

## Lampiran 1

### Rumusan Bab II

Rumus yang digunakan untuk menentukan energi foton pada keadaan awal.

$$E = h\nu = \frac{hc}{\lambda} \quad (1-1)$$

dan momentumnya :

$$p = \frac{E}{c} \quad (1-2)$$

Dalam interaksi ini berlaku kekekalan energi dan momentum, yakni :

$$E_{\text{awal}} = E_{\text{akhir}} \quad (1-3)$$

atau :

$$\frac{hc}{\lambda} + m_0c^2 = \frac{hc}{\lambda'} + mc^2 \quad (1-4)$$

Untuk kekekalan momentum berturut-turut ke arah horisontal dan vertikal, harus memenuhi :

$$\frac{h}{\lambda} = \frac{h}{\lambda'} \cos \theta + mv \cos \phi \quad (1-5)$$

$$0 = \frac{h}{\lambda} \sin \theta - mv \sin \phi \quad (1-6)$$

Dari persamaan (1-5) dan (1-6), didapatkan perubahan panjang gelombang foton sebesar:

$$\Delta\lambda = \lambda' - \lambda = \frac{h}{m_0c} (1 - \cos \theta) \quad (1-7)$$

dan hubungan antara sudut–sudut hamburan dari foton dan elektron, sebesar :

$$\cot \frac{\theta}{2} = \left( 1 + \frac{h}{m_0 c} \right) \tan \phi \quad (1-8)$$

atau :

$$\Delta\lambda = 0,0242 (1 - \cos \theta) \quad (1-9)$$

Persamaan (1-8) memperlihatkan bahwa elektron tidak dapat dihamburkan melalui sudut yang lebih besar dari 90°.



## Lampiran 2

### Tabulasi Perhitungan Data.

Tabel 3.1 Tabel Perhitungan Derajat Kehitaman

Nisbah Kisi		Jarak fokus ke film (cm)							
		50	60	70	80	90	100	110	120
5:1	R1	1,44	1,13	1,54	1,41	1,23	1,14	1,14	1,15
	R2	1,48	1,16	1,59	1,45	1,25	1,17	1,17	1,17
	0	1,77	1,33	1,78	1,58	1,34	1,22	1,20	1,18
	L2	1,48	1,16	1,59	1,45	1,25	1,17	1,17	1,17
	L1	1,44	1,13	1,54	1,41	1,23	1,14	1,14	1,15
6:1	R1	1,95	1,54	1,58	1,34	1,11	1,08	1,20	1,22
	R2	1,98	1,58	1,62	1,41	1,16	1,14	1,24	1,24
	0	2,42	1,88	1,92	1,60	1,30	1,24	1,34	1,32
	L2	1,98	1,58	1,62	1,41	1,16	1,14	1,24	1,24
	L1	1,95	1,54	1,58	1,34	1,11	1,08	1,20	1,22
8:1	R1	2,20	2,23	2,43	2,41	2,03	2,41	2,45	2,47
	R2	2,26	2,35	2,60	2,47	2,10	2,50	2,51	2,53
	0	2,82	2,82	3,00	2,90	2,41	2,80	2,78	2,74
	L2	2,26	2,35	2,60	2,47	2,10	2,50	2,51	2,53
	L1	2,20	2,23	2,43	2,41	2,03	2,41	2,45	2,47
10:1	R1	1,68	1,50	1,17	1,18	1,28	1,34	1,37	1,05
	R2	1,72	1,54	1,20	1,22	1,32	1,38	1,40	1,07
	0	2,21	1,92	1,46	1,43	1,51	1,55	1,56	1,18
	L2	1,72	1,54	1,20	1,22	1,32	1,38	1,40	1,07
	L1	1,68	1,50	1,17	1,18	1,28	1,34	1,37	1,05

Tabel 2.2 Hasil prosentase kehilangan sinar primer dengan nisbah kisi 5:1  
pada kisi sinar-X paralel.

FFD (cm)	50	60	70	80	90	100	110	120
% CUT OFF	18,64	15,04	13,37	10,76	8,21	6,56	5,00	2,54

Tabel 2.3 Hasil prosentase kehilangan sinar primer dengan nisbah kisi 6:1  
pada kisi sinar-X paralel.

FFD (cm)	50	60	70	80	90	100	110	120
% CUT OFF	19,42	18,08	17,71	16,25	14,61	12,90	10,45	7,57

Tabel 2.4 Hasil prosentase kehilangan sinar primer dengan nisbah kisi 8:1  
pada kisi sinar-X paralel.

FFD (cm)	50	60	70	80	90	100	110	120
% CUT OFF	21,99	20,92	19,00	16,90	15,77	13,93	11,87	9,85

Tabel 2.5 Hasil prosentase kehilangan sinar primer dengan nisbah kisi 10:1  
pada kisi sinar-X paralel.

