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The Effect of Geometric Factors on Saturation Flow at Selected Intersections of Kathmandu

by

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A THESIS

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ABSTRACT

The main objective of intersection design is to facilitate the convenience, comfort and safety of people traversing the intersection by enhancing the efficient movement of road users. The intersections on urban roads in Nepal generally cater heterogeneous motorized traffic, along with slow-moving traffic including pedestrians. It is therefore necessary to consider saturation flow for mixed traffic conditions to evaluate the overall operation of signalized intersections. This study focuses on analyses of saturation flow rate conducted at signalized intersections with mixed traffic conditions in selected intersection of Kathmandu, Nepal. Studies were carried out at 19 signalized junctions in Kathmandu with varying geometric factors such as width of road (w), gradient of road (g), and turning radius (r) for right turning vehicles. Saturation flow rate at first was computed as per Highway Capacity Manual (HCM: 2000). Then geometric factors, which affect the saturation flow, have been considered and accordingly a new model has been proposed for determining saturation flow. It has been shown that by the introduction of the suggested adjustment factors, the saturation flow rate can give better picture of the field conditions, especially under heterogeneous traffic conditions of an urban area.

Keywords

Saturation Flow, Signalized Intersection, Heterogeneous Traffic, Adjustment Factor

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APPROVAL

The undersigned certify that they have read and recommended to the Institute of Engineering for acceptance, a final thesis entitled "The effect of Geometric factors on Saturations Flow at Selected Intersections of Kathmandu" submitted by Gagan Dev Yadav (072/MST/256) in partial fulfillment of the requirements for the degree of Master of Science in Transportation Engineering, Nepal is a record of works carried out by him under my supervision and guidance.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

PCU	Passenger Car Unit
LOS	Level of Service
DOF	Degree of Freedom
HCM	Highway Capacity Mannual
TRL	Transport Research Laboratory
TRB	Transport Research Board
Km	Kilometer
m	Meter
m/s	Meter Per Second
s	Second
S.F.	Saturation Flow Per Hour
RT	Right Turning Radius
W	Width of Approach Lane
T	Effective Green Time
G	Gradient of Approach Lane
DoR	Department of Road

CHAPTER ONE: INTRODUCTION

1.1 Background

The growth of traffic in the road network of cities in developing countries, like Nepal, is a serious concern from the traffic engineer's point of view. In developing countries like Nepal, road traffic in general and urban roads traffic is highly heterogeneous, comprising vehicles of widely varying static and dynamic characteristics. Further, the vehicles have the same road space without separate lanes. Knowledge of basic traffic flow characteristics like traffic volume under such heterogeneous conditions is fundamental, since traffic volume is the basic input variable in planning, designing and operation of roadway systems.

The saturation flow required to calculate the capacity of a signalized intersection can be obtained in two ways. First approach involves conducting field studies to measure saturation flows at intersections of interest. In this approach, capacity influencing factors are empirically included, and the measured saturation flows represents the capacity of the intersections under the existing conditions.

The second approach involves the use of "base saturation flow values," such as theoretical maximum values. These base values can be than adjusted to account for the physical and operating conditions of the intersections, approaches being analyzed and used in intersection capacity studies. The assumption implicit in the use of base flow rates in capacity studies is that quantifiable relationships exist between saturation flows and the physical and operating characteristics of signalized intersections.

Signalized intersections use a common form of traffic control to address roadway operations. Signalized intersections allow road users to access new streets and change in the direction of travel. Intersections should be able to serve their varying traffic demands, cause minimum delay in passage, and maximum safety to all types of users especially pedestrians. One generally evaluates the functioning of a typical signalized intersection in two parameters: 1) capacity, that is, volume to capacity (v/c) ratio, and 2) the level of service (LOS), with its delay and queue ranges. These parameters are functions of traffic volume characteristics, signal characteristics and geometry of the intersection. One evaluates the capacity on the concept of saturation flow, whereas, LOS is measured based on the delay that a user experiences, while crossing an intersection.

1.2 Flow Characteristics

Traffic flow in itself is a very complex phenomenon: the complexity results from the mutual interaction of various factors: vehicular, human, road and environment. The flow of traffic comprises two major components; namely the road users (drivers) and the vehicle. Both have their unique characteristics and hence the nature of the flow is governed by the range of variation of driver (human) and vehicular characteristics. Various factors like speed and volume are directly influenced by the intersection between above mentioned component of stream. Traffic flow modeling attempts to explain the various phenomena associated with the flow of traffic.

1.3 Intersection

Intersection is an area shared by two or more roads. This area is designated for the vehicles to turn to different directions to reach their desired destinations. Its main function is to guide vehicles to their respective directions. Traffic intersections are complex locations on any highway. This is because vehicles moving in different direction want to occupy same space at the same time. In addition, the pedestrians also seek same space for crossing. Drivers have to make split second decision at an intersection by considering his route, intersection geometry, speed and direction of other vehicles etc. A small error in judgment can cause severe accident. It also caused delay and it depends on type, geometry and type of control. Overall traffic flow depends on the performance of the intersections. It also affects the capacity of the road. Therefore, both form the accident perspective and the capacity perspective, the study of intersection is very important for the traffic engineers in the case of urban scenario.

Traffic signals are a common form of traffic control used to address roadway operations. They allow the shared use of road space by separating conflicting movements in time and allocating delay. The can also be used to enhance the mobility of some movements. Traffic signals play a prominent role in achieving safer performance at intersections. Research has shown that, under the right circumstances, the installation of traffic signals will reduce the number and severity of crashes. But inappropriately designed and/or located signals can have an adverse effect on traffic safety, so care in the placement, design and operation is essential.

1.3.1 Classification of Intersection by Traffic Control

Unsignalized Intersections

Unsignalized Intersections are of particular concern because there are so many of them in the roads of Kathmandu Valley as a sufficient number of road crashes in such areas indicate a need to improve safety. Unsignalized intersections represent potential hazards not present at signalized intersections because of the priority of movement on the main road. Unsignalized intersection may be uncontrolled, controlled by yield or stop sign or controlled by a traffic police.

Signalized Intersections

The capacity of an urban road is related primarily to the signal timing and the geometric characteristics of the facility as well as to the composition of traffic on the facility. At signalized intersections, the additional element of time allocation is introduced into the concept of capacity. The way in which time is allocated significantly affects the operation and capacity of the intersection and its approaches. In analyzing a signalized intersection, the physical unit of analysis is the lane group. A lane group consists of one or more lanes on an intersection approach.

1.4 Signalized Intersection Flow Characteristics

For a given lane group at a signalized intersection, three signal indications are displayed: green, yellow and red. The red indication may include a short period during which all indications are red, referred to as an all-red interval, which with the yellow indication forms the change and clearance interval between two green phases. The signal cycle for a given lane group has two simplified components: effective green and effective red. Effective green time is the time that may be used by vehicles on the subject lane group at the saturation flow rate. Effective red time is defined as the cycle length minus the effective green time. Each time a movement is started and stopped, two lost times are experienced. At beginning of movement, the first several vehicles in the queue experience start-up losses that result in movement at less than the saturation flow. At the beginning of green, the start-up losses are called start-up lost time. At the beginning of the yellow, when vehicles tend to continue to enter the intersection for a short period of time, an extension of effective green (e) is experienced.

1.5 Saturation Flow

While the vehicular arrival flow represents the travel demand, saturation flow is the underlying variable that determines stop line capacity. This is the capability to accommodate the vehicular arrival flow, measured by individual intersection lane. It is the highest sustainable departure flow across the stop line during the green interval. Saturation flow forms the basis for the calculation of many parameters that describe how well the intersection operates. Saturation flow is a fundamental macroscopic vehicular traffic characteristics, which reflects the impact of interrupted vehicular inherent in signal operations. It is defined as the rate at which vehicles that have been waiting in a queue during the red interval cross the stop line of a signalized intersection approach lane during green interval. Saturation flow is generally expressed in passenger car units per hour of green time per lane (PCU/hour/lane).

1.6 Basic saturation flow

The basic saturation flow reflects the departure rate of straight –through vehicular traffic flow at the stop line of a signalized intersection approach lane during the green interval under ideal geometric, pavement surface, traffic, and weather condition in the given community.

Base condition for intersection approaches include

i. Lane width of 3.6
ii. Level grade
iii. No curb parking on the approaches
iv. Only passenger cars in the traffic streams and no local transit buses stopping at the travel lanes,
v. Intersection located in a non-central business district area, and
vi. No pedestrians.

1.6.1 Effect of different factors on saturation flow

The value of saturation flow is affected by the following factors at an intersection:

- Lane width
- Approach Grade
- Heavy vehicle in traffic stream
- Parking

- Blockage effect of local bus
- Area type
- Lane utilization
- Left turns
- right turns
- pedestrians left turn movement
- pedestrians right turn movements
- turning radius

1.7 Statement of the problem

Highway manual capacity is widely used for capacity analysis of signalized intersection in developed countries. Capacity analysis of signalized intersection mainly includes determination of saturation flow and delay. HCM and other works assume homogeneous traffic for analyses which exist in those countries but traffic flow in countries like Nepal consist of different classes of vehicles. Present practice is to convert all classes of vehicles into single unit called Passenger Car Unit (PCU). This problem needs to be solved. But the value of PCU Changes from place to place and no method gives true value of PCU. There are no proper guidelines to estimate Saturation flow for mixed traffic condition. HCM 2000 uses a default ideal base saturation flow rate of 1900 vehicles per hour which may not be true in context of Nepal. The adjustment factors given by HCM 2000 related to geometric factor like width, gradient, and turning radius in traffic prevailing condition of Nepal.

Based on the above discussion, this research tries to answer the following questions:

i. Is the capacity of a signalized intersection changed due to the mixed traffic condition?
ii. Are the geometric adjustment factors different from HCM 2000?

1.8 Passenger Car Units

The signalized intersection is the most serious capacity constraint along an urban street. The effect of traffic factor on the capacity of an intersection approach is usually allowed for by the use of weighting factors, referred to as passenger Car Equivalents assigned to differing vehicle categories.

The term passenger car equivalent (PUE) was introduced in the 1965 HCM. Since 1965, considerable research effort has been directed toward the estimation of PCE value for various roadway types. However, at present, there is neither a commonly accepted nor clearly defined theoretical basis for the concept of passenger car equivalent. There have been many researchers to estimate PUE at signalized intersection based on microscopic as well as macroscopic approach, giving different numerical results.

1.9 Objectives and Scope of the Study

The overall objective of this study is to study saturation flow and to suggest correction factor with respect to geometric parameters of signalized intersections based on heterogeneous traffic flow condition.

The specific objective of the study can be summarized as bellow:-

i. To obtain saturation flow from field data for selected signalized intersection.
ii. To develop the models with respect to lane width approach gradient and turning radius.
iii. To develop of geometric adjustment factors for lane width, approach gradient and right turning radius based on field value.
iv. Comparison of filed value with proposed model HCM 2000.

1.10 Limitations and Assumptions of the Study

The limitations and assumption of the study are as follows:

i. Only six categories of vehicle would be considered
ii. Saturation flow model have been considered for the particular case study only.
iii. Only some of the geometric parameters namely lane width, approach gradient and right turning radius are considered for models.
iv. Effect of weather conditions would not be considered and thus, data would be observed in similar conditions in all study area.

1.11 Organization of the Study

This research report altogether consists of six chapters, which are illustrated in systematic order.

Chapter 1 provides an introduction, objective, research questions, assumptions and limitation and organization of the research.

Chapter 2 provides detail introduction of literature review of adjustment saturation flow rate and geometric factors on saturation flow rate which has been used by previous researchers.

Chapter 3 is the main theme of researcher so detail step by step description of methodology and approach used in this study are presented in this chapter.

Chapter 4 contains analysis and modeling. It includes calculation and development of various models.

Chapter 5 contains validation of model. In this chapter the developed models are verified from different available techniques.

Chapter 6 includes conclusion and recommendation. It also includes future work for other researchers also.

The collected dates and their analysis are attached in appendices with necessary charts.

CHAPTER TWO: LITERATURE REVIEW

Several studies have been carried out on HCM signalized intersection model, its applicability, and its modifications. This section addresses some of traffic model proposed so far, for modeling heterogeneous traffic movement at signalized intersections. Some research works related to saturation flow rate for signalized intersections have been presented in this section.

2.1 Highway Capacity Manual

The highway capacity manual (HCM) is published by Transportation Research Board (TRB) of the National Academies of Science in the United States. It offers standards, tips, and computational tactics for calculating the capacity and fine of carrier of various motor way centers, such as freeways, highways, arterial roads, roundabout, signalized and un-signalized intersections, rural highways, The effect of mass transit, pedestrians, and bicycles at the overall performance of these systems. It has also serving as a base for numerous Nations, specific capacity manuals.

The main hypothesis behind the project of developing Indonesia Highway capacity manual (IHCM), is Indonesian traffic characteristics are basically different from those of developed countries. Existing capacity manuals from such countries therefore cannot be successfully implemented in Indonesia. The main aim of research behind the production of IHCM manual has been to explore and model Indonesian driver behavior and fundamental road traffic characteristics by means of extensive field data collection and analysis.

The Central Road Research Institute(CRRI),India is one of the research institute under the umbrella organization Council of Scientific and Industrial Research (CSIR), has undertaken a national study to develop the Indian Highway Capacity Manual(Indo-HCM).

Transportation Research Board (TRB) has used the saturation flow rate model as shown in Figure 2.1. The saturation flow rate of an approach at a signalized intersection can be calculated using Equation (1).

$$S = S_0 N f_w f_{hv} f_g f_p f_{bb} f_a f_{LU} f_{LT} f_{RT} f_{Lpb} Fl_{Rbb} \text{ PCU/ hg} \quad (1)$$

Where,

S = saturation flow rate under prevailing conditions, expressed in vehicle per hour of effective green time in lane group (PCU/hg).

S = saturation flow in PCU/hg,

S_o = 1900, base flow in veh/hr.,

N=number of lanes,

f_w= factor of width.

f_{hv} = adjustment factor for heavy vehicle,

f_g = adjustment factor for gradient,

f_p = adjustment factor for parking,

f_{bb} = Factor for bus blocking,

f_a = Factor for type of area,

f_{Lu} = Factor of lane utilization,

f_{LT} = adjustment factor for left turn movement,

f_{RT} = adjustment factor for right turn movement,

f_{Lpb} = adjustment factor for pedestrian and bike movement for left turns,

f_{Rpb} = adjustment factor for pedestrian and bike movement for right turns.

Many countries have developed their own capacity manuals based on HCM, as per their physical and geographical conditions.

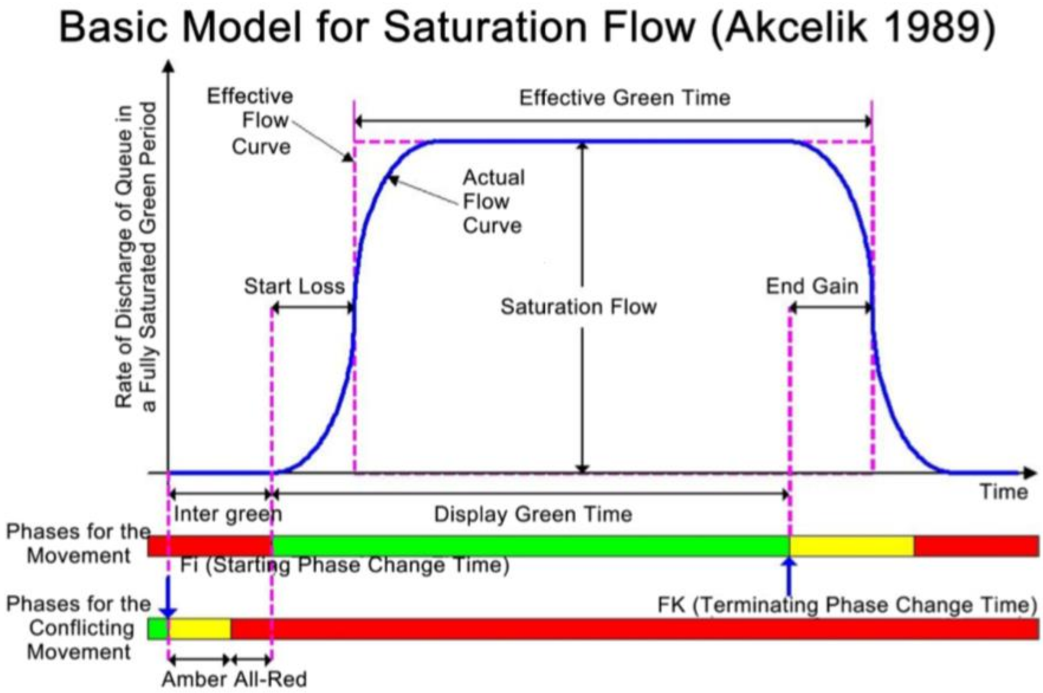

Figure 2.1 Basic model of saturation flow rate (Source: HCM 2000)

2.2. Factors Affecting Saturation Flow Rate

Base Saturation Flow Rate

For the analysis of saturation flow rat, a fixed volume is taken as a base called base saturation flow rate usually 1,900 passenger cars per hour per lane (pc/h/lane). This value is adjusted for a variety of conditions. The adjustment factors are given below.

Adjustment for Lane Width: The lane width adjustment factor, f_w accounts for the negative impact of narrow lanes on saturation flow rate and allows for an increased flow rate on wide lanes. The lane width factor can be calculated for lane width greater than 4.8m. The use of two narrow lanes will always result in higher saturation capacity than one single wide lane.

$$Fw = 1 + \frac{(w-3.6)}{9}$$

Where, w = width of lane

Standard lane widths are 3.6m. The lane width factor may be calculated with caution for lane widths greater than 4.8m, or an analysis using two narrow lanes may be conducted. Note that use of two narrow lanes will always result in higher saturation flow rate than a single wide lane, but in either case, the analysis should reflect the way in which the width is actually used or expected to be used. In no case should the lane width factor be calculated for widths less than 2.4m.

Adjustment for Heavy Vehicles and Grade: Passenger care are affected by approach grades, are heavy vehicles. The heavy-vehicle factor accounts for the additional space occupied by these vehicles and for the difference in operating capabilities of heavy vehicles compared with passenger cars. The passenger-car equivalent (ET) used for each heavy vehicle is 2.0 passenger car units and is reflected in the formula. The grade factor accounts for the effect of grades on the operation of all vehicles.

$fhv = 100/(100+\%HV\,(E_T-1)$

$fg = 1–\%G/200$

Where, % HV = heavy vehicles for lane group volume, $E_T = 2.0$,

%G = % grade on a lane group approach

Adjustment for Parking: Parking maneuver assumed to block traffic for 18 s. Use practical limit of 180 maneuvers/h. the parking adjustment factor, f_p, accounts for the frictional effect of a parking lane on flow in an adjacent lane group as well as for the occasional blocking of an adjacent lane by vehicles moving into and out parking spaces. Each maneuver (either in or out) is assumed to block traffic in the lane nest to the parking maneuver for an average of 18 s.

$fp = (N–0.1 –\left(\frac{18Nm}{3600}\right))/N$

Where, N_m = number of parking maneuvers/h N = no. of lanes

Adjustment for Area Type: The area type adjustment factor, f_a, accounts for the relative inefficiency of intersections in business districts in comparison to those in other locations. Application of this adjustment factor is typically appropriate in areas that exhibit central business district (CBD) characteristics. It can be represented as f_a =0.9 in CBD (central business district) and 1.0 in all others.

Adjustment for Lane Utilization: The lane utilization adjustment factor, f_{LU}, accounts for the unequal distribution of traffic among the lane in a lane group with more than one lane. The factor provides an adjustment to the base saturation flow rate. The adjustment factor is based on the flow in the lane with the highest volume and is calculated by Equation 10.

Flu = Vg/ (VG1×N)

Where, Vg = unadjusted demand flow rate for lane group (veh/ h), V_{g1} = unadjusted demand flow rate on single lane with highest volume in the lane group and N = no. of lanes in the group.

Adjustment for Right Turns: The right-turn adjustment factors, $f_{RT,}$ primarily intended to reflect the effect of geometry. A separate pedestrian and bicycle blockage factor is used to reflect the volume of pedestrians and bicycles using the conflicting crosswalk. The right-turn adjustment factor depends on a number of variables, including

- whether the right turn is made from an exclusive or shared lane, and
- Proportion of right-turning vehicles in the shared lanes.

Adjustment for Left Turn: The left-turn adjustment factor, f_{LT}, is based on variable similar to those for the right-turn adjustment factor, including

- whether left turns are made from exclusive or shared lanes,
- type of phasing (protected, permitted, or protected-plus-permitted),
- proportion of left-turning vehicles using a shared lane group,
- opposing flow rate when permitted left turns are made, and
- An additional factor for pedestrian blockage is provided, based on pedestrian volumes.

Capacity: Capacity at a signalized intersection is based on the concept of saturation flow and saturation flow ratio for a given lane group is defined as the ratio of the actual or projected demand flow rate for the lane group (V_i) and the saturation flow rate (S_i). The flow ratio is given the symbol (V/S) for lane group i. The capacity of given lane group is given by,

$$C_i = S_i \times \frac{gi}{c}$$

Effective Green Time (gi): Effective green time is the actual time available for the vehicles to cross the intersection. It is the sum of actual green time (G_i) plus the yellow minus the applicable lost times. This lost time is the sum of start-up lost time (l_1) and clearance lost time (l_2) denoted as Tl. Thus effective green time cab be written as,

$$gi = G_i + Y_i - t_i$$

2.3 Previous Study

Research in the field of signalized intersection capacity and design has completed about a half a century. First US Highway Capacity Manual published in 1965 provided a detailed guideline for capacity analyses and design of signalized intersection.

Branston (1997) investigated the variation of saturation flow for different ties of a day and he suggested two linear relationships, one for the peak period and the other for the off-peak period of traffic flow considering lane width as the independent variable. Working on lane width varying form 3.0 – 4.3 meters, he observed that there is a variation of saturation flow with lane width for individual lanes although the values for nearside and offside lanes of two-lane approaches were not significantly different. However, in a full-scale TRRL test track experiment for lane-based traffic, Kimber et al. (1983) found no significant difference between nearside, central and offside lanes at the multi-lane approach. For approach widths ranging from 2.5 m to 12 m and lane width varying from 2.5 m to 4 m, they found that saturation flow per lane for lane-based traffic increased non-linearly with lane width In Kimber et al (1986), based on a database from 64 sites throughout the UK, they suggested a saturation flow of 2080 PCU/hr. for a lane width of 3.25, and an increase of 100 PCU/hr. per meter width in excess of the standard width as mentioned. They additionally found a reduction of 140 PCU/for the nearside lane. These values were obtained from the mean saturation flow over all sites where gradients were not found to affect flows. In Australia, Leong (1968) conducted the study on the effect of lane widths on saturation flow for lane-based traffic condition. He used the headway ratio method to calculate saturation flow values. The majority of this lane width in this study were in the in the range of 2.75 m to 3.5 m and he concluded that lane width had very little effect on saturation flows. This result in confirmed later by Australian Road Research Board from subsequent investigations.

