



Traffic Control at Worksites Manual

In the Name of Allah the Compassionate the Merciful



This translation is provided
for guidance. The governing
text is the Arabic text



Definitions:

Traffic control devices:

These devices are traffic regulation, warning, and guidance signs, traffic lights, signs, and any other devices, placed or installed by the competent authorities in order to secure the protection and safety of cars and pedestrians inside and outside the worksites to give pedestrians the necessary time to react towards the road conditions.

Traffic sign:

A sign installed on a stand above road level, stating a specific message in words or symbols.

Traffic lights:

A device to control the traffic; it works with electricity that alternately directs traffic to stop and resume traffic through red, yellow and green lights

Traffic Signs:

The means of organizing the traffic consist of lines, shapes, words, symbols, or colours drawn on or near to the road surface.

Traffic barriers:

The traffic barriers are roadside barriers, midway barriers, shock mitigation means, and bridge fences the guidance or protection of the traffic from roadsides hazards, including collisions with other cars.

Transition area:

It is a section of a paved road with variable width used when moving from one lane to another lane of less or greater width.



Manual of traffic control means at worksites

1- Introduction

The Manual of Traffic Control Means, in Worksites aims, to provide a brief statement and a unified quick reference of the basic principles, that control the design and usage of traffic control means in worksite work and construction areas. Here, the manual presents examples and illustrations in the field of procedures applications for controlling and organizing traffic in the worksites. The manual also demonstrates the traffic safety means in case of the construction and maintenance of streets and roads. This manual has been prepared to outline the practical and applied procedures to regulate traffic in worksite during construction and maintenance works for streets, roads and utilities. It is noteworthy that the presented information in this brief manual is indicative information that is not intended to represent, in any way, the development of new specifications. It is also subject to updating and development if necessary with the approval of all competent authorities.

It is obligated to unitedly apply the specifications of traffic control; thus, the specifications and conditions are same among all the competent authorities to be able to direct and rationalize traffic in a safe and effective way in the work and construction sites or in other areas that may pose a danger to those existing in it. Properly putting signs and markings of standard roads and any other means for traffic control in worksites is an important responsibility constantly handled and assumed by all concerned parties.

Objectives of controlling and regulating traffic in worksites

With the aim of planning traffic control in construction worksites to achieve the maximum possible safety and security, eliminate potential conflicts and delays, and ensure the flow of traffic in worksites. There are two main objectives:

First goal: To avoid accidents.

To achieve this goal, the following procedures shall be adopted:



- Use effective control means that are easy to see and distinguish.
- Minimize the use of fixed objects and materials to avoid collision.
- Minimize the gathering of employees' traffic, equipment in worksites and transit vehicles traffic.
- Ensure clear visibility by using flashing signs, reflective means, and warning lights.
- Secure safe paths for pedestrian traffic, separated from vehicle movement and patterns in the worksite.
- Secure safe entrances and exits, for worksite individuals, storage areas, and housing in the worksite.
- Use banners and flashing lights fixed or carried on vehicles belonging to the worksite that should be clear with regard to vehicles approaching or passing through the worksite.

The second goal: is reducing traffic problems in the worksite and making the traffic flow smooth without interruption. To achieve this, the following procedures shall be followed:

- Avoid causing slow speeds so not to cause inconveniences, delays and long congestion.
- Clarifying the route or alternative plan in the worksite to re-control the traffic in case of an accident or emergency, as well as using signs, flag bearers and radio to notify vehicle drivers of delays and their causes.
- Before starting construction or maintenance works in the worksite, emergency services such as police, civil defence, and aids shall be informed of the proposed project.
- Giving first priority to the passage of emergency vehicles and ambulances while crossing the worksite, or using an alternative lane to cross them.
- Securing appropriate entrances and exits to police stations, civil defence stations, fire hydrants and hospitals.

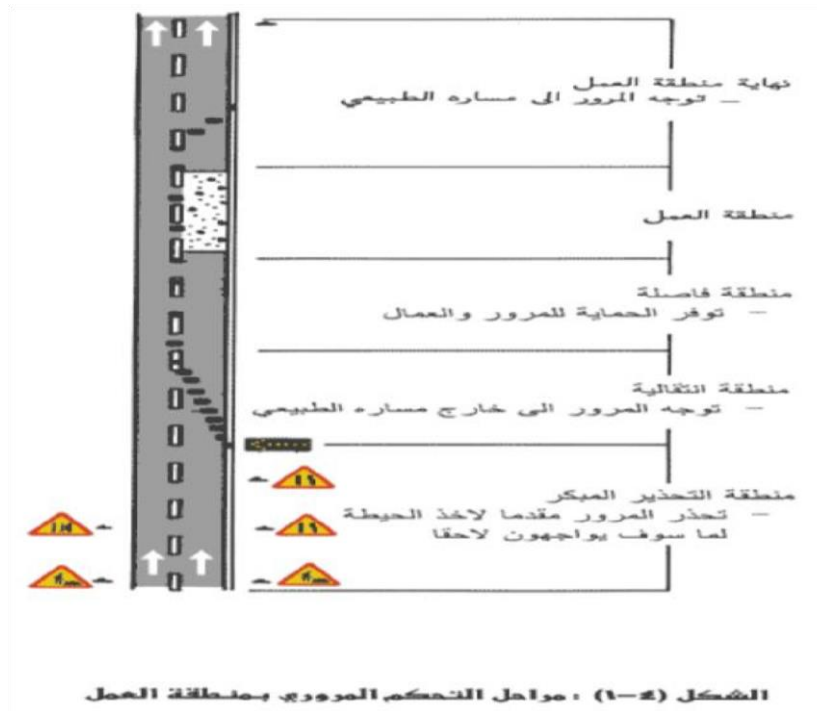


- After the construction or maintenance works are completed, the lanes of the road shall be opened to traffic as soon as possible to restore the road to its maximum operational efficiency.
- Before starting the construction, work or repairing and maintenance work or any other activities in the worksites, a traffic control plan shall be developed, so that it constitutes an integral part in the plans, specifications and estimates of the construction or maintenance project.
- Officials in the traffic and transportation departments of municipalities and the Ministry of Communications at the local and national levels.
- Officials in the Traffic Police Department, Civil Defence and Health at the local and national levels according to the project site to be implemented.
- Departments and companies concerned with public utilities.

Then after preparing and approving traffic control plans in project worksites, and before the commencement of implementation, the following parties should be informed:

- The population and public entities within the scope of the worksite.
- Neighbouring institutions
- School administrations to give instructions and directions for buses to transport students if necessary.
- Local administrations and authorities.
- Ambulance institutions and towing vehicles on the roads.
- 4 stages of using traffic control devices in worksites.

As is known, it is normal for road construction or maintenance operations to be accompanied by changes in the normal traffic patterns. In order for traffic, pedestrians and workers to be directed and secured through the worksite, it is necessary to provide special means for controlling traffic in the project worksite, which is often divided into five areas as shown in Figure (4.1) as follows:



End of worksite - direct traffic to its normal path

Worksite

A buffer zone that provides protection for traffic and workers

A transition zone- directs traffic outside its normal path

The early warning zone - warns traffic in advance to take care of what they will encounter later

Figure (4-1): The stages of traffic control in the worksite. Below is a brief presentation of each stage:

1- Early warning zone

In the field of early warning before reaching to the worksites, drivers shall be notified in advance of the nature of the situations and potential dangers ahead of them on the road, so that they can control the driving of their cars through the worksite. The use of warning signs shall be varied from a series of signs that begin to be put from a point preceding the banners mark or flashlights on a car. The length of the advance warning area in most worksites shall be 1.6 to 2 km on the highway, and it shall be decreased according to the speed of road in progress and the length of the fully residential square within the cities.



4-2 Transition zone

In the transitional area of the worksite, traffic shall be directed from the regular road lanes to the diversions necessary for traffic through the worksite. Also, the means of directing traffic shall be placed in places that narrowing gradually within the transitional zone. The traffic speed and the width of the path to be closed shall be determined with the length of the gradual narrowing that will be used, the number of units of the recommended barriers and the distance between each unit according to the different speeds and the width of the closed path. After the narrowed progressive barriers are placed, traffic shall be monitored and properly integrated into the cleared traffic path.

4-3 Buffer zone

The separation zone shall be located between the transitional area and the worksite itself, and its purpose is to ensure the safety of drivers and workers within the worksite, and it shall not be used to store equipment, materials and work vehicles.

4-4 Worksite

It is the area in which construction or maintenance works shall be implemented wherein all the processes related to workers' movement, equipment and construction materials shall be taken place. It is usually identified using devices, routers and barriers to keep traffic and pedestrians away from it and in the case of night work, the following procedures are recommended:

- Traffic lanes must be clearly visible.
- Putting tools to guide traffic between the cleared traffic path and the worksite.
- Securing safe exits and entrances for work vehicles to and from the worksite.
- Putting adequate warning signs at the entrances to the worksite, as well as using the car that carries flags or the function guiding traffic movements that can also be used to ensure the safety of mobile operations and traffic.
- Using banners and flashing lights on work cars which its movement interferes with normal traffic.
- Using concrete barriers to separate traffic from the worksite if it is adjacent to it.



