

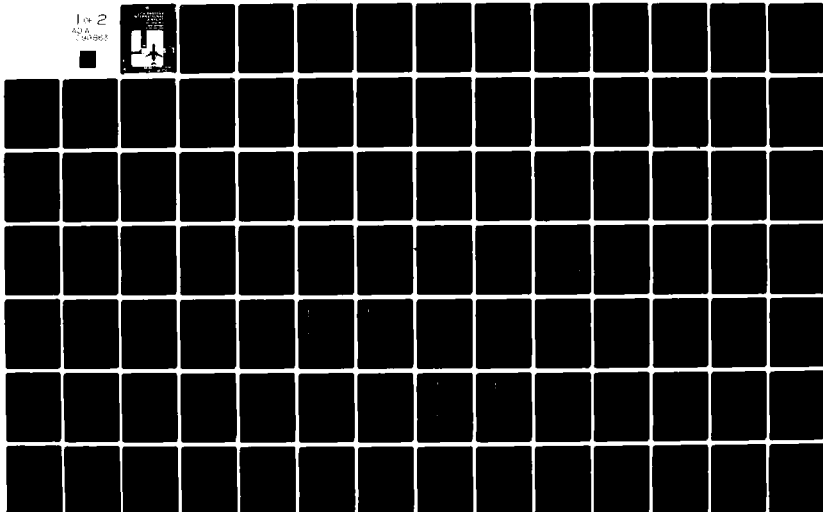
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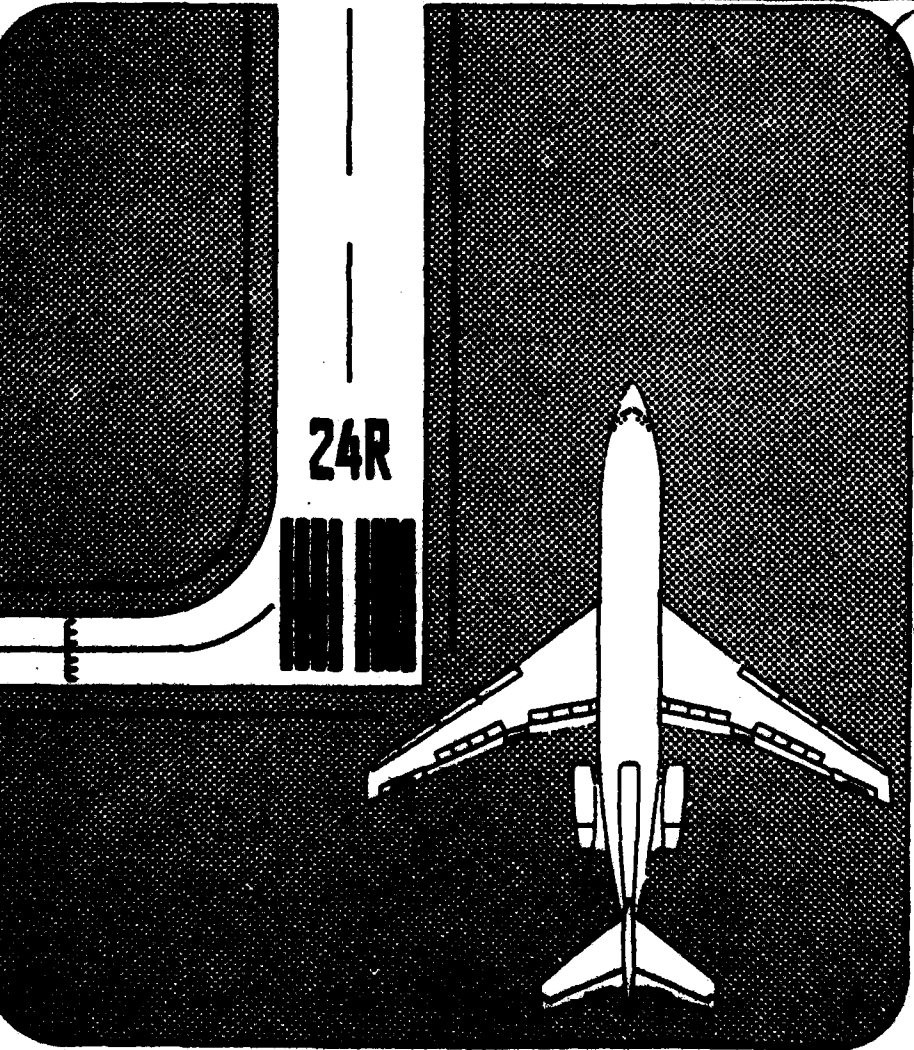
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**LOS ANGELES INTERNATIONAL AIRPORT**

DATA PACKAGE <sup>Number</sup> NO. 10

**AIRPORT IMPROVEMENT TASK FORCE DELAY STUDIES.**

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DATE: July 18, 1980  
SUBJECT: Revisions for LAX Data Package No. 10  
FROM: John Vander Veer, ACT-220  
TO: Members of the Los Angeles Task Force

Enclosed are the revisions for Los Angeles International Data Package No. 10. The replacements are for pages 23, 25, 40, 46, 47, 55, 56, 59, 60, 64, 65, 69, 77 and 78.

The changes in annual delay were the result of a miscalculation and the other changes were the result of transcription.

  
John Vander Veer

81 6 08 111

TABLE 9  
RESULTS OF VFR -- WESTERLY FLOW

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL				
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY TAXI		RUNWAY X-ING	ARRIVAL AIR		ARRIVAL GROUND	DEPARTURES GROUND	TOTAL	
1	1978	-	-	NONE	1978	803	46	80	2712	482	2	74	3477	4077	1529	5677	11283
7	1982	-	-	NONE	1978	634	57	61	2598	562	0	30	3336	4027	1610	5659	11296
7A	1982 +5%	-	-	NONE	1978	1576	66	119	4182	697	4	293	5582	5723	1708	7905	14756
7B	1982 +15%	-	-	NONE	1978	5671	226	105	5541	1591	4	1118	8587	9339	1907	10084	22130
11	1982	-	-	NEAR TERM	1982	1358	123	108	4130	1357	4	1133	6856	4709	1681	8097	15287
11	1982	-	-	NEAR TERM	1982	405	58	87	2048	494	8	6	3106	3717	1501	4801	10100
13	1982	-	-	BY-PASS TO RUNWAY 24A, HOLDING AREA ON TAXIWAY 24B	1982	436	61	88	2300	468	8	21	3026	3828	1611	5304	10742
18	1982	-	-	DUAL TAXIWAY	1982	516	48	59	2626	581	9	27	3331	3914	1623	5705	11242
18	1982	-	-	DUAL TAXIWAY	1982	382	48	60	2277	485	10	31	2911	3786	1625	5349	10759
18A	1982	-	-	DUAL TAXIWAY	1982	409	55	62	2190	659	10	3	2980	3748	1629	5775	10532
18A	1982	-	-	TERMINAL EXPANSION	1978	525	39	45	2346	424	8	12	2873	3823	1586	5151	10560

→ = REVISION A, 7/18/80

TABLE 10

RESULTS OF IFR -- WESTERLY FLOW

EXP. DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)			TOTAL DELAYS			TRAVEL TIMES (minutes)		TOTAL
					RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE	ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES AIR	DEPARTURES GROUND	
2	1178	—	NONE	1178	8235	26	56	2170	100	3	69	2424	11024	1324	4524	16871
2*	1178	—	NONE	1178	4444	35	60	2895	128	4	315	3437	7610	1548	5577	14755
3*	1178	—	NONE	1178	7009	1054	84	9535	241	5	5305	16222	9970	2546	16754	29270
8*	1182	—	NONE	1178	5100	37	63	2714	164	5	304	3288	8324	1578	5560	15970
8A*	1982	—	NONE	1178	7945	36	56	3777	170	1	416	4456	11111	1573	6774	19539
8B*	1982	—	NONE	1970	12703	81	56	5442	297	2	2285	8163	16030	1648	10600	28277
12	1982	—	NEAR TERM	1982	5046	55	54	2373	165	3	223	2874	8279	1594	4810	14602
12*	1982	DEPARTURES SENT FROM 25R TO 24L	NEAR TERM	1982	2321	50	58	2713	189	6	290	3307	5406	1665	5744	12575
23	1982	DEPARTURES SENT FROM 25L TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION	1978	4776	131	17	5292	331	7	4318	9948	7353	1757	11343	20452
24	1982	—	RUNWAY 25L TUNNEL CONSTRUCTION	1978	5967	108	18	6327	177	0	5112	9741	9595	1893	11386	22874
24	1982	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION	1978	5043	173	20	6020	304	0	4872	11479	8826	1911	13505	36557

\* ORIGINAL ARRIVAL RUNWAY DISTRIBUTION OF TRAFFIC DEMAND HAS BEEN MODIFIED

→ = REVISION A, 7/18/80

TABLE 14 (CONTINUED)  
1976 OPERATIONS WITH 1982 DO-NOTHING CASE

EXP.	DEMAND MODIFIED	ARRIVAL DEMAND	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL				
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY TAXI		RUNWAY X-ING	ARRIVAL GROUND		DEPARTURES GROUND			
2	1978	5 ARRIVALS ON 252 CHANGED TO 252		NONE	1978 (IFR)	444	35	60	2815	128	4	315	3437	7610	1548	5597	19755
8	1982	55 ARRIVALS ON 252 CHANGED TO 248		NONE	1978 (IFR)	5100	39	63	2714	164	5	304	3288	8324	1578	5568	15470
RESULTS: The 1982 demand resulted in greater arrival delays and reduced departure delays.																	
5	1978	ALL ARRIVALS PLACED ON RR		NONE	1978 (IFR)	1245	4	0	1130	5	0	0	1139	2142	466	1647	4255
10A	1982	N		NONE	1978 (IFR)	2040	4	0	1205	13	0	0	1302	3001	447	1935	5323
RESULTS: The 1982 demand resulted in greater arrival and departure delays.																	

\* = Modified Demand

← = REVISION A, 7/18/80

TABLE 17

1982 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)			TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL		
						AIR	RUNWAY	TAXI	RUNWAY	TAXI	GATE		ARRIVAL AIR	ARRIVAL GROUND		DEPARTURES GROUND	
1	1978	-	-	NONE	1978 (VFR)	803	46	80	2792	482	2	74	3477	4077	1529	5677	11283
7	1982	-	-	NONE	1978 (VFR)	634	57	81	2598	562	8	30	3336	4027	1610	5659	11296
7A	1982 +5%	-	-	NONE	1978 (VFR)	1576	66	119	4182	897	4	293	5562	5223	1708	7905	14736
7B	1982 +15%	-	-	NONE	1978 (VFR)	5671	226	105	5541	1591	4	118	8587	9339	1907	10884	22130
* 2	1978	45 ARRIVALS CHANGED ON 2/28	-	NONE	1978 (IFR)	4444	35	60	2895	128	4	315	3437	7610	1548	5397	14255
* 8	1982	53 ARRIVALS CHANGED ON 2/28	-	NONE	1978 (IFR)	5100	39	63	2714	164	5	304	3288	8324	1578	5368	15470
* 8A	1982 +5%	53 ARRIVALS CHANGED ON 2/28	-	NONE	1978 (IFR)	7945	36	56	3777	170	1	416	4456	11191	1573	6774	19539
* 8B	1982 +15%	61 ARRIVALS CHANGED ON 2/28	-	NONE	1978 (IFR)	12703	81	56	5942	297	2	2285	8153	16030	1648	10600	28277

RESULTS: The 1982 DO-NOTHING CASE resulted in progressively higher arrival and departure delays as the demand was increased by 5% and 15%.

6A

← REVISION A, 7/18/80

TABLE 18

PEAK AVERAGE DELAY (AVERAGE DAY)  
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY	
					ARRIVAL	DEPARTURE
→ 1	1978	VFR	NONE	1978	5.3	12.7
7	1982	VFR	NONE	1978	3.5	9.5
7A	1982+ 5%	VFR	NONE	1978	9.9	13.8
7B	1982+15%	VFR	NONE	1978	35.7	16.9
2	1978	IFR	NONE	1978	25.7	12.5
8	1982	IFR	NONE	1978	26.6	10.0
8A	1982+ 5%	IFR	NONE	1978	45.8	12.1
8B	1982+15%	IFR	NONE	1978	65.1	19.0

→ = REVISION A, 7/18/80



TABLE 20

1982 DO-NOTHING CASE WITH 1982 SEPARATIONS AND NEAR-TERM IMPROVEMENTS

EXP. DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS		ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)			TOTAL GROUND DELAYS		TRAVEL TIMES (minutes)		TOTAL
				AIR	(VFR)	RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY X-ING	TAXI	RUNWAY X-ING	GATE	ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	
7	1982	—	NONE	634	1978(VFR)	57	81	2578	562	8	30	5336	4427	1610	5659	11296
11	1982	DEPARTURES SENT FROM 25R TO 24R	NEAR TERM	405	1982(VFR)	58	87	2048	494	8	6	3106	3797	1501	4801	10100

RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower arrival and departure delays.

* 9	1982	43 ARRIVALS ON 25L CHANGED TO 24L	NONE	408	1978(VFR)	85	57	2370	406	10	67	3302	3785	1595	5072	10652
* 16	1982	—	HIGH SPEED EXITS, RUNWAY 7L BY-PASS	332	1982(VFR)	76	62	2271	309	13	65	2795	3898	1602	4898	76319

RESULTS: The high speed exits, runway 7L by-pass and the 1982 separations resulted in lower arrival and departure delays.

* 8	1982	50 ARRIVALS ON 25L CHANGED TO 24L	NONE	5700	1978(IFR)	39	63	2714	164	5	304	3288	8324	1578	5360	15470
* 12	1982	50 ARRIVALS ON 25L CHANGED TO 24L	NEAR TERM	2321	1982(IFR)	50	58	2713	189	6	290	3307	5706	1665	5944	12515

RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower arrival delays.

\* = Modified Demand

→ = REVISION A, 7/18/80

TABLE 21

PEAK AVERAGE DELAY (AVERAGE DAY)  
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY	
					ARRIVAL	DEPARTURE
7	1982	VFR	NONE	1978	3.5	9.5
11**	1982	VFR	NEAR-TERM	1982	1.6	7.5
8*	1982	IFR	NONE	1978	26.6	10.0
12*	1982	IFR	NEAR-TERM	1982	25.5	8.3
→ 12**	1982	IFR	NEAR-TERM	1982	13.1	9.9

\* = Modified Demand

\*\* = Rerouted Departures

→ REVISION A, 7/18/80

TABLE 23  
1978 OPERATIONS WITH 1987 SEPARATIONS AND LONG-TERM IMPROVEMENTS VARYING THE 1987 DEMAND

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS		TRAVEL TIMES (minutes)		TOTAL		
						RUNWAY AIR	TAXI	RUNWAY X-ING	TAXI	RUNWAY X-ING	RUNWAY GATE	ARRIVAL AIR	ARRIVAL GROUND		DEPARTURES GROUND	DEPARTURES TOTAL
1	1978	—	—	NONE	1978(VFR)	803	46	80	2792	482	2	74	4077	1529	5677	11283
25	1987	—	—	FAR TEAM	1987(VFR)	189	34	32	1325	245	1	2	3720	1452	5579	8692
25A	1987 + 10%	—	—	FAR TEAM	1987(VFR)	257	40	38	1957	415	1	73	3819	1505	4455	9859

RESULTS: The FAR-TERM improvements and 1987 VFR separations resulted in substantial reductions of arrival and departure delays.

* 2	1978	45 ARRIVALS ON 25L CHANGE TO 1978	—	NONE	1978(IFR)	4444	35	60	2815	128	4	315	7610	1548	5597	14755
26	1987	—	—	FAR TEAM	1987(IFR)	831	23	35	1923	88	2	79	4392	1577	4010	9920

RESULTS: The FAR-TERM improvements and 1987 IFR separations resulted in substantial reductions of arrival and departure delays.

\* - Modified Demand

→ REVISION A, 7/18/80

TABLE 24

PEAK AVERAGE DELAY (AVERAGE DAY)  
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY	
					ARRIVAL	DEPARTURE
→ 1	1978	VFR	NONE	1978	5.3	12.7
25	1987	VFR	FAR-TERM	1987	0.6	5.0
25A	with 1987 peaks	VFR	FAR-TERM	1987	0.9	7.9
2	1978	IFR	NONE	1978	25.7	12.5
26	1987	IFR	FAR-TERM	1987	4.6	7.0

→ = REVISION A, 7/18/80

TABLE 26

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL CIRCUM DELAYS		TRAVEL TIMES (minutes)		TOTAL		
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY TAXI	RUNWAY X-ING	RUNWAY GATE	ARRIVAL AIR	ARRIVAL GROUND		DEPARTURES GROUND	
7	1982	—	—	NONE	1978 (VFR)	634	57	81	2598	562	8	30	4027	1610	5759	11296
22	1982	—	DEPARTURES SENT FROM 25L TO 24R	RUNWAY 25R TUNNEL CONSTRUCTION	1978 (VFR)	993	233	19	4200	1450	11	944	4903	2100	9082	15586
22A	1982	—	11	RUNWAY 25R TUNNEL CONSTRUCTION WITH DUAL TAXIWAY	1978 (VFR)	1034	187	16	4071	1359	11	1048	4444	2101	9001	15547
35*	1982	50 ARRIVALS ON 25R CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24R	RUNWAY 25L TUNNEL CONSTRUCTION (25R COMPLETE)	1978 (VFR)	969	65	10	2925	800	0	50	4340	1653	6159	12153

RESULTS: Experiment #22-- Runway 25R tunnel construction resulted in larger departure delays (about 56%), Experiment #22A-- The availability of the dual taxiway system during tunnel construction reduced the taxi delays. Experiment #35-- Runway 25L tunnel construction after the completion of runway 25R resulted in less delay compared to the delays during the tunnel construction on runway 25R (Experiment #22).

8*	1982	50 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978 (IFR)	5700	39	63	2714	164	5	304	8324	1578	5568	15470
23	1982	—	DEPARTURES SENT FROM 25L TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION	1978 (IFR)	4776	131	17	5292	331	7	4318	7353	1757	11343	20452
36*	1982	50 ARRIVALS ON 25R CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION (25R COMPLETE)	1978 (IFR)	6297	81	14	5375	344	0	3339	9319	1527	11028	21873

RESULTS: Experiment #23-- Runway 25R tunnel construction resulted in larger departure delays during IFR weather. Experiment #36-- Runway 25L tunnel construction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for the use of runway 25R) than Experiment #23.

\* - Modified Demand

→ = REVISION A, 7/18/80

TABLE 26 (CONTINUED)  
SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

EXP.	DEMAND MODIFIED	ARRIVAL DEMAND	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)			TRAVEL TIMES (minutes)		TOTAL				
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
* 8	ON 25L CHANGE TO 25R		—	NONE	1978 (IFR)	5700	39	63	274	164	5	304	3288	0324	1578	5368	15770
24	—		DEPARTURES SENT FROM 25R TO 25L	RUNWAY 25L TUNNEL CONSTRUCTION	1978 (IFR)	5043	173	20	6020	394	0	4872	11479	0626	1911	13505	36537
* 37	5 ARRIVALS ON 25L CHANGE TO 25R		DEPARTURES SENT FROM 25R TO 25L	RUNWAY 25R TUNNEL CONSTRUCTION (25L COMPLETE)	1978 (IFR)	6535	95	15	5493	328	11	3572	9454	0719	1696	11664	23079

RESULTS: Experiment #24-- Runway 25L tunnel construction resulted in larger departure delays during IFR weather. (Experiment #24 compared to Experiment #23 indicated that the construction of runway 25L produced larger delays than the initial construction of runway 25R.)  
Experiment #37-- Runway 25R tunnel construction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for the use of runway 25R) than Experiment #24.

→ = REVISION A, 7/18/80

TABLE 27

IMPROVEMENT COMPARISONS

EXP.	DEMAND MODIFIED	ARRIVAL DEMAND	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL				
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY		TAXI	RUNWAY X-ING		GATE	ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND
7	—	—	—	NONE	1978(VFR)	634	57	81	2598	562	8	30	3336	4027	1610	5659	11296
18	—	—	—	DUAL TAXIWAY	1982(VFR)	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
RESULTS: The dual taxiway system and the 1982 separations resulted in reduced arrival delays. No change was noted in the taxi delays.																	
18	—	—	DEPARTURES SENT FROM 25K TO 24K	DUAL TAXIWAY	1982(VFR)	302	48	60	2277	485	10	31	2911	3786	1625	5349	10759
11	—	—	"	NEAR TERM	1982(VFR)	405	58	87	2048	494	8	6	3106	3797	1501	4801	10100
RESULTS: The NEAR-TERM improvements resulted in reduced departure delays.																	
18	—	—	—	DUAL TAXIWAY	1982(VFR)	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
13	—	—	—	BY-PASS TO RUNWAY 24K HOLDING AREA IN TAXIWAY 15	1982(VFR)	436	61	88	2360	468	8	21	3026	3828	1611	5304	10742
RESULTS: The by-pass to runway 24K and the holding area on taxiway 75 resulted in reduced departure delays.																	

→=REVISION A, 7/18/80

TABLE 31

## SUMMARY OF ANNUAL DELAYS (ESTIMATES)

<u>DEMAND</u>	<u>ATC SYSTEM SCENARIO</u>	<u>IMPROVEMENTS</u>	<u>ANNUAL DELAY (HOURS)</u>
1978	1978	none	<u>37,991</u>
1982	1978	none	<u>39,630</u>
1982 + 5%	1978	none	56,289
1982 +15%	1978	none	130,137
1982	1982	none	<u>33,953</u>
1982	1978	1982	<u>24,113</u> ← <i>was 33/50</i>
1982	1982	1982	<u>21,036</u>
1987	1978	none	<u>41,339</u>
1987	1978	1987	<u>22,908</u> ← <i>was 21,188</i>
1987	1987	none	<u>24,354</u> <del>13,496</del> ← <del>21,728 (DATA)</del>
1987	1987	1987	<u>13,496</u> <del>13,496</del> <i>PAGE 59</i>

← = REVISION A, 7/18/80



130, 137  
DO NOTHING

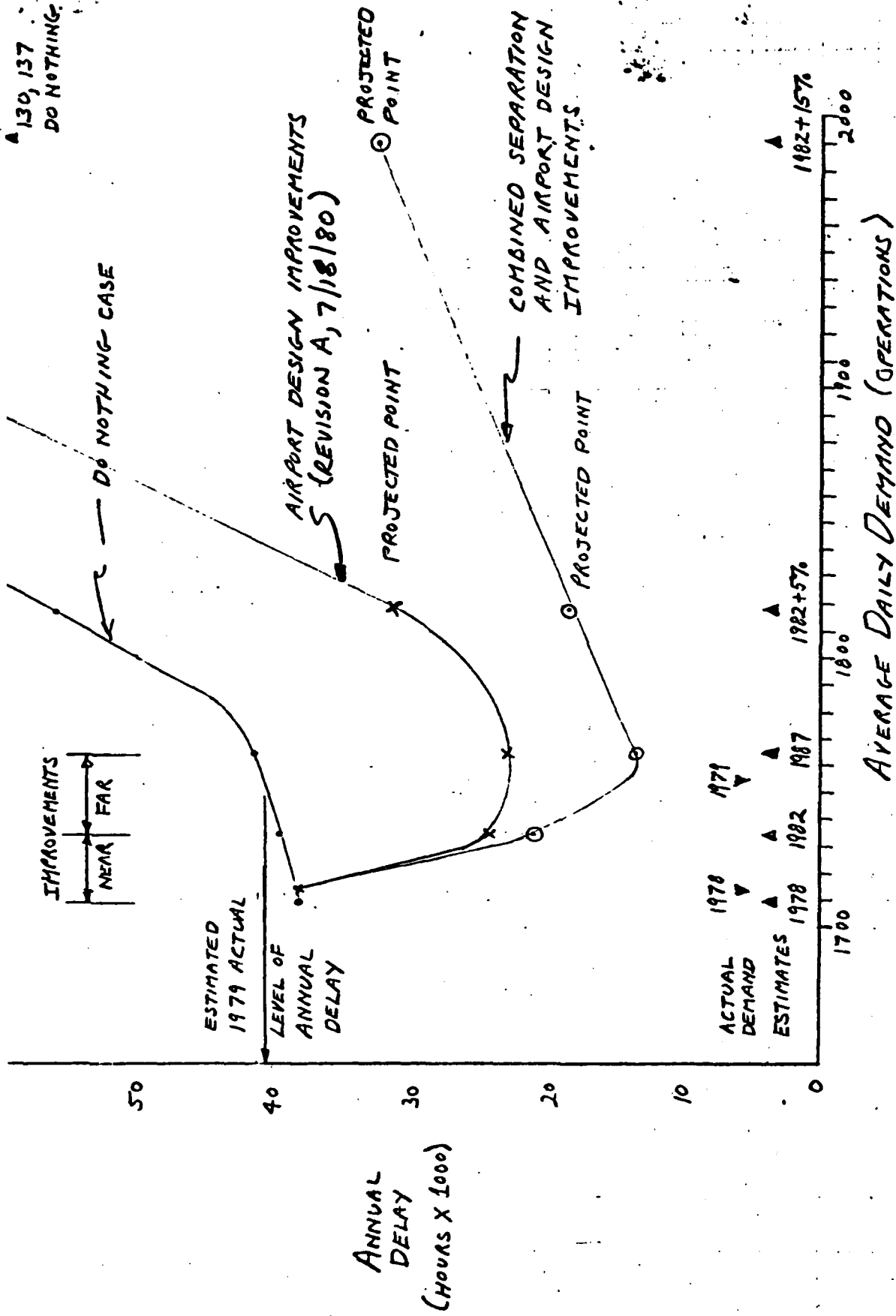


FIGURE 15 SUMMARY OF ANNUAL DELAY ESTIMATES

REVISION A, 7/18/80

**DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION**

**NATIONAL AVIATION FACILITIES  
EXPERIMENTAL CENTER  
ATLANTIC CITY, NEW JERSEY 08406**



DATE:  
IN REPLY  
REFER TO:

SUBJECT: Los Angeles Simulation Model Results

FROM: Program Manager, ACT-220

TO: Frank Jones, AWE-530

Enclosed is Data Package No. 10 for review by the Task Force members. Data package No. 9 was presented at the last meeting of the Task Force on April 29, 1980.

*THIS RECEIVED*  
Attachment A contains the results of experiments #35, 36 and 37 requested by the Task Force to study delays after construction is completed on either runway 25R (VFR and IFR weather) or runway 25L (IFR weather).

*Also*  
Attachment B includes a comparison of the traffic counts for the first Friday in August of 1978 and 1979.

Attachment C includes comparisons and analyses of various experiments. The purpose of this attachment is to provide a narrative summary of those results for use by the Los Angeles Task Force in preparing their final report.

