MODULE II Traffic Regulation and Control

Importance:

 Timely warning of hazardous.

 Regulating traffic by imparting messages to the drivers about need to shop give way and limit their speeds.

 They give information as to highway routes, directions and points of interest.

General Principles of traffic signing:

 Traffic signing should be installed only by authority of law. Unofficial and Non-Essential signs should not permit.

 For imparting a sense of respect towards signs, proper enforcement measures should be taken.

 Excessive use of signs shouldn’t be more. Conservative use of warning and regularly signs is recommended.

 Signs should be put up only after traffic engineering studies.

 High visibility, both during night and day.

 Lettering or symbols of adequate size for being read from far way.

 Simplicity and uniformity in design, position and application.

 Location at conspicuous position to be able to be seen by drivers.

 It is desirable that there should be two sizes for types of sign.

 Standard size (b) a reduced size.

Where conditions do not permit in the safety of road users doesn’t require the erection of the standard size.

Types of Traffic signs (3 types):

 Danger signs or warnings signs or Cautionary signs:

 Necessary to warn traffic of existing or potentially hazardous conditions on or adjacent to a highway or steel.

 Warning signs are of great help in ensuring safety of traffic.

 Should be keep minimum because their unnecessary use tends disrespect for all signs.

 IRC standard 900mm for a standard size, 600mm for a reduced size.

 Signal have red border and symbols are black in color with white background.

 Regulatory signs:

 Signs giving definite instruction sub divided into

 Prohibitory signs:

 To inform the highway users of traffic laws or regulations.

 This signs gives definite negative instructions prohibiting the motorist from making particular manoeuvres.

Types:

 Movement Prohibition: Examples-certain turns, prohibited of entry, prohibited overtaking, One-way Traffic.

 Waiting restrictions signs, such as prohibited waiting.

 Restrictions on dimension, weight or speed of vehicle.

 According IRC these signs are circular shape of 0.6m dia standard 0.4m for reduced size.

 Signs have red border, white color background for speed control, blue for waiting and parking restrictions and direction control also. Symbols are black in color per prohibited and white in color for direction control signs.

 Mandatory signs:

 These are intended to convey definite positive instructions when it is desired that motorists take some positive action.

 2 important mandatory signs are (i) stop (ii) Yield or Give way

STOP:

 These signs require all vehicles to come to half before the stop line.

 Because it causes substantial inconvenience to motorists.

 It is generally used at intersections should be used follows

 Intersection of less important roads with a main road.

 Street entering a through highway or street.

 Un signalized intersect in a signalized.

 Where combination of high speed, restricted view and serious accident record indicates a need for control by stop sign.

Shouldn’t be used:

 On through roadways or expressways.

 For speed control

 At signalized intersection.

 IRC octagon with white border and red background and sides of octagon being 900mm for stand and 600mm for smaller size.

 Combination with a definition plate carrying message stop.

Yield or Give way:

 Used to assign right of way to traffic on certain approaches to an intersect.

 Vehicle controlled by yield sign need to stop only when necessary to avoid interference with other traffic that is given the right of way.

They are used in under following conditions:

 On a minor road at the entrance to an intersection where it is necessary to assign right of way to major road where stop is not necessary at all times.

 Entrance ramp to an express-way when acceleration lane is not provided.

 If there is separate or channelized left-turn lane without adequate acceleration lane.

 Within intersection with a divided highway where entrance stop sign is present at entrance to 1st road way and where median width b/w two road ways exceeds 9m.

 Where special problem exists at any intersections.

Shouldn’t be used:

 Control the major flow of traffic at intersection.

 On the through roadways or expressways.

 On the approaches of more than 1 of the intersection streets or highways or at any intersection where there are stop signs on one or more of the approaches, except under special circumstances, to provide minor movement control within complex intersection.

 IRC downward pointing equilateral triangle red border and white background. 900mm standard triangle 600mm long smaller size.

 Shall be used in combination with a definition plate carrying massage “GIVE WAY”.

