# TIPPER SYSTEM AND ITS OPERATION

**Au Say Kiat and Low Meng Koon***

## ABSTRACT

*In a palm oil mill, an overhead crane/hoist is the conventional system used to lift sterilized fruit bunches in cages to the threshing machines. The Tipper System is a good alternative with a much higher capacity. Its advantages will especially be more pronounced in the new mills having larger capacities. There is a limit to the size of cage when used with the overhead crane/hoist. The Tipper System, however, can handle cages with more than 3.5 tonnes FFB capacity.*

*The key features of the Tipper System is that it is easy to use and maintain and has a high FFB throughput. This paper highlights the principles of its operation and its advantages. It provides potential users with an option to choose from in the handling of sterilized bunches.*

## INTRODUCTION

Plantations today are generally larger than what they used to be. For the economy of scale to be realized, mills must be able to handle the larger crop in an efficient and profitable manner. As such, much effort has been made to optimize the mechanical handling systems and machinery so as to ensure cost-effective operation.

The Tipper System is not an entirely new system, having already been in use in the early 80's. Indeed, we introduced the system to Indonesia in the late 80's and in Malaysia, we have built the system for Golden Hope Plantations in Sabah.

This paper focuses on only one aspect of the milling process - the handling of sterilized FFB from the cages to the threshing machines. In the system described, consideration has been given to:

- Size of cages
- Time of handling
- FFB throughput

We are offering to share our experience in the use of the Tipper System.

## FEATURES

The main function of the Tipper System is to transfer sterilized FFB from the sterilizer cages onto a conveyor or elevator for transport to the threshing machines. The key features of the System are:

- Ability to handle cages of all sizes.
- Simplicity of construction
- Easy of operation
- Low operating cost
- Low maintenance required.

## CONFIGURATION OF THE TIPPER SYSTEM

The configuration can vary, but the popular ones are:

a) Tipper Drum + Bucket Elevator
b) Tipper Drum + Horizontal Conveyor - Bucket Elevator
c) Tipper Drum + Inclined Conveyor.

The choice of configuration largely depends on:

- Space available
- Maintenance consideration
- Individual choice

*Figures 1* to 4 show the elevation views of the different configurations.

## COMPONENTS OF THE TIPPER DRUM

The tipper drum consist of:

| Component | Function |
|---|---|
| Drum frame | Hold fruit cages on rails within the framework. |
| Rollers (2 sets) | Support drum framework, allow tipping. |
| Drive | Sprocket wheel and chain driven by hydraulics or motor. |
| Bottom support | Plinth mounted on concrete slabs/steel structure to support rollers. |

## TIPPING

The tipper drum tips, preferably in a clockwise direction, to unload its content of FFB in 'front feeding', The drum is tipped through an angle of about 120°C and the FFB unloaded into a chute.

It is possible to have tip of up to 180°C or even one of a full circle (360°C) by having a fixed chain position or endless chain drive respectively. Limit switches may also be used but are not necessary.

## SELECTION OF DRIVE MECHANISM

Several types of drive systems may be used to tip the drum:

