CAPACITY AND PERFORMANCE ANALYSIS OF SUAME ROUNDABOUT, KUMASI-GHANA

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Abstract

Roundabouts are an increasingly popular alternative to traffic signals for intersection control in the United States. Roundabouts have a number of advantages over traffic signals depending on the conditions. They reduce the severity of crashes since head-on and right-angle conflicts are nearly eliminated. They reduce through traffic speeds to provide a "calmer" roadway environment. They may consume less land area since turn pocket lanes are not needed and also have lower energy and maintenance costs.

This study analyzed capacity and performance of Suame roundabout in Kumasi, Ghana. Traffic and geometric data were collected on the field. The analysis revealed that Suame roundabout was operating at a level of service F, which represented worst conditions. Signalized intersection with 5 approach lanes was proposed to control all the movements. Exclusive pedestrian phases were proposed to protect pedestrians.

***Index Terms**: Performance analysis, Suame roundabout, Capacity analysis, Transportation network performance, Mampong Road*

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1. INTRODUCTION

As defined by the Federal Highway Administration [1], modern roundabouts are circular intersections with specific traffic control and design features. These features include yield control at entry, channelized approaches, and geometric approach curvature (deflection) to induce entering traffic to slow down to the design speed of the circulatory roadway. The crosswalks are set back from the intersection to minimize conflicts with turning vehicles. Roundabouts have characteristics that differentiate them from traffic circles, rotaries and traffic calming circles. Roundabouts have a proven safety record that is superior to other forms of traffic control [2 - 4]. Mampong Road is a very busy road and congested throughout the day. This can be due in part to the many commercial and social facilities abutting the road, attracting a lot of traffic. These include the Tafo cemetery, which is the largest public cemetery in Kumasi, the Tafo market and lorry station, which are located very close to the road, the auto mechanic workshops and schools [5]. The Tafo area is a densely populated area and most residents make return trips to Kejetia and its surroundings to work, trade and school. It is common to see vehicular queues moving at snail pace between the Tafo market and Suame roundabout during most times of the day [5]. Previous studies on the performance of the roundabout attributed the congestion critical capacity and abuse to motorists and/or pedestrians. As part of the recommendations, the report proposed to improve upon the signalization and capacity at Suame roundabout. They recommended that if at-grade capacity cannot be obtained for the minimum requirements, then a grade separation scheme should be constructed at the roundabout. This could either be a flyover or an interchange. The estimated cost of the project is about US$ 708,000 [5].

These recommendations have not been implemented due to lack of funds and therefore long queues and frequent delays still persist during peak hour conditions at the roundabout. It is in this light that this study was undertaken to analyze once again the capacity and performance of Suame roundabout in Kumasi to find out possible, cheaper and effective way of resolving the traffic congestion problem in the interim or short term basis.

2. METHODOLOGY

2.1 Site Selection and Description

Suame roundabout was selected based on its accident and safety records in the past and also the levels of congestion associated with the roundabout.

Suame roundabout has five (5) legs with two (2) approach/entry lanes and two (2) exit lanes on each leg as shown in Fig.1. It is the intersection of four (4) Principal arterials, namely: Mampong road, Okomfo Anokye road, Offinso road and the Western By-Pass road as shown in Fig. 1.

