

Final Term Exam Summer 2020

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Reg No: 7720

Subject: Transportation I.

Department of Civil Engineering

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①

Q1 - The remaining portion of Peshawar Ring road has to be designed @ 15 mins to be used what will be the PHF.

Given 60,000 vehicles monthly (30 days).
Peak flow rate of 550 vehicles @ 15 mins.

Required Number of vehicles moving per lane per hour in each direction = ?

Peak hour factor PHF = ?

Solution :-

60,000 vehicles moving in 30 days

$$\text{So, vehicle per day} = \frac{60,000}{30} = 2000 \text{ veh/day}$$

$$\text{Now, vehicle per hour} = \frac{2000}{24} = 83.3 \approx 84 \text{ veh/hour}$$

Consider three lanes in each direction (6)
Total six lanes for both directions. $\frac{84}{6} = 14$

Hence, 14 vehicles are moving per lane per hour in each direction.

$$\text{PHF} = \frac{\text{Hourly Volume}}{4 \times \text{max 15 min vol within hour}}$$

$$= \frac{14}{4 \times 550}$$

$$\text{PHF} = 0.0063$$

Q2:- Calculate the TMS and SMS for given data.

Vehicle Number Distance (meters) Travel Time (minutes) Speed (km/hr)

1	1400	1.31	64.122
2	1400	1.51	55.629
3	1200	1.11	64.865
4	1500	0.90	100.000
5	1600	1.12	85.714
6	1800	1.52	72.053
7	1200	1.45	49.655
8	950	0.90	63.333
9	1175	1.33	53.008
10	1200	1.13	63.717
11	1300	1.30	60.000
12	1400	1.20	70.000
13	1800	1.24	87.097
14	1700	1.11	91.892
15	1800	1.00	108.000
16	2100	1.12	112.500
17	1200	0.87	82.759
18	1700	1.40	72.857
19	1600	1.21	79.339
20	1700	0.55	185.455

Total Average

$$\frac{29725}{20} = 1486.25 \text{ meters}$$

$$= 1.48625 \text{ (km)}$$

$$\frac{23.28}{20} = 1.164 \text{ (min)}$$

$$= 0.094 \text{ (hr)}$$

$$\frac{1620.995}{20} = 81.049 \text{ km/hr}$$

$$TMS = \frac{\sum \text{speed}}{n} = \frac{1620.995}{20} = 81.049 \text{ km/hr}$$

(3)

$$\text{SMS} : \frac{nx}{ET} \quad (x : \text{distance})$$

T: Time

$$= \frac{20 \times 1.48625}{0.388}$$

$$= \frac{29.725}{0.388}$$

$$= 76.61 \text{ km/hr}$$

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Q3: Explain Railway Engineering in detail.

Ans: **Railway Engineering:** The branch of civil engineering which deals with the planning, design, construction, operation and maintenance of the railway tracks for safe and efficient movement of trains (people and goods) is called Railway engineering.

Primary objective: Primary objective of civil engineering are:
1/ safety
2/ Efficiency

History: The history of railway is closely linked with the development of civilization. At necessity arose, human beings developed various methods of transporting goods from one place to another. The efforts were made to replace animal power with mechanical power.

In 1769, Nicholas a french man, carried out the pioneering work of developing "steam energy".
* Richard Trevithick designed and constructed a steam locomotive in 1804. However, this locomotive could be used for traction on roads only.
* The credit for perfecting the design goes to George Stephenson who in 1814 developed the first steam locomotive used for traction on railways.

(5)

With passage of time UK, Europe, US and Germany started their railway lines from 1825 - 1835.

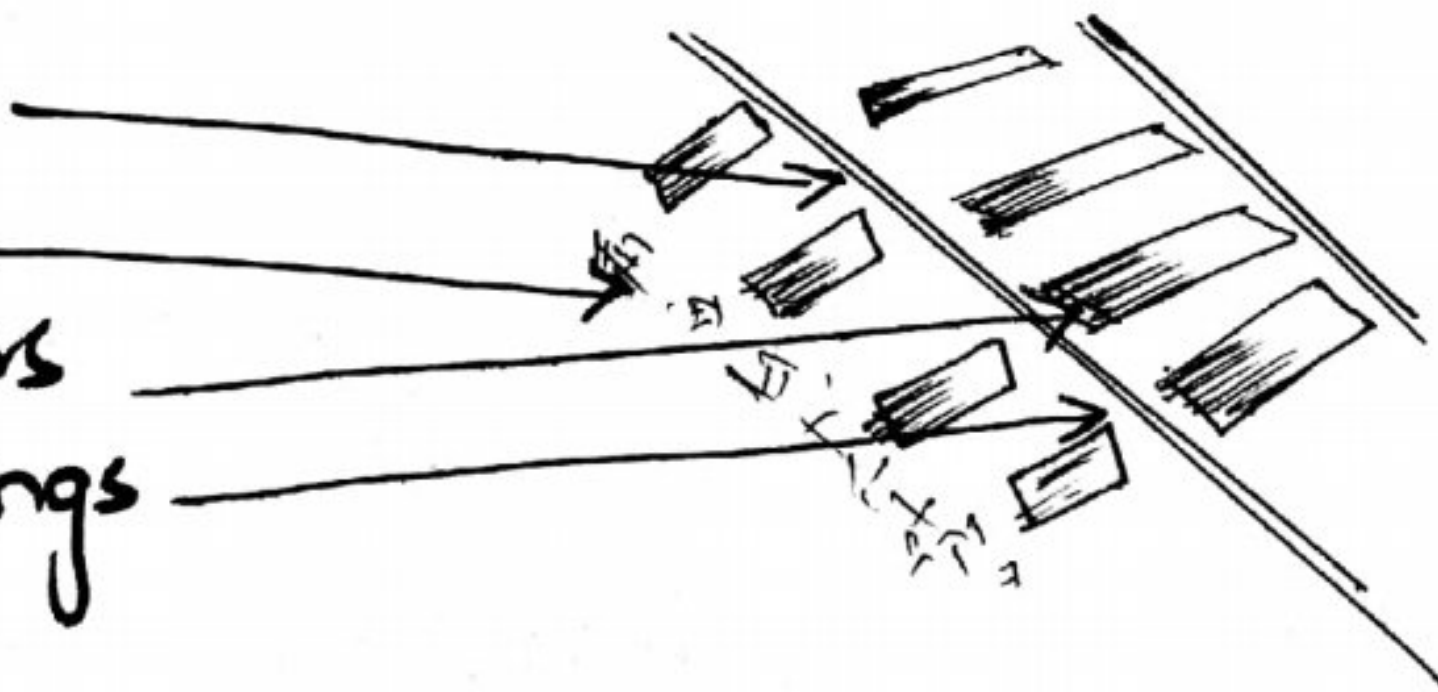
→ The first railway line in India was opened in 1853. consisting of one steam engine and four coaches.

