Chapter 4 Writing Guide: Data, Analysis and Discussion

A comprehensive guide for Diploma in Civil Engineering students to complete a systematic, analytical Chapter 4 for their Final Year Project (FYP) that meets academic standards.

FINAL YEAR PROJECT (FYP) DIPLOMA IN CIVIL ENGINEERING



Overview of Chapter 4

Chapter 4 is the core of the FYP report because it presents the **actual research findings**, data analysis, and discussion that answer each of the set objectives. This chapter is structured based on the methodology in Chapter 3 and serves as evidence that the study was carried out carefully and systematically.

Research Findings

Presentation of raw data obtained from experiments, tests, or field studies.

Data Analysis

Interpretation, comparison, and statistical calculations based on the collected data.

Discussion

Relating the findings to the literature review, standards, and achievement of objectives.

Core Principles of Chapter 4

> Chapter 4 is not merely about presenting tables, charts, or images. Every finding must be **presented, analyzed, discussed, and summarized** to show whether the research objectives have been achieved.

This principle ensures that Chapter 4 is not just a collection of meaningless data, but a coherent scientific narrative that convinces the evaluator that each research objective has been answered with solid evidence.

Overall Structure of Chapter 4

Chapter 4 is organized logically according to the research methodology sequence. Each section addresses one research objective directly and completely.



Arrangement of Sections in Chapter 4

01

4.1 Introduction

Introduces the content of Chapter 4, the data collection methods, and the presentation structure.

02

4.2 Addressing Research Objective 1

Title based on activities or methodology — Data Presentation, Analysis, Discussion.

03

4.3 Addressing Research Objective 2

Title based on activities or methodology — Data Presentation, Analysis, Discussion.

04

4.4 Addressing Research Objective 3

Title based on activities or methodology — Data Presentation, Analysis, Discussion.

05

4.5 Overall Discussion

Brings together all findings to comprehensively answer the main research question.

06

4.6 Chapter Summary

Summarizes the main findings and links them to Chapter 5.

CHAPTER 4 — SECTION 4.1

Introduction to Chapter 4

Purpose of This Section

Introduce the reader to the content of Chapter 4, state that the findings are presented based on the methodology in Chapter 3, and explain the presentation structure.

Content That Should Be Included

- Summary of the data collection methods used
- Summary of the data analysis methods carried out
- Overview of the presentation structure of Chapter 4
- Connection to the research methodology in Chapter 3

Suggested length: **1–2 paragraphs only.**

Example Writing for Section 4.1

> This chapter presents the research findings, data analysis, and discussion based on the methodology described in Chapter 3. The data were obtained through laboratory tests conducted in accordance with the MS EN 12390 standard procedures. Each section is organized according to the sequence of research activities, beginning with the concrete mix design, followed by the compressive strength test, and then the evaluation of the effectiveness of recycled plastic use. This arrangement ensures that each research objective is addressed systematically and in sequence.

ⓘ A good introduction provides readers with a "road map" of what will be presented throughout Chapter 4.

CHAPTER 4 — SECTION 4.2

Section 4.2: Addressing Research Objective 1

This section is the first part that presents the research findings directly. The title should reflect the actual activity or test carried out, not merely "Objective 1".



Sample Title for Section 4.2

Choose a title that describes the **actual activity or test** carried out. Below are examples by project type:

Concrete Experiment Project

Concrete Mix Design
(Answering Research Objective 1)

BIM Project

Development of BIM Model
(Answering Research Objective 1)

Drainage System Project

Development of Smart Drainage System
(Answering Research Objective 1)

Structural Project

Preparation of Concrete Specimens
(Answering Research Objective 1)

Three Main Components of Each Section



Data Presentation

Data Analysis

Discussion

Each main section in Chapter 4 (4.2, 4.3, 4.4) must contain these three components in sequence. These components ensure that the findings are not only presented but also interpreted and discussed academically.

4.X.1 — FIRST COMPONENT

Data Presentation

Data presentation is the first step in every section. Data should be presented using the most suitable medium for the type of data and the information intended to be conveyed to the reader.

Table

Test results, measurement readings, or numerical data comparisons between samples.

Diagram

Sketches, models, layouts, plans, or technical illustrations related to the study.

Chart

Bar, line, pie, or scatter charts to show trends, comparisons, and data relationships.

Photo

Experimental processes, assembly, laboratory testing, or final project results as visual evidence.

Visual Presentation Guide

Mandatory Requirements

- Every table, diagram, graph, chart, and photo **must** be numbered and titled
- Format: **Table 4.1**, **Figure 4.1**, **Graph 4.1**
- Every visual material must be referenced in the text before or after it appears

How to Refer in Text

Do not let tables or graphs "stand alone" without explanation. Examples of correct reference sentences:

- *"Table 4.1 shows the compressive strength test results at 7 days and 28 days."*
- *"As shown in Graph 4.2, concrete strength increased with age."*

