The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

PROCEEDINGS —

Twenty-fourth Annual Meeting

Volume XXIV • Number 1 1983

TRANSPORTATION RESEARCH FORUM

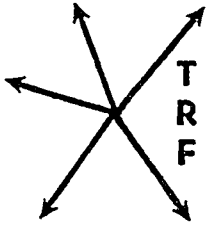
PROCEEDINGS —
Twenty-fourth Annual Meeting

Theme:

"Transportation Management, Policy and Technology"

November 2-5, 1983
Marriott Crystal City Hotel
Marriott Crystal Gateway Hotel
Arlington, VA

Volume XXIV • Number 1 1983



TRANSPORTATION RESEARCH FORUM

A Sketch Analysis of Transportation Service for the 1992 Chicago World's Fair

*by Eugene Ryan** and *David Zavattero**

OVERVIEW

THE SITE selected for the proposed Chicago 1992 World's Fair, on the shore of Lake Michigan just south of the Central Business District, locates the Fair in the region's most accessible area. Chicago's ground transportation network has developed in a radial pattern with the Loop at its center. Seven expressways and nineteen rail transit lines currently converge on the CBD, bringing over 1,000,000 people into the Central Area every day. A twentieth rail transit line is scheduled to begin service from the city's southwest neighborhoods to the Loop in the late 1980's. When the Fair was proposed it was recognized that the capacity of this system to deliver fairgoers to the Central Area, the amount and location of parking, and the ability of the area's roadways to accommodate vehicles moving to and from the Fair would have to be thoroughly investigated.

The purpose of this article is to describe the corridor level analysis conducted as part of the initial transportation planning effort for the Fair (1). This effort is preliminary in the sense that it looks only at potential major deficiencies in the highway and transit systems currently serving the Chicago Central Area and the Fair site. The analysis was included in the city's presentation to the Bureau of International Exposition (BIE) delegation to indicate the feasibility of the proposed site from a transportation standpoint (2). The demand analysis produced estimated weekday Fair visitor trips by travel corridor by line and mode. These trip estimates were then used in an evaluation of the adequacy of existing line haul transportation modes, a determination of shuttle requirements, and an identification of needed modifications to the transportation system to accommodate Fair visitors.

Transportation demand estimates were prepared for a hypothetical design weekday and for the three critical hourly time periods during the design weekday. The analysis used the regional radial freeway system as the basis for defining six regional corridors of travel. Using seasonal attendance estimates prepared by King Cole, Inc. and data from previous fairs, design day and hourly attendance figures were estimated (3, 4). The visitors' geographic origin for trips to the Fair and the destination of trips from the Fair were estimated through application of some travel behavior assumptions using attendance by market area, as well as information on the location of population, employment, and hotel rooms. Using the CATS sketch planning model (5), the Fair trip movements were simulated and summed to the corridors. Mode split estimates were made and the resulting trips were compared to modal capacity in each corridor. After adjustments to account for capacity limitations a tabulation of trips by corridor by time period was developed. The following sections provide an explanation of each of the steps in this process.

DESIGN WEEKDAY ATTENDANCE

The 90th percentile weekday attendance was chosen to define the design weekday used as the basis for transportation planning. Data from previous world's fairs was used to estimate the attendance for this hypothetical weekday. Table 1 shows seasonal attendance, 90th percentile weekday attendance and their ratio for three previous world's fairs. The average ratio of 90th percentile weekday attendance to seasonal attendance for these fairs was computed. Initial planning for the 1992 World's Fair is based on a projected seasonal attendance of 54.4 million visitors. Applying this average ratio to the seasonal attendance estimate for the 1992 Chicago Fair yields a design weekday attendance of slightly under 400,000. The design weekday attendance was thus set at 400,000 visitors.

DESIGN WEEKDAY TRAVEL DEMAND BY LOCATION

The estimated seasonal attendance was developed for the five geographic market areas shown in Figure 1. These metro market, basic market, one-day market, and tourist/visitor market. The prime metro market area is Cook County and the expanded metro market area includes the five collar counties, Kanka-

**Chicago Area Transportation Study, Chicago, IL.*

TABLE 1

ATTENDANCE DATA FROM PREVIOUS WORLD'S FAIRS

Fair	Seasonal Attendance	90th Percentile Weekday Attendance	Ratio of 90th Percentile to Seasonal Attendance
Osaka, Japan	64,219,000	513,000	.008
Seattle	9,610,000	68,000	.007
Spokane	5,200,000	37,000	.007

kee County, and Lake and Porter Counties in Indiana. The basic market includes those persons residing outside the prime and expanded metro market but within a few hours drive to Chicago. The one-day market includes those persons located further from Chicago than the basic market but within a reasonably comfortable day's drive. The tourist/visitor market includes all other potential visitors from the rest of the United States and around the world.