FFD (cm)	50	60	70	80	90	100	110	120
% CUT OFF	23,98	21,87	19,86	17,48	15,23	13,55	12,18	11,02

### Lampiran 3

### Tabulasi Perhitungan Ralat

1. Perhitungan ralat dari hasil eksperimen untuk perbandingan 5:1

FFD = 50 cm

$L_2 = 1,44$	$L_{21} = 1,44$	$O_1 = 1,72$	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ $= 18,64\%$
$O = 1,77$	$L_{22} = 1,39$	$O_2 = 1,85$	
	$L_{23} = 1,50$	$O_3 = 1,77$	
	$L_{24} = 1,47$	$O_4 = 1,79$	
	$L_{25} = 1,40$	$O_5 = 1,72$	

$$\frac{\partial CO}{\partial DO} = \frac{\overline{DT}}{\overline{DO}} = \frac{1,44}{1,77^2} = 0,4596$$

$$\frac{\partial CO}{\partial DT} = -\frac{1}{\overline{DO}} = -\frac{1}{1,77} = -0,5649$$

$$\delta DO = \sqrt{\frac{\sum (DO_i - \overline{DO})^2}{n(n+1)}}$$

$$= 0,0243$$

$$= \sqrt{\frac{(1,72 - 1,77)^2 + (1,85 - 1,77)^2 + (1,77 - 1,77)^2 + (1,79 - 1,77)^2 + (1,72 - 1,77)^2}{20}}$$

$$\delta DT = \sqrt{\frac{\sum (DT_i - \overline{DT})^2}{n(n+1)}}$$

$$= 0,0207$$

$$= \sqrt{\frac{(1,44 - 1,44)^2 + (1,39 - 1,44)^2 + (1,50 - 1,44)^2 + (1,47 - 1,44)^2 + (1,40 - 1,44)^2}{20}}$$

$$sCO = \left[ \left( \frac{\partial CO}{\partial O} - sO \right)^2 + \left( \frac{\partial CO}{\partial L_2} - sL_2 \right)^2 \right]^2$$

$$= 0,0162$$

$$= 1,62\%$$

FFD = 60 cm

FFD = 60 cm

L <sub>2</sub> = 1,13 O = 1,33	L <sub>21</sub> = 1,11	O <sub>1</sub> = 1,33	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 15,04%
	L <sub>22</sub> = 1,09	O <sub>2</sub> = 1,30	
	L <sub>23</sub> = 1,15	O <sub>3</sub> = 1,34	
	L <sub>24</sub> = 1,17	O <sub>4</sub> = 1,38	
	L <sub>25</sub> = 1,13	O <sub>5</sub> = 1,30	

FFD = 70 cm

L <sub>2</sub> = 1,542 O = 1,78	L <sub>21</sub> = 1,54	O <sub>1</sub> = 1,78	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 13,37%
	L <sub>22</sub> = 1,52	O <sub>2</sub> = 1,80	
	L <sub>23</sub> = 1,57	O <sub>3</sub> = 1,76	
	L <sub>24</sub> = 1,55	O <sub>4</sub> = 1,79	
	L <sub>25</sub> = 1,53	O <sub>5</sub> = 1,72	

FFD = 80 cm

L <sub>2</sub> = 1,41 O = 1,58	L <sub>21</sub> = 1,41	O <sub>1</sub> = 1,55	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 10,76%
	L <sub>22</sub> = 1,38	O <sub>2</sub> = 1,58	
	L <sub>23</sub> = 1,42	O <sub>3</sub> = 1,62	
	L <sub>24</sub> = 1,40	O <sub>4</sub> = 1,55	
	L <sub>25</sub> = 1,44	O <sub>5</sub> = 1,60	

FFD = 90 cm

L <sub>2</sub> = 1,23 O = 1,34	L <sub>21</sub> = 1,24	O <sub>1</sub> = 1,31	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 8,21%
	L <sub>22</sub> = 1,23	O <sub>2</sub> = 1,40	
	L <sub>23</sub> = 1,26	O <sub>3</sub> = 1,28	
	L <sub>24</sub> = 1,20	O <sub>4</sub> = 1,39	
	L <sub>25</sub> = 1,22	O <sub>5</sub> = 1,30	

FFD = 100 cm

L <sub>2</sub> = 1,14 O = 1,22	L <sub>21</sub> = 1,06	O <sub>1</sub> = 1,24	$CO = \frac{\overline{DO} - \overline{DT}}{DO}$ = 6,56%
	L <sub>22</sub> = 1,14	O <sub>2</sub> = 1,22	
	L <sub>23</sub> = 1,18	O <sub>3</sub> = 1,18	
	L <sub>24</sub> = 1,12	O <sub>4</sub> = 1,26	
	L <sub>25</sub> = 1,20	O <sub>5</sub> = 1,20	