Example Table: Concrete Compressive Strength

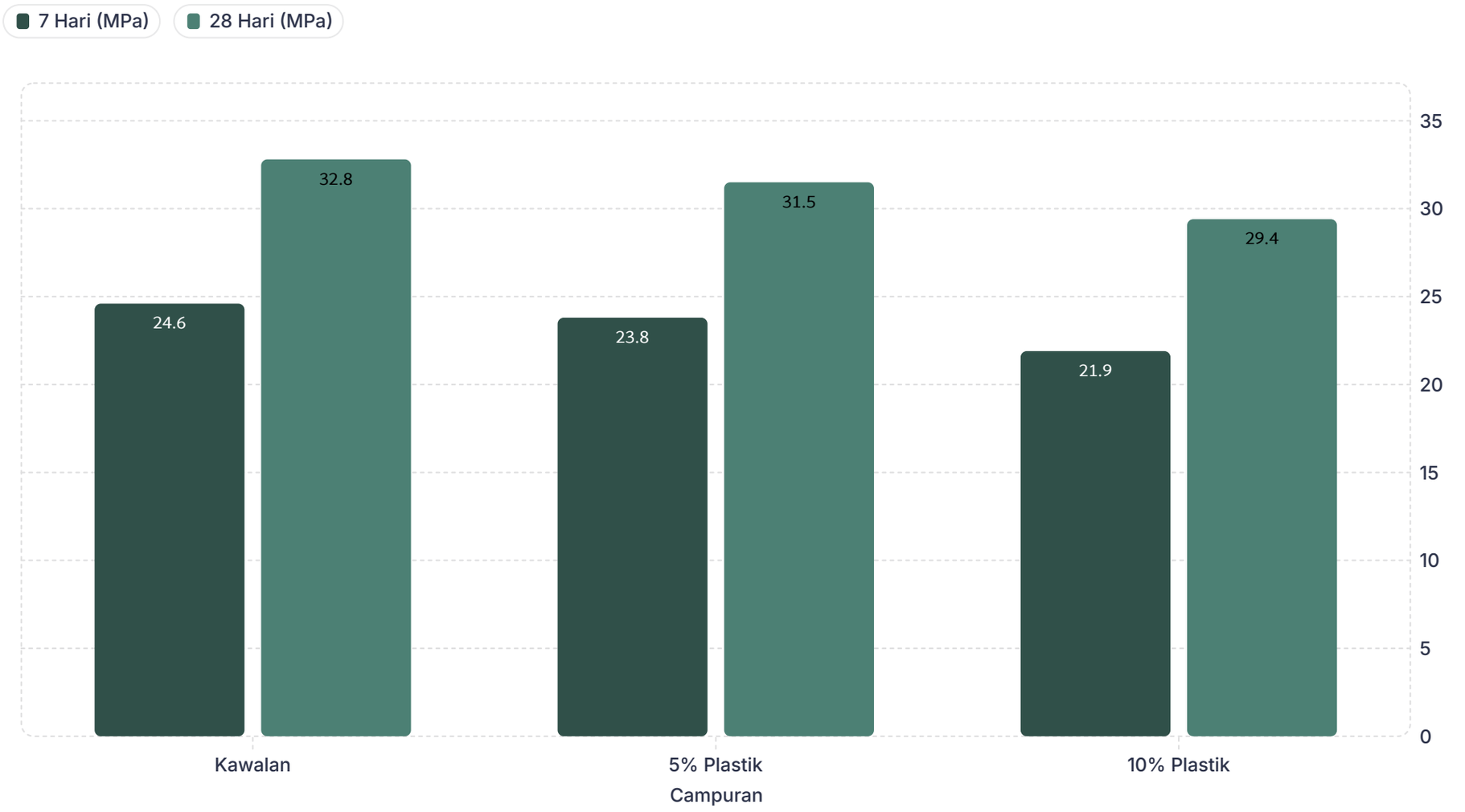
Below is an example of the correct table format for a concrete-related project. Note the table number format, descriptive title, and clear measurement units.

Concrete Mix	7-Day Strength (MPa)	28-Day Strength (MPa)
Control (0% Plastic)	24.6	32.8
5% Recycled Plastic	23.8	31.5
10% Recycled Plastic	21.9	29.4

Table 4.1: Test results for the compressive strength of concrete blocks at 7 days and 28 days for each mix.

Data Visualization: Example Compressive Strength Graph

The bar chart below shows a comparison of compressive strength for three concrete mix types at 7 days and 28 days. This graph helps readers see the trend more clearly than a table alone.



4.X.2 — SECOND COMPONENT

Data Analysis

After the data is presented, students need to **analyze and interpret** the results. Analysis is the process of explaining the meaning behind the numbers and charts that have been presented.

Make Comparisons Between Samples

Compare the values between the control sample and the test sample. State which is higher or lower and by how much the difference is.

Identify Data Trends or Patterns

Do the values increase, decrease, or remain unchanged as the material content increases? Describe the pattern observed.

Calculate Relevant Statistical Values

Calculate the average, percentage difference, rate of change, or other statistical values relevant to the study.

Compare with Standards or Specifications

Check whether the results meet the minimum requirements according to MS, BS, ASTM, or other relevant specifications.

Example of Data Analysis Writing

Below is an example of how data analysis should be written based on the concrete compressive strength table:

> Based on Table 4.1, the compressive strength of the control mix at 28 days was 32.8 MPa, while the mix with 5% and 10% recycled plastic recorded strengths of 31.5 MPa and 29.4 MPa, respectively. This shows a decrease in strength of 3.96% for the 5% plastic mix and 10.37% for the 10% plastic mix compared with the control mix. However, all values exceeded the minimum limit of 25 MPa as specified in MS 522: Part 2.

A good analysis provides specific numbers, not just stating "higher" or "lower" without quantitative values.

4.X.3 — THIRD COMPONENT

Discussion

Discussion is the most critical component and requires critical thinking. This is where students connect their findings with the broader scientific world.



Four Elements of a Comprehensive Discussion

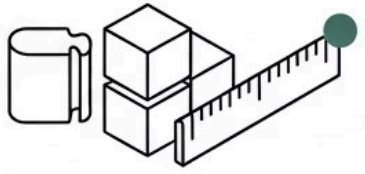
KAITKAN KAJIAN LITERATUR



Hubungkan penemuan dengan kajian terdahulu (Bab 2).

BANDINGKAN PIAWAIAN

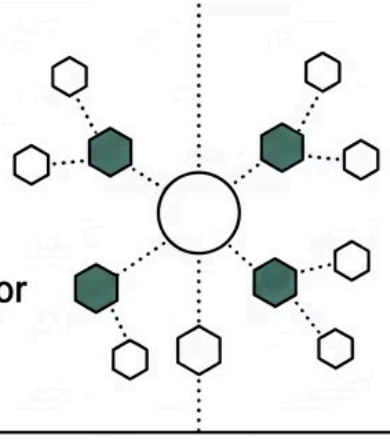




Bandingkan dengan piawaian MS, BS, ASTM.

JELASKAN FAKTOR PENYEBAB

Terangkan faktor-faktor yang mempengaruhi keputusan.



NYATAKAN PENCAPAIAN OBJEKTIF

Nyatakan sama ada objektif kajian tercapai.



Discussion: Linking to the Literature Review

Why Is It Important?

Linking findings to previous studies shows that the student's research is placed within the correct academic context and contributes to the existing body of knowledge.

How to Do It

- Refer to relevant studies from Chapter 2 that relate to your findings
- State whether your findings are **consistent with or different from** previous studies
- Explain the reason for any differences, such as differences in material type, test method, or research context
- Use the format: *"These findings are consistent with Ahmad et al. (2020), who found that..."*

Discussion: Comparing with Standards

Comparison with technical standards provides professional context for research findings. Standards commonly used in Malaysian Civil Engineering:

MS (Malaysian Standard)

Malaysian standards established by SIRIM. Example: MS 522 for concrete.

BS (British Standard)

British standards that are still referenced in the Malaysian civil engineering context.

ASTM (American Standard)

American international standards, especially for testing construction materials and soil.

EN (European Standard)

European standards that are increasingly adopted in the Malaysian construction industry.

State the Achievement of Objectives

At the end of each discussion section (4.2.3, 4.3.3, 4.4.3), students **must explicitly state** whether the relevant research objective has been achieved. This is an important academic assessment requirement.

✅ Objective Fully Achieved

"Based on the findings and analyses conducted, Research Objective 1 — namely to design a concrete mix that replaces part of the cement with recycled plastic — has been successfully achieved."

