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The Federal Register notices, which provide detailed discussions of the FHWAs decisions, can be viewed at Whenever you see an easytoread sign, a bright edgeline marking on a foggy night, the countdown timer at a crosswalk, or a wellplaced bike lane, take a moment to reflect on the more than eighty years of progress and innovation that the MUTCD embodies. This progress has resulted in safer, more efficient travel on our Nations roads. Over the years, the MUTCD has unknowingly become the travelers best friend and silent companion, guiding us on our way along the streets, bikeways, back roads, and highways. As the direct means of communication with the traveler, traffic control devices speak to us softly, yet effectively and authoritatively. Active devices at rail crossings save lives by giving us a positive message about train traffic. And countdown timers on pedestrian signals help us cross a busy street. So the next time you hit the pavement, the path, or the pedals, you can be sure that the MUTCD, through our dedicated professionals who make complex decisions on what devices to install, will help you get where you want to go safely, efficiently, and comfortably. They indicate which part of the road to use, provide information about conditions ahead, and indicate where passing is allowed. Yellow lines separate traffic flowing in opposite directions. Drivers should stay to the right of yellow lines. A solid yellow line indicates that passing is prohibited. A dashed yellow line indicates that passing is allowed. White lines separate lanes for which travel is in the same direction. A double white line indicates that lane changes are prohibited. A single white line indicates that lane changes are discouraged. A dashed white line indicates that lane changes are allowed. A diamond indicates a lane reserved for use by highoccupancy vehicles. A

bicycle indicates a lane reserved for bicyclists. Arrows show required or permitted movements at intersections.http://akersbergaibf.se/userfiles/comma-too-chicago-manual-of-style.xml

A row of solid triangles indicates that the road user must yield. A letter X with a letter R on each side indicates a highwayrail grade crossing ahead. A hollow triangle indicates a yield ahead. A series of progressively wider lines across a lane indicates a speed hump ahead. Design specifications for pavement markings are in the Standard Highway Signs Book. Both of these books are available online at. The MUTCD is also available for purchase through the American Association of State Highway and Transportation Officials , the Institute of Transportation Engineers , the American Traffic Safety Services Association , and the U.S. Government Printing office . The Standards Highway Signs Book can be purchased from the U.S. Government Printing Office and the American Traffic Safety Services Association. This website will not display correctly and some features will not work. Learn more about the browsers we support for a faster and safer online experience. It’s now easier than ever to find Ontario laws. We welcome your feedback. See the guidance on reopening. Signs Traffic signs tell you about traffic rules, special hazards, where you are, how to get where you are going and where services are available. The shape and color of traffic signs give indications to the type of information they provide REGULATION SIGNS normally are white rectangles with black letters or symbols, but some are different shapes, and some can use red letters or symbols. WARNING SIGNS normally are yellow and diamondshaped, with black letters or symbols. DESTINATION SIGNS are green with white letters and symbols. SERVICE SIGNS are blue with white letters and symbols. Know the signs shown below and what they mean. You will be asked about them on your written test. Here are descriptions of common traffic signs and what they indicate REGULATION SIGNS Stop Sign COLOR Red, with white letters.

MEANING Come to a full stop, yield the rightofway to vehicles and pedestrians in or heading toward the intersection. Go when it is safe. You must come to a stop before the stop line, if there is one. Yield Sign COLOR Red and white, with red letters. MEANING Decrease speed as you reach the intersection. Prepare to stop and yield the rightofway to vehicles and pedestrians in or heading toward the intersection. You must come to a full stop at a YIELD sign if traffic conditions require it. When you approach a YIELD sign, check carefully for traffic and be prepared to stop. MEANING These signs give information about rules for traffic direction, lane use, turns, speed, parking and other special requirements. Some regulation signs have a red circle with a slash over a symbol. This indicates that an action, like a right turn, is not allowed or that some vehicles are restricted from the road. Rectangular white signs with black or red letters or symbols are indications to be alert for special rules. WARNING SIGNS COLOR Yellow, with black letters or symbols. MEANING You are approaching a hazardous location or a location where there is a special rule, as shown in the sample signs. This indicates reduced speed is advised in that area. Work Area Signs COLOR Orange, with black letters or symbols. MEANING People are at work on or near the roadway and traffic can be controlled by a flag person. Even if no speed limit is provided, you must drive at a reduced speed through the work zone and you must always obey the flag persons. These illustrations show some signals a flag person will use. Know and obey them. STOP PROCEED SLOW Destination Signs COLOR Green, with white letters. MEANING Show the direction and distance to locations. Route Signs COLOR Varied. MEANING Indicate interstate, U.S., state or county routes. The shape tells you the type of route you are on. The sample signs, left to right, are for state, U.S., and interstate routes.

