



UNIVERSITI PUTRA MALAYSIA

**COMPARISON BETWEEN SOLID AND LAMINATED PANEL DOOR
IN THEIR MANUFACTURING INDUSTRY**

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**FACULTY OF FORESTRY
UNIVERSITY PUTRA MALAYSIA
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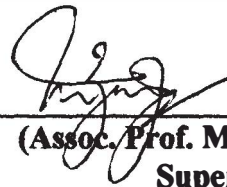


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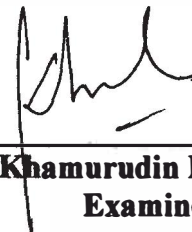
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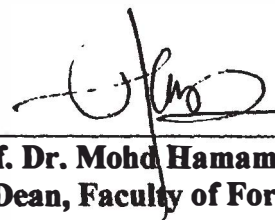
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**COMPARISON BETWEEN SOLID AND LAMINATED PANEL DOOR
IN THEIR MANUFACTURING INDUSTRY**

BY

ISHAK BIN MUHAMAD

**Thesis submitted in fulfillment of the requirement
for the Degree of Master of Science in the Faculty of Forestry,
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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



ISHAK BIN MUHAMAD

May 2003



TABLE OF CONTENTS

| | |
|--------------------------|-------------|
| APPROVAL SHEET | I |
| TITLE PAGE | II |
| ACKNOWLEDGEMENT | III |
| DECLARATION | IV |
| TABLE OF CONTENTS | V |
| LIST OF TABLES | VI |
| LIST OF FIGURES | VII |
| ABSTRACT | VIII |

CHAPTER

| | | |
|------------|-------------------------------------------------------|-----------|
| 1.0 | INTRODUCTION | 1 |
| | 1.1 Background | 1 |
| | 1.2 Problem Statement | 3 |
| | 1.3 Objectives | 4 |
| | 1.4 Limitation of the Study | 4 |
| 2.0 | LITERATURE REVIEW | 5 |
| | 2.1 Mouldings Industry in Malaysia | 5 |
| | 2.2 Wooden Door Specification | 7 |
| | 2.3 Machinery and Equipment | 8 |
| | 2.4 Properties of Raw Material for Door Manufacturing | 10 |
| | 2.5 Laminating Panel in Door Manufacturing | 11 |
| 3.0 | METHODOLOGY AND METHODS | 13 |
| | 3.1 Study Site | 13 |
| | 3.2 Data Collection | 14 |
| | 3.3 Volume Estimation | 14 |
| | 3.4 Data Analysis | 15 |
| 4.0 | RESULTS AND DISCUSSION | 16 |
| | 4.1 Introduction | 16 |
| | 4.2 Manufacturing Process Flow | 18 |
| | 4.3 Machineries and Manpower | 21 |
| | 4.4 Raw Material Cost | 23 |

| | | |
|------------|------------------------------------------------|-----------|
| 5.0 | CONCLUSION AND RECOMMENDATION | 26 |
| | 5.1 Conclusions | 26 |
| | 5.2 Recommendation | 27 |
| | REFERENCES | 28 |
| | APPENDICES | 30 |
| | PUBLICATION OF THE PROJECT UNDERTAKINGS | 41 |

LIST OF TABLES

| | | |
|-----------------|----------------------------------------------------------------------------------------------------|-----------|
| Table 1: | Production of Moulding in Malaysia | 5 |
| Table 2: | List of Machinery and Equipment for Doors Manufacturing At Golden Pharos Doors Sdn Bhd | 8 |
| Table 3: | The Export of Doors at Golden Pharos Doors Sdn Bhd in 1999 – 2002 | 17 |
| Table 4: | The Additional Rotary Compressor Machine to Operate 570 Pieces Laminated Panel Door per Day | 22 |
| Table 5: | The Additional Manpower for Manufacture Laminated Panel Door | 22 |
| Table 6: | The Cost of Sawn Timber for Solid Doors and Laminated Panel Door | 24 |