In Pakistan, on 13th May, 1861 the first railway line was opened for public traffic between Karachi city and Kotri, the distance of 105 miles (169 km), speed was 12 mph and speed is 375 mph.

Components of railway track

An engineered structure consisting of two metal guiding rails which vehicles are self propelled or pulled by a locomotive is called railway track.

- > Rails
- > Ballast
- > Sleepers
- > Fastenings



→ Rails: Rails are members of track laid in two parallel lines to provide a continuous and level surface for the movement of trains.
→ To be able to withstand stresses, they are made of high carbon steel.
→ It has inverted T or I shaped cross section.



functions of rail

1. Provide a continuous and level surface for movement of trains.
2. Provide a pathway which is smooth and has very little friction. The friction between the steel wheel and the steel rail is about one-fifth of the friction between the pneumatic tyre and metalled road.
3. Serve as lateral guide for the wheels.
4. Rails bear the stresses developed due to the vertical loads transmitted to them through axles and wheels of rolling stock.
5. Rail carries the function of transmitting the load to a large area of formation through sleepers and the ballast.

Types of rail

Double headed rail

Bull headed rail

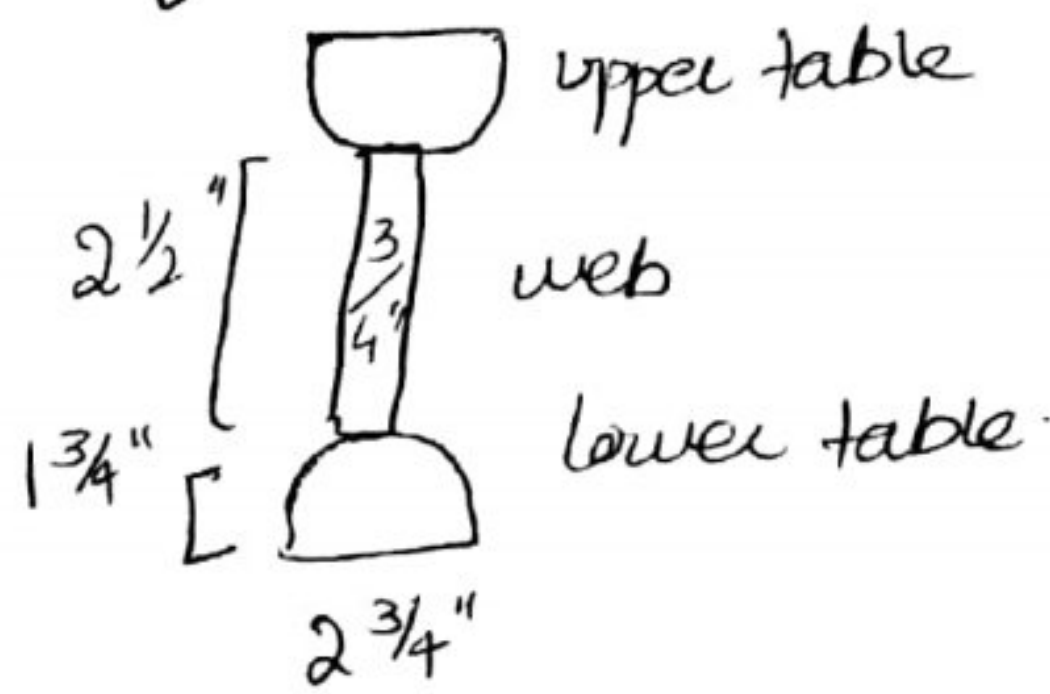
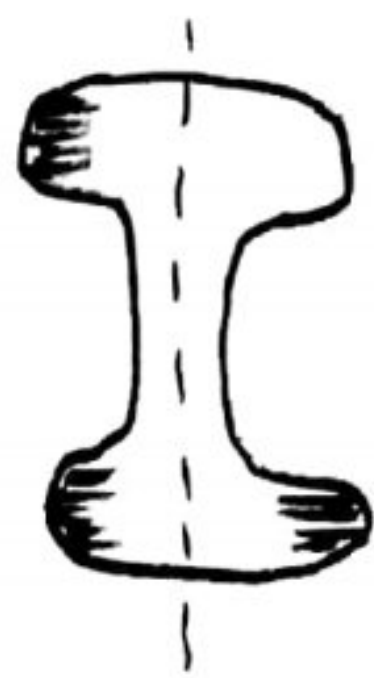
Flat footed rail

Double headed rail : These were the rails which were used in the beginning, which were double headed and consist of the following three parts.

