

## BAB IV

### KESIMPULAN

Setelah simulasi dilakukan, dari analisis hasilnya dapat ditarik kesimpulan sebagai berikut :

1. Pengendali fuzzy dapat digunakan dengan baik untuk mengendalikan perubahan sudut slewing yang diperlukan dalam sistem pengendali kran kapal ditinjau dari kemampuannya memperbaiki tanggapan waktu rata-rata 9 detik lebih cepat untuk setiap waktu slewingnya atau dalam memindahkan setiap satu container. Jadi dalam melakukan bongkar muat 208 TEU'S ada efisiensi waktu sebesar 1 jam 2 menit 24 detik.
2. Berkurangnya waktu yang ditempuh oleh sistem untuk mencapai keadaan stabil (steady state) mengakibatkan over shoot pada setiap sudut slewing yang diinginkan dan akan terbentuk kesalahan dalam kemampuan menstabilkan sistem (steady state error), dimana steady state error dalam simulasi ini relatif kecil atau dapat diabaikan.
3. Dalam pengoperasian kran khususnya dalam melakukan slewing, Operator tidak perlu lagi mengatur untuk menghentikan jalannya kran pada sudut yang diinginkan, karena sistem kendali fuzzy secara otomatis dapat mengerjakan sesuai dengan aturan-aturan kendali fuzzy yang telah ditetapkan.

## DAFTAR PUSTAKA

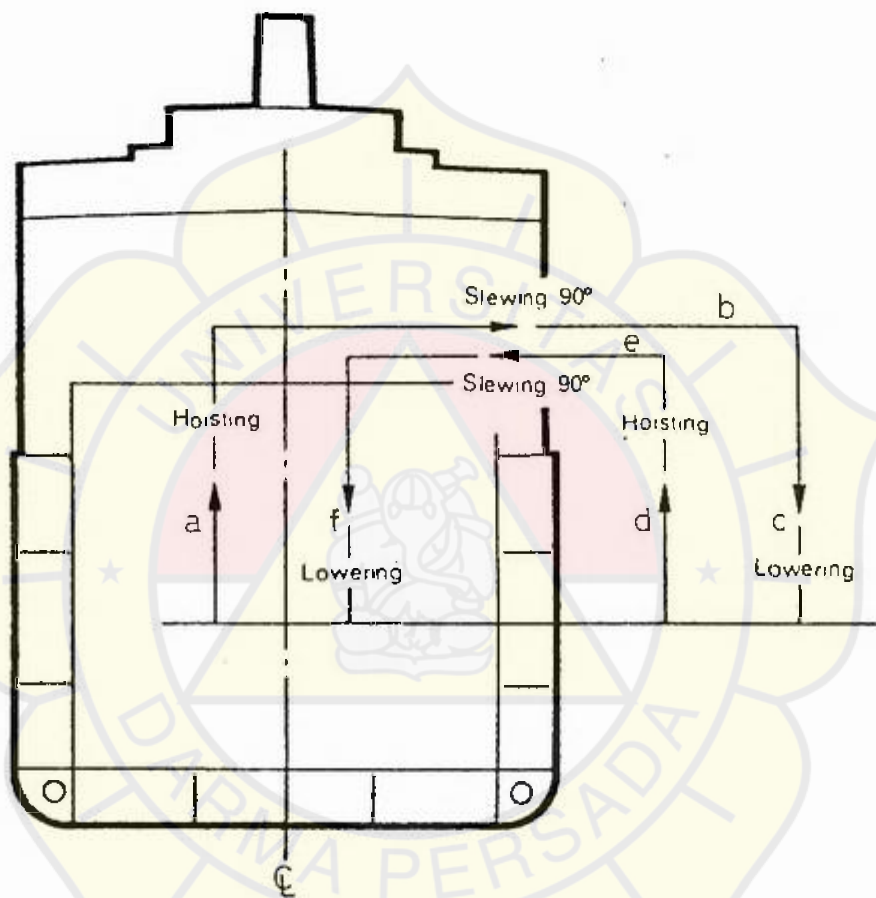
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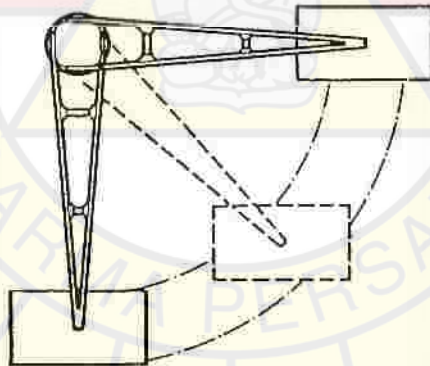
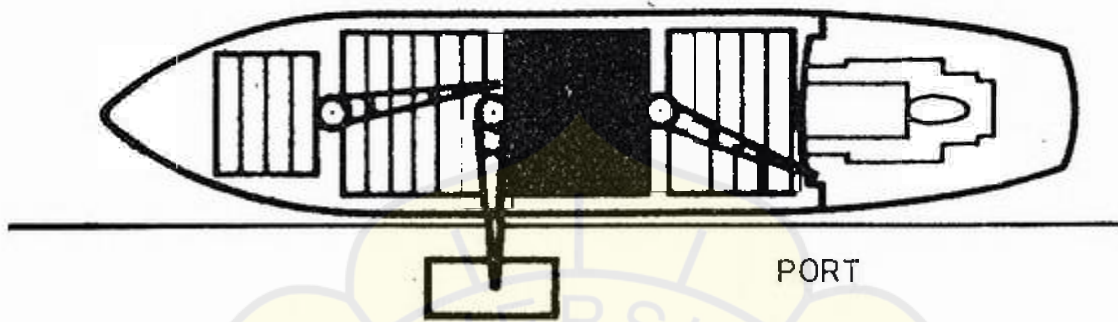


## Lampiran I. Crane Cycle (Siklus Kran)

Crane cycle :

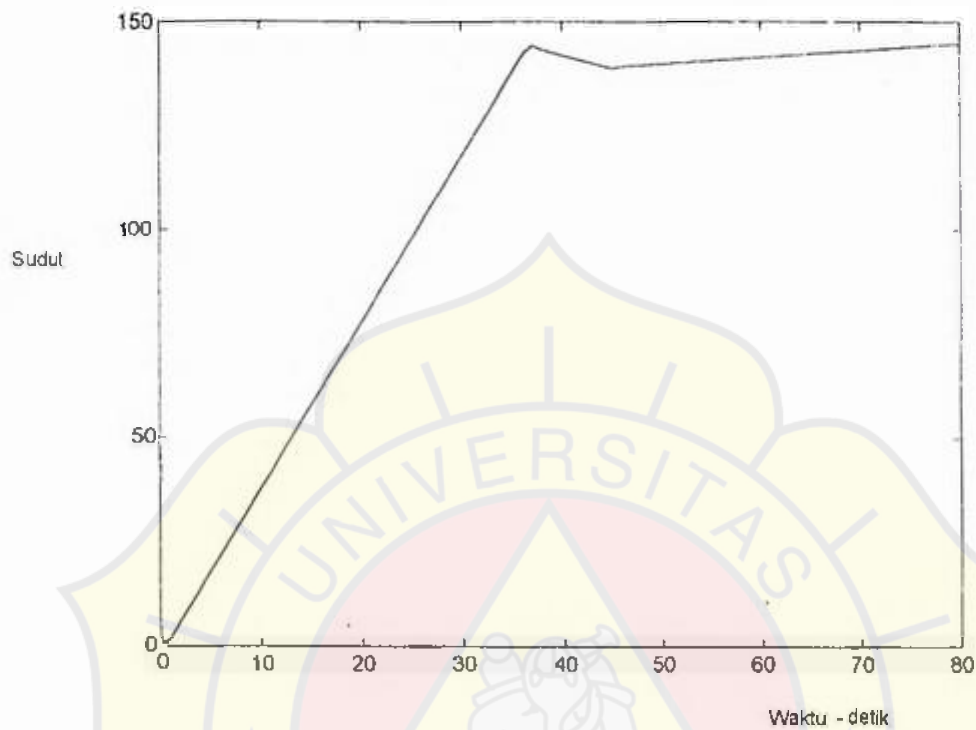
- a. Hoisting at full load
- b. Slewing
- c. Lowering at full load
- d. Hoisting at empty hook
- e. Slewing
- f. Lowering at empty hook

