A study on the design strategies of Fish Landing Jetty Complexes in Malaysia to enhance the efficiency of the building

Z Y Lau, Azhar Ghazali*
School of Housing, Building and Planning, Universiti Sains Malaysia, 11800 Gelugor, Penang, Malaysia

*Email: azhar.ghazali@usm.my

Abstract. Malaysia has a booming and successful fishery development. Fisheries Development Authority of Malaysia Complexes (LKIM) are located in every state of Malaysia to function as a fish landing jetty complex to allow fishing vessels for fish handling operations. However, the design and facility of Fish Landing Jetty Complexes in Malaysia are not up to date even though the fishery development contribute to Malaysia’s economy. Proper facilities and design strategies of fish landing jetty will ensure that fish handling operations work efficiently and enhance the fishery development in Malaysia. In this research, the design components and facilities of fish landing jetty complexes are studied for determining the design strategies of fish landing jetty complexes in Malaysia to enhance the efficiency of the building itself. In this research, a few precedent study and survey questionnaire had been conducted as a research methodology to review and compare the design components and facility of the precedent studies. Besides, the survey questionnaire is to collect the data and their opinion from the general public and users of the Fish Landing Jetty Complex to understand their satisfaction and expectation towards the current condition of the Fish Landing Jetty Complex in Malaysia. There are 41% of respondents are stated that majority of the Fish Landing Jetty Complexes in Malaysia are unsuccessful in achieving the efficiency of the fish landing process. The design strategies of Fish Landing Jetty Complex should consider on the working flow diagram of fish landing. Application of mechanical quay-side lifting winches, built-in conveyor system, rainwater harvesting system and solar energy able to increase the efficiency of the building. It is important to apply the commercial and public recreation spaces inside a Fish Landing Jetty Complex to sustain longer and produce revenue to the building.

1. Introduction
Malaysia has a booming and successful fishery development. For decades, Malaysia’s fishery industry has been the leading protein supplier for the population [1]. According to [2], Malaysia has 7 million tonnes of total fishery production in 2017. The amount of fishery production from capture and aquaculture are 1.5 million tonnes and 0.2 million tonnes, respectively. Besides, the fishery development in Malaysia also plays a vital role to enhance the economy and society for the users, investors and fishermen [3].
An authorized body mainly contributes to Malaysia's vibrant and successful fishery development which is Fisheries Development Authority of Malaysia (LKIM). LKIM is under the Ministry of Agriculture and Agriculture Base Industry. The functions of LKIM are mainly to enhance the efficiency of management of the fishery industry and establish the facilities for fish production. Thus, many LKIM Fisheries Complexes are located in every state of Malaysia to function as a fish landing jetty complex to allow fishing vessels for fish handling operations [4]. Fish Landing Jetty Complex is considered as a ‘landing place’ for fish products from fishing vessels and usually required proper landing area, cleaning area, sorting area, selling area and storage [5].

Customer’s demand to purchase fresh fish from fish landing jetty is growing since the fish is still fresh from the sea [6]. People are willing to buy fish at the very first fish landing places to make sure they can get their freshest sea product. Thus, the fish landing jetty is not only occupying by fishermen but also function as a fish market and commercial area for the public. Sydney Fish Market in Australia, designed by 3XN Architects is functioning as a typical Fish Landing Port and integrating the public recreation and modern fish market place to the public. The design of the building is integrated the sustainable elements to function the building itself, such as rainwater harvesting system and BIPV Roof Panel. Besides, the Sydney Fish Market also becomes a urban landmark in Sydney’s harbor [7].

![Figure 1. Current situation in LKIM Fisheries Complex, Penang, Malaysia.](image)

However, the design and facility of Fish Landing Jetty Complexes in Malaysia are not up to date even though the fishery development contribute to Malaysia’s economy [8]. As shown in Figure 1, a few of the Fish Landing Jetty Complexes in Malaysia are still relying on human manpower to complete the fish landing operation rather than using the mechanical automation system. It will slower the efficiency of the fish landing process. Proper facilities and design strategies of fish landing jetty will ensure that fish handling operations work efficiently and enhance the fishery development in Malaysia [9].

In this paper, the design components and facilities of fish landing jetty complexes are studied for determining the design strategies of fish landing jetty complexes in Malaysia to enhance the efficiency of the building itself.

