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EVALUATING THE PEAK HOUR FACTOR OF INTERSECTION

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Abstract- For many transportation projects, the Peak Hour Factor (*PHF*) is a crucial statistic for flow evaluation and traffic modeling. This study's goal was to assess the *PHF*'s features for two mean-off days and mean workdays for one week. The volume of traffic has been quickly rising across the region. People are having a difficult time due to traffic problems, particularly during peak hours. One of the most serious problems in Baqubah, Iraq is the traffic congestion at main signalized intersections. The intersection is used to facilitate changes in the direction of the traffic flow. The peak hour factor describes changes in traffic flow that occur for the period of the busiest 15 minutes of the highest hour. The process of assessing rush-hour traffic flow circumstances, such as volume and Level of Service, uses this metric. This study has evaluated the current reality of the intersection of Hai Al-Mustafa intersection where the traffic volumes were collected for all approaches and for each movement (right, left, through) and on the bus of which the morning peak was found for the intersection. The Peak hour factor for all approaches was calculated in mean off and Mean Work Day ranging (from 0.80-0.917). The mean Off Day is lower than the Mean Work Day by 17% and the maximum peak period between (7:45-8:45 AM).

Keywords: *PHF*, Traffic, Intersection, Volume, Time, Approaches.

1. INTRODUCTION

As the development of the automotive industry and the increase in the load and speed made, it is needed to increase attention to the durability of roads and their ability to withstand the weight of vehicles, as well as attention to the specifications of roads and design in a safe and comfortable [1]. In addition to the great progress that has been made in the machines used in the construction and in the management of the construction work itself in the work and in the control of traffic, making the design and maintenance of roads now more efficient and less expensive. In the road network, road intersections were (where traffic flows in different directions merge) played a critical function. The sites are complicated in a traffic system, and they significantly affect both the movement efficiency and the safety of vehicles [2].

The *PHF* value means the extreme situation in which the complete hourly volume occurs in a single 15-minute interval. In practice, *PHF*s variety from 0.70 in rural and scarcely developed areas, usually represented by low traffic, to 0.98 in congested metropolitan sectors, denoted by intense traffic [4].

The intersection represents a public area in which two or more roads intersecting each other. The most significant purposes of these intersections are to provide all required safety features to lessen the inter-vehicle interception process's possible dangers and to assure the simplicity and convenience of all trips through which it passes. Approximations could be used in the lack of peak-hour factor (*PHF*) field observations [5]. 0.92 is a good approximation for *PHF* under crowded conditions. While 0.88 is a plausible estimate for *PHF* when the flow is mostly constant during the peak hour but there is still a discernible peak. Before starting the calculations, the peak-hour capacities must be separated by the *PHF* in order for the investigation to accurately replicate surroundings during the peak 15 minutes. The *PHF* can also be tuned to 1.00 and the peak 15-min flow rates entered directly if the analyst has them. *PHF* Typically, the hourly demand over four times the peak 15-min demand ratio falls between the values of 0.75 and 0.95. As demand increases and the facility's capacity is approached, greater values frequently appear. In the absence of local data, default ideals of 0.88 for rural regions in addition 0.92 for urban regions could well be utilized [6].

The geometric elements and the traffic congestion and determined the remedial measures to reduce this traffic congestion of the traffic Mor intersection in Pabna city. As a result, Pabna's population is growing by the day, as is traffic congestion. One of Pabna's most important intersections is Traffic Mor. In the larger context, the Mor Road intersection is an important part of the city's existing traffic infrastructure. At ground level in the *T* type intersection of Mor. The traffic flow at this intersection is mixed, and both directions are two-way [7]. This study examines the geometric features, traffic jams, and traffic control systems at the Traffic Mor Road intersection. [8].

The high way capacity Manuel 2010 default (*PHF*) ideals for multilane and two-lane rural highways, as well as the default (*PHF*) value for expressways (as mentioned in HCM 2010), is considered as 0.94 [9].

