Cost Modelling for Public Housing in The State of Kuwait

Alia H Esmael[1]

[1]Accociate Teaching Assistant, Kuwait University, Kuwait
E-mail: alia.esmael@ku.edu.kw

Abstract

The construction of public residential projects in Kuwait started in the 1950s by the Public Authority of Housing welfare. Today, an approximate waiting period of 20 years is needed to obtain a house ready to live in. The major problem is that most of the owners of these public housing units are unsatisfied with the overall design and finishing. These public houses have one design and structure that does not fulfill the end users' needs and aspirations. This leads to a long revamping process carried out by the units' owners that provides end-users with all means of comfort and satisfactions. The repercussions that stem from this is a delay in moving time and the cost expenses that the end users have to suffer as the people in need of these homes have limited financial incomes and cannot afford these expenses.
A survey assessing public housing design and cost are implemented for projects constructed by Housing Welfare. Additionally, personal interviews and questionnaires surveys for both public and private residential projects end users formed the data base for the study. The estimate of revamping expenses is determined along with identifying the reasons behind the changes. This paper presents the findings of a research project aiming to determine the cost comparison between private and public residential projects. The research shows that concrete costs are consistent across both types of housing, with the overall cost being primarily influenced by the quality of the finishing. Additionally, the paper investigates owner satisfaction with public housing to identify potential improvements in policies, plans, and procedures for future public residential projects. It is recommended that homeowners be given the option to either complete their own finishing or receive a house with finishing already done.

Keywords: Public Residential Projects, Cost Modeling, Cost Increase, Public Residential Project Cost, Residential Renovation Cost

INTRODUCTION

The State of Kuwait, is a country in western Asia situated in the northern edge of Eastern Arabia, ranking as the fourth largest OPEC oil producer. The construction industry in Kuwait has grown rapidly since the Kuwait National Development Plan (KNDP, New Kuwait 2035) was approved. For the achievement of the KNDP, the government needs to execute a highly strategic plan to accomplish the stated objectives in and, as a result, develop and improve their various governmental bodies. The construction industry consists of multiple sectors including the governmental residential project which has expanded rapidly.

In recent years, the issue of low-income individuals' houses has become increasingly persistent in Kuwait. The existing policy and procedures surrounding public housing in the country need a comprehensive review and restructuring to better address the needs of those with limited financial resources. An approximate 20 years waiting time to receive a house in Kuwait is too long. The public houses executed by the government has one design that is not suitable for all owners' families. Moreover, these public houses have a poor finishing materials and quality that always needs a

renovation after a couple of years of using or sometimes before the owner moving time. Uniform design, color, and outdoor features in public housing contribute to a perception of blandness or lack of character in an urban area. Beauty, durability and usability are the features of good architecture and should also be the distinguishing qualities of every residential building (Nowogońska and Cibis, 2017).

This study delves into the challenges faced by individuals waiting for affordable housing and emphasizes the necessity for a more effective and compassionate approach by investigating the major problems experienced by these homeowners. Hence, it is imperative for the Kuwaiti Government to develop a more effective policy and procedure for addressing housing needs in this category. This study focuses on this critical issue due to the financial constraints faced by individuals awaiting such housing, who often have limited incomes that cannot cover the expenses associated with renovations and modifications. Additionally, comparing cost analyses of public and private housing helps inform governmental financial strategies.

Literature Review

The construction plays an important and vital role in enhancing the productivity of countries around the world (Othman & Ismail, 2014). As populations grow and urbanization accelerates, the construction industry plays a crucial role in accommodating this growth by developing infrastructure, housing, and amenities in cities and urban areas.

A. Technical Problems

Nowogonska and Cibis (2017) described the most important problems connected with using any building especially the residential building, is to ensure an adequate technical condition and the most effective type of renovation works are preventive measures based on securing the building against damages. Maintaining residential buildings in adequate technical condition is indeed crucial for shaping the image of a city and ensuring the well-being of its residents. Given the importance of maintaining residential buildings, renovation becomes inevitable as buildings age or undergo wear and tear over time.

Indeed, time inexorably marches forward, and with it, aging becomes more pronounced. This aging process is a natural phenomenon that affects not only living organisms, but also materials and structures. Moreover, residential buildings are constructed using a variety of building materials, each with its own set of characteristics and lifespan. Over time, these materials inevitably undergo aging loosing their performance characteristics. Recognizing the inevitability of aging, architects, engineers, and urban planners must adopt strategies for sustainable design, construction, and maintenance to minimize the impact of aging on buildings. This includes selecting durable materials, implementing preventive maintenance programs, and designing structures to withstand environmental stress and changing conditions.