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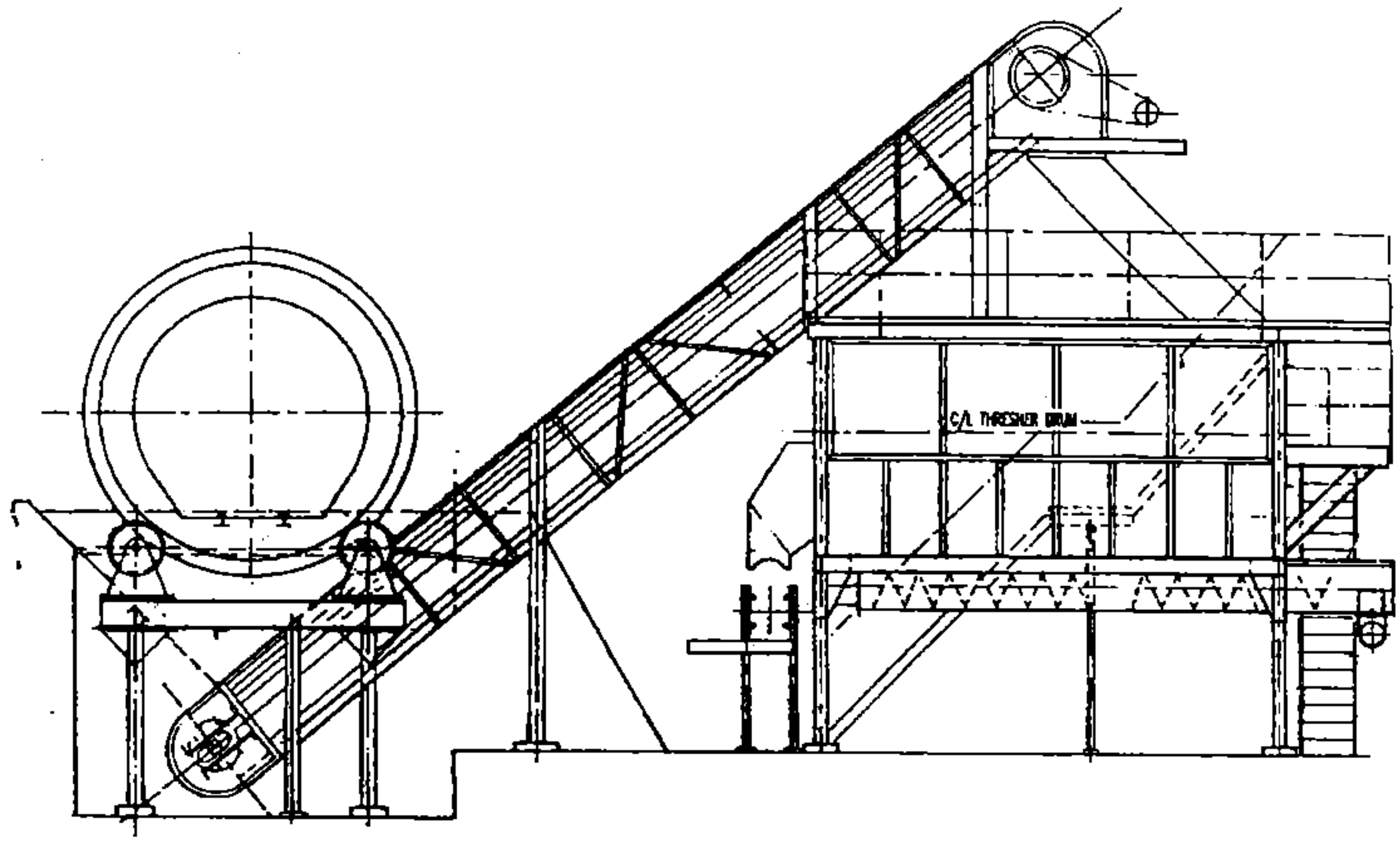