Table 2 gives estimated seasonal atare the price metro market, expanded tendance by market area. For the design weekday it was assumed that the percentage distribution of visitors from the various market areas would be identical to the seasonal percentages. Thus for a design weekday attendance of 400,000 Table 2 also shows the number of visitors by market area. Obviously, the largest number of visitors will come from the market areas closest to the Fair. The prime and expanded metro markets will account for nearly 60% of all Fair visitors. Many of these persons are expected to come to the Fair more than once during its six-month season. In fact, residents of the prime metro market were assumed to average about four trips to the Fair.

In order to distribute visitor origins/destinations to smaller geographic units within each market area a number of assumptions had to be made. For the prime and expanded metro market visitors were generally expected to begin the trip to the Fair at their home and return to their home after the Fair. All persons within a market area were assumed to have equal probability of attending the fair on the design weekday. Thus the population distribution within each market area served as a basis for distributing the visitor origins and des-

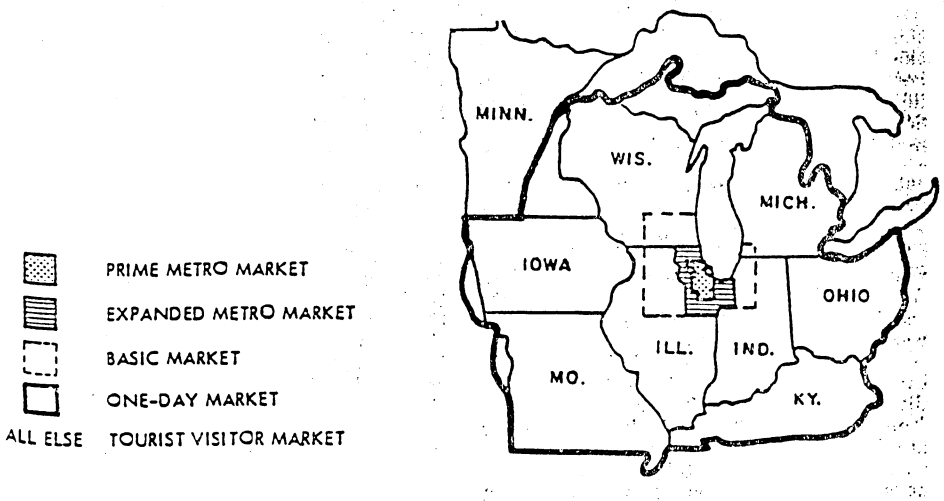


FIGURE 1

TABLE 2

SEASON AND DESIGN WEEKDAY VISITORS BY MARKET AREA

Market Area	Season Visitors (Thousands)	Percent	Design Weekday Visitors
Prime Metro	22,014.7	40.4	161,600
Expanded Metro	9,551.9	17.5	70,000
Basic	5,639.4	10.4	41,600
One-Day	9,718.5	17.9	71,600
Tourist/Visitor	7,518.5	13.8	55,200
Total	54,443.0	100.0	400,000

tinations to smaller zones. One exception to this method anticipated that many people employed in the Chicago Central Area would attend the Fair after work. Because of the proximity of the Central Area to the Fair site it was assumed that the probability of an employee in the Central Area attending the Fair on the design weekday was 50% higher than the average person living in the prime metro market area. The assumption yielded 23,000 such visits or about 10% of the prime plus expanded metro market total. It was assumed that all such Central Area employee Fair visitors would return to their home after the Fair and thus destinations were distributed on a population basis within the prime and expanded metro markets.

For the basic market one-half the trips to the Fair were assumed to originate that day at the visitor's residence. These trips were assigned to the transportation network at cordon points on the region's boundary. The other half of the basic market was assumed to have begun their trip to the Fair from lodging within the Chicago region. Of these 80% were assumed lodged at hotel-motels and 20% at private residences and other places throughout the region. The one-day market visitors, having longer to travel, were assumed to have a greater propensity to secure lodging within the region. Thus, only 10% were assumed to enter at the region's cordon, 70% hotel-motels and 20% at private residences and other places within the region. Tourist/visitors were all expected to begin their trips at lodging within the region. Because these tourist/visitors presumably live a greater distance from the area and also include a greater number of business travelers, 90% were assumed lodged at hotel-motels and 10% at private residences. Assumptions on destination distribution were the same as the origin distribution for the basic and tourist/visitor markets. For the one-day market a higher share (20 versus 10 percent) of the departing visitors were assigned to the region's cordon reflecting a greater propensity to return home after a last day's visit to the Fair. The visitor trip locational distributions by market area resulting from these assumptions are given in Table 3.