Embracing beauty, usability, and durability as core principles for residential architecture is indeed wise. These qualities not only enhance the aesthetic appeal of a building but also ensure its practical functionality and long-term sustainability. However, while uniformity in design and features for public housing can streamline construction processes and reduce costs, it's also important to consider the diverse needs and preferences of residents. Customization and flexibility in design can contribute to creating spaces that truly feel like home for individuals and families. By accepting resilience, adaptability, and longevity as guiding principles, we can better navigate the challenges posed by the aging process and ensure the continued functionality, safety, and longevity of our built environment for future generations.

B. Cost Estimation

Estimating is the process of defining and calculating the expected quantities and costs of the materials, labor, and equipment for a construction project. It should always include some indication of accuracy,

(e.g. + x percent) (PMBOK 2017). In the residential project, there are many estimates and re-estimates for the cost performed throughout all the project phases. It is mainly based on the phase of the project development. In the planning and design stages of a house, preliminary cost estimate reflects the overall budget needed for the house. Estimating methods may vary by type and class of estimate.

Gardner, Gransberg and Jeong (2016) defined the preliminary estimate or conceptual cost estimate as the first construction cost estimate completed for the project at the conceptual stage where there is little information known about the project and the detailed design has not yet begun. Estimate based on the conceptual design for a residential building is prepared when the basic information of the design and the construction known. Design information includes the level of design complexity, the total area of the house, and the overall design. While construction information mainly depends on two main categories, the cost needed to complete the house structure itself, and is the finishing materials level chosen by the owner.

C. Renovation Cost

Residential renovation cost can vary widely depending on several factors, including the scope of the project, the size and condition of the property, the quality of materials and finishes selected, and the location. At present, there are relatively few studies on cost allocation in the renovation of old residential communities at home and aboard (Zhuo and Li, 2022). Renovation projects may involve various interventions, such as repairing facades, upgrading building systems, improving energy efficiency, or adapting spaces to meet changing needs. Furthermore, Renovations can range from minor updates and cosmetic improvements to extensive remodelling and structural changes.

Overall, homeowners should carefully assess their renovation goals, prioritize their needs and preferences, and work closely with professionals to develop a realistic budget that aligns with their vision and financial resources. By considering these factors and planning thoughtfully, homeowners can achieve successful renovation outcomes within their desired budget parameters. Furthermore, prioritizing maintenance and investing in renovation efforts, cities can enhance the attractiveness, liveability, and sustainability of their residential neighbourhoods, contributing to the overall well-being and prosperity of their communities. Moreover, proactive maintenance and renovation strategies can help cities adapt to evolving challenges, such as climate change, urbanization, and demographic shifts, ensuring that residential buildings remain safe, resilient, and vibrant for generations to come.

METHODOLOGY

A. Data Gathering

The comprehensive approach to gather data for the study is divided into three methodologies with initial phase of cost survey for a real residential project which is implemented by the Public Authority for Housing Welfare (Jaber Al-Ahmed Residential District). The second phase is based on end user survey as questionnaires involve gathering feedback from 120 residents about their experiences, preferences, and satisfaction about their houses. The survey focused on one type of public housing that represents the largest percentage of the total public housing stock. The study did not include the other five types of public housing, so residents of these other types may have different opinions. The third phase involves conducting 26 interviews with residential property owners and reviewing newspaper articles concerning housing issues. This approach provides an opportunity to explore deeper insights into specific issues, challenges, and best practices associated with residential building maintenance and contribute in investigating private residential actual costs.

B. Data Analysis

Analysing the collected data enables identifying trends, patterns, and correlations, as well as developing recommendations for improving maintenance practices, enhancing building performance, and promoting resident satisfaction. By combining the data collected to obtain a comprehensive estimation for residential buildings construction divisions. Additionally, integrating multiple data

sources enhances the validity, reliability, and robustness of the study's findings. Since most of the data pertain to cost analysis, which frequently changes, this approach helps ensure that the cost results remain accurate and reflective of current conditions.

