COMPARATIVE ANALYSIS OF PRECAST CONCRETE IN THAILAND

CHAWISA SAELOR
GAI MITCHELL

A SPECIAL PROJECT SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENT FOR THE DGREE OF BACHELOR

INTERNATION ENGINEERING PROGRAM

KING MONGKUT'S INSTITUTE OF TECHNOLOGY LADKRABANG

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July 20th, 2021

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ABSTRACT

PM2.5 have drawn widely attention due to the worsening climate changes in Bangkok as Thailand progressively industrializes, the goal of developing a low-carbon economy while upgrading the building industry with an objective to find the highest effective performing precast concrete walls with the term of level of finish. This study is an exploratory research on the comparative analysis of precast concrete walls in Thailand, hypothetical deductive investigation in qualitative data with key informants selected by the companies that product precast concrete wall products. Content analysis utilized coding, categorizing and ranking qualitative data into quantitative data. The results found that none of the precast concrete walls contains 5 highest level of the finished required.

Keywords: *Content analysis; Precast concrete wall; Load Bearing wall; Cladding wall.*

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We also want to express my gratitude to all lecturers for your support and guidance to ours for the whole two years. Also, we would like to thank all of our friends who always be there to support and motivate us as always. Moreover, we also would love to express our gratitude to all respondents who contribute their information and time on this study. And we do believe the study could not been done without their input.

Finally, we must express our very greatest gratitude to our parents and all relatives for providing us with unfailing support and continuous motivation throughout our years of study. This accomplishment would not have been possible without them.

Chawisa Saelor

Gai Mitchell

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CHAPTER 1

INTRODUCTION

1.1 Introduction

PM2.5 have drawn widely attention due to the worsening climate changes in Bangkok as Thailand progressively industrializes, the role of housing is rapidly growing in importance, with the goal of developing a low-carbon economy while upgrading the building industry. This special project aims identify the most effective performance precast concrete panels which the researchers used 5 main factors in analyzing and ranking the results in the term of Level of finish through interviews of manufacturer companies to conclude the most effective performance that is currently on the domestic market.

1.2 Statement of Problems

The rapidly growing economy in Thailand has made it hard to grasp what is currently available to those of interests in the type of Precast concrete walls and what is the highest level of finished product. This study aims to identify the current precast concrete in Thailand.

1.3 Objective of Study

The objective of this study is as the following.

1. To identify precast concrete walls that are currently on the market.
2. To categories the level of finishes of precast concrete panels that are currently on the market and minimized the decision of selection time in precast construction.

1.4 Scope of Study

The scope of this study is to compare the precast concrete panels that are currently on the market by.

1. General purpose of the study is identifying the highest level of finishes that the domestic manufacturer produces.

2. The sample are interviewing key informants from the companies that produce precast concrete wall products the results will be based on the interviews form and will be screened by content analysis to find the companies finished product.

3. The duration this study is 1st of June 2021 till 31st July 2021.

4. The topics and theories that will be discussed Grouping precast concrete, into categories which the researchers used as the term Level of Finish, and the use of content analysis to help researchers view qualitative and quantitative in a systematic matter.

1.5 Research Methodology

This research was conducted through a phone call interview concerning precast concrete finished product by companies. Figure 1.1 describes the researcher's procedure.

1. Review literatures, interviews, and e-commerce concerning construction systems (types, method, advantage, and disadvantage or limitation), research works concerning the performances, i.e.

2. Label the concerning attributes.
3. Collect, analyze and compare qualitative of concerning attributes to rank in a quantitative analysis the precast concrete wall. Content analysis table and a nominal Scale in percentage to display the results and select the highest performing values.

