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LEVEL OF SERVICE FOR USING COMPUTER SIMULATION TRANSYT NETWORK SOFTWAREOF INTERSECTION

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ABSTRACT

This paper determines the coordination system pattern of traffic signal for four intersections in Cheras town at Malaysia. The data required for the study were mainly collected through video filming technique during the peak hour. Besides, the calculation and evaluation were constructed with simulation model software Traffic was used to evaluate the possible coordination of both signalized intersections. The calibration of delay, queues and journey times were practically measured. The results showed that the value of delay, journey time, and stops were reduced the before optimization from (F) LOS after optimization to (C) with performance index (PI). Simulation helps decision makers identify different possible options by analyzing enormous amounts of data. Hence, it can be used effectively to analyze traffic flow patterns and signal light timing at the traffic congestion.

مستوى الخدمة باستخدام محاكاة الحاسوب ببرنامج ترانزيت للتقاطع

الكلمات المفتاحية

:تحسين ،ترانزيت ، التقاطع ،المحاكاة ، مؤشر الاداء

الخلاصة

تحدد هذه الدراسة نمط تنسيق إشارات المرور لأربعة تقاطعات في مدينةشيرازفي ماليزيا. وقد تم جمع البيانات اللازمة للدراسة بصورة رئيسية من خلال تقنية تصوير الفيديو خلال ساعة الذروة. الى جانب ذلك، تم استخدامنموذج المحاكاة في تنسيق التقاطعات بالاشارات الضوئية. تم قياس معايرة،التأخر، الطوابير واوقات الرحلة عمليا. أظهرت النتائج أنخفاض قيمة التأخير، وقت الرحلة، والتوقف وقد تغير مستوى الخدمة من **(F)** الى مستوى الخدمة **(C)**مع مؤشر الأداء **(PI).** المحاكاة تساعد صناع القرار في تحديد الخيارات الممكنة من خلال تحليل كميات هائلة من البيانات. و بالتالي فان ترانزيت يمكن ان يستخدم بصورة فعالة في تحليل انسيابية المرور واوقات الاشارات وتوقيت اضاء الإشارة المرورية**.**

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Introduction

The TRANSYT-7F is a microcomputer-based system. Mainframe support of the TRANSYT-7F Model itself has been discontinued; due to the considerable productivity improvements of PCs [1]. TRANSYT-7F is an acronym for TRAffic Network StudY Tool, version 7F. The original TRANSYT model was developed by the Transport Research Laboratory (formerly Transport and Road Research Laboratory) in the United Kingdom. TRANSYT, version 7 was "Americanized" for the Federal Highway Administration (FHWA); thus the "7F." The TRANSYT-7F program and the original TRANSYT-7F manual were developed for the Federal Highway Administration (FHWA) under the National Signal Timing Optimization (NSTOP) Project by the University of Florida Transportation Research Center (TRC).TRANSYT-7F is a traffic simulation and signal timing optimization program. The primary application of TRANSYT-7F is signal timing design and optimization [2].

TRANSYT-7F features genetic algorithm optimization of cycle length, phasing sequence, splits, and offsets.TRANSYT-7F is the only software package available that combines a state-of-the-art optimization process (including genetic algorithm, multi-period, and CORSIM optimization) with a state-of-the-art macroscopic simulation model (including queue spillback, platoon dispersion, and actuated control simulation). CORSIM is a program that performs microscopic traffic simulation of surface streets and/or freeways. CORSIM is sold separately within the TSIS package, which also includes TRAFED (graphical input editor) and TRAFVU (animation and static graphics viewer) [3]. CORSIM cannot optimize signal timing on its own, but recent versions of TRANSYT have been designed to work closely with CORSIM [4]. The primary qualities of the underlying macroscopic traffic model within TRANSYT-7F include detailed simulation of platoon dispersion, queue spillback, queue spillover, traffic-actuated control, and the flexibility to perform lane-by-lane analysis. In addition, while other models are limited to analyzing 4 or 5 intersection approaches, there is no practical limitation to the number of approaches that can be simulated by TRANSYT. Explicit handling of both right-hand and left-hand driving, as well as both English and metric units, allow TRANSYT to be used worldwide [3]. The primary qualities of the TRANSYT optimization process include the availability of multiple search techniques (hill-climb and genetic algorithm), numerous optimization objective functions (e.g., involving combinations of progression opportunities, delay, stops, fuel consumption, throughput,and queuing), extensive ability to customize the optimization process, and the ability to optimize all signalsettings (cycle length, phasing sequence, splits, and offsets)[4]. The current version of TRANSYT is dimensioned to accommodate a maximum of 99 intersections per data file. Although many cities contain more than 99 coordinated intersections, they are typically subdivided into much smaller coordinated sections, with small groups (or "clusters") of intersections coordinated with one another. The software can analyze a maximum of 7 "single-ring" signal phases per intersection, which is sufficient for modeling virtually any pre-timed or traffic-actuated control plan [4]**.**Three copies of each In addition to signalized intersections, TRANSYT-7F can explicitly simulate two-way stop-controlled (TWSC) intersections and yield-controlled intersections. All-way stop-controlled (AWSC) intersections and roundabouts can be modeled implicitly through their effects on platoon dispersion and signalized intersections, but measures of effectiveness (MOEs) for these intersections are not estimated or provided.