4-5 End of the worksite

- It has a short space as traffic prepares to resume its normal path.

5-1 Traffic sign functions

There are three main types of traffic signs, which are regulatory - warning - and indicative, and they are considered an important means of controlling and directing traffic in an appropriate and proper way. Also, traffic signs include fixed signs, hand signs, banners, lighting units, directional signs, boundary and pedestrian signs, and mobile barriers. All traffic signs that will be used at the sites shall be of the reflective type with international accepted specifications. And in case that external lighting interferes with the reflective signs, which weaken the signs functionality, special lights shall be used on the traffic signs so that they do not cause any glare or distress for drivers.

5-2 Sign locations and installations

Traffic signs shall be placed in the appropriate places to give drivers the desired message in the best possible way in line with the design and road path and to allow them to respond at a suitable time. These signs shall be installed at certain distances within city streets at workplaces, and the signs shall usually be on the right side of the road, unless the case calls for the use of double fittings, which consist of two double signs on each side of the left and right road.

Figure (1-5) shows an example of the process of installing signs on bendable or breakable poles with the required heights and lateral distances from asphalt roads according to the specifications.

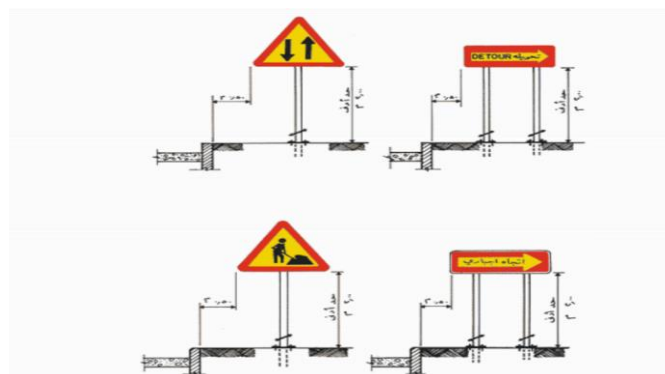


Figure (5-1): Height and Lateral position for foldable signage within cities- Typical installation



Dashboard of cascade arrows



Cone with ensign



A warning sign on mobile holder



A warning sign on holder

Figure (5-2): Examples of the installation process for temporary and mobile signs

Figure (5-2) also shows examples of types of temporary and mobile signs.



Figure (5-1): Height and Lateral Placement of Urban Flexible signs - Typical Installation

Figure (5-2): Examples of the process of installing temporary and mobile signage

5-3 Regulatory signs

Regulatory signs are those that impose all traffic movements to adhere to and adhere to. Consequently, they shall be used according to the traffic law in the Kingdom, for example, the sign "Stop" has an octagonal shape, and the "No Entry" sign is in a circular shape. The regulatory signs are used in worksites or during maintenance and in case that regulatory signs are used for a temporary period, the regulatory signs should be removed or covered if they would be contradictory to what has been new in the worksite, so as not to cause confusion for drivers.



Forced direction	Forced direction	Forced direction
17V / 1 l	17V / 6r	16V / 2
1100 m	1100 mm	1100 mm



No thoroughfare	speed limit 3/1 v	No Parking
5/1 v	1100mm	14/1 v
1100mm		1100mm

Figure (5-3): Examples of regulatory banners used



Figure (5-3) illustrates examples of the organizational signs used

5-4 Warning signs

The aim of using warning signs in construction or maintenance areas is to inform drivers to take caution while passing through this area, as there is a possibility of certain dangers. Drivers shall be notified in an appropriate way within a sufficient period of time to inform them that the vehicle's speed must be modified with the condition of the road to avoid danger.



In front of you is a banner stand H / 3 1500 mm	The right lane is closed H / 2 1500 mm	Road works H / 1 1500 mm
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passing in their direction H / 5 1100 mm	In front of you is a stop sign H 1/20 100 mm	The curve refers to the right H / 4 1500 mm
--	--	--



The road narrows, Commit to the left H 3/2 1100 mm	End of the double road H32/1 1100 mm	Sign of a change in direction H 1/37 450 mm x 600 mm
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Figure (5-4): Examples of warning signs used in construction and maintenance areas

Figure (5-4) shows examples of warning signs used in the work and maintenance areas. There are additional warning signs that have general uses, such as bumps sign, asphalt finish, truck exit, be prepared to stop; road shoulder is low, and others.

And the floor of warning signs should be reflective and yellow, with writing or symbols in black, and the frame in red.

5-5 Informational banners

Informational signs and ground signs for the work or maintenance area include the following:

1. Standard pavement markings for the road, in the case, that necessary requires a temporary change of the road lane.
2. Indicative signs and the names of roads or streets and their use with the detour mark, on which the writing is in black and on a yellow floor.
3. Special informational signs related to the beginning and ending of the worksite. This is also the writing on it in black and ground in yellow.



Construction signs shall be installed on the boundaries of the work or maintenance area, the distance is appropriate and according to the approved traffic plan, while maintaining the traffic flow through the worksite. This sign is shown in Figure (5-5), and the informational sign "Road construction is at a distance of 1 km" can be installed at the barrier. This sign is used as required by work, especially in the streets inside the city, which are modified to write the appropriate distance on them.

The informational signs "Road construction End" are installed at a distance of about 150 meters or at a suitable distance inside the city streets after the end of the work or maintenance area boundaries. They are also shown in Figure 5-5.

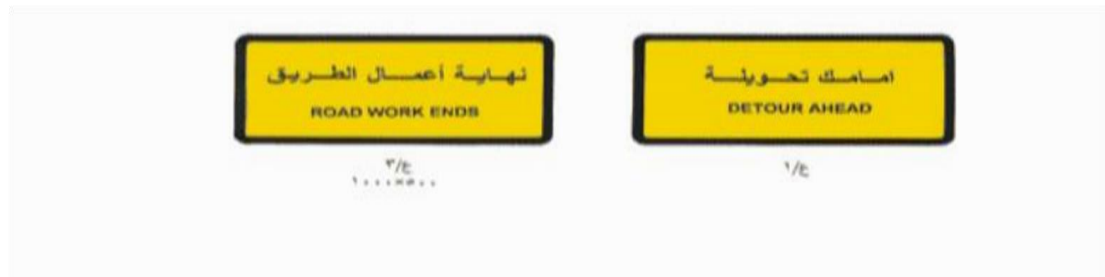


Figure (5-5): Samples of Information signs

Construction WORK ENDS	DETOUR AHEAD
ROAD WORKS The next 200 meters	DETOUR 2 KM

A "detour" sign with the arrow is used when a road or transit road is closed. This sign can be installed under the "Road is closed" sign or the "Local Traffic" sign. And the drawing of the arrow on the switchboard sign is horizontal and in the direction to the right or left, depending on the location and it is shown in Figure (5-6)





Detour arrow

P 20/1

500 x 1500 mm

1000 x 3000 mm

Figure (5-6): Drawing the arrow on the detour sign

There is also the use of the "End of the detour" sign to inform drivers that the detour lane has ended, and it should be placed at an appropriate distance (200, 50 m) after the end of work.

Figure 5-5: Examples of informational signs

Figure (5-6): Drawing the arrow on the detour sign

6- Barriers and temporary guidance devices

One of the functions of temporary steering devices is to alert and warn drivers of potential dangers while they are passing in or near the worksite, and to guide and direct them to pass the worksite safely. Among the most important temporary steering devices are cones, reflective vertical panels, reflective plastic barrels and mobile barriers.

The steering devices are used to provide better flow and a gradual change of traffic from one path to another from the road in the worksite and are made of materials that do not cause any damage to cars if they hit them. The purpose is that it be used within an appropriate traffic plan for the worksite with other control devices to ensure flow of traffic and for the safety of workers and equipment within the worksite.

6.1 Temporary orientation

One of the most important elements of the traffic control system that is used in narrow gradual worksites, and this gradual narrow must be well designed and appropriate and not to cause traffic congestion or accidents. Therefore, the following equations must be used in rate calculating of gradual narrow of work or maintenance areas.



$T = MS / 4 r 155$ when the speed limit is less than 70 km / h.

$T = MS / 610 r 1a$ when the speed limit is 70 km / h or more.

Where: t is the total length of the narrow gradual part (in meters).

M: is the side distance that the traffic must move (in meters). S: is regularity speed limit (or 85% of the speed) km / h.

These equations are applied to roads and streets with reasonable flat slopes and their tracks as straight as possible. A distance of visibility must be provided for traffic safety at and before entering the gradual narrow part to inform drivers that the guiding line is continuing.

Table (1-6) shows the lengths of the gradual narrow for the normal speeds and the distance that the traffic must move.