The next step in the process was to assign the trips in Table 3 to the CATS sketch network zone system. This zone system consists of 305 zones covering the eight county Chicago region and 12 zones for points of entry on the region's boundary. For the Fair trips in those categories to be distributed by population a straight forward assignment to zones based on zonal population was used. For instance, the prime metro market trips were distributed to all zones within Cook County based on the zone's proportion of the county's population. Central Area employment generated trips were all assigned to the single zone covering the Central Area. Hotel-motel trips were distributed to zones based on the number of hotel rooms. This resulted in the Central Area zone receiving 68% and the O'Hare Area hotel complex 23% of these hotel bound trips. The other 9% of the hotel-motel trips were distributed throughout the region. The trips to be assigned to the region's cordon were split into the twelve cordon zones based on the relationship of population centers outside the area to the cordon zones. The resulting allocation to zones (less the cordon zones) far daily inbound visitor trips is shown in Figure 2.

DESIGN WEEKDAY DEMAND BY TIME OF DAY

For the purpose of the transportation

TABLE 3

VISITOR ORIGIN/DESTINATION LOCATION DISTRIBUTION FOR THE DESIGN WEEKDAY

Market Area	Origin location distributed as:			
	Population	Central Area Employment	Hotel-Motel	Region's Cordon
Prime Metro	145,440	16,160	0	0
Expanded Metro	63,000	7,000	0	0
Basic	4,160	0	16,640	20,800
One-Day	14,320	0	50,120	7,160
Tourist/Visitor	5,520	0	49,680	0
Total	232,440	23,160	116,440	27,960

Market Area	Destination location distributed as:			
	Population	Central Area Employment	Hotel-Motel	Region's Cordon
Prime Metro	161,600	0	0	0
Expanded Metro	70,000	0	0	0
Basic	4,160	0	16,640	20,800
One-Day	14,320	0	42,960	14,320
Tourist/Visitor	5,520	0	49,680	0
Total	255,600	0	109,280	35,120

analysis three key time periods during the design weekday were identified. These were the opening hour, the closing hour, and the evening peak hour. Hourly demand percentages were developed by using data from other world fairs. The opening of the Fair is expected to produce the highest hourly inbound flux of visitors; about 15% of the design weekday. The closing hour is expected to produce the highest outbound flow; about 23% of the total trips leaving the Fair on the design weekday. The third critical time period identified is the evening peak hour between five and six o'clock. During this hour a heavy concentration of visitors leaving and entering the Fair coincides with the normal work to home rush period. For this evening peak it was assumed that approximately 14% of the daily inbound visitors would enter and 10% of the daily outbound visitors would leave.

Trips were assigned to the critical time periods generally by applying the percentages noted above to the daily totals of all market types. However, some exceptions were made. For instance, trips from Central Area employees were expected to have a heavy concentration in the evening peak and be negligible in the opening hour.

DESIGN WEEKDAY TRAVEL BY CORRIDOR

A travel simulation of total daily inbound trips and directional trips from each of the critical time periods was performed on the sketch highway network. Free speed travel times were used in the network, as the purpose of the assignment was simply to summarize trips to general travel corridors rather than to get detailed link volumes. The travel corridors used in this analysis are shown in Figure 2. As was noted these corridors are defined by the region's expressway system, each corridor being served by at least one major expressway. The resultant demand by corridor from the sketch assignment is given in Table 4. These corridors define the general direction that Fair visitors might be expected to enter or leave the Chicago Central Area as they go to the Fair. The analysis assumes that once in the Central Area (either by car or tran-