## Lampiran II. Gerak memindahkan barang (Slewing)

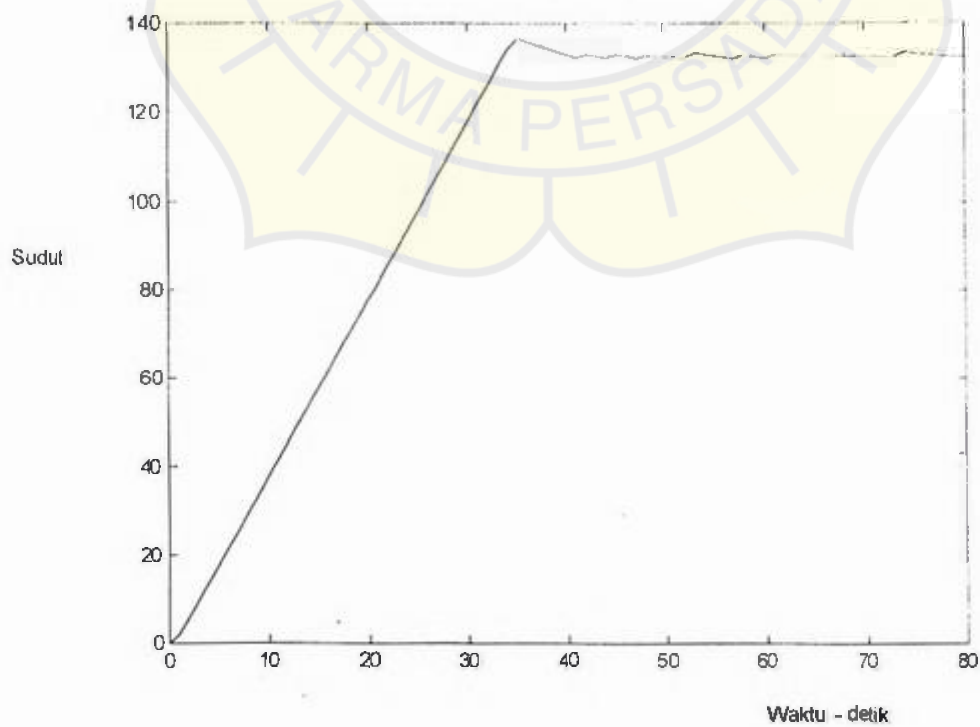
Slewing dengan sudut  $90^\circ$

## Lampiran III. Respon waktu perubahan sudut slewing

- Respon waktu perubahan sudut slewing  $139^\circ$

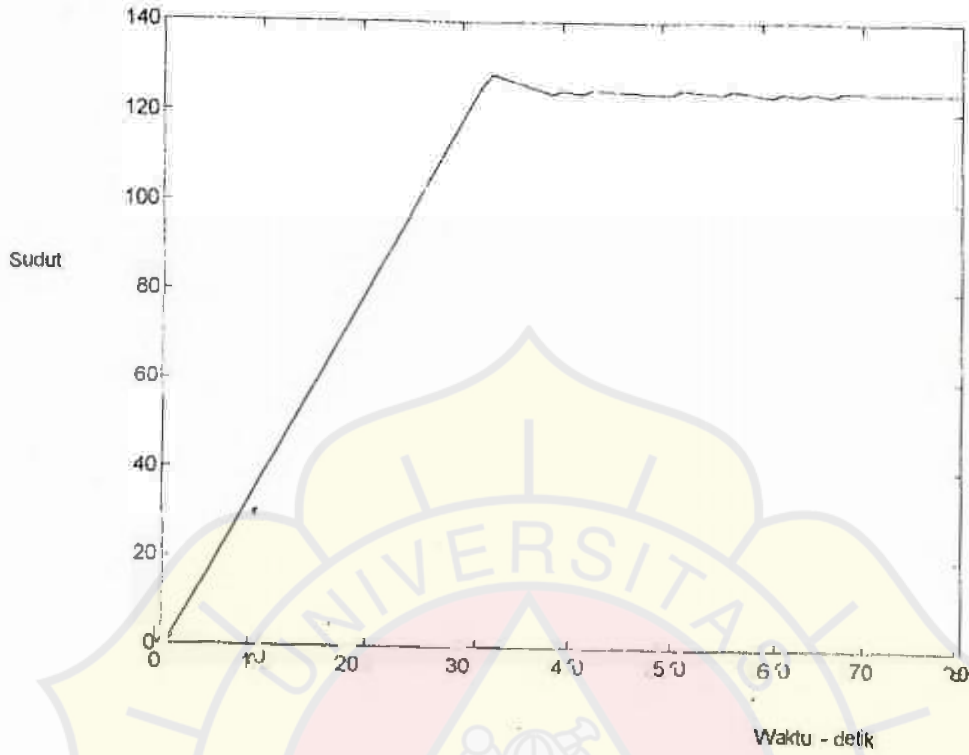