LIST OF FIGURES

| | | |
|------------------|--------------------------------------------------------------------------------------------------|-----------|
| Figure 1: | Example Two Types of Decorative Door | 1 |
| Figure 2: | Malaysia Export of Moulding in 1998 | 6 |
| Figure 3: | Malaysia Major Market of Moulding in 1998 | 6 |
| Figure 4: | The Laminating Structure for Laminated Panel | 12 |
| Figure 5: | Solid Door Manufacturing Process Flow | 19 |
| Figure 6: | Laminated Panel Door Manufacturing Process Flow | 20 |
| Figure 7: | The Sawn Timber Cost for Solid Doors and Laminated Panel Doors with 570 Pieces Production | 25 |

ABSTRACT

The wooden base doors manufacturing in Malaysia is listed under mouldings industry. In this manufacturing industry there are two types of decorative doors, that is solid door and laminated panel door. The characteristic and properties of these doors are different each other because of their structure. The laminated panel door is less durable than solid door in external condition but the demand for this door increases every year. The laminated panel door has extra attractive characteristic where this door provide the excellent pattern in the surface area and it make the laminated panel door suitable to setup in the high class premises like hotel and office building. This study provides a framework to process laminated panel door with same equipment and machineries to produce 570 pieces of solid door per day. With a few additional machine and manpower, the laminated panel door could reduce the raw material cost where 85% of the cost was covered by sawn timber. This condition can help the manufacturer to increase their margin from the production activity and its can make sure the manufacturer will survive among the competitors in the door manufacturing industries.

Chapter 1

Introduction

1.1 Background

Doors are important aspect of housing and building construction. Replacing a shabby entry door can make premises more inviting to guests and provides higher security against intruders. In wood based doors manufacturing two types of decorative doors are produced, that is solid door and laminated panel door. In solid door manufacturing, manufacturer only used solid timber for processing but for laminated panel door a combination of veneer, strip and core materials are used. Figure 1 shows the example of solid door and laminated panel door.