*John R. Vanderveer*  
JOHN VANDERVEER

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ATTACHMENT A

RESULTS OF EXPERIMENTS #35, #36 and #37

(TUNNEL CONSTRUCTION)

TABLE 1

1

SET 8 DEMAND

EXPERI- MENT	RWY 24R	RWY 24L	RWY 25R	RWY 25L	TOTAL	
22 (22A)	A	95	72	0	196	363
	D	29	162	0	235	426
	TOTAL	124	234	0	431	789
35	A	121	17	225	0	363
	D	25	117	284	0	426
	TOTAL	146	134	509	0	789
23	A	167	0	0	196	363
	D	0	191	0	235	426
	TOTAL	167	191	0	431	789
36	A	138	0	225	0	363
	D	0	142	284	0	426
	TOTAL	138	142	509	0	789
24	A	174	0	189	0	363
	D	0	185	241	0	426
	TOTAL	174	185	430	0	789
37	A	138	0	0	225	363
	D	0	142	0	284	426
	TOTAL	138	142	0	509	789
	A					
	D					
	TOTAL					

\* MODIFIED DEMAND

LAX - STAGE 2EXPERIMENT NO. 35OBJECTIVE:

To assess the impact on aircraft delay in 1982 under VFR1 weather conditions due to the closure of 25L during construction of the Sepulveda Tunnel. Tunnel construction on 25R was complete and 1978 aircraft separations were utilized.

ARRIVAL RUNWAYS

24L, 24R, 25R

DEPARTURE RUNWAYS

24L, 24R, 25R

RELATED COMPARISON EXPERIMENTS:

Experiment #22 with tunnel construction on 25R and no improvement on 25L.

REMAINING DATA ITEMS:

1978 VFR1 separations were used. The 1982 demand was achieved by modifying the arrival demand for experiment #11 (moving 50 arrivals on the south complex to runway 24R) and changing all arrivals and departures on 25L to 25R.

TABLE 2

CLASS AND RUNWAY DEMAND DISTRIBUTION  
FOR ARRIVALS AND DEPARTURES

EXPERIMENT NO. 35

RUNWAY NAME	24R	24L	25R	25L	TOTAL
	ARRIVALS				
CLASS 1 (HEAVY)	30	6	32	0	68
CLASS 2 (LARGE)	55	2	147	0	204
CLASS 3 (SMALL)	31	8	28	0	67
CLASS 4 (SMALLER)	5	1	18	0	24
TOTAL	121	17	225	0	363

	DEPARTURES				
CLASS 1 (HEAVY)	0	53	44	0	97
CLASS 2 (LARGE)	8	51	174	0	233
CLASS 3 (SMALL)	13	10	54	0	77
CLASS 4 (SMALLER)	4	3	12	0	19
TOTAL	25	117	284	0	426

ARRIVAL AND DEPARTURE TOTALS	146	134	509	0	789
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TABLE 3

LAX EXP 35 DEMAND=82 SEF=78UFR1 CONFIG=A SCHED=X35 RTE=X1 25L CLOSED 25R TUNNEL COMPLETE  
 AVERAGE FLOW RATES

TIME	ARRIVALS			DIF	DEPARTURES			DIF	AVERAGE TRAVEL TIMES												
	RWY 24L	RWY 25R	RWY 25L		RWY 24L	RWY 25R	RWY 25L		FIX TO THRESH	THRESH TO GATE	GATE TO ROLL										
700-800	3.0	1.0	22.0	0.0	0.0	0.0	27.0	-1.0	2.3	13.0	25.7	0.0	0.0	0.0	41.0	48.0	-7.0	10.91	4.25	6.74	
800-900	19.0	1.0	25.0	0.0	0.0	0.0	44.0	1.0	14.3	13.8	28.2	0.0	0.0	0.0	56.3	64.0	-7.7	11.58	4.61	13.15	
900-1000	7.0	1.0	31.8	0.0	0.0	0.0	39.8	40.0	-2	16.2	22.4	21.3	0.0	0.0	59.9	54.0	5.9	13.37	3.93	15.89	
1000-1100	19.9	3.0	30.9	0.0	0.0	0.0	53.8	53.0	-1.2	15.1	11.8	22.6	0.0	0.0	49.5	48.0	1.5	11.09	4.74	13.82	
1100-1200	21.8	3.0	31.9	0.0	0.0	0.0	56.7	60.0	-3.3	6.3	16.0	26.8	0.0	0.0	49.1	52.0	-2.9	12.46	4.52	10.11	
1200-1300	24.3	1.0	23.6	0.0	0.0	0.0	48.9	45.0	3.9	17.3	11.6	27.5	0.0	0.0	56.4	65.0	-8.6	14.19	4.89	17.88	
1300-1400	9.1	2.0	27.7	0.0	0.0	0.0	38.8	39.0	-2	18.0	21.1	20.9	0.0	0.0	60.0	54.0	6.0	10.67	4.80	21.99	
1400-1500	14.9	3.0	31.8	0.0	0.0	0.0	53.7	53.0	.7	15.7	7.0	24.6	0.0	0.0	47.3	41.0	6.3	11.56	4.51	14.43	
* 1500-1500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

AVERAGE DELAYS

TIME	ARRIVALS			RWY TAXI IN	DEPARTURES			RWY TAXI OUT	AVERAGE DELAYS											
	RWY 24L	RWY 25R	RWY 25L		RWY 24L	RWY 25R	RWY 25L		ARR	DELAY	REP									
700-800	0.0	0.0	2.2	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	2.0	2.0	1.7						
800-900	.9	.4	2.6	0.0	0.0	0.0	1.9	.0	2	7.7	2.8	7.3	0.0	0.0	2.0	7.4				
900-1000	.0	.0	4.8	0.0	0.0	0.0	3.8	.0	1	8.6	6.4	8.2	0.0	0.0	3.9	10.0				
1000-1100	.9	.4	3.4	0.0	0.0	0.0	2.3	.1	2	5.0	4.2	8.5	0.0	0.0	2.5	8.0				
1100-1200	.5	.8	4.1	0.0	0.0	0.0	2.5	.0	1	4.7	1.8	5.2	0.0	0.0	2.7	4.6				
1200-1300	6.5	.0	3.8	0.0	0.0	0.0	5.1	.0	4	17.4	5.3	6.9	0.0	0.0	5.5	12.0				
1300-1400	.4	0.0	2.2	0.0	0.0	0.0	1.7	.0	3	18.2	8.9	7.2	0.0	0.0	2.0	16.3				
1400-1500	1.1	.2	2.7	0.0	0.0	0.0	2.0	.0	0	9.4	1.4	6.1	0.0	0.0	2.1	8.5				
* 1500-1500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

\* clean-up hour

LAX - STAGE 2EXPERIMENT NO. 36OBJECTIVE:

To assess the impact on aircraft delay in 1982 under IFR1 weather conditions due to the closure of 25L during construction of the Sepulveda Tunnel. Tunnel construction on 25R was complete and 1978 aircraft separations were utilized.

ARRIVAL RUNWAYS

24R, 25R

DEPARTURE RUNWAYS

24L, 25R

RELATED COMPARISON EXPERIMENTS:

Experiment #23 with tunnel construction on 25R and no improvement on 25L.

REMAINING DATA ITEMS:

1978 IFR1 separations were used. The 1982 demand was achieved by changing the schedule used in experiment #12M (modified) - the arrivals on 25L were moved to 25R.



TABLE 4

CLASS AND RUNWAY DEMAND DISTRIBUTION  
FOR ARRIVALS AND DEPARTURES

EXPERIMENT NO. 36

RUNWAY NAME	24R	24L	25R	25L	TOTAL
	ARRIVALS				
CLASS 1 (HEAVY)	36	0	32	0	68
CLASS 2 (LARGE)	57	0	147	0	204
CLASS 3 (SMALL)	39	0	28	0	67
CLASS 4 (SMALLER)	6	0	18	0	24
TOTAL	138	0	225	0	363

	DEPARTURES				
CLASS 1 (HEAVY)	0	53	44	0	97
CLASS 2 (LARGE)	0	59	174	0	233
CLASS 3 (SMALL)	0	23	54	0	77
CLASS 4 (SMALLER)	0	7	12	0	19
TOTAL	0	142	284	0	426

ARRIVAL AND DEPARTURE TOTALS	138	142	509	0	789
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TABLE 5

LAX EXP 36 DEMAND=82 SEP=78IFR1 CONFIG=A SCHED=X36 RTE=X1 25L CLOSED 25R TUNNEL COMPLETE

TIME	ARRIVALS						DEPARTURES						AVERAGE DELAYS				AVERAGE TRAVEL TIMES			
	RWY 24R	RWY 24L	RWY 25R	RWY 25L	TOT DE- MAND	DIF	RWY 24R	RWY 24L	RWY 25R	RWY 25L	TOT DE- MAND	DIF	RWY 24R	RWY 24L	RWY 25R	RWY 25L	ARR DELAY	DEF DELAY	FIX TO THRESH	GATE TO ROLL
700-800	4.0	0.0	21.9	0.0	0.0	-1.1	0.0	18.6	20.7	0.0	0.0	0.0	0.0	39.3	48.0	-8.7	12.65	4.28	8.39	
800-900	20.0	0.0	24.5	0.0	0.0	.5	0.0	27.0	18.4	0.0	0.0	0.0	0.0	45.4	64.0	-18.6	13.65	4.69	20.29	
900-1000	6.0	0.0	25.1	0.0	0.0	-5.9	0.0	36.0	19.1	0.0	0.0	0.0	0.0	55.1	55.0	.1	18.28	4.08	26.50	
1000-1100	17.0	0.0	26.2	0.0	0.0	-9.8	0.0	34.4	16.2	0.0	0.0	0.0	0.0	50.6	48.0	2.6	22.67	4.74	37.03	
1100-1200	21.5	0.0	26.0	0.0	0.0	-12.5	0.0	34.0	17.3	0.0	0.0	0.0	0.0	51.3	52.0	-7	31.67	4.82	33.86	
1200-1300	21.0	0.0	22.1	0.0	0.0	-1.9	0.0	28.9	18.3	0.0	0.0	0.0	0.0	47.2	65.0	-17.8	44.47	4.74	26.10	
1300-1400	19.6	0.0	23.9	0.0	0.0	4.5	0.0	28.9	16.7	0.0	0.0	0.0	0.0	45.6	54.0	-8.4	42.67	4.79	33.60	
1400-1500	19.3	0.0	23.3	0.0	0.0	-10.4	0.0	28.7	16.7	0.0	0.0	0.0	0.0	45.4	41.0	4.4	34.68	5.08	42.77	
* 1500-1600	17	0.0	22.4	0.0	0.0	23.3	0.0	25.8	8.0	0.0	0.0	0.0	0.0	33.8	0.0	33.8	61.78	4.13	48.43	

\* clean-up hour

LAX - STAGE 2EXPERIMENT NO. 37OBJECTIVE:

To access the impact on aircraft delay in 1982 under IFR1 weather conditions due to the closure of 25R during construction of the Sepulveda Tunnel. Tunnel construction on 25L was complete and 1978 aircraft separations were utilized.

ARRIVAL RUNWAYS

24R, 25L

DEPARTURE RUNWAYS

24L, 25L

RELATED COMPARISON EXPERIMENTS:

Experiment #24 with tunnel construction on 25L and no improvement on 25R.

REMAINING DATA ITEMS:

1978 IFR1 separations were used. The 1982 demand was achieved by changing the schedule used in experiment #12M (modified) - the departures on 25R were moved to 25L.

TABLE 6

CLASS AND RUNWAY DEMAND DISTRIBUTION  
FOR ARRIVALS AND DEPARTURES

EXPERIMENT NO. 37

RUNWAY NAME	24R	24L	25R	25L	TOTAL
	ARRIVALS				
CLASS 1 (HEAVY)	36	0	0	32	68
CLASS 2 (LARGE)	57	0	0	147	204
CLASS 3 (SMALL)	39	0	0	28	67
CLASS 4 (SMALLER)	6	0	0	18	24
TOTAL	138	0	0	225	363

	DEPARTURES				
CLASS 1 (HEAVY)	0	53	0	44	97
CLASS 2 (LARGE)	0	59	0	174	233
CLASS 3 (SMALL)	0	23	0	54	97
CLASS 4 (SMALLER)	0	7	0	12	19
TOTAL	0	142	0	284	426

ARRIVAL AND DEPARTURE TOTALS	138	142	0	509	789
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TABLE 7

LAX EXP 37 DEMAND=82 SEP=78IFR1 CONFIG=A SCHED=X37 RTE=X1 25R CLOSED 25L TUNNEL COMPLETE

TIME	ARRIVALS										DEPARTURES										AVERAGE DELAYS				AVERAGE TRAVEL TIMES						
	RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	TOT	DE-MAND	DIF	RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	TOT	DE-MAND	DIF	RWY	TOT	CRS	TAXI	RWY	TOT	ARR	DELAY	DEP	DELAY	FIX TO THRESH	GATE TO ROLL			
700-800	4.0	0.0	0.0	0.0	0.0	21.9	0.0	0.0	0.0	19.0	0.0	0.0	0.0	0.0	20.7	0.0	0.0	0.0	39.7	48.0	0.0	0.0	0.0	0.0	0.0	0.0	12.14	4.50	7.90		
800-900	20.0	0.0	0.0	0.0	0.0	24.5	0.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	19.2	0.0	0.0	0.0	44.2	54.0	0.0	0.0	0.0	0.0	0.0	13.60	5.00	20.00			
900-1000	8.0	0.0	0.0	0.0	0.0	23.1	0.0	0.0	0.0	37.3	0.0	0.0	0.0	0.0	18.9	0.0	0.0	0.0	56.2	55.0	0.0	0.0	0.0	0.0	0.0	18.39	4.51	26.75			
1000-1100	19.0	0.0	0.0	0.0	0.0	26.8	0.0	0.0	0.0	34.2	0.0	0.0	0.0	0.0	15.5	0.0	0.0	0.0	49.7	48.0	0.0	0.0	0.0	0.0	0.0	22.64	4.98	36.41			
1100-1200	21.6	0.0	0.0	0.0	0.0	26.7	0.0	0.0	0.0	32.7	0.0	0.0	0.0	0.0	19.3	0.0	0.0	0.0	52.0	52.0	0.0	0.0	0.0	0.0	0.0	31.98	5.14	33.60			
1200-1300	22.3	0.0	0.0	0.0	0.0	29.3	0.0	0.0	0.0	31.1	0.0	0.0	0.0	0.0	18.7	0.0	0.0	0.0	49.8	65.0	-15.2	0.0	0.0	0.0	0.0	44.21	4.96	28.84			
1300-1400	21.1	0.0	0.0	0.0	0.0	26.2	0.0	0.0	0.0	30.9	0.0	0.0	0.0	0.0	16.7	0.0	0.0	0.0	47.6	54.0	-6.4	0.0	0.0	0.0	0.0	41.49	5.05	37.51			
1400-1500	20.9	0.0	0.0	0.0	0.0	29.1	0.0	0.0	0.0	29.9	0.0	0.0	0.0	0.0	17.9	0.0	0.0	0.0	47.8	41.0	6.8	0.0	0.0	0.0	0.0	33.59	5.58	45.67			
* 1500-1600	1.1	0.0	0.0	0.0	0.0	23.4	0.0	0.0	0.0	20.9	0.0	0.0	0.0	0.0	9.9	0.0	0.0	0.0	39.8	0.0	0.0	0.0	0.0	0.0	0.0	59.52	4.58	58.51			
AVERAGE DELAYS																															
TIME	RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	TOT	CRS	TAXI	RWY 24R	RWY 24L	RWY 25R	RWY 25L	RWY	TOT	CRS	TAXI	RWY	TOT	ARR	DELAY	DEP	DELAY	DEP	DELAY	DEP	DELAY	FIX TO THRESH	GATE TO ROLL			
700-800	0.0	0.0	0.0	0.0	0.0	3.6	.0	.1	0.0	.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
800-900	3.2	0.0	0.0	0.0	0.0	4.0	.1	.2	0.0	12.8	0.0	0.0	0.0	0.0	12.0	.0	.7	1.0	4.3	13.7	2.5	2.5	2.5	2.5	2.5	13.60	5.00	20.00			
900-1000	.0	0.0	0.0	0.0	0.0	8.7	.0	.2	0.0	15.4	0.0	0.0	0.0	0.0	14.0	.0	.8	6.2	8.9	21.0	30.3	30.3	30.3	30.3	30.3	18.39	4.51	26.75			
1000-1100	3.2	0.0	0.0	0.0	0.0	12.8	.1	.1	0.0	17.8	0.0	0.0	0.0	0.0	17.0	.0	1.3	12.0	12.9	30.3	30.3	30.3	30.3	30.3	30.3	22.64	4.98	36.41			
1100-1200	15.2	0.0	0.0	0.0	0.0	22.2	.0	.4	0.0	16.3	0.0	0.0	0.0	0.0	14.3	.0	1.2	12.1	22.6	27.6	27.6	27.6	27.6	27.6	27.6	31.98	5.14	33.60			
1200-1300	24.0	0.0	0.0	0.0	0.0	34.9	.0	.3	0.0	19.3	0.0	0.0	0.0	0.0	16.3	.0	.8	5.4	35.3	35.3	35.3	35.3	35.3	35.3	35.3	44.21	4.96	28.84			
1300-1400	22.2	0.0	0.0	0.0	0.0	32.5	.0	.3	0.0	21.0	0.0	0.0	0.0	0.0	14.0	.0	.7	12.6	32.8	31.6	31.6	31.6	31.6	31.6	31.6	41.49	5.05	37.51			
1400-1500	4.6	0.0	0.0	0.0	0.0	24.4	.0	.5	0.0	21.5	0.0	0.0	0.0	0.0	17.3	.0	.8	21.5	25.0	25.0	25.0	25.0	25.0	25.0	25.0	33.59	5.58	45.67			
* 1500-1600	6.8	0.0	0.0	0.0	0.0	19.6	.0	.0	0.0	16.2	0.0	0.0	0.0	0.0	14.2	.1	.9	16.2	19.6	19.6	19.6	19.6	19.6	19.6	19.6	59.52	4.58	58.51			

\* clean-up hour

ATTACHMENT B  
COMPARISON OF TRAFFIC COUNTS AND DEMAND

The traffic counts and projected demands over a 24-hour period are shown in Table 1. In addition, the 1978 and 1979 OAG schedules for the first Friday in August were obtained to determine the changes in scheduled activity.

In 1979, airlines who scheduled OAG flights in 1978 increased their activity by 3.3%. There were 1323 scheduled flights in the 1978 OAG and 1366 scheduled by the same airlines in the 1979 OAG.

The actual activity level for 1979 showed an increase of 2.2% for the 24-hour traffic count over the same period of time in 1978 (1717 aircraft in 1978 and 1755 aircraft in 1979). The projected 1982 demand represents a 1.5% increase over the 1978 24-hour base demand (1735 aircraft in 1982 and 1710 aircraft in 1978). The 1982 demand was increased by 5% and 15% resulting in an increase of 6.3% and 16.4% over the 1978 24-hour base demand. The 1987 demand represents 3.2% increase over the 1978 24-hour base demand (1764 aircraft in 1987 and 1710 aircraft in 1978).

The 1982 demand for the 24-hour period is 1.2% less than the actual 1979 traffic count (1735 aircraft in 1982 and 1755 aircraft in 1979). The actual 1979 traffic count is less than the 1982 +5% level of activity and the projected 1987 demand. The fleet mix percentages for the 1979 OAG schedule and the projected 1982 OAG schedule are as follows:

	<u>1979</u>	<u>1982</u>
Heavy-Class 1	24.7%	28.9%
Large-Class 2	56.5%	59.4%
Small-Class 3	16.4%	11.7%
Smaller-Class 4	2.4%	0.0%

Comparisons indicated that the 1979 demand on the Los Angeles International Airport increased to a level slightly above the projected 1982 demand, but the projected 1982 conversion of the fleet to the larger aircraft has not occurred in the 1979 demand.



TABLE 1

TRAFFIC COUNT FOR FIRST FRIDAY IN AUGUST

<u>TIME</u>	<u>1978</u> <u>TRAFFIC COUNT</u>	<u>1978</u> <u>DEMAND</u>	<u>1979</u> <u>TRAFFIC COUNT</u>	<u>1982</u> <u>DEMAND</u>	<u>1982</u> <u>DEMAND +5%</u>	<u>1982</u> <u>DEMAND +15%</u>	<u>1987</u> <u>DEMAND</u>	
0000	37	43	43	45	47	52	43	
0100	42	37	42	41	43	47	43	
0200	24	23	20	23	24	26	23	
0300	11	9	8	8	8	10	11	
0400	8	17	14	16	16	18	16	
0500	14	17	15	19	19	23	18	
0600	34	33	32	34	36	40	34	
0700	69	77	83	73	76	84	77	
0800	105	103	88	109	114	125	113	
0900	87	92	106	95	100	108	92	
1000	101	98	114	101	106	116	103	
1100	118	111	114	114	120	131	114	
1200	106	110	107	109	114	124	115	
1300	98	93	93	94	99	108	95	
1400	88	86	96	94	98	107	92	
1500	79	86	80	79	83	91	85	
1600	108	96	98	105	110	120	98	
1700	76	88	94	83	88	96	94	
1800	97	95	103	95	99	109	95	
1900	108	108	101	111	116	127	108	
2000	91	78	83	80	84	91	85	
2100	83	83	79	80	84	92	80	
2200	80	69	78	69	73	79	67	
2300	53	58	64	58	61	67	63	
TOTAL	1717	1710	1755	1735	1818	1991	1764	
	ACTUAL	BASE	2.2% Increase Over 1978 Actual Traffic Count	1.5% Increase over 1978 Base Demand	6.3% Increase Over 1978 Base Demand	16.4% Increase Over 1978 Base Demand	3.2% Increase Over 1978 Base Demand	

ATTACHMENT C

NARRATIVE SUMMARY OF RESULTS

(INFORMATION FOR THE TASK FORCE FOR PREPARATION OF FINAL REPORT)

TABLE OF CONTENTS

1. INTRODUCTION
    - 1.1. General
    - 1.2. Objective
    - 1.3. Background
  2. DISCUSSION
    - 2.1. Air Traffic Control Procedures
    - 2.2. Experimental Design and Model Application
      - 2.2.1. Air Traffic Control Scenario
      - 2.2.2. Airport Design Improvements
      - 2.2.3. Air Traffic Demand
    - 2.3. Experimental Results
    - 2.4. Comparison of Experimental Results
    - 2.5. Analysis of Results (Interpretation)
  3. SUMMARY OF RESULTS
  4. CONCLUSIONS
  5. RECOMMENDATIONS
- APPENDIX A - Tables of Air Traffic Demand
- APPENDIX B - Computer Output of Experimental Results

## LIST OF TABLES

TABLE NO.	DESCRIPTION	PAGE
1	LOS ANGELES DELAY EXPERIMENTS	6
2	1978 DEMAND	13
3	1982 DEMAND	14
4	1982 + 5% DEMAND	15
5	1982 +15% DEMAND	16
6	1987 DEMAND	17
7	1987 DEMAND WITH PEAKS	18
8	ANALYSIS OF YEARLY TOTAL FOR PASSENGER AND AIRCRAFT OPERATIONS	19
9	RESULTS OF VFR -- WESTERLY FLOW	23
10	RESULTS OF IFR -- WESTERLY FLOW	25
11	RESULTS OF VFR -- EASTERLY FLOW AND NIGHTTIME OPERATIONS	27
12	1982 VFR CAPACITY RESULTS -- NO NOISE CONSTRAINTS	28
13	1982 VFR CAPACITY RESULTS -- RELAXED NOISE CONSTRAINTS	29
14	1978 OPERATIONS WITH 1982 DO-NOTHING CASE	39
15	PEAK AVERAGE DELAY (Average Day)	41
16	ANNUAL DELAY ESTIMATES	42
17	1982 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND	46
18	PEAK AVERAGE DELAY (Average Day)	47
19	ANNUAL DELAY ESTIMATES	48
20	1982 DO-NOTHING CASE WITH 1982 SEPARATIONS AND NEAR-TERM IMPROVEMENTS	55
21	PEAK AVERAGE DELAY (Average Day)	56
22	ANNUAL DELAY ESTIMATES	57

LIST OF TABLES (Continued)

TABLE NO.	DESCRIPTION	PAGE
23	1978 OPERATIONS WITH 1987 SEPARATIONS AND LONG-TERM IMPROVEMENTS VARYING THE 1987 DEMAND	59
24	PEAK AVERAGE DELAY (Average Day)	60
25	ANNUAL DELAY ESTIMATES	61
26	SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE	64
27	IMPROVEMENT COMPARISONS	69
28	1982 DO-NOTHING CASE WITH 1982 SEPARATIONS, HIGH SPEED EXITS OFF RUNWAYS 6R AND 7L, AND DEPARTURE BY-PASS AROUND RUNWAY 7L	71
29	1982 DO-NOTHING CASE WITH TERMINAL EXPANSION AND THE PRESENCE AND ABSENCE OF 1982 SEPARATIONS	73
30	REMOTE TERMINAL WITH DUAL TAXIWAY IMPROVEMENT	75
31	SUMMARY OF ANNUAL DELAYS (Estimates)	77

## LIST OF FIGURES

FIGURE NO.	DESCRIPTION	PAGE
1	LAX LINK NODE DIAGRAM (Present)	9
2	LAX LINK NODE DIAGRAM (Combined Improvements)	10
3	EXPERIMENTS #1 AND #7	34
4	EXPERIMENTS #6(M) AND #9(M)	35
5	EXPERIMENTS #4(M) AND #10(M)	36
6	EXPERIMENTS #2(M) AND #8(M)	37
7	EXPERIMENTS #5(M) AND #10A(M)	38
8	EXPERIMENTS #7, #7A AND #7B	44
9	EXPERIMENTS #8(M), #8A(M) AND #8B(M)	45
10	EXPERIMENTS #7 AND #11 -- DELAYS	50
11	EXPERIMENTS #7 AND #11 -- TRAVEL TIMES	51
12	EXPERIMENTS #9(M) AND #16(M)	52
13	EXPERIMENTS #8(M) AND #12(M) -- DELAYS	53
14	EXPERIMENTS #8(M) AND #12(M) -- TRAVEL TIMES	54
15	SUMMARY OF ANNUAL DELAY ESTIMATES	78

## 1. INTRODUCTION

### 1.1. General.

Airfield operations at the Los Angeles International Airport are expected to increase in the immediate future. A study of the effects of this increase in air traffic demand and proposed improvements at the airport (procedures, hardware, and airport design) was initiated in June 1975. The results of the initial capacity study appeared in an Interim Report (September 1977) issued by the Los Angeles International Airport Improvement Program Task Force. The present delay study was based upon the report and a technical plan prepared in September 1978, along with a Federal Aviation Administration report (FAA-EM-78-8A) entitled "Parameters of Future ATC Systems Relating to Airport Capacity/Delay" (June 1978).

