

BAB V
ANALISIS DAN PEMBAHASAN

5.1. Analisis Data Penelitian

5.1.1. Analisis Data Pasangan Keramik Dengan Menggunakan MU-450

Tabel 5.1 Data Pekerjaan Pasangan Keramik Dengan Alat Perekat MU-450

PRODUCTION CYCLE DELAY SAMPLING								
Metode pemasangan keramik dengan alat perekat MU-450							Unit first Production unit : second	
Production cycle	Production cycle time (sec)	Environment delay (sec)	Equipment delay (sec)	Labor delay (sec)	Material delay (sec)	Management delay (sec)	Minus mean non delay time (sec)	Remarks
1	2	3	4	5	6	7	8	9
1	370						130	Tanpa penundaan
2	230					10	10	Tukang Membantu laden
3	130					110	110	Tukang Membantu laden
4	770			530			530	Ngobrol dan istirahat
5	570				221.1	108.9	330	Menunggu kiriman material dan tukang mengerjakan tugas laden
6	270			30			30	istirahat
7	470			230			230	Istirahat
8	380					140	140	Tukang Mengerjakan tugas laden
9	360						120	Tanpa penundaan
10	1340			1045		55	1100	Istirahat dan tukang mengerjakan tugas laden
11	1350			1025.6		84.4	1110	Istirahat dan tukang mengerjakan tugas laden
12	220						20	Tanpa penundaan
13	240					0	0	Tukang Mengerjakan tugas laden
14	300					60	60	Tukang Mengerjakan tugas laden
15	390			32.1		117.9	150	Istirahat dan tukang mengerjakan tugas laden
16	350			110			110	istirahat
17	300						60	Tanpa penundaan
18	270			15.6		14.4	30	Istirahat, ngobrol dan tukang mengerjakan tugas laden
19	370			21.7		108.3	130	Tukang mengerjakan tugas laden dan ngobrol

PRODUCTION CYCLE DELAY SAMPLING								
Metode pemasangan keramik dengan alat perekat MU-450							Unit first Production unit : second	
Production cycle	Production cycle time (sec)	Environment delay (sec)	Equipment delay (sec)	Labor delay (sec)	Material delay (sec)	Management delay (sec)	Minus mean non delay time (sec)	Remarks
1	2	3	4	5	6	7	8	9
20	290			50			50	Ngobrol
21	640					400	400	Tukang mengerjakan tugas laden
22	220						20	Tanpa penundaan
23	3330			2750.1	339.9		3090	Istirahat dan menunggu kiriman material
24	240						0	Tanpa penundaan
25	100						140	Tanpa penundaan
26	120						120	Tanpa penundaan
27	460			220			220	Istirahat
28	370			130			130	Istirahat
29	1150			873.6		36.4	910	Istirahat dan tukang mengerjakan tugas laden
30	1240			1000			1000	Istirahat
31	1450			1210			1210	Istirahat dan ngobrol
32	230						10	Tanpa penundaan
33	280			40			40	Ngobrol dan istirahat
34	350			110			110	istirahat
35	3000			2746.2		13.8	2760	Istirahat dan tukang mengerjakan tugas laden
total	22150	0	0	12170	561	1259.1	14610	

(data berada di lampiran 1)

Tabel 5.2 MPDM Processing for Glue MU-450.

MPDM Processing					
Date :	Production unit : (second)				
Method :					
Units	TOTAL PRODUCTION	NUMBER OF CYCLE	MEAN CYCLE TIME	$\sum ((\text{Cycle time}) - (\text{Non-delay cycle time})) / n$	
A) Non-Delayed production cycle	2160	9	240	68.89	
B) Overall production unit	22150	35	632.86	417.43	
DELAY INFORMATION					
	DELAY				
	Environment	Equipment	Labor	Material	Management
C) Occurrences	0	0	19	2	14
D) Total added time	0	0	12170	561	1259.1
E) Probability of occurrence	0	0	0.54	0.057	0.4