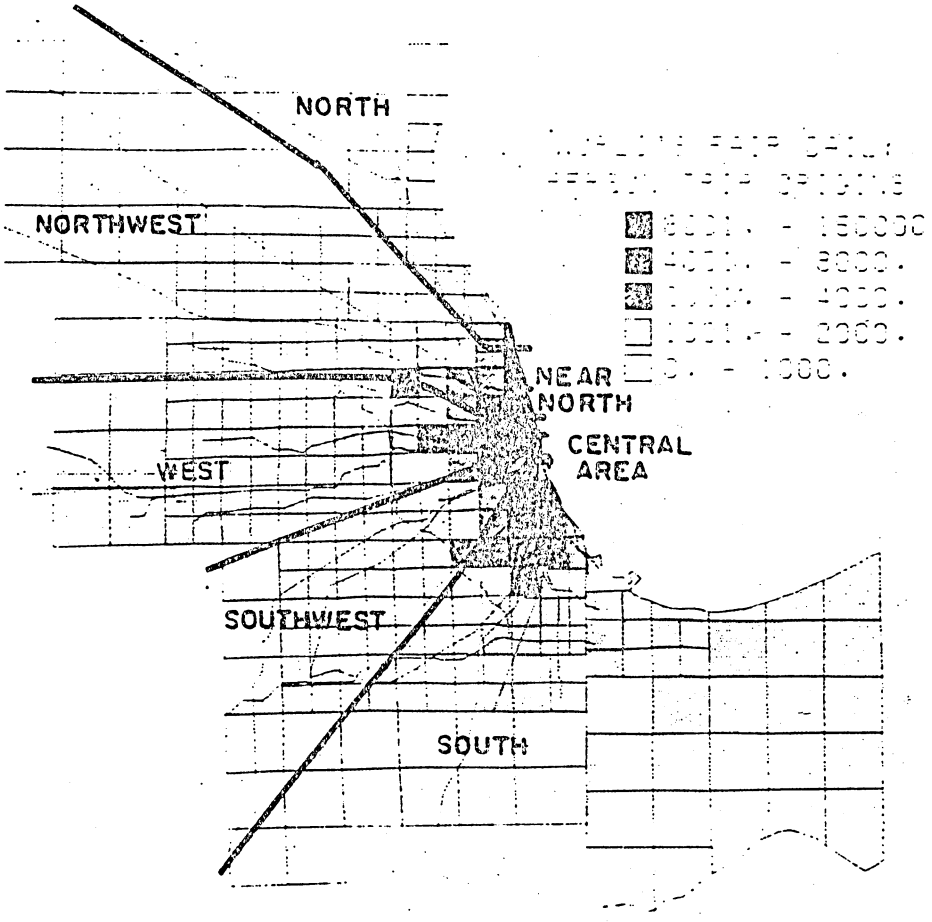


FIGURE 2

sit) the Fair visitors will have an equally easy or difficult time getting to the actual Fair site near Lake Michigan.

LINE HAUL MODE SHARES BY CORRIDOR

The general procedure used in this analysis for estimating mode shares by corridor is shown in Figure 3. The key step in this process is labelled "Mode Split Calculation." This calculation was performed by dividing the region into three geographic rings. The inner ring consists of Chicago and its adjacent mature suburbs. The intermediate ring extends in the boundary of the eight-county region. The outer ring encompasses all the area outside the eight counties of northeastern Illinois and northwestern Indiana.

Trips originating from or destined for the outer ring were all considered highway trips because of the lack of direct service to the Fair by public transportation for these areas. Residents from these areas using public transportation to the Chicago area are assumed to have an intermediate origin or destination within the eight-county region and these trips are thus included in either the inner or intermediate ring calculations. Thus, the assumption of one hundred percent highway mode for the outer ring trips does not imply all residents outside the eight counties use highway as their

TABLE 4

1992 WORLD'S FAIR DESIGN WEEKDAY CORRIDOR OF ENTRY/EXIT BY HOUR AND DIRECTION

General Corridor of Entry/Exit to Chicago Central Area	Time Period and Direction (Thousands of Visitors) Daily Inbound	First Hour Inbound	Evening Peak Inbound	Evening Peak Outbound	Closing Hour Outbound
Near North	8.1	1.2	.8	.9	2.2
North/Northwest	119.8	18.0	10.2	12.7	29.1
West	37.5	5.6	3.6	4.1	10.2
Southwest	43.3	6.5	3.7	4.9	10.8
South	80.8	12.1	6.9	9.1	20.2
Near South	6.3	1.0	.6	.7	1.7
Within Central Area	104.1	12.1	32.7	7.7	19.1
Total	400.0	56.5	58.6	40.1	93.3

line haul mode to the Fair site on a specific day.