Miller (1968) dealt with lane width instead of approach width and observed that the lane width in the range of 2.0 to 4.8 meters had a small effect on saturation flow. Akcelik (1981) confirmed that there is no need for adjustment for saturation flow within a lane width range of 3.0 m to 3.7 m. In this range, he proposed a single saturation flow i.e. 1850 PCU/hr. For lane widths outside this range, an adjustment factor is to be applied against the standard value with the value of adjustment factor depends on the lane.

Maini and Khan (2000) performed a study on clearing speeds of heterogeneous traffic at signalized intersections in two Indian cities. Findings of the his study show that the intersection leading speed is nearly constant for different vehicle types and has the potential to have an effect on the methodology for determining the passenger car unit (PCU) values. The finding of this study is, platoon-clearing speed may be more relevant to estimating intersection capacity.

Ibrahim et al. (2002) had carried out a study to determine the ideal saturation flow at signalized intersections under Malaysian road conditions. They adopted the method of measuring saturation flow published by the Road Research Laboratory (1963).the averaged flow values were the regressed with lane widths to obtain a linear regression model: S=1020+265W; R^2=.876 where, S: measured saturation flow rate in PCU/hr. S=1107+398.22W

&W: lane width (m).

In Nepalese condition, Shrestha (2013), proposed following model for saturation flow of signalized intersection after regressing the data of three intersections of Kathmandu Valley,

- R-squared value is only .415, so recommended model is not fit.

Shrestha also developed following model (related to the length of green time)

S=462.2W+.465GT+293%RT+19705HV+558%TW

- R-squared value is satisfied but the t-value of some parameter are not relevant. The result is not fit because there is positive relation between saturation flow and percentage of right turn vehicle, percentage of heavy and two wheelers, which are contradict.

Where,

W= width of study approach at stop line being surveyed

GT= length of signal green time for the approach being surveyed

%RT= percentage of right turning vehicle (include all type of vehicle)

%HV=percentage of heavy vehicle

%TW=percentage of two wheeler

Chang–qiao (1911) deals with saturation flow at signalized intersection with lane width, approach gradient and right turn radius. Finding of this study shows the base saturation flow was found to be 1800 PCU/hr. and this was not consistent with HCM. The adjustment factors were developed in these studies is not same as the one given by HCM 2010.

Findings of this study are:

- Fw= $\left(1 + \frac{W-3.5}{6.56}\right)$ 2.8m≤WL3.9m

  Where, fw = adjustment factor for lane width
- Fg = $1 - \frac{\%G}{100}$

  Where, fg = the adjustment factor for approach grade
- S = $\frac{3600}{1+\left(\frac{5}{r}\right)}$

  Where, S = the saturation flow rate for both outside land and inside lane

  r = left turn radius (m)

Sarita et al (2017) conducted a study in India on the saturation flow rate and found the geometric adjustment factors as the saturation flow.

The findings of the study are:

- SO = 600 × W PCU/hr., W = width road (m)

  SO = base saturation flow
- Factors of gradient (fg) is calculated by

  fg = 1 – 0.013 (%g)

  g = approach gradient (%)
- Proposed factor of turning radius (ftr) is calculated by

  Ftr = $\left(1 + 4 \times \frac{r}{1000}\right)$

2.4 Study on saturation flow rate of signalized intersections,

Shrestha and Marsani (2014) conducted a study in Nepal observed that regression model have developed to estimate saturation flow rate showed good correlation with field values. Study carried out by Alam and Zaha (2010) at Makkah, Saudi Arabia, has shown that saturation flow rate and capacity adjustment factor for signalized intersections varied from HCM recommendations. However, the outputs can form the basis formulating a HCM for the country and therefore estimated parameters is also useful for signal design and traffic system performance in Saudi Arabia. study conducted by Shao and Liu (2011) at china ,base saturation flow was found to be 1800 PCU/hg and factor of width ,turning radius and gradient affects are studied and a model is developed based on that, which yield better realistic field conditions. Savita and Jadish (2017) conducted a study in India, showed that the geometric factor affects the saturation flow at signalized intersection and model has developed from the filed data. The adjustment factor has been given that is different from HCM adjustment factor that gives the better realistic picture of the field conditions especially under heterogeneous traffic conditions of an urban area. Study conducted by Liu and X (2011) at Beijing revealed that for different signalized intersections, the queue discharge headway distribution are often not identical. IRC:SP41-1994 showed guidelines for design at grade intersections for rural and urban area, has defined saturation flow as S =525*W, PCU/hr (s-saturation flow in PCU/hr. width of road in m) for roads having width above 5.5 m, and gives saturation flow rate based on radius of right turning vehicles. However, it does not specify anything about defining Los for signalized intersections. Study was conducted by Chand and Jain (2016) in new-Delhi India developed saturation flow model at signalized intersection and estimate the saturation flow and methodology was developed to calculate PCU for mixed traffic. Another study in Japan has developed saturation regression model for shared left turn lane at signalized intersections. In this study numerical model is proposed to test the effect of lane blockage and significant influencing factors on saturation flow rate estimation in shared left turn lane .study from India shows that saturation flow is affected by geometric factor and head way method is not adopted to calculate saturation flow rate due to non-disciplined road and there is significant lateral movement among vehicles and this study has given the PCU and geometric adjustment factors from the field data.

2.5 Base condition for signalized intersection

In order to estimate the saturation flow rate and to determine the adjustment factors, base saturation flow is firstly determined. The standard lane with at available intersection is 3.5 meters. This is not consistent with the HCM (Table 2.1) about the definition of standard lane width. In addition it is necessary to note that the base conditions for signalized intersections are mainly defined for through lane group because the radius is not taken into account. However the effect of turn radius has a great effect one the capacity of lane.

Table 2.2 Base Saturation Flow

Method	Ideal Saturation Flow Rate PCU per hour Per Lane
1985 HCM Operations	1800
1985 HCM Planning	1400
1994 HCM Operations and Planning	1900
1997 HCM Operations and Planning	1900
2000 HCM Operations and Planning	1900
6 the international symposium in chine 2011	1800

Given the above back ground and importance, the present study gives an insight into the traffic flow parameter influencing the capacity at signalized intersections of Kathmandu urban area. The saturation flow rates which are affected by geometric factors like lane width, approach gradient and right turning radius are considered in this study.

CHAPTER THREE: RESEARCH METHODOLOGY

To achieve the objective stated in above study, the following methodology as depicted in the following chart below (Figure 3.1) has been adopted for the development of saturation flow in at selected intersection.

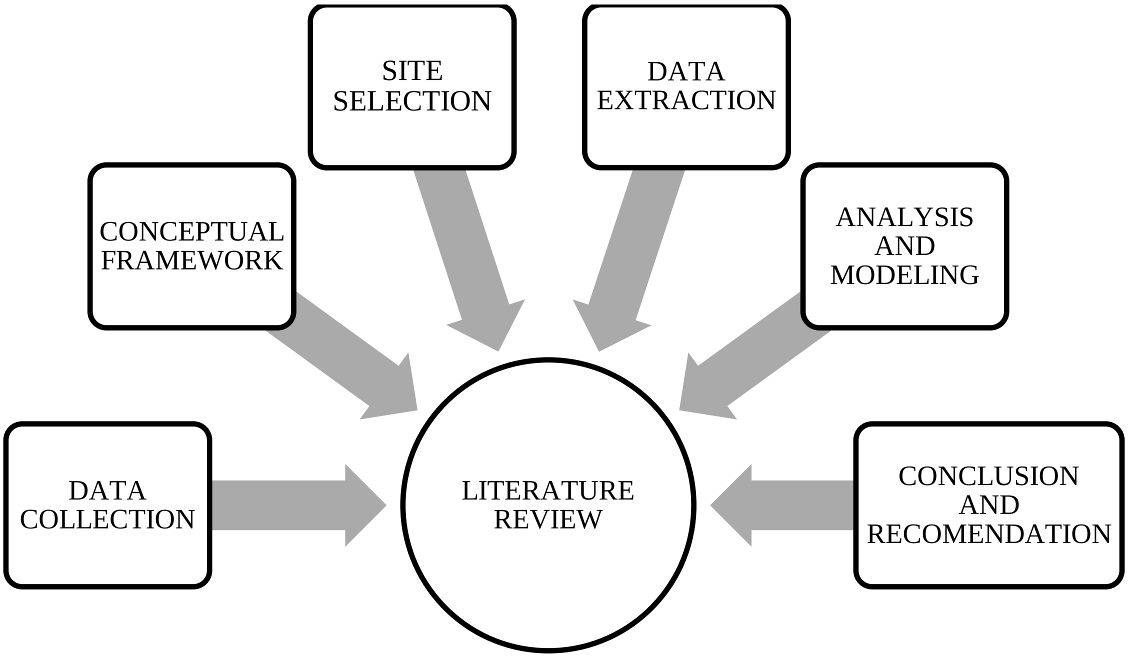

Figure 3.1 Framework of Research

3.1 Site Selection

Three signalized intersections (Figure 3.2) were chosen for the present study (Gaushala, Maharajgang, Chakrapath and Satdobato intersections). All are four legged intersection having heavier through traffic flow during peak hours and long queue is formed. The effect of lane width, approach gradient and right turning radius on saturation flow rates are analyzed using Multi-linear regression model. These study area are accessible via public bus, tempo, micro, taxi and two wheelers etc.


Gaushala Chwok Road


Satdobato Bus Stop

Figure 3.2 Study Area

3.2. Data Collection

During the primary survey, data related to traffic and topographical of the study area were collected. Traffic Data was collected during peak hour 9 AM to 11 AM and 3 PM to 5 PM for three days. The following necessary data are described below:

a. Traffic data: The traffic data from Figure 3.3 was collected by videography method. Video camera was placed at vantage point to cover flow over the entire approach at required intersection. From the videography through flow and right turn flow data were collected along with the vehicle categorization in six different categories is shown in appendix.

- Bus
- Micro-bus
- Truck
- Two-wheeler
- Car

- Tempo

Figure 3.3 Traffic Data Collection at Satdobato Intersection by Videography

b. Road Geometric Data: It involves the lane width, approach gradient and right turning radius which are obtained from measurement tape, abney level, compass and videography as depicted in Figure 3.4.

Figure 3.4 Geometric Data Collection Using Measuring 30m Tape, Abney Level and Prismatic Compass.

Representation of the geometric data as lane width, approach gradient and right turning radius for selected intersection is shown and Table 3.1 provide the clear information about the lane width, approach gradient and right turning radius.

Table 3.1 Related Geometric Data at Selected Intersection

S. N.	Lane group	Width (m)	Gradient (%)	Right Turning Radius(m)
1	Hatiban to Koteshwor Rt	7	0.5	27.3
2	Kalanki to Hatiban Rt	7	-0.5	29.8
3	Kalanki to Koteshwor Th	11	0.5	9999
4	Lagankhel to Hatiban Th	6	-0.5	9999
5	Koteshwor to Lagankhel Rt	4.5	0.5	19
6	Koteshwor to Kalanki Th	11	0.5	9999
7	Hatiban to Lagankhel Th	6	0.5	9999
8	Gaushala to Mitrapark Rt	8	6	27
9	Mitrapark to old Baneshwor Th	6	-2	9999
10	Old Baneshwor to Mitrapark Th	5	2	9999
11	Mitrapark to Gyanshwor Rt	4	-2	32
12	Airport to Gyaneshwor Th	5.5	6	9999
13	Gyaneshwor to Airport Th	6.5	8	9999
14	Dhumbarahi to Basundhara Th	10	0.5	9999
15	Basundhara to Dhumbarahi Th	12	4	9999
16	Gangalal to Lainchaur Th	7	0.5	9999
17	Lainchaur to Gangalal Th	6	-0.5	9999
18	Dhumbarahi to Gangalal Rt	5	0.5	21
19	Gangalal to Basundhara Rt	3.5	-0.5	23

c. Signal Data: This include the saturation time and green time which is shown in appendix.

3.3 Data Extraction

The recorded video was replayed in the computer to extract the required data. Saturation flow green time and classified vehicle counts were collected from the video recorded for the development of saturation flow, modeling and other information related another objective. Observation point was selected by playing video recordings. Start of green time will be noted down from video camera timer. Initial 10 seconds from the start of green are left to take into account start up loss time. Saturation flow ends when the rear axle of the last vehicle from a queue crosses the stop line. 10 seconds after the start of green time the classified vehicles shall be counted until the last vehicles in the queue crossed the observation point. It is not possible to count all classified vehicle count at a time for all movements. Therefore, video was replayed number of times and every time vehicle count of one or two categories was done. The above procedure was repeated for each cycles of recorded period. Vehicles are classified as:

i. Car
ii. Light vehicles: micro bus, utility vehicles, four-wheel drive,
iii. Three-wheeler vehicle tempo
iv. Heavy vehicle: multi axle, heavy truck, light truck
v. Two-wheeler motorbike
vi. Bus: standard bus, mini bus

3.4 Estimation of Saturation Flow (in PCU/hr.)

The normally headway method based on time headway of passing vehicles cannot be used for non-lane-based traffic condition, because, in non-lane-based traffic flow, headways are hard to observe, as vehicles do not move in definite lanes. Traffic is analyzed based on total width of approach and hence, the option of vehicle counting is adopted saturation flow is considered autonomously for each observed saturation period and then averaged over observed cycles. Saturation flow was estimated in PCU/hr. using the PCU values given by JICA survey report in 2012 from Table 3.2. Saturation green time (T sec) was divided by the number of different categories of vehicles that have been converted into passenger car unit to get the time headway.

Inverse of headway gives the saturation flow. Thus, the saturation flow in PCU/hr. was obtained as:

$S= (PCU_C*x_1+PCU_T*x_2+PCU_B*x_3+PCU_{TW}*x_4+PCU_{MB}*x_5+PCU_{TEM}*x_6)*3600/T$

Where,

T= saturation green time (sec)

$X_1, x_2, x_3, x_4, x_5, x_6$=Number of Car, Truck, Bus, Two-wheeler, Microbus and Tempo respectively

PCU_C, PCU_T, PCU_B, PCU_B, PCU_{TW}, PCU_{MB}, PCU_{TEM}=Passenger Car Unit of Car, Truck, Bus, Two-Wheeler, Micro Bus and Tempo.

Table 3.2 Average Calculated PCU Value

PCU	Car	Light truck	Mini bus	Two-wheeler	Microbus	Tempo
JICA survey report 2012 of Kathmandu	1	1.5	3	0.3	1.5	1
NRS 2070	1	1.5	3	0.5	1.5	NA
Report published by Samriddhi Shrestha	1	2.65	2.19	0.25	1.67	1.3

The PCU values for selected types of vehicles are suggested by the different authors and reports. Among them, some of them are listed above and the value given by JICA Survey Report 2012 of Kathmandu is taken in this study.

Table 3.3 Saturation Flow Values at Satdobato Intersection

S.N.	Lane group	Saturation Flow (PCU/hr.)	Width (m)	Gradient (%)	Right Turning Radius (m)
1	Hatiban to Koteshwor Rt	3544	7	0.5	27.3

S.N.	Lane group	Saturation Flow (PCU/hr.)	Width (m)	Gradient (%)	Right Turning Radius (m)
2	Kalanki to Hatiban Rt	3546	7	-0.5	29.8
3	Kalanki to Koteshwor Th	5696	11	0.5	9999
4	Lagankhel to Hatiban Th	3467	6	-0.5	9999
5	Koteshwor to Lagankhel Rt	2144	4.5	0.5	19
6	Koteshwor to Kalanki Th	5645	11	0.5	9999
7	Hatiban to Lagankhel Th	3485	6	0.5	9999
8	Gaushala to Mitrapark Rt	4060	8	6	27
9	Mitrapark to old Baneshwor Th	3255	6	-2	9999
10	Old Baneshwor to Mitrapark Th	2698	5	2	9999
11	Mitrapark to Gyanshwor Rt	2117	4	-2	32
12	Airport to Gyaneshwor Th	2947	5.5	6	9999
13	Gyaneshwor to Airport Th	3220	6.5	8	9999
14	Dhumbarahi to Basundhara Th	5238	10	0.5	9999
15	Basundhara to Dhumbarahi Th	6208	12	4	9999
16	Gangalal to Lainchaur Th	3693	7	0.5	9999
17	Lainchaur to Gangalal Th	3483	6	-0.5	9999
18	Dhumbarahi to Gangalal Rt	2597	5	0.5	21
19	Gangalal to Basundhara Rt	1828	3.5	-0.5	23

Table 3.3 shows that saturation flow is calculated using PCU given by JICA Survey Report 2012 with related geometric data.

CHAPTER FOUR: DATA ANALYSIS AND MODELLING

As the traffic flow of Kathmandu is heterogeneous, so saturation flow in vehicle per hour is not used. Instead saturation flow is calculated in PCU per hour. Extracted data was analyzed to assess the effect of approach width, gradient and turning radius on saturation flow the multiple regression analysis was conducted on IBM SPSS statistics 23 to developed saturation flow rate (in PCU/hr.) model. To develop a model, PCU value proposed in JICA survey report 2012 Kathmandu valley.

4.1 Saturation Flow Analysis

The amount of traffic that may pass through a signal-controlled intersection from a given approach depends on the available green time to the traffic and on the maximum flow of vehicles pass/cross the stop line during the green time. Once the signal changes to green, vehicles take some second to start, accelerate and attain the normal speed. After a few seconds, the queue discharges at constant rate called saturation flow (S). Thus, saturation flow is the flow, which would be obtained if there was a continuous queue of vehicles and they were passed at green time, or the saturation flow is maximum departure rate, which can be obtained when there is a queue. Saturation flow is the maximum rate of vehicle that can pass through a given intersection approach, if the signal remains green all the time. This one is the important parameter in capacity analysis of signalized intersection. Knowledge of saturation flow is essential in signal design also. Saturation flow depends upon number of different parameters. The saturation flow is generally expressed in vehicles per hour green time.

4.2 Development of Saturation Flow Model

In the present study, field data were collected at eight approaches. Using this data, multiple regression analysis was conducted in order to estimate the saturation flow in passenger car unit per hour.

Following 5 (five) different type of models are prepared:

i. Model 1 (model between SF, Width)
ii. Model 2 (Model between SF, W, R and G)
iii. Model 3 (Model between SF, W and R)
iv. Model 4 (model between SF, W and G)

v. Model 5 (Model between SF and G)

Table 4.1 gives the R-squared and t-value of different models. On t- value, SNS indicates some of the parameter/variables on model is insignificant because of the value less than -1.96 or 1.96 at 5% level of significance. The sig indicates the t-value of the variable is significant.

Table 4.1 Saturation Flow Model

Model no	Model	R square	t value
Model 1	S. F=143.769+506.247W	0.919	Sig
Model 2	S. F=143.097+510.162W-22.045G	0.921	Sig
Model 3	S. F=135.271+487.434W-28.439G+0.028R	0.930	Sig
Model 4	S. F=136.771+484.363W+0.025R	0.927	Sig
Model 5	S. F=2846.448+0.129R	0.241	Sig
Note: Sig= all significant, SNS= some non-significant			

Table 4.2: Independent Variable Used for Saturation flow

Independent Variable for Saturation Flow(S), PCU/hr.	
Variable	Variable name description
Width(w)	Width of study approach at stop line being surveyed
Gradient(G)	Approach gradient
Right Turning Radius(R)	Right turning radius of vehicles

Table 4.3 Model Summary: Model 1

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.959[a]	.919	.919	359.853

a. Predictors: (Constant), Width

Table 4.4 ANOVAa : Model 1

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,682,747,100.197	1	1,682,747,100.197	12,994.757	.00[b]
	Residual	148,011,998.641	1,143	129,494.312		
	Total	1,830,759,098.838	1,144			

a. Dependent Variable: Sat_flw

b. Predictors: (Constant), Width

Table 4.5 Coefficientsa : Model 1

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	143.769	32.582		4.413	.000
	Width	506.247	4.441	.959	113.995	0.000

a. Dependent Variable: Sat_flw

As shown in Table 4.3, the adjusted R-squaredvalue is .919, i.e. only 91.9% of variance of original field data is explained by the variance of field data obtained from MLR equation. In Table 4.5, t- value of constant and variables are greater than 1.96 against a tabular value of 1.96 at 95% level of confidence, so these constant and variables are significance. F-value of constant and variables are less than .05 at 5% level of significance.

The model thus obtained is: Model 1 S.F=143.769+506.247W

Table 4.6 Model Summary: Model 2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.960[a]	.921	.921	355.530

a. Predictors: (Constant), Gradient, Width

Table 4.7 ANOVAa : Model 2

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,686,408,708.638	2	843,204,354.319	6,670.847	.000[b]
	Residual	144,350,390.200	1,142	126,401.392		
	Total	1,830,759,098.838	1,144			

a. Dependent Variable: Sat_flw

b. Predictors: (Constant), Gradient, Width

Table 4.8 Coefficientsa : Model 2

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	143.097	32.191		4.445	.000
	Width	510.162	4.448	.966	114.707	0.000
	Gradient	-22.045	4.096	-.045	-5.382	.000

a. Dependent Variable: Sat_flw

As shown in Table 4.6, the adjusted R-squaredvalue is .921, i.e. only 92.1% of variance of original field data is explained by the variance of field data obtained from MLR equation. In Table 4.7, t- value of constant and variables are greater than 1.96 against a tabular value of 1.96 at 95% level of confidence, so these constant and variables are significance. F-value of constant and variables are less than .05 at 5% level of significance.

The model thus obtained is: Model S.F= 143.097+510.162W-22.045G

Table 4.9 Model Summary : Model 3

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.964[a]	.930	.930	335.135

a. Predictors: (Constant), Tur_Rad, Gradient, Width

Table 4.10 ANOVAa : Model 3

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,702,606,949.574	3	567,535,649.858	5,053.042	.000[b]
	Residual	128,152,149.264	1,141	112,315.644		
	Total	1,830,759,098.838	1,144			

a. Dependent Variable: Sat_flw

c. Predictors: (Constant), Tur_Rad, Gradient, Width

Table 4.11 Coefficientsa : Model 3

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	135.271	30.351		4.457	.000
	Width	487.434	4.600	.923	105.968	0.000
	Gradient	-28.439	3.898	-.058	-7.297	.000
	Tur_Rad	.028	.002	.105	12.009	.000

a. Dependent Variable: Sat_flw

As shown in Table 4.9, the adjusted R-squared value is .930, i.e. only 93.0% of variance of original field data is explained by the variance of field data obtained from MLR equation. In Table 4.11, t- value of constant and variables are greater than 1.96 against a tabular value of 1.96 at 95% level of confidence, so these constant and variables are significance. F-value of constant and variables are less than .05 at 5% level of significance.