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When you plan a trip, use a highway map to decide which routes to take. During the trip, watch for destination signs so you will not get lost, or have to turn or stop suddenly. Service Signs COLOR Blue, with white letters or symbols. MEANING Show the location of services, like rest areas, gas stations, camping and medical facilities. Traffic Signals Traffic Lights Traffic lights are normally red, yellow and green from the top to bottom or left to right. At some intersections, there are lone red,

yellow or green lights. Some traffic lights are steady, others flash. Some are round, and some are arrows. State law requires that if the traffic lights or controls are out of service or does not operate correctly when you approach an intersection, you must come to a stop as you would for a stop sign. You must then continue according to the rules of rightofway, unless you are told to continue by a traffic officer. Here is what different traffic lights indicate Steady Red Stop. Do not go until the light is green. If a green arrow is shown with the red light, you can go toward the arrow and only if the intersection is clear. You can make a right turn at a steady red light after you come to a full stop and yield the rightofway to oncoming traffic and pedestrians. You can make a left turn at a steady red light when you turn from a oneway road into another oneway road after you come to a full stop and yield the rightofway to oncoming traffic and pedestrians. You cannot make a turn at a red light if there is a NO TURN ON RED sign posted or another sign, signal or pavement marking prevents the turn. You are not allowed to turn on a red light in New York City unless a sign that permits it is posted. The driver of a school bus containing pupils cannot turn right on any red light. Flashing Red Means the same as a STOP sign Stop, yield the rightofway, and go when it is safe.

R ed Arrow Do not go in the direction of the arrow until the red arrow light is off and a green light or arrow light goes on. A right or left turn on red is not permitted at a red arrow. Steady Yellow The light will change from green to red. Be prepared to stop for the red light. Flashing Yellow Drive with caution. Yellow Arrow The protection of a green arrow will end. If you intend to turn in the direction of the arrow, be prepared to stop. Steady Green Go, but yield the rightofway to other traffic at the intersection as required by law see Chapter 5 . Green Arrow You can use this lane. Pavement Markings Lines and symbols on the roadway divide lanes and tell you when you can pass other vehicles or change lanes. They also tell you which lanes to use for turns and where you must stop for signs or traffic signals. The arrows on these illustrations show the direction of traffic. Edge and Lane Lines Solid lines along the side of the road tell you where its edge is where the travel lane ends and the shoulder begins. It is illegal to drive across the edge line, except when told to by a police officer or other authorized official or when allowed by an official sign. An edge line that angles toward the center of the road shows that the road is narrower ahead. Lines that separate lanes of traffic that moves in the same direction are white. Lines that separate traffic that moves in opposite directions are yellow. There may be two lines between lanes and lines can be solid or broken. Read Chapter 6 for the rules on how to pass other vehicles. What some lane lines indicate One broken line You can pass other vehicles or change lanes if you can do so safely without interfering with traffic. Solid line with broken line If you are on the side with the solid line, you cannot pass other vehicles or go across the line except to make a left turn into a driveway. If you are on the side with the broken line, you can pass if it is safe to and you will not interfere with traffic.

Double solid lines You can not pass or change lanes. You cannot go across the lines except to turn left to enter or leave the highway e.g., to or from a driveway or to do a Uturn see Chapter 5 . One solid line You can pass other vehicles or change lanes, but you can only do so when obstructions in the road or traffic conditions make it necessary. When required to stop because of a sign or light, you must stop before you reach the stop line, if there is one, or the crosswalk. You need only stop at a stop line or crosswalk if required to by a light, sign or traffic officer, or to yield to a pedestrian, inline skater or scooter at a marked or unmarked crosswalk. A single stop line may be placed at intersections to allow room for larger vehicles such as tractortrailers, buses and trucks to turn without forcing other traffic to back up. Arrows Arrows show which lanes you must use. In this illustration, for example, you can turn right only from the right lane. To go straight, you must use the left lane. You must be in the correct lane before you reach the solid line that separates the lanes. You cannot enter and use these lanes unless your vehicle complies with the occupancy or other