⚠️ Objective Partially Achieved

"Research Objective 2 has been achieved partially. The compressive strength meets the minimum standard limit, but the 10% plastic mix shows a significant reduction that requires further study."

FYP PROJECT EXAMPLE

Case Study: Recycled Plastic in Concrete Blocks

FYP Title: ***"The Effect of Recycled Plastic as Partial Replacement Material in Concrete Blocks"***
This case study is used as an example throughout this guide to illustrate the practical application of Chapter 4 structure.



Chapter 4 Structure — Concrete FYP Example

1. **4.1 Introduction**
   Summary of laboratory test methods and the arrangement of research findings.
2. **4.2 Concrete Mix Design**
   Addresses Research Objective 1 — Data Presentation, Analysis, Discussion.
3. **4.3 Concrete Block Compressive Strength Test**
   Addresses Research Objective 2 — Data Presentation, Analysis, Discussion.
4. **4.4 Evaluation of Recycled Plastic Effectiveness**
   Addresses Research Objective 3 — Data Presentation, Analysis, Discussion.
5. **4.5 Overall Discussion**
   Combines all findings and discusses the overall implications of the study.
6. **4.6 Chapter Summary**
   Summary of the main findings and transition to Chapter 5.

4.2 — WRITING EXAMPLE

4.2 Concrete Mix Design

This section presents the concrete mix design process that replaces part of the fine aggregate with recycled plastic at 0%, 5%, and 10%. The mix design was carried out based on ACI 211.1 standards.

1 **4.2.1 Data Presentation**

The water-cement ratio, material content, and slump values for each mix are shown in Tables 4.1 to 4.3.

2 **4.2.2 Data Analysis**

Comparisons of material ratios, differences in slump values, and compliance with the limits set by the standard are calculated and analyzed.

3 **4.2.3 Discussion**

The findings are related to previous studies on the use of replacement materials in concrete and MS 26:2013 standards.

Slump Test — Data Presentation

Slump tests were conducted for each concrete mix to determine workability. The following are the slump test results for the three mixes:

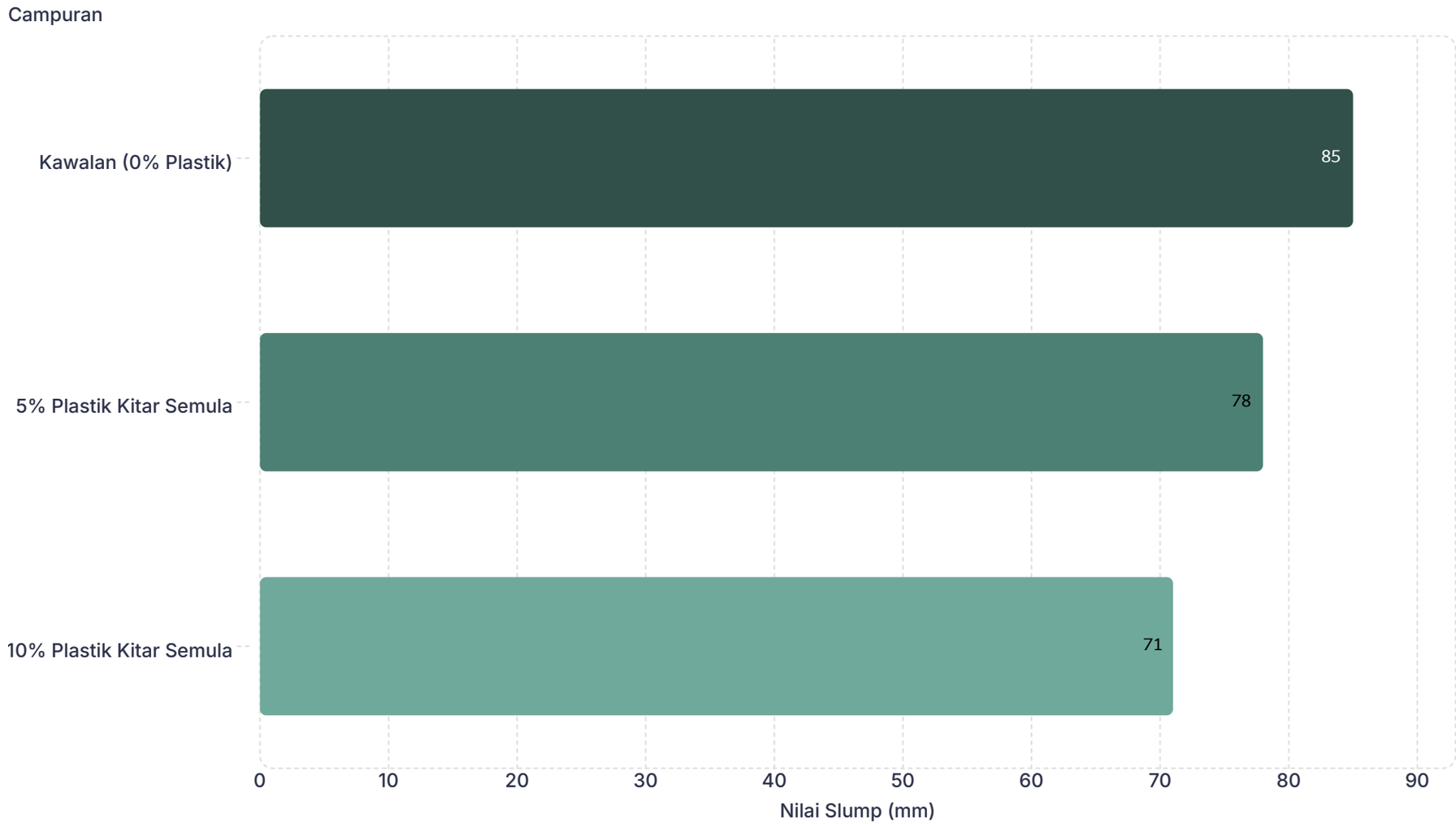


Figure 4.1: Slump value for each concrete mix. Accepted slump range: 60–90 mm (BS 1881: Part 102).

Mix Design Analysis

Based on Graph 4.1, the slump values for all three mixes are within the range of 71–85 mm, which meets the minimum requirement of 60 mm to a maximum of 90 mm as specified in BS 1881: Part 102.

Observed Trend

- The slump value **decreases** as the plastic content increases
- A decrease of **8.2%** from 0% to 5% plastic
- A decrease of **16.5%** from 0% to 10% plastic
- All values are still within the **accepted range**

Cause Factors

The decrease in slump value is caused by the smooth surface of plastic and its inability to absorb water compared to natural sand aggregate, resulting in a drier mixture overall.