The model thus obtained is: Model 3 S. F=135.271+487.43W-28.439G+.028R

Table 4.12 Model Summary: Model 4

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.963[a]	.927	.927	342.715

a. Predictors: (Constant), Tur_Rad, Width

Table 4.13 ANOVAa : Model 4

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1,696,627,075.141	2	848,313,537.570	7,222.541	.000[b]
	Residual	134,132,023.698	1,142	117,453.611		
	Total	1,830,759,098.838	1,144			

a. Dependent Variable: Sat_flw

b. Predictors: (Constant), Tur_Rad, Width

Table 4.14 Coefficientsa : Model 4

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	136.771	31.037		4.407	.000
	Width	484.363	4.684	.917	103.406	.000
	Tur_Rad	.025	.002	.096	10.871	.000

a. Dependent Variable: Sat_flw

As shown in Table 4.12, the adjusted R-squared value is .927, i.e. only 92.7% of variance of original field data is explained by the variance of field data obtained from MLR equation. In Table 4.14, t- value of constant and variables are greater than 1.96 against a tabular value of 1.96 at 95% level of confidence, so these constant and variables are significance. F-value of constant and variables are less than .05 at 5% level of significance.

The model thus obtained is: Model 4 S. F= S. F=136.771+484.363W+.025R

Table 4.15 Model Summary: Model 5

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.491[a]	.241	.240	1,102.780

a. Predictors: (Constant), Tur_Rad

Table 4.16 ANOVAa : Model 5

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	440,730,525.409	1	440,730,525.409	362.406	.000[b]
	Residual	1,390,028,573.430	1,143	1,216,122.986		
	Total	1,830,759,098.838	1,144			

a. Dependent Variable: Sat_flw

b. Predictors: (Constant), Tur_Rad

Table 4.17 Coefficientsa : Model 5

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2,846.778	53.503		53.208	0.000
	Tur_Rad	.129	.007	.491	19.037	.000

a. Dependent Variable: Sat_flw

As shown in Table 4.15, the adjusted R-squared value is .240, i.e. only 24.0% of variance of original field data is explained by the variance of field data obtained from MLR equation. In Table 4.17, t- value of constant and variables are greater than 1.96 against a tabular value of 1.96 at 95% level of confidence, so these constant and variables are significance. F-value of constant and variables are less than .05 at 5% level of significance.

The model thus obtained is: Model 5 S=2846.778+.129R

4.3 Effect of Geometric conditions on the Saturation Flow

4.3.1 The effect of lane width on the saturation flow rates

Among the geometric conditions, the width of the lane has an effect on the capacity of the signalized intersections, in order to analyze the influence of width on the capacity, the non-linear model is considered.

FW=1+ (W-3.5)/a 2.5<W<_4.0m

Where, FW= adjustment factor for lane width

W= width of lane meter,

a= parameter

Using nonlinear least square (NLS) method, the parameter a is estimated as shown in Table 4.18 and the saturation flow rate adjustment factor for lane width is;

FW= 1+ (W-3.5)/3.862

Table 4.18 Parameter Estimates: Width Adjustment Factor

Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
a	3.862	0.053	3.748	3.975

Table 4.19 ANOVAa,b for Parameter Estimates: Width Adjustment Factor

Source	Sum of Squares	df	Mean Squares
Regression	14.427	1	14.427
Residual	0.001	15	0.000
Uncorrected Total	14.428	16	
Corrected Total	0.241	15	

Dependent variable: W

a. The solution results in negative sum of squares.

b. R squared = 1 - (Residual Sum of Squares) / (Corrected Sum of Squares)

4.3.2 The Effect of Lane Approach Grade on the Saturation Flow Rate

In the HCM 2000, the approach grade is taken as one of the significance influences factors on the capacity. In this present study, the analysis shows when the approach grade is increased, the saturation flow is decreased that is the inverse effect of grade on saturation flow. To calculate the grade adjustment factor on saturation flow, the same number of lanes whereas with different approach grade should be chosen.

4.3.3 Effect of right turning radius

Different from the through movement, the right turning movement is not only affected by the lane width, but it is also affected by turn radius of movement.

By using negative least square method as shown in Table 4.20, the right turn saturation adjustment factor is

FR= 1+14.836 * r/1000

Where, FR= right turn saturation adjustment factor

Table 4.20 Parameter Estimates: Right Turn Radius Adjustment Factor

Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
a	14.836	1.134	12.419	17.253

r= right turn radius of right turning vehicles

Table 4.21 ANOVAa,b for Parameter Estimates: Right Turn Radius Adjustment Factor

Source	Sum of Squares	df	Mean Squares
Regression	35.697	1	35.697
Residual	0.323	15	0.022
Uncorrected Total	36.020	16	
Corrected Total	0.000	15	

Dependent variable: R

a. R squared = 1 - (Residual Sum of Squares) / (Corrected Sum of Squares)

Table 4.22: Adjustment Factors

W	R	G	Predicted-Model 3	Adjustment-Factor	Pedicted-model1	Predicted-Model5	FW	FR
2.5	16	-8	1585.82	0.83	1409	2849	0.74	1.4994
2.6	18	-7	1605.68	0.85	1460	2849	0.77	1.4995
2.7	20	-6	1625.54	0.86	1511	2849	0.80	1.4997
2.8	22	-5	1645.40	0.87	1561	2850	0.82	1.4998
2.9	24	-4	1665.26	0.88	1612	2850	0.85	1.4999
3	26	-3	1685.12	0.89	1663	2850	0.88	1.5001
3.1	28	-2	1704.98	0.90	1713	2850	0.90	1.5002
3.2	30	-1	1724.84	0.91	1764	2851	0.93	1.5003
3.3	32	0	1744.70	0.92	1814	2851	0.95	1.5005
3.4	34	1	1764.56	0.93	1865	2851	0.98	1.5006
3.5	36	2	1784.42	0.94	1916	2851	1.01	1.5007
3.6	38	3	1804.28	0.95	1966	2852	1.03	1.5009
3.7	40	4	1824.14	0.96	2017	2852	1.06	1.5010
3.8	42	5	1844.00	0.97	2068	2852	1.09	1.5012
3.9	44	6	1863.86	0.98	2118	2852	1.11	1.5013
4	46	7	1883.72	0.99	2169	2853	1.14	1.5014

As shown in Table 4.22, it can be observed that with the increase of lane width and right turning radius, the saturation flow rate increases too. From the model 3 with the increase of approach grade the saturation flow rate decreases. But the gradient factors show the positive result on saturation flow due to greater width and right turn radius having less value in gradient. So, to analyze the effect of approach grade on saturation flow, the same number of lengths with different approach grade should be chosen.

CHAPTER FIVE: VALIDATION OF THE MODELS

The process of ensuring that the model behaves as intended, usually by debugging or through animation is the verification. Verification is necessary but not the sufficient for validation hat is a model may be verified but not valid. Validation ensures that there is no significant difference between the model and the real system and that model reflects reality. Validation can be achieved through statistical analysis. Sometimes, face validity may be obtained by having the model reviewed and supported by an expert.

5.1 Data from the same intersection

The models developed in the earlier section are validated using the independent data of two hour collected at each intersection that were not used for model development. Saturation flow models at these intersections are determined from field data and estimated using developed model. It indicates that all data points are close to the 45-degree line, indicating a good match between observed value and predicted value.

Table 5.1: Result from Validation of Model from Same Intersection Data

S.N.	Model	R square	F-value	T- value	Correlation factor(r)
1	For saturation flow model with lane width (Model 1)	0.792	0.000	Significance	0.813
2	For saturation flow with lane width and gradient (Model 2)	0.795	0.000	Significance	0.892
3	For saturation flow with lane width, gradient and turning radius (Model 3)	0.812	0.000	Significance	0.901

From the Table 5.1, Model 3 is the best model to calculate the saturation flow obtained from present study because R-squared value is more than other models

i. Adjusted R-squared value= 0.792 (i.e. 79.2) of the variance of original field data is explained by the variance of field data from the multi linear regression
ii. Significance F= 0.000 (i.e. there is 0% possibility that the regression output was merely a chance occurrence
iii. T value = all parameter is significant because t- value is either less than -1.96 or greater than 1.96 at 5% level of significance
iv. Regression equation: Predicted value = 41.067 + 0.878 * observed value

5.2 From Multiple Regression Tests

The developed models are also verified from the regression test. It is the process of deciding whether the numerical result quantifying the hypothesized relationship between variables, obtained from regression analysis, are in fact acceptable as a description of data. The validation can involve the goodness of fit of the regression, analyzing whether the regression residual is random.

R Square and Significance F: -

R square delineates to what degree the output variables variance is explained by the input variables variance with respect to the real data. Significance F indicates whether the regression output could have been obtained by certain circumstances. The validity of regression output is confirmed by the small significance F value. T value test is conducted to test the significance of variable at 5 % level of significance.

Correlation Coefficient: -

The correlation coefficient (or person correlation coefficient) is often used to access, measure and describe the strength along with the direction of the relationship between two numerical variables. Professionals show proclivity to consider one or more variables from the set of data and their relationships in traffic engineering problems and research works. The relationship between two variables can be statistically measured by the correlation coefficient -1.00 to 1.00 is two extreme end values of the correlation coefficient. The positive coefficient depicts the increasing relationship between two variables and vice versa by negative coefficient. A correlation coefficient of 0 indicates that the movements of the variables are totally random that is an increase in first variable doesn't show any expected directional movement of the variable.

Table 5.2: Result of Validation Test from Statistics

S. N	Model	R square value	F- value	T value	Correlation factor(r)
1	Saturation flow model 1	0.919	0.000	Significance	0.943
2	Saturation flow model 2	0.921	0.000	Significance	0.965
3	Saturation flow model 3	0.930	0.000	Significance	0.975

In Table 5.2, Adjusted R-squared value= 0.930 (i.e. 93.0 % of the variance of original field data is explained by the variance of field data from the multi linear regression.)

Significance F= 0.000 (i.e. there is 0% possibility that the regression output was merely a chance occurrence

T value = all parameter is significant because t- value is either less than -1.96 or greater than 1.96 at 5% level of significance

Correlation coefficient (r) = 0.975 the saturation flow is positively related with the geometric condition

The best fit line as shown in Figure 5.1, 5.2 and 5.3 is also plotted for the proposed models.

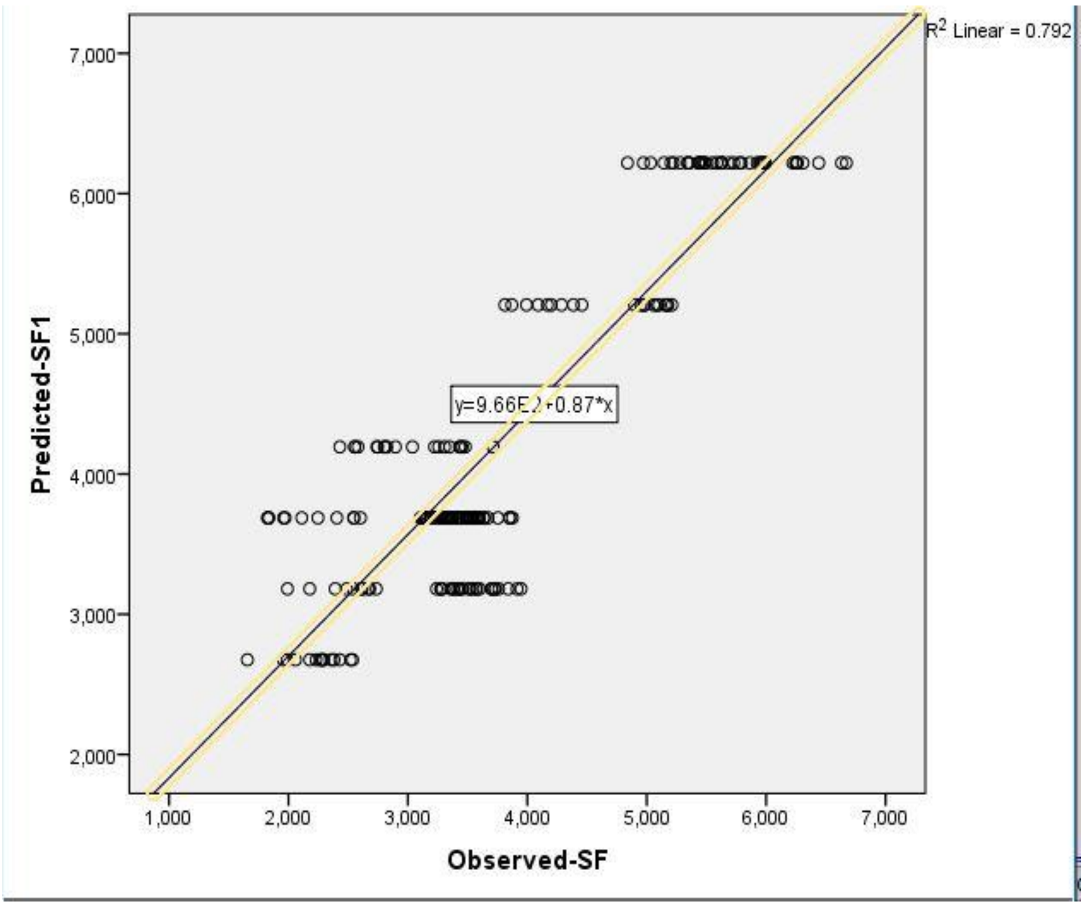

Figure 5.1 Validation of Saturation Flow Model 1

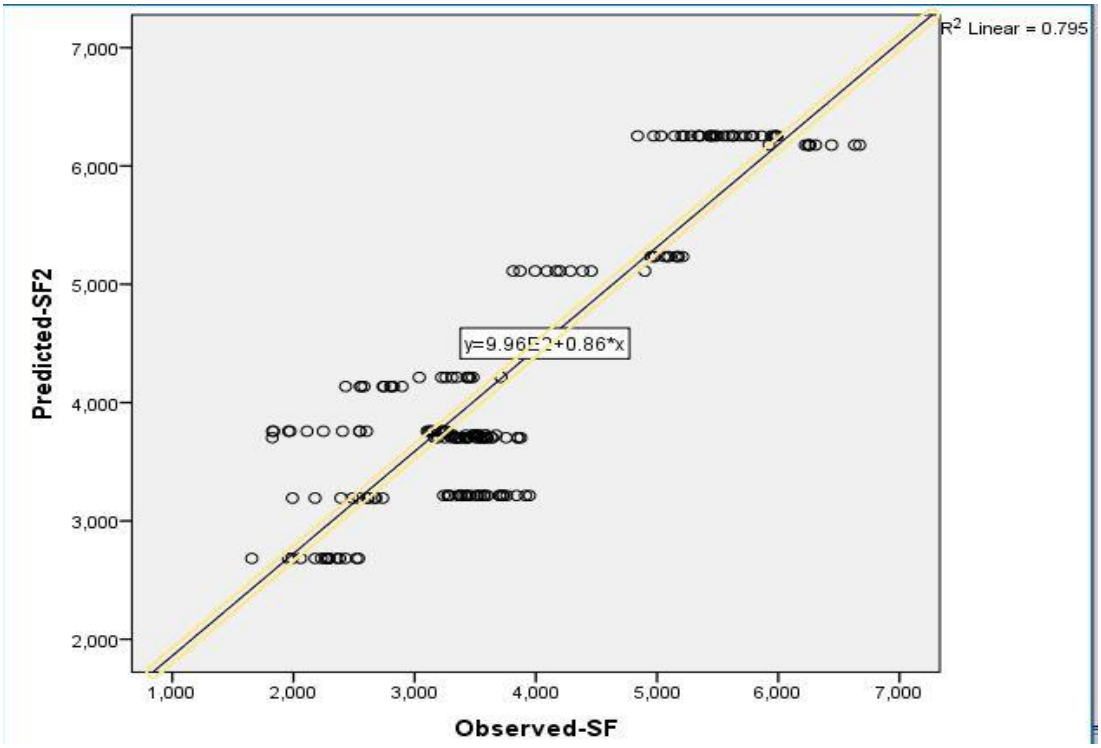

Figure 5.2 Validation of saturation model 2

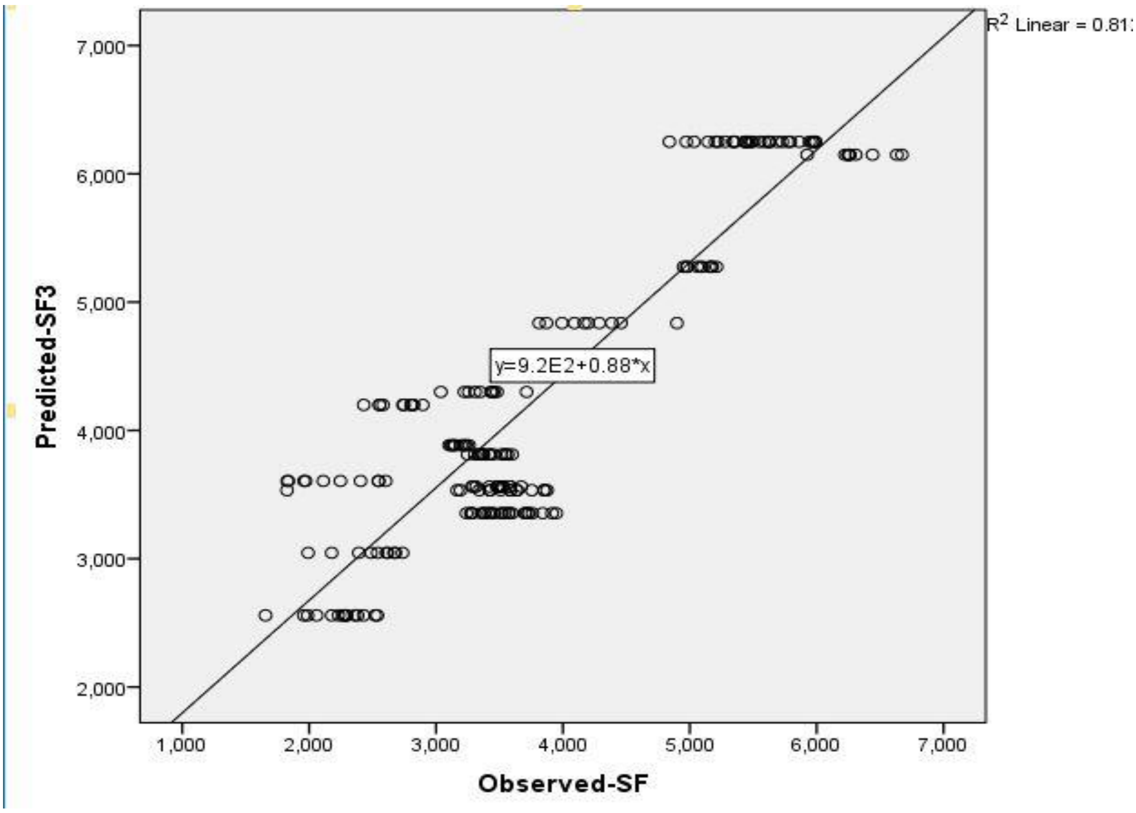

Figure 5.3 Validation of saturation flow model 3

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

This is the study of saturation flow rate at signalized intersections and some influence of factors referring to the methodology of highway capacity manual. The saturation flow model was developed based on the field data collected at three intersections of Kathmandu city. Due to the complexity of influence factors, only part of them are analyzed as lane width, approach grade and turning radius

6.1 Conclusions

i. The regression model developed for saturation flow rate is mainly based on approach width, approach gradient and right turn radius.
ii. Model 1 SF= 143.769+506.247W, Model 2 SF= 143.097+510.162W-22.045G and Model 3 SF=135.371+487.434W-28.439G+0.028R as a best model.
iii. The base saturation flow was taken as 1900 PCU /hr. HCM 2000.
iv. The adjustment factor for width (FW), is given by FW= 1+ (W-3.5)/3.862, where W is the width of lane.
v. The adjustment factor for right turn radius (FR) = 1+14.836*r/1000, where r is the right turning radius of right turning vehicles.
vi. It is found that the lane width and right turning radius has positive effect and saturation flow and the gradient has negative impact on saturation flow rate.
vii. By introducing of the adjustment factors to the proposed model it can give better realistic field values, which will be helpful in obtaining the capacity at signalized intersections which in turn help to assess the level of service (LOS) at signalized intersections, specially under heterogeneous traffic condition.

6.2 Future Work for Other Researchers

i. The regression model developed for saturation flow is fused on traffic data collected for 3 signalized intersections of Kathmandu city. The further study needs to be done considering more intersections.
ii. Saturation flow depends on various factors. In this study, only effect of lane width, approach gradient and right turn radius where considered. All

these factors need to studied and developed new model. Taking into account maximum variables.

iii. The saturation flow model is developed only considering through and right moving vehicles, the effect of left turn vehicles on saturation flow must be checked.

iv. The effect of grade is shown in all selected parameters. It should be checked for the same lane width different gradient.

v. The effect of right turnings should be checked for only right turning movement apart from through movement for better result.

vi. In present study, PCU is considered from JICA survey report 2012 of Kathmandu City. It should be obtained from the individual intersections.