Mode splits for the inner and intermediate ring trips were calculated using sketch network times, estimated costs of travel, and the behavioral equations of the CATS network sensitive mode split model (6). The following assumptions were made: 1) parking at the Fair would average $7.50 a day in 1982 dollars, 2) commuter rail single ride tickets would be priced at the monthly ticket price rate, 3) all other costs would be at 1982 levels, 4) access/egress time to the Fair within the Central Area would be equal for all modes of line haul travel, and 5) auto occupancy would average 3.5 persons/vehicle. Based on these assumptions the mode split model produced the transit shares given in Table 5 for the inner and intermediate rings by time period.

The mode splits for the inner ring were applied to the trips to or from each zone within the ring. As transit service is uniformly good across all the corridors within the inner ring no modification by corridor was made. The intermediate ring however, does have significant variation in the quality and quantity of transit service by corridor and some adjustment was deemed necessary. The average morning peak mode split for work trips to the Chicago Central Area was used as the basis for adjusting the average intermediate ring split by corridor. Intermediate ring transit trips in the north and northwest corridors with the best service were adjusted upward by 5% and in the west corridor with good transit service upward by 2%. In the south corridor with a lower level of service, transit trips were reduced by 2% whereas in the outer southwest corridor with the least commuter rail service, they were adjusted downward by 10%.

LINE HAUL MODE DEMAND CAPACITY EVALUATION

The trips from each ring were summed to yield Fair induced demand for highway and transit by corridor, time period, and direction. Both highway vehicle and transit trips were compared to the available modal capacity by corridor. The available modal capacity was obtained by using current usage adjusted for future growth in regular daily usage. Supply was generally calculated using existing facilities and service. The demand capacity comparison is shown in Figure 4 for transit and Figure 5 for highway. With the exception of a few minor problems the Fair induced transportation demand could be met by available capacity for each corridor.

The demand capacity evaluation for transit is based on transit capacity using current transit schedules. Given capacity figures for the Chicago Transit Authority assume eight-car trains for all lines except the Ravenswood-Jackson Park/Engelwood and Evanston lines which are assumed to have six-car trains. The excess capacity for commuter rail assumed that trains would be lengthened