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Literature Review

The development of efficient signal timing plans for urban traffic networks has always been a challenging task for the traffic analyst. These networks can be quite complex in nature, serving a variety of vehicular and non-motorized users, and private as well as public transportation modes. Further, the performance of signal control strategies on such networks is quite difficult to predict due to the stochastic nature of traffic flows, as evident by day-today variations in traffic demand, vehicle composition and service times[5].

By extension, the production of signal control strategies that can effectively respond to such variations is also quite difficult to achieve. It is no coincidence, therefore, that signal timing methods are developed almost exclusively in macroscopic, deterministic traffic environments. For example, all the traditional Optimization models for isolated, signalized intersections cited infall in the category of macroscopic deterministic approaches [5]. Direct optimization in the context of this document refers to the use of a single, high-fidelity traffic model both for signal timing generation and for plan evaluation. Direct optimization provides a highly flexible environment for solving the signal timing optimization problem. Any measure (or combination of measures) of effectiveness produced by the model can be used. Link-based or network wide constraints can be incorporated, so can advanced signal control logic such as the designation of subnet works and double cycling. Finally, time dependent signal settings can be derived, as long as time dependent demands can be accommodated in the model [6]. The criteria for model selection include an ability to produce a realistic representation of the traffic environment, adequate model breadth to incorporate most urban traffic management features (e.g., parking, STOP control, bus stops and routes) and an ability to represent system variability both in time and space. In the U.S.A., the microscopic, stochastic CORSIM (1997) model is the closest one to meeting all these requirements. Further, CORSIM has a long history of acceptance by traffic professionals and support from the U.S.A Federal Highway Administration and State Departments of Transportation. Variations of this model have been used in the U.S. for over thirty years. While recognized as an excellent traffic simulator, CORSIM has no optimization capabilities. Therefore, an optimization interface with CORSIM is required in order to enable direct optimization [6]. Coordinating two or more signals on a signalized arterial requires the Determination of the following four signal-timing parameters to achieve the desired results or objectives: Cycle length, Green splits, Phase sequence or order, Offsets.

Providing or maintaining safe flow of traffic and pedestrian traffic at each signal in the system is very important. Engineers achieve this objective by selecting phase clearance times that satisfy minimum requirements based on operational needs and driver expectancy. In addition, engineers can coordinate signals to achieve one or more of the following objectives: Minimizing delay, Minimizing number of stops, Maximizing progression efficiency, Minimizing queue size at approaches and Maximizing system throughput.

All of the above objectives may not apply under a given set of geometric and traffic conditions. Even if they do all apply, it may not be possible to fully achieve all objectives simultaneously. Delay to vehicles at a link, for instance, is a function of how much time vehicles spend traveling on the link and the time they spend stopped in queue at a signalized approach. Neither of these delays can be completely eliminated. Thus, engineers desire to minimize this delay. They can minimize time spent waiting during a red phase by using a smaller cycle length, which produces less red time and shorter cycle-by-cycle queues. However, since a smaller cycle length also produces smaller green time, the number of stops to vehicles may increase. In addition to using a smaller cycle length, engineers can minimize delay by timing the lights such that the bulk of vehicles arrive during green. In minimizing delay, priority is given to the most significant traffic stream (through or cross street) flowing from an upstream signal to the downstream signal [7].

Maximizing progression, on the other hand, gives priority to arterial through traffic. Thus, it minimizes stops and delay to through traffic at the expense of cross street traffic, so it may not result in the lowest possible total delay. Signal timings providing maximum through progression are easily noticed and appreciated by drivers. The reason is that these drivers generally do not mind extra delay at minorapproaches, but they do not like a situation where they have to stop many times while traveling through on the arterial. On the other hand, drivers cannot easily notice differences in delay [7].

Optimization Procedure

Traditional TRANSYT optimization takes into account the reduced traffic flows due to queue spillback, unless the chosen performance index (PI) is PROS-only. All other PI's (besides PROS-only) consider delay, or throughput, or both. When maximizing throughput, the timing plan that maximizes the (reduced) traffic flows is recommended as optimal. When minimizing delay, the timing plan that maximizes the (reduced) capacity of each movement is recommended as optimal, because lower capacities produce higher delay estimates. Recent versions of TRANSYT-7F are capable of optimizing cycle lengths at uncoordinated intersections within the network, independent of the network background cycle length [7].It is also possible to optimize

Phasing sequence and splits at uncoordinated intersections. However, since phasing sequence optimization is mostly beneficial for improving progression, it is not always beneficial for uncoordinated intersections. The initial timing model, which corresponds with the initial timing "flag," is useful for instantly generating a reasonable and effective set of green times from scratch. Users typically request initial timing from TRANSYT-7F when the existing timing plan is unknown, or when they think the program may be able to develop an effective starting point for optimization The Objectives of this section are optimization: Introduce TRANSYT-7F model's background for traffic flow and his application on timing signal. , Connect traffic flow and timing signal to processes applies in TRANSYT- 7F [7]. The programmer structure was as shown in Figure 1.