4.3 — WRITING EXAMPLE

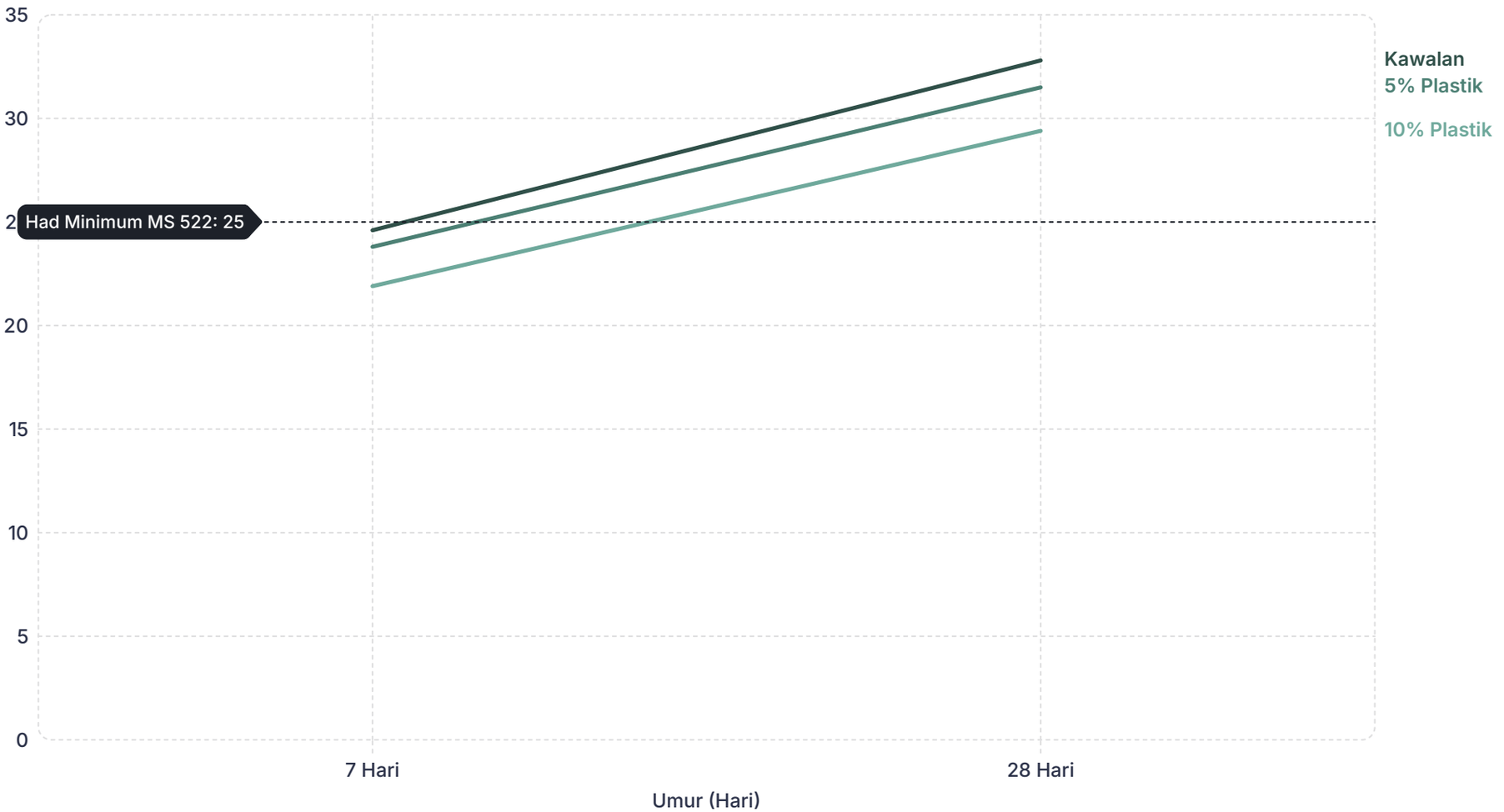
4.3 Compressive Strength Test of Concrete Blocks

This section presents the compressive strength test results of concrete blocks conducted at 7 days and 28 days in response to Research Objective 2, namely to test the compressive strength of concrete containing recycled plastic.



Compressive Strength — Age vs. Strength Trend

The graph below shows the compressive strength development for all three mixes from 7 days to 28 days. The trend of increasing strength over time is a natural characteristic of the cement hydration process.



Graph 4.2: Compressive strength development by age for three concrete mixes. The minimum limit line is 25 MPa (MS 522: Part 2).

Compressive Strength Analysis

32.8	31.5	29.4
MPa — Control	MPa — 5% Plastic	MPa — 10% Plastic
Highest compressive strength at 28 days. Meets the MS 522 minimum requirement.	3.96% reduction compared to the control. Still meets the MS 522 standard.	10.37% reduction compared to the control. Still exceeds the minimum 25 MPa limit.

Although there is a decrease in compressive strength with increasing plastic content, all mixes still meet the minimum compressive strength limit set in MS 522: Part 2, namely 25 MPa at 28 days.

Discussion: Compressive Strength vs. Previous Studies

Comparing the findings of this study with previous studies shows significant consistency, providing confidence in the validity of the research results.

Consistent with Saikia & de Brito (2014)

Saikia and de Brito (2014) found that replacing aggregates with recycled plastic at 5–15% led to a decrease in compressive strength of between 5–20%. The findings of this study (3.96%–10.37%) are consistent with the reported range.

Consistent with Aliabdo et al. (2015)

Aliabdo et al. (2015) reported that concrete with 10% plastic retained more than 85% of its original strength. This study recorded 89.6% strength retention at the 10% level, confirming the literature findings.



4.4 — WRITING EXAMPLE

4.4 Evaluation of the Effectiveness of Using Recycled Plastic

This section assesses the overall effectiveness of using recycled plastic as a partial replacement material in concrete, addressing Research Objective 3 related to environmental and engineering implications.

Effectiveness Assessment — Engineering Aspects

The effectiveness assessment involves two main dimensions: technical performance and environmental sustainability potential. Both aspects are analyzed simultaneously to provide a comprehensive overview.

Technical Performance

All mixes meet the MS 522 standard. The 5% plastic mix shows an optimal balance between strength and reduction of natural aggregate.

Environmental Sustainability

The use of recycled plastic reduces the consumption of natural sand and helps address the increasingly critical problem of plastic waste disposal.