 Information signs: (3 types)

 Intended to guide motorist along street and highways to inform him of intersecting routes, to direct him to cities, towns. Villages or other important destination to identify nearby rivers and streams, parks, forests generally to give him such information as will help him.

 Signs not lose their effectiveness by over-use.

 Important dealing with provision of informatory signs is the size of lettering.

 Letters should be of such size as can be easily read when the vehicle are moving at speed.

 Indication signs:

 Provide information of facilities such as hospitals, filling station, telephone, eating place, first aid etc.

 Generally required shape 600mm  450mm with black symbol, blue background and white rectangle.

 Information regarding parking facilities are frequently needed.

 Direction signs, Advanced direction signs and place identification:

 Sign indicate name of the place and rectangular in shape, terminating in the form of an arrow head.

 Advanced direction signs are necessary at intersection of roads. They are Rectangle in shape.

 Reassurance sign reassures the traveler about the places ahead and the direction.

Overhead signs:

Used to provide following consider exist

 Traffic volume at or near capacity

 Complex interchange

 3 or more lanes in each direction

 Restrict sight distance

 Closely spaced interchanges

 Multi-lane exists

 Large percent of trucks

 Street lighting background

 High speed traffic

 Right exist ramps

Existence of any or more of the conditions listed doesn’t automatically justify the use of overhead signs.

Height of the panel ranges from 125cm to 305cm, depending on no. of line sand messages. Letter size range 25-30cm. Vertical clearance needed in India 5.5m.

Types of Supporting Systems:

 Cantilever with one post

 Butterfly with one post

 Two post unit

Route Marker signs:

RMS for national highways has been standardized in India by IRC. It consists of shield painted on a rectangle plate 450mm  600mm. Sign has yellow background and lettering and border are in black.

Location, height and maintenance of traffic signs:

 Located at left side of road. Repeated on other side of carriage on multiple line carriage ways.

 On wide expressways, overhead signs may also necessary.

 On hill road, they are normally fixed valley side of road.

 IRC not less than 60cmaway from edge of kerb in case of kerbed roads and distance 2-3m from carriage way edge in unkerbed roads.

 Stop sign located at point where vehicle has to stop or near there to say 1.5 to 3m if there is pedestrian crossing stop shall be 1.2m in advance of pedestrian cross stop line.

 Give way sign located at near to point where the vehicle is to stop say distance 1.5 to 3m it should be erected 1.2m in advance of marking.

 Warning sign: to be located at the following distance in advance hazard warned against,

Non-Urban locations Plain and rolling terrain Hilly or mountainous terrain

National Highways and

 State Highways

120m

60m

Major District Roads 90m 50m

Other District Roads 60m 40m

Village Roads 40m 30m

For urban location: 50m

 Sign post should be maintaining proper position.

 Damaged signs should be removed and replaced immediately.

 Periodic painting of signs should be routine part of maintenance.

 Variable Message Signs or Dynamic Message Signs:

 Which can be changed whenever need by means of remote control at a centralized location.

 Information such as severe weather conditions, incident notification (accident, road closure) congestion, travel time b/w distance.

 UMS display board uses high intensity LED’s generally yellow color size of letter 380-400mm.

Traffic signals

 Advantages:

 Orderly movement of Traffic flow.

 Because of proper layouts and control measures, they can increase the traffic-handling capacity of intersection.

 Reduce frequency of certain types of accident.

 Under favorable condition, they can be coordinated to provide for continuous or nearly continuous movement of traffic at definite speed along given route.

 Used to interrupt heavy traffic at intervals to permit other vehicular or pedestrian to cross.

 Traffic signals dispense with police control and can thus be economical.

Disadvantages:

 Excessive delays to vehicle may be caused, particularly during indication.

 Unwarranted signal installation tends to encourage the disobedience of signals.

 Driver may use less adequate and less safe routes to avoid delays at signals.

 Accident frequency, especially of rear end type may increase.

 When installation breakdown, total and widespread confusion and difficulties can result.