F) Relative Severity	0	0	1.01	0.44	0.14
G) Expected % delay time per production cycle	0	0	54.5	2.51	5.6

5.1.1.1. Non Delayed Production Cycle (Baris A)

Sesuai rumus no: 1

$$\begin{aligned} \text{mean cycle time non delayed production cycle} &= \frac{\sum \text{production time}}{n} \\ &= \frac{2160}{9} \\ &= 240 \text{ second} \end{aligned}$$

sesuai rumus no: 2

$$\begin{aligned} &\text{mean of minus mean non delay time in delayed production cycle} \\ &= \frac{\sum \text{minus mean non delay time from non delayed production cycle}}{n} \\ &= \frac{620}{9} \\ &= 68.89 \text{ second} \end{aligned}$$

5.1.1.2. Overall Production Cycle (Baris B)

Sesuai rumus no: 3

$$\begin{aligned}
 \text{mean cycle time overall production cycle} &= \frac{\sum \text{total production time}}{n} \\
 &= \frac{22150}{35} \\
 &= 632.86 \text{ second}
 \end{aligned}$$

sesuai rumus no:4

$$\begin{aligned}
 &\text{mean of minus mean non delay time in overall production cycle} \\
 &= \frac{\sum \text{minus mean non delay time from overall production cycle}}{n} \\
 &= \frac{14610}{35} \\
 &= 417.43 \text{ second}
 \end{aligned}$$

5.1.1.3. Occurrences (Baris C)

Occurrences adalah banyaknya kejadian penundaan produksi dalam keseluruhan produksi siklus dari masing-masing penyebab penundaan, macam-macam penyebab penundaannya adalah : faktor lingkungan kerja (*environment*), faktor peralatan atau alat bantu (*equipment*), faktor tenaga kerja (*labor*), faktor bahan bangunan (*material*) dan faktor manajemen (*management*).

Banyaknya kejadian tiap-tiap faktor adalah:

1. environment delay = 0
2. equipment delay = 0
3. labor delay = 19

4. material delay = 2
 5. management delay = 14

5.1.1.4. Total Added Time (Baris D)

Sesuai rumus no: 5

$$Total\ added\ time = \sum \left[\frac{\text{prosentase delay akibat satu faktor dalam satu siklus}}{\left(1 - \text{hasil pengurangan nilai rata-rata tanpa delay}\right)} \right]$$

1. *total added time environment* = 0 second
2. *total added time equipment* = 0 second
3. *total added time labor*
 = 530 + 30 + 230 + 1045 + 1025.64 + 32.1 + 110 + 15.6 + 21.71 + 50
 + 2750.1 + 220 + 130 + 873.6 + 1000 + 1210 + 40 + 110 + 2746.2
 = 12170 second
4. *total added time material* = 221.1 + 339.9
 = 561 second
5. *total added time management*
 = 10 + 110 + 108.9 + 140 + 55 + 84.36 + 0 + 60 + 117.9 + 14.4
 + 108.29 + 400 + 36.4 + 13.8
 = 1259.1 second

5.1.1.5. Probability of Occurrence (Baris E)

Sesuai rumus no: 6

$$\text{Probability of occurrence} = \frac{\text{Banyaknya pemundaan akibat setiap faktor}}{\text{Banyaknya siklus}}$$

$$1. \text{ probability of occurrence environment} = \frac{0}{35}$$

$$2. \text{ probability of occurrence equipment} = \frac{0}{35}$$

$$3. \text{ probability of occurrence labor} = \frac{19}{35}$$

$$= 0.54$$

$$4. \text{ probability of occurrence material} = \frac{2}{35}$$

$$= 0.057$$

$$5. \text{ probability of occurrence management} = \frac{14}{35}$$

$$= 0.4$$

5.1.1.6. Relative Severity (Baris F)

Sesuai rumus no: 7

$$\text{Relative severity} = \frac{\left(\frac{\text{total added time}}{\text{occurrences}} \right)}{\text{mean cycletime from overall production cycle}}$$