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Appendix A: Data Set for Saturation Flow Estimation from Hatiban to Koteshwor Right at Satdobato Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	16	8	0	1	22	0	0	3960
2	20	10	0	1	26	0	0	3744
3	15	7	0	0	26	0	0	3552
4	16	8	0	1	22	0	0	3960
5	19	9	0	1	23	1	0	3865
6	24	10	1	0	39	0	0	3480
7	26	12	0	1	39	0	0	3697
8	16	8	1	1	20	0	0	4163
9	31	15	0	0	49	0	0	3449
10	22	10	1	1	29	1	0	4042
11	20	8	0	1	39	0	0	4086
12	9	3	0	0	13	1	0	3360
13	16	6	1	0	30	0	0	3713
14	30	10	0	1	46	1	0	3396
15	22	7	1	1	39	0	0	3796
16	15	5	1	1	21	0	0	3792
17	17	8	0	1	24	0	0	3854
18	28	9	1	0	49	1	0	3433
19	25	6	0	1	49	1	0	3629
20	13	2	2	1	19	0	0	3794
21	18	5	0	1	37	0	0	3820
22	23	6	1	1	39	0	0	3475
23	9	4	0	0	12	1	0	3640
24	20	6	0	1	28	0	0	3132
25	24	7	0	1	36	0	0	3120
26	23	8	0	1	35	1	0	3600
27	29	9	1	1	42	0	0	3240
28	15	6	1	0	26	0	0	3672
29	32	10	1	2	42	0	0	3386
30	20	6	0	0	40	0	0	3240
31	19	3	1	1	34	0	0	3354
32	12	3	1	0	20	1	0	3600
33	18	6	1	1	24	0	0	3540
34	28	9	1	2	40	0	0	3664
35	24	8	1	0	36	1	0	3270
36	32	10	1	1	44	1	0	3285
37	20	6	0	1	38	0	0	3672
38	27	10	0	0	44	1	0	3293
39	26	9	1	1	42	0	0	3614

40	15	8	0	0	22	0	0	3504
41	22	7	1	1	32	0	0	3453
42	16	3	1	0	30	1	0	3375
43	17	6	1	0	29	0	0	3431
44	18	6	1	0	34	0	0	3540
45	23	9	1	0	42	0	0	3616
46	28	9	1	1	40	1	0	3471
47	14	3	1	1	22	0	0	3626
48	32	7	2	1	50	1	1	3431
49	23	4	1	1	34	1	0	3162
50	18	6	1	0	30	0	0	3300
51	18	6	1	1	16	1	0	3360
52	17	5	1	0	34	0	0	3536
53	21	7	1	1	26	1	0	3566
54	17	5	0	0	34	0	0	3219
55	21	5	1	0	38	1	0	3326
56	14	4	1	0	27	0	0	3497
57	29	10	0	1	44	1	0	3439
58	25	9	1	1	42	0	0	3758
59	12	4	0	0	22	1	0	3630
60	15	5	1	0	28	0	0	3576
61	17	6	1	0	30	1	0	3812
62	19	5	2	0	31	0	0	3278
63	15	5	1	0	32	0	0	3864
64	16	8	0	0	30	0	0	3825
65	26	8	0	1	42	1	0	3475
66	30	12	1	1	37	0	0	3312
67	12	6	0	0	18	1	0	3870
68	20	7	1	0	37	0	0	3528
69	12	6	0	0	17	1	0	3780
70	33	6	1	1	62	0	0	3175
71	23	7	0	1	48	0	0	3819
72	19	8	0	0	40	0	0	3789
73	15	8	0	0	22	0	0	3504
74	25	9	0	1	40	1	0	3672
75	20	5	1	1	32	0	0	3438
76	29	6	1	1	50	0	0	3166
77	18	6	1	0	32	0	0	3420
78	13	4	0	1	18	1	0	3849
79	14	5	0	0	32	0	0	3754
80	14	5	0	0	2	1	0	1826
81	17	6	1	0	36	0	0	3875
82	18	8	1	0	24	0	0	3340
83	17	8	0	0	34	0	0	3854

84	21	8	0	0	44	0	0	3634
85	27	9	2	0	51	0	0	3640
86	17	6	1	0	29	0	0	3431
87	32	12	2	1	44	0	0	3510
88	26	10	2	0	38	1	0	3586
89	30	11	0	1	42	0	0	3192
90	26	10	1	1	38	0	0	3586

Appendix B: Data Set for Saturation Flow Estimation from Kalanki to Hatiban Right at Satdobato

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	14	2	0	1	22	1	0	3369
2	15	5	1	1	19	0	0	3648
3	30	6	1	2	50	0	1	3540
4	32	7	1	1	60	1	0	3488
5	22	12	1	0	24	0	0	3387
6	23	6	1	1	38	1	0	3663
7	9	4	0	0	11	1	0	3520
8	31	12	2	1	37	1	0	3554
9	24	10	0	1	37	0	0	3615
10	37	13	1	1	57	0	1	3464
11	28	16	1	0	30	1	0	3600
12	28	9	1	0	58	0	0	3587
13	27	10	0	1	48	0	0	3653
14	23	11	0	1	30	0	0	3600
15	22	4	0	1	46	0	0	3404
16	22	6	1	1	40	0	0	3682
17	26	10	1	1	35	1	0	3669
18	30	11	1	2	37	1	0	3732
19	18	6	0	1	27	1	0	3720
20	17	8	0	1	19	0	0	3536
21	16	6	0	0	34	0	0	3645
22	22	10	1	0	32	0	0	3453
23	30	8	1	1	50	1	0	3480
24	17	5	1	1	26	0	0	3664
25	34	10	2	1	50	1	1	3547
26	22	7	1	1	34	0	0	3551
27	20	8	1	0	32	1	0	3708
28	27	13	2	0	37	0	0	3613
29	26	12	1	0	38	0	0	3448
30	35	17	2	0	52	0	0	3662
31	20	8	0	1	32	0	0	3708
32	25	6	2	1	42	0	0	3542
33	25	6	0	2	39	0	1	3557

34	19	7	1	0	29	1	0	3543
35	20	8	1	1	25	0	0	3600
36	15	5	0	1	26	0	0	3792
37	22	13	0	0	31	0	0	3649
38	40	15	1	1	62	0	0	3429
39	10	4	1	0	14	0	1	3852
40	18	6	2	0	24	1	0	3540
41	25	12	0	1	32	0	0	3542
42	14	5	1	0	26	0	0	3677
43	28	12	1	1	37	0	0	3549
44	14	4	1	0	22	1	1	3754
45	30	17	1	0	42	0	0	3732
46	16	7	1	0	16	0	0	2993
47	14	7	0	0	22	0	0	3497
48	15	9	1	0	16	0	0	3672
49	17	10	1	0	20	0	0	3706
50	19	9	0	1	21	0	0	3467
51	10	2	0	1	15	0	0	3420
52	15	5	1	1	17	0	0	3504
53	11	4	0	1	13	0	0	3567
54	10	5	0	0	10	1	0	3420
55	12	5	1	0	15	0	0	3300
56	24	8	2	1	35	0	0	3675
57	41	20	0	1	50	1	0	3468
58	19	9	0	1	25	0	0	3695
59	24	12	1	0	24	1	0	3330
60	27	12	0	0	47	0	0	3480
61	10	5	1	0	10	0	0	3420
62	22	12	0	0	35	0	0	3682
63	18	8	0	0	25	1	0	3400
64	25	7	2	1	36	0	0	3427
65	38	17	1	1	57	0	0	3657
66	19	4	2	1	25	0	0	3316
67	10	5	0	0	10	1	0	3420
68	22	12	1		28	0	0	3584
69	17	6	0	1	25	0	0	3494
70	28	10	2	1	33	1	0	3523
71	15	5	0	0	26	1	1	3672
72	17	8	0	0	25	0	0	3282
73	16	8	0	0	20	1	0	3488
74	17	9	0	1	15	0	0	3494
75	26	13	2	0	26	0	0	3295
76	30	14	1	1	35	0	0	3480
77	19	12	0	0	22	0	0	3524

78	15	9	0	0	14	1	0	3528
79	25	12	0	1	28	1	0	3586

Appendix C: Data Set for Saturation Flow Estimation from Kalanki to Koteshwor through at Satdobato Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	31	17	1	6	41	0	0	5667
2	47	25	5	8	66	0	0	5844
3	52	15	7	8	75	2	0	5192
4	51	35	6	9	72	0	0	6536
5	40	21	5	7	78	3	1	7056
6	61	43	6	8	78	3	0	6132
7	16	8	1	0	16	0	1	3443
8	65	31	2	10	84	0	1	4996
9	46	20	3	10	64	1	2	6042
10	12	4	1	1	12	0	0	3630
11	26	8	4	5	44	1	0	6051
12	61	30	5	8	79	2	2	5323
13	46	33	3	7	62	1	1	6230
14	50	36	5	6	68	3	0	6221
15	56	32	9	8	74	0	1	5959
16	61	36	8	6	78	0	1	5335
17	55	25	6	8	68	1	1	5295
18	53	18	2	12	68	0	0	5257
19	48	27	5	8	64	2	0	6053
20	63	35	6	7	79	0	1	5126
21	59	37	4	9	78	4	0	6065
22	64	31	8	13	81	0	0	5979
23	20	4	1	2	21	2	2	4104
24	58	25	11	11	70	0	0	5928
25	58	38	8	10	76	0	2	6505
26	46	21	4	7	64	2	0	5494
27	50	29	8	7	70	0	0	5976
28	53	22	8	11	66	2	0	6100
29	46	22	6	0	64	4	1	4477
30	66	39	6	6	85	0	0	4991
31	52	31	5	8	71	3	0	6113
32	30	18	5	5	46	0	0	6516
33	51	33	7	8	72	0	3	6501
34	15	8	2	2	18	1	0	5736
35	28	12	2	5	45	2	0	5979
36	48	28	6	1	76	0	0	4710
37	59	29	8	9	78	3	0	5852
38	53	25	7	10	75	0	2	6113

39	50	30	2	10	65	1	0	6048
40	66	32	7	9	83	0	3	5313
41	15	5	3	1	15	0	0	4080
42		31	4	12	82	0	0	5856
43	51	22	5	12	76	1	0	6339
44	60	29	9	12	80	0	1	6210
45	59	37	8	8	89	4	0	6449
46	61	49	1	8	85	0	0	5902
47	71	38	5	9	91	5	2	5542
48	45	22	8	5	92	0	0	6128
49	62	35	10	5	81	6	3	5882
50	27	10	2	4	47	3	1	5947
51	53	29	5	7	73	5	2	6038
52	55	25	7	8	75	2	0	5564
53	30	12	4	4	45	1	0	5400
54	36	15	5	7	51	0	3	6180
55	62	41	8	2	92	0	0	5028
56	18	4	4	3	18	2	0	5480
57	63	31	6	13	83	0	4	6166
58	68	42	2	10	92	3	0	5670
59	68	40	7	7	85	0	5	5400
60	61	35	9	8	81	5	0	6155
61	63	49	10	6	91	0	1	6303
62	60	35	10	5	92	6	0	6096
63	48	26	4	10	67	0	0	6158
64	32	18	2	6	40	2	0	6075
65	52	30	7	4	72	0	1	5199
66	65	37	9	11	85	0	2	6148
67	61	11	7	13	81	3	1	5329
68	51	42	6	6	66	0	0	6268
69	48	28	4	8	60	1	0	5813
70	24	12	6	4	24	0	0	6030
71	50	34	8	0	64	0	2	4838
72	54	38	5	5	70	4	0	5833
73	55	37	5	8	76	0	0	5976
74	63	28	7	7	79	0	2	4869
75	64	38	8	4	85	2	0	5091
76	30	14	4	6	36	0	1	5976
77	57	40	4	7	87	0	1	5943
78	45	27	6	3	62	3	0	5448
79	56	36	5	7	72	1	0	5631
80	32	16	3	5	42	2	2	5974
81	21	10	3	4	18	2	0	5983
82	28	14	5	4	37	0	1	5863

83	52	26	6	6	71	0	0	5144
84	40	20	4	4	60	3	0	5445
85	45	22	8	7	36	0	1	5344
86	45	23	7	6	78	0	0	5992
87	46	21	8	6	64	2	0	5729
88	51	26	9	7	71	0	0	5774
89	50	25	7	7	65	0	3	5688
90	60	40	4	5	85	1	0	5280
91	35	21	5	6	35	0	1	5966
92	40	20	5	4	64	2	0	5553

Appendix D: Data Set for Saturation Flow Estimation from Lagankhel to Hatiban Through

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	30	10	0	1	54	0	0	3504
2	20	5	1	0	40	2	0	3870
3	20	5	0	0	49	1	0	3816
4	21	7	0	0	37	2	0	3617
5	15	5	0	1	22	1	0	3864
6	23	6	0	1	27	2	0	3146
7	22	7	0	0	59	0	0	4042
8	29	7	0	0	59	1	0	3252
9	16	8	0	0	28	0	0	3690
10	41	15	0	1	60	2	0	3424
11	40	12	0	1	74	2	0	3618
12	20	5	0	0	48	0	0	3492
13	19	4	0	0	39	1	0	3259
14	32	13	0	1	58	0	0	3758
15	30	11	0	0	54	2	0	3624
16	10	4	0	0	14	2	0	4032
17	25	4	0	0	62	0	0	3254
18	28	6	0	0	54	2	0	3240
19	25	6	0	2	40	1	0	3672
20	22	6	0	1	37	1	0	3535
21	19	7	0	0	38	0	0	3486
22	10	2	0	1	16	0	0	3528
23	10	2	0	0	28	0	0	3744
24	24	6	0	0	48	2	0	3510
25	25	8	1	0	40	2	0	3528
26	18	6	0	0	36	0	0	3360
27	40	15	1	0	70	0	0	3375
28	40	14	0	1	59	2	0	3393
29	24	5	2	0	44	1	0	3405
30	20	5	1	1	24	2	0	3546

31	37	14	0	1	54	1	0	3376
32	25	6	1	1	44	0	0	3413
33	30	15	0	0	38	2	0	3528
34	35	11	0	0	84	0	0	3723
35	23	6	1	0	49	0	0	3475
36	26	5	0	1	50	0	0	3185
37	15	3	0	1	29	0	0	3528
38	20	5	2	0	23	2	0	3222
39	20	5	1	0	40	0	0	3330
40	22	4	1	0	48	0	0	3256
41	23	5	0	1	44	0	0	3318
42	42	10	1	1	92	0	0	3609
43	38	9	0	1	72	0	0	3183
44	20	5	1	0	38	0	0	3222
45	12	2	0	0	24	2	0	3660
46	35	10	0	0	74	2	0	3621
47	42	14	2	0	77	0	0	3437
48	19	4	0	1	30	2	0	3600
49	40	10	0	0	72	3	0	3249
50	39	10	0	1	74	0	0	3249
51	24	6	2	0	48	0	0	3510
52	25	7	0	0	55	0	0	3384
53	24	6	0	1	38	1	0	3285
54	11	1	0	1	21	1	0	3862
55	10	2	0	1	21	0	0	4068
56	20	5	0	0	40	2	0	3600
57	22	5	0	1	50	0	0	3764
58	21	4	0	1	42	0	0	3360
59	25	6	1	0	50	1	0	3456
60	40	10	0	2	57	2	0	3249
61	30	8	1	0	48	3	0	3408
62	15	3	1	1	28	0	0	3816
63	34	9	1	0	55	2	0	3176
64	41	10	2	0	72	1	0	3170
65	36	9	1	0	67	1	0	3210
66	25	5	0	0	50	2	0	3312
67	40	10	0	0	74	2	0	3168
68	41	10	1	1	72	0	0	3170
69	35	8	1	0	67	1	0	3199
70	16	3	0	0	38	1	0	3578
71	20	5	2	0	38	0	0	3492
72	42	10	0	0	87	3	0	3480
73	20	5	0	0	36	2	0	3384
74	36	9	0	0	72	2	0	3360

75	41	11	1	1	76	0	0	3363
76	44	15	0	0	84	0	0	3289
77	36	15	0	0	48	2	0	3240
78	42	21	1	0	62	0	0	3523
79	26	10	0	1	32	2	0	3545
80	32	15	0	1	37	0	0	3274
81	17	5	0	0	30	2	0	3600
82	29	6	0	1	58	0	0	3277
83	20	6	1	0	40	0	0	3510
84	19	6	0	0	40	0	0	3411
85	13	2	0	1	24	0	0	3378
86	15	3	0	0	38	0	0	3456
87	12	2	0	1	18	1	0	3570
88	17	3	1	0	39	0	0	3431
89	16	3	1	0	38	0	0	3578
90	20	5	0	1	31	1	0	3384

Appendix E: Data Set for Saturation Flow Estimation from Koteshwor to Lagankhel Right at Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	17	3	0	1	11	0	1	2181
2	17	2	0	0	15	1	2	2118
3	37	6	0	2	35	0	2	2384
4	16	2	0	0	14	1	2	2183
5	36	6	0	2	40	0	0	2400
6	17	1	1	1	10	0	0	1800
7	22	4	0	1	25	0	1	2536
8	22	3	0	0	25	0	2	2045
9	17	3	1	1	13	0	0	2414
10	24	4	0	1	25	0	0	2175
11	16	1	0	0	13	0	0	1103
12	16	1	0	1	9	0	0	1508
13	14	1	0	0	13	0	2	1774
14	12	2	0	0	14	0	1	2160
15	14	1	0	1	7	0	1	1826
16	17	2	0	1	17	0	0	2139
17	11	1	0	0	9	0	1	1538
18	23	4	0	1	25	1	0	2504
19	22	3	0	1	15	0	1	1882
20	19	2	0	1	19	0	2	2406
21	17	4	1	1	14	0	1	2901
22	22	4	0	1	20	0	1	2291
23	19	2	0	1	19	0	0	2027
24	22	4	0	1	24	0	1	2487

25	11	1	0	0	9	1	1	2029
26	20	2	0	1	20	0	2	2340
27	18	2	1	1	17	0	0	2320
28	16	1	0	1	14	1	0	2183
29	15	1	0	1	12	0	0	1824
30	14	1	1	1	10	0	1	2443
31	17	3	0	1	17	0	1	2562
32	14	2	0	1	13	0	0	2289
33	32	4	0	1	35	1	2	2363
34	19	2	0	1	19	0	2	2406
35	17	2	0	1	15	0	1	2224
36	18	3	0	0	19	0	2	2140
37	16	1	0	0	13	0	2	1553
38	21	3	0	1	24	1	0	2520
39	19	3	0	1	19	0	1	2406
40	20	3	0	0	15	0	0	1350
41	16	1	1	1	12	0	0	2048
42	17	2	0	1	13	0	2	2308
43	19	2	0	1	14	0	2	2122
44	17	2	0	0	15	0	3	2012
45	16	3	0	1	12	0	1	2385
46	14	2	0	1	9	0	1	2237
47	15	2	1	1	8	0	0	2136
48	22	4	0	1	24	0	1	2487
49	19	3	0	0	24	0	3	2501
50	28	4	1	1	25	1	2	2507
51	19	3	0	0	20	0	2	2084
52	24	4	1	1	22	0	2	2565
53	18	2	0	1	14	0	2	2240
54	27	4	0	2	28	0	0	2453
55	20	2	0	1	21	0	1	2214
56	18	2	0	0	17	1	2	2120
57	18	2	0	1	13	0	3	2380
58	18	3	0	1	9	0	4	2540
59	22	4	0	1	18	0	2	2356
60	17	2	0	1	16	0	1	2287
61	16	1	0	1	14	1	1	2408
62	13	2	0	1	11	0	0	2298
63	18	2	0	1	11	0	1	1860
64	23	3	1	1	28	0	0	2489
65	22	3	0	1	20	0	3	2455
66	17	2	0	1	12	1	1	2351
67	18	2	0	1	17	0	1	2220
68	15	1	0	0	14	0	0	1248

69	18	2	0	1	17	0	1	2220
70	17	2	0	1	9	1	0	1948
71	21	3	0	1	22	0	0	2160
72	19	3	0	1	14	0	0	1933
73	18	2	1	1	17	0	0	2320
74	20	4	0	0	18	1	2	2322
75	17	4	0	0	10	0	2	1906
76	29	6	0	1	30	0	1	2359
77	31	7	0	1	35	0	0	2381
78	19	3	2	0	17	0	1	2293
79	21	4	0	1	12	0	1	1989
80	20	5	0	1	15	0	1	2430
81	22	6	0	0	15	1	2	2291
82	28	6	1	1	27	0	1	2520
83	25	5	0	1	21	0	0	2059
84	21	3	0	0	24	1	1	2177
85	34	7	1	0	40	0	1	2276
86	17	2	0	1	14	1	0	2266
87	16	2	0	1	9	0	1	1958
88	22	4	0	1	20	1	1	2536
89	15	2	0	0	13	0	1	1656
90	15	3	1	0	16	0	0	2232

Appendix F: Data Set for Saturation Flow Estimation from Koteshwor to Kalanki through at Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	50	35	3	4	75	1	0	5436
2	61	35	5	7	91	1	0	5447
3	58	34	6	6	92	0	0	5499
4	52	23	5	8	79	1	0	5518
5	51	19	1	10	91	0	0	5492
6	63	32	4	9	90	1	0	5343
7	61	33	3	7	100	0	0	5223
8	60	43	2	5	130	1	0	6090
9	53	34	0	6	100	1	0	5672
10	56	31	3	6	102	0	0	5406
11	36	23	3	5	67	0	0	6260
12	38	19	2	4	65	0	0	5068
13	61	28	4	13	65	0	0	5459
14	42	36	2	8	86	1	0	7740
15	20	11	3	4	25	0	0	6300
16	42	23	4	5	72	0	0	5623
17	45	33	3	3	60	0	0	5160
18	61	40	4	7	100	0	0	5725

19	58	43	3	5	102	0	0	5779
20	56	44	3	4	98	0	0	5779
21	45	25	4	5	95	0	0	5960
22	46	24	5	5	94	0	0	5846
23	62	41	7	6	112	0	0	5986
24	55	42	0	7	102	0	0	6127
25	60	44	0	7	118	0	0	6024
26	59	44	0	8	108	0	0	6126
27	57	32	4	3	100	0	0	4863
28	41	25	5	4	87	0	0	6199
29	42	20	4	6	85	0	0	5957
30	31	25	0	4	61	0	0	6422
31	42	41	0	4	84	0	0	6703
32	22	12	2	3	29	0	0	5351
33	40	25	4	5	78	1	0	6381
34	41	33	3	3	76	0	0	6085
35	44	41	0	2	91	0	0	6079
36	53	44	3	1	102	0	0	5577
37	40	22	2	6	50	0	0	5220
38	47	26	3	4	95	0	0	5438
39	46	23	2	6	93	0	0	5627
40	52	36	3	4	105	0	0	5815
41	66	38	4	4	115	0	0	4936
42	55	49	0	3	135	0	0	6447
43	54	44	0	5	109	0	0	6113
44	44	32	0	3	110	0	0	6055
45	56	28	4	5	87	1	1	4989
46	42	32	4	3	78	0	0	6034
47	39	29	2	4	69	0	0	5972
48	45	22	6	3	95	0	0	5480
49	20	8	4	1	35	0	0	4950
50	55	35	6	5	110	0	0	6022
51	51	42	1	4	80	0	0	5612
52	52	34	4	5	92	0	0	5718
53	45	23	5	1	90	1	0	4960
54	48	19	1	5	95	1	0	4913
55	61	32	9	5	112	1	0	5642
56	65	33	3	7	129	0	0	5383
57	50	43	4	1	94	1	0	5882
58	62	34	7	11	105	1	0	6416
59	61	31	3	8	113	0	0	5512
60	35	23	3	2	79	0	0	5883
61	60	19	6	8	90	2	1	4980
62	58	38	4	7	92	0	0	5748

63	42	36	0	3	75	0	0	5786
64	21	11	3	3	25	0	0	5486
65	46	23	4	7	76	0	0	5697
66	48	33	3	3	90	1	0	5625
67	51	40	4	1	92	0	0	5407
68	55	35	5	4	95	0	0	5433
69	58	37	6	3	98	1	0	5332
70	42	26	5	1	82	1	0	5366
71	41	22	1	4	80	0	0	5224
72	49	36	5	3	75	1	0	5620
73	61	33	3	3	110	1	1	4839
74	58	53	0	1	100	1	0	5431
75	55	33	7	5	95	1	0	5793
76	61	46	3	3	112	0	0	5494
77	53	40	3	3	77	0	0	5203
78	41	22	5	3	75	0	0	5356
79	32	25	0	2	55	0	0	5344
80	43	32	4	2	66	1	0	5467
81	21	10	3	1	30	1	1	4971
82	38	26	4	3	60	0	0	5589
83	41	32	0	3	77	0	0	5628
84	44	34	3	1	85	0	0	5482
85	49	32	4	3	90	0	0	5437
86	51	26	5	7	56	0	0	5033