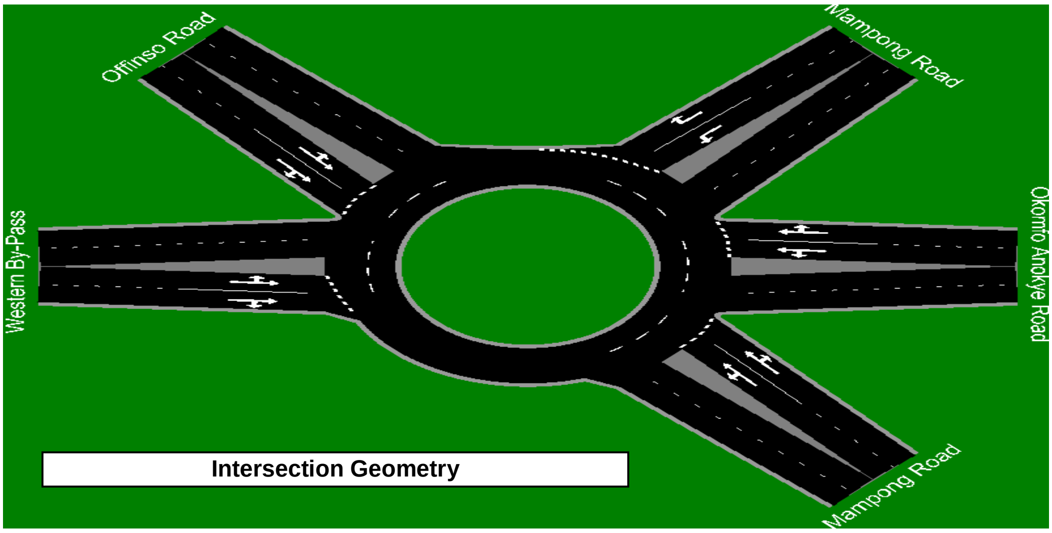

Fig-1: Geometry of Suame Roundabout; Source: BCEOM and ACON Report (2004)

2.2 Study Area

2.2.1 Mampong Road

The Mampong road is a North-South principal arterial, covering an urban (study) length of about 5 km, (from the Tafo Market to the Kejetia traffic light). The road is paved for the entire length and comprises both single carriageway, (about 70 percent), and two-lane dual carriageway about (30 percent). The single carriage way is from Tafo Market to about 250 meters from Suame roundabout, (about 3.5 km), and the dual carriage way is from Suame roundabout to Kejetia, (about 1.5 km). It is a very busy road, congested throughout the day. This can be due to the many commercial and social activities located along the road which in effect creates a lot of traffic. These include the Tafo cemetery, which is the largest public cemetery in Kumasi, the Tafo market and lorry stations, which are located very close to the road, the auto mechanic workshops and schools. The Tafo area is a densely populated area and most residents make return trips to Kejetia and its surroundings to work, trade and school. It is common to see vehicular queues moving at snail pace between the Tafo market and Suame roundabout during most times of the day.

2.2.2 Offinso Road

The Offinso road is a principal arterial that runs in a North-West/South-East direction. It covers an urban (study) length of about 3.3 km, (from the Breman junction to Suame roundabout). The road is paved for the entire length and comprises both single carriageway, (about 22 percent), and two-lane dual carriageway (about 78 percent). The single carriage way is from Breman junction to Suame New road intersection, (about 700 meters), and the dual carriage way is from Suame New road intersection to Suame Roundabout (about 2.6 km). The Offinso road is a very busy road that is used as the main travelling route to the Northern parts of Ghana. There is a lot of confusion, especially at the Suame New Road intersection where North bound traffic (towards Offinso), on the dual carriageway enters the single carriageway. The continuation of the dual carriageway from the Suame New Road intersection was still under construction at the time of the studies. Commercial drivers were seen using portions of the uncompleted dual carriageway within the intersection as lorry station. Breman Road intersection is normally controlled by Police personnel during the peak periods to ensure smooth and safe flow of traffic.

2.2.3 Western Bypass

The Western By-Pass is a principal arterial that runs in an East/West direction, (Suame Roundabout to Sofoline Roundabout) and North/South direction, (Sofoline Roundabout to Santasi Roundabout). It covers a distance of about 5.3 km, (from Suame Roundabout to Santasi Roundabout). The road is paved for the entire length and comprises both single carriageway (about 63 percent), and two-lane dual carriageway (about 37 percent). The single carriage way is from Sofoline Roundabout to Santasi Roundabout (about 3.4 km), and the dual carriage way is from Suame Roundabout to Sofoline Roundabout, (about 1.9 km). The road forms part of the Ring road.