The *PHF* produced the following ranges, either with or without the influence of the heavy vehicle factors, when employed on the superior calibrated models. In place of urban and out-of-town freeways and multilane highways, the range is 0.88 to 0.99; for two-lane rural highways, it is 0.81-0.97; for urban arterials, it is 0.922 to 0.972; and for rural freeways, it is 0.88 to 0.99 [8]. The use of synchro 10 software for the assessment and study of the Al-Fallah intersection's traffic performance in Baghdad. The analysis's findings showed that the Al-Fallah intersection operates at level of service F during peak hours, through a regular controller delay of (322.1 s/v) and a degree of saturation of (2.56 v/c) [11-12].

Economically active persons who were traveling for a "work" were the strata driving the most demand, and it was discovered that a minor shift in the modal split in favor of free public transportation [13]. The field information was used, in Kerbala city, to count and analyze the current traffic condition in the research area. The findings demonstrated that the flyover bridge functions at the level of service (LOS F), where the vehicle's capacity in proportion to the road's capacity is (1.48) With the Busis analysis map showing the current traffic situation on the bridge [14]. In this study, optimization suggestions were made in addition to geometric enhancements in order to increase the level of service [15]. The crucial placement of the road network is at intersections [16]. In Port Harcourt, the morning and evening have the highest traffic densities, while the afternoon has the lowest densities [17].

The studies deal with the intersections in the city are evaluated for updating, so that specialists can draw plans and strategies that would adopt comprehensive studies that means are developed the traffic problems in the urban areas of the city [18]. The number and distribution of traffic movement, the mix of traffic, the geometry, and the specifics of the intersection must all be examined during intersection analysis [19]. The state of roads and intersections are giving the opportunity to researchers and specialists to improve the city [20].

1.1. Objectives of Study

The objectives could be summarized as in the following:

1. Calculating the traffic volumes in all approaches in the intersection at peak period of mean mourning day by manually for one week.
2. Determining the peak hour volumes and their distribution in the intersection for one week at peak period.
3. Calculating the peak hour factor (*PHF*) for the intersection mean off and mean workday for one week.
4. Comparing the peak hour factor (*PHF*) for all approaches by using Microsoft-excel program to compere.

2. CASE STUDY

Located in the heart of Baquba city, Hai Al-Mustafa intersection is a busy intersection. There are four important streets that meet at Hai Al-Mustafa:

- Al-Taboo Street
- 7-Nissan Street
- Al-Mofreq Street
- Al-Jesser Bridge.

The crossroads of Hai Al-Mustafa is an important location, and its high traffic volume can be attributed to:

➢ Hai Al-Mustafa intersection is connecting the main roads linking four parts of the city (south, north, East and West direction)

➢ The presence of several public events closes to the intersection of Hai Al-Mustafa. These activities increase traffic flow and cause delays, especially during peak hours.

The improvements in this research includes the intersection and its four entries. Figure 1 displays the sketch of the intersection at Hai Al-Mustafa from the edge of the study area. (Google Earth 20 February 2021).

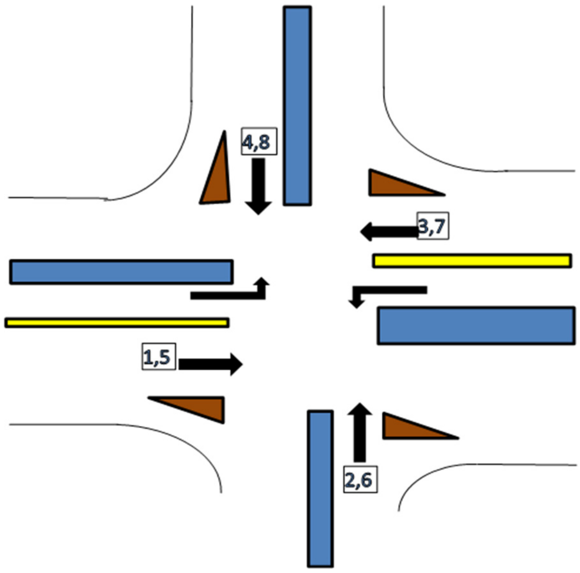

Figure 1. The sketch of intersection details [15]