### 1.2. Objective. The purpose of this effort was:

1. To identify the causes of delay and determine the effect of various airport design improvements on delay at the airport.
2. To identify the delay reduction benefits of alternative procedures and the hardware improvement options for immediate, short term and long term implementation.
3. To determine the relationships between air traffic demand and delay in the present and future time periods as an aid to establishing acceptable air traffic movement levels.
4. To obtain new insight into the interdependence of terminal facilities, airport design, procedures, fleet mix and air traffic demand.

### 1.3. Background.

The airport delay study began with a description of the present day air traffic control procedures at the Los Angeles International Airport. A report was prepared in July 1978 (FAA-NA-96-156-1) which revised and updated the ground/airborne scenarios. The next step was the preparation of a technical plan which included a list of the experiments to be performed and information regarding the application of the airfield simulation model. Various steps and milestones were planned along with a description of data requirements for the computer (model) runs.

The effort was accomplished by the Airport Improvement Task Force reviewing a series of data packages containing information on the preparation of the model runs, revisions to the experimental design (suggested by the Task Force) and the results of the experiments. The data packages contained information on the calibration of the model based on field data, description of the model inputs for the experiments, air traffic demand forecasts (including runway and aircraft class distributions), results of experiments and preliminary analysis of those results.

Comments on each of the data packages by the Task Force were incorporated into subsequent work performed on the program.



## 2. DISCUSSION.

### 2.1. Air Traffic Control Procedures.

The air traffic control service at the Los Angeles International Airport is extended to each airline company, general aviation, the military, the airport authority, the local and regional residents, and the general public. The ATC procedures employed at the airport are responsive to a variety of geographic and airfield conditions. The desired result is a safe level of service which holds delays to minimum throughout the day by applying present day air traffic control rules and regulations.

Some specific service conditions reflected in the ATC procedures are:

1. The assignment, when possible, of arrivals to runways closest to their gate areas.
2. The assignment of departures to runways based on the route of flight (with the exception of heavy aircraft which must use the north complex).
3. Restricted use of departure runway 24R as a noise abatement procedure.
4. Over ocean nighttime operations.
5. Greater utilization of south complex.

The ATC procedures are considered in the study in two ways. The separations maintained between arrivals and departures are used as model inputs for the computer run. The present day conditions at the airfield are reflected in the gate and runway distributions used for experiments with VFR conditions and no airport design improvements.

## 2.2. Experimental Design and Model Application.

The experimental design for this effort was developed early in the program and is shown in Table 1. The experiments were divided into two stages to permit a review of some initial results and changes in the remaining experiments to take advantage of any redirection of effort indicated by those findings. The three main areas of the experiments which had to be translated into model inputs were the air traffic control scenario, the airport design improvements and the air traffic demand.

### 2.2.1. Air Traffic Control Scenarios.

The time frame for the air traffic control scenario indicated the aircraft separation values to be used for the experiment for either VFR or IFR weather conditions. Present day VFR separation values were established by calibrating the model (i.e., matching model output to field data collected at the facility). The base values for arrival-to-arrival and departure-to-departure separations were obtained from the FAA report on "Parameter of Future ATC Systems Relating to Airport Capacity/Delay" (FAA-EM-78-8A). The remaining values for separations followed the results obtained through calibration. Specific nighttime separations had to be developed from information provided by the facility. The referenced separations did not apply to a runway dependency with arrivals opposing the flow of the departures.

### 2.2.2. Airport Design Improvements.

The airport design improvements were initially identified in the Los Angeles International Airport Improvement Task Force Interim Report. The near term improvements were noted in Table 1, Los Angeles Delay Experiments.

The near term improvements included:

1. High-speed taxiway off runway 25L to the south (Improvement #2).
2. Strengthening of the Sepulveda Tunnel (Improvement #3).
3. New taxiway access to the threshold of runway 24R.
4. Temporary holding areas for future taxiway 75.
5. Parking for 20 aircraft at the west end of the airport.
6. Terminal Expansion including Satellite 1 and the International Terminal.
7. High-speed taxi exit off runway 7L (Improvement #5).
8. High-speed exit off runway 6R to taxiway 47 (Improvement #7).
9. Departure by-pass around 7L to 7R (Improvement #8).
10. Opening runway 25 for small aircraft arrivals and departures during tunnel construction.

Various near term improvements were introduced into different experiments to determine their effectiveness in reducing delays and processing the air traffic demand. The improvements were introduced into the experiments by changing the model inputs and the runway demand distributions.

The changes in the model inputs can be illustrated by comparing a link-node diagram of the airport used to develop model inputs for the present day setup, Figure 1, with the diagram showing the noted improvements, Figure 2. Some of the improvements necessitated changes in the distribution of the air traffic demand to the runways and gates. For example, strengthening of the Sepulveda Tunnel permitted heavy departures from the south complex and generated a greater demand on runways 25R and 25L because of their proximity to the gate areas 4, 5, 6, 7 and 8.

TABLE 1  
LOS ANGELES DELAY EXPERIMENTS

Experiment number	Model	Study cases <sup>a</sup>	Arrival runways	Departure runways	Weather	Demand	ATC System scenario <sup>b</sup>	Near Term improvements
Stage 1 Experiments								
1	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1978	1978	None
2	ASM	2	24L, 24R, 25L, 25R	24L, 25R	IFR1	1978	1978	None
3	ASM	3	24R, 25L	24L, 25R	IFR2	1978	1978	None
4	ASM	5	6R, 7L	24L, 25R	VFR1	1978	1978	None
5	ASM	6	6R, 7L	24L, 25R	IFR1	1978	1978	None
6	ASM	4	6L, 6R, 7L, 7R	6L, 6R, 7L, 7R	VFR1	1978	1978	None
7 (7A) (7B)	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982 (+5%)	1978 (+15%)	None
8 (8A) (8B)	ASM	2	24L, 24R, 25L, 25R	24L, 25R	IFR1	1982 (+5%)	1978 (+15%)	None
9	ASM	4	6L, 6R, 7L, 7R	6L, 6R, 7L, 7R	VFR1	1982	1978	None
10	ASM	5	6R, 7L	24L, 25R	VFR1	1982	1978	None
10A	ASM	6	6R, 7L	24L, 25R	IFR1	1982	1978	None
11	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	1982 <sup>e</sup>
12	ASM	2	24L, 24R, 25L, 25R	24L, 25R	IFR1	1982	1982	1982
13	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	2, 3
15	ASM	5	6R, 7L	24L, 25R	VFR1	1982	1982	5, 7 <sup>g</sup>
16	ASM <sup>h</sup>	4	6L, 6R, 7L, 7R	6L, 6R, 7L, 7R	VFR1	1982	1982	5, 7, 8 <sup>g</sup>
17	ADM <sup>i</sup>	n. a.	n. a.	n. a.	n. a.	1978	1978	None
17A	RCM <sup>j</sup>	7	24L, 24R, 25L	24L, 24R, 25L	VFR1	1982	1982	Tunnel Construction <sup>j</sup>
17B	RCM	7	24L, 24R, 25L, 25x <sup>k</sup>	24L, 24R, 25L, 25X	VFR1	1982	1982	Tunnel Construction
17C	RCM	7	24L, 24R, 25L, 26	24L, 24R, 25L, 26	VFR1	1982	1982	Comments-Usage for Light

n. a. = not applicable.

a. Study cases (combinations of runway use and weather conditions) are defined in Figure III-1.

b. FAA will describe impact of 1982 and post-1987 ATC systems on model inputs.

c. Potential near-term improvements are identified in the Los Angeles International Airport Improvement Task Force Interim Report, and in Appendix B.

d. Airfield Simulation Model.

e. Task Force establishes packages of near-term improvements most likely to be implemented in 1982 and 1987 time frames. The 1982 package includes improvement # 2 (high-speed taxiway off Runway 25L to the south), improvement # 3 (strengthening of the Sepulveda Tunnel), (cont.)

TABLE 1 (CONTINUED)  
LOS ANGELES DELAY EXPERIMENTS

- e. (cont.) new taxiway access to threshold of Runway 24R, and temporary holding areas on future Taxiway 75. The 1987 package includes all 1982 improvements plus Satellite 1, International Terminal, and/or remote parking for 20 aircraft at west end of airport. These packages of improvements are subject to Task Force review and revision.
- f. Impact of absence of Improvements # 2 and #3 (high-speed taxiway of Runway 25L and strengthening of the Sepulveda Tunnel).
- g. Improvement # 5 is a high-speed taxi exit off Runway 7. Improvement # 7 is a high-speed taxi exit to Taxiway 47 from Runway 6R. Improvement #8 is a bypass area on the north side of Runway 7L.
- h. Annual Delay Model.
- i. Runway Capacity Model.
- j. Runway 25R closed for tunnel construction.
- k. During closure of 25R for tunnel construction, parts of Runway 25 are open for small aircraft arrivals and departures.

TABLE 1 (CONTINUED)

LOS ANGELES DELAY EXPERIMENTS

Experiment number	Model	Study case <sup>a</sup>	Arrival Runways	Departure Runways	Weather	Demand	ATC System scenario <sup>b</sup>	Near-term improvements <sup>c</sup>
Stage 2 Experiments								
18	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	10 <sup>1</sup>
19 A	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1978	Terminal Expansion <sup>n</sup>
20	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	Terminal Expansion <sup>n</sup>
21	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1982	1982	Remote Terminal <sup>o</sup>
22	ASM	7	24L, 24R, 25L	24L, 24R, 25L	VFR1	1982	1978	Tunnel Construction
22A	ASM	8	24L, 24R, 25L	24L, 24R, 25L	VFR1	1982	1978	Dual Taxiway <sup>p</sup>
23	ASM	8	24R, 25L	24L, 25L	IFR1	1982	1978	Tunnel Construction 25R
24	ASM	9	24R, 25R	24L, 25R	IFR1	1982	1978	Tunnel Construction 25L
25	ASM	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1987	1987	1987 <sup>o</sup>
25A	ASH	1	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	VFR1	1987	1987	1987
26	ASH	2	24L, 24R, 25L, 25R	24L, 24R, 24R	IFR1	1982	1982	1982
27	ADM	n.a.	n.a.	n.a.	n.a.	1982	1982	None
28	ADM	n.a.	n.a.	n.a.	n.a.	1982	1978	1982
29	ADM	n.a.	n.a.	n.a.	n.a.	1982	1978	None
30	ADM	n.a.	n.a.	n.a.	n.a.	1982	1978	None
31	ADM	n.a.	n.a.	n.a.	n.a.	1987	1987	1987
32	ADM	n.a.	n.a.	n.a.	n.a.	1987	1987	None
33	ADM	n.a.	n.a.	n.a.	n.a.	1987	1978	1987
34	ADM	n.a.	n.a.	n.a.	n.a.	1987	1978	None
35	ASH	n.a.	24L, 24R, 25R	24L, 24R, 25R	VFR1	1982	1978	Tunnel Construction 25L, 25R Done
36	ASH	n.a.	24R, 25R	24L, 25R	IFR1	1982	1978	Tunnel Construction 25L, 25R Done
37	ASH	n.a.	24R, 25L	24L, 25L	IFR1	1982	1978	Tunnel Construction 25R, 25L Done

1. Improvement #10 consists of a series of taxiway improvements identified in Appendix B.  
n. Construction of Satellite 1 and International Terminal. The need for this experiment will be reviewed by the Task Force after consideration of future airline terminal locations.  
o. Remote parking for 20 aircraft at west end of Airport.  
p. Additional experiment may be needed to test value of dual taxiway system around Satellite 4 during tunnel construction!

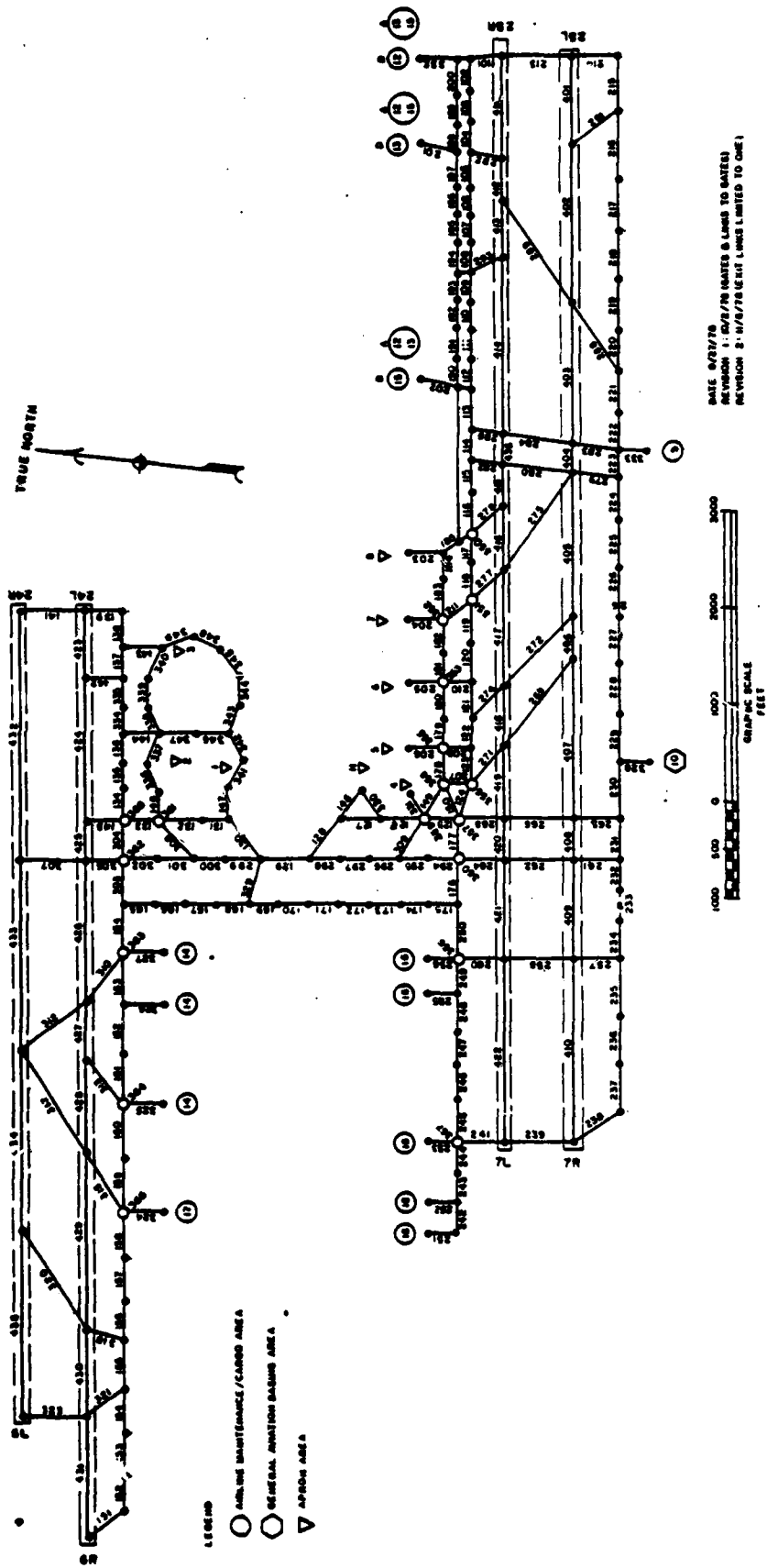


FIGURE 1 LAX LINK NODE DIAGRAM (PRESENT)

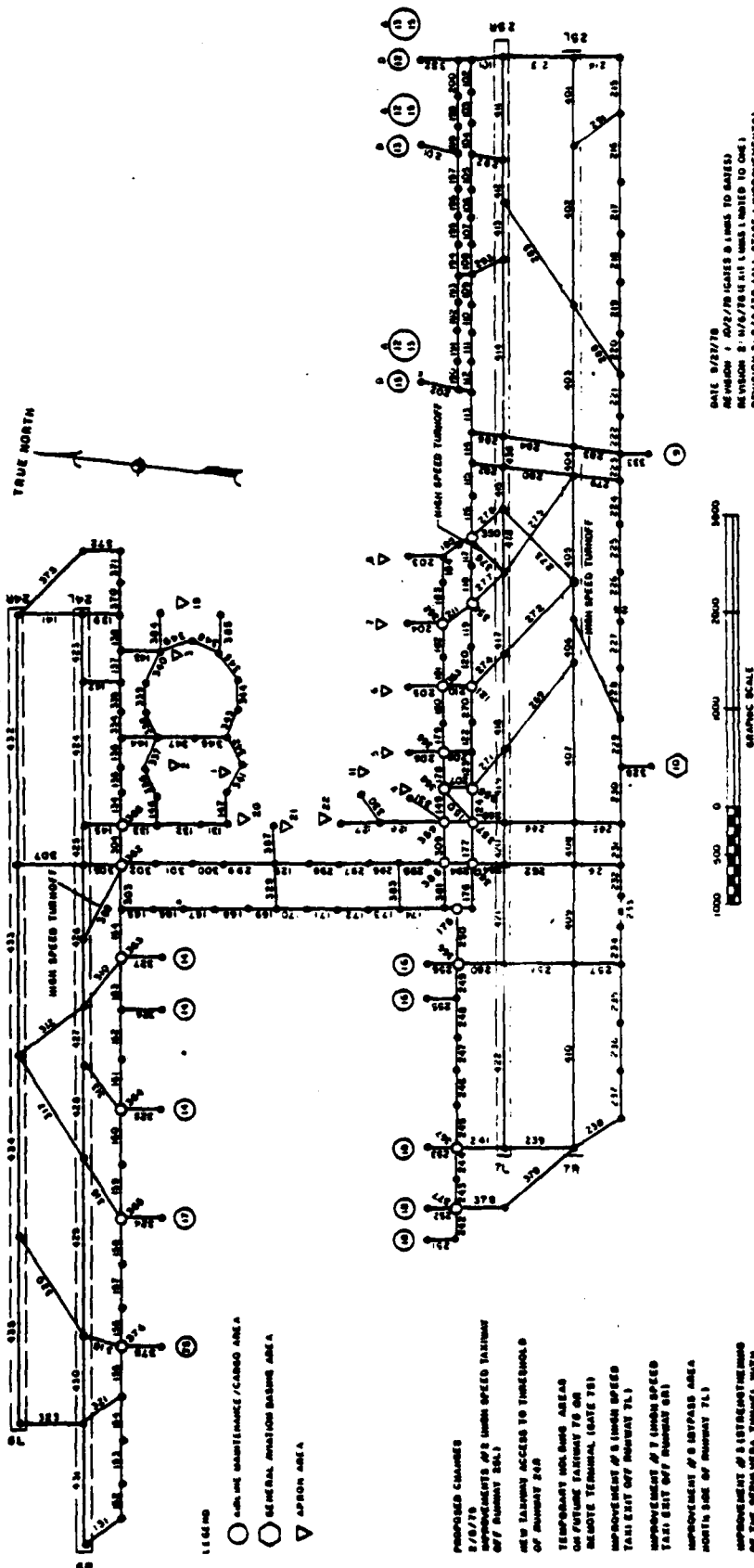


FIGURE 2 LAX LINK NODE DIAGRAM (COMBINED IMPROVEMENTS)



### 2.2.3. Air Traffic Demand.

Actual and forecasted air traffic demands were prepared for the 1978, 1982 and 1987 time periods. Additional 1982 aircraft schedules were prepared in total daily increases of 5% and 15% over the projected 1982 operations. Another air traffic demand schedule was constructed for the 1987 time period which added a 10% increase in arrivals and departures during peak hours. The hourly air traffic demands are shown in Tables 2 through 7.

Each air traffic demand applied to an experiment required a specified arrival and departure runway distribution and individual gate assignments by airline.

The basis for the initial VFR distribution of traffic was the field data collected at the airport during the week of September 24, 1978. Data reduction programs calculated the actual distribution of traffic over the runways and gates.

When the experiment required another weather condition or an improvement in airport design, the aircraft schedule was changed to reflect the proper weather condition or the revised airport operation. After the computer simulation of a particular experiment, the delay and travel time summaries were analyzed to determine whether the results represented logical operating conditions for the airport. If necessary, the demand was modified to produce a reasonable distribution of traffic on the runways by reassigning arrivals from the south complex to the north complex of the airport. This was done by changing the runway assignments in the schedule and/or dynamically reassigning runways during the model run.

As an example, the original demand for experiment #2 was modified by reassigning arrivals and is referred to as demand schedule #2M. For experiment #11 (rerouted), the original demand schedule for experiment #11 was dynamically modified by changing one of the model's input parameters. When delays for departures on runway 25R began to build to a high level, departures assigned to runway 25R on the south complex were rerouted to runway 24R on the north complex.

Changes in the demand, whether by schedule changes and/or dynamic rerouting, produced lower delay values and better traffic flow over the entire airport.

The actual (1978) and projected (1982, etc.) demand schedules were used to calculate the estimated annual demand and passenger enplanements for the Los Angeles International Airport. The basic assumption in the calculation was that the demand represented an average day over a 2 month period, July and August, which comprised about 19% of the total traffic and 25% of the passenger enplanements. The calculations are shown in Table 8.

TABLE 2

## 1978 DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL		
<u>ARRIVALS</u>							
0000	16	0	1	2	19		
0100	10	7	0	1	18		
0200	6	7	1	0	14		
0300	1	3	1	0	5		
0400	5	5	0	0	10		
0500	4	2	1	0	7		
0600	9	0	3	4	16		
0700	16	1	7	5	29		
0800	23	4	5	7	39		
0900	25	2	4	9	40		
1000	35	1	6	8	50		
1100	41	4	6	8	59		
1200	31	1	4	9	45		
1300	29	0	3	10	42		
1400	29	4	4	10	47		
1500	26	1	5	11	43		
1600 to 2400	269	10	32	52	363		
TOTALS	575	52	83	136	846		
<u>DEPARTURES</u>							
0000	19	1	2	2	24		
0100	9	10	0	0	19		
0200	1	7	1	0	9		
0300	1	2	1	0	4		
0400	1	5	1	0	7		
0500	4	5	0	1	10		
0600	9	2	4	2	17		
0700	32	4	6	6	48		
0800	49	3	3	9	64		
0900	38	4	5	5	52		
1000	34	2	6	6	48		
1100	34	3	4	11	52		
1200	44	5	5	11	65		
1300	39	1	1	10	51		
1400	20	0	7	12	39		
1500	30	0	6	7	43		
1600 to 2400	214	22	32	44	312		
TOTALS	578	76	84	126	864		
CLASS DISTRIBUTION (0000 to 2400)							
Class 1		Class 2		Class 3		Class 4	
21.5 %		55.4 %		17.9 %		5.2 %	

TABLE 3

14

## 1982 DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
<u>ARRIVALS</u>					
0000	12	4	1	2	19
0100	14	7	0	1	22
0200	4	7	2	0	13
0300	3	1	0	0	4
0400	4	5	0	0	9
0500	5	3	1	0	9
0600	6	0	6	1	13
0700	17	1	2	5	25
0800	27	4	7	7	45
0900	26	2	4	9	41
1000	38	2	5	8	53
1100	43	4	7	8	62
1200	30	1	4	9	44
1300	28	0	2	10	40
1400	35	4	4	10	53
1500	19	1	5	11	36
1600 to 2400	271	12	33	52	368
TOTALS	582	58	83	136	859
<u>DEPARTURES</u>					
0000	22	0	2	2	26
0100	8	11	0	0	19
0200	4	5	1	0	10
0300	0	9	1	0	4
0400	4	2	1	0	7
0500	4	5	0	1	10
0600	10	2	4	2	18
0700	30	6	6	6	48
0800	49	3	3	9	64
0900	42	2	5	5	54
1000	34	2	6	6	48
1100	34	3	4	11	52
1200	42	7	5	11	65
1300	43	0	1	10	54
1400	22	0	7	13	41
1500	30	0	6	7	43
1600 to 2400	213	24	32	44	313
TOTALS	591	75	84	126	876
CLASS DISTRIBUTION (0000 to 2400)					
	Class 1	Class 2	Class 3	Class 4	
	23.9 %	55.0 %	15.9 %	5.2 %	

TABLE 4

1982 + 5% DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
<u>ARRIVALS</u>					
0000	12	5	1	2	20
0100	14	8	0	1	23
0200	4	8	2	0	14
0300	3	1	0	0	4
0400	4	5	0	0	9
0500	5	3	1	0	9
0600	6	1	6	4	17
0700	17	2	2	5	26
0800	27	6	7	7	47
0900	26	4	4	9	43
1000	38	5	5	8	56
1100	43	7	7	8	65
1200	30	3	4	9	46
1300	28	2	2	10	42
1400	35	6	4	10	55
1500	19	3	5	11	38
1600 to 2400	271	30	33	52	386
TOTALS	582	99	83	136	900
<u>DEPARTURES</u>					
0000	22	1	2	2	27
0100	8	12	0	0	20
0200	4	5	1	0	10
0300	0	3	1	0	4
0400	4	2	1	0	7
0500	4	5	0	1	10
0600	10	3	4	2	19
0700	30	8	6	6	50
0800	49	6	3	9	67
0900	42	5	5	5	57
1000	34	4	6	6	50
1100	34	6	4	11	55
1200	42	10	5	11	68
1300	43	3	1	10	57
1400	22	2	7	12	43
1500	30	2	6	7	45
1600 to 2400	213	40	32	49	329
TOTALS	591	117	84	126	918
CLASS DISTRIBUTION (0000 to 2400)					
	Class 1	Class 2	Class 3	Class 4	
	23.9 %	55.3 %	15.9 %	4.9 %	

TABLE 5

1982 + 15% DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
<u>ARRIVALS</u>					
0000	12	7	1	2	22
0100	14	10	0	1	25
0200	4	9	3	0	15
0300	3	2	0	0	5
0400	4	6	0	0	10
0500	5	5	1	0	11
0600	6	3	6	4	19
0700	17	5	2	5	29
0800	27	10	7	7	51
0900	26	7	4	9	46
1000	38	10	5	8	61
1100	43	13	7	8	71
1200	30	7	4	9	50
1300	28	6	2	10	46
1400	35	11	4	10	60
1500	19	7	5	11	42
1600 to 2400	271	67	33	52	423
TOTALS	582	185	83	136	986
<u>DEPARTURES</u>					
0000	22	4	2	2	30
0100	8	14	0	0	22
0200	4	6	1	0	11
0300	0	4	1	0	5
0400	4	3	1	0	8
0500	4	7	0	1	12
0600	10	5	4	2	21
0700	30	13	6	6	55
0800	49	13	3	9	74
0900	42	10	5	5	62
1000	34	9	6	6	55
1100	34	11	4	11	60
1200	42	16	5	11	74
1300	43	8	1	10	62
1400	22	6	7	12	47
1500	30	6	6	7	49
1600 to 2400	213	69	32	44	358
TOTALS	591	204	84	126	1005
CLASS DISTRIBUTION (0000 to 2400)					
Class 1		Class 2		Class 3	
23.9 %		55.6 %		15.9 %	
				Class 4	
				4.6 %	

