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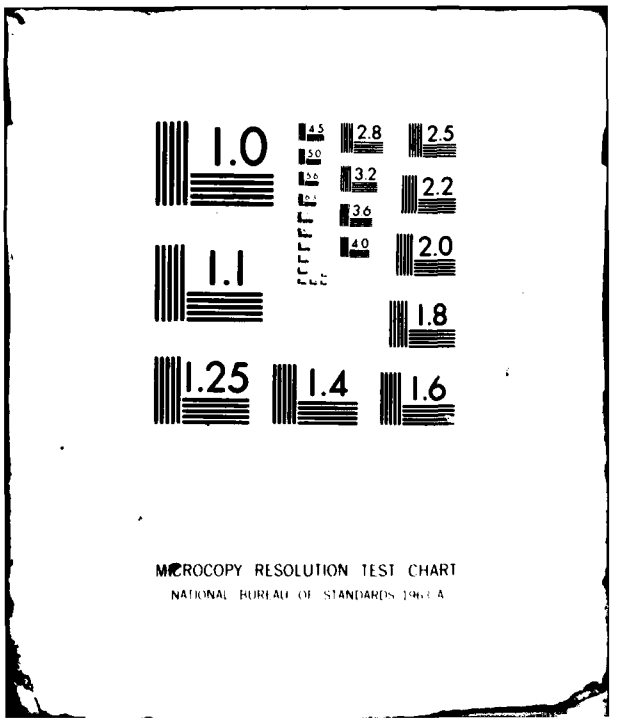
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Report No. FAA-RD-80-79
FAA-CT-80-40

NEW TERMINAL RADAR APPROACH CONTROL IN TOWER CAB (TRACAB) CONCEPT FOR LOVE FIELD, DALLAS, TEXAS

DONALD BOTTOMLEY
EDWARD G. EZEKIEL
THOMAS E. ZURINSKAS

FEDERAL AVIATION ADMINISTRATION TECHNICAL CENTER
Atlantic City, N. J. 08405

FINAL REPORT

AUGUST 1980

Prepared for

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Systems Research & Development Service
Washington, D. C. 20590

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16. Abstract

This study was accomplished by the Federal Aviation Administration (FAA) Technical Center, in response to a request from Air Traffic Service (AAT-100), for development of a mockup to evaluate a centrally positioned terminal radar approach control in a tower cab (TRACAB) console. Presently, the Local Control position at Love Field, Dallas, Texas, generally faces both southeast runways, with all the attendant instrumentation in front of the controller. However, when conditions dictate a northwest operation, the Local Controller must turn away to see and sequence his traffic. The work effort addressed the relocation of operational positions from their usual peripheral sites in the tower cab to a unique four-winged central console with each wing having its own instrumentation. This console housed two Local Control and two Airport Surveillance Radar (ASR) positions on one side of the console and a Ground Control position on the opposite side with identical instrumentation. These five positions were endowed with a "flip/flop" capability as traffic dictated. The other two positions, Clearance Delivery/Flight Data and Watch Supervisor, remained constant at each end of the console, regardless of traffic flow. While the four-winged central console solved the Local Controller's instrumentation availability, it reflected two problems. Limited room on the console caused overcrowding and the resultant overheating of the operational equipment. Local Control perambulation was restricted due to the two ASR controllers and tower peripheral boundaries. Since few airports require the "flip/flop" design necessary by a tower located between dual runways, it was concluded that no further evaluation of this console concept would be made.

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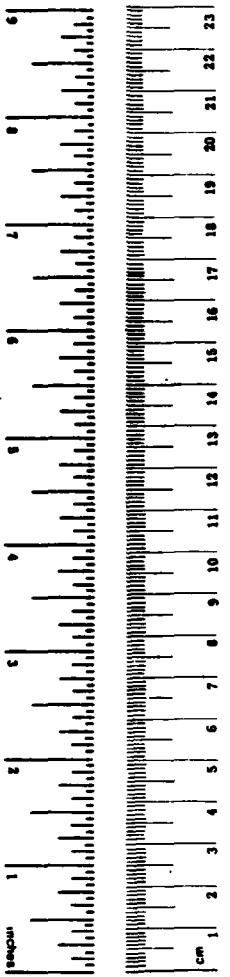
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

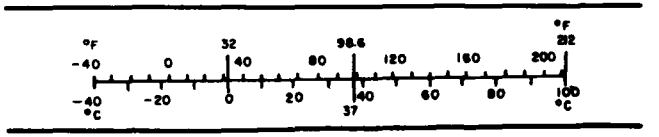
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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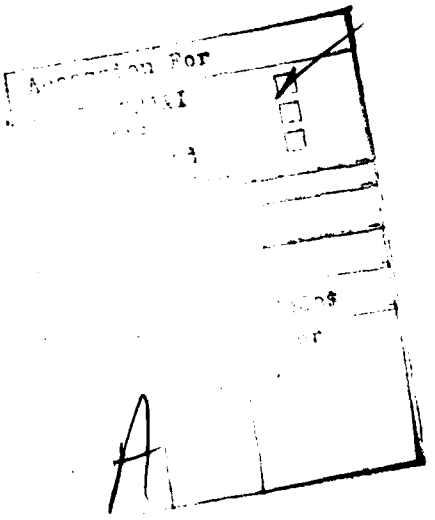


LIST OF ILLUSTRATIONS

INTRODUCTION

PURPOSE.