requirements indicated by signs for the times the special conditions are in effect. When used to designate reserved lanes on city streets, sections of the solid white line that separates the diamond lanes from the normal lanes can be replaced by broken white lines. In these locations, nonHOV can enter the HOV lane if they make a right turn at the next intersection. Bus lanes and HOV lanes are to promote the most efficient use of limited street and highway capacity. They assure that vehicles with the highest importance move the fastest. Traffic Officers Directions given by traffic officers take precedence over signs, signals or pavement markings. If a traffic officer signals you to stop at a green light, for example, you must stop.

If an officer signals you to drive through a red light or stop sign, you must do it. Among the persons authorized to direct traffic are police officers, fire police, highway work area flag persons, and school crossing persons. Questions Before you move on to Chapter 5, make sure you can identify the signs in this chapter and know what they mean. Also, make sure you can answer these questions A regulation sign is normally what shape. What is the normal color and shape of a warning sign. What color and shape is a destination sign. What must you do at a STOP sign. What must you do when facing each of the following a flashing red light, flashing yellow light, steady yellow light, a red light with a green arrow. What does it indicate if an edge line angles in toward the center of the road. What do each of these lines indicate one broken, one solid, double solid, solid and broken together. If an intersection has crosswalk lines but no STOP line, where must you stop for a red light at that intersection. What type of pavement marking is used to show you which lane you must use for a turn. Which of the following must you obey over the other three steady red light, flashing red light, STOP sign, police officer. Seasonal and monthly variations in traffic demand are higher on highways serving resorts, beaches, national parks, historical places, botanical gardens, etc. Highways with significant intercity traffic have lower monthly variations. The traffic demand differences by day of the week are also associated with the highway type. For example, traffic weekday volumes are significantly higher than the traffic weekend volumes on many urban freeways in the world. The situation is completely reverse for freeways that serve recreational traffic. It is also well documented that traffic flow rates usually fluctuate over the course of a day and over the course of an hour.

It is usual to use volume and flow rate to measure the number of vehicles passing a point over a given point or section of a lane during a given time interval. Volume is the number of vehicles that pass a point for the duration of one hour. On the other hand, flow rate denotes the number of vehicles that pass a point through a time interval of less than 1 h usually 15 min, but expressed as an equivalent hourly rate. Let us consider Fig. 5.2. Fig. 5.2. Peak flow rates 1 and 2. Fig. 5.2 shows 15 min peak flow rates and a hour volumes. Let us consider the situation when the hourly volume is equal in both cases that are shown in Fig. 5.2. The 15min peak flow rate 1 is significantly higher than the 15 min peak flow rate 2. Transportation facilities are not designed to accommodate the hourly traffic volume, since it could produce an oversaturated traffic conditions for a considerable part of the hour. In other words, we would make a significant design mistake if we used in our calculations hourly volume instead of 15 min peak flow rate. The HCM recommendation to the traffic engineers is to analyze the peak 15 min of flow during the analysis hour. The HCM exploits the peak hour factor PHF to change hourly volume into a peak 15min flow rate. In the case of lower PHF values, traffic flow has high variability, while the high PHF values indicate less flow variation within the hour. ABC can be used to reduce the mobility, safety, and environmental impacts of work zone activities by reducing the overall duration of the project. The higher cost premium of using ABC is offset partially or fully by the gains in work zone road user costs. View chapter Purchase book Read full chapter URL Traffic Operations Bastian J. Schroeder PhD, PE, in Highway Engineering, 2016 5.1.2 Highway Capacity Manual The U.S.