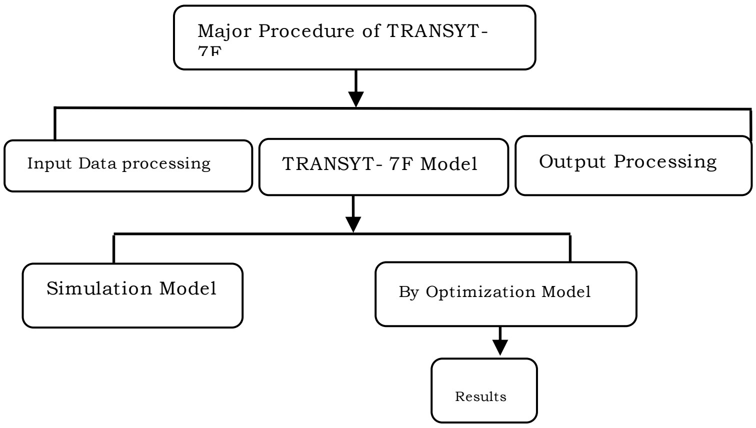

Figure .1 Structure TRANSYT-7F

Traffic Signal Optimization

TRANSYT-7F is a macroscopic traffic simulation program and signal timing optimization tool. This tool primarily considers platoons of vehicles and utilizes platoon dispersion model [8]. This model considers the spreading out of platoons as they travel downstream. For traffic signal optimization, TRANSYT-7F suggests the following steps for best results: Cycle length, Phase sequences and offset simultaneously, Green splits and offset simultaneously.

Default Traffic Volume

The default traffic volume for each turning movement is specified here. Later on the user will need to code the correct hourly traffic volumes on the edit Lanes screen, or the edit Traffic screen. Hourly volumes (vph) are typically specified, even if the duration of analysis is only 15 minutes. An option is also available (through Options Preferences) to specify volumes in units of vehicles per time period (vpp). Refer to the Preferences Screen section of the documentation for more details [8].

Default Peak Hour Factor

The default peak hour factor (PHF) for each turning movement is specified here. Later on the user need to code the correct peak hour factors on the edit Lanes screen. When the peak hour factor is lower than 1.00, it implies that the user wishes to model the peak period within the hour, which experiences a somewhat higher flow rate than the hourly volume would indicate. It is usually calculated using the following formula [8]:

$$\mathrm{PHF} = \frac{HourlyVolume(vph)}{4*(peak\,15\min uteVolume)}$$

The peak hour factor should be coded as 1.00 under the following conditions: the duration of analysis is 60 minutes or more,multi-period analysis and volumes are being specified inunits of vehicles per time period (vpp)[9].

Data Requirement

The data required for this study are: Traffic flow at each junction in AM and PM peak hour with vehicle classification, Queue length in majorroad, Control delay at intersection, Speed and Travel time between intersections.Besides the data listed above, network charactering data such as geometric data, number of lanes, distance between two nodes and traffic light cycle time in each approach will be used in the software.

Data Collection

Each plan timing must be done assessment by using different requirement level in different period in a single day. Plan timing could be developed in three period times according to need traffic namely morning peak hour, evening peak hour (PM) and off peak hour. Plan timing most suitable be selected on the basis of results from engineering field aspect and cater to need traffic majority which might.

Field data collections were carried out at selected site using three types of equipment which are video camera, character generator and trumeter, Video camera is one of the methods for traffic data collection. However, one particular difficulty with the method is in finding a suitable vantage point with good visibility to acquire the data. Consequently, this problem contributes to the major factor affecting the type of data obtained at the site. This equipment is then attached with character generator, which is an external time device in order to provide a permanent record of stopwatch. While trumeter is used to measure distance between thirteen intersections that function as a marker for distance the passage of vehicles. Morning peak hour determined at 7.30 in the morning - 9.30 mornings because at that time, road users enter Cheras town to be working. At 11.30 in the morning - 1.30 evenings, vehicleare many because then is lunch and rest time of workers. Evening peak hour in 4.30 evenings - 6.30 evenings also determined on past time reason work. Consumer's road gets out of town Cheras and returned to respective destinations. Evening peak period notice at is earlier study site than usual because field research had been undertaken in Fast month. Within 9.30 mornings - 11.30 morning and 1.30 evenings - 4.30 evenings, vehicle is less that because of the time was working hours. Then, these periods categorized as external time peak.

Data Extraction

The videotapes from the study site were initially played back to retrieve the relevant data. The data used for this study need to be separated between peak and off peak hours. For every lane, vehicle classification and time at specific distance were recorded to complete a cycle.[10] Then the process was repeated until the total numbers of 44 vehicles for sample data were achieved. This process necessitates full attention in order to get precise data from each vehicle.

Study Area

The location and intersections of the study area is as shown in Figure 2 which is located at the Cheras of Kuala Lumpur. Cheras region is one of the most important urban areas in KL is busy traffic areas, especially in peak hours, one of the more developed regions the population in Malaysia. Thirteen intersections in Cheras and with more traffic congestion and have found that some intersections need to be regulated on the timing of traffic signals and coordination of traffic signals, particularly some of the convergent and give sufficient time to time the length of the session and the division of the optimum time for the session.