2.2.4 Okomfo Anokye Road

The Okomfo Anokye Road is a principal arterial running mostly in a North/South direction (Anloga Junction to Airport Roundabout) and mostly in an East/West direction (Airport roundabout to Suame Roundabout). It covers a distance of about 6.4 km, (from Anloga Junction to Suame Roundabout). The road is a paved 2-lane dual carriageway (4-lane 2-way), over its entire stretch. The road forms part of the ring road and it provides a major vital link between the Western By-Pass, Mampong Road and Offinso Road and the 24th February Road. This vital link serves as a bypass route, especially for the North/South travellers of the country.

The intersections along this road are the main cause of bottlenecks on the road. The intersection controls are not good enough and driver indiscipline also compounds it. The Adukrom intersection experiences illegal U-turns within the intersection, which creates hazardous conditions for on-coming traffic. There are lots of delay and conflicting movements at the Asokore Mampong Road/Aboabo Road intersection. This is due to the existing phasing plan/signal timings. There is a lot of diverted traffic joining the Asokore Mampong leg from Buokrom to avoid the congestion at the Airport Roundabout. This makes the approach volume heavy as against a small green time allotted to it.

2.3 Basic Theoretical Background

One of the oldest and most well known cases of the use of simulation in theoretical research is the “car-following” analysis based on the Generalized General Motors (GM) models. In these models a differential equation governs the movement of each vehicle in the platoon under analysis [6]. Car-following, like the intersection analysis, is one of the basic equations of traffic flow theory and simulation, and the analysis has been active after almost 40 years from the first trials [7].The car-following theory is of significance in microscopic traffic flow theory and has been widely applied in traffic safety analysis and traffic simulation [8, 9]. There have been many car-following models in the past 60 years, and the models can be divided into two categories. One is developed from the viewpoint of traffic engineering and the other is based on statistical physics. From the perspective of traffic engineers [10], car-following models can be classified as stimulus-response models [11,12], safety distance models [13], psycho-physical models [14], and artificial intelligence models [15, 16].

The car-following theory is based on a key assumption that vehicles will travel in the center line of a lane, which is unrealistic, especially in developing countries. In these countries, poor road conditions, irregular driving discipline, unclear road markings, and different lane widths typically lead to non-lane-based car-following driving [17]. Heterogeneous traffic, characterized by diverse vehicles, changing composition, lack of lane discipline, etc., results in a very complex behavior and a non-lane-based driving in most Asian countries [18]. Therefore, it is difficult for every vehicle to be moving in the middle of the lane. Vehicles are positioned laterally within their lanes, and the off central-line effect results in lateral separations. However, to the limit of our knowledge, the effect of lateral separation in the car-following process has been ignored by the vast majority of models. A few researchers have contributed efforts on this matter. [17] first developed a car-following model with lateral discomfort. He improved a stopping distance based approach that was proposed by [13], and presented a new car-following model, taking into account lateral friction between vehicles.

[19] proposed a non-lane-based car following model using a modified full-velocity difference model. All the above models have assumed that drivers are able to perceive distances, speeds, and accelerations. However, car-following behavior is a human process. It is difficult for a driver of the following vehicle to perceive minor lateral separation distances, and drivers may not have precise perception of speeds and distances, not to mention accelerations.

2.3.1 Car-following Models

The logic used to determine when and how much a car accelerates or decelerates is crucial to the accuracy of a microscopic simulation model. Most simulation models use variations on the GM model. Although it was developed in the 1950s and 1960s, it has remained the industry standard for describing car-following behavior and continues to be verified by empirical data. A variation on the GM model is the PITT car-following model, which is utilized in FRESIM. The GM family of models is perceived to be the most commonly used in microscopic traffic simulation models and are, therefore, the focus of this article.