3. FIELD DATA

The traffic volume is most important data to evaluate and determine the required treatments is the calculation of traffic volumes at the intersection. Thus, traffic volumes collected manually in one week between (7 A.m.) and (9 A.m.) to determine the peak hour demand. Volumes of traffic for these days are collected. The data is required to study and evaluating the intersection. The geometric characteristic is included the width to determine the number of current corridors of companies within the intersection, also includes pedestrian sizes within the intersection. Al-Mofreq Street has been identified with a width of 20 m, Al-Taboo Street 16.8 m, Al-Jesser Street with a width of 16 m and 7- Nissan Street with a width of 22.6 m.

3.1. Field Data Collection

The process of data collection has gone through several stages in order to be accurate in the collection so that the representative sample. The data are close to the reality of the traffic situation and its various activities in the study area where the data collection process has passed. Stages of the survey, the stage of installation measurements of stations. Through determine a specific intersection in the study area of the two-traffic volume mean work day as shown in Tables 1-4, also the data were collected for mean off day as shown in Tables 6-9. The traffic counting stations for all approaches have been computed by watching and calculating manual for one week at the same peak period. The type of vehicles is counted for all approaches in one week. The time is recorded for 15 minutes in two peak hours (7:00 - 9:00 A.M) for the mean work and mean off day of period, also the distance is measured by measuring tape where the length of the section is about (20m) in terms of distance measuring.

3.2. Peak Hour Factor (*PHF*)

Peak hour factor (*PHF*): is defined as the hourly volume divided by the maximum 15minutes rate of flow in the hour. Data collected the information the necessary field for this intersection by calculating the traffic volumes of the vehicles with all the information other essentials. Field data on traffic flow were collected (V/hr) units. By calculating traffic volumes, entering and leaving the intersection and Peak Hour Volume (*PHV*) as shown in Tables 5 and 10.

The calculation of traffic volumes was for every quarter of an hour of the critical hour Rate. Determination of the critical hour is due to the condition of the road and over two hours for mean day of one week [3].

4. DATA ANALYSIS

4.1. Data of Peak Hour Volume at Mean Work Day

The traffic volumes were collected in two hours shown in Tables 1 to 4. Mean Work Day for all approaches of intersection between (7:00 to 9:00 AM). The Tables below illustrate the field data was collected from the study area and the maximum volumes between (7:45 to 8:45), and Figures 2 to 3. By using Excel program were analyze to specify the peak hour factor(*PHF*). The (*PHF*) provides information on how the volume of traffic varies during peak hours. The following observations were made based on site analysis and traffic data.

Table 1. Traffic volume of Al-Moffreq street mean work day

Time	Through (Al-Jesser)				Left (Al-Taboo)		Right (7-Nessan)				Total
	Bus	PCU	M	p	Bus	PCU	Bus	PCU	M	P	
7:00-7:15	60	45	5	8	14	19	3	12	8	19	193
7:15-7:30	86	58	3	18	13	35	5	15	18	35	286
7:30-7:45	195	64	8	16	25	45	13	25	16	45	452
7:45-8:00	130	74	14	21	31	66	18	32	21	30	437
8:00-8:15	110	99	15	23	35	55	21	35	23	60	476
8:15-8:30	85	90	8	13	38	38	20	21	13	55	381
8:30-8:45	77	88	9	12	26	26	12	20	12	43	325
8:45-9:00	65	82	8	9	18	26	8	20	9	33	278