These distances apply only to the parts with the slopes are simple and parts of straight or curved road moderately.

Also, the distance between the steering devices and means on the borders of places of gradual narrow must be appropriate in order to leave an impression on cars drivers that the manual and the directional line is continuous, and this is shown in Table (6-2), and also Table (3-6) shows the distance between them at the curves with regard to a distance for the radius of the curve.

Table (6-1): The lengths of necessary gradual narrow in meters for side movement

Speed	The distance in meters that the traffic must move to the right or the left						
	1R5	2R5	2R75	3R0	3R25	3R5	3 R75
30	9	15	16	17	19	20	22
35	11	20	22	24	36	28	30
40	15	26	28	31	34	36	39
45	20	33	36	39	42	46	49
50	24	40	44	48	52	56	60



55	29	49	54	58	63	68	73
60	35	58	64	70	75	81	87
65	41	68	75	82	88	95	102
70	65	109	120	131	141	152	163
75	70	117	128	140	152	163	175
80	75	124	137	149	162	174	186
85	79	132	145	158	172	185	198
90	84	140	154	168	182	196	210
95	89	148	162	177	192	207	221
100	93	155	171	186	202	218	233
105	98	163	179	196	212	228	245
110	103	171	188	205	222	239	256
115	107	179	197	214	232	250	268
120	112	184	205	224	242	261	280

Source: "Manual of Regulatory Control Devices in traffic in Worksites", Traffic and Safety Engineering Department, Ministry of Transport, Kingdom of Saudi Arabia, October, 1987

Table (6-2): The distance between devices and means of guidance in places of gradual narrow

Places of installation or 85% Speed (KM/H)	The distance between devices and means of guidance
30	6
40	8
50	9
60	11



70	13
80	15
90	17
100	19
110	21
120	23

* Note: This distance is for large cones (approximately 90 cm), vertical panels 30 cm x 6 cm, and barriers of the two types 1 and 2. In case small cones (45 cm) are used, the distances should be half of the values shown only. The distance may be required to be less if drivers are entering between the steering devices.

Source: “Manual of Regulatory Control Devices in traffic in Worksites”, Traffic and Safety Engineering Department, Ministry of Transport, Kingdom of Saudi Arabia, October 1987

Table (6-3): The distance between the steering devices and means when curves

The distance between steering devices and means (meters)	Bending radius (meters)
7	25
10	50
12	75
15	100
18	125
20	150
21	175
22	200



25	250
27	300
33	400
36	500
50	More than 500

Note: These distances do not apply to mobile barriers, and the distance may be required to be less if it is found that drivers are entering between the steering devices and means.

Source: "Manual of Regulatory Control Devices in traffic in Worksites", Traffic and Safety Engineering Department, Ministry of Transport, Kingdom of Saudi Arabia, October 1987

(6-2) Cones of traffic and tubular border markers.

There are different types of traffic cones shapes that must be not less than 45 cm in height and have a relatively wide base to prevent them from tipping over. They are usually made of materials that withstand vehicle shocks without damaging or causing any damage to vehicles. And for high-speed roads a larger size cones are used, so that the guidance and direction are clearer.

The red colour represents the predominant colour in cones and traffic pipes, which are preferably made of a red material colour rather than made of any other material and their external surface is painted red colour. And it must always be in a clean and bright condition to fulfil the purpose and also made of reflective materials for night vision or provide it suitable lighting to easily see it. The cones that are used especially at night must include a yellow reflective tape of no less than 150 mm width and be wrapped on distance of no more than 75 mm from the top of the cone. As for the Tubular cones, they must include two red reflective tapes, each of which is not less than 75 mm in width and put at a distance of approximately 100 mm one over the other, as shown in Figure (1.6). An alternative to the above for the cone or Tubular border marker can be their colours all reflective.



6-3 Vertical panels:

Vertical panels that are used as temporary guidance devices as warning signs must be 300 mm wide and 900 mm high as a minimum, and their colour is reflective red on a floor with yellow stripes also reflective like barriers and installed, so that the upper end is at a height of 1.5 meters from the surface of the ground as a minimum. Vertical panels are used to separate traffic or road shoulder barriers when the clearance is as little or as little as possible (see Figure 2-6). And when using a single headboard at night, a flashing lamp must be placed on it to warn off traffic, and when using a series of these headboards as guidance devices, lamps with continuous lighting must be placed on it.

Figure (6-1): Scales of cones

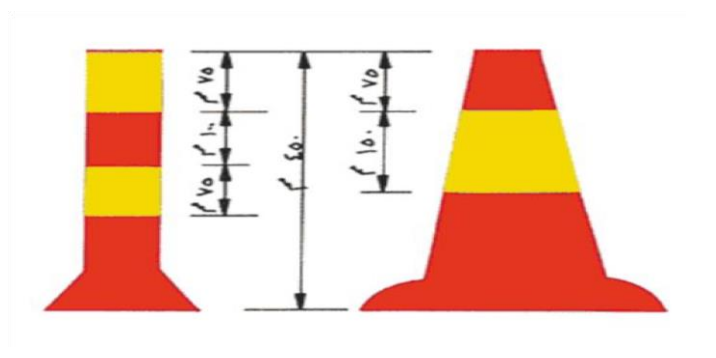
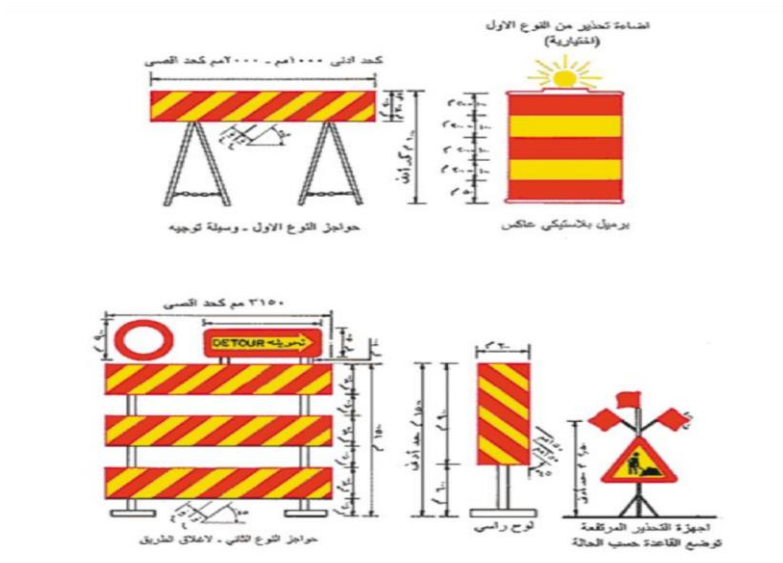


Figure (6-2): Barriers and temporary steering devices





6-4 Plastic barrels:

Plastic barrels to be used for traffic warning or for temporary guidance shall be at least 900 mm in height and 500 mm in diameter. It should also be surrounded by reflective red and yellow tapes, and the width of these tapes ranges between 100 mm and 200 mm and made of a material with a smooth surface and tightly protected from the outside and be almost the same color during the day and night.

And on each barrel, there must be at least two ribbons in red and two ribbons in yellow. The barrels are easy to move from one place to another in the worksite, and when they are used, they usually remain for a long period of time, and after installing the barrels in their locations, other traffic signs are used with them in advance to warn traffic. The barrels must be made of plastic and not be filled with sand, water, or stones until their full height, which makes them dangerous for vehicles when colliding with them, but only fill them with sand up to a height of 250 mm only to prevent them from moving or overturning due to wind or air rushing from the vehicles. And when used during the night, warning lights must be placed on them. In addition, other traffic signs can be installed on the drums, such as arrows or vertical panels, if necessary, to be complementary to other signs. The previous figure (6-2) shows those barrels.

5-6 Barriers:

Barriers are fixed or mobile traffic control devices on which the appropriate traffic sign is made up of one or three horizontal panels used to close a street or to define a part or more of the street's boundaries. The barriers are divided into two types and are explained with the characteristics of each type in Table (4-6), and the horizontal panels consist of red and yellow stripes with a reflective characteristic of a material with a smooth surface. The barriers are tightly protected from the outside and have almost the same colour during the day or night. These strips flow at a 45-degree angle across the board and in the direction the passage will pass from (see previous Figure 6-2).



Barriers are installed in a way that allows drivers to see them easily and to be on cradles capable of keeping them in place during regular storms and the rushing air as a result of the traffic of vehicles next to them.

Table (6-4): Barrier characteristics *

Characteristics	First type	Second type
Width of the bar	20 - 30 cm	20 - 30 cm
Length of the beam	1- 2 meters as a minimum	1.5 meters is a minimum
Height	1 meter is a minimum	1.5 meters is a minimum
Number of faces of the reflective girder	(1-2 in each direction)	3 (If the facing traffic is in one direction) 6 (If the facing traffic is in two directions)

* Source: "Manual of Regulatory Control Devices in Traffic in Worksites", Traffic and Safety Engineering Department, Ministry of Communications, Kingdom of Saudi Arabia, Shawwal 1408 AH.