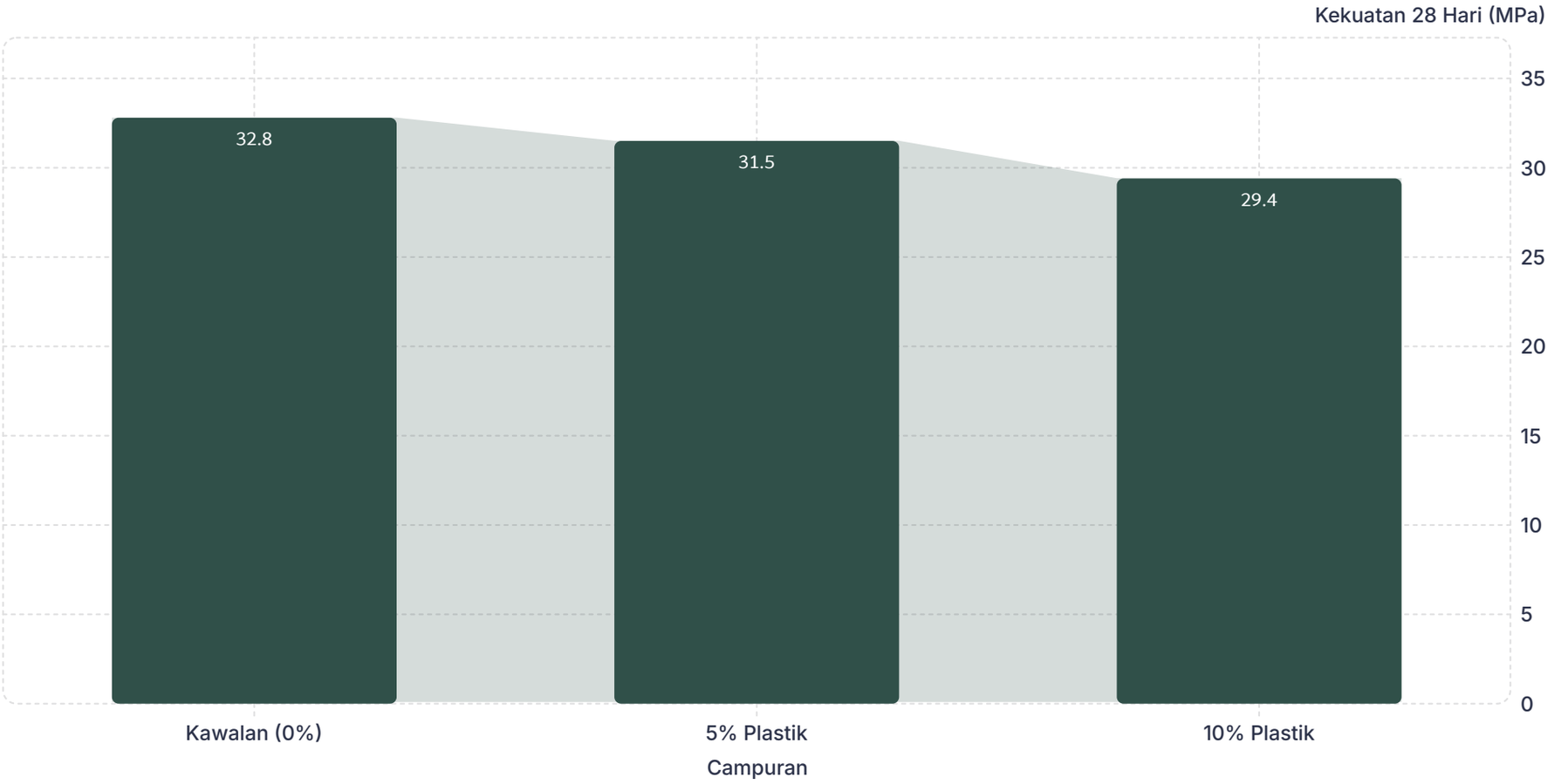
Industrial Application Potential

The 5% plastic mix has the potential to be applied in the construction of non-structural concrete blocks such as fence and boundary walls.

Percentage Reduction in Strength — Quantitative Assessment

89.63%

Total conversion rate



This funnel chart shows the progressive reduction in compressive strength with increasing plastic content. Although there is a decline, keep in perspective that all values still remain well above the 25 MPa minimum limit set by the standard.

Discussion: Implications for Civil Engineering

Technical Implications

- Recycled plastic can be used up to 10% without affecting standard compliance
- The optimum 5% rate offers the best balance between strength and sustainability
- Further studies are needed at 56 days and 90 days

Sustainability Implications

- Reduces demand for river sand, which is becoming increasingly scarce
- Helps reduce plastic waste in landfills
- Aligns with green construction goals
- Has the potential to reduce long-term construction material costs

CHAPTER 4 — SECTION 4.5

4.5 Overall Discussion

Section 4.5 is a space to integrate all findings from Sections 4.2, 4.3, and 4.4 in order to answer the **main research question** comprehensively. This is not a repetition of the summary, but a deeper synthesis.

Overall Discussion Content



Relationship Between Objectives

Explain how the achievement of Objective 1 (mixed design) enables Objective 2 (strength testing) and then Objective 3 (effectiveness evaluation).



Overall Findings Discussion

Discuss all findings in an integrated way — not one by one. Look for connections and the larger meaning of the overall study.



Project Strengths and Weaknesses

Assess honestly the strengths of the methodology and study findings, as well as any weaknesses that may affect the reliability of the results.