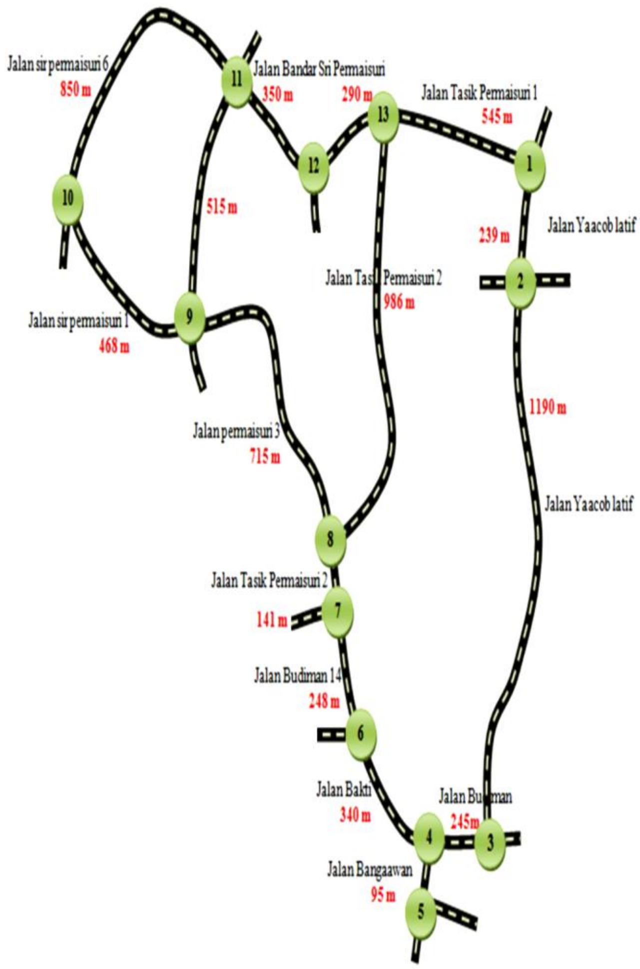

Figure 2. Location study area in Cheras

Data Processing and Analysis

The extracted data on the vehicle movement were stored in Excel spreadsheet. The data were analyzed for total volume of peak hour movement and convert to Percentage Car Unit (PCU).[11] The PCU is based on the official document (13/87) as shows in Table 1. Contains a methodology for analyzing the capacity and level of service (LOS) of signalized intersections. The analysis must consider a wide variety of prevailing conditions, including the amount and distribution of traffic movements, traffic composition, geometric characteristics, and details of intersection signalization.[11]

Table 1.: Conversion factors to pcu's [12]

Type Of Vehicle	Factor
van	1
car	1
Motor cycle	0.33
Bus	2
Heavy lorry	2.5
Light lorry	1.5

The methodology focuses on the determination of LOS for known or projected conditions. The methodology also addresses the capacity, LOS, and other performance measures for lane groups and intersection approaches as well as the LOS for the intersection as a whole. The capacity is evaluated in terms of the ratio of demand flow rate to capacity (v/c ratio), whereas LOS is evaluated on the basis of control delay per vehicle (in seconds per vehicle). Control delay is the portion of the total delay attributed to traffic signal operation for signalized intersections. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.

Level of Service (Los)

The average control delay per vehicle is estimated for each lane group and aggregated for each approach and for the intersection as a whole. LOS is directly related to the control delay value. The criteria are listed in Table 2.

Table 2. Los criteria for signalized intersections [12]

Type Of Vehicle	Factor
A	≤ 10
B	> 10-20
C	> 20-35
D	> 35-55
E	> 55-80
F	> 80

Results and Discussion

The Plate 3 below illustrates a sample New File dialog screen, asrendered by the T7F10 graphical user interface (GUI).[13].

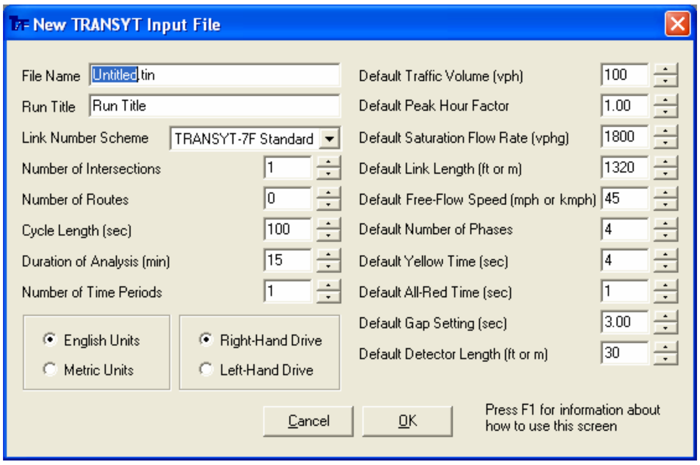

Plate 3. Typical new file dialog screen

Map View

A map rendering screen (Map View) is available for displaying network geometry, and editing network input data. As show in Plate 4. Use of the Map View is optional because input data can be coded on the other edit screens and because node coordinates do not affect results from the model. However the Map View may allow the user to better understand the data entry process, which could indirectly improve results from the model, and may assist in explaining the model to unfamiliar parties. In addition, the ability to display input and output data on the map can be useful for verification and validation of the model.

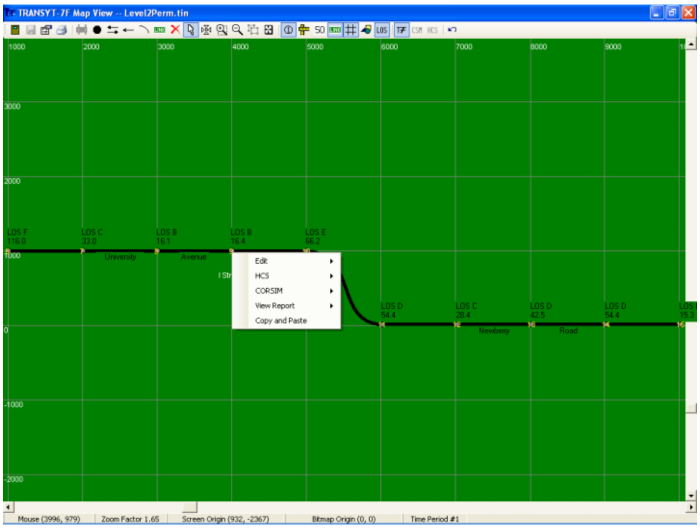

Plate 4. Typical map views

Lane Configuration

This input screen establishes lane channelization and usage for the traffic network is show in Plate 5. It can also be used to establish saturation flow rates, link lengths, traffic volumes, and turn pocket lengths. It is for most traffic network analyses [13].