Highway Capacity Manual, or HCM TRB, 2015 , is the primary reference for traffic operational analysis, methodologies, and level of service LOS concepts in the United States, as well as many other countries. The HCM is a collection of concepts and methods that guide analysts on how to evaluate a particular type of intersection or roadway segment, based on what can be extensive national or international datasets of operational performance. The HCM is also the primary source for defining the capacity of different roadway elements that are used in many applications beyond traffic operations, including transportation planning and even safety analyses. While the HCM is the primary traffic operations resource developed for the United States, many other countries have adopted the HCM for their own use, often with some countryspecific modification and calibration of methods to better suit local conditions. Some countries have developed their own traffic operations manuals, such as, for example, the German HBS manual for measuring street systems, FGSV, 2001 . The HCM, first produced in 1950, is updated regularly based on new research supported by the Transportation Research Board TRB. The manual is updated through the Highway Capacity and Quality of Service Committee of TRB. HCM 2010, the most recent edition, was distributed in early 2011; a major update of the 2010 HCM is expected for publication in late 2015. The HCM is principally organized into four volumes, covering 1 general concepts, 2 methods for uninterrupted flow freeways, 3 methods for interrupted flow arterial streets, and 4 supplemental information to further document the methods in the second and third volumes. Each volume is organized into chapters that describe a particular element of the transportation system, ranging from basic freeway segments to signalized intersections, to modern roundabouts, to sharedused pedestrian and bicycle paths. Table 5.

1 shows the highlevel organization of the 2010 Highway Capacity Manual in the three primary printed volumes. Martin Fellendorf, in Global Practices on Road Traffic Signal Control, 2019 4.5.5 Quality The quality of traffic flow is checked according to the German Highway Capacity Manual with average delay for motor vehicles and maximum delay for cyclists and pedestrians as the indicator stationarity during peak hour assumed. Table 4.4 contains the relevant data and level of service for all lanes and pedestrian crossings. It also provides maximum queue lengths. All major signal groups i.e., through and rightturning traffic achieve LOS D, which is considered acceptable. LOS E means that delay is considered long and a queue at the end of green is possible.The BPR equation was modified to obtain transportation times of the modes for every time interval, t. The BPR equation constants were obtained from Horowitz 1985. In general, BPR equation constant b is assumed as “4” but in our case it is taken as “1” to handle the nonlinearity of the Eqn 16.18 because BPR equation depends on carried quantity by road transportation. However, the error gap between these two values is less than 5%. So, it is acceptable and used in our model. View chapter Purchase book Read full chapter URL India Shriniwas Arkatkar. Tom Mathew, in Global Practices on Road Traffic Signal Control, 2019 12.5.1.1 Adjustment for bus blockage The adjustment factor for bus blockage accounts for the reduction in saturation flow due to the presence of bus stops within a 75m vicinity of the intersection Indian Highway Capacity Manual INDOHCM, 2018 . The adjustment factor for bus blockage is adapted from HCM 2010 with appropriate modifications. The average width of the road section blocked by the buses is taken as 3 m and the value of the average blockage time t b during green is taken as 18 s.

This value is arrived at based on reasonably large data of bus dwell times collected at various locations having different land uses in urban areas. This factor is be used only if the stops made by the buses at the intersections hinder the discharge during the green interval of the signal, otherwise the factor is taken as 1. In addition, in the case where exclusive bus bays are present, the factor is taken as 1. View chapter Purchase book Read full chapter URL Bridge Life Cycle Costing Mark Hurt, Steven D. Schrock, in Highway Bridge Maintenance Planning and Scheduling, 2016 6.3.2 User Costs Most common bridge maintenance activities involve work at the roadway, resulting in disruption of the normal flow of traffic. Traffic must be diverted at the work zone, either onto adjacent lanes or on

designated detour routes around the site. This imposes direct costs on the intended user of the bridge in the form of increased travel time due to delay and, for detoured traffic, in form of extra distance that must be driven also known as adverse travel. The lowest agency cost for bridge construction work is usually achieved when the bridge is closed to traffic. Facilitating traffic through a construction area on a bridge requires traffic control measures of either carrying traffic at site on an adjacent temporary structure, or of phasing the construction work and carrying traffic on adjacent open lanes. For a bridge with two or more lanes traveling the same direction, one lane can be closed and the entire volume of traffic on the open lanes. For a twolane bridge carrying traffic each direction, traffic may be phased with signalization. Either of these phasing options require traffic control measures, prolong the length of time needed for construction and require the contractor to remobilize for each phase of construction. This can be considerably more expensive than closing the bridge to traffic during construction.