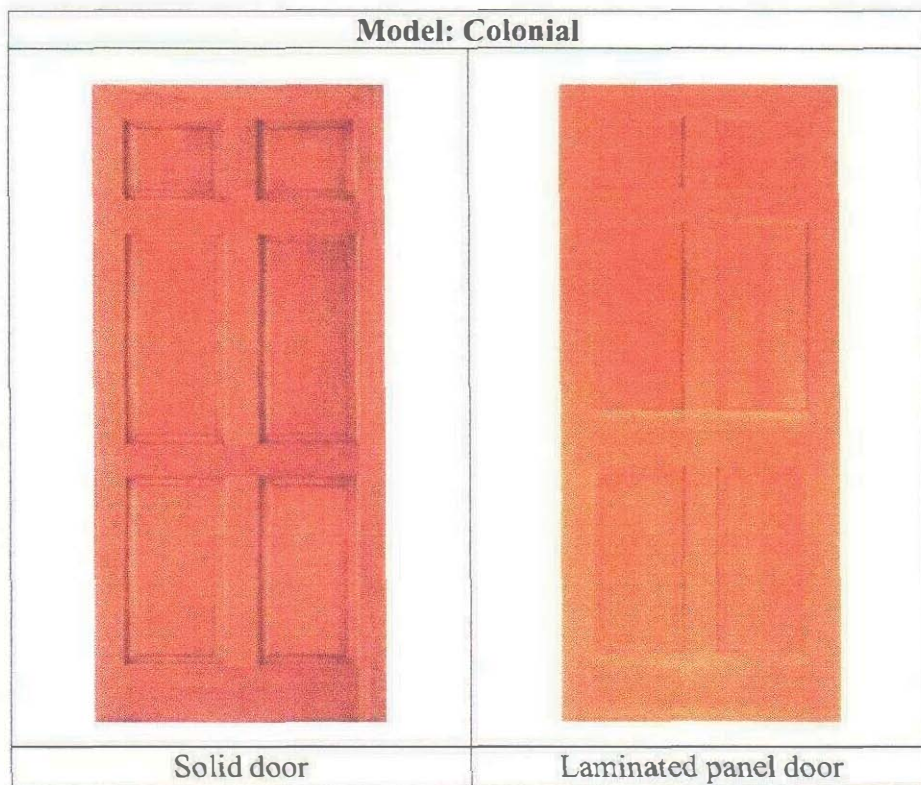


Figure 1: Example Two Types of Decorative Door

In Malaysia door manufacturing is categorized into the mouldings industry. The first mouldings mills were established in Peninsular Malaysia in the 1960s. Malaysia production of mouldings in 1997 was 742,942 m³ and in 1998 the production was 664,612 m³, decreased by 13% from achieved in 1997. The forestry and wood-based industries sector is a major player in Malaysia's economic growth. Despite the economic crisis that hit the Asian region in mid-1997, Malaysia's export of timber and timber products recorded a credible RM 14.2 billion in 1998, accounting for 5% of the total export earnings of RM282 billion (Ismail Awang, 2000).

The variation of the product design for the wooden panel doors could base on types of arrangement, size and shape of the wooden panel to insert into the wooden frame. Almost of laminated panel door suitable for interior and exterior used because the properties of its design were quiet same with solid wood door. For Golden Pharos Doors Sdn. Bhd., they used the Douglas fir wood as the veneer and strip materials to insert with core materials in laminated panel door. The selected design in this manufacturing area was to indicate in popular demand in the overseas market as well as the cost consideration under local condition.

1.2 Problem Statement

The laminating panel in mouldings and furniture sectors of many South-east Asian economies are major industries in terms of the value of the products made and the number of people employed. Many countries in Asia are experiencing a strong demand for low cost, quality furniture and laminating panel based fitting such as door, cabinets, wall panels and flooring.

In addition, export opportunities exist in Western countries for the supply the good quality, low cost furniture provided this meets the requirements of the country of use. With increased competition and rising costs, it is becoming harder to be successful in the increasingly competitive doors market. It is thus essential to accurately balance the requirements of quality, cost and performance and not to under-engineer or over-engineer the finished product.

In solid doors processing, they could only achieve about 60% recovery of sawn timber in their production activity because of defects. This condition could cause increase in manufacturing cost because 85% of the cost are attribute to sawn timber material. The best solution to cover out the lost cost in manufacturing was by producing the laminated panel door. In this practice, all of sawn timber for producing solid door will be selected first, and the unsuitable sawn timber can be used for core material in laminated panel door.

1.3 Objectives

The main objective for this study is to make comparison between solid door and laminated panel door in their manufacturing industry. The specific objectives and the detail of jobs to be accomplished are:

- i. To prepare a solid door and laminated panel door process flow chart
- ii. To identify additional machine and manpower in producing laminated panel door
- iii. To determine sawn timber cost for solid door and laminated panel door
- iv. To know the most practical door to produce in door manufacturing.

1.4 Limitation of the Study

Among some of the limitations in this study are:

- 1) The layout design and processing technique for door manufacturing is not included in this study because the Golden Pharos Company did not allow to this.
- 2) The data for complaint and rejected door from customers are not available for public use.

Chapter 2

Literature Review

2.1 Mouldings Industry in Malaysia

The manufacture of mouldings represents the first stage in the downstream processing of sawn timber. In 1998, there were 149 mouldings plants in Peninsular Malaysia, while Sabah and Sarawak had 173 plants respectively. The moulding plants in Peninsular Malaysia produced 321,948 m³ of mouldings or 50% of national production in 1998 while Sabah was a close second with 282,762 m³ or 44% of total production. Sarawak with 39,902 m³ contributed only 6% (Ismail Awang, 2000). The detail production of moulding industries in Malaysia for 1980 to 1998 has shows in Table 1.