2.3.1.1Generalized General Motors Models

The first GM model modeled car-following is a stimulus-response process in which the following vehicle attempts to maintain space headway. When the speed of a leading vehicle decreases relative to the following vehicle, the following vehicle reacts by decelerating. Conversely, the following vehicle accelerates when the relative speed of the leading vehicle increases. This process can be represented by the first GM model, given equation 1.

$$\ddot{\chi}_F = \alpha_F \times \left(\dot{\chi}_L(t) - \dot{\chi}_F(t) \right) \qquad \text{Eq. (1)}$$

Where:

$\ddot{\chi}_F$ = acceleration of the following vehicle,

$\dot{\chi}_F$ = speed of the following vehicle,

$\dot{\chi}_L$ = speed of the leading vehicle,

α_F = sensitivity of the following vehicle, and

t = time.

2.3.1.2 PITT Car-following Model

FRESIM uses the PITT car-following model, which is expressed in terms of desired space headway, shown in the equation 2.

$$h_s(t) = L + m + kV_2 + bk[V_1(t) - V_2(T)]^2 \qquad \text{Eq. (2)}$$

Where:
hs(t) = desired space headway at time t,
L = length of leading vehicle,
m = minimum car-following distance (PITT constant),
k = car-following sensitivity factor for following vehicle,
b = relative sensitivity constant,
$v_1(t)$ = speed of leading vehicle at time *t*, and
$v_2(t)$ = speed of following vehicle at time *t*.

Equation above can be solved for the following vehicle's acceleration, given by the equation 3.

$$a = \frac{2\times\left[x - y - L - m - V_2(K+T) - bk(V_1(t) - V_2(t))^2\right]}{T^2 + 2KT}$$

Eq. (3)

Where:
a = the acceleration of the following vehicle,
T = the duration of the scanning interval,
x = position of the leading vehicle, and
y = position of the following vehicle.

2.4 Algorithm on Synchro/SimTraffic software

Simulation is basically a dynamic representation of some part of the real world achieved by building a computer model and moving it through time. The results obtained from any simulation model will be as good as the model replicates the specific real world characteristics of interest to the analyst.
Once a vehicle is assigned performance and driver characteristics, its movement through the network is determined by three primary algorithms:

2.4.1Car following

This algorithm determines behavior and distribution of vehicles in traffic stream. Synchro varies headway with driver type, speed and link geometry whereas SimTraffic generates lower saturation flow rates.

2.4.2 Lane changing

This is always one of the most temperamental features of simulation models. There are three types of lane-changing which includes

- Mandatory lane changes (e.g., a lane is obstructed or ends)
- Discretionary lane changes (e.g., passing)
- Positioning lane changes (e.g., putting themselves in the correct lane in order to make a turn): There is heavy queuing and this is a common problem for modeling positioning lane changes. Vehicles often passed back of queue before attempting lane change and their accuracy relates to degree of saturation and number of access points such as congested conditions which requires farther look ahead and densely-spaced access (i.e. short segments) which presents a problem.

2.4.3 Gap Acceptance

Gap acceptance affects driver behavior at unsignalized intersections, driveways (e.g., right-in-right-out) and right-turn-on-red (RTOR) movements. If default parameters are too aggressive, vehicle delay will be underestimated and there is serious implication for frontage roads. Conversely, parameters which are too conservative may indicate need for a signal when one isn't necessary. Gap acceptance parameters are network-wide in SimTraffic.

2.4.4 Turning movement counts

Data was collected manually at Suame roundabout because it was difficult getting good elevation observer positions. Turning movement counts were collected between 0600hours and 1800 hours during the morning and evening peak periods of the day at the roundabout. Two enumerators each were positioned on each leg of the approach to the roundabout. The number of vehicles entering and leaving any of the four principal arterials such as Mampong road, Okomfo Anokye road, Offinso road and the Western By-Pass road were counted using the vehicle number plate method. All the Turning movement counts were conducted at 15min intervals. Fig. 2 below is a sketch of the approaches at Suame roundabout.