 Signal Indication:

 Indian practice:

 Amber period 2 seconds as transition interval b/w termination of related green movement and exhibition of indication or b/w termination of red indication and commence of green movement.

Pedestrian Signal indication: Red standing man represents don’t cross and green walking man represents indication cross.

Flashing amber: Signal is a hazard identification beacon is normally used to warn of obstruction and intersections to supplement regulatory signs and to warn of mid block cross walks.

 Signal Face:

 Minimum number of senses in a signal face is 3- red, amber, green. Maximum no. of American practice is 5.

 Lenses in a signal face can be arranged in a vertical or horizontal straight line.

 Relative position top to bottom or left to right are red, amber, green.

 Lenses normally of 2 sizes 200mm and 300mm dia.

 Large size used where 85% approach speeds exceed 65 KPH; for special problem. Location, for all arrow indication, for intersection where signalization unexpected and for intersection where drivers may view both traffic control and lane direction signs simultaneously.

 IRC recommended size 200mm for light signals intended for drive, 300mm for green arrow signals and 300mm for signals intended for pedestrians.

 Arrow pointed vertically upward to indicate a straight through movement and in horizontal direction to indicate a turn at approximately.

 Illumination of Signals:

 Illumination of signals as to be visible for a distance of atleast 0.4km under normal atmospheric conditions.

 Number and location of signals faces:

 American practice: Minimum of 2 signals faces to be provided and be visible from a point atleast. Normally one primary signal is installed at 0.9m from the stop line and secondary signal is commonly installed diagonally opposite the 1st primary signal on the back, on the back of the primary signal intended for opposite traffic.

 Indian practice: When erected the center of the amber signals shall not be less than 2.4m nor more than 4m above carriageway level.

Amber period:

Indian practice: Amber interval is a transition interval b/w termination of related green movement and exhibition of a red indication or wise versa b/w termination of red and commencement of related green movement.

 1st case it is called “Clearance Amber” and 2nd case “Initial Amber”. Amber period is 2 seconds.

 Cycle length is time required for one complete sequence of signal indications phase is defined as sequence of condition applied to one or more streams of traffic.

Fixed Time Signals and Vehicle actuated Signals:

 Which the green periods, hence the cycle length is predetermined and of fixed duration.

 Vehicle actuated signals, are which the green period varies and are related to the actual demands made by traffic. Popular in U.K.

 Intermediate type semi-vehicle actuated on all the available i.e., right of way normally rests with the main road and detections are located only on side roads.

Type Advantages Disadvantages

Fixed time i) Simple in construction

ii)Relatively in expensive

iii)Most successfully used in linked system required fixed cycle length for a given pattern. i)Inflexible cause avoidable delay

ii)Required careful setting

Vehicle-actuated i)Flexible and able to adjust to change in traffic condition automatically

ii)Delay held minimum and maximum traffic capacity achieved i)costly equipment

ii)Can’t provide signal coordination

Semi-vehicle actuated Useful for junction of a side street having low traffic volume with main street having flow Cause high accident rates at times of light traffic.

Determination of Optimum cycle length and signal setting for intersection with time signals:

 Important step in fixed time signals system is to determine the cycle time.

 Main consideration is selecting the cycle time should be outlined that the least delay is caused to the traffic passing through the intersection.

 In selecting a cycle time other guiding factor is proportion of the time lost (in the inter green period and starting delay) to the cycle time.

 If the cycle time is small, the proportion of the time lost to the cycle time will be high resulting in large, proportion of time lost to the cycle time will be small and signal operation will be more efficient.

 If the cycle time is too large, there is danger that a good portion of green time will be used by unsaturated flow of traffic which again leads inefficiency.

 For each traffic flows, there is an optimum cycle time which results minimum delay to the vehicle.

 From graph traffic flows, there is an optimum valve the delay is never more than 10-20% above that the given optimum cycle time.

 Result could be used in determining the comprise cycle time that would suit variation inflow during the delay.