RESEARCH CASE STUDY

Jaber AlAhmed Residential District is a significant residential area located in the west side of Kuwait City with its 12 square kilometers of land. It seems to have a mix of residential properties, including residential lands, governmental houses, and residential apartments. The 4494 residential lands areas suggest there's a substantial amount of space for individual homes. Additionally, the 1375 governmental houses add another layer to the community, providing housing likely for lower income peoples. The inclusion of 710 residential apartments adds further diversity to the housing options available in Jaber Town, catering to different lifestyles and preferences. It's interesting that the governmental houses come in six different models (A, B, C, D, G and H), each presumably with its own design features and specifications. These two-story houses are covering an area of 400 square meters. Model H is of particular interest for research purposes due to its prevalence within Jabr Town. With 482 housing units, it comprises over 30% of the total governmental houses in the area, making it a significant portion of the residential landscape. Conversely, model H boasts the highest construction cost among all house models. This makes it a suitable focus for a research study, likely to explore various aspects such as cost, design, quality, occupancy and even efficiency in space utilization.

A. Cost Analysis

Creating construction breakdown cost is a crucial step in costing the construction project. Each division includes various tasks and components that contribute to the overall construction cost. Concrete, finishing, mechanical and electrical divisions are adopted in the research. Concrete division encompasses earthwork, concrete structure, and wall works. It includes all material and labour costs for formwork, reinforcement, pouring, and masonry. Second division is finishing work that covers a broad spectrum of activities including material and installation costs for flooring, ceiling, insulation, doors and windows. It also includes internal wall finishes as painting, plastering, and panelling, as well as cladding tasks like primers, sealers, and exterior paint application. Mechanical work division focusing on HVAC (ventilation and air conditioning) units, ductwork, and installation costs, this division also incorporates plumbing, including pipes, fittings, and fixtures installation expenses. Finally, the electrical division includes wiring, cables, conduits, circuit breakers, and distribution boards. It also covers materials and installation costs for lighting fixtures, bulbs, sockets, and switches.

The comprehensive breakdown of costs for model H amounts to KD 51,504, as detailed in Table 1, showcasing a thorough allocation across all divisions. In figure 1, the concrete structure expenses constitute 39.44% of the overall expenditure, with the remaining 60.56% distributed across other divisions.

Table 1. Divisions Cost Breakdown

Concrete	KD. 20,314
Finishing	KD. 22,185
Mechanical	KD. 4,652
Electrical	KD. 4,353
Total	KD. 51,504

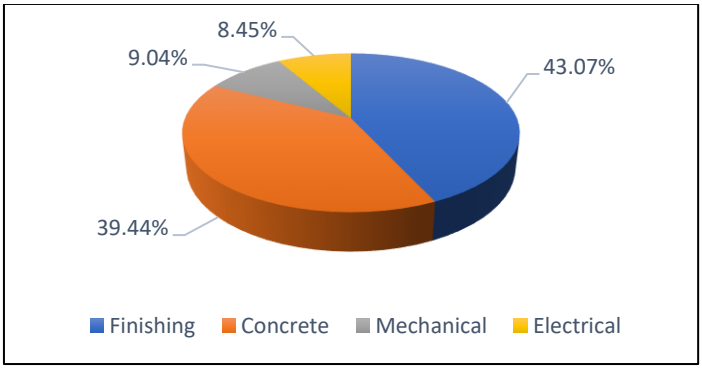


Figure 1. Divisions Cost Percentages

B. Residents Survey Analysis

Cost analysis employed a dual methodology, with initial investigation based on questionnaires to assess the experiences for model H public houses residents. A total of one hundred and twenty completed questionnaires captured different satisfaction aspects related to renovation expenses.

The first question of the survey inquired participants about renovation process for the houses before moving in. It was discovered that a total of 107 responses, which is comparable to 89% of completed questionnaires are already renovated their units, the renovation percentage is shown in figure 2. The next question determined the work trades and types that end-users are mostly change. As depicted in figure 3 the biggest percentages of 90% goes to tiling works, kitchen, and toilet wares. Followed by doors and windows by 45%. The least percentages of 18%, 10% and 8% goes to external cladding, air conditioning and roofing works consequently. The following question determined the renovation cost range held by the residents. It is discovered in figure 4 that 73 of residents as 60.8% had the renovation expenditures exceeded than KD. 30,000, while the remaining percentages is distributed as 19.2% to KD. 20,000 and KD. 30,000, 15% to KD. 20,000 and KD. 10,000 and the remaining towards KD. 10,000 and KD. 5,000.