Table 2. Traffic volume of 7-Nessan street at mean work day

Time	Through (AL-Taboo)				Right (Al-Jesser)				Total
	Bus	PCU	M	p	Bus	PCU	M	P	
7:00-7:15	1	18	2	8	10	9	0	0	48
7:15-7:30	10	17	8	5	13	12	0	0	65
7:30-7:45	20	18	6	17	15	12	2	1	91
7:45-8:00	27	31	11	10	20	25	0	0	124
8:00-8:15	28	36	2	25	21	29	1	1	143
8:15-8:30	22	41	8	13	30	22	0	0	136
8:30-8:45	20	26	9	13	15	18	6	4	111
8:45-9:00	5	21	8	9	10	11	3	1	68

Table 3. Traffic volume of Al-Jesser street at mean work day

Time	Through (Al-Moffreq)				Left (7-Nessan+ Al-Jesser)				Right (Al-Taboo)				Total
	Bus	PCU	M	p	Bus	PCU	M	p	Bus	PCU	M	P	
7:00-7:15	55	35	2	3	5	3	5	4	12	0	0	0	124
7:15-7:30	50	45	5	0	8	4	5	8	10	2	2	1	140
7:30-7:45	95	60	0	0	12	6	9	9	15	5	1	1	213
7:45-8:00	110	89	6	4	18	9	12	4	22	6	0	0	280
8:00-8:15	145	80	0	0	25	10	16	10	25	8	0	0	319
8:15-8:30	109	77	0	0	28	12	15	15	26	10	4	2	298
8:30-8:45	92	60	4	3	15	8	10	13	25	5	0	0	235
8:45-9:00	67	64	0	0	9	7	7	8	14	4	0	0	180

Table 4. Traffic volume of Al-Taboo street at mean work day

Time	Through (7-Nessan+Al-Jesser)				Left (Al-Taboo)				Right (Al-Moffreq)				Total
	Bus	PCU	M	p	Bus	PCU	M	P	Bus	PCU	M	P	
7:00-7:15	10	10	4	2	0	2	0	0	14	11	0	0	53
7:15-7:30	12	11	2	1	0	4	0	0	13	14	0	2	59
7:30-7:45	15	25	1	1	1	4	1	2	25	15	4	5	99
7:45-8:00	18	31	0	0	5	7	0	0	31	20	7	6	125
8:00-8:15	20	35	2	2	0	9	2	3	31	24	4	8	140
8:15-8:30	30	38	2	0	1	3	1	3	35	32	3	10	157
8:30-8:45	22	26	0	0	2	4	0	0	35	22	2	5	118
8:45-9:00	12	18	0	0	0	2	0	0	16	12	3	4	67

For the Mean Work Day, as shown in the Figure 2, the maximum total traffic volume is (452 v per 15 min) in Al-Mofreq through direction, and in the other hand, the minimum total traffic volume is (48 v per 15 min) in 7-Nissan Direction. The process of data collection has gone through several stages in order to be accurate in the collection so that the representative sample.

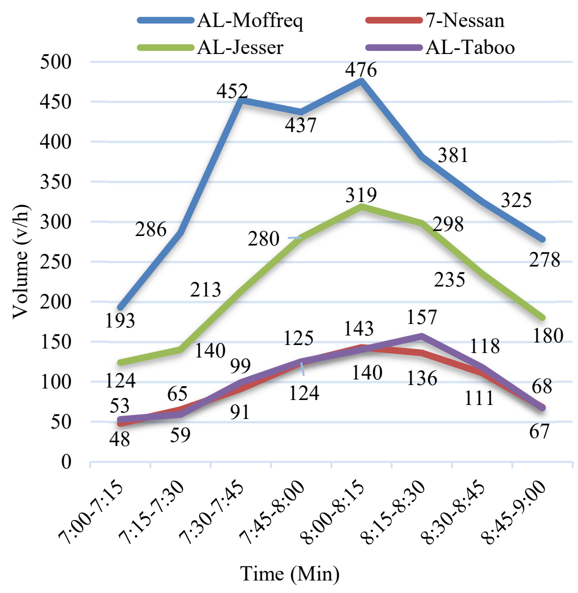

Figure 2. The Relationship Traffic Volume with the Time for all Approaches in Mean Work Day

For the Mean Off Day, as shown in the Figure 3, The relationship between the traffic volume with the time period for all approaches. Tables 6 to 9 are shown the maximum total traffic volume is (160 v per 15 min) in Al-Mofreq through direction, and in the other hand, the minimum total traffic volume is (7 v per 15 min) in 7-Nissan Direction.