- Respon waktu perubahan sudut slewing  $133^\circ$

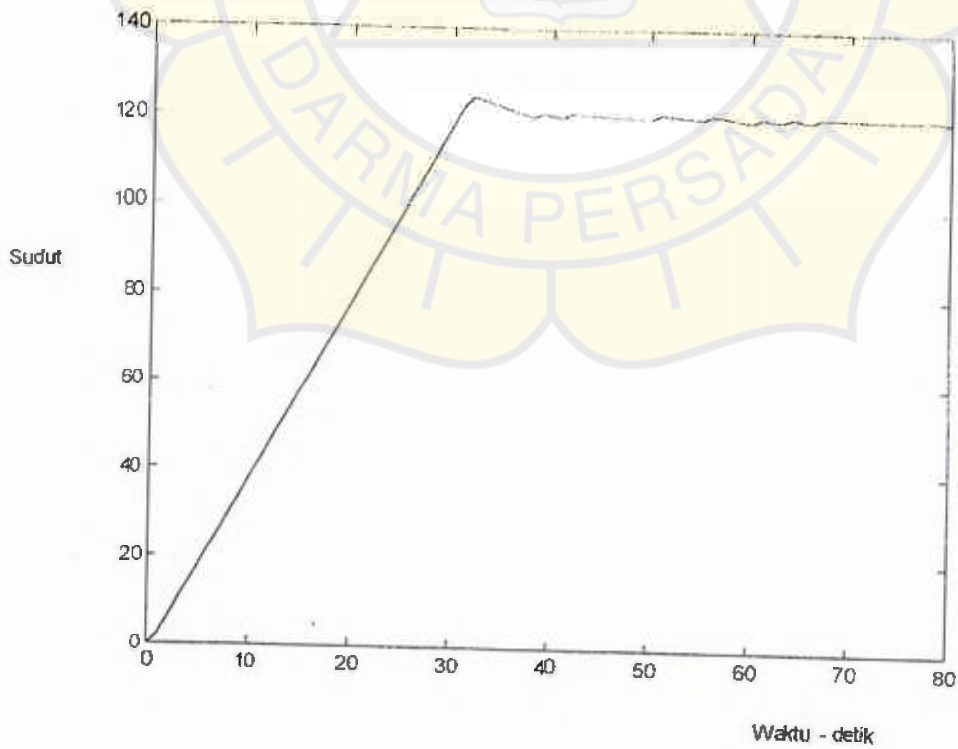




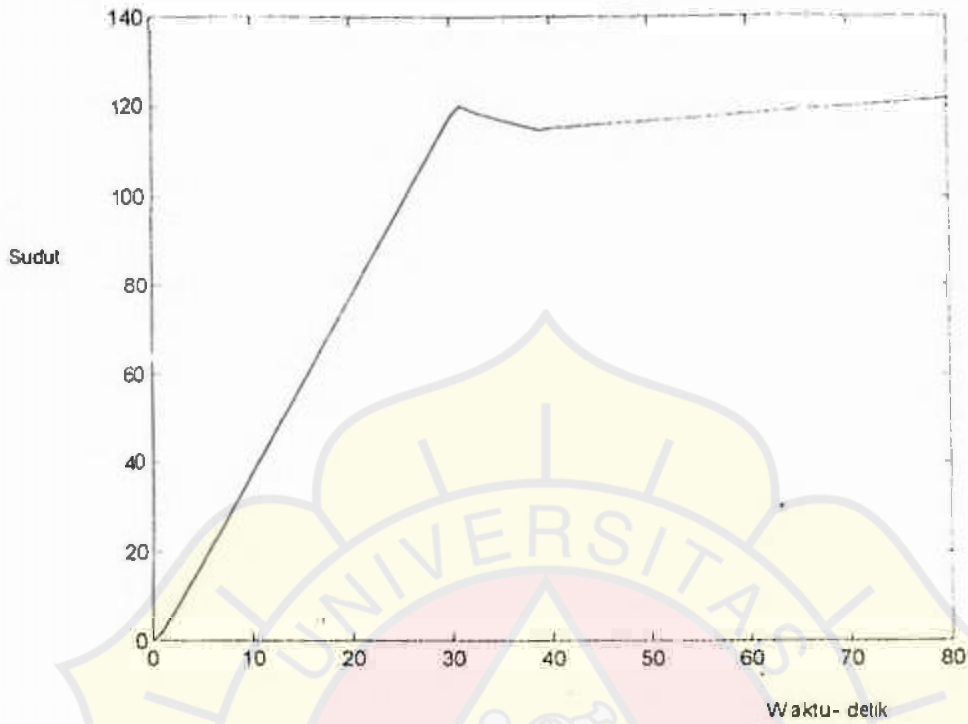
- Respon waktu perubahan sudut slewing  $125^\circ$



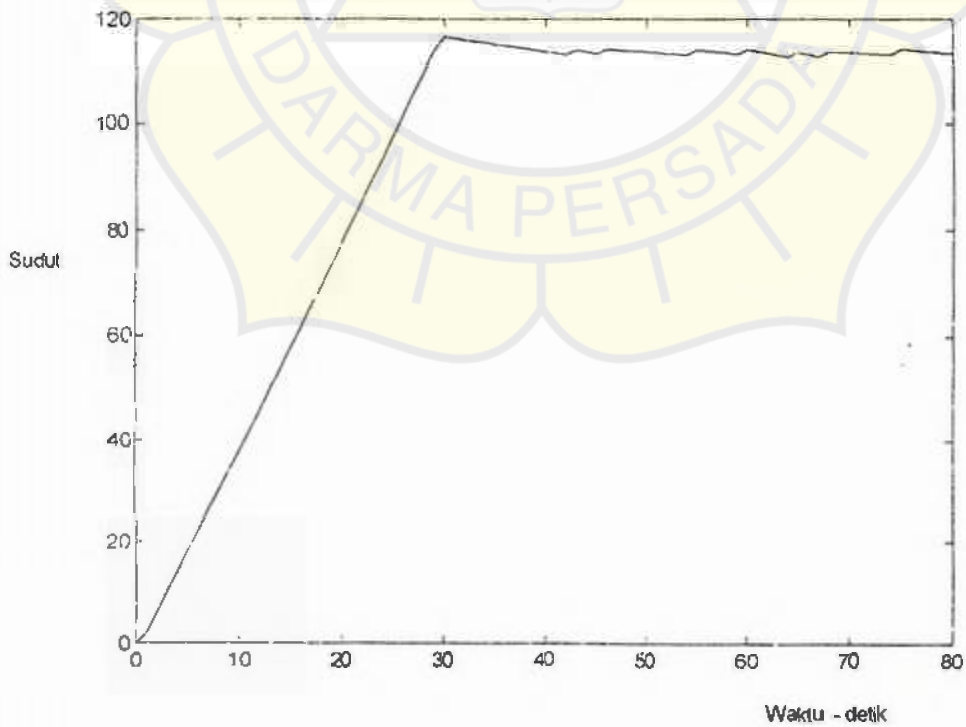
- Respon waktu perubahan sudut slewing  $121^\circ$