2. Problem statement
Fish Landing Jetty Complex’s efficiency is often related to productivity and performance. It depends on the technologies and facilities implemented by the Fish Landing Jetty Complex [10]. However, the fishing vessel and fishing methods always focused by the fisheries industry to enhance the efficiency of fisheries rather than focus on the facilities and design strategies of Fish Landing Jetty Complexes. Thus, there is a lack of study on the design strategies of Fish Landing Jetty Complexes. Thus this research aims to determine the design strategies of Fish Landing Jetty Complexes in Malaysia to enhance the efficiency of the building itself.
Besides, there are many issues caused by Fish Landing Jetty Complexes in Malaysia due to a lack of emphasis on its design strategies and facilities. Including fishermen have low efficiency of fish landing from the boat since they keep using the traditional hand-carry method and the technology is not updated. According to [11], fishermen from LKIM Fisheries Jetty in Batu Maung, Penang complained that it is hard to sell the fish and other seafood due to lack of proper spaces and facilities to keep the freshness fish after landing from the boat. The demand for Fish Landing Jetty is overgrowing, but the current surrounding of fish landing jetty in Malaysia is messy and dirty. The fishing boats are clamped together; the majority of fishermen land the fish on the beach. This is due to the size of the fish landing jetty is not design properly.

3. Research questions
In order to study the design strategies of Fish Landing Jetty Complexes in Malaysia to enhance the efficiency of the building, a few research questions have been developed.

1) What are the design components and facilities of proper Fish Landing Jetty Complexes?
2) What are the satisfaction and expectation of the current Fish Landing Jetty Complexes in Malaysia?

4. Purpose of the study
1) To study the design components and facilities of proper Fish Landing Jetty Complexes.
2) To investigate the satisfaction and expectation of the current Fish Landing Jetty Complexes in Malaysia.

5. Research methods
Firstly, the literature review is done before the research regarding the operations and efficiency of a Fish Landing Jetty Complex, the components and facilities of proper Fish Landing Jetty Complexes. The chosen precedent study is then analyzed using qualitative content analysis from local Malaysia which served as a Fish Landing Jetty Complex to support the findings. Moreover, further discussion based on the data obtained from the survey questionnaire to collect their opinions towards the satisfaction and expectation of current Fish Landing Jetty Complexes in Malaysia to support the findings. The questionnaire will be targeted to be answered by the fisherman, users and staff of LKIM Fisheries Complexes.

5.1. Data collection from literature review
First and foremost, reading resources are searched before investigation of the research topic. The current situation's issues have been identified. The challenges extend from architecture to architectural philosophy to innovative technology that promote the design strategies of Fish Landing Jetty Complexes. To support the current concerns and facts, research background and basic information are gathered from reading materials, such as books, journal articles, and conference papers from the USM Hamzah Sendut Library Online Resource and the Internet.

5.2. Data collection from precedent study
The precedent study is based on a chosen project that was built in Malaysia to compare their design components and facilities. The precedent studies chosen must serve as Fish Landing Jetty Complex, Fishing port or Fish Market Complex. Besides, their design components and facilities are studied for further analysis. The following is a list of building that has been chosen for the precedent study of Fish Landing Jetty Complexes:

(a) LKIM Batu Maung, Penang, Malaysia
(b) LKIM Kuala Kedah, Kedah, Malaysia
Based on the literature review studies, the two aspect of criteria which is Design Components and Facility are listed to study the selected precedent study of Fish Landing Jetty Complexes (Table 1 & Table 2).

**Table 1. Study of design components between selected Fish Landing Jetty complexes.**

| Design Components | Descriptions |
|-------------------|--------------|
| Site Location     | To study the building’s location. |
| Building’s Form   | To study the building design form and inspiration. |
| Building’s Layout | To study the building design layouts of precedent studies. |
| Building’s Spaces | To study the spaces provided in the buildings. |
| Building’s Material | To study the materials used of wall, floor, roof, and structure in the precedent studies. |
| Circulation Spaces | To study the circulation and flow of user experience in the precedent studies. |
| Jetty Design      | To study the size and form of the jetty. |
| Number of boats occupied in jetty | The amount of boats and fisherman occupied in the jetty provided. |
| Deliver fish from jetty to Packaging Warehouse | To study the method of deliver fish from jetty to Packaging Warehouse in the precedent studies. |
| Loading Area      | To study the location and efficiency of loading area in the precedent studies |