FFD = 110 cm

L <sub>2</sub> = 1,14 O = 1,20	L <sub>21</sub> = 1,14	O <sub>1</sub> = 1,16	$CO = \frac{\overline{DO} - \overline{DT}}{DO}$ = 5%
	L <sub>22</sub> = 1,10	O <sub>2</sub> = 1,22	
	L <sub>23</sub> = 1,15	O <sub>3</sub> = 1,20	
	L <sub>24</sub> = 1,19	O <sub>4</sub> = 1,24	
	L <sub>25</sub> = 1,12	O <sub>5</sub> = 1,18	

FFD = 120 cm

L <sub>2</sub> = 1,15 O = 1,18	L <sub>21</sub> = 1,17	O <sub>1</sub> = 1,22	$CO = \frac{\overline{DO} - \overline{DT}}{DO}$ = 2,54%
	L <sub>22</sub> = 1,15	O <sub>2</sub> = 1,20	
	L <sub>23</sub> = 1,12	O <sub>3</sub> = 1,16	
	L <sub>24</sub> = 1,19	O <sub>4</sub> = 1,18	
	L <sub>25</sub> = 1,12	O <sub>5</sub> = 1,14	

Hasil analogi perhitungan ralat ratio 5:1

FFD (cm)	$\frac{\partial CO}{\partial DO}$	$\frac{\partial CO}{\partial DT}$	$\delta DO$ (cm)	$\delta DT$ (cm)	$\delta CO$ (%)
50	0,4596	0,5649	0,0243	0,0207	1,62
60	0,6388	0,5649	0,0222	0,0180	1,75
70	0,4867	0,5618	$7,0711 \cdot 10^{-3}$	$8,0023 \cdot 10^{-3}$	0,59

80	0,5648	0,6229	0,0138	0,0100	1,00
90	0,6850	0,7463	0,0238	0,0100	1,79
100	0,7659	0,7463	0,0141	0,0145	2,12
110	0,7917	0,8333	0,0141	0,0152	1,69
120	0,8259	0,8475	0,0141	0,0138	1,65

2. Perhitungan ralat dari hasil eksperimen untuk perbandingan 6:1

FFD = 50 cm

L <sub>2</sub> = 1,45 O = 2,42	L <sub>21</sub> = 1,95	O <sub>1</sub> = 2,40	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 15,04%
	L <sub>22</sub> = 2,04	O <sub>2</sub> = 2,46	
	L <sub>23</sub> = 1,98	O <sub>3</sub> = 2,42	
	L <sub>24</sub> = 1,88	O <sub>4</sub> = 2,44	
	L <sub>25</sub> = 1,90	O <sub>5</sub> = 2,38	

FFD = 60 cm

L <sub>2</sub> = 1,54 O = 1,88	L <sub>21</sub> = 1,52	O <sub>1</sub> = 1,85	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 18,08%
	L <sub>22</sub> = 1,51	O <sub>2</sub> = 1,85	
	L <sub>23</sub> = 1,57	O <sub>3</sub> = 1,88	
	L <sub>24</sub> = 1,60	O <sub>4</sub> = 1,92	
	L <sub>25</sub> = 1,50	O <sub>5</sub> = 1,90	

FFD = 70 cm

L <sub>2</sub> = 1,58 O = 1,92	L <sub>21</sub> = 1,58	O <sub>1</sub> = 1,94	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 17,71%
	L <sub>22</sub> = 1,62	O <sub>2</sub> = 1,90	
	L <sub>23</sub> = 1,56	O <sub>3</sub> = 1,92	
	L <sub>24</sub> = 1,59	O <sub>4</sub> = 1,91	
	L <sub>25</sub> = 1,55	O <sub>5</sub> = 1,93	



FFD = 80 cm

L <sub>2</sub> = 1,34 O = 1,60	L <sub>21</sub> = 1,34	O <sub>1</sub> = 1,56	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 16,25%
	L <sub>22</sub> = 1,32	O <sub>2</sub> = 1,60	
	L <sub>23</sub> = 1,36	O <sub>3</sub> = 1,62	
	L <sub>24</sub> = 1,38	O <sub>4</sub> = 1,64	
	L <sub>25</sub> = 1,30	O <sub>5</sub> = 1,58	

FFD = 90 cm

L <sub>2</sub> = 1,11 O = 1,30	L <sub>21</sub> = 1,15	O <sub>1</sub> = 1,30	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 14,61%
	L <sub>22</sub> = 1,15	O <sub>2</sub> = 1,32	
	L <sub>23</sub> = 1,05	O <sub>3</sub> = 1,28	
	L <sub>24</sub> = 1,09	O <sub>4</sub> = 1,35	
	L <sub>25</sub> = 1,11	O <sub>5</sub> = 1,25	