Appendix G: Data Set for Saturation Flow PCU Estimation from Hatiban to Lagankhel through at Satdobato Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	45	20	1	1	62	1	0	3648
2	42	18	0	1	54	1	0	3446
3	46	20	1	2	50	2	0	3639
4	42	17	0	1	57	1	0	3437
5	44	18	0	2	54	2	0	3657
6	43	18	0	0	63	2	0	3466
7	52	21	0	2	68	1	0	3489
8	55	23	1	2	61	2	0	3456
9	31	8	0	0	62	1	0	3437
10	35	12	0	2	42	3	0	3765
11	26	10	0	0	40	1	0	3462
12	42	19	0	1	52	2	0	3609
13	32	12	1	1	40	2	0	3656
14	55	19	1	2	75	1	1	3436
15	21	9	0	0	25	2	0	3600
16	54	22	1	1	72	2	0	3473

17	42	16	0	0	75	1	0	3557
18	39	15	1	1	48	1	0	3360
19	46	18	1	2	54	2	0	3577
20	38	14	1	0	57	1	0	3325
21	43	14	0	1	65	2	0	3433
22	40	14	0	1	65	0	0	3420
23	56	28	0	1	70	2	0	3632
24	52	27	0	1	66	1	0	3655
25	53	23	1	1	72	1	0	3505
26	49	21	0	0	76	3	0	3659
27	45	22	0	0	74	1	0	3776
28	39	18	0	1	52	0	0	3517
29	56	24	0	2	72	1	0	3510
30	44	17	0	2	56	1	0	3502
31	45	21	0	1	57	1	0	3528
32	48	21	1	1	54	2	0	3428
33	50	26	0	1	52	1	0	3427
34	41	18	0	0	53	2	0	3372
35	41	19	0	1	53	0	0	3460
36	55	26	0	2	67	0	0	3508
37	58	23	1	2	70	2	0	3445
38	42	15	0	2	57	1	0	3523
39	41	14	0	1	58	3	0	3547
40	55	28	0	1	57	2	0	3443
41	48	23	0	1	67	1	0	3683
42	59	32	0	1	72	0	0	3545
43	49	29	0	1	51	0	0	3585
44	41	20	1	1	43	1	0	3503
45	39	18	0	0	61	1	0	3628
46	24	10	0	1	27	1	0	3615
47	42	18	0	0	57	3	0	3523
48	45	25	0	1	47	1	0	3608
49	45	21	2	1	47	1	0	3448
50	46	18	0	2	65	0	0	3522
51	48	16	1	1	70	2	0	3413
52	41	15	1	2	53	1	0	3591
53	41	13	0	1	70	0	0	3380
54	49	18	1	1	70	2	0	3490
55	51	17	0	2	73	2	0	3487
56	45	14	1	2	57	2	0	3408
57	50	19	0	2	62	1	0	3355
58	52	16	1	3	64	1	0	3337
59	46	13	0	2	68	1	0	3318
60	41	11	0	2	66	1	0	3495

61	45	12	0	2	67	1	0	3288
62	46	17	0	2	68	0	0	3514
63	48	15	0	2	71	2	0	3510
64	42	15	0	2	63	0	0	3549
65	51	25	0	0	63	1	0	3311
66	48	23	0	0	63	2	0	3480
67	40	12	0	0	75	1	0	3375
68	45	15	0	2	68	1	0	3552
69	55	18	0	1	90	0	0	3240
70	35	12	1	2	47	0	0	3559
71	33	8	0	2	48	1	1	3535
72	46	15	0	2	65	2	0	3522
73	42	16	0	1	54	2	0	3403
74	28	7	0	1	51	0	0	3446
75	29	12	0	0	41	0	0	3203
76	42	17	0	2	47	2	0	3566
77	41	18	0	1	45	2	0	3424
78	53	25	0	1	67	0	0	3369
79	43	18	0	1	60	1	0	3516
80	48	20	0	2	61	1	0	3548
81	52	23	0	1	64	1	0	3337
82	39	13	0	1	65	0	0	3415
83	49	19	1	2	56	1	0	3365
84	48	15	1	1	80	1	0	3450
85	46	24	0	2	46	0	0	3545
86	41	21	1	1	35	0	0	3249
87	29	14	0	1	35	0	0	3600
88	42	18	0	0	60	1	0	3343
89	49	23	1	1	50	1	0	3306
90	32	12	0	0	55	0	0	3375

Appendix H: Data Set for Saturation Flow Estimation from Airport to Mitrapark Right at Gaushala Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	35	8	1	4	55	0	0	3909
2	20	2	0	3	34	1	0	4086
3	20	5	0	3	15	0	0	3330
4	30	15	0	2	40	0	0	3960
5	22	7	0	2	27	0	0	3453
6	20	3	0	3	28	1	0	3942
7	21	10	0	3	15	0	0	4029
8	22	6	0	1	39	1	0	3633
9	15	3	0	2	22	1	0	4104
10	19	7	0	2	20	1	1	4074
11	20	7	0	2	25	0	0	3690
12	30	12	0	4	30	1	0	4140
13	22	6	1	2	37	1	0	4271
14	19	7	0	1	32	1	1	4187
15	16	7	0	1	20	2	0	4275
16	20	6	0	3	35	0	0	4590
17	26	10	0	4	30	0	0	4292
18	21	5	0	2	35	2	0	4200
19	25	9	0	3	23	3	0	4234
20	25	8	0	1	40	3	0	3960
21	30	9	0	4	32	2	1	4152
22	20	9	0	2	25	0	0	4050
23	21	8	0	0	40	2	0	3943
24	23	5	0	4	30	0	0	4070
25	30	10	0	3	40	1	0	3900
26	18	4	0	2	30	0	0	3800
27	22	7	0	3	28	1	0	4238
28	35	19	0	2	41	0	0	3837
29	23	11	0	2	28	1	0	4210
30	15	3	2	1	30	0	0	4320
31	27	10	0	3	35	1	0	4133
32	18	6	0	1	36	1	0	4260
33	23	10	0	2	40	0	0	4383
34	30	10	0	3	46	1	1	4236
35	15	4	0	2	19	1	0	4128
36	25	4	0	3	35	1	0	3600
37	22	8	0	1	42	0	0	3862
38	16	6	2	1	8	2	0	3915
39	19	6	0	3	18	0	0	3865
40	26	8	0	2	55	0	0	4223

41	14	9	0	0	22	1	0	4397
42	25	7	0	3	33	0	0	3730
43	18	5	0	2	34	1	0	4540
44	12	4	0	1	12	2	0	4080
45	20	9	0	2	22	0	0	3888
46	22	13	0	1	22	1	0	3944
47	15	6	0	1	30	0	0	4320
48	20	2	0	5	17	2	0	4518
49	21	2	0	2	11	2	0	2451
50	23	11	0	2	30	0	0	4070
51	28	9	1	4	32	4	0	4899
52	27	9	0	3	45	0	0	4200
53	22	4	0	4	30	0	0	4091
54	17	6	0	2	20	0	0	3812
55	20	4	0	3	20	1	1	3870
56	32	6	0	3	72	1	0	4286
57	22	7	0	3	31	1	0	4385
58	22	4	0	3	33	1	0	3993
59	21	8	1	1	40	1	0	4457
60	19	7	1	1	30	1	0	4168

Appendix I: Data Set for Saturation Flow Estimation from Mitrapark to old Baneshwor Through at Gaushala Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	22	9	0	1	23	0	1	3256
2	32	14	0	2	24	1	0	3229
3	35	15	0	1	29	2	2	3261
4	22	12	0	0	24	0	1	3305
5	32	11	0	2	28	1	1	3139
6	34	14	0	1	31	2	1	3208
7	15	5	0	0	26	0	1	3312
8	35	16	0	0	35	2	2	3240
9	32	13	0	0	44	2	0	3285
10	24	9	0	2	13	0	2	3135
11	20	9	0	0	28	1	0	3402
12	22	10	1	0	22	0	1	3125
13	25	8	1	1	20	1	2	3168
14	26	15	0	0	28	0	0	3240
15	15	11	0	0	8	0	0	3216
16	16	5	1	0	18	1	1	3240
17	19	9	0	0	20	0	2	3221
18	16	8	1	0	8	1	1	3240
19	14	4	0	1	11	0	2	3163

20	25	11	1	0	28	0	1	3154
21	14	9	0	0	8	0	1	3189
22	36	14	1	2	24	1	1	3120
23	25	8	0	3	15	0	1	3240
24	14	3	0	0	15	2	2	3214
25	14	2	1	0	16	2	2	3420
26	22	7	0	1	30	1	0	3355
27	13	8	0	0	10	1	0	3462
28	20	10	0	0	11	2	1	3114
29	25	11	0	1	28	0	0	3226
30	16	9	0	0	8	1	2	3353
31	24	14	0	0	20	1	0	3225
32	23	8	0	2	21	0	1	3334
33	9	3	0	0	11	1	2	3920
34	15	2	0	1	11	2	2	3192
35	18	7	0	1	17	0	1	3220
36	14	8	0	0	10	1	1	3471
37	22	10	0	0	14	2	2	3142
38	11	4	0	0	10	2	0	3273
39	22	8	0	1	23	1	1	3338
40	14	8	0	0	7	1	1	3240
41	17	11	0	0	5	1	2	3388
42	16	7	0	1	16	0	0	3330
43	18	7	0	0	18	1	2	3180
44	10	5	1	0	8	0	1	3564
45	18	8	0	0	18	1	2	3380
46	17	8	0	0	15	1	2	3388
47	14	5	0	0	16	1	1	3163
48	18	9	1	0	18	0	0	3180
49	22	11	0	0	12	2	2	3207
50	22	10	1	0	18	1	1	3175
51	20	9	0	1	18	0	0	3132
52	16	8	0	0	11	0	3	3218
53	16	5	0	1	14	0	2	3195
54	15	4	2	0	10	0	3	3120
55	24	9	0	0	25	2	2	3225
56	18	5	0	1	21	0	2	3260
57	20	12	0	0	20	0	0	3240
58	24	10	0	0	20	2	2	3150
59	29	14	1	0	20	1	2	3103
60	15	7	0	1	7	0	1	3144

Appendix J: Data Set for Saturation Flow Estimation from old Baneshwor to Mitrapark Through at Gaushala Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	41	8	1	0	51	1	1	2397
2	23	3	0	1	35	0	0	2583
3	19	4	0	0	32	0	1	2766
4	21	4	0	0	24	1	1	2349
5	23	8	0	0	33	0	0	2802
6	37	8	0	1	51	1	0	2705
7	32	9	0	0	40	1	1	2644
8	30	7	0	1	44	1	0	2964
9	22	8	1	0	25	0	0	2782
10	20	6	0	0	23	1	1	2772
11	18	7	0	0	14	1	1	2740
12	23	8	0	1	18	0	1	2723
13	25	6	0	0	30	1	2	2664
14	21	6	0	0	31	1	0	2880
15	18	4	0	1	8	0	2	2280
16	37	9	1	0	40	2	2	2676
17	22	5	0	0	25	0	1	2209
18	16	6	0	0	20	0	0	2700
19	19	4	1	0	25	0	1	2653
20	31	10	0	0	35	1	3	2903
21	17	4	1	0	24	0	0	2689
22	20	8	0	0	15	1	0	2520
23	15	5	0	0	10	1	0	2280
24	27	5	0	0	35	1	1	2400
25	18	4	0	1	15	1	0	2600
26	32	8	0	0	33	2	3	2689
27	37	7	1	0	45	2	3	2724
28	31	9	0	0	35	1	3	2787
29	19	11	0	0	23	1	0	3676
30	23	4	0	1	23	2	0	2645
31	21	5	0	0	20	1	0	2143
32	33	8	0	1	43	1	1	2880
33	17	8	0	0	20	0	0	2965
34	24	4	2	1	25	0	0	2625
35	28	9	0	0	35	1	0	2700
36	27	7	0	0	28	2	2	2720
37	16	4	0	0	24	1	0	2858
38	42	15	0	1	42	1	2	2923
39	21	7	0	0	25	0	1	2657
40	23	4	0	1	33	1	0	2880

41	19	5	0	1	22	0	0	2766
42	23	5	0	1	25	1	0	2661
43	37	9	0	1	51	1	1	2899
44	32	8	0	1	35	0	3	2756
45	30	7	0	0	35	2	2	2700
46	22	9	1	0	25	0	0	2945
47	20	6	0	0	25	1	0	2700
48	37	7	1	0	52	2	0	2637
49	22	8	0	0	22	1	0	2635
50	41	4	2	1	50	3	1	2678
51	23	4	0	0	45	0	0	2739
52	19	5	0	0	33	0	0	2823
53	41	5	2	1	55	3	0	2810
54	23	3	0	0	45	0	0	2583
55	19	4	0	0	35	0	0	2747
56	21	5	0	0	28	1	0	2554
57	23	8	0	0	25	0	3	2896
58	37	7	0	1	51	1	2	2802
59	32	6	0	1	32	0	3	2430
60	31	7	0	0	30	2	3	2555

Appendix K: Data Set for Saturation Flow Estimation from Mitrapark to Gyaneshwor Right at Gaushala Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	13	4	0	0	13	0	0	2188
2	20	6	0	0	6	2	0	1944
3	18	5	1	0	8	1	0	2080
4	14	4	0	0	14	0	0	2109
5	21	7	1	0	17	0	0	2331
6	31	8	0	0	16	1	0	1661
7	18	5	0	0	13	0	0	1780
8	38	4	0	0	31	2	0	1544
9	29	3	0	1	19	0	2	1701
10	14	2	1	0	3	1	0	1517
11	19	4	0	0	8	0	0	1213
12	22	4	0	0	31	1	0	2422
13	21	3	1	0	22	1	0	2160
14	37	5	0	0	18	0	0	1012
15	18	5	0	1	4	1	0	2140
16	14	5	0	0	8	1	0	2289
17	22	4	1	1	19	0	0	2324
18	25	7	0	0	17	0	0	1742
19	22	4	0	1	23	0	0	2275

20	26	8	0	0	17	1	0	2022
21	32	8	0	0	29	2	0	2216
22	23	8	0	0	17	0	0	2050
23	23	9	0	0	8	0	0	1784
24	27	9	0	0	24	0	0	2160
25	22	8	0	0	16	1	0	2340
26	34	9	0	1	21	0	0	1938
27	14	5	1	0	8	1	0	2674
28	16	6	0	0	16	0	0	2430
29	32	13	0	0	18	0	0	2070
30	23	8	0	0	20	0	0	2191
31	32	8	0	0	24	0	0	1710
32	21	5	0	0	17	1	0	1989
33	24	9	0	0	15	0	0	2025
34	25	8	2	1	11	0	0	2491
35	15	3	0	0	17	1	0	2304
36	26	8	0	0	23	0	1	2202
37	26	5	0	0	9	1	0	1274
38	9	3	0	0	10	0	0	2400
39	29	7	2	0	26	1	0	2396
40	16	4	0	0	18	1	0	2453
41	20	6	0	0	24	0	1	2556
42	18	5	1	1	7	0	0	2320
43	29	5	0	0	35	1	0	2110
44	24	5	0	1	31	0	0	2595
45	12	3	0	0	10	0	0	1800
46	27	6	0	0	35	1	1	2533
47	30	8	1	0	32	1	0	2472
48	24	5	0	0	35	0	1	2475
49	27	4	0	1	20	1	0	1933
50	23	5	0	1	29	0	0	2614
51	26	7	1	0	26	1	1	2603
52	28	12	0	0	26	0	0	2546
53	21	4	0	0	20	1	0	1971
54	34	8	0	0	35	0	0	1959
55	10	2	0	0	7	0	1	1836
56	26	7	1	1	23	0	0	2548
57	26	9	0	0	9	1	0	1828
58	22	9	0	0	19	0	0	2405
59	25	9	0	0	17	1	0	2246
60	22	3	0	1	23	0	0	2111

Appendix L: Data Set for Saturation Flow Estimation from Airport to Gyaneshwor through at Gaushala Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	35	8	1	0	56	0	1	2808
2	22	4	0	1	42	0	0	3207
3	18	5	0	0	32	1	1	3420
4	20	6	0	0	25	1	1	2880
5	22	5	1	0	33	1	0	2929
6	36	10	0	1	55	1	0	3100
7	31	9	1	0	44	0	1	2868
8	33	8	0	1	44	1	0	2804
9	22	8	1	0	27	0	0	2880
10	20	5	0	0	28	1	1	2862
11	18	7	1	0	16	1	1	3160
12	23	8	0	1	24	0	1	3005
13	25	8	1	0	30	1	2	3168
14	21	6	0	0	32	1	0	2931
15	18	4	0	1	18	1	2	3180
16	37	9	1	1	46	0	2	2851
17	23	5	1	1	28	0	1	2958
18	16	6	0	0	25	0	0	3038
19	19	3	1	1	25	0	1	3032
20	31	10	0	0	35	1	0	2555
21	17	4	1	0	24	0	0	2689
22	20	8	1	0	20	1	0	3060
23	15	5	0	1	10	1	0	3000
24	27	5	0	1	35	1	1	2800
25	18	4	0	1	16	1	0	2660
26	32	8	0	0	23	2	1	2126
27	37	7	1	1	45	2	0	2724
28	31	9	1	0	46	1	0	2996
29	18	11	0	0	23	1	0	3880
30	23	4	0	1	29	2	0	2927
31	21	7	1	0	20	1	0	2743
32	33	8	0	1	43	1	1	2880
33	17	8	0	0	20	0	0	2965
34	24	4	2	1	25	0	0	2625
35	28	9	0	0	35	1	0	2700
36	27	7	0	0	28	2	2	2720
37	16	4	0	0	24	1	0	2858
38	40	15	0	1	42	1		2889
39	21	7	0	0	32	0	1	3017
40	22	4	0	1	33	1	0	3011

41	19	6	0	1	22	0	0	2956
42	23	5	0	1	35	1	1	3287
43	37	9	0	1	56	1	1	3045
44	25	8	0	1	35	0	0	3096
45	33	7	0	1	42	2	2	3011
46	22	9	1	0	33	0	0	3338
47	20	6	0	0	29	1	0	2916
48	37	7	1	0	59	2	0	2841
49	22	8	1	0	22	1	0	2880
50	36	4	2	1	58	0	1	2840
51	23	4	0	0	49	1	0	3162
52	19	5	1	1	33	0	0	3676
53	35	5	2	1	55	0	0	2829
54	23	3	0	0	45	0	0	2583
55	19	4	0	0	35	0	0	2747
56	21	5	0	0	28	1	0	2554
57	23	8	0	1	29	0	0	3083
58	36	7	0	1	60	1	2	3150
59	32	8	1	1	39	1	0	2891
60	31	7	1	1	43	1	0	3008

Appendix M: Data Set for Saturation Flow Estimation from Gyaneshwor to Airport through at Gaushala Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	21	8	0	1	28	1	0	3583
2	31	12	1	0	29	1	0	2752
3	34	15	0	1	35	0	2	3229
4	20	12	0	0	28	0	1	3852
5	30	12	0	2	25	1	1	3360
6	32	15	0	1	39	0	0	3341
7	16	4	0	0	35	0	1	3488
8	33	15	0	0	39	2	0	3240
9	29	12	0	0	46	0	0	3203
10	24	9	0	2	19	0	0	3105
11	20	9	0	0	29	1	0	3456
12	22	10	1	0	22	0	1	3125
13	25	8	1	1	20	1	2	3168
14	25	13	0	0	28	0	0	3082
15	15	11	0	0	8	0	0	3216
16	16	5	1	0	18	1	1	3240
17	20	8	0	0	20	0	0	2520
18	16	8	1	0	8	1	1	3240
19	14	4	0	1	15	0	2	3471

20	25	10	1	0	28	0	1	3010
21	14	9	0	0	8	0	1	3189
22	36	12	1	2	24	1	1	2920
23	25	8	0	3	15	0	1	3240
24	14	3	0	0	15	2	2	3214
25	14	2	1	0	16	2	0	2906
26	22	7	0	1	33	1	0	3502
27	13	6	0	0	12	1	0	3074
28	20	10	0	0	11	2	1	3114
29	25	11	0	1	28	0	0	3226
30	16	7	0	0	8	1	1	2678
31	24	14	0	0	20	1	0	3225
32	23	8	0	2	21	0	1	3334
33	11	4	0	0	11	1	2	3535
34	15	3	0	1	11	2	2	3432
35	20	8	0	1	19	0	1	3186
36	14	8	0	0	12	1	1	3626
37	22	10	0	0	13	2	0	2765
38	11	5	0	0	12	2	0	3796
39	24	8	0	1	29	1	1	3330
40	14	8	0	0	8	1	1	3317
41	17	11	0	0	8	1	0	3155
42	16	7	0	1	19	0	0	3533
43	21	7	0	0	20	1	2	2829
44	10	6	1	0	10	0	0	3780
45	19	8	0	0	22	1	2	3429
46	17	8	0	0	18	1	2	3579
47	14	4	0	0	16	1	1	2906
48	18	9	1	0	23	0	0	3480
49	21	11	0	0	14	1	2	3206
50	22	10	1	0	22	1	1	3371
51	20	9	0	1	23	0	0	3402
52	17	8	0	0	12	0	0	2456
53	16	5	0	1	16	0	2	3330
54	15	4	2	0	12	0	0	2544
55	25	9	0	0	28	2	2	3226
56	18	6	0	1	23	0	2	3580
57	20	12	0	0	20	0	0	3240
58	25	9	0	0	24	2	2	3053
59	30	12	1	0	20	1	0	2520
60	18	6	0	1	22	0	1	3320

Appendix N: Data Set for Saturation Flow Estimation from Dhumbarahi to Basundhara through at Narayan Gopal Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	16	6	1	3	16	0	0	4793
2	21	7	0	4	23	2	0	4954
3	25	11	1	5	29	0	0	5213
4	20	12	1	3	18	1	0	5292
5	17	8	1	2	26	1	0	5252
6	16	6	0	3	18	2	0	5265
7	19	11	0	3	26	0	0	5267
8	16	11	0	3	17	1	0	5985
9	32	16	2	7	36	1	0	5884
10	21	10	0	5	22	1	0	5674
11	17	12	0	2	24	1	0	5654
12	19	6	0	4	37	1	0	5798
13	23	8	1	5	35	2	0	5948
14	14	4	1	4	17	0	0	5811
15	24	12	0	3	43	3	0	5760
16	19	13	0	3	24	0	0	5533
17	23	8	2	4	25	1	0	5009
18	28	6	1	9	28	1	0	5709
19	20	12	1	3	14	1	0	5076
20	23	8	1	4	35	1	0	5243
21	23	7	1	3	35	3	0	5087
22	12	3	1	3	9	1	0	5310
23	20	12	0	2	30	2	0	5400
24	17	8	1	2	22	2	0	5315
25	23	8	2	5	23	2	0	5619
26	17	14	1	0	27	1	0	5315
27	18	12	3	1	22	1	0	5520
28	19	8	0	5	18	0	0	5381
29	38	19	2	9	29	0	0	5466
30	25	8	3	5	27	0	0	5126
31	20	4	1	4	23	1	0	4662
32	25	10	0	6	22	3	0	5630
33	25	6	0	7	28	2	0	5530
34	29	7	0	8	30	0	0	4966
35	15	8	1	2	19	0	0	5088
36	25	5	1	4	42	3	0	5126
37	23	5	1	4	28	3	0	4915
38	19	7	1	2	40	0	0	5021
39	18	7	0	5	11	1	0	5360
40	21	5	1	6	15	1	0	5229