The purpose of this study was to evaluate, through mockup techniques, the adequacy of the proposed "island" console concept as a viable air traffic control (ATC) tower cab design alternative for terminal radar approach control in tower cabs (TRACAB's) with a class and complexity similar to that of Love Field, Dallas, Texas.

BACKGROUND.

Interest in the island console concept for ATC tower cabs has been stimulated as a result of a beneficial suggestion from a former controller at the Love Field TRACAB in Dallas, Texas. The recommended design is a complete departure from the standard TRACAB design which incorporates consoles, equipment, work areas, and controller positions around the perimeter of the cab. As the Dallas controller noted in his suggestion, this has certain disadvantages for certain positions. "At Dallas TRACAB, the console is located primarily on one side, facing the runway 13 operation. The Local Control position on the console places the controller's back toward runway 31, requiring him to turn around in order to see arriving/departing aircraft when 31 is in use. The Local Controller's duties require him to record inbound/outbound aircraft numbers, issue altimeter settings and wind instrument readings, coordinate (holding down interphone buttons) to obtain releases from Dallas/Fort Worth (DFW) Departure Control in the DFW [Terminal Radar Approach Control Facility] TRACON and to observe the Bright Radar Indicator Tower Equipment (BRITE) displays. Again, his back is turned away from traffic. When the Local Controller does not face traffic activity, an unsafe condition is a potential."

It should be noted that the location of the tower at Dallas Love Field is unique. Whereas most towers are located to one side of an airport runway complex, the Dallas Love Field tower is located between dual northwest/southeast (NW/SE) runways. This requires a unique adaptability for ATC tower cab design.

Though this island console proposal is not scheduled for incorporation at Dallas Love Field, various aspects of it merit further consideration. Some of these are as follows:

1. The possibility of construction cost savings due to descreased wiring.

2. The ease of a "flip/flop" operation in duplicating positions on either side of the island console.

3. The advantage of mobile modules for rollaway repairs and maintenance.

4. The apparent ease of 360° visual circumspection.

5. The possibility of mass production cost savings, since the island console need not be cut to fit any particular tower cab perimeter design.

However, all the proposed gains would be negated if either the equipment or controllers cannot adapt to the concept.

To determine the island console concept utility, Air Traffic Service (AAT-120), issued a request for a "complete mockup of this center console design...so that an operational and equipment layout evaluation can be made." In response to this request, the Technical Center project team studied all proposed equipment operating characteristics for incorporation in that design layout. Based on the results of these studies, modeling techniques were used in conjunction with the "final" island

mockup (foamcore/plywood) to determine the effectiveness of proposed equipment installation/cooling arrangements. Following this evaluation, actual equipment was to be installed and operated in a "final product" island console for demonstration purposes.

There were three phases to this evaluation: (1) plywood/foamcore mockup construction, (2) role-playing (operational testing), and (3) engineering considerations.

DISCUSSION

ISLAND LAYOUT AND OPERATION.

Figure 1 is a schematic diagram of the TRACAB modular island console design. All wire dispersal emanates from the center of the cab. The four "wings" were detachable for ease of maintenance. Maintenance could be accomplished from any side of this equipment, which could not be done if the consoles were located along the perimeter.

Figure 2 shows the plywood and foamcore mockup of the design constructed by the Federal Aviation Administration (FAA) Technical Center team. All equipment and controls necessary for operation were simulated in either faceplate or replica form. Evaluation of the mockup entailed movement of these equipment replicas about the consoles until optimumly placed. Engineering expertise was available to determine the depth and wire run requirements of equipment below the surface of the console to ascertain if suggested placements were feasible. Figures 3, 4, and 5 show the various positions of operation and indicate the proposed equipment configuration.

An original prime requisite in the design of the island console concept was the determination of the feasibiliy of a flip/flop operation from one side of the console to the other to accommodate operations in either direction. To accommodate this, the island console was bilaterally symmetrical about it's length, and both Radar Control and Local Control positions were duplicated on either side for flip/flop operation should the direction of traffic change.

METHOD OF EVALUATION.

The evaluation methodology consisted of subjective determination of concept utility by Air Traffic Service, System Research and Development Service, and Technical Center personnel. Hands-on role-playing at the positions in the full size mockup allowed a firsthand experience of system functions. Suggested rearrangements of displays and equipment were acted out, until final positioning reached concensus. Photographs were taken which documented the resulting island console configuration, and engineering drawings were made of the finished version.

PROPOSED ENGINEERING EVALUATION.

An engineering evaluation had been proposed to determine maintenance accessibility and the operating environment ramifications of equipment installed in the island console. Temperature airflow studies would ensure that proper conditions were maintained within the interior portions of the console. BRITE I operating environment specifications of +10° to +40° Celsius (C) and humidity limits of 10 to 80 percent would be the operational range. Tests would be conducted with operating equipment installed in a wood mockup to determine cooling grill effectiveness and location. The necessity for auxiliary cooling fans would then be determined. Based upon subjective opinion of a group of technicians, maintenance accessibility would also be determined.