**Table 2. Study of facility between selected Fish Landing Jetty Complexes.**

| Facility                              | Descriptions                                           |
|---------------------------------------|--------------------------------------------------------|
| Unloading and handling facilities     | To compare the unloading and handling facilities in the precedent studies. |
| Packaging Warehouse                   | To study the efficiency of packaging warehouses provided by the precedent studies. |
| Fish Market Halls                     | To study the efficiency of Fish Market Halls provided by the precedent studies. |
| Fish Auction Hall                     | To study the efficiency of Fish Auction Hall provided by the precedent studies. |
| Management Office                     | To compare the location and space planning of Management Office in the precedent studies. |
| Ice Plants                            | To study the efficiency of Ice Plants provided by the precedent studies. |
| Freezer and cold                      | To study the efficiency of Freezer and cold storages provided by the precedent studies. |
5.2.1 Precedent study - LKIM Batu Maung, Penang, Malaysia

LKIM Batu Maung, Penang as shown in Figure 2 is located in Southeast Penang, Malaysia. The building is constructed in the year 1984 and extend construction by adding International Tuna Port in 2003. LKIM Batu Maung is one of the fisheries jetty managed by an authorized body, Fisheries Development Authority of Malaysia (LKIM). The land size of the building is around 6 acres, and the building is constructed on the shore of Penang Straits. The fisheries jetty able to consists of 79 fishing vessel and total of 610 fishermen. LKIM Batu Maung’s design layout is a cluster layout design. All the building blocks are separated by each other since the construction of the building is completed separately in different period.

![Figure 2. Aerial view of LKIM Batu Maung, Penang.](image)

5.2.2 Precedent study - LKIM Kuala Kedah, Kedah, Malaysia

LKIM Kuala Kedah as shown in Figure 3 is located in Kedah, Malaysia. The building is constructed on the shore of the Kedah River where connected to the Straits of Malacca. The size of Fish Landing Jetty is around 6000m²; the Fish Landing Jetty able consist of 48 fishing vessel and total 500 fishermen. The building consists of a fish landing jetty, management office, packaging warehouse, multipurpose hall, freezer hall, diesel supply, and TNB services. Traditional Malay House inspires the form of the building with stilted design. The management office is raised at upper floor area where can observe the whole process of the jetty and better privacy. In contrast, the ground floor area is function as a fish landing jetty, freezer hall and sorting area. The Fish Landing Jetty is designed to parallel with the Kedah River, and the length of the jetty is around 180m.
5.2.3  **LKIM Tanjong Bako, Sarawak, Malaysia**

LKIM Tanjong Bako as shown in Figure 4 is located in Sarawak, Malaysia. The building is constructed on the shore of the Sarawak River and completed construction in 2017. LKIM Tanjong Bako is the largest and advanced Fish Landing Jetty Complex in Southeast Asia [12]. The size of the fish landing jetty in LKIM Tanjong Bako is around 9000m²; the building also consists of a packaging warehouse, pontoon jetty, management office, 2 blocks of a cafeteria, mosque, multipurpose hall and a fisherman market.

5.3.  **Data Collection from Questionnaire**

The questionnaires (Table 3) are given out online and manually to the fisherman, users and staff in LKIM Fisheries Complexes. To determine their satisfaction based on the current design and existing facilities of Fish Landing Jetty Complexes and their expectation towards the criteria of Fish Landing Jetty Complex that can enhance the efficiency of the building.

| **Table 3. Questionnaire** |
|-----------------------------|
| **Question 1:** You feel satisfied of the overall building design of your current Fish Landing Jetty Complex? |
| **Question 2:** You feel satisfied of the Infrastructure and Facilities of your current Fish Landing Jetty Complex? |
| **Question 3:** You feel satisfied of the safety of your current Fish Landing Jetty Complex? |
Question 4: The reason of unsafety in Fish Landing Jetty Complex?

Question 5: You feel satisfied of the jetty provided of your current Fish Landing Jetty Complex?

Question 6: You feel satisfied of the Packaging Warehouse provided of your current Fish Landing Jetty Complex?

Question 7: You feel satisfied of the hygiene and cleanliness of your current Fish Landing Jetty Complex?

Question 8: You feel satisfied of the Ice Plants provided of your current Fish Landing Jetty Complex?

Question 9: You feel satisfied of the Slipway and Fishing Boat Service Workshop provided of your current Fish Landing Jetty Complex?

Question 10: Infrastructure and Facilities is important to enhance the efficiency of fish landing process?

Question 11: Space Planning is important to enhance the efficiency of fish landing process?

