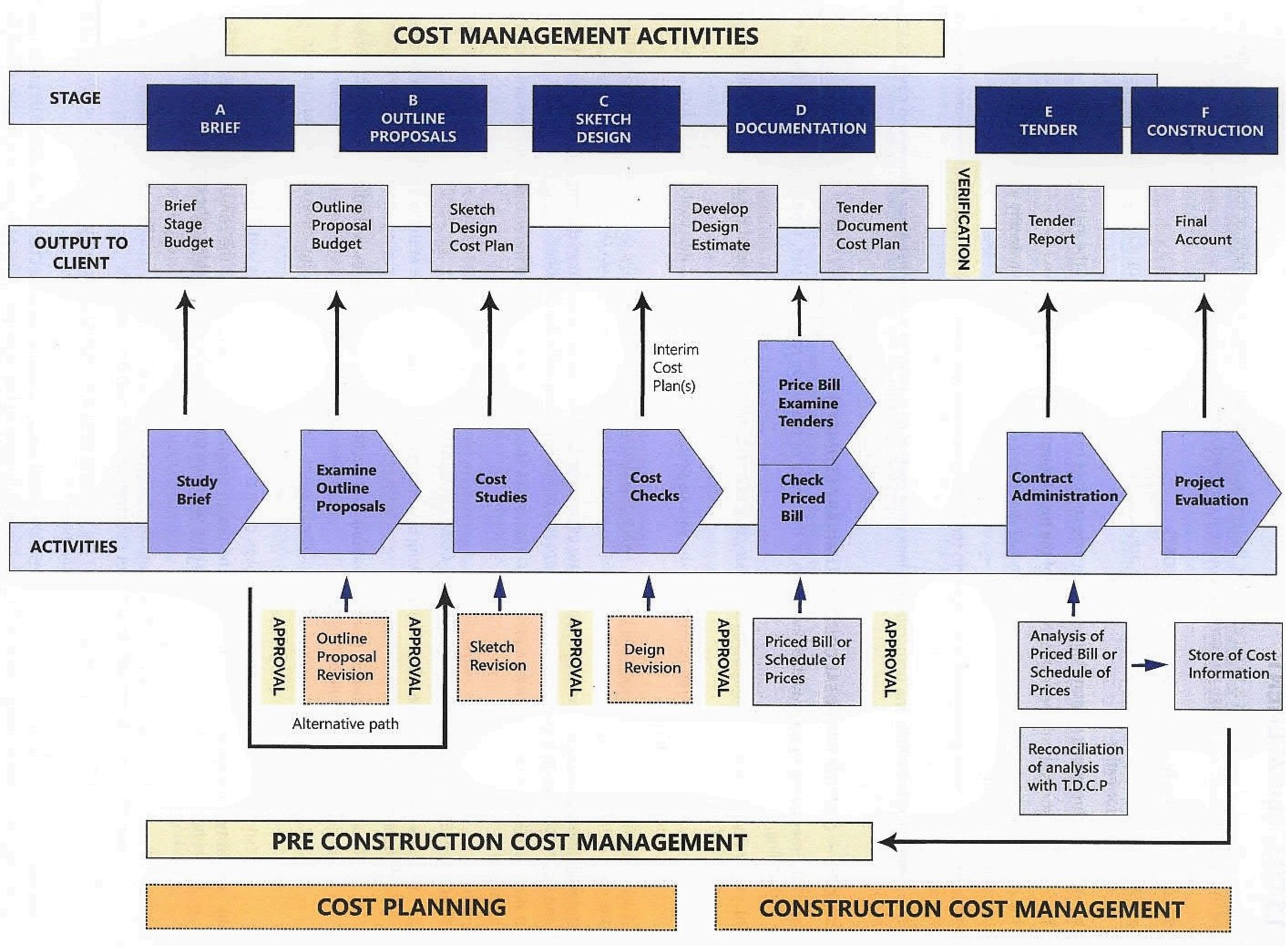


Figure A.1 Cost Management Activities from *The Australian Cost Management Manual* (3rd ed., Vol. 1, 2022) by Australian Institute of Quantity Surveyors, used with permission.

REVIEW STATEMENT

Building Cost Planning: Best Practices and Insights was produced with support and Open Textbook Grant funding from the Open Educational Resources Collective, an initiative of the Council of Australian University Librarians.

This book has been peer reviewed by a subject expert.

The review was structured around considerations of the intended audience of the book, and examined the following:

- Comprehensiveness
- Accuracy
- Relevance/longevity of content
- Clarity
- Consistency
- Modularity
- Organisation/structure/flow
- Diversity and inclusion

The authors wish to thank Dr Gayani Karunasena, Senior Lecturer, Deakin University, for lending their time expertise to help enhance this book. We recognise that peer reviewing is a generous act of service and this book would not be the robust, valuable resource that it is were it not for their feedback and input.

VERSIONING HISTORY

This page provides a record of changes made to this resource. Each set of edits is acknowledged with a 0.1 increase in the version number. The exported files for this resource reflect the most recent version.

If you find an error in this resource, please contact us via Ask the Library: https://ask.library.unisa.edu.au

Version	Date	Change	Details
1.1	10 June, 2024	Full resource published.	All chapters complete and published and have undergone pre-publication peer review.
1.0	4 May, 2023	Four chapters of this resource published on the CAUL OER Collective Pressbooks platform: chapters 1, 2, 5, and 6.	Chapters published as part of the CAUL OER Collective grant program. Full book not yet published.