Table 5. Result of peak hour volume in workday for all approaches

Approach \ Time	7:00-8:00	7:15-8:15	7:30-8:30	7:45-8:45	8:00-9:00	*PHF* (Mean Work Day)
AL-Jesser (V)	757	952	1110	1132	1032	0.887147
AL-Jesser (V15)	280	319	319	319	319	
AL-Taboo	336	423	521	540	482	0.859873
AL-Taboo V15	125	140	157	157	157	
AL-Moffreq V	1368	1651	1746	1619	1460	0.917
AL-Moffreq V15	452	452	476	476	476	
7-Nessan V	328	423	494	514	458	0.898
7-Nessan V15	124	143	143	143	143	

Table 6. Volume traffic of Al-Moffreq street at mean off day

Time	Through (Al-Jesser)				Left (Al-Taboo)				Right (7-Nessan)				Total
	Bus	*PCU*	*M*	*P*	*Bus*	*PCU*	*M*	*P*	*Bus*	*PCU*	*M*	*P*	
7:00-7:15	18	15	0	0	0	1	3	3	0	2	0	0	42
7:15-7:30	25	12	3	2	1	4	4	7	1	4	0	0	63
7:30-7:45	42	29	2	1	2	6	4	12	2	5	0	0	105
7:45-8:00	35	38	0	0	4	7	6	16	1	7	2	1	117
8:00-8:15	58	46	5	2	3	9	7	17	5	8	0	0	160
8:15-8:30	50	42	0	0	5	11	10	12	0	4	3	0	137
8:30-8:45	38	35	5	2	4	5	3	13	2	2	0	0	109
8:45-9:00	32	13	0	0	2	7	3	5	4	3	0	0	69

Table 7. Traffic volume of 7-Nessan streetat mean off day

Time	Through (AL-Taboo)				Right (Al-Jesser)				Total
	Bus	*PCU*	*M*	*p*	*Bus*	*PCU*	*M*	*P*	
7:00-7:15	0	3	1	3	1	2	0	0	7
7:15-7:30	1	3	3	4	1	2	0	0	13
7:30-7:45	1	8	5	6	2	5	0	0	27
7:45-8:00	3	15	6	8	5	8	0	0	45
8:00-8:15	9	12	5	10	3	10	0	0	48
8:15-8:30	8	12	6	8	2	12	0	0	48
8:30-8:45	1	7	5	3	1	7	0	0	27
8:45-9:00	0	4	2	3	0	4	0	0	13

Table 8. Traffic volume of Al-Jesser streetat mean off day

Time	Through (Al-Moffreq)				Left (Al-Jesser)				Right (AL-Taboo)				Total
	Bus	*PCU*	*M*	*p*	*Bus*	*PCU*	*M*	*P*	*Bus*	*PCU*	*M*	*p*	
7:00-7:15	6	14	0	0	0	0	1	0	0	2	0	0	23
7:15-7:30	8	13	0	0	0	0	1	1	1	2	0	0	26
7:30-7:45	10	25	1	1	2	3	0	0	1	5	4	3	55
7:45-8:00	25	31	0	0	1	4	2	1	3	8	7	4	86
8:00-8:15	34	35	3	1	3	1	0	0	2	9	4	0	92
8:15-8:30	30	38	3	2	2	4	0	0	2	13	3	5	102
8:30-8:45	28	26	0	0	1	6	0	0	1	4	2	7	75
8:45-9:00	13	18	0	0	0	2	0	0	0	7	3	1	44