41	30	13	2	4	45	1	0	5160
42	29	5	3	6	35	1	0	4903
43	33	8	2	5	14	2	0	3622
44	15	7	2	1	28	1	0	5496
45	38	7	1	5	50	0	0	3647
46	43	10	5	11	34	0	0	5082
47	30	9	3	8	22	1	0	5472
48	30	6	3	6	30	3	0	5040
49	38	15	3	8	38	1	0	5343
50	21	5	2	6	15	1	0	5486
51	22	6	3	2	42	1	1	5171
52	21	2	3	5	19	2	0	5177
53	21	6	3	3	28	1	1	5211
54	25	7	0	7	16	2	0	5155
55	22	7	1	4	23	2	0	4975
56	16	7	1	2	12	3	0	5085
57	20	5	3	3	25	1	0	4950
58	18	12	1	1	25	1	0	5100
59	19	8	1	4	16	0	0	4983
60	19	3	1	5	19	1	0	5059

Appendix O: Data Set for Saturation Flow Estimation from Basundhara to Dhumbarahi through at Narayan Gopal Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	32	20	2	5	46	2	0	6165
2	14	4	2	3	21	2	0	6506
3	8	0	1	3	7	1	1	6795
4	14	7	1	3	18	1	0	6274
5	19	5	0	6	26	1	1	6309
6	12	8	0	3	12	0	0	6180
7	10	3	0	2	24	1	1	6732
8	12	4	1	3	20	1	1	6900
9	14	5	1	3	22	1	1	6326
10	42	20	2	7	74	2	1	6017
11	28	8	2	5	58	2	1	6094
12	24	9	1	5	49	1	0	6255
13	21	6	0	4	47	2	1	6189
14	16	9	1	1	37	2	0	6210
15	16	7	0	2	40	1	1	6188
16	17	4	1	3	35	2	0	5929
17	16	4	1	3	41	1	0	6368
18	20	10	1	3	40	1	0	6120
19	28	10	1	6	50	1	1	6043

20	15	7	1	2	31	1	1	6312
21	18	4	1	1	57	2	1	5920
22	17	7	1	1	42	2	2	6162
23	15	8	0	3	21	1	0	5952
24	12	6	1	2	22	0	0	6030
25	16	8	1	3	26	0	0	5918
26	16	8	0	3	27	0	1	5873
27	23	16	2	1	48	2	0	6167
28	25	15	0	4	42	1	0	5918
29	23	7	1	4	45	3	0	6026
30	11	8	0	1	22	1	0	6251
31	25	13	1	6	32	1	0	6278
32	14	6	0	2	29	1	1	5966
33	18	6	1	3	34	2	1	6140
34	8	1	2	2	16	0	0	6660
35	17	8	2	2	36	1	0	6205
36	14	5	1	2	32	3	0	6840
37	18	5	1	4	36	1	0	6160
38	17	6	1	2	34	3	1	6184
39	15	7	0	2	35	1	0	6000
40	22	14	0	3	40	1	0	5973
41	18	5	1	3	42	2	1	6420
42	15	6	0	2	36	2	0	6192
43	28	12	2	4	58	0	0	5709
44	24	11	1	4	45	0	0	5700
45	20	12	0	1	47	1	0	5508
46	29	12	1	5	59	1	1	6046
47	13	6	0	2	32	1	0	6397
48	19	6	3	2	44	2	0	6196
49	22	7	1	4	48	2	0	6202
50	22	6	1	4	60	1	0	6382
51	35	15	2	6	62	2	0	5925
52	15	5	0	2	51	1	0	6672
53	19	8	1	4	45	0	0	6632
54	21	8	1	4	46	1	0	6309
55	22	10	1	2	64	1	0	6251
56	18	13	1	1	44	1	0	6440
57	28	12	2	4	67	1	0	6249
58	42	20	2	7	87	1	1	6223
59	28	10	1	7	49	1	0	6261
60	24	9	1	5	49	1	0	6255

Appendix P: Data Set for Saturation Flow Estimation from Gangalal to Lainchaur through at Narayan Gopal Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	10	4	1	0	13	0	1	3744
2	18	4	0	0	33	2	1	3580
3	6	1	0	1	10	0	0	4200
4	9	2	0	0	11	2	1	3720
5	29	18	0	0	28	1	1	3588
6	24	9	0	1	44	1	0	4005
7	28	9	1	1	47	0	0	3549
8	9	1	0	1	11	1	1	3920
9	35	13	0	1	47	2	1	3507
10	29	8	0	1	46	1	1	3389
11	17	5	0	1	30	0	1	3812
12	20	5	0	1	41	0	0	3654
13	14	3	0	2	7	2	0	3626
14	9	4	1	0	10	0	0	3400
15	36	13	0	0	65	1	1	3500
16	14	4	0	1	18	2	0	3960
17	26	5	0	2	48	0	0	3517
18	15	6	0	0	31	0	1	3912
19	23	7	0	1	46	0	0	3725
20	17	7	1	0	30	0	1	3918
21	12	1	0	1	20	1	1	3750
22	16	3	1	1	16	2	0	3443
23	14	5	0	1	14	1	0	3523
24	15	6	0	1	23	0	0	3816
25	6	2	0	0	6	1	1	3780
26	16	7	0	2	12	0	0	3735
27	13	3	1	1	6	2	1	3683
28	9	3	0	1	9	1	0	4080
29	8	2	0	1	7	0	1	3645
30	7	2	0	1	8	0	0	3806
31	10	5	0	0	17	0	0	3636
32	13	5	0	1	9	1	0	3378
33	14	3	0	2	8	2	1	3960
34	15	6	1	1	17	0	0	3744
35	8	2	0	1	6	0	1	3510
36	5	1	1	0	7	0	0	3312
37	10	4	1	1	9	0	0	4032
38	18	9	0	1	28	0	0	4080
39	19	9	0	1	18	1	0	3581
40	11	5	0	1	9	0	0	3502

41	19	6	1	0	22	2	1	3429
42	24	7	0	2	26	1	1	3495
43	18	2	0	1	30	2	2	3800
44	14	4	1	1	14	1	0	3651
45	18	8	1	0	22	1	0	3520
46	12	5	1	0	15	1	0	3750
47	6	4	0	0	3	0	1	3540
48	13	2	1	2	7	1	0	3628
49	21	12	0	1	16	2	0	3909
50	25	7	1	1	35	1	1	3528
51	11	2	1	0	16	2	0	3698
52	11	3	0	2	8	0	0	3731
53	9	4	0	1	8	0	0	3760
54	29	18	0	2	26	0	0	3948
55	24	9	0	1	42	1	0	3915
56	28	9	0	1	42	1	0	3356
57	26	5	0	1	51	1	0	3434
58	15	6	0	0	30	0	1	3840
59	23	7	0	1	46	0	0	3725
60	17	7	0	0	35	0	0	3706

Appendix Q: Data Set for Saturation Flow Estimation from Lainchaur to Gangalal through at Narayan Gopal Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	16	7	0	0	19	1	0	3195
2	22	5	0	2	27	0	0	3125
3	16	6	0	1	12	1	0	3173
4	16	6	0	1	21	0	0	3443
5	17	8	0	0	24	1	0	3536
6	14	7	0	0	19	0	0	3266
7	9	2	0	1	11	0	0	3320
8	20	12	0	0	25	0	0	3510
9	11	3	0	0	26	1	0	4025
10	13	7	0	0	19	0	0	3517
11	13	7	0	0	19	0	0	3517
12	12	4	0	0	20	1	0	3450
13	28	13	0	1	26	1	0	3253
14	11	5	1	0	16	0	0	3698
15	19	6	1	1	28	0	0	3581
16	19	7	0	1	28	0	0	3486
17	17	6	0	1	26	0	0	3558
18	46	22	0	2	61	1	0	3741
19	25	10	0	0	42	1	0	3470

20	26	6	1	1	41	0	0	3157
21	23	10	0	0	33	1	0	3350
22	15	8	0	0	24	0	0	3648
23	22	10	0	0	36	0	0	3404
24	18	10	0	0	26	0	0	3560
25	22	5	1	0	41	1	0	3322
26	21	8	0	1	48	1	0	4611
27	21	4	0	1	41	1	0	3566
28	23	7	0	1	41	0	0	3490
29	21	10	0	0	37	0	0	3617
30	10	3	0	0	21	1	0	3888
31	24	11	0	1	18	1	1	3285
32	14	10	0	0	10	0	0	3343
33	14	10	0	0	14	0	0	3651
34	18	8	0	0	26	1	0	3460
35	37	15	1	3	28	1	0	3444
36	29	4	1	3	35	1	1	3414
37	24	10	0	2	22	1	0	3615
38	13	1	1	1	19	1	0	3517
39	20	9	0	1	19	0	0	3186
40	8	4	0	0	16	0	0	3960
41	16	9	0	0	23	0	0	3578
42	15	5	1	0	24	0	0	3288
43	11	6	0	0	15	0	0	3436
44	12	3	0	1	10	2	0	3600
45	9	4	0	0	19	0	0	3880
46	22	5	0	2	26	1	0	3322
47	16	9	0	0	21	0	0	3443
48	46	22	0	0	59	1	0	3224
49	21	10	1	0	32	0	0	3617
50	19	6	0	1	32	0	0	3524
51	19	7	0	0	42	0	0	3714
52	17	3	1	1	24	1	0	3431
53	21	8	0	1	26	1	0	3480
54	21	4	1	0	40	1	0	3257
55	23	7	0	3	8	2	0	3350
56	16	9	0	0	21	0	0	3443
57	20	12	0	0	24	0	0	3456
58	16	6	0	1	10	1	0	3038
59	16	6	0	1	19	0	0	3308
60	22	11	0	0	24	1	0	3224

Appendix R: Data Set for Saturation Flow Estimation from Dhumbarahi to Gangalal Right at Narayan Gopal Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	23	6	0	0	39	0	0	2770
2	26	8	0	1	24	1	0	2728
3	29	8	0	1	33	0	0	2594
4	14	5	0	0	20	0	0	2829
5	25	6	0	0	39	1	0	2765
6	24	10	0	0	28	0	0	2760
7	16	6	0	0	22	0	0	2835
8	19	4	1	1	21	0	0	2804
9	19	7	0	0	26	0	0	2804
10	31	9	0	1	36	0	0	2648
11	18	7	0	0	22	0	0	2720
12	25	9	0	0	27	1	0	2678
13	20	5	0	0	29	1	0	2736
14	30	4	1	1	44	0	0	2604
15	18	9	0	0	14	0	0	2640
16	17	6	0	0	23	0	0	2732
17	29	4	1	1	44	0	0	2694
18	13	2	0	1	17	0	0	2797
19	18	4	0	1	22	0	0	2720
20	30	5	0	1	32	2	0	2472
21	13	3	0	1	8	1	0	2742
22	15	2	1	1	19	0	0	2928
23	9	3	0	0	16	0	0	3120
24	16	8	0	0	12	0	0	2610
25	20	6	0	0	26	1	0	2754
26	30	5	1	1	34	1	0	2544
27	17	4	0	0	29	0	0	2689
28	15	4	0	0	24	0	0	2688
29	14	5	0	0	18	0	0	2674
30	22	4	0	1	33	0	0	2765
31	13	2	0	0	14	1	0	2132
32	26	7	0	1	28	0	0	2548
33	37	8	1	1	39	1	0	2501
34	24	4	1	1	24	0	0	2355
35	13	3	0	1	12	0	0	2658
36	23	10	0	0	15	1	0	2504
37	23	6	0	1	25	0	0	2583
38	17	5	1	0	19	0	0	2584
39	22	2	0	1	24	1	0	2242
40	18	5	0	1	18	0	0	2680

41	20	4	0	0	22	1	0	2178
42	23	5	0	1	23	0	0	2332
43	17	1	0	1	24	1	0	2689
44	18	5	0	0	24	0	0	2440
45	17	4	0	1	19	0	0	2689
46	17	6	0	0	19	0	0	2478
47	20	2	0	1	27	1	0	2628
48	12	5	0	0	9	0	0	2310
49	18	3	1	0	20	0	0	2100
50	15	5	0	0	17	0	0	2424
51	11	4	0	0	12	0	0	2487
52	20	4	0	0	22	1	0	2178
53	16	5	0	1	12	0	0	2610
54	14	3	0	0	16	1	0	2391
55	10	4	0	0	12	0	0	2736
56	17	6	0	0	17	1	0	2668
57	9	4	0	0	9	0	0	2680
58	37	9	0	2	32	1	0	2539
59	22	4	0	1	30	0	0	2618
60	30	7	0	0	32	0	0	1992

Appendix S: Data Set for Saturation Flow Estimation from Gangalal to Basundhara Right at Narayan Gopal Intersection

S.N.	Saturation Time	Car	Truck	Bus	Two wheeler	Microbus	Tempo	saturation flow
1	30	5	0	0	35	0	0	1860
2	29	6	0	1	22	0	0	1937
3	31	6	0	1	19	1	0	1881
4	35	5	0	0	37	0	0	1656
5	27	4	0	0	28	1	0	1853
6	32	8	0	0	26	0	0	1778
7	19	5	0	0	17	0	0	1914
8	28	4	1	1	19	0	0	1826
9	19	5	0	0	17	0	0	1914
10	31	8	0	0	21	0	0	1661
11	19	5	0	0	14	0	0	1743
12	28	6	0	0	25	1	0	1929
13	20	4	0	0	21	0	0	1854
14	32	4	1	0	37	0	0	1868
15	18	6	0	0	12	0	0	1920
16	17	4	0	0	18	0	0	1991
17	29	4	0	1	29	0	0	1949
18	13	2	0	0	21	0	0	2298
19	18	3	0	1	11	0	0	1860

20	30	5	0	1	15	2	0	1860
21	13	2	0	0	15	0	0	1800
22	15	1	1	1	9	0	0	1968
23	9	2	0	0	8	0	0	1760
24	16	4	0	0	14	0	0	1845
25	25	4	0	0	24	1	0	1829
26	30	5	0	1	27	0	0	1932
27	25	4	0	1	20	0	0	1872
28	17	3	0	0	19	0	0	1842
29	16	4	0	0	16	0	0	1980
30	28	4	0	0	31	0	0	1710
31	13	2	0	0	11	0	0	1468
32	26	7	0	0	18	0	0	1717
33	37	7	1	1	22	1	0	1907
34	24	2	1	1	11	1	0	1695
35	13	3	0	0	12	0	0	1828
36	26	8	0	0	15	1	0	1938
37	23	4	0	1	16	0	0	1847
38	17	4	0	0	11	0	0	1546
39	22	2	0	0	19	1	0	1505
40	18	4	0	0	18	0	0	1880
41	20	3	0	1	10	1	0	1890
42	23	5	0	0	16	0	0	1534
43	17	1	0	0	19	1	0	1736
44	22	5	0	0	20	0	0	1800
45	25	4	0	1	11	1	0	1699
46	17	6	0	0	10	0	0	1906
47	21	2	0	0	25	0	0	1629
48	16	4	0	0	9	0	0	1508
49	18	3	0	0	18	0	0	1680
50	15	4	0	0	12	0	0	1824
51	11	3	0	0	8	0	0	1767
52	24	4	1	0	18	1	0	1860
53	18	2	0	0	22	1	0	2020
54	14	3	0	0	16	0	0	2006
55	15	3	0	0	14	0	0	1728
56	17	4	0	0	12	1	0	1927
57	14	4	0	0	15	0	0	2186
58	37	10	0	1	17	1	0	1907
59	26	4	0	0	32	0	0	1883
60	30	7	0	1	16	0	0	1776

Appendix T: Database Used for the Development of Regression Model for Saturation Flow

Saturation Flow	Width (m)	Gradient (G)	Right Turn Radius
3960	7.00	0.50	27.30
3744	7.00	0.50	27.30
3552	7.00	0.50	27.30
3960	7.00	0.50	27.30
3865	7.00	0.50	27.30
3480	7.00	0.50	27.30
3697	7.00	0.50	27.30
4163	7.00	0.50	27.30
3449	7.00	0.50	27.30
4042	7.00	0.50	27.30
4086	7.00	0.50	27.30
3360	7.00	0.50	27.30
3713	7.00	0.50	27.30
3396	7.00	0.50	27.30
3796	7.00	0.50	27.30
3792	7.00	0.50	27.30
3854	7.00	0.50	27.30
3433	7.00	0.50	27.30
3629	7.00	0.50	27.30
3794	7.00	0.50	27.30
3820	7.00	0.50	27.30
3475	7.00	0.50	27.30
3640	7.00	0.50	27.30
3132	7.00	0.50	27.30
3120	7.00	0.50	27.30
3600	7.00	0.50	27.30
3240	7.00	0.50	27.30
3672	7.00	0.50	27.30
3386	7.00	0.50	27.30
3240	7.00	0.50	27.30
3354	7.00	0.50	27.30
3600	7.00	0.50	27.30
3540	7.00	0.50	27.30
3664	7.00	0.50	27.30
3270	7.00	0.50	27.30
3285	7.00	0.50	27.30
3672	7.00	0.50	27.30
3293	7.00	0.50	27.30
3614	7.00	0.50	27.30
3504	7.00	0.50	27.30

3453	7.00	0.50	27.30
3375	7.00	0.50	27.30
3431	7.00	0.50	27.30
3540	7.00	0.50	27.30
3616	7.00	0.50	27.30
3471	7.00	0.50	27.30
3626	7.00	0.50	27.30
3431	7.00	0.50	27.30
3162	7.00	0.50	27.30
3300	7.00	0.50	27.30
3360	7.00	0.50	27.30
3536	7.00	0.50	27.30
3566	7.00	0.50	27.30
3219	7.00	0.50	27.30
3326	7.00	0.50	27.30
3497	7.00	0.50	27.30
3439	7.00	0.50	27.30
3758	7.00	0.50	27.30
3630	7.00	0.50	27.30
3576	7.00	0.50	27.30
3812	7.00	0.50	27.30
3278	7.00	0.50	27.30
3864	7.00	0.50	27.30
3825	7.00	0.50	27.30
3475	7.00	0.50	27.30
3312	7.00	0.50	27.30
3870	7.00	0.50	27.30
3528	7.00	0.50	27.30
3780	7.00	0.50	27.30
3175	7.00	0.50	27.30
3819	7.00	0.50	27.30
3789	7.00	0.50	27.30
3504	7.00	0.50	27.30
3672	7.00	0.50	27.30
3438	7.00	0.50	27.30
3369	7.00	-0.50	29.80
3648	7.00	-0.50	29.80
3540	7.00	-0.50	29.80
3488	7.00	-0.50	29.80
3387	7.00	-0.50	29.80
3663	7.00	-0.50	29.80
3520	7.00	-0.50	29.80
3554	7.00	-0.50	29.80
3615	7.00	-0.50	29.80

3464	7.00	-0.50	29.80
3600	7.00	-0.50	29.80
3587	7.00	-0.50	29.80
3653	7.00	-0.50	29.80
3600	7.00	-0.50	29.80
3404	7.00	-0.50	29.80
3682	7.00	-0.50	29.80
3669	7.00	-0.50	29.80
3732	7.00	-0.50	29.80
3720	7.00	-0.50	29.80
3536	7.00	-0.50	29.80
3645	7.00	-0.50	29.80
3453	7.00	-0.50	29.80
3480	7.00	-0.50	29.80
3664	7.00	-0.50	29.80
3547	7.00	-0.50	29.80
3551	7.00	-0.50	29.80
3708	7.00	-0.50	29.80
3613	7.00	-0.50	29.80
3448	7.00	-0.50	29.80
3662	7.00	-0.50	29.80
3708	7.00	-0.50	29.80
3542	7.00	-0.50	29.80
3557	7.00	-0.50	29.80
3543	7.00	-0.50	29.80
3600	7.00	-0.50	29.80
3792	7.00	-0.50	29.80
3649	7.00	-0.50	29.80
3429	7.00	-0.50	29.80
3852	7.00	-0.50	29.80
3540	7.00	-0.50	29.80
3542	7.00	-0.50	29.80
3677	7.00	-0.50	29.80
3549	7.00	-0.50	29.80
3754	7.00	-0.50	29.80
3732	7.00	-0.50	29.80
2993	7.00	-0.50	29.80
3497	7.00	-0.50	29.80
3672	7.00	-0.50	29.80
3706	7.00	-0.50	29.80
3467	7.00	-0.50	29.80
3420	7.00	-0.50	29.80
3504	7.00	-0.50	29.80
3567	7.00	-0.50	29.80

3420	7.00	-0.50	29.80
3300	7.00	-0.50	29.80
3675	7.00	-0.50	29.80
3468	7.00	-0.50	29.80
3695	7.00	-0.50	29.80
3330	7.00	-0.50	29.80
3480	7.00	-0.50	29.80
3420	7.00	-0.50	29.80
3682	7.00	-0.50	29.80
3400	7.00	-0.50	29.80
3427	7.00	-0.50	29.80
3657	7.00	-0.50	29.80
3528	7.00	-0.50	29.80
3586	7.00	-0.50	29.80
5667	11.00	0.50	9999.00
5844	11.00	0.50	9999.00
5192	11.00	0.50	9999.00
6536	11.00	0.50	9999.00
7056	11.00	0.50	9999.00
6132	11.00	0.50	9999.00
3443	11.00	0.50	9999.00
4996	11.00	0.50	9999.00
6042	11.00	0.50	9999.00
3630	11.00	0.50	9999.00
6051	11.00	0.50	9999.00
5323	11.00	0.50	9999.00
6230	11.00	0.50	9999.00
6221	11.00	0.50	9999.00
5959	11.00	0.50	9999.00
5335	11.00	0.50	9999.00
5295	11.00	0.50	9999.00
5257	11.00	0.50	9999.00
6053	11.00	0.50	9999.00
5126	11.00	0.50	9999.00
6065	11.00	0.50	9999.00
5979	11.00	0.50	9999.00
4104	11.00	0.50	9999.00
5928	11.00	0.50	9999.00
6505	11.00	0.50	9999.00
5494	11.00	0.50	9999.00
5976	11.00	0.50	9999.00
6100	11.00	0.50	9999.00
4477	11.00	0.50	9999.00
4991	11.00	0.50	9999.00