RESULTS

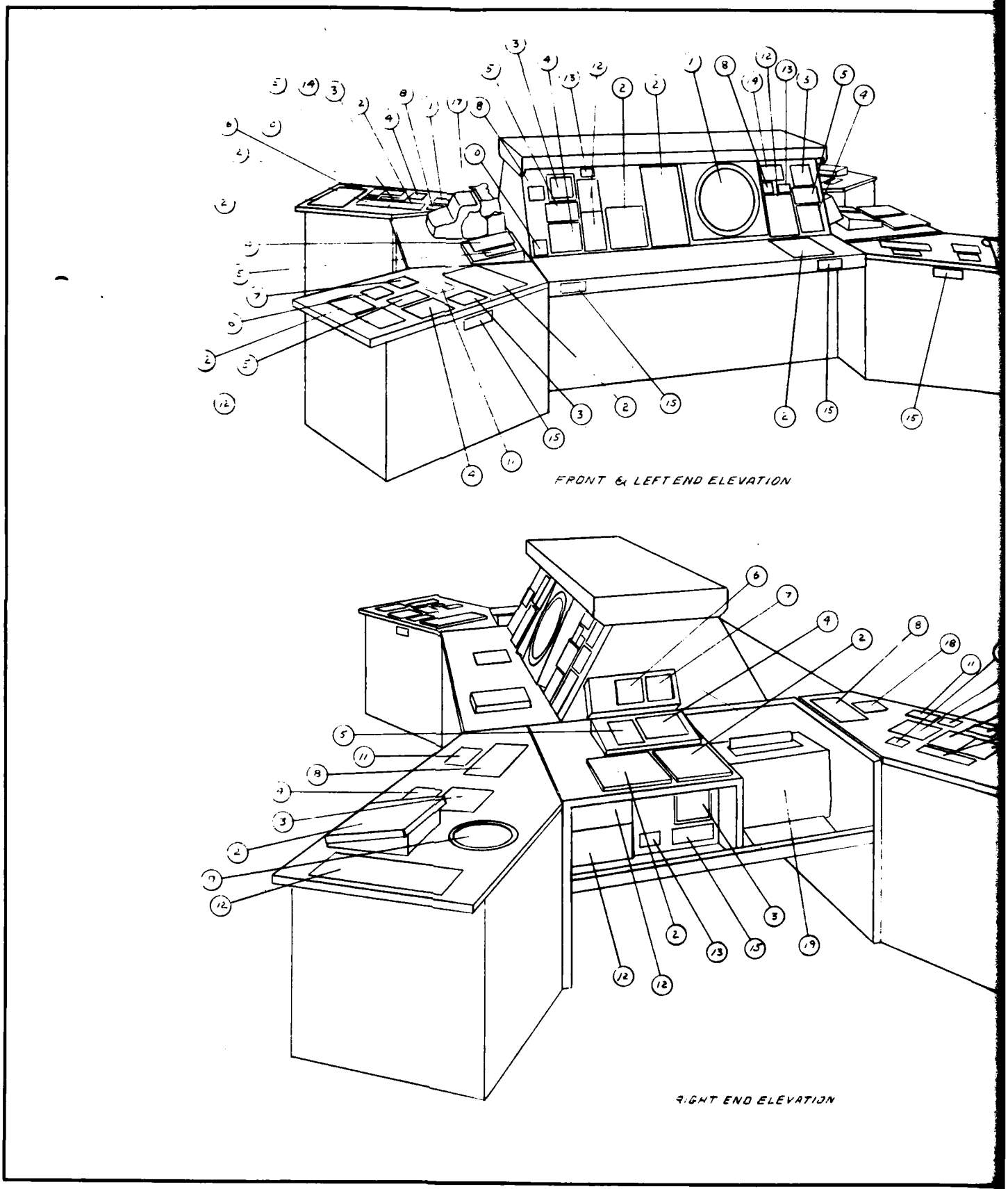
Through judicious placement of equipment on the console, especially in the turret area where equipment was placed back to back, it was found that all equipment could be made to fit. However, this resulted in placement of some items in less than optimum areas. This was determined to be of no major consequence.

Since the placement of the equipment was judged feasible, an operational role playing, hands-on assessment was made. Difficulty of mobility in the tower cab was encountered due to the "wing" feature of the island console. The proximity of the "wings" to the perimeter of the cab was judged constricting. In addition, there was a lack of space behind the Airport Surveillance Radar (ASR) positions for the Local Controllers to move about.

The final analysis as to the utility of the island design rested in it's probability of adoption as a standard. Standarization would allow production in numbers in order to achieve certain economies. But, as was pointed out, utilization of this design depends upon the unique requirement for flip/flop operations. It was found by the evaluating team that there was not a sufficient number of towers which required this application. In a letter dated March 27, 1980, to the Director of Air Traffic Service (AAT-1) from the Director of Systems Research and Development Service (ARD-1), it was stated: "Upon initial mockup of this design, it was jointly determined by AAT, ACT [Technical Center], and ARD that the application of this console is limited to a specific site and does not have national application. Due to this limited application, further evaluation of heat dissipation and operational and engineering evaluation of this console will not be made; therefore, we are considering this request completed." The proposed engineering evaluation was cancelled.

CONCLUSION

It was concluded that the "island" console TRACAB design as fabricated and evaluated at the Technical Center was feasible; however, since the design did not have national application, no further evaluation need be made.