Table 1: Production of Moulding in Malaysia (m³)

| Year | Peninsular | Sarawak | Sabah |
|------|------------|---------|---------|
| 1980 | n.a | n.a | n.a |
| 1990 | 178,036 | 48,015 | n.a |
| 1997 | 354,602 | 42,180 | 346,160 |
| 1998 | 321,948 | 39,902 | 282,762 |

(Source: Malaysian Timber Council)

The common products from the moulding plants are general mouldings, S4S, door stops, door jambs, casing, skirtings, architraves, doors and windows. A total of RM 745 million worth of moulding were exported in 1998, with Peninsular Malaysia accounting for more than half of the exports with RM 387 million. Sabah and Sarawak exported RM 294 million and RM 65 million respectively. The major markets of mouldings were Japan (RM 154 million), EU (RM 150 million), Taiwan (RM 121 million), USA (RM 108

million) and Australia (RM 72 million). Figure 2 and figure 3 will illustrate exported mouldings and their major market in 1998.

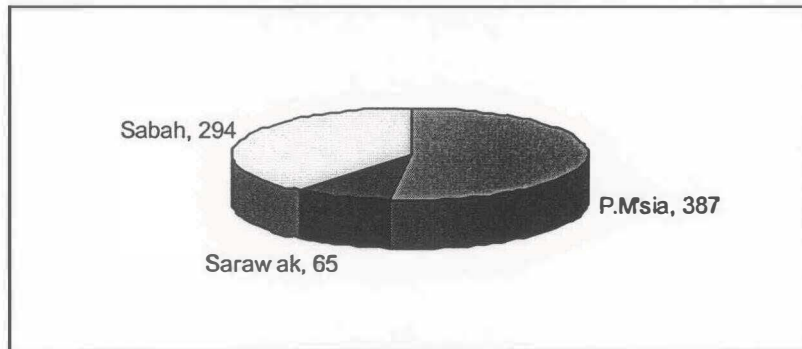


Figure 2: Malaysia Export of Moulding in 1998 (RM Million)
(Source: Malaysian Timber Council)

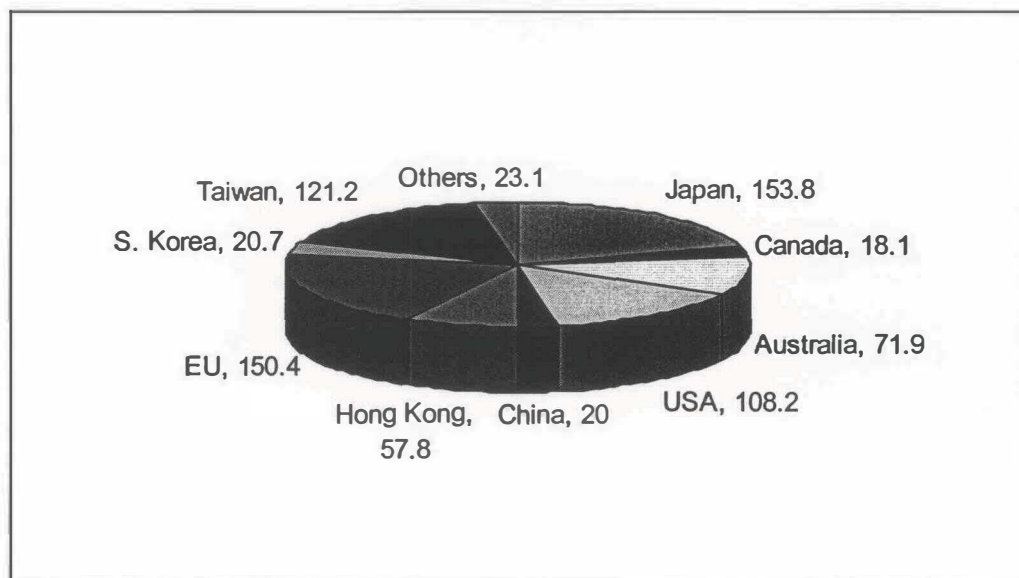


Figure 3: Malaysia Major Market of Moulding in 1998 (RM Million)
(Source: Malaysian Timber Council)

2.2 Wooden door Specification

Basically, the manufacture of a wooden door involves cutting and processing kiln dried timber into panels and frame and arranging the panels to be inserted into the frame (FIDA 1976). Each pieces of wooden panel (of 40mm thickness standard) is formed by laminating 3 layer of wood (of 13.33 mm thickness each). The lamination of wood in the formation of panel gives not only a touch of specialty of the door but also quality surface of the panel.