However, closing a bridge can impose a significant inconvenience on the travel public. Monetizing this inconvenience in BLCCA, calculations can provide a means of assessing the impact to users and comparing to it to the budget impact on the bridge owner. This may be used to justify either maintaining traffic through construction or accelerating the construction work. Of the three possibilities for handling traffic at a work zone, the easiest to calculate user cost for is the detour option. First the adverse mileage is calculated. This is simply the length of the detour less the length of the normally traveled route. The additional travel time is also calculated. This may be as simple as finding the difference between traveling the detour route at its signed speed and traveling the normal route at its usual signed speed. Or, the calculation may be expanded to include delay time is slowing and stopping. Many state departments of transportation will provide standard road user cost for passenger vehicular and trucks for use by consulting engineers. The cost imposed on each user is the length of adverse travel times the VOC per mile plus the time of adverse travel times VOC per hour. Calculations for VOC per mile include consideration of fuel and oil usage and depreciation of the vehicle. Calculations for VOC per hour include consideration of the value of time for the occupants and of any freight being carried. The reader is referred to the FHWA guide for specifics in calculations. The alternative to detouring traffic is to carry it through the construction site. If the site has more than one lane in each direction, the simplest phasing scheme is to reduce the number of lanes for traffic. In this case, determining the user cost requires calculating how many vehicles are expected to be delayed due the traffic demand exceeding the reduced capacity through the bridge site, and what the average delay is expected to be.

For urban areas, peak hour traffic volumes may be available for major routes from the local highway agency. If not, the peak hour volume may be estimated by multiplying the AADT by an hourly traffic variation factor. Exhibit 1014 of the 2010 HCM provides values for lane capacities of longterm construction zones. For a reduction of two lanes to one, the single lane has a default capacity of 1400 vehicles 2 per hour. For reductions of three lanes to two, each remaining lane has a default capacity of 1450 vehicles per hour. There are three adjustments provided for the baselane capacity values. The first is for the effect of heavy vehicles in the traffic stream. A heavyvehicle adjustment factor is provided that is a function of the proportion of trucks and of recreational vehicles in the traffic stream. A second adjustment is for the presence of ramps. The third adjustment is for lane widths. In lieu of reducing the capacity of the lane considered, the traffic volume may be increased by counting trucks as 1.5 passenger vehicles. To determine if a queue will form, resulting delay at a work zone, compare the capacity of the lane or lanes to the passenger vehicle equivalent traffic. As an example, consider a deck repair project to a pair of twolane highway bridges, each carrying directional traffic with an AADT of 14,100 vehicles and 5% truck traffic. If there are no ramps in the work zone and 12 ft.If the peak hour traffic volume does exceed the work zone capacity a closer look must be taken at the hourly distribution of traffic to determine how many hours a day volume exceeds capacity. Delay can be calculated by assuming that vehicle arriving at the work zone in

excess of capacity are queued and then discharged at the lane capacity as arrivals taper. Table 6.5 shows the results for the calculation of a daily user cost from queue lengths and delays for a location with an AADT of 16,000 and 5% truck volume based on KDOT hourly traffic variation factors for weekday traffic.

In this example, the peak hour volume only slightly exceeds the work zone lane capacity. The maximum delay during rush hour is only less than 4 min. This example is not atypical. Phased construction may significantly extend the working days required to complete a project, but it has considerably less usercost impact than even short detours. For signalized work zones, the delay calculation become more complex. An example of calculations for delay and user cost for a signalized work zone on a 300 ft.The calculations for delay shown earlier and in the appendix are truly rough estimates. To better calculate work zone delays that might be expected, the involvement of an experienced traffic engineer and a site assessment would be required for each project. Complex bridge sites might require microsimulation modeling of local traffic patterns to determine the likely responses of local drivers to work zones. However, the examples serve to illustrate the scale of user impacts. In urban areas with higher traffic volumes, the user costs of detouring traffic can readily compare to, or exceed, the agency costs of substantial maintenance work for bridges. As a result, in these areas, phased construction is standard practice for most bridges with high traffic volumes where possible. Acquiring such data would require quantifying the increase in crash rates that might be expected from the presence of a work zone. Bridge owners, which must employ work zones on a frequent basis, are loathe to do so because of the liability implications in future litigation. An item to note from Bai’s report is that only 5% of work zone crashes occurred at bridge sites. Bridge projects tend to be fairly short in comparison to other maintenance projects involving pavement rehabilitation or shoulder reconstruction. Travelers are exposed for a relatively limited time at sites involving bridge construction.