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Dust Extraction System For A Sawmill

by

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Introduction

In wood based industry, the removal of wood waste is an important activity. This activity to a certain extent affects the productivity and profitability of the mill operation. Generally two types of waste are produced in sawmilling; sawdust and waste slabs. The forms and sizes of these waste materials call for two different systems of removal, one for the sawdust and another for the waste slabs. Both systems must function efficiently to ensure a smooth production flow.

In a typical Malaysian sawmill, the waste slabs are the loaded in a specially constructed bin or rack and removed by forklift to the waste collection site or incinerator. In most cases, this is carried out quite efficiently. However, in the removal of sawdust, very often the dust extraction system is not performing as expected due to many reasons notably improperly designed, haphazard installation and under capacity. The sawdust accumulated at the bandsaw site often leads to health hazardous working environment. Valuable production time is wasted to clear the sawdust and the productivity of the workers is affected.

The purpose of this article is to discuss the basic specifications of the various components that make up a dust extraction system for a sawmill. While the information log is not intended to be an all-encompassing system design manual or design blueprint for all typical sawmills, it does provide some key guidelines when speciflying for an efficient system.

Typical Malaysia Sawmill

All categories of saws used in a sawmill are mainly bandsaws. In Peninsular Malaysia, a typical sawmill-has a breakdown saw (headrig), four resaws and two recovery saws. A central conveyor system runs through these installations. Its main function is to transfer flitches from the breakdown saw to the resaws for ripping to size. Bigger waste slabs from the resaws are transferred to a recover saw for recovering purposes. A typical layout of this type of sawmill is shown in Figure 1.

The Malaysia context, the bandsaw is normally sized according to the diameter of its pulley. For a typical sawmill, the size of the breakdown saw can range from 1450 to 1800 mm (58 to 72 inches). The sizes of resaws range from 900 to 1100 mm (36 to 44 inches), whereas the recovery saws can range from 760 to 900 mm (30 to 36 inches).

The discussion of the dust extraction system below is based on a typical sawmill with the following configuration:

(i) One breakdown saw with pulley diameter 1500 mm (60 inches),
(ii) four resaws with pulley diameter 1050 mm (42 inches), and
(iii) two recovery saws with pulley diameter 900 mm (36 inches).

The installed capacity of such a sawmill is 22,000 m^3 log input per annum based on one 8-hour shift operation a day and 290 working days. With the present sawmilling scenario where there is an overall overcapacity in the industry, it is assumed that the sawing operation in this sawmill will not be expanded. This will confine the discussion to the system designed specifically for these installations only.