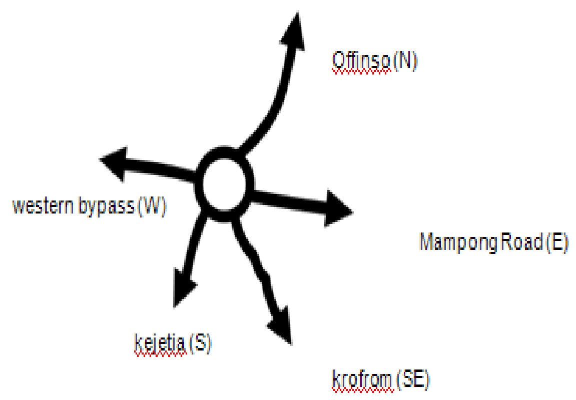

Fig-2: Sketch of the approaches at Suame roundabout; Source: from study

2.4.5 Intersection Capacity analysis for Suame Roundabout

The Department of Transport of the UK recommends a research carried out by the Transport and Road Research Laboratory (TRRL) that predicts an equation for the determination of the capacities of roundabouts. The predictive equation for entry capacity into the circulatory area was used for entry capacity determination and is given by equation 4.

$$Qe = K^*(F - fc\ Qc) \qquad \text{Eq. (4)}$$

Where

Qe is the entry flow into the circulatory area in passenger car units per hour (pcu/hr)

Qc is the flow in the circulatory area in conflict with the entry flow in passenger car units per hour (pcu/hr).

$K = 1\text{-}0.00347(\phi - 30) - 0.978(1/r - 0.05)$

$F = 303X2$

$fc = 0.21tD(1+0.2X2)$

$tD = 1+0.5/(1+M)$

$M = \exp[(D - 60)/10]$

$X2 = v + (e - v)/(1+2S)$

$S = 1.6(e - v)/l'$

e = entry width (metres) - measured from a point normal to the rear kerbside

v = approach half-width: measured along a normal from a point in the approach stream from any entry flare

l′ = average effective flare length: measured along a line drawn at right angles from the widest point of the entry flare

S = sharpness of flare: indicates the rate at which extra width is developed within the entry flare

D = inscribed circle diameter: the biggest circle that can be inscribed within the junction

ϕ = entry angle: measures the conflict angle between entering and circulating traffic

r = entry radius: indicates the radius of curvature of the nearside kerb line on entry.

2.4.6 Intersection Capacity Analysis

The intersection Capacity analysis was performed using intersection capacity utilization (ICU) to determine the Level of service (LOS) at Suame roundabout. An initial analysis was performed for the existing rotary intersection to determine its performance. Once the ICU was fully calculated, the ICU LOS for the roundabout was subsequently calculated based on the criteria given by [20] Table -1.

Table -1: Intersection Capacity Utilization LOS and Grading Criteria

LOS	ICU (%)	Grading Criteria
A	≤ 55	Intersection has no congestion
B	55<ICU<64	Intersection has very little congestion
C	64<ICU<73	Intersection has no major congestion
D	73<ICU<82	Intersection normally has no congestion
E	82<ICU<91	Intersection is on the verge of congested conditions
F	91<ICU<100	Intersection is over capacity and likely experiences congestion periods of 15 to 60 consecutive minutes
G	1005<ICU<109	Intersection is 9% over capacity and experiences congestion periods of 60 to 120 consecutive minutes.
H	>109%	The intersection is 9% or greater over capacity and could experience congestion periods of over 120 minutes per day.

3. RESULTS AND DISCUSSION

3.1 Turning movement counts

Summary of total approach volume for each approach at Suame roundabout is shown in Table 2.

Table -2: Summary of Total Approach volume at Suame Roundabout

Approaches	Mampong	Offinso	Western bypass	Kejetia	Krofrom	Total
Mampong	0	60	249	302	189	800
Offinso	69	0	392	653	501	1615
Western bypass	389	236	0	245	587	1457
Kejetia	550	493	340	0	101	1484
Krofrom	195	335	399	56	0	761
Total	1203	1064	1131	954	1189	

Source: from study

It can be deduced from Table 2 that 26.4% of vehicles moved from Offinso to the other approaches at Suame roundabout. This was followed by 24.3% of vehicles from Kejetia, 23.8% of vehicles from Western bypass whiles 13.1% of vehicles moved from Mampong. Krofrom had 12.4% of vehicles moving to other approaches.