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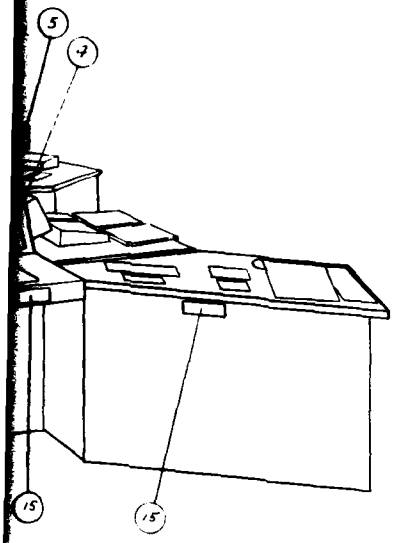
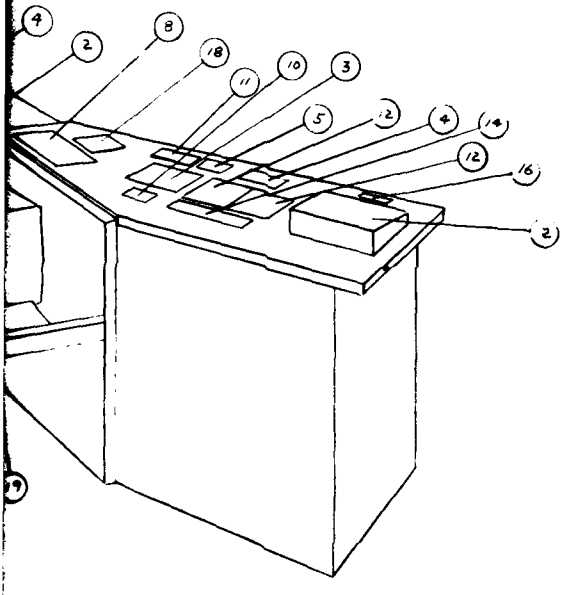


1-HRITE DISPLAY
2-STRIP BAY
3-TELCO SPEAKER
4-301 TELCO SELECTOR PANEL
5-TELCO DIAL
6-WIND DIRECTION INDICATOR
7-WIND SPEED INDICATOR
8-DIGITAL WIND DIRECTION
9-ALTIMETER (KOLLSMAN)
10-DIGITAL ALTIMETER
11-VAS
12-FREQUENCY SELECTOR PANEL & SPEAKER
13-TELCO FAA SWITCH
14-CLOCK
15-JACK
16-USED STRIP HOLDER
17-TYPEWRITER
18-VASI
19-STRIP PRINTER



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FEDERAL AVIATION ADMINISTRATION
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER — ATLANTIC CITY, N.J.

LOVE FIELD AIRPORT
DALLAS TEXAS
ACTC EXPERIMENTAL CENTER
CONSOLE
PICTORIAL

SUBMITTED BY: ACT-210	DRAWN BY: E. BOTTOMLEY	
PROJECT OF: NAS	ISSUED BY: ACT-63C	DATE: 6/19/80
		DRAWING: XD-3068

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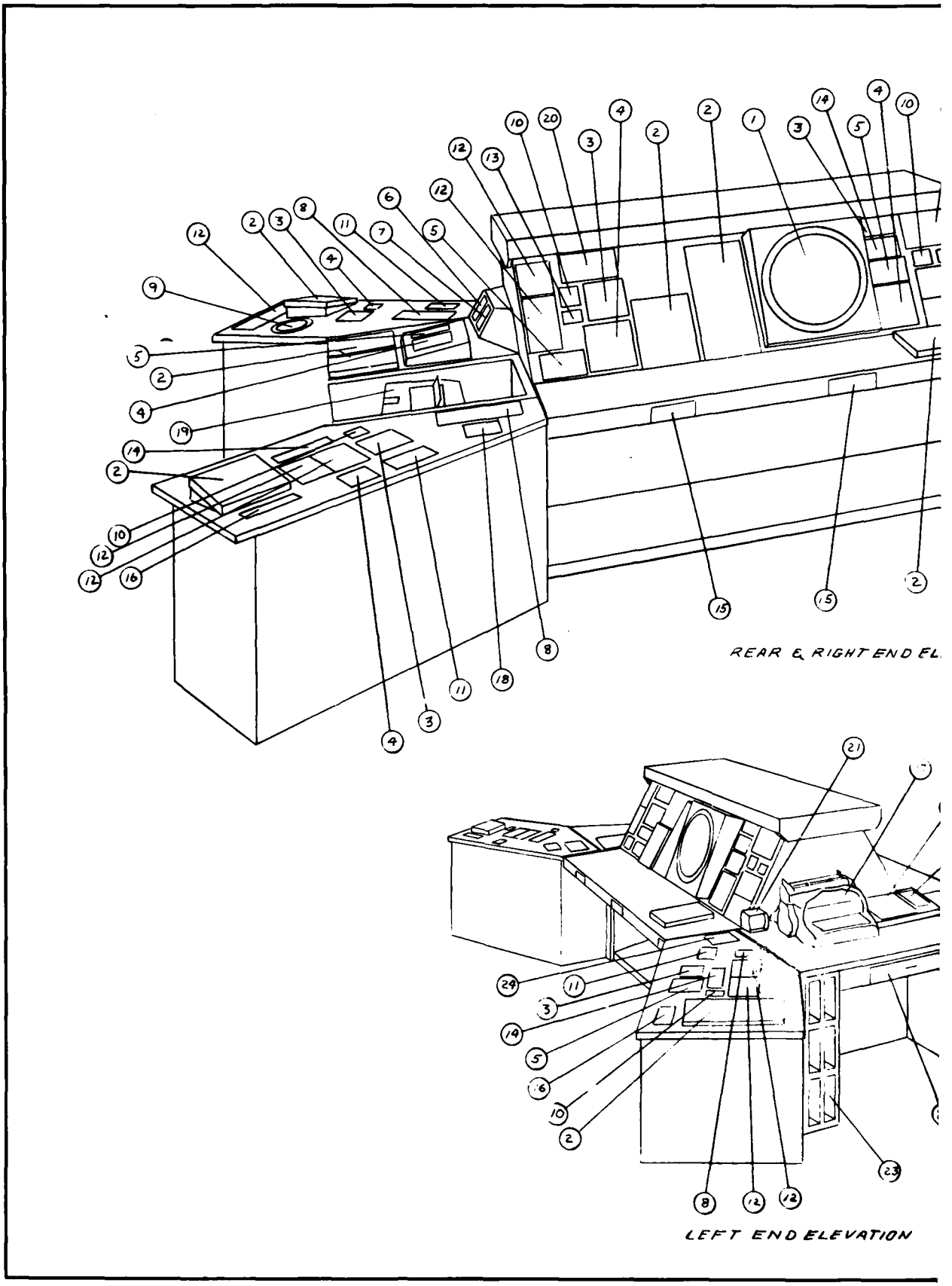
AL OF THE MODULAR ISLAND CONSTRUCTION (SHEET 1 OF 2)