1. *relative severity environment* 0
2. *relative severity equipment* 0
3. *relative severity labor* $\frac{(12170_{19})}{632.86}$
= 1.01
4. *relative severity material* $\frac{(561_2)}{632.86}$
= 0.44
5. *relative severity management* $\frac{(1259.1_{14})}{632.86}$
= 0.14

5.1.1.7. Expected % Delay Time Per Production Cycle (Baris G)

Sesuai rumus no: 8

Expected % delay time per production cycle

$$= (\text{Relative severity} \times \text{Probability of occurrence}) \times 100 \%$$

1. *Expected % Delay Time per Production Cycle environment*
= 0 %
2. *Expected % Delay Time per Production Cycle equipment*
= 0 %
3. *Expected % Delay Time per Production Cycle labor*
= (1.01 X 0.6) X 100% = 54.5 %

4. *Expected % Delay Time per Production Cycle material*

$$= (0.44 \times 0.057) \times 100\% = 2.51 \%$$

5. *Expected % Delay Time per Production Cycle management*

$$= (0.14 \times 0.343) \times 100\% = 5.6 \%$$

5.1.1.8. Persamaan Produktivitas

Sesuai rumus no: 9

$$\begin{aligned} \text{Ideal productivity} &= \frac{1}{\text{mean nondelay cycle time}} \\ &= \frac{60 \text{ min/hr} \times 60 \text{ sec/min}}{240} \\ &= 15 \text{ m}^2/\text{hr} \end{aligned}$$

Sesuai rumus no: 10

$$\begin{aligned} \text{Overall method productivity} &= \frac{1}{\text{mean overall cycle time}} \\ &= \frac{60 \text{ min/hr} \times 60 \text{ sec/min}}{632.86} \\ &= 5.6 \text{ m}^2/\text{hr} \end{aligned}$$

Sesuai rumus no: 11

$$\text{overall productivity} = (\text{ideal productivity}) \times (1 - E_{en} - E_{eq} - E_{la} - E_{mt} - E_{mn})$$

$$5.6 \text{ m}^2/\text{hr} = (15 \text{ m}^2/\text{hr}) \times (1 - 0 - 0 - 0.545 - 0.025 - 0.056) \dots \dots \text{OK}$$

5.1.1.9. Method Indicators

A. Variability of method productivity :

Sesuai rumus no: 12

$$\begin{aligned} \text{Ideal cycle variability} &= \frac{\text{variation measure} - \text{Row A}}{\text{mean nondelay cycle time}} \\ &= \frac{68.89}{240} \\ &= 0.29 \end{aligned}$$

Sesuai rumus no: 13

$$\begin{aligned} \text{Overall cycle variability} &= \frac{\text{variation measure} - \text{Row B}}{\text{mean overall cycle time}} \\ &= \frac{417.43}{632.86} \\ &= 0.66 \end{aligned}$$

B. Delay information MU-450 :

Tabel 5.3 Delay Information Glue MU-450

	DELAY				
	Environmen	Equipment	Labor	Material	Management
Probability of Accurrences	0	0	0.54	0.057	0.4
Relative Severity	0	0	1.01	0.44	0.14
Expected % delay time per production cycle	0	0	54.5	2.51	5.6

Hasil analisis pekerjaan pasangan keramik dengan menggunakan alat perekat MU-450 menunjukkan bahwa prosentase faktor penundaan produktivitas tertinggi adalah penundaan akibat tenaga kerja (*labor delay*) yaitu 54.5%, urutan kedua adalah manajemen (*management delay*) yaitu 5.6%, urutan ketiga adalah faktor pendistribusian bahan bangunan (*material*) yaitu 2.51%, sedangkan penundaan akibat faktor lingkungan kerja (*environment*) dan faktor peralatan atau alat bantu (*equipment*) tidak ada.