4. Conclude the most effective performance of precast concrete panels that are currently on the market.

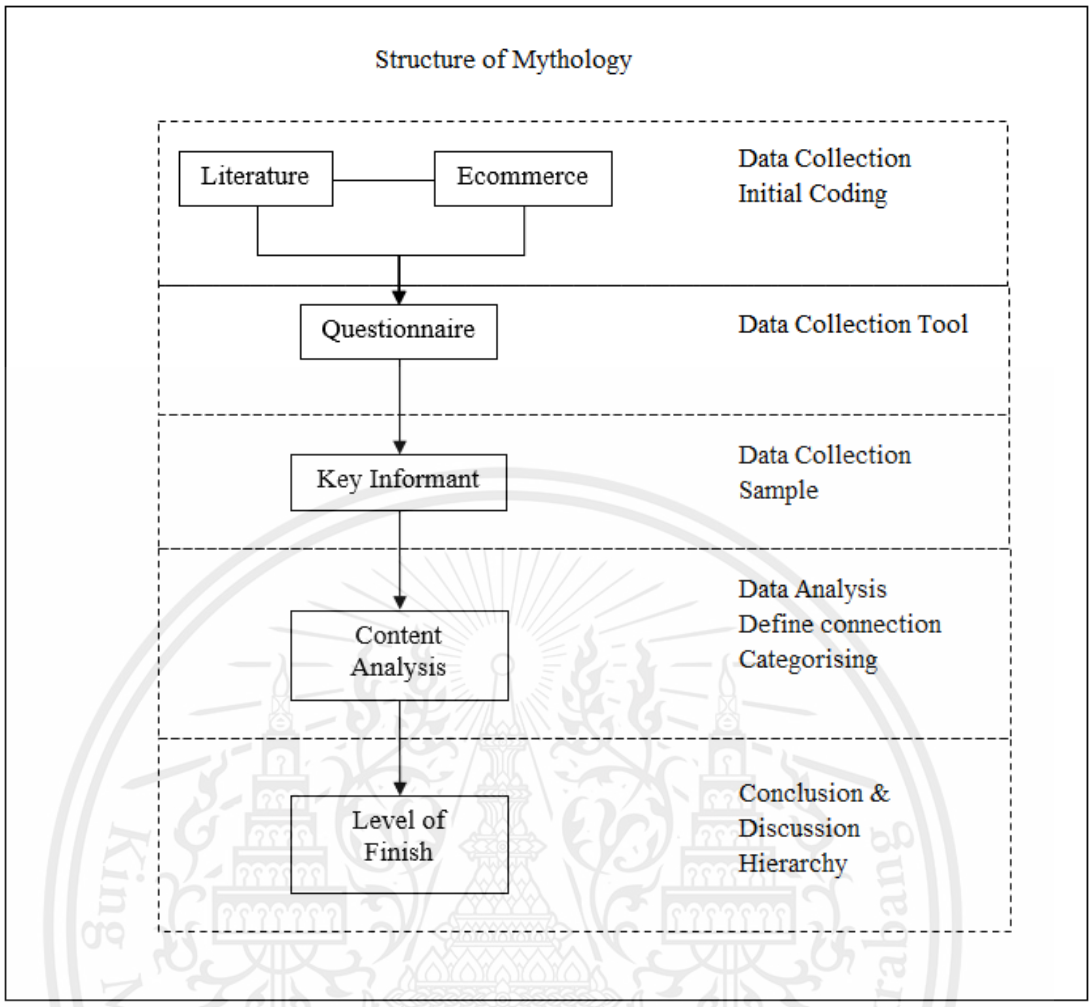

Figure 1.1 Structure of mythology

1.6 Benefits of Study

1. Types of domestic products and level finishes.
2. A basic understanding of precast concrete level of finish.
3. Easy for designers to select construction materials.
4. The effective construction process reduces the wastage of resources in large amount.
5. Building construction methods that saves the construction cost, time and carbon emission.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The researchers were interested in lowering the carbon footprint in the construction industry in Thailand, Precast concrete walls were introduced to the researchers through e-commerce. This chapter explains the research on the topics and theories of Comparative Analysis of Precast Concrete Walls and focuses on the finish level of precast cast concrete wall products. Due to the COVID-19 pandemic outbreak in Thailand, the data from this research will be collected by literature reviews, interviews from the manufacturer, and e-commerce products with a semi open-ended questionnaire, all reading of text, are converted into numbers quantitative analysis of qualitative data.

2.2 Content Analysis

Content Analysis is a research tool used to determine the presence of certain words, themes, or concepts within some given qualitative data (i.e., The Cost) Using content analysis, researchers can quantify and analyze the presence, meanings and relationships of such certain words, themes, or concepts. This study follows the STEPS by Kvale and Brinkmann, (2009) proposed procedures of qualitative analysis STEPS, and Content analysis by Nowell, Norris, White, and Moules, (2017) which provides methods in structuralizing tables.

2.2.1 Qualitative Analysis

STEP 1, reading the transcripts.

- Browse through all transcripts, as a whole.
- Make notes about your impressions.
- Read the transcripts again, one by one.
- Read very carefully, line by line.

STEP 2, labeling relevant pieces

- Label relevant words, phrases, sentences, or sections.
- Labels can be about actions, activities, concepts, differences, opinions, processes, or whatever you think is relevant.
- You might decide that something is relevant to code because.
  - It is repeated in several places.
  - The interviewee explicitly states that it is important.
  - You have read about something similar in reports, e.g., scientific articles.
  - It reminds you of a theory or a concept.

You can use preconceived theories and concepts, be open-minded, aim for a description of things that are superficial, or aim for a conceptualization of underlying patterns. It is all up to you.

It is your study and your choice of methodology. You are the interpreter and these phenomena are highlighted because you consider them important. Just make sure that you tell your reader about your methodology, under the heading Method. Be unbiased, stay close to the data, i.e., the transcripts, and do not hesitate to code plenty of phenomena. You can have lots of codes, even hundreds.