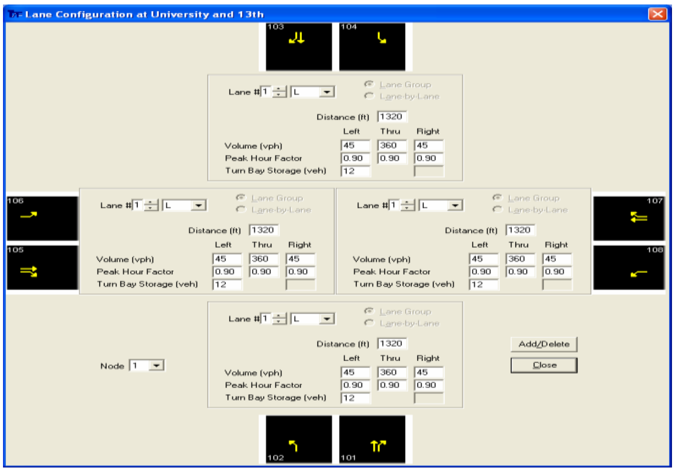

Plate 5. Typical lane configurations

Lane Configuration

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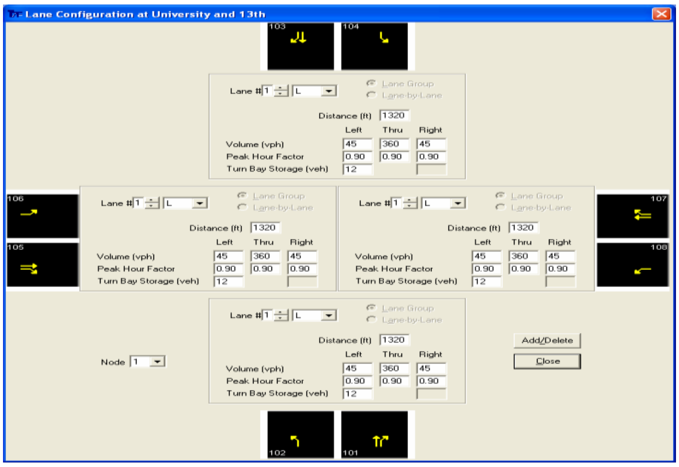

Plate 6. Typical lane configurations

Traffic Screen

Traffic volume is typically specified in units of vehicles per hour, regardless of theduration of simulation. This volume is specified as the total number of vehicles,including heavy vehicles. Later on, the saturation flow rate (and queuing headways)can be used to reflect the percentage of heavy vehicles in the analysis. Traffic volumeis specified as the desired input demand, and not necessarily the number of vehiclesdischarged. The Traffic screen is show in Plate 6.

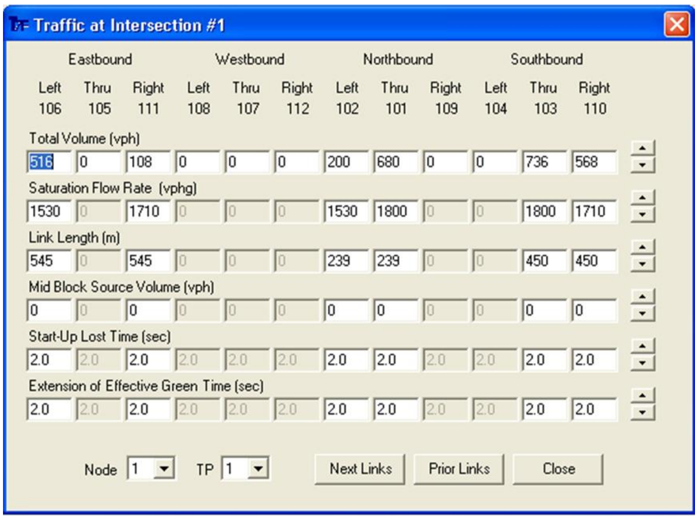

Plate 7. Typical Traffic screens

Timing View Screen

The Timing View screen allows graphical coding and viewing of signal timing plans,with features such as the "phasing diagram" and "bar diagram". Is show in Plate7.There are also "spinners" available for quickly coding interval durations, and aprominent display of the split durations, where a split is defined as the summation ofgreen, yellow, and all-red interval durations.[13].

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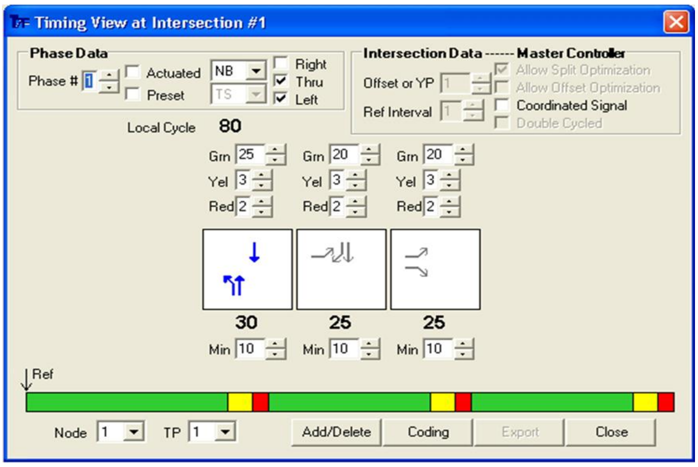

Plate 8. Typical timing view screens

Analysis Screen

At this stage, it is possible to proceed to the Edit Analysis screen is illustrated inPlate 8. To specify run instructions. The screen below indicates single-cycle stepwisesimulation, with the typical analysis period of 15 minutes. The initial timingflags should be deactivated so that the coded timing plan can be explicitly simulated.The disutility index is selected as the objective function for any upcoming Optimization runs [13].