6-5-1 Use of barriers

The use of the first and second types of barriers applies in cases that are intended to direct traffic through the area of road construction or reconstruction, and it may be used individually or as a group of barriers to determine the danger or as a series of barriers to direct traffic. The first type of barrier is usually used on normal roads and city streets. As for the second type of barrier, which contains more reflective panels, it is used on the main roads and highways with high speeds.

Roads that allow high speeds will have sandbags placed at the base of the barriers only so that they are not overturned by wind or the like. In road or street that contains maintenance work, it is



rare for the street to be completely closed except in cases that require this, such as re-establishing sewage or other things. Emergency road works usually use the first type of barrier. In road construction work, when a part of the road is required to be closed, the second type of barriers is used, as they are installed at the closure points. Barriers can be installed at the points of the right pavement edge to the left pavement edge. And when the need requires providing an entrance or an outlet for equipment and construction vehicles, the second type of barrier contains a gate or a moving part of the barrier that is closed at non-working hours, or an indirect entrance may be constructed so as not to encourage the entry of public vehicles. When using the second type of checkpoint, a responsible person is assigned to ensure that the gate is closed after the end of each working day.

In cases where a road or street is required to be closed and local traffic is provided for entry, the second type of barriers will not be used completely across the street. Rather, measures are taken to discourage transit traffic from entering, as signs indicating permission for local traffic only. The application of this method is illustrated in Figures (11-14) and (11-15) later in typical examples.

There is a special use of barriers, as they can be placed successively on one or both sides of the road, as they suggest to drivers that they are approaching a worksite or that the road is getting narrow, which attracts their attention and makes them reduce their speed. When using this method, successive barriers are placed, starting from the outer edge of the road shoulder and taking the gradual narrowing of the asphalt edge. The barriers can be used to install warning and guidance signs or lighting devices, and the application of successive barriers is illustrated in Figure (36).

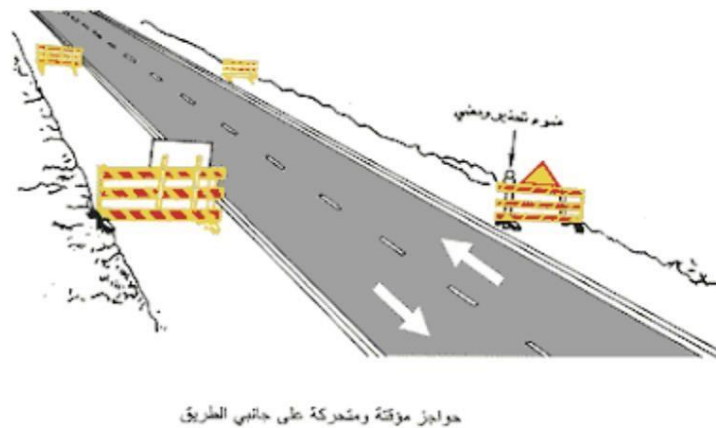
And some traffic signs can be installed at barriers, such as "The road is closed" and "There is a diversion in front of you" and flashing or continuous warning lights can be installed in the case of using these barriers at night. The continuous lights must be used on each of the successive barriers to direct traffic and identify the boundaries of the road.



6-5-2 Mobile barriers:

Mobile barriers are used to prevent vehicles from veering out of the road or shoulder, and as much as possible to diminish the light of oncoming vehicles in the opposite direction on drivers and their passengers. Mobile barriers can be moved from one place to another, and they are made of reinforced cement, metal, or any other material capable of preventing vehicles from drifting out of the boundaries of the road or street. Figure (4-6) shows a mobile concrete barrier with another type. When using barriers to direct traffic, they must be of light colour such as white and painted with red reflective strips of 150 mm width to facilitate their visibility. And for night use, it must provide direction and traffic control signs, such as providing it with a reflective boundary mark, the minimum area of which is not less than 800 cm². Warning lights must also be installed at the continuous checkpoints, and only at the beginning of the checkpoint on each side should yellow flashing lights be installed, after which continuous yellow lights must be installed to direct traffic. Also, a buffer or shock absorber must be installed at the beginning of the mobile barrier, as this part represents an extreme danger when vehicles collide with it if the necessary precautions are not taken, and that the start of the barrier is gradually bent outward from the edge of the road, and it must also be provided with a sloping end part.

Figure (6-3): Existing Barriers Application Form with Warning and Instruction Signs Installation

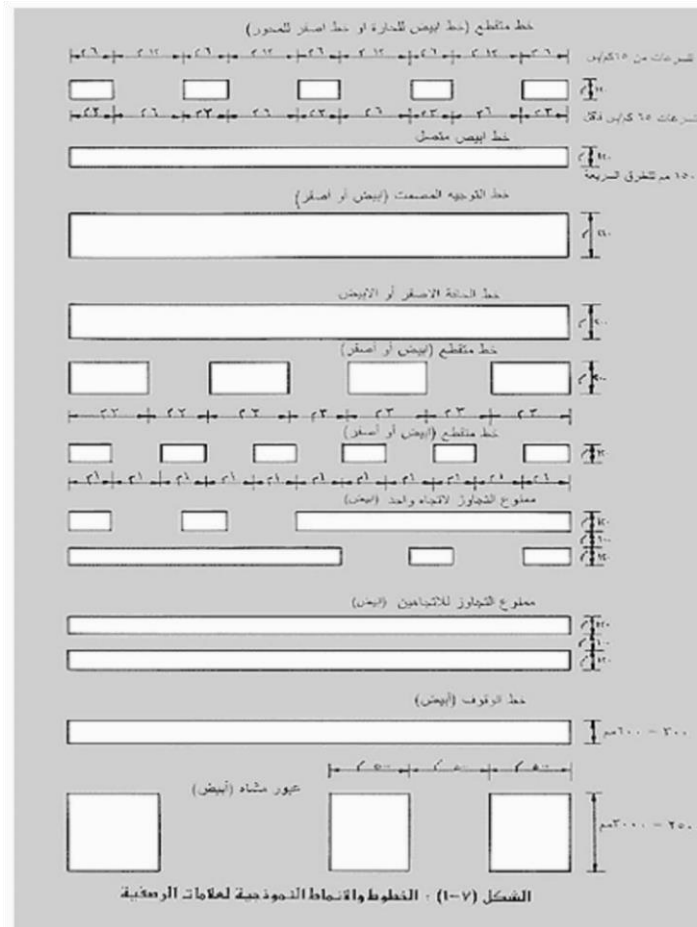




to vehicle lanes. The process of changing the lane of vehicles should not take place unless sufficient time, equipment, materials and people are available for this process, so that it can be successfully completed before the end of the daily working hours, and previous signs on the road that is likely to confuse or mislead drivers must be removed or obliterated. Figure (7-1) shows typical lines and patterns for Rusheid markers.

In worksites where the maintenance or construction time is relatively short, the reflective tape should be used, which is fixed by pressure or prominent sidewalks as it is less expensive and easier to use and remove than other materials.

Figure (7-1): Typical lines and patterns for ratified markers





Source: “Manual of Systematic Control Devices for Traffic in worksite”, Traffic and Safety Engineering Department, Ministry of Transportation, Kingdom of Saudi Arabia, Shawwal 1408 AH.

8- Border signs:

When using reflective border signs, they are installed on cradles so that the height of the reflective unit is about 1.2 meters above the road edge surface, and it can be seen in the dark from 300 meters under normal weather conditions when the high beam falls on it from the headlights of cars. These signs are installed According to the required distance between each of these signs, and in a manner that the following sign is always clearly visible to the drivers, according to aforementioned Tables (6-2) and (6-3).

The area of the reflective unit for border signs shall be 100 cm² as a minimum and of a yellow colour. It is used in worksites and traffic diversions to clarify the direction and paths of the road for drivers, as well as in winding roads in which curves follow and in parts of the road where the speed is normal or close to normal. And also to separate traffic in both directions of the road, as there is not enough space for the use of other means.

9- Lighting devices:

Construction and maintenance work on roads often cause an atmosphere of danger, especially during the night time when drivers have less ability to see well, so it must be provided in addition to means of reflective traffic signs, barriers and other means good lighting devices with generators and backup lighting in the event of a power failure, and headlights Portable and charged emergency lighting.

9-1 Warning lights:

There are three types of portable warning lights that work with batteries and have plastic lenses that give a yellow light. They are Type (A), which is a low-brightness flashing light, Type (B), which is a high-brightness reflective panel, and Type (C), which is a constant light. Figure (9-1) shows these three types. The lights of two types (A) and (C) are designed to turn off automatically, and



they must be installed on the lenses at a height of approximately one meter above the ground and be visible at a distance of 1000 meters. As for warning lights with high-brightness reflective panels of type (b), they must be visible at a distance of 350 meters when the sun is bright, as they are designed for day and night operation and are used with other advanced warning signs when approaching the worksite and with barriers where extreme conditions prevail. Type C is fixed lights are used to supplement reflective panels and long barriers to determine which path vehicles should travel through the worksite.