As illustrated in figure 5, 94.4% of residents prefer to receive the unit without implementing the finishing works. The next question is for residents who agreed to receive unfinished units and demonstrated the suggested reasonable budget set for such finishing. Figure 6 is showing that the highest percentage of 54.17% comprises 65 responses suggested amount varies between KD.50,000 and KD. 70,000, 32 responses are looking for more than KD. 70,000 with a percentage of 26.66%, then followed by 17 responses as 14.17% requested the amount of KD. 25,000 and KD. 40,000 and the remaining percentage of 5% goes to the lowest range of KD. 10,000 to KD. 25,000.

On the other hand, questionnaire covered the owners satisfaction for the houses design issues, figure 7 depicts the response to residents' satisfaction for the unit design. Observations indicate that 42% of the residents are unhappy with the unified design, while 47% are quite satisfied and 11% are fully satisfied. As depicted in figure 8, 89% of the residents who are satisfied with the design are unsatisfied with the unit's finishing and the quality.

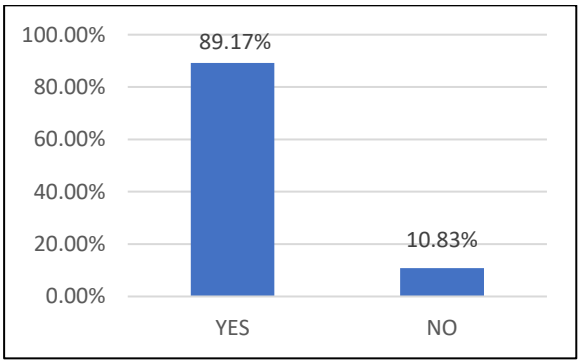


Figure 2. Renovated Units Before Moving-in

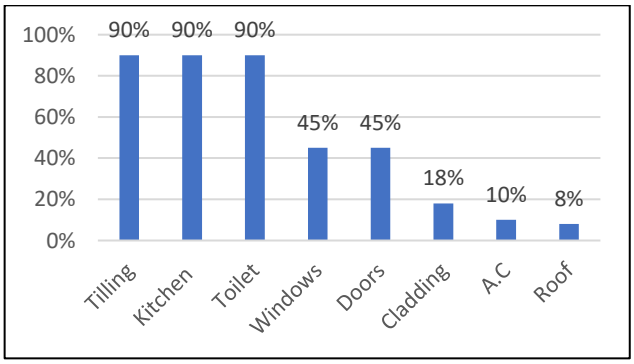


Figure 3. Renovation Trades

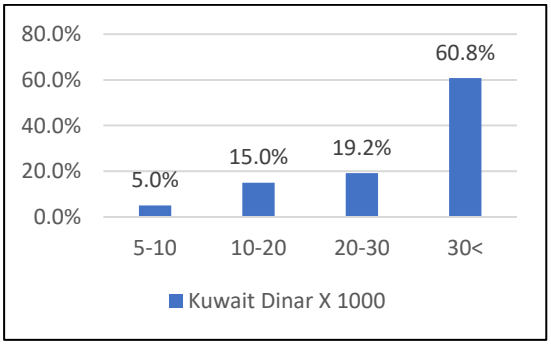


Figure 4. Renovation Actual Cost

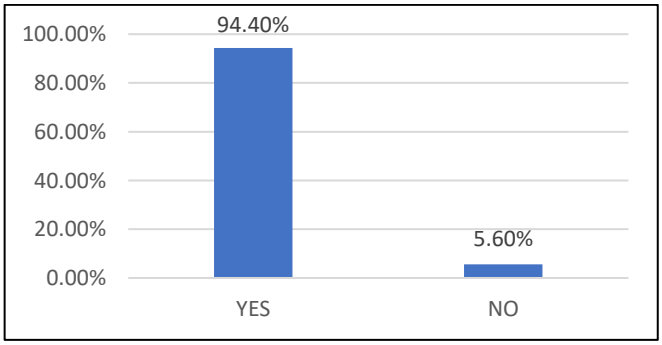


Figure 5. Residents' Preferences of Unfinished Units

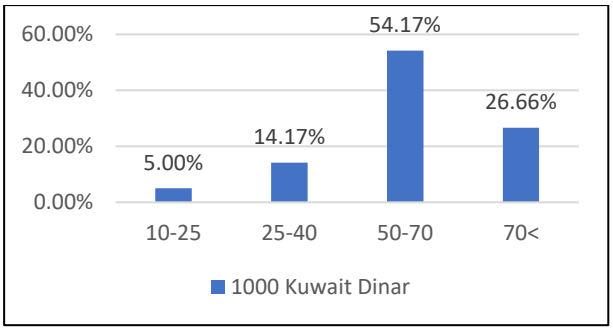


Figure 6. Renovation Suggested Cost

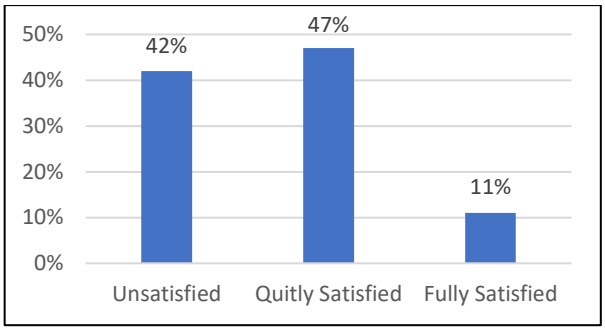


Figure 7. Residents' Satisfaction of Design

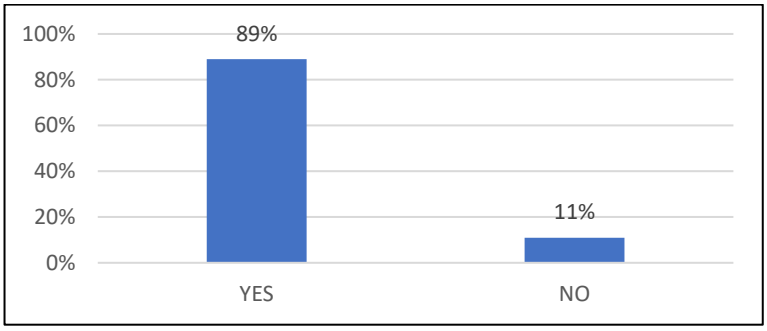


Figure 8. Residents' Satisfaction of Finishing Quality

Interviews with public residential property owners serve as a valuable means to understand their specific satisfactions and preferences regarding the unit design, finishing materials, and qualities. The most important issue mentioned by the residents is the finishing materials that used in tiling, cladding, windows and doors. On the other hand, most of the residents concentrated on bathrooms fittings and kitchens quality before moving in. Furthermore, air conditioning brands is an issue to consider especially after years of usage. Additionally, revisions made to newspaper articles based on residents' feedback about housing issues they've encountered after moving in. The major problems is the leakage in plumbing pipe connections affecting ceilings and walls, electrical works issues with all electrical installations and roof insulation problems.

C. Estimation Analysis

Interviews with 26 private resident owners are presented in figure 9, shows that finishing, electrical, and mechanical costs constitute a significant portion of the total cost of residential projects, with the majority falling between 65% and 75% of the total cost. The division cost estimation is implemented using estimation software created for private residence owners in Kuwait, it is defined as a friendly excel software for estimating the private residences activities and total cost by just entering the total building area and required finishing category (Esmael, 2018). As presented in figure 10, the estimation for the finishing, electrical and mechanical expenditures are calculated for model H house building area of 449 square meter, using such software for average and below average finishing ranks.