FFD = 100 cm

L <sub>2</sub> = 1,08 O = 1,24	L <sub>21</sub> = 1,08	O <sub>1</sub> = 1,20	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 12,90%
	L <sub>22</sub> = 1,11	O <sub>2</sub> = 1,24	
	L <sub>23</sub> = 1,06	O <sub>3</sub> = 1,30	
	L <sub>24</sub> = 1,10	O <sub>4</sub> = 1,26	
	L <sub>25</sub> = 1,05	O <sub>5</sub> = 1,20	

FFD = 110 cm

L <sub>2</sub> = 1,34 O = 1,20	L <sub>21</sub> = 1,24	O <sub>1</sub> = 1,32	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 10,45%
	L <sub>22</sub> = 1,18	O <sub>2</sub> = 1,34	
	L <sub>23</sub> = 1,22	O <sub>3</sub> = 1,38	
	L <sub>24</sub> = 1,16	O <sub>4</sub> = 1,30	
	L <sub>25</sub> = 1,20	O <sub>5</sub> = 1,36	

FFD = 120 cm

L <sub>2</sub> = 1,32 O = 1,22	L <sub>21</sub> = 1,22	O <sub>1</sub> = 1,28	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 7,57%
	L <sub>22</sub> = 1,25	O <sub>2</sub> = 1,36	
	L <sub>23</sub> = 1,23	O <sub>3</sub> = 1,32	
	L <sub>24</sub> = 1,24	O <sub>4</sub> = 1,36	
	L <sub>25</sub> = 1,16	O <sub>5</sub> = 1,28	

Hasil analogi perhitungan relatif untuk rasio 5:1

FFD (cm)	$\frac{\partial CO}{\partial DO}$	$\frac{\partial CO}{\partial DT}$	$\delta DO$ (cm)	$\delta DT$ (cm)	$\delta CO$ (%)
50	0,3333	-0,4130	0,0141	0,0286	0,28
60	0,4360	-0,5320	0,0137	0,0190	1,18
70	0,4290	-0,5210	$7,0711 \cdot 10^{-3}$	0,0122	0,70
80	0,5230	-0,6250	0,0141	0,0141	1,15
90	0,6568	-0,7692	0,0171	0,0189	1,83
100	0,7024	-0,8065	0,0189	0,0114	1,61
110	0,6683	-0,7463	0,0141	0,0141	1,41
120	0,7002	-0,7576	0,0179	0,0158	1,73

## 3. Perhitungan relatif dari hasil eksperimen untuk perbandingan 8 : 1

FFD = 50 cm

L <sub>2</sub> = 2,20 O = 2,82	L <sub>21</sub> = 2,18	O <sub>1</sub> = 2,82	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 21,99%
	L <sub>22</sub> = 2,24	O <sub>2</sub> = 2,88	
	L <sub>23</sub> = 2,22	O <sub>3</sub> = 2,82	
	L <sub>24</sub> = 2,17	O <sub>4</sub> = 2,87	
	L <sub>25</sub> = 2,19	O <sub>5</sub> = 2,80	

FD = 60 cm

L <sub>2</sub> = 2,23 O = 2,82	L <sub>21</sub> = 2,28	O <sub>1</sub> = 2,83	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 20,42%
	L <sub>22</sub> = 2,26	O <sub>2</sub> = 2,82	
	L <sub>23</sub> = 2,23	O <sub>3</sub> = 2,79	
	L <sub>24</sub> = 2,18	O <sub>4</sub> = 2,80	
	L <sub>25</sub> = 2,20	O <sub>5</sub> = 2,86	

FFD = 70 cm

L <sub>2</sub> = 2,43 O = 3,00	L <sub>21</sub> = 2,52	O <sub>1</sub> = 2,48	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 19,00%
	L <sub>22</sub> = 2,48	O <sub>2</sub> = 3,10	
	L <sub>23</sub> = 2,38	O <sub>3</sub> = 3,02	
	L <sub>24</sub> = 2,37	O <sub>4</sub> = 2,92	
	L <sub>25</sub> = 2,40	O <sub>5</sub> = 2,98	

FFD = 80 cm

L <sub>2</sub> = 2,41 O = 2,90	L <sub>21</sub> = 2,45	O <sub>1</sub> = 2,96	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 16,90%
	L <sub>22</sub> = 2,45	O <sub>2</sub> = 2,94	
	L <sub>23</sub> = 2,43	O <sub>3</sub> = 2,80	
	L <sub>24</sub> = 2,53	O <sub>4</sub> = 2,94	
	L <sub>25</sub> = 2,38	O <sub>5</sub> = 2,86	

FFD = 90 cm

L <sub>2</sub> = 2,03 O = 2,41	L <sub>21</sub> = 2,05	O <sub>1</sub> = 2,41	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ = 15,77%
	L <sub>22</sub> = 2,00	O <sub>2</sub> = 2,32	
	L <sub>23</sub> = 2,02	O <sub>3</sub> = 2,47	
	L <sub>24</sub> = 2,01	O <sub>4</sub> = 2,40	
	L <sub>25</sub> = 2,07	O <sub>5</sub> = 2,45	