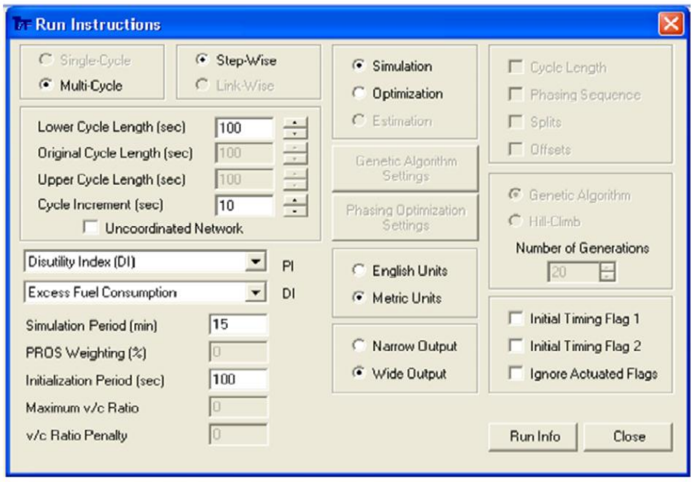

Plate 9. Typical analysis screens

At this time, after saving the data on the Analysis screen, we be possible to runTRANSYT but with getting some errors like omissions on the Lanes, Traffic,Timing, or Feeders screens. After the correction data we can got possible to runTRANSYT without getting any fatal errors.[13].

Result of the Software TRANSYT- before Optimization

A product (output) of this software application would be produced after all of the input dataachieved, analyzed, grouped and included in software. This product will giving valueperformance index (PI) minimum. Which account a technique iteration and gradient search which required numerical computation using the computer optimization procedure would be tabled in followingsection. Interpretation and analysis based on product (output) process result TRANSYT-7Foptimization the result of software before optimization, It is shownus level service for every intersection and delay. Most of all intersection need to optimizationof level service has shown us at figure 10.

```
    SYSTEM-WIDE PERFORMANCE: ALL NODES
    ----------------------------------
                                               System
 Performance Measures    Units                 Totals
 ------------------------------------------------------
 Total Travel            veh-km/hr              1228
 Total Travel Time       veh-hr/hr              3715
 Total Uniform Delay     veh-hr/hr               625
 Total Random Delay      veh-hr/hr              2860
 Total Delay             veh-hr/hr              3485
 Average Delay           sec/veh               450.8
 Passenger Delay         pax-hr/hr              4182
 Uniform Stops:          veh/hr                21759
                         %                        78
 Random Stops:           veh/hr                10506
                         %                        38
 Total Stops:            veh/hr                32265
                         %                       116
Degree of Sat > 1        # of links               17
Queue Spillback          # of links               14
Time Jammed              %                         3
Period Length            sec                     900
System Speed             km/hr                   3.3
Fuel Consumption         lit/hr                11401
Operating Cost           $/hr                  13740
Performance Index        DI                    3559.
-------------------------------------------------------
```

Figure 10. System performance at PM peak hour (Before optimization)

Figure 10.Illustrates the system performance, where average delay is 450.8 sec/veh. Thisdelay is used indicator of the level of service (LOS). The value reflects unstable conditions ofthe system. Another indicator performance index (PI) which is the performance index for theWhole rout, the value is 3559 the value is dependent on the term of delay. Table 4.2 showsthe summary of TRANSYT-7F results of all nodes (before optimization).[13].

The table shows value DI, travel time, fuel consumption and delay for all nodes during peak hour. The DI result for some nodes is similar some other. From the researchers observation one of the reasons for difference between nodes is related to the capacity of intersections. It is noted that, the capacity of intersection 1, 2, 3, and 4 are lower capacity of intersections thus there is some of deficiency for discharging of some intersections.[13].

Table 3. Summary of TRANSYT results of all nodes (before optimization)

Intersection no.	Delay (sec / veh)	Travel time (veh /- h)	DI	LOS
1	87.0	31.81	72.6	F
2	316.2	143.39	242.7	F
3	286.5	60.78	158.o	F
4	4056.7	88.16	1562.4	F
5	1009.7	96.71	315.6	F
6	155.6	87.07	69.3	F
7	54.3	21.23	24.4	D
8	16.9	7.71	13.7	B
9	151.7	7.35	126.5	F
10	37.0	19.07	34.3	D
11	136.3	39.89	102.1	F

Entry Data

Entry was made into TRANSYT by using (TRANSYT editor input) after grouping the data collection, the parameters and turnover selection related other information. All need data be included while parameter value other not obtained is follow default value existing in TRANSYT. This input file will be kidnapped for operation next level optimization. Shows the results of the entry of data after the optimization process has been improved levels of service at intersections after the entry of changes to the first results.