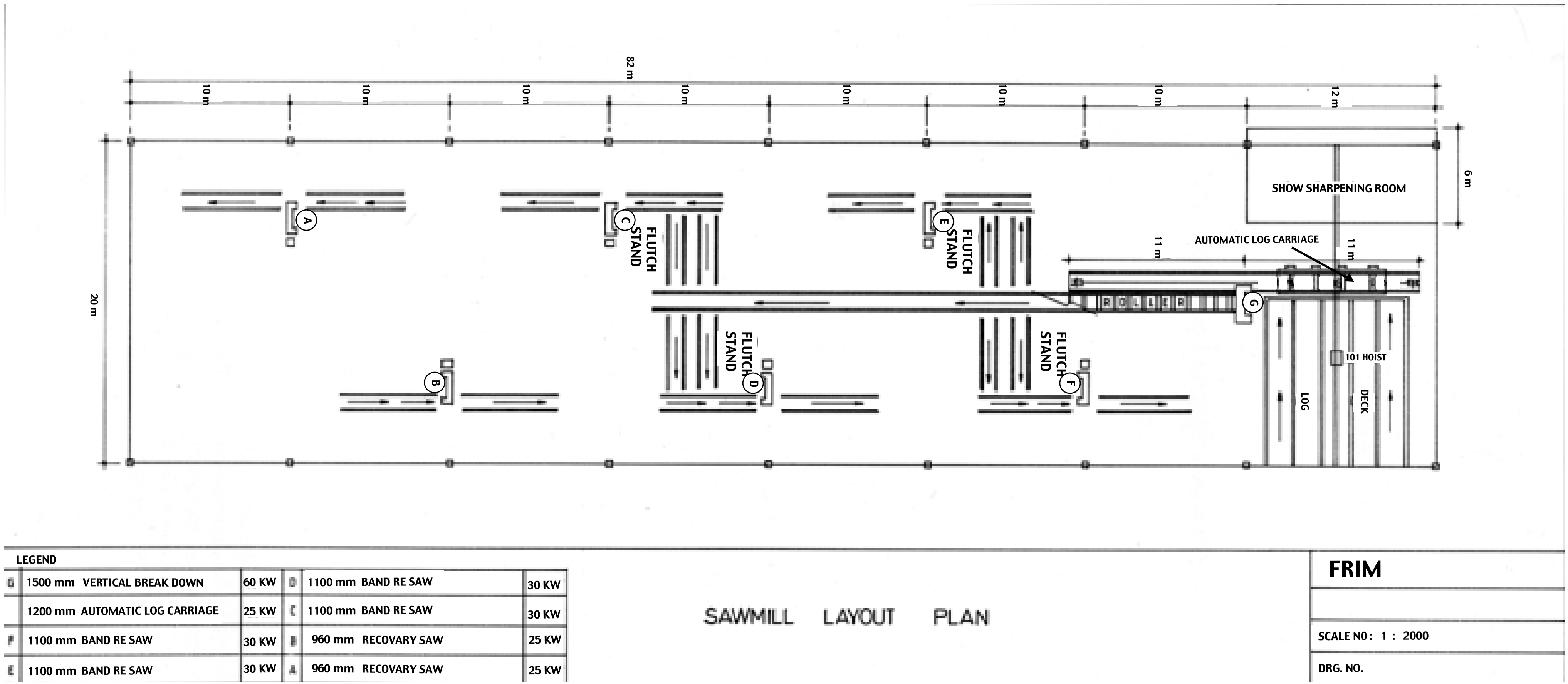

Figure 1. Sawmill Layout

Dust Extraction System

The basic function of a dust extraction system is to collect the moist sawdust as and when produced by the bandsaws and to convey this waste to a collection point. A dust extraction system consist of the hoods, the ducting from the hoods to the fan and dust collector, the dust collector and the fan. Due attention must be given to all four component mentioned as an excellent dust collector will prove inefficient with a poorly designed ducting system and a good ducting system will be defeated by a poorly functioned collector.

Hoods

The bandsaw is mounted in a concrete pit with the necessary foundation. During production the sawdust will be drawn into the pit where a hood is installed. Figure 2 shows the hood design suitable for the bandsaw. The basic functions of a hood are:

(i) to capture the sawdust that is thrown into it by the action of the bandsaw blade, and,
(ii) it should not obstruct the saw balde during operation and when removing for maintenance.

The velocity must be high enough to avoid sawdust from settling along the ducting. For moist sawdust, the velocity can range from 4500 to 5000 fpm.

Based on these, a design data sheet for the system can be drawn out as given in Table 1.

The total resistance or static pressure (S.P) drop of the system is determined by calculation, using the longest run of duct including all elbows, tapers and fittings. A sample of the calculation is given in Appendix 1.

The static pressure in the branch ducts close to the hood connection is frequently referred to as suction head or hood suction. It is the sum of the hood entrance loss and the velocity pressure in the duct.

Bends and branch entries in the ducting system should not be too sharp. The general rules being that the radius of end on the center line of the ducting shall be twice the diameter of the duct and branch entry or tee shall be 30^0.