1/ upper table 2/ web 3/ lower table.

The idea behind using these rails was that when the head was worn out in course of time, the rail can be inverted and reused. but idea turned out to be wrong due to continuous contact of lower table with the train made the surface of lower table rough (7)

and hence the smooth running of the train was impossible



Bull headed rails

These rail consist of three parts.

- 1/ The head
- 2/ The web
- 3/ The foot

The head is of larger size than foot and the foot is designed only to hold up properly the wooden keys with which rails are secured.

Two cast iron chairs are required per each sleeper when these rails are adopted

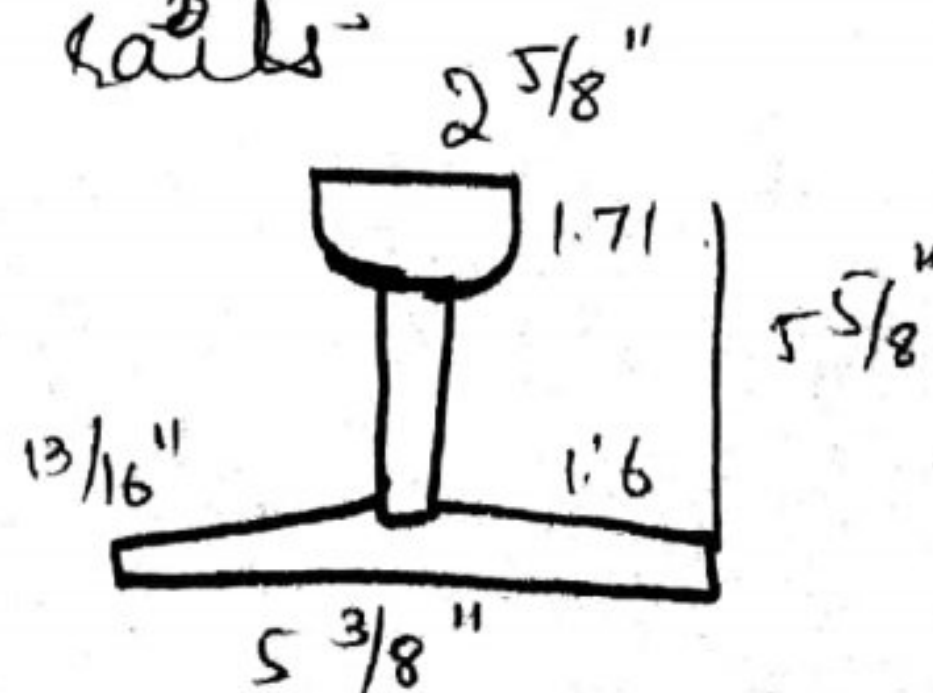
Bull-headed



Flat footed Rails - These rails were first of all invented by Charles Vignoles in 1836 and hence these rails are also called Vignoles rails. It consist of three parts: 1/ The head 2/ The web 3/ The foot.

→ The foot is spread out to form a base.

→ This form of rail has become so much popular that about 90% of railway track in world are laid with this uniform rails.

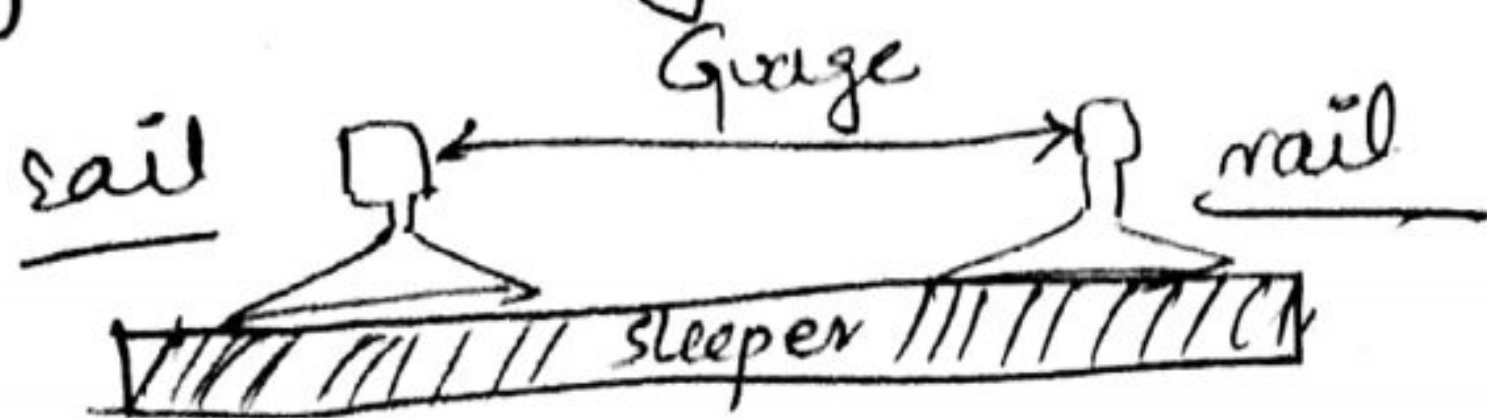


Advantages

- ### of flat footed Rails:-
- 1) They don't need any chain and can be directly spiked or keyed to the sleeper.
 - 2) They are much stiffer both vertically and laterally.
 - 3) They are less liable to develop kinks and maintain a more regular top surface than bull headed.
 - 4) They are cheaper.
 - 5) The loads from wheels of trains are distributed over large area.

Railway Track gauge.

Rail gauge is the distance between the inner sides of the two parallel rails that make up a single railway line.