- Respon waktu perubahan sudut slewing  $115^\circ$

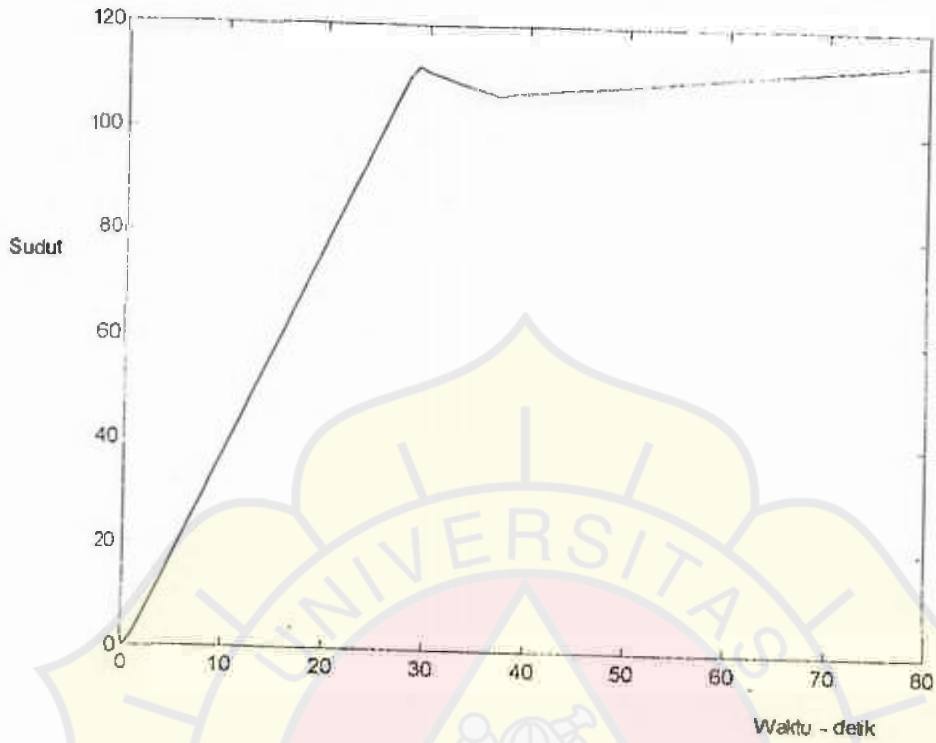


- Respon waktu perubahan sudut slewing  $114^\circ$

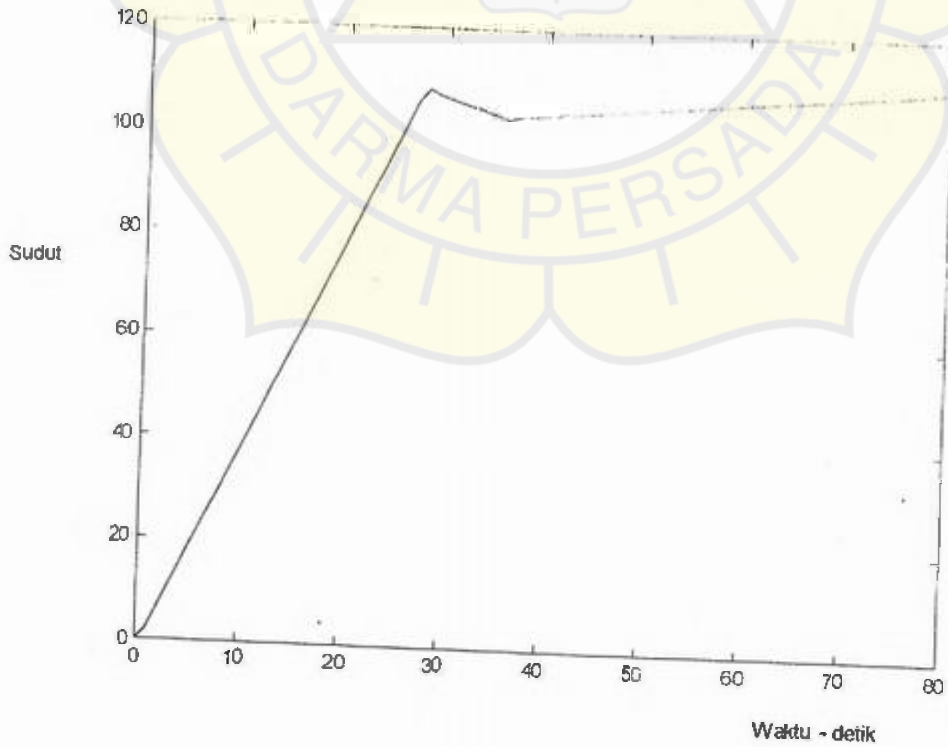




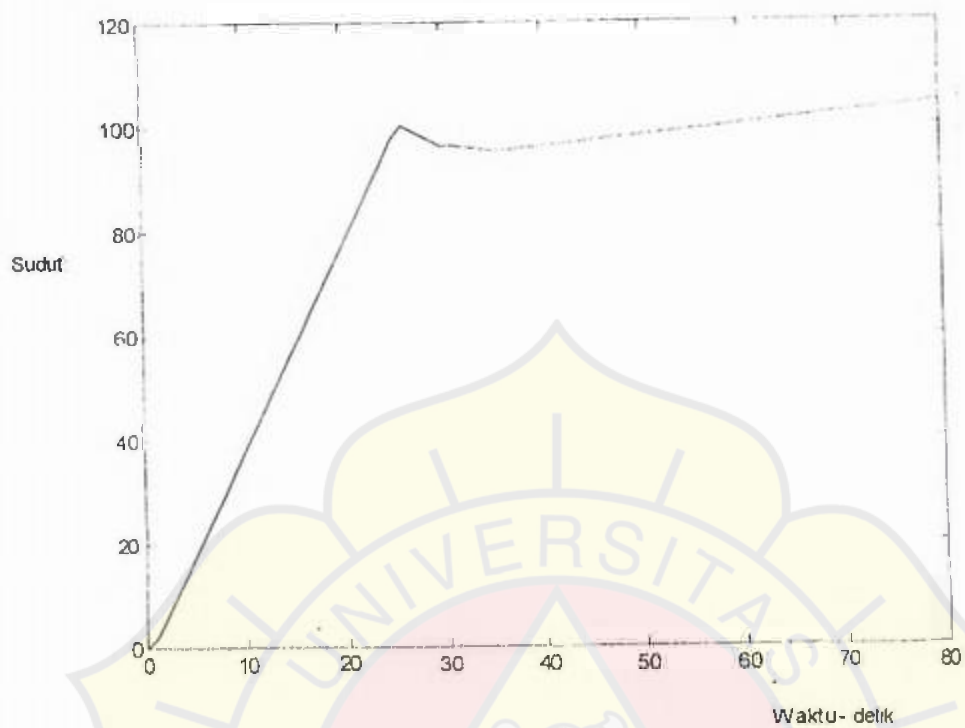
- Respon waktu perubahan sudut slewing  $107^\circ$



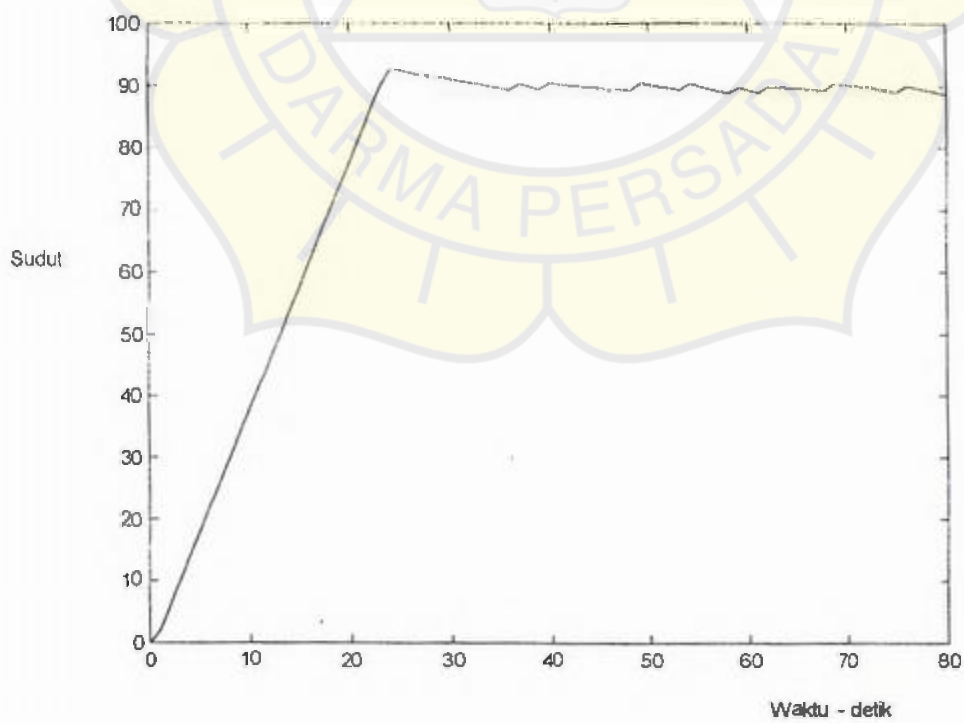
- Respon waktu perubahan sudut slewing  $103^\circ$