Table 9. Traffic volume of Al-Taboo streetat mean off day

Time	Through (7-Nessan+AlJesser)				Left (Al-Taboo)				Right (Al-Moffreq)				Total
	Bus	*PCU*	*M*	*p*	*Bus*	*PCU*	*M*	*p*	*Bus*	*PCU*	*M*	*p*	
7:00-7:15	0	2	0	0	0	2	0	2	0	3	0	0	9
7:15-7:30	1	1	2	1	2	4	0	3	1	4	0	0	19
7:30-7:45	2	4	0	0	1	4	0	5	0	6	1	1	24
7:45-8:00	4	5	1	1	4	7	3	8	4	8	0	0	45
8:00-8:15	3	6	2	1	2	9	2	9	0	9	2	1	46
8:15-8:30	4	3	0	0	2	3	2	3	4	12	0	0	33
8:30-8:45	0	2	1	3	1	2	0	2	4	3	0	0	18
8:45-9:00	2	4	0	0	0	4	0	4	2	3	0	0	19

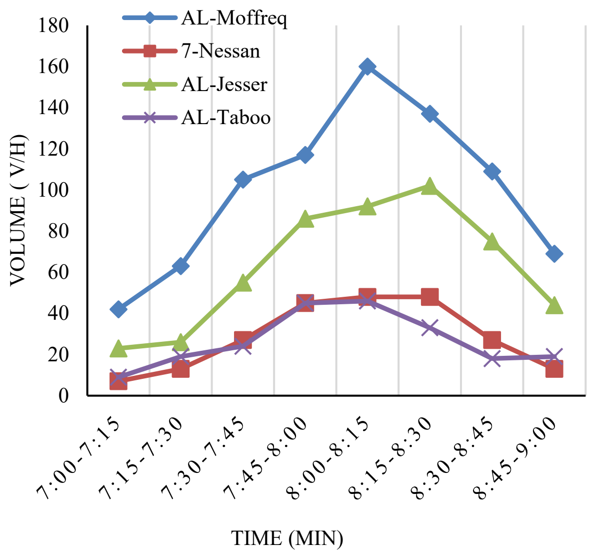

Figure 3. The Relationship Between the Traffic Volume with the Time Period for all Approaches in Mean Off Day

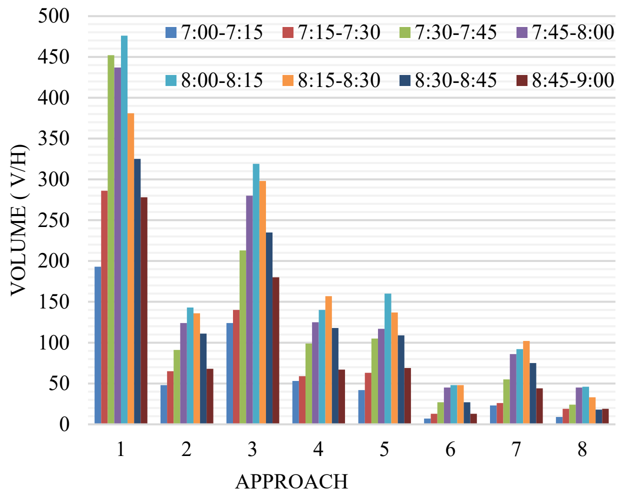

Figure 4. The Comparison between the Traffic Volume with the Time Period for all Approaches in Mean Work and Off Day

Table 10. Result of peak hour factor for all approaches off day

Approach \ Time	7:00-8:00	7:15-8:15	7:30-8:30	7:45-8:45	8:00-9:00	*PHF* (mean off day)
AL-Jesser (*V*)	190	259	335	355	313	0.87
AL-Jesser *V*15	86	92	102	102	102	
AL-Taboo	97	134	148	142	116	0.804
AL-Taboo *V*15	45	46	46	46	46	
AL-Moffreq *V*	327	445	519	523	475	0.817
AL-Moffreq *V*15	117	160	160	160	160	
7-Nessan *V*	92	133	168	168	136	0.875
7-Nessan *V*15	45	48	48	48	48	