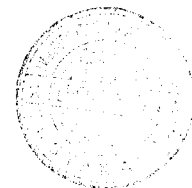
5.1.2. Analisis Data Pasangan Keramik Menggunakan Semen Biasa

Tabel 5.4 Data Pekerjaan Pasangan Keramik Dengan Alat Perekat Semen Biasa

PRODUCTION CYCLE DELAY SAMPLING								
Metode pemasangan keramik dengan alat perekat semen								Unit first
Production unit : second								
Production cycle	Production cycle time (sec)	Environment delay (sec)	Equipment delay (sec)	Labor delay (sec)	Material delay (sec)	Management delay (sec)	Minus mean non delay time (sec)	Remarks
1	2	3	4	5	6	7	8	9
1	500						129.29	Tanpa penundaan
2	350						20.71	Tanpa penundaan
3	1450					1079.3	1079.29	Tukang mengerjakan tugas laden
4	350			6.9		13.8	20.71	Tukang mengerjakan tugas laden dan istirahat
5	840			469.3			469.29	Istirahat
6	500			129.3			129.29	Istirahat dan konfirmasi atasan
7	330			40.7			40.71	Istirahat
8	290			72.6		8.1	80.71	Istirahat, ngobrol dan tukang mengerjakan tugas laden
9	330			40.7			40.71	Istirahat dan ngobrol
10	570			199.3			199.29	Istirahat dan ngobrol
11	490					119.3	119.29	Tukang mengerjakan tugas laden
12	470						99.29	Tanpa penundaan
13	670						299.29	Tanpa penundaan

PRODUCTION CYCLE DELAY SAMPLING								
Metode pemasangan keramik dengan alat perekat semen						Unit first		
Production unit : second								
Production cycle	Production cycle time (sec)	Environment delay (sec)	Equipment delay (sec)	Labor delay (sec)	Material delay (sec)	Management delay (sec)	Minus mean non delay time (sec)	Remarks
1	2	3	4	5	6	7	8	9
14	840						469.29	Tanpa penundaan
15	350						20.71	Tanpa penundaan
16	820			499.3			449.29	Istirahat dan ngobrol
17	390			17.6		1.7	19.29	Istirahat dan tukang mengerjakan tugas laden
18	210						160.71	Tanpa penundaan
19	310						60.71	Tanpa penundaan
20	210						160.71	Tanpa penundaan
21	220						150.71	Tanpa penundaan
22	1270			899.3			899.29	Istirahat
23	500					129.3	129.29	Tukang mengerjakan tugas laden
24	860			97.9		391.4	489.29	Tukang mengerjakan tugas laden dan istirahat
25	240			65.35		65.35	130.71	Ngobrol dan tukang mengerjakan tugas laden
26	480			76.2	26.4	6.7	109.29	Istirahat, ngobrol, tukang mengerjakan tugas laden dan menunggu kiriman material
27	210						160.71	Tanpa penundaan
28	260			55.35	55.35		110.71	Menunggu kiriman material dan istirahat
29	340						30.71	Tanpa penundaan
30	260				110.7		110.71	Menunggu kiriman material
31	870			499.3			499.29	Istirahat dan ngobrol
32	210				160.7		160.71	Menunggu kiriman material
33	270			100.7			100.71	Ngobrol dan istirahat
34	300						70.71	Tanpa penundaan
35	770			387.3		12	399.29	Istirahat dan tukang mengerjakan tugas laden
36	370			0.7			0.71	istirahat
37	340			12.7	17.96		30.71	Istirahat dan menunggu kiriman material
38	290			80.7			80.71	istirahat
39	500			129.3			129.29	istirahat
40	210						160.71	Tanpa penundaan
41	360			9.2		1.5	10.71	istirahat dan tukang mengerjakan tugas laden
42	500			129.3			129.29	istirahat
43	520				149.3		149.29	Menunggu kiriman material
44	1360			950.7	38.6		989.29	Menunggu kiriman material dan istirahat
total	21780	0	0	4919.6	559	1829	9301.8	

(data berada dilampiran 2)