TABLE 6

## 1987 DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
<u>ARRIVALS</u>					
0000	11	4	0	2	17
0100	13	8	1	1	23
0200	5	7	1	0	13
0300	5	1	1	0	7
0400	4	5	0	0	9
0500	4	3	1	0	8
0600	7	0	5	4	16
0700	18	1	5	5	29
0800	31	3	7	7	48
0900	23	3	2	9	37
1000	37	3	6	8	54
1100	44	4	6	8	62
1200	32	3	5	9	49
1300	28	0	2	10	40
1400	32	4	4	10	50
1500	27	0	4	11	42
1600 to 2400	277	13	33	52	375
TOTALS	598	62	83	136	879
<u>DEPARTURES</u>					
0000	22	0	2	2	26
0100	8	12	0	0	20
0200	4	5	1	0	10
0300	0	3	1	0	4
0400	4	2	1	0	7
0500	4	5	0	1	10
0600	10	2	4	2	18
0700	30	6	6	6	48
0800	50	3	3	9	65
0900	43	2	5	5	55
1000	35	2	6	6	49
1100	35	2	4	11	52
1200	43	7	5	11	66
1300	44	0	1	10	55
1400	23	0	7	12	42
1500	30	0	6	7	43
1600 to 2400	215	24	32	44	315
TOTALS	600	75	84	126	885
CLASS DISTRIBUTION (0000 to 2400)					
	Class 1	Class 2	Class 3	Class 4	
	27.0 %	54.0 %	13.9 %	5.1 %	

TABLE 7

## 1987 DEMAND WITH PEAKS

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL		
<u>ARRIVALS</u>							
0000	11	4	0	2	17		
0100	13	8	1	1	23		
0200	5	7	1	0	13		
0300	5	1	1	0	7		
0400	4	5	0	0	9		
0500	4	3	1	0	8		
0600	7	0	5	4	16		
0700	18	1	5	5	29		
0800	31	8	7	7	53		
0900	25	3	2	9	37		
1000	37	3	6	8	54		
1100	44	10	6	8	68		
1200	32	3	5	9	49		
1300	28	0	2	10	40		
1400	32	4	4	10	50		
1500	27	0	4	11	42		
1600 to 2400	277	13	35	52	375		
TOTALS	598	73	83	136	890		
<u>DEPARTURES</u>							
0000	22	0	2	2	26		
0100	8	12	0	0	20		
0200	4	5	1	0	10		
0300	0	3	1	0	4		
0400	4	2	1	0	7		
0500	4	5	0	1	10		
0600	10	2	4	2	18		
0700	30	6	6	6	48		
0800	50	8	3	9	70		
0900	43	2	5	5	55		
1000	35	2	6	6	49		
1100	35	2	4	11	52		
1200	43	14	5	11	73		
1300	44	0	1	10	55		
1400	23	0	7	12	42		
1500	30	0	6	7	43		
1600 to 2400	215	24	32	44	315		
TOTALS	600	87	84	126	897		
CLASS DISTRIBUTION (0000 to 2400)							
Class 1		Class 2		Class 3		Class 4	
27.0 %		54.2 %		13.8 %		5.0 %	



TABLE 8

ANALYSIS of YEARLY TOTAL for PASSENGER and AIRCRAFT OPERATIONS

	1978	1982	1982 +5%	1982 +15%	1987
Total Daily Air Carrier and Air Taxi Operations	1448	1473	1556	1729	1502
Total Departures (avg.)	724	737	778	865	751
% of Class 1	22.7	25.2	25.2	25.1	28.5
Class 2	58.4	58.0	58.1	58.2	56.9
Class 3	18.9	16.8	16.7	16.7	14.6
# of Seats per Aircraft (avg.)					
Class 1	280	300	300	300	300
Class 2	140	160	160	160	170
Class 3	16	20	20	20	25
Occupied Seats Per Air- Craft (avg.) (L.F.=0.65)					
Class 1	182.0	195.0	195.0	195.0	195.0
Class 2	91.0	104.0	104.0	104.0	110.5
Class 3	10.4	13.0	13.0	13.0	16.5
Daily Passenger Totals (avg.)					
Class 1	29,911	36,216	38,230	42,337	41,736
Class 2	38,476	44,455	47,009	52,356	47,218
Class 3	<u>1,423</u>	<u>1,609</u>	<u>1,689</u>	<u>1,878</u>	<u>1,809</u>
TOTAL	69,810	82,280	86,928	96,571	90,763
	<u>x60</u>	<u>x60</u>	<u>x60</u>	<u>x60</u>	<u>x60</u>
July-August Passenger Enplanements	4,188,600	4,936,800	5,215,680	5,794,260	5,445,780
TOTAL % of Yearly totals	± 0.25	± 0.25	± 0.25	± 0.25	± 0.25
Yearly Passenger Count (Enplanements) x 1000	16,754	19,747	20,862	23,177	21,783

TABLE 8 (cont.)

## ANALYSIS of YEARLY TOTAL for PASSENGER and AIRCRAFT OPERATIONS

	1978	1982	1982 +5%	1982 +15%	1987
<b>Total Daily Air Carrier and Air Taxi Operations</b>	1448	1473	1556	1729	1502
	<u>x60</u>	<u>x60</u>	<u>x60</u>	<u>x60</u>	<u>x60</u>
	86,880	88,380	93,360	103,740	90,120
<b>July-August Aircraft Operations : % of Yearly Total</b>	<u>÷0.19</u>	<u>÷0.19</u>	<u>÷0.19</u>	<u>÷0.19</u>	<u>÷0.19</u>
<b>Yearly Aircraft Count (Air Carrier and Air Taxi)</b>	457,263	465,157	491,368	546,000	474,315
<b>GA Count</b>	<u>+53,000</u>	<u>+53,000</u>	<u>+53,000</u>	<u>+53,000</u>	<u>+53,000</u>
<b>TOTAL</b>	510,263	518,157	544,368	599,000	527,315

### 2.3. Experimental Results.

Each experiment produced a summary of hourly results which was reduced to tabular form. The information in the table included: average flow rates for each runway, average total flow rate for the airport, average arrival and departure delays for each runway (including average delay for all runways), average runway crossing delays, average taxiway delays and average gate hold conditions. In addition, average travel times were listed for airborne arrivals (arrival fix to threshold), arrival ground travel (threshold to gate) and departure ground travel (gate to roll including gate hold time). The tables for each experiment are shown in Appendix B.

The summaries of the experiments were used to calculate the total delays and the travel times accumulated during each hour of the simulation. The delay and travel times were added for each experiment (8 hour totals for daytime and 7 hour totals for nighttime). The results of this data reduction are shown in Tables 9 to 11. The tables list sets of experiments which have common weather conditions, traffic flow, etc.

The runway capacity model was exercised during the effort to determine the capacity of the airport during tunnel construction. The results of the experiments (17A, 17B and 17C) are shown in Tables 12 and 13.

The results of the simulation model runs formed the basis for calculation of the annual delays for the airport. Experiment 1 was rerun for a time period from 0700 to 2400 and served as a guide for calculating the total delay for an average day. The results of this simulation, shown in Table ,

Appendix B, indicate that about one-half of the arrival delays for operations from 0700 to 2400 occurred in the first eight hours of the simulation. Delays from the simulation were combined with the delays from the nighttime operations and used to calculate the annual delay. It was assumed that the average day was representative of two months of activity which comprised about 19% of the total delays. The results of the simulation experiments whose conditions matched those required for the annual delay calculation were used as a base for the determination of total annual delay.

TABLE 9  
RESULTS OF VFR -- WESTERLY FLOW

EXP.	DEMAND ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL				
					RUNWAY AIR	TAXI	RUNWAY Z-ING	RUNWAY TAXI		RUNWAY Z-ING	ARRIVAL AIR		ARRIVAL GROUND	DEPARTURES GROUND		
1	1978	—	NONE	1978	803	46	80	2712	482	2	74	3477	4077	1529	5677	11283
7	1982	—	NONE	1978	643	57	81	2598	562	8	30	3336	4027	1610	5659	11296
7A	1982 +5%	—	NONE	1978	1576	66	119	4182	897	4	293	5582	5723	1708	7905	14736
7B	1982 +15%	—	NONE	1978	5871	226	105	5541	1591	4	1118	8587	9339	1907	10884	22130
11	1982	—	NEAR TERM	1982	1358	123	108	4130	1357	4	1133	6856	4789	1681	8897	15287
11	1982	DEPARTURES SENT FROM 25R TO 24R	NEAR TERM	1982	405	58	87	2048	494	8	6	3106	3717	1501	4801	10100
13	1982	—	BY-PASS TO RUNWAY 24A INCLUDING AREA BETWEEN 24R AND 25R	1982	436	61	88	2380	468	8	21	3026	3828	1611	5304	10742
18	1982	—	DUAL TAXIWAY	1982	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
18	1982	DEPARTURES SENT FROM 25R TO 24R	DUAL TAXIWAY	1982	382	48	60	2277	485	10	31	2911	3786	1625	5349	10759
18A	1982	—	DUAL TAXIWAY	1982	409	55	62	2190	659	10	3	2980	3748	1629	5775	10532
18A	1982	—	TERMINAL EXPANSION	1978	525	39	45	2346	424	8	12	2873	3823	1586	5751	10560

TABLE 9 (cont'd.)  
RESULTS OF VFR -- WESTERLY FLOW

EXP.	SQUAD	ARRIVAL DEMAND MODIFIED	DEPARTURES RESOURCED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TRAVEL TIMES (minutes)		TOTAL GROUND DELAYS	ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY TAXI	RUNWAY X-ING	ARRIVAL AIR					
20	1982	—	—	TERMINAL EXPANSION	1982	420	48	51	2494	432	8	52	3781	1634	5357	10766
21	1982	—	—	REMOTE TERMINAL	1982	440	46	63	2668	588	6	28	3845	1590	5749	11185
22	1982	—	—	RUNWAY 25R TUNNEL CONSTRUCTION	1978	3073	57	16	4343	355	2	694	6383	1872	7664	15919
22	1982	—	DEPARTURES SENT FROM 25L TO 24R	RUNWAY 25R TUNNEL CONSTRUCTION	1978	993	233	19	4200	1450	11	944	4403	2100	9082	15386
22A	1982	—	11	RUNWAY 25R TUNNEL WITH DUAL TAXIWAY	1978	1034	187	16	4071	1359	11	1048	4444	2101	9001	15347
25	1987	—	—	FAR TERM	1987	189	34	32	1325	245	1	2	3720	1452	3579	8692
25A	1987	—	—	FAR TERM	1987	257	40	38	1957	415	1	73	3899	1505	4455	9857
35	1982	50 ARRIVAL ON 25R CHANGED TO 25R	DEPARTURES SENT FROM 25L TO 24R	RUNWAY 25L TUNNEL CONSTRUCTION	1978	969	65	10	2925	800	0	50	4340	1653	6159	12153

TABLE 10

RESULTS OF IFR -- WESTERLY FLOW

EXP. DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)			TRAVEL TIMES (minutes)			TOTAL	
					BUMWAY AIR	TAXI	RUNWAY X-ING	BUMWAY X-ING	TAXI	RUNWAY X-ING	ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND		
2	1170	—	NONE	1978	8235	26	56	2170	100	3	69	11024	1324	4524	16071
2	1170	—	NONE	1978	4444	35	60	2895	128	4	315	7610	1548	5597	14755
3	1170	—	NONE	1978	7009	1054	84	9535	241	5	5305	9970	2546	16754	29270
8	1182	—	NONE	1978	5100	37	63	2714	164	5	304	8324	1578	5560	15970
8A	1182 +5%	—	NONE	1978	7945	36	56	3777	170	1	416	11111	1573	6774	19539
8B	1182 +15%	—	NONE	1978	12703	81	56	5442	297	2	2285	16030	1648	10600	28277
12	1182	—	NEAR TERM	1982	5046	55	54	2373	165	3	223	8279	1594	4810	14682
12	1182	DEPARTURES SENT FROM 25R TO 24L	NEAR TERM	1982	2321	50	58	2713	189	6	290	5406	1665	5744	12575
23	1182	DEPARTURES SENT FROM 25L TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION	1978	4776	131	17	5292	331	7	4318	7353	1757	11343	20452
24	1182	—	RUNWAY 25L TUNNEL CONSTRUCTION	1978	5967	108	18	6329	177	0	3112	9595	1893	11386	22094
24	1182	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION	1978	5083	173	20	6020	394	0	4892	8626	1911	13505	36557

\* ORIGINAL ARRIVAL RUNWAY DISTRIBUTION OF TRAFFIC DEMAND HAS BEEN MODIFIED





TABLE 11

RESULTS OF VFR -- EASTERLY FLOW  
AND NIGHTTIME OPERATIONS

EXP.	DEPARTURE DEMAND MODIFIED	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)			TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL		
						AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI		RUNWAY X-ING	GATE		AIR	ARRIVAL GROUND
6	1978	1978	—	NONE	1978	1405	601	50	3633	1052	3	1010	4851	2094	7842	14787
6*	1978	1978	—	NONE	1978	460	160	42	2546	606	0	384	3989	1631	6017	11638
9*	1982	1978	—	NONE	1978	408	85	57	2370	406	10	67	3185	1595	5072	10652
10*	1982	1982	—	HIGH SPEED EXITS, RUNWAY TL BY-PASS	1982	332	76	62	2271	309	13	65	3898	1602	4898	10399
4	1978	1978	—	NONE	1978	374	3	0	457	5	0	0	1358	376	3198	4933
10	1982	1978	—	NONE	1978	1035	4	0	686	15	0	0	1966	481	1243	3710
35	1982	1982	—	HIGH SPEED EXITS	1982	844	4	0	617	15	0	0	1800	502	1203	3505
5*	1978	1978	—	NONE	1978	1245	4	0	1130	5	0	0	2142	466	1647	4255
10A	1982	1982	—	NONE	1982	2048	4	0	1285	13	0	0	3001	497	1825	5323

\* ORIGINAL ANNUAL RUNWAY DISTRIBUTION OF TRAFFIC DEMAND HAS BEEN MODIFIED

TABLE 12

## 1982 VFR CAPACITY RESULTS -- NO NOISE CONSTRAINTS

## 24R, 24L and 25L -- MIXED OPERATIONS

## NO NOISE RESTRICTIONS

Because of mixed operations on both runways on the north complex, there is an estimated 5% departures capacity loss due to crossover departure paths on the ground. The departure capacity was 35 for the north complex for all arrival percentages (40%, 45%, 50%, 55%, 60%). A 5% departure capacity loss ( 2 departures) resulted in a departure capacity of 33 on the north complex.

<u>Runways</u>	Hourly Capacity By % Arrivals				
	<u>40%</u>	<u>45%</u>	<u>50%</u>	<u>55%</u>	<u>60%</u>
24R, 24L	99	100	100	101	102
25L	55	55	55	55	55
<hr/>					
All 3 Runways	154	155	155	156	157

(Note: The capacity figures listed above reflect the 5% departure capacity loss.)

TABLE . 13

## 1982 VFR CAPACITY RESULTS -- RELAXED NOISE CONSTRAINTS

24R -- ARRIVALS  
 24L -- DEPARTURES  
 25L -- MIXED OPERATIONS

The relaxed noise restrictions were the result of running on arrivals on 24R.

Runways	Hourly Capacity By % Arrivals				
	40%	45%	50%	55%	60%
24R, 24L	91	86	77	70	64
25L	55	55	55	55	55
<hr/>					
All 3 Runways	146	141	132	125	119

#### 2.4. Comparison of Experimental Results.

The comparison of experimental results was directed towards satisfying the objectives of the effort and determining:

1. The effects of demand on delay.
2. Peak average delays and annual delay values.
3. Demand versus delay comparisons for increases in total daily demand.
4. The percentage of reduction in delay, travel time and estimated annual delays due to proposed procedures, hardware improvement options and airport design improvements for near-term and long-term implementation.
5. The effects of tunnel construction on delay.
6. The interdependence of terminal facilities, airport design procedures, fleet mix and air traffic demand on airport operations.

The following comparisons were made:

1. 1978 operations with 1982 do-nothing case.
2. 1978 operations with 1982 do-nothing cases varying the 1982 demand.
3. 1982 do-nothing case with 1982 separations and near-term improvements.
4. 1978 operations with the 1987 separations and long-term improvements varying the 1987 demand.
5. Sequences of tunnel construction activities with 1982 do-nothing case.
6. 1982 separations and dual taxiway improvements with 1982 do-nothing case.
7. Near-term improvements with dual taxiway improvement.
8. Departure by-pass around runway 24L with dual taxiway improvement.

9. 1982 do-nothing case with 1982 separations, high speed exits off of runways 6R and 7L and departure by-pass around runway 7L.
10. Do-nothing 1982 case with terminal expansion and the presence and absence of 1982 separations.
11. Remote terminal with dual taxiway improvement.

(NOTE: The 1982 do-nothing case refers to 1978 operations with a 1982 demand.)

COMPARISON OF 1978 OPERATIONS WITH 1982 DO-NOTHING CASE

(1978 OPERATIONS USING 1978 and 1982 DEMANDS)

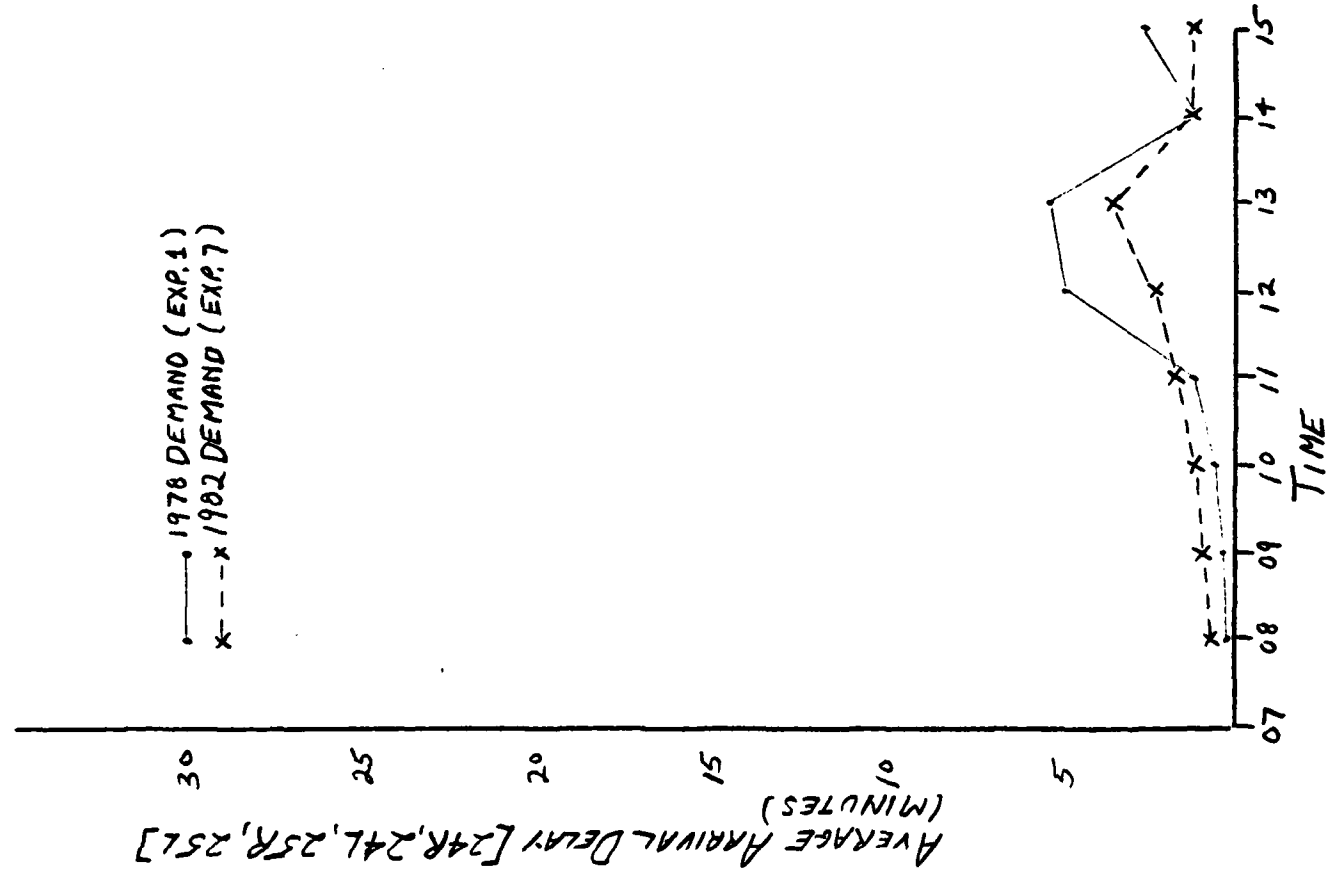
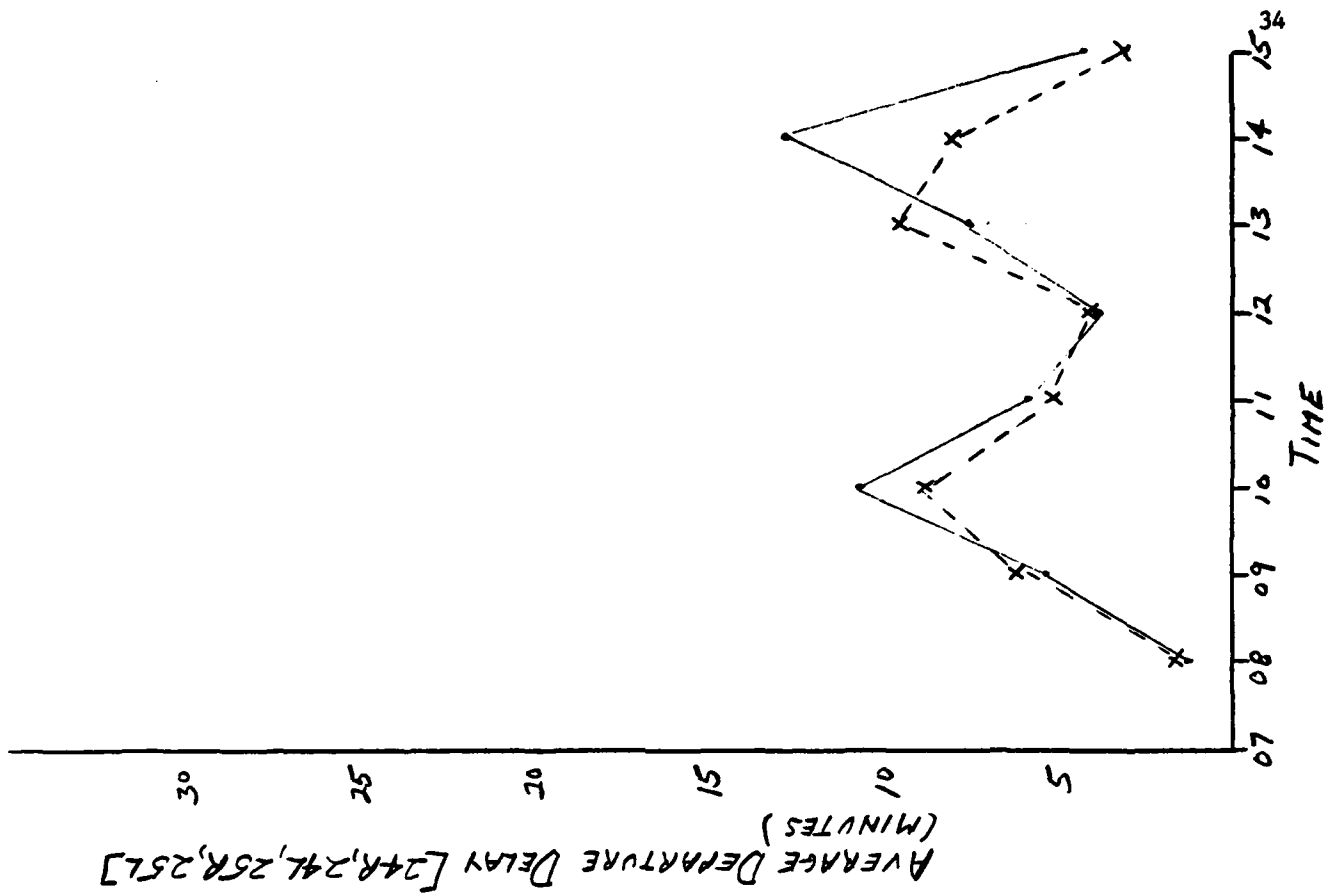
The basis for comparing these simulation experiments (1978 operations) includes all combinations of easterly and westerly traffic flow, VFR and IFR weather conditions, and daytime and nighttime operations under both 1978 and 1982 demands. These configurations represent those exercised during the year at Los Angeles International Airport.

<u>EXPERIMENTS</u>	<u>CONFIGURATIONS</u>
(1978 and 1982 - respective demands)	
#1 and #7	VFR-Daytime-Westerly Flow
#6(Modified) and #9(Modified)	VFR-Daytime-Easterly Flow
#4(Modified) and #10(Modified)	VFR-Nighttime
#2(Modified) and #8(Modified)	IFR-Daytime-Westerly Flow
#5(Modified) and 10A(Modified)	IFR-Nighttime

Figures 3 through 7 show the average delays for arrival and departure runways. Table 14 gives a direct comparison of the experiments showing the total delays and travel times accumulated during the simulation. The results of each comparison are noted on the table.

Compared to 1978 levels, the 1982 demand, fleet mix and distribution of traffic over the runways and gates produced slightly less delays for VFR conditions, but higher delays and travel times for both IFR weather conditions and nighttime operations.

Tables 15 and 16 show the peak average delays and annual delay estimates for the 1978 operations and the 1982 do-nothing case.