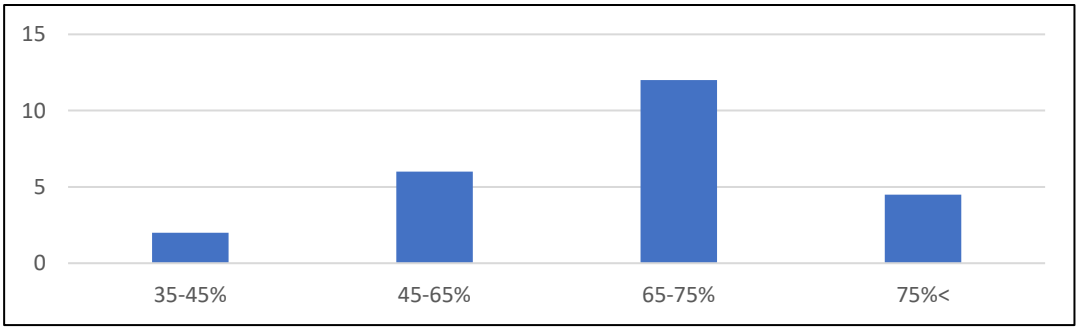
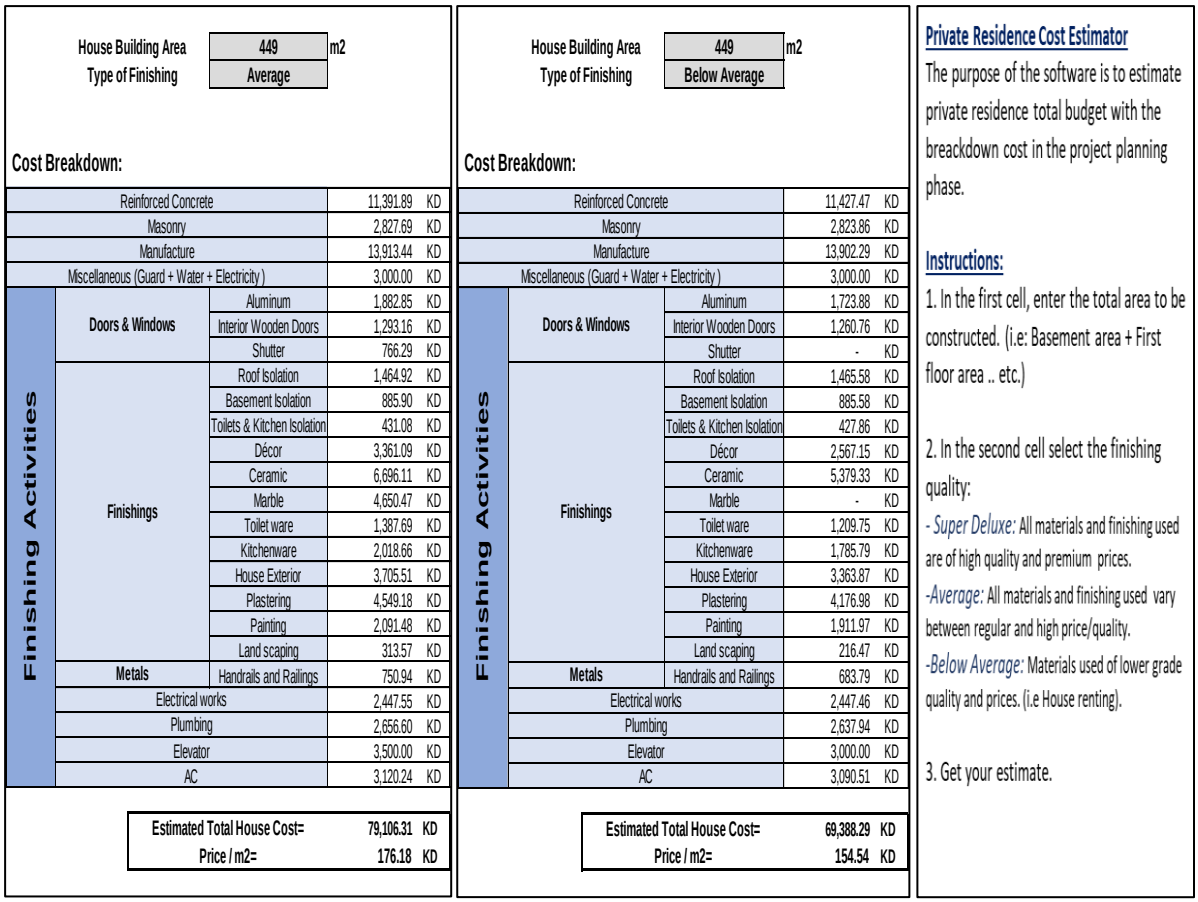


Figure 9. Private Residential Percentages for Finishing., Electrical & Mechanical



House Building Area: 449 m2
Type of Finishing: Average

Cost Breakdown:

Reinforced Concrete			11,391.89 KD
Masonry			2,827.69 KD
Manufacture			13,913.44 KD
Miscellaneous (Guard + Water + Electricity)			3,000.00 KD
Finishing Activities	Doors & Windows	Aluminum	1,882.85 KD
		Interior Wooden Doors	1,293.16 KD
		Shutter	766.29 KD
	Finishings	Roof Isolation	1,464.92 KD
		Basement Isolation	885.90 KD
		Toilets & Kitchen Isolation	431.08 KD
		Décor	3,361.09 KD
		Ceramic	6,696.11 KD
		Marble	4,650.47 KD
		Toilet ware	1,387.69 KD
		Kitchenware	2,018.66 KD
		House Exterior	3,705.51 KD
		Plastering	4,549.18 KD
		Painting	2,091.48 KD
		Land scaping	313.57 KD
	Metals	Handrails and Railings	750.94 KD
	Electrical works		2,447.55 KD
	Plumbing		2,656.60 KD
	Elevator		3,500.00 KD
	AC		3,120.24 KD