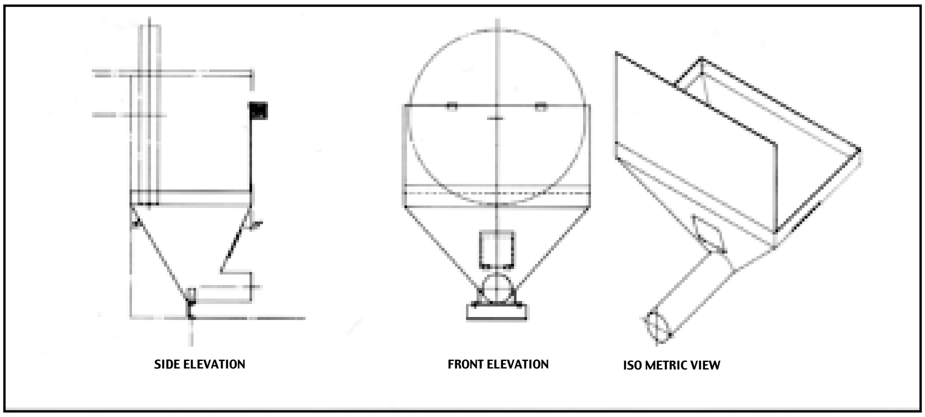

Figure 2. Hood for bandsaw

Ducting

The ducting system that connects the hoods, cyclone and fan must be properly sized. To start off three basic steps need to be taken first;

(i) Prepare a line sketch of the center line of the ducting system which represents the actual runs on the machinery layout plan. Figure 3 shows the sketch for the above mentioned sawmill configuration.

(ii) Determine the volume flow rate required by each machine. For this case: breakdown saw - 1800 cfm; resaw - 1400 cfm; and recovery saw 1000 cfm[1].
(iii) Ascertain the velocity of flow in the ducting.

Suction Fan

Centrifugal fans are mainly used in a dust extraction system. The fans must be rugged in construction to withstand the wear and tear due to sawdust hitting it at a very high speed. Based on the total volume flow rate and total static pressure the most appropriate fan for the system are selected. There are various makes of centrifugal fan in the market. Care should be taken when carrying out the selection as the fan is the heart of the system.

[1]Quoted in cubic feet per minute or cfm to facitate the use of reference Tables 1 & 2 which are in Imperial units.