STEP 3, decide which codes are the most important, and create categories by bringing several codes together.

- Go through all the codes created in the previous step. Read them, with a pen in your hand.
- You can create new codes by combining two or more codes.
- You do not have to use all the codes that you created in the previous step.
- In fact, many of these initial codes can now be dropped.
- Keep the codes that you think are important and group them together in the way you want.
- Create categories. (You can call them themes if you want.)
- The categories do not have to be of the same type. They can be about objects, processes, differences, or whatever.
- Be unbiased, creative, and open-minded.
- Your work now, compared to the previous steps, is on a more general, abstract level. You are conceptualizing your data.

STEP 4, label categories and decide which are the most relevant and how they are connected to each other.

- Label the categories. Here are some examples:
  - Adaptation (Category)
  - Updating rulebook (sub-category)
  - Changing schedule (sub-category)
  - New routines (sub-category)
  - Seeking information (Category)
  - Talking to colleagues (sub-category)
  - Reading journals (sub-category)
  - Attending meetings (sub-category)
  - Problem-solving (Category)
  - Locate and fix problems fast (sub-category)
  - Quick alarm systems (sub-category)
- Describe the connections between them.
- The categories and connections are the main results of your study. It is new knowledge about the world, from the perspective of the participants in your study.

STEP 5, some options

- Decide if there is a hierarchy among the categories.
- Decide if one category is more important than the other.
- Draw a figure to summarize your results.

STEP 6, write up your results.

- Under the heading Results, describe the categories and how they are connected. Use a neutral voice, and do not interpret your results.
- Under the heading Discussion, write out your interpretations and discuss your results. Interpret the results considering, for example.
  - results from similar, previous studies published in relevant scientific journals.
  - theories or concepts from your field.
  - other relevant aspects.

STEP 7, Ending remark

Nb: it is also OK not to divide the data into segments. Narrative analysis of interview transcripts, for example, does not rely on the fragmentation of the interview data.

- Notes from participatory observations.
- Documents.
- web pages.
- or other types of qualitative data.

2.2.2 Reliability

Three criteria comprise the reliability of a content analysis:

- Stability: the tendency for coders to consistently re-code the same data in the same way over a period of time.
- Reproducibility: tendency for a group of coders to classify categories membership in the same way.
- Accuracy: extent to which the classification of text corresponds to a standard or norm statistically.

2.2.3 Validity

Validity is the extent to which the scores from a measure represent the variable they are intended to.

2.3 Precast Concrete Walls

There are 3 types of precast concrete walls, produced by casting concrete with wire mesh or rebar in a reusable mold or "form" which is then cured in a controlled environment, then transported to the construction site, and/or cast in sitsu where the environment is depended on the climate and seasons, then lifted in to place. Types, advantages, and the finished product will be shown in the following accordingly.

2.3.1 Types of Precast concrete

Types of Precast concrete (Freedman, 1999)

- Cladding or Curtain Wall

  The Cladding or Curtain Walls are framed structures, loads are transferred from the beam to column and column to the foundation suitable for loose soil or recently filled up ground with deep piling. As the loads are carried by the structural frame the thickness of the walls is required much smaller, and due to the thinner walls, the floor space is more available. They are non-load bearing walls utilized to oppose the wind, thermal, acoustic, fire resistance, and encase the space.

Figure 2.1 Cladding or Curtain walls
Source: https://www.designingbuildings.co.uk/wiki/Precast_concrete_cladding

- Load-Bearing Wall

  The Load bring Walls is an active structural element of a building, loads are transferred from the walls of the structure to the foundation suitable for well compacted soil or a stable rock. As the loads are carried by the walls the thickness of the walls is required much higher, and due to the thicker walls, the floor space is less available.

Figure 2.2 Load-Bearing walls
Source: https://ascelibrary.org/doi/full/10.1061/%28ASCE%29AE.1943-5568.0000141

- Shear Wall
  The Shear Walls are utilized to give a parallel load opposing structural frame, are wind and seismic loads. Both cladding or curtain walls and load bearing walls can to be modified to act as a shear wall depending on the structural designs.

Figure 2.3 Shear walls
Source: http://www.lafargeprecastedmonton.com/precast-products/precast-shear-walls/

2.3.2 Precast Concrete Wall Advantages

Advantages of precast concrete wall inspired the researchers to study the comparative analysis on precast concrete walls.

- The precast concrete wall is used as an interior surface which saves time and money by eliminating the need for separate stud framing and drywall costs.