Estimated Total House Cost= 79,106.31 KD
Price / m2= 176.18 KD

House Building Area: 449 m2
Type of Finishing: Below Average

Cost Breakdown:

Reinforced Concrete			11,427.47 KD
Masonry			2,823.86 KD
Manufacture			13,902.29 KD
Miscellaneous (Guard + Water + Electricity)			3,000.00 KD
Finishing Activities	Doors & Windows	Aluminum	1,723.88 KD
		Interior Wooden Doors	1,260.76 KD
		Shutter	- KD
	Finishings	Roof Isolation	1,465.58 KD
		Basement Isolation	885.58 KD
		Toilets & Kitchen Isolation	427.86 KD
		Décor	2,567.15 KD
		Ceramic	5,379.33 KD
		Marble	- KD
		Toilet ware	1,209.75 KD
		Kitchenware	1,785.79 KD
		House Exterior	3,363.87 KD
		Plastering	4,176.98 KD
		Painting	1,911.97 KD
		Land scaping	216.47 KD
	Metals	Handrails and Railings	683.79 KD
	Electrical works		2,447.46 KD
	Plumbing		2,637.94 KD
	Elevator		3,000.00 KD
	AC		3,090.51 KD

Estimated Total House Cost= 69,388.29 KD
Price / m2= 154.54 KD

Private Residence Cost Estimator

The purpose of the software is to estimate private residence total budget with the breackdown cost in the project planning phase.

Instructions:

1. In the first cell, enter the total area to be constructed. (i.e: Basement area + First floor area .. etc.)

2. In the second cell select the finishing quality:

- *Super Deluxe:* All materials and finishing used are of high quality and premium prices.
- *Average:* All materials and finishing used vary between regular and high price/quality.
- *Below Average:* Materials used of lower grade quality and prices. (i.e House renting).

3. Get your estimate.

Figure 10. Estimation Software Outputs

RESULTS

A. Actual Divisions Costs and percentages

Table 2. Divisions Costs and percentages

	Division	Percentage	Cost
Public Residential House	Concrete Structure	40%	KD. 20,314
	Finishing, Electrical and Mechanical	60%	KD. 31,190
Private Residential House Note: (The values are not for the same public house building area)	Concrete Structure	30%	KD. 50,800
	Finishing, Electrical and Mechanical	70%	KD. 108,000

B. Estimated Divisions Costs

Table 3. Estimated Divisions Costs

Finishing Rank	Concrete Structure	Finishing, Electrical and Mechanical
Average	KD. 31,163.02	34,596.71 + 2,447.55 + 5,776.84 = KD. 42,821.1
Below Average	KD. 31,153.62	27,058.76 + 2,447.46 + 5,728.45 = KD. 35,234.7

C. Actual Renovation Cost

Almost 61% of public houses homeowners spent more than KD. 30,000 for renovation before moving in.

Table 2 clearly shows that the concrete cost for public residential projects is higher than for private residential projects, although it remains unaffected by quality. In contrast, the cost of finishing work in public residential projects is lower, reflecting a lower quality of finishing. Table 3 compares costs for houses with the same total building area, concluding that the concrete structure cost remains fixed and is not influenced by quality. Instead, expenses in other areas control the total cost. Private residents tend to spend more on higher-quality finishing, which does not impact the cost of the concrete structure. However, as the cost of finishing increases for better quality, the percentage value of the concrete division decreases.

CONCLUSION

There are significant issues with public housing in Kuwait, particularly concerning the finishing, electrical, and mechanical aspects of the units. It appears that poor contractor performance and significant engineering mistakes are contributing to the dissatisfaction among homeowners in Kuwait. These issues lead to ongoing maintenance problems for elements that were supposed to have been addressed during the renovation process before the homeowners moved in. The study addresses the fact that people residing in these houses do not have the financial means to carry out the renovation and changes expenses. By addressing the unique challenges faced by low-income individuals awaiting affordable housing, the Kuwaiti government can significantly improve the living conditions of the citizens. A comprehensive review and reconstructing of housing policies are necessary to ensure that housing remains not just a necessity but a right accessible to all, irrespective of their financial status.