LINE HAUL MODE CORRIDOR ESTIMATION PROCEDURE

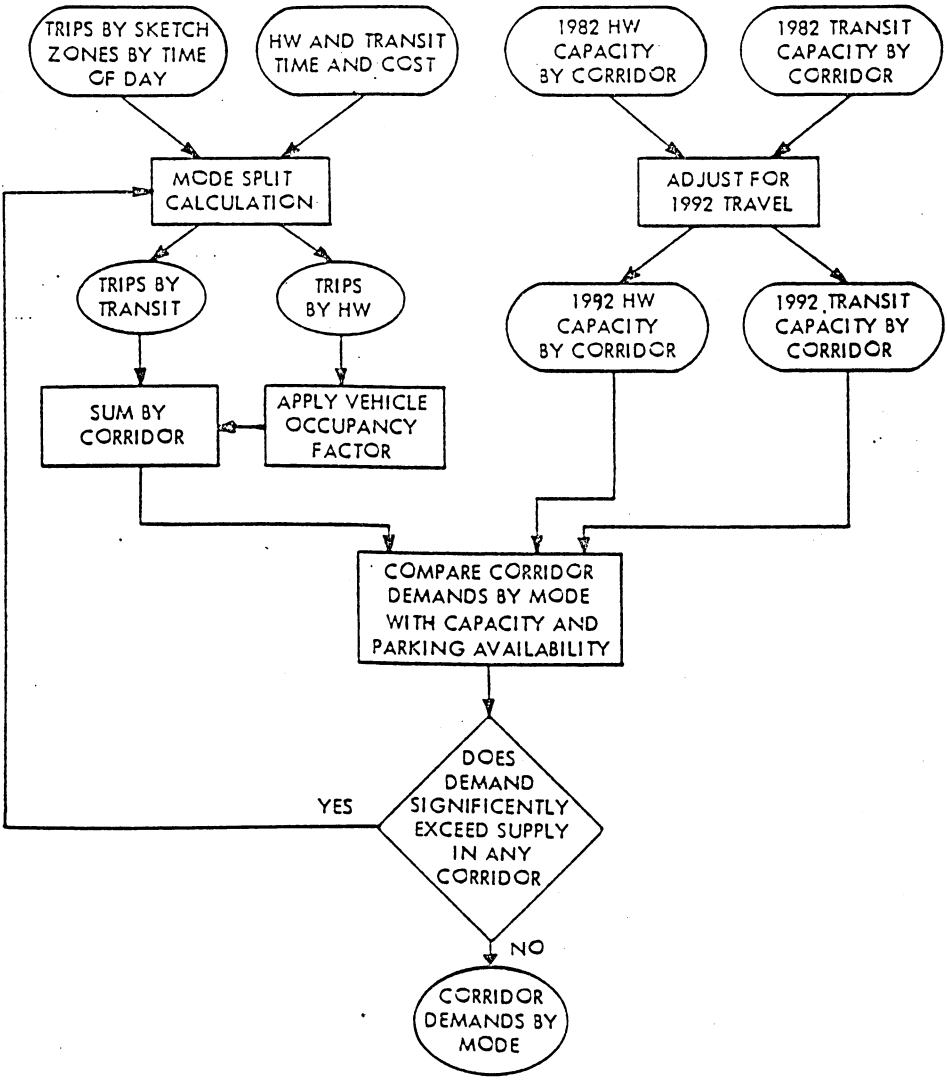


FIGURE 3

TABLE 5

TRANSIT SHARE BY RING, TIME PERIOD, AND DIRECTION

	Opening In	Evening In	Evening Out	Closing Out
Inner Ring	45%	45%	75%	40%
Intermediate Ring	25%	25%	45%	25%