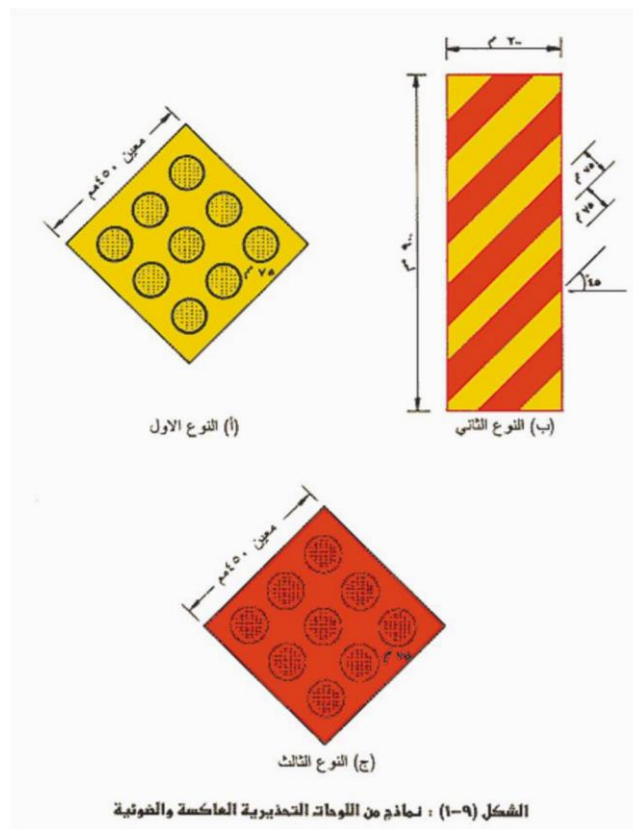


Figure (9-1): Examples of reflective and light warning signs

9-2 Hazard identification beacons:

Hazard identification beacons are of a yellow flashing signal with a diameter of not less than 200 mm and preferably 300 mm, and are used to supplement the appropriate warning or regulatory mark, and when used they must be operated 24 hours a day and flash at a rate of not less than 50 times and not more than 80 times per day. Per-minute, and to use a lamp with a minimum nominal capacity of 600 lumens with a small lens or a lamp of 1750 lumen with a large lens.



Warning beacons can be a self-contained unit consisting of a flashing device, an electrical source, and a sign. These beacons are usually installed on a trailer for ease of transportation. They are useful in worksites to warn of the existence of mobile maintenance operations.

9-3 Warning panels with flashing arrows:

Warning panels with flashing arrows are used when traffic is heavy and approach speeds are high, or in places where roads and streets are closed, or to reduce speed, or at the point where traffic is required to divert from its normal path. The warning panels consist of units with yellow lights arranged in the form of an arrow or a change of-direction mark on a rectangular panel with a black matte floor and the lights flash simultaneously, and they must fulfil the requirements shown in Table 9-1.

There are three types in the uses of warning signs with flash arrows, and they are Type (A) and it is used only in streets and local and collective roads where traffic density is medium and traffic speed is not high, Type (B) is used on roads and main and highways, and Type (C) is used on roads Fast, heavy traffic.

Each lamp in the stock board must have a visible diameter of 100 mm as a minimum, and the flashing or sequence of the lamps must not be less than 30 full revolutions per minute, and not more than 45 full revolutions per minute. A small flashing lamp should be installed alternately with the warning sign on the back of the stock panel. Table (1-9): Warning Signs with Flash Arrows

*

Type	Minimum size (mm)	smaller number of panel light	Minimum clear distance (km)
A	600 x 1200	12	0.80
B	750 x 1350	13	1.25
C	1200 x 2400	15	1.50

Source: "Manual for Traffic System Control Devices in Worksites" Traffic and Safety Engineering Department, Ministry of Transportation, Kingdom of Saudi Arabia, Shawwal 1408 AH



9-4 Floodlights:

The uses of floodlights are generally limited, but their use in worksites for construction and maintenance is important. They are used at night in the parking places of flag bearers and at points where work trucks cross the highway or intersections, or in sudden changes to the direction of the road or in any place of high risk. Floodlights are used with other devices and means to complement them and not replace them, and when floodlights are used to illuminate the worksite, they must be carefully placed so as not to dazzle drivers' eyes.

10- Traffic control in worksites:

The main objective of traffic control measures is to manual traffic in the right direction, whether through, around, or next to the worksite, where the first consideration is always traffic safety and the personnel working in the area.

Traffic control in worksites is an important part in the process of constructing or maintaining roads and facilities, and for this reason, laws have been developed for them that must be applied, such as the different traffic regulations and control of the stops and the speed specified for each area, and their uses differ according to the work requirements. Maintaining good public relations with the public is essential, as worksite workers and flag bearers must be at a good level of kindness in their dealings with drivers.

10-1 Flag bearers:

Since the flag bearers are responsible for traffic safety, they face the public through their work, so they must be chosen in a way that qualifies them for this job, as their intelligence shouldn't be less than average, and in good physical condition, mindful and have a good appearance, modest and strict behaviour and have a sense of responsibility towards Safety of the public and site workers.

The flag bearer must wear a safety vest or a shirt and a red hat, and it must be reflective when used at night-time. The flag-bearer must be visible at a sufficient distance for the approaching traffic. On roads inside cities, the flag bearer is located at a distance of 50 to 75 meters or even 150 meters before the worksite according to the road classification and the speed specified on it,



so that the flag bearer can warn drivers to reduce their normal speed and control their vehicle promptly, and for the safety of workers inside the worksite.

The banners used for hand pointing are made of durable red fabric with an area of at least 60 x 60 cm. They are attached to a stick about 1-meter long and made of strong and lightweight material. The banner raised on a stand inscribed "Stop" or "Slow down" shall be on an octagonal shape with a diameter of not less than 600 mm, and the letters shall be written not less than one-third of the height of the sign and mounted on a round and rigid column with a length of approximately two meters.

10-2 Procedures for marking the flag:

Several procedures must be followed when controlling traffic with a flag.

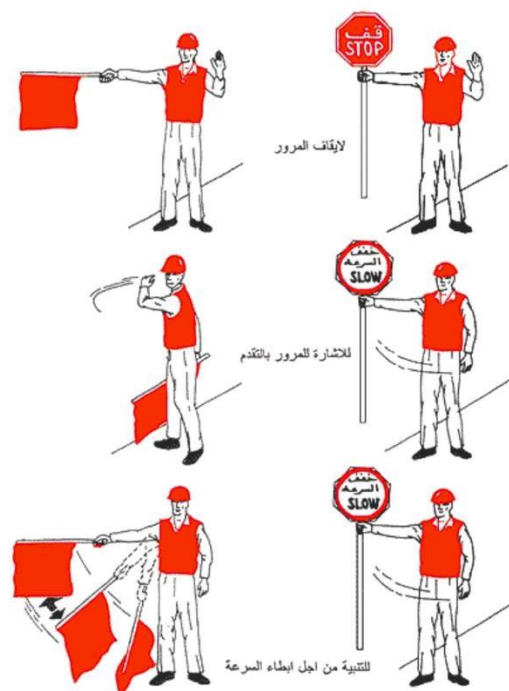


Figure (10-1) illustrates these procedures, which are as follows:

- 1- To stop traffic, the flag bearer must stand facing the traffic, then raise the flag in a horizontal form on the path, and the flag carrier must stand still so that the entire area of the flag hanging from



the mast is fully visible and for further confirmation, he must raise his other hand so that the palm of the hand is in the direction of oncoming traffic.

2- When the situation is safe for the progress of traffic, the flag bearer stands in a position parallel to the traffic. The flag carrier lowers the flag away from the driver's vision, then uses his other arm to signal the traffic to move forward. The flag should not be used here to indicate the maintaining of driving.

3- When the flag bearer wants to alert the traffic or slow down his speed without stopping completely, he is standing facing the traffic, then he slowly raises his arm carrying the flag and then lowers it. The flag must be moved in an oblique motion so that the outstretched arm that carries the flag rises to shoulder level and then falls straight. The arm and the banner should rise beyond the shoulder level.

The following procedures shall be followed when controlling traffic with a standing sign:

1- To stop traffic, the Flagger must stand in front of the traffic. The flagger must extend his arm in the horizontal direction, so that the sign becomes in a vertical position, and that the face of the sign marked "STOP" is facing the approaching traffic. For further confirmation, he can raise his other hand so that his palm is in the direction of oncoming traffic.

2- When the situation is safe about the progress of traffic, the flag bearer turns the face of the sign written "SLOW" in the face of the approaching traffic, then uses his other arm to signal to the traffic in progress.