*Figure 1. Tipper with inclined conveyor.*

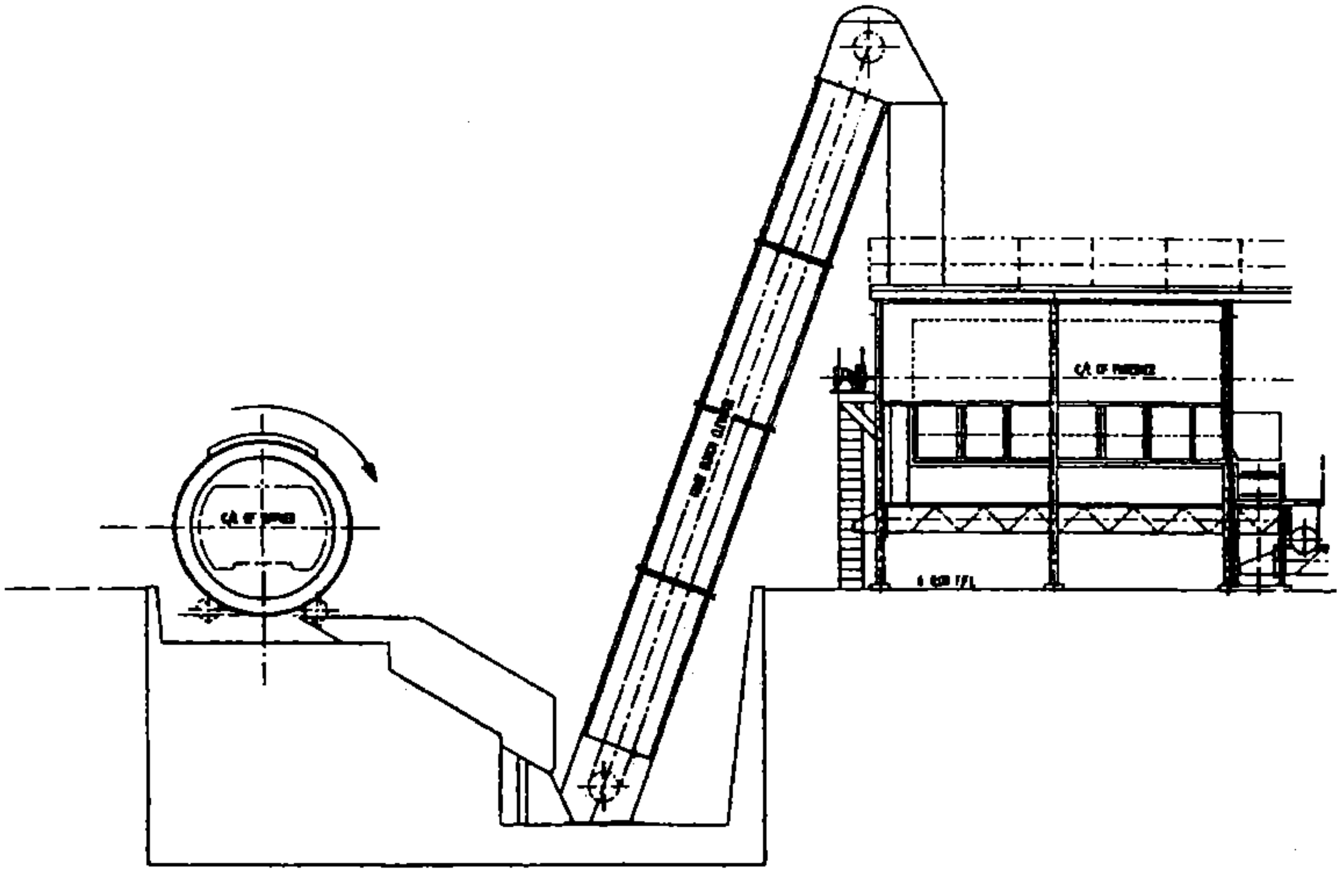