Hourly flow rate for the approaches at Suame Roundabout is shown in Table 3

3.2 Capacity Analysis

Table -3: Capacity calculations for Roundabout

Approaches	Hourly flow rate (veh/hr)
East Bound North (EBN), V_1	60
East Bound West (EBW), V_2	249
East Bound South (EBS), V_3	302
East Bound South East (EBSE), V_4	189
West Bound North (WBN), V_5	236
West Bound East (WBE), V_6	389
West Bound South (WBS), V_7	245
West Bound South East (WBSE), V_8	587
North Bound East (NBE), V_9	69
North Bound West (NBW), V_{10}	392
North Bound South (NBS), V_{11}	653
North Bound South East (NBSE), V_{12}	501
South Bound North (SBN), V_{13}	493
South Bound West (SBW), V_{14}	340
South Bound East (SBE), V_{15}	550
South Bound South East (SBSE), V_{16}	101
South East North (SEN), V_{17}	335
South East West (SEW), V_{18}	399
South East South (SES), V_{19}	56
South East East (SEE), V_{20}	195

Source: from study

From Table 3, it was realized that North Bound South (NBS), V11 had the highest hourly flow rate of 653veh/hr at Suame roundabout. This meant that 6533 vehicles traversed the north bound south direction in an hour. Similarly, South East South (SES), V19 had the lowest hourly flow rate of 56 veh/hr meaning 56 vehicles traversed the East Bound North direction within an hour.

Table - 4: Approach Flow at Suame Roundabout

Approach Flow (veh/hr)	Approach Volume, Va
$V_{a,E} = V_1+V_2+V_3+V_4$	800
$V_{a,W} = V_5+V_6+V_7+V_8$	1457
$V_{a,N} = V_9+V_{10}+V_{11}+V_{12}$	1615
$V_{a,S} = V_{13}+V_{14}+V_{15}+V_{16}$	1484
$V_{a,SE} = V_{17}+V_{18}+V_{19}+V_{20}$	985

Source: from study

Offinso approach (Va, N) had the highest approach flow of 1615veh/hr as shown in Table 4 at Suame roundabout. This meant that 1615vehicles came from Offinso in an hour. 1484veh/hr came from Kejetia approach (Va,S), followed by

Western bypass approach (Va,W) which had 1457veh/hr. Krofrom approach (Va,SE) gave 985veh/hr and Mampong approach gave a lowest approach volume of 800 veh/hr.

Table -5: Circulating flows at Suame Roundabout

Circulating Flow	Flow, Qc (veh/hr)	Flow in pcu/hr (x1.1)	Factored Flow (x1.125)
$Vc,E = V_1+V_2+V_3+V_4$	1859	2045	2301
$Vc,W = V_5+V_6+V_7+V_8$	1535	1689	1900
$Vc,N = V_9+V_{10}+V_{11}+V_{12}$	1770	1947	2190
$Vc,S = V_{13}+V_{14}+V_{15}+V_{16}$	1971	2168	2439
$Vc,SE = V_{17}+V_{18}+V_{19}+V_{20}$	2077	2285	2570

Krofrom approach (Vc,SE) had the highest circulating flow of 2077veh/hr at Suame roundabout, followed by Kejetia approach (Vc,S) which gave a circulating flow of 1971veh/hr as shown in Table 5. The Mampong approach (Vc, E) had a circulating flow of 1859veh/hr with Western bypass (Vc, W) having the lowest circulation flow of 1535veh/hr. Similarly, in terms of flow in pcu, Krofrom approach gave the highest flow of 2285pcu/hr and the Western bypass approach gave the least flow of 1689pcu/hr.

Entry capacity, circulating flow and reserve capacities for each approach at Suame roundabout is shown in Table 6.