● 1978 DEMAND (EXP. 1)  
 x --- 1982 DEMAND (EXP. 7)

FIGURE 3. EXPERIMENTS #1 and #7  
 VFR - DAYTIME - WESTERLY FLOW



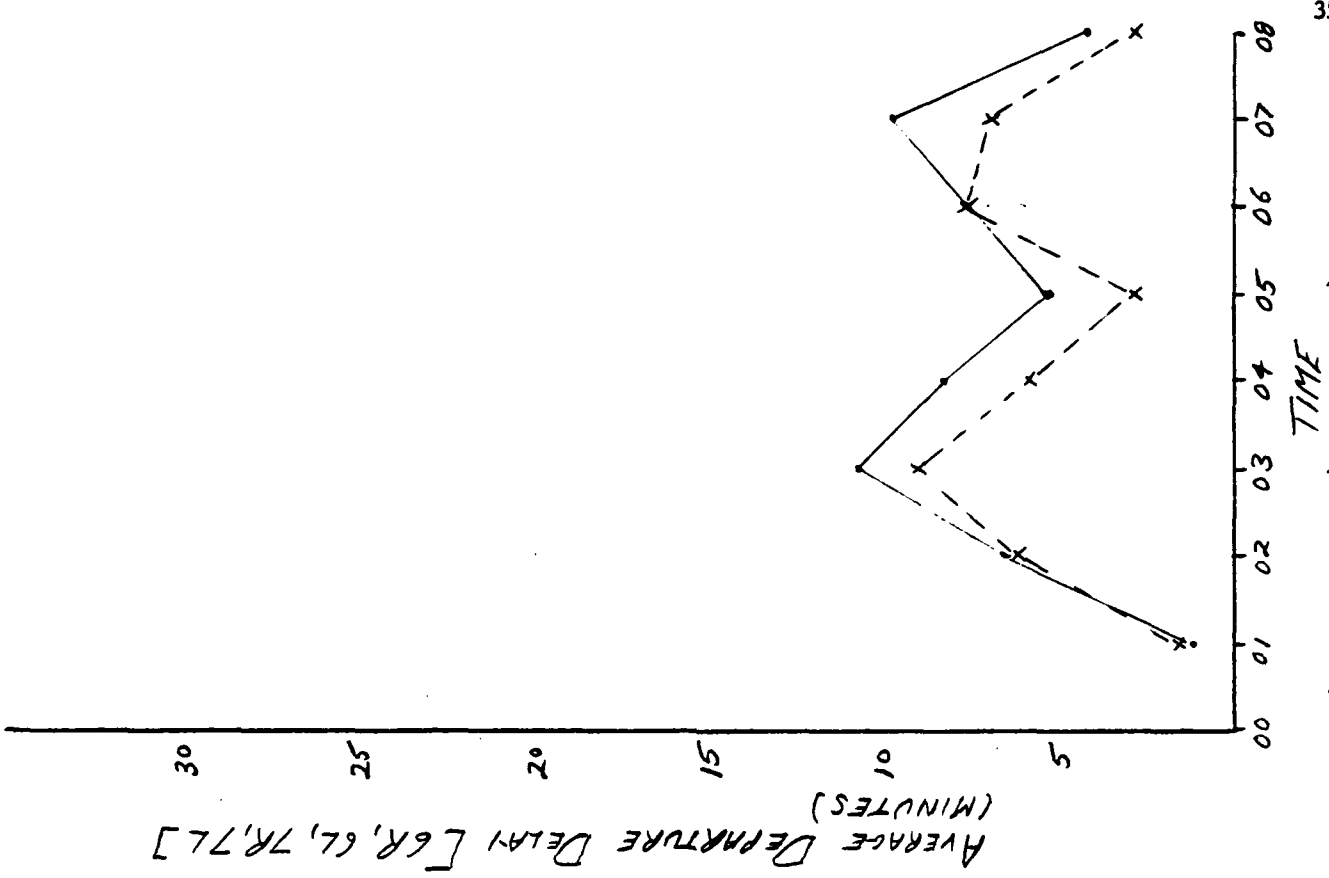
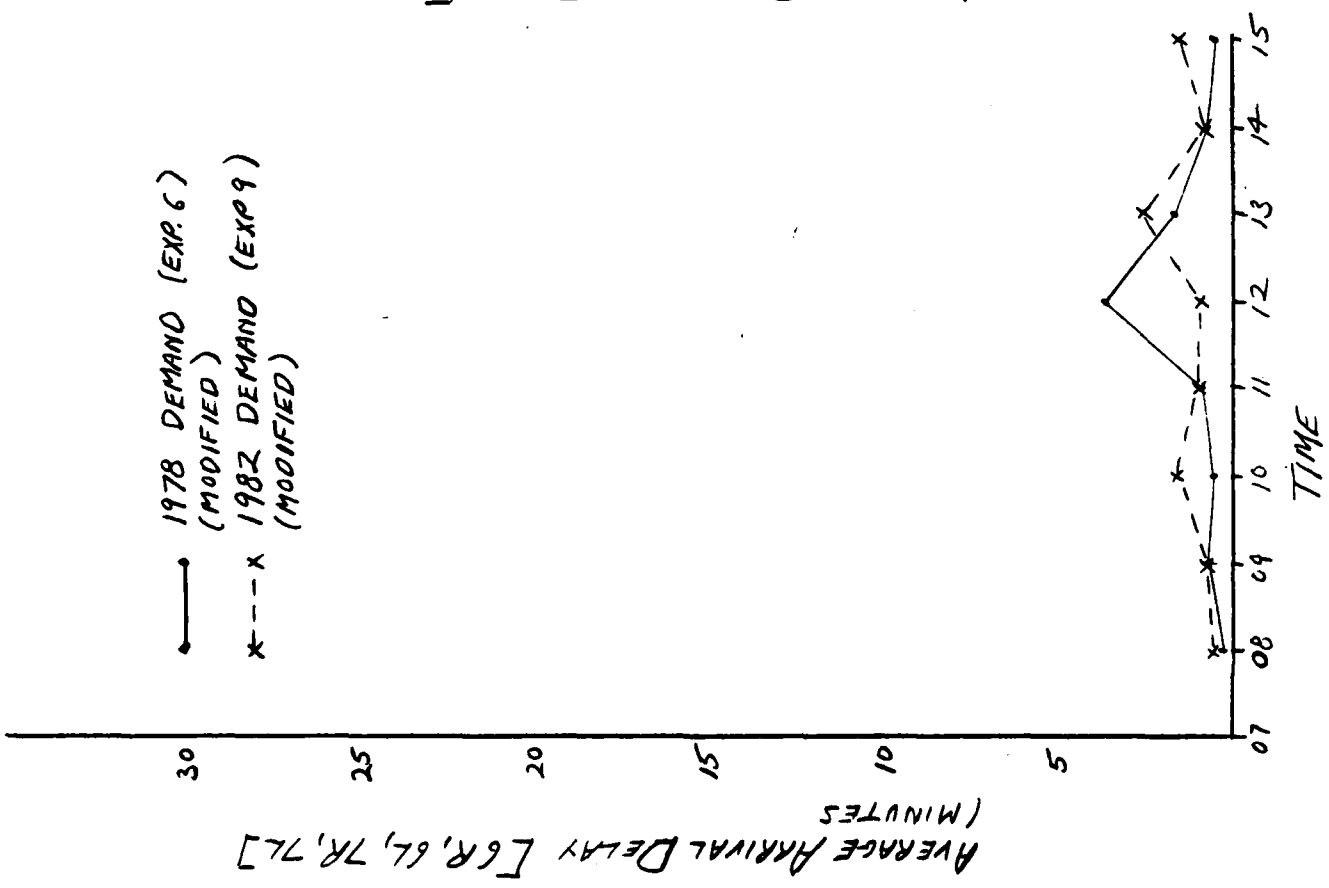
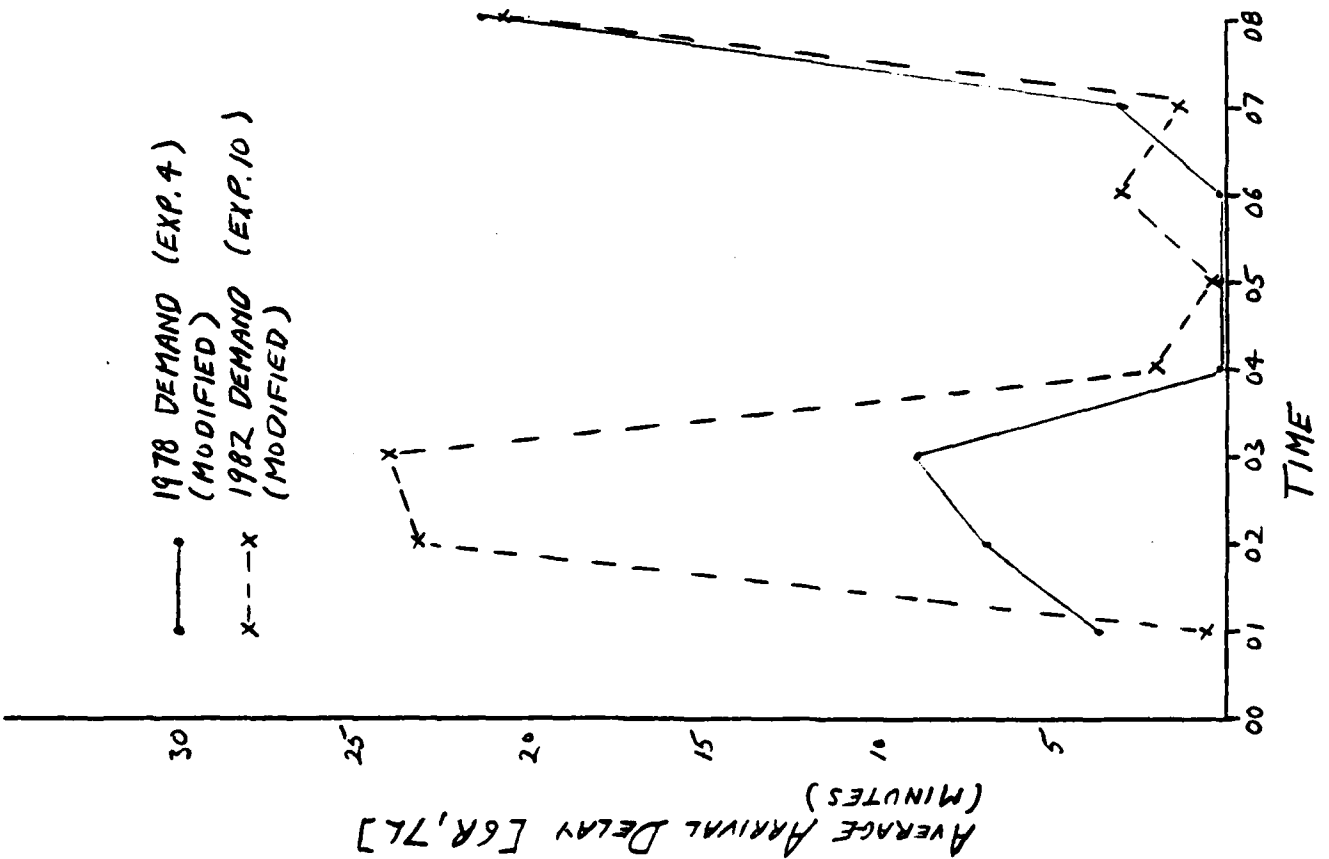
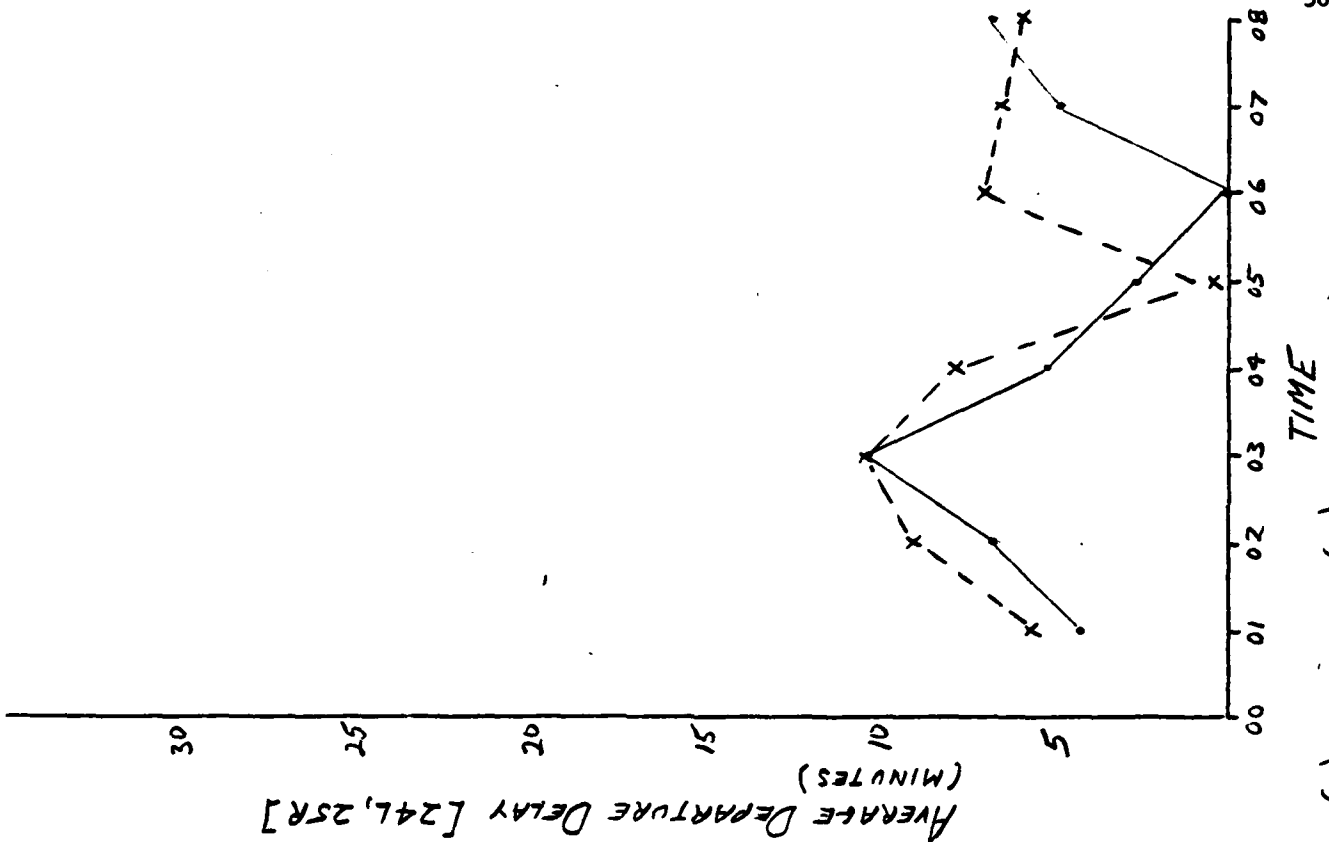


FIGURE 4 EXPERIMENTS #6(M) and #9(M)  
 VFR - DAYTIME - EASTERLY FLOW

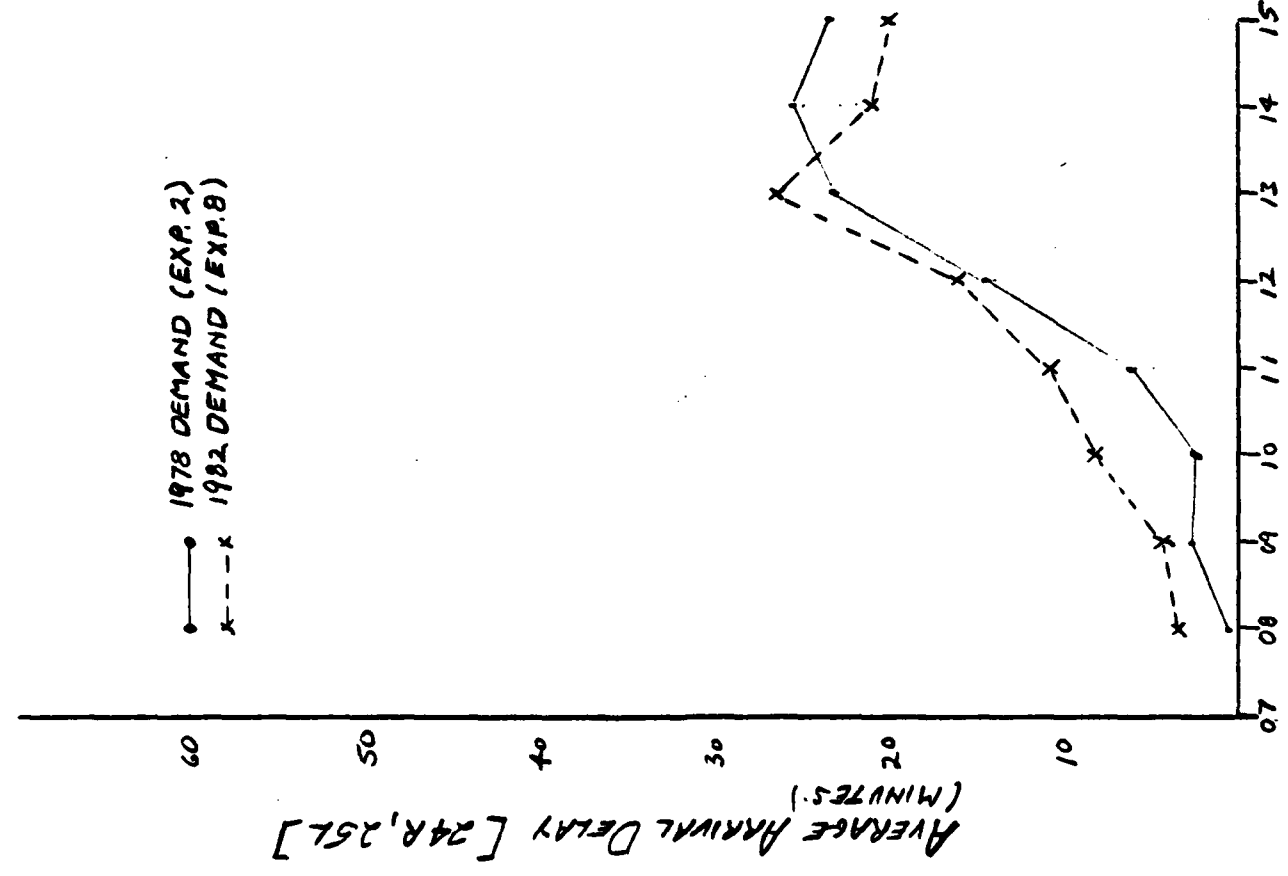
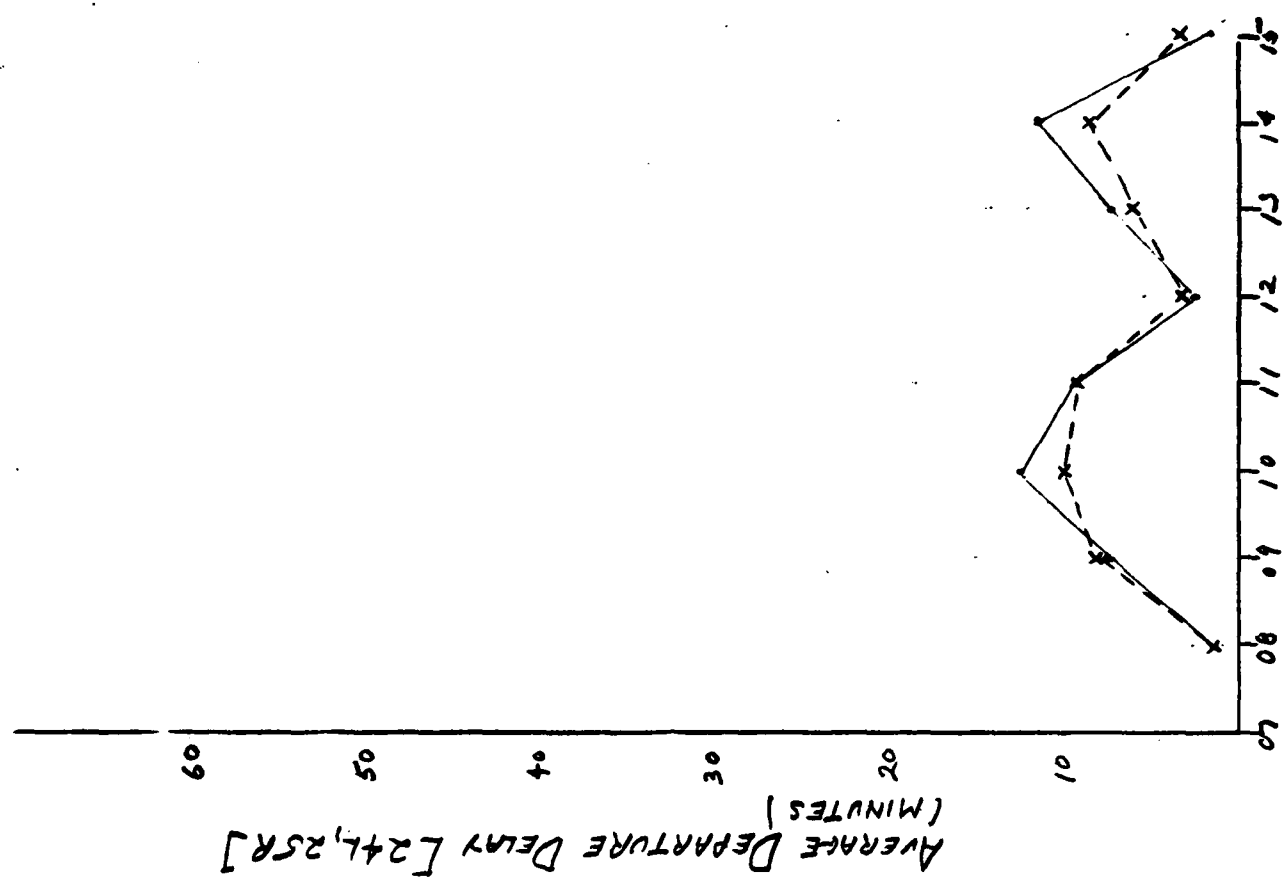


●—— 1978 DEMAND (EXP. 4)  
 (MODIFIED)  
 x---x 1982 DEMAND (EXP. 10)  
 (MODIFIED)

TIME

TIME

FIGURE 5 EXPERIMENTS #4 (M) AND #10 (M)  
VFR - NIGHTTIME



● 1978 DEMAND (EXP. 2)  
 x---x 1982 DEMAND (EXP. 8)

FIGURE 6 EXPERIMENTS #2 (M) and #8 (M)  
 IFR - DAYTIME - WESTERLY FLOW

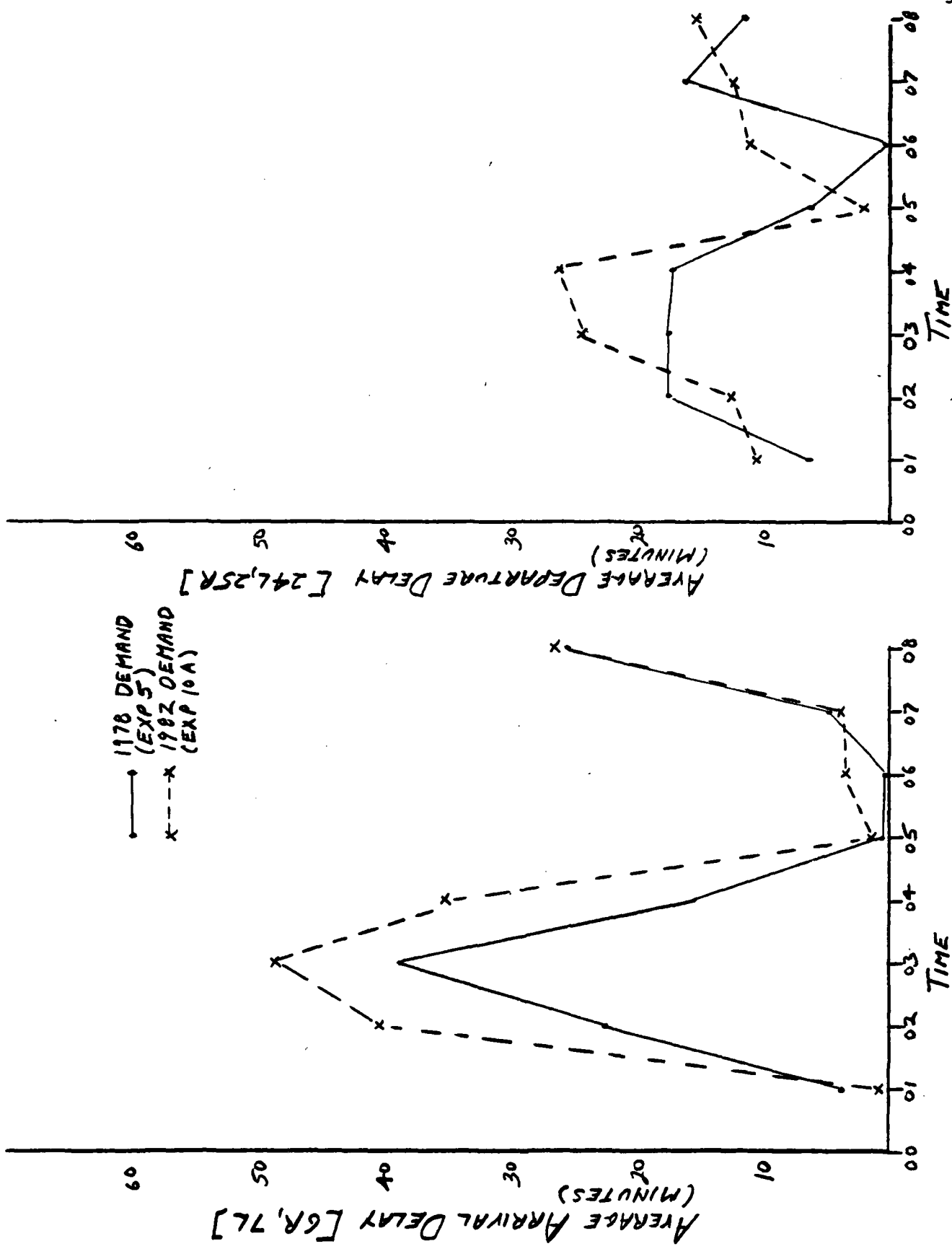


FIGURE 7 EXPERIMENTS #5(M) and #10A (M)  
IFR - NIGHTTIME

TABLE 14  
1978 OPERATIONS WITH 1982 DO-NOTHING CASE

EXP. DEMAND	ARRIVAL DEMAND MODIFIED	REPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)			TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL		
					RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY X-ING	TAXI	RUNWAY		GATE	ARRIVAL AIR		ARRIVAL GROUND	DEPARTURE GROUND
1	1978	—	NONE	1978 (VFR)	803	46	80	2792	482	2	74	3477	4077	1529	5677	11283
7	1982	—	NONE	1978 (VFR)	643	57	81	2578	522	8	30	3336	4027	1610	5659	11296
RESULTS: The 1982 demand resulted in reduced arrival and departure delays due to the change in the aircraft mix and the distribution of the air traffic demand over the runways.																
6	1978	—	NONE	1978 (VFR)	460	166	42	2596	606	0	384	3795	3989	1631	6017	11638
9	1982	—	NONE	1978 (VFR)	408	85	57	2370	406	10	67	3302	3985	1575	5072	10652
RESULTS: The 1982 demand resulted in reduced arrival and departure delays due to the change in the aircraft mix and the distribution of the air traffic demand over the runways.																
4	1978	—	NONE	1978 (VFR)	374	3	0	457	5	0	0	465	1358	376	3198	4933
10	1982	—	NONE	1978 (VFR)	1035	4	0	606	15	0	0	705	1986	481	1243	5710
RESULTS: The 1982 demand resulted in greater arrival and departure delays.																