Question 12: Which is your preferable of Jetty Design?

Question 13: Which is your preferable of Building Structure in Fish Landing Jetty Complex?

Question 14: Which is your preferable of Roof Design in Fish Landing Jetty Complex?

Question 15: Application of solar panel is important to enhance the efficiency of fish landing process?

Question 16: Application of rainwater harvesting system is important to enhance the efficiency of fish landing process?

Question 17: Quay-side lifting winches is high efficiency of fish landing in the jetty?

Question 18: Which is your preferable of methods to deliver fish catches in Fish Landing Jetty Complex?

Question 19: Which spaces you prefer to add into Fish Landing Jetty Complex?

6. Findings

6.1. Data collection from precedent studies
A comparison analysis study based on a few criteria is discussed for further understanding. The comparative studies of Fish Landing Jetty Complex are summarized in the Table 4 and Table 5 below:

| Precedent Study | LKIM Batu Maung, Penang, Malaysia | LKIM Kuala Kedah, Kedah, Malaysia | LKIM Tanjong Bako, Sarawak, Malaysia |
|-----------------|----------------------------------|----------------------------------|----------------------------------|
| Design Components | Site Location | Building’s Form | Building’s Layout | Building Spaces |
|                  | Inshore of Penang Straits | Typical industrial and open air building blocks | Clustered | -Fish Landing Jetty |
|                  | Inshore of Kedah River | Inspired by Traditional Malay Stilted House | Integrated | -Fish Landing Jetty |
|                  | Inshore of Sarawak River | Metaphor of Whale Shape, curvy and smooth form. | Separated | -Fish Landing Jetty |
|                  |                       |                                  |                   | -Management Office |
|                  |                       |                                  |                   | -Packaging Warehouse |

Table 4: Summary of design components parameters Between selected Fish Landing Jetty Complexes.
- Freezer Room  
- Fish Market Place  
- Hotel Pen Mutiara  
- Restaurant  
- Sales Office  
- Refuse Chamber  
- TNB Substation  
- Loading Bay  
- Water Tank

- Freezer Room  
- Multipurpose Hall  
- Sales Office  
- Restaurant  
- Fragile Chamber  
- TNB Substation  
- Loading Bay  
- Sewage Treatment Plant

- Packaging Warehouse  
- Freezer Room  
- Fisherman Market  
- Restaurant  
- Multipurpose Hall  
- Sales Office  
- Refuse Chamber  
- TNB Substation  
- Loading Bay  
- Mosque  
- Water Tank

| Building’s Material | Concrete Floor Finishes, Typical Steel structure with Metal Deck Roofing, Concrete Blocks | Concrete Floor Finishes, Steel structure with Metal Deck Roofing, Concrete Blocks, Glass Canopy at drop off area | Concrete Floor Finishes, I Beam Column integrated with reinforce concrete, Steel Trusses structure with Metal Deck Roofing, Concrete Blocks |
| --- | --- | --- | --- |
| Jetty Design | The circulation of fish landing jetty is crowded since the jetty width is narrow for forklift and fisherman are using at the same time. | The circulation of staff and fisherman are separated vertically by different floor level design. The ground floor of the building is mainly for fish landing process, while the first floor is the management office. | The building blocks are separated from each other based on different function and zoning. Every space owns their vehicles and people circulation. Proper drop off area and car park for every building block. |
| Number of boats occupied in jetty | 79 fishing vessel, 610 fishermen | 48 fishing vessel, 500 fishermen | 224 fishing vessel, 1772 fishermen |
| Deliver fish from jetty to | Forklift, Trolley by man-power. | Mechanical Lifting Winches, Trolley | Forklift, Trolley by man-power. |
Packaging Warehouse

Loading Area  Attached with Packaging Warehouse  Attached between the fish landing jetty and packaging warehouse. Lifting winches facility is provided in the loading area for easier carry the fish catches to the truck.