FFD = 100 cm

$L_2 = 2,41$ $O = 2,80$	$L_{21} = 2,41$	$O_1 = 2,94$	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ $= 13,93\%$
	$L_{22} = 2,47$	$O_2 = 2,94$	
	$L_{23} = 2,43$	$O_3 = 2,80$	
	$L_{24} = 2,36$	$O_4 = 2,70$	
	$L_{25} = 2,38$	$O_5 = 2,80$	

FFD = 110 cm

$L_2 = 2,45$ $O = 2,78$	$L_{21} = 2,56$	$O_1 = 2,85$	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ $= 11,87\%$
	$L_{22} = 2,49$	$O_2 = 2,72$	
	$L_{23} = 2,38$	$O_3 = 2,78$	
	$L_{24} = 2,42$	$O_4 = 2,80$	
	$L_{25} = 2,40$	$O_5 = 2,75$	

FFD = 120 cm

$L_2 = 2,47$ $O = 2,74$	$L_{21} = 2,44$	$O_1 = 2,70$	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ $= 9,85\%$
	$L_{22} = 2,52$	$O_2 = 2,77$	
	$L_{23} = 2,50$	$O_3 = 2,79$	
	$L_{24} = 2,45$	$O_4 = 2,70$	
	$L_{25} = 2,43$	$O_5 = 2,74$	

Hasil analogi perhitungan ralat untuk rasio 8:1

FFD (cm)	$\frac{\partial CO}{\partial DO}$	$\frac{\partial CO}{\partial DT}$	$\delta DO$ (cm)	$\delta DT$ (CM)	$\delta CO$ (%)
50	0,2766	-0,3546	0,0167	0,0130	0,65
60	0,2804	-0,4484	0,0122	0,0184	0,89

70	0,2700	-0,3333	0,0297	0,0297	1,27
80	0,2866	-0,3448	0,0303	0,0201	1,11
90	0,3495	-0,4149	0,0434	0,0130	1,61
100	0,3074	-0,3571	0,0496	0,0192	1,67
110	0,3170	-0,3597	0,0221	0,0332	1,38
120	0,3289	-0,3649	0,0182	0,0177	0,88

4. Perhitungan ralat dari hasil eksperimen untuk perbandingan 10 : 1

FFD = 50 cm

$L_2 = 1,68$ $O = 2,21$	$L_{21} = 1,68$	$O_1 = 2,21$	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$  $= 23,98\%$
	$L_{22} = 1,72$	$O_2 = 2,19$	
	$L_{23} = 1,64$	$O_3 = 2,25$	
	$L_{24} = 1,66$	$O_4 = 2,18$	
	$L_{25} = 1,70$	$O_5 = 2,22$	

FFD = 60 cm

$L_2 = 1,50$ $O = 1,92$	$L_{21} = 1,48$	$O_1 = 1,94$	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$  $= 21,87\%$
	$L_{22} = 1,50$	$O_2 = 1,92$	
	$L_{23} = 1,53$	$O_3 = 1,88$	
	$L_{24} = 1,52$	$O_4 = 1,96$	
	$L_{25} = 1,47$	$O_5 = 1,90$	

FFD = 70 cm

$L_2 = 1,17$ $O = 1,46$	$L_{21} = 1,19$	$O_1 = 1,40$	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$  $= 19,86\%$
	$L_{22} = 1,20$	$O_2 = 1,46$	
	$L_{23} = 1,16$	$O_3 = 1,51$	
	$L_{24} = 1,14$	$O_4 = 1,42$	
	$L_{25} = 1,15$	$O_5 = 1,51$	

FFD = 80 cm

L <sub>2</sub> = 1,18 O = 1,43	L <sub>21</sub> = 1,19	O <sub>1</sub> = 1,40	$CO = \frac{\overline{DO} - \overline{DT}}{DO}$ = 17,48%
	L <sub>22</sub> = 1,21	O <sub>2</sub> = 1,45	
	L <sub>23</sub> = 1,18	O <sub>3</sub> = 1,43	
	L <sub>24</sub> = 1,17	O <sub>4</sub> = 1,48	
	L <sub>25</sub> = 1,15	O <sub>5</sub> = 1,39	

FFD = 90 cm

L <sub>2</sub> = 1,28 O = 1,51	L <sub>21</sub> = 1,32	O <sub>1</sub> = 1,53	$CO = \frac{\overline{DO} - \overline{DT}}{DO}$ = 15,23%
	L <sub>22</sub> = 1,28	O <sub>2</sub> = 1,49	
	L <sub>23</sub> = 1,30	O <sub>3</sub> = 1,55	
	L <sub>24</sub> = 1,26	O <sub>4</sub> = 1,47	
	L <sub>25</sub> = 1,24	O <sub>5</sub> = 1,51	