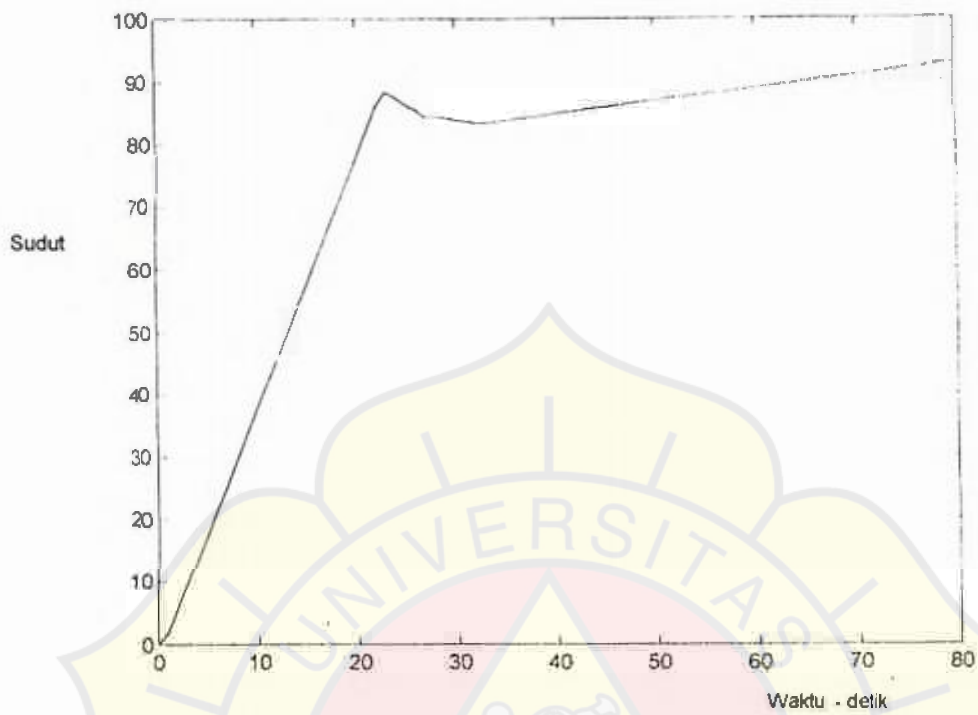
- Respon waktu perubahan sudut slewing  $96^\circ$



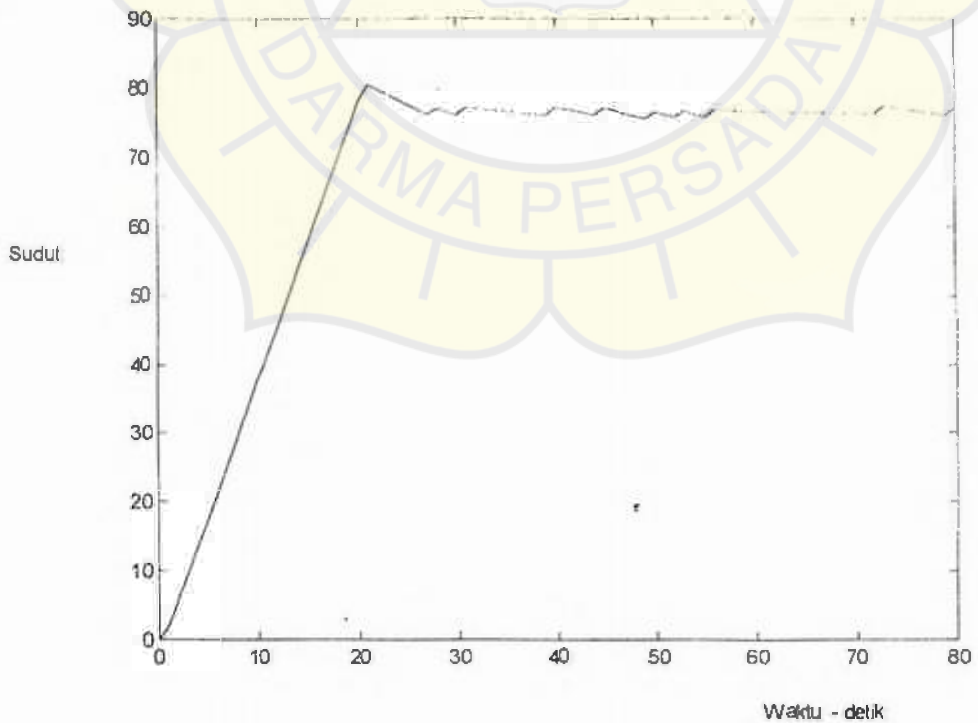
- Respon waktu perubahan sudut slewing  $90^\circ$



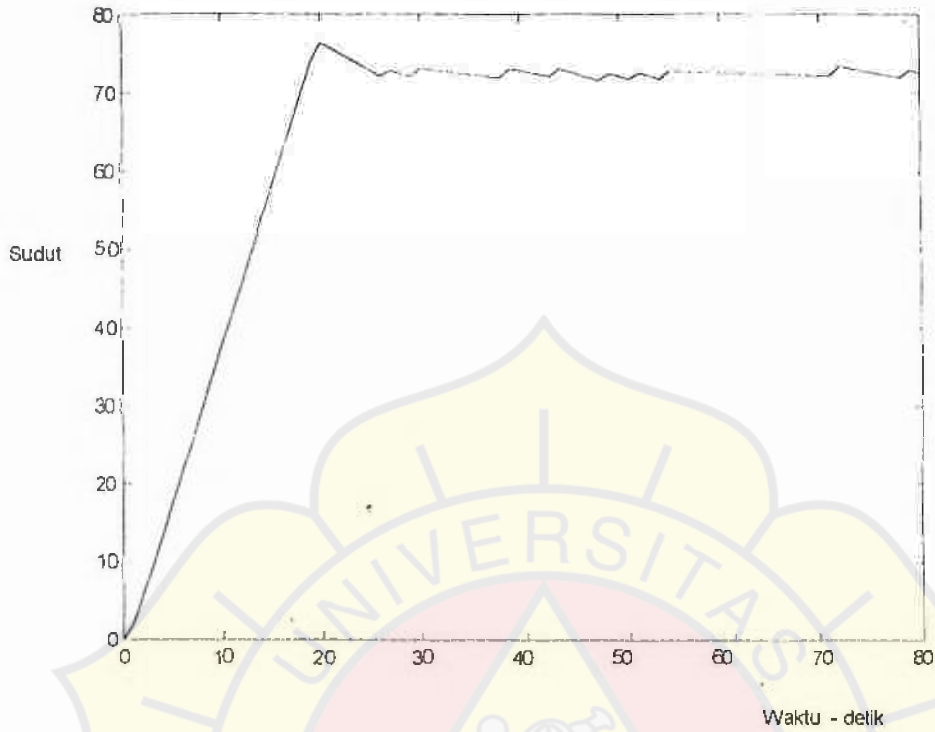
- Respon waktu perubahan sudut slewing  $84^\circ$