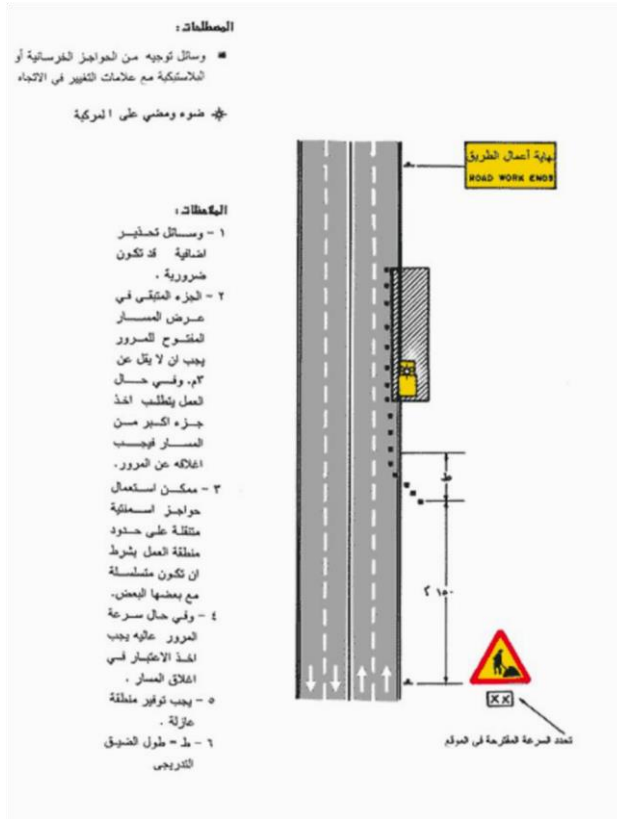
3- When the flag bearer wishes to warn the traffic or slow its speed, he stops in the same way as in the case of stopping traffic and then displays the face of the sign written "SLOW" in front of the approaching traffic.

11- Typical examples

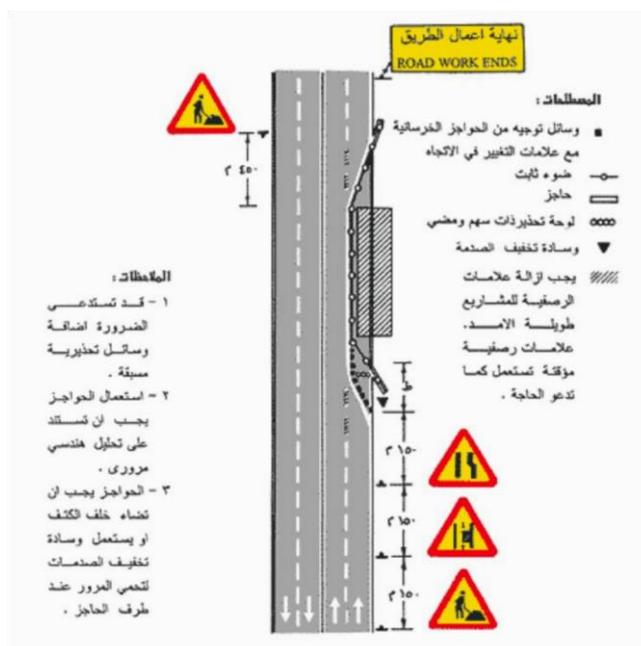
The following paragraphs include typical cases of using traffic control and routing devices in worksites.



Figures (11-1) and (11-2) show how to direct traffic if the worksite occupies a small part of the road on which average and high speeds are allowed.



(Figure 11-1): An example of the applying a means of traffic control in case of using a narrow space from the right lane for maintenance work





(Figure 11-2): An application model for the use of mobile barriers in traffic control in work areas when there is a complete path is used for the benefit of the work

- Figures (11-3) and (11-4) illustrate the use of the flag carrier in the event of continuing work on the road, for short and long periods of time.

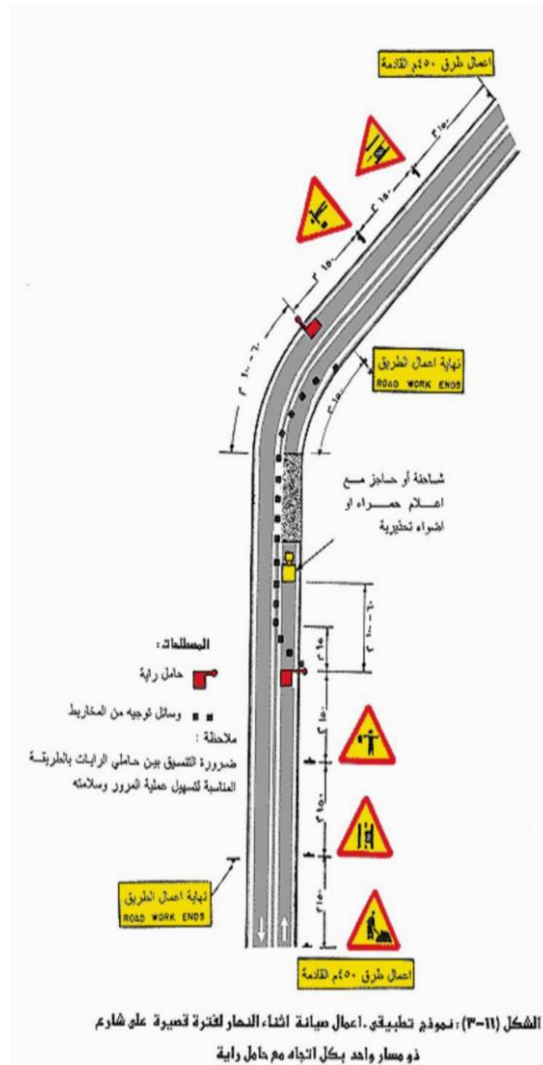


Figure (11-3): An application model for short-term daytime maintenance work on a road of one lane in each way with the provision a banner holder

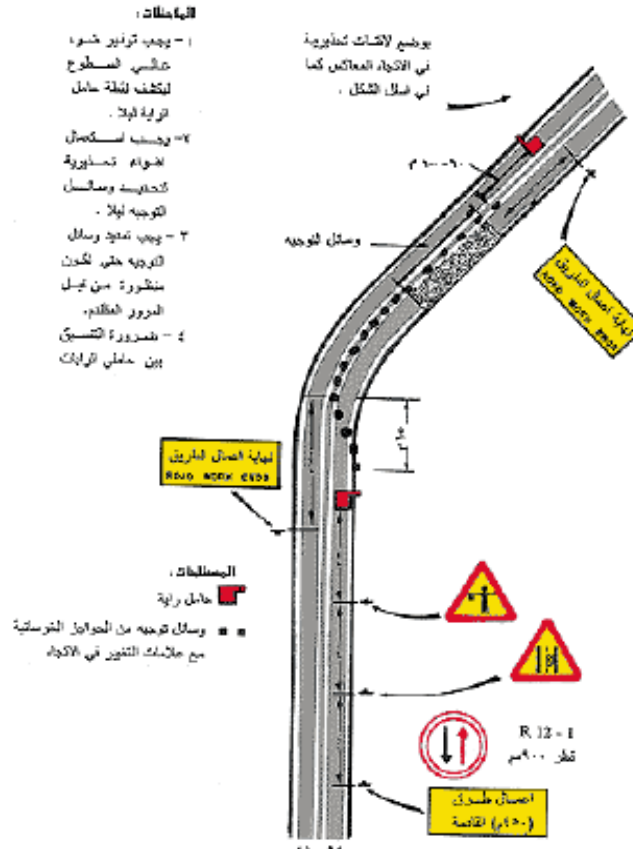


Figure (11-4): An application model for traffic control devices on a road of two lanes in each direction and one of these two lanes is closed with the provision of a banner holder
Figure (11-5) illustrates the usage of traffic control means when the volume of traffic in one direction is greater than in the second direction