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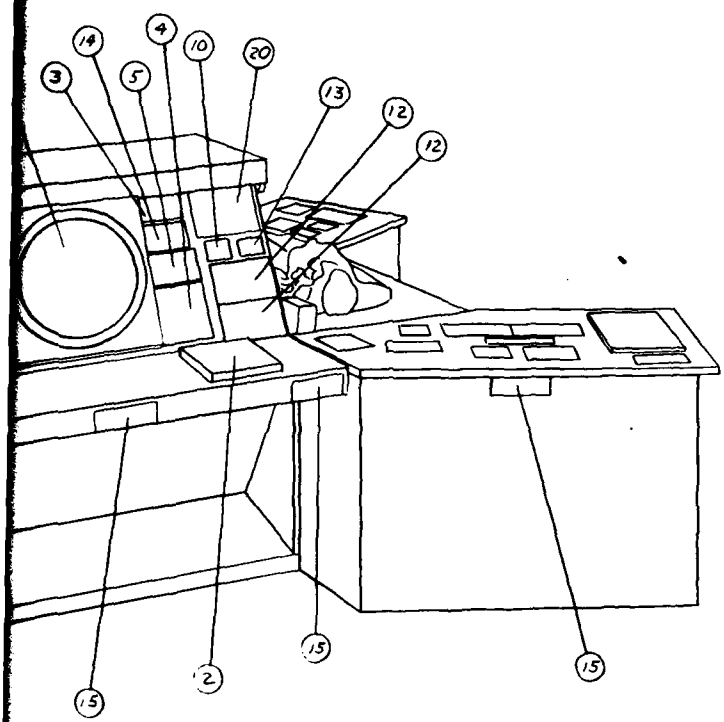
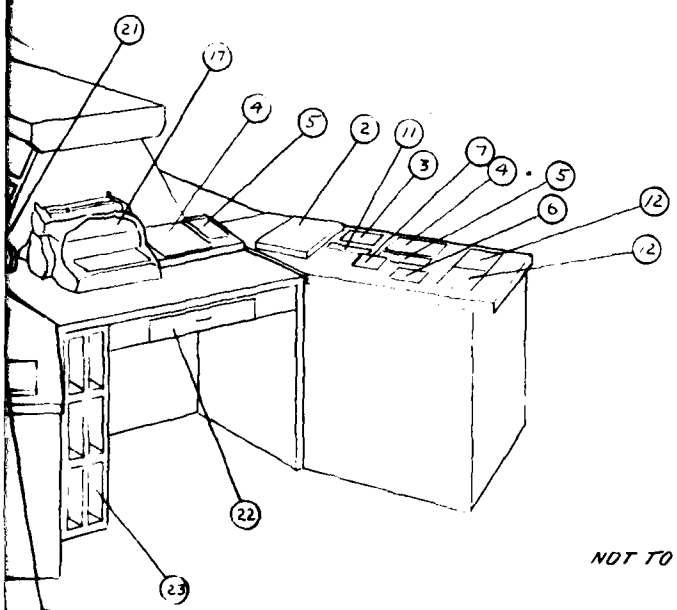


R & RIGHT END ELEVATION

1-BRITE DISPLAY
2-STRIP BAY
3-TELCO SPEAKER
4-301 TELCO SELECTOR PANEL
5-TELCO DIAL
6-WIND DIRECTION INDICATOR
7-WIND SPEED INDICATOR
8-DIGITAL WIND DIRECTION
9-ALTIMETER (KOLLSMAN)
10-DIGITAL ALTIMETER
11-VAS
12-FREQUENCY SELECTOR PANEL & SPEAKER
13-TELCO FAA SWITCH
14-CLOCK
15-JACK
16-USED STRIP HOLDER
17-TYPEWRITER
18-VASI
19-STRIP PRINTER
20-RVR
21-RECORDER
22-PENCIL DRAWER
23-FORMS STORAGE
24-CONTROLLERS LOG



ND ELEVATION

NOT TO SCALE

80-40-1B

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FEDERAL AVIATION ADMINISTRATION
NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER ATLANTIC CITY, N.J.