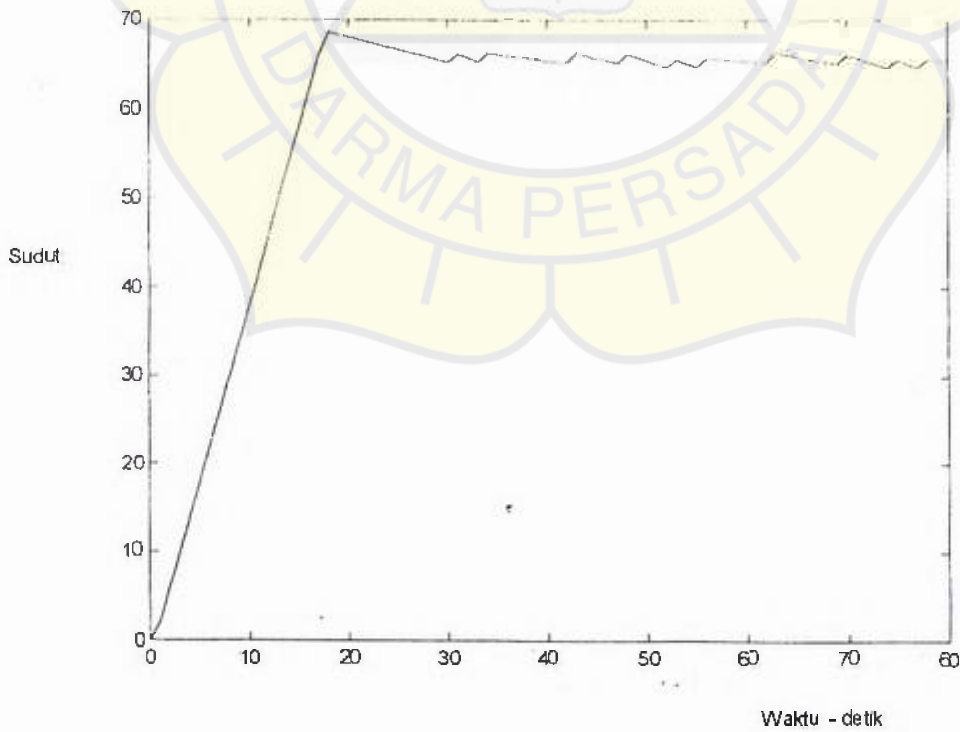
- Respon waktu perubahan sudut slewing  $77^\circ$



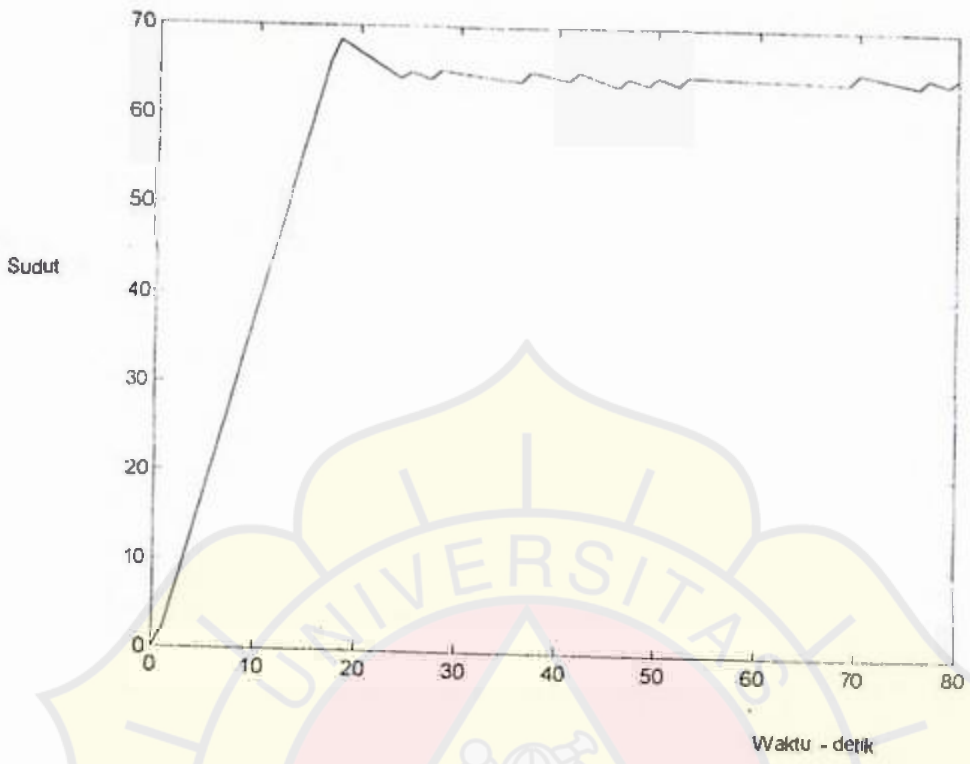
- Respon waktu perubahan sudut slewing  $73^\circ$



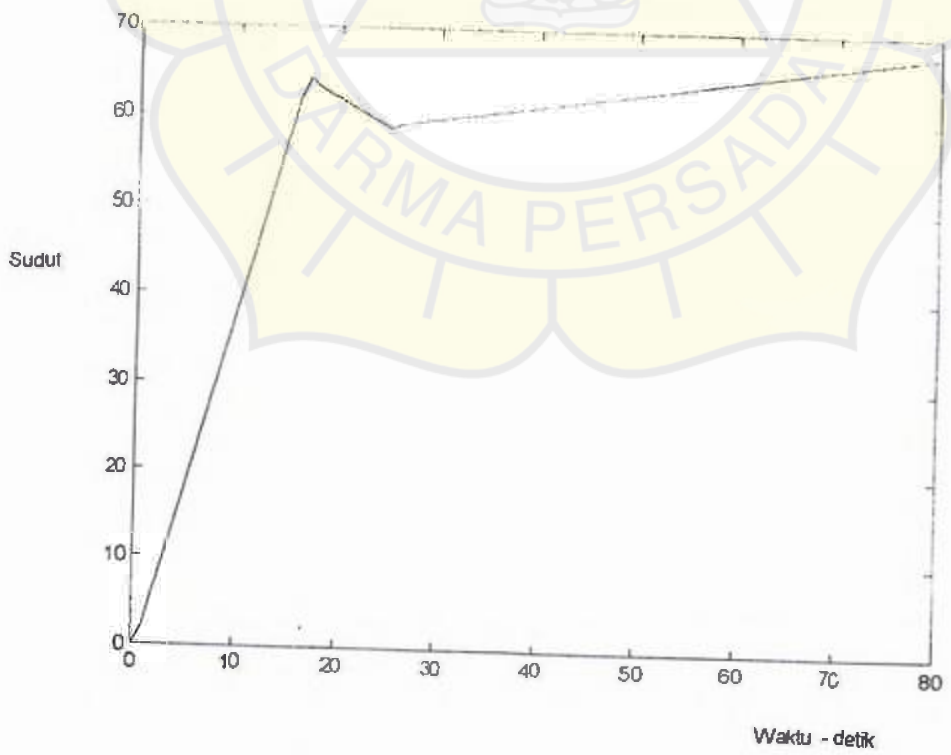
- Respon waktu perubahan sudut slewing  $66^\circ$