- * Gauge uniformity is necessary for the railway track of country.
- * A loading gauge defines the maximum height and width for railway vehicles and their loads to ensure the safe passage through bridges, tunnels and other structure.
- * Construction gauge: The construction gauge is decided by adding the necessary clearance to the loading gauge so the vehicle can move safely at the prescribed speed without any infringement.
- * Standard rail section: A rail length of 13m for broad gauge and 12m for Meter and Narrow gauges has been standardized.

BALLAST

Granular material usually broken stones and kanker gravel and sand. Placed and packed around the sleeper to transmit load from sleeper to formation layer. Size: 20mm - 65mm.

Functions - 1/ To transfer and distribute the load from sleepers to a larger area.

2/ To provide elasticity and resilience to track for getting proper riding comfort.

3/ To provide necessary resistance to track for longitudinal lateral stability.

4/ To provide effective drainage to track.

Sleepers

Sleepers are members generally laid transverse to the rails on which the rails are fixed to transfer the loads from the rails to the ballast and subgrade.

Types -
Wooden sleepers.
Metal sleepers.
Concrete sleepers.

Fastenings

Rail fastening means fixing rails to sleepers, used to keep rails in proper position.

Types of Joints According to position of sleepers.

1/ supported joints 2/ suspended joints 3/ Bridge joints

According to position of joints.

1/ squared joint 2/ staggered joint

Q4:- Briefly Explain Airport Engineering

Ans:-

Airport Engineering

Airport Engineering encompasses the planning, design and construction of terminals, runways and navigation aids to provide safe movement for passenger and freight service.

Airport:

An airport is a facility where passenger connects from ground transportation to air transportation.

Airfield: is an area where an aircraft can land and take off which is equipped with any navigation aids, marking and terminal facility.

Aerodromes: is a defined area on land or water (including any building, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

The International Civil Aviation Organization.

ICAO an agency of United Nations, codifies the principles and techniques of international air navigation and fosters the planning and development of the international air transport to ensure safe and orderly growth.

→ 1944 - Chicago Convention, establishing provisional ICAO (International Civil Aviation Organization).

Components of Airport.

1/ Runway

2/ Taxiway

3/ Apron

4/ Terminal building

5/ Control Tower

6/ Hanger

7/ Parking.

* **Runway:** Runway is a paved land strip on which landing and takeoff operations of aircraft take place. It is in leveled position without any obstructions on it.

* Special markings are made on the runway to differ it from normal roadways. Similarly, specially provided lightings are helped the aircrafts for safe landing.

* Many factors are considered for design of runway. The direction of runway should be in direction of land.

* The number of runways for an airport depends upon the traffic. If the traffic is more than 30 movements per hour, it is necessary to provide another.

* Runway can be used using bitumen or concrete.

* The width of runway depends upon the maximum size of aircrafts utilizing it.

* **Taxiway:** Taxiway is a path which connects each end of the runway with terminal area, apron, hanger etc.

Control Tower: is a place where aircraft under particular zone is controlled whether they are in land or in air. The observation is done by controller through radars and information is carried through radio.

The Controller from control tower observes all the aircraft within in zone and inform pilots about their airport traffic, landing, routes, visibility, runway details etc. based on which pilot decides and attempts safe landing.

Hanger: Hanger is a place where repairing and servicing of aircraft is done. The Taxiway connects the hanger with runway. So when a repair is needed, aircraft is moved to hanger easily. It is constructed in the form of large shed using steel, trusses and frames. Large area should be provided for hanger for comfortable movement of aircrafts.

Parking: This is a place provided for parking the vehicles of airport staff or passengers which is outside the terminal building or sometimes under the ground of terminal building.

→ These are laid with asphalt or concrete like runways.

→ In modern airports, taxiway are laid at an angle of 30 degree to the runway so the aircraft can use it to change one runway to other

Apron:

Apron is a place which is used as parking place for aircrafts. It is also used for loading and unloading of aircrafts. Apron is generally paved and is located in front of terminal building or adjacent to hangar.

The size of area to be allotted for apron and design of apron is "generally governed by number of aircrafts" and characteristics of aircraft.

Proper drainage facilities should be provided with suitable slope of paved. sufficient clearances must be provided for aircrafts to bypass each other.

Terminal building: Terminal building is a place where airport administration facilities takes place. In this building, pre-journey and post journey checking of passenger take place.

→ The terminals can house cafes and lounges to serve as waiting area passenger.

→ Ticket counters, luggage check-in or transfer security checks and customs are the basics of all airport service.

Runway Marking.

These are provided with different purposes like:

Runway centre line marking

Runway edge stripe.

Touch down or landing zone marking

Threshold marking

Runway marking / numbering

Airport Lighting

Airport beacon.

Approach lighting

Threshold lighting

Runway lighting

Taxiway lighting

Apron lighting

Boundary lighting

Lighting of wind direction indicator.

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Mid Term Exam Summer 2020

Name: Muhammad Abdullah Khan

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Q No 1: Consider the intersection

Deceleration rate = 10 ft/s^2

Given Data:

PHF = 0.92.

Target V/C = 0.90

All lanes = 20 ft.