Tabel 5.5 MPDM Processing Semen Biasa

MPDM Processing					
Date :	Method :			Production unit : (second)	
Units	TOTAL PRODUCTION	NUMBER OF CYCLE	MEAN CYCLE TIME	$\Sigma\{(\text{Cycle time}) - (\text{Non-delay cycle time})\}/n$	
A) Non-Delayed production cycle	5190	14	370.7	142.4	
B) Overall production unit	21780	44	495	211.4	
DELAY INFORMATION					
	DELAY				
	Environment	Equipment	Labor	Material	Management
C) Occurrences	0	0	24	7	11
D) Total added time	0	0	4919.6	559	1829
E) Probability of occurrence	0	0	0.54	0.15	0.25
F) Relative severity	0	0	0.37	0.1	0.24
G) Expected % delay time per production cycle	0	0	20	1.5	6

5.1.2.1. Non Delayed Production Cycle (Baris A)

Sesuai rumus no: 1

$$\text{Mean cycle time non delayed production cycle} = \frac{\sum \text{Production time}}{n}$$

$$= \frac{5190}{14}$$

$$= 370.7 \text{ second}$$

Sesuai rumus no: 2

Mean of minus mean non delay time in delayed production cycle

$$= \frac{\sum \text{Minus mean non delay time from non delayed production cycle}}{n}$$

$$= \frac{1994,2}{14}$$

$$= 142,4 \text{ second}$$

5.1.2.2. Overall Production Cycle (Baris B)

Sesuai rumus no: 3

$$\text{Mean cycle time overall production cycle} = \frac{\sum \text{Total production time}}{n}$$

$$= \frac{21780}{44}$$

$$= 495 \text{ second}$$

Sesuai rumus no: 4

Mean of minus mean non delay time in overall production cycle

$$= \frac{\sum \text{Minus mean non delay time from overall production cycle}}{n}$$

$$= \frac{9301,8}{44} = 211,4 \text{ second}$$

5.1.2.3. Occurrences (Baris C)

Occurrences adalah banyaknya kejadian penundaan produksi dalam keseluruhan produksi siklus dari masing-masing penyebab penundaan, macam-macam penyebab penundaannya adalah : faktor lingkungan kerja (*environment*), faktor peralatan atau alat bantu (*equipment*), faktor tenaga kerja (*labor*), faktor bahan bangunan (*material*) dan faktor manajemen (*management*).

Banyaknya kejadian tiap-tiap faktor adalah:

1. environment delay = 0
2. equipment delay = 0
3. labor delay = 24
4. material delay = 7
5. management delay = 11

5.1.2.4. Total Added Time (Baris D)

Sesuai rumus no: 5

$$Total\ added\ time = \sum \left[\frac{\text{prosentase delay akibat satu faktor dalam satu siklus}}{\left(1 - \text{hasil pengurangan nilai rata - rata tanpa delay} \right)} \right]$$

1. total added time environment = 0 second
2. total added time equipment = 0 second
3. total added time labor

$$\begin{aligned}
& 6.9 + 469.3 + 129.3 + 40.7 + 72.6 + 40.7 + 199.3 + 499.3 + 17.6 + 899.3 \\
& + 97.9 + 65.35 + 76.2 + 55.35 + 449.3 + 100.7 + 387.3 + 0.7 + 12.7 \\
& + 129.3 + 9.2 + 129.3 + 950.7 \\
& = 4919.6 \text{ second}
\end{aligned}$$

4. *total added time material*

$$\begin{aligned}
& = 26.4 + 55.35 + 110.7 + 160.7 + 17.96 + 149.3 + 38.6 \\
& = 559 \text{ second}
\end{aligned}$$

5. *total added time management*

$$\begin{aligned}
& = 1079.3 + 13.8 + 8.1 + 119.3 + 1.7 + 129.3 + 391.4 + 65.35 + 6.7 \\
& + 12 + 1.5 \\
& = 1829 \text{ second}
\end{aligned}$$