The bottom rails of the wooden door frame are formed also by laminated wood. The stiles are joined to the rails by dowel joints secured with T & G moulding. The doors are hand smoothed and then packed in painted or unpainted in the wrapping plastic depends on customer order. The final sizes of the various components of a panel door are shown as following:-

| Components | Sizes (mm) |
|--------------------|-------------------|
| Top rails | 40 x 120 x 607 |
| Stiles | 40 x 120 x 200 |
| Intermediate rails | 40 x 120 x 607 |
| Intermediate rails | 40 x 180 x 607 |
| Bottom rails | 40 x 250 x 607 |
| Panel | 19 x 174 x 242 |
| Panel | 19 x 174 x 562 |
| Mullion | 40 x 120 x 264 |
| Mullion | 40 x 120 x 584 |

Sawn timber used should be properly selected and moisture content carefully checked before processing. In each stages of operation, it is important to ensure that components are processed at one operation within the specific size requirement and tolerance limit before sending to the next operation. All joints, moulding and boring

should be cut through moulder machine, double end tenoner and boring machine within the tolerance limit of ± 0.5 mm.

2.3 Machinery and Equipment

The production capacity for 8 hours working period was about 570 pieces of doors. The using available machinery and equipment at Golden Pharos doors are as shown in Table 2.

Table 2: List of Machinery and Equipment for the Doors Manufacturing at Golden Pharos Doors Sdn. Bhd.

| Name of Machine & Equipment | unit |
|-----------------------------|------|
| Jump saw | 6 |
| Double Planer | 4 |
| Single Rip Saw | 4 |
| Single End Tenoner | 2 |
| Multi Rip Saw | 1 |
| Double End | 5 |
| Double End Tenoner | 1 |
| Moulder 8 head | 1 |
| Rotary Compressor | 5 |
| Moulder 6 head | 2 |
| Stile Auto | 1 |
| Mullion Auto | 1 |
| Bar Auto | 1 |
| Panel Auto | 1 |
| Spindle Moulder | 2 |
| Single Air Borer | 6 |
| Step on Borer | 2 |
| Vertical Borer | 6 |
| Side Borer | 1 |
| Profile Panel Sanding | 4 |
| Band Saw | 4 |
| CNC Router | 1 |
| World Max | 1 |

In the actual selection of machines and equipment, cost and efficiency factors must be considered. Fixers and jigs which are essential in wood machining, laminating and assembling can be designed and fabricated locally at relatively lower cost, than the imported one. This will not only lower initial machine investment cost but also has the merit of easy availability of spare parts of machine and equipment and technical skills. As all the components need to be processed within stringent tolerance limit of ± 0.5 mm, fixers and jigs should be specifically designed with precision make so that they can withstand wears and tears (metal could be used to make fixers and jigs for wears resistance).

To facilitate efficient material handling and production flow, plants layout should be planned. It would be useful to consider using certain handling equipment such as roller table for handling long timber in cross cutting and ripping, push-carts for transferring timber from one machine to another and manually operated hydraulic lift-carts for handling finished products.

Underground saw dust extraction system which bears similar installation cost as the conventional one is recommended here. This system is efficient in reducing sound and dust pollution within the plant.

2.4 Properties of Raw material for Door Manufacturing

Generally, doors require timber with sufficient strength, good machining properties, good dimensional stability and reasonable durability. Other properties such as density, gluing properties, colour, grain patterns and texture are also important factors (Sim 1990).

Stronger timbers usually mean heavier timbers and hence heavier doors. As a rule of thumb, timbers strength Group C and above, with densities of about 500 kg/m³ are generally suitable for making doors.

Good machining properties are required to produce good quality doors. Thus, timbers for doors should ideally be easy to plane, saw, turn on bore, and the surfaces produced by these processes must be smooth without any tearing of fibres. Although ease of machining and surface quality can be improved by using tungsten-carbide tools and extensive sanding, these will invariably incur extra costs.