- The precast concrete wall can be used as load-bearing structures and will save costs by eliminating the need for an additional structural framing system.
- Precast concrete walls can be designed to be reused for future building expansions.
- Precast concrete's durability creates a low maintenance structure, which stands up to harsh climate conditions.
- Precast concrete colors and finishes can be achieved through the use of various aggregates, cement, pigments and finishing techniques.
- Precast concrete walls can be produced with textures including form liner shapes, artwork, and lettering to provide distinctive accent treatments.
- Precast concrete wall panels can have electrical boxes and conduit cast into the panels, to provide flush electrical fixtures on walls that are not to be framed out.
- Precast concrete wall panels can reduce the general resources wastage in construction. The effective construction process reduces the wastage of resources in large amount and climate change in the process.
- recast concrete panels in construction projects for an eco-friendly environment.

2.3.3 Precast Concrete Finished Product
The initial coding can be described in the following.

- Door & Window openings
  All types of precast concrete finished products comes with door and window openings from the factory.

Figure 2.4 Door & Window openings
Source:https://www.pinterest.com/pin/817262663620223188/feedback/?invite_code=9fbe17ce86f84f47b37455c46501ac76&sender_id=365847307138151100

- Electrical & Sanitary
  Electrical boxes and Sanitary conduit can be provided in precast concrete design phase and implemented from the factory, and/or commonly be constructed on situ.

Figure 2.5 Electrical box
Source: https://www.behance.net/gallery/55222943/Electrical-Installations-in-Concrete-CGI

Figure 2.6 Sanitary conduits
Source: https://www.industrysearch.com.au/pipe-penetration-seals-solutions/p/58632

- Insulation
  Insulation can be provided in precast concrete design phase and implemented from the factory, and/or can be constructed on situ.

Figure 2.7 Insulation
Source:https://www.pinterest.com/pin/671458625687177929/feedback/?invite_code=e1a3dc3c940945 39b18cf8c7ff785c2&sender_id=365847307138151100

- Exterior Wall
  Exterior Wall can be provided in precast concrete design phase and implemented from the factory, and/or can be constructed on situ.

Figure 2.8 Exterior walls

Source:https://www.pinterest.com/pin/671458625687177929/feedback/?invite_code=e1a3dc3c940945f 39b18c78c7ff785c2&sender_id=365847307138151100

2.4 Literatures

Azman, Ahamad, and Hussin, (2012) The traditional methods of construction industry have made the appropriate initiative to make a paradigm shift in the prefabrication construction in order to achieve a higher standard and to adapt to the global business trend. This review paper presents the challenges faced by the construction industry to integrate the prefabrication construction with the existing traditional method and to

make the comparative study among the three countries; United Kingdom, Australia and Malaysia. This research studies the pattern of MMC, OSM and IBS to identify the pattern research scholars in the three countries and precast concrete system become popular system. Conversely, to highlight the important role of the government and researcher in educating the construction industry players and to transform the construction industry into a modern and efficient industry

Dineshkumar, and Kathirvel, (2015) A residential building is taken for comparing and it includes the preparation of plan, data collection from precast industry, estimation of quantities, and determination of project duration. The comparison showed there is enormous cost difference between the methods, which the prefab is very high when compared to conventional on this type of individual houses. The prefab construction for individual double story residential building cost is 13% more than the conventional construction. This is main drawback for prefab construction which is not economical to construct in this case. At the same time the prefab construction is easy to work and reduces the project duration, is reduced by 60 days when compared to the conventional. But in individual houses there are lot of constraints and lack of knowledge it can be struggling to implement in our country. At this stage conventional construction is economical and comfortable when compared to the prefabrication construction.

Tochaiwat, Pimma, and Mantala, (2015) A research studied the construction performance (durations, costs, and quality) of one-storey and two-storey houses built by traditional and precast load-bearing wall systems and analyzed the effects of the number of floors on the house construction performance. The results showed that: (1) As to the quality perspective, it was found that the number of defects per area is constant for precast load bearing wall houses while it is increased for conventional ones, when the number of floors is increased; (2) The construction durations of the traditional system houses are increased (130.26%) depending on the number of floors because the upper storey have more processes than the first storey. On the other hand, construction duration in precast houses will be less increased (55.00%) when the storey is increased because the second-floor component installation will be faster than the first-floor ones and the amount of components in the upper storey is also less than the first storey; and (3) The unit cost of precast houses is decreased when the number of floors is increased while that of conventional houses is increased.

2.5 Literature Review Conclusion

The researchers conducted literature review to have a basic knowledge in the research and to have an overview of the outcome. The results found in the literature review were mostly quantitative comparative analysis between precast concrete walls (i.e., Conventional construction), due to the COVID-19 pandemic it is impossible to collect field data, hence the research will be a qualitative research through content analysis to categories and rank each code.

CHAPTER 3

DATA COLLECTION

3.1 Introduction

This study aims to conduct a Comparative Analysis of Precast Concrete Walls in the domestic market Thailand to find the products finish level through content analysis. Interviews with companies that produce precast concrete wall products was required to perform this study. The questionnaire was conducted through literature reviews, then sent to the companies that produce precast concrete wall products in request of an interview.