5.1.2.5. Probability of Accurrent (Baris E)

Sesuai rumus no: 6

$$\text{Probability of accurrence} = \frac{\text{banyaknya penundaan akibat setiap faktor}}{\text{banyaknya siklus}}$$

1. *probability of accurrence environment* = 0

2. *probability of accurrence equipment* = 0

3. *probability of accurrence labor* = $\frac{24}{44}$

0.54

$$4. \text{ probability of occurrence material} = \frac{7}{44}$$

$$= 0.1$$

$$5. \text{ probability of occurrence management} = \frac{11}{44}$$

$$= 0.25$$

5.1.2.6. Relative Severity (Baris F)

Sesuai rumus no: 7

$$\text{relative severity} = \frac{\left(\frac{\text{total added time}}{\text{occurrences}} \right)}{\text{mean cycle time from overall production cycle}}$$

$$1. \text{ relative severity environment} = 0$$

$$2. \text{ relative severity equipment} = 0$$

$$3. \text{ relative severity labor} = \frac{\left(\frac{49693.65}{24} \right)}{495}$$

$$= 0.37$$

$$4. \text{ relative severity material} = \frac{\left(\frac{559}{7} \right)}{495}$$

$$= 0.15$$

$$5. \text{ relative severity management} = \frac{\left(\frac{1829}{11} \right)}{495}$$

$$= 0.24$$

5.1.2.7. Expected % Delay Time per Production Cycle (Baris G)

Sesuai rumus no: 8

Expected % delay time per production cycle

$$= (\text{relative severity} \times \text{probability of occurrence}) \times 100\%$$

1. *Expected % Delay Time per Production Cycle environment*

$$= 0 \%$$

2. *Expected % Delay Time per Production Cycle equipment*

$$= 0 \%$$

3. *Expected % Delay Time per Production Cycle labor*

$$(0.54 \times 0.37) \times 100\% = 20 \%$$

4. *Expected % Delay Time per Production Cycle material*

$$= (0.15 \times 0.1) \times 100\% = 1.5 \%$$

5. *Expected % Delay Time per Production Cycle management*

$$= (0.25 \times 0.24) \times 100\% = 6 \%$$

5.1.2.8. Persamaan Produktivitas

Sesuai rumus no: 9

$$\begin{aligned} \text{Ideal productivity} &= \frac{1}{\text{meannondelaycycletime}} \\ &= \frac{60 \text{ min/hr} \times 60 \text{ sec/min}}{370.7} \end{aligned}$$

$$= 9.7 \text{ m}^2/\text{hr}$$

Sesuai rumus no: 10

$$\text{Overall method productivity} = \frac{1}{\text{mean overall cycle time}}$$

$$= \frac{60 \text{ min/hr} \times 60 \text{ sec/min}}{495}$$

$$= 7 \text{ m}^2/\text{hr}$$

Sesuai rumus no: 11

$$\text{Overall productivity} = (\text{ideal productivity}) \times (1 - E_{en} - E_{eq} - E_{ta} - E_{mt} - E_{mn})$$

$$7 \text{ m}^2/\text{hr} = (9.7 \text{ m}^2/\text{hr}) \times (1 - 0 - 0 - 0.20 - 0.15 - 0.06) \dots \text{OK}$$

5.1.2.9. Method Indicators

A. Variability of method productivity :

Sesuai rumus no: 12

$$\text{Ideal cycle variability} = \frac{\text{variation measure} - \text{Row A}}{\text{mean nondelay cycle time}}$$

$$= \frac{142.4}{370.7}$$

$$= 0.38$$

Sesuai rumus no: 13

$$\begin{aligned} \text{Overall cycle variability} &= \frac{\text{variation measure} - \text{Row B}}{\text{mean overall cycle time}} \\ &= \frac{211.4}{495} \\ &= 0.43 \end{aligned}$$

B. Delay information Semen Biasa

Tabel 5.6 Delay Information Semen Biasa

	DELAY				
	Environmen	Equipment	Labor	Material	Management
Probability of Accurrences	0	0	0.54	0.15	0.25
Relative Severity	0	0	0.37	0.1	0.24
Expected % delay time per production cycle	0	0	20	1.5	6