FFD = 100 cm

L <sub>2</sub> = 1,34 O = 1,55	L <sub>21</sub> = 1,36	O <sub>1</sub> = 1,35	$CO = \frac{\overline{DO} - \overline{DT}}{DO}$ = 15,23%
	L <sub>22</sub> = 1,38	O <sub>2</sub> = 1,49	
	L <sub>23</sub> = 1,34	O <sub>3</sub> = 1,55	
	L <sub>24</sub> = 1,32	O <sub>4</sub> = 1,47	
	L <sub>25</sub> = 1,24	O <sub>5</sub> = 1,51	

FFD = 110 cm

L <sub>2</sub> = 1,37 O = 1,56	L <sub>21</sub> = 1,39	O <sub>1</sub> = 1,54	$CO = \frac{\overline{DO} - \overline{DT}}{DO}$ = 10,45%
	L <sub>22</sub> = 1,40	O <sub>2</sub> = 1,60	
	L <sub>23</sub> = 1,34	O <sub>3</sub> = 1,56	
	L <sub>24</sub> = 1,37	O <sub>4</sub> = 1,54	
	L <sub>25</sub> = 1,35	O <sub>5</sub> = 1,56	

FFD = 120 cm

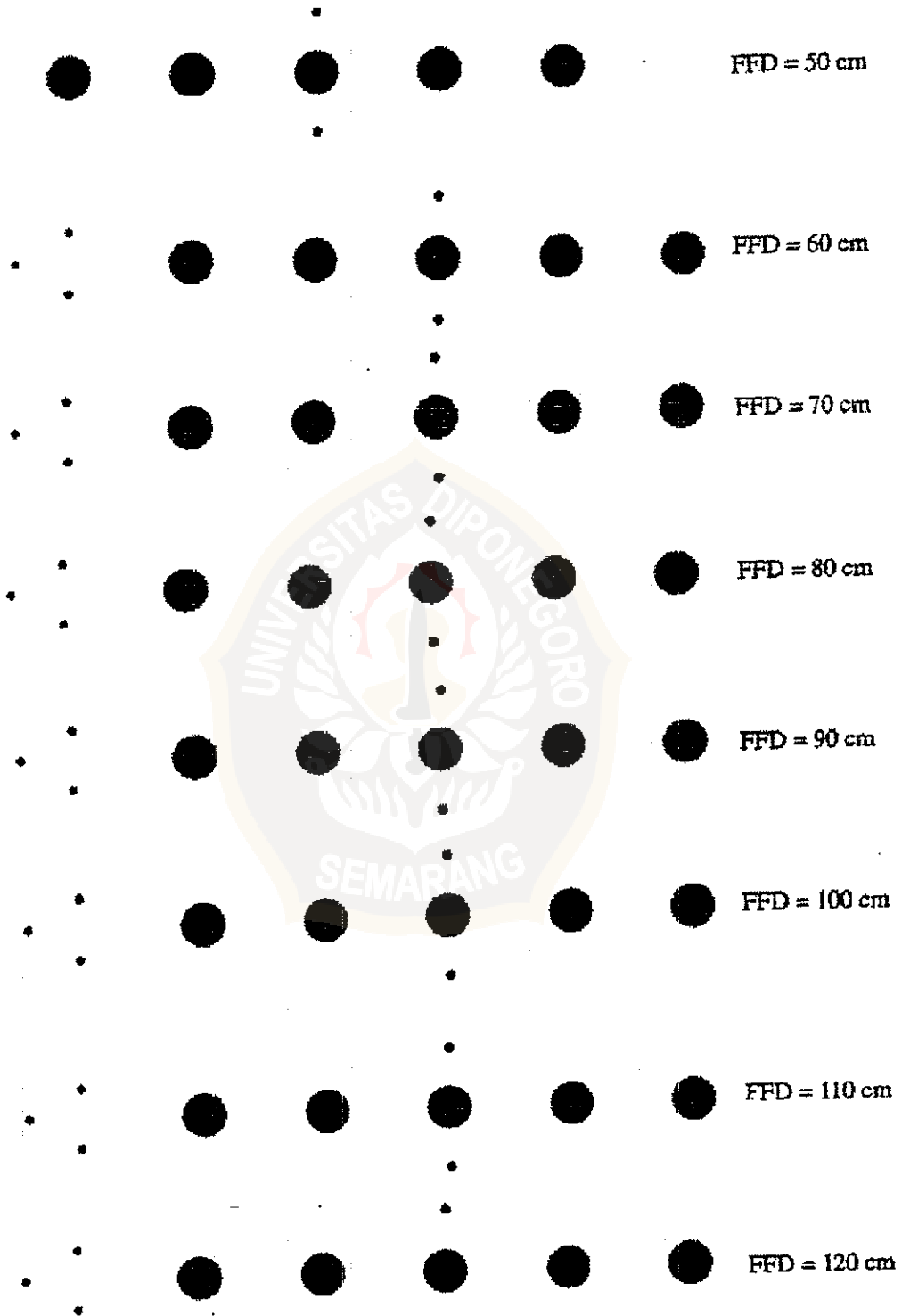
$L_2 = 1,05$ $O = 1,18$	$L_{21} = 1,04$	$O_1 = 1,17$	$CO = \frac{\overline{DO} - \overline{DT}}{\overline{DO}}$ $= 11,02\%$
	$L_{22} = 1,04$	$O_2 = 1,16$	
	$L_{23} = 1,03$	$O_3 = 1,18$	
	$L_{24} = 1,06$	$O_4 = 1,25$	
	$L_{25} = 1,08$	$O_5 = 1,14$	