Total delay for intersection w.r.t cycle time for the optimum cycle time,

Co = (1.5L+5)/(1-Y) seconds

Co = optimum cycle time

L = total lost time per cycle

Y = y1+y2+y3+…….. +yn ;

 y1, y2, y3, ……… are the maximum ratios of flow to saturation flow for phase.

 Fig 1 shows that as soon as green signal is given, rate of discharge begins to pick up and some time is lost before the flow reaches maximum value.

 Similarly, termination of green phase, flow tends to taper off further lost time

Lost time L = K + a – g

For phase K = green time for phase

 a = Amber time for phase

 g = Effective green time = b/s ; s=saturation flow

 therefore, b = No. of vehicle discharge on the average during a saturation flow

 Total lost time due to delays per cycle will be l, if there are n phases in cycle.

In addition to this lost time, time R during each cycle, when all signals display red simultaneously is also lost to the total traffic.

 Therefore, Total lost L = nl + R

 Value Y sum of y values for each phase will handle one or more intersection, each approach having its own traffic flow and saturation flow.

 y, value taken a s highest ratio of traffic flow to saturation flow.

 Effective green available in a cycle can be apportioned to the difference phases as

 g1:g2:g3:……:gn = y1:y2:…..:yn

 = effective green time allotted to phases = 1,2,3,4,….,n respectively

 From practical consideration, tower limit of the cycle time may be taken as 25 second upper limit may be regarded as 2 minutes.

Saturation Flow:

 Determine y values, saturation flow should be measured rather than estimated value. For designing new signal installation. Following form devised by Road Research Laboratory.

 S = 525 w PCU/hr

S = Saturation flow

W= width of approach road in meter measured kerb to inside of pedestrian or center line, whichever is nearer or to the inside of central reserve refuse in case of dual carriage way.

 When approaches are in gradient, saturation flow needs some adjustment approx. This can be done by decreasing the saturation flow by 3% for each 1% uphill gradient and increase in saturation flow by 3% for each 1% of downhill gradient.

Effect of Right – turning traffic on the saturation flow accounted as follows:

 No opposing flow, no exclusive right turning lanes

For this calculation using above eq S = 525w PCU/hr

 No opposing flow, exclusive right turning lanes

Saturation flow of right turning stream through a right angle should be obtained separately.

 S = 1800/(1+(1.52/r) ) PCU/hr for single file streams.

 S = 3000/(1+(1.52/r) ) PCU/hr for Double file stream file stream

 R = radius of curvature of right turning stream

 Opposing flow, no exclusive right turning lanes:

Effects are possible under these circumstances.

 Opposing traffic, the right turning are delayed themselves and consequently delay.

Non- right turning vehicle in the same stream.

 Their presence tends to inhibit the use of off-side lane by straight ahead vehicle.

These two effects can be allowed by assuming that on the average. Each right turning vehicle is equivalent to 1.75 straight ahead vehicle.

 It pertains to the discharge of right turners through suitable gaps in the opposing (flow) stream.

 maximum no. of right turn vehicle nr = Sr  (gs-qc)/(s-q)

 Sr = right turning saturation flow

 g = green time

 c = cycles time

 q = flow in opposing arm

S = saturation flow for opposing arm

Average no of right turning lanes per cycle is > nr, then difference b/w two nw will have to wait at the intersection at the terminating of green time. For allowing all these nw vehicle to clear the intersection, inter green time can be made equal to 2 1/2 nw sec, assuming each vehicle takes 2 1/2 sec to clear.

 Opposing flow, Excessive turning lanes:

 There is no delay to straight ahead traffic using the same approach as the right turners.

 But there will be effect on the cross phase and this should be calculated.as outlines

 If % of left turner is <10. Then it is degraded.

 If >10% then corrections are made.

Assuming Each left turner is equivalent to 1.25 straight ahead vehicles.

IRC laid these 4 warrants, one or more of which must be met with before signal can be installed.