Study Constraints or Limitations

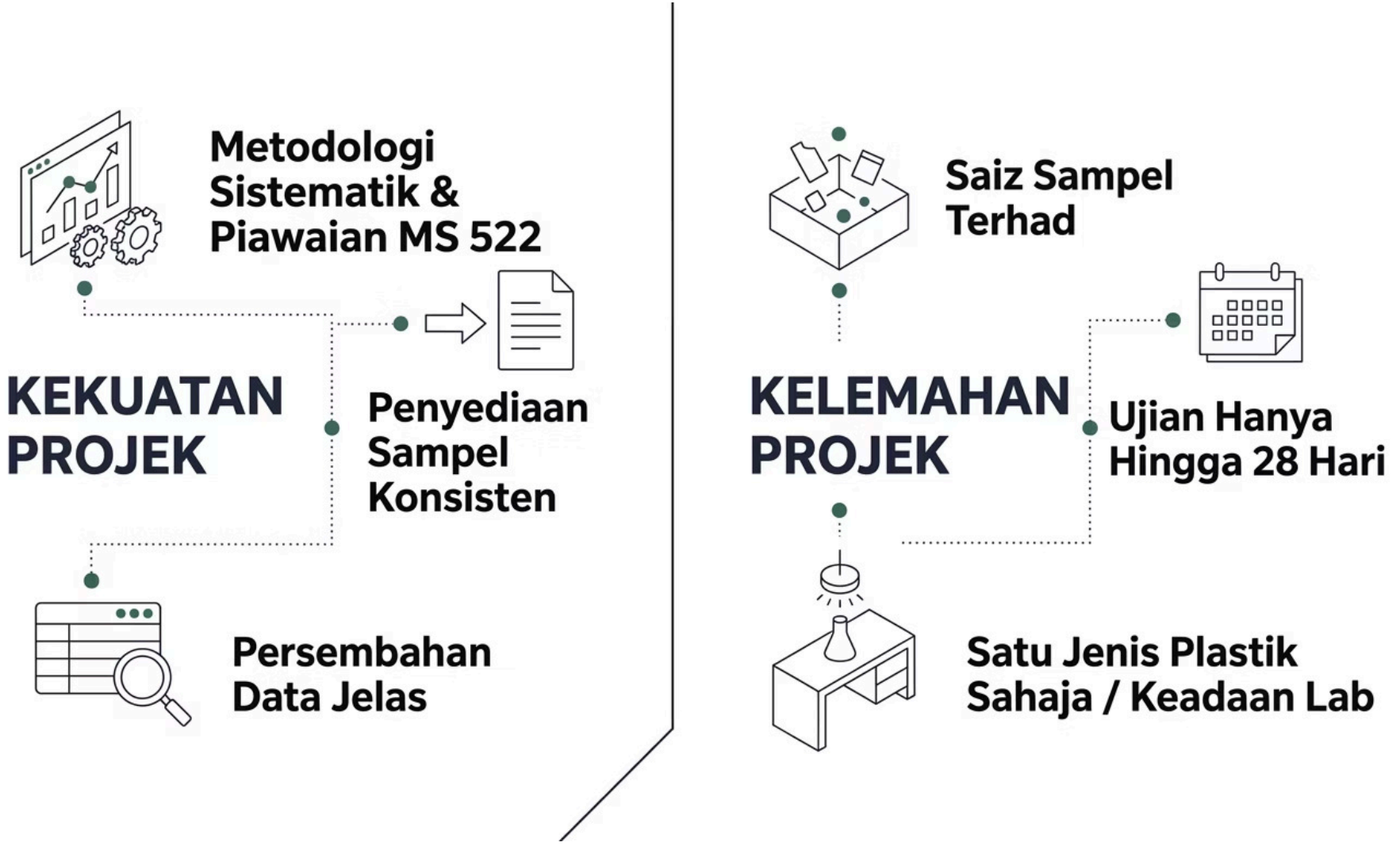
State limitations such as a limited sample size, test duration, material availability, or other factors that may affect the findings.

Writing Example: Overall Discussion

> Overall, this study proves that recycled plastic can be used as a partial replacement material in concrete without significantly affecting structural performance. The carefully designed mix design (Objective 1) produced specimens that could be tested consistently (Objective 2), and the results of those tests made it possible to assess effectiveness in a well-founded manner (Objective 3). The main limitation of this study was that the testing period was limited to 28 days and the number of repetitions should be increased in future studies.

Notice how the example above connects all three objectives, evaluates the study as a whole, and states the limitations honestly in one coherent paragraph.

Project Strengths and Weaknesses



Implications for the Construction Industry

The findings of this study have broad implications for the Malaysian construction industry, particularly in the context of sustainable construction and solid waste management, which is a global issue.



CHAPTER 4 — SECTION 4.6

4.6 Chapter Summary

The final section of Chapter 4 summarizes the overall findings and provides a bridge to Chapter 5, which will discuss the study's conclusions and recommendations for further research.

Summary Content

- Summary of the main findings from each section
- Statement of achievement for each research objective
- Transition to Chapter 5

Recommended length: **1–2 paragraphs only.**

Example Summary Writing

"This chapter has presented the research findings for all three research objectives. Overall, all three research objectives have been achieved. Chapter 5 will discuss the overall conclusions of the study as well as recommendations for improvement and further research."

Relationship Between Chapter 3 and Chapter 4

The continuity between Chapter 3 (Methodology) and Chapter 4 (Findings) is the foundation of coherent FYP writing. Every element in Chapter 3 has its counterpart in Chapter 4.

Chapter 3: Research Methodology	Chapter 4: Data, Analysis and Discussion
Research design	Findings based on the research design
Experimental procedure	Experimental results
Materials, equipment and instruments	Data from tests or instruments
Data collection methods	Presentation of data: tables, figures, graphs, photos
Data analysis methods	Analysis and interpretation of results
Research objectives	Answers to each research objective

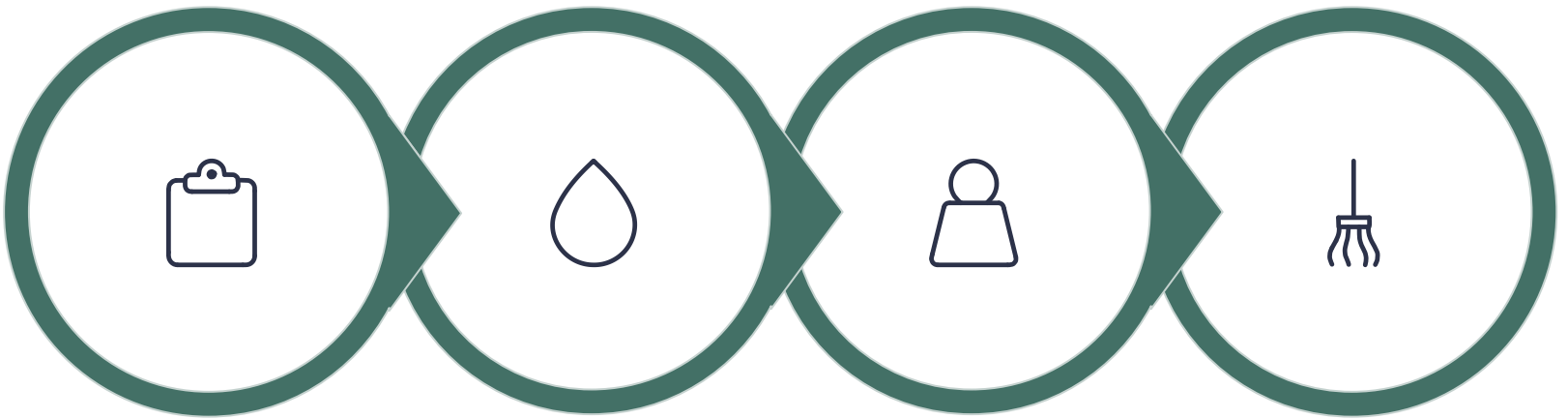
Principle: Follow the Methodology Sequence

This guide is one of the most critical guidelines that is often overlooked by students. The structure of Chapter 4 must reflect the order of procedures in Chapter 3.

> If Chapter 3 explains specimen preparation, slump test, compressive strength test, and water absorption test — then Chapter 4 should present the findings in the **exact same** order.

⚠ Inconsistent ordering between Chapter 3 and Chapter 4 will confuse readers and make the report appear unstructured. This will affect the assessment score.