Hasil analogi perhitungan ralat untuk rasio 10 : 1

FFD (cm)	$\frac{\partial CO}{\partial DO}$	$\frac{\partial CO}{\partial DT}$	$\delta DO$ (cm)	$\delta DT$ (cm)	$\delta CO$ (%)
50	0,3439	-0,4525	0,0122	0,0141	0,76
60	0,4069	-0,5208	0,0141	0,0114	0,83
70	0,5489	-0,6849	0,0226	0,0116	1,47
80	0,5770	-0,6993	0,0164	0,0100	1,18
90	0,5614	-0,6623	0,0141	0,0141	1,22
100	0,5578	-0,6452	0,0114	0,0141	1,11
110	0,5629	-0,6410	0,0109	0,0114	1,41
120	0,7541	-0,8475	0,0187	$8,9443 \cdot 10^{-3}$	1,60

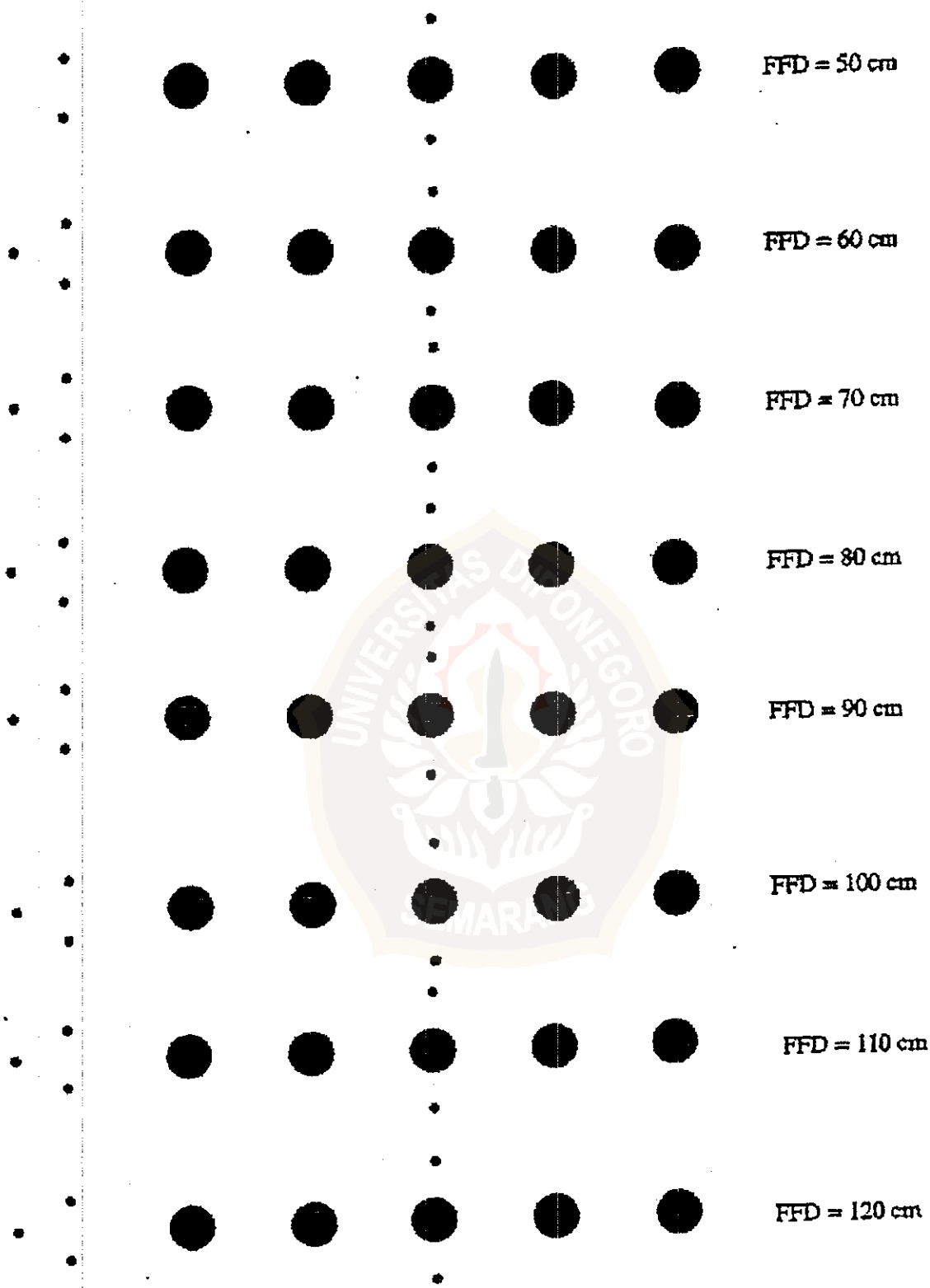
# Lampiran 4

Grid Rasio 5:1

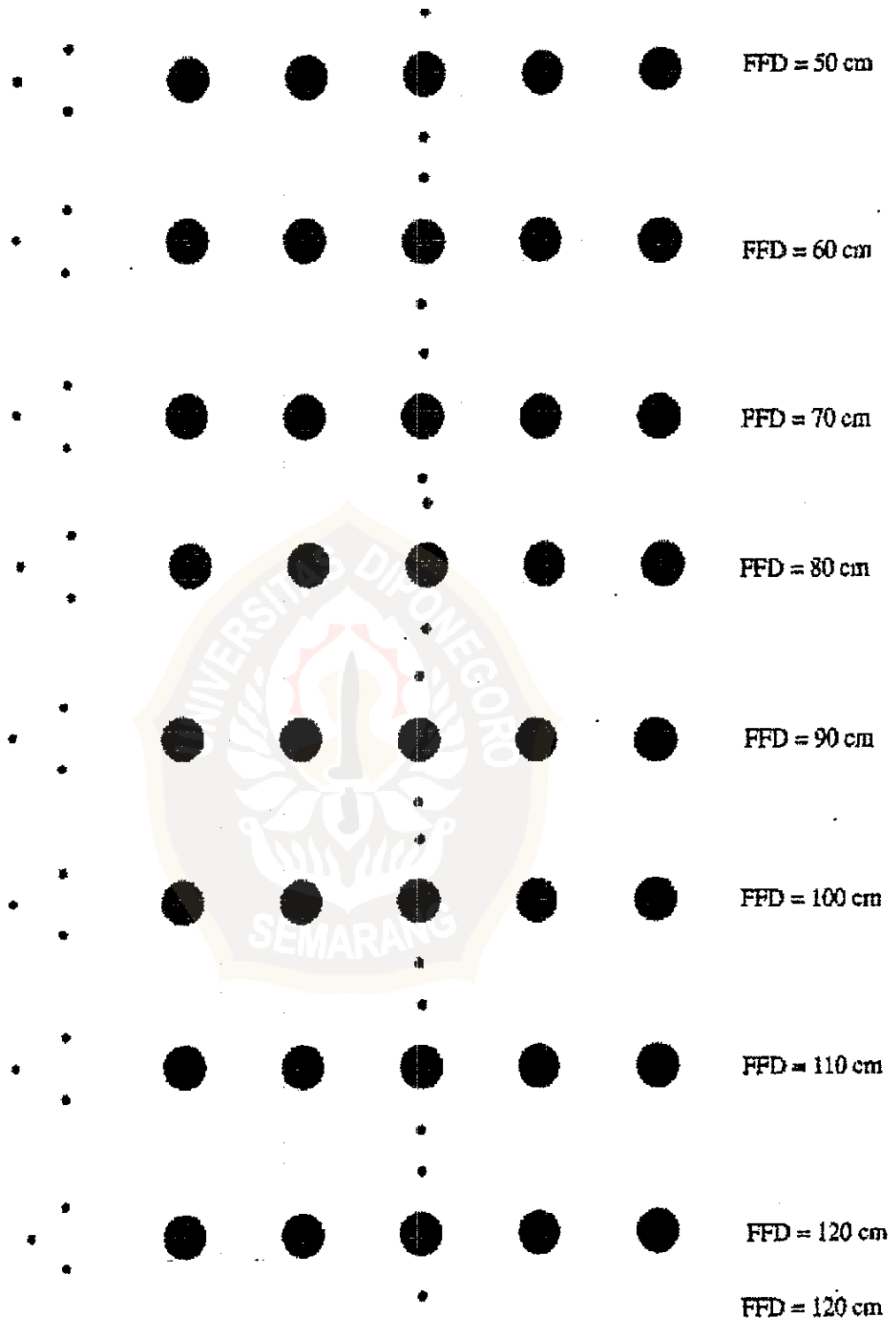




Rasio 6:1



## Grid Rasio 8:1



## Grid Rasio 10:1