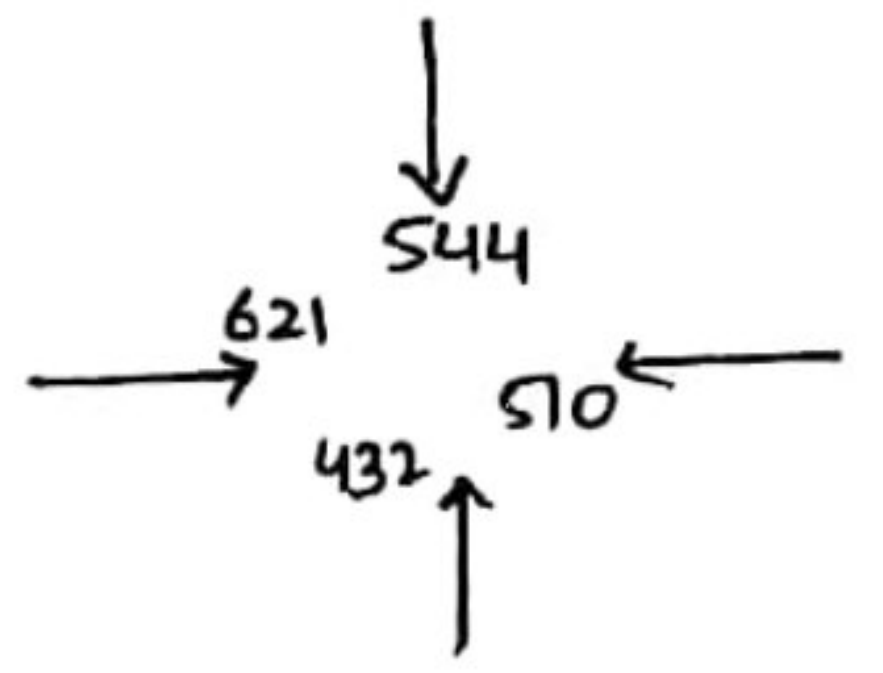
Average speed = 35 mph

Level grades.

Cross walks = 10 ft.

Driver reaction Time = 2.0 s

Deceleration rate = 10 ft/s^2 .



Determine yellow interval:

$$y = t + \frac{1.47 S_{85}}{2a + (64.4 \times 0.01 G)}$$

$$S_{85} = 35 + 5 = 40 \text{ mph.}$$

$$S_{15} = 35 - 5 = 30 \text{ mph.}$$

$$y = \frac{2 + 1.47 \times 40}{2(10) + (64.4 \times 0.01 \times 0)}$$

$$y = 2 + \frac{58.8}{20}$$

$$y = 2 + 2.94$$

$$y = 4.94 \text{ s}$$

Length of all-red clearance interval:

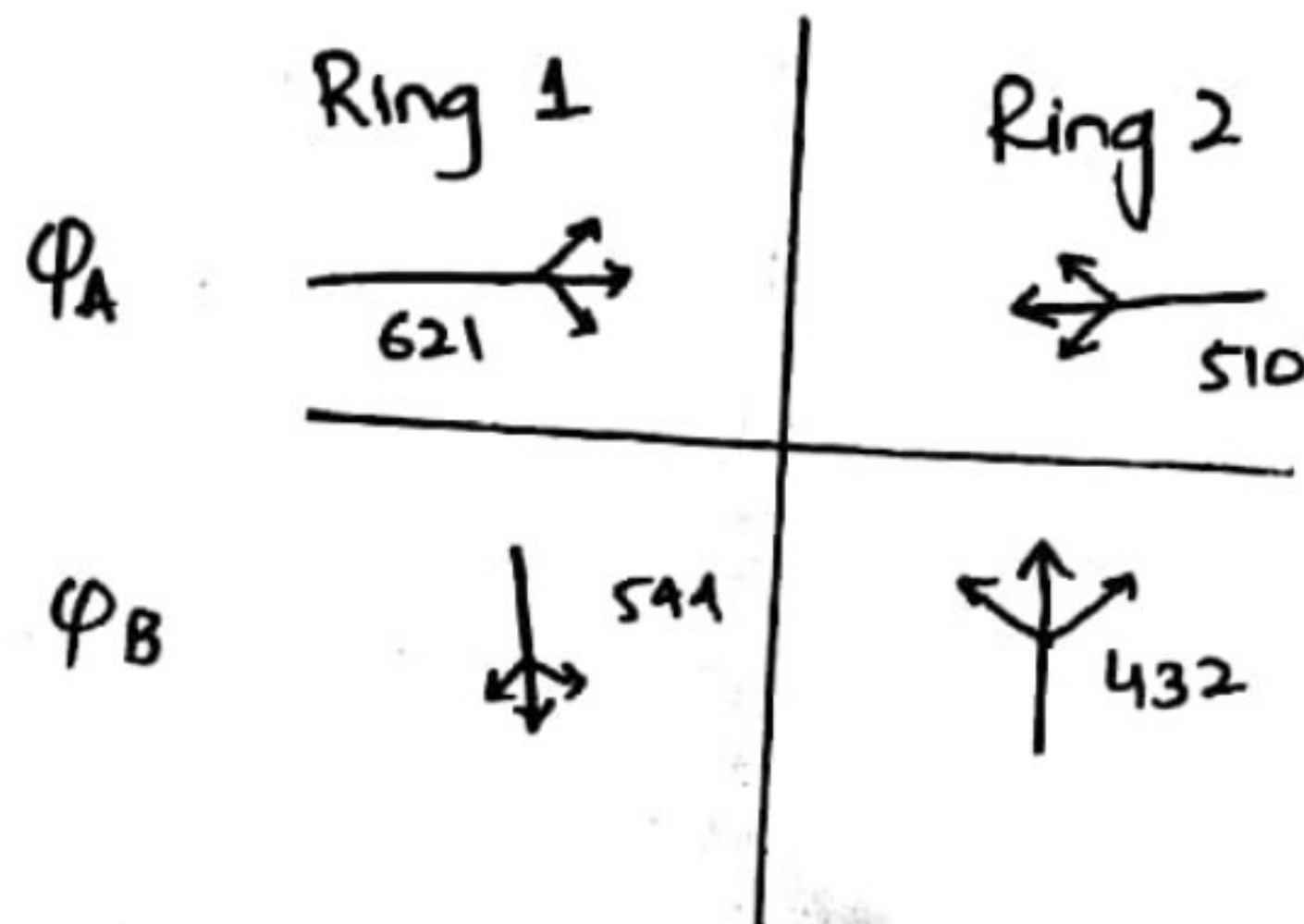
Considering moderate pedestrian traffic

$$a_r = \frac{w + L}{1.47 S_{15}} \Rightarrow \frac{40 + 20}{1.47 \times 30} = 1.16 \text{ sec}$$

$$a_r = \frac{y}{1.47515} = \frac{50}{1.47 \times 35} = 0.97$$

$$a_r = 1.16 \text{ sec}$$

Determine critical lane volume.