TRANSIT FAIR DEMAND VERSUS AVAILABLE CAPACITY

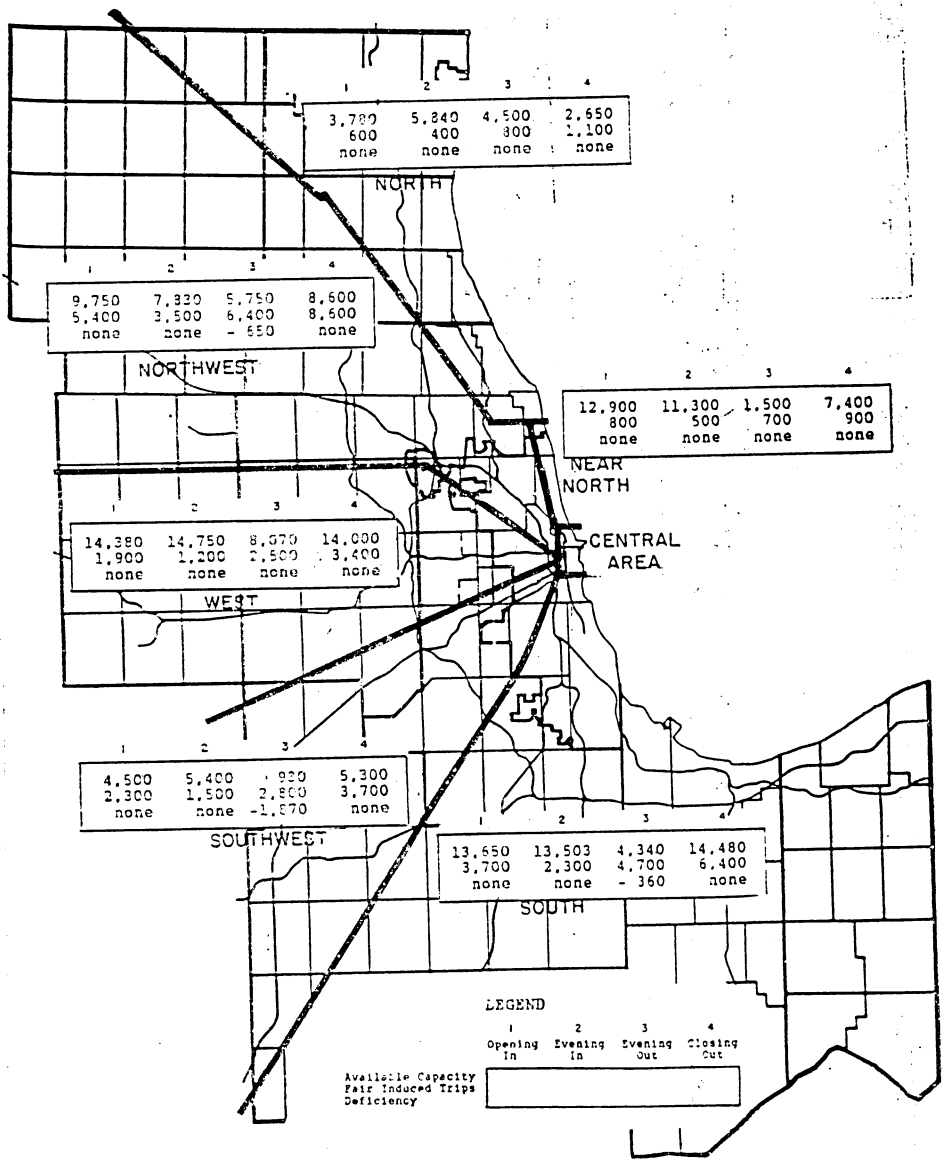


FIGURE 4

where possible. Finally, this comparison used seated capacity on commuter rail and an average 90 passengers per car on the CTA. As seen in Figure 4 only the evening northbound rush in the southwest corridor poses any significant problem. As noted a new transit line will be built in the southwest corridor in time to serve the Fair. All other corridors, directions, and time periods can be adequately handled with the transit service available.

The highway evaluation compares Fair induced highway vehicle trips with

HIGHWAY FAIR DEMAND VERSUS AVAILABLE CAPACITY

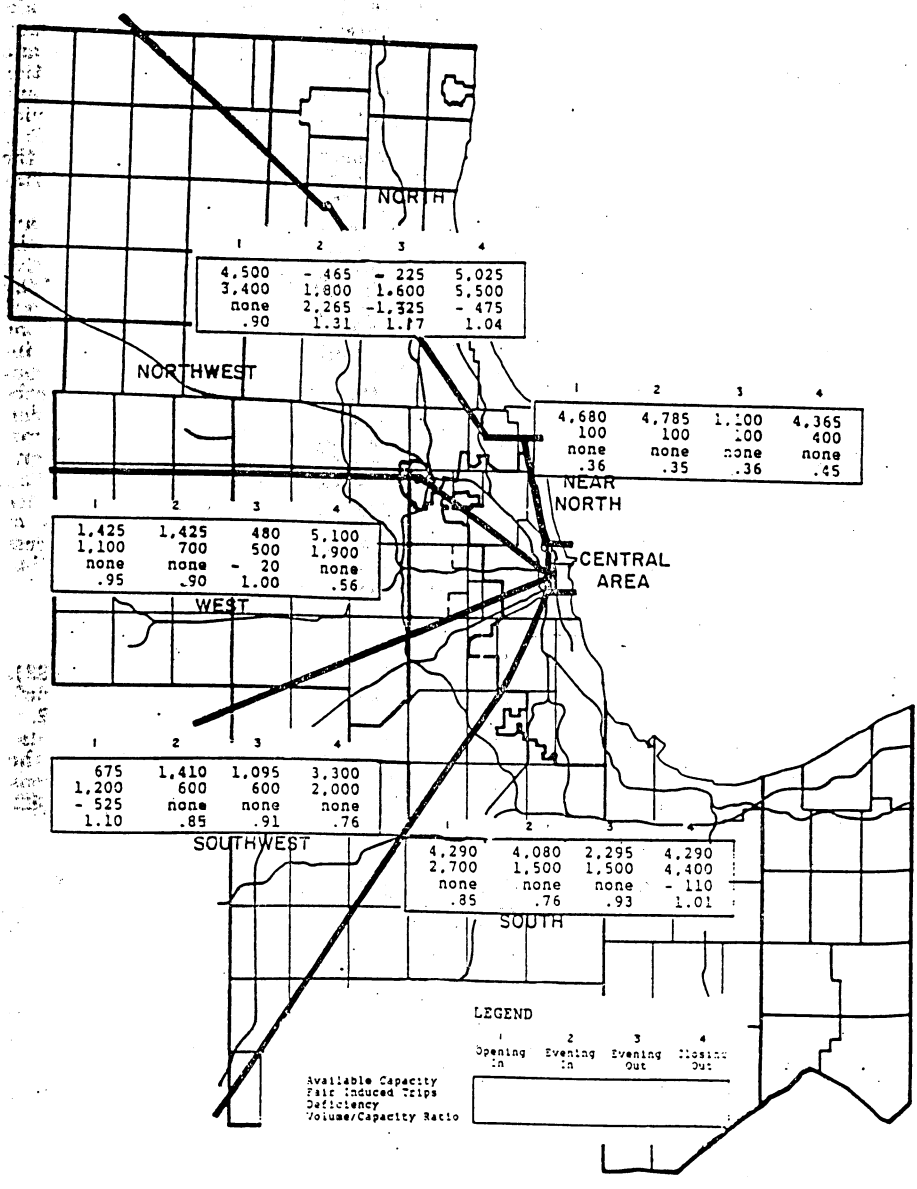


FIGURE 5

the available capacity on expressways located within the corridor. Highway vehicle trips were obtained by dividing the person trips by the assumed occupancy rate of 3.5 persons per vehicle. The north and northwest corridor capacities take into account the reversible lanes on the Kennedy expressway for the opening hour inbound, evening hour outbound, and closing hour outbound. The south corridor capacity includes only the Dan Ryan expressway. In addition to the highway deficiencies, Figure 5 also gives the corridor roadway volume to capacity