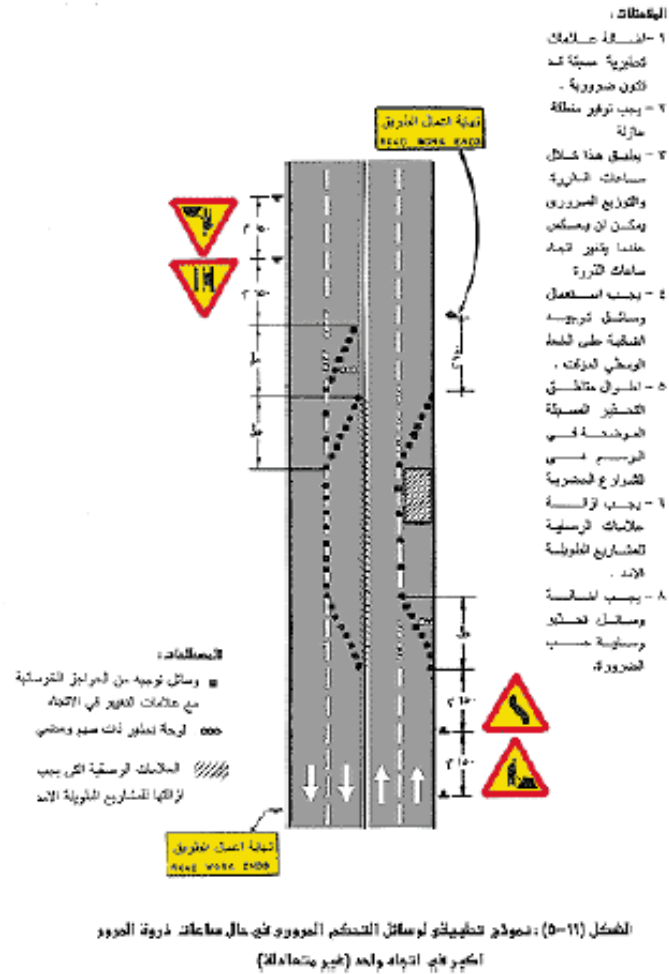


Figure (11-5): An application model for traffic control means in case the peak traffic hours are greater in one direction (not equal)

Notes:

1. Adding warning signs in advance shall be necessary
2. An isolating zone must be provided
3. This should be applied during peak hours and traffic distribution directing means should be used on the temporary midline
4. The longest advanced warning areas shown in the graphic are urban streets
5. Sidewalk can be reversed when the peak hours direction changes.
6. Additional signs should be removed for long-term projects
7. Medium warning means should be added according to necessity.



Terminology: Directing means from concrete barriers with signs of change in direction

Warning panel with flashing arrow

Sidewalk signs that must be removed for long-term projects

Figure (11-6): A model of closing one Passage lane on a two-lane road in each direction with an intermediate island for short period to carry out necessary maintenance work.

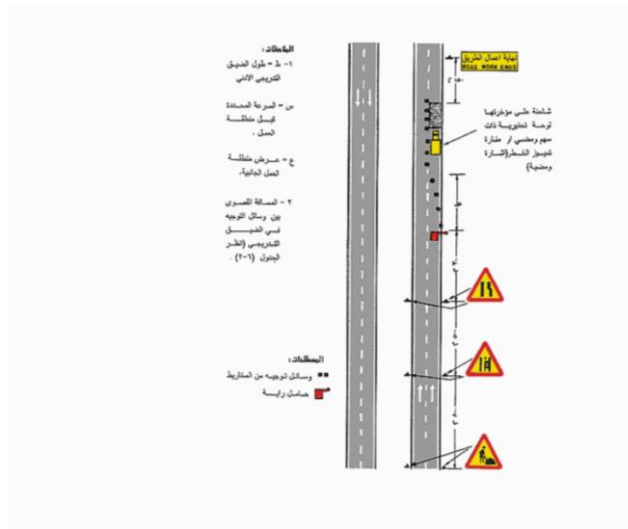


Figure (11-6): An application model - for short-time maintenance work during morning on a two-lane road in each direction with a middle island

A truck on its rear, a warning plate with an arrow, or a beacon to distinguish the danger (flashy sign)

Notes:

1- T= Minimal gradual narrow length

S= The Speed limit before the worksite

A= width of the side worksite

**2- The maximum distance between the directing means in the gradually narrowing
See the table (2-6)**

Terminology



Directing means from cones

Ensign

Figure (11-7) shows the case of the worksite being in the left lane on a road without an intermediate island, providing an entrance to the worksite from the adjacent lane, as this ensures easy entry and exit to the worksite, more safety and security for drivers and workers.

Warning signs are placed in the opposite direction and as at the bottom of the figure.

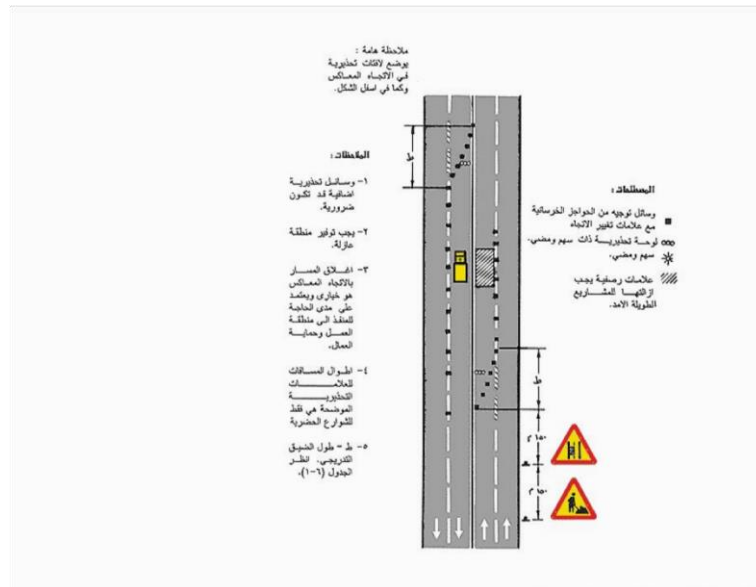


Figure (11-7): An application model - worksite in the left lane with an executive in the adjacent lane

Terminology

Directing means from concrete barriers with signs of change of direction

Warning sign with a flashy arrow

Flashy arrow

Pavement signs should be removed for long-term projects



Notes:

- Additional warning means may be necessary
- An insulation area must be provided
- Reversing lane closure is optional and depends on the need of the executive for the worksite and workers protection
- The lengths of distances for the warning signs shown are only for urban streets. -
The length of the gradual narrowing see table (1-6)

Figure (11-8) illustrates the usage of traffic control means on a dual road without an intermediate island in the case that two lanes in one direction are closed.



Figure (11-8): An application model - a double road without a middle island in the case that two lanes are closed in one direction.

Terminology: directing means of concrete

barriers

Warning sign with an arrow and illuminated

Flashing warning light



The suggested speed is decided on the site

Notes

1-T = Minimal gradual narrow length

s = speed limit before the worksite

= width of the worksite

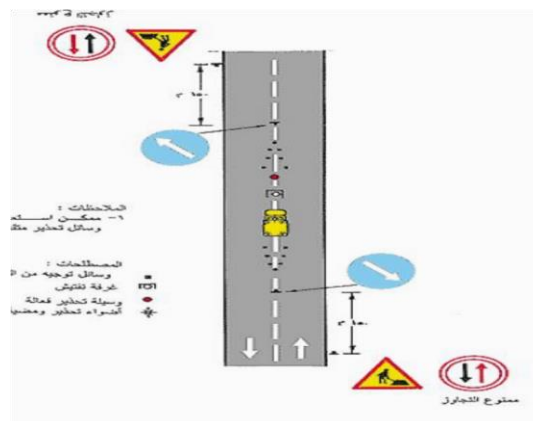
2-The maximum distance between the directing means in the gradual narrowing. See Table (2-6)

3-Permanent Pavement signs should be removed so as not to cause confusion to drivers, use temporary means according to necessity

4 - Lighting should be used on the borders of the directing means to warn drivers at night.

5 -Flashing lights and red flags can be used on a portable carrier to warn drivers, in advance.

Figures (11-9) and (11-10) illustrate applied models for using traffic control methods for maintaining facilities





Overtaking is prohibited



Overtaking is prohibited

Notes- :

1. It is possible to use advanced warning methods

Terminology: directing means of cones Inspection room

An effective warning method

Flashing and warning lights on the vehicle

Figure (11-9): An application model - Using Traffic Control Means in Maintenance of Facilities for a

Short Period of Time in a site inside the City

Notes:

Banner holders are placed in case of high traffic volume or vision

problems Terminology directing means of cones

Vehicle with flashing warning lights

Worksite

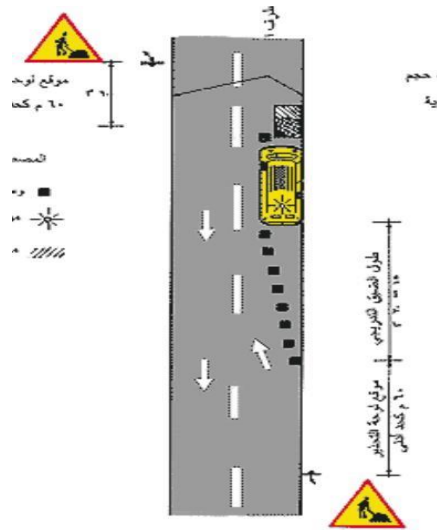
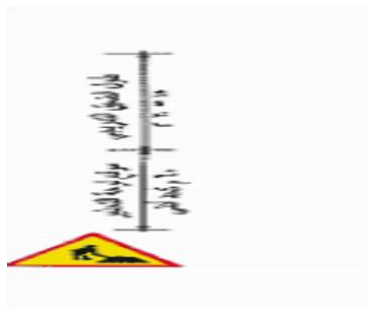