621 or 510
 $V_{CA} = 621 \text{ tvu/h}$

544 or 432
 $V_{CB} = 544 \text{ tvu/h}$

$$V_c = 621 + 544 = 1165 \text{ tvu/h}$$

Determination of lost time:

$$Y = y + a_r$$

$$= 4.94 + 1.16$$

$$Y = 6.1 \text{ s}$$

$$l_2 = Y - e \Rightarrow 6.1 - 2 \Rightarrow 4.1 \text{ s}$$

$$t_L = L_1 + L_2$$

$$= 2 + 4.1$$

$$t_L = 6.1 \text{ s}$$

$$\text{Total lost time per cycle} = L = 6.1 + 6.1 = 12.2 \text{ sec}$$

Determination of cycle length:

$$C_{des} = \frac{L}{1 - \left[\frac{V_c}{1615 \times PH \times V/C} \right]}$$

$$C_{des} = \frac{12.2}{1 - \left[\frac{1165}{1615 \times 0.92 \times 0.9} \right]}$$

$$C_{des} = 94.7 \approx 95 \text{ sec}$$

effective green time available.
 $= 95 - 12.2 = 82.8 \text{ sec.}$

$$g_A = g_{TOT} \times \left[\frac{V_{CA}}{V_c} \right] \Rightarrow 82.8 \times \left(\frac{621}{1165} \right)$$
$$= 44.13 \text{ sec.}$$

$$g_B = g_{TOT} \times \left[\frac{V_{CB}}{V_c} \right] = 82.8 \left(\frac{544}{1165} \right)$$
$$= 38.66$$

Check

$$44.13 + 38.66 + 12.2 = 94.99 \approx 95 \text{ sec.}$$

cycle length.

Q2? Discuss and Draw different types of traffic signs.

Traffic Signs: Traffic signs are means for exercising control on or passing information to the road users.

They may be regulatory, warning and informative.

Among the design aspects of the sign, the size, shape

color and location matter. Some of the signs along with examples are discussed as follows.

Types of Traffic Signs:- Traffic signs can be classified into three main categories.

1- **Regulatory Signs:-** These signs require the driver to obey the signs for the safety of the road user.

2- **Warning signs:** These signs are for the safety of oneself who is driving and advise the driver to obey.

3- **Informative Signs:** These signs provide information to the driver about the facilities available ahead, the route and distance to reach the specific destination.

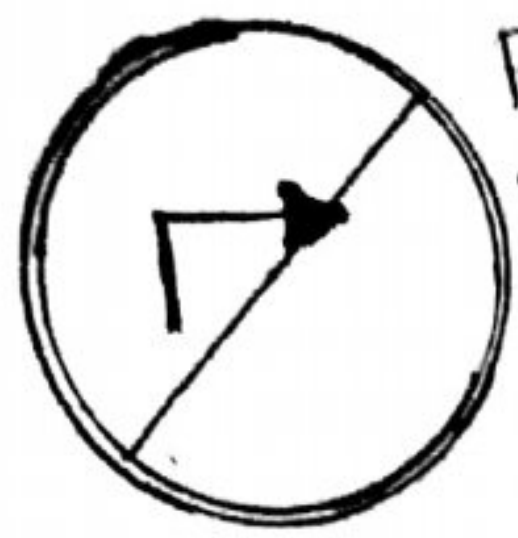
* **Work Zone Signs:-** Special type of traffic signs used to give warning to the road users when some construction work is going on the road, placed for small duration and removed soon after work is over.

1 - Regulatory Signs: (Mandatory signs)

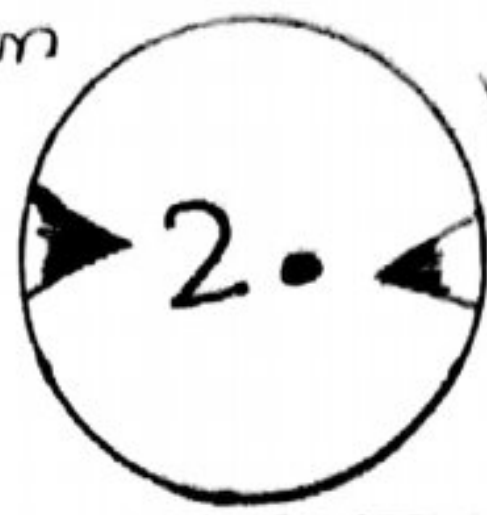
These signs are mandatory for the driver to obey. If the driver fails to obey them, the control agency has the right to take legal action against the driver. These signs are primarily meant for the safety of the road users. These signs have generally black legend on a white background. → They are circular in shape with red borders. These regulatory signs can be further classified:

(i) Right of way series: These include two unique signs that assign the right of way to the selected approaches of an intersection. They are the **STOP** and **GIVE WAY** signs. e.g.: When one minor road and major road meet at an intersection, preference should be given to the vehicles passing through the major road. Hence the give way sign board will be placed on the minor road to inform the driver on the minor road that he should give way for the vehicles on the major road.