LOVE FIELD AIRPORT
DALLAS TEXAS
ATCT EXPERIMENTAL CENTER
CONSOLE
PICTORIAL

DRAWN BY	ACT-210	APPROVED BY	D BOTTOMLEY
CHECKED BY NF	ACT-63C	DATE	6/20/80
		DRAWING NO.	XD-3068

E PICTORIAL OF THE MODULAR ISLAND CONSTRUCTION (SHEET 2 OF 2)

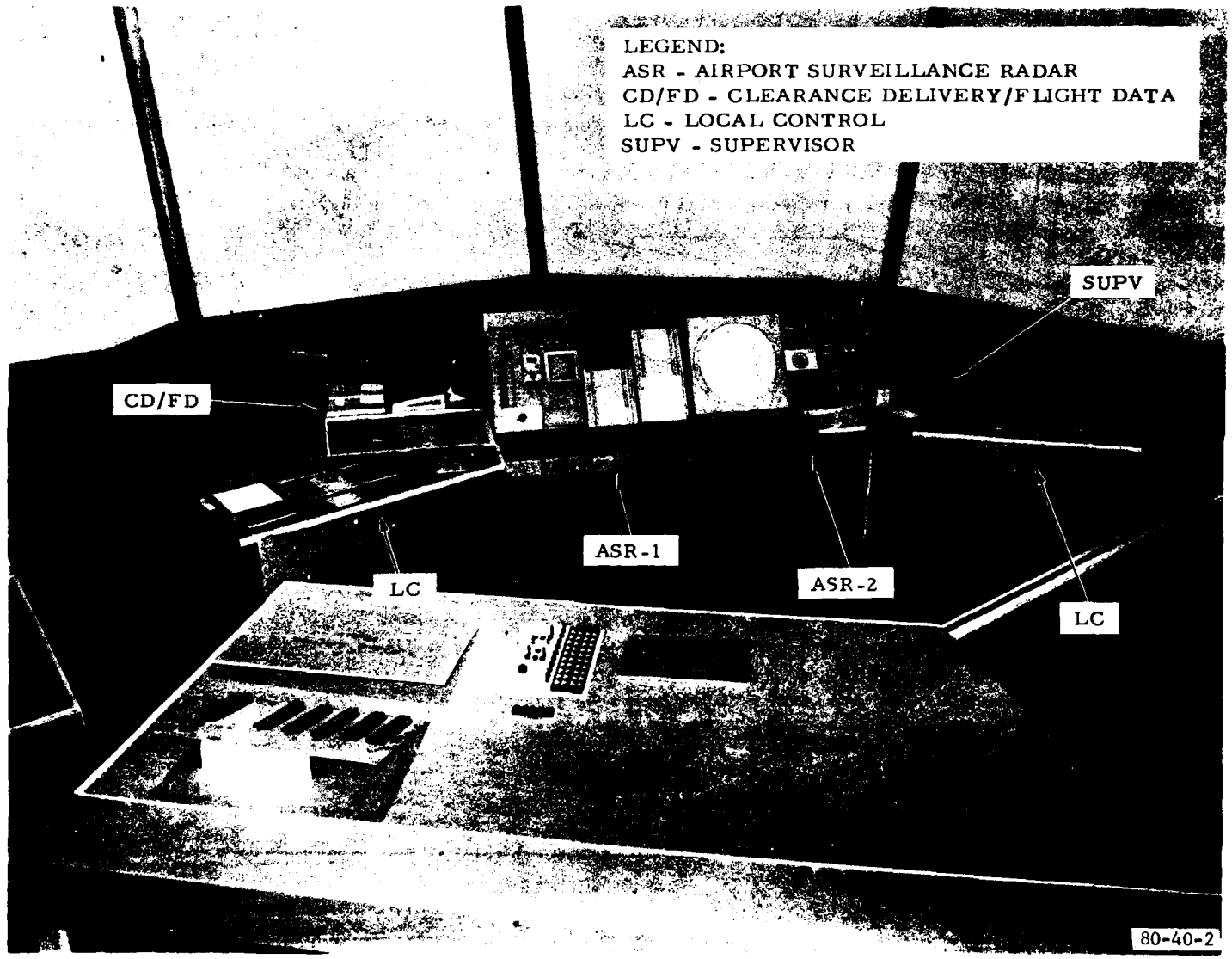

FIGURE 2. OVERVIEW OF TRACAB FROM EAST SIDE

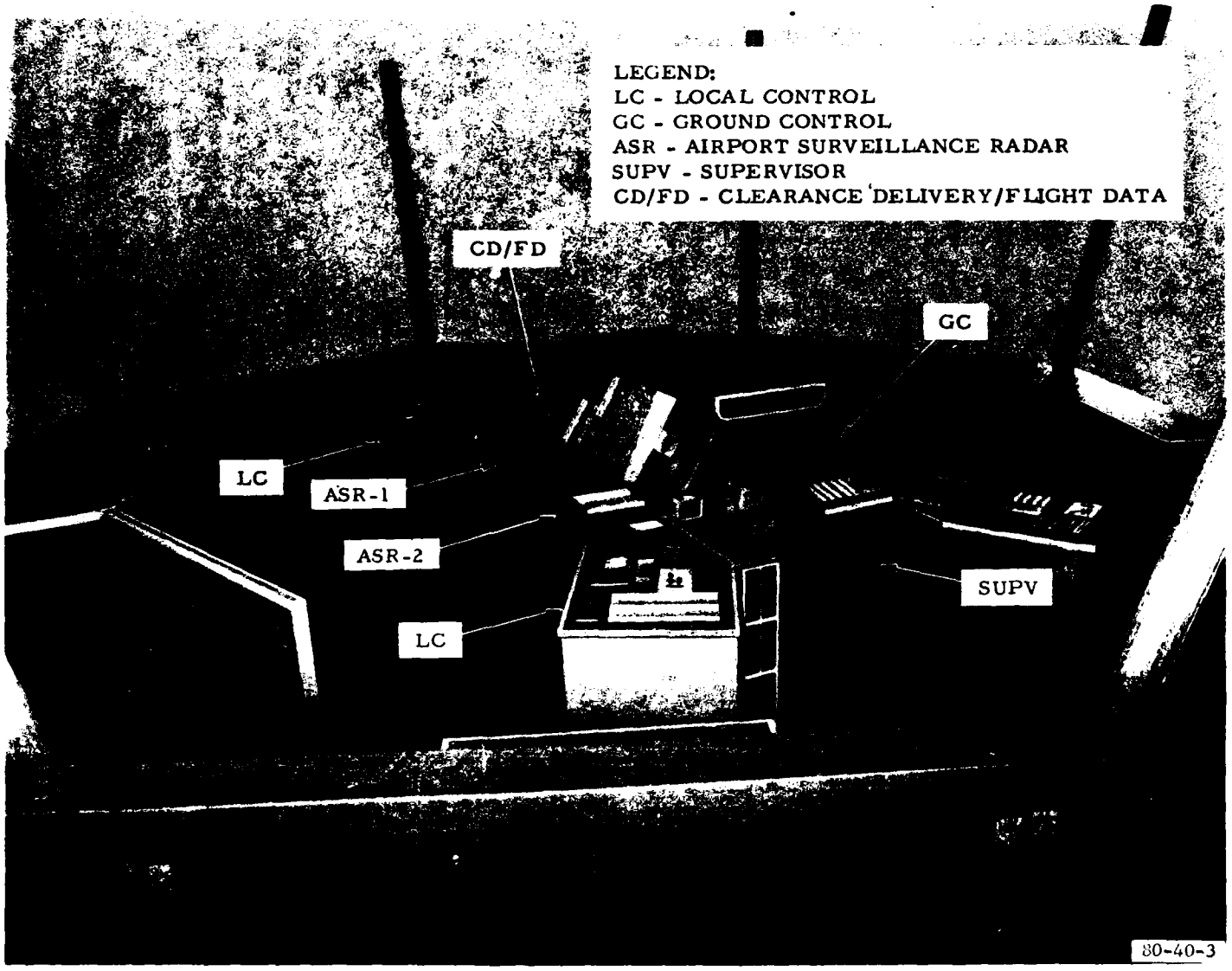

FIGURE 3. OVERVIEW OF TRACAB FROM NORTH SIDE