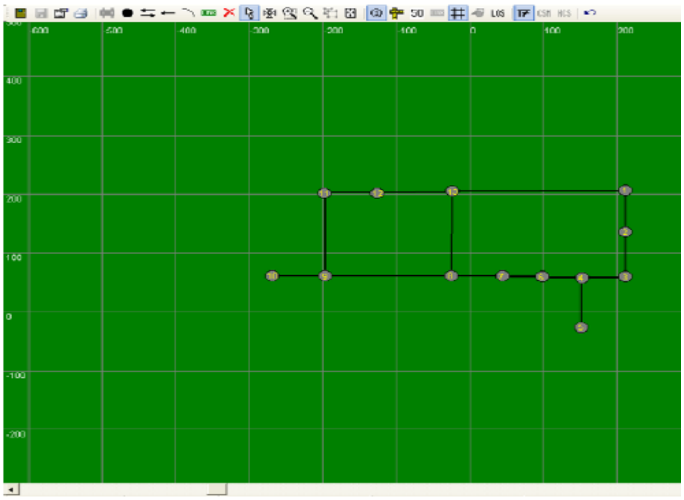

Plate 11. Typical map view show level of service after optimization

The Map View as show in Plate 11. Illustrates intersection delay and level of service, free-flow speeds, and the progression route all nodes after optimization. Focus Roadway Improvements on Safety and Congestion “Hotspots” at Intersectionsanother area of major emphasis is on improving the safety and efficiency of theregion’s critical intersections by making geometric improvements and improvingtraffic signals. These intersection projects are a higher priority than widening roadwaysegments and other roadway capacity increasing projects. The Plan also calls for theseprojects to incorporate transit, motorcycle and pedestrian environments, incorporatingthese elements where appropriate and feasible. Typical eligible Intersection proposalsare: Addition or upgrade of signals, Addition or widening of shoulders, Addition of turning or through lanes and Addition cycle time of signal[13].

Increase Cycle Time

Increase cycle time at intersection number 1, 2, 3, and 4. Level ofservice of some intersections has changed for the better after increasing the cyclelength and some intersections has changed performance index. This way is the bestway and cheaper cost to solve this problem[13].

Increase Lane

The other suggestion is add one lane to some intersections because it’s has increase intraffic flow like intersection number 2,3,4,5 to intersection number 11 from south tonorth on the side left (length=1550 m & width = 3.3 m).also increase lanes tointersection number 9, 11 from east and west (length=1200 m & width = 3.3 m) Theseare more expensive than change.

Add the Lane for Heavy Vehicles

A proposal to install priority bus lanes from intersection number 4 to intersectionnumber 9 the plan to ease congestion on the major arterials .This proposal wouldinvolve making the left lane along sections a bus lane and heavy vehicles during peaktimes. The proposal for Stud Road involves making the left lane along sections of theroad full-time bus lanes and heavy vehicles. Because this area is the commercial and Industrial area. Bus lanes are being introduced on key routes across to help improveservice reliability and travel times to keep traffic moving. Giving buses dedicated roadspace helps them avoid delays along their route.

Increase Lane Width

Increase lane width to intersection number 3, 5, 9 and 11 from all sides then hashanged performance index to better. The width of the lane was 2.4m changed to3.6m.

Table Traffic Performance

Various effectiveness measurement (measures of effectiveness, MOEs) traffic performance generated by TRANSYT-7F reported through Performance Traffic Table. This table may be printed for end signal performance after optimization only or both early sign before optimization and last signal after optimization. Product results for each link found in format product are such as journey average time, traffic total volume, degree of saturation, saturated flow rate, delay time number, delay average pervehicle, stop uniform (uniform stops), bans back maximum, load lined up, fuel consumption, printed. The index value uselessness (disutility index, DI) for each node also is reported. Chain networksummary produced indicated in Figure9. This summary tableincludes thesystemsoperations and performance index total cost (PI) network for plan timing signal which reportedly.

Performance table inside conclude in this study table 2. Found it isreasonable. MOE value to link which particular unreasonable may be caused dataentry mistake tolink on orthat datanot reflecting real situation on site exactly.From this studiesoutcome of decision may say the right and representing actual situation in study area.Signal plan timing for this network is won optimized. A conclusion table set forperformance early sign before last optimization and signal after optimization for thisstudy has shown such as Table 4. To be donefor further comparison.

Table 4. Shows us compare of level service before and after optimization

Intersection no.	Delay (sec / veh)	Travel time (veh /- h)	DI	LOS
1	87.0	31.81	72.6	F
2	316.2	143.39	242.7	F
3	286.5	60.78	158.o	F
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5	1009.7	96.71	315.6	F
6	155.6	87.07	69.3	F
7	54.3	21.23	24.4	D
8	16.9	7.71	13.7	B
9	151.7	7.35	126.5	F
10	37.0	19.07	34.3	D
11	136.3	39.89	102.1	F

Comparison of Result

A performance measurement set of values for network system were generated in Product after optimization process by TRANSYT-7F. Measurement comparison of Performance effectiveness for network system before and after able optimization shown as in Table 5.