Table -6: Entry capacity, circulating flow and reserve capacity for the approaches at Suame Roundabout

Parameters	Mampong	Western bypass	Offinso	Kejetia	Krofrom
Entry width, e	7.7	7.7	7.7	7.7	7.7
Approach Half width, v	7	7	7	7	7
Average Effective Flare Length, l’	15	15	15	15	15
Sharpness of Flare, S	0.07467	0.07467	0.07467	0.07467	0.07467
Inscribed Circle Diameter, D	78	78	78	78	78
Entry Angle, Φ	60	60	60	60	60
Entry Radius, r	60	60	60	60	60
M	6.04965	6.04965	6.04965	6.04965	6.04965
X_2	7.60905	7.60905	7.60905	7.60905	7.60905
tD	1.07093	1.07093	1.07093	1.07093	1.07093
fc	0.56714	0.56714	0.56714	0.56714	0.56714
F	2305.5418	2305.5418	2305.5418	2305.5418	2305.5418
K	0.9285	0.9285	0.9285	0.9285	0.9285
Qc	2301	1900	2190	2439	2570
Qe	929	1140	987	856	787

Source: from study

From Table 6, it was realized that the Krofrom approach had the highest circulatory flow of 2570pcu/hr at Suame roundabout. This meant that 2570 of the flow in the circulatory are was in conflict with the entry flow of 787. Western bypass had the lowest circulatory flow of 1900pcu/hr. This again meant that 1900 of the flow in the circulatory area was in conflict with the entry flow of 1140.

The flow to capacity ratios of each approach at Suame Roundabout is shown in Table 7.

Table -7: Flow to Capacity ratios at Suame Roundabout

Approaches	Circulating flow, Qc	Entry capacity (pcu/hr)	Entry flow (pcu/hr)	Reserve capacity (%)	Flow to capacity ratio
Mampong	2301	929	800	14	0.86
Western bypass	1900	1140	1457	-28	1.28
Offinso	2190	987	1615	-64	1.64
Kejetia	2439	856	1484	-73	1.73
Krofrom	2570	787	985	-25	1.25

Source: from study

It was realized again from the capacity analysis that Suame roundabout was at full capacity based on the overall volume to capacity ratio as shown in Table 7. The above flow to capacity ratios revealed that Suame roundabout was operating at a level of service F. Level of service F described a forced-flow operation at low speeds, where volumes were below capacity. These conditions usually resulted from queues of vehicles backing up a restriction downstream at the roundabout. Speeds were reduced substantially and stoppages occurred for short or long periods of time because of the downstream congestion. It represented worst conditions.

3.3 Intersection Capacity Analysis

Performance of Suame roundabout after capacity analysis is shown in Table 8

Table 8: Performance of Suame roundabout

Intersection	Control Type	v/c ratio	ICU %	ICU LOS
Suame Roundabout	Roundabout	3.48	157.9	H

Source: from study

The result from Table 8 showed that Suame roundabout was performing beyond capacity in that, the roundabout was 9% or greater over capacity and was experiencing congestion over 2 hours per day.

3.4 Signalisation and Improvement of Suame Roundabout

The proposed Geometry for Suame Roundabout is shown in Fig.3.