Table 5. Summary of facility parameter between selected Fish Landing Jetty Complexes.

| Precedent Study | LKIM Batu Maung, Penang, Malaysia | LKIM Kuala Kedah, Kedah, Malaysia | LKIM Tanjong Bako, Sarawak, Malaysia |
|----------------|----------------------------------|----------------------------------|----------------------------------|
| Facility       |                                  |                                  |                                  |
| Unloading and handling facilities | None. Using Hand carry method. | Mechanical Quay-side Lifting Winches. | Mechanical Quay-side Lifting Winches. |
| Packaging Warehouse | -Provided -Sufficient water supply -Not enough washing and sorting fish table | -Provided -Sufficient water supply -Not enough washing and sorting fish table | -Provided -Sufficient water supply -Concrete washing and sorting fish table is provided |
| Fish Market Halls | None. Fishermen are selling their fish catches on fish landing jetty | None. Fishermen are selling their fish catches on fish landing jetty | Proper fisherman market is provided and concrete washing and sorting table is also provided |
| Fish Auction Hall | None | None | None |
| Management Office | 2 blocks of Management Office attached with the fish landing jetty. | Located at the upper floor of Fish Landing Jetty, better privacy and a view of the whole process of the fish landing jetty. | Located far away from the fish landing jetty. Connected by a covered pedestrian walkway. |
| Ice Plants | None. Ice supply delivered from outside of the building. | None. Ice supply delivered from outside of the building. | None. Ice supply delivered from outside of the building. |
| Freezer and cold storages | Small scale Freezer Room attached in the packaging warehouse. | Small scale Freezer Room attached in the packaging warehouse. | Large scale Freezer Hall provided in the packaging warehouse. |
There are few types of building design layout of Fish Landing Jetty Complex, which are integrated form, clustered form and separated form. Each form of design layout is having its advantages and concern. The comparative studies of the building design layout of Fish Landing Jetty Complex are summarized in the Table 6 below:

**Table 6. Comparison of building layout design of Fish Landing Jetty Complex.**

| Building Design Layout | Advantages                                                                 | Concern                                                                 |
|------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Integrated Form-        | -Fully utilized the limited land size                                     | -Limited Loading Area                                                    |
| LKIM Kuala Kedah, Kedah, Malaysia | -Sharing Services and Facility                                              | -Limited size of the fish landing jetty                                 |
|                        | -Easy access between each space                                           | -Unable to apply natural daylight to each space                          |
|                        | -Lower construction cost                                                  | -Wayfinding is hard                                                       |
|                        |                                                                          | -Zoning and privacy of spaces planning should considered                 |
| Cluster Form-          | -More pocket spaces between the building blocks                           | -The opening spaces between the building block is uncovered               |
| LKIM Batu Maung, Penang, Malaysia | -Easy access between each spaces                                         | - Wayfinding is medium                                                    |
|                        | -Able to apply natural daylight to each spaces                            | - Limited Loading Area                                                    |
|                        | -Pedestrian-Friendly                                                      |                                                                         |
As shown in Table 6, the three types of Fish Landing Jetty Complex layout are compared and analyses. Construction cost and existing land size might be a constraint to affect the design layout of Fish Landing Jetty Complex. However, Table 6 shows that the cluster form of design layout has the balance between the integrated form and separated form. Thus, cluster form of design layout might be considered as a priority of layout form to design a new and efficient Fish Landing Jetty Complex in the future.

However, the space planning of Fish Landing Jetty Complex is important to enhance the efficiency of fish landing process during the design preliminary stage. Understanding the process flow diagram from sorting, weighing, washing, chilling, storage and export. In general, the basic space requirement for an effective Fish Landing Jetty Complex are fish landing jetty, weighing and cleaning area, packaging warehouse, fish market area, freezer hall, ice plants, management office, services and loading bay. The Fish Landing Jetty Complex unable to function without the spaces stated above.

6.2. Data collection from questionnaire

The questionnaires were distributed to the public to collect the data for further analysis. A total number of 112 respondents participated which are general public and also fisherman, staff of LKIM and people who are working in the fishery industry. The purpose of this questionnaires is to determine their opinion towards their satisfaction based on the current design and existing facilities of Fish Landing Jetty Complexes and their expectation towards the criteria of Fish Landing Jetty Complex that can enhance the efficiency of the building. Table 7 summarized the outcome:

| Question 1: Most of the people are standing neutral of their opinion towards the overall design of Fish Landing Jetty Complex in Malaysia. |
| Question 2: Most of the Fish Landing Jetty Complex in Malaysia do not provide sufficient infrastructure and facility to the public and users. |
| Question 3: Majority of respondent are dissatisfied with the safety of the Fish Landing Jetty Complex in Malaysia. |
| Question 4: Most of the respondents think the Fish Landing Jetty in Malaysia is unsafe because of the Forklift Drive on Fish Landing Jetty and hand-carry method to unload the fish catches. |
| Question 5: Most of the people are standing neutral of their opinion towards the jetty provided of Fish Landing Jetty Complex in Malaysia. |
| Question 6: Majority of Packaging Warehouse provided in Fish Landing Jetty Complex is sufficient. |
| Question 7: 40% of respondents are dissatisfied the hygiene and cleanliness of current Fish |
Landing Jetty Complex in Malaysia.