3.2 Data Collection

Data collection procedures follow STEPS proposed by Kvale, and Brinkmann, (2009). The researchers aim to find the highest Level of Finish which is the theme of precast concrete walls from the companies by selecting the sampling of convince. Data is based the categories that is the structural loading of the structure and the coding are components of a finished precast concrete walls.

3.2.1 Literature Review

The literature review provides an overview of what types of precast concrete products, structural loading, advantages, limitations and the highest finish level a manufacturer can produce, in order to construct the questionnaire for companies that produce precast concrete in Thailand.

3.2.2 E-commerce

The E-commerce provide researchers a comparison of different types of precast concrete product in Thailand.

3.2.3 Interview Companies

Data collection from companies that produce precast concrete wall products in Thailand, the results will be analyzed with content analysis. The sample was selected by convince of the companies, due to the current situation. When approved an interview with semi-open-ended questionnaire with a key informant not less than one personnel from the company.

3.3 Key Informants

Information was collected and provided by the convince of the companies that produce precast concrete walls in Thailand, through interviews with the companies selected personnel. 4 companies out of 22 companies accepted a request for interview, 3 decline due to the heavy work load, 1 company was out of business.

3.3.1 Data Collection Tools

Qualitative analysis STEPS procedures, proposed by Kvale, and Brinkmann, (2009), which is the main concept utilized in conducting codes for the semi-open-ended questionnaire in interviewing Key Informants.

3.4 Data Analysis

Content Analysis is a method considered which allows for qualitative and quantitative analysis. This study aims to find the Level of Finishes of precast concrete from the factory, the STEPS by Kvale, and Brinkmann, (2009) proposed procedures of qualitative analysis consisting of 8 STEPS, and apply content analysis structure by Nowell, Norris, White, and Moules, (2017). can be shown in Table 3.1 and Table 3.2.

To find the level of finish it is necessary to know what types, and what levels of finishes the precast concrete companies can accomplish out of their product in Thailand. Each company have one precast concrete wall type or more, results qualitative data from the interview will be coded units in the following table as a quantitative analysis.

3.5 Summary of Data

One theme, consisting of 2 mayor categories, and 5 initial coding, analyzed then ranked. THEME is the level of finished of precast concrete walls. Can be describe in the following:

- THEME 1: The level of finish of precast concrete walls can describe as the finished product a manufacture can produce to supply customers.

- Category 1: Precast Concrete Cladding wall are walls that separate the interior from the exterior, but only support their own weight and the loads imposed on them (such as wind loads, seismic loads, and so on) which they transfer back to the primary structure of the building, they are generally associated with large, multi-storey buildings.

- Category 2: Load Bearing Wall, is a wall that supports vertical load in addition to its own weight and is an active structural element of a building. Load-bearing walls typically provide separation between the internal spaces of a building and transfer loads from other parts of the structure to the foundations.

Table 3.1 Content analysis sample table

No.	Categories	Initial Coding			Count
	Type	Precast Concrete Wall Type			
		☐Load Bearing	☐ Cladding	☐Others ……..	
1.	Openings	Dose The Precast Concrete Wall Product Has Door and Window Openings?			
		☐ Yes	☐ No		
2.	Electrical Box	Electrical Box System Built-in			
		☐ Yes	☐ No		
3.	Plumbing conduit	Plumbing conduit System Built-in?			
		☐ Yes	☐ No		
4.	Insulation	Dose The Precast Concrete Wall Product Has Insulation			
		☐ Yes	☐ No		
5.	Exterior Wall	Exterior Wall Installation Such as Paint, Patterns, and Finishes			
		☐ Factory	☐ On-site		

No = Is the number of codes.

Categories = Are groups of labels of relevant words.

Initial Coding = Is the Coding unit that you think that is relevant.

Count = Count and/or occurrence of same type.

For the next step to compare the two types, it was found that they were very different. In order to find the most efficient on the market, quantitative analysis was compared by the categorizing things in common and rank them. The method will be shown in the content analysis table as an example.

Table 3.2 Content analysis ranking sample

Highest Finish level						
Type	**Count**					**Rank**
	1	**2**	**3**	**4**	**5**	
Ex. Load Bearing	1	1	1	1	1	Level 5
Ex. Shear	0	0	1	1	0	Level 2
Ex. Cladding	0	1	1	0	0	Level 2
Ex. Load Bearing	1	0	0	0	0	Level 1

For Count and/or occurrence of same type, the researchers has modified it into a binary count and sums up the highest category so that we know what types of precast concrete walls have the highest level of finish ranking.

For Rank can be describe as the most complete product a company can produce, and to be utilized in the most efficient way, as can be shown in the following:

Table 3.3 Content analysis rank definition sample.