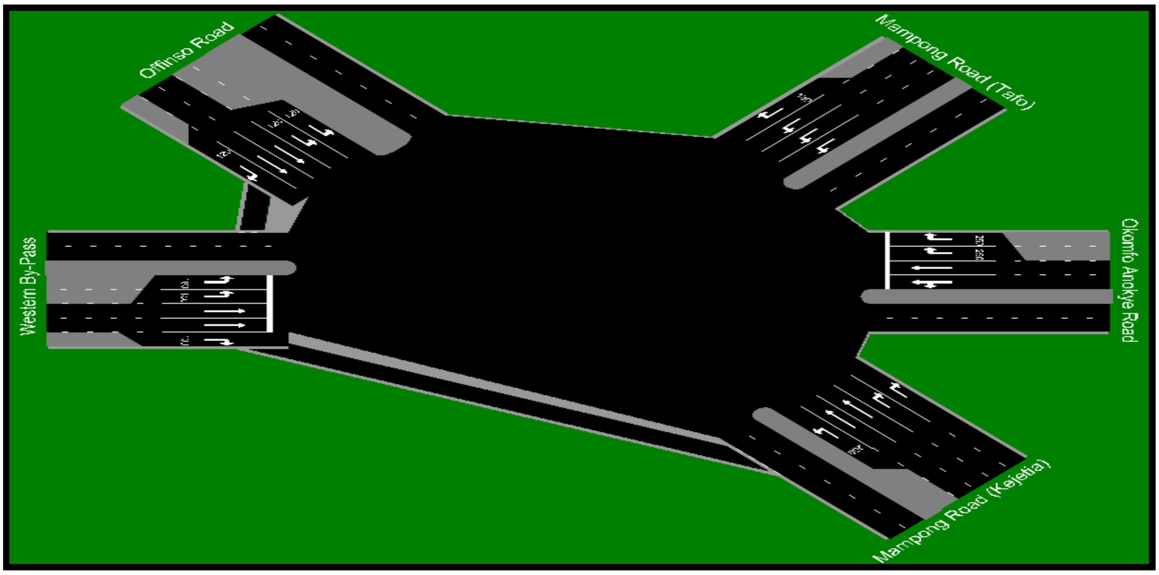

Figure 3: Proposed Geometry for Suame Roundabout; **Source**: from study

Signalized intersection with 5 approach lanes was proposed as shown in Fig. 3. The Suame roundabout signalization was basically to improve on vehicular movement. However, signalization was proposed considering the non-availability of funds. By critical and careful examination of the conditions, signalization of the Suame roundabout was proposed to control all the movements. The proposed geometric data in Table 9 when implemented will improve upon the performance of the intersection. The central island would be channelized to aid motorists to move from one approach to the other in order to prevent conflicts and enhance safety. Pedestrian movements would be separated in order not to interrupt the flow by considering the number of lanes at each approach to the roundabout. A pedestrian footbridge was thus proposed on all legs to the roundabout.

Table -9: Proposed Geometric Data for Suame Roundabout

Intersection: Suame Roundabout							
Movement	From (Area)	To (Area)	Veh/hr	% of Heavy vehicles	No. of Lanes	Lane width (m)	Storage Length (m)
EBL2		Offinso	306	7	1	4.0	180.0
EBL	Western Bypass	Mampong	404	26	1	3.3	180.0
EBT		Krofrom	813	4	2	3.3	
EBR		Kejetia	264		1	4.8	100.0
WBL		Kejetia	86				shared
WBT	Krofrom	Western bypass	738	3	2	3.3	
WBR2		Mampong	396	34	1	4.8	250.0
WBR		Offinso	627	3	1	3.3	250.
NWBL		Western bypass	528	15	1	3.3	200.0
NWBT	Kejetia	Offinso	861	4	2	3.3	
NWBR		Mampong	988	21	2	3.3	
NWBR2		Krofrom	143	14			shared
SEBL		Krofrom	851	10	2	3.3	120.0
SEBL2	Offinso	Mampong	93	13			shared
SEBT		Kejetia	1070	4	2	3.3	
SEBR		Western bypass	624	2	1	4.8	120.0
SWBL2		Krofrom	335	8	1	4.0	
SWBL	Mampong	Kejetia	613	6	2	3.3	
SWBR2		Offinso	80	6			shared
SWBR		Western bypass	356	13	1	3.3	180.0

Source: from study

CONCLUSIONS

Suame roundabout was performing at full capacity based on the overall volume to capacity ratio. Suame Roundabout should be signalized to control all the movements.

It is cheaper to implement the signalised intersection to control and alleviate vehicular movement than implementing the interchange. The central island should be channelized to enable motorists move from one approach to the other in order to prevent conflicts and enhance safety. A pedestrian footbridge should be constructed on all legs to the roundabout.

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