6113	11.00	0.50	9999.00
6516	11.00	0.50	9999.00
6501	11.00	0.50	9999.00
5736	11.00	0.50	9999.00
5979	11.00	0.50	9999.00
4710	11.00	0.50	9999.00
5852	11.00	0.50	9999.00
6113	11.00	0.50	9999.00
6048	11.00	0.50	9999.00
5313	11.00	0.50	9999.00
4080	11.00	0.50	9999.00
5856	11.00	0.50	9999.00
6339	11.00	0.50	9999.00
6210	11.00	0.50	9999.00
6449	11.00	0.50	9999.00
5902	11.00	0.50	9999.00
5542	11.00	0.50	9999.00
6128	11.00	0.50	9999.00
5882	11.00	0.50	9999.00
5947	11.00	0.50	9999.00
6038	11.00	0.50	9999.00
5564	11.00	0.50	9999.00
5400	11.00	0.50	9999.00
6180	11.00	0.50	9999.00
5028	11.00	0.50	9999.00
5480	11.00	0.50	9999.00
6166	11.00	0.50	9999.00
5670	11.00	0.50	9999.00
5400	11.00	0.50	9999.00
6155	11.00	0.50	9999.00
6303	11.00	0.50	9999.00
6096	11.00	0.50	9999.00
6158	11.00	0.50	9999.00
6075	11.00	0.50	9999.00
5199	11.00	0.50	9999.00
6148	11.00	0.50	9999.00
5329	11.00	0.50	9999.00
6268	11.00	0.50	9999.00
5813	11.00	0.50	9999.00
6030	11.00	0.50	9999.00
4838	11.00	0.50	9999.00
5833	11.00	0.50	9999.00
5976	11.00	0.50	9999.00
4869	11.00	0.50	9999.00

5091	11.00	0.50	9999.00
5976	11.00	0.50	9999.00
5553	11.00	0.50	9999.00
3504	6.00	-0.50	9999.00
3870	6.00	-0.50	9999.00
3816	6.00	-0.50	9999.00
3617	6.00	-0.50	9999.00
3864	6.00	-0.50	9999.00
3146	6.00	-0.50	9999.00
4042	6.00	-0.50	9999.00
3252	6.00	-0.50	9999.00
3690	6.00	-0.50	9999.00
3424	6.00	-0.50	9999.00
3618	6.00	-0.50	9999.00
3492	6.00	-0.50	9999.00
3259	6.00	-0.50	9999.00
3758	6.00	-0.50	9999.00
3624	6.00	-0.50	9999.00
4032	6.00	-0.50	9999.00
3254	6.00	-0.50	9999.00
3240	6.00	-0.50	9999.00
3672	6.00	-0.50	9999.00
3535	6.00	-0.50	9999.00
3486	6.00	-0.50	9999.00
3528	6.00	-0.50	9999.00
3744	6.00	-0.50	9999.00
3510	6.00	-0.50	9999.00
3528	6.00	-0.50	9999.00
3360	6.00	-0.50	9999.00
3375	6.00	-0.50	9999.00
3393	6.00	-0.50	9999.00
3405	6.00	-0.50	9999.00
3546	6.00	-0.50	9999.00
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3413	6.00	-0.50	9999.00
3528	6.00	-0.50	9999.00
3723	6.00	-0.50	9999.00
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3528	6.00	-0.50	9999.00
3222	6.00	-0.50	9999.00
3330	6.00	-0.50	9999.00
3256	6.00	-0.50	9999.00
3318	6.00	-0.50	9999.00

3609	6.00	-0.50	9999.00
3183	6.00	-0.50	9999.00
3222	6.00	-0.50	9999.00
3660	6.00	-0.50	9999.00
3621	6.00	-0.50	9999.00
3437	6.00	-0.50	9999.00
3600	6.00	-0.50	9999.00
3249	6.00	-0.50	9999.00
3249	6.00	-0.50	9999.00
3510	6.00	-0.50	9999.00
3384	6.00	-0.50	9999.00
3285	6.00	-0.50	9999.00
3862	6.00	-0.50	9999.00
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3600	6.00	-0.50	9999.00
3764	6.00	-0.50	9999.00
3360	6.00	-0.50	9999.00
3456	6.00	-0.50	9999.00
3249	6.00	-0.50	9999.00
3408	6.00	-0.50	9999.00
3816	6.00	-0.50	9999.00
3176	6.00	-0.50	9999.00
3170	6.00	-0.50	9999.00
3210	6.00	-0.50	9999.00
3312	6.00	-0.50	9999.00
3168	6.00	-0.50	9999.00
3170	6.00	-0.50	9999.00
3199	6.00	-0.50	9999.00
3578	6.00	-0.50	9999.00
3492	6.00	-0.50	9999.00
3480	6.00	-0.50	9999.00
3384	6.00	-0.50	9999.00
3360	6.00	-0.50	9999.00
3384	6.00	-0.50	9999.00
2181	4.50	0.50	19.00
2118	4.50	0.50	19.00
2384	4.50	0.50	19.00
2183	4.50	0.50	19.00
2400	4.50	0.50	19.00
1800	4.50	0.50	19.00
2536	4.50	0.50	19.00
2045	4.50	0.50	19.00
2414	4.50	0.50	19.00
2175	4.50	0.50	19.00

1103	4.50	0.50	19.00
1508	4.50	0.50	19.00
1774	4.50	0.50	19.00
2160	4.50	0.50	19.00
1826	4.50	0.50	19.00
2139	4.50	0.50	19.00
1538	4.50	0.50	19.00
2504	4.50	0.50	19.00
1882	4.50	0.50	19.00
2406	4.50	0.50	19.00
2901	4.50	0.50	19.00
2291	4.50	0.50	19.00
2027	4.50	0.50	19.00
2487	4.50	0.50	19.00
2029	4.50	0.50	19.00
2340	4.50	0.50	19.00
2320	4.50	0.50	19.00
2183	4.50	0.50	19.00
1824	4.50	0.50	19.00
2443	4.50	0.50	19.00
2562	4.50	0.50	19.00
2289	4.50	0.50	19.00
2363	4.50	0.50	19.00
2406	4.50	0.50	19.00
2224	4.50	0.50	19.00
2140	4.50	0.50	19.00
1553	4.50	0.50	19.00
2520	4.50	0.50	19.00
2406	4.50	0.50	19.00
1350	4.50	0.50	19.00
2048	4.50	0.50	19.00
2308	4.50	0.50	19.00
2122	4.50	0.50	19.00
2012	4.50	0.50	19.00
2385	4.50	0.50	19.00
2237	4.50	0.50	19.00
2136	4.50	0.50	19.00
2487	4.50	0.50	19.00
2501	4.50	0.50	19.00
2507	4.50	0.50	19.00
2084	4.50	0.50	19.00
2565	4.50	0.50	19.00
2240	4.50	0.50	19.00
2453	4.50	0.50	19.00

2214	4.50	0.50	19.00
2120	4.50	0.50	19.00
2380	4.50	0.50	19.00
2540	4.50	0.50	19.00
2356	4.50	0.50	19.00
2287	4.50	0.50	19.00
2408	4.50	0.50	19.00
2298	4.50	0.50	19.00
1860	4.50	0.50	19.00
2489	4.50	0.50	19.00
2455	4.50	0.50	19.00
2351	4.50	0.50	19.00
2220	4.50	0.50	19.00
1248	4.50	0.50	19.00
2220	4.50	0.50	19.00
1948	4.50	0.50	19.00
2160	4.50	0.50	19.00
1933	4.50	0.50	19.00
2320	4.50	0.50	19.00
2322	4.50	0.50	19.00
2232	4.50	0.50	19.00
5436	11.00	0.50	9999.00
5447	11.00	0.50	9999.00
5499	11.00	0.50	9999.00
5518	11.00	0.50	9999.00
5492	11.00	0.50	9999.00
5343	11.00	0.50	9999.00
5223	11.00	0.50	9999.00
6090	11.00	0.50	9999.00
5672	11.00	0.50	9999.00
5406	11.00	0.50	9999.00
6260	11.00	0.50	9999.00
5068	11.00	0.50	9999.00
5459	11.00	0.50	9999.00
7740	11.00	0.50	9999.00
6300	11.00	0.50	9999.00
5623	11.00	0.50	9999.00
5160	11.00	0.50	9999.00
5725	11.00	0.50	9999.00
5779	11.00	0.50	9999.00
5779	11.00	0.50	9999.00
5960	11.00	0.50	9999.00
5846	11.00	0.50	9999.00
5986	11.00	0.50	9999.00

6127	11.00	0.50	9999.00
6024	11.00	0.50	9999.00
6126	11.00	0.50	9999.00
4863	11.00	0.50	9999.00
6199	11.00	0.50	9999.00
5957	11.00	0.50	9999.00
6422	11.00	0.50	9999.00
6703	11.00	0.50	9999.00
5351	11.00	0.50	9999.00
6381	11.00	0.50	9999.00
6085	11.00	0.50	9999.00
6079	11.00	0.50	9999.00
5577	11.00	0.50	9999.00
5220	11.00	0.50	9999.00
5438	11.00	0.50	9999.00
5627	11.00	0.50	9999.00
5815	11.00	0.50	9999.00
4936	11.00	0.50	9999.00
6447	11.00	0.50	9999.00
6113	11.00	0.50	9999.00
6055	11.00	0.50	9999.00
4989	11.00	0.50	9999.00
6034	11.00	0.50	9999.00
5972	11.00	0.50	9999.00
5480	11.00	0.50	9999.00
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6022	11.00	0.50	9999.00
5612	11.00	0.50	9999.00
5718	11.00	0.50	9999.00
4960	11.00	0.50	9999.00
4913	11.00	0.50	9999.00
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6416	11.00	0.50	9999.00
5512	11.00	0.50	9999.00
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5786	11.00	0.50	9999.00
5486	11.00	0.50	9999.00
5697	11.00	0.50	9999.00
5625	11.00	0.50	9999.00
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5332	11.00	0.50	9999.00
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5224	11.00	0.50	9999.00
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3446	6.00	0.50	9999.00
3639	6.00	0.50	9999.00
3437	6.00	0.50	9999.00
3657	6.00	0.50	9999.00
3466	6.00	0.50	9999.00
3489	6.00	0.50	9999.00
3456	6.00	0.50	9999.00
3437	6.00	0.50	9999.00
3765	6.00	0.50	9999.00
3462	6.00	0.50	9999.00
3609	6.00	0.50	9999.00
3656	6.00	0.50	9999.00
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3632	6.00	0.50	9999.00
3655	6.00	0.50	9999.00
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3776	6.00	0.50	9999.00
3517	6.00	0.50	9999.00
3510	6.00	0.50	9999.00
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3528	6.00	0.50	9999.00
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3508	6.00	0.50	9999.00
3445	6.00	0.50	9999.00
3523	6.00	0.50	9999.00
3547	6.00	0.50	9999.00
3443	6.00	0.50	9999.00

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3608	6.00	0.50	9999.00
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3487	6.00	0.50	9999.00
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3535	6.00	0.50	9999.00
3522	6.00	0.50	9999.00
3403	6.00	0.50	9999.00
3446	6.00	0.50	9999.00
3203	6.00	0.50	9999.00
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4086	8.00	6.00	27.00
3330	8.00	6.00	27.00
3960	8.00	6.00	27.00
3453	8.00	6.00	27.00
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4590	8.00	6.00	27.00
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4234	8.00	6.00	27.00
3960	8.00	6.00	27.00
4152	8.00	6.00	27.00
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3943	8.00	6.00	27.00
4070	8.00	6.00	27.00
3900	8.00	6.00	27.00
3800	8.00	6.00	27.00
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3837	8.00	6.00	27.00
4210	8.00	6.00	27.00
4320	8.00	6.00	27.00
4133	8.00	6.00	27.00
4260	8.00	6.00	27.00
4383	8.00	6.00	27.00
4236	8.00	6.00	27.00
4128	8.00	6.00	27.00
3600	8.00	6.00	27.00
3862	8.00	6.00	27.00
3915	8.00	6.00	27.00
3865	8.00	6.00	27.00
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3730	8.00	6.00	27.00
4540	8.00	6.00	27.00
4080	8.00	6.00	27.00
3888	8.00	6.00	27.00
3944	8.00	6.00	27.00
4320	8.00	6.00	27.00
4518	8.00	6.00	27.00
2451	8.00	6.00	27.00
4070	8.00	6.00	27.00
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3229	6.00	-2.00	9999.00
3261	6.00	-2.00	9999.00

3305	6.00	-2.00	9999.00
3139	6.00	-2.00	9999.00
3208	6.00	-2.00	9999.00
3312	6.00	-2.00	9999.00
3240	6.00	-2.00	9999.00
3285	6.00	-2.00	9999.00
3135	6.00	-2.00	9999.00
3402	6.00	-2.00	9999.00
3125	6.00	-2.00	9999.00
3168	6.00	-2.00	9999.00
3240	6.00	-2.00	9999.00
3216	6.00	-2.00	9999.00
3240	6.00	-2.00	9999.00
3221	6.00	-2.00	9999.00
3240	6.00	-2.00	9999.00
3163	6.00	-2.00	9999.00
3154	6.00	-2.00	9999.00
3189	6.00	-2.00	9999.00
3120	6.00	-2.00	9999.00
3240	6.00	-2.00	9999.00
3214	6.00	-2.00	9999.00
3420	6.00	-2.00	9999.00
3355	6.00	-2.00	9999.00
3462	6.00	-2.00	9999.00
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3353	6.00	-2.00	9999.00
3225	6.00	-2.00	9999.00
3334	6.00	-2.00	9999.00
3920	6.00	-2.00	9999.00
3192	6.00	-2.00	9999.00
3220	6.00	-2.00	9999.00
3471	6.00	-2.00	9999.00
3142	6.00	-2.00	9999.00
3273	6.00	-2.00	9999.00
3338	6.00	-2.00	9999.00
3240	6.00	-2.00	9999.00
3388	6.00	-2.00	9999.00
3330	6.00	-2.00	9999.00
3180	6.00	-2.00	9999.00
3564	6.00	-2.00	9999.00
3380	6.00	-2.00	9999.00
3388	6.00	-2.00	9999.00
3163	6.00	-2.00	9999.00

3180	6.00	-2.00	9999.00
3207	6.00	-2.00	9999.00
3175	6.00	-2.00	9999.00
2397	5.00	2.00	9999.00
2583	5.00	2.00	9999.00
2766	5.00	2.00	9999.00
2349	5.00	2.00	9999.00
2802	5.00	2.00	9999.00
2705	5.00	2.00	9999.00
2644	5.00	2.00	9999.00
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2782	5.00	2.00	9999.00
2772	5.00	2.00	9999.00
2740	5.00	2.00	9999.00
2723	5.00	2.00	9999.00
2664	5.00	2.00	9999.00
2880	5.00	2.00	9999.00
2280	5.00	2.00	9999.00
2676	5.00	2.00	9999.00
2209	5.00	2.00	9999.00
2700	5.00	2.00	9999.00
2653	5.00	2.00	9999.00
2903	5.00	2.00	9999.00
2689	5.00	2.00	9999.00
2520	5.00	2.00	9999.00
2280	5.00	2.00	9999.00
2400	5.00	2.00	9999.00
2600	5.00	2.00	9999.00
2689	5.00	2.00	9999.00
2724	5.00	2.00	9999.00
2787	5.00	2.00	9999.00
3676	5.00	2.00	9999.00
2645	5.00	2.00	9999.00
2143	5.00	2.00	9999.00
2880	5.00	2.00	9999.00
2965	5.00	2.00	9999.00
2625	5.00	2.00	9999.00
2700	5.00	2.00	9999.00
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2858	5.00	2.00	9999.00
2923	5.00	2.00	9999.00
2657	5.00	2.00	9999.00
2880	5.00	2.00	9999.00
2766	5.00	2.00	9999.00

2661	5.00	2.00	9999.00
2899	5.00	2.00	9999.00
2756	5.00	2.00	9999.00
2700	5.00	2.00	9999.00
2945	5.00	2.00	9999.00
2700	5.00	2.00	9999.00
2637	5.00	2.00	9999.00
2635	5.00	2.00	9999.00
2678	5.00	2.00	9999.00
2188	4.00	-2.00	32.00
1944	4.00	-2.00	32.00
2080	4.00	-2.00	32.00
2109	4.00	-2.00	32.00
2331	4.00	-2.00	32.00
1661	4.00	-2.00	32.00
1780	4.00	-2.00	32.00
1544	4.00	-2.00	32.00
1701	4.00	-2.00	32.00
1517	4.00	-2.00	32.00
1213	4.00	-2.00	32.00
2422	4.00	-2.00	32.00
2160	4.00	-2.00	32.00
1012	4.00	-2.00	32.00
2140	4.00	-2.00	32.00
2289	4.00	-2.00	32.00
2324	4.00	-2.00	32.00
1742	4.00	-2.00	32.00
2275	4.00	-2.00	32.00
2022	4.00	-2.00	32.00
2216	4.00	-2.00	32.00
2050	4.00	-2.00	32.00
1784	4.00	-2.00	32.00
2160	4.00	-2.00	32.00
2340	4.00	-2.00	32.00
1938	4.00	-2.00	32.00
2674	4.00	-2.00	32.00
2430	4.00	-2.00	32.00
2070	4.00	-2.00	32.00
2191	4.00	-2.00	32.00
1710	4.00	-2.00	32.00
1989	4.00	-2.00	32.00
2025	4.00	-2.00	32.00
2491	4.00	-2.00	32.00
2304	4.00	-2.00	32.00

2202	4.00	-2.00	32.00
1274	4.00	-2.00	32.00
2400	4.00	-2.00	32.00
2396	4.00	-2.00	32.00
2453	4.00	-2.00	32.00
2556	4.00	-2.00	32.00
2320	4.00	-2.00	32.00
2110	4.00	-2.00	32.00
2595	4.00	-2.00	32.00
1800	4.00	-2.00	32.00
2533	4.00	-2.00	32.00
2472	4.00	-2.00	32.00
2475	4.00	-2.00	32.00
1933	4.00	-2.00	32.00
2614	4.00	-2.00	32.00
2808	5.50	6.00	9999.00
3207	5.50	6.00	9999.00
3420	5.50	6.00	9999.00
2880	5.50	6.00	9999.00
2929	5.50	6.00	9999.00
3100	5.50	6.00	9999.00
2868	5.50	6.00	9999.00
2804	5.50	6.00	9999.00
2880	5.50	6.00	9999.00
2862	5.50	6.00	9999.00
3160	5.50	6.00	9999.00
3005	5.50	6.00	9999.00
3168	5.50	6.00	9999.00
2931	5.50	6.00	9999.00
3180	5.50	6.00	9999.00
2851	5.50	6.00	9999.00
2958	5.50	6.00	9999.00
3038	5.50	6.00	9999.00
3032	5.50	6.00	9999.00
2555	5.50	6.00	9999.00
2689	5.50	6.00	9999.00
3060	5.50	6.00	9999.00
3000	5.50	6.00	9999.00
2800	5.50	6.00	9999.00
2660	5.50	6.00	9999.00
2126	5.50	6.00	9999.00
2724	5.50	6.00	9999.00
2996	5.50	6.00	9999.00
3880	5.50	6.00	9999.00

2927	5.50	6.00	9999.00
2743	5.50	6.00	9999.00
2880	5.50	6.00	9999.00
2965	5.50	6.00	9999.00
2625	5.50	6.00	9999.00
2700	5.50	6.00	9999.00
2720	5.50	6.00	9999.00
2858	5.50	6.00	9999.00
2889	5.50	6.00	9999.00
3017	5.50	6.00	9999.00
3011	5.50	6.00	9999.00
2956	5.50	6.00	9999.00
3287	5.50	6.00	9999.00
3045	5.50	6.00	9999.00
3096	5.50	6.00	9999.00
3011	5.50	6.00	9999.00
3338	5.50	6.00	9999.00
2916	5.50	6.00	9999.00
2841	5.50	6.00	9999.00
2880	5.50	6.00	9999.00
2840	5.50	6.00	9999.00
3162	5.50	6.00	9999.00
3676	5.50	6.00	9999.00
2829	5.50	6.00	9999.00
2583	5.50	6.00	9999.00
2747	5.50	6.00	9999.00
2554	5.50	6.00	9999.00
3083	5.50	6.00	9999.00
3150	5.50	6.00	9999.00
2891	5.50	6.00	9999.00
3008	5.50	6.00	9999.00
3583	6.50	8.00	9999.00
2752	6.50	8.00	9999.00
3229	6.50	8.00	9999.00
3852	6.50	8.00	9999.00
3360	6.50	8.00	9999.00
3341	6.50	8.00	9999.00
3488	6.50	8.00	9999.00
3240	6.50	8.00	9999.00
3203	6.50	8.00	9999.00
3105	6.50	8.00	9999.00
3456	6.50	8.00	9999.00
3125	6.50	8.00	9999.00
3168	6.50	8.00	9999.00

3082	6.50	8.00	9999.00
3216	6.50	8.00	9999.00
3240	6.50	8.00	9999.00
2520	6.50	8.00	9999.00
3240	6.50	8.00	9999.00
3471	6.50	8.00	9999.00
3010	6.50	8.00	9999.00
3189	6.50	8.00	9999.00
2920	6.50	8.00	9999.00
3240	6.50	8.00	9999.00
3214	6.50	8.00	9999.00
2906	6.50	8.00	9999.00
3502	6.50	8.00	9999.00
3074	6.50	8.00	9999.00
3114	6.50	8.00	9999.00
3226	6.50	8.00	9999.00
2678	6.50	8.00	9999.00
3225	6.50	8.00	9999.00
3334	6.50	8.00	9999.00
3535	6.50	8.00	9999.00
3432	6.50	8.00	9999.00
3186	6.50	8.00	9999.00
3626	6.50	8.00	9999.00
2765	6.50	8.00	9999.00
3796	6.50	8.00	9999.00
3330	6.50	8.00	9999.00
3317	6.50	8.00	9999.00
3155	6.50	8.00	9999.00
3533	6.50	8.00	9999.00
2829	6.50	8.00	9999.00
3780	6.50	8.00	9999.00
3429	6.50	8.00	9999.00
3579	6.50	8.00	9999.00
2906	6.50	8.00	9999.00
3480	6.50	8.00	9999.00
3206	6.50	8.00	9999.00
3371	6.50	8.00	9999.00
3402	6.50	8.00	9999.00
2456	6.50	8.00	9999.00
3330	6.50	8.00	9999.00
2544	6.50	8.00	9999.00
3226	6.50	8.00	9999.00
3580	6.50	8.00	9999.00
3240	6.50	8.00	9999.00

3053	6.50	8.00	9999.00
2520	6.50	8.00	9999.00
3320	6.50	8.00	9999.00
4793	10.00	0.50	9999.00
4954	10.00	0.50	9999.00
5213	10.00	0.50	9999.00
5292	10.00	0.50	9999.00
5252	10.00	0.50	9999.00
5265	10.00	0.50	9999.00
5267	10.00	0.50	9999.00
5985	10.00	0.50	9999.00
5884	10.00	0.50	9999.00
5674	10.00	0.50	9999.00
5654	10.00	0.50	9999.00
5798	10.00	0.50	9999.00
5948	10.00	0.50	9999.00
5811	10.00	0.50	9999.00
5760	10.00	0.50	9999.00
5533	10.00	0.50	9999.00
5009	10.00	0.50	9999.00
5709	10.00	0.50	9999.00
5076	10.00	0.50	9999.00
5243	10.00	0.50	9999.00
5087	10.00	0.50	9999.00
5310	10.00	0.50	9999.00
5400	10.00	0.50	9999.00
5315	10.00	0.50	9999.00
5619	10.00	0.50	9999.00
5315	10.00	0.50	9999.00
5520	10.00	0.50	9999.00
5381	10.00	0.50	9999.00
5466	10.00	0.50	9999.00
5126	10.00	0.50	9999.00
4662	10.00	0.50	9999.00
5630	10.00	0.50	9999.00
5530	10.00	0.50	9999.00
4966	10.00	0.50	9999.00
5088	10.00	0.50	9999.00
5126	10.00	0.50	9999.00
4915	10.00	0.50	9999.00
5021	10.00	0.50	9999.00
5360	10.00	0.50	9999.00
5229	10.00	0.50	9999.00
5160	10.00	0.50	9999.00