Hasil analisis pekerjaan pasangan keramik dengan menggunakan alat perekat semen biasa menunjukkan bahwa prosentase faktor penundaan produktivitas tertinggi adalah penundaan akibat tenaga kerja (*labor delay*) yaitu 20 %, urutan kedua adalah penundaan akibat manajemen (*management delay*) yaitu 6 %, urutan ketiga adalah faktor pendistribusian bahan bangunan (*material*) yaitu 1.5 %, sedangkan penundaan akibat faktor lingkungan kerja (*environment*) dan faktor peralatan atau alat bantu (*equipment*) tidak ada

5.2. Pembahasan

5.2.1. Perbandingan Produktivitas

Dari hasil analisis perbandingan produktivitas pekerjaan pasangan keramik menggunakan alat perekat MU-450 dan alat perekat semen biasa pada proyek bangunan gedung seperti tabel 5.7:

Tabel 5.7 Perbandingan Penundaan Produktivitas

Expected % delay time per production cycle		
Faktor	Perekat MU-450	Perekat semen biasa
Environment	0	0
Equipment	0	0
Labor	54.5	20
Material	2.51	1.5
Management	5.6	6

Dari tabel diatas perbandingan penundaan produktivitas pada masing-masing faktor antara perekat MU-450 dan perekat semen biasa adalah :

$$1. \textit{Environment} = 0$$

$$2. \textit{Equipment} = 0$$

$$3. \textit{Labor} = \frac{54.5}{20}$$

$$= 2.7 : 1$$

$$4. \textit{Material} = \frac{2.51}{1.5}$$

$$\begin{aligned}
 & 1.7 : 1 \\
 5. \text{ Management} &= \frac{5.6}{6} \\
 &= 1 : 1.1
 \end{aligned}$$

Sehingga penundaan produktivitas pekerjaan pasangan keramik dengan alat perekat MU-450 dan alat perekat semen biasa pada faktor lingkungan adalah sama, faktor peralatan adalah sama, faktor tenaga kerja lebih tinggi menggunakan alat perekat MU-450, faktor material lebih tinggi menggunakan alat perekat MU-450, dan faktor manajemen lebih tinggi menggunakan alat perekat semen biasa.

Perbandingan produktivitas total antara pekerjaan pasangan keramik dengan alat perekat MU-450 dan alat perekat semen biasa adalah

$$\frac{\text{overall production glue MU - 450}}{\text{overall production glue cement}} = \frac{5.6 \frac{m^2}{hr}}{7 \frac{m^2}{hr}} = \frac{1}{1.3} = 1 : 1.3$$

Produktivitas total lebih tinggi menggunakan alat perekat semen biasa.

5.2.2. Penyebab Terjadinya Penundaaan Tiap Faktor

Menurut tabel 5.1 dan tabel 5.4 penundaan produktivitas akibat faktor tenaga kerja (*labor delay*) karena tukang dan tenaga laden sering istirahat dan ngobrol. Penundaan produktivitas akibat faktor manajemen (*management delay*) karena tukang sering melakukan pekerjaan yang seharusnya pekerjaan tersebut adalah tugas laden karena tenaga laden adalah wanita sehingga tukang sering membantu pekerjaan laden yang berat dan menunda pekerjaan tukang yang seharusnya. Penundaan produktivitas akibat faktor material (*material delay*)

karena terlambatnya pendistribusian material sehingga pekerjaan tukang dan tenaga laden tertunda.

Dari pernyataan diatas dapat disimpulkan istirahat, ngobrol, tenaga laden wanita dan terlambatnya pendistribusian material sebagai penyebab tidak maksimalnya produktivitas pekerjaan pasangan keramik baik menggunakan alat perekat MU-450 atau perekat semen biasa pada proyek bangunan gedung.