**Question 8**: Most of the Fish Landing Jetty Complex is lacking of Ice Plants facility.

**Question 9**: Most of the people are satisfied with the slipway and fishing boat service workshop.

**Question 10**: Majority of people are strongly agreed that infrastructure and facility is important to enhance the efficiency of fish landing process.

**Question 11**: Most of the people are strongly agreed that space planning is important to enhance the efficient of Fish Landing Jetty Complex.

**Question 12**: Jetty design with perpendicular to sea able to approach deeper water and two sides of jetty can consist of fishing vessels. It is getting lesser of wave compare to design of parallel to sea.

**Question 13**: Majority of people are preferred steel structure since it is easy to construct, easy maintenance, low budget and able to construct in different form.

**Question 14**: 51% of respondents are preferred curvy roof design in fish landing jetty complex, since the curvy and wavy roof design is reflected the site context of surrounded by water. However, there is 43% of respondents are preferred pitch roof design in Fish Landing Jetty Complex, Pitch Roof design is practical and suitable for rainwater harvesting especially in the tropics and humid climate country.

**Question 15**: Most of the people are agree application of solar panel can effectively reduce the energy consumption of Fish Landing Jetty Complex in Malaysia.

**Question 16**: Majority of people agree that rainwater harvesting system is important to supply fresh water to the Fish Landing Jetty Complex and reduce the water consumption.

**Question 17**: Majority of people strongly agree that Quay-side Lifting Winches able to increase the efficiency of fish landing process in Fish Landing Jetty Complex.

**Question 18**: Built-in conveyor is the highest percentage of chosen by the respondents which has 65% of respondents.

**Question 19**: 34% of respondents are preferred wholesales fish market and fish auction hall respectively. Following by the seafront promenade and seafood restaurant have same percentage of respondents which is 13% respectively.

### 7. Conclusions

The fishery industry is playing an important role to enhance the economy and society for Malaysia. The research objectives are achieved and proof that the good design strategies and fully equipped facility can enhance the overall efficiency of the Fish Landing Jetty Complex. However, most of the respondents are dissatisfied the current Fish Landing Jetty Complexes in Malaysia since they are unsuccessful in achieving the efficiency of the fish landing process.

Building layouts of Fish Landing Jetty Complex should consider on the working flow diagram of fish landing. The process from landing, weighing, cleaning, sorting, storage and export of fish catches decide the spatial arrangement of the building. Cluster Layout is a good option to design a new Fish Landing Jetty Complex. Thus, the space requirement of a functional Fish Landing Jetty Complex is fish landing jetty, cleaning and sorting area, packaging warehouse, freezer hall, ice plants, loading bay, fish market, management office and services.

Moreover, the design strategies are suggested as shown in figure 5. The building form design is subjective, but design based on the site context or reflection of the character is a reference to start a design. An open-air and optimized daylight building design is important to apply in the Fish Landing Jetty Complex. The perpendicular fish landing jetty design can consist of more fishing vessels and approach deeper sea; it can also minimize the wave load compared to a jetty design parallel to sea. Practical and functional of building materials are priority consideration for a Fish Landing Jetty Complex. Thus, concrete floor finishes, painted steel structure and metal deck roofing are selected as materials used. Since these materials are durable, easy to clean, and sustainable.
Besides, the Fish Landing Jetty Complex facility plays a vital role in enhancing the efficiency of the fish landing process. Quay-side lifting winches has better performance of fish handling compare to hand-carry by a fish basket. A built-in conveyor system in fish landing jetty can provide a safe and faster delivery of fish catches to the Packaging Warehouse (Figure 5). Application of rainwater harvesting system and solar energy able to increase the efficiency of the building.

Finally, it is important to apply the commercial and public recreation spaces inside a Fish Landing Jetty, such as Fish Auction Hall, Fish Market, Seafood Restaurant, Seafront Promenade and Landscaping. A welcoming and happening Fish Landing Jetty Complex able to sustain longer and produce revenue to the building.

![Figure 5. Design strategies of fish landing jetty.](image)

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