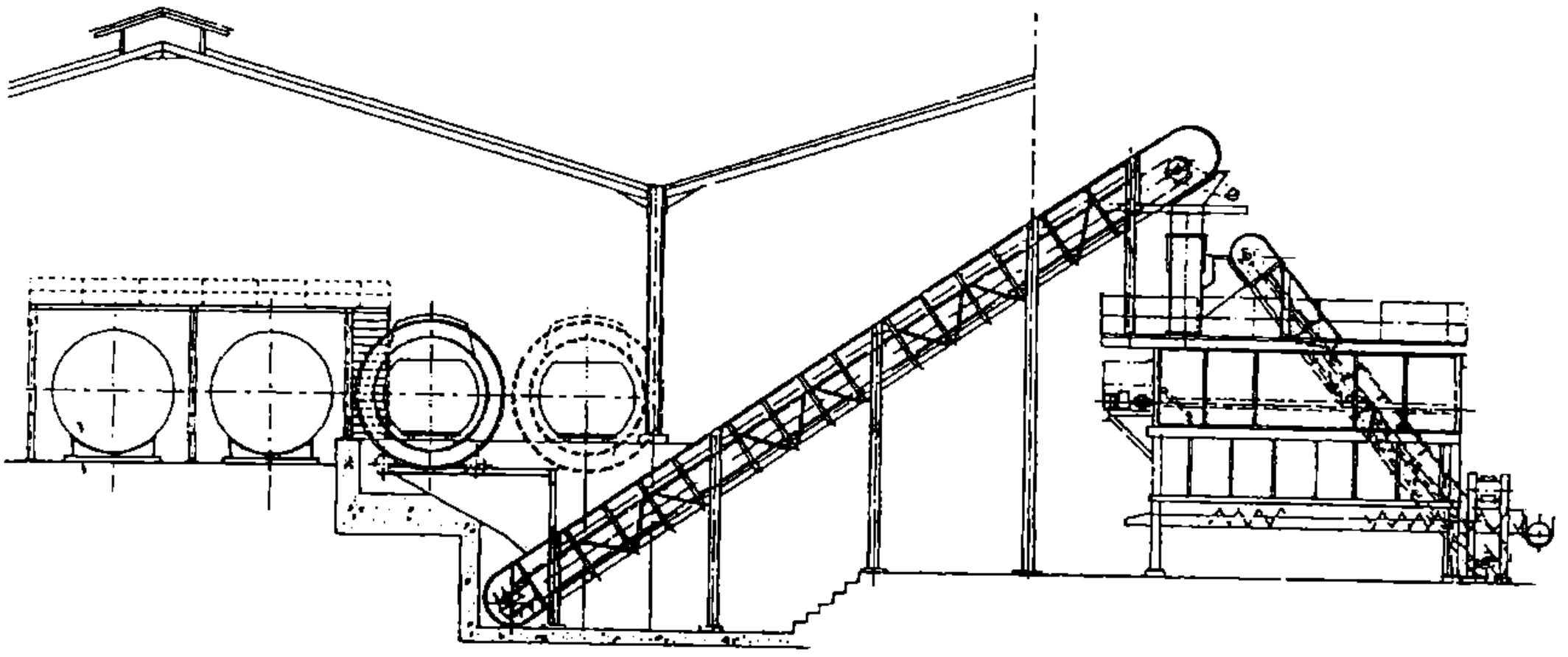
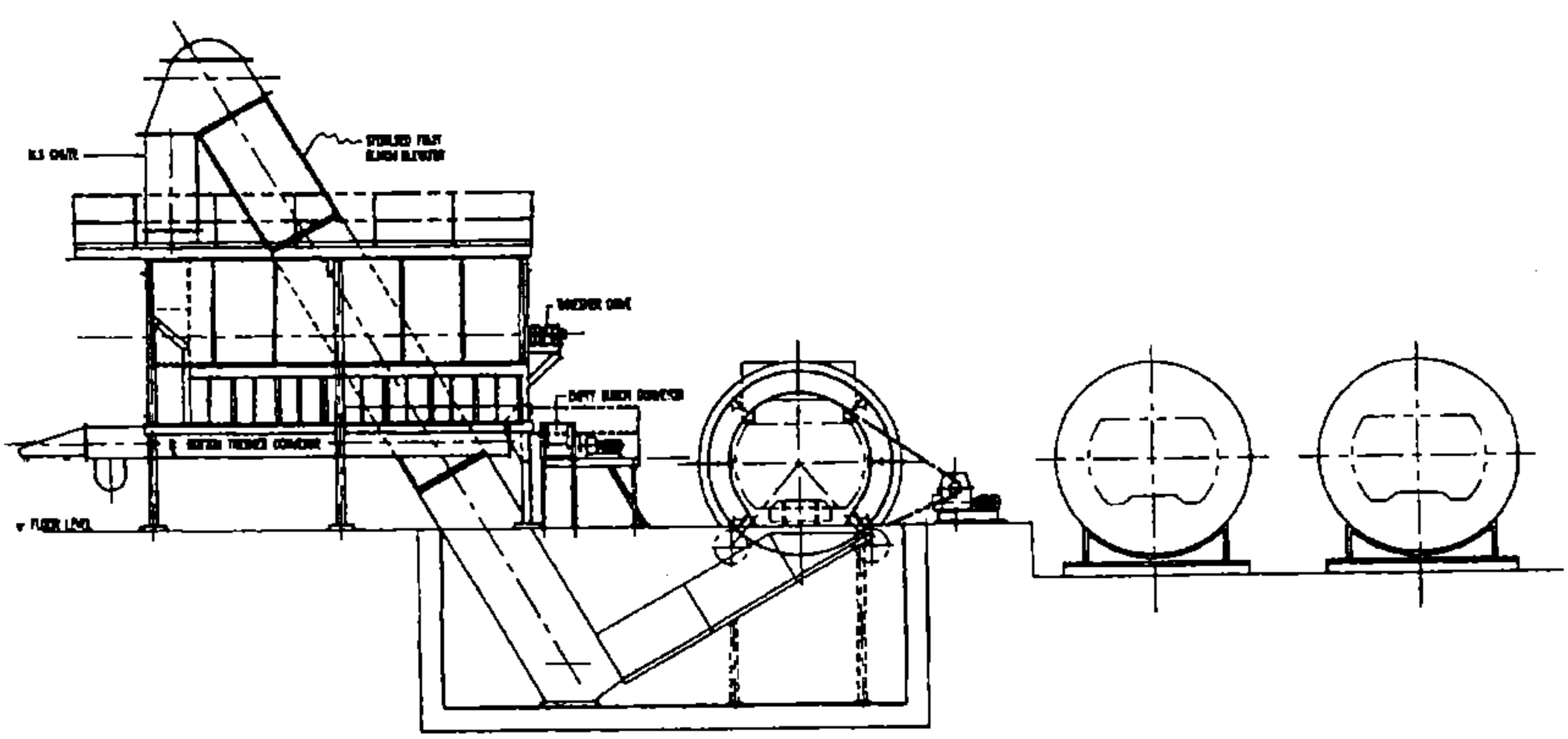