Warrants for signals:

IRC warrants 1: Minimum vehicle volume

 Traffic volume on major streets and the higher volume minor street for each of any 8hr of an average day. Should be equal to values

No. of lanes Vehicle/hour on major street

(both approaches) Vehicle/hour on minor street

(one direction only)

Major Minor

1 1 650 200

2 or more 1 800 200

2 or more 2 or more 800 250

1 2 or more 650 250

Warrant 2: Interruption of continuous Traffic.

 Traffic volume on major street and higher volume minor street for each street of average day

No. of lanes on each approach Vehicle/hour on major street

(both approaches) Vehicle/hour on minor street

(one direction only)

Major street Minor street

1 1 1000 100

2 or more 1 1200 100

2 or more 2 or more 1200 150

1 2 or more 1000 150

Warrant 3: Min pedestrian volume

 For each of any hour of any 8hr of average day following traffic must exists

 On the major streets, 600 or more vehicles/hour enter the intersection (both approaches) or there is a raised median island 1.2 m or more in width, 1000 or more vehicle/hr both direction enter intersection.

 During same 8hr, there are 150 or more pedestrians/hr on the highest volume cross=walk crossing major street.

Warrant 4: Accident experience

 Adequate trail of less restrictive remedies with satisfactory observance and enforcement have failed to reduce the accident frequency.

 5 or more reported accidents, of types susceptible of correction by traffic signal have occurred within period of 12 months.

 Signal installation will not seriously make a break in traffic flow.

Coordination control of signals:

Need:

 Desirable to reduce delays and avoid main traffic from having to stop at every junction.

 Signal indicates a stop aspect at a junction, a queue of vehicle is formed behind stop line. When signal changes to green, vehicle start moving in platform.

 If this platoon in made to meet a green aspect at the next junction no delay is caused to vehicle.

 This principle of linking adjacent signals so as to secure maximum benefits to flow of traffic is called coordinates of signals.

Objects of coordinates:

 To pass maximum amount of traffic without enforced halts.

 Have minimum overall delay t traffic streams both in main and side roads.

 Prevent queue of vehicle at one intersection from extending and reaching next intersection.

Off set:

Difference b/w the start of green time at successive upstream and downstream signal.

 It is important consideration planning coordinates system.

 If start of green at downstream signal is offset at particular value such that platoon, which starts at upstream signal upon green indication there arrives at downstream signal just time for green signal platoon has Unhindered movement.

Time and Distance diagram:

 Planning as system of coordinates signal control, indication the system diagrammatically known as “Time and Distance” diagram.

 Time and signal settings are indicated along the horizontal axis suitable scale.

 Distance travelled along the major rote is plotted vertically to suitable scale.

Types and Coordinates signal system: 4 systems

 Simultaneous system or synchronized system:

 Signals along this street always display same indication to the same traffic stream at the same time.

 Division of cycle time is the same at all intersection.

 A master controller is employed to keep the series of signals in step.

Disadvantages:

 It is not conductive to give continuous movement of all vehicles.

 It encourages spending of drivers between stops.

 Overall speed is often reduced.

 Because the division of cycle time is same all the intersections, inefficiency is inevitable at same intersection.

 Simultaneously stoppage continuous line of traffic at all intersections often results in difficulty for the side street vehicles in turning or crossing main side street.

 Alternative System: (limited progressive system)

 In this consecutive signal installation along a given road show contrary indications at same time.

 This permits vehicle to travel one block in half the cycle time.

 It is very efficient when blocks are equal lengths.

Disadvantages:

 Green times for both main and side streets have o substantially equal resulting inefficiency at most of the intersection.

 If blocks length is unequal, the system is not well suited.

 Adjustments are difficult for changing traffic condition.

 Simple progressive system:

 In these various signals along a street display green aspects in accordance with a time schedule to permit as nearly as possible, continuous operation of platoons of vehicle along the street at a planned rate of motion.

 Offset at each installation is determined so as to secure the best continuous movement of platoons in both directions.

 These offsets are fixed and can’t be altered at different periods of the day.

 Each signal installation had a cycle division different from the others but division remains fixed throughout the day.