TABLE 14 (CONTINUED)

1978 OPERATIONS WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REQUESTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS		TRAVEL TIMES (minutes)		TOTAL		
						AIR	TAXI	RUNWAY X-ING	RUNWAY TAXI	RUNWAY X-ING	RUNWAY GATE	AIR	ARRIVAL GROUND		DEPARTURES GROUND	
2	1978	14 Annual on 251 compared to 1978		NONE	1978 (IFR)	444	35	60	2015	128	4	315	7610	1548	5597	19758
8	1982	70 Annual on 251 compared to 1978		NONE	1978 (IFR)	5100	39	63	2714	164	5	304	8324	1578	5568	15470
RESULTS: The 1982 demand resulted in greater arrival delays and reduced departure delays.																
5	1978	ALL ARRIVALS PLACED ON 251		NONE	1978 (IFR)	1245	1	0	1130	5	0	0	2142	466	1647	4255
10A	1982	"		NONE	1978 (IFR)	2048	4	0	1285	13	0	0	3001	447	1835	5523
RESULTS: The 1982 demand resulted in greater arrival and departure delays.																

\* - Modified Demand

TABLE 15

PEAK AVERAGE DELAY (AVERAGE DAY)  
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY	
					ARRIVAL	DEPARTURE
1	1978	VFR	NONE	1978	5.3	12.7
7	1982	VFR	NONE	1978	3.5	9.5
2	1978	IFR	NONE	1978	25.7	12.5
8	1982	IFR	NONE	1978	26.6	10.0
					NIGHTTIME DELAY	
					ARRIVAL	DEPARTURE
4	1978	VFR	NONE	1978	8.9	10.3
10	1982	VFR	NONE	1978	24.1	10.2
5	1978	IFR	NONE	1978	38.9	17.6
10A	1982	IFR	NONE	1978	48.8	26.1

TABLE 16  
ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNUAL DELAY (hours)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	11,485	26,505	37,991
7,8 & 10	1982	NONE	1978	13,270	26,359	39,630
				ANNUAL OPERATIONS		
				TOTAL X 1000		
1,2 & 4	1978	NONE	1978	510		
7,8 & 10	1982	NONE	1978	518		
				AVERAGE ANNUAL DELAY (minutes)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	2.7	6.2	4.5
7,8 & 10	1982	NONE	1978	3.1	6.1	4.6



COMPARISON OF 1978 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND

(1978 OPERATIONS USING 1978 AND VARIED 1982 DEMAND)

The basis for comparing these simulation experiments (1978 daytime operations) includes the VFR and IFR weather conditions for the westerly traffic flow under these various demands - 1978 demand, 1982 demand, a 5% increase in the 1982 demand and a 15% increase in the 1982 demand.

EXPERIMENTS

CONFIGURATIONS

(1978, 1982, 1982 +5%, 1982 +15%,  
respectively)

#1, #7, #7A and #7B

VFR-Daytime-Westerly Flow

#2(Modified), #8(Modified), #8A(Modified)

and #8B(Modified)

IFR-Daytime-Westerly Flow

Figures 8 and 9 show the average delays for arrival and departure runways.

Table 17 gives a direct comparison of the experiments showing the total delays and travel times accumulated during the simulation. The result of each comparison is noted in the table.

The effects of the 1982 demands on the peak average delays and the annual delay estimates are shown in Tables 18 and 19.

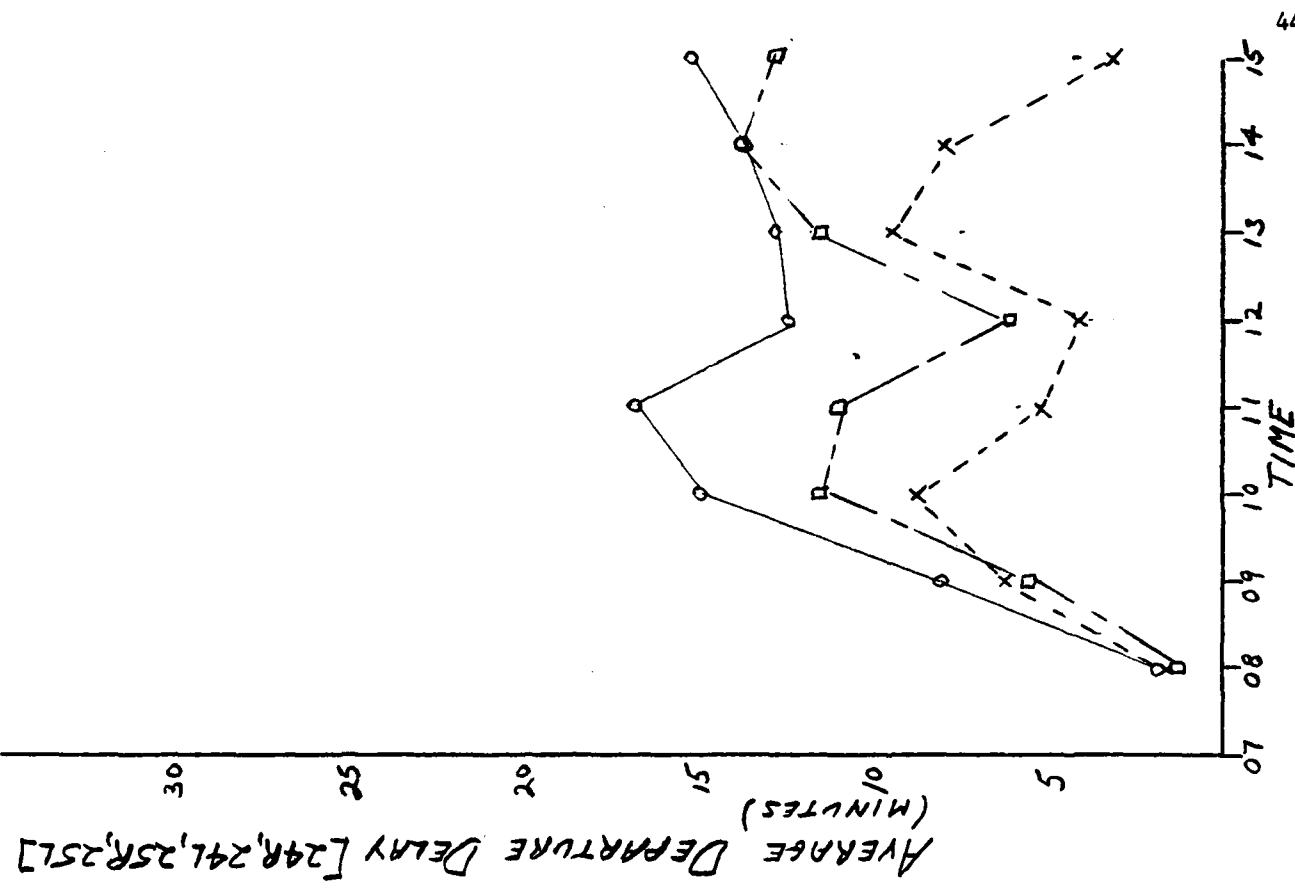
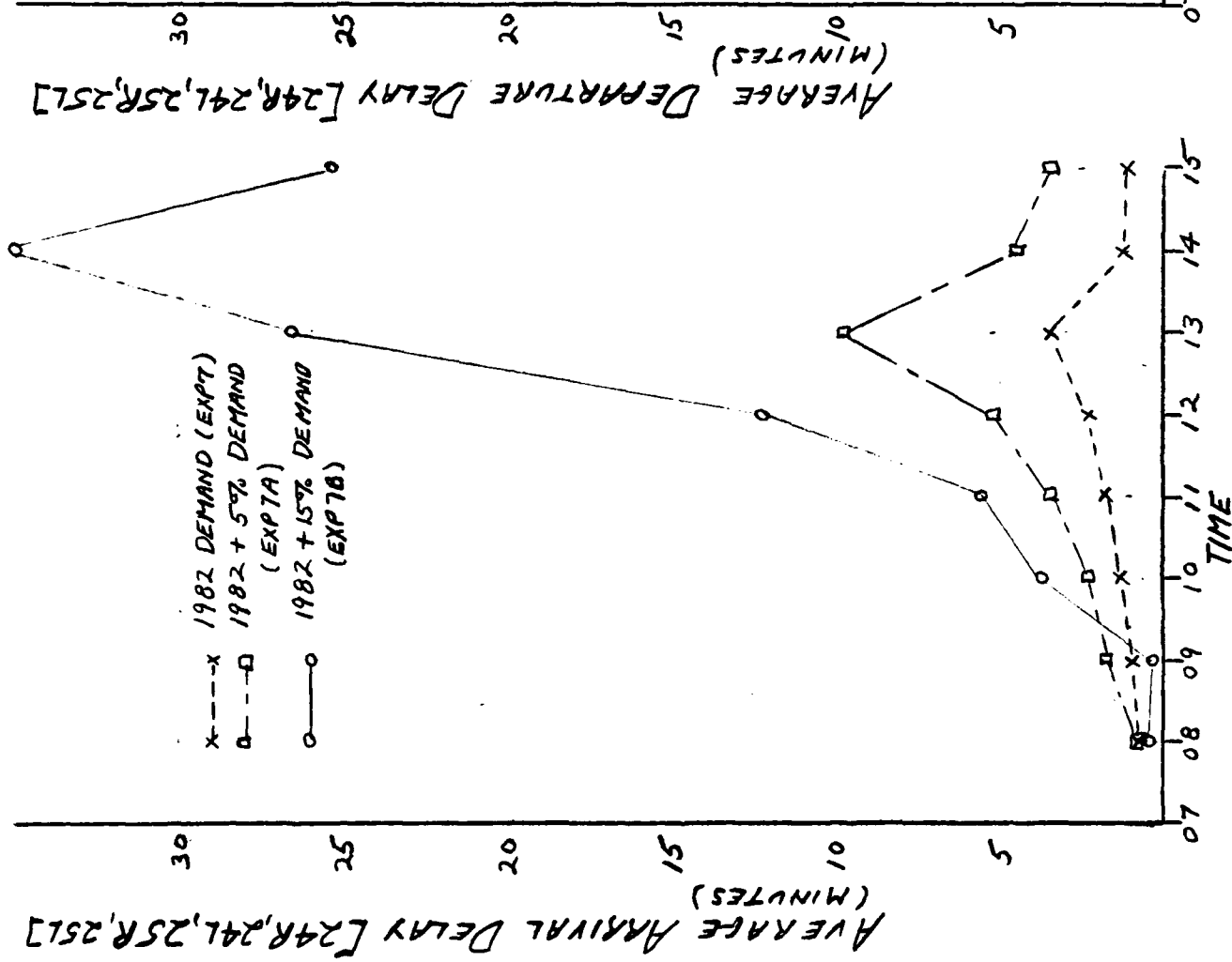
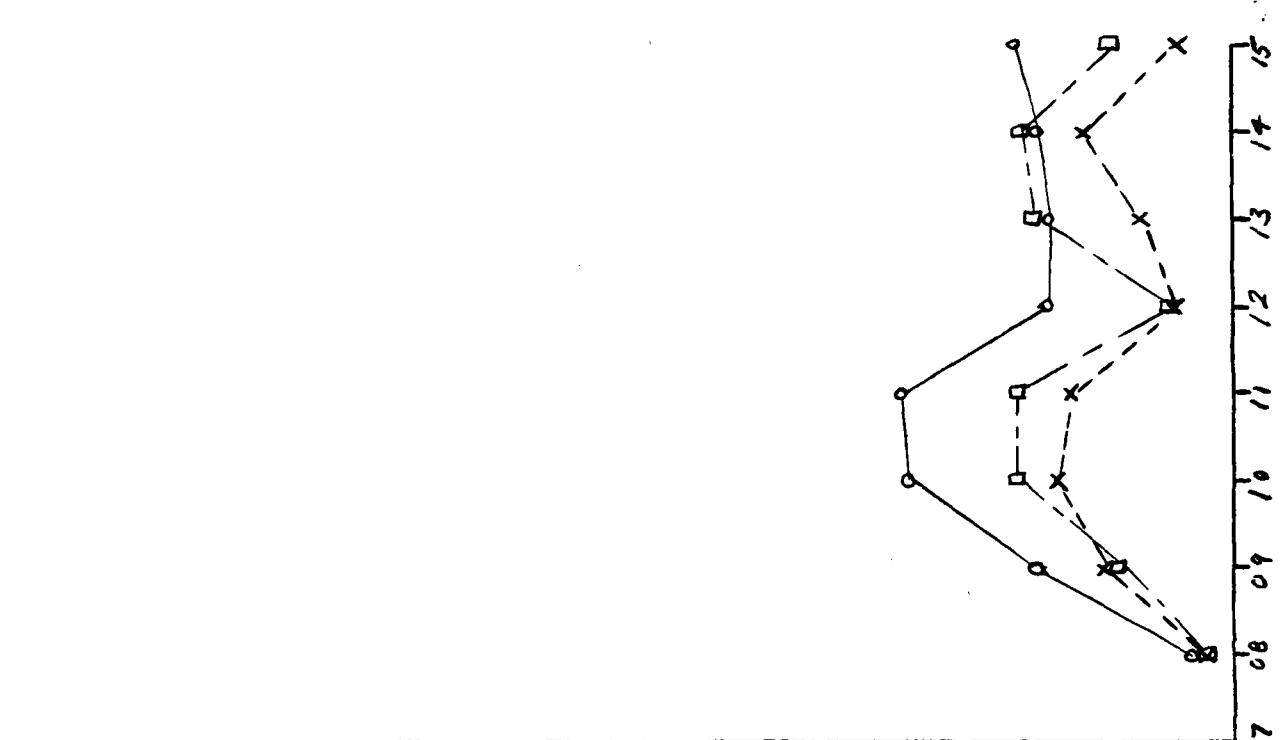
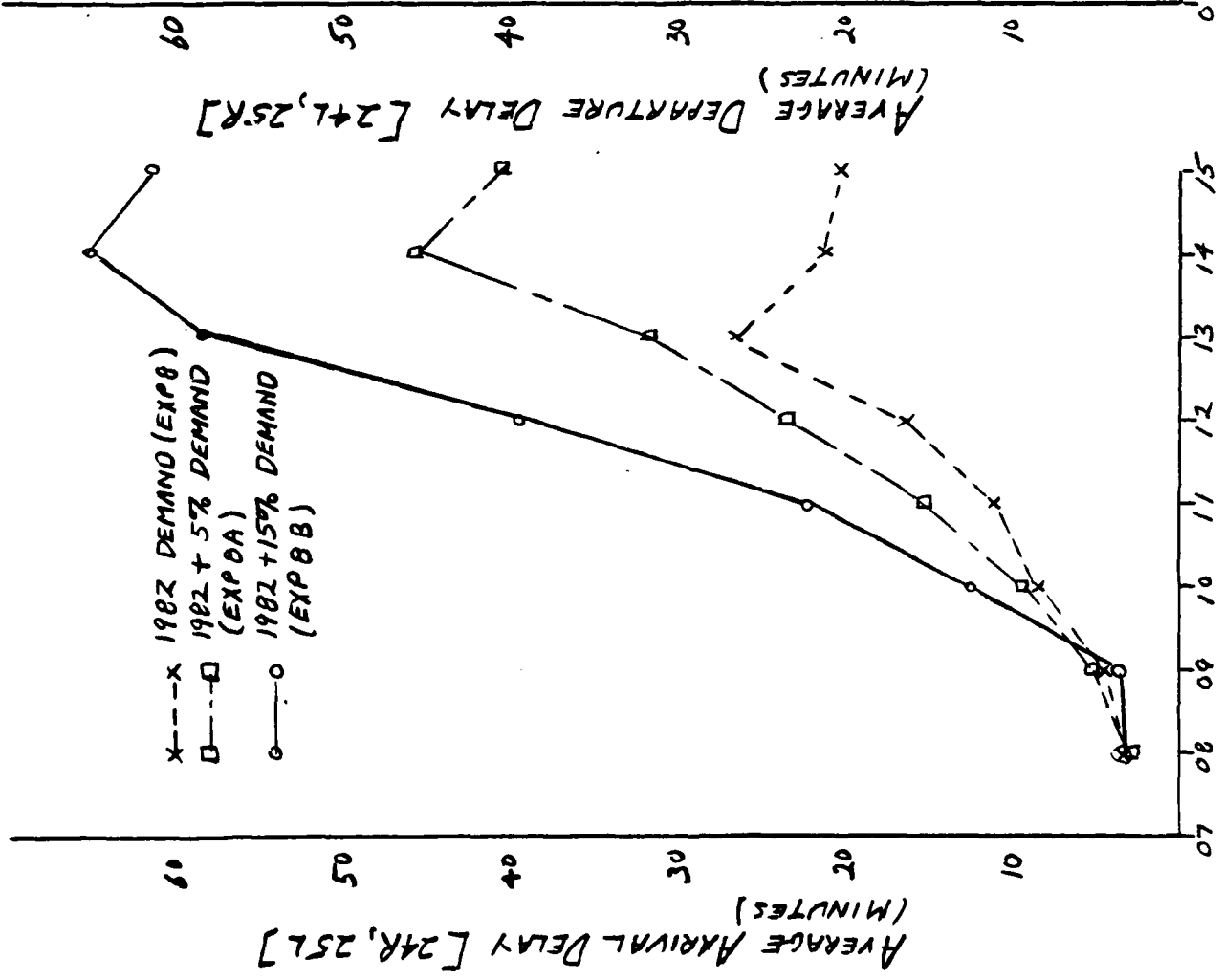


FIGURE 8 EXPERIMENTS # 7, # 7A and # 7B  
VFR-DAYTIME - WESTERLY FLOW



45

TIME

TIME

FIGURE 9 EXPERIMENTS #8(M), #8A(M) and #8B(M)  
 IFR - DAYTIME - WESTERLY FLOW

TABLE 17

1982 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND

DATE	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TRAVEL TIMES (minutes)		TOTAL GROUND DELAYS	ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND	TOTAL
				RUNWAY AIR	TAXI	RUNWAY AIR	TAXI	RUNWAY X-ING	X-ING					
1976	—	NONE	1976(VFR)	803	46	2792	482	2	74	3477	4077	1529	5677	11283
1977	—	NONE	1978(VFR)	643	57	2598	562	8	50	3336	4027	1610	5659	11296
1978	—	NONE	1978(VFR)	1576	66	4182	897	4	293	5562	5223	1708	7905	14736
1979	—	NONE	1978(VFR)	5671	226	5541	1591	4	1118	8587	9339	1907	10884	22130
1980	—	NONE	1978(IFR)	4444	35	2895	128	4	315	3437	7610	1548	5377	14255
1981	—	NONE	1978(IFR)	5100	39	2714	164	5	304	3288	8324	1578	5368	15470
1982 5%	—	NONE	1978(IFR)	7995	36	3777	170	1	416	4456	11191	1573	6774	19539
1982 15%	—	NONE	1978(IFR)	12703	81	5442	297	2	2285	8153	16030	1648	10600	28277

REMARKS: The 1982 DO-NOTHING CASE resulted in progressively higher arrival and departure delays as the demand was increased by 5% and 15%.

TABLE 18

PEAK AVERAGE DELAY (AVERAGE DAY)  
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY	
					ARRIVAL	DEPARTURE
1	1978	VFR	NONE	1978	5.3	10.6
7	1982	VFR	NONE	1978	3.5	9.5
7A	1982+ 5%	VFR	NONE	1978	9.9	13.8
7B	1982+15%	VFR	NONE	1978	35.7	16.9
2	1978	IFR	NONE	1978	25.7	12.5
8	1982	IFR	NONE	1978	26.6	10.0
8A	1982+ 5%	IFR	NONE	1978	45.8	12.1
8B	1982+15%	IFR	NONE	1978	65.1	19.0

TABLE 19  
ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNUAL DELAY (hours)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	11,485	26,505	37,991
7,8 & 10	1982	NONE	1978	13,271	26,359	39,630
7A,8A	1982+ 5%	NONE	1978	21,085	35,204	56,289
7B,8B	1982+15%	NONE	1978	75,102	55,035	130,137
				ANNUAL OPERATIONS		
				TOTAL X 1000		
1,2 & 4	1978	NONE	1978	510		
7,8 & 10	1982	NONE	1978	518		
7A,8A	1982+ 5%	NONE	1978	544		
7B,8B	1982+15%	NONE	1978	599		
				AVERAGE ANNUAL DELAY (minutes)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	2.7	6.2	4.5
7,8 & 10	1982	NONE	1978	3.1	6.1	4.6
7A,8A	1982+ 5%	NONE	1978	4.7	7.8	6.2
7B,8B	1982+15%	NONE	1978	15.0	11.0	13.0

COMPARISON OF 1982 DO-NOTHING CASE WITH 1982 SEPARATIONS AND NEAR-TERM

IMPROVEMENTS

A 1982 demand is used in all the simulation experiments comparing the 1982 do-nothing case (i.e., 1978 operations) with the 1982 separations and near-term improvements. The basis of these comparisons includes the VFR and IFR weather conditions for the westerly flow of traffic and the VFR conditions for the easterly flow.

EXPERIMENTS

CONFIGURATIONS

(Do-nothing and near-term, respectively)

#7 and #11(Rerouted)

VFR-Daytime-Westerly Flow

#9(Modified) and #16(Modified)

VFR-Daytime-Easterly Flow

#8(Modified) and #12(Modified and rerouted)

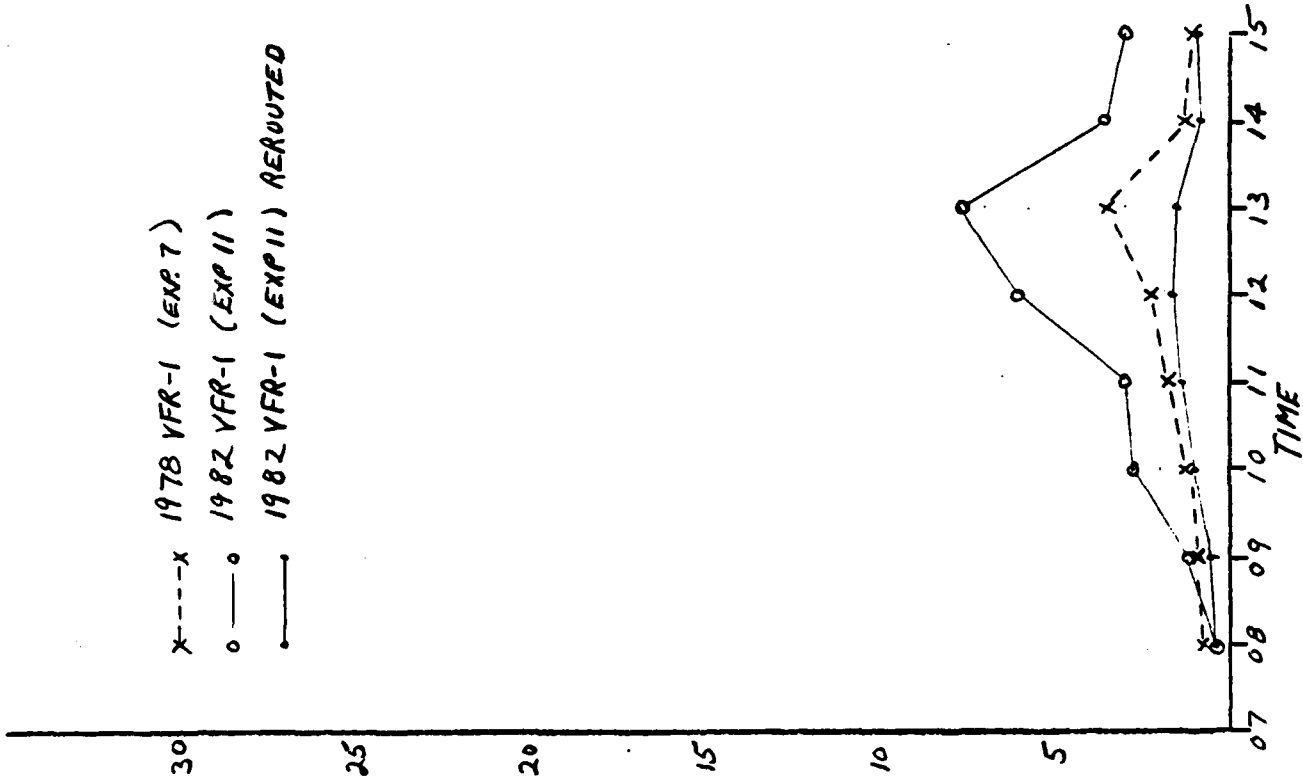
IFR-Daytime-Westerly Flow

The results of the experiments are shown in Figures 10 through 14 and Table 20. The figures show the average delays for arrival and departure runways. Included in the figures are the initial results from experiments #11 and #12 demonstrating the necessity to reroute departures to the north complex when delays start to build on the south runways. The table shows a direct comparison of the experiments and the effects of the improvements on delay and travel times.

The peak average delay and the annual delay estimates are shown in Tables 21 and 22.