Level 1	Consisting of one category (Lowest)
Level 2	Consisting of two categories (Low)
Level 3	Consisting of three categories (Moderate)
Level 4	Consisting of four categories (High)
Level 5	Consisting of five categories (Highest)

3.6 Evaluate and Justify Your Methodological Choice

This study aims to study the Comparative analysis on precast concrete walls. Content analysis is utilized to research on qualitative and quantitative analysis, which is then ranked in identify the highest effective performance of walls in Thailand which the researchers describe in the terms of level of finish.

Kvale, and Brinkmann, (2009) helps provide qualitative procedures. When categorizing the data, quantitative analysis tables by Nowell, Norris, White, and Moules, (2017) the count was modified to be binary a number so that the researchers can identify the highest effective performance of walls in the terms of level of finish.

3.6.1 Reliability

This study is a subject error research, technological advancement is achievable standards. Results are generalized in Thailand and the research findings

- Participant error: Factors which adversely altars the way in which a participant performs.
- Participant bias: Factors which produce a false response.
- Research error: Factors which alters the researcher's interpretation

- Researcher bias: Factor which includes bias in the research's recording process

3.6.2 Validity

Validity (extent to which a measure is related to other measures in a way consistent with hypotheses derived from theory; do the measures and their outcomes relate in the way they should relate according to the outcome)

- Construct validity: Exploratory research, data collection on precast concrete walls from the literature review to construct the questionnaire to search for the most effective precast concrete wall in the term of level of finish.

- Internal validity measuring: The level of finished product a producer can provide a consumer, to achieve the most effective performance of precast concrete walls.

- External validity: The interview samples were key informants provided by the precast concrete manufacturer. Each setting was different, each company does not product the same products.

CHAPTER 4

DATA ANALYSIS

4.1 Introduction

This chapter describes the results of research the on comparative analysis of precast concrete walls to find the most effective in Thailand. The hypothesis that the researchers used to approach this was call the Level of Finish that was conducted through content analysis.

4.2 Report Finding

The report findings include of each of the precast concrete wall loading types, category, and then ranked. The results are from the interview with key informants.

4.3 Converting Qualitative Data to Quantitative Data

The results acquired the from key informants are qualitative data, in order to rank the data, the researchers convert the data into quantitative data in the modified content analysis table of each company's precast concrete finished product by comparing the walls with the results found in E-commerce which require all 5 levels to be complete show in Figure 4.1. The data is then accumulated and ranked to find the highest level of finished product.

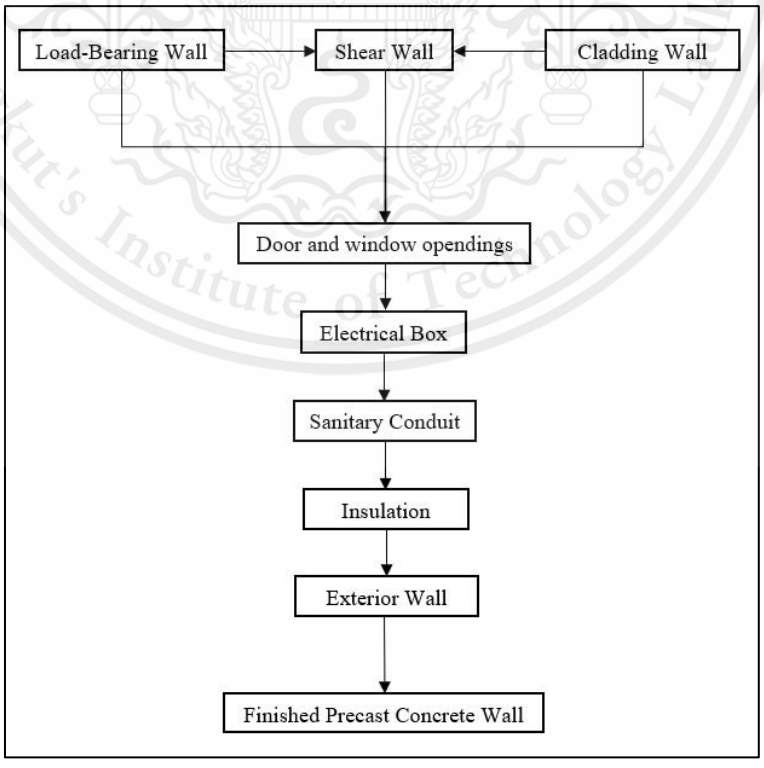

Figure 4.1 Finished precast concrete process diagram

Table 4.1 Content analysis coding table of TPK Precast company

No.	Categories	Initial Coding		Count
	Type	Precast Concrete Wall Type.		
		Load Bearing		1
			Cladding	1
1.	Openings	Dose The Precast Concrete Wall Product Has Door and Window Openings?		
		Yes	Yes	1
2.	Electrical	Electrical Box Built-in.		
		Yes	Yes	1
3.	Plumbing System	Plumbing System		
		No	No	0
4.	Insulation	Dose The Precast Concrete Wall Product Has Insulation		
		No	No	0
5.	Exterior Wall	Exterior Wall Installation Such as Paint, Patterns, and Finishes.		
		On-site	On-site	0

The information was provided by Mr. Asawin Tiratohn which is the engineer of precast concrete walls. The company consists of two types of precast concrete load bearing and cladding walls. The finished product can include door and window openings, and electrical boxes built-in from the factory. The load bearing system was used in AP housing, and for the wall cladding system was utilized in Park Origin Phayathai.