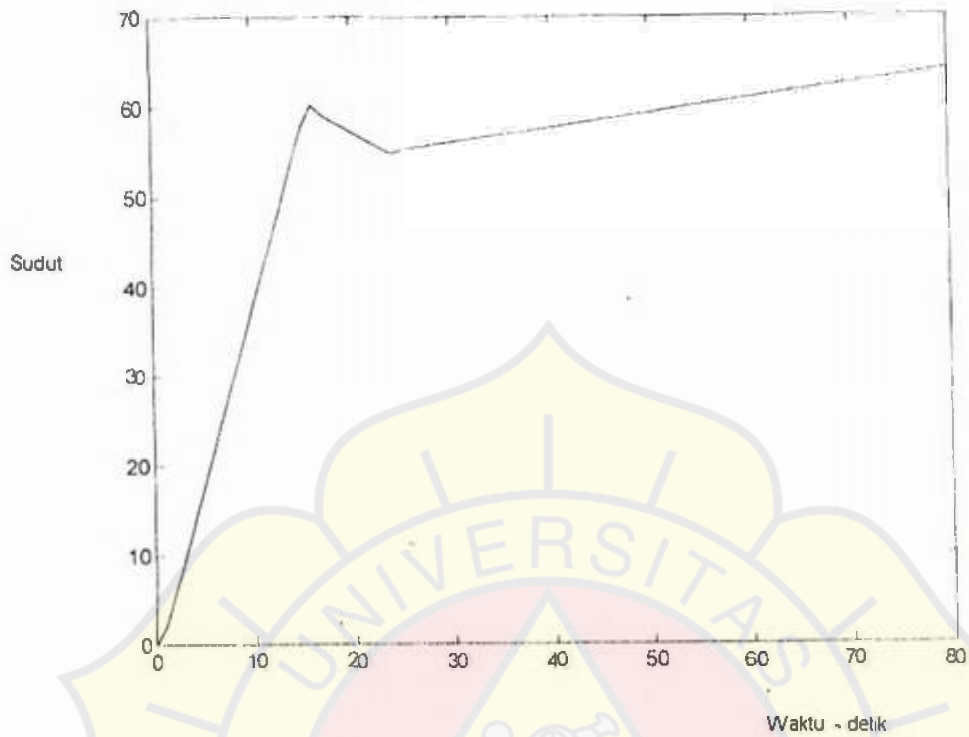
- Respon waktu perubahan sudut slewing  $65^\circ$



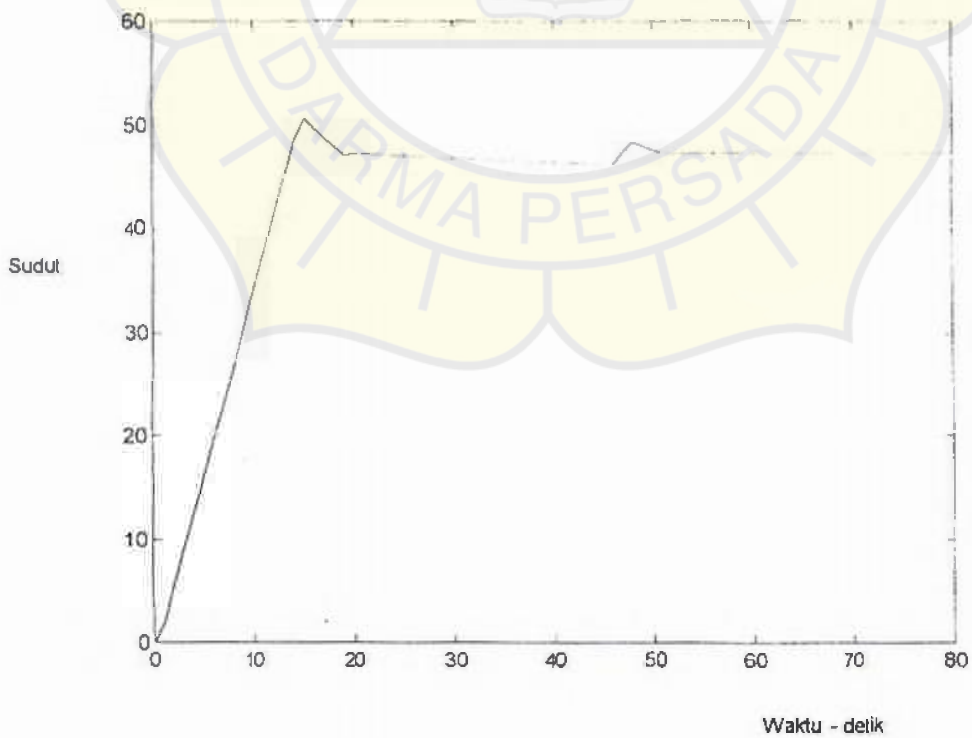
- Respon waktu perubahan sudut slewing  $59^\circ$



- Respon waktu perubahan sudut slewing  $55^\circ$

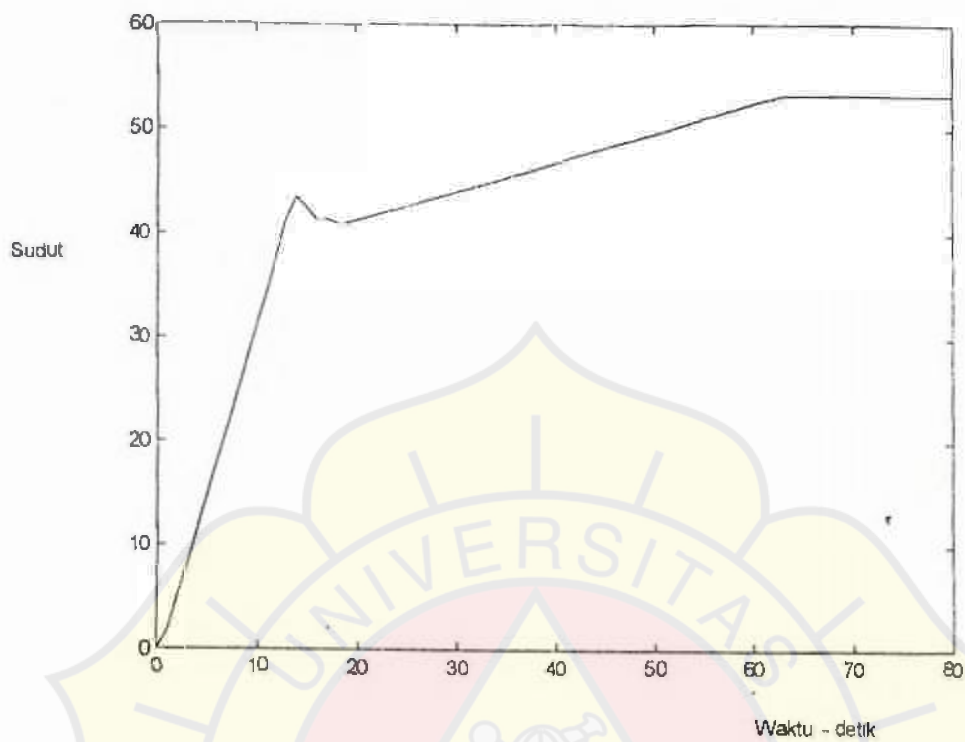


- Respon waktu perubahan sudut slewing  $47^\circ$





- Respon waktu perubahan sudut slewing  $41^\circ$



## Lampiran IV.

Perbandingan Waktu Slewing Simulasi dan Pengamatan  
pada Cargo Hold No.2 KM. CARAKA JAYA III 4.180 DWT

No.	Sudut Slewing 0	Tier	Bay - Row	Waktu Simulasi (ts) detik	Waktu Pengamatan (tp) detik	Selisih Waktu (ts -tp) detik
1	121	5	9 - A	33.00	48.04	-15.04
2	107	5	9 - B	30.00	41.89	-11.89
3	96	5	9 - C	27.00	37.00	-10.00
4	84	5	9 - D	24.00	31.57	-7.57
5	73	5	9 - E	21.00	26.47	-5.47
6	59	5	9 - F	18.00	19.70	-1.70
7	139	5	11 - A	36.00	55.84	-17.84
8	125	5	11 - B	34.00	49.78	-15.78
9	103	5	11 - C	29.00	40.12	-11.12
10	77	5	11 - D	22.00	28.34	-6.34
11	55	5	11 - E	17.00	17.68	-0.68
12	41	5	11 - F	15.00	17.08	-2.08
13	114	3	9 - A	31.00	44.97	-13.97
14	103	3	9 - B	29.00	40.12	-11.12
15	90	3	9 - C	25.00	34.30	-9.30
16	77	3	9 - D	22.00	28.34	-6.34
17	66	3	9 - E	19.00	23.14	-4.14
18	133	3	11 - A	36.00	55.42	-19.42
19	115	3	11 - B	32.00	45.41	-13.41
20	90	3	11 - C	25.00	34.30	-9.30
21	65	3	11 - D	19.00	22.65	-3.65
22	47	3	11 - E	16.00	17.38	-1.38
					Σ =	-197.54
					trata-rata =	-8.98

Waktu slewing tiap 1 peti kemas (1 TEU) lebih cepat = 8.98 detik, atau 9 detik per satu kali slewing

Untuk melakukan bongkar muat peti kemas sebanyak 208 TEU'S, memerlukan waktu slewing selama :

$$9 \times 208 \text{ TEU} \times 2 = 3744 \text{ detik}$$

$$= 62.4 \text{ menit} = 1 \text{ jam } 2 \text{ menit } 24 \text{ detik}$$

TEST OF JIB CRANE  
KM. CARAKA JAYA NIAGA III - 35  
DKB/1230/JKT



PT. DOK & PERKAPALAN KODJA BAHARI  
( PERSERO )  
UNIT GALANGAN JAKARTA II

**CRANE No. 1**  
**FUNCTION TEST (without load)**

DESCRIPTION	TIME (second)	REMARKS
Lowering & Hoisting of the hook from the lowest to the maximum position.	11 -> 20 m/min	see attache explanation
Luffing of the Jib from 25° to abd. 80° and back.	19 => 75. 24 => 87.	(H). (L)
Slewing of the crane 360° in both directions.	71 -> 0.84 RPM	see attache explanation
Luffing of the Jib into sea lashing position.	----	
Hoisting of the cargo block into sea lashing position.	OK	
Testing and adjusting of limit switches for min. and max. outreach.	OK	
Testing and adjusting of limit for upper hook position	OK	
Demonstration of bridging of limit switches.	OK	
TESTING OF FOLLOWING CABIN EQUIPMENT.	-	
- Window wiper	OK	
- Signal horn	-	to adjust membrane of horn
- Illumination	OK	
- Ventilation	OK	
- Alarms Indicator	OK	lamp indi. in cabin panel

APPROVED BY :

MAKERS	OWNER SURVEYOR	CLASS BKI	QC UGJ II
Voss Gubh <i>[Signature]</i>		<i>[Signature]</i> Aetawan Sunarso	<i>[Signature]</i> HARYADI



LOAD TEST WITH 5 Tons LOAD

DESCRIPTION	TIME (second)	REMARKS
Hoisting of load at 16 M. outreach.	45"	
Luffing of the Jib minimum outreach.	31"	
Slewing of crane 360° both directions at min. outreach.	1' 29" 1' 15"	Right to Left Left to Right
Slewing of crane 360° both directions at max. outreach.		

LOAD TEST WITH 22.5 Tons (max. heel angle 5°)

DESCRIPTION	TIME (second)	REMARKS
Hoisting of load at 16 M. outreach.	19" 17"	-> 11.5 m/min. ( H ) -> 12.9 m/min. ( L )
Luffing of the Jib minimum outreach.	19 => 75 24 => 87	( H ) ( L ) . . . — — —
Slewing of crane 360° both directions at min. outreach.	71"	-> 0.84 RPM
Slewing of crane 360° both directions at max. outreach.	71"	-> 0.84 RPM

OVERLOAD TEST WITH 27.5 Tons (max. heel angle 5°)

DESCRIPTION	TIME (second)	REMARKS
Hoisting of load at 16 M. outreach.	1' 00"	Test has been carried out to the satisfaction of
Luffing of the Jib minimum outreach.	44"	BKI Class, incl : emergency stop switch
Slewing of crane 360° both directions at min. outreach.	1' 11" 1' 10"	Right to Left Left to Right
Slewing of crane 360° both directions at max. outreach.		

APPROVED BY :

MAKERS	OWNER SURVEYOR	CLASS BKI	QC UGJ II
RUOSS GmbH <i>[Signature]</i>			<i>[Signature]</i> HARYADI



ROBERT NYBLAD GmbH  
MASCHINENFABRIK

ON BEHALF  
OF  
B + V

REMARKS TO ACCEPTANCE PROTOCOL  
FOR THE TWO CRANES ON HULL 1230  
OF DK B II

THE CONTRACT SPEEDS ARE AS FOLLOWS

HOOK: WITHOUT LOAD: 20 M/MIN  
WITH FULL LOAD: 10 M/MIN

THIS CORRESPONDS WITH A TIME FOR 4  
REVOLUTIONS OF THE WINCH DRUM WITHIN  
11 SECONDS RESP. 22 SECONDS.

CYLINDERS: LUFFING TIME FROM MAX. TO MIN.  
WORKING RADIUS 100 SECONDS.

THIS CORRESPONDS WITH A SPEED AT THE  
CYLINDERS OF 1 M / 51 sec.  
STATED ARE THE TIMES FOR 0,5 M

REVOLVING: REVOLVING SPEED IS  
0.8 REVOLUTIONS /  
MINUTE

THIS CORRESPONDS WITH A TIME OF 75 SECONDS  
FOR 360°

15.4.97 Sprengle