Guideline 1: Methodology Sequence



Consistency between the methodology and the presentation of findings shows the assessor that the study was conducted in a structured and systematic way, reflecting professional engineering practice.

Guideline 2: Use Meaningful Titles

Section titles in Chapter 4 should reflect the actual activity or test, not generic labels such as "Objective 1" or "Research Findings." The comparison below shows the clear difference:

❌ Weak Titles

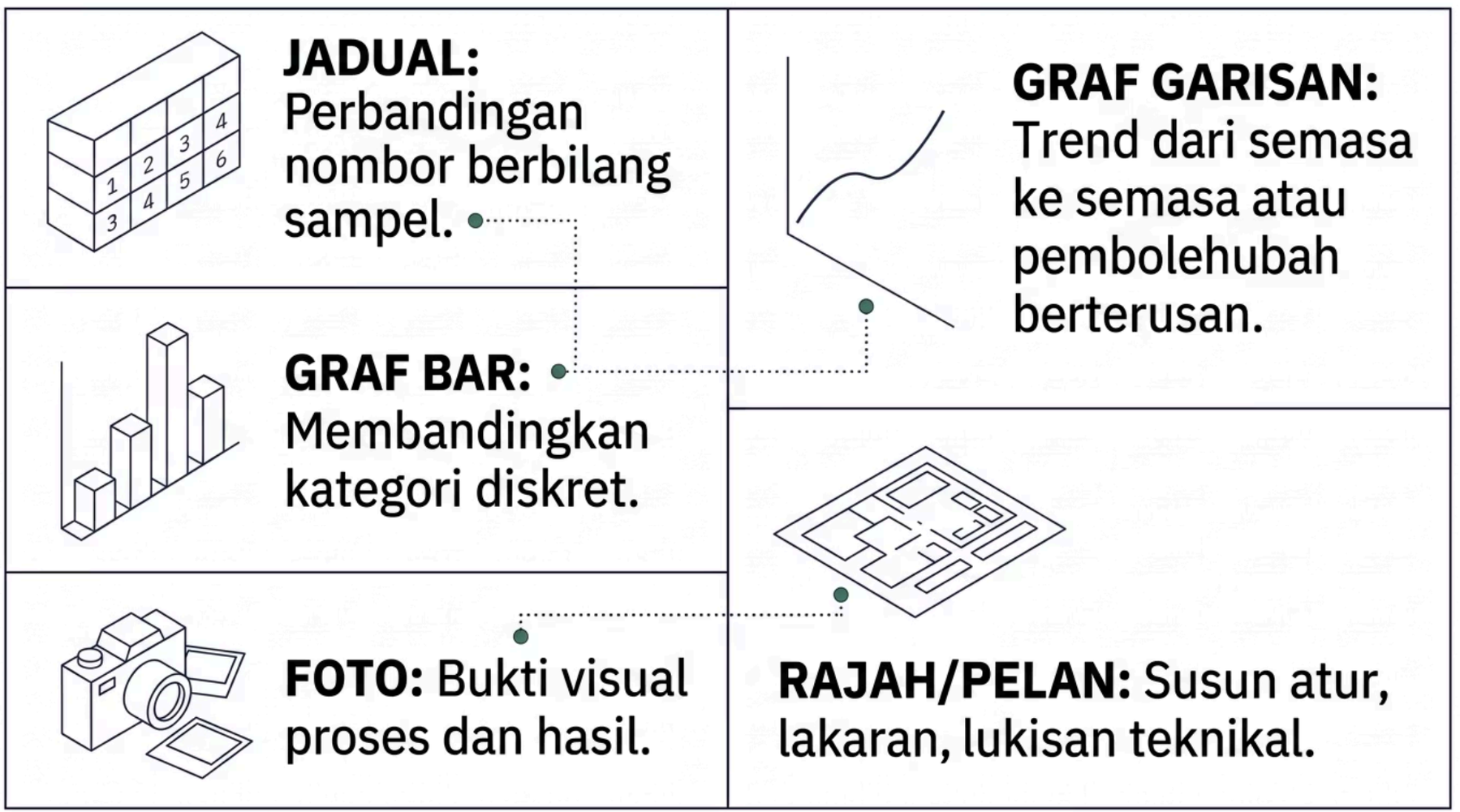
- 4.2 Research Findings for Objective 1
- 4.3 Objective 2
- 4.4 Research Result 3

✅ Strong and Descriptive Titles

- 4.2 Concrete Mix Design (Answering Research Objective 1)
- 4.3 Concrete Block Compressive Strength Test (Answering Research Objective 2)
- 4.4 Evaluation of Recycled Plastic Effectiveness (Answering Research Objective 3)

Guideline 3: Appropriate Data Presentation

The choice of the right data presentation medium depends on the type and purpose of the data. Use the following guide to make a wise choice:



Guide 4: Three Components Are Mandatory

Every main section in Chapter 4 **must** contain these three components. The absence of any one component will cause the section to be incomplete and not meet the assessment requirements.

Data Presentation

Show raw data through tables, graphs, diagrams, or photos. Provide a number and title for each visual. Refer to each visual in the text.

Data Analysis

Describe the results, identify trends, calculate statistical values, and compare them with standards. Use specific numbers, not just general statements.

Discussion

Link to the literature review, compare with standards, explain causal factors, and state explicitly whether the objectives have been achieved.

Guide 5: Explain Each Finding

The most common mistake in Chapter 4 writing is presenting tables or graphs without any explanation. Remember this basic principle:

Explain the Meaning of the Results

What do these numbers or data show? What is the main message that should be conveyed to the reader?

Identify Trends

Do the values increase, decrease, or stay stable? How quickly does the change occur? Is there a significant turning point?

Compare with References

How do these results compare with previous studies or relevant technical standards?

Explain Contributing Factors

Why were these results obtained? What scientific or technical factors caused the values to be high or low?