 Flexible progressive system:

This is improving over simple progressive system with follow provision.

 It is possible to vary the cycle time and division at each signal depend on traffic.

 Possible to vary the offset.

 Possible the introduce flashing or shut down during off peak hours.

Signal Approach Dimensions:

 Approach dimension have an influence on the design and perform of intersection.

 Modify the approach dimensions. We can improve the efficiency of signalized intersection.

 Signal permit traffic movement from any approach for only a proportion of the time reason that is approach roads in immediate vicinity of the intersection should have wider roadway than the normal.

 These when planning or improvement in the geometric layout of existing intersection or planning for new facilities, it helps to keep in view the improvement in flow conditions for new achieved with wider approaches.

 Webster and Newby have produced the following rules for determine approach

 For 2 phase cross roads the approach widths should be proportion to the square roots of the flows.

 q1 and q2 are maximum flows on phase1 and 2 respectively, green times g1 and g2 length widened d1 & d2 , width w1 & w2 are related as

 w1/w2=g1/g2=d1/d2=√(q1/q2)

 if approach width deduced from the above rule is less than of feeder road, it should be made equal to that of feeder road and the green time made corresponding less.

 Extra green time thus allocated to other phase results in less widening being necessary.

 Flow used should be the maximum flow on the 2 or more arms of the same phase.

 With multiple phase intersection

w1:w2:w3:…….:wn = √q1: √q2:√q3:…..∶√qn

 = g1:g2:……:gn =d1:d2:…….:dn

 T – junctions with 2 phase control,

 w1/w2=√(q1/(2 q2)) ; g1/g2=d1/d2=√((2 q1)/q2)

 2 refers to stem of T-junction.

Area Traffic Control:

Introduction:

 Area traffic control is futhur extension of coordinated signal systems. Description of simple linked system along a single road.

 If works on same principle of coordination to include signals in a sustainable area.

 Area Traffic Control is technique through for a centralized control of numerous signal installation distributed through an urban area, such that there is a planned coordination b/w signals at different junctions. Technique invariable employs digital computers for achieving the desired.

Objectives:

 Minimizing journey time for vehicle.

 Reducing accidents

 Minimizing person time

 Minimizing vehicle stops, resulting less noise, less pollution and less consumption of fuel.

 Discouraging use of certain areas.

Traffic Control Methods:

 Fixed time plans based on historical data and calculation off line by a computerized optimizing technique. Information movement is obtained manually on through detectors and fed to the computed which then determine the signal.

 Coordinated system will response from at each signal,

Example: FLEXIPROG (Flexible Progressive) and EQUISAT (Equally Saturated).

 Fully responsive system such as S.P.G (Signal Plan Generation).

 Road User Characteristics:

 Physiological – Vision, hear

 Psychological – perception, Intellection, Emotion, Violation (2.5 sec)

 Speed – Spot speed, Journey speed, Running Speed, Time mean speed, Space mean speed.

 Methods of spot speed:

 Time taken by a vehicle to cover distance

 Long distance

 Direct timing method

 Enoscope

 Pressure contact tube

 Short distance

 Radar method

 Photographic

 Running and journey speed:

 Moving observer

 Registration number method

 Elevated observer method

 Volume

 Needs

 Types of counts

 Level of measurement

 Short term and long term

 Short term

 Daily volume count or counts for full day

 Counts for week

 Continuous counts

 Methods

 Manual

 Mannual and mechanical

 Automatic devices

 Electric plate

 Pneumatic tube

 Co-axial cable

 Radar

 Photo electric

 Infrared ultrasonic

 Magnetic

 Moving observer method

 Photographic method

 Origin and Destination:

 Needs

 Methods

 Home interview

 Full interview technique

 Home questionnaire technique

 Registration number plate survey

 Postal survey

 Public transportation

 Road- side interview survey

 Tag on vehicle survey

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 Determination of optimum cycle length and setting signs at intersections

 Saturation and right turning effects on saturation flow

 Warrants

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 Area Traffic control

 Coordinate control of signals

 Needs

 Objectives

 Types

(1). Average normal flow of a traffic on a cross roads A and B during design speed 400 and 200 pcu/hr. The saturation flow values are 1250 and 1000 pcu/hr. The all red time for pedestrian crossing is 12 sec. Design two phase traffic signals by WEBSTACH’s method?