Table 4.2 Content analysis coding table of Post & Precast company

No.	Categories	Initial Coding	Count
	Type	Precast Concrete Wall Type.	
		Load Bearing	0
		Cladding	1
1.	Openings	Dose The Precast Concrete Wall Product Has Door and Window Openings?	
		Yes	1
2.	Electrical	Electrical Box Built-in.	
		No	0
3.	Plumbing System	Plumbing System	
		No	0
4.	Insulation	Dose The Precast Concrete Wall Product Has Insulation	
		No	0
5.	Exterior Wall	Exterior Wall Installation Such as Paint, Patterns, and Finishes.	
		On-site	0

The information was provided by Mr. Satit Jingjaluansuk which is the production engineer of precast concrete walls. The company can produce precast concrete cladding walls. The finished product can include door and window openings built-in from the factory. This system was used in Lumpini condominium.

Table 4.3 Content analysis coding table of Asia Group company

No.	Categories	Initial Coding	Count
	Type	Precast Concrete Wall Type.	
		Load Bearing	1
		Cladding	0
1.	Openings	Dose The Precast Concrete Wall Product Has Door and Window Openings?	
		Yes	1
2.	Electrical	Electrical Box Built-in.	
		No	1
3.	Plumbing System	Plumbing System	
		No	0
4.	Insulation	Dose The Precast Concrete Wall Product Has Insulation	
		No	0
5.	Exterior Wall	Exterior Wall Installation Such as Paint, Patterns, and Finishes.	
		From Factory	1

The information was provided by Ms. Ropshana Eingjawong which is the production sale engineer of precast concrete walls. The company can produce precast concrete load bearing walls. The finished product can include door and window openings, Electrical boxes, and Exterior wall patterns built-in from the factory. This system was used in Land and House.

Table 4.4 Content analysis coding table of ABC Builder company

No.	Categories	Initial Coding		Count
	Type	Precast Concrete Wall Type.		
		Load Bearing		1
			Cladding	1
1.	Openings	Dose The Precast Concrete Wall Product Has Door and Window Openings?		
		Yes	Yes	1
2.	Electrical	Electrical Box Built-in.		
		Yes	Yes	1
3.	Plumbing System	Plumbing System		
		Yes	Yes	1
4.	Insulation	Dose The Precast Concrete Wall Product Has Insulation		
		No	No	0
5.	Exterior Wall	Exterior Wall Installation Such as Paint, Patterns, and Finishes.		
		From Factory	From Factory	1

The information was provided by Ms. Chayarat Makme which is the production Key informant of precast concrete walls. The company consists of two types of precast concrete load bearing and cladding wall. The finished product can include door and window openings, electrical boxes, plumbing system, and exterior walls built-in from the factory.

4.4 Results Ranking

For Table 4.5 displays the content analysis result findings in categories according to the structural load and ranked with by the highest level of finish.

Table 4.5 Precast concrete code ranking.

Highest Finish level								
No. of Companies	**Type**	**Percentage of Type**	**Count**					**Rank**
			1	**2**	**3**	**4**	**5**	
1. TPK Precast	Load Bearing	16.66%	1	1	0	0	0	Level 2
	Cladding	16.66%	1	1	0	0	0	Level 2
2. Post & Precast	Cladding	16.66%	1	0	0	0	0	Level 1
3. Asia Group	Load Bearing	16.66%	1	1	0	0	1	Level 3
4. ABC Builder	Load Bearing	16.66%	1	1	1	0	1	Level 4
	Cladding	16.66%	1	1	1	0	1	Level 4
			Median					2.5

From the results of the research, it was found that there were 3 cladding walls and 3 load bearing walls. The load bearing wall contains higher level of finished wall required then cladding walls. Freeman, (1999) found, for example, when all the advantages of using architectural precast concrete as loadbearing walls are added up, it makes good sense to use this structural form in building applications. Load bearing structure are preferred by the architecture due to the products completeness in the construction design. According to table 3.3 the median of the level of finish are in between low to moderate.

CHAPTER 5

DISCUSSION AND RECOMMENDATION

5.1 Introduction

In this chapter the conclusions derived from the findings of this study on the of comparative analysis of precast concrete walls in Thailand are described. The conclusions were based on the purpose of identifying the most effective performance, the implications of these findings and the resultant recommendations will also be explained. Recommendations were based on the conclusions and purpose of the study.