Private houses sector in Kuwait is fueled partly by the affluence loan programs, every Kuwaiti household head with eligible for a long-term cash of KD. 70,000. It seems that there's a significant disparity between the initial cost of public houses in Kuwait and the amount homeowners end up spending on renovations. Public houses are priced lower than the loan amounts typically taken out by homeowners and renovation expenses despite the lower initial cost, many homeowners are spending more than KD 30,000 on renovations. On the other hand, the concrete structure costs of public houses are relatively low, covering only one-third of the loan amount due to economies of scale from mass construction. The recommendation proposes a division of responsibilities between the government and homeowners. The government could oversee and ensure the implementation of high-quality concrete structures for public houses and homeowners would then be responsible for aspects such as finishing, electrical, and mechanical work. This includes improving quality, durability, and aesthetics, which are often found lacking in public housing. On the financial allocation, part of the governmental loan amount could be designated for homeowners to carry out these necessary improvements with a proposed structural approach. Loan structured approach not only helps in managing costs effectively but also ensures that government resources are utilized efficiently. It is summarized to:

- Cost Estimation and Loan Introduction: The estimated costs associated with different divisions (electrical, mechanical and finishing) which range between KD 43,000 and KD 35,000. This estimation helps in determining an appropriate loan amount for homeowners.
- Electrical and Mechanical Divisions: These divisions have similar costs for both average and below-average finishing levels. The variation of KD 7,500 is attributed to the differences in finishing material costs, highlighting the importance of material choice in overall project expenses.
- Government's Contribution: The cost of the concrete structure, which is borne by the government, is integrated into the total estimated division costs. This ensures that the total does not exceed the boundary set by the loan amount, indicating fiscal responsibility and efficient budget management.
- Installment Payments: The proposal suggests dividing the loan into installments that are disbursed as each phase of the finishing network is completed. This phased approach ensures

that funds are released progressively based on completed work, minimizing financial risks and ensuring accountability in project execution.

This recommendation suggests a flexible approach that accommodates different preferences and needs of the owners. Homeowners should have the option to choose between two main approaches, first is Ready-to-Live House so homeowners can receive a house that is fully finished and ready for immediate occupancy. Second is Concrete Structure with Loan, alternatively homeowners can choose to receive the house as a concrete structure and have the option to take out the loan to finance the completion of finishing work according to their own preferences and requirements. This approach aims to streamline the construction process, improve overall housing quality, and mitigate dissatisfaction among homeowners by addressing critical issues at their source while empowering homeowners to enhance their living conditions. Implementing this strategy could enhance community aesthetics by allowing each house to feature its own unique exterior finishing and decoration, rather than adhering to a uniform outdoor pattern. Additionally, it would improve the durability and usability of the houses, reducing the need for maintenance or renovations over time. Future short-term research on other housing types in the Jaber Al-Ahmad District is recommended to support the findings of this study and provide further insights and recommendations for improving government plans for public housing. Furthermore, any new plans that are implemented should be followed by long-term research focusing on owner satisfaction and addressing any new issues that may arise.

REFERENCES

Esmael, A., 2018. Cost Estimation Software for Private Residences in The state of Kuwait: a case study in Kuwait University. In Proceedings of 1st International Conference on Construction Project Management and Construction Engineering, 03-06 Dec 2018, Sydney, Australia.

Gardner, B., Gransberg, D. and Jeong, H., 2016. Reducing Data-Collection Efforts for Conceptual Cost Estimating at a Highway Agency. Journal of Construction Engineering and Management, 142(11), 04016057. https://doi.org/10.1061/(asce)co.1943-7862.0001174

Nowogońska, B. and Cibis, J., 2017. Technical Problems of Residential Construction. IOP Conference Series: Materials Science and Engineering, vol. 245, Oct. 2017, p. 052042, https://doi.org/10.1088/1757-899x/245/5/052042. Accessed 10 Apr. 2022.

Othman, A. and Ismail, S., 2014. Delay in Government Project Delivery in Kedah, Malaysia. Recent Advances in Civil Engineering and Mechanics, 248-254.

Project Management Body of Knowledge (PMBOK), Sixth Edition, PMI, 2017.

Zhuo, X., & Li, H., 2022. A Study on Cost Allocation in Renovation of Old Urban Residential Communities. Sustainability, 14(11), 6929. https://doi.org/10.3390/su14116929