*Figure 2. Tipper with fruit bunch elevator (Note: Inclination of elevator).*



STERILIZER STATION TRESHING STATION

*Figure 3. Tipper with fruit bunch elevator (Note: Front feeding).*



STERILIZER STATION TRESHING STATION

*Figure 4. Tipper with fruit bunch elevator (Note: Back feeding).*

**TABLE 1.**

| Cage Size (Tonnes) | Cycle Time Actual (Minutes) | Required Cycle Time-Theoretical 30 TPH | Required Cycle Time-Theoretical 40 TPH | Required Cycle Time-Theoretical 60 TPH |
|---|---|---|---|---|
| 3.5 | 4 | 6.6 | 5 | 3.5 |
| 5 | 5 | 10 | 7.5 | 5 |
| 7 | 5 | 12 | 10 | 6.6 |
| 10 | 6 | 20 | 15 | 10 |

**TABLE 2. COMPARISON OF HANDLING SYSTEMS**

| Cage | Hoisting Crane | Tippler Drum | |
|---|---|---|---|
| | 3.5T | 5.0T | 7.0T |
| 1. Process Building | Roof truss necessary<br>Cost: 10<br>Runway Beam x 3 sets<br>Cost : 8 Catwalk x 3 sets<br>Cost : 10 | Normal building without Reinforcement | Normal building without Reinforcement |
| 2. Hoisting Crane | 3 units Cost :72 | - | - |
| 3. Bunch Auto Feeder | 3 units Cost : 18 | - | - |
| 4. Cages | 80 units Cost: 68 | 64 unit Cost : 76 | 48 units Cost : 64 |
| 5. Sterilizer (@ 90 minute cycle) | 10 cage x 4 units (93 TPH)<br>2.7m x 24.8m S/L | 8 cage x 4 units (106 TPH)<br>2.7m x 28m S/L<br>Cost : 40 | 6 cage x 4 units (93 TPH)<br>2.7m x 26m S/L<br>Cost : 38 |
| 6. Tipper Drum | - | 2 units Cost : 16 | 1 unit Cost : 18 |
| 7. Tipper Pit | - | 2 units Cost : 5 | 1 unit Cost : 7 |
| 8. Bunch Conveyor | - | 2 units Cost : 24 | 1 unit Cost : 16 |
| 9. Transfer Carriage | - | 1 units Cost : 16 | 1 unit Cost : 16 |
| 10. Manpower | Crane Operator : 3<br>Auto Feeder : 3<br>Cage Link Man : 6<br>**Total : 12** | Cage Handler : 4<br>T. Carriage operator : 1<br>Tipper Drum : 2<br>**Total : 7** | Cage Handler : 4<br>T. Carriage Operator : 1<br>Tipper Drum : 1<br>**Total : 6** |
| Total Initial Cost | 222.40 | | |
| **Cost in %** | **140%** | **111%** | **100%** |