Timber changes in dimension when the moisture content in the wood is varied. Excessive dimensional changes will cause distortions in door components and perhaps, the whole pieces subsequently. Timbers of inherently low shrinkages are thus ideal for doors making. Furthermore, woods should be quarter sawn, as quarter sawn woods will shrink less. Additional precautions, such as applying coats of varnishes or paints on all exposed surface will reduce moisture uptake during service, thus minimizing dimensional changes.

As a general rule, denser timbers are more durable than lighter timbers. However, the durability of the lighter and less durable timbers can be improved by preservative treatment. Proper preservative treatment will protect the wood against insects and fungal attacks before manufacturing and also during subsequent service. However, the right type of preservatives must be used in order to avoid damaging the appearance of the timber.

2.5 Laminating Panel in Door Manufacturing

Contrary to popular opinion, laminated panel will produce a stronger and more durable piece of door than one constructed from a solid piece of wood. Solid wood is subject to warping, cracking, shrinkage, and other defects resulting from such conditions as moisture loss and the effects of heat. A laminated panel construction, on other hand, combines three to five layers of wood glued together to form a single piece (James 1985).

Basically, the manufacture of laminated panel door involves slicing, cutting, laminating, joining and processing kiln dried timber into panels and arranging the panels to be inserted into the frame. Each piece of wooden laminating panel (of 42 mm thickness standard) is formed by laminating 3 layers of wood base; they are core, strip and veneer. The lamination of wood in the formation of panel gives not only a touch of specialty of the door but also quality surface of the panel. The structure of laminating panel has shows below:

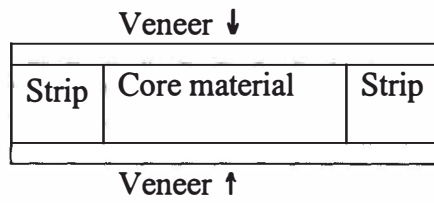


Figure 4: The Laminating Structure for Laminated Panel

The thickness of material is list below:

- Thickness of veneer = 2 mm
- Thickness of core = 38 mm
- Thickness of strip = 38 mm

Chapter 3

Methodology

3.1 Study Site

The study was conducted at Golden Pharos doors Sdn. Bhd., Jalan Kapar, Klang, Selangor. Golden Pharos Doors Sdn Bhd is a specialist in manufacturing of wooden doors. It principally involved in the making of an extensive range of laminated panel doors and solid doors.

From the previous background, the doors manufacturing activities started in March 1980 in Port Klang as Fairhaven (M) Sdn Bhd. On March 1986, took over Golden Pharos Wood Industries Sdn Bhd. Later, the Company was converted to Public Listed Company and assumed its name as Golden Pharos Berhad in 27 August 1992. To strengthen the production flow, Golden Pharos Berhad is transformed as a Holding Company and the operation side has become Golden Pharos Doors Sdn Bhd on 1st January 1998. Being part of GPB Group, they contribute a large input to the Group's production and profits.

Golden Pharos Doors Sdn. Bhd. has established a global marketing network with its own distribution channels through our sister companies, which are Golden Pharos Europe in United Kingdom and GP USA Inc. Their major export markets include Holland, Italy, Poland, South Korea and Australia.



3.2 Data Collection

The information about production process flow activities and data collection was taken from production line at Golden Pharos Doors Sdn Bhd. From the production line, all of differences between solid doors and laminated panel doors processing activities and the used of the machineries for processing were identified. After all the process flow for both doors was identified, the data were transferred into the simple chart to get the clear picture about the activity.

For the sawn timber volume data collection, the volume was taken in the preparation section. In this section the materials for doors manufacturing was cutting into rough size for all of doors part. Several doors model were selected to look over the volume of sawn timber for solid door and laminated panel door in their manufacturing. The models are Colonial, Richmond, Victoria, 2XGG, SA 77 and 2XG 2 Panel. These models were covered from the more complicated structure model to the very easy structure of the model.

3.3 Volume Estimation

In order to investigate the discrepancy between the solid doors and laminated panel doors volume, the data for each part of doors was calculated by using volume equation as follow:

$$\text{Volume} = \text{Thick} * \text{Width} * \text{Length}$$

Unit: inches