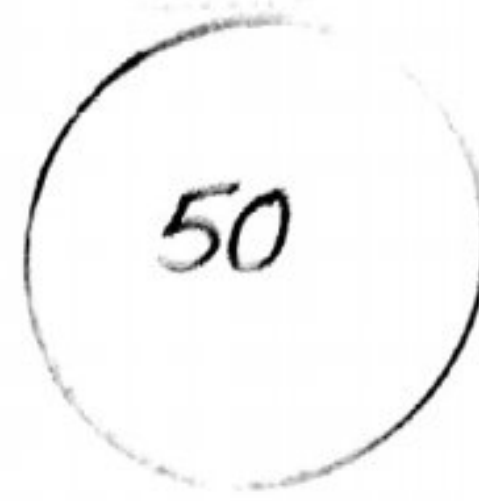
(ii) Speed series: Number of speed signs may be used to limit the speed of vehicle on the road. They include typical speed limit signs, truck speed, minimum speed signs etc. Safety is again a predominant reason. e.g.: speed limit signs placed to limit speed for many reasons like separate truck speed limit for commercial vehicles to slower their speed.



Prohibition for right turn.



Vehicle width limit sign



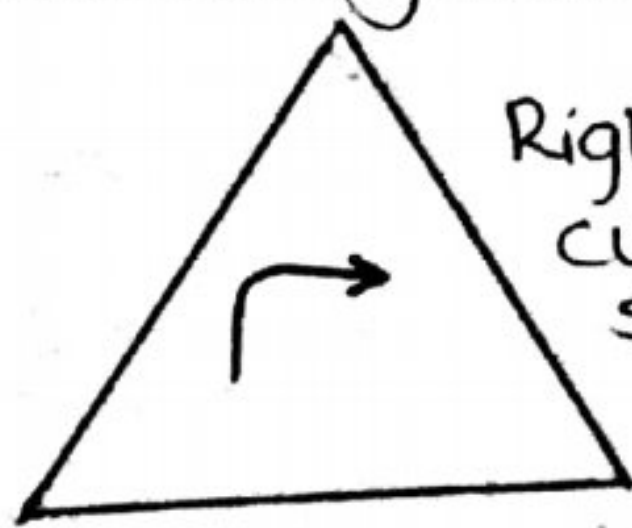
Speed Limit Sign

2: Warning signs: Warning signs or cautionary signs give information to the driver about the impending road condition. They advise the driver to obey the rules. They call for extra vigilance from the part of drivers. The color convention used for this type of sign is that the legend will be black in color with white background.

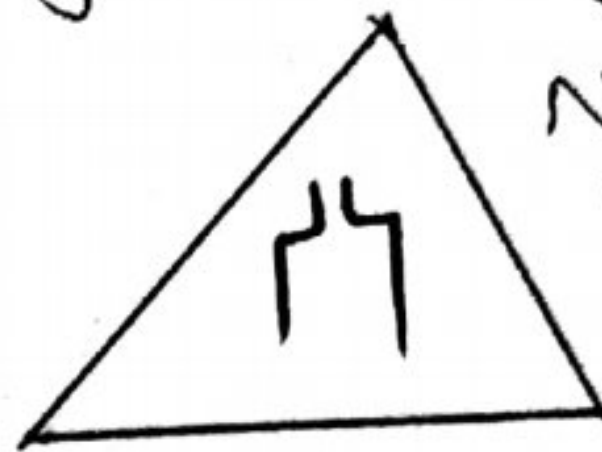
The shape used for this type is upward triangle or diamond shape with red borders

e.g:

Right hand curve sign board, signs for narrow roads, sign indicating railway track ahead etc.



Right hand curve sign



Narrow road sign



Railway Track ahead

3: Informative signs: (Guide signs) are provided to assist the drivers to reach their desired

destinations. They are predominantly meant for the drivers who are unfamiliar to the place.

e.g: Route markers, destination signs, mile posts, etc.

III) Movement Series: They contain a number of signs that affect specific vehicle maneuvers. These include turn signs, alignment signs, exclusion signs, one way signs etc. Turn signs include turn prohibitions and lane use control signs. Lane sign make use of arrows to specify the movement of all vehicles in the lane must take. Turn signs are used to safely accommodate turns in unsignalized intersections.

(IV) Parking Series: They include parking signs which indicate not only parking prohibitions and restrictions but also indicate places where parking is permitted, the type of vehicle to be parked and duration of parking etc.

They include both legend and symbol signs. These signs are meant for the safety of pedestrians and include signs indicating pedestrian only roads, pedestrian crossing sites etc.

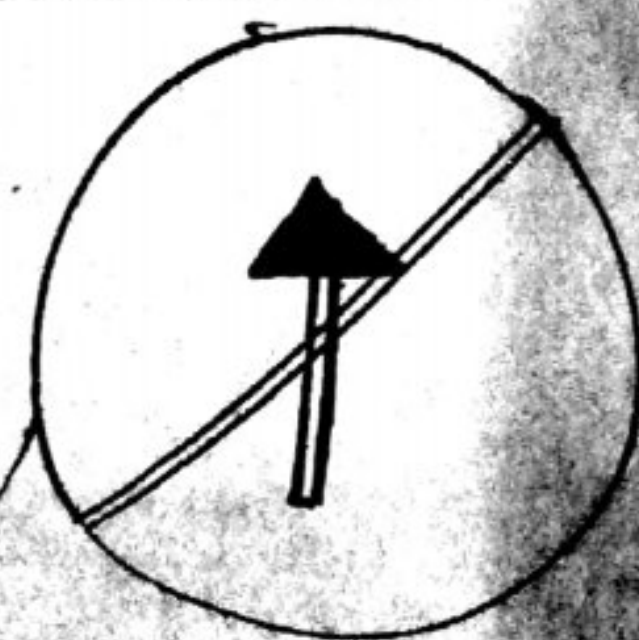
Wide variety of signs that are included in this category are: a "KEEP OF MEDIAN" sign, signs indicating road closures, signs restricting vehicles carrying hazardous cargo or substances, signs indicating vehicle weight limitations etc.