ratio which includes the effect of World's Fair traffic as well as that of the ordinary traffic. A few minor deficiencies are identified in Figure 5. The only significant problems as indicated by the deficiency and V/C ratio appear to be in the corridor served by the Kennedy expressway.

PARKING DEMAND CAPACITY EVALUATION

The parking demand implied by the hourly vehicle figures was extrapolated to a daily total and a peak accumulation. This extrapolation was accomplished by using a visitor hourly entry/exit pattern based on the Osaka data. The visitor entry/exit pattern and resulting hourly parking accumulation is shown in Figure 6. The peak accumulation of 34,000 vehicles was judged to be reasonably providable at or near the Fair site.

SUMMARY

The proposed 1992 Chicago World's Fair promises tremendous cultural and economic benefits to Chicago and to Illinois. But the success of the Fair depends on identifying and solving the transportation problems associated with an event of this magnitude. The Fair's location south of the Chicago Loop along the lakefront is in the vicinity of many major highway and transit facilities. The preliminary analysis described here has shown that with a few exceptions no major problems will be created by the Fair induced demand for modal facilities serving the Central Area and the Fair. Of course these facilities are already well used especially in peak periods and thoughtful planning and coordination between transportation providers and the Fair sponsors is needed to provide viable transportation access to the Fair and an acceptable level of service to the many regular users of the transportation system.

The recent aproval of Chicago's application to host a World's Fair by the BIE means that a much more exhaustive analysis will be performed as part of the required environmental impact assessment. This assessment will examine the transportation impacts of the Fair including a detailed analysis of modal links, the identification of specific problem areas and locations, and the development and prioritization of solutions. The analysis presented here represents the first steps in this planning process. Obviously as 1992 approaches much more detailed and refined analysis of each line haul mode and other access systems will be conducted to insure that the Fair is enjoyed by all.

REFERENCES

1. Chicago 1992 Corporation (1982), "1992 Chicago World's Fair Briefing Materials," February 1, 1982.
2. City of Chicago (1982), "Presentation by the City of Chicago to the Bureau of International Expositions Site Visit Delegation," May 4, 1982.

VISITOR PARKING DEMAND AND VEHICLE ACCUMULATION BY HOUR

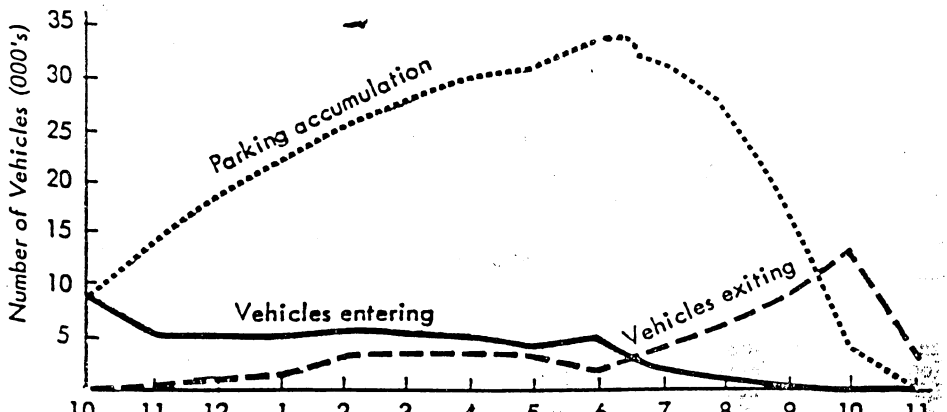


FIGURE 6

3. King Cole, Inc. (1980), "Chicago 1992 Phase I," October 30, 1980.
4. Commemorative Association for the Japan World's Exposition (1972), *Japan World Exposition, Osaka 1970, Official Report*, March 1, 1972.
5. Boyce, D., Chon, K., and Eash, R., "Development of a Family of Sketch Planning Models," *CATS Research News*, December 1982.
6. CATS (1978), *Network Sensitive Mode Choice Models*, Chicago, Illinois.