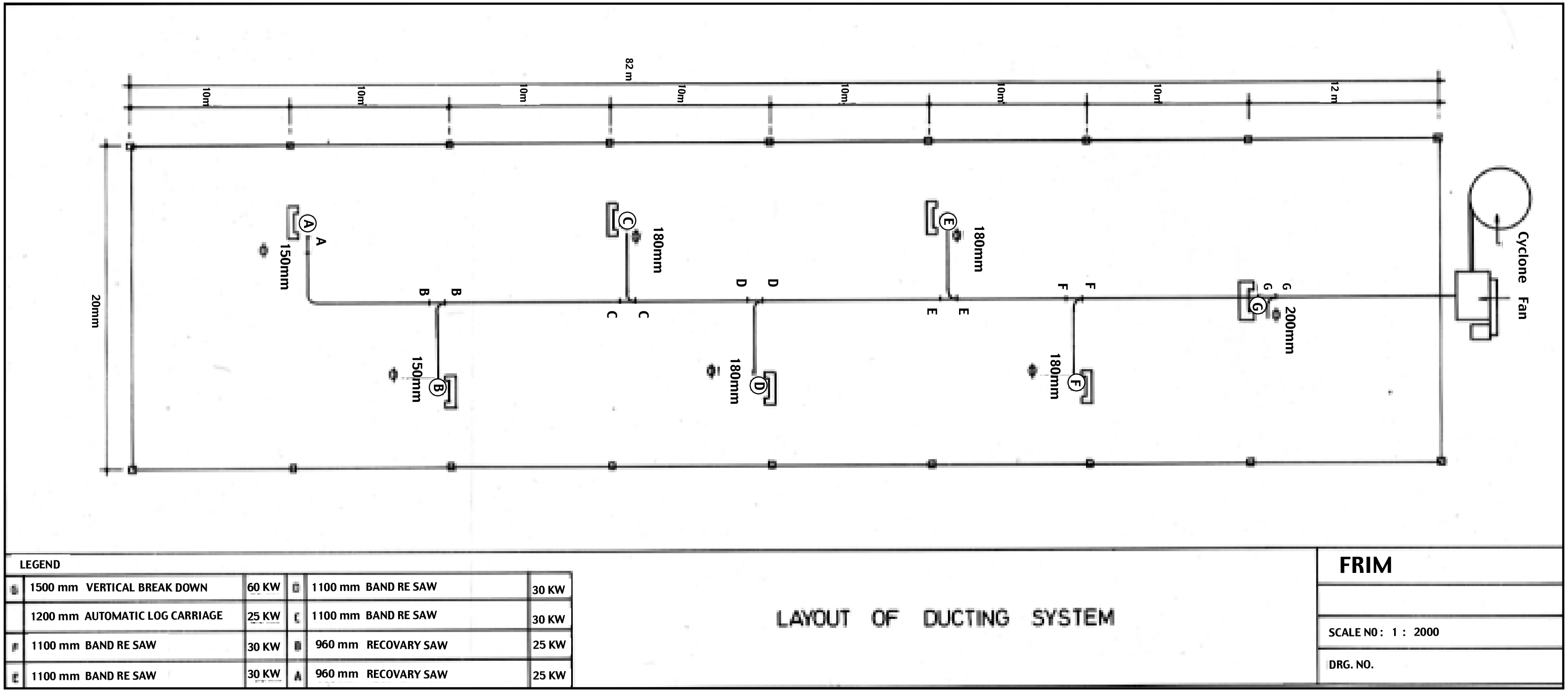

Figure 3. Ducting Layout

Table 1. Design data sheet for dust extraction system

Machine	Type	Branch flow rate	Main duct flow rate	Diameter	Velocity	Length	Static pressure S.P.
		cfm	cfm	in	fpm	ft	in wg.
A	b_A	1000		6	5093	79	5.135
	t_{AB}					3	0.095
B	b_B	1000		6	5093		
	m_{BC}		2000	9	4527	36	1.152
C	bc	1400	7				
	tcc					3	0.106
D	m_{CD}	1400	3400	11	5152	23	0.690
	b_D			7		3	
	t_{DD}					36	0.010
	m_{DE}		4800	13	5207		0.828
E	b_E	1400					
	t_{EE}			13		3	0.028
F	m_{EF}	1400	6200	15	5052	23	0.46
	b_F			7			
	t_{FF}		7600			3	0.040
	m_{FG}			17	4822	36	0.576
G	b_G	1800		8			
	t_{GG}					3	0.79
	m_{GH}		9400	19	4774	80	1.120
					Sub-total		10.319
					Suction head		2.5
					Filter loss		4.0
					Total S.P.		16.819

Note: The loss in tapered section is quite low compare to other losses and can be neglected.

b	branch duct
t	tapered section
m	main duct
wg.	water gauge
S.P.	static pressure

Dust Collector

Dust collector comprises two components. First, the separator and in this case is the cyclone. The main function of the cyclone is to separate the sawdust from the air. Normally cyclone for sawdust is designed with a pressure drop of 100 mm (4 inches) wg. between the inlet and outlet. The size of a cyclone used is determine by the total volumetric flow rate in the ducting system. And secondly, the receiver bin to collect the sawdust. The rate of sawdust being generated and the frequency of disposing the waste will determine its size to be installed.

In sawmilling, the sawdust generated is approximately 8% of the total volume of log input. Generally we can assume that the volume of sawdust is about three times the volume of wood which it is made up of. And in this case, the rate of sawdust being generated is about 18 m^3 /day. Depending on how often the sawdust will be disposed off or utilised in another process, the size of bin can be easily ascertained.

Sample calculation of resistance or static pressure(S.P.) drop in ducting

The calculation of resistance or S.P. drop in the ducting from Machine A to point B as shown in the layout plan (Figure 3) is discribed here. A schematic figure of the ducting is shown in Figure 4.