5.2 Overview of The Study

Themes and categories that emerged from the data were augmented with literature, including literature from the Internet. Trustworthiness of the data was assured and ethical considerations respected by Lincoln and Guba (1985).

The findings and recommendations described below are centered on the research question, the objectives and the themes emerging from the data analysis. The research question to be answered was:

- To identify precast concrete panels that are currently on the market.
- To categories the level of finishes of precast concrete panels that are currently on the market and minimized the decision of selection time in precast construction.

5.3 Discussion

- The study on the comparative analysis on precast concrete walls, was found that there were 3 cladding walls and 3 load bearing walls. The precast concrete finished wall products in Thailand did not reach the maximum level required, sanitary conduits, insulation, and exterior wall finishes are mainly done on site for both load bearing and cladding walls.
- The ranking level according to table 3.3 is between low and moderate according to the findings, and there is still room for improvement in the wall construction industry in Thailand.

5.4 Recommendations

In the light of the limitations identified and the findings of the study, the following are recommended as future research subjects:

- Technique utilized in this research can be modified to categories and rank research findings.

- Follow up studies can be added, research can be extended on the theme to provide broader aspects, including time, money, material, carbon emission, etc.

- To whom of interest acquire knowledge on the current technology in the construction industry of the precast concrete level of finish.

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APPENDIX A

RESEARCH TOOL

Questionnaire

on

Comparative Analysis of Precast Concrete Wall

General Information

Personnel name:.....

Contact Number:.....

Job Position:.....

Project Examples:.....

Company name:.....

Location used for wall casting:

☐ Factory ☐ Construction Site

Type of wall:

☐ Load-bearing Wall ☐ Cladding Wall

☐ Shear Wall ☐ Others:.....

Suitable for type of structures

.....

.....

Type of wall:

Wide: ..... m.

Height: ..... m.

Depth: ..... m.

Cost Per Panel: ..... Baht/m²

Installation Cost: ..... Baht/m²

Weight: ..... kg/m²

Number of Personnel Needed to Construct:

..... Person/Team

Installation speed: ..... m²/Team/day

Type of wall:

Wide: ..... m.

Height: ..... m.

Depth: ..... m.

Cost Per Panel: ..... Baht/m²

Installation Cost: ..... Baht/m²

Weight: ..... kg/m²

Number of Personnel Needed to Construct:

..... Person/Team

Installation speed: ..... m²/Team/day

Materials inside the wall:

☐ Concrete ☐ Steel ☐ Aggregate

☐ Wire Mesh ☐ Insulation ☐ Exterior Wall Finishes

Other: .....

Strengths or Advantages of the Precast Concrete Panel:

.....

.....

Strengths or Advantages of the Precast Concrete Panel Between Other Types:

.....

.....

<u>Walls Installation Information</u>

Sanitary Systems Installation:

☐ Mortise before Installation ☐ Already Designed ☐ Others: .....

Electrical Systems Installation:

☐ Mortise before Installation ☐ Already Designed ☐ Others: .....

Equipment used for Installation of Precast Concrete Wall:

Requirements of Door and window frames of Precast Concrete Wall:

Procedure for Installation of Precast Concrete Wall:

Joint Connection of Precast Concrete Wall:

☐ Bolt ☐ Weld ☐ Dowel ☐ Others

Problems of Installation of Precast Concrete Wall:

APPENDIX B

RAW DATA OF RESEARCH

Table B.1 Input qualitative data of precast concrete companies

Company	Type	Door and Window Opening	Electrical Box	Plumbing Conduit	Insulation	Exterior Wall
Post & Precast Co.,Ltd	Cladding	Yes	No	No	No	No
TPK Precast Co.,Ltd	Cladding	Yes	Yes	No	No	No
	Load Bearing	Yes	Yes	No	No	No
Asia Group Precast Co.,Ltd	Load Bearing	Yes	Yes	No	No	No
ABC builder Co.,Ltd	Cladding	Yes	Yes	Yes	No	Yes
	Load Bearing	Yes	Yes	Yes	No	Yes

Table B.2 Output of quantitative data of precast concrete companies

Company	Type	Finishes Requirement					Total	Range
		Door and Window Openings	Electrical Box	Plumbing Conduit	Insulation	Exterior Wall		
Post & Precast Co.,Ltd	Cladding	1	0	0	0	0	1	Level 1
TPK Precast Co.,Ltd	Cladding	1	1	0	0	0	2	Level 2
	Load Bearing	1	1	0	0	0	2	Level 2
Asia Group Precast Co.,Ltd	Load Bearing	1	1	0	0	1	3	Level 3
ABC builder Co.,Ltd	Cladding	1	1	1	0	1	4	Level 4
	Load Bearing	1	1	1	0	1	4	Level 4

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