Table 11. Compare result peak hour factor for mean work day and mean off day

No.	Approach	*PHF*		Increasing %
		Mean Work Day	Mean Off Day	
1	Al-Moffreq	0.917	0.817	11%
2	7-Nessan	0.898	0.875	2.5%
3	Al-Jesser	0.887	0.870	2%
4	Al-Taboo	0.859	0.804	6.5%

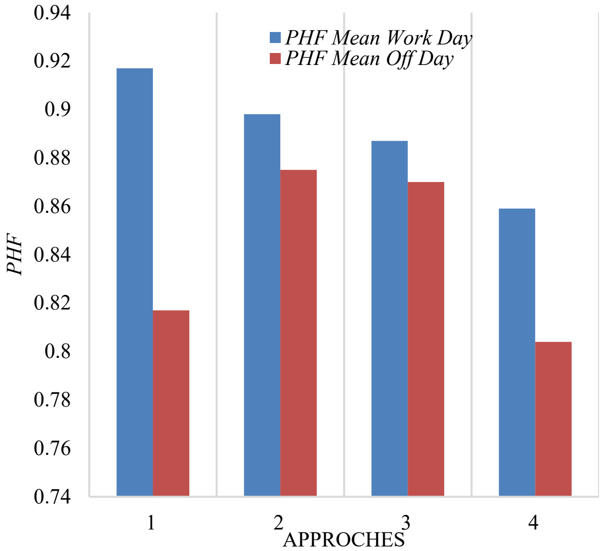

Figure 5. Peak hour factor for mean work day and mean off day for all approaches

The (*PHF*) provides information on how the volume of traffic varies during peak hours. The tables below illustrate the collected data from the study area, which were analyzed to determine the (*PHF*) as shown in Tables 5 and 10. The following observations were made based on site analysis and traffic data:

For the case Mean Work Day, as shown in the Figure 4 and Table 5, the maximum total traffic volume is (1746 v/h) in Al-Mofreq Direction, and in the other hand, the minimum total traffic volume is (328 v/h) in 7-Nissan Direction the present of increase 18 time.

For the results in Table 10, shows the calculated the peak hour factor in Mean Off Day for all approaches also in Table 11 and figure 5 are shown the *PHF* for Mean Work Day ranged between 0.917 and 0.859, and the *PHF* Mean Off Day ranged between 0.875 and 0.804.and the increasing ranged between (11-2 %).

The data is closed to the reality of the traffic situation and its various activities in the study area where the data collection process has passed. Stages of the survey, the stage of installation of stations, the stage of measurements.

5. CONCLUSIONS

In this paper showed that *PHF* has a strong influence on traffic investigation effects. The public training is to use a default value suggested by general or local procedures or to use partial field notes. This paper studies the changeability of *PHF* over period and crossways places. The documents of the existing study at the intersection are concluded the volume in through direction increasing 18 time from the other directions (left and right) in intersection. The *PHF* is good indication for working the intersection between mean workday and Mean off Day also, The *PHF* for Mean Work Day ranged between 0.917and 0.859 and the *PHF* Mean off Day ranged between 0.875 and 0. 804.The increasing 11%. The peak period between 7:45 to 8:45 for all approaching and given maximum volumes of vehicles.

NOMENCLATURES

1. Acronyms

M	Motor cycle
1,2,3,4	No. Approaches of Intersection workday
5,6,7,8	No. Approaches of Intersection Mean off day

2. Symbols / Parameters

P: Pickup
PCU: Passenger car unit
PHF: Peak Hour Factor
PHV: Peak Hour Volume
*V*15: Volume at Peak 15 Minute
V: Volume

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