5.2.3. Peningkatan Produktivitas

Produktivitas dapat ditingkatkan dengan memperbaiki faktor-faktor yang menyebabkan penundaan produktivitas tersebut sehingga produktivitas pada pekerjaan pasangan keramik baik menggunakan alat perekat MU-450 maupun alat perekat semen biasa dapat maksimal.

- a. Pada pekerjaan pasangan keramik menggunakan perekat MU-450, bila salah satu faktor penundaan produktivitas diperbaiki adalah

1. Produktivitas total apabila *labor delay* = 0

$$\begin{aligned} \text{Produktivitas total} &= (15 \text{ m}^2/\text{hr}) \times (1 - E_{in} - E_{eq} - E_{la} - E_{mat} - E_{man}) \\ &= (15 \text{ m}^2/\text{hr}) \times (1 - 0 - 0 - 0 - 0.025 - 0.056) \\ &= 13.8 \text{ m}^2/\text{hr} \end{aligned}$$

2. Produktivitas total apabila *material delay* = 0

$$\begin{aligned} \text{Produktivitas total} &= (15 \text{ m}^2/\text{hr}) \times (1 - E_{in} - E_{eq} - E_{la} - E_{mat} - E_{man}) \\ &= (15 \text{ m}^2/\text{hr}) \times (1 - 0 - 0 - 0 - 0.545 - 0 - 0.056) \\ &= 6 \text{ m}^2/\text{hr} \end{aligned}$$

3. Produktivitas total apabila *management delay* = 0

$$\begin{aligned} \text{Produktivitas total} &= (15 \text{ m}^2/\text{hr}) \times (1 - E_m - E_{eq} - E_{la} - E_{mat} - E_{man}) \\ &= (15 \text{ m}^2/\text{hr}) \times (1 - 0 - 0 - 0.545 - 0.025 - 0) \\ &= 6.5 \text{ m}^2/\text{hr} \end{aligned}$$

- b. Pada pekerjaan pasangan keramik menggunakan perekat semen biasa, bila salah satu faktor penundaan produktivitas diperbaiki adalah

1. Produktivitas total apabila *labor delay* = 0

$$\begin{aligned} \text{Produktivitas total} &= (9.7 \text{ m}^2/\text{hr}) \times (1 - E_m - E_{eq} - E_{la} - E_{mat} - E_{man}) \\ &= (9.7 \text{ m}^2/\text{hr}) \times (1 - 0 - 0 - 0 - 0.015 - 0.06) \\ &= 8.9 \text{ m}^2/\text{hr} \end{aligned}$$

2. Produktivitas total apabila *material delay* = 0

$$\begin{aligned} \text{Produktivitas total} &= (9.7 \text{ m}^2/\text{hr}) \times (1 - E_m - E_{eq} - E_{la} - E_{mat} - E_{man}) \\ &= (9.7 \text{ m}^2/\text{hr}) \times (1 - 0 - 0 - 0.20 - 0 - 0.06) \\ &= 7.2 \text{ m}^2/\text{hr} \end{aligned}$$

3. Produktivitas total apabila *management delay* = 0

$$\begin{aligned} \text{Produktivitas total} &= (9.7 \text{ m}^2/\text{hr}) \times (1 - E_m - E_{eq} - E_{la} - E_{mat} - E_{man}) \\ &= (9.7 \text{ m}^2/\text{hr}) \times (1 - 0 - 0 - 0.20 - 0.015 - 0) \\ &= 7.6 \text{ m}^2/\text{hr} \end{aligned}$$

Perbaikan pada faktor penundaan tenaga kerja (*labor delay*), akan meningkatkan produktivitas total yang signifikan pada pekerjaan pasangan keramik menggunakan perekat MU-450 dan perekat semen biasa.

Produktivitas total akan lebih besar menggunakan perekat MU-450, bila pada faktor penundaan tenaga kerja (*Labor delay*) diperbaiki, yaitu: 13.9 m²/hr dibandingkan dengan perekat semen biasa yaitu: 8.9 m²/hr.