Guideline 6: State the Achievement of Objectives

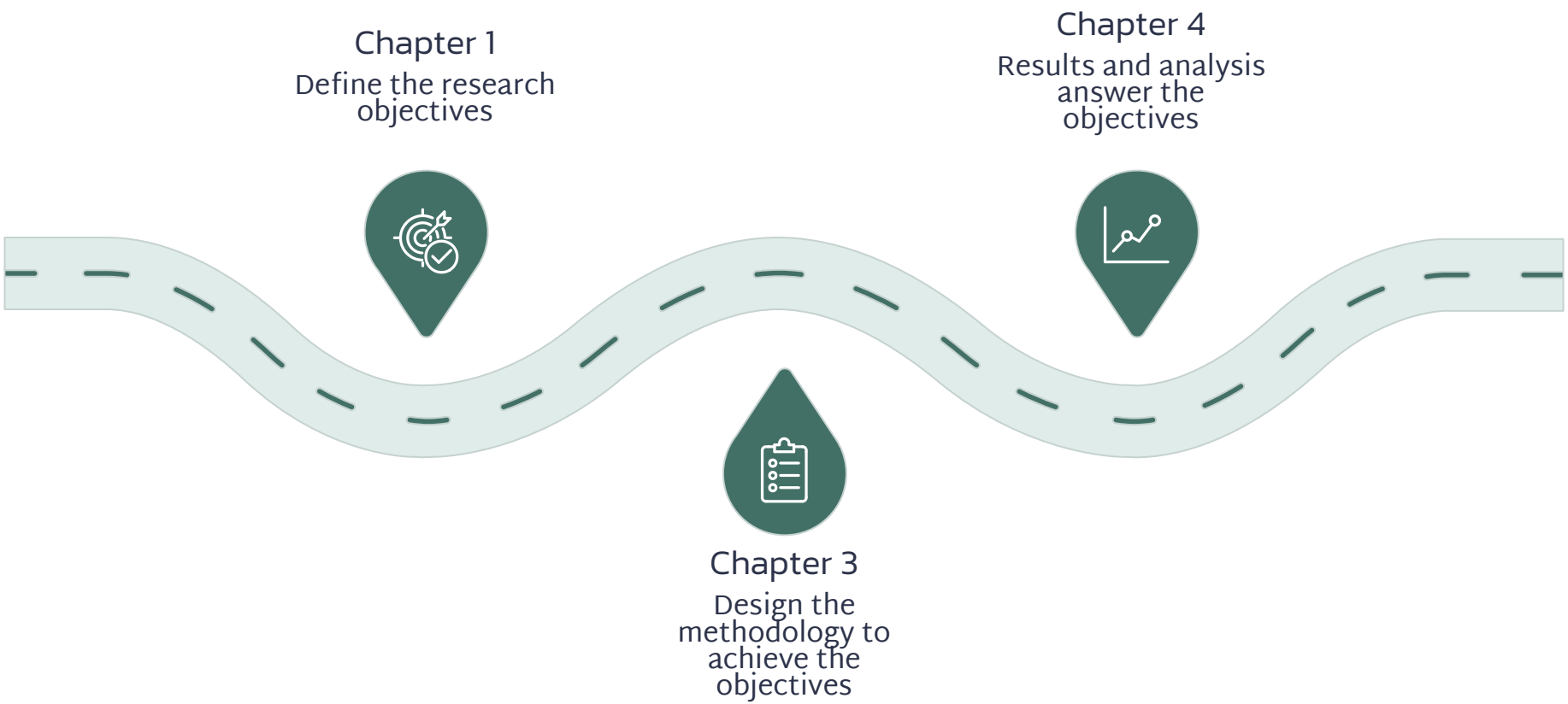
Why Is This Important?

Evaluators will explicitly look for whether each research objective has been achieved. Without a clear statement, evaluators cannot accurately assess the success of the study. This directly affects the marks.

Where Should It Be Stated?

- At the end of section **4.2.3** — achievement of Objective 1
- At the end of section **4.3.3** — achievement of Objective 2
- At the end of section **4.4.3** — achievement of Objective 3
- In **4.5** — overall achievement of the research questions
- In **4.6** — summary of the achievement of all objectives

Continuity Between Chapters 1, 3 and 4



Clear continuity between Chapter 1 (research objectives), Chapter 3 (research methodology), and Chapter 4 (findings, analysis, and discussion) makes the FYP writing systematic, easy to understand, and compliant with academic assessment requirements.

Checklist: Before Submitting Chapter 4

Use this checklist to ensure your Chapter 4 is complete and meets all assessment requirements before submitting it to your supervisor.

Structure and Content

- ☐ Section 4.1 introduction is written in 1–2 paragraphs
- ☐ Each of sections 4.2, 4.3, 4.4 contains 3 components
- ☐ Section titles reflect the actual research activities
- ☐ Arrangement follows the sequence of the Chapter 3 methodology
- ☐ Section 4.5 discusses all findings in an integrated manner
- ☐ Section 4.6 is written in 1–2 closing paragraphs

Data and Analysis

- ☐ All tables, figures, and graphs are numbered and titled
- ☐ Each visual is referenced and explained in the text
- ☐ Analysis includes specific quantitative values
- ☐ Findings are compared with MS, BS, or ASTM standards
- ☐ Findings are linked to the literature review in Chapter 2
- ☐ The achievement of each objective is stated explicitly

Common Mistakes to Avoid



Five Most Common Mistakes in Chapter 4

1	**Tables Without Explanation** Presenting tables or graphs without writing any analysis or discussion. This makes Chapter 4 merely an appendix of data.
2	**No Statement of Objective Achievement** Forgetting to state whether each research objective has been achieved at the end of each discussion section.
3	**Not Referring to the Literature Review** Writing a discussion without linking the findings to previous studies from Chapter 2, causing the discussion to lack academic strength.
4	**Inconsistent Structure** The presentation order in Chapter 4 does not follow the methodology sequence explained in Chapter 3.
5	**Generic and Non-Descriptive Titles** Using titles such as "Objective 1" or "Research Findings" that do not describe the actual activity or test.

Chapter 4 Structure Summary

Section	Title	Main Content
4.1	Introduction	Data collection methods, analysis methods, Chapter 4 structure
4.2	Activity Title (Obj. 1)	Data Presentation + Analysis + Discussion
4.3	Activity Title (Obj. 2)	Data Presentation + Analysis + Discussion
4.4	Activity Title (Obj. 3)	Data Presentation + Analysis + Discussion
4.5	Overall Discussion	Relationship of objectives, strengths/weaknesses, limitations, implications
4.6	Chapter Summary	Key findings, achievement of objectives, transition to Chapter 5

Conclusion: Characteristics of an Excellent Chapter 4

Systematic

The presentation sequence aligns with Chapter 3 methodology and answers all research objectives in order.

Analytical

Each finding is analyzed quantitatively and qualitatively, rather than merely presented without interpretation.

Literature-Based

The discussion is consistently linked to previous studies and relevant technical standards.

Addresses the Objectives

Each section ends with a clear statement about the achievement of the relevant research objective.

Good Luck with Your FYP!

Follow this guide carefully to produce a systematic, analytical Chapter 4 that meets the academic standards of the Civil Engineering Diploma. Every finding presented, analyzed, and discussed well will reflect the quality of a disciplined and integrity-driven researcher.

📋 Follow the Structure

4.1 → 4.2 → 4.3 → 4.4 → 4.5 → 4.6

📊 Three Components

Presentation → Analysis → Discussion

🎯 State the Achievement

Each objective must be answered explicitly