4903	10.00	0.50	9999.00
3622	10.00	0.50	9999.00
5496	10.00	0.50	9999.00
3647	10.00	0.50	9999.00
5082	10.00	0.50	9999.00
5472	10.00	0.50	9999.00
5040	10.00	0.50	9999.00
5343	10.00	0.50	9999.00
5486	10.00	0.50	9999.00
6165	12.00	4.00	9999.00
6506	12.00	4.00	9999.00
6795	12.00	4.00	9999.00
6274	12.00	4.00	9999.00
6309	12.00	4.00	9999.00
6180	12.00	4.00	9999.00
6732	12.00	4.00	9999.00
6900	12.00	4.00	9999.00
6326	12.00	4.00	9999.00
6017	12.00	4.00	9999.00
6094	12.00	4.00	9999.00
6255	12.00	4.00	9999.00
6189	12.00	4.00	9999.00
6210	12.00	4.00	9999.00
6188	12.00	4.00	9999.00
5929	12.00	4.00	9999.00
6368	12.00	4.00	9999.00
6120	12.00	4.00	9999.00
6043	12.00	4.00	9999.00
6312	12.00	4.00	9999.00
5920	12.00	4.00	9999.00
6162	12.00	4.00	9999.00
5952	12.00	4.00	9999.00
6030	12.00	4.00	9999.00
5918	12.00	4.00	9999.00
5873	12.00	4.00	9999.00
6167	12.00	4.00	9999.00
5918	12.00	4.00	9999.00
6026	12.00	4.00	9999.00
6251	12.00	4.00	9999.00
6278	12.00	4.00	9999.00
5966	12.00	4.00	9999.00
6140	12.00	4.00	9999.00
6660	12.00	4.00	9999.00
6205	12.00	4.00	9999.00

6840	12.00	4.00	9999.00
6160	12.00	4.00	9999.00
6184	12.00	4.00	9999.00
6000	12.00	4.00	9999.00
5973	12.00	4.00	9999.00
6420	12.00	4.00	9999.00
6192	12.00	4.00	9999.00
5709	12.00	4.00	9999.00
5700	12.00	4.00	9999.00
5508	12.00	4.00	9999.00
6046	12.00	4.00	9999.00
6397	12.00	4.00	9999.00
6196	12.00	4.00	9999.00
6202	12.00	4.00	9999.00
6382	12.00	4.00	9999.00
3744	7.00	0.50	9999.00
3580	7.00	0.50	9999.00
4200	7.00	0.50	9999.00
3720	7.00	0.50	9999.00
3588	7.00	0.50	9999.00
4005	7.00	0.50	9999.00
3549	7.00	0.50	9999.00
3920	7.00	0.50	9999.00
3507	7.00	0.50	9999.00
3389	7.00	0.50	9999.00
3812	7.00	0.50	9999.00
3654	7.00	0.50	9999.00
3626	7.00	0.50	9999.00
3400	7.00	0.50	9999.00
3500	7.00	0.50	9999.00
3960	7.00	0.50	9999.00
3517	7.00	0.50	9999.00
3912	7.00	0.50	9999.00
3725	7.00	0.50	9999.00
3918	7.00	0.50	9999.00
3750	7.00	0.50	9999.00
3443	7.00	0.50	9999.00
3523	7.00	0.50	9999.00
3816	7.00	0.50	9999.00
3780	7.00	0.50	9999.00
3735	7.00	0.50	9999.00
3683	7.00	0.50	9999.00
4080	7.00	0.50	9999.00
3645	7.00	0.50	9999.00

3806	7.00	0.50	9999.00
3636	7.00	0.50	9999.00
3378	7.00	0.50	9999.00
3960	7.00	0.50	9999.00
3744	7.00	0.50	9999.00
3510	7.00	0.50	9999.00
3312	7.00	0.50	9999.00
4032	7.00	0.50	9999.00
4080	7.00	0.50	9999.00
3581	7.00	0.50	9999.00
3502	7.00	0.50	9999.00
3429	7.00	0.50	9999.00
3495	7.00	0.50	9999.00
3800	7.00	0.50	9999.00
3651	7.00	0.50	9999.00
3520	7.00	0.50	9999.00
3750	7.00	0.50	9999.00
3540	7.00	0.50	9999.00
3628	7.00	0.50	9999.00
3909	7.00	0.50	9999.00
3528	7.00	0.50	9999.00
3195	7.00	-0.50	9999.00
3125	6.00	-0.50	9999.00
3173	6.00	-0.50	9999.00
3443	6.00	-0.50	9999.00
3536	6.00	-0.50	9999.00
3266	6.00	-0.50	9999.00
3320	6.00	-0.50	9999.00
3510	6.00	-0.50	9999.00
4025	6.00	-0.50	9999.00
3517	6.00	-0.50	9999.00
3517	6.00	-0.50	9999.00
3450	6.00	-0.50	9999.00
3253	6.00	-0.50	9999.00
3698	6.00	-0.50	9999.00
3581	6.00	-0.50	9999.00
3486	6.00	-0.50	9999.00
3558	6.00	-0.50	9999.00
3741	6.00	-0.50	9999.00
3470	6.00	-0.50	9999.00
3157	6.00	-0.50	9999.00
3350	6.00	-0.50	9999.00
3648	6.00	-0.50	9999.00
3404	6.00	-0.50	9999.00

3560	6.00	-0.50	9999.00
3322	6.00	-0.50	9999.00
4611	6.00	-0.50	9999.00
3566	6.00	-0.50	9999.00
3490	6.00	-0.50	9999.00
3617	6.00	-0.50	9999.00
3888	6.00	-0.50	9999.00
3285	6.00	-0.50	9999.00
3343	6.00	-0.50	9999.00
3651	6.00	-0.50	9999.00
3460	6.00	-0.50	9999.00
3444	6.00	-0.50	9999.00
3414	6.00	-0.50	9999.00
3615	6.00	-0.50	9999.00
3517	6.00	-0.50	9999.00
3186	6.00	-0.50	9999.00
3960	6.00	-0.50	9999.00
3578	6.00	-0.50	9999.00
3288	6.00	-0.50	9999.00
3436	6.00	-0.50	9999.00
3600	6.00	-0.50	9999.00
3880	6.00	-0.50	9999.00
3322	6.00	-0.50	9999.00
3443	6.00	-0.50	9999.00
3224	6.00	-0.50	9999.00
3617	6.00	-0.50	9999.00
3524	6.00	-0.50	9999.00
2770	5.00	0.50	21.00
2728	5.00	0.50	21.00
2594	5.00	0.50	21.00
2829	5.00	0.50	21.00
2765	5.00	0.50	21.00
2760	5.00	0.50	21.00
2835	5.00	0.50	21.00
2804	5.00	0.50	21.00
2804	5.00	0.50	21.00
2648	5.00	0.50	21.00
2720	5.00	0.50	21.00
2678	5.00	0.50	21.00
2736	5.00	0.50	21.00
2604	5.00	0.50	21.00
2640	5.00	0.50	21.00
2732	5.00	0.50	21.00
2694	5.00	0.50	21.00

2797	5.00	0.50	21.00
2720	5.00	0.50	21.00
2472	5.00	0.50	21.00
2742	5.00	0.50	21.00
2928	5.00	0.50	21.00
3120	5.00	0.50	21.00
2610	5.00	0.50	21.00
2754	5.00	0.50	21.00
2544	5.00	0.50	21.00
2689	5.00	0.50	21.00
2688	5.00	0.50	21.00
2674	5.00	0.50	21.00
2765	5.00	0.50	21.00
2132	5.00	0.50	21.00
2548	5.00	0.50	21.00
2501	5.00	0.50	21.00
2355	5.00	0.50	21.00
2658	5.00	0.50	21.00
2504	5.00	0.50	21.00
2583	5.00	0.50	21.00
2584	5.00	0.50	21.00
2242	5.00	0.50	21.00
2680	5.00	0.50	21.00
2178	5.00	0.50	21.00
2332	5.00	0.50	21.00
2689	5.00	0.50	21.00
2440	5.00	0.50	21.00
2689	5.00	0.50	21.00
2478	5.00	0.50	21.00
2628	5.00	0.50	21.00
2310	5.00	0.50	21.00
2100	5.00	0.50	21.00
2424	5.00	0.50	21.00
1860	3.50	-0.50	23.00
1937	3.50	-0.50	23.00
1881	3.50	-0.50	23.00
1656	3.50	-0.50	23.00
1853	3.50	-0.50	23.00
1778	3.50	-0.50	23.00
1914	3.50	-0.50	23.00
1826	3.50	-0.50	23.00
1914	3.50	-0.50	23.00
1661	3.50	-0.50	23.00
1743	3.50	-0.50	23.00

1929	3.50	-0.50	23.00
1854	3.50	-0.50	23.00
1868	3.50	-0.50	23.00
1920	3.50	-0.50	23.00
1991	3.50	-0.50	23.00
1949	3.50	-0.50	23.00
2298	3.50	-0.50	23.00
1860	3.50	-0.50	23.00
1860	3.50	-0.50	23.00
1800	3.50	-0.50	23.00
1968	3.50	-0.50	23.00
1760	3.50	-0.50	23.00
1845	3.50	-0.50	23.00
1829	3.50	-0.50	23.00
1932	3.50	-0.50	23.00
1872	3.50	-0.50	23.00
1842	3.50	-0.50	23.00
1980	3.50	-0.50	23.00
1710	3.50	-0.50	23.00
1468	3.50	-0.50	23.00
1717	3.50	-0.50	23.00
1907	3.50	-0.50	23.00
1695	3.50	-0.50	23.00
1828	3.50	-0.50	23.00
1938	3.50	-0.50	23.00
1847	3.50	-0.50	23.00
1546	3.50	-0.50	23.00
1505	3.50	-0.50	23.00
1880	3.50	-0.50	23.00
1890	3.50	-0.50	23.00
1534	3.50	-0.50	23.00
1736	3.50	-0.50	23.00
1800	3.50	-0.50	23.00
1699	3.50	-0.50	23.00
1906	3.50	-0.50	23.00
1629	3.50	-0.50	23.00
1508	3.50	-0.50	23.00
1680	3.50	-0.50	23.00
1824	3.50	-0.50	23.00
1767	3.50	-0.50	23.00
1860	3.50	-0.50	23.00
2020	3.50	-0.50	23.00
2006	3.50	-0.50	23.00
1728	3.50	-0.50	23.00

1927	3.50	-0.50	23.00
2186	3.50	-0.50	23.00
1907	3.50	-0.50	23.00
1883	3.50	-0.50	23.00
1776	3.50	-0.50	23.00

Appendix U: Database Used for validation for Model between observed and predicted Saturation Flow

Observed-SF	Width	Gradient	T. Rad.	Predicted-SF1	Predicted-SF2	Predicted-SF3
3166	7.00	0.50	27.30	3687	3703	3534
3420	7.00	0.50	27.30	3687	3703	3534
3849	7.00	0.50	27.30	3687	3703	3534
3754	7.00	0.50	27.30	3687	3703	3534
1826	7.00	0.50	27.30	3687	3703	3534
3875	7.00	0.50	27.30	3687	3703	3534
3340	7.00	0.50	27.30	3687	3703	3534
3854	7.00	0.50	27.30	3687	3703	3534
3634	7.00	0.50	27.30	3687	3703	3534
3640	7.00	0.50	27.30	3687	3703	3534
3431	7.00	0.50	27.30	3687	3703	3534
3510	7.00	0.50	27.30	3687	3703	3534
3586	7.00	0.50	27.30	3687	3703	3534
3192	7.00	0.50	27.30	3687	3703	3534
3586	7.00	0.50	27.30	3687	3703	3534
3316	7.00	-0.50	29.98	3687	3725	3563
3420	7.00	-0.50	29.98	3687	3725	3563
3584	7.00	-0.50	29.98	3687	3725	3563
3494	7.00	-0.50	29.98	3687	3725	3563
3523	7.00	-0.50	29.98	3687	3725	3563
3672	7.00	-0.50	29.98	3687	3725	3563
3282	7.00	-0.50	29.98	3687	3725	3563
3488	7.00	-0.50	29.98	3687	3725	3563
3494	7.00	-0.50	29.98	3687	3725	3563
3295	7.00	-0.50	29.98	3687	3725	3563
3480	7.00	-0.50	29.98	3687	3725	3563
3524	7.00	-0.50	29.98	3687	3725	3563
3528	7.00	-0.50	29.98	3687	3725	3563
3586	7.00	-0.50	29.98	3687	3725	3563
5943	12.00	0.50	9999.00	6219	6254	6250
5448	12.00	0.50	9999.00	6219	6254	6250
5631	12.00	0.50	9999.00	6219	6254	6250
5974	12.00	0.50	9999.00	6219	6254	6250
5983	12.00	0.50	9999.00	6219	6254	6250

5863	12.00	0.50	9999.00	6219	6254	6250
5144	12.00	0.50	9999.00	6219	6254	6250
5445	12.00	0.50	9999.00	6219	6254	6250
5344	12.00	0.50	9999.00	6219	6254	6250
5992	12.00	0.50	9999.00	6219	6254	6250
5729	12.00	0.50	9999.00	6219	6254	6250
5774	12.00	0.50	9999.00	6219	6254	6250
5688	12.00	0.50	9999.00	6219	6254	6250
5280	12.00	0.50	9999.00	6219	6254	6250
5966	12.00	0.50	9999.00	6219	6254	6250
5553	12.00	0.50	9999.00	6219	6254	6250
3289	6.00	-0.50	9999.00	3181	3215	3354
3240	6.00	-0.50	9999.00	3181	3215	3354
3523	6.00	-0.50	9999.00	3181	3215	3354
3545	6.00	-0.50	9999.00	3181	3215	3354
3274	6.00	-0.50	9999.00	3181	3215	3354
3600	6.00	-0.50	9999.00	3181	3215	3354
3277	6.00	-0.50	9999.00	3181	3215	3354
3510	6.00	-0.50	9999.00	3181	3215	3354
3411	6.00	-0.50	9999.00	3181	3215	3354
3378	6.00	-0.50	9999.00	3181	3215	3354
3456	6.00	-0.50	9999.00	3181	3215	3354
3570	6.00	-0.50	9999.00	3181	3215	3354
3431	6.00	-0.50	9999.00	3181	3215	3354
3578	6.00	-0.50	9999.00	3181	3215	3354
3384	6.00	-0.50	9999.00	3181	3215	3354
2359	5.00	0.50	19.00	2675	2683	2559
2381	5.00	0.50	19.00	2675	2683	2559
2293	5.00	0.50	19.00	2675	2683	2559
1989	5.00	0.50	19.00	2675	2683	2559
2430	5.00	0.50	19.00	2675	2683	2559
2291	5.00	0.50	19.00	2675	2683	2559
2520	5.00	0.50	19.00	2675	2683	2559
2059	5.00	0.50	19.00	2675	2683	2559
2177	5.00	0.50	19.00	2675	2683	2559
2276	5.00	0.50	19.00	2675	2683	2559
2266	5.00	0.50	19.00	2675	2683	2559
1958	5.00	0.50	19.00	2675	2683	2559
2536	5.00	0.50	19.00	2675	2683	2559
1656	5.00	0.50	19.00	2675	2683	2559
2232	5.00	0.50	19.00	2675	2683	2559
5224	12.00	0.50	9999.00	6219	6254	6250
5620	12.00	0.50	9999.00	6219	6254	6250
4839	12.00	0.50	9999.00	6219	6254	6250

5431	12.00	0.50	9999.00	6219	6254	6250
5793	12.00	0.50	9999.00	6219	6254	6250
5494	12.00	0.50	9999.00	6219	6254	6250
5203	12.00	0.50	9999.00	6219	6254	6250
5356	12.00	0.50	9999.00	6219	6254	6250
5344	12.00	0.50	9999.00	6219	6254	6250
5467	12.00	0.50	9999.00	6219	6254	6250
4971	12.00	0.50	9999.00	6219	6254	6250
5589	12.00	0.50	9999.00	6219	6254	6250
5628	12.00	0.50	9999.00	6219	6254	6250
5482	12.00	0.50	9999.00	6219	6254	6250
5437	12.00	0.50	9999.00	6219	6254	6250
5033	12.00	0.50	9999.00	6219	6254	6250
3566	7.00	0.50	9999.00	3687	3703	3813
3424	7.00	0.50	9999.00	3687	3703	3813
3369	7.00	0.50	9999.00	3687	3703	3813
3516	7.00	0.50	9999.00	3687	3703	3813
3548	7.00	0.50	9999.00	3687	3703	3813
3337	7.00	0.50	9999.00	3687	3703	3813
3415	7.00	0.50	9999.00	3687	3703	3813
3365	7.00	0.50	9999.00	3687	3703	3813
3450	7.00	0.50	9999.00	3687	3703	3813
3545	7.00	0.50	9999.00	3687	3703	3813
3249	7.00	0.50	9999.00	3687	3703	3813
3600	7.00	0.50	9999.00	3687	3703	3813
3343	7.00	0.50	9999.00	3687	3703	3813
3306	7.00	0.50	9999.00	3687	3703	3813
3375	7.00	0.50	9999.00	3687	3703	3813
4899	10.00	6.00	32.00	5206	5112	4837
4200	10.00	6.00	32.00	5206	5112	4837
4091	10.00	6.00	32.00	5206	5112	4837
3812	10.00	6.00	32.00	5206	5112	4837
3870	10.00	6.00	32.00	5206	5112	4837
4286	10.00	6.00	32.00	5206	5112	4837
4385	10.00	6.00	32.00	5206	5112	4837
3993	10.00	6.00	32.00	5206	5112	4837
4457	10.00	6.00	32.00	5206	5112	4837
4168	10.00	6.00	32.00	5206	5112	4837
3132	7.00	-2.00	9999.00	3687	3758	3885
3218	7.00	-2.00	9999.00	3687	3758	3885
3195	7.00	-2.00	9999.00	3687	3758	3885
3120	7.00	-2.00	9999.00	3687	3758	3885
3225	7.00	-2.00	9999.00	3687	3758	3885
3260	7.00	-2.00	9999.00	3687	3758	3885

3240	7.00	-2.00	9999.00	3687	3758	3885
3150	7.00	-2.00	9999.00	3687	3758	3885
3103	7.00	-2.00	9999.00	3687	3758	3885
3144	7.00	-2.00	9999.00	3687	3758	3885
2739	8.00	4.00	9999.00	4194	4136	4199
2823	8.00	4.00	9999.00	4194	4136	4199
2810	8.00	4.00	9999.00	4194	4136	4199
2583	8.00	4.00	9999.00	4194	4136	4199
2747	8.00	4.00	9999.00	4194	4136	4199
2554	8.00	4.00	9999.00	4194	4136	4199
2896	8.00	4.00	9999.00	4194	4136	4199
2802	8.00	4.00	9999.00	4194	4136	4199
2430	8.00	4.00	9999.00	4194	4136	4199
2555	8.00	4.00	9999.00	4194	4136	4199
2603	7.00	-2.00	26.50	3687	3758	3606
2546	7.00	-2.00	26.50	3687	3758	3606
1971	7.00	-2.00	26.50	3687	3758	3606
1959	7.00	-2.00	26.50	3687	3758	3606
1836	7.00	-2.00	26.50	3687	3758	3606
2548	7.00	-2.00	26.50	3687	3758	3606
1828	7.00	-2.00	26.50	3687	3758	3606
2405	7.00	-2.00	26.50	3687	3758	3606
2246	7.00	-2.00	26.50	3687	3758	3606
2111	7.00	-2.00	26.50	3687	3758	3606
5171	10.00	0.50	9999.00	5206	5234	5275
5177	10.00	0.50	9999.00	5206	5234	5275
5211	10.00	0.50	9999.00	5206	5234	5275
5155	10.00	0.50	9999.00	5206	5234	5275
4975	10.00	0.50	9999.00	5206	5234	5275
5085	10.00	0.50	9999.00	5206	5234	5275
4950	10.00	0.50	9999.00	5206	5234	5275
5100	10.00	0.50	9999.00	5206	5234	5275
4983	10.00	0.50	9999.00	5206	5234	5275
5059	10.00	0.50	9999.00	5206	5234	5275
5925	12.00	4.00	9999.00	6219	6177	6149
6672	12.00	4.00	9999.00	6219	6177	6149
6632	12.00	4.00	9999.00	6219	6177	6149
6309	12.00	4.00	9999.00	6219	6177	6149
6251	12.00	4.00	9999.00	6219	6177	6149
6440	12.00	4.00	9999.00	6219	6177	6149
6249	12.00	4.00	9999.00	6219	6177	6149
6223	12.00	4.00	9999.00	6219	6177	6149
6261	12.00	4.00	9999.00	6219	6177	6149
6255	12.00	4.00	9999.00	6219	6177	6149

3698	6.00	-0.50	9999.00	3181	3215	3354
3731	6.00	-0.50	9999.00	3181	3215	3354
3760	6.00	-0.50	9999.00	3181	3215	3354
3948	6.00	-0.50	9999.00	3181	3215	3354
3915	6.00	-0.50	9999.00	3181	3215	3354
3356	6.00	-0.50	9999.00	3181	3215	3354
3434	6.00	-0.50	9999.00	3181	3215	3354
3840	6.00	-0.50	9999.00	3181	3215	3354
3725	6.00	-0.50	9999.00	3181	3215	3354
3706	6.00	-0.50	9999.00	3181	3215	3354
3714	8.00	0.50	9999.00	4194	4213	4300
3431	8.00	0.50	9999.00	4194	4213	4300
3480	8.00	0.50	9999.00	4194	4213	4300
3257	8.00	0.50	9999.00	4194	4213	4300
3350	8.00	0.50	9999.00	4194	4213	4300
3443	8.00	0.50	9999.00	4194	4213	4300
3456	8.00	0.50	9999.00	4194	4213	4300
3038	8.00	0.50	9999.00	4194	4213	4300
3308	8.00	0.50	9999.00	4194	4213	4300
3224	8.00	0.50	9999.00	4194	4213	4300
2487	6.00	0.50	24.00	3181	3193	3046
2178	6.00	0.50	24.00	3181	3193	3046
2610	6.00	0.50	24.00	3181	3193	3046
2391	6.00	0.50	24.00	3181	3193	3046
2736	6.00	0.50	24.00	3181	3193	3046
2668	6.00	0.50	24.00	3181	3193	3046
2680	6.00	0.50	24.00	3181	3193	3046
2539	6.00	0.50	24.00	3181	3193	3046
2618	6.00	0.50	24.00	3181	3193	3046
1992	6.00	0.50	24.00	3181	3193	3046