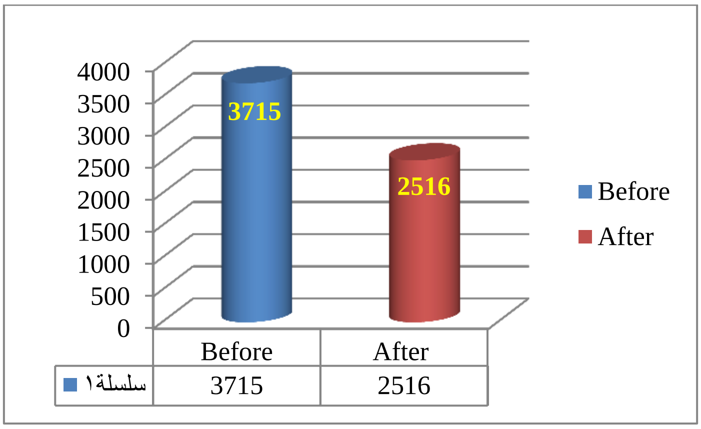

Figure (12) Relation between comparison total travel time before and after optimization

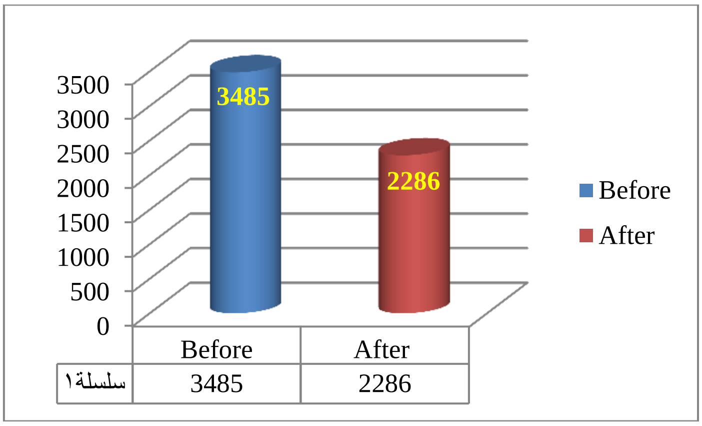

Figure (13) Relation between comparison total delays before and after optimization

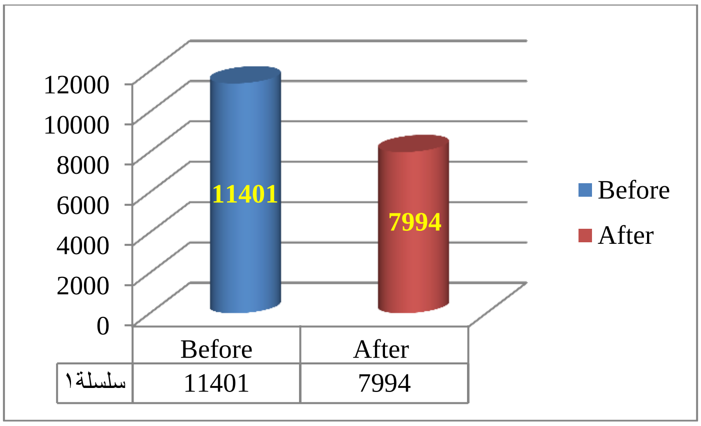

Figure (14) Relation between comparison fuel consumption before and after optimization

Table 5 .Measurement comparison of performance systems effectiveness before and after optimization.

Performance achievement	Before Optimization	After Optimization	Reduction and Increase % after Optimization
Journey time amount, hour	3715	2516	32.27%
Delay amount, hour vehicle/ hour	3485	2286	34.40%
Delay vehicle, second / vehicle	450.8	275.4	38.90%
Stop amount, vehicle / hour	32265	24957	22.65%
Saturated degree > 1, chain	17	7	58.82%
Queue spill back, chain	14	3	78.57%
System speed, km /hour	3.3	4.9	- 32.65%
Fuel usage, liter / hour	11401	7994	29.88%
Operation cost,$ /hour	13740	10117	26.36%

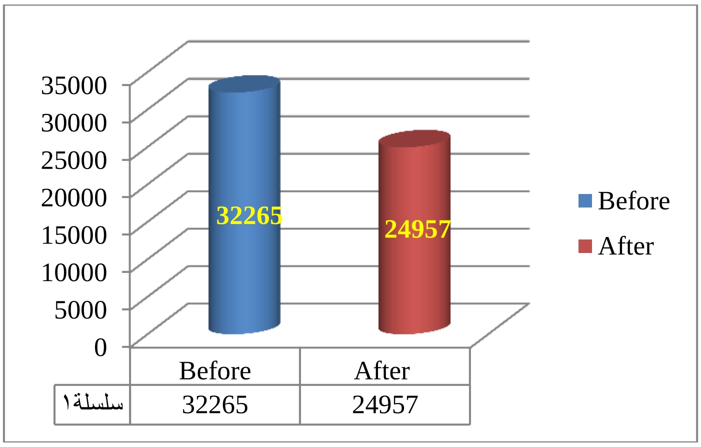

Figure (15) Relation between comparison total stops before and after optimization

Conclusions

The results from both studies before and after optimization of the TRANSYT revealed that the total travel time, total delay, average delay, total stops, degree of saturation, queue spill back, time jammed, fuel consumption, operation cost and performance index were on the reduction sides and the percentage varies (The lowest) and (The highest). There was also an increase in the total stops for the peak period for about a positive increase in the system speed for both scenarios and the percentage varies and depend on the traffic on the network road the effectiveness measurement forwhole system was formulated in traffic performance tables while detailed information of plan or plan timing in every junction also indicated in Signal Timing Tables TRANSYT. Optimization operation by TRANSYT in this study has succeeded in optimizing system network and PI value was reduced to a minimum value through theoptimum cycle time was selected in this study. Fuel and operating cost use were reduced in this study.

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