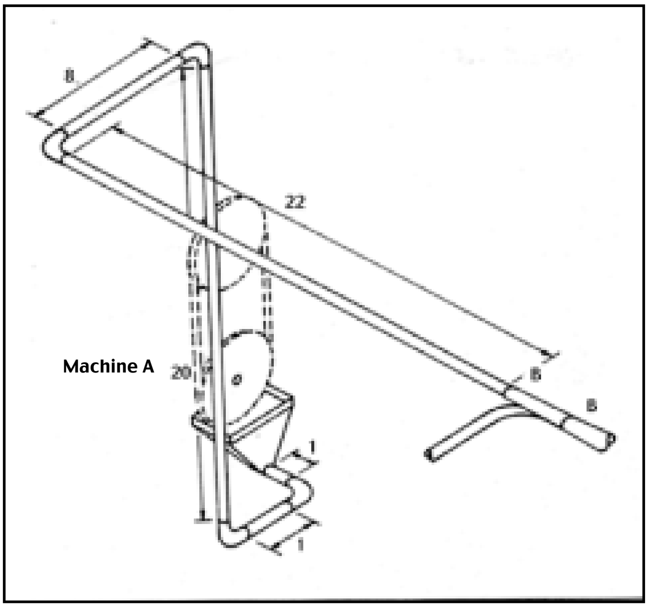

Figure 4. Ducting from machine A to point B

To determine the resistance in the ducting, charts are available based on volume flow rate (CFM) and duct diameter. The chart used in this sample is given in Figure 5. Besides that, a table for determining the equivalent duct length for elbows is given in Table 2.

The volume flow rate in this section of ducting with diameter 6 in. is 1000 cfm at a speed 5093 fpm. Once these parameters are fixed, the next stage is to determine the total length of this ducting i.e., total of straight lengths ducting plus equivalent diameter 6 in. and radius of bend on centre line of duct twice the duct diameter, the equivalent length of straight duct is 7 ft per 90^0-elbow.

Thus, the total length of ducting is:

22 + 4(7) + 20 + 6 + 2 + 1 = 79 feet

From Figure 5, the resistance in water gauge per 100 feet length of 6 in duct at resistance for this portion of ducting is 5.135 in. wg.

Table 2. Equivalent resistance of elbows in feet of straight duct

Dia. of duct	90^0 elbow	
	redius to center line of duct	
inches	1 1/2D	2D
3	5	4
4	7	5
5	9	6
6	11	7
7	13	9
8	14	10
10	20	13
12	25	17
14	30	21
16	36	24
18	41	28
20	46	32
24	57	38
30	75	51
36	87	60

For 60^0 elbow ..x 75
45^0 elbow .. x 50

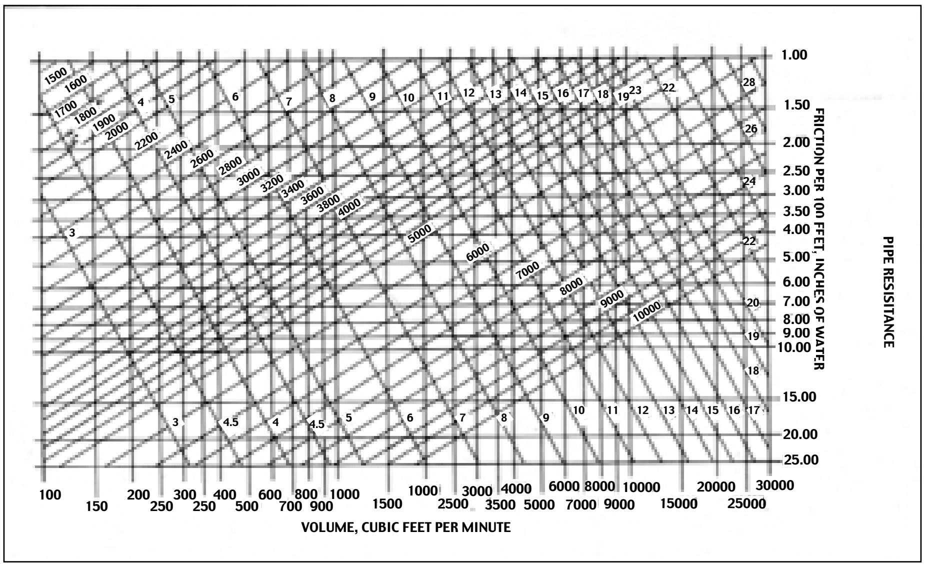

Figure 5. Pipe Resistence

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