AVERAGE ARRIVAL DELAY [24R, 24L, 25R, 25L] (MINUTES)

- x---x 1978 VFR-1 (EXP. 7)
- o---o 1982 VFR-1 (EXP. 11)
- 1982 VFR-1 (EXP. 11) REROUTED



AVERAGE DEPARTURE DELAY [24R, 24L, 25R, 25L] (MINUTES)

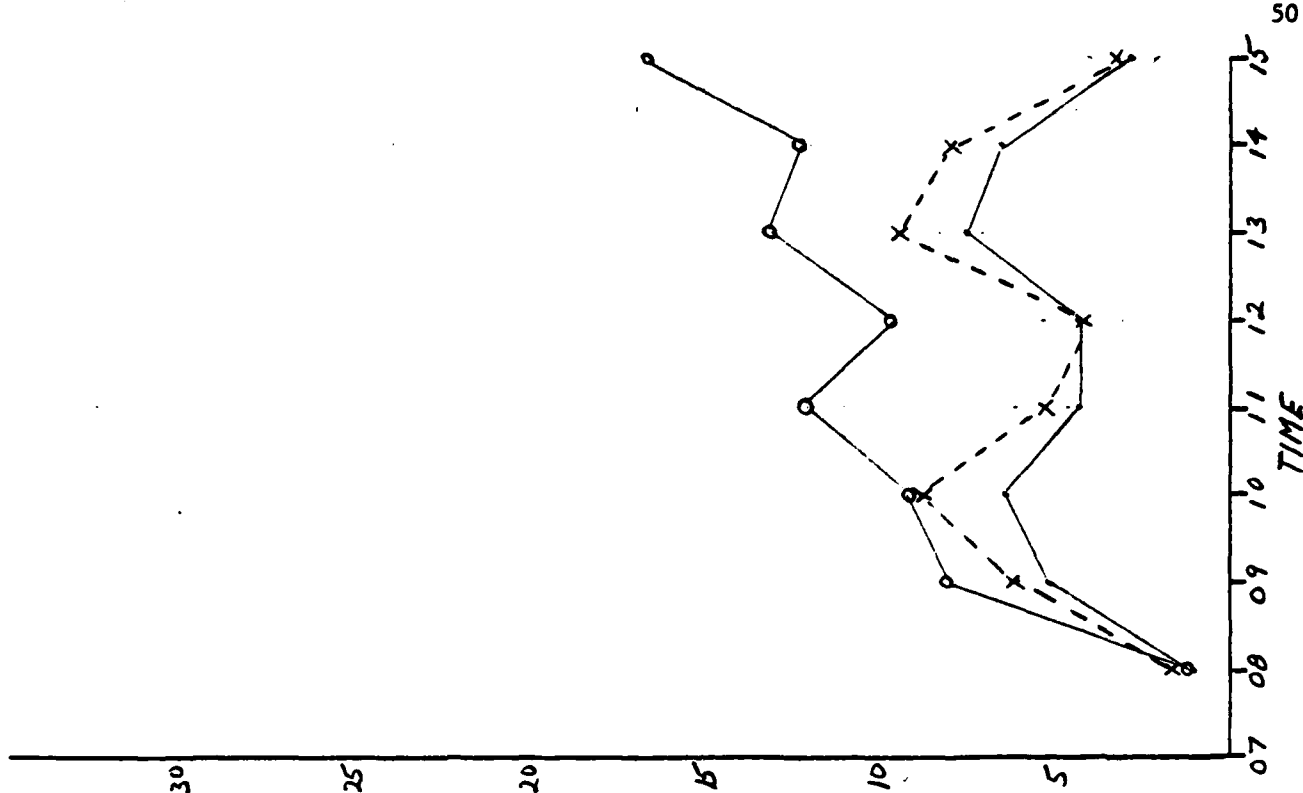


FIGURE 10 EXPERIMENTS #7 and #11 - DELAYS  
VFR - DAYTIME - WESTERLY FLOW



x---x 1982 DEMAND (EXPT 7)  
 o---o 1982 DEMAND (EXPT 11)  
 .---. 1982 DEMAND (EXPT 11) REROUTED

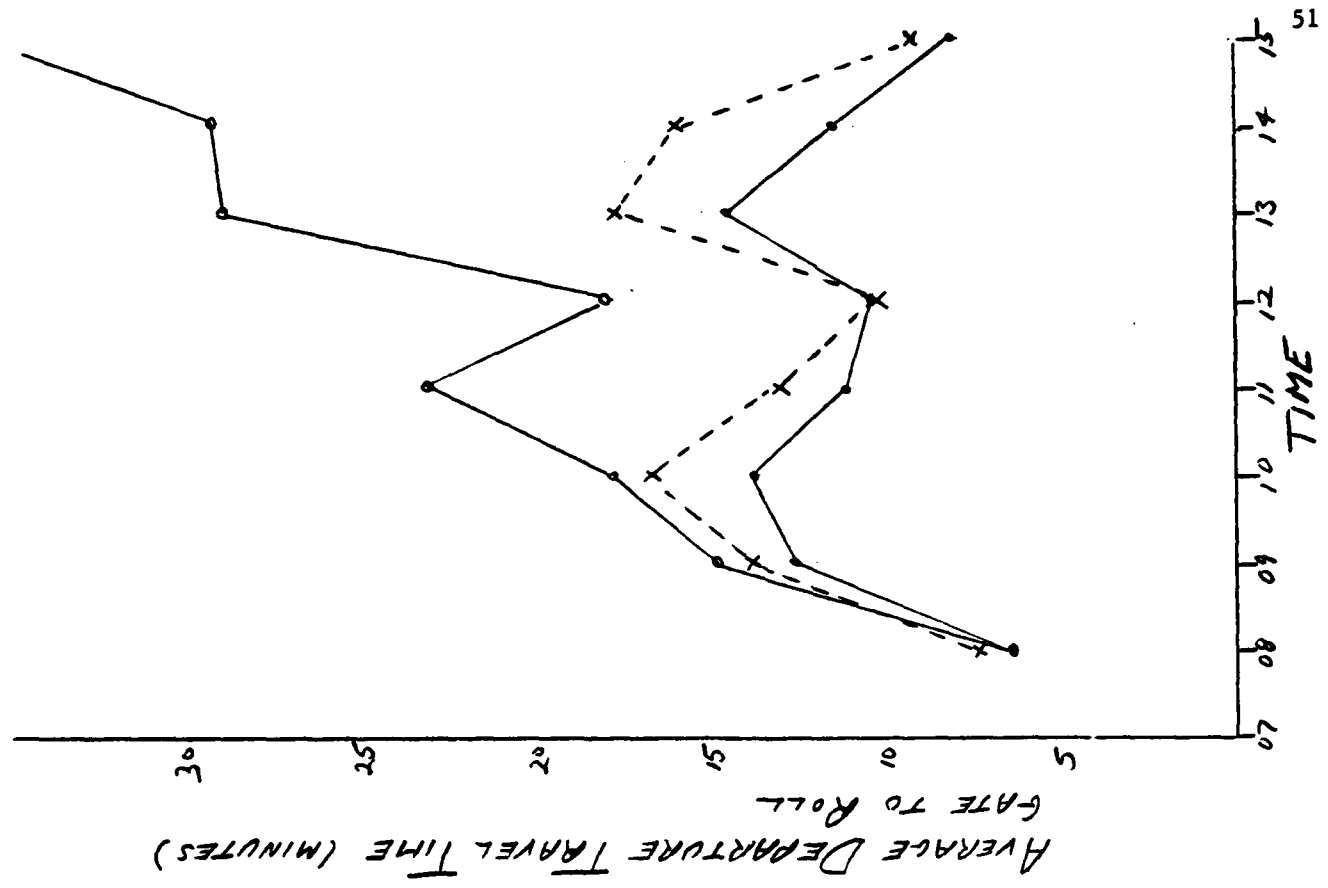
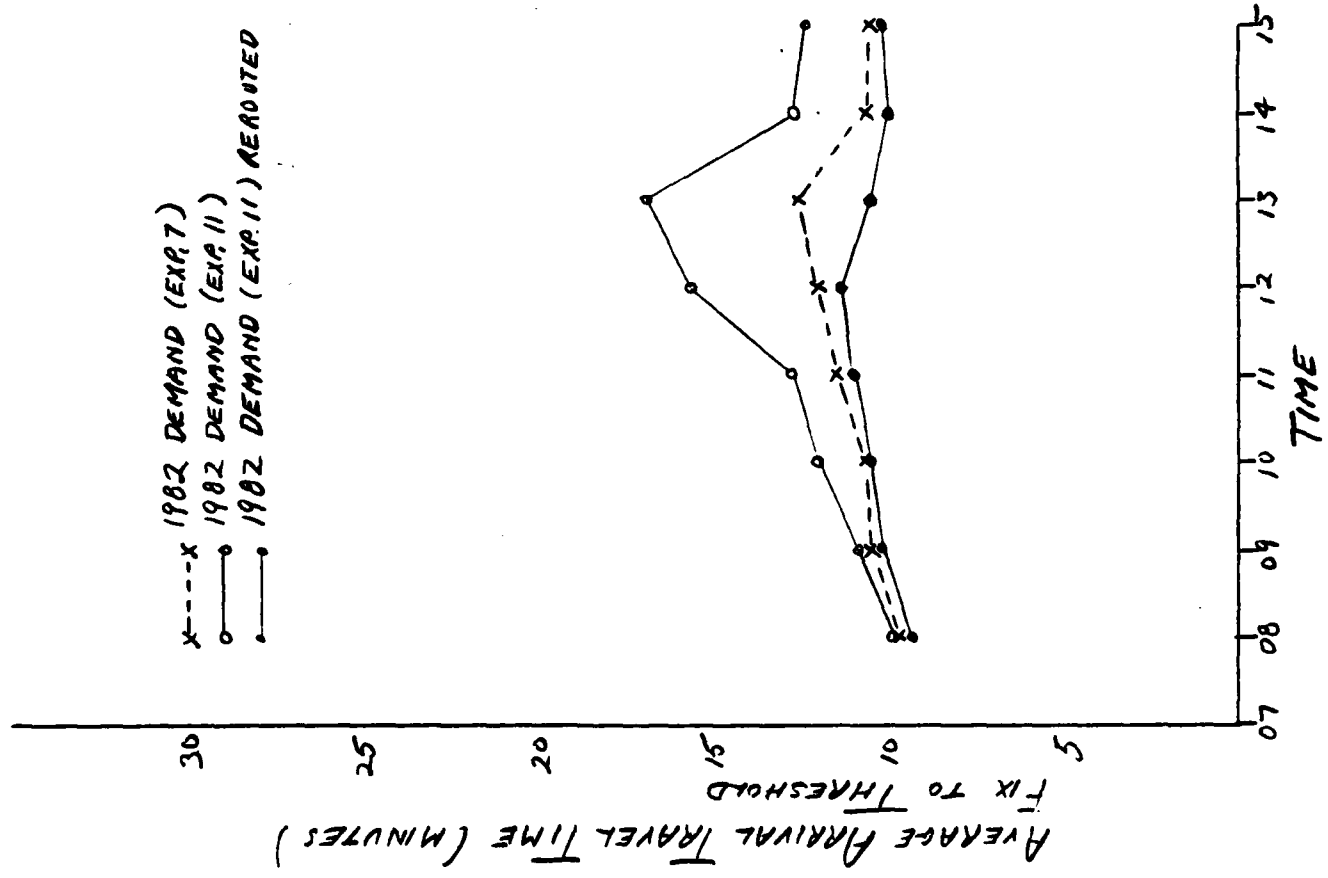


FIGURE 11 EXPERIMENTS #7 and #11 - TRAVEL TIMES  
 VFR- DAYTIME - WESTERLY FLOW

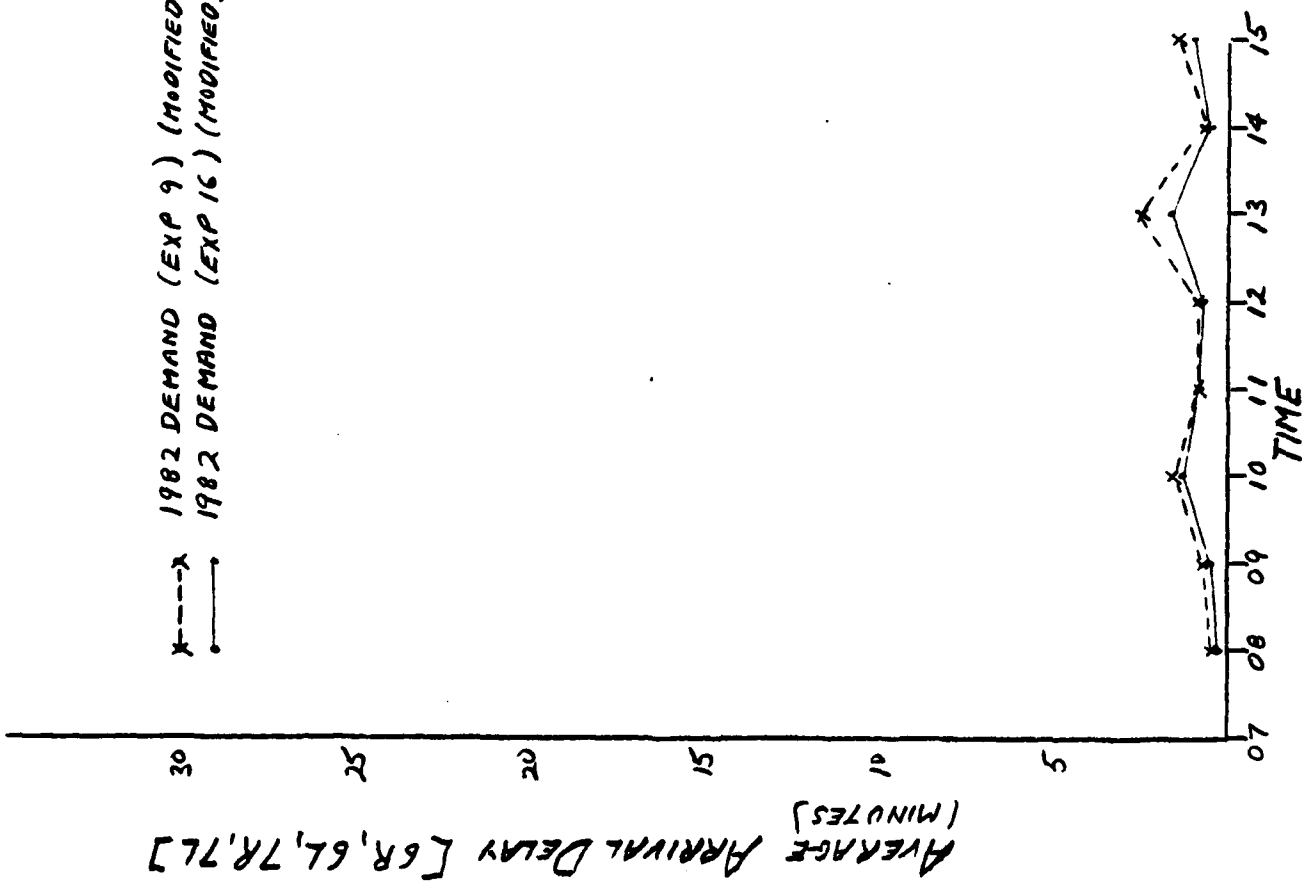
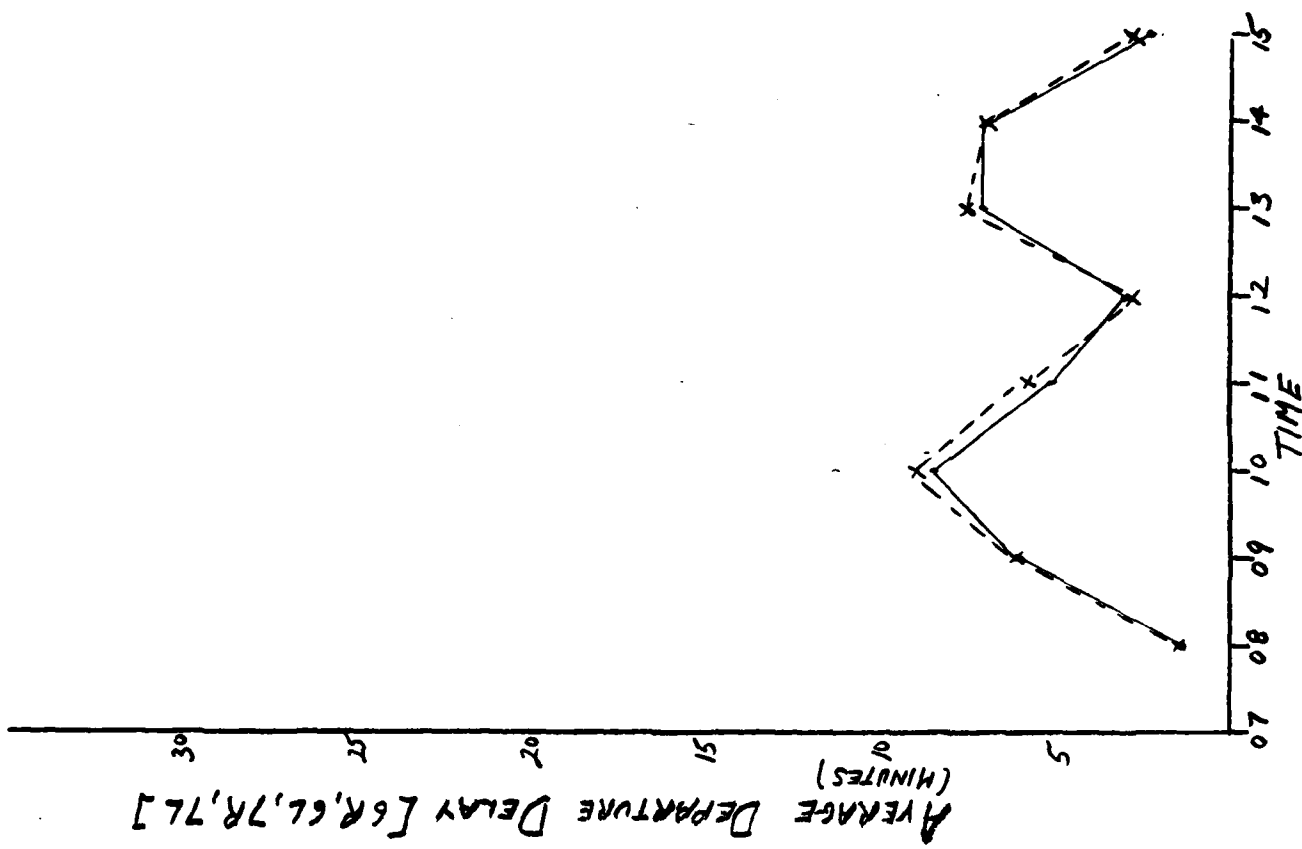


FIGURE 12 EXPERIMENTS #9(M) and #16(M)  
VFR-DAYTIME - EASTERLY FLOW

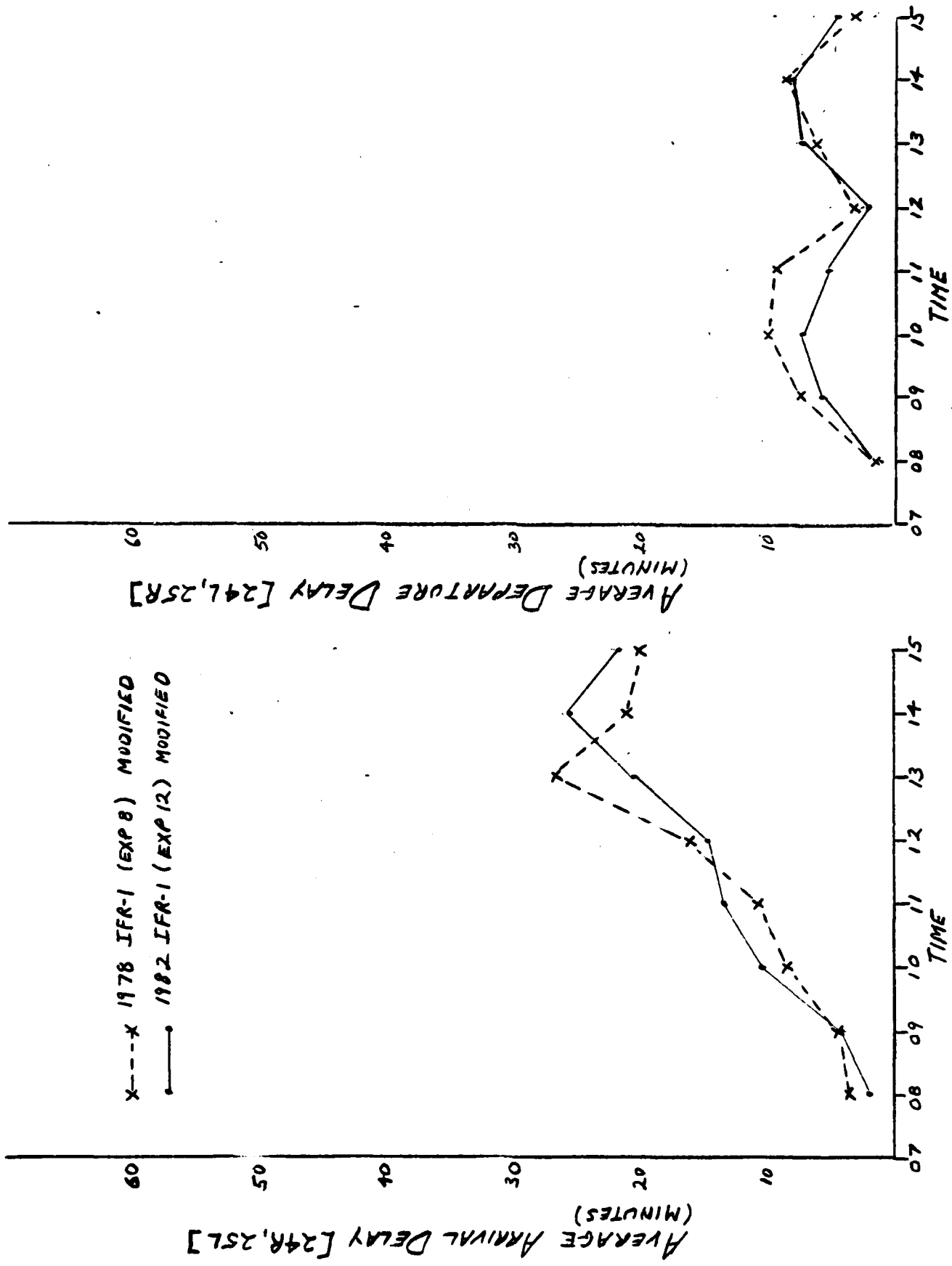


FIGURE 13 EXPERIMENTS #8(M) and #12(M) - DELAYS  
IFR - DAYTIME - WESTERLY FLOW

x---x 1982 DEMAND (EXP 8)  
 o---o 1982 DEMAND (EXP 12)  
 ●---● 1982 DEMAND (EXP 12) REROUTED DEPARTURES  
 \*---\* MODIFIED

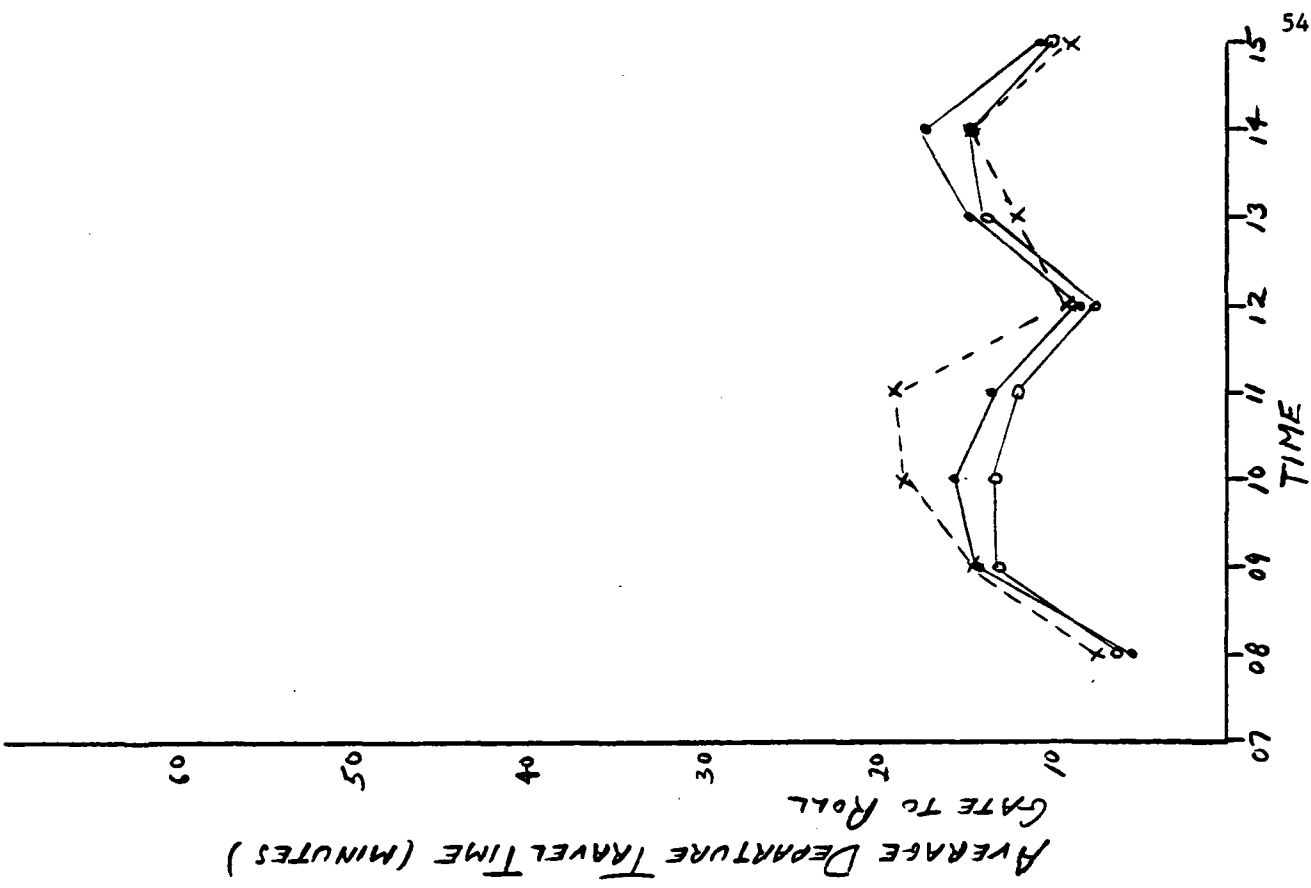
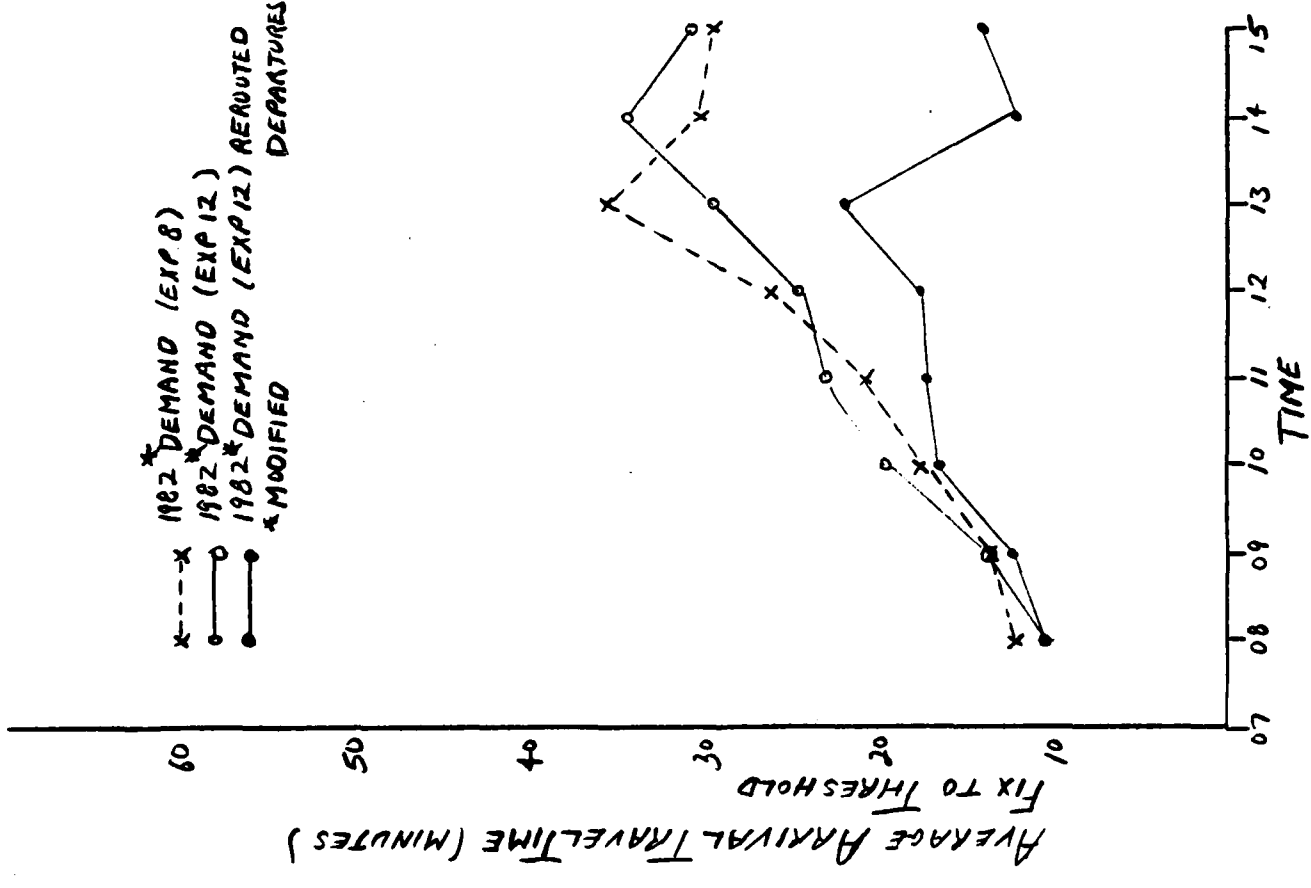


FIGURE 14 : EXPERIMENTS #8(M) and #12(M) - TRAVEL TIMES  
 IFR - DAYTIME - WESTERLY FLOW

TABLE 20  
1982 DO-NOTHING CASE WITH 1982 SEPARATIONS AND NEAR-TERM IMPROVEMENTS

EXP.	DEMAND ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)			TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL		
					RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY X-ING	TAXI	RUNWAY X-ING		GATE	ARRIVAL AIR		ARRIVAL GROUND	DEPARTURES GROUND
7	1982	—	NONE	1978 (VFR)	643	57	81	2578	562	8	30	3336	4427	1610	5659	11296
11	1982	DEPARTURES SENT FROM 25R TO 24L	NEAR TERM	1982 (VFR)	405	58	87	2048	494	8	6	3106	3797	1501	4801	10100
RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower arrival and departure delays.																
* 9	1982	43 ARRIVALS CHANGED FROM 25L TO 24L	—	NONE	1978 (VFR)	408	85	57	2370	406	10	67	3785	1595	5072	10652
* 16	1982	"	—	HIGH SPEED EXITS, RUNWAY 7L BY-PASS	1982 (VFR)	332	76	62	2271	309	13	65	3898	1602	4898	10399
RESULTS: The high speed exits, runway 7L by-pass and the 1982 separations resulted in lower arrival and departure delays.																
* 8	1982	40 ARRIVALS CHANGED FROM 25L TO 24L	—	NONE	1978 (VFR)	5700	39	63	2714	164	5	304	8324	4578	5380	15470
* 12	1982	50 ARRIVALS CHANGED FROM 25R TO 24L	—	NEAR TERM	1982 (VFR)	2321	50	58	2713	189	6	290	5406	1665	5444	12515
RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower arrival delays.																