**TABLE 3. COMPARISON OF TIPPER SYSTEM WITH HOISTING CRANE**

| System | Advantages | Disadvantages |
|---|---|---|
| Tipper Simple | * Design, can cater for fruit cage of any sizes<br>* Simple construction<br>* Easy to operate<br>* Low initial maintenance and operating cost<br>* Reduction in building height<br>* Steel trusses for supporting crane not necessary<br>* Normal fitter can perform maintenance<br>* Less cages handled<br>* Continuous feeding of fruit bunch possible<br>* Less manpower needed<br>* Rail lines - straight and no crossings and bends. | * Cage transfer carriage necessary to shift cages<br>* May overload thresher if not operating well<br>* Maintenance of conveyor |
| Hoisting Crane | * Well established design<br>* Easy to operate | * High maintenance cost<br>* Safety : Crane operation poses danger to safety of personnel operating when crane travels<br>* Too many cages to handle, results in cage shunting problem<br>* More manpower required<br>* Autofeeder is necessary<br>* Need highly skilled technicians for maintenance<br>* Requires annual inspection by Machinery Dept. |

| Drive | Remarks |
|---|---|
| Brake motor | Compact.<br>Limitation - Manufacturer's specification allows only three start/stop cycles a minute. |
| Clutch brake assembly | More expensive but effective. However, reverse rotation is only possible after forward motion is fully stopped. |
| Hydraulic motor | Smooth,<br>operation Reversible. |

The drive mechanism is hooked to the drum by:

- Transmission chain, lugs and sprocket, or
- Wire rope, lug and sprocket.

## CYCLE TIME OF TIPPING

Although the speed of operation depends, to a certain extent, on operator skills and other technical factors, a study on the system has allowed some indicative times of operation to be drawn up.

It is easy to cope with mills with high capacities - those with FFB throughputs of 30 tonnes/hour and above. For example, shunting only 6 x 10-tonne cages an hour suffices for a mill of 60 tonnes/hour.

It is therefore obvious that tremendous time savings can be made in the milling operation and the system allows for great flexibility in the design of a mill.

## CONVEYING FFB

As described earlier, either a Bucket Elevator sterilizedor a Scraper-plate Conveyor can be used to move the FFB from the tipper to the threshers.

From experience, although less space is required for a Bucket Elevator system, bunches get bottled up at the chute because of its inclination. Also overfeeding from the tipper overloads the bucket reception and imposes severe strain on the conveyor chain.

It is therefore preferable to use an inclined Scrapper-plate Conveyor installed below the tipper drum to bring the bunches to the threshers. Operation is simple and there is seldom overloading of the conveyor.

A horizontal conveyor can also be used to receive bunches from the tipper drum located on an inner rail track. However, this system entails higher maintenance.

## TIPPER PIT

A pit is normally dug to receive bunches when tipping

bunches into the tipper drum. However, we have also built split-level layouts, that is having the Tipper drum at zero elevation and the main process floor lower at - three metres. This avoids a deep pit and is easily accessible for maintenance. However, the split-level design is only convenient on a slope and more difficult to build on flat land.

## CHOICE OF SYSTEM

Both the Tipper System and conventional overhead hoist crane work satisfactorily. However, construction and operational costs have to be considered when choosing the system.

A comparison of the construction costs is made for both, for a mill with a capacity of 90 tonnes/hour. The details are shown in *Table 2*.

It is clear that in this case, construction cost is lower for the Tipper System, and although not computed, the labour requirement for the Tipper System is also lower.

## ADVANTAGES AND DISADVANTAGES

The advantages/disadvantages of both the Tipper System and conventional overhead crane hoist are shown in *Table 3*.

## CONCLUSIONS

Both the Tipper System and conventional overhead crane hoist are satisfactory and reliable systems in many mills However, the Tipper System offers more flexibility in designing the handling system for larger mills. Larger cages can be used to obviate the necessity for more cages having to shunt from ramp to sterilizer and thence to the threshing machines. In Malaysia, particularly, the lower labour requirement must surely be a boon.

The construction cost of a Tipper System is lower for large mills. Also, from our experience, maintenance cost is also lower with greater reliability (less breakdowns).

In conclusion, we recommend using the Tipper System based on our experience and flexibility the system can offer. In our opinion, its advantages far outweighs its disadvantages.

## ACKNOWLEDGEMENT

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