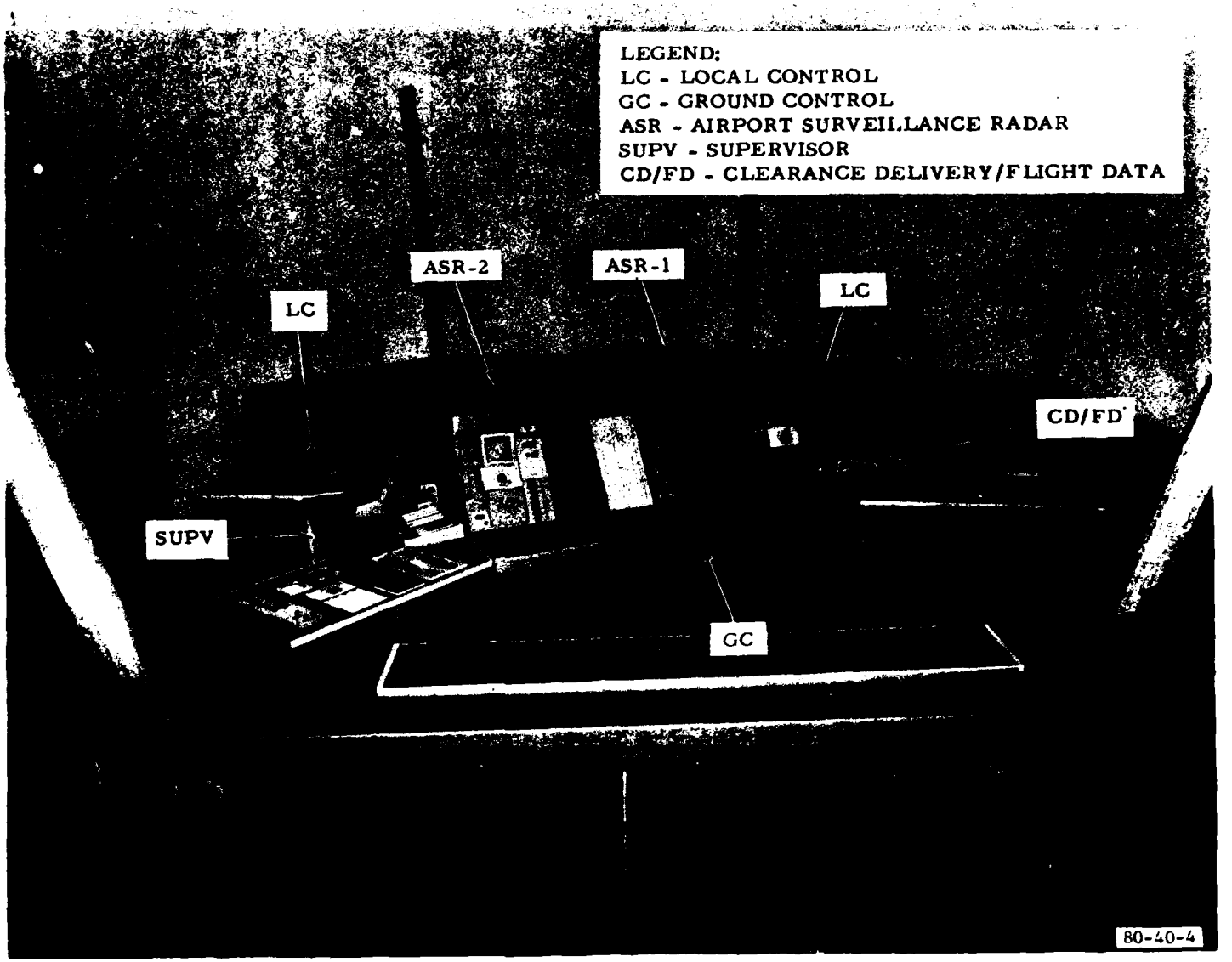

FIGURE 4. OVERVIEW OF TRACAB FROM WEST SIDE

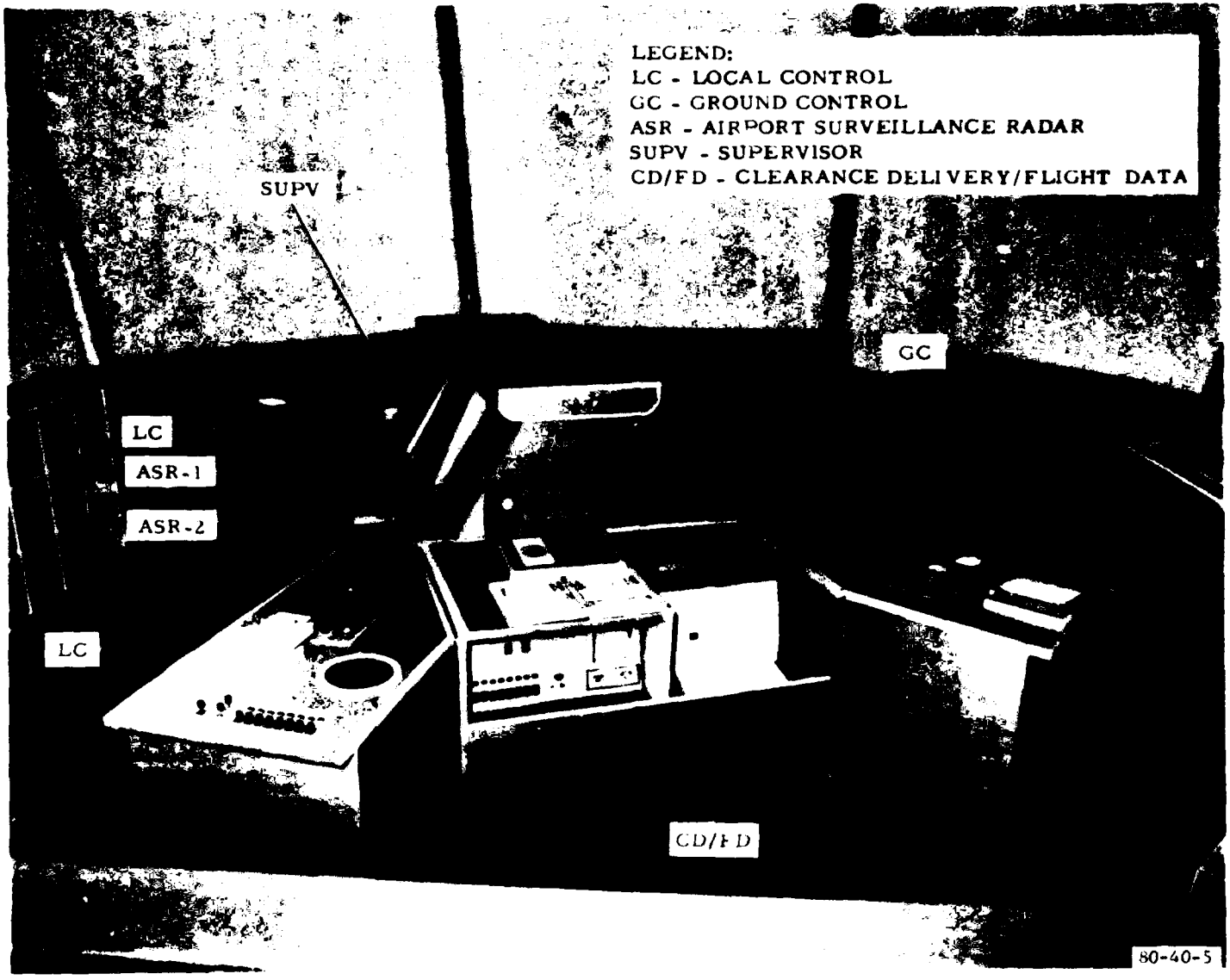

FIGURE 5. OVERVIEW OF TRACAB FROM SOUTH SIDE