Figure (11-10): An application model for the worksite maintenance of facilities on a local (Residential) street with a light traffic volume



Location of warning sign

60 m as a minimum

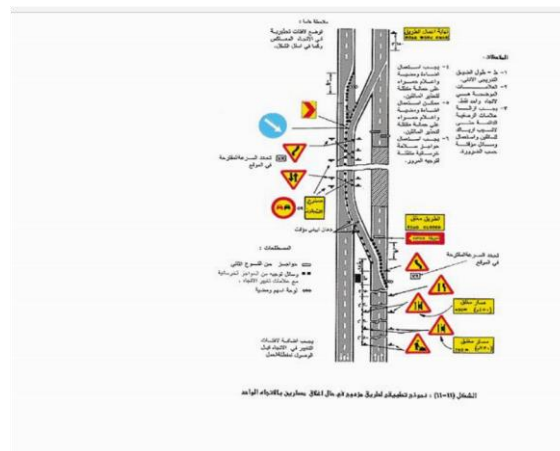


Length of the gradually narrowing



60 m as a minimum

Figure (11-11) illustrates the use of means of control and directing traffic on a road with a middle island consisting of four lanes where part of it is to be closed and in such cases, there are special matters in the planning, design, and construction stages that need to be taken into account



Notes:

Minimum length of the gradually narrowing

1-The signs shown are for one direction only

2-Permanent pavement signs should be removed so as not to confuse drivers, and temporary means should be used as necessary

3- Flashlights and red flags must be used on a portable carrier to warn drivers

4- Flashlights and red flags Can use on a portable carrier to warn drivers

5- Mobile concrete safety barriers must be used to direct traffic

Determine the suggested speed on the site

Important note

Warning signs are placed in the opposite direction as at the bottom of the figure

Determine the suggested speed on the site Terminology barriers of the second type



Directing means made of concrete barriers with signs of changing direction

Flashy arrows panel

Signs for change of direction should be added before reaching the worksite

Important note:

Signs are placed in the opposite direction and as below the figure

Direction markings must be added before reaching the worksite

Figure (11-11) an application model for a dual road in case of closing two lanes in one direction

Figures (11-12) - (11-13) - (11-14) shows the ideal usage of traffic control means in case the worksite is adjacent to an intersection or existing in the middle of the intersection



Notes:

- 1- Additional warning means may be necessary.
- 2- A buffer zone should be provided between the reflective passages as shown in the figure.
- 3- Prevent some U-turns according to necessity



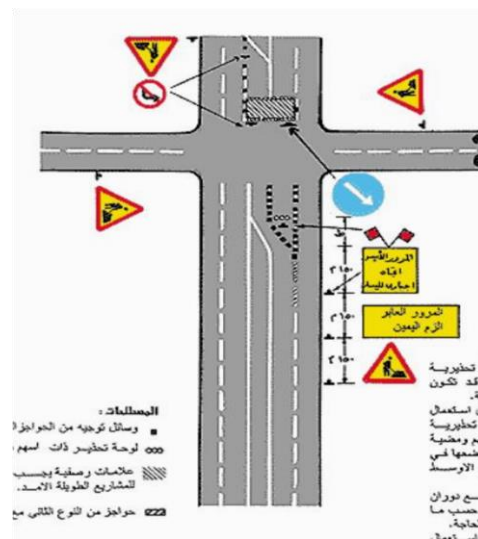
- 4- Usage of directing means to separate between transit traffic and turning to the right is an optional action depending on the volume of traffic, the working period, and the current situation of the traffic control means.

Terminology directing means from concrete– plastic barriers Warning sign with flashing arrow barriers of the second type with flashing lights

Sidewalk signs should be removed for long-term projects

Temporary sidewalk signs are put as needed

Figure (11-12): An application model for traffic control around the worksite near the intersection of two streets while allowing the traffic to turn right



Notes

1. Additional warning methods may be necessary.
2. In the case that a warning sign with flashing arrows is used, it should be placed in the closed middle track.
3. Prevent traffic turning as needed
4. It is suggested to use large flags and signs to increase visibility and control

Terminology



Directing means of concrete barriers

Warning board with flashing arrows

Paving marks that must be removed for long-term projects

Barriers of the second type with flashing lighting

Figure (11-13): An application model, to use the traffic control means near the intersection of two streets, while providing an access to the storage path for a left turn



Notes

1. Additional warning means may be necessary
2. Prevent the circulation of traffic as needed
3. Apply the same traffic control means to the rest of the parts of intersection

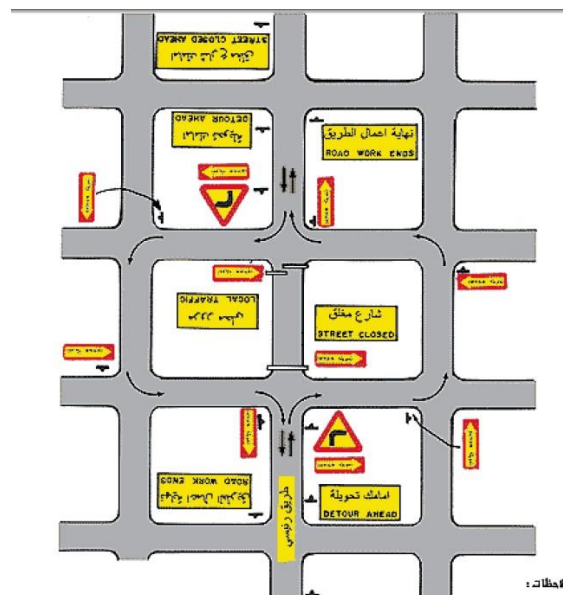
Terminology

- directing means from concrete barriers Warning sign with flashing arrow
 - barriers of the second type with flashing lights
 - paving signs should be removed for long-term projects
- Temporary paving signs are used as needed



Figure (11-14): An application model for traffic control means; in case the worksite is located in the middle of the intersection of two streets

Figure (11-15) shows the case of street closures inside the city and the ideal means for marking the borders of the detour.



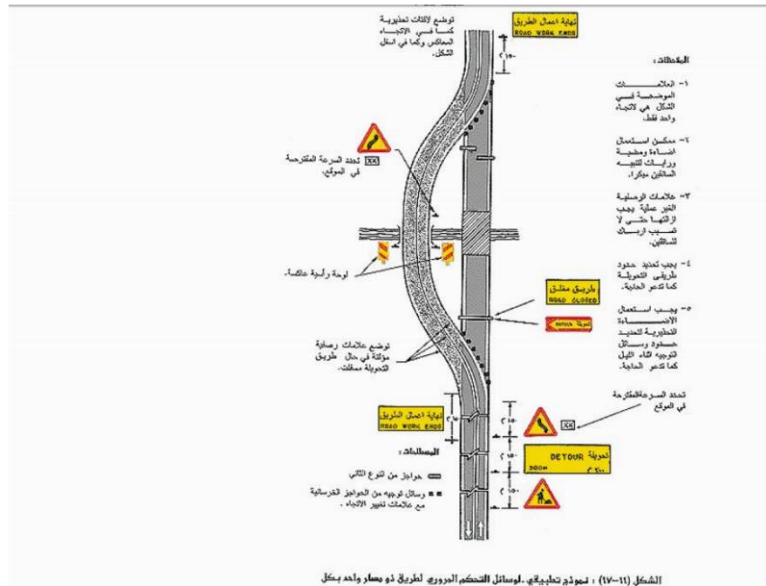
Notes:

- 1- Warning lights must be used to determine barriers at night as needed
- 2- Street names can be used Terminology Barriers of the second type

Figure (11-15): An application model of detour signs for a project of constructing a street or maintaining a street network

Figure (11-16) shows the case of road closures after a sign (detour ahead) If the traffic should be warned in advance closing the street, the local traffic can use the road to the detour point and put sign

"The road is closed to transit traffic" detour banners should be installed in a proper and appropriate way to enable traffic resuming its normal course on the road



Notes

- The signs shown in the figure are only one-way
- Flashing lights and banners can be used to notify drivers early
- Impractical paving signs should be removed not to cause confusion for drivers
- The borders of the two detour paths must be determined as needed
- Warning lighting must be used to determine the borders of the guidance means at night as needed

The suggested speed is determined at the site

Reflective headboard

Temporary pavement signs shall be put in case the detour road is asphalted

Terminology

Barriers of the second type

Directing means from concrete barriers with signs of changing direction Figure (17-11): An application model for traffic control means for a one-path road in each direction in case that the entire road is closed, and a side detour road is provided.



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- 2. **Roads Union Administration, Traffic Control Manual, United States Transportation Authority, 1983D.**
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- 6. **American Association of Road and Transport Engineering, A guide to selecting, identifying and designing barriers, Washington DC, US Transportation Service**