STOP SIGN



GIVE AWAY SIGN



SIGN FOR NO ENTRY

* Route markers: used to identify numbered highways designs are distinctive and unique, black words written on yellow

* Destination signs: use to indicate direction to the critical destination points to mark important intersection

* Mile Posts: are provided to inform the driver about the progress along a route to reach his destination

* Service Guide: Sign give information to the driver regard various services such as food, fuel, medical assistance etc

Route marker



Destination sign



Service Centre Information

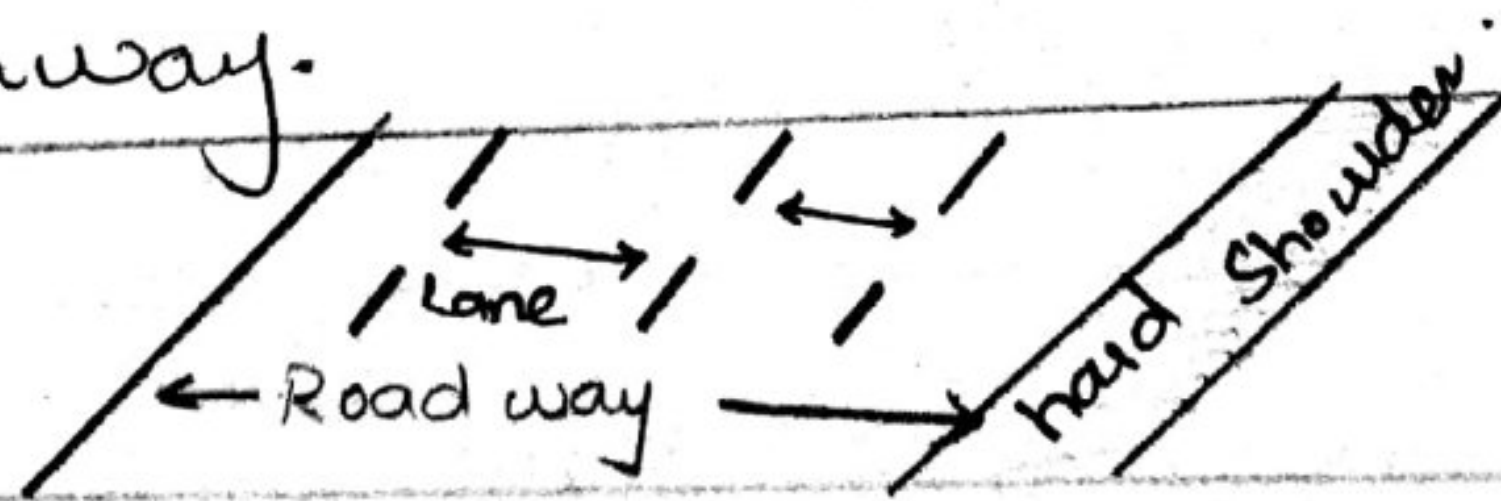
Q3: Discuss road margins.

Road Margin:- The portion of the road beyond the carriage way and on the roadway can be generally called road margin. Various element that form road margins are given below.

- 1/ Shoulders
- 2/ Parking lanes
- 3/ Bus-bays
- 4/ Service road
- 5/ Cycle track
- 6/ Footpath
- 7/ Guard rails

1: Shoulders: shoulders are provided along the road edge and is intended for accommodation of stopped vehicles, serve as an emergency lane for vehicles and provide lateral support for base and surface courses. The shoulder should be strong enough to bear the weight of a fully loaded truck, even in wet conditions.

The shoulder width should be adequate for giving working space around a stopped vehicle. It is desirable to have a width of 4.6 m for the shoulder. A minimum width of 2.5 m is recommended for 2-lane rural highway.



2: Parking lanes Parking lanes are provided in urban lanes for side parking. Parallel parking is preferred because it is safe for the vehicles. 9/

moving on the road. The parking minimum of 3.0 m width in the case of parallel parking

3- Bus-bays:

Bus-bays are provided by recessing the kerbs for bus stops. They are provided so that they don't obstruct the movement of vehicles in the carriage way. They should be at least 75 meters away from the intersection.

4- Service Roads:

Service roads or frontage roads give access to controlled highways like free ways or express ways. They run parallel to the highway and will be usually isolated by a separator and access will be provided only at selected points.

These roads are provided to avoid congestion in the expressways and also the speed of the traffic in those lanes are not reduced.



Cycle Track:

Cycle tracks are provided in urban areas where the volume of cycle traffic is high. Minimum width of 2 meters is required which may be increased by 1 meter for every additional track.

6: Footpath: Footpaths are exclusive right of way to pedestrians especially in urban areas. They are provided for the safety of the pedestrians when both the pedestrian traffic and vehicular traffic is high. Minimum width is 1.5 meter and may be increased based on the traffic. The footpath should be either as smooth as the pavement or more smoother than that to induce the pedestrian to use the footpath.

7: Guard rails: They are provided at the edge of the shoulder usually when the road is on the embankment. They serve to prevent the vehicles from the running out of the embankment, especially height of embankment increase or exceeds 3m. There are various designs of guard rail. Guard stones are painted in alternate black and white are usually used. They also give better visibility of curve at night after highlights of vehicle.

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