Sol:

 Saturation flow (S1) = 1250 pcu/hr

 Saturation flow (S2) = 1000 pcu/hr

 Design speed (q1) = 400 pcu/hr

 Design speed (q2) = 200 pcu/hr

 Red time for pedestraining (R) = 12 sec

 Number of phases (n) = 2

 Total lost time per cycle (L) = (l\*n) + R (assume l=2)

 = 2\*2 + 12

 = 4+ 12

 = 16

 Optimum cycle length C0 = (1.5\*L+5)/(1-Y)

 Where Y = Maximum ratio of flow to saturation flow

 Y1 = q1/S1 Y2 = q2/S2

 Y1 = 0.320 Y2 = 0.250

 Y = Y1 + Y2

 Y = 0. 320 + 0 .250

 Y = 0.570

 Gn= Yn/Y(C0 – L)

 Where G = Effective green time

G1 = Y1 / Y (C0 – L) G2 = Y2/Y (C0 -L)

G1 = 0.320/ 0.570 (67.442-16) G2 = 0.250/0.570 (67.442-16)

G1 = 28.880 sec G2 = 22.562 sec

(2). A T-junction has a design year flow 300 veh/hr on the south and 2400 veh/hr on the eastern and west arms. What should be the ratio of approach with lengths and green time of the arms?

Sol. Given Data

 Year flow q1 = 300 veh/hr

 q2 = 2400 veh/hr

 W1/W2=g1/g2=d1/d2 =√((q1 )/(q2 ))

 Ws/Wes =√((q1 )/(2\*q2 )) g1/g2 =√((q1 )/(q2 )) =√((300 )/(2\*2400)) g1/g2 =√((2\*300)/2400)

 = 1/4 = 1/2

 Ws : Wes = 1:4 g1: g2 = 1:2

(3). 15 minutes traffic counts on cross roads 1 and 2 during peak hours are observed as 178 and 142 veh/lane respectively approaching the intersection in the direction of heavier traffic flow. If the amber time requires are 3 and 2 seconds respectively. For the two loads based on the approach speed. Design the signal timing by trial and error method average time headway as 2.5 seconds given green phase?

 Sol. Given data

 q1 = 178 veh/hr

 q2 = 142 veh/hr

Amber time A1 = 3 sec

Amber time A2 = 2 sec

Time t= 15 min =15\*60 = 900 sec

Average time Headway = 2.5

Trail No: 1

Assume C0 = 50 sec

Cycle = t/ C0

 = 900/50

 = 18

Green time g1 = q1/18 \*2.5 Green time g2 = q2/18 \* 2.5

 = 178/18 \*2.5 = 142/18 \*2.5

 = 24.723 sec = 19.722 sec

Total cycle length = A1+A2+ g1+g2

 = 2+3+24.723+19.722

 = 49.445 sec

Trail No: 2

Assume C0 = 48 sec

 Cycle = 900/48

 = 18.750

 Green time g1 = q1/18.750 \*2.5 Green time g2 = q2/18.750 \* 2.5

 = 178/18.750\*2.5 = 142/18.750\*2.5

 =23.733 sec = 18.333sec

Total cycle length = A1+A2+ g1+g2

 = 2+3+23.733+18.333

 = 47.066 sec

Trail No: 3

Assume C0 = 45 sec

 Cycle = 900/45

 = 20

Green time g1 = q1/20 \*2.5 Green time g2 = q2/20 \* 2. 5

 = 178/20\*2.5 = 142/20\*2.5

 = 22.250 sec = 27.750 sec

 Total cycle length = A1+A2+ g1+g2

 = 2+3+22.250+17.750

 = 45 sec