\* - Modified Demand

TABLE 21

PEAK AVERAGE DELAY (AVERAGE DAY)  
(minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIME DELAY	
					ARRIVAL	DEPARTURE
7	1982	VFR	NONE	1978	3.5	9.5
11**	1982	VFR	NEAR-TERM	1982	1.6	7.5
8*	1982	IFR	NONE	1978	26.6	10.0
12*	1982	IFR	NEAR-TERM	1982	25.5	8.3

\* = Modified Demand

\*\* = Rerouted Departures

TABLE 22  
ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNUAL DELAY (hours)		
				ARRIVAL	DEPARTURE	TOTAL
7,8 & 10	1982	NONE	1978	13,270	26,359	39,630
11,12	1982	NEAR-TERM	1982	4,389	16,646	21,036
				ANNUAL OPERATIONS		
				TOTAL X 1000		
7,8 & 10	1982	NONE	1978	518		
11,12	1982	NEAR-TERM	1982	518		
				AVERAGE ANNUAL DELAY (minutes)		
				ARRIVAL	DEPARTURE	TOTAL
7,8 & 10	1982	NONE	1978	3.1	6.1	4.6
11,12	1982	NEAR-TERM	1982	1.0	3.9	2.4

COMPARISON OF 1978 OPERATIONS WITH 1987 SEPARATIONS AND LONG-TERM  
IMPROVEMENTS VARYING THE 1987 DEMAND

The basis for comparing the 1978 operations with the 1987 separations and long-term improvements includes the VFR and IFR weather conditions for the westerly traffic flow during the daytime - under demands for 1978, 1987 and 1987 with 10% greater peaks.

EXPERIMENTS

CONFIGURATIONS

(1978, 1987, 1987 with peaks, respectively)

#1, #25 and #25A

VFR-Daytime-Westerly Flow

#2(Modified) and #26

IFR-Daytime-Westerly Flow

The results of the experiments are shown in Table 23. The peak average delays, Table 24, and the estimated annual delays, Table 25, under the various demands (1978, 1987 and 1987 with 10% greater peaks) show substantial improvement in delay.



TABLE 23  
 1978 OPERATIONS WITH 1507 SEPARATIONS AND LONG-TERM IMPROVEMENTS VARYING THE 1987 DEMAND

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS		TRAVEL TIMES (minutes)		TOTAL		
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY TAXI	RUNWAY X-ING	ARRIVAL AIR	ARRIVAL GROUND	ARRIVAL AIR		ARRIVAL GROUND	DEPARTURES GROUND
1	1978	—	—	NONE	1978(VFR)	803	46	00	2792	2	74	3477	4077	1529	5677	11283
25	1987	—	—	FAR TERM	1987(VFR)	189	34	32	1325	1	2	1639	3720	1452	5579	8692
25A	1987 +10%	—	—	FAR TERM	1987(VFR)	257	40	38	1957	1	73	2524	3819	1505	4455	9859

RESULTS: The FAR-TERM improvements and 1987 VFR separations resulted in substantial reductions of arrival and departure delays.

1	1978	44-ARRIVALS ON 25% CHANGE IN 1978	—	NONE	1978(IFR)	4444	35	60	2895	4	315	3437	7610	1548	5597	14755
16	1987	—	—	FAR TERM	1987(IFR)	831	23	35	1823	2	79	2150	4392	1577	4010	9920

RESULTS: The FAR-TERM improvements and 1987 IFR separations resulted in substantial reductions of arrival and departure delays.

• • Modified Demand

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TABLE 25  
ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNUAL DELAY (hours)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	11,485	26,505	37,991
25,26	1987	FAR-TERM	1987	2,148	11,348	13,496
				ANNUAL OPERATIONS		
				TOTAL X 1000		
1,2 & 4	1978	NONE	1978	510		
25,26	1987	FAR-TERM	1987	527		
				AVERAGE ANNUAL DELAY (minutes)		
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	2.7	6.2	4.5
25,26	1987	FAR-TERM	1987	0.5	2.6	1.5

COMPARISONS OF SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH  
1982 DO-NOTHING CASE

The basis for comparing the possible sequences of tunnel construction activities includes: the availability of the dual taxiway during the closure of runway 25R during VFR weather with and without the completion of runway 25L, and the closure of a runway (25R or 25L) during IFR weather with and without the completion of the other runway.

EXPERIMENTS

CONFIGURATIONS

(Do-nothing and activity, respectively)

#7 and #22A	VFR-Daytime-Westerly Flow
#7 and #22(rerouted)	VFR-Daytime-Westerly Flow
#22(rerouted) and #35(rerouted)	VFR-Daytime-Westerly Flow
#8(modified) and #23(rerouted)	IFR-Daytime-Westerly Flow
#8(modified) and #24(rerouted)	IFR-Daytime-Westerly Flow
#23(rerouted) and #36(rerouted)	IFR-Daytime-Westerly Flow
#24(rerouted) and #37(rerouted)	IFR-Daytime-Westerly Flow

The results of the experiments are shown in Table 26. There is a series of experiments performed under both VFR and IFR weather conditions in which runway 25R is closed for tunnel construction, and then after its completion, runway 25L is closed. Under IFR weather conditions, there

is a sequence of experiments in which runway 25L is closed for tunnel construction, and then, after its completion, runway 25R is closed. The effect of the dual taxiway during tunnel construction on 25R, under VFR conditions, is shown in experiment #22A.

TABLE 26  
SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL DELAYS		TRAVEL TIMES (minutes)		TOTAL		
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY X-ING	TAXI	RUNWAY	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND
7	1982	—	—	NONE	1978 (VFR)	643	57	81	2598	562	0	30	4027	1610	5659	11296
22	1982	—	DEPARTURES SENT FROM 25L TO 24R	RUNWAY 25R TUNNEL CONSTRUCTION	1978 (VFR)	993	233	19	4200	1450	11	944	4403	2100	9082	15586
22A	1982	—	"	RUNWAY 25R TUNNEL CONSTRUCTION WITH DARK THIRWAY	1978 (VFR)	1034	187	16	4071	1357	11	1048	4444	2101	9001	15547
35	1982	50 ARRIVALS ON 25A CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24R	RUNWAY 25L TUNNEL CONSTRUCTION (25A CONTRAS)	1978 (VFR)	969	65	10	2925	800	0	50	4340	1653	6159	12153

RESULTS:  
 Experiment #22-- Runway 25R tunnel construction resulted in larger departure delays (about 56%).  
 Experiment #22A-- The availability of the dual taxiway system during tunnel construction reduced the taxi delays.  
 Experiment #35-- Runway 25L tunnel construction after the completion of runway 25R resulted in less delay compared to the delays during the tunnel construction on runway 25R (Experiment #22).

8	1982	40 ARRIVALS ON 25L CHANGED TO 24R	—	NONE	1978 (IFR)	5700	39	63	2714	164	5	304	8524	1578	5568	15470
23	1982	—	DEPARTURES SENT FROM 25L TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION	1978 (IFR)	4776	131	17	5292	331	7	4318	7353	1757	11543	20452
36	1982	50 ARRIVALS ON 25A CHANGED TO 24R	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION (25R CONTRAS)	1978 (IFR)	6297	81	14	5375	344	0	3339	9319	1527	11028	21873

RESULTS:  
 Experiment #23-- Runway 25R tunnel construction resulted in larger departure delays during IFR weather.  
 Experiment #36-- Runway 25L tunnel construction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for the use of runway 25R) than Experiment #23.

\* - Modified Demand

TABLE 26 (CONTINUED)

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	ARRIVAL REMOVED	DEPARTURES REMOVED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS		TRAVEL TIMES (minutes)		TOTAL		
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY X-ING	TAXI	GATE	ARRIVAL AIR	ARRIVAL GROUND		DEPARTURES GROUND	TOTAL
* 8	1982	40 ARRIVALS ON 25L CHANGE TO 25R	—	NONE	1978 (IFR)	500	39	63	274	167	5	304	8324	1578	5588	15770
24	1982	—	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25L TUNNEL CONSTRUCTION	1978 (IFR)	5043	173	20	6020	394	0	4872	8626	1911	13505	36537
* 37	1982	50 ARRIVALS ON 25L CHANGE TO 25R	DEPARTURES SENT FROM 25R TO 24L	RUNWAY 25R TUNNEL CONSTRUCTION (25L COMPLETE)	1978 (IFR)	6535	95	15	5493	328	11	3572	9719	1696	11664	23079

RESULTS: Experiment #24-- Runway 25L tunnel construction resulted in larger departure delays during IFR weather. (Experiment #24 compared to Experiment #23 indicated that the construction of runway 25L produced larger delays than the initial construction of runway 25R.)

Experiment #37-- Runway 25R tunnel construction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for the use of runway 25R) than Experiment #24.



COMPARISON OF 1982 SEPARATIONS AND DUAL TAXIWAY IMPROVEMENT WITH  
1982 DO-NOTHING CASE

The basis for determining the effect of the dual taxiway on delays and travel times includes a comparison of the 1982 do-nothing case (experiment #7) with experiment #18 (1982 separations with dual taxiway). Both experiments have identical 1982 demands.

EXPERIMENTS

CONFIGURATION

(Do-nothing vs. separations and taxiway)

#7 and #18

VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 27.

COMPARISON OF NEAR-TERM IMPROVEMENTS WITH DUAL TAXIWAY IMPROVEMENT

The basis for determining the percentage (%) of reduction of departure ground travel times for the near-term improvements includes a comparison of experiments with 1982 demands and 1982 separations. Experiment #18 (rerouted) has a dual taxiway improvement and experiment #11 (rerouted) has the near-term improvements (tunnel construction, by-pass around 24L to runway 24R, high speed exit from runway 25L to the south, etc.). These experiments, similar in demand and separations, permit isolation of the effects of the near-term improvements since a previous comparison has shown that the dual taxiway shows no improvement under the 1982 demand.

EXPERIMENTSCONFIGURATION

(Dual taxiway and near-term, respectively)

#18(rerouted) and #11(rerouted)

VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 27.

COMPARISON OF DEPARTURE BY-PASS AROUND RUNWAY 24L WITH DUAL TAXIWAYIMPROVEMENTS

The basis for determining the percentage (%) of improvement for the departure by-pass around runway 24L to runway 24R involves a comparison of experiment #13 with experiment #18 (dual taxiway improvement). Since both experiments have identical 1982 demands and 1982 separations and a previous comparison shows no improvement due to the dual taxiway for the 1982 demand, this comparison isolates the effect of the by-pass.

EXPERIMENTSCONFIGURATION

(Dual taxiway and by-pass, respectively)

#18 and #13

VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 27.

TABLE 27  
IMPROVEMENT COMPARISONS

EXP. DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL DEPARTURES				
					RUNWAY AIR	TAXI	RUNWAY X-ING	TAXI		RUNWAY X-ING	ARRIVAL AIR		ARRIVAL GROUND			
7	1982	—	NONE	1978(VFR)	643	57	81	2598	562	8	30	3336	4027	1610	5659	11296
18	1982	—	DUAL TAXIWAY	1982(VFR)	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242

RESULTS: The dual taxiway system and the 1982 separations resulted in reduced arrival delays. No change was noted in the taxi delays.

EXP. DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL DEPARTURES				
					RUNWAY AIR	TAXI	RUNWAY X-ING	TAXI		RUNWAY X-ING	ARRIVAL AIR		ARRIVAL GROUND			
18	1982	—	DUAL TAXIWAY	1982(VFR)	382	48	60	2277	485	10	31	2911	3786	1625	5349	10759
11	1982	—	NEAR TERM	1982(VFR)	405	58	87	2048	494	8	6	3106	3797	1501	4801	10100

RESULTS: The NEAR-TERM improvements resulted in reduced departure delays.

EXP. DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)		TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL DEPARTURES				
					RUNWAY AIR	TAXI	RUNWAY X-ING	TAXI		RUNWAY X-ING	ARRIVAL AIR		ARRIVAL GROUND			
18	1982	—	DUAL TAXIWAY	1982(VFR)	516	48	59	2626	561	9	27	3331	3914	1623	5705	11242
13	1982	—	BY-PASS TO RUNWAY 24R HOLDING AREA ON TAXIWAY 15	1982(VFR)	436	61	88	2380	468	8	21	3026	3828	1611	5304	10742

RESULTS: The by-pass to runway 24R and the holding area on taxiway 15 resulted in reduced departure delays.

COMPARISON OF 1982 DO-NOTHING CASE WITH 1982 SEPARATIONS, HIGH SPEED EXITS  
OFF OF RUNWAYS 6R and 7L, AND DEPARTURE BY-PASS AROUND RUNWAY 7L

The basis for determining the effect on delays and travel times of the 1982 separations, the high speed exits off of runways 6R and 7L, and the departure by-pass around runway 7L to runway 7R includes a comparison of experiments #6(M), #9(M) and #16(M). Experiment #6 (with modified arrival demand) is the base case with 1978 separation values. Experiments #9(M) and #16(M) have the 1982 demand (with modified arrival demand) but differ with respect to the improvements noted above

<u>EXPERIMENTS</u>	<u>CONFIGURATION</u>
(1978, do-nothing and improvements - respectively)	
#6(M), #9(M) and #16(M)	VFR-Daytime-Easterly Flow

The results of these experiments are shown in Table 28.

TABLE 28  
1982 DO-NOTHING CASE WITH 1982 SEPARATIONS, HIGH SPEED EXITS OFF RUNWAYS 6R AND 7L, AND DEPARTURE BY-PASS AROUND RUNWAY 7L

EXP.	DEMAND	ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)		DEPARTURE DELAY (minutes)			TRAVEL TIMES (minutes)		TOTAL			
						RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	GATE		ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND
6*	1978	44 ARRIVALS CHANGED FROM 7R TO 6L	—	NONE	1978 (VFA)	460	166	42	2546	606	0	384	3989	1631	6017	11638
9*	1982	43 ARRIVALS CHANGED FROM 7R TO 6L	—	NONE	1978 (VFR)	408	85	57	2370	406	10	67	3985	1595	5072	10652
16*	1982	"	—	HIGH SPEED EXITS, RUNWAY 7L BY-PASS	1982 (VFR)	332	76	62	2271	309	13	65	3898	1602	4898	10599

RESULTS: Experiment 9-- The 1982 demand resulted in reduced arrival and departure delays due to the change in the aircraft mix and the distribution of the air traffic demand over the runways.  
 Experiment 16-- The 1982 demand, the high speed exits and the runway 7L by-pass showed an even greater reduction in arrival and departure delays than did Experiment 9.

\* - Modified Demand

COMPARISON OF 1982 DO-NOTHING CASE WITH TERMINAL EXPANSION AND THE  
PRESENCE AND ABSENCE OF 1982 SEPARATIONS

The basis for determining the effect of terminal expansion (with and without the 1982 separations) on delays includes a comparison of the 1982 do-nothing case (experiment #7) with experiments #19A and #20. All of these experiments have 1982 demands.

EXPERIMENTS

CONFIGURATION

(Do-nothing vs. expansion vs. expansion and separations, respectively)

#7, #19A and #20

VFR-Daytime-Westerly Flow

The results of these experiments are shown in Table 29.

TABLE 29  
1982 DO-NOTHING CASE WITH TERMINAL EXPANSION AND THE PRESENCE AND ABSENCE OF 1982 SEPARATIONS

EXP.	DEMAND ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)			TRAVEL TIMES (minutes)			TOTAL GROUND DELAYS	TOTAL
					RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY	TAXI	RUNWAY X-ING	ARRIVAL AIR	ARRIVAL GROUND	DEPARTURES GROUND		
7	1982	—	NONE	1978(VFR)	643	57	81	2598	562	8	30	4027	1610	5657	11296
19A	1982	—	TERMINAL EXPANSION	1978(VFR)	525	39	45	2346	424	8	12	3823	1586	5157	10580
20	1982	—	TERMINAL EXPANSION	1982(VFR)	420	48	51	2494	432	8	52	3781	1634	5351	10766

RESULTS: Experiment 19A-- Terminal expansion resulted in a reduction in departure delays due to the distribution of the air traffic demand over the runways.

Experiment 20-- Terminal expansion with 1982 separations resulted in reduced arrival and departure delays compared to Experiments 7 and 19A. (Experiment 20 had the lowest arrival delays and Experiment 19A had the lowest departure delays.)



COMPARISON OF REMOTE TERMINAL WITH DUAL TAXIWAY IMPROVEMENT

The basis for determining the effect of a remote terminal improvement includes a comparison of experiments with 1982 demands and 1982 separations. Experiment #21 has a remote terminal added for international flights and a new distribution of traffic to and from the gate areas. Since experiment #18 (with the dual taxiway system) showed no improvement over the 1982 do-nothing case, a comparison of experiments #18 and #21 isolates the effect of the remote terminal.

EXPERIMENTSCONFIGURATION

(Dual taxiway and remote terminal,  
respectively)

#18 and #21

VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 30.

TABLE 30

REMOTE TERMINAL WITH DUAL TAXIWAY IMPROVEMENT

EXP.	DEMAND ARRIVAL DEMAND MODIFIED	DEPARTURES REROUTED	IMPROVEMENTS	AIR TRAFFIC SEPARATIONS	ARRIVAL DELAY (minutes)			DEPARTURE DELAY (minutes)			TOTAL GROUND DELAYS	TRAVEL TIMES (minutes)		TOTAL DEPARTURES	
					RUNWAY AIR	TAXI	RUNWAY X-ING	RUNWAY AIR	TAXI	RUNWAY X-ING		ARRIVAL AIR	ARRIVAL GROUND		DEPARTURES GROUND
18	1982	—	DUAL TAXIWAY	1982(VFR)	576	48	57	2826	581	9	27	3977	1623	5705	11242
21	1982	—	REMOTE TERMINAL	1982(VFR)	440	46	63	2668	588	6	28	3845	1590	5749	11185

RESULTS: The remote terminal resulted in reduced arrival delays and slightly increased departure delays.

### 2.5. Analysis of Results (interpretation)

The results of the experiments performed under the delay studies of the Los Angeles International Airport Task Force have demonstrated the relationship of air traffic demand and delay, and identified the delay reduction benefits of various near-term and far-term improvements.

Several performance measurements have been introduced to indicate the changes which occur as improvements are introduced into both the air traffic control scenario and the airport design. These measures include the peak average delays, the annual delay estimates, the total delays and the travel times during a simulated time period. They are calculated under different estimates of air traffic demand and operating conditions.

In addition, the estimated demands are periodically compared with the actual demand encountered at the facility.

Table 31 is a summary of annual delay estimates for the various demands, the ATC system scenarios and the improvements. The results are plotted in Figure 15 to illustrate both past and present operating conditions at the airport. Projected points on the curves are calculated using the percentages of improvement in delay attributed to the near-term or far-term conditions of both the ATC scenario and the airport design. Markers are set on the scale to show the actual demands encountered in 1978 and 1979.

TABLE 31

## SUMMARY OF ANNUAL DELAYS (ESTIMATES)

<u>DEMAND</u>	<u>ATC SYSTEM SCENARIO</u>	<u>IMPROVEMENTS</u>	<u>ANNUAL DELAY (HOURS)</u>
1978	1978	none	37,991
1982	1978	none	39,630
1982 + 5%	1978	none	56,289
1982 +15%	1978	none	130,137
1982	1982	none	33,953
1982	1978	1982	33,150
1982	1982	1982	21,036
1987	1978	none	41,339
1987	1978	1987	31,500
1987	1987	none	13,496
1987	1987	1987	13,496

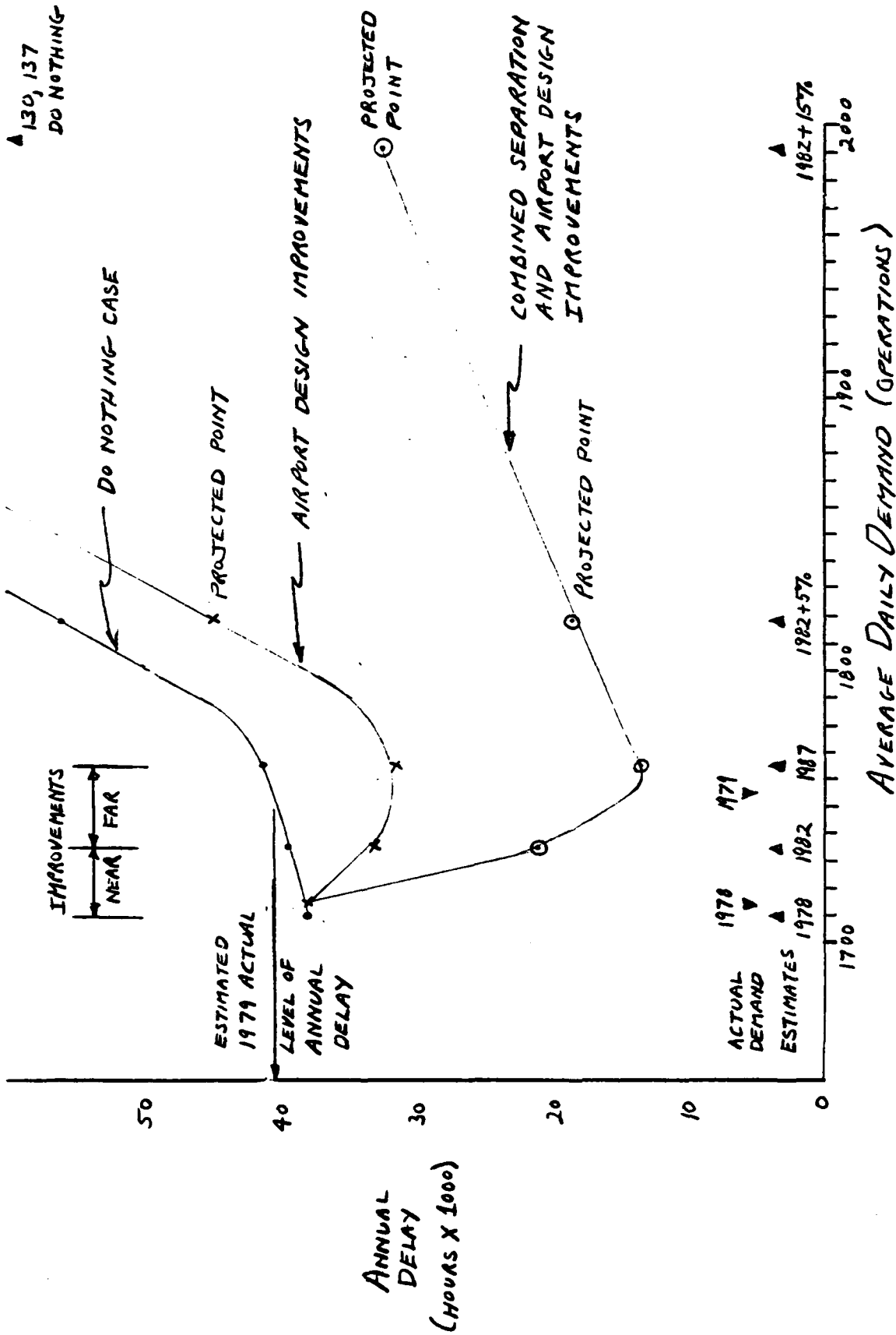


FIGURE 15 SUMMARY OF